RESPONSE TO PUBLIC COMMENTS ON THE MAY 2012 DRAFT OF

AN ASSESSMENT OF POTENTIAL MINING IMPACTS ON SALMON ECOSYSTEMS OF BRISTOL BAY, ALASKA

U.S. Environmental Protection Agency

Region 10

Seattle, WA

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INTRODUCTION

In May 2012, the U.S. Environmental Protection Agency (EPA) released the 1st external review draft of *An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska*. Following its release, the public was invited to review the draft document and submit comments to EPA during a 60-day public comment period.

There was significant public interest in the May 2012 draft assessment. EPA received comments from a wide variety of public stakeholders, including local community members, fishers, the mining industry, local villages, tribal governments and corporations, state and federal government agencies, businesses, and non-governmental organizations. EPA appreciates the technical input and the range of perspectives shared during the public comment period.

EPA revised the May 2012 draft of the assessment based on these public comments, peer review comments, and consultation with tribes. In April 2013, EPA released the 2nd external review draft of the assessment for additional public and peer review and comment. After revision of the April 2013 draft of the assessment based on the input received, EPA released the final assessment in January 2014.

This document presents an overview of the public comments EPA received on the May 2012 draft of the assessment, the text of technical public comments relevant to the science presented in the assessment, and EPA's responses to those comments. EPA also received many written comments that were non-technical in nature; responses to these comments are not included in this document. The text of mass mailers and oral comments from the eight public meetings are included as appendices to this document.

Public comments on the April 2013 draft of the assessment and EPA responses to those comments are included in a separate document, which is available online at www2.epa.gov/bristolbay. EPA responses to peer review comments on both the May 2012 and April 2013 drafts of the assessment also are available online at www2.epa.gov/bristolbay.

PUBLIC COMMENT PROCESS

The public comment period for the May 2012 draft of the assessment began on May 18 and ended on July 23, 2012. Comments could be submitted to Federal Docket EPA-HQ-ORD-2012-0276 using an online form, by email, letter or fax, or in person at a public meeting.

Following this public comment period, an independent EPA contractor, the Horsley Witten Group, Inc. (HWG), organized, summarized, and sorted the comment letters received to help EPA fully consider and respond to all public comments. HWG downloaded all submitted comment letters from the federal docket and maintained a spreadsheet of comment letters received that included information on the commenter and the docket-assigned comment letter number. HWG also created an overview of the public comments that summarized the commenters and the general themes and issues represented in the public comments.

HWG organized technical public comment letters that were directly relevant to the science presented in the assessment according to the relevant assessment chapter or appendix. Individual comment letters were typically split into parts and assigned a comment number based on the relevant assessment chapter or appendix. EPA used these chapter-and appendix-specific public comment compendiums as the organizational basis for this response to public comments document.

As HWG completed these tasks, EPA also read through all of the submitted technical public comment letters. As the public comment compendiums were received from HWG, EPA checked that the compendiums included all relevant text from the technical public comment letters submitted to EPA.

The process used to organize, summarize, and respond to mass mailer and public meeting comments is detailed in the introduction to those appendices.

SUMMARY OF PUBLIC COMMENTS

EPA received more than 233,000 on-time public comment letters on the May 2012 draft of the assessment. More than 227,000 of these comment letters resulted from 27 different on-time mass-mailing campaigns identified by the EPA docket center. Twenty-one of these campaigns, generating over 217,500 letters, requested EPA take action to protect Bristol Bay. Five campaigns, generating approximately 9,000 letters, were not supportive of EPA action. The remaining mass-mailing campaign, signed by 318 people, requested a comment period extension. Comments from these mass-mailing campaigns are included in Appendix 1 of this document.

In addition to these mass-mailing campaign letters, EPA received more than 5,500 on-time unique comment letters. The unique comment letters included technical comment letters as well as more general comment letters, postcards, letters modified from mass-mailing campaigns, and letters from pre-written letter campaigns that were similar in format and overall content. Comments were received from a variety of organizations and individuals.

EPA also received oral comments during a series of public meetings held following the release of the May 2012 draft. These public hearings occurred in Seattle, WA (May 31); Anchorage, AK (June 4); Dillingham and Naknek, AK (June 5); Igiugig and Levelock, AK (June 6); and New Stuyahok and Nondalton, AK (June 7). Public comments received during these hearings are included in Appendix 2 of this document.

STRUCTURE OF THE RESPONSE TO PUBLIC COMMENTS DOCUMENT

This document comprises the main document and three appendices. The main document includes the text of technical public comment letters received on the May 2012 draft of the assessment, as well as EPA responses to those comment letters; Appendix 1 includes the mass mailing and petition letter campaigns identified by the EPA docket center; and Appendix 2 contains comments from the public meetings. The issues raised in the mass-mailing campaign letters and in comments at the public hearings generally were similar to many of the issues raised in the non-technical individual comments. Appendix 3 provides comment information (commenter and docket number) for the comment letters included in the main document.

The main document. is organized according to the structure of the May 2012 draft assessment, and presents public comment text and EPA responses relevant to each chapter (Chapters 1 through 8) and each appendix (Appendices A through I).

It is important to keep the following points in mind as you read through this document.

- Individual comment letters that referred to more than one subject were split into parts, so that each part could be included in the relevant assessment chapters or appendices. Both the commenter and the comment letter number (as assigned by the federal docket) are provided for each comment in the main text of the document, and Appendix 3 provides a list of the commenters, comment document numbers, and chapters in which each comment document occurs. This information may provide a useful way to search for specific comments and responses. The full text of each comment is available to the public at www.regulations.gov under docket EPA-HQ-ORD-2012-0276.
- Numbering for pages, chapters, sections, tables, figures, and text boxes changed between the May 2012, April 2013, and January 2014 versions of the assessment. Numbering cited in the public comments included here refers to the May 2012 version of the assessment (i.e., the draft assessment). Unless otherwise noted, numbering cited in EPA responses refers to the April 2013 (i.e., the revised assessment). Archived copies of the May 2012 and April 2013 drafts of the assessment are available online at:

  May 2012 draft: http://cfpub.epa.gov/ncea/bristolbay/recordisplay.cfm?deid=241743

  April 2013 draft: http://cfpub.epa.gov/ncea/bristolbay/recordisplay.cfm?deid=242810
- In some cases, a comment may be relevant to more than one chapter or appendix. To avoid redundancy, these comments are included only once in this document, at the most relevant location.
- Many commenters submitted similar comments. Instead of repeating a response, readers are referred to the initial response.
- EPA acknowledges and appreciates every comment letter, even those that may not be included in this response document because they did not directly relate to the technical content of the assessment.

PUBLIC COMMENTS AND EPA RESPONSES

Chapter 1: Introduction

No relevant comments.

Chapter 2: Characterization of Current Condition

National Park Service and U.S. Geological Survey (Doc. #4607)

2.1 Section 2.2.1, Pacific Salmon Populations: The salmon species of the Kvichak and Nushagak drainages are described in this section with appropriate references to other sections and appendices. However, since the five species of Pacific salmon are the focus of this Assessment, a more detailed description of these species may be warranted here. Consider devoting a paragraph to each of the five species noting such details as their life history, dominant age classes for specific drainages and preferred habitats.

Rainbow Trout and Dolly Varden Char: Same comments apply here as to (4). These species are an integral part of the ecosystem that support salmon and are important to subsistence and sport fishers. The Assessment may benefit from specific paragraphs, in the body of the document, devoted to these species. A description of the relationship and interaction between these species and salmon would be appropriate e.g., rainbow trout attain large size in part because they feed on rearing salmon.

Other Freshwater Resident and Anadromous Fish Species: The Assessment makes only passing mention to fish species that are not of primary use by those who harvest fish in the Kvichak and Nushagak watersheds, e.g., sculpin, lamprey, stickleback, various whitefishes. Section 2.2.2, Resident Fish Populations, fails to mention these species. Although an in depth discussion of these fishes may not be warranted, they do comprise part of the ecosystem that supports salmonids and other species of importance to commercial, sport, subsistence and other user groups. Some expansion of the discussion related to these species, their place in the ecosystem and their interaction/relationship to salmonids may be desirable.

EPA Response: Additional background information on fish species and their life histories was incorporated into Chapter 5. Throughout the assessment we have clarified that we focus on a subset of species in the assessment and that this focus does not imply that other fishes (or other aquatic biota) are not important components of the ecosystem or are unlikely to be affected by potential mining.

2.2 Within the draft document itself, descriptions and projections often refer directly to the need for scientific baseline data. It would be beneficial to reviewers if the types and dates of baseline data collected and used for the assessment were listed in an appendix. For example Appendix B refers to “key” fish habitat conditions that include elevation, slope and groundwater, and yet data for none of these are presented; similar issues exist for Appendix C and wildlife distributions. Also, the assessment of projected scenarios (e.g., evaluation of road impact, pipeline failure etc.) require information on parameters such as permafrost distribution, slope, aspect, surficial materials stability etc., and yet these scientific data are not presented, cited or referenced in this document.

EPA Response: Additional background information on physical characteristics of the Bristol Bay region (e.g., permafrost extent, geology, vegetation, and soil characteristics) has been included in Chapter 3.

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

2.3 The scope of the Assessment and methods for evaluating impacts of mining uses various geographic regions and scales of study, depending on the subject area and availability of information. Generally, four different geographic scales are applied to the study and include:

- The Bristol Bay Region, which encompasses the bay and the land area of six watersheds that drain into it;
- The Nushagak River and Kvichak River watershed, which comprise the largest of the Bristol Bay watershed's six watersheds and compose about 50% of the total Bristol Bay watershed area;
- The headwaters of the tributaries that flow within the proposed Pebble Project including: the North Fork Koktuli River, located to the northwest of the Pebble deposit, which flows into the Nushagak River via the Mulchatna River; the South Fork Koktuli River, which drains the Pebble deposit area and converges with the North Fork west of the Pebble deposit; and Upper Talarik Creek, which drains the eastern portion of the Pebble deposit and flows into the Kvichak River via Iliamna Lake; and The hypothetical mine site, which includes the area of direct impact as described in the hypothetical mine scenario.

Although the document is titled An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska, the Executive Summary limits the scope of the watershed assessment to the Nushagak and Kvichak River watersheds. However, in assessing potential impact of mining to the study area, most of the focus and discussion is limited to the area of the North Fork and South Fork Koktuli Rivers, Upper Talarik Creek and the hypothetical mine site.

<u>EPA Response:</u> Chapter 2 now explicitly describes the five different geographic scales considered in the assessment and the sections of the assessment where each geographic scale is generally considered. Broader geographic scales are considered in the problem formulation chapters (Chapters 1-5) to give an overview of the general region; narrower geographic scales are considered in the risk analysis and characterization chapters (Chapters 7-12) to evaluate specific impacts. Throughout the assessment we have clarified which geographic scale is being used in the analyses presented.

2.4 Figures in Chapter 2 exaggerate the area of the Pebble deposit. Using Figure 2-2 as an example, it could be argued that this scale is too small to accurately show the area, but perceptions and opinions of impacts are based on these figures. The maximum mine disturbance from the map on Page ES-17 is approximately 30.8 square miles, while the map of Figure 2-2 shows 116.4 square miles, based on the scale of the map.

<u>EPA Response:</u> All maps showing the approximate Pebble deposit location have been modified, such that the deposit is now indicated by a star rather than a larger rectangle.

2.5 *Section 2.0* and Throughout

Comment: No reference to, or consideration of, winter freezing or permafrost is provided in the risk assessment. Winter ice and permafrost both have potentially dramatic implications in seasonal groundwater flow, particularly shallow groundwater.

Recommended Change: Provide section of the report, or include in a new groundwater section, the potential/likely influence of winter freeze and/or permafrost on groundwater volume, flow, and stream recharge potential. Incorporate this information into estimations of stream recharge and groundwater flow into and through mining pit and Tailings Storage Facilities.

EPA Response: Chapter 3 now includes a map showing permafrost extent in the region, and Table 3-1 indicates that, as reported in Warhaftig (1965), permafrost is sporadic or absent in the Nushagak-Bristol Bay Lowland physiographic division.

2.6 *Appendix A, Section 2.1, Page 15*

Comment: Snowpack is the predominant source of water and there is a water surplus in the Nushagak-Big River Hills physiographic region, which is a "wet" climate class.

Thus, downstream "dewatering" is less likely to be an issue. If permafrost moves up into stored waste rock, then less groundwater flow through it. Handling of snowpack and snow melt is important to impact assessment.

EPA Response: Analysis of flow modification is described in Chapter 7, where we describe the importance of the flow regime and risks associated with deviations from the flow regime to which local aquatic life may be adapted. Although the region may indeed be "wet", alterations to streamflow regime can have serious implications for aquatic life, even in systems where water is abundant. We concur that snowpack and snowmelt are important considerations for understanding regional hydrology. If permafrost expanded into waste rock it could reduce groundwater flow, but permafrost in the area is discontinuous so it is unclear whether or not permafrost would expand.

2.7 *Section 2.0, 4.0, and Executive Summary*

Comment: The report is lacking information on regional hydrogeology, local hydrogeology, groundwater and surface water interaction. A mine of this size could greatly impact the water balance in the area. A more detailed understanding of the above area is needed.

Recommended Change: Provide a hydrogeological analysis on the watershed. The report should include regional and local geology and hydrogeology, and surface water and groundwater interaction as well. Provide cross-section, logs, lithologies, groundwater levels, and hydrographs of the aquifers. Provide estimation of hydraulic parameters for the aquifers.

EPA Response: Expanded discussion of regional geology and soils is now included in Chapter 3 of the revised assessment. Much site-specific or local information is either unknown or not publicly available, but more extensive discussion of groundwater surface water interaction and possible effects has been supplemented in the revised assessment by incorporating information from Woody and Higman (2011) and PLP (2011) (see Chapter 7). We agree that more detailed understanding of the region's hydrology and hydrogeology could reduce uncertainties and improve the assessment, but there are currently insufficient data available to complete a comprehensive hydrogeological analysis. The scope of the recommended investigation and analysis would be more appropriate as the responsibility of the potential mine developer.

2.8 *Section 2.0 and 4.3.7*

Comment: High seasonal fluctuations exist in the mine area as shown in Figure 2-7, page 2-23. However, the seasonal effects were not adequately considered in the water balance estimation. Frozen conditions would have a major impact on flows in creeks and runoff. Peak seasonal precipitation and snow melt would also have a major impact on the water balance. Water balance estimated with averaged precipitation (as in Box 4-2, page 4-28) will not represent the seasonal field conditions.

Recommended Change: Provide temporal and seasonal fluctuation of rainfall, stream flow, and groundwater level. Evaluate the mining impact on water balance under long term average condition and high seasonal flow condition.

EPA Response: The assessment primarily considers potential changes in annual flows that would be caused by the development of the mine scenarios. For some aspects, such as water table drawdown due to pit dewatering, seasonal fluctuations would be small compared to the amount of drawdown. For specific stream reaches in which seasonal variations in flow would be more pronounced, available data do not permit the quantification of location- and species-specific impacts on fish. Section 7.3.4 discusses the uncertainties and assumptions associated with the assessment of streamflow changes due to the development of a mine. The mine operator would have some flexibility to use available onsite storage to optimize the timing and rate of water releases and provide seasonal variability.

2.9 *Section 2.0, Page 2-1 through 2-26*

Comment: While some description of the regional conditions is warranted, much of Chapter 2 is irrelevant to assessing impacts of a mine at the Pebble deposit.

EPA Response: The purpose of Chapter 2 is not to assess the impacts of a mine at the Pebble deposit, but to describe the general region as part of the assessment's problem formulation. This has now been clarified in Chapter 2 of the revised assessment, which explains the purpose of and geographic scales used in different parts of the assessment.

2.10 *Section 2, Page 2-1 through 2-26*

Comment: This chapter is lacking sufficient detail expectant of a discussion of current conditions, more appropriately referred to as background or baseline conditions. The area's biodiversity instead is generalized in tables and figures. There is no discussion of current water quality for each of the 17 hydrogeologic areas nor any habitat mapping, biological survey information, and threatened or endangered information. A more in-depth evaluation of wildlife is provided by U.S. Fish and Wildlife in Appendix C and should be referenced more prominently in this chapter.

Recommended Change: Include additional information describing current (baseline) conditions and reference Appendix C more prominently.

EPA Response: These sections are meant to provide a brief overview of the region's physical and biological environment, particularly in terms of the endpoints considered in the assessment. Additional material on physical setting (e.g., geology, soils,

permafrost extent, etc.) was added to Chapter 3, and additional information on biota in the region was pulled into Chapter 5. We also clarified that the appendices contain more detailed information on geological setting (Appendix H), fishes (Appendices A and B), wildlife (Appendix C), and human populations (Appendix D) in the region.

2.11 *Section 2, Page 2-1*

Comment: In the context of risk assessment terminology, characterization of current condition is typically referred to as background or baseline conditions.

Recommended Change: Change in chapter title.

<u>EPA Response:</u> Chapter 2 has been restructured in the revised assessment into Chapters 3 (Region) and 5 (Endpoints), as part of the problem formulation chapters of the assessment, to highlight how this information is related to the risk assessment process.

2.12 *Section 2.1, Page 2-2*

Comment: This page shows that the Togiak, Naknek, Egegik and Ugashik watersheds are completely isolated from any of the mine drainages and could not be affected by the mine in any way yet nowhere in the text is this mentioned, especially when discussing the value of the fisheries, Native cultures, and direct impact to neighboring villages.

Recommended Change: The text in the executive Summary and in Chapter 2 should point out that these watersheds could not be affected by the mine and that they represent approximately xx% of the population of the Bristol Bay region and xx% of the economy.

<u>EPA Response:</u> Chapter 2 now explicitly describes the five different geographic scales considered in the assessment, and the sections of the assessment where each geographic scale is generally considered. Table 2-1 clarifies the proportion of the entire Bristol Bay watershed that each geographic scale comprises. Chapter 13 also addresses how induced development may affect watersheds not directly affected by mining activities.

2.13 *Section 2.1 to 2.2.1, Pages 2-2, 2-4, 2-5 and 2-12*

Comment: The Figures on these pages exaggerate the area of the Pebble Deposit. The legend states that the area in red is the approximate area of the Pebble Deposit. A more accurate way to present this is the "Likely Maximum Disturbed Area of the Pebble Mine". Using Figure 2-2 as an example of all of these figures. It could be argued that this scale is too small to accurately show the area, but perception of these figures is easily swayed and it is important as people form their opinions of the impacts. The maximum mine disturbance from the map of Page ES-17 is approximately 30.8 square miles, while the map of Figure 2-2 shows 116.4 square miles, based on the scale of the map.

Recommended Change: The figures above should be revised to show Likely Maximum Disturbed Area of the Pebble Mine, reflecting the smaller area. The actual area should be shown on each figure.

<u>EPA Response:</u> See response to Comment 2.4.

2.14 *Section 2.1 Page 2-3*

Comment: The document states that "the great majority obtain most of their food resources from subsistence, fishing, hunting, and gathering". There are several studies that show this is not the case. One report published by the International Journal of Circumpolar Health Titled: The Dietary Intake of Alaska Native People, concluded 21 % of calories, 46 % of protein, and 3 % of carbohydrates came from traditional Alaska Native foods. This study was limited to only two regions of rural Alaska but there are other studies that could be referenced that came to similar conclusions.

Recommended Change: The document should include scientific peer reviewed facts for this statement.

EPA Response: The assessment has been revised to more accurately reflect the available information about subsistence use and diet. Although we have statistics from ADF&G for percentage of residents using subsistence resources and per capita harvest of subsistence resources in these watersheds, we do not have any dietary studies. The per capita subsistence harvest is quite high, leading to the conclusion that subsistence accounts for a major part of the diet of most residents. The text has been revised to clarify these distinctions and reference a dietary study from a nearby watershed (Johnson et al. 2009).

2.15 *Section 2.2 and 6.6*

Comment: Sections 2.2 and 6.6 discuss Alaska Native Cultures and the Effects on Human Welfare and Alaska Native Cultures. According to the report "because the cultures are subsistence-based and reliant on salmon in particular, any negative impact on salmon quality and/or quantity resulting from failures or accidents should be assumed to cause a negative impact on human health and welfare, both directly from loss or change in food resources, and indirectly from disruption to an integral part of the culture." The report goes on to discuss how subsistence is important for Alaska Natives, especially salmon. According to the Alaska Department of Fish and Game Division of Subsistence update of subsistence economies in Alaska 2010, which is available to the public on the Department's website, just over half of the harvest of wild foods in Bristol Bay is salmon. This important resource is used by the region's diverse population (Alaska Natives and others). Although communities in Bristol Bay are dominantly Alaska Native, these communities do have a more complex demographic and all residents rely on wild resources, especially salmon. According to the U.S. Census in Dillingham, the region's largest community, 68% of the population is Alaska Native.

Recommended Change: This report should take into account how subsistence, especially salmon is important for all residents of the region. Many non-Alaska Native peoples in Bristol Bay have lived in the area for multiple generations.

EPA Response: We focused on the Alaska Native communities in response to the original request we received from nine federally recognized tribal governments. The assessment has been expanded to acknowledge the strong cultural ties of many non-Alaska Natives to the region and potential effects on all residents from loss of a subsistence way of life. However, the focus of the assessment remains on effects on indigenous cultures (Chapter 12 of the revised assessment). The importance of the commercial fishery to the regional culture also has been added to the text.

2.16 *Sections 2.2 and 6.6; Appendix D*

Comment: The watershed assessment report further says that "It is not possible to quantify the magnitude of subsistence resources that would be lost." The ADF&G, Division of Subsistence has conducted extensive research in the Bristol Bay Watershed, and has conducted research specifically at quantifying the harvest of wild resources. Appendix D of this report does reference some of these reports including the Alaska Subsistence Salmon Fisheries 2005 Annual report (Fall, Caylor et al. 2007), An Overview of Subsistence Fisheries in the Bristol Bay Management Area (Fall, Krieg et al. 2009), the Kvichak Watershed Subsistence Salmon Fishery: An Ethnographic Study (Fall, Holen et al. 2010), and 2 of the 5 baseline studies that were conducted specifically for the Pebble Project (Fall, Holen et al. 2006; Krieg, Holen et al. 2009). Although the data from these studies were used in compiling Appendix D, staff at the Division of Subsistence were not consulted for this assessment; it appears as a result that the authors failed to consult several important recent publications including both technical papers and articles that are also necessary for understanding the complexity of subsistence and the intersection of subsistence and culture in the Bristol Bay region (Holen, Krieg et al. 2005; Krieg, Chythlook et al. 2005; Fall, Brown et al. 2009; Fall, Brown et al. 2009; Holen 2009; Holen 2009; Holen and Lemons 2010; Fall, Brown et al. 2011; Holen 2011; Holen 2011; Fall, Braem et al. 2012; Holen 2012). Consultation with Division of Subsistence staff would also have alerted the authors to a key source of local and traditional knowledge (LTK) about salmon in the Bristol Bay Area: From Neqa to Tepa, Łuq'a to Chuqilin: A Database with Traditional Knowledge about the Fish of Bristol Bay and the Northern Alaska Peninsula, which is available on CD from the division.

Recommended Change: Authors of these sections of the watershed assessment should consult with the ADF&G, Division of Subsistence to ensure an accurate and complete depiction of the complexity of subsistence and the intersection of subsistence and culture in the Bristol Bay region.

<u>EPA Response:</u> EPA consulted with the ADF&G when preparing the draft assessment and again prior to releasing the revised assessment. We are grateful for their assistance in providing additional resources and information for the assessment. The revised assessment includes included additional references and information provided by ADF&G, as well as subsistence use maps generated from ADF&G data.

2.17 *Volume 1 Economics of Ecological Resources*

Comment: There's no effort made to quantify how many of the workers and how much of earnings are made by non-residents. According to Alaska Department of Labor and Workforce Development Research and Analysis Bristol Bay Region Fishing and Seafood Industry Data in 2009, 58.8% of total gross earnings earned by non-resident permit holders and 87.1% of wages were earned by non residents. The characterization of the Bristol Bay Commercial Fishery is incomplete without a reflection of the profits gained from Alaska's fisheries resources by non residents and how much of the gross earnings leave the state, is not spent in Alaska, or in the Bristol Bay region.

Similar data presented for the general public is also published the November 2009 issue of Alaska Economic Trends published by the Alaska Department of Labor and Workforce Development, including that in 2008:

- 46% of Alaska's crew members lived outside the state
- 73% of seafood processing employees lived outside the state and they earned $187 million that year
- Seafood processing since at least the mid-1980s has been the sector with the highest percentage of nonresidents, both within the fishing industry and in all wage and salary employment in the state.

Warren, J. and Hadland, J. Employment in Alaska's Seafood Industry in Alaska Economic Trends November 2009. State of Alaska Department of Labor and Workforce Development, Research and Analysis Section. pp. 4-10. p. 6-7 and Exhibit 7.

Alaska Department of Labor and Workforce Development Research and Analysis. Fishing and Seafood Industry in Alaska Current Data. Fishing and Seafood industry in Alaska Overall Seafood Industry Data Tables. Fish Harvesting and Processing Workers and Wages. Bristol Bay Region Seafood Industry, 2003-2009.

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. Any mine development in the region is not dependent on a healthy ecosystem and thus is outside the scope of this economic valuation.

2.18 *Table 2-2, Page 2-7*

Comment: The table title "…as a Percentage of Entire Watershed Area" is misleading, as the rows (which sum to 100 percent) are for sub-areas of the two watersheds (Nushagak and Kvichak).

Recommended Change: Recommend revising the table title.

<u>EPA Response:</u> Table heading changed to read "Values represent percentage of total area in the two watersheds."

2.19 *Section 2.2, Page 2-8*

Comment: The Figure shows pictures of various rivers and lakes in the Bristol Bay region, many of which would not be affected by the mine in any way according to the maps provided throughout the Bristol Bay Watershed Assessment however, the actual stream sections that would be blocked or eliminated are not included.

Recommended Change: The figure above should be revised (or a new figure added) to show the actual stream sections that would be blocked or eliminated by the mine.

<u>EPA Response:</u> The purpose of this figure is to provide a general overview of the diverse types of aquatic habitats present in the larger Bristol Bay watershed—not to show specific streams and wetlands eliminated by the mine, which is addressed in Chapter 7. However, the approximate location of each photo is now indicated on Figure 3-1 to show where these habitats fall in relation to the Pebble deposit area.

2.20 *Page 2-9*

Comment: Only resident, non-anadromous Dolly Varden are considered in the assessment but there are significant anadromous Dolly Varden populations in the Kvichak and Nushagak watersheds.

Recommended Change: Consider incorporating anadromous Dolly Varden of the Kvichak and Nushagak watersheds in the assessment.

<u>EPA Response:</u> This endpoint is now presented in terms of other fish rather than resident fish, and information on anadromous and nonanadromous Dolly Varden is included in Section 5.2.

2.21 *Section 2.2, Page 2-10*

Comment: The Table 2-3 on this page shows the surveyed stream lengths occupied by each major fish species. Nothing is mentioned about the lengths that would be blocked or eliminated by the two mine scenarios.

Recommended Change: The Table should be revised to include additional columns of the actual stream lengths occupied that would be affected by the two mine scenarios, and the % of the total.

<u>EPA Response:</u> The effects of mining are not considered in Chapter 5 (where this table now resides), so this information is not included here. Specifics on the stream lengths eliminated or blocked by potential mine footprints are presented in Chapter 7.

2.22 *Section 2.2.1, Page 2-12, Figure 2-5 (and ES-3, Figure ES-1)*

Comment: The black dots represented as Native villages are not shown in legend.

Recommended Change: The figure should include in the legend the black dots representing the villages (Native communities).

<u>EPA Response:</u> All relevant maps have been revised to include a black dot, indicating towns and villages, in the legend.

2.23 *Section 2.2.1, Page 2-13, Figure 2-6*

Comment: The figure 2-6b (and ES-4b) shows relative average annual fish abundance in the Bristol Bay Watershed. The figure does not show each of the six separate watersheds, and combines Nushagak, Kvichak, Naknek watersheds.

Recommended Change: Show each of the six Bristol Bay watersheds including the Togiak, (splitting out the Nushagak, Kvichak, Naknek), Egegik, and Ugashik Rivers. Also, highlight which watersheds (Nushagak, Kvichak) will be directly impacted by the mine scenario.

<u>EPA Response:</u> In Figure 5-9B (where the figure referenced above now occurs), the Nushagak, Kvichak, and Naknek watersheds are shown separately.

2.24 *Section 2.2.2 and 2.2.3, Page 2-15 through 2-17*

Comment: Consideration of threatened or endangered species is an important aspect of the ecological risk assessment, but yet they are not are not discussed in these sections.

Recommended Change: List known of suspected threatened species within the study area.

EPA Response: The assessment has been revised to clarify that there are no known breeding or otherwise significant occurrences of any species listed by the USFWS as being threatened or endangered under the Endangered Species Act within the Nushagak and Kvichak River watersheds. There is also no designated critical habitat within these watersheds. Please note that the scope of the assessment (see Chapter 2), and thus this conclusion, do not extend to marine resources.

2.25 *Section 2.2.2, Page 2-15, Table 2-5*

Comment: Table 2-5 needs to be updated with the latest published information. The table characterizes sport catch and harvest from 2003-2007, but there are more recent published data that should be used (through 2010).

Recommended Change: Update Table 2-5 to most recent catch and harvest data per references.

EPA Response: This table has been deleted in the revised assessment.

2.26 *Section 2.2.3, Page 2-15*

Comment: Wildlife populations are described as generally "large." ADF&G does not know what that is supposed to mean. Moose densities are often low, and caribou numbers are low compared to the 1990s.

Recommended Change: Describe what is meant by "large".

EPA Response: The assessment has been revised to delete the term "large" in this context. There are no good population estimates of moose or brown bear and populations of all species fluctuate over time. The point being made is that southwest Alaska wildlife habitat is relatively intact and still supports the presence of large carnivores and ungulates.

2.27 *Section 2.2.3, Page 2-16*

Comment: The 2008 caribou estimate is listed as 30,000. It should be 30,000-40,000.

Recommended Change: Include the estimate range.

EPA Response: Woolington (2009a), the source used by the USFWS in their report, estimates the 2008-2009 herd size as 30,000. There is no estimate for 2007-2008 and no range is reported. No other reference was provided in the comment.

2.28 *Section 2.2.3, Page 2-16*

Comment: Text states that the Mulchatna caribou herd spends a considerable amount of time in other watersheds. Approximately how much time does the Mulchatna caribou herd spend in the Nushagak and Kvichak River watersheds?

Recommended Change: Specify how much time the Mulchatna caribou herd spends in the Nushagak and Kvichak River watersheds as compared to other watersheds in the Bristol Bay watershed. This information might be presented as a fractional use estimate.

EPA Response: We are not aware of data (and none were provided in the comment) that would allow a quantitative fractional use estimate to be completed. The barren ground caribou section of the USFWS report discusses historical data, which indicate that population size and range have varied over time.

2.29 *Section 2.2.4, Page 2-17*

Comment: If the total estimated annual salmon ecosystem direct expenditures is $479.6 million that should be put in context with the value of the mineral resources in the same area.

EPA Response: The economics of fish resources are considered because those resources represent the main assessment endpoint of interest and they represent current economic activity dependent on a healthy ecosystem. The assessment is not a cost-benefit analysis and is not comparing the value of fish versus mineral resources, so any discussion of mineral values in the region is not relevant to the assessment's purpose. However, the total estimated value of the Pebble deposit is mentioned in Chapter 1 of the final assessment.

2.30 *Section 2.3.1, Page 2-20*

Comment: If Bristol Bay has 90,000 km of streams and Nushagak and Kivichak have 58,000 km of streams, those numbers should be compared with the km of streams that would be impacted by the mine to give perspective on the percentage of the area that could be impacted by mining. Table 5-3 in chapter 5 lists 61.4 km streams eliminated by footprint for minimum mine size, and 125.1 km for maximum mine size. 125.1/90,000 = 0.1 percent.

EPA Response: Data are now provided that characterize the total length of stream at geographic scales ranging from the Bristol Bay watershed down to the mine scenario watersheds and stream channels directly lost to the mine footprint. Details are provided in Chapters 3 and 7 of the revised assessment.

2.31 *Section 2.3.2, Page 2-21*

Comment: While the statement "Densities of salmon-supporting streams tend to be lower in regions with lower permeability and less extensive exchange between groundwater and surface water" may be true, the references used (Johnson and Blanche 2011, ADFG, 2012) don't support that assertion.

Recommended Change: EPA needs to use appropriate references to support the assertion.

EPA Response: This statement has been deleted from the revised assessment.

2.32 *Section 2.3.2, Page 2-21*

Comment: The second part of the first sentence in the second paragraph is not supported in the document by any hydrogeologic data or information. As it stands, the reader must accept the premise that these glacial soils actually exist and have high permeabilities.

Recommended Change: The report should contain at least a minimal amount of hydrogeologic data to support this statement. These could include geologic and hydrogeologic cross-sections, and hydraulic conductivity results.

EPA Response: Maps showing geology, soils, groundwater resources, and permafrost extent have been added to Chapter 3. Hydraulic conductivity data are shown in Figure 6-7.

2.33 *Section 2.3.2, Page 2-21*

Comment: The use of the word "tight" in paragraph 2 of this section is potentially misleading, and is not technically used for describing the hydraulic connection between surface and ground waters. In hydrogeology, the word "tight" is more commonly used to describe the permeability (hydraulic conductivity) of a soil or rock. A "tight" soil would not normally result in a good hydraulic connection between a river and aquifer, which is the apparent intent of the sentence.

Recommended Change: Recommend replacing the word with an appropriate hydrogeologic descriptive term.

EPA Response: This has been reworded in the revised assessment (see Section 3.3).

2.34 *Section 2.3.2, Page 2-21; 2-23 (Figure 2-7)*

Comment: The third paragraph discusses the relative stability of the Pebble area streams and baseflow, and Figure 2-7 charts data for several rivers and streams using gage data. The chart y-axes show "runoff in mm". The relationship between this metric and groundwater contribution to the river/stream is not adequately described, and the baseflow component (versus other sources) of the hydrographs is not defined. Also, "high baseflows" is a relative term that can only be put in context if compared to flows in other similar systems.

Recommended Change: Recommend revising the figures to more clearly illustrate the relationship between the gage data and the baseflow component. Also, some discussion of the time periods used and any statistical bias between data sets of different durations is warranted.

EPA Response: This section discusses the flow regime of regional rivers and focuses on the comparison of peak flows and base flows for individual rivers. The lower Nushagak and Kvichak Rivers, for instance, exhibit a more moderated flow regime (higher base flows, lower peak flows) than more variable river systems. This figure illustrates that the difference between peak flow and base flow is lower for the Nushagak and Kvichak Rivers compared to other regional rivers. It is not intended to be a comprehensive hydrographic analysis.

2.35 *Section 2.3.5, Page 2-25*

Comment: The document states " the primary human manipulation of the Bristol Bay ecosystem is the marine harvest of approximately 70 % of salmon returning to spawn" This level of harvest of a salmon resource suggests there is substantial opportunity to mitigate minor or temporary impacts from other human activities. The document goes into lengthy details of a perceived impact from a hypothetical mine using numerous assumptions but ignores the current impact to the salmon resource from the excessive by-catch by the marine commercial fishing industry. The document fails to adequately address the already significant impact to the salmon resource by human activities and that the marine harvest could be manipulated to increase uses for subsistence users.

Recommended Change: The document could address the substantial opportunity to manage and mitigate minor or temporary losses in salmon resources by actively managing the marine harvest to increase the availability of the resources to subsistence users as is already being done to account for excessive by-catch and other impacts.

EPA Response: Potential use of commercial fishery management as a compensatory mitigation measure is addressed in Appendix J. No change is needed in the problem formulation section of the assessment (Chapters 1-6), as it is not the purpose of this section to address how potential effects of mining or how those effects may be mitigated.

2.36 *Section 2.4, Page 2-25*

Comment: Last paragraph states "The status of Pacific salmon throughout the United States highlights the value of the Bristol Bay watershed as a salmon sanctuary or refuge." Use of the term sanctuary or refuge infers a designated legally protected status of the watershed and bay.

Recommended Change: This comment likely warrants additional consideration, investigation, and reporting on legalities and/or financially feasible option for a conservation area or refuge for the region.

EPA Response: The quoted sentence indicates that the Bristol Bay watershed is a de facto salmon sanctuary or refuge. It does not indicate a legal status, because there clearly is none.

Curyung Tribal Council (Doc. #4821)

2.37 The document falls short on the seismic/volcanic conditions of the region. The area in question has been and will continue to be prone to seismic and volcanic activity. Company core samples have shown the active plate. What happens when this plate is open, where does the pressure go (the pressure of the ground holding down the activity of the plate) what happens to it?

EPA Response: The assessment recognizes that the area is prone to seismic activity and describes the seismicity of the Bristol Bay region and the proposed mine site. Recent volcanic activity has not been identified in the Pebble deposit area.

Lake and Peninsula Borough (Doc. #4108)

2.38 The social and cultural analysis is a welcome addition to the literature on our area, but it is incomplete. The analysis accurately describes the importance of salmon in our culture; however, it misses an important part of what is happening in our villages. A generation ago, our villages practiced a subsistence economy that was much less dependent on cash and employment. Many families could earn enough income in a six-week commercial fishing season that, along with subsistence, they could make a reasonable living. Today's fishing prices and higher operational costs, combined with the fact that permits are increasingly owned not by our villagers, but by people outside our Borough (and our state), too often means that commercial fishing openings in Bristol Bay – while still important to many of our citizens – no longer provides enough money for families to live off, even with a subsistence lifestyle. The consequence of change is that our villages need steady employment and income in order to survive.

Additionally, contrary to the information in the assessment, our population is not stable. Our villages are losing population. The Borough lost over 18% of its people since the 2000 census and the population is projected to continue the decline. The village of Ivanof Bay is a good example. The village lost its school and as a result the village closed over a decade ago. Pedro Bay lost its school in November 2010 and struggles to meet the population requirements for public services. Borough schools are facing an even steeper population loss. In 2002 there were 480 students enrolled in the LPB school district. In contrast, in 2011 there were 335 students attending school. This reflects a 30% decline in the student population. Ten years ago Nondalton had 73 students in its school; the most recent count was less than 30 students. A declining population is a problem for some of our villages; for others it is a crisis.

EPA Response: We recognize that not all families in these watersheds benefit from or participate in the commercial fishing industry. Appendix E provides an analysis of the complexities of participation in the commercial salmon fishery by local residents, based on available information.

The census population statistics for each village are provided in Appendices D and E. The census data are summarized in the assessment and show, as the comment notes, increases in some villages and decreases in others. As a whole, villages in the watersheds experienced significant growth after 1970, slower growth in the 1990s, and some population decline from 2000 to 2010. The assessment has been revised to indicate that some village populations have decreased, whereas others have increased.

The Pebble Limited Partnership (Doc. #3797)

2.39 The context and scale of EPA's charge questions is inappropriately narrow in two critical respects: First, several questions narrowly focus on potential injury to individual salmonid fish: they ignore population and ecosystem level analysis. Second, the questions focus only on discrete portions of the Bristol Bay watershed - the Nushagak and Kvichak watersheds which contain the proposed Pebble Project. The proper focus should be on the potential adverse impacts to the Bristol Bay watersheds that support salmon, and the salmon fishery, wildlife and Alaska Native cultures associated with those watersheds.

EPA Response: This comment recommends expanding the scope of the assessment. The assessment focuses on effects of large-scale porphyry copper mining on salmon resources in the Nushagak and Kvichak River watersheds and resulting fish-mediated effects on wildlife and Alaska Native culture. This scope was set during the planning and problem formulation processes to encompass the expressed concerns of the Alaska Native organizations that asked EPA to address potential mining in the Bristol Bay watershed, as well as the needs of EPA's decision makers. This scoping process is in keeping with the Guidelines for Ecological Risk Assessment (USEPA 1998).

<u>Northern Dynasty Minerals Ltd. (Doc #4611)</u>

2.40 *Pg. 2-1*: "The land area draining to Bristol Bay consists of six major watersheds-from west to east, the Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik Rivers"

This is incorrect. As stated in the Introduction to each of the Bristol Bay Annual Management Reports published by Alaska Department of Fish and Game, "The area includes 9 major river systems, not 6: Naknek, Kvichak, Alagnak, Egegik, Ugashik, Wood, Nushagak, Igushik and Togiak." There are two significant aspects of this EPA error. First, the agency undertook to perform an analysis on a "watershed" without doing enough background homework to understand its areal extent and the major river systems that comprise the Bristol Bay system. Second, this error magnifies the flawed approach that considered only two drainages, rather than taking a more comprehensive and inclusive approach by assessing all 9 watersheds. Further, EPA in certain instances seems to have lumped some of these drainages together in an attempt to attribute more salmon production to the Nushagak and the Kvichak than actually exists.

<u>EPA Response:</u> The assessment is correct, although it did not split certain "major" river systems into their own sub-watersheds. The Wood River is included in the Nushagak River watershed and the Alagnak River is included in the Kvichak River watershed because these are tributaries at the mouth of the larger rivers. This is functionally important because a catastrophic failure that reached the mouth of the Nushagak or Kvichak River would likely affect salmon moving into these tributaries. We judged the Igushik River to be other than a major river, which does not imply that it is insignificant. Where appropriate, the relative contributions of different sub-watersheds within these larger areas (e.g., the Wood River subwatershed vs. the remaining Nushagak River watershed) are considered independently.

2.41 *Pg. 2-3:* "The Nushagak and Kvichak River watersheds, which account for more than half the area of the Bristol Bay watershed…"

This is inconsistent with the PLP's Environmental Baseline Document Chapter 7 Technical Summary, Pg. 7-1: "The largest rivers draining into Bristol Bay are the Nushagak and Kvichack rivers. Their drainage areas…comprise 49 percent, by area, of the Bristol Bay drainage basin."

<u>EPA Response:</u> As shown in Table 2-1, our calculations show that the Nushagak and Kvichak River watersheds make up 52% of the area of the Bristol Bay watershed. No change is required.

2.42 *Pg. 2-4, Figure 2-2*: Hydrologic Landscapes

This figure highlights the error in EPA's failure to identify all nine river systems. It shows the Wood River subsumed by the Nushagak watershed and the Alagnak River subsumed by the Kvichak watershed. This is inappropriate. The Wood River enters the Nushagak estuary (Nushagak Bay) below the salt chuck and the Alagnak enters the Kvichak estuary below the salt chuck (Kvichak Bay). Both the Wood and the Alagnak have independent escapement goals and estimates, and returns to these systems are accounted separately (from the Nushagak and Kvichak Rivers, respectively) in the Bristol Bay Annual Management Reports. This gives further credence to the notion that EPA may have inappropriately combined these systems in an attempt to attribute more salmon production to the Nushagak and the Kvichak than actually exists.

<u>EPA Response:</u> **The figure accurately represents the positions of the Wood River and the Alagnak River. In the revised assessment, the use of different geographic scales in different sections of the assessment has been clarified. In the problem formulation portion of the assessment (which includes the referenced figure, now in Chapter 3), broader geographic scales are considered to provide background information on the Bristol Bay region, particularly the Nushagak and Kvichak River watersheds. Potential effects of mining are not considered in this section, at these geographic scales.**

2.43 *Pg. 2-6, Table 2-1*: Elevations of physiographic regions in table that encompass the Pebble Study Area:

- Southern Alaska Range: Elevation 2,100-3,600 meters
- Nushagak -Big River Hills: Elevation 450-750 meters
- Nushagak - Bristol Bay Lowland: Elevation 15-1 50 meters

The regions in Table 2-1 are adjacent to each other, and yet there are gaps in the elevation ranges. This is not possible. What happens between elevation 150 and 450m? What about between 750 and 2,100m?

<u>EPA Response:</u> **Elevations in this table (Table 3-1 in the revised assessment) have been revised.**

2.44 "Active Metal Mines of the Fraser River Basin and Fish - Case Studies" by Oscar Gustafson

The Fraser River is among the world's most productive salmon rivers and supports commercial, recreational, and aboriginal fisheries. Mining can create concern with respect to fisheries conservation due to potential negative effects to the land base, water quality, water quantity, and fish habitat. This paper presents case studies from four active metal mines in the Fraser River watershed as a means to assess the risk of these operations to fisheries. These mines are all examples, with proven track records, of sustainable low impact operations adjacent to important fish habitat in the Fraser River drainage.

The Fraser River is among the most productive salmon rivers and fish habitats on the planet, supporting five species of Pacific salmon and 65 other species of fish. Commercial, recreational, and aboriginal fisheries are conducted for Fraser River salmon throughout their adult life cycles in both saltwater and freshwater habitats. The numbers of salmon that return to the Fraser River on an annual basis are in the tens of millions. From an economic and cultural perspective, arguably the most important and iconic fish species in the Fraser River watershed is the sockeye salmon.

<u>EPA Response:</u> **The Fraser River watershed is not a good analogue for the Bristol Bay watershed. It is less productive and much more variable in its productivity than Bristol Bay. Many years of low productivity prompted an independent review panel (the Cohen Commission), which concluded that the cause of poor returns was unclear but described mining as one of several contributing factors. We agree that available data are inadequate to determine the role of mining in Fraser River salmon production. In**

addition, the mining industry in the Fraser River watershed is largely isolated from salmon spawning habitat, unlike the mineral resources in the Bristol Bay watershed.

2.45 A comparison of the Fraser River and Bristol Bay sockeye run sizes (escapement and catch) showed that Bristol Bay (11.5 million) had almost 4 times the run size of the Fraser River (3.1 million) between 1980 and 2010. A comparison of exploitation rates between the 2 watersheds showed that the rates between 1981 and about 1995 rates were similar but from 1995 to 2010 the Fraser River exploitation rates were consistently lower. The landed value of British Columbia fish was consistently higher than the reported landed value of Bristol Bay fish.

<u>EPA Response:</u> Comment noted; no change required.

2.46 As already noted in NDM's comments, Bailey argues that the Draft Assessment contains numerous instances where the "data" used in the assessment is inappropriate, incomplete, misinterpreted by the authors, or just plain in error. It points out that one of the most egregious data quality problems is the Draft Assessment's use of the State of Alaska's Anadromous Waters Catalog and Freshwater Fish Inventory information to support conclusions regarding population level effects of the hypothetical mine development scenario on salmon populations. Neither of these data sources contains information on relative abundance and the authors lacked sufficient familiarity with the quality and appropriateness of data within these two sources or the stream geomorphology in the hypothetical project area to understand the true nature of salmon use in this area. As a result, the Draft Assessment reaches the wrong conclusions regarding the development of the mine area on salmon populations.

<u>EPA Response:</u> The limitations of fish sampling efforts in the study region are acknowledged and described in numerous sections of the revised assessment. For more detail on why we did not use the AWC or the AFFI to estimate fish abundance, see response to Comment 5.107.

2.47 The Draft Assessment contains a large volume of extraneous information that is not relevant to the assessment objectives. Bailey observes that the Draft Assessment contains a large volume of extraneous information that is not relevant to an assessment of the hypothetical mining scenario in the Nushagak and Kvichak river watersheds. For example, most of Appendices A and B in Volume I1 are not applicable to the specific life histories of the fish species found near the area in which PLP could mine. Thus, all of the discussion and information on the distribution of salmon around the Pacific Rim and the run sizes and economics from the watersheds in the Bristol Bay area other than the two of interest is extraneous and irrelevant.

<u>EPA Response:</u> Chapter 5 and Appendices A and B are meant to provide an overview of the fish species present in the Nushagak and Kvichak River watersheds, not evaluate potential effects of mining on species at the mine site. This purpose is now clarified in Chapters 1 and 2 of the revised assessment, and the assessment's focus on peer-reviewed data sources is clarified in Chapter 2. Information on other locations puts Bristol Bay fish resources into context of runs around the world, and thus is relevant. Chapter 2 also now clarifies the different geographic scales used in the problem formulation vs. risk analysis and characterization portions of the assessment.

The life history material in Appendix B was carefully tailored in response to conditions in the Nushagak and Kvichak River drainages based on analyses of information compiled at the ADF&G Fish Resource Monitor website and from area field studies, including the data and experience gained by the author of Appendix B while leading six extensive fish community sampling field projects within the study area.

2.48 Summary Comment 2: The report was not developed in accordance with EPA's "Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated for the Environmental Protection Agency"—The report contains numerous instances where the "data" used in the assessment is inappropriate, incomplete, misinterpreted, or just plain in error. One of the most egregious data quality problems is the use of the State of Alaska's Anadromous Waters Catalog and Freshwater Fish Inventory information to support conclusions regarding population level effects of the hypothetical mine development scenario on salmon populations. Neither of these data sources contains information on relative abundance and EPA lacked sufficient familiarity with the quality and appropriateness of data within these two sources or the stream geomorphology in the hypothetical project area to understand the true nature of salmon use in this area. As a result, the Assessment reaches the wrong conclusions regarding the development of the mine area on salmon habitat or on populations.

<u>EPA Response:</u> See response to Comment 2.46.

2.49 With regard to the reliance on peer-review, published literature and other information specific to Bristol Bay, again the Assessment is fundamentally and fatally flawed because the authors failed to use a significant and relevant set of data that was personally known to at least one of the authors and specific to the Pebble project area. Another fatal flaw of the Assessment was the reliance on the information contained in the Anadromous Waters Catalog (AWC) and Alaska Freshwater Fish Inventory (AFFI). While this information is technically published, the authors and EPA internal peer reviewers failed to apply EPA's established guidelines on data quality and had they done so, they would have reached vastly different assumptions and conclusions regarding the ecological risk. What this major shortcoming demonstrates quite clearly is that the authors of the report and the EPA internal peer reviewers did not use critical, publically available, site-specific data known to them, do not have a good, science-based understanding of the physical site about which they are writing, they do not understand the life histories of the fishes at the Pebble project site, do not have an understanding of the limitations of the information contained in the Anadromous Waters Catalog, and failed to use significant information contained in the Pebble Limited Partnership's Environmental Baseline Document. It is also apparent that EPA did not use their guidelines with respect to ecological risk assessment and data quality. If they had, then these problems would not have occurred. As a result of these problems, the entire Assessment is fatally flawed in its assumptions and conclusions.

<u>EPA Response:</u> See response to Comment 2.46.

2.50 The Assessment failed to use publically available data, which would have resulted in site specific descriptions of the biological resources present in the hypothetical mine area and not the general salmon life history information for Bristol Bay presented in Chapter 2 and Appendices A and B. Specific examples of data publically available but not used include:

data on fish distribution and abundance from the fish collection permit reports provided each year to the Alaska Department of Fish and Game; a compilation of all collection permit data submitted to ADFG for the period 2004 to 2007, from a June 2008 Fish Technical Work Group meeting in Anchorage in which an EPA representative was present and declined a paper copy of approximately 200 pages of fish distribution, fish density, snorkel counts, electrofishing surveys; salmon escapement estimates presented at each of the agency meetings; the Northern Dynasty Minerals 2004 progress report on fish and aquatic studies which contained information on fish distribution, relative abundance, salmon escapement counts, aquatic invertebrate information to name several topics; 1991 and 1993 fish survey reports prepared by Dr. James Buell for Cominco for streams associated with the Pebble prospect area; and 2005 freshwater fish inventory completed by the Alaska Department of Fish and Game for several streams in the Pebble project area including the specific watersheds under the hypothetical Tailing Storage Facilities 1 and 2.

EPA Response: See response to Comment 2.47.

2.51 *Section 2.1:* The Assessment states on page 2-1: "To assess potential impacts of mining development on the Bristol Bay watershed, one must first consider the current condition of the region's resources. In this section, we summarize the current status and condition of the Bristol Bay watershed's biological and cultural resources, the watershed characteristics that contribute to the quality and quantity of these resources, and the significance of these resources relative to those in other regions, particularly in terms of Pacific salmon stocks. More detailed characterizations of the Bristol Bay region's natural and cultural resources can be found in Appendices A through D".

Comment: This Assessment suffers from a distinct lack of focus. Chapter 2 of the Assessment provides only generic Bristol Bay oriented information, as do Appendices A and B. No data from the publically available PLP Environmental Baseline Document (EBD) is presented in these sections of the Assessment. Beginning in Chapter 5 of the Assessment, the biological focus changes to two watersheds and the chapter uses EBD fish information for the first time. The scientifically unsupported and professionally inadequate "ecological risk assessment" presented in this document is focused on two of the nine watersheds that contribute to Bristol Bay's fisheries. However Chapter 2 of the Assessment contains a large amount of extraneous material that tries to present a global picture of salmon in the North Pacific, but fails to provide a "Characterization of Current Condition" for the two watersheds in question. The Assessment either needs to have a chapter that describes the current conditions in the Pebble project area and then places those conditions in context with the remainder of the two watersheds or it needs to present the global conditions, but then must complete an ecological risk assessment for all nine watersheds. It cannot be split the way it is currently presented.

EPA Response: See response to Comment 2.3.

2.52 *Section 2.2:* The Assessment page 2-11: Section 2.2.1 Pacific Salmon Populations

Comment: This entire section presents no information on the current conditions of the salmon populations in the two watersheds that will eventually become the focus of the Assessment. This section does not present the current conditions for Pacific salmon in an ecological context from which to begin the ecological risk assessment. No foundation from which to begin an ecological risk assessment has been provided. The information that is presented is extraneous to the purpose of the Assessment which is to provide an ecological risk assessment, using appropriate and scientifically defensible data and analysis, theoretically based on the conceptual models presented in Chapter 3 of the Assessment. The information presented in this section of the Assessment and Appendix A of Volume II is mostly irrelevant and not applicable to the purpose of the Assessment. This section is mostly fluff and filler with no scientific substance. This entire section should be completely rewritten using the biologically important data and a clear description of how the fish populations fit the streams and lakes in the area from an ecological context.

EPA Response: The information presented is scientifically defensible, supported by available data, and directly relevant to the purpose of the assessment as detailed in the problem formulation chapters. Also see response to Comment 2.3.

2.53 *Section 2.3*: The Assessment page 2-15: Section 2.2.2 Resident Fish Populations

Comment: This entire section presents no information on the current conditions of the resident fish populations in the two watersheds that will eventually become the focus of the Assessment. All this section presents is an incomplete list of resident fish present generally in the area which are important for sport and subsistence fishing. This section does not present the current conditions for resident fish in an ecological context from which to begin the ecological risk assessment. No foundation from which to begin an ecological risk assessment has been provided. The information that is presented is extraneous to the purpose of the Assessment which is to provide an ecological risk assessment, using appropriate and scientifically defensible data and analysis. This entire section should be completely rewritten using the biologically important data and a clear description of how the fish populations fit the streams and lakes in the area from an ecological context.

EPA Response: See response to Comment 2.52.

2.54 *Section 2.4:* The Assessment page 2-20: Section 2.3 Factors Contributing to Status and Condition of Resources states: “The exceptional quality of Bristol Bay’s fish populations and their importance to the region’s wildlife and Alaska Natives results from five key, interrelated characteristics of the Bristol Bay watershed: (1) the quantity, quality, and diversity of aquatic habitats found in the watershed; (2) the importance of groundwater inputs and flow stability in shaping these habitats; (3) the high level of biological complexity that these diverse habitats support; (4) the increased ecosystem productivity associated with anadromous salmon runs; and (5) the environmental integrity of the watershed’s ecosystems”.

Comment: This section of the Assessment is again focused on Bristol Bay as a whole and not on the watersheds of interest to the Assessment. Also, the Assessment contains no rationale or documentation on what process and scientific documentation was used to determine the five factors posited as contributing to the status and conditions of the resources. What the Assessment fails to mention is that Pacific salmon evolved separate species, with different life history patterns in order to take advantage of the physical habitats that are present in the watersheds. The different life history patterns limit competition for food and space through habitat partitioning, differences in food selection, and juvenile residency time prior to emigration. Bristol Bay has an abundance of lakes which favor sockeye salmon, just as Prince William Sound has an abundance of small streams which flow into saltwater which favors pink salmon production. The same evaluation and conclusions used by EPA could be drawn for Chinook salmon in the Central Valley of California. Also, if the Assessment was properly focused on the Pebble project area then it is likely that the five factors currently identified as contributing to the status and condition of the salmon resources would be different. It is apparent that very little ecological thought went into the development of this section. In addition, the documentation and rationale presented for each of the subsections is general and not applicable to a scientifically valid ecological risk assessment.

<u>EPA Response:</u> Section 3.4 of the revised assessment provides a general characterization of the quantity and diversity of aquatic habitats in the region. Additional detail characterizing habitat at finer geographic scales within the region is provided in Chapters 7 and 10. These discussions include citations of research specific to fish-habitat relationships in the Bristol Bay region, which support conclusions of the importance of habitat quality, quantity and diversity, groundwater, biological complexity, salmon-derived nutrients, and the current integrity of the watershed.

2.55 *Section 2.5:* The Assessment page 2-20: Subsection 2.3.1 Quantity, Quality, and Diversity of Aquatic Habitats

Comment: This subsection again casts a broad net over the Bristol Bay watershed as a whole. The information provided does not describe the current conditions (characterization) of the area that would be influenced by a hypothetical mine development. Instead, this subsection discusses the miles of stream in the watershed, speculates about potential under documentation of anadromous streams in the larger watershed, describes the importance of lakes for spawning and rearing for sockeye salmon, and provides a totally useless paragraph on physical habitat complexity based on some remote sensing modeling effort. What this subsection does not do is describe the quantity, quality, and diversity of aquatic habitats that would serve as a comparative basis for conducting a scientifically based assessment of the current ecological conditions that might be affected by development and failure of one feature of a modern mine development. For example, the Assessment never mentions the fact that within the North and South Fork watersheds there is only one small (<100 fish) sockeye salmon spawning population in Big Wiggly Lake in the North Fork. It does not mention that there is no lake spawning sockeye population in the South Fork Koktuli and the majority of the comparatively small sockeye populations spawning in the North and South Fork watersheds are river type sockeye, which do not use lakes as a rearing area. Why? There are no suitable lakes in the Koktuli River watershed for rearing sockeye. Why is this discussion of the role of lakes in sockeye salmon included when it is really irrelevant to the current conditions?

<u>EPA Response:</u> See response to Comment 2.52.

2.56 *Section 2.6:* The Assessment page 2-21 states: “Overall physical habitat complexity in the Bristol Bay watershed is higher than in many other systems supporting sockeye salmon populations. Of 1,509 North Pacific Rim watersheds, the Kvichak, Wood, and Nushagak (exclusive of Wood) Rivers ranked third, fourth, and forty-fourth, respectively, in physical habitat complexity, based on an index that included variables such as lake coverage, stream junction density, floodplain elevation and density, and human footprint (Luck et al. 2010)”.

Comment: This sentence again refers to the satellite photo assessment made by Luck et al. (2010) for watersheds apparently in the North Pacific Ocean. However, this sentence does not explain how the parameters used to develop the ranking were used or weighted to develop the final rating. In addition, this sentence contains no specifics about the Pebble project area and how it applies to this rating of physical habitat complexity. In fact, how does the reader know that this rating of physical habitat complexity is scientifically valid? The physical habitats in the Pebble project area are very simple. There are only a few small lakes, with only one having a sockeye spawning population of less than 100 fish. River type sockeye spawn in the North and South Fork Koktuli rivers, with the majority of the population spawning in spring upwelling areas. The vast majority of sockeye that spawn in Upper Talarik Creek spawn a significant distance downstream of a potential mine development disturbance, with juveniles having a short emigration to Iliamna Lake. The North Fork Koktuli only has three significant, but small in width, tributaries in ~60 km of main stem channel. The South Fork Koktuli also has only two significant tributaries in about the same length of main stem channel. Upper Talarik Creek has a few more significant tributaries, but most are small and generally host only a few spawning fish. The exceptions are First Creek which is a tributary entering near Iliamna Lake and will be unaffected by mine development and the Northeast Tributary (coded as UT 1.350) which contained a run of a few hundred coho during aerial surveys conducted by PLP. So basically, mine development will result in minimal change to the parameters used by Luck et al. (2010) to assess physical habitat complexity. In order to serve as a comparative parameter for an ecological risk assessment, the Assessment needs to focus on those parameters and areas which would be influenced by mine development. In addition, The Assessment suffers a fatal flaw since it fails to present a quantitative comparison of habitat quantity, quality, and diversity before and after mine development (both non-failure and failure scenarios). The Assessment also needs to present a quantitative comparison of the fish populations in the larger watersheds pre and post mine development.

<u>EPA Response:</u> Luck et al. (2010) is a peer-reviewed scientific study and thus is assumed to be scientifically valid. The relevance of information presented at the entire Bristol Bay watershed scale in the problem formulation chapters of the assessment has been addressed in the responses to Comments 2.3 and 2.52.

2.57 *Section 2.7:* The Assessment page 2-21, Section 2.3.2 Groundwater Exchange and Flow Stability states: "A key aspect of the Bristol Bay region's aquatic habitats is the importance of groundwater exchange. Because salmon rely on clean, cold water flowing over and through porous gravels for spawning, egg incubation, and rearing (Bjornn and Reiser 1991), areas of groundwater upwelling create high-quality salmon habitat (Appendix A). For example, densities of beach spawning sockeye salmon in the Wood River watershed were highest at sites with strong groundwater upwelling, and zero at sites with no upwelling (Burgner 1991). Densities of salmon-supporting streams tend to be lower in regions with lower permeability and less extensive exchange between groundwater and surface water (Johnson and Blanche 2011, ADFG 2012)".

Comment: This paragraph contains several general ecological statements regarding salmon habitat and the influence of groundwater. However, the paragraph does not contain any information regarding the Pebble project area or comparison of conditions found in the

Pebble project area to the cited literature. Also, the sentence regarding beach spawning is irrelevant, since none of the major sockeye spawning locations in the watersheds near the Pebble project area contain lakes that sockeye use for spawning, with the possible exception of Big Wiggly Lake which has a documented spawning population of <100 fish and some of those are known to spawn in tributaries to the lake. How can these parameters be used in an ecological risk assessment when the Assessment fails to provide any data or comparative analysis to show what impact to these specific parameters might occur under a mine development and operations scenario? This paragraph is fluff and filler.

<u>EPA Response:</u> See response to Comment 2.52. Given the importance of Iliamna Lake as a sockeye spawning area and its proximity to the mine site, discussion of lakes as spawning areas is directly relevant to the assessment. The different geographic scales considered in different sections of the assessment have been clarified in Chapter 2. Geographic scales more restricted to the mine site are considered in the risk analysis and characterization chapters of the revised assessment (Chapters 7-12).

2.58 *Section 2.8:* The Assessment page 2-21, Section 2.3.2 Groundwater Exchange and Flow Stability states: “This tight connection between groundwater and surface waters helps to moderate water temperatures and stream flows. For example, groundwater contributions that maintain water temperatures above 00 C are critical for maintaining winter refugia in streams that might otherwise freeze (Power et al. 1999)”.

Comment: While these sentences are generally true, they fail to capture the ecological significance of groundwater to the streams in the Pebble project area. The last sentence indicates that groundwater that maintains water temperatures above freezing helps provide winter refugia in streams. However, the sentence misleads the reader with respect to the Pebble project area. First, the sentence fails to inform the reader that significant portions of the South Fork Koktuli main stem channel freeze solid in the winter, even though a major portion of that channel overlies a large groundwater aquifer in the watershed, that the South Fork has several “losing” reaches which results in water flow into the ground, often resulting in areas that freeze solid in the winter or greatly reduce any liquid water in the main stem channel, that the volume of groundwater inflow may be insufficient to provide suitable winter refugia (particularly for older age salmon juveniles) in all years, that a major portion of the winter flow for Upper Talarik Creek depicted in Figure 2-7A comes from a natural interbasin transfer of groundwater of approximately 20-25 cfs from a major groundwater aquifer of the South Fork Koktuli, or that a large groundwater inflow to the North Fork Koktuli enters the main stem from the north and upstream of the gaging station used to calculate the data presented in Figure 2-7B. These examples only illustrate that the Assessment failed to use publically available data and analyses which would provide the reader with a much clearer understanding of the influence of groundwater on stream flows in the Pebble project area. This section also clearly illustrates that the authors are totally unfamiliar with the physical and ecological implications of groundwater hydrology on the streams in the Pebble project area. The Assessment failed to use, critical and publically available site-specific data in violation of EPA’s own ecological risk assessment guidelines, resulting in fatally flawed assumptions and conclusions.

<u>EPA Response:</u> The revised assessment includes a refined characterization of the water balance for the mine project area, including additional consideration of groundwater connectivity and interbasin flows.

2.59 *Section 2.9:* The Assessment page 2-21, Section 2.3.2 Groundwater Exchange and Flow Stability states: “These groundwater contributions to stream flow also support flows in the region’s streams and rivers that are more stable than those typically observed in many other salmon streams (e.g., in the Pacific Northwest or southeastern Alaska)”.

Comment: The entire discussion with respect to stream flow stability as it relates to the Pebble project area is not a scientifically valid comparison for several reasons. First, the comparison of the Pebble area with Pacific Northwest and southeastern Alaska is not a valid comparison, because a majority of the streams in these two areas are driven by rainfall events. Only streams in the higher elevations of these areas may behave similarly to Pebble project area streams, depending on the influence of groundwater inflows. Pebble area streams are driven by a combination of groundwater inflows, spring breakup, and late summer rainfall. Second, the stream hydrographs presented in Figure 2-7 are misleading because they fail to accurately represent the conditions that occur at the top of the North Fork, South Fork, and Upper Talarik Creek watersheds, where the Pebble project area is located. The data used to develop Figure 2-7 comes from gaging stations that are located approximately 30 km downstream of the Pebble project area and fail to account for the geology and groundwater hydrology found in the Pebble project area or the intervening factors which influence stream flow at the selected gaging stations. Third, and most importantly, there is nothing unique or unusual about the hydrographs shown in Figure 2- 7. These hydrographs really depict basically the same hydrograph one would expect to see for most any smaller stream in South Central or Southwestern Alaska. What these hydrographs show is higher flows in the spring as a result of snow melt and spring break up, variable flows during the summer due to rainfall events, and a gradual decrease in stream flow as winter approaches and portions of the watershed begin to freeze and contribute less runoff. Winter flows will be highly variable depending on the size of the stream and the proximity of any flow measurements to groundwater inputs to the main channel. Also, note that the data depicted in Figure 2-7 is only for a six year time period and does not include any error bars or range of data for each month. The next paragraph of the Assessment includes statements regarding the role of upstream lakes in providing flow stability. This statement is irrelevant, since the North Fork and South Fork Koktuli watershed lack any lakes of significant size that contribute a major stabilizing influence on stream flows. Upper Talarik Creek contains no lakes or ponds of significance. In summary, Section 2.3.2 of the Assessment fails to provide any scientifically valid data or analysis that could be used in completing an ecological risk assessment in accordance with EPA guidelines. It also clearly illustrates that the authors of the Assessment did not use publically available data to develop this section of the Assessment and lack even a rudimentary understanding of the relationship between groundwater and stream flow in the Pebble project area. The entire discussion in the Assessment regarding flow stability is not scientifically valid for the Pebble project area and based on inappropriate data and analyses.

<u>EPA Response:</u> See response to Comment 2.58.

2.60 *Section 2.10:* The Assessment page 2-22: Subsection 2.3.3 Biological Complexity

Comment: This subsection of the Assessment presents only a fraction of the information necessary to understand the biological complexity in the area and as a result fails to present a comprehensive understanding of the ecological strategies and life history drivers behind salmon behavior. There is no doubt that having all suitable habitats occupied by one or more species does bring more stability to salmon populations as a whole. However, to suggest that each spawning stock is genetically distinct without discussing the role that straying plays in maintaining population genetic diversity and the ability of a species to recover from a catastrophic event in a particular watershed is intellectually dishonest. Straying rates among Pacific salmon range from a few percent in sockeye (depending on their specific life history pattern) to possibly 25% in pink salmon. Also, the Assessment fails to place the sockeye salmon populations found in Pebble project area streams in context with the overall sockeye populations in the Kvichak and Nushagak watersheds. If you assume a sockeye spawning run of 50,000 fish in Upper Talarik Creek (a high estimate based on historical ADFG counts) and an 8,000,000 escapement goal for the Kvichak, a total loss of the Upper Talarik stock in one year would equal about 0.38% of the total escapement into the watershed. This stock would not be lost, because there are several age classes of immature fish that are either in Iliamna Lake or the ocean to recolonize the stream. Also, fish from nearby systems will stray into Upper Talarik Creek. On the Nushagak side, sockeye runs into the North and South Fork Koktuli rivers total a few thousand fish which equates to at most 0.01% of the Nushagak escapement goal. This Assessment fails to properly characterize the minute contribution of fish from the project area to the overall production of salmon in the watersheds, and thereby seriously misleads the reader with regard to ecological risk and impacts associated with mine development. The Assessment's attempt to use the Chinook salmon from the Sacramento River as an example of biological complexity that is applicable to the Kvichak or Nushagak watersheds is totally inappropriate. The Assessment fails to accurately present what happened to the Chinook salmon populations in the Sacramento River system. First, the Sacramento River historically had four races of Chinook salmon:

Winter-run which entered the system in the winter and migrated upstream into the Pit River watershed and spawned in the cold spring-fed waters of the Modoc and Pit River plateaus in June and July. Water temperature in the spawning areas was the driving force behind adult entry timing into freshwater. Most of these fish matured at 3-4 years of age.

Spring-run fish entered freshwater during spring runoff and migrated into higher elevations where they spent the summer in cold holding areas and then spawned in the fall. Juveniles spent at least one year rearing before emigration. Fall-run were acclimated to the low elevations of the Central Valley and lower portions of the various tributary rivers. These fish entered in October and November, spawned immediately, and smolts left the system at about 70 mm in length in April or May of the following spring. Exploitation rates of 75% in the commercial fishery, combined with massive introductions of hatchery origin fish as mitigation for lost habitat access resulted in this race being reduced from an age composition of 3-8 year old adults, to a population that is nearly totally dominated by age 3 adults, with a large component of age 2 jacks in some years. Hatchery mitigation fish total approximately 20 million smolts per year.

Late-fall run fish entered freshwater in December through January, spawned in Battle Creek which is primarily spring fed from the Mt. Lassen area, resulting in one year smolts.

Access to historical habitats due to blockage by dams with no fish passage facilities resulted in denying winter and spring-run fish spawning areas and they persisted only in limited locations where the water temperatures below the dams permitted continuation of the genetically controlled life cycle. Late-fall run fish from Battle Creek were never blocked by a dam, but the 75% exploitation rate on the fall run stocks in the commercial fishery took its toll on this limited stock. Fall run fish fluctuate wildly over relatively short time spans. For example, spawning escapements in the Sacramento River in the early 2000s were some 500,000 to 700,000 fish which is 3-5 times the spawning escapement goal range. In the late 2000s the spawning escapement was about 65,000 fish, with hatchery supplementation remaining constant. Ocean conditions drive the variations in this Chinook salmon population as does ocean conditions drive the population fluctuations in sockeye salmon populations using the North Pacific. The use of the Sacramento River Chinook salmon declines in biological complexity is totally inappropriate since the factors which caused the decline there are not relevant to the assumptions and conditions used in the Assessment. The Assessment fails to present any relevant and/or comparative information or analysis to draw any conclusion about how the hypothetical mine development would influence biological complexity in the two watersheds of interest. Also, by not presenting any factual information on which to base an ecological comparison, the Assessment fails to establish a basis for completing an ecological risk assessment. This entire section should be either updated with relevant information or omitted from the document. It is all speculation, misuse of scientific information or innuendo.

<u>EPA Response:</u> The assumption that salmon would readily recolonize streams destroyed, dewatered, or otherwise made inhospitable due to toxic sediments, habitat alteration, or other changes is unrealistic. Successful recolonization would be contingent upon many factors, including habitat configuration, accessibility, food availability, and water quality. Given some of the scenarios presented in the assessment, rapid recolonization is highly speculative.

2.61 *Section 2.11:* The Assessment page 2-24: Subsection 2.3.4 Salmon-Derived Productivity

Comment: This subsection of the Assessment discusses the role of marine derived nutrients (MDN) and the role of these nutrients in the biological productivity of salmon streams. While the information cited is true, most of it is irrelevant to the discussion of the Pebble project area. First, MDN may play an important role in the mid to lower portion of Upper Talarik Creek, but only in the month or two before sockeye salmon emigrate to Iliamna Lake. The nutrient input to Iliamna Lake should be placed in the context of the total amount of nutrients imported by all returning adults. The Assessment fails to mention that sockeye salmon in Upper Talarik Creek spawn in July and August and that a smaller peak occurs in September and that studies show that the benefits of MDN are transient and do not last much more that about 4 months or so. Also, the Assessment fails to mention that most of the groundwater flows into the main channels of the North Fork, South Fork, and Upper Talarik Creek, so that the generally accepted transfer of MDN into the hyporheic zone and adjacent riparian areas is not as significant as it is in other locations. In the North Fork Koktuli River, insignificant numbers of salmon spawn upstream of about the location of the hypothetical Tailing Storage Facility 1 (TSF 1) tributary stream, thus limiting the influence of MDN in the watershed except in certain downstream areas, particularly since these are river type sockeye salmon. A greater influence on rearing coho and Chinook could be expected, but is not mentioned in the Assessment. On the South Fork Koktuli River, the Assessment fails to mention or recognize that no significant spawning occurs upstream of the "South Fork Springs" which starts at about the location of the hypothetical Tailings Storage Facility 2 (TSF 2) tributary and lies downstream of this location. The Assessment incorrectly assumed significant spawning and rearing of salmon upstream of this location, based on an inappropriate and incorrect use of the AWC map and data. Only an occasional salmon has been recorded spawning in this 21 km stretch of river downstream of Frying Pan Lake. The Assessment fails to recognize that no salmon spawning has been documented in the 8.5+ km of main stem South Fork upstream of Frying Pan Lake. Also, the Assessment fails to incorporate the natural water chemistry data in these three streams, which limit primary productivity just by the low concentrations of critical constituents. For example, the mean alkalinity in the South Fork is less than the minimum state standard. Even if sufficient nutrients were present, there is no guarantee that fish production would be any higher. As a result of these mistakes, the Assessment's inference to the reader that MDNs are an important source controlling salmon productivity is not supported by a valid analysis or complete analysis of the ecological factors controlling primary productivity in the three Pebble project area watersheds. The Assessment completely misrepresents the importance of MDNs in the Pebble project area.

<u>EPA Response:</u> See response to Comment 2.52.

2.62 *Page ES-2 §2:* To say that the Pebble prospect "is located at the intersection of the Nushagak River and Kvichak River watersheds" is terribly imprecise. The "intersection" of these two watersheds is nearly 300 miles long. It is more precise and informative to say that it is located at the divide between two relatively minor tributaries of these two watersheds.

It is inaccurate and misleading to say that the three principal streams in the Pebble area (North Fork Koktuli, South Fork Koktuli, Upper Talarik Creek) are "biologically productive" because, despite supporting salmon runs, all three streams have very low hardness and alkalinity and relatively low biological productivities as measured by periphyton and aquatic invertebrate communities. This is particularly true of the Koktuli forks.

<u>EPA Response:</u> Text in the revised assessment clarifies that the Pebble deposit is located in the headwaters of the Nushagak and Kvichak River watersheds. Text has also been clarified to confirm that these tributaries support salmon runs.

2.63 *Page ES-8 §2:* While habitat quality and diversity is certainly important in maintaining healthy fish populations, the most important factor for Bristol Bay salmon is management of the fisheries, as the history of boom and bust prior to the implementation of the current management system very clearly demonstrates. Several crashes in Bristol Bay salmon have occurred since intensive harvest first arrived in the region in the 1890s, and it is only through conservative management that stocks have been able to rebound, habitat notwithstanding. EPA should have known this and taken account of this extremely important factor in the assessment. Hilborn (2006) attributes success of sockeye management in Bristol Bay to four factors: a clear objective of maximum sustainable yield; the escapement-goal system, assuring the maintenance of biological productive capacity; management by a single agency with clear objectives and direct-line responsibilities; and good luck, especially with respect to lack of habitat degradation and favorable ocean conditions during the period. An intensive

Stock Assessment Program is an integral part of the Bristol Bay fisheries management system and is designed to promote scientifically based in-season fishery management. Although Hilborn does cite lack of habitat degradation, this factor is well down on his list, and the permitting and oversight system firmly in place in Alaska is quite capable of keeping habitat degradation of such a very large system at a minimum.

EPA Response: Information on fisheries management in Bristol Bay has been added to the revised assessment (Box 5-2).

2.64 *Page 2-1 §2:* Introduction to Bristol Bay Region – This introductory paragraph states, "The land area draining to Bristol Bay consists of six major watersheds—from west to east, the Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik Rivers." This is incorrect. As stated in the Introduction to each of the Bristol Bay Annual Management Reports published by Alaska Department of Fish and Game, "The area includes 9 major river systems: Naknek, Kvichak, Alagnak, Egegik, Ugashik, Wood, Nushagak, Igushik and Togiak." There are two significant aspect of this EPA error. First, the agency undertook to perform an analysis on a "watershed" without doing enough background homework to understand its areal extent and the major river systems that comprise the Bristol Bay system. Second, this error magnifies the flawed approach that considered only two albeit large drainages, rather than taking a more comprehensive and inclusive tack.

EPA Response: See response to Comment 2.40.

2.65 *Page 2-4 Figure 2-2:* This figure highlights an error pointed out above. It shows the Wood River subsumed by the Nushagak watershed and the Alagnak River subsumed by the Kvichak watershed. This is inappropriate. The Wood River enters the Nushagak estuary (Nushagak Bay) below the salt chuck and the Alagnak enters the Kvichak estuary below the salt chuck (Kvichak Bay). Both the Wood and the Alagnak have independent escapement goals and estimates, and returns to these systems are accounted separately (from the Nushagak and Kvichak Rivers, respectively) in the Bristol Bay Annual Management Reports. Lumping these rivers with their adjacent systems is inappropriate, and reveals a lack of knowledge and understanding on the part of EPA of the systems, the associated fish populations and management of these populations by the State of Alaska, in the preparation of their analysis.

EPA Response: See response to Comment 2.40.

2.66 *Page 2-12 Figure 2-5:* Land area statistics in the figure legend are incorrect, since the map inappropriately includes areas occupied by the Alagnak and Wood rivers.

EPA Response: This figure has been removed from the revised assessment.

2.67 *Page 2-20 §5:* This paragraph correctly points out that large nursery lakes are important to sockeye salmon productivity, "rivertype" sockeye populations notwithstanding. Importantly, however, the section fails to point out the almost complete lack of large nursery lakes in the great majority of the Nushagak watershed, except for the Nuyakuk River drainage, a relatively modest sized tributary that receives the drainage from Tikchik and Nuyakuk Lakes. This explains the relatively modest contribution of sockeye salmon by the Nushagak system to the Bristol Bay fisheries, in spite of its large overall drainage area. The Nushagak system without its Nuyakuk component contributes only about 15% of the sockeye to the Nushagak

District and only about 8.5% of the total Bristol Bay run. This is a very important consideration when analyzing the potential impacts of mining in one of nine watersheds on sockeye salmon runs in Bristol Bay, but it was inappropriately ignored by EPA.

EPA Response: Chapter 9 of the revised assessment clarifies the estimated relative role of riverine sockeye salmon to the Nushagak River basin. Run size information has been updated in the revised assessment from ADF&G published reports containing estimates of total run and escapement. The Nushagak District contributes nearly 10 million fish on average, or 26% of the Bristol Bay run (2002 to 2011 average reported in Fair et al. 2012). The Nushagak River system contributes on average approximately 2.0 million fish, 20% of the Nushagak District run or about 5% of the total Bristol Bay run. Escapement count data to the Nuyakuk River system component were discontinued after 2006, so data for the same time period are not available. However, the Nuyakuk River comprised 31% of the Nushagak River escapement from 1995 to 2006. Assuming sockeye return to the Nushagak River without the Nuyakuk River component was 69% of the total run to the Nushagak River, then the total run would be about 1.3 million fish on average, or 3.5% of the total sockeye run to Bristol Bay.

2.68 The EPA Report authors do not clarify why the Wood River watershed was lumped into the Nushagak-Kvichak watershed complex. The Wood River system is discussed as being distinct from the Kvichak and Nushagak watersheds in some scientific fisheries literature (e.g,, Schindler et al. 2012, Hilborn et al. 2002), but is included in others (e.g., Luck et al. 2010). This has implications for the descriptions and quantification of overall watershed-level landscape, climatic, and ecological characteristics.

EPA Response: See response to Comment 2.40.

2.69 There are several instances where the information cited in the EPA Report is not substantiated by the cited reference. For example, on p. 2-20, the text states “In other North Pacific river systems supporting sockeye salmon populations, from northern Russia to western North America, these values tend to be much lower (e.g., 0.2 to 2.9%) (Luck et al. 2010)”; however, the cited values are not specified in Luck et al. (2010).

EPA Response: The comment is correct. Luck et al. (2010) is cited here because it describes the Riverscape Analysis Project. It would be more accurate to cite the RAP’s data portal here (http://rap.ntsg.umt.edu), and this has been corrected in the final assessment.

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2.70 *Section 2.3.2, page 2-21, paragraph 5.* Nushagak River is defined with “high base flow”. This is incorrect, according to Figure 2-78.

EPA Response: See response to Comment 2.34.

2.71 *Section 2.3.1.* Four paragraphs to describe existing conditions of Aquatic Habitats (Quantity, Quality and Diversity) are not adequate for this analysis. It is understood that salmonid and andadromous fish habitat have intrinsic value; however, these values are not the only values for which the existing conditions of aquatic habitats should be described. A review of the studies conducted by PLP (Environmental Baseline Document) would provide a more complete analysis of existing conditions of Aquatic Habitats, but it is clear that USEPA has generally ignored the PLP baseline data throughout this assessment.

EPA Response: The information on aquatic habitats in the PLP's Environmental Baseline Document has been used in all drafts of the assessment, and additional information has been added to Chapter 3. A check of the assessment's citations demonstrates that the PLP EBD data were far from ignored. However, the EBD data are not as credible as they might have been, because they are not yet peer-reviewed and they were provided only in pdf format, rather than a numeric format that would have allowed us to perform original data analyses or to replicate the EBD authors' data analyses.

2.72 *Section 2.3.4, 1st paragraph, sentences 4 and 5.* The logic presented in these two paragraphs is flawed since it assumes that all the returning fish escape into the rivers to spawn. Per Figure 6-1, the average escapement into the entire study area averages 16,142 fish, not 30 to 40 million. At an average size of 2.32 kg per fish (Burgner 1991), this is equivalent to approximately 37,500 kg of fish. Only a small percent of that weight is nitrogen and phosphorus (typically 11 to 12 percent nitrogen). So the total import must be less than 4,000 kg of nitrogen and an even smaller amount of phosphorus, not the estimated 20 million kg reported in the referenced paragraphs. Furthermore, Moore and Schindler (2004) indicate that on average, smolts export 12% of the phosphorus and 16% of the nitrogen that their parents bring in, so the nutrients available to other biota are smaller than the total nutrients imported by the parents.

EPA Response: The assessment text accurately reflects the findings of the cited works, does not contain logical inconsistencies, and does not make any argument regarding import vs. export of marine-derived nutrients. No change required.

2.73 *Section 2.2.2 page 215, Table 2.5.* Reported catch levels of lake trout presented in this section are an order of magnitude higher than the catch rates reported in Appendix B pg. 25 'Abundance and Harvest' (17,000 for 2004 vs. 3,651 in 2009 for comparable areas).

EPA Response: This table has been deleted from the revised assessment.

2.74 *Section 2.2.3.* Minimal information is provided describing the location or size of projected mine locations. Significant improvements to the assessment are needed to support an analysis of impacts on wildlife. Without specific foot prints and project design, there is not enough data to support any impact analysis, especially when there are no detailed assessments of wildlife populations or habitat, or use of that habitat in the immediate footprint, or within an area of influence from proposed activities.

EPA Response: Specific impacts of the mine are considered in the risk analysis and characterization chapters of the assessment (Chapters 7-13), not the problem formulation chapters (Chapters 1-6). No change required.

2.75 *Section 2.3.3.* There is no discussion of species diversity, sensitive species, listed species, genetically fragile, or diverse species (other than salmon), or any mention of complex vegetation and whether this complexity lends itself to greater resistance to changes in environmental conditions. The lack of adequate analysis greatly undermines the scientific credibility of the assessment.

<u>EPA Response:</u> The assessment focuses on potential risks to salmon and other fish from large-scale mining and resulting fish-mediated effects on Alaska Native culture and wildlife, although we do recognize the complexity of potential direct, secondary, and cumulative effects on other species in the mining area and transportation corridor. See response to Comment 2.24 for information on endangered and threatened species.

2.76 *Section 2.2.3, Page 1 and 3.* In this section, the statement is made that "In many cases little abundance data specific to the Bristol Bay watershed are available". The report states that a comprehensive survey of bald eagles or bald eagle nests has not been conducted in the Bristol Bay watershed. The report assumes, however, that abundance patterns mirror other watersheds. This general assumption is used throughout the analysis of impacts. Recognizing data are lacking, the assessment fails to indicate the basis for assuming that bald eagle population estimates derived from other watersheds are applicable.

<u>EPA Response:</u> For many species, including bald eagles, there are no abundance data specific to the Nushagak and Kvichak River watersheds. However, based on the information available on various species, as well as the relatively intact habitat in these two watersheds, there is reason to believe that population estimates from other similar watersheds are reasonable. The assessment report has been revised to identify this as an uncertainty which could over- or underestimate potential effects.

2.77 *Section 2.1, page 2-3 (PDF page 55), paragraph 2; Appendix E, Table 3, page 18.* Citations are missing describing components of the annual water budget.

<u>EPA Response:</u> It is not clear what this comment is referring to, as the comment does not match the specified text (i.e., the text does not deal with water budget issues). However, in the revised assessment economic implications of fisheries are briefly discussed in Section 5.2.3 and Table 5-4 directs the reader to Appendix E (Table 3 of the Executive Summary and Section 4) for additional information on the reported values.

2.78 Section 2.1, Page 2-1; Figure 2-1, Page 2-2; and Section 2.2, Table 2-1, page 2-6

There are 6 watersheds listed (Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik Rivers) in the text and labeled on Figure 2-1. Citations are missing describing the source for this information. On the internet, the USEPA shows different watershed boundaries and uses different watershed names (http://cfpub.epa.gov/surf/state.cfm?statepostaI=AK).

<u>EPA Response:</u> No change required. The watersheds shown on the website cited in the comment are defined at smaller hydrologic units. We combined these smaller units into the seven watersheds considered at the largest geographic scale in the assessment (Scale 1). The North Alaska Peninsula was added at this geographic scale to more accurately describe the entire Bristol Bay watershed.

With regard to geography, the USEPA should make two corrections: (a) Aleutian Range--Elevation should be 300 - 1,200 meters (1,000 - 4,000 feet), rather than 200 - 1,200 meters. (b) Nushagak-Bristol Bay Lowland--A moraine lake is listed as a freshwater habitat. It is likely that the EPA meant morainal lake.

<u>EPA Response:</u> See response to Comment 2.43.

2.79 *Section 2.1, page 2-1.* Citations are missing describing vegetation and freshwater habitats of the Bristol Bay watershed.

EPA Response: Additional information on vegetation and freshwater habitats in the Bristol Bay watershed has been added to Chapter 3.

2.80 *Section 2.2.4, Page 2-17, Table 2.6*. The only justification for the values presented for each economic sector states "see Appendix E for additional information on these values." There are many calculations and value estimates throughout Appendix E. In order to verify calculations, specific references to the specific locations in Appendix E where the relevant information can found need to be stated.

EPA Response: This information is included as Table 5-4 in the revised assessment; the table heading now directs readers to Appendix E (Table 3 of the Executive Summary and Section 4) for additional information on the reported values.

2.81 *Chapter 2, Section 2.2.1, Figure 2-5*. Demory et al. 1964 is not listed in the reference section. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: This reference was provided in the references section for Chapter 5 in the original draft assessment, and is included in the appropriate references section in the revised assessment.

2.82 *Section 2.2.2 page 215, Table 2.5.* There are not supporting technical references in notes a and c of the Table. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: This table has been removed from the revised assessment.

2.83 *Section 2.3.4, lst paragraph, sentence 4.* The reference to work by Moore and Schindler is missing from the reference section. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: This reference was provided in the references section for Chapter 2, and is included in the appropriate references section in the revised assessment.

2.84 *Section 2.3.4, lst paragraph, sentence 5.* The statement refers to Appendix C for the source of information. It is not apparent where in Appendix C the supporting information can be found. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: The relevant references are Hilborn et al. (2003) and Ruggerone et al. (2010), both of which were provided in the references section for Chapter 2 in the original draft assessment. Citations to these references have been added to the text in the revised assessment.

<u>Alaska Conservation Foundation (Doc. #4120)</u>

2.85 I provide here some constructive comments. First, while the Assessment appropriately refers to the "pure" or "clean" water of the region (see section 2 "Characterization of the Current Condition") it would be worth stating that the waters are so clean that they far exceed virtually all water quality standards set by the state of Alaska, and are so pure that aquatic life will be highly susceptible to any increase in metals.

<u>EPA Response:</u> The assessment does not compare current water quality to state standards, except to note that copper exceeds standards in the headwaters of the South Fork Koktuli, which drain the ore body. The relationship of receiving water quality to the toxicity of metals is discussed in Chapter 8 of the revised assessment.

<u>D. S. Braund (Doc. #0859)</u>

2.86 Salmon have always played an important role in human culture, both for native peoples and more recently settlers (Schtickzelle and Quinn 2007). More than 20,000 species of bony fishes currently dominate the earth's waters; one percent of those fish migrate between fresh and salt water (Woody 2011). Anadromous salmonids link freshwater and saltwater ecosystems by carrying nutrients from the sea, where they grow, to the lakes and tributaries, where they die after spawning (Schtickzelle and Quinn 2007). Salmon are extremely important economically, generating billions of dollars through commercial and recreational fisheries (Schtickzelle and Quinn 2007).

Atlantic salmon (*Salmo salar*) on the east coast of North America once sustained viable fisheries, but now populations are less than two percent of historical abundance (Woody and O'Neal 2010). Pacific salmon are also in decline. There are naturally occurring Pacific salmon populations throughout the coastal waters of the North Pacific Ocean, Arctic Ocean and nearby seas (ADFG 2011c, 2011d, 2011e, 2011f, 2011g). About a third of 1,400 Pacific salmon (*Oncorhychus* spp.) populations along the western contiguous U.S. are now extinct, representing at least 40 percent of their freshwater range (Woody and O'Neal 2010). A third of remaining populations are threatened or endangered with extinction, and 28 distinct population segments are now listed as endangered or threatened in the U.S. (Woody and O'Neal 2010).

<u>EPA Response:</u> Comment noted; no change required.

2.87 The rivers that flow into Bristol Bay comprise some of the last great wild salmon ecosystems in North America (Duffield *et al.* 2007). The area includes nine major river systems: Naknek, Kvichak, Alagnak, Egegik, Ugashik, Wood, Nushagak, Igushik, and Togiak (ADFG 2011). Collectively, these rivers are home to the largest commercial sockeye salmon fishery in the world (ADFG, 2011). Almost 50 percent of all the sockeye salmon produced in the world originate from Bristol Bay Drainages alone (ADFG 2009). The Bristol Bay drainages have produced an average of 30 .63 million salmon from 1956 to 2011 (ADFG 2011b). In the last decade, total runs have averaged over 40 million salmon (ADFG 2011b). Sockeye salmon are by far the most abundant salmon species that return to Bristol Bay each year, but Chinook (*Oncorhynchus tshawytscha*), chum (*Oncorhynchus keta*), Coho (*Oncorhynchus kisutch*), and pink (*Oncorhynchus gorbuscha*) return to the region as well (ADFG 2011).

A key to the success of the sustainability of Bristol Bay sockeye and the fisheries that depend on them has been the conservation of biodiversity, which is derived from a wide variety of life history types and multiple district locally adapted populations (ADFG 2009). Genetic studies, conducted by the Alaska Department of Fish and Game (ADF&G), have identified numerous discrete populations of sockeye salmon within each of the drainages of Bristol Bay (ADFG 2009). ADF&G, Division of Commercial Fisheries, is responsible for managing the commercial fisheries in Bristol Bay under the sustained-yield principle (ADFG 2009). The sustained-yield principle requires that annual returns of salmon be managed to reach biologically determined escapement goals for discrete river systems that ensure viable populations of offspring make it to adulthood. Salmon escapement is managed according to the following factors: number of spawners; sex ratio; age composition; temporal entry into the system; and spatial distribution within the salmon spawning habitat (ADFG 2009). The management objective for each river is to achieve escapements within established ranges for the major salmon species while harvesting fish in excess of those ranges through orderly fisheries (ADFG 2011).

In addition to a globally significant salmon fishery, Bristol Bay offers world-class sport fishing, and provides an important food source and cultural identity for local communities (Parker *et al*. 2008). Athabaskan, Aleut, and Yup'ik peoples annually harvest over 140 thousand salmon, which they dry, smoke, pickle, salt, can and store for winter sustenance, as they have for thousands of years (ADFG 2011; Woody and O'Neal 2010). The rich salmon-based ecology also supports many other species, including: Alaska brown bears; a healthy population of rainbow trout; one of only two resident freshwater seal populations in the world; and the Mulchatna caribou herd, one of Alaska's largest (Duffield *et al*. 2007; Parker *et al.* 2008).

<u>EPA Response:</u> Comment noted; no change required.

2.88 The question of metapopulation dynamics in salmon is not simply a rhetorical exercise. Salmon utilize a series of biotopes for their different life stages, which are spread over large areas of land and ocean. Metapopulation dynamics are processes occurring on large scales. Therefore, it would be advisable for policy makers to consider the whole collection of sites needed for a viable metapopulation when making land use decisions. Management strategies intended to foster long-term persistence of the highly productive Bristol Bay salmon stock must prioritize the preservation of regional salmon populations, occupied habitat, and vacant but suitable habitat.

<u>EPA Response:</u> Comment noted. The importance of diverse, regional salmon populations is discussed in Sections 5.2.4 and 13.4.1 of the revised assessment.

2.89 Duffield et al. (2007) evaluated the economic values associated with sustainable use of the wild salmon ecosystem resources - primarily fisheries and wildlife - of the major watersheds of Bristol Bay. The total value of the Bristol Bay area watersheds include components of subsistence use, commercial fishing, sportfishing and other recreation, and preservation values held the U.S. resident population and other users. Annual net economic value associated with direct use of the natural resource services provided by the Bristol Bay ecosystem is approximately $179 million annually (Duffield *et al.* 2007). These are values for renewable resource services that in principle should be available in perpetuity.

EPA Response: **Comment noted; no change required.**

V. Wilson III (Doc. #4149)

2.90 I applaud EPA's analysis that shows that nearly half of the world's wild sockeye salmon come from the Bristol Bay region. To understand the economic benefits of this unparalleled fishery, WWF's August 2011 study titled "The Value of Commercial Fisheries Near Bristol Bay, Alaska" shows a sample of the geographical distribution of Bristol Bay salmon sold in the global market by just one salmon processor, with its salmon product reaching four out of the seven continents, and as far as Japan, South Africa and the United Kingdom. The WWF study also has a multiplier effect for Bristol Bay salmon that shows the overall economic benefits, including direct and indirect benefits, of the fishery to both the local economy that is important to Alaska Natives, as well as the global economy. The report also shows the residency of 2008 Bristol Bay salmon permit holders in the United States, which documents where the permit holders reside. In 2008, Bristol Bay permit holders resided in 45 of the 50 U.S. states as well as many locations throughout Alaska and Bristol Bay, emphasizing the national, statewide and regional importance of the fishery to provide jobs and economic benefits for Alaska Native tribal members, as well as American's from all walks of life.

EPA Response: **Because the assessment focuses on peer-reviewed analyses, this reference was not included.**

2.91 I would like to point out a report from fisheries reporter Laine Welch's and her findings on Bristol Bay's sockeye in July 2012. In her report, she states that Bristol Bay's sockeye are by far Alaska's most valuable salmon fishery; well over one-third (sometimes as much as half) of the state's total salmon fishing earnings come from Bristol Bay. The bay also has the most fishermen, with more than 2,800 salmon permit holders.

EPA Response: **See response to Comment 2.90.**

Fisheries Research and Consulting (Doc. #4580)

2.92 *Section 2*

Comment: One important but overlooked aspect of current conditions is the fact that the region has a limited capacity to neutralize acid and hardness dependent dissolved metals such as Cu as hardness and DOC are very low.

EPA Response: **Information on water chemistry has been expanded in Chapter 8, particularly in terms of the role of water chemistry in the toxicity of copper and other metals.**

2.93 *Page 2-3, "…with a total population of 7475 in 2010"*

Comment: Citation. US Census Alaska, Alaska Community Database.

EPA Response: **This information has been incorporated into Chapter 5 of the revised assessment, and is appropriately cited.**

2.94 *Page 2-3, "Salmon account for the majority of the subsistent diet"*

Comment: Citation. Duffield, J. 2009. Bristol Bay Wild Salmon Ecosystem Economics 2008 Update.

EPA Response: See response to Comment 2.93.

2.95 *Page 2-3 "…and these regions serve as major water source areas for lower portions of the Nushagak and Kvichak watersheds"*

Comment: Citation. Alaska Community Database.

EPA Response: This summary statement is drawn from the conclusions of the hydrologic landscape analysis that follows. Selkregg's (1974) characterization of southwest Alaska has been added to this section in the revised assessment.

2.96 *Page 2-3, "Annual water balance in the mountains and hills is dominated by snowpack accumulation…"*

Comment: Citation.

EPA Response: The Selkregg (1974) citation has been added to the revised assessment.

2.97 *Page 2-3, "The Bristol Bay watershed provides habitat for numerous animal species…"*

Comment: Citation. ADFG management reports (wolves, brown bear, caribo, furbearers, black bear, moose all available from http://www.adfg.state.ak.us/pubs/dept_publications.php); Alaska Shorebird Group. 2008. Alaska Shorebird Conservation Plan. Boudreau, T.A., R.A. Sellers, and L. Van Daele. 1992. Investigation of wildlife use and harvest in the proposed Cominco Pebble Copper Mine area, Iliamna Lake, Alaska. ADFG Division of Wildlife Conservation. Bristol Bay Native Association. 2010. Marine mammals: belugas, walrus, seals. (BBNA website); Cook, J.A. and S.O. MacDonald. 2004. Mammal inventory of Alaska's National Parks and Preserves: Lake Clark National Park and Preserve. National Park Service, Southwest Alaska Network Inventory and Monitoring Program.

EPA Response: These references have been included in the revised assessment.

2.98 *Page 2-4, Figure 2-2 Legend*

Comment: Include no. of years of data characterized by map.

EPA Response: Precipitation climate classes are 30-year mean annual averages from 1971-2000 representing historic conditions; this has been added to the caption in the revised assessment.

2.99 *Page 2-7, Table 2-2 Legend*

Comment: Totals for each climate class for each watershed (i.e., Nushagak overall and Kvichak overall) would be useful.

EPA Response: Including these values in the table would make the table difficult to follow, but this information can easily be calculated for each watershed from the Nushagak River (whole watershed) and Kvichak River (whole watershed) rows (e.g., the

total amount of wet climate in the Nushagak River watershed would be 16% + 25% + 24% = 65%).

2.100 *Page 2-9, Box 2-1: "…we consider nonanadromous or resident populations of…Dolly Varden"*

Comment: Some Dollys in Bristol Bay are anadromous and most have never been properly evaluated for anadromy.

<u>EPA Response:</u> Discussion of Dolly Varden has been clarified in Chapter 5 text.

2.101 *Page 2-11, "no hatchery fish are raised or released in the watershed"*

Comment: This is a fair statement, but it's interesting note past 'enhancement' activities including hatchery fish.

<u>EPA Response:</u> Comment noted; no change required.

2.102 *Page 2-11, Paragraph 2*

Comment: Is it worth pointing out what is mentioned elsewhere in the report: Approximately half of the Bristol Bay sockeye salmon production is from the Nushagak River and Kvichak River watersheds--the area of focus for this assessment.

<u>EPA Response:</u> Comment noted; no change required.

2.103 *Page 2-12, Figure 2-5*

Comment: This categorization seems odd; what is 'likely' presence based on? How much does it matter? No evidence category is confusing--looks like salmon aren't expected, but that isn't logical. Also, Chinook ARE documented on the north side of the Kvichak.

<u>EPA Response:</u> This figure has been removed from the revised assessment.

2.104 *Page 2-15, Section 2.2.2*

Comment: Perhaps subsistence uses are covered elsewhere in the report? But it is worth noting the importance of these fish to subsistence users.

<u>EPA Response:</u> Text has been added to Chapter 5 to clarify that many resident fish are important subsistence resources.

2.105 *Page 2-15, re: Dolly Varden*

Comment: Some Dollys in Bristol Bay are anadromous and most have never been properly evaluated for anadromy.

<u>EPA Response:</u> See response to Comment 2.100.

2.106 *Page 2-15, Table 2-15*

Comment: Citations for Habitat information.

<u>EPA Response:</u> This table has been removed from the revised assessment.

2.107 *Page 2-15, re: Dolly Varden habitat*

Comment: Citation? Dolly Varden seem to be ALL OVER the drainages.

EPA Response: See response to Comment 2.106.

2.108 *Page 2-15, re: char habitat*

Comment: Talk to Mark Lisac (USFWS) and Penny Crane (USFWS); these two species are impossible to distinguish in the field, so habitat information seems unlikely.

EPA Response: See response to Comment 2.106.

2.109 *Page 2-16, "in the past year"*

Comment: Seems odd given the study cited is from 2004.

EPA Response: No change required, as the text implies that it was in the past year from when the survey was conducted.

2.110 *Page 2-17, Table 2-6*

Comment: Citation for legend? Duffield, J. 2009. Bristol Bay Wild Salmon Ecosystem Economics 2008 Update

EPA Response: No change required, as the table cites Appendix E of the assessment, which is where this information was taken from.

2.111 *Page 2-18, " Population in the region grew substantially from 1980 to 2000, and remained relatively stable from 2000 to 2010"*

Comment: Great stat, but needs citation. US Census Bureau, 2010

EPA Response: Citation added to the revised assessment.

2.112 *Page 2-19, " the Yup'ik and Dena'ina"*

Comment: I believe there are also Aleuts in Bristol Bay.

EPA Response: Although there may be Aleuts as well as other Alaska Natives and American Indians living in the region, the focus of the assessment is on the two major cultures in the region, Yup'ik and Dena'ina.

2.113 *Page 2-19, First paragraph*

Comment: Citations needed: US Census Alaska, Alaska Community Database.

EPA Response: Citation added to the revised assessment.

2.114 *Page 2-19, Last Paragraph*

Comment: Citations needed: Fall, J.A., T.M. Krieg, and D. Holen. 2009. An overview of the subsistence fisheries of the Bristol Bay Management Area. ADFG, Division of Subsistence. Technical Paper No. 316; Krieg T., D. Holen, and D. Koster. 2009. Subsistence harvests and uses of wild resources in Igiugig, Kokhanok, Koliganek, Levelock, and New Stuyahok, Alaska 2005. ADFG Division of Subsistence. Technical Paper no. 322.

EPA Response: These references were added to the revised assessment.

2.115 *Page 2-20, "13% of this total stream length has been documented…"*

Comment: Citation: http://www.adfg.alaska.gov/sf/SARR/AWC/.

EPA Response: Johnson and Blanche 2012 (the ADF&G Anadromous Waters Catalog) has been cited (and the percentage has been updated to 14%).

2.116 *Page 2-20, Section 2.3.1. Second to last paragraph on page*

Comment: Tazimina Lakes are also a significant lake system in the Kvichak drainage but inaccessible to salmon.

EPA Response: Text has been modified to say that, with very few exceptions, major lakes are accessible to salmon.

2.117 *Page 2-21, "With the exception of Chikuminuk Lake…"*

Comment: Citation: http://www.adfg.alaska.gov/sf/SARR/AWC/

EPA Response: See response to Comment 2.116. Specific reference to Chikuminuk Lake has been removed.

2.118 *Page 2-21, " Kaskanek"*

Comment: Change to Kaskanak.

EPA Response: Corrected in the revised assessment.

2.119 *Page 2-21, re: Iliamna Lake*

Comment: May be worth noting its relative size here.

EPA Response: No change required.

2.120 *Page 2-22, "In other watersheds with previously robust salmon fisheries, such as the Sacramento River's Chinook fishery, losses of biocomplexity have contributed to salmon population declines (Lindley et al. 2009)."*

Comment: The Fraser River is also an example of how reduced biodiversity can result in fisheries closures and less predictable sustainable runs.

EPA Response: We agree with the findings of the Cohen Commission that the causes of the Fraser River's highly variable salmon fishery productivity are unclear and likely due to multiple factors. Therefore, we do not believe that we can attribute it to low biocomplexity. The final assessment provides additional examples of salmon biocomplexity observed within the Bristol Bay region, including discussions of variation in body morphology, habitat use, and run and spawning timing.

2.121 *Page 2-22, "For example, sockeye salmon may spend anywhere from 0 to 3 years rearing in freshwater habitats, then return to the Bristol Bay watershed anytime within a 4-month window (Table 2-7)."*

Comment: Change to read: For example sockeye salmon may spend 0-3 years rearing in freshwater, then one to four years feeding at sea, then return to Bristol Bay anytime within a four month window.

<u>EPA Response:</u> Text in revised assessment no longer contains this sentence; information is displayed in Table 5-2 of the revised assessment.

2.122 *Page 2-24, "Salmon-Derived Productivity"*

Comment: A seminal citation that should be included: Kline TC Jr. et al. 1993 Canadian J. of Fisheries and Aquatic Sciences. 50:2350-2365. et al. conducted seminal work on salmon derived nutrient cycling to the Kvichak watershed.

<u>EPA Response:</u> Citation added to Chapter 5 in the revised assessment.

2.123 *Page 2-24, Section 2.3.4*

Comment: Lacking Citations: Cederholm, C.J,, M. Kunze, T. Murota, and A. Sibatani. 1999. Pacific salmon carcasses: essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. Fisheres 24(10): 6-15. Gende, S.M., R.T. Edwards, M.F. Willson, and M.S. Wipfli. 2002. Pacific salmon in aquatic and terrestrial ecosystems. Bioscience 51(10): 917- 928.

<u>EPA Response:</u> Citations added to Chapter 5 in the revised assessment.

2.124 *Page 2-24, "litter size"*

Comment: Replace "litter" with "brood".

<u>EPA Response:</u> No change required.

2.125 *Page 2-25, Last Paragraph*

Comment: It may be worth pointing out that in 1972 the Alaska State Legislature designated a portion of Bristol Bay as a Fisheries Reserve. "Within the Bristol Bay fisheries reserve no surface entry permit to develop an oil or gas lease may be issued on state owned or controlled land until the legislature by appropriate resolution shall specifically find that such entry shall not constitute danger to the fishery."

<u>EPA Response:</u> No change required, as this information is not relevant to the assessment of potential risks from mining.

2.126 *Page 2-26, Last Paragraph*

Comment: Due to increasing global shortages of clean fresh water and the generally dependable high protein food resource represented by salmon, it is also important to stress that the region is important from a perspective of regional and potentially National food and water security.

<u>EPA Response:</u> No change required, as the national importance of Bristol Bay as a food and water resource is too speculative to include in the assessment. The assessment does include discussions of the importance of salmon as a subsistence resource.

A. Sutton-Grier (Doc. #3806)

2.127 I am concerned that streams in the area are deemed to be salmon-producing are defined as those with confirmed fish sitings. (p 2-11 "Confirmed salmon-producing watersheds—that is, watersheds where field reports have documented spawning or rearing salmon within their boundaries—make up more than 65% of the total area surveyed in the Nushagak River and Kvichak River watersheds."). Most of these streams are likely to be fish-producing because this is some of the best habitat for salmon in the entire world. I think it would be a more conservative approach to assume that the streams are fish-producing unless a stream is found to not have any fish on several occasions during peak migrating time when one would expect to see fish there reproducing. This would follow the precautionary principle that when we don't know and we don't have all the info, we assume that the streams are good habitat until proven otherwise.

EPA Response: We have not taken a precautionary approach to this assessment. Rather, we have used best current science. In particular, we have assessed effects on confirmed salmon-producing watersheds rather than speculating about occurrence. However, we also acknowledge uncertainties due to incomplete information.

We acknowledge the limitations of fish sampling conducted in the study watersheds. For this reason, we do not assume that streams with low (or zero) fish observations are therefore unimportant. On the contrary, in the revised assessment we explicitly acknowledge the contributions of non-salmon-bearing streams to downstream, salmon-supporting waters. See response to Comment 5.107.

S. Wehmeyer (Doc. #3486)

2.128 The Bristol Bay watershed is comprised of seven distinct hydrological regions over approximately 40,000 square miles (six major watersheds and a seventh region on the Alaska Peninsula comprised of seven small watersheds). The EPA draft Assessment ignores the marine area of Bristol Bay itself, and focuses on a very small part of two hydrologic units, considering that small area to be wholly representative of the entire region – an unsupported leap of logic.

EPA Response: See response to Comment 2.3. The assessment focuses on the Nushagak and Kvichak River watersheds because they are the most likely to be affected by large-scale mining. Information on marine resources is presented in Appendix F.

2.129 Chapter 2 of the draft Assessment characterizes the current conditions in the study area. The Pebble Limited Partnership has conducted arguably the most in-depth studies of the current conditions in the regions, yet these studies are not cited or referenced a single time in this chapter.

EPA Response: We have included EBD data extensively in both drafts of the assessment.

G. A. Beischer (Doc. #4372)

2.130 The draft Assessment claims to be a Bristol Bay study, but neglects 5 of 7 hydrological units – focusing only on the Nushagak and Kvigach.

EPA Response: See response to Comment 2.128.

2.131 Chapter 2 of the draft Assessment characterizes the current conditions in the study area. The Pebble Limited Partnership has conducted arguably the most in-depth studies of the current conditions in the regions, yet these studies are not cited or referenced a single time in this chapter. The selective inclusion of quotations by only anti-mining residents in this draft Assessment is entirely inappropriate and biased. It introduces an emotional (non-scientific) argument not supported by data and not balanced with quotes from residents that have a different viewpoint.

EPA Response: See response to Comment 2.129.

2.132 The report does not consider any positive effects of mineral development in a region of Alaska facing severe hardships and a lack of economic opportunity.

EPA Response: Purpose and scope of the assessment have been clarified in Chapters 1 and 2 of the revised assessment. The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy.

Chapter 3: Problem Formulation

Alaska Department of Natural Resources (Doc. #4818)

3.1 This section does not serve the normal purpose of a typical problem formulation. The primary purpose of problem formulation is to focus the risk assessment. This lack of focus is exemplified by the conceptual models on pages 3-7 through 3-11 that seem to present every conceivable issue, rather than just what is to be the focus of the risk assessment.

Recommended Change: Problem formulation should start with a discussion of the array of issues, and then through site-specific knowledge provide logical winnowing of issues to those that are most important. It would be okay to put the existing conceptual models at the beginning of the section as the universe of issues. Then through problem formulation discuss what is important and will be addressed in the risk assessment. The conceptual models at the end of the section should then reflect the most important issues and aspects of each issue. This elimination of some issues is particularly important for the Bristol Bay Watershed Assessment, which actually glosses over many smaller issues to focus on those that are most significant. Yet the provided conceptual model is not representative what could or should be investigated.

EPA Response: The revised assessment has been structured as a more traditional ecological risk assessment document, with a problem formulation section and a risk analysis and characterization section. Chapters in the problem formulation section (Chapters 1-6) present background information in terms of region, type of development, and endpoints. This section culminates in the conceptual models, which present all hypothesized linkages between components discussed in the problem formulation section. In later chapters, these diagrams have been excerpted to show those pathways considered most significant and actually evaluated in the risk analysis.

3.2 Page 3-2 Comment: Omitting mine worker housing and other related mine operation infrastructure is significant. This could be the biggest city in the entire Bristol Bay region with 2000 or more residents.

Recommended Change: Incorporate the development of a mine personnel living quarters should be considered into the risk assessment.

EPA Response: See response to Comment 2.39. The issue of personnel living quarters is discussed qualitatively in Chapter 13, which considers cumulative effects of multiple mines.

3.3 Page 3-1, 3-8, Figure 3-2b Comment: Report Section 3.1, mine type of development states "Certain activities associated with mining, but not directly related to mine operations, are not considered in this assessment. These include support activities such as housing workers and disposing of their wastes, power generation and transmission, construction and operation of a deepwater port at Cook Inlet, and secondary development (i.e., development that is not part of the mine project, but for which the mine project provides the impetus or opportunity, such as rural recreation or residential and commercial growth resulting from improved access). Exclusion of an activity from this assessment does not imply that it would be benign or have no effect on the environment, and many of these activities could have significant repercussions for the Bristol Bay ecosystem. The assessment focuses on activities directly associated with mine development, operation, and maintenance, which are most likely to have significant effects on the region's fish populations (Section 3.3)."

Report Section 3.6, Conceptual Models (Figure 3-2b) shows secondary development, housing and construction activities.

EPA Response: Conceptual models have been revised to more accurately reflect the scope of the assessment. In addition, a conceptual model illustrating the overall scope of the assessment has been added to Chapter 2 of the revised assessment.

3.4 The report study approach focuses on impact potential to the regions fisheries, and inferring impacts to the Native and indigenous cultures. The approach likely understates or underestimates the social-political and Native community effects secondary development may have beyond the direct fish to cultural impacts on Native and indigenous cultures.

Recommended Change: In order to evaluate cumulative impacts, a detailed analysis and cumulative effects analysis of additional proposed mine claims, as well as secondary mine development for mine towns, energy, utilities, road/transportation, ports and ore transport route risks, will need to be addressed to understand watershed and fisheries impacts and indigenous culture impacts. Secondary mine development impacts, especially social-political and economic impacts on Native, and indigenous, subsistence living cultures could be significant. For example, while grants and loans can be obtained to support building local infrastructure projects, the economic health of the community to maintain the infrastructure is often the limiting factor in many Alaska Native and rural communities. An overall improvement in the local economy would allow for drinking water and sanitation projects that are currently uneconomic for local communities to maintain. Need to understand the entirety of long term mine development proposals and their cumulative effects.

<u>EPA Response:</u> We agree that secondary effects on indigenous culture from large-scale mining could be significant. The scope of the assessment is focused on potential risks to salmon from large-scale mining and resulting effects to indigenous culture and wildlife. However, a qualitative discussion of potential impacts from secondary development is included in Chapter 13 of the revised assessment. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.

We acknowledge that drinking water and sanitation operation and maintenance are of concern to many Alaska Native villages. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources.

3.5 *Pages 3-1 and 3-2*

Comment: The report states that the study focuses on mine operation activities only, as they pose the greatest potential for impacting salmon habitat. Multiple mines and secondary developments (including residential/commercial development, power, water/wastewater, roads, goods and services) likely have significant potential to impact both salmon habitat and Native indigenous cultures than is assumed in the report, especially in a near "pristine" watershed.

Recommended Change: Mine scenario should include evaluation of watershed development as a result of mine construction for all likely proposed mines to adequately address cumulative impacts to salmon fisheries and Native indigenous cultures.

<u>EPA Response:</u> See response to Comment 2.39. Evaluation of these cumulative effects of multiple mines has been expanded in Chapter 13 of the revised assessment.

3.6 *Section 3.3, Page 3-2*

Comment: The endpoints 2, 3, and 4 are essentially glossed over, while endpoint 1 is not well related or scaled to represent the likely site-specific impacts of the Pebble mine. The conclusions of this document is used to directly assess impacts of the mine without an in depth consideration and quantification of site-specific actions and impacts.

<u>EPA Response:</u> Throughout the assessment, we have clarified that the primary endpoint of interest is salmonid fish resources, with secondary endpoints concerning fish-mediated effects on wildlife and Alaska Native cultures. Where possible, detailed information on stressors and endpoints at project-relevant scales (i.e., the mine site watersheds, the mine footprints, and along the transportation corridor) are presented in the risk characterization and analysis sections (e.g., fish distribution maps in Chapter 7).

3.7 *Section 3.3, Page 3-4*

Comment: This page states that the study limits the scope of the watershed assessment to the Nushagak and Kvichak River watersheds. This approach is acceptable in limiting the extents of the study, and then relating the impacts to the overall Bristol Bay Watershed. The report should refer to Bristol Bay watershed impacts, but not attempt to evaluate the baseline and impacts to the entire watershed.

Recommended Change: This discussion should be highlighted and brought forward in the introduction and executive summary. The sheer size/scale of the watershed cannot be fully studied. Therefore an expanded discussion of how a study would be performed by evaluating critical basins, namely focusing on the Nushagak and Kvichak River watersheds, and then relating the linkages and impacts to the larger Bristol Bay Watershed.

<u>EPA Response:</u> See response to Comment 2.3.

3.8 *Page 3-5*

Comment: The risk assessment approach using types of evidence and inference, conceptual modeling and characterization of risks by the lines (or multiple lines) of evidence is appropriate for generally understanding and scoping the watershed risk assessment. Higher risk (probability) failure or impact effects will likely require additional studies and numerical modeling to refine and better understand and quantify project risks and uncertainties.

Recommended Change: The study should outline what additional data, studies and numerical models would be appropriate to evaluate higher risk mine elements (i.e., tailings facilities failures), that would be appropriate to support a comprehensive watershed assessment and risk analysis, and will prepare agencies and lay the groundwork for future mine permit studies.

<u>EPA Response:</u> This is beyond the scope of the current assessment.

3.9 *Page 3-5*

Comment: In the first paragraph, EPA suggests “potential mitigation measures” were considered. Aside from the efficacy of mitigation discussion in Appendix I, we found little evidence of mitigation measures being considered and incorporated into the assessment.

Recommended Change: EPA needs to be clear how potential mitigation measures were considered in the watershed assessment.

<u>EPA Response:</u> The scenarios evaluated in the original draft assessment assumed that modern, conventional mine design, practices, and technologies were implemented and working effectively. Mitigation measures included in the mine scenarios were those that could reasonably be expected to be proposed for an actual mine, many of which were presented as appropriate for the Pebble deposit in Ghaffari et al. (2011). This has been clarified in the revised assessment, and an appendix on compensatory mitigation (Appendix J) has been added. Analysis of alternative mitigation measures is outside the scope of this assessment. The assessment is not evaluating how to best minimize potential impacts of mining—rather, it is evaluating how avoidable and unavoidable impacts, were they to occur, could affect the assessment endpoints.

3.10 *Page 3-6 through 3-11, Figures 3-2A through 3-2E*

Comment: The conceptual models attempt to evaluate the entirety of potential mine impacts on fisheries habitat by phase (mine development and operation, and then during closure). The models are complex and difficult to interpret, and they do not demonstrate the potential scales of risks (i.e., high probability and small impact area or high probability and large impact area) nor the spatial aspects of the risks, or scale of impacts, all of which are related to fish habitat impacts.

Recommended Change: Recommend breaking out the conceptual models by major impact types as described in the No-Failure and Failure scenarios, and evaluating spatial distribution of impacts on fisheries habitat by showing the impacted stream habitat using GIS maps and spatial analyst techniques. Breaking these out will help understand the risks, and allow for overlaying the various risks and impacts in a spatial context. This type of presentation will allow for meaningful communication of the potential impacts to both a broad public audience, as well as a highly technical audience and reviewers.

EPA Response: The conceptual models have been simplified to more clearly illustrate issues within the scope of the assessment. Sub-diagrams, or excerpts from these larger diagrams, have been incorporated into specific chapters to highlight the pathways considered in those chapters. Additional background information on conceptual models and how they are used has been incorporated into Chapters 2 and 6 of the revised assessment.

3.11 *Figure 3-2A: Conceptual Model Illustrating Potential Habitat Effects Associated with Mine Construction and Operation; Figure 3-2B and 3-2C*

Comment: Every possible impact is provided, but no relative judgment is provided as to what is most important, and to be assessed in the Bristol Bay Watershed Assessment. Authors are suggesting everything is just “bad” and it is all going to occur regardless of the degree of potential impact, frequency and possible mitigation methods.

Recommended Change: Provide more specific conceptual models that show how/why certain items are more important than others and are to be included for assessment in the Bristol Bay Watershed Assessment.

EPA Response: See response to Comment 3.10.

3.12 *Page 3-9*

Comment: There should be a box in the figure that depicts filling the pit with water and the lack of dewatering water to maintain river flows.

EPA Response: The post-closure diagram was removed from the assessment, but this issue is discussed in the text in Chapter 6 of the revised assessment.

3.13 *Page 3-10*

Comment: Change “slurry transport” to “slurry and return water transport”.

EPA Response: This shape was removed from the conceptual model as part of simplifying the diagrams.

3.14 *Page 3-10*

Comment: Maybe add a box in figure for “waste rock” which could leach metals and change other parameters, becoming more acid generating than predicted.

<u>EPA Response:</u> This pathway is currently reflected in the conceptual model for water quality.

3.15 The Assessment has virtually no discussion on the local and regional geology and hydrogeology which would be a required part of state agency review of any proposed mine project. The Assessment only mentions field investigations and testing from previous exploration programs. However, site-specific data exists on key aspects of the subsurface environment, but that information was not considered in the assessment of direct hydrologic impacts and its effects on fish and habitat. An obvious source for site-specific data is the Pebble Limited Partnership (PLP) Environmental Baseline Document (EBD), a 27,000 page document released in November, 2011.

<u>EPA Response:</u> See response to Comment 2.71.

<u>Northern Dynasty Minerals Ltd. (Doc #4611)</u>

3.16 The scope of the Draft Assessment is inappropriately circumscribed to porphyry copper deposits based on an incorrect premise that porphyry copper is the major mineral resource type in the area. As noted elsewhere in Buell's analysis, other types of mineralization calling for differing approaches to development are the rule, not the exception, in the Bristol Bay area. Even within the two watersheds being considered by the EPA in its too-narrow analysis, the Pebble deposit is the only porphyry copper deposit of the five planning units specifically set aside in the 2005 Bristol Bay Area Plan for mineral exploration and development, and other identified deposits not specifically set aside for development are also not porphyry copper deposits. This incorrect premise is, unfortunately, representative of many premises in the analysis, and points out a major failing of the document.

<u>EPA Response:</u> The assessment considers porphyry copper deposits because, given the advanced state of exploration at the Pebble deposit and the interest it has generated in other exploration companies, these deposits appear the most likely (and by far the largest) deposits to be developed in the near future. Because other types of deposits being explored would have the same basic mine elements (open pit, waste rock, tailings impoundments), the general effects explored here are applicable to multiple deposit types. This is discussed in Chapters 4 and 6 of the revised assessment.

3.17 3-1 §2 Type of Development – This introductory paragraph states, "The assessment addresses potential mining development in the watersheds of the Nushagak and Kvichak Rivers. It is limited to the mining of porphyry copper ores, which appear to be the major mineral resource type in the area." The scope of the assessment is inappropriately circumscribed to porphyry copper deposits based on an incorrect premise, that porphyry copper is the major mineral resource type in the area. As has been pointed out above, other types of mineralization, calling for differing approaches to development, are the rule, not the exception in the Bristol Bay area. Even within the two watersheds being considered by the EPA in its too-narrow analysis, the Pebble deposit is the only porphyry copper deposit of the five planning units specifically set aside in the 2005 Bristol Bay Area Plan for mineral exploration and development, and other identified deposits not specifically set aside for development are also not porphyry copper deposits. This incorrect premise is, unfortunately, representative of many premises in the analysis, and points out a major failing of the document.

EPA Response: See response to Comment 3.16.

3.18 3-1 §2 – 3-2 §1 This paragraph states, "The types of development considered in the assessment would be common to all porphyry copper mining in the area." This is impossible because Pebble appears to be the only viable porphyry copper deposit in the area, according to information presented in the 2005 Bristol Bay Area Plan. EPA background "research" should have turned up this relevant and very accessible fact, but it failed to do so.

EPA Response: See response to Comment 3.16.

3.19 3-2 §3 This paragraph states, "[T]he assessment applies to most sites in the Nushagak River and Kvichak River watersheds." This statement cannot be true because the Pebble deposit is not representative of other deposits specifically set aside for mineral exploration and development and considered most likely to be developed within the Bristol Bay Area Plan planning horizon.

EPA Response: See response to Comment 3.16.

3.20 Bailey indicates that the Draft Assessment presents several conceptual models which contain a multitude of assessment parameters. While a number of the assessment parameters are specifically excluded from the assessment, the documentation and rationale on how the conceptual models were used to support the analysis process is lacking. It is impossible to determine from the Draft Assessment as written whether or not the conceptual models did serve as the basis to conduct the assessment.

EPA Response: See response to Comment 3.10.

Alaska Miners Association, Inc. (Doc. #4612)

3.21 The Watershed Assessment applies to all lands in Bristol Bay Area, including the Kvichak and Nushagak watersheds. This area is more than 15 million acres, approximately the size of West Virginia.[1] The area is geologically diverse, and yet the Assessment uses only one mineral type – copper porphyry – to characterize all potential large-scale mining in the watershed. There are other potential deposits in the area. Therefore, an Assessment that focuses solely on copper porphyry deposit does not represent other potential large-scale mining in Bristol Bay.

EPA Response: See responses to Comments 2.39 and 3.16.

Trout Unlimited (Doc. #4579)

3.22 *Ancillary / Secondary Developments*: The Assessment omits consideration of critical mining related project components such as energy production and transmission infrastructure as well as secondary developments such as employee support infrastructure and other developments

[1] Area taken from the Watershed Assessment, Appendix C, Figure 1. Area calculations included the Kvichak and Nushagak watersheds, but not the offshore areas in that figure.

likely to result from increased access and transportation infrastructure. While we understand the benefit of focusing the Assessment on primary development impacts, it is clear that any mining extraction will require related infrastructure and that the impacts of this related development will only further exacerbate or add to the impacts caused by primary development activities. If such ancillary impacts cannot be effectively evaluated in the absence of a specific mining proposal before the Agency, at a minimum, we recommend that the Assessment further clarify that additional impacts are certain, but are not fully evaluated. This clarification is necessary to accurately present the level of risk associated with large-scale mining in the region.

<u>EPA Response:</u> The scope of the assessment has been clarified in Chapter 2 of the revised assessment, and this type of ancillary/secondary development is identified as outside of scope. Secondary development is discussed qualitatively in the context of cumulative risks from the development of multiple mines in Chapter 13 of the revised assessment.

3.23 *Geographic Scope*: The Assessment is not targeted at any specific project or proposal, and is, instead, intended to evaluate the potential impacts of large-scale mining in the Bristol Bay watershed. As such, the Assessment should evaluate a maximum build-out of the known Pebble deposit, 10.78 billion tons, not just the 6.5 billion ton scenario considered as the maximum in the draft Assessment. Moreover, while the Assessment includes some discussion of potential watershed scale effects of multiple mining scenarios (e.g.: Chapter 7), we believe that existing information related to the size and extent of mineral deposits in the area (both Pebble and other deposits) indicates that large-scale mining under a full build-out scenario would have significantly greater potential impacts than are identified in the draft Assessment. We recommend the EPA expand its consideration of development impacts across the full deposit area or at a minimum, that the Assessment make clear that the geographic scope of review represents a conservative estimate of potential mining development and related environmental impacts.

<u>EPA Response:</u> The revised assessment acknowledges that the largest mine size scenario considered in the assessment does not represent the complete build-out of the Pebble deposit (Chapter 6). The 6.5-billion ton scenario is a maximum for the open pit mine. More advanced mining methods would be required to extract the entire deposit. Consideration of the cumulative effects of multiple mines has been expanded in Chapter 13 of the revised assessment.

3.24 *Scope of Resources Evaluated*: The Assessment reviews, analyzes, and synthesizes available information related to the potential impacts of large-scale mining development "on Bristol Bay fisheries and subsequent effects on the wildlife and Alaska Native cultures of the region." While we agree that the salmonid fisheries are the appropriate focal point for this analysis, we believe the draft Assessment does not fully capture potential impacts to environmental values beyond salmonid fisheries. For example, impacts to wildlife related to terrestrial habitat fragmentation, loss of wetlands, and water quality degradation are not adequately evaluated and therefore are underestimated in the draft Assessment. The final Assessment should identify the full range of resources that would likely be harmed by large-scale mining, and acknowledge that large-scale mining will clearly impact these resources even if such impacts are not thoroughly evaluated in the Assessment. Again, this revision is needed to more accurately capture the level of risk and potential impacts.

EPA Response: We have clarified how and why assessment endpoints were chosen in the revised assessment (e.g., Chapters 2 and 5). We acknowledge throughout the assessment that direct effects of mining on wildlife and Alaska Native cultures may be significant, but are beyond the scope of this assessment. Also see response to Comment 2.39.

A. Sutton-Grier (Doc. #3806)

3.25 It is also a conservative estimate because it does not take into account any additional development that is likely to occur if the mine goes in. (Exec Summary: "This assessment also does not consider potential impacts resulting from secondary development that is likely to accompany a large-scale mine development. Secondary development includes, but is not limited to, additional support services for mine employees and their families, increased recreational development due to increased access, development of vacation homes, and increased transportation infrastructure (i.e., airports, docks, and roads).") There would certainly be additional development for housing for the mining community at a very minimum and likely the construction of the road would mean people who currently do not have access would come to access the areas near there for hunting, fishing, recreation, etc. There are also other potential mining opportunities in the area and we don't know what the cumulative impacts of several mines would be on the salmon and ecosystem services. Multiple mines would likely have a greater impact than simply the additive impacts of each mine assessed separately. So, it is important to consider how this mine might eventually impact a landscape that has multiple other developments in it, including other mines. As a result, if this mine goes in, the impacts to the salmon fishery will most likely be quite a bit larger than what is presented here in this report. So, again, this is a very conservative estimate of impacts.

EPA Response: See response to Comment 3.5.

3.26 This assessment also deals only with the impacts to the freshwater ecosystems that would be impacted by this project. (Exec Summary: "Although the mine scenario assumes development of a deep-water port on Cook Inlet to ship concentrated product elsewhere for smelting and refining, impacts of the development and operation of a deepwater port are not assessed.") It is important to think about impacts to the marine environment that will be likely as well. The port that is mentioned will have big impacts on the marine resources in that area, both by impacting salmon populations but also impacting other marine organisms and habitats. So, again, this report is very conservative in its estimates of impacts to the region because it only looks at the impacts to fish based on impacts to the freshwater habitats and not also to impacts and threats that will develop in the marine habitat due to the mining operations. I know there were good reasons for the EPA to focus on freshwater habitats, but it is critical to understand that there will be larger impacts to ecosystems and hence to the salmon, as well as to all the other benefits people get from nature in that region that go beyond what is addressed in this report. Again, this means this is a conservative estimate of impacts.

EPA Response: We have clarified throughout the text that the points raised in the comment are important considerations and their exclusion does not suggest they would be unaffected by potential large-scale mining. Scope of the assessment has been clarified in Chapter 2 of the revised assessment. Also see response to Comment 2.39.

Bristol Bay Native Corporation (Doc. #4145)

3.27 Risks are appropriately tied to impacts to salmon and those human and animal populations that depend on these fishes. However, the actual ecological risks to wildlife go beyond their nutritional needs, and the direct loss of non-aquatic habitats, although perhaps small on a regional scale, are nevertheless substantial. Moreover, the risks associated with secondary impacts that mining and associated infrastructure would undoubtedly enable are specifically not considered in EPA's BBWA (Chapter 3, page 3-2, and page 3-4), and therefore are underestimates.

EPA Response: Direct wildlife effects, secondary development, and effects on other important fish species are beyond the scope of the assessment, as detailed in Chapter 2. The scope of the assessment is focused on potential risks to salmon from large-scale mining and resulting salmon-mediated effects to indigenous culture and wildlife. However, qualitative discussion of potential impacts from secondary development is included in Chapter 13. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.

3.28 Fish species assessed are also limited to those that EPA considers more dependent upon rearing habitat than those that may spawn but not rear in those waters (Chapter 3, page 3-4). Similarly, some species considered important for subsistence and/or sport-fishing were not evaluated (considered representative) if their ecology was not well-known or if they were considered less sensitive than species selected for further analysis.

EPA Response: The scope of the assessment in terms of endpoints considered has been clarified in Chapters 2 and 5 of the revised assessment. We acknowledge throughout that endpoints not considered in the assessment also may be affected by potential large-scale mining in the region.

3.29 In its description of types of evidence and inference (Section 3.5), it seems inappropriate for EPA to identify the Fraser River as being an analogous watershed to BBWA even though the Fraser River watershed has hardrock mines and supports salmon resources (page 3-5), although EPA does note important differences. In fact, later in the BBWA Chapter 7, Box 7-1, page 7-2), EPA concludes that the Fraser River watershed is a "poor analog" because other development within the watershed "obscures any impacts of the mines at a watershed scale," and that most of the salmon runs therein" are listed as threatened or endangered."

EPA Response: We considered the Fraser River as a possible analogue in Section 3.5 because it has been suggested as an example of how salmon can coexist with metal mining. However we concluded that it is not a good analogue (see response to Comment 2.44). That discussion is expanded in the revised assessment to make this issue clearer.

Fisheries Research and Consulting (Doc. #4580)

3.30 *Page 3-2, Section 3.2 Region*

Comment: Again it would help readers understand why you focused on these watersheds if Pebble claims and other leases were outlined. Include a map with claims outlined.

EPA Response: Scope of the assessment has been clarified in Chapters 1 and 2 of the revised assessment. A map showing mine claims in the Nushagak and Kvichak River watersheds is included in Chapter 13 of the revised assessment.

3.31 *Page 3-6, "habitat vs. water quality"*

Comment: Water is a component of habitat.

EPA Response: Text has been clarified to show that conceptual models were broken into physical habitat and water quality for ease of presentation.

3.32 *Page 3-8, Figure 3-2B*

Comment: In the section showing increases in specific metals Hg is indicated as increasing. I was unaware that Hg is in this particular deposit. Also the amount of blasting that would take place would also introduce potentially toxic levels of Nitrogen into the watersheds.

EPA Response: Mercury was removed from the conceptual model. Nitrogen as a stressor is considered in Section 6.4.2, but was not included in the scope of the assessment because it was not judged to be a significant factor for fish populations in this assessment.

National Park Service and U.S. Geological Survey (Doc. #4607)

3.33 Section 3.3, Problem Formulation, Endpoints: The second paragraph reads "These fisheries generate significant economic benefit for commercial fishermen, provide subsistence for Alaska Natives and support a significant recreational sector." Similar references to subsistence occur elsewhere in the Assessment. Federal regulation provides a subsistence priority in the Nushagak and Kvichak River for rural residents of the immediate area to include Native and non-Native Alaska residents. The State of Alaska regulations provide that all Alaska residents are subsistence users and all residents are eligible to participate in the Nushagak and Kvichak River subsistence fishery under applicable State regulations. Although Alaska Natives may be the primary subsistence user of the fisheries in the Nushagak and Kvichak River watersheds, note that non-Native Alaska residents may also participate under Federal and/or State regulation. The report should consider how commercial, sport and non-Native subsistence fishers who have participated in Bristol Bay fisheries for multiple generations might qualify as having cultural ties to the Bay's salmonid and other fishery resources.

EPA Response: The assessment has been expanded to acknowledge the importance of the fishery to non-Alaska Native subsistence users. Potential effects on commercial and recreational fisheries were not evaluated as part of this assessment, although we recognize that any impacts to salmonid and other fishery resources would affect these

sectors. We also recognize, but do not evaluate in detail, the complex relationship between subsistence, commercial, and recreational fishing.

<u>G. Y. Parker (Doc. #4115)</u>

3.34 The assessment does not appear to define the term “endpoints.” I infer that the meaning is analogous to what most people would refer to as “sidebars” on a discussion of resultant effects. If so, that should be clearly stated, and the reason for the sidebars or “endpoints” should be clearly explained. I assume that the reason is that, as a practical matter, EPA simply has to have some sort of focus, and that the focus on the four “endpoints” or sidebars is driven by several factors, such as certainty versus uncertainty, direct versus indirect or secondary effects, and quantifiable versus unquantifiable effects. Nevertheless, a better explanation of the reasoning behind these “endpoints” in Chapter 3, section 3.3, would be helpful.

<u>EPA Response:</u> Discussion of the endpoints considered in the assessment and how they were selected has been expanded in Chapters 2 and 5.

<u>The Pebble Limited Partnership (Doc. #4962)</u>

3.35 *Section 3.3, Page 3-4, 2nd paragraph*

Comment: The sentence identifies rainbow trout as a non-salmon species. Rainbow trout were re-classified as Onchorhynchus mykiss many years ago; they are considered a life history variant of one of the 5 species of Pacific salmon.

<u>EPA Response:</u> Rainbow trout are members of the genus *Oncorhynchus*, which includes the Pacific salmon (chum, pink, sockeye, coho, and chinook) and Pacific trouts (rainbow trout, including steelhead trout, and cutthroat trout). Confusion about the taxonomy and spelling of this group is understandable given the many changes over the years and the relative fluidity of taxonomic classification for this closely-related group, but usage in the assessment is consistent with current classifications and usage. To avoid potentially adding further confusion, the sentence noted in the comment has been revised.

3.36 *Section 3.3, Page 3-4, Paragraph 1*

Comment: The analysis assumes that only three (sockeye, coho, and Chinook) of the five salmon species are potentially impacted by mining development. The other two species (pink and chum) are assumed to spend less time in the watershed’s streams, rivers, and lakes, and therefore are less likely to have potential impacts from mining development. There is no supporting literature for these statements and conclusions. In the absence of technical references to the relevant literature upon which these statements, presumably, are made the basis for these statements cannot be evaluated.

<u>EPA Response:</u> Relevant citations have been added to Chapter 5.

3.37 *Section 3.3, Page 3-4, Paragraph 2*

Comment: The analysis assumes that only rainbow trout and Dolly Varden, non-salmon species, will be assessed, but the other non-salmon species (such as whitefish and grayling) will not be assessed since they “are believed to be less sensitive than the other species”. The use of unsupported assumptions and the reliance on beliefs and presumptions is one of the key greatest shortcomings identified throughout this document. In the absence of technical references to the relevant literature upon which these statements, presumably, are made the basis for these statements cannot be evaluated.

EPA Response: Throughout the text, particularly in Chapters 2 and 5, we have clarified how and why assessment endpoints were chosen. Also see response to Comment 2.39.

3.38 The report concludes the following on each of these endpoints:

Endpoint 1 and 2: Risk to salmon and other fish. As mentioned above, the report states the loss and degradation of habitat on actual fish populations, which is the ultimate metric, could be quantified (pg ES-26). USEPA also fails to take into account any mitigation that would minimize net habitat impacts.

EPA Response: We recognize that more detailed site-specific processes may refine the risk management process if a mine is proposed and assessed in the future. We do not address the specific engineering methods that would be employed by the mining companies. Rather, the assessment mine scenarios assume modern conventional mine design, practices, and technologies, particularly those described in Ghaffari et al. (2011).

Endpoint 3: Risk to wildlife: “Although the affects of reduced salmon, trout, and char production on wildlife - the fish mediated risk to wildlife – cannot be quantified given available data, some reduction in wildlife would be expected under the mine scenario” (ES-23). This conclusion does not help the reader in understanding the significance of the potential impacts.

EPA Response: Quantified reductions of wildlife populations due to reduced fishery production cannot be estimated with the available data.

Endpoint 4: Risk to Alaska native culture: “The predicted loss and degradation of salmon, char, and trout habitat in North Fork Koktuli and South Fork Koktuli and Upper Talarik Creek is expected to have some impact on Alaska Native cultures of the Bristol Bay watershed” (pg ES-23). This conclusion does not help the reader in understanding the significance of the potential impacts.

EPA Response: There is not enough information to quantitatively predict specific effects on Alaska Native cultures from loss of subsistence fisheries. However, it is possible to qualitatively discuss likely and potential impacts to Alaska Native culture, and the text of the assessment has been expanded to reflect this.

It appears the report’s conclusions on its self-defined four major endpoints is that they don’t know (for salmon and other fish), some reduction expected (for wildlife), and some impact (for Alaska native culture). The report does not have sufficient information to conclude whether any of the potential impacts are significant on any of the endpoints.

EPA Response: The conclusions of the assessment are misrepresented in this comment. Effects on fish are defined in terms of the kilometers of stream habitat lost, modified or

rendered toxic and the reported abundances of fish in the affected reaches that would no longer have usable habitat. Effects on wildlife are reported in terms of their abundance, their dependence on salmon, and the expectation that they would decline in response to lost resources. Effects on Alaska Native cultures are presented in terms of their use of salmon and other fish, their cultural dependence on salmon, and their own testimonies concerning the effects of salmon losses.

3.39 *Section 3.5*

Comment: This assessment is not a predictive assessment, as USEPA claims. This assessment lacks substantive information describing the mining operation and the environmental conditions in which the mining operation will occur. The first type of evidence used to support the assessment is based on "general scientific knowledge". The second type of evidence focuses on past mining activities in comparable watersheds, some of which are not located in Alaska or the United States and may not be comparable. The report relies inappropriately on evidence that does not reflect activity in the Bristol Bay area; in fact, no project design nor project efforts to avoid, minimize or mitigate by design or by technological advance have been proposed or analyzed in the report.

<u>EPA Response:</u> There is no activity currently underway in the Bristol Bay area that represents the mining activities considered in the assessment, which is why the assessment is predictive rather than descriptive. It is an assessment of scenarios based on a preliminary mine plan put forth by Northern Dynasty Minerals (Ghaffari et al. 2011). An assessment of mine plans submitted in the NEPA process would also be predictive in nature. Unless that plan assumes that no accidents or failures occur, it should consider the experience at other sites.

3.40 *Section 3.5*

Comment: These two types of evidence are based on two flawed suppositions: 1) worst case scenario of a hypothetical mine, and 2) mining methodology that is decades, if not centuries outdated, and does not represent current practices in the mining industry.

<u>EPA Response:</u> In the original draft of the assessment, the "no-failure" scenario represented a best-case scenario in which modern conventional mitigation technologies were in place and functioning properly. This has been clarified in the revised assessment.

3.41 *Section 3.5, Page 3-5 and 3-6, Paragraph 2*

Comment: This paragraph describes the use of data from existing mines as the basis for a Bristol Bay mining scenario. While stating that there are important differences between existing mine sites and any scenario within the Bristol Bay region (some very large and significant differences), it also states that existing mines that have had an impact on areas supporting trout and salmon populations "offer some parallels to potential tailing dam failures in the Bristol Bay region -even if the underlying causes of failure differ." These statements are not valid because current mining practices are very different from historical mining practices. In the absence of technical references to the relevant literature upon which these statements, presumably, are made the basis for these statements cannot be evaluated.

EPA Response: **Modern technologies may reduce the probability that failures will occur or change the types of failures that may be most likely to occur. However, existing mines, even those with older technologies, provide evidence of what may occur in receiving ecosystems should failures occur.**

3.42 *Section 3.6, Page 3-6, Box 3.1*

Comment: This box describes the conceptual model diagrams on the pages that follow in this section. Mitigation measures are completely left out of the conceptual model diagrams. The diagrams describe the pathways as “plausible”. “Plausible” means likely to occur. It would be much more accurate to represent these pathways as “possible”, as some may be likely to occur and others would be far less likely to occur, or not occur at all.

EPA Response: **Text has been revised to indicate that the conceptual models illustrate potential pathways that vary in likelihood of occurrence and magnitude of effects, and to clarify how the conceptual models were used in the assessment. Mitigation has been included in the diagrams in the final assessment.**

3.43 *Section 3.6*

Comment: The conceptual models use scenarios that the authors state may not actually occur. The conceptual model diagrams do not incorporate any avoidance, minimization or mitigative measures that are used in the mining industry to reduce or eliminate potential impacts to receptors, endpoints and sensitive resources. On this basis alone, the conceptual models will, in fact, not occur and should not be used in the assessment. There is little basis to presume that the conceptual models described in the document are applicable to any mining efforts proposed in the watershed. Furthermore, the conceptual models fail to meaningfully address assessment endpoints and, instead, specify endpoints such as genetic diversity that have no clear and direct causal connection to mining practices.

EPA Response: **See response to Comment 3.42.**

Nondalton Tribal Council (Doc. #5465)

3.44 The Draft Assessment discusses fugitive dust only as it relates to roads. However, fugitive dust from mining operations can be a source of sulfuric acid drainage. Pebble would have thousands of explosions per year, so the dust issue seems significant. It appears on the flow chart for impacts related to mining operations (Figure 3-2B), but it is not addressed in the text.

EPA Response: **The occurrence of dust from blasting is poorly documented and its effects are unknown. The revised assessment notes that the main impact of dust at the mine site would be a direct increase in fine bed sediment, but the issue is not considered further. Dust from unpaved roads is known to affect streams and is included in the revised assessment (Chapter 10).**

Center for Science in Public Participation (Doc. #4122)

3.45 The conceptual models clearly demonstrate potential contaminant source – path – receptor routes with defined biotic response endpoints. These provide the basis for research supporting risk assessments. Areas that could use improvement are listed below.

Change to make more accurate. A conceptual model should combine 3.2-A (Habitat, Operations) and 3.2-B (Water, Operations) into a model "Habitat and Water, No Failure" to support the text of Chapter 5. Model 3.2-A would remain essentially the same, but some pathways in 3.2-B would be eliminated and would remain only in models 3.2-C (Water and Habitat, Closure) and 3.2-D (Water and Habitat, Failure). Figure 3.2-D (Habitat and Water, Failures) should have Failure pathways added for "Waste Rock" and "Housing Construction".

<u>EPA Response:</u> See response to Comment 3.10.

Comment on clarity. A "walk-through" narrative might better explain the conceptual models. For instance, it is not at all intuitive why certain metals (e.g., Hg, Se) would increase under the different model scenarios for Assessment Figures 3.2-B and 3.2-C; they do not appear to come from discussions of waste rock and tailings leachate or any other obvious source. Nor is it clear why strong components of leachate (e.g., Al, Cd) are not listed.

<u>EPA Response:</u> See response to Comment 3.10.

Change to make more accurate. In Assessment Figure 3.2-A, is a box for "Increased inter-basin water transfers". Under the minimum mine size, with tailings stored in the North Fork Koktuli valley, it is not clear how there will be inter-basin water transfer; such transfer has only been documented between the South Fork Koktuli and Upper Talarik Creek (PLP 2012). This comment also applies to Assessment Figure 4-9, a nice diagram but it suggests water could flow to/from the pit lake to the tailings facility, which is not plausible under the minimum size scenario.

<u>EPA Response:</u> This shape has been removed from the conceptual model, and Figure 4-9 has been replaced with a figure illustrating water balance components and water management at the mine site.

Comment on presentation. The models could be printed on fold out sections for easier viewing in print format.

<u>EPA Response:</u> The pdf file is formatted this way, so the models should print out on larger paper when the printer can accommodate it (see printing instructions on the website where the assessment pdf is located).

Stratus Consulting (Doc. #4973)

3.46 Issue: Conceptual model of water quality effects (Figure 3-2B, p. 3-8). The conceptual model diagrams presented in Chapter 3 are helpful in terms of seeing how mine-related impacts can affect different parts of the Bristol Bay ecosystem, but some additional work is needed. My comments focus on Figure 3-2B, which addresses water quality effects, but some of them also apply to the other conceptual model figures.

Although sources are clearly identified in Figure 3-2B, pathways and receptors are not. Relevant receptors (they can also be pathways) include surface water, groundwater, and aquatic biota; these receptors should be included in the diagram. The groundwater to surface water pathway is ignored, and infiltration of contaminated leachate to groundwater is not included.

EPA Response: Clarification on how the conceptual models are structured has been added to Chapter 2 of the revised assessment. Only endpoints considered in the assessment are included as "receptors", and discharges of contaminated water include both groundwater and surface water pathways.

3.47 The "mine construction and operation" box at the top is not needed (in title).

EPA Response: This shape has been removed from the conceptual models.

3.48 The operational phase of mining should be "extraction" (open pit and underground mining) and "beneficiation and processing" (milling, tailings and concentrate production, etc.). The tailings boxes should be under "milling & ore processing" rather than "open pit and underground mining." Dewatering should be under "extraction" rather than in a separate box. Discharge of treated water should be included in the diagram, and its potential to change background water quality should be noted.

EPA Response: These shapes have been removed from the conceptual models for simplification purposes.

3.49 Dry stack tailings is one of the boxes in Figure 3-2B, yet the description of tailings management options in Chapter 4 (p. 4-13) suggests that such a management approach is unlikely for porphyry deposits (low-grade deposits) with large amounts of tailings.

EPA Response: This shape was removed from the conceptual models, to better illustrate issues within the scope of the assessment.

3.50 Nitrate and ammonia concentrations increase as a result of blasting operations [use of ammonium nitrate-fuel oil, or ANFO; see, e.g., Kensington Mine, Alaska, Final Supplemental Environmental Impact Statement (USDA Forest Service, 2004)], yet there is no mention in the Draft Watershed Assessment of these mine-related contaminants. These constituents should be added to the list of increasing contaminants and discussed in the relevant section of the final report.

EPA Response: Nitrogen as a stressor is considered in Section 6.4.2, but was not included in the scope of the assessment because it was not judged to be a significant factor for fish populations in this assessment.

Chapter 4: Mining Background and Mining Scenarios

Alaska Department of Natural Resources (Doc. #4818)

4.1 *Volume 1 Geological Resources and Mine Scenario*

Comment: While the assessment lays out a potential mine it does not make an attempt to assess the economic impact or number of workers employed by such a mine. While the assessment notes public sources for data used to determine the so called plausible mine scenario present. The same attempt is not made concerning economic impacts or workforce, despite there being the publically available information posted by the Pebble Limited Partnership.

Pebble Limited Partnership, http://www.pebblepartnership.com/opportunity.php

<u>EPA Response:</u> See response to Comment 2.17.

4.2 *Section 4, Page 4-2*

Comment: Table 4-1 shows significantly lower grades of ore than that reported in the 2011 Report done for Dynasty Minerals by Wardrop. For example, copper % grade is reported as 0.34% in the Bristol Bay Watershed Assessment while the Waldrop states it is from 0.38% for the small mine and 0.46% for the full mine. This is significant since it relates to the economics of the project. Gold is also reported in the Bristol Bay Watershed Assessment as 0.31 grams per ton while the Waldrop report has it as 0.36 grams per ton.

Recommended Change: The potential range of grades for the deposit should be reported in this table.

<u>EPA Response:</u> No change required. The source for this information was PLP (2009), from Appendix H. The point of this table was to consider the full potential of the Pebble deposit, so the value shown here is the average grade for "measured and indicated resources" plus the "inferred resources" for their 0.3% cut-off grade values. Regardless, the ore grade differences mentioned above do not affect the conclusions of the assessment.

4.3 *Section 4.1.2, Page 4-4*

Comment: EPA states, "…there are limitations in our ability to make predictions with a high level of certainty because of the inherent complexity of natural materials and their environment." EPA then goes on to compare the Pebble deposit to the Bingham Canyon deposit in Utah, and unilaterally make significant and substantial assumptions and predictions about physical settings, features and impacts of mining in the Bristol Bay region.

<u>EPA Response:</u> Limitations do not infer a complete void of information nor preclude our ability to analyze the information available. Rather, they imply that we must not overly generalize and must proceed with caution. Our use of Bingham Canyon is in the context of a generalized discussion of porphyry copper deposits around the world and is not a direct comparison to the Pebble deposit. We used data from the Pebble deposit where available and appropriate. No change required.

4.4 *Section 4.1.2, Page 4-4*

Comment: It is inappropriate to start the Environmental Chemistry section with a statement that mining can pose a risk. This approach is repeated throughout the document, putting a conclusive statement in the introduction to a section, and then only discussing generally how the stated impact occurs. Because of this, the Bristol Bay Watershed Assessment seems to be trying to influence readers without any substantiation.

The limitations on the ability to quantify releases to the environment should be discussed in detail in the Uncertainty Assessment if not elsewhere.

Recommended Change: Change structure of sections with an introduction to the issues, present data that is available and that is not, conclude what can be surmised from the data, and describe what the data gaps exist and what can and can't be concluded.

EPA Response: These sentences give the reader a sense of what will be provided in subsequent sections. The beginning of this section has been changed to read "Exposure to hazards associated with mining porphyry copper deposits can pose risks to aquatic and terrestrial ecosystems and to human health." The next sentence has been changed to read: "These risks can range from insignificant to extremely harmful depending on a variety of factors that control the hazards, including…" In addition, the assessment has been reorganized to improve clarity.

4.5 *Section 4, Page 4-4 to 4-7*

Comment: Considerable narrative is presented on the hypothetical chemistry of the porphyry copper deposits, discussing how the acid generation potential (AP), the net neutralization potential (NP) and the neutralizing potential ratio (NPP) are calculated and what they mean. On page 4-5, it is stated that "In general, the rocks associated with porphyry copper deposits tend to straddle the boundary between being net acidic and net alkaline, as illustrated by Borden (2003) for the Bingham Canyon, Utah porphyry copper deposit (Figures 4-2 and 4-3). This is good information but the specific AP, NP and NPP of the Pebble Deposit are not discussed here. This is crucial information since it has bearing on potential environmental impacts during the mine and after the mine life in perpetuity. Good information on the humidity cell tests of the Tertiary and Pre-Tertiary waste rocks are included in Table 4 on page 15 of Appendix H. This information is more valuable than the extensive hypothetical discussion and should be incorporated into pages 4-4 through 4-7.

Recommended Change: Place the information from Appendix H (in summary form) on pages 4-4 through 4-7.

EPA Response: The purpose of this section was to inform the reader of the geochemistry of porphyry copper deposits in a general way, not specific to the Pebble deposit. Bingham Canyon is a well-studied deposit that provides a good example of data from which to draw. The assessment has been reorganized to more clearly present what is background information (Chapter 4 in the revised assessment) versus what pertains to the evaluated scenarios (Chapter 6 in the revised assessment). Discussions of the geochemistry of the Pebble deposit are included in Chapters 6 and 8.

4.6 EPA states that the mine scenarios described in the Assessment reflect "current good, but not necessarily best, mining practices" for porphyry copper mining. Therefore, the assumptions made by the EPA based on "good practices" may not reflect the "best practices" that may be used by an actual mining operation or that may be required by state or federal regulatory agencies through the permitting process for a large mine. This approach is unrealistic considering the amount of scrutiny expected from the public and the requirements of the regulatory agencies that issue permits and approvals for mines in Alaska.

<u>EPA Response:</u> Our intent was to express that there are practices that are commonly used because they are considered to adequately protect the environment, and there are other practices that might be more effective but could be considered prohibitively expensive. We assume that the modern conventional practices commonly used at the time a mine is developed would be used. The assessment uses existing information to determine the environmental risks associated with mining given those modern conventional practices. It also describes the confidence associated with the information and conclusions.

We avoided the term "best practices" because there are always better practices which could be prohibitively expensive. Text has been revised to reflect that best practices in the sense of best current practices are assumed. Additionally, the revised assessment includes a discussion of terminology in Box 4-1. The mitigation measures proposed within the assessment's mine scenarios are those that could reasonably be expected to be proposed for a mine described as "permittable" in Ghaffari et al. (2011).

4.7 *Section 4, Page 4-8 to 4-11*

Comment: The following comment is an example of how possible mitigation methods could reduce the level of environmental concern and significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes.

The referenced pages discuss the processing operation, but only in brief detail. The Northern Dynasty Minerals, Ltd. Report of 2011 was used to supplement this information. The accuracy of this report in representing PLP current plans is unknown, but this report does provide details and specifics that would be expected from a submitted mining project proposal. From pages 4-8 through 4-11 and pages 164 through 174 in the Northern Dynasty Minerals, Ltd. Report of 2011, a prospective plan is to grind the ore to 80% passing 200 μmeters and produce rougher tailings which are basically inert and are approximately 85% of the total ore feed. The remaining 15% goes to another grinding circuit where the material will be ground to 80% passing 30 μmeters. There will then be various recovery flotation units for copper, molybdenum, etc. Gold will also be recovered. Of the 15% that is reground, 14% will be pyritic tailings that will be over 50% to 80% pure pyrite. This material will be encapsulated in the TSFs to prevent (or retard) oxidation and thus the production of sulfuric acid and dissolution of metals. As a potential mitigation measure, PLP should consider modifying the processing mill to get full recovery of the pyrite and place none of it in the TSFs. It is fully recognized that this major change would require a full evaluation but it is based on the following reasons: 1) Page 173 of the Northern Dynasty Minerals, Ltd. report shows that considerable gold is locked up in solid solution with the pyrite and additional grinding of the pyrite produces significantly better recoveries of gold; 2) the pyrite could potentially be oxidized by bio-leaching, roasting and other methods; 3) if the site produces nearly 1 billion tons of pyritic tailings over the life of the mine, a reasonable estimate of iron content of these tailings is 25%. This is 250 million tons of iron. When this project was first evaluated, iron's value was $50 per ton. It is now $160 per ton and has no sign of easing, due to the growth in China and India. This value is $4 billion and although the cost of this recovery is expensive, this value would help offset it; 4) substantial savings in the design of liners in the TSFs could be realized since all of the material in the TSFs would be inert and there is no compelling reason to spend large sums in stopping seepage for water quality reasons; 5) large sums could also be saved in water treatment for decades and possibly centuries since treatment may not be needed of the seepage water. Pumping costs from seepage ponds could also be saved; 6) since the iron would be sold, the overall size of the TSFs could be reduced by approximately 10-12%, saving additional sums of money in dam construction; and 7) offering this change could help in easing permitting costs and addressing a major concern of water quality from the TSFs would be eliminated.

This is not to say that this must be done; it may not be economically possible in spite of the benefits cited above. However, it is certainly worth some evaluation and discussion. Included is a reference paper done by the University of Capetown in South Africa on “Mitigating the Generation of Acid Mine Drainage from Copper Sulfide tailings impoundments in perpetuity: “A Case Study for an Integrated Management Strategy” by Hesketh, Broadhurst and Harrison in 2009. This study showed successful separation of nearly 100% of the pyrite from a copper porphyry tailing.

Recommended Change: Evaluate this item in more detail in conjunction with the Pebble Limited Partnership. Make changes to the document in many places.

<u>EPA Response:</u> This assessment is not an evaluation of the PLP’s mine plan. Rather, components from Ghaffari et al. (2011) were assumed to be typical for mining of a porphyry copper deposit. We recognize that mine plans can change during the permitting process and over time with changing economics, but it is outside the scope of this assessment to evaluate alternatives based on future unknowns.

4.8 *Section 4, Page 4-9*

Comment: The following comment is an example of how possible mitigation methods could reduce the level of environmental concern and significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes. The Simplified Schematic of Mined Material Processing does not separate the waste rock into PAG waste rock and NAG waste rock. This is important since the PAG waste rock can have impacts on the environment if not placed properly and if considerable acid formation occurs. The Northern Dynasty Minerals, Ltd. 2011 report states that the PAG waste rock will be piled on the west side of the pit and will be processed at the end of the mining operations and the tailings will be placed in the mine pit. If the price of copper drops, it may not be economically feasible to run this material through the mill at that time (it is low grade ore). This possibility must be addressed for long term post-closure, particularly with regard to water capture and treatment. If the material is strongly PAG, it should not be allowed to place this material in the mine pit since it will potentially affect groundwater in the area for a very long time if not treated. Also, full capture and treatment could be difficult in the long term. Table 4 of Appendix H shows that the Pebble East Pre-Tertiary waste rock humidity cell tests result is an average pH of 4.8.

Recommended Change: Revise the Schematic to include PAG and NAG waste rock. According to Northern Dynasty Minerals, Ltd., the 25 year plan would produce 2.4 billion tons of NAG and 0.6 billion tons of PAG. Include more discussion on possible impacts of leaving the PAG waste in permanent piles and in the mine pit, assuming that no future processing is undertaken.

<u>EPA Response:</u> The simplified processing schematic was intended to show the steps involved in ore processing, rather than to discuss the waste rock material; therefore, no change has been made. Discussions of management of waste rock material and tailings from the mineral processing were discussed elsewhere in the assessment. In the revised assessment, scenarios include processing all PAG waste rock so that none would be stored in the pit or on the surface.

4.9 *Section 4.2.2, Page 4-10*

Comment: EPA points out that mill processes can affect tailings properties and reduce the acid-generating potential of tailings by producing pyrite concentrate. Cyanide processes for gold recovery are briefly described. Mitigation measures are discounted because of secondary handling requirements.

<u>EPA Response:</u> We disagree that mitigation measures are discounted in the assessment. Secondary handling of pyritic wastes is included in the description of this process. We chose a more common and economic scenario of disposing of pyritic wastes in the tailings storage facility. Pyritic wastes do not play a significant role in our failure scenarios, so this aspect of the scenarios is fairly inconsequential to the assessment's outcomes. No change required.

4.10 *Section 4.3, Page 4-13*

Comment: The mine scenarios assessed by the EPA are representative of a very, large scale mining with a particular set of mine development elements that are not representative of a large percentage of porphyry copper deposit mines. For example, an open pit mine is selected while there are a number of large scale mines of such deposits that mine by bulk underground methods such as block caving, sub-level caving vertical crater retreat and other underground methods. The volume of waste rock created by such underground mining methods is several orders of magnitude less than that assumed in the EPA mine scenarios.

<u>EPA Response:</u> Underground mining methods would reduce the volume of waste rock placed on the surface of the mining site, but a given quality of material mined via underground methods would produce the same amount of tailings as that material mined via surface methods. A "tradeoff" in the amount of waste rock brought to the surface is the issue of rock surfaces that are exposed to oxidation and groundwater in underground mined regions. We discuss underground methods in general in Chapter 4 of the revised assessment. In Chapter 6 of the revised assessment we mention that, although our scenarios consider open pit mining, deeper parts of the deposit could be mined via underground methods. We also recognize that many of the potential effects from wastes produced using either mining method would be similar.

4.11 *Section 4.3, Page 4-13*

Comment: The tailings disposal method by hydraulically placed, slurry tailings is one of a number of methods that can be considered. While it is the most favored of the disposal methods for cost, there is an increasing tendency to adopt alternative methods such as paste and filtered, dry stacked tailings that effectively address water management issues and environmental protection. Paste tailings technology is being applied at large scale porphyry copper mines such as the Esperanza mine in Chile. These alternative tailings disposal methods permit greater freedom for the selection of disposal facilities and can be used to address specific environmental concerns. For example, with a smaller footprint, the need to build a cross valley dam can be eliminated, along with impacts to stream flow and salmon habitat. By selecting a tailings disposal method that requires the tailings storage facility in a location where the stream impact is maximized, the Assessment results in environmental impacts greater than can be achieved by alternative methods.

EPA Response: The tailings disposal method used in the assessment is the one proposed by Northern Dynasty Minerals in Ghaffari et al. (2011). We agree that there are alternative methods for long term storage of tailings. However, those methods are expensive and not commonly used. We chose to evaluate the potential risks associated with the more likely method of an impoundment, although discussion of other tailings disposal methods has been added to Chapter 4 of the final assessment (e.g., Box 4-7).

4.12 The Assessment does not adequately consider Alaska regulations, standards, or the mitigating aspects of modern mine construction methods, operation, and closure. The Assessment provides a very basic review from dated mining projects outside of this region that do not adhere to modern mining methods, regulations, or engineering standards. These examples, which may have no applicability to this study area, were used to predict potential impacts to the study area.

EPA Response: The mitigation measures incorporated into the assessment's mine scenarios are those that could reasonably be expected to be proposed and are assumed to meet requirements. We are aware that an actual mine may differ somewhat from what we have proposed. However, what is proposed does consider the location and has been suggested as appropriate by Ghaffari et al. (2011).

When referring to other mines, we limit our analyses to specific aspects of those mines that are comparable to the environment in our scenarios. For example, when describing the fate of pollutants on a floodplain after a tailings spill, we did not address the cause of the spill or the flow dynamics of the tailings, but only described the long term behavior of metals in the environment, which is comparable to metals that would remain on the floodplain of a stream in the Bristol Bay watershed.

4.13 The hypothetical inflows and outflows of a speculative design do not constitute a water balance. A fundamental element in any mine review is an accurate water balance for the project. The Assessment attempts to describe the negative hydrological effects of a conceptual and unpermitted facility, but an understanding of water balance cannot be reached in the absence of a detailed proposal, including proposed water use within the facility itself.

EPA Response: Risk assessments must analyze the implications of potential scenarios. An assessment performed after a mine is permitted would not serve to inform decision making.

Although each mine is unique and requires calculation of a careful water balance to efficiently operate, all mines that operate with certain processes, such as a flotation circuit, do so within a range of conditions, including water use. Therefore it is possible for us to estimate a water balance for a mine at the Pebble site, or any other site in the Nushagak and Kvichak River watersheds. The revised assessment contains a more detailed water balance than the original draft.

To assess potential environmental impacts, only withdrawals from and discharges to the environment are relevant. Water use within the facility itself has no direct impact on the environment, except for unplanned spills and leaks. The assessment estimates the sources and amount of water consumed under the mine scenarios and considers the locations, concentrations, and amounts of expected discharges from those mine scenarios.

4.14 The Assessment does not take into account the seasonal fluctuations of groundwater and surface water flow and its effect on determining impacts from the mining scenario. Furthermore, the Assessment does not consider the substantial amount of information contained in the EBD. This includes information needed to determine the rates of groundwater flow, soils composition, porosity, hydraulic conductivities, permeability, presence of permafrost, fracturing in bedrock and other important aspects of groundwater before any mine development.

<u>EPA Response:</u> We assume that water storage capacity under the mine scenarios presents wide latitude to buffer seasonal flow fluctuations, so the water balance considers annual averages only. We have included data from the EBD extensively in both drafts of the assessment.

4.15 There are hundreds of references to groundwater in the Assessment and it is repeatedly listed as a key factor in fish habitat and other wildlife habitat functions. Yet, hydrogeology within the proposed pit and tailings storage facilities is not described in the Assessment.

<u>EPA Response:</u> Section 7.3 of the revised assessment discusses exchanges between groundwater and surface waters, particularly moderating effects on base flows and temperature. The available evidence indicates that mining operations would result in changes in groundwater levels due to drawdown around the open pit, disruption of streamflow, and discharges from mine operations. Section 7.3.4 discusses the uncertainties and assumptions associated with estimates of streamflow changes due to the mine development. Groundwater modeling was beyond the scope of this effort and, as noted in Chapter 6, net balance of water from groundwater sources is one of the larger sources of uncertainty for water balance calculations.

4.16 The Assessment assumes that the mine would be located on a water divide and there will be little groundwater contribution into the area defined by the cone of depression. However, the surface water divide does not necessarily match the groundwater divide. The Assessment did not evaluate regional groundwater flow to determine the location of the groundwater divide.

<u>EPA Response:</u> We agree that surface water divides and groundwater divides are not always colocated. In the highly permeable overburden layers in the mine area, groundwater flow direction is most likely to be similar to the surface flow direction.

Any imprecision introduced into the analysis by this assumption would not be expected to materially change the results of the analysis.

4.17 The amount of water used during mining operations is not consistently reported in the Assessment. This has major implications to the water balance, instream flows, and the health of fisheries below the hypothetical mine. Dewatering and mining activities in the mine site will change the local, and possibly the regional, groundwater flow field, which will change the water balance.

<u>**EPA Response:**</u> **The comment does not provide sufficient context or information to evaluate the claim that "The amount of water used during mining operations is not consistently reported in the assessment." The estimates of various components of the water balance reported in Table 6-3 were used throughout the assessment to analyze potential impacts.**

4.18 The Assessment does not adequately consider the complex, site-specific and stream flow conditions and relate the information directly to measured fish/salmon presence and potential impact. The EBD contains information that shows gaining and losing reaches in the area of study. However, the Assessment does not include sufficient information on groundwater / surface water interactions that must be used to estimate impacts to fish habitat from mining activity.

<u>**EPA Response:**</u> **Although the EBD contains information on gaining and losing reaches under present conditions, it does not include predictions of streamflow changes due to mine development and operation. Site-specific streamflow, salmon density, and salmon breeding information is not available for the entire potentially affected stream network. Section 7.3.4 acknowledges and discusses the uncertainties related to potential habitat modification and streamflow changes.**

4.19 The Assessment provides examples of impacts from mines developed from the late 1800 and early 1900s, related to acid mine drainage and mobilization of metals and does not distinguish nor consider current mine technology or regulatory framework and oversight to prevent environmental harm. These historic examples do not apply directly to a modern mine under current regulatory regimes.

<u>**EPA Response:**</u> **We are not comparing the technologies used in old mines, but rather evaluating how metals released to the environment have behaved over long periods of time. This is independent of the technologies that were used then or now. We are learning from the results of past errors, not evaluating the errors or the activities that resulted in those errors. We have clarified these points in the final assessment.**

4.20 While the presentation of the various geographic scales and associated information gives perspective to the expansive area that makes up the larger Bristol Bay region, the Assessment fails to address or quantify the potential impacts of the hypothetical mine as it relates to the various scales it presents.

As an example, if Bristol Bay has about 90,000 km of streams and Nushagak and Kvichak has about 58,000 km of streams, those numbers and associated contribution to the respective fish contribution should be compared with the area of streams that would be impacted by the mine to give an overall perspective of impacts. The Assessment cites that 125.1 kilometers of streams would be lost for the maximum hypothetical mine scenario which would equate to an overall stream loss of 0.1 percent of the Bristol Bay watershed or about 0.2 percent of the Nushagak and Kvichak watersheds (Furthermore, presentation of kilometers down to the tenth of a kilometer implies a level of accuracy in impact assessment that is misleading). The Assessment fails to put into context how the loss of length of streams and habitat or area of wetlands directly relates to effects on fish production and the overall effect on subsistence, sport or commercial fishing at the larger scales. Without quantifying the effect of the impacts at each scale presented, the Assessment is essentially incomplete for the purpose of a risk assessment document.

<u>EPA Response:</u> Because data on the abundance and production of salmonids and on habitat quality across the Nushagak and Kvichak River watersheds are lacking, it is not possible to estimate losses of fisheries at those larger geographic scales. Therefore, it was necessary to focus on the three streams that drain the Pebble deposit. We have clarified the different geographic scales considered in the assessment in Chapter 2 of the revised assessment (also see response to Comment 2.3).

4.21 Data are presented on potential acid rock drainage in the Assessment, a known concern for long-term impacts from sulfide ore mining. The text in Chapter 4 (pages 4-4 through 4-7) discusses the Bingham mine results from Utah, but does not refer to site-specific information from the potential Pebble site included in Appendix H.

<u>EPA Response:</u> See response to Comment 4.5.

4.22 *Section 4.3.3 and 4.3.9.1, Page 4-1, 4-19, and 4-34*

Comment: "Described mining practices and our mine scenario reflect the current practice for porphyry copper mining around the world, and represent current good, but not necessarily best, mining practices. "

"Based on standard mining practices, we assume that drill and blast methods would be used to excavate the rock, at a processing rate of approximately 200,000 metric tons/day for both the minimum and maximum mine sizes (Table 4-3)."

"Material sources for road embankment fill, road topping, and riprap would be available at regular intervals along the road route, and we assume standard practices for design, construction, and operation of the road infrastructure, including design of bridges and culverts for fish passage."

Why are standard but not best practices assumed in the scenario? It is reasonable to assert that practices better than current best practices will be in place for any mine development in the region given the advances in technology and engineering that are likely between now and the date of construction and actual mining.

<u>EPA Response:</u> See response to Comment 4.6.

4.23 *Section 4, Page 4-1*

Comment: EPA uses basic concepts of engineering features in general descriptions of a broad assortment of technical issues related to tailings dams and mining. For example, tailings dams are described as being upstream, centerline, or downstream fill. Such elementary level descriptions defy technical review because of the lack of specific information. There are no conceptual designs, site investigation reports, engineering plans or specifications. EPA then describes impacts of such features in terms of their physical presence (e.g., footprint) and in terms of hypothetical, catastrophic failures. In fact, there is a probability that any engineering feature will fail, including buildings, bridges, jet engines, etc.; however, the simple probability of failure does not ensure its failure, and the benefits of those features provide incentive to take the risk that the failure does not occur because of mitigation measures engineered into the design. For example, Figure 5 in Silva, et al., 2008 shows tolerable risk based on annual probably of failure compared to people and dollars lost for various industrial features including mine pit slopes, dams, commercial aviation, and super tankers. This paper also includes an in depth review of risk management at an actual operating mine with tailings dams.

<u>EPA Response:</u> We agree that risk is posed against the benefits of an engineered structure. We do not imply that these structures should not be built. The assessment is intended to evaluate potential risks of adverse environmental effects resulting from construction a porphyry copper mine in the Bristol Bay watershed. Any decision regarding limitations on constructing a mine may come at some later date and would result from an independent process.

4.24 *Chapter 4*

Comment: EPA mine scenarios consider minimum and maximum sized mines. In terms of mined ore/tailings disposal volumes those boundaries are 2 billion metric tons (tonnes) and 6.5 billion tonnes, respectively. At 2 billion tonnes, the minimum mine scenario would be considered a very large mine on a global scale, and exaggerates the respective potential impacts under normal operations and failure scenarios. There are probably less than 10 mines in the world with estimates of 2 billion tonnes or more of tailings. The Andina Mine in Chile is the only mine known to be studying the concept of storing 5.8 billion tonnes of tailings. There are currently no metal mines with tailings storage facilities of this magnitude.

<u>EPA Response:</u> Our scenarios conceive of a mine with multiple tailings storage facilities (TSFs), not a single facility that stores all tailings of a mine this large. This approach is conservative, in the sense that failure of a larger TSF would result in more extreme effects and that more TSFs would result in a greater footprint.

Comment: EPA mentions the Pebble Limited Partnership (PLP) and states, "Although the Pebble deposit is used as an example of mining in the region, the assessment does not predict what the PLP may eventually propose." In Section 4.3, EPA states "Although we borrow details from Ghaffari, et.al (2011), our mine scenario is not based on a specific mine permit application…" In Section 4.3.5, EPA mentions the 2006 water rights application to ADNR by Northern Dynasty, but that application, and the Initial Application Report submitted to ADNR Dam Safety and Construction Unit which included the tailings dam concepts, are not included in Chapter 9, Cited References. The Tailings Storage Facility (TSF) 1 and other features in the EPA mine scenario are virtually identical to the conceptual location of Tailings Impoundment G and other features in the Northern Dynasty application. The dam illustrated in Figure 4-8 is based on Northern Dynasty's concept for dams at Tailings

Impoundment A. It is notable that the 2006 water rights application was submitted prior to the significant volume of baseline information released by the Pebble proponents in 2011. The Assessment relies heavily on concepts developed by Northern Dynasty who are party to the Pebble Limited Partnership but do not necessary represent PLP, the prospective Pebble proponent.

<u>EPA Response:</u> To create plausible mine scenarios, we used scenarios described by an actual mining company for this site. Northern Dynasty Minerals has stated that the basis for the assessment's mine scenarios was a plausible and permittable mine plan (NDM 2006, Ghaffari et al. 2011). It includes the elements of most mines of this type existing and proposed around the world. Thus, the scenarios evaluated in the assessment are reasonable.

It is difficult to make technical observations regarding the mine development model used in the Assessment because the basis of the model is comprised of a number of assumptions and not real data. While the proposed mine and scenarios that were assumed by the EPA may appear to be realistic in a sense, based on a given set of conditions, they by no means represent the only options and outcomes that could apply to a mine located in the Bristol Bay area, or any mine that is in the planning, development, operational or closure stages.

<u>EPA Response:</u> Many of the details of a mine plan may differ from what we have described. However, the essential elements of a mine plan are represented here and would have similar effects regardless of modifications implemented. We used the elements described by Northern Dynasty Minerals as plausible and permittable (Ghaffari et al. 2011).

4.25 *Section 4.2, Page 4-5*

Comment: EPA states that the Bristol Bay watershed encompasses 23,539 square miles, and loosely describes existing infrastructure in the region. EPA fails to compare the area of the mine scenarios as a percentage of the total area. Based on the surface areas for the minimum and maximum mine scenarios listed in Table 4-3 (and assuming the total transportation corridor is 0.25 kilometers wide), the areas of development are approximately 0.1% and 0.2% of the total area of the watershed, respectively. Note that the minimum mine size would be a very large mine on a global scale.

<u>EPA Response:</u> A comparison of the mine site to the entire watershed may not be the appropriate scale of analysis. Both aquatic resources and potential adverse effects of mining exist at multiple scales throughout the watershed. The purpose of the assessment is to describe those adverse effects on aquatic resources. Determining if those scales of impact are significant is part of a later process.

4.26 *Section 4, Page 4-11 and 4-12*

Comment: The following comment is an example of how possible mitigation methods could reduce the level of environmental concern and significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes.

The illustration and narrative on these pages is identical to the narrative in the Northern Dynasty Minerals, Ltd. report with regard to the type of dam construction (i.e., initial dam will be the downstream type which is the most stable, which will be approximately 50% of the total dam height). The upper 50% will be centerline construction. Given the magnitude of this dam and the potential for serious earthquakes, this design must be evaluated in minute detail for stability. The long term strength parameters of the tailings behind the dam must be evaluated since this could affect the stability of the upstream portion of the dam, in particular, the upper portion.

Recommended Change: Use a seasoned dam expert with experience in extremely cold conditions and high risk of earthquake to provide a full evaluation of the dam design with respect to slope stability.

EPA Response: The assessment assumes that a seasoned dam expert with appropriate experience would design any dam that is built. We assume that any dam would comply with requirements of the Alaska Dam Safety Program, and that all necessary mitigative measures would be included in the dam design. However, the long-term risk of dam failure, including an accumulation of small defects over long timeframes due to earthquakes and extreme weather, would remain a threat that cannot be addressed by the existing experience of the industry.

4.27 *Section 4, Page 4-11 and 4-21*

Comment: The following comment is an example of how possible mitigation methods could reduce the level of environmental concern and significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes. The narrative on Page 4-11 discusses some general dam design criteria and page 4-21 has a very brief discussion about the lining of the dam. The Northern Dynasty Minerals, Ltd. Report of 2011 has a detailed cross section in Figure 18.3.1 on Page 355. This design shows a 100 mil HPDE liner over a geosynthetic clay liner, surrounded by some fine material above and below to protect the liner. The Northern Dynasty Minerals, Ltd. report also states that the lack of fine material has required the use of these linings. In other words, the rest of the dam will be built out of waste rock from the mine that may be permeable. For most situations, this design would be perfectly suitable, however, given the possibility of earthquakes, the sheer volume of the tailings and the sensitivity of the fisheries downstream, the risk is very high and additional layers of protection on the dams should be evaluated, such as a secondary HDPE liner with a second GCL layer.

Recommended Change: Use a dam expert with experience in extremely cold conditions and high risk of earthquake to provide a full evaluation of the dam design and lining requirements.

EPA Response: The liner described in Ghaffari et al. (2011) (the Northern Dynasty Minerals report of 2011 described in the comment) is proposed only for the dam itself. Seepage through the dam would be collected near the toe of the dam. The surface of the dam constitutes a small percentage of the entire surface area of the proposed reservoir, most of which would not be lined. Seepage though the floor of the reservoir would contribute to groundwater recharge.

In addition, the points raised in the comment would not change the outcome of our analysis. We assume that over the long timeframes that the tailings would be in place, seepage to groundwater would occur but that downstream consequences would be relatively negligible. Additional measures to contain tailings seepage would not change this outcome, because the toxicity of the tailings leachate is estimated to be relatively low.

4.28 *Section 4.2.3, Page 4-11*

Comment: EPA states, "…geomembrane technology has not been available long enough to know their service life…" and generally discounts the potential mitigation value of the product. In fact, the advent of geomembranes began in 1839 when Charles Goodyear vulcanized natural rubber with sulfur which led to the development of thermoset polymers. Polyvinyl chloride resin production began in 1939 and mass production of polyethylene compounds began in 1943. The U. S. Bureau of Reclamation began using geomembranes in the 1960s. The geosynthetics industry broadly shifted to thermoplastic polymers in the 1980s. HDPE and other formulations of polyethylene are routinely approved by EPA and other international regulatory agencies for use in solid and hazardous waste landfills around the world (which have indefinite design lives, also). (Reference: Designing with Geosynthetics, 5th Edition. Koerner, 2005 ISBN-10: 0131454153)

Comment: The EPA states, "…geomembranes are generally estimated by manufacturers to last 20 to 30 years when covered by tailings (North pers. comm.) [sic]". The statement appears to be referenced based on personal communication. While this may be the approximate service life of some geomembranes exposed to ultraviolet rays (sun), it is more typical of product warranties issued by manufacturers. The lifetime of buried geomembranes has been estimated as much as 400 years or more for a high density polyethylene (HDPE) by noted experts such as Robert M. Koerner.(see citation in comment above).

<u>EPA Response:</u> We have incorporated work by Koerner and Rowe into the assessment and modified our statements regarding geomembranes.

4.29 *Section 4.3, Page 4-17*

Comment: The report in the first paragraph on this page states "Our mine scenario represents current good, but not necessarily best, mining practices". This is stated differently in the Executive Summary Pages ES-14 where the report states "No failure, or routine operation, is a mode of operation defined as using the highest design standards and day-to-day practices, with all equipment and management systems operated in accordance with applicable specifications and requirements practices.

Recommended Change: Reconcile the statements.

<u>EPA Response:</u> The Executive Summary has been revised to more accurately reflect the content of the main report, and the revised assessment stresses that the use of modern conventional mine design, practices, and technologies is assumed.

4.30 *Chapter 4*

Comment: Much of what the Pebble Limited Partnership can do for environmental protection is based on the economics for the mine. This is not discussed in the Bristol Bay Watershed Assessment. It would be helpful to know the long term economics of the mine, which are described in detail in the Northern Dynasty Minerals, Ltd. Report of 2011, and whether they are based on conservative metal prices. The following list shows prices used in the economics calculated for the Northern Dynasty Minerals, Ltd. Report of 2011 compared to current prices.

- Copper $2.50/lb Current $3.33/lb
- Gold $1050/ounce Current $1610/ounce
- Molybdenum $13.50/lb Current $14.90/lb
- Silver $15.00/ounce Current $28.00/ounce
- Rhenium $3000/lb Current $2900/lb
- Palladium $490/ounce Current $618/ounce

EPA Response: Our approach was conservative in that we assumed that there are sufficient funds to implement modern conventional environmental protection measures. We then evaluated likely effects of such an operation on salmon resources. Whether existing economic conditions would support such measures is beyond the scope of this assessment.

4.31 In Chapter 4, the Assessment provides examples of catastrophic dam failures, and further describes failure mechanisms, such as overtopping and slope instability and then discusses failure statistics. However, the Assessment fails to point out that the failure statistics, as presented, do not distinguish catastrophic failures from relatively inconsequential incidents. This effectively exaggerates the probability of failure of the dam in the hypothetical mine scenario.

EPA Response: The statistics cited in the original draft assessment pertain to failures and do not include non-failure incidents unless noted. For example, the discussion of the ICOLD statistics (p. 4-44 of the original draft assessment) says "The International Commission on Large Dams compiled a database of 221 tailings dam accidents and failures that occurred from 1917 through 2000 (ICOLD 2001). Causes of accidents and failures were reported for 220 of these; Table 4-8 summarizes information for 135 of the reported failures (ICOLD 2001)." This material is found in Section 9.1.1 of the revised assessment.

4.32 *Section 4.3, Page 4-6, Table 4-4*

Comment: To help place these data in context, the authors should add a column that shows the equivalent information for the hypothetical Pebble mine. Also, the table does not provide information on the local/regional geology or hydrogeology that would also help the comparison.

EPA Response: Information on the Pebble mine has been added to this table (Table 4-1 in the revised assessment).

4.33 *Section 4.3, Page 4-16*

Comment: In Table 4-4, EPA lists other mines and prospects in Alaska using Levit and Chambers, 2012 as the source. Fort Knox and Red Dog are the largest operating mines listed with tailings volumes of 200 and 100 million tonnes, respectively. The Donlin prospect is also included at 472 million tonnes. No mines outside of Alaska are listed. The basis for the ore volumes is not mentioned.

EPA Response: This table (Table 4-1 in the revised assessment) is meant to illustrate scope of a potential mine at the Pebble deposit relative to other mines in Alaska; thus, mines outside of Alaska are not considered here (although the relative size of worldwide porphyry copper deposits is shown in Figure 4-1). Citations are provided for the information in Table 4-1.

4.34 *Section 4.3.2, Page 4-17*

Comment: EPA mentions two other mines outside of Alaska: "the largest porphyry copper mine in the United States (based on 2008 data) is the Safford Mine in Arizona, at 7.3 billion metric tons of ore [and] the largest in the world (based on 2008 data) is the Chuquicamata Mine in Chile, at 21.3 billion metric tons of ore." However, the source of the data is not clear. The 2011 annual report for Freeport-McMoRan Copper & Gold Inc. lists 206 million metric tons of ore at the Safford Mine. The basis for the discrepancy is not clear. EPA lists the potential mined ore at Pebble at 11 billion metric tons but fails to indicate the terms of these estimates (e.g., measured, indicated and inferred; proven and probable, etc.).

EPA Response: Size information for these two mines has been removed from the final assessment.

4.35 *Section 4.1.1, Page 4-17*

Comment: While many of the hypothetical mine features may be transferable to other part of the region, the geologic and hydrogeologic conditions at the Pebble site area are likely to be unique. For example, the flow and seepage of groundwater into an 800 meter deep pit would very likely differ between site locations within the region due to different surficial soils and bedrock/aquifer permeability and connection with surface water bodies. This is a significant issue for the mine design.

Recommended Change: Recommend revising this paragraph/sentence to acknowledge that the geologic and hydrogeologic conditions are not as readily transferable as other features.

EPA Response: We agree that geology and hydrogeologic conditions are important considerations in assessing potential mine impacts. Although any other site could differ from the assessment scenarios in ways that would affect the magnitude of individual impacts (e.g., in terms of mine size, mine layout, geology, hydraulics, hydrogeology, and topography), the nature of the impacts would be expected to be similar to those discussed in the assessment. The reader or assessor would need to consider potential effects of any differences between the scenarios discussed in the assessment and any specific mine plan to judge the relative impacts.

4.36 *Section 4.3, Page 4-17*

Comment: The No Failure impact and effects scenario is likely overly conservative. Full containment and failure-free mining are not likely mine scenarios. Also, combining cumulative risks from the Failure scenario is not likely either. The risk analysis method used in the assessment describes the conceptual model framework identifying an envelope of potential risks, but does not quantify the risks to any degree of certainty. The risk assessment should seek to evaluate risks (and quantify where feasible) and identify the mostly likely mine development and failure scenarios to understand likely impacts, while stating the range of knowable risks.

Recommended Change: Risk should be quantified, and estimated, where feasible (i.e., mine site footprint impacts, hydrologic impacts, dam failure) on elements of the study where this is feasible, and for items where calculation of risks and effects are unfeasible, scale of risk should be assigned (i.e., high probability and small area or low impact). A probabilistic risk based analysis of a likely mine operation and failure scenario would reduce uncertainties leading to underestimates and overestimates of stated risks and impacts.

EPA Response: We reorganized the assessment to better reflect our original intent. The "no failure" scenario in the draft assessment has been changed to a chapter on the effects of the mine footprint, without regard for operational problems (Chapter 7 of the revised assessment). Failures of different types (e.g., water collection, treatment, and discharge; pipelines; tailings dam) are considered in separate chapters of the revised assessment.

4.37 *Section 4.3.2, Page 4-17 and 4-19*

Comment: On page 4-17, the report states that "If fully mined, the Pebble deposit may exceed 11 billion metric tons of ore…" On page 4-19, the report states that "In our mine scenario, we have defined a minimum and a maximum mine size of 2 billion metric tons and 6.5 billion metric tons of ore, respectively."

Recommended Change: Include justification for why the 6.5 billion metric tons of ore scenario is the "most likely" mine size versus the estimated maximum potential of 11 billion metric tons of ore.

EPA Response: The Ghaffari et al. (2011) report, which was commissioned by Northern Dynasty Minerals (one to the Pebble partners), states that the ore body (measured and inferred) measures 10.9 billion tons. However, the ore body has not been fully explored and it may exceed this number. We recognize that the entire ore body may not be mined and chose to evaluate smaller mines rather than the Pebble deposit's full potential.

4.38 *Section 2.2.3, Page 4-20, Figure 4-7*

Comment: Whereas the maximum mine size figure appears to show a dam for the TSF1, there is no indication of the dam location for TSF2 or TSF3.

Recommended Change: Recommend adding the dams to this figure.

EPA Response: Figure 6-3 in the revised assessment shows the three TSFs that would have the capacity to hold tailings from 6.5 billions tons of ore.

4.39 *Section 4.3.5, Page 4-21*

Comment: The dam size, location and retaining volume are estimated and described, but there is no discussion as to how the quantities were estimated.

EPA Response: Because this is a description of mine scenarios for the purpose of evaluating potential effects of a large mine, rather than a specific mine proposal, the method for evaluating the volume of a tailings spill is not important; the modeled volume is the important metric.

4.40 *Section 4.3.5, page 4-21*

Comment: In the first sentence in the first paragraph, the report discusses a 2006 water right application submitted by Northern Dynasty Mine. These quantities should be compared to the volumes/rates discussed later in the water balance part of Section 4.

EPA Response: The water balance calculations presented in Chapter 6 of the final assessment rely on estimates of water utilized by mine operations and form the basis for streamflow calculations presented in Chapter 7. Thus, our analysis rests on estimates calculated based on projected use for specific scenarios, rather than upon quantities requested in the water rights applications.

4.41 *Section 4, Page 4-21*

Comment: The following comment is an example of how possible mitigation methods could reduce the level of environmental concern and significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes.

The narrative is identical to the narrative in the Northern Dynasty Minerals, Ltd report with regard to the percent of pyritic tailings versus bulk tailings. The Northern Dynasty Minerals, Ltd. report defines these tailings as inert or non-acid producing. They are the rougher tails from the first flotation circuit. The Bristol Bay Watershed Assessment says that the pyritic tailings would be discharged below the water surface of the tailings pond and encapsulated in NAG tailings to retard the rate of pyrite oxidation. Given the fact that nearly 1 billion tons of pyritic tailings would be produced for the full mine, it is important to evaluate in greater detail the potential for this material to oxidize. Variables that are not immediately clear are a) what will be the percolation rate of water through the tails?; b) there is approximately 65 feet of gravel in many areas of the TSFs and they will not be lined. What will be done to prevent seepage in these gravels?; c) how will the TSF dams be constructed to greatly reduce seepage under the dam?; d) how will rainwater and snowmelt (which is relatively high in dissolved oxygen), affect the oxidation rate?; and e) how will normal seepage through the dam affect water movement and hence oxidation, through the pyritic tails?

Recommended Change: Get more detailed information on this topic and include it in Section 4.3.5 of the Bristol Bay Watershed Assessment.

EPA Response: These factors would be important to evaluate for any proposed mine. In our mine scenarios we assume that water will seep into gravel underlying the tailings and flow to downstream waters. The revised assessment includes additional discussion of leachate seepage from the TSFs in Section 8.1.1.1. The estimated seepage quantities and chemical composition were used in the calculations of stream water quality.

4.42 *Section 4.3.6, Page 4-23*

Comment: In Section 4.3.6, waste rock disposal areas are described without a specific description of the basis for the estimated size or footprint, apart from stating "these piles will be constructed with a geometry designed to reduce the amount of runoff requiring treatment."

EPA Response: The size of the waste rock piles is based on the volume of waste rock generated, as described in Ghaffari et al. (2011). The location of the waste rock piles is based on their location as shown in the site plan put forth by Ghaffari et al. (2011) (see Figure 18.3.2 of that document), which minimizes transport and footprint.

4.43 *Section 4.3.5, Page 4-23*

Comment: The second paragraph discusses a well field to monitor groundwater flowing down the valley. However, no specific details are provided for these wells.

Recommended Change: Recommend including estimates of the number of wells that might be needed to monitor groundwater quality and intercept seepage, well depths, spacings, diameters, construction materials and possible drilling challenges based on the local hydrogeology. Also recommend discussing the well maintenance program options that would ensure the wells are kept operational.

EPA Response: The scenarios evaluated in the assessment assume that there will be sufficient wells to monitor and collect groundwater. No change required.

4.44 *Section 4.3.6, Page 4-25, Figure 4-9*

Comment: This schematic figure gives a misleading sense of the depth of the open pit relative to the groundwater conditions (as they appear to be understood). Although this figure is not to scale, if the intended pit depth is 800 meters, the base of the pit should be far deeper than shown. Also, one would expect a local groundwater mound to develop beneath the Waste Rock area in the lower figure (Post-Closure), with groundwater moving towards the pit and the stream.

Recommended Change: Revise the figure to better reflect the pit depth and groundwater flow pattern.

EPA Response: This figure (Figure 6-5 in the revised assessment) was intended as a schematic to illustrate the general relationships between surface water and groundwater; it is not drawn to scale. Certain aspects of the figure have been revised in the revised assessment, but it is still meant to be used only as a general illustration of water management and balance under the mine scenarios.

4.45 *Section 4.3.6, Page 4-25, Figure 4-9*

Comment: The figure shows a simplified schematic of the dewatering and water management system at the mine. What are the potential groundwater seepage and contaminant pathways? Pathways that come to mind are the shallow groundwater seepage through the bottom (unlined) portions of the TSF and fracture zones in the weathered bedrock layers.

Recommended Change: Recommend adding geology and soils information regarding the glacial deposits, with underlying weathered and competent bed-rock to the figure and discussion. Identify potential contaminant pathways on the schematic which should be consistent with the conceptual modeling schematics in Section 3.

EPA Response: See response to Comment 4.44.

4.46 *Section 4.3.7, Page 4-26*

Comment: The river diversion plan assumes that the blocked creeks/rivers will eventually find a way to flow around the mine site and TSF, however, it might not be the case in many areas, particularly during the high flow season (either caused by heavy rainfall and snow melt). During the high flow season, surface water runoff might cause flooding, top the TSF, and/or move the potential contaminants into downstream water bodies if PAG waste rock is encountered.

Recommended Change: Provide more detailed info on the river diversion plan, including the topographic information for the areas where the streams will be blocked by the mine pit or waste rock piles. Provide high seasonal flow information in the affected area and its impact on the mine site and safety of the TSF dam.

EPA Response: Our intent was to state the concept that waters otherwise blocked by mine facilities would be actively diverted around the facilities in constructed conveyances. This has been clarified in the revised assessment.

4.47 *Section 4.3.7, Page 4-26*

Comment: The document points out impacts that would “reduce or eliminate stream flows”. While these statements may be correctly applied to the local streams near the potential mine site, the impact to the larger stream systems is negligible, especially to the Bristol Bay Watershed. The document fails to put this in proper perspective.

Recommended Change: The document should demonstrate the potential impact to a larger stream system and overall potential impact to the Bristol Bay Watershed.

EPA Response: The description in the assessment is accurate. The area of reduced streamflow may extend many miles from a mine site. However, we have included an explanation of the various geographic scales used in the assessment to clarify the appropriate scale for each analysis.

4.48 *Section 4.3.7, Page 4-27, Box 4-2*

Comment: The report notes (Box 4-2) that a range of hydraulic conductivities have been measured in the area. However, the seepage calculation assumes a single value for each of the upper 200 meters and deeper materials. This range is not provided to enable the reader to put the selected values into context. Also, the selection of a relatively low hydraulic conductivity (10^{-8} m/s) for the deeper materials should be discussed in terms of primary or secondary porosity, and the likelihood that a mine of such dimensions would encounter water-bearing fracture zones and what the inflow contribution might be.

Recommended Change: Revise the seepage calculations and discussions to include a range of hydraulic conductivity values and the potential for water-bearing fracture flow contributions.

<u>EPA Response:</u> The seepage calculation in the original draft assessment used a continually varying hydraulic conductivity in the upper 200 m, not a constant value. As Box 6-2 of the revised assessment explains, "We based our analysis on the hydraulic conductivity (k) varying with depth, with log k varying linearly from the surface to a depth of 200 m; specifically, with k = 1 x10^{-4} m/s at the surface and k = 1 x10^{-8} m/s at depths greater than or equal to 200 m." We assumed a constant value below 200 m, but Box 6-2 clarifies that "[g]iven these values, negligible flow occurs below a depth of 200 m, so our model included a no-flow boundary at that depth." Given these hydraulic conductivities, over 99% of flow into the pit originates in the uppermost 100 meters. Although the existence of water-bearing fractures cannot be ruled out, the 31 packer tests performed below 200 m had an average length greater than 34 m and presumably intercepted and incorporated the effects of some fractures.

4.49 *Chapter 4, Page 4-27*

Comment: This page states that the mining operation would always consume some water and there would always be less water available in streams during active mining than there was before the mine was present. This contradicts Section 5.3.1 which states that "During the start-up phase, all water from the site would be collected and used in operations. However, during the minimum and maximum mine operations, 5 million to 48 million cubic meters of water available on the site per annum would exceed operational needs, and treated water would be discharged. (Section 4.3.7)". This contradiction is important to rectify since it has implications to the health of the streams and fisheries below the mine.

Recommended Change: Evaluate this item in detail and provide narrative on it. Make any changes to the water balance.

<u>EPA Response:</u> There is no contradiction here. At start-up and in some later phases, some water will be consumed and will not be available downstream. However, during other later phases of mining not all water will be used and some will be discharged, but still less than would reach downstream areas without mining.

4.50 *Section 4.3.7, Page 4-27*

Comment: The report assumes that the mine would be located on a water divide; therefore, there will be little groundwater contribution into the area defined by the cone of depression. This assumption is not well supported due to two reasons: 1. The surface water divide does not necessarily match the groundwater divide. Regional groundwater flow is not presented in the report to determine the location of groundwater divide.

Recommended Change: Provide regional hydrogeological information such as cross-sections, logs, lithologies, groundwater levels, and groundwater contour maps.

<u>EPA Response:</u> See response to Comment 4.16.

4.51 *Section 4.3.7, Page 4-27 and 4-28*

Comment: The water budget section of the report indicates how the estimation of water budgets was conducted by stating "Developing a water balance for these stages is important to the assessment, because it determines the amount of water available at the site that could still contribute to downstream flows (Box 4-2). However, water balance development is challenging and requires a number of assumptions. It depends upon the amount of water needed to support mining operations, the amount of water delivered to the site via precipitation, the amount of water lost due to evapotranspiration, and the net balance of water to and from groundwater sources. Information exists to estimate precipitation and evapotranspiration, and estimates of water needed for mining operations are available based on typical mining practices (Ghaffari et al. 2011). More challenging, and potentially the largest source of uncertainty, is determining the net balance of water from groundwater sources." The water budget estimating methods described in Box 4-2 do not specify the type of calculation or model used to evaluate the water budget. It is assumed that a deterministic, spreadsheet, model was used to grossly estimate the mine water budgets for the various mine development and closure phases.

Recommended Change: Provide an expanded discussion of the type of water budget model used, assumptions made, data sources, uncertainties and limitations in modeling estimates. The use and application of a more robust modeling system that can integrate surface and groundwater hydrology and mining industrial water operations is needed to more accurately represent water management and water budget conditions.

<u>EPA Response:</u> We disagree that the "use and application of a more robust modeling system that can integrate surface and groundwater hydrology and mining industrial water operations" is required for the level of precision appropriate to this assessment. See response to Comment 4.13.

4.52 *Chapter 4, Page 4-28*

Comment: This page describes the water balance calculations expected for the mine. The mine inflow assumptions seem reasonable and are calculated to be 1.06 cubic meters per second for the maximum mine. However, this number has such an important bearing on the overall water balance that it must be checked in detail. If the number is actually much lower, then the mine may not discharge during the mine life, since considerable water will be consumed in the tailings deposition. This could affect fish habitat for some distance downstream. If it is much higher, the flows in the streams could be increased downstream of the mine, resulting in increased erosion of the banks for some distance downstream.

Recommended Change: Use a seasoned ground water expert with experience in evaluating mine inflows from large pits to provide a full evaluation of the mine inflow predictions. Make any changes to the water balance, if necessary.

<u>EPA Response:</u> The water balance calculations presented in the assessment were made by a "seasoned ground water expert." The effect on streamflow is not sensitive to the individual components of the water balance because all of the water considered derives from precipitation falling on the mine footprint. This includes groundwater inflow captured in the mine pit, because at steady state the inflow is balanced by precipitation falling within the cone of depression generated by the pit drawdown. If the pit inflow were lower, it would mean that less precipitation became groundwater draining into the pit and that more precipitation remained available to sustain streamflow. Conversely, if the pit inflow were higher, it would mean that more precipitation became groundwater draining into the pit and that less precipitation remained available to sustain

streamflow. In all cases, the total amount of precipitation falling within some arbitrarily defined area larger than the cone of depression remains the same, but with different amounts in each case following natural pathways or being captured by the mine operations. The amount consumed by mine operations also remains the same, so the net amount returned to the streams remains constant as well.

4.53 *Chapter 4, Page 4-28, Box 4-2*

Comment: The report assumes that groundwater is limited to the top 100 meters, only. Is there any evidence that a deeper aquifer does not exist at the mine site? As stated in Table 4-3, page 4-15, the mine pit will extend to 800 meters and 1,200 meters for the minimum and maximum mine, respectively. The potential to encounter a deeper aquifer under the mine will change the water balance significantly due to potential for a large amount of water from fracture flows in the deeper portion of the mine pit.

Recommended Change: A detailed hydrogeological description in the mining area is needed to determine if a deeper aquifer(s) exists to a depth of 1,200 meters.

<u>EPA Response:</u> The assessment does not assume that groundwater is limited to the top 100 meters. We recognize that hydraulic conductivity generally decreases with depth, but we assume that all the strata remain essentially saturated. The exploratory program performed by PLP included borings to depths in excess of 1,350 m, with no evidence of any highly permeable water-bearing strata that would significantly alter the results of the water balance.

4.54 *Section 4.3.7, Page 4-28*

Comment: Box 4-2. Water Balance Calculations: The fundamental definition of a water balance is not adhered to in the discussion, thus making the results of the analysis worthless. Although the authors purportedly seem to be able to design AND comment on the negative effects of a yet to be designed and permitted facility, the water balance cannot be finalized until an understanding of water use within the facility itself is complete. The hypothetical inflows and outflows of a speculative design do not in itself, constitute a water balance.

<u>EPA Response:</u> See response to Comment 4.13. In hydrology, a water balance is an analysis based on the principle of conservation of mass that is used to describe the flow of water into and out of a system, which has numerous applications.

4.55 *Section 4.3.7, Page 4-30, table 4-5*

Comment: The geographical basis for the water balance provided in Table 4-5 excludes the area outside the immediate vicinity of the mine site. Typically, project-area water balances take into account flows for individual surface water bodies, water-bearing units/aquifers, and areal variability of precipitation and runoff components. In short, this water balance appears to lack acknowledgement of the key natural systems at and near the mine site. Also, water balances consider seasonality aspects (for example, monthly) and the effect of wetter- and drier-than-average years.

Recommended Change: The water balance should be fully reconsidered taking into account the comments above, and represented in a concise way with supporting figures, charts and tables.

EPA Response: See response to Comment 4.13. We assume that water storage capacity under the mine scenarios presents wide latitude to buffer seasonal flow fluctuations, so the water balance considers annual averages only. The analysis assesses potential changes in streamflow and does implicitly assume that the magnitude of any changes to the hydrology in the mine area, other than those caused by water consumption of the mine itself, would be small relative to those attributable to the mine.

4.56 *Section 4, Page 4-30, Table 4-5*

Comment: Table 4-5 indicates that water captured at the mine site is the same for the maximum mine condition and for the Post-Closure condition (both 41.2E6 cubic meter/year). The amount of water captured should not be the same under these two conditions due to the change in groundwater/surface water interaction. As mining progresses, the mine pit has the potential to intersect more groundwater from fracture flow. After the mine is closed, as the water level increases in the mine pit, less groundwater could flow into the mine.

Recommended Change: Provide explanation for the same amount of water being captured for the maximum mine and post-closure conditions.

EPA Response: Based on the groundwater flow calculations described in Box 6-2 of the revised assessment, over 99% of groundwater flow into the mine pit comes from the uppermost 100 meters. Therefore, groundwater inflow would remain essentially constant during most of the time required to fill the pit. In the revised assessment, we have presented estimates of the water balance flows both during and after pit filling to account for the decreased pit inflow associated with the reduction in area of the drawdown zone around the mine pit as the pit fills (see Section 6.3.4 of the revised assessment).

4.57 *Section 4, Page 4-30, Table 4-5*

Comment: Table 4-5 indicates that the "stored in TSFs as pore water" for the Start-up condition is 25.5E6 m^3/year. The amount of the water as shown in the table indicates the same amount of water "stored in TSFs as pore water" for each year for minimum mine operation period. There should be a minimum amount of material in TSFs, if any, during the Start-Up phase.

EPA Response: The quantities shown in Table 4-5 of the original draft assessment were annual quantities. Based on a constant or average production rate over the life of the mine, the annual volumes of tailings produced and of interstitial pore water within those tailings would be relatively constant over the life of the mine.

4.58 *Section 4, Page 4-30*

Comment: This page summarizes the water balance calculations expected for the mine. Although the water that will be captured by blocked streams is not actually part of the mine, it is an important part of the water balance and therefore, should be addressed. It is understood that diversions will be placed in the blocked drainages to divert what amount is feasible downstream through diversions, but there is no discussion of what blocked stream segment water will be backed up against the embankments that cannot be conveyed through diversions due to elevation. Pass through pipes underneath the TSFs will probably not work in perpetuity.

Recommended Change: Evaluate this item in detail and provide narrative on it. Make any changes to the water balance, if necessary.

EPA Response: It is unlikely that a design that allowed runoff or streamflow to pond against the toe of a rockfill or earthen embankment would be proposed or approved. By and large, TSFs are placed near the headwaters of streams to minimize streamflow interruption. Any flow originating upstream of the TSFs is presumed to be diverted to a natural watercourse as described in the assessment. The analysis does not explicitly consider any upstream flows or runoff captured by the TSFs, but any such amounts are expected to be small because the mine operator would have an incentive to divert the water to avoid having to treat it.

4.59 *Section 4, Page 4-30*

Comment: Using retention of 30% water by weight, calculations of the amount of pore water that will remain in the tailings each year after settlement and recapture of clean water using the floating barge in the TSFs can be estimated. The amount of 26.5 million cubic meters per year shown in the Table is reasonable. The post-closure column (Table 4-5) also correctly shows that no new water will be stored in the TSFs as pore water. What is not mentioned is that approximately 735 million cubic meters of permanent water will remain in the tailings as pore water over the life of the mine that will not be recaptured by the floating barge. This water would primarily come from precipitation and water inflow from the mine pit. This may be acceptable over 78 years time, but it is an extremely large amount of water that will essentially be taken from groundwater (in the mine pit) and placed in the TSFs. This should be discussed in the water balance. A more detailed evaluation of the water balance is needed.

Recommended Change: Describe the consumptive use of the pore water in the tailings over the life of the mine and its possible effects downstream on the groundwater and surface water systems.

EPA Response: We agree with the comment. This is exactly what the water balance does: it considers all of the consumptive losses (including the water in the tailings pore volumes) and subtracts them from baseline streamflows.

4.60 *Section 4.3.8, Page 4-31*

Comment: The document states an assumption that the mine would close " when all currently identified economically profitable ore is removed". PLP has not demonstrated that there is any "economically profitable ore" at this time. Final feasibility studies, mine plans and numerous other studies would have to be complete before PLP could report a reserve or "profitable ore".

Recommended Change: Drop "currently identified" from the text.

<u>EPA Response:</u> Change made in revised assessment.

4.61 *Section 4.3.8.3, Page 4-3EPA 1*

Comment: The document (p. 4-32) uses an assumption that a stable angle for waste rock slopes would be less than 15 %. There is no basis for this and our experience has shown that most reclaimed waste rock dumps are stable at 33 % and depending on the material, may be stable at steeper slopes. A steeper slope could reduce the overall footprint.

Recommended Change: Eliminate the 15 % reference.

<u>EPA Response:</u> This was a typographic error and it has been corrected in the revised assessment.

4.62 *Section 4.3.8.5, Page 4-33*

Comment: Premature mine closure is discussed (p. 4-33). There are two sentences that need additional discussion. First "In one study of international mine closures between 1981 and 2009, 75% of the mines considered were closed before the mine plan was fully implemented (Laurence 2011)." Second, later in the section states "Because premature closure is an unanticipated event, water treatment systems would likely be insufficient to treat the excessive and persistent volume of low pH water containing high metal concentrations." If the premise of a high rate of premature closure is true as presented in the assessment, it would be reasonable for the authors to assume premature closure as a likely scenario and the study should include this consideration in the No-Fail scenario or likely scenario analyses.

Recommended Change: Include an expanded discussion of premature closure, the uncertainty, and the potential impacts on fisheries and indigenous cultures as this condition is likely to occur.

<u>EPA Response:</u> We agree that this is an important issue. However, the potential range of premature closure conditions was judged to be too uncertain to develop a defensible scenario and assess the associated risks.

4.63 *Section 4. Page 4-33 and 4-39*

Comment: Page 4-33 states that the water from the leachate collection systems would be treated until necessary. Page 4-39 discusses water collection and treatment failure but focuses on a prediction of seepage flows through the TSFs, which would be untreated. This section goes on to state that if a treatment failure occurs, the expected discharge rate is 0.00115 m^3/sec. This is not a large flow and it is probably not the biggest risk with this type of failure. If a large treatment plant is in place, it may be possible that a large surge of untreated water would be discharged and this is not addressed in detail. The extreme weather conditions of this site combined with the fact that water treatment would go on for a very long time after closure, point to a significant possibility of "incidents" with the water treatment system which could produce much larger quantities than the expected seepage, albeit for a short time. Nevertheless, a surge like this could have a significant impact downstream. The treatment plant designs must have significant backup systems and safety factors to account for these possibilities.

Recommended Change: Describe the potential impacts of temporary failures of the water treatment system and the effects of possible surges of poor quality water on the downstream fish habitat.

<u>EPA Response:</u> Temporary failures of water treatment systems are addressed in Chapter 8 of the revised assessment.

4.64 *Section 4, Page 4-35 and Appendix G*

Comment: These pages show the road and pipeline corridor on maps. The maps fail to point out that a portion of the road is already built, which is from Williamsport to Pile Bay, as shown on Figure 18.2.5 of the Northern Dynasty Minerals, Ltd. Report of 2011. Another smaller section near Pedro Bay is also in place.

Recommended Change: Revise these pages and maps to show those sections of road that are already built and describe the widths and stream crossings that are in place and may need upgrading.

<u>EPA Response:</u> The point of mapping the road route is to show the waters that could be affected by a road, pipelines, and associated spills. We understand that streams crossed by the road may already be affected, but this is not relevant to the purposes of the assessment. However, existing roads are shown in Figure 2-7 of the revised assessment.

4.65 *Section 4.4.1, Page 4-39*

Comment: In the first paragraph, the report discusses failure of the collection and treatment facility, and assumes a hydraulic conductivity for the permeable substrate for the upper 30 meters by using a value from the Pebble Limited Partnership's 2011 report. This value is two orders of magnitude lower than the value used in the mine pit seepage calculation (Box 4-2) despite representing a shallower layer of material that one would expect to have a similar (or even higher) hydraulic conductivity.

Recommended Change: The report should provide some clarification regarding the selected parameter value, and even consider providing flows based on a range of values given the apparent uncertainty regarding the actual site location and specific hydrogeologic conditions.

<u>EPA Response:</u> The mine pit seepage parameters were derived from borings located in the area of the mine pit. The geology and hydraulic permeability of the area near the TSF dam were developed from boring data reported by Ghaffari et al (2011) in the area of the dam. The tests on those borings showed hydraulic conductivities varying between 10^{-4} m/s and 10^{-8} m/s. We varied the hydraulic conductivity continuously between those limits from the surface to intact bedrock, yielding an effective equivalent hydraulic conductivity of 1.45×10^{-6} m/s.

4.66 *Section 4.4.2, Page 4-39*

Comment: EPA states, "A tailings dam failures occurs when a tailings dam loses its structural integrity and releases tailings material from the impoundment. The released tailings flow under the force of gravity as a fast-moving flood containing a dense mixture of solids and liquids, often with catastrophic results." EPA lists examples of such catastrophic failures in Box 4-4. EPA then describes failure mechanisms such as overtopping and slope instability and then discusses failure statistics. However, EPA fails to point out that the failure statistics as presented do not distinguish catastrophic failures from relatively inconsequential incidents, thus implying that the failure probabilities are applicable to the uncontrolled release of tailings or otherwise catastrophic failures.

EPA Response: See response to Comment 4.31.

4.67 *Section 4.4.2, Page 4-40*

Comment: EPA implies that because the tailings dam heights used in the mine scenario are very large, the impacts of a failure would be much greater than the historical failure record from much smaller dam failures. Box 4-4 lists four examples of tailings dam failures, including the 2008 flash pond failure at the Kingston Power Plant in Tennessee. All of the dams described are less than 30 meters high, and all have questionable design and operational histories. EPA fails to acknowledge that tailings dam failure statistics are biased by the failure incidents of such small dams, because there have been no catastrophic failures of large dams approaching the scale of the mine scenarios used in the Assessment.

EPA Response: A proposed dam and tailings storage facility constructed today would need to adhere to updated construction, operational, and maintenance standards into perpetuity. However, should a failure occur from such a large facility, the potential failure is expected to yield much larger discharge and sediment run-out results.

4.68 *Section 4.4.2.1, Page 4-40*

Comment: EPA describes causes of tailings dams failure such as overtopping, slope instability, earthquakes and foundation failures. However, such failures are highly dependent on a number of site and project specific factors such as available construction materials, foundation type, (bedrock vs. depositional soil) and hydrology and hydraulics design.

EPA Response: The purpose of the discussion was to provide the reader with information about possible modes of failure. No change required.

4.69 *Section 4.4.2.1, Page 4-44*

Comment: The Assessment indicates that overtopping is one of the leading causes of inactive tailings dam failures. However, this data is biased because the sample population includes a number of failures of dams with inadequate spillway designs. Any large or very large tailings dam in Alaska must be designed to accommodate the Probable Maximum Flood (PMF) during operations, and safely pass the PMF through a properly designed spillway in closure. Note that the PMF is a misnomer, in that there is no specific probability associated with the event since it represents the result of the most severe meteorological and hydrologic event that is reasonably possible at a given site. The argument that a large or very large tailings dam built in Alaska would be particularly susceptible to failure due to overtopping based on historical evidence of international tailings dam failure incidents is systematically flawed.

EPA Response: We agree that dams can be designed to safely accommodate a design flood and to safely pass a design flood flow. We also recognize that selection of the PMF is based on limited data and certain assumptions, and that over time climatic conditions can change. However, the analysis considered that no spillway was in place or

operational as the facility was still being raised (in-construction), or that the temporary spillway and water storage management were not adequate to accommodate a storm event. The assessment does not state that “a large or very large tailings dam built in Alaska would be particularly susceptible to failure due to overtopping”, only that it is one potential mode of failure. Despite the best intentions of designers, dams have failed due to design errors, construction errors, operational errors, material failures, and extreme environmental events.

4.70 *Section 4.4.2.1, Page 4-44*

Comment: In Table 4-7, EPA lists examples of earthquakes in Alaska ranging from a magnitude 3.0, located 122 km from the project, to the Great Alaska Earthquake of 1964, a magnitude 9.2 located 469 km from the project. The nearest earthquake listed is a magnitude 4.3, located 30km from the project. A note on the table states, “…earthquakes in the range of magnitudes 2.5 to 3.6 occur regularly in the Lake Clark area…)”. The earthquakes listed by EPA in relation to the Pebble deposit are technically insignificant. National guidelines for incident reporting for dams do not require reporting for earthquakes less than 5.0 within 24 km of the project site, or for earthquakes greater than 8.5 more than 102 km from the site.

<u>EPA Response:</u> These earthquakes provide the seismic context for the area of the mine facilities. No change required.

4.71 *Section 4.4.2.2, Page 4-45*

Comment: EPA references Chambers and Higman (2011) for tailings dam failure statistics (p. 4-45). Reviewers question the use of this reference as it is a literature summary drawing conclusions that do not appear to have been peer reviewed and is written by a non-profit advocacy organization. See:
http://www.csp2.org/reports/Long%20Term%20Risks%20of%20Tailings%20Dam%20Failure%20-%20Chambers%20&%20Higman%20Oct11.pdf

<u>EPA Response:</u> Chambers and Higman (2011) was cited as one of several available reviews of dam failures. We primarily relied on the ICOLD review for failure statistics and examples.

4.72 *Section 4.4.2.2, Page 4-45*

Comment: EPA states, “Low failure frequencies and incomplete datasets also make any meaningful correlations between the probability of failure and dam height or other characteristics questionable. Very few existing rockfill dams approach the size of the structures in our mine scenario, and none of these large dams have failed.” Nevertheless, EPA continues in their conjecture to presume that the tailings dam fail during both the operation and post-closure phases of the mine.

<u>EPA Response:</u> We do not presume that the tailings dam will fail, but we do describe the probability of such an event and its potential consequences, should it occur. No change required.

4.73 *Section 4.4.2.2, Page 4-45*

Comment: The EPA presents statistics on dam failures and gives an upper bound of one failure per approximately 2,000 mine years. However, the EPA fails to describe whether the respective failures had any adverse impact on the environment. For example, a slope stability type dam failure may be reported, but not necessarily have resulted in any adverse impact on the environment downstream of the dam.

EPA Response: The statistics analyzed in the assessment pertain to the probability of dam failure and not to the consequences of such failures, which of course depend on the site-specific environment, resources, population, and development downstream of the failed dams. Other parts of the assessment discuss the potentially impacted site-specific resources in the geographical area of the assessment.

The tailings dam failure scenarios and their probability of occurrence are based on design goals, and only corroborated at the upper end by the historical record. The consequences of some past failures are briefly summarized in Box 9-1, but the effects in those cases are not assumed to be predictive of those that would occur at a mine in the Bristol Bay watershed.

4.74 *Section 4.4.2.2, Page 4-46*

Comment: EPA states, "This analysis considers the effects of earthquakes based on a site-specific evaluation of seismicity in the area. Box 4-6 describes the selection of earthquake characteristics for design criteria." In fact, Box 4-6 describes earthquake design criteria in general terms such as the Operating Basis Earthquake (OBE) and the Maximum Design Earthquake (MDE), but cites Northern Dynasty for specific, proposed ground motions (NDM, 2006). This reference is not included in Chapter 9, Cited References. While Figure 4-11 shows a seismic activity map for southwestern Alaska, EPA has not conducted a presented a technically defensible, probabilistic or deterministic seismic study for the region.

EPA Response: The development of an independent probabilistic or deterministic seismic hazard assessment for the mine scenarios was beyond the scope of this assessment. The selection of earthquake characteristics for design criteria is based on probabilistic and deterministic analyses conducted by Northern Dynasty Minerals (Ghaffari et al. 2011). The revised assessment includes references for the ground motions included in Chapter 4 (Box 9-2 of the revised assessment).

4.75 *Section 4.4.2.2, Page 4-46*

Comment: EPA cites ADNR Guidelines for Cooperation with the Alaska Dam Safety Program (June, 2005) (ADNR Dam Safety Guidelines) and references therein to U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and Federal Energy Regulatory Commission guidelines for designing water retaining dams to safety factors of 1.5 (for slope stability). Box 4-6, Selecting Earthquake Characteristics for Design Criteria, includes general descriptions of earthquake design criteria, and criticizes the ADNR dam safety guidelines as 'inconsistent with the expected conditions for a large porphyry copper mine developed in the Bristol Bay…" Section 13.2.2, Tailings Storage Facilities, of the ADNR Dam Safety Guidelines specifically states, "Complete guidance on tailings dam design and closure is beyond the scope of this document…tailings dams represents certain challenges that require professionals with significant relevant experience." EPA leans heavily on the 1.5 safety factor for estimating failure probabilities and references (Silva, et al. 2008). However, unlike the Assessment, Silva presents a balanced discussion on risk for a mine project, and other engineering features such as dams.

<u>EPA Response:</u> We acknowledge that the assessment cites ADNR guidelines, but disagree with the characterization that the assessment "criticizes" the ADNR dam safety guidelines. The design life for the TSF may be much longer than the return period normally considered appropriate for selecting the MDE for a Class II dam. The comment mentions the safety factor of 1.5 but it is unclear whether the comment is suggesting that a higher or lower safety factor would be appropriate. We agree that Silva et al. (2008) presents a balanced discussion on risk.

4.76 *Section 4.4.2.2, Page 4-47*

Comment: EPA uses curves from Figure 1 of Silva et al, 2008 to convert the factor of safety associated with the mine scenario tailings dam to an annual probability of failure (p. 4-47). The scope of Silva's paper is broad and is intended for a wide range of potential geotechnical applications. The four categories of "Level of engineering" included in the Assessment are abbreviations of the more detailed Table 1 included in the referenced paper. A review of Table 1 indicates that the Class II (Above Average) category is reserved for "above average" geotechnical works in a general sense. For example, Class II structures do not require an investigation of site geologic history, design peer review, full time supervision by a qualified engineer during construction or implementation of a performance program during operation, all of which would be required of any new tailings dam constructed in Alaska. The EPA assumes that the mine scenario tailings dam will be between a Class II and Class I structure and chooses to use the annual probability of failure associated with Class II structures (10^{-4} with a FOS of 1.5) for comparison with high historical tailings dam failure rates. Based on Silva's definition, a new large or very large tailings dam constructed in Alaska would almost certainly fall into category 1 (Best). The corresponding annual probability of failure of a Class I structure with a FOS of 1.5 is 10^{-6}.

<u>EPA Response:</u> The original draft of the assessment (p. 4-47) says "Combining the required factor of safety with the correlations between slope failure probability and factor of safety (Figure 4-12) derived from Silva et al. (2008) yields an expected annual probability of slope failure between 0.000001 and 0.0001." This comment suggests that regulators would "almost certainly" require the level of design, construction, operation, and monitoring for Category I structures as detailed in Table 1 of Silva et al. (2008). Requiring this level of engineering would, as explained in the assessment, be expected to lower the probability of failure.

4.77 *Section 4.4.2.2, Page 4-47*

Comment: The likelihood has been estimated, substantially, from the historic records of dam failures that have been recorded in the years 1960 to 2010. Many of the dams that are included in this failure record were constructed in periods prior to current engineering and oversight. The ability to perform effective analyses must precede the practice of performing such analyses and if we look to when a) the capability and b) the practice of analyses of very important aspects of dam design were developed, we can see that many dams that have failed were not designed with adequate design methods. The flowing times are when the technology and practice became common for critical elements of tailings dam design in North America:

- Slope stability analyses 1960's
- Seepage and drainage analyses 1970's
- Seismicity, foundation soils and tailings liquefaction, and dynamic analyses 1970's and 80's
- Modeling tools for deformation (FLAC, PLAXIS) Post 1980's
- Design for Closure and Closure management (not just abandonment) has only been a substantive requirement since the 1990's.
- In areas other than North America, these technologies and the regulatory oversight and corporate governance that today control the security of dam construction were not applied till substantially later.
- Thus many of the dams, indeed the vast majority, included in the failure statistics did not include the design, specifications and construction and operation supervision that would be required today for a major tailings dam constructed in Bristol Bay.
- The site investigation, construction material characterization, design effort and construction supervision that is applied to smaller, lower hazard dams are vastly less than are applied to very large high hazard dams. The engineering man-hours that would be devoted to the investigation, design and construction supervision for the 'very large dam' that has been assumed for the MS would be many times (orders of magnitude) greater than that applied to the smaller dams of several decades ago.
- The likelihood of failure of a large dam constructed with the current technology, regulatory control and corporate governance, that would be applicable at Bristol Bay, would be grossly overestimated by the likelihood ranges derived from historic failures.

<u>EPA Response:</u> We agree that the failure probability of a dam designed to current engineering and regulatory standards would be lower than the historical average, and acknowledged this throughout the assessment. For example, the original draft assessment (p. ES-18) says "Some studies suggest that improved design, construction, and monitoring practices can reduce the failure rate by an order of magnitude or more" and "An assessment of the correlation of dam failure probabilities with safety factors against slope instability suggests an annual probability of failure of 1 in 1,000,000 for Category I Facilities (those designed, built, and operated with state-of-the-practice engineering)." We have added text to the revised assessment to reinforce that historical frequencies of tailings dam failures represent an upper bound on the failure probability of a modern tailings dam.

4.78 *Section 4.4.2.2, Page 4-47*

Comment: Dam failure probabilities based on existing and anecdotal information shows a wide range (several orders of magnitude) difference in probability of failure.

Recommended Change: Considering the potential risks involved, the dam failure study should include a site specific dam failure analysis. A stochastic, risk based modeling approach is needed to address risk and uncertainty and incorporating sensitivity analyses of seismicity, soil strength and hydraulic conductivity properties, inflow hydrology, dam breach sizes, hydraulic and sediment transport downstream modeling. The analysis will refine probabilities and estimates of dam failure scenarios and reduce the uncertainty in dam failure orders of magnitude difference in estimated failure probabilities.

EPA Response: Comment noted. It is unclear if this comment recommends that a "stochastic, risk based modeling approach" as described should be a requirement for permitting a large tailings dam in the Bristol Bay watershed "[c]onsidering the potential risks involved."

4.79 *Section 4.4.2.2, Page 4-47*

Comment: Hydraulic modeling of downstream areas from dam failure and overtopping was performed as described in Box 4-8. The approach analyzes a probable maximum flood (PMF) inflow using Hydrologic Engineering Center's (HEC) -1 for hydrologic modeling. Downstream rivers and streams were modeled using HEC-River Analysis System (HEC-RAS). The methods section does not describe specifically how dam breach size estimates were determined, and how the downstream sediment transport analyses were performed.

Recommended Change: The report should include information about what methods were used to analyze the dam breach size and flow conditions, and the associated sediment transport analyses. Empirical methods applied should be specified, such as those outlined in Prediction of Dam Breach Parameters, USBR 1998, and/or use of dam-break software to estimate breach sizes. This is important as the breach size; reservoir and tailings stages will highly influence the flood hydrograph. The sediment transport data collection and modeling work should be expanded in support of the study (both spatially and identifying / specifying the type of model being used). If not already being used, a mobile bed sediment transport and sediment routing model will likely be necessary to understand dam breach, sediment transport conditions and spatial extents of tailings deposition extents to any degree of certainty. Once the sediment deposition areas have been established, then downstream water quality impact assessments could be updated and refined. Dam break sedimentation impact areas could also be directly overlaid with existing fish habitat areas using GIS. The use of this type of model was likely beyond the scope and means of the initial assessment. However, it will be important to understand, characterize and quantify impacts (sediment and water quality), as well as to communicate risks and impacts to a broad audience regarding the potential catastrophic impacts to fisheries resources from a tailings dam break scenario.

EPA Response: It is unclear if this comment recommends that sediment transport, sediment routing, and sediment deposition analyses, together with GIS overlays of fish habitat as described, should be a requirement for permitting a large tailings dam in the Bristol Bay watershed because "a mobile bed sediment transport and sediment routing model will likely be necessary to understand dam breach, sediment transport conditions and spatial extents of tailings deposition extents to any degree of certainty" and "it will be important to understand, characterize and quantify impacts (sediment and water quality), as well as to communicate risks and impacts to a broad audience regarding the

potential catastrophic impacts to fisheries resources from a tailings dam break scenario."

A complete evaluation of a potential tailings dam failure was outside the scope of this assessment. Thus, we used a simplified approach to understand the potential magnitude of the floodwave and associated sediment distribution if the tailings dam were breached and tailings were rapidly released. Additional analyses should be completed to determine ultimate sediment transport and distribution for a variety of scenarios at the time an actual TSF is designed and proposed.

4.80 *Section 4.4.2.2, Page 4-48*

Comment: In Box 4-6, EPA suggests that an earthquake return period of 2500 years may be too short for a tailings dam that could have a life expectancy of 10,000 years after operations cease. The design earthquakes that Northern Dynasty proposed seems reasonable, based on the information presented, but the accelerations used for design must be coupled with details for the structures setting. For earthquakes return periods greater than 2500 years, the design earthquake can be set so high that, should it occur, rivers and streams may be naturally destroyed while the dam itself would be unaffected.

<u>EPA Response:</u> Comment noted; no change required.

4.81 *Section 4, Page 4-48*

Comment: This page states that the maximum credible earthquake (MCE) of 7.8 was used to determine a maximum ground acceleration of 0.44g to 0.48g, which was used in the stability calculations of the dam. The Knight Piesold Report in 2006 titled "Pebble Project Tailings Impoundment A – Initial Application Report" shows an MCE of 7.8 producing a maximum bedrock acceleration of 0.30.

Recommended Change: Correct or explain the rationale for the discrepancy.

<u>EPA Response:</u> The text has been revised to more accurately describe the seismic design values used (Box 9-2 of the revised assessment). The initial application (NDM 2006) proposed an MCE of 7.8, producing a maximum bedrock acceleration of 0.30 g, whereas the design described in Ghaffari et al. (2011) determined a maximum credible ground acceleration of 0.44 to 0.47 g would be used for design.

4.82 *Section 4.4.4, Page 4-63*

Comment: The narrative does not recognize BMP of culvert designs, particularly in anadromous stream crossings. Besides the discussion regarding bridges versus culvert crossings, any culvert crossing would be designed to accommodate fish passage except at times of extreme flooding when fish passage through ordinary stream channels may be impeded as well. The evolution of culvert design has greatly advanced in the last 20 years or more.

<u>EPA Response:</u> The potential for blocked or reduced fish passage and reduction of habitat exists even under an assumption of best management practices (BMPs) and daily maintenance inspections. Our estimates of risk take into account the use of BMPs or other mitigation measures that are discussed in text boxes throughout Chapter 10 of

the revised assessment. Although culverts are designed to certain specifications (Box 10-2), they are not always installed correctly or do not stand up to the rigors of a harsh environment. This is reflected in the failure frequencies cited in the revised assessment.

The assessment assumes that the transportation corridor would receive daily inspection and maintenance during the operation of the mine. Under such surveillance, a single erosional failure of a culvert that damaged the road would likely be identified soon after it occurred and temporary repairs would be made to protect the road and possibly provide fish passage. However, long-term fixes may not be possible until conditions are suitable to replace a culvert or bridge crossing. After mine operations end, traffic would be reduced to that which is necessary to maintain any residual operations on the site, and inspections and maintenance would likely decrease.

S. Wehmeyer (Doc. #3486)

4.83 In section 4.3.2 the draft Assessment notes that if Pebble were "fully mined … may exceed 11 billion metric tons of ore…" The 11Bt noted by Ghaffari and used here by the EPA is the total resource – not the mineable, economic reserve.

EPA Response: See response to Comment 4.37.

4.84 Suggest that low tonnage deposits are low grade as well (table 4.1), revealing unfamiliarity with porphyry projects globally.

EPA Response: This table was adapted from a USGS publication on porphyry copper deposits of the world (Singer et al. 2008), and we trust the USGS as a source of this information. No change required.

4.85 The authors have an obvious lack of exposure to the mining industry in general, and to Alaska specifically. For instance, Table 4.4 includes a flow chart suggesting a ball mill process after concentrate has been created – a process which makes no sense [note: reference to Table 4.4 should be Figure 4.4].

EPA Response: The use of these terms is appropriate, and they are used in Ghaffari et al. (2011) and other existing mining plans and documents. The concentrate mentioned is not the final product concentrate. However, the figure (Figure 4-3 in the revised assessment) has been clarified to show the material going into the regrind ball mill is the rougher concentrate and the product from it is the milled concentrate.

4.86 Example tailings dam height (Figure ES-8) is compared to St. Louis Gateway Arch and the Washington Monument. Using familiar landmarks for comparison of height is understandable but comparison of a dam to these structures is not reasonable. The Hoover dam would be a better comparison in terms of structure type (dam) and height (221 m) but would still be inappropriate as it is not an embankment dam. Similarly a landform such as a local hill or mountain would be more appropriate than the examples selected in the EPA document.

EPA Response: Our intention with this figure is to give a point of reference that the public would understand. No change required.

4.87 The hypothetical mine scenario used in the draft Assessment wouldn't be permitted under existing standards.

EPA Response: **As described by Northern Dynasty Minerals (in Ghaffari et al. 2011), the scenarios represent a "permittable" mine plan that could be submitted by a mining company. No change required.**

4.88 No exposure to or design input from AK industrial developers. For instance, in section 4.2.3 (page 4-11) the author states that geomembrane technology has not been available long enough to predict service life, based on personal communications with a single geomembrane supplier and a modified bitumen roofing supplier. Significant data on geomembrane service life are almost certainly available from mining and other industry and governmental sources. Geomembrane/geotextile materials have been widely used in mining for well over 30 years, and are key components of virtually all hazardous and radioactive waste landfill designs in the US. In the latter application, detailed studies are normally required to predict facility performance over the long term.

EPA Response: **This section (Section 4.2.3 of the revised assessment) has been revised to reflect published laboratory studies and documentation from liners at landfills.**

4.89 The draft Assessment provides contradictory and conflicting information. For instance, Box 4-3 describes local faults and the known activity on those faults, and later describes the uncertainty in identifying fault locations and interpreting the frequency and distribution of earthquakes. Box 4-5 (paragraph 3) discusses earthquake effects, but notes that "Such displacement is not likely to occur in the Bristol Bay watershed because of the absence of large faults, but there is a potential for a small amount of ground spreading and cracking from larger earthquakes". This would seem to contradict with the final paragraph in Box 4-3, which emphasizes that there is a significant amount of uncertainty around predicting seismic activity in the Bristol Bay area.

EPA Response: **We disagree. All of these statements demonstrate the high degree of uncertainty that exists when trying to predict earthquakes, particularly in an area that is poorly studied. Section 3.6 of the revised assessment indicates that there is a potential for seismic hazard in the Pebble area. These seismic hazards are one of the potential causes for tailings dam failures described in Section 9.1.**

4.90 Section 4.4.3.1 assumes a 98% failure rate of pipelines associated with mining in the study area, and assumes that the total volume of the product with in a pipe would flow to ground in a failure scenario. This is unrealistic, as flow rates reduce during shut downs, reducing the volume spilled.

EPA Response: **The assessment does not assume "that the total volume of product within a pipe would flow to ground in a future scenario." Rather, the volume in a pipe between the point of failure and the nearest upstream valve would drain. The flow rate due to gravity following a failure is actually estimated to be greater than the relatively low pumped flow rate specified by Northern Dynasty Minerals (Ghaffari et al 2011). In the revised assessment, we have refined the analysis by considering local high points in topography at specific stream crossings and significantly reducing the length of free draining pipe (see Chapter 11).**

4.91 Box 4-4 presents four examples of catastrophic tailings dam and impoundment facility bank failures. None of these Case Histories are relevant to the regulatory requirements or construction techniques that would be expected for potential development at Pebble.

EPA Response: A risk assessment must consider the history of failures and cannot ignore the fact that tailings dams have failed. The case histories are presented to inform the reader of potential implications of a significant tailings release, not the likelihood of a significant release. The assessment states that differences in design are likely to reduce risk.

4.92 2/3 of report focuses on tailings facility failures, however, section 4.4.2 notes how few tailings facilities that may be similar to Pebble's have ever actually failed.

EPA Response: The comment is correct, but the assessment also notes that tailings facilities similar to those in the scenarios are rare and have been operating for a relatively short time. The assessment allocates substantial discussion to tailings dam failures, in spite of their low probability, because of the high degree environmental hazard posed. However, the revised assessment now considers other failures in expanded detail as well (see Chapters 8 through 11).

4.93 The draft Assessment in part utilized sources with a known bias on projects in the study area. Claims by many of these sources have been found in Alaska courts to be unsubstantiated, and in one case claims by a cited source are refuted by other agency sources in Box 4-3 of the draft Assessment.

EPA Response: This comment is not supported by specific instances of bias that would allow a substantive response. Despite this, it should be noted that in developing the assessment we have generally limited information sources to peer reviewed, published scientific, industry and government publications. However, we used a limited amount of information from sources such as the Pebble Limited Partnership's Environmental Baseline Document and non-governmental organizations. Before including information from non-governmental organizations into the assessment, it was subjected to independent peer review. In all cases, this information is provided as supporting information only and it does not affect the assessment's conclusions. We are confident that we used the information in a context that is appropriate and reliable.

The Pebble Limited Partnership (Doc. #4962)

4.94 4.2.3 Tailings Storage: 4-1 1 A dam designed as a hybrid upstream/centerline was recently constructed at the Fort Knox Mine tailings impoundment near Fairbanks, Alaska. The downstream method is considered more stable, but it is also the most expensive option. Centerline construction is a hybrid of upstream and downstream methods and has risks and costs lying between them (Martin et al. 2002).

The above statement is not from Martin et al. (2002) who states that "centerline and downstream constructed tailings dams are generally considered to be more robust than upstream tailings dams" but from Chambers and Higman (2011), who state that "centerline construction is a hybrid of downstream type dam construction, and from a seismic stability standpoint the risk is lies between that of centerline and upstream types". The reference is correctly cited but incorrectly quoted in appendix I.

<u>EPA Response:</u> **The statement about the Fort Knox Mine was based on personal knowledge of one of the assessment authors and therefore did not need a citation, but a reference to the authorizing Army Corps of Engineers Clean Water Act Section 404 permit has been added. The second line is a restatement from Martin et al. (2002), not a quote. Neither statement cites or quotes Chambers and Higman (2011).**

In Appendix I, this sentence did have an error (in the use of the term "two" without reference to a second type), which has been corrected in the revised assessment.

4.95 The Assessment is based on a hypothetical project, rather than an assessment of the watershed. The Assessment evaluated a hypothetical project with minimal mitigation of potential project effects. Therefore, the hypothetical project evaluated in this document is not simply a worse-case scenario; it is a very unrealistic scenario - a mining operation scenario that has not been permitted in the United States since late in the 19^{th} or very early in the 20^{th} century. Without engineering design and site-specific data, there is no technical way to accurately predict physical and chemical changes that could result in the natural systems. As a result, the Assessment is flawed and unusable.

<u>EPA Response:</u> **We disagree. The mine scenarios described in the assessment are based on descriptions published by Northern Dynasty Minerals (a Pebble Limited Partnership partner) in Ghaffari et al. (2011). Ghaffari et al. (2011) described the scenarios as permittable. The scenarios include the primary features of a mine such as an open pit, a tailings impoundment and a waste rock pile surrounding the open pit. They assume that the details of construction and operation would comply with modern conventional mining practices and the mines would be operated in a responsible fashion. The assessment then evaluates the environmental consequences of failure in any of these systems. Because we assume that modern conventional standards and practices would be used, the details of operation are not significant for the purposes of the assessment—only the consequences of failure are relevant.**

<u>G. A. Beischer (Doc. #4372)</u>

4.96 The authors have an obvious lack of exposure to the mining industry in general, and to Alaska specifically. For instance, Table 4.4 includes a flow chart suggesting a ball mill process after concentrate has been created **–** a process which makes no sense [note: reference to Table 4.4 should be Figure 4.4].

<u>EPA Response:</u> **See response to Comment 4.85.**

4.97 No exposure to or design input from AK industrial developers. For instance, in section 4.2.3 (page 4-11) the author states that geomembrane technology has not been available long enough to predict service life, based on personal communications with a single geombrane supplier and a modified bitumen roofing supplier. Significant data on geomembrane service life are almost certainly available from mining and other industry and governmental sources. Geomembrane/geotextile materials have been widely used in mining for well over 30 years, and are key components of virtually all hazardous and radioactive waste landfill designs in the US. In the latter application, detailed studies are normally required to predict facility performance over the long term.

<u>EPA Response:</u> See response to Comment 4.88.

4.98 In section 4.3.2 the draft Assessment notes that if Pebble were "fully mined … may exceed 11 billion metric tons of ore…". The 11Bt noted by Ghaffari and used here by the EPA is the total resource – not the mineable, economic reserve. This seems to be an intentional inflammatory statement designed to alarm, and reveals the Authors unfamiliarity with the mining industry.

I would further point out that if a public mining company were to report in a public document that it had 11 billion metric tons of ore, it would be subject to serious ramifications from stock exchange regulators. The EPA authors clearly do not have strong knowledge of the difference between a resource and a reserve.

<u>EPA Response:</u> See response to Comment 4.37.

4.99 The draft Assessment in part utilized sources with a known bias on projects in the study area. Claims by many of these sources have been found in Alaska courts to be unsubstantiated, and in one case claims by a cited source are refuted by other agency sources in Box 4-3 of the draft Assessment.

<u>EPA Response:</u> See response to Comment 4.93.

4.100 The draft Assessment provides contradictory and conflicting information. For instance, Box 4-3 describes local faults and the known activity on those faults, and later describes the uncertainty in identifying fault locations and interpreting the frequency and distribution of earthquakes. Box 4-5 (paragraph 3) discusses earthquake effects, but notes that "Such displacement is not likely to occur in the Bristol Bay watershed because of the absence of large faults, but there is a potential for a small amount of ground spreading and cracking from larger earthquakes". This would seem to contradict with the final paragraph in Box 4-3, which emphasizes that there is a significant amount of uncertainty around predicting seismic activity in the Bristol Bay area.

<u>EPA Response:</u> See response to Comment 4.89.

4.101 Section 4.4.3.1 assumes a 98% failure rate of pipelines associated with mining in the study area, and assumes that the total volume of the product with in a pipe would flow to ground in a failure scenario. This is unrealistic, as flowrates reduce during shut downs, reducing the volume spilled.

<u>EPA Response:</u> See response to Comment 4.90.

4.102 Box 4-4 presents four examples of catastrophic tailings dam and impoundment facility bank failures. None of these Case Histories are relevant to the regulatory requirements or construction techniques that would be expected for potential development at Pebble.

<u>EPA Response:</u> See response to Comment 4.91.

4.103 2/3 of report focuses on tailings facility failures, however, section 4.4.2 notes how few tailings facilities that may be similar to Pebble's have ever actually failed.

<u>EPA Response:</u> See response to Comment 4.92.

<u>National Park Service and U.S. Geological Survey (Doc. #4607)</u>

4.104 Overall Scope: Though the intent of the Assessment is to address a typical mine scenario, its focus is on a single large mine. While the report makes some attempt at addressing cumulative impacts of multiple large mine projects, this scenario should be developed more fully, and should include scenarios of smaller developments on other claims in the area.

<u>EPA Response:</u> Discussion of the cumulative impacts of multiple mines has been expanded in Chapter 13 of the revised assessment.

4.105 Maximum Mine Scenario: The maximum mine scenario outlined in the Assessment mentions the likelihood of an underground component that would use block cave mining methods, but there is nothing in the Assessment document that addresses the risks and impacts associated with block caving at the proposed Pebble site. Considering the complex hydrology of the area, the report should discuss the potential impacts of block caving to surface and groundwater resources and whether an underground mining operation would require a de-watering system similar to the one described for an open pit. It should also identify monitoring and other issues unique to the underground component that should be considered after the mine is closed.

<u>EPA Response:</u> The mine size scenarios have been updated to three sizes in the revised assessment. For each of these scenarios, we have considered open-pit mining methods. We present underground mining issues qualitatively in Chapter 4 of the revised assessment and discuss that underground mining methods could be used for deeper portions of the deposit.

4.106 Section 4 and Appendix I: On water quality mitigation, refer to the non-acid generating versus acid-generating potential of overburden and waste rock as critical controls on mitigation practices for any proposed development. Yet this assessment does not document, present, cite or refer to any existing mineralogic or analytical geochemical data on material properties from the actual Nushagak or Kvichak watersheds.

<u>EPA Response:</u> Geochemical information for the site is presented in some detail in Appendix H of both the original and revised assessments. The assessment includes presentation of mitigation measures that allow water collection and treatment to meet water quality criteria. Data are discussed in Chapter 8 of the revised assessment and in Appendix H, and geological information is presented in Chapter 3. The discussion of acid-generation and non-acid generation was a general discussion that has been moved to Chapter 4 in the revised assessment, with scenario-specific information provided in Chapter 6 in the revised assessment.

4.107 Pages 4-38, second full paragraph, line 7: The report states, the USGS has concluded there is no evidence for movement on the Lake Clark Fault “in the past 1.8 million years.” The USGS has never taken the position as stated in the report. The text in quotes should be replaced with “since the last glaciation around 11,000 to 13,000 years ago.”

<u>EPA Response:</u> Text has been corrected in the revised assessment (see Section 3.6).

4.108 Pages 4-48, Box 4-6: From a geological and hazards perspective, the tailings dam should be designed to withstand shaking from the “Maximum Credible Earthquake” or MCE. The mine will be in operation a relatively short period of time, but the tailings dam will be there in perpetuity. If the regulatory desire is for contaminants to not escape the tailings dam, the seismic hazard will exist as long as the dam is in place. A related issue is that the MCE is established by consensus of knowledgeable scientists. This MCE is also subject to interpretation and it would be appropriate for the EPA to include the best earthquake scientists in this decision making process. A related topic is whether the EPA needs to have a concrete or legal definition of an active fault. In California, the legal definition is one that has been active or shows movement in the last 10,000 years. Although perhaps an arbitrary figure, in many regions of Alaska we can determine if a fault has moved since the last glaciation, which is slightly longer than 10,000 years. For this report, we suggest that an active fault be defined as, “one that has moved in either the last 10,000 years or since the last glacial maximum around 11,000 to 13,000 years ago, whichever time frame is more practical to determine.”

EPA Response: The design criteria used in the assessment were based on analyses presented in Ghaffari et al. (2011). It is beyond the scope of this assessment to develop independent seismic design criteria for the tailings dam, or to re-evaluate definitions used for design criteria.

4.109 Page 4-48, Box 4-6, bottom paragraph: The ground accelerations listed during various magnitude earthquakes are likely global averages for earthquakes of a given magnitude; however, there are common examples of ground accelerations exceeding such values. For example, the relatively small 1994 Northridge earthquake in the Los Angeles area had a moment magnitude of 6.7, but ground accelerations measured 1.7g. Design criterion should take into account the possibility of high ground accelerations that exceed average accelerations for a facility that needs to remain intact in perpetuity. In addition, the source of the listed ground accelerations should be cited.

EPA Response: The design criteria used in the assessment were based on analyses presented in Ghaffari et al. (2011). The reference for the ground accelerations (Ghaffari et al. 2011) is included in the revised assessment (Box 9-2).

4.110 Page 4-38, line 5, “length of the fault”: The size of an earthquake is directly related to the area of the fault that ruptures not just the length of the fault. This should be clarified in the report.

EPA Response: The text has been changed to more accurately describe the relationship of earthquake size to rupture area.

4.111 Page 4-38, line 9 and following to the end of the paragraph: These are the largest strike slip fault systems in the region, but not all of them are known to be seismically active; it is implied that they are. The Border Ranges Fault, the Lake Clark fault, the Iditarod-Nixon Fork faults are not known to be active. This should be clarified in the report.

EPA Response: The comment is correct that not all of the faults, or all sections of the faults, are seismically active. Text in the revised assessment has been changed to more accurately describe the seismic activity of the faults (Section 3.6).

4.112 Page 4-38, paragraph 3: This discussion about the location of the Lake Clark fault is irrelevant if the Lake Clark fault is not active. Right now, there is no evidence for activity. Note, additional work could be done to assess if the fault is active, such as looking for the fault using airborne LIDAR, and looking for the fault beneath Lake Clark with multibeam bathymetry and seismic profiling.

EPA Response: Current evidence indicates that the Lake Clark fault is not active, but there is some uncertainty in seismic hazard determination of the Pebble deposit area. Thus, discussion of the location of the Lake Clark fault is appropriate in this context.

4.113 Page 4-39 last sentence: Geologic studies can also provide information on the rate of fault movement as well. Please include this in the list. It is important for seismic hazards as to whether faults are moving quickly or slowly. Also we suggest deleting "many" before "uncertainties" at the end of the sentence.

EPA Response: References to additional studies have been removed from this section (Section 3.6 of the revised assessment). The sentence referred to in this comment no longer appears in the revised assessment.

4.114 Page 4-43, Box 4-5, second to the last paragraph: This earthquake is known as the "Denali Fault earthquake," not the "Denali earthquake" as written. This should be corrected in the report.

EPA Response: References to the Denali Fault Earthquake of 2002 have been removed from this section.

4.115 Page 4-44, Table 4-7: The depth of these earthquakes, not just distance, is also very important. Depth should to be added to the table. We recommend the use of appropriate labels with the type of earthquake e.g., 1964 - megathrust earthquake; 2002 - Denali fault earthquake; 1985 - crustal earthquake or Benioff zone earthquake.

EPA Response: We agree that epicentral depth is an important factor in understanding seismic hazards. This table (Table 3-5 in the revised assessment) has been modified to include the depth of the epicenter of the earthquakes. No changes have been made to label the type of earthquake mechanism.

4.116 Page 4-44, last sentence: The term "overtopping" of what is not clear. It may be important as to the overall effect of earthquakes. This should be clarified in the report.

EPA Response: "Overtopping" is defined in Section 9.1.1 of the revised assessment, and refers to water levels exceeding the crest height of a dam and the water flowing over the top of the dam.

Curyung Tribal Council (Doc. #4821)

4.117 Secondly, when looking at the operations of your mining scenario(s), it would be helpful to include seasonal differences, such as dewatering and fugitive dust. There would be drastic differences in water tables in the summer/fall versus winter/spring as well as fugitive dust from the pit.

<u>EPA Response:</u> We assume that water storage capacity under the mine scenarios presents wide latitude to buffer seasonal flow fluctuations, so the water balance considers annual averages only. Also see response to Comment 3.44.

<u>G. Y. Parker (Doc. #4115)</u>

4.118 The assessment discusses fugitive dust only as it relates to roads. However, fugitive dust from mining operations can be a source of sulfuric acid mine drainage. A Pebble mine could have tens of thousands of explosions per year in an open pit, so the dust issue seems significant. It appears on the flow chart for impacts related to mining operations (Figure 3-2B), but it is not addressed in the text. If the matter is addressed, EPA should address it in the context of certainty versus uncertainty regarding both operations and effects. Finally, to a lay person like me, dust suppression may be feasible with respect to dust from roads, but dust suppression seems infeasible with respect to blasting in an open pit. So I think EPA needs to add text to address dust from blasting in an open pit.

<u>EPA Response:</u> See response to Comment 3.44. The revised assessment also mentions that stormwater runoff from the mine site would lead to an increase in metals.

<u>Bristol Bay Native Corporation (Doc. #4145, #4382, and #5449)</u>

4.119 The BBWA does not adequately address the difficulty (risks) of actually implementing a mine design that could practicably collect and treat mining wastewater to meet water quality standards at the point of discharge, particularly the quantities of water that will be necessary for a largescale hardrock mine to operate in the “no failure” mode within the Bristol Bay watershed. If such a design is not practicable for the short-term or long-term treatment of water, EPA’s “nofailure” scenario is rendered meaningless. Accordingly, EPA should at least offer examples of large-scale hardrock mining operations that have successfully treated and discharged similar volumes of wastewater.

<u>EPA Response:</u> We recognize that all engineered systems have an inherent, small but acceptable failure rate. The intent in offering a “no-failure” scenario was to identify and evaluate the unavoidable environmental effects of only the mine footprint. The revised assessment no longer uses the term “no-failure”, but instead presents effects resulting from the mine footprints (Chapter 7 of the revised assessment), from potential failures having higher probability and lesser magnitude (e.g., failure to collect and treat leachate water, in Chapter 8 of the revised assessment), and from potential failures having lower probability and higher magnitude (e.g., tailings dam failure, in Chapter 9 of the revised assessment).

4.120 In addition to summarizing information about mineral deposits in the Nushagak and Kvichak River watersheds, this chapter provides estimates of the surface area that would be covered by a 25-year mine at the Pebble Deposit, including the mine pit, waste rock disposal areas, and a tailings storage facility (TSF1) in an unnamed drainage that is tributary to the North Fork Koktuli River. These hypothetical footprints are taken directly from Wardrop (2011). EPA estimates the mine pit to cover 1,358 acres, adjacent waste rock disposal areas to cover approximately 3,286 acres, and TSF1 to have a surface area of approximately 3,686 acres, 4 or a total footprint of 8,330 acres. Whereas it is safe to assume that all habitat (wetland, aquatic, and upland) would be destroyed within this footprint, these estimates appear to be substantially low.

<u>EPA Response:</u> **Our total footprint includes estimates for the mill area, laydown areas, a diesel and truck shop areas, the camp, a tank farm, ore stockpile areas, the crushing and screening plant, the road and pipeline corridor between the mill and the TSF, and an allowance for other small disturbed areas. Depending on the particular analysis, we also include the area around the mine pit dewatered by the mine pit drawdown. The total footprint for the Pebble 2.0 scenario (the 25-year mine), including the drawdown area but not including the transportation corridor to Cook Inlet, equals 11,300 acres. We based our estimates on the data available, and they are reasonable estimates for these mine scenarios. For estimates of stream and wetland coverage, we used the best known and up-to-date data that were publicly available. We reference in Box 7-1 that these estimates are likely a lower bound and support revision upon availability of higher resolution datasets.**

4.121 EPA relies on engineering drawings of these mining features as shown in Wardrop (2011); Huffman-Broadway, Inc. made GIS measurements of these features that suggest the actual impacts may be substantially greater (approximately 9,400 acres), particularly if the strip of land between the mine pit and the surrounding waste rock disposal area is included, as well as a seepage cut-off area that abuts the waste rock disposal area. Inasmuch as EPA's estimated 25- year Pebble mine footprint appears to be more than 1,000 acres too low, its estimates of direct losses of habitat will also be correspondingly low.

<u>EPA Response:</u> **See response to Comment 4.120. We believe our estimates are reasonable approximations of losses under the mine scenarios considered. However, we agree that impacts would be commensurately larger if mine footprints are larger.**

4.122 The EPA should describe any mine, preferably a copper-porphyry mine, that is currently able to treat waste streams of the magnitude described in the water balance (Table 4-5, p. 4-30) to meet low hardness-based metals criteria end-of-pipe (i.e., no dilution). Every major mine in Alaska currently operates with some sort of mixing zone to provide much needed dilution in order to comply with the applicable State of Alaska Water Quality Criteria (WQC). Yet the wastewater streams at these other Alaska mines are a mere fraction of what would be expected for a project of Pebble's magnitude (see Table 1, Riley and Yocom, 2011).

<u>EPA Response:</u> **The no-failure scenario was meant to show impacts based on a mine operating as designed without any accidents or failures, so we assumed all water was managed properly and treated to the required levels for discharge (although we did acknowledge that there could be seepage that was not captured). Outside of the no-failure scenario, the magnitude of water is an issue that multiple treatment plants operating in parallel could handle. The quality of the effluent is another matter. We have no examples of mines in Alaska that directly meet water quality-based effluent limitations at the discharge point. Of the mines in Alaska, Greens Creek Mine is the only mine with an authorized mixing zone for metals (into marine waters). The Red Dog Mine has an authorized mixing zone for total dissolved solids, ammonia, and cyanide. The Pogo Mine utilizes flow augmentation to avoid a mixing zone in a river that supports salmon spawning. The Kensington Mine is uniquely permitted allowing the**

dilution of the Army Corps of Engineer's designated disposal site and treatment prior to having to meet end-of-pipe water quality-based effluent limitations. An example of a large copper porphyry mine is Kennecott Utah Copper, LLC (Bingham Canyon), but that is also a unique situation where the majority of discharges are to the Great Salt Lake, which is not subject to the hardness-based freshwater standards.

4.123 It is somewhat alarming to find in such a professionally crafted and scientifically-based document no reference whatsoever for mean net annual precipitation, the hydrologic "driver" for all site water management and starting point for a credible water balance. The EPA "estimated" a mean net annual precipitation (MNAP) of 803 mm (31.61 inches/year) for the mine site and 804 mm (31.65 inches/year) for the tailings storage facilities (Box 4-2, p. 28). The Environmental Baseline Document (EBD) prepared by the Pebble Limited Partnership (PLP, 2012) calculated MNAP for all 15 sub-basins within the watershed in order to reconcile observed stream flows and runoff with precipitation data collected at several met stations in the project area. The authors of the EBD assume that precipitation data was under-represented due to wind interference with the gages. MNAP for the TSF 1 site was calculated to be 45.7 inches/year, nearly 50% higher than the 31.65 inches/year estimated by EPA in the DBBWA. When considering the minimum 4,000 acre (TSF 1) to the maximum 12,000 acre (TSF 1,2 and 3) footprint for the higher elevation tailings storage facilities, this difference in MNAP indicates that the water balance as shown in Table 4-5 significantly underestimates the minimum and maximum wastewater treatment requirements.

<u>EPA Response:</u> The revised assessment used a uniform value of 860 mm/yr across the entire mine site. Because operation of the mine does not require all of the water that falls on the disturbed areas of the mine site, higher mean net annual precipitation would require the mine operator to treat and release more water to streams. Since the water consumed by mine operations would remain the same, it would equal a smaller percentage of the precipitation and would result in a smaller percentage reduction in streamflow than reported in the assessment.

4.124 Water treatment systems, including collection and conveyance structures, also need to be designed to handle anticipated peak flows. Accordingly, the water balance should be bracketed in terms of anticipated extreme wet years and extreme dry years. This is critical because water treatment systems, as well as the collection and conveyance systems that would deliver contaminated site water for treatment, must be adequately sized to accommodate these extreme flows. And the Final BBWA should address the feasibility, based on operating mines elsewhere and state-of-the-art wastewater treatment technologies, of properly collecting, conveying and treating wastewater streams of the magnitude depicted in the water balance to meet end-of-pipe low hardness-based metals WQC without relying on dilution.

<u>EPA Response:</u> Chapter 8 now considers wastewater treatment, including evaluation of potential risks associated with unforeseen events and accidents. Extreme flows are assumed to be temporarily stored for treatment, but failure mechanisms discussed in Section 8.1.2 include the possibility that storage may be inadequate, resulting in releases of untreated water.

4.125 During operation, per Table 4-5, the tailings are expected to consume 95% of all site water consumed, or approximately 35% of all site water captured. This seems high, as does the 46% pore space by volume within the consolidated tailings. Is there a reference available? Regardless, this pore volume will migrate over time into the colluvium and fractured bedrock underlying the tailings. The "no failure" scenario anticipates that seepage of tailings leachate will simply be captured in wells downstream of the tailings dam, sent to a treatment facility and discharged to a nearby stream. The assessment does not consider the site-specific and uncommonly porous nature of the surficial deposits and fractured bedrock in the project area, which helps explain the high connectivity between surface water and groundwater that plays an important role in sustaining high quality salmon habitat. Capturing leachate in each TSF without a fully lined impoundment, as envisioned in the no failure scenario, ignores the hydraulic conductivity data from site TSF 1 (e.g., piezometer GH08-170) and other information presented in the PLP EBD documents which place in serious doubt the ability of a conventional, unlined tailings impoundment to capture toxic tailings leachate before it enters the local groundwater system.

EPA Response: Consideration of the mine scenario footprints (Chapter 7 of the revised assessment) is intended to provide a lower bound estimate of the reasonably foreseeable impacts for each mine scenario; it is not intended to predict or estimate the expected impacts of an actual mine in operation. The impacts of an actual mine would be expected to be greater than the lower bound estimate, with the significance of the greater impacts dependent on the magnitude and frequency of deviations from mine footprint effects.

4.126 Lastly, the post-closure water balance shows over half the site water being "consumed" in the mine pit. This may be true while the pit is filling but once filled, all site water will be "reintroduced." It is also highly conceivable that the mine pit would be filled at an accelerated schedule to reduce oxidation of mineralized sections of the pit wall (as was proposed for the Crown Jewel project in Washington State), thus advancing the time when all site water (well over 76.3 million cubic meters per year or 55 million gallons per day or MGD) would require capture and treatment prior to discharge to nearby streams. Are there any examples anywhere of a closed mine that treats such volumes of water and discharges treated effluent that meets applicable WQC end-of-pipe, with no dilution?

EPA Response: The 76.3 million m^3/yr of water estimated to be captured under the Pebble 6.5 scenario post-closure period is approximately 60% greater than the amount estimated to be reintroduced during operation. The Pebble 6.5 scenario mine pit is expected to take over 200 years to fill, so there would be ample time to design and build a wastewater treatment plant of the required size and processing capacity. There are mines that discharge similar quantities of water. For example, the White Pine Mine in Michigan is regulated under an NPDES permit and has had final effluent discharges from its tailings system in excess of 60 million gallons per day.

4.127 Another significant finding that affects the feasibility of treating mine site wastewater discharges is the fact that the average mean annual temperature at the project site is below freezing for seven out of twelve months of the year (Meteorology and Climate, PLP, 2012). This means that all project site wastewater would need to be treated and discharged during a brief five month window, like the Red Dog project. But unlike Red Dog, no dilution would be available due to the preponderance of salmon spawning and rearing habitat in all nearby receiving waters. Even if one accepts 76.3 million cubic meters as the ultimate water balance output, this annual volume of wastewater when treated and discharged over a five month period would be equal to 132 MGD, an unprecedented quantity of mine site wastewater that would need to be treated and discharged to meet very low hardness-based metals WQC end-of-pipe.

<u>EPA Response:</u> The reintroduction of captured and treated water would be subject to a number of restrictions, including but not necessarily limited to chemical content, temperature, minimum flow rate, and maximum flow rate. Reintroduced flows may also be restricted to certain locations or discharge periods. The required wastewater treatment plant would be large by industry standards, but the engineering design details of such a plant are beyond the scope of this assessment.

4.128 The draft BBWA mining scenario projects up to 43.7 km^2 (11,803 acres or 18.4 square miles) of tailings impoundments and 22.6 km^2 (6104 acres or 9.5 square miles) of waste rock piles (Table 4-3; see also comments regarding discrepancies in area calculations). That equates to a total of approximately 66.3 km^2 (17,908 acres or 28 square miles) of land, much of it if not most formerly aquatic habitat, that would need to be reclaimed. As much of the mine waste materials would be potentially acid generating, including pyritic tailings and PAG waste rock, these areas would need to be kept saturated to inhibit further oxidation and subsequent acid generation. In other words, aquatic habitat would need to be recreated on an unprecedented scale. The materials required for a reclamation effort of this magnitude would include cover material to physically isolate tailings and topsoil to enable establishment of a vegetative cover. Waters within the reclaimed areas would need to meet WQC. Accordingly, the BBWA should address the following questions:

- Is there adequate cover material available to effectively isolate 28 square miles of potentially toxic mine waste?
- Could top soils removed during mining operations, which would include a significant quantity of peat, be stockpiled for decades and still be viable as a growth medium?
- Has any mining project in a sub-arctic region ever successfully achieved reclamation of this nature on so large a scale?

A similar question regarding the availability of material suitable for constructing fully lined tailings impoundments should also be addressed as the tailings and PAG waste rock do not appear to be acceptable as clean fill material and are not likely to be suitable for unconfined disposal in waters of the U.S. (see Riley and Yocom, 2011 for further discussion).

<u>EPA Response:</u> The assessment is not a mine plan, an evaluation of a mine plan, or a mine permit application. Whether there would be adequate material for reclamation at this site is outside the scope of the assessment. An appendix addressing compensatory mitigation has been added to the assessment (Appendix J).

4.129 The Draft Assessment does not squarely address the challenges of constructing and operating a modern day mine that could actually meet the “no failure” scenario with respect to reclamation. Post-closure, aquatic habitats would have to be recreated on an unprecedented scale and waters within the reclamation area would have to meet water quality standards. The

Draft Assessment leaves unanswered a number of questions about the feasibility of reclamation, including whether there will be adequate cover material and topsoil, and whether any mining project in a sub-arctic region has ever successfully achieved reclamation of this nature on so large a scale. We recommend that EPA address these questions in the Final Assessment.

EPA Response: We agree that these topics are not addressed in the assessment, since for our purposes they are outside the assessment's scope. We have conservatively reviewed the primary elements of a mine, which we feel confident would be present, for potential environmental impacts. If we find that there are predictable effects from these mine elements, these effects can be addressed in a future action. We understand that there will be many elements of a mine that we have not addressed. No change required.

The Pebble Limited Partnership (Doc. #3797)

4.130 The Need to Adequately Describe and Assess Mine Mitigation Measures, Using "Best Practices." The peer reviewers should be asked whether the report adequately assesses specific available design, pollution control, and mitigation technologies, including (but not limited to) containment or impoundment structures; water treatment, retention, and release options; milling of potentially acid generating (PAG) tailings or waste rock; mitigation and monitoring; adaptive measures in the event of failures; and habitat modification. EPA's Assessment (at p. 4-1) states that the described mining practices "represent current good, but not necessarily best, mining practices." The peer reviewers should be asked whether "best mining practices" should be described and how the use of best available practices can limit impacts.

EPA Response: This comment concerns the charge questions for the peer review panel. No change to the assessment is suggested or required. However, the assessment assumes that modern conventional mining practices and technologies have been incorporated into the design, and this has been clarified throughout the text in the revised assessment.

Northwest Mining Association (Doc. #4119)

4.131 EPA's failure to consider the full panoply of federal and state programs developed by the Congress, the States and the relevant federal and state hardrock mine regulatory authorities to protect the environment when seeking to assess potential impacts of hardrock mines is shocking in view of the success the current regulatory programs have had in protecting the environmental since their inception in the 1990s. The evolution of federal and state regulation of hardrock mining and milling facilities is a remarkable success story of environmental protection. The bottom line is that current hardrock mine regulation is demonstrably protective of the environment. This is well illustrated by analysis of the vintages of Hardrock Mines on the EPA National Priorities List of environmental cleanup sites.

EPA Response: The revised assessment discusses the legal requirements for permitting large mining projects in Alaska (Box 4-2).

4.132 No large scale modern mine (within the past 25 years) has been approved exactly as proposed by the company. Each of the many State and federal agencies review the permit application, baseline data and EIS requirements and each requires large or minor changes before it is satisfied that the mine will be able to operate according to that agency's requirements. The Assessment assumes designs for various aspects of the mine and then criticizes those designs as not being acceptable. The Assessment does not effectively address avoidance, minimization and mitigation, all of which are employed by the agencies and the companies to address concerns that arise over the initial design. This approach to "assume design and then say it is not acceptable" was used in the Assessment for: siting of mine facilities, siting of roads, siting of tailings pipeline, design of bridges, tailings management, water use, water discharge, financial assurance (bonding), etc.

EPA Response: We have further addressed the issue of mitigation in the assessment. We did not judge any of the mine elements included in the scenario to be acceptable or not, but identified the risks associated with them assuming modern conventional mitigation measures are taken to minimize risks. Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. Nevertheless, in response to public and peer review comments, we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

Northern Dynasty Minerals Ltd. (Doc. #4611)

4.133 The Assessment page 4-8: Section 4.2.2 states: "Crushed ore is carried by truck or conveyer to a ball mill, where particle size is further reduced (e.g., less than 200 μm) …" and "Bulk tailings are the materials left after the first flotation circuit, and are directed to a tailings storage facility (TSF)…" and later states in the same paragraph "The copper molybdenum (+gold) concentrate may be fed through a second ball mill to grind the particles again (e.g., to less than 25 μm) …". This paragraph describes the particle size after passage though the ball mill "…less than 200 μm" (0.2 mm) and the second ball mill which reduces the particle size to "to less than 25 μm" (0.025 mm). However, on page 4-10, in Section 4.2.3, particle sizes of the tailings are stated to be "silt to fine sand (0.001- to 0.6-mm)…". On page 4-49 the Assessment states: "The bulk tailings would be uniformly graded, consist largely of sand and silt-sized particles (D_{80} = 200 μm)". However, the data presented in Figure 4-13 conflicts with these statements in the Assessment regarding particle size and the fact that the particles stored as tailings "would be uniformly graded". This discrepancy should be explained, since particle size is a critical, determinate factor in supporting assumptions and conclusions regarding the fate of tailings released downstream in the Failure Scenario presented in Chapter 6 of the Assessment. On page 4-49 the Assessment states that bulk tailings would make up 85% of the mass with pyritic tailings comprising 14% of the tailings with a D_{80} of 30 μm (0.03 mm). That means that at least 82% of the particles in the tailings would be less than 0.2 mm in diameter. Threshold shear velocity to initiate transport for particles of this size is approximately 0.04 ft/sec. According to Box 4-9 on page 4-57 all tailings particles are assumed to have a diameter of 1 mm or less. Threshold shear velocity to initiate transport for a 1 mm particle is approximately 0.08 ft/sec, which is less than half the velocity cited (0.16 ft/sec) in Box 4-9. What these differences mean is that the entire modeling effort on sediment transport is suspect in the Assessment. The consequences of incorrectly characterizing the fate of sediments released from the tailings facility during the Failure Scenario is that sediment would be transported at much lower water velocities than presented in Box 4-9. This questionable characterization and assumption is critical to the conclusions regarding the fate of sediments released and the ability of those sediments to form dam(s) in areas downstream in the main stem Koktuli, Mulchatna, or Nushagak Rivers. This entire topic in the Assessment should be reevaluated to determine if any incorrect or false assumptions have been made.

EPA Response: Section 4.2 discusses typical processes at a porphyry copper mine. Some details of the mine scenarios analyzed in Section 4.3 may vary from examples mentioned in Section 4.2. The text from Section 4.2.2 cited in the comment clearly indicates that the particle sizes mentioned are examples. The text cited in the comment from Section 4.2.3 refers to typical tailings particle sizes of silt to fine sand (0.001- to 0.6-mm), a range which includes the previously mentioned sizes of 200 µm and 25 µm.

The text from p. 4-49 cited in the comment refers to tailings particle size information from Ghaffari et al. (2011). This source document did not present particle size distribution curves for the tailings, only the P_{80} values. For the assessment, we reviewed published particle size distribution curves for tailings at other copper mines and then constructed similarly shaped curves that had a P_{80} of 200 µm for the bulk tailings and a P_{80} of 30 µm for the cleaner tailings. The comment is correct that the tailings represented by particle size curves shown in Figure 4-13 would not be uniformly graded (meaning a D_{60}/D_{10} less than 2), and we attribute this discrepancy to an imprecise use of the term "uniformly graded" in Ghaffari et al. (2011). Box 4-9 refers to and is consistent with the particle size distribution curves in Figure 4-13.

The Hjulstrom curve was used to determine the threshold velocity between transport and deposition. By inspection of the curve, the boundary for a 1-mm grain occurs at 0.16 ft/s as described in the report. It is possible that the comment is based on other accepted methods for determination of minimum transport shear velocity for a discrete particle size (i.e., Shields, etc.). As the comment describes, a more conservative estimate of necessary velocity to transport material will allow the estimation of sediment transport potential to extend farther downstream. The estimated velocity (0.16 ft/s) was applied to better understand when sediment could be deposited during the receding flood flow resulting from a large tailings dam failure. The estimate is coarse and relies on a hydraulic model to determine flood flow characteristics. It is recognized that additional study could refine the estimate and further describe sediment transport potential for a highly concentrated sediment flow as it distributes downstream and mixes with other clear water tributary inputs. We also acknowledge that the assessment does not provide great detail about non-dam failure sediment transport, but focuses on the potential for large quantities of sediment to be easily distributed down valley, causing an immediate alteration of stream and floodplain habitat. By volume, TSFs can release sediment quantities that can result in depositional layers measured in meters. The comment is correct that these sediments can then be re-suspended and transported during subsequent flood events and potentially during typical low flows in areas of potential head cutting and along the stream bank margins.

4.134 One of NDM's primary concerns about the Draft Assessment is that EPA presumes to measure environmental impacts of proposed mining activity without having any definitive mining proposal from PLP. The Draft Assessment makes clear that it has made a whole range of assumptions concerning fundamental details of mine activity that PLP has yet to propose, including the location of mine facilities and related infrastructure; the scale of the mine and the time period over which mining will occur; mining and milling methods; annual production; size, placement and chemistry of waste rock; and the size, placement, chemistry of tailing storage facilities, construction and mine operation practices, design criteria, mitigation measures, and a host of other assumptions. See Draft Assessment at pp. 4-13 to 4-17. With EPA's reliance on this hypothetical mining operation to prepare the Draft Assessment, it cannot pretend to have conducted a sound science-based review of the impact of PLP's proposed mine on the Bristol Bay watershed.] It would be impossible to do so given that it does not have an actual mine plan to assess. This single fact vitiates the scientific validity of the Draft Assessment and compels EPA to withhold analysis and judgment on impacts of mining activity on the subject watershed until such time as PLP actually submits definitive mine plans for consideration.

<u>EPA Response:</u> We did not intend to evaluate a specific mine. Instead, we use Ghaffari et al. (2011) to identify elements of a plausible mine for evaluation of potential impacts to salmon. We agree that the Ghaffari et al. (2011) report represents a plausible mine, permittable under existing standards, and believe that it describes the elements of a mine likely to be constructed at any of the sites in the Nushagak and Kvichak River watersheds.

4.135 NDM believes that EPA's proposed mining plan will differ significantly and in important ways from a plan that PLP would seek to have permitted. Without having an actual mine plan before it, EPA is left guessing as to what PLP's operation would look like. A realistic assessment of impacts from mining activity cannot be left to supposition and guesswork. Moreover, the Pebble mine would be located in an area of Alaska state land that was designated through two democratic land use planning processes for mineral exploration and development, giving further credence to the fact that EPA should wait to assess a specific mining proposal for this area rather than to base its analysis on a hypothetical mine proposal to determine whether mining is in fact an acceptable use of the area.

<u>EPA Response:</u> We based our mine scenarios on the preliminary mine plan put forth by Northern Dynasty Minerals in Ghaffari et al. (2011). A formal mine plan for any deposit would include a great deal of detail that we did not address. We assumed that these details would be well thought out and comply with regulations and industry standards. The major components of any submitted mine plan are likely to include those we have included here: an open pit (with a possible underground component), tailings impoundments, and waste rock piles. Our evaluation focused on the likely effects of these major mine components.

4.136 Even if the footprint of PLP's proposed activity is similar to the 25-year hypothetical mining plan that EPA has proposed, NDM believes significant differences would remain concerning the detailed design, construction, and operation of engineered facilities, (e.g., tailings embankments) and mitigation measures proposed. Given these differences, the validity and relevance of EPA's hypothetical mining plan and the resulting environmental impacts are highly suspect.

<u>EPA Response:</u> We disagree with the comment. Our analysis of potential effects, based on the scientific literature, experience at other mines, and the experience of EPA

scientists and engineers, is accurate. We assume that mine components are designed, constructed and operated effectively. However, we also assume that, in spite of best efforts, system failures will occur. It is these failures that we evaluate for environmental effects.

4.137 EPA's hypothetical scenario does not adequately incorporate modern engineering design features that would avoid or mitigate many of the impacts described in its report, as evidenced by the preponderance of real life examples in North America. Indeed, EPA admits that its analysis considers "good, but not necessarily best, mining practices."

<u>EPA Response:</u> The assessment assumes that modern, conventional engineering design features are included and properly implemented. The mitigation measures included in the mine scenarios are those that could be reasonably expected to be proposed for an actual mine, many of which were presented as appropriate for the Pebble deposit in Ghaffari et al. (2011). We have made inclusion of these mitigation measures clearer in the revised assessment. Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. Nevertheless, in response to public and peer review comments, we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

4.138 Failing to include in its assessment state-of-the-art measures that would avoid and mitigate many of the impacts described in the report leads to misleading, inaccurate and unfair conclusions about the actual impacts of mining activity in the area. Indeed, Alaska agencies and EPA/other federal agencies would not permit such a plan as hypothesized by EPA in the first instance, especially with the exclusion of modern engineering design and mitigation measures.

<u>EPA Response:</u> See response to Comment 4.137.

4.139 The EPA's problem formulation presents an unrealistic overestimation of potential impacts without adequate consideration of mitigation.

<u>EPA Response:</u> See response to Comment 4.137.

4.140 Along the transportation corridor, under the routine scenario, EPA assumes that culverts will be improperly installed and that blockages to fish passage will occur due to improper construction and maintenance. This is not only impossible, it violates EPA's own assumption that things are working as designed. Also, EPA assumes that daily maintenance inspections will occur. NDM cannot understand how the predicted impacts could occur if everything is working according to plan. Agencies would never permit a project that had the culverts installed incorrectly and were routinely blocking fish passage. Thus, EPA's assumptions are not valid and the conditions they describe would never be permitted by either state or federal agencies.

<u>EPA Response:</u> See response to Comment 4.82.

4.141 NDM and subsequently PLP have taken great pains over eight years to avoid as many environmental impacts of viable project development as possible. The project footprint has been adjusted many times and the sequencing of development of various project elements has been revised over and over to avoid and/or minimize impacts to local streams and wetlands. At no time did EPA demonstrate that it took account of any of these environmentally important design principles when coming up with its hypothetical mine concept. Further, PLP has taken great pains to design a transportation corridor that would avoid and/or minimize impacts to streams and wetlands, including incorporation of advanced approaches to stream crossings that would assure that bridges would be used wherever appropriate and that culvert design and placement would preclude failure either of the structures themselves or their abilities to provide unimpeded fish passage for all relevant species and life stages. Not only did EPA fail to incorporate appropriate road and pipeline design standards, but they assumed a failure rate that would never occur for any modern, well-designed, all-weather industrial road in Alaska, especially given today's stringent permitting requirements. PLP has always incorporated the *best* design and operational standards for physical project elements, such as tailings storage facility embankments, water treatment facilities (such as redundant, modular design) and site water collection and distribution systems. EPA's design and performance standards, as explicitly stated in their analysis were merely "good" as opposed to best; it seems this was necessary so that EPA could posit a series of still-unreasonable failures and by doing so, have something to analyze.

EPA Response: See response to Comment 4.137.

4.142 Another glaring lapse is EPA's failure to acknowledge and incorporate one of the most basic requirements of the permitting process: full, functional mitigation for all unavoidable, residual project impacts. PLP has consistently acknowledged its mitigation responsibility and has assumed that permit requirements would stipulate mitigation obligations amounting to a significant multiple of actual impacts, resulting in a net gain in anadromous and resident fish productive capacity (hence potential net gains to subsistence, commercial and recreational fisheries), as has been the case with other projects in Alaska. PLP has identified numerous opportunities for increasing anadromous fish habitat, as well as the productive capacity of that habitat for anadromous fish, greatly in excess of reasonably anticipated losses. Examples of such available opportunities include judicious water management, including storage, and strategic delivery of excess water to streams and aquifers without adverse impacts such as seasonally incompatible temperatures; providing access to existing but inaccessible aquatic habitats and creation of extensive new habitats such as groundwater-fed secondary channels for anadromous and resident fish spawning, rearing and overwintering in local floodplains; concentrating mitigation efforts in more heavily utilized lower portions of local watersheds (North Fork Koktuli, South Fork Koktuli, Upper Talarik Creek) in order to maximize actual use of new habitat by the fish for which it is intended. Offsite but in-watershed (Kvichak/Nushagak) opportunities include such things as fish passage at significant anadromous fish barriers, opening up very large areas to anadromous access, significantly increasing salmon runs in associated systems. More remote opportunities include facilitation of reclamation and rehabilitation activities in existing disturbed areas. EPA chose not to include any such mitigation approaches in any of its scenarios, but rather to assume the persistence of unavoided and unmitigated adverse project impacts. This failure flies in the face of the CEQ Guidelines, requirements of the CWA, the large mine permitting process in place and familiar to all in Alaska, and is inconsistent with modern mining industry practices.

EPA Response: **The purpose of the assessment is to evaluate potential effects of a mine on salmon at this location. Compensatory mitigation would be considered as part of a regulatory process to offset effects identified in completion of the assessment. Nevertheless, we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.**

4.143 The following comments are summarized from tables that can be found in Doc. #4611:

- Pg. 4-11: "A clay liner may have a saturated hydraulic conductivity of 10^{-8} m/s, whereas a geomembrane may have a hydraulic conductivity of approximately 10^{-10} m/s (Commonwealth of Australia 2007). However, geomembrane technology has not been available long enough to know their service life, and geomembrances are generally estimated by manufacturers to last 20 to 30 years when covered by tailings (North pers. comm.)."
- *Comment:* Modern clay liners are most commonly constructed with a saturated hydraulic conductivity of 10^{-9} m/s, one order of magnitude lower than the Draft Assessment suggests.

EPA Response: **The saturated hydraulic conductivity of a clay liner is used as an example in the section describing background and the appropriate reference is noted. The comment does not provide a substitute reference for the value they suggested, so no change is required.**

- *Comment:* Geomembranes used in typical lining applications typically have hydraulic conductivities of 10^{-14} or 10^{-15} m/s, several order of magnitude lower than stated.

EPA Response: **The source of information presented in the assessment is cited. Without a source for the information the comment provides for verification, we are unable to use it. Therefore, no change is required.**

- *Comment:* Most of the research on geomembranes is performed by independent universities and research institutes such as the Geosynthetic Institute (http://www.geosynthetic-institute.org/).

EPA Response: **Comment noted; no change required.**

- Pg. 4-15, Table 4-3: TSF 1 surface area is 14.9 km^2
- *Comment:* This is inconsistent with pg. 4-50: "Under the partial volume dam failure, the peak flood is estimated at 1,862 m^3/s immediately downstream of the TSF 1 dam, where the contributing watershed area is only 1.4 km^2." Such a massive over-estimation by EPA eliminates credibility.

EPA Response: **This was a typographical error that has been corrected in the revised assessment. 14.9 km^2 is the correct area and was used in the analysis.**

- Pg. 4-20, Figure 4-7: The figure displays minimum and maximum mine footprints hypothesized and shows hypothetical mine infrastructure overlaying a map that hypothetically depicts "freshwater habitat".

- *Comment:* Figure 4-7 fails to define freshwater habitat. The maps presented greatly exaggerate the amount of fish bearing waters and leaves the reader with the impression that there are a large number of lakes in the area. This is incorrect. What the maps should depict is the streams channels which contain or contribute water to fish bearing channels. The scale on the map only makes the exaggeration worse. NDM's analysis shows that certain maps included in the Draft Assessment exaggerate stream widths by as much as 7,000%. The situation is particularly bad in the Upper Talarik Creek watershed. The background maps should be revised to accurately depict the stream distribution in the area represented, as related to the three fish species which are the subject of the Assessment.

EPA Response: Figure 4-7 displays all types of freshwater habitat, including wetlands, ponds, and streams, not just fish habitat. Maps typically denote small streams as lines that show the location but not the size of the channel, which is the case in this figure.

- Pg. 4-25, Figure 4-9B: The figure, "Post Closure with No Water Management" shows a scenario after completion of mineral extraction where leachate is being generated from the tailings and waste rock piles, but no water management is occurring.

- *Comment*: This is an inaccurate depiction of the post-closure period. The post-closure implementation period will include long term water management that effectively manages and controls any leachate that does not meet water quality criteria.

EPA Response: This was intended to represent the situation where financial assurance had run out or there had been some other reason for the company to no longer be able to provide water management. This figure is not included in the revised assessment.

- Regarding hydraulic conductivity in water balance (Box 4-2), Pg. 4-28: "We based our analysis on the hydraulic conductivity (k) varying with depth, with log k varying linearly from the surface to a depth of 200 m; specifically, with $k = 1 \times 10^{-4}$ m/s at the surface and $k = 1 \times 10^{-8}$ m/s at depths greater than or equal to 200 m."

- *Comment*: This is inconsistent with Chapter 8 of PLP's Environmental Baseline Document Pg. 8-25: "The hydraulic conductivity tests in overburden…had a geometric mean of $2x10^{-5}$ m/s, and a median of 3x10-5 m/s." Pg. 8-25: "Response test in bedrock in the Pebble Deposit were performed near the top of rock (shallow bedrock)….The geometric mean of the calculated values was 1x10-5 m/s and the median was 1x10-5 m/s. Impact: EPA has overestimated hydraulic conductivity in shallow overburden and underestimated it at depth in bedrock.

EPA Response: The distribution of hydraulic conductivities used to estimate mine pit inflow in the original draft assessment analysis was derived from an analysis of 33 borings reported in Chapter 8 of PLP's Environmental Baseline Document. The hydraulic conductivities reported by PLP range from $1x10^{-3}$ m/s to $5x10^{-8}$ m/s with considerable scatter in the data (as shown in Figure 6-7 of the revised assessment). The data cited in the comment is not inconsistent with our modeled hydraulic conductivity distribution.

- Pg. 4-33: "Because premature closure is an unanticipated event, water treatment systems would likely be insufficient to treat the excessive and persistent volume of low pH water containing high metal concentrations."
- *Comment:* This statement is incorrect. Premature closure would be one of the events planned for, with appropriate financial assurances, as part of the permitting process. Further, NDM believes PLP would ensure that sufficient water treatment capacity exists at all times to address premature closure.

<u>EPA Response:</u> We have noted in the revised assessment that, "In the past, however, financial assurance often has not been adequate, and taxpayers have been left with substantial cleanup costs (USEPA 1997). This may be changing, as agencies update bonding requirements to reflect cleanup costs more accurately, but projecting these costs far into the future is a difficult task…" with respect to premature closure (Section 6.3.5).

- Pg. 4-45: "Several studies have estimated the probability of tailings dam failures, resulting in the failure probabilities listed below.
    - 1 tailings dam failure every 2,000 mine years.
    - 1 tailings dam failure every 2,041 mine years.
    - 1 tailings dam failure every 1,754 to 714 mine years."
- *Comment:* These probabilities are not relevant. The failure case histories used to develop the probabilities are almost exclusively based on older tailings facilities started without the benefit of modern engineering practices and regulations. In all cases, mitigation of the failure would have been possible through proper investigation, design, construction, and/or operations consistent with modern mining practices. An analysis that simply utilizes a retrospective failure rate to estimate future failures at a modern mining site significantly exaggerates the risk of a TSF failure, and therefore results in a biased assessment of future outcomes.

<u>EPA Response:</u> The probabilities for tailings dam failure were not derived from the historical record. Historical failures were discussed as supporting background information and present a defensible upper bound on the failure probabilities. The failure probabilities are based on Alaska's dam classification and required safety factors applied to the method of Silva et al. (2008). The discussion of failure probabilities is expanded in the revised assessment to clarify this issue. The use of current dam engineering and construction methods would be expected to reduce the probability of failure, as discussed in Chapter 9. On the other hand, building such tall rockfill dams is pushing the boundaries of past experience and could have unforeseen performance issues.

4.144 Given the lack of scientific rigor, the Assessment is an inadequate basis for a permitting decision for the Pebble Project, which should be evaluated pursuant to the normal Environmental Impact Statement process under NEPA. The Assessment is based on a "mining scenario" describing a mine that today could not be legally built, and other mine structures that fail to meet modern mine construction or operation methods. It is based on culverts that fail to meet modern design criteria for fish passage. It relies on data from mines constructed in the 1800s that now could not be constructed or operated in the same way. Thus, an EPA Section 404(c) veto of the Pebble Project based on this report would be a triumph of politics over science.

<u>EPA Response:</u> The assessment is not intended to evaluate a permit decision for the Pebble project. It assesses potential effects of the mine components expected to be common to any large porphyry copper mine on salmon resources in the Nushagak and Kvichak River watersheds. The assessment scenarios are based on a report commissioned and distributed by Northern Dynasty Minerals (Ghaffari et al. 2011), which states that the scenarios are plausible and permittable.

References to mines from the 1800s do not address design of those mines. We use them as examples of the transport and fate of mine waste contaminants released to the environment. There is no implication that a modern mine would similarly fail, rather we evaluate how the pollutants behaved once they have entered the environment.

4.145 The Assessment mistakenly suggests that fundamental permitting requirements will not be applied to a potential development within the Bristol Bay watershed. This is a fundamentally flawed premise. It is also extraordinary that an EPA document would suggest that this is a reasonable basis for its impact assessment, because it assumes that a federal regulatory process would completely ignore modern standards for tailings dams. The Assessment does not take into account these modern design criteria.

<u>EPA Response:</u> We assume that all appropriate design criteria will be included. However, we also assume that all engineered systems will fail at one time or another. The mitigation measures proposed within the assessment's mine scenarios are those that could reasonably be expected to be proposed for a real mine and are assumed to meet requirements. We are aware that an actual mine may differ somewhat from what we have proposed in the assessment scenarios. However, what is proposed has been suggested as appropriate for the Pebble deposit by Ghaffari et al. (2011).

4.146 The Assessment wholly ignores standards and regulatory guidelines on the design and construction of waste rock piles. These standards are clearly laid out in state and federal regulatory schemes and should be the building blocks for the development of any hypothetical mining scenario.

<u>EPA Response:</u> See response to Comment 4.145.

4.147 The Assessment indicates that the assumed mining operation would modify natural runoff and infiltration, but fails to highlight the extensive studies that are required to understand baseline conditions and to determine the changes to flow conditions during construction, operation and after mine closure. These studies are fundamental requirements for the permitting process, and are required to determine appropriate mitigation measures to ameliorate potential impacts.

<u>EPA Response:</u> We believe it is scientifically valid to assume that mining operations would modify natural runoff and infiltration. We assume that additional studies will be completed and the results incorporated into design of mining facilities.

4.148 The pipeline failure rates used in the Assessment are based on aggregated information from several countries spanning a wide range of construction techniques and pipe sizes. It is not clear what design standards to which those pipelines were constructed.

<u>EPA Response:</u> The assessment considers failure rates across multiple countries, in various climates, of various pipe sizes, and owned by operators with varying experience levels. The analysis looked at data from nearly 20 million kilometer-years of pipe operation, but selected a failure rate based on datasets for pipelines less than 20 cm in diameter, pipelines in a climate similar to Alaska, and pipelines run by small operators to carry forward in the analyses. Chapter 11 of the revised assessment more thoroughly describes pipeline failure scenarios.

4.149 In its hypothetical mine scenario, EPA relies on tailings facilities built in the late 1800s while ignoring modem engineering that would have prevented historical dam failures. EPA grossly underestimates the high standard to which a mine in the Bristol Bay watershed would have to be designed and engineered in order to obtain permits to operate in the watershed. It also underestimates the role of various federal and state regulatory agencies in the permitting process that will help ensure that a technically advanced mine would be designed and operated.

<u>EPA Response:</u> We did not compare tailings facilities from the 1800s to current engineering. We compared the behavior of metals on river floodplains where spills from old mines had occurred to similar situations from a new mine. We have not referenced the technology used to build those mines, merely the fate of the pollutants once they have entered the environment.

4.150 EPA's statistics overstate the chances of a tailings dam failure today. ICOLD statistics referenced in the report do not support the premise that tailings dam failure is a reasonable hypothesis for a modern mine operation in the Bristol Bay watershed. The Assessment incorrectly implies that generalized statistics for worldwide tailings dam failures can be applied to individual tailings dams to suggest a high potential for failure over an extended period of time. This premise is erroneous and misleading, as it is incorrect to imply that any particular proposed or actual dam structure is more or less likely to fail based solely on extrapolation of general dam failure statistics based on dissimilar dams.

<u>EPA Response:</u> In the revised assessment we clarify that we use historic tailings dam failure data to give the reader a sense of history and set a reasonable upper bound on dam failure probabilities. In both the original and revised drafts, we acknowledge that the use of current dam engineering and construction methods may reduce the failure rate by an order of magnitude or more (Section 9.1.2). We also describe predictions of tailings failure probabilities from several other publications. Our predicted failure statistics are based on Silva et al. (2008), which deals with slope stability of modern dams. However, we would be negligent if we did not cite the historical record in the assessment.

4.151 The new design criteria for fish passage culverts typically produce a culvert with a much greater flow capacity, resulting in lower failure potential. The analysis of road and culvert failure in the Assessment does not address the distinction between the two culvert types, or describe adequately the advances in design criteria for fish passage, and therefore overstates the potential for failure of project culverts on fish bearing streams.

EPA Response: See response to Comment 4.82. One reference in the draft assessment (Flanders and Cariello 2000) has been deleted from the revised assessment.

4.152 A properly formulated culvert design maintains sediment, debris, and flood flow, and aquatic organism conveyance (both upstream and downstream) similar to that of the natural stream. The Alaska Department of Transportation and Public Facilities and Alaska Department of Fish and Game have collaborated to develop a comprehensive strategy that establishes design criteria to maintain the stream function for culverts in Alaska. This cooperation resulted in a *Memorandum of Agreement for the Design, Permitting, and Construction of Culverts for Fish Passage*. The design criteria within this MOA have become not only the standard for DOT&PF projects, but also for any project managed by other public and private entities in the state. The Assessment demonstrates that its authors lack knowledge of maintenance requirements and these Alaska-specific standards to maintain stream function for culverts.

EPA Response: See response to Comment 4.82. The impacts to fish passage described in the revised assessment use modern design guidelines for culverts. These specifications are described in Box 10-2, which references the memorandum of agreement (MOA) between the Alaska Department of Fish and Game and the Alaska Department of Transportation and Public Facilities. Box 10-2 also summarizes three design approaches for culverts, including the Stream Simulation Design developed by USDA.

4.153 The mining scenario and analysis of environmental impacts failed to consider mitigation activities that are routinely adopted in the United States for mining and similar large resource and infrastructure projects. In practice, mitigation of project effects is required by federal law to the extent that is reasonably attainable. The hypothetical mining project evaluated in the Draft Assessment not only reflects a worst-case possible scenario, it also reflects an unrealistic scenario. It analyzes a mining operation scenario that has not been permitted in the United States since late in the 19th or very early in the 20th century. The document inappropriately refers to mining impacts in the last century, relying upon information from mining activities conducted in countries with lax or non-existent environmental regulations.

EPA Response: The mine scenarios draw elements from the scenarios described as permittable in Ghaffari et al. (2011). Mitigation features are presumed to be incorporated into mine design, and the revised assessment better describes these potential mitigation measures. References made to mines from the last century do not address design features from those mines; these references are used to evaluate the fate of pollutants that have spilled from those mines (i.e., we are considering the fate of pollutants once they have entered the environment).

4.154 The input assumptions used in the hydrological modeling are incorrect. For instance, an SCS-Type IA storm was used in developing one of the models used in the assessment. Based on known data for Alaska, a different SCS Type I distribution should have been used. Applying a different distribution would change the results of the analysis and reduce some of the greatly exaggerated results.

<u>EPA Response:</u> The comment is correct. SCS Type I is appropriate for this region of Alaska. The hydrologic input was corrected in the revised assessment. In the final assessment, however, the probable maximum flood is no longer modeled.

4.155 There is ample precedent for the successful design, construction, and operation of tailings impoundments around the world, including Alaska. Each site is unique and the designs are specific to site conditions. The Fort Knox tailings dam is an example of a large dam that has been constructed and continues to be operated in Alaska. This tailings dam will be raised to its ultimate height of 360 ft in 2013, and it is situated in an area where the cold winter conditions are more severe than those at the Pebble site. The dam is designed to withstand the Probable Maximum Flood as well as the peak ground acceleration of 0.63g generated by a Maximum Credible Earthquake of M7.5.

<u>EPA Response:</u> We agree. However, these tailings impoundments must remain in place in perpetuity and it is unlikely that they will all do so. Myriad variables are involved in stability of a dam, not all of which are controllable or predictable in the perpetual time frames that a dam must hold tailings in place. The risk associated with failure of each dam varies with site characteristics and consequences of failure.

4.156 In the text of the Assessment, an assumption is made that water surplus to operations needs will be routed to the streams downstream of the infrastructure footprint, but makes no mention of supplemental water from some other source to mitigate for flow reductions or other water management measures that would address water temperature concerns.

<u>EPA Response:</u> Section 4.3.7 of the original draft included water withdrawal for mine operations. This water could conceivably be taken from another source to mitigate losses at the site. However, withdrawal from other sources for any purpose would simply transfer the adverse effects to another system. Supplemental flows from other sources are not included in the assessment.

4.157 Table 4-2 on page 4-14 states that under the Premature Closure scenario, "Closure of mine before planned mine lifespan is reached and without planned site management". This assumption is not "realistic" given the five-year environmental and bonding review required by the State of Alaska. What this assumption, as presented in Table 4-2 fails to recognize is that some form of site management in case of a premature closure or stoppage in production would be performed with funding from the bonds required. This is not a realistic part of a scenario and should be revised to reflect the State's requirements.

<u>EPA Response:</u> The discussion of premature closure has been expanded in the revised assessment (Section 6.3.5). It includes examples of premature closure that illustrate the issues involved. In addition, financial assurance issues are discussed in Box 4-3 of the revised assessment.

4.158 Figure 4-7 on page 4-20 displays minimum and maximum mine footprints hypothesized and shows hypothetical mine infrastructure overlaying a map that hypothetically depicts "freshwater habitat". Figure 4-7 fails to define freshwater habitat and is scientifically and professionally dishonest. The maps presented greatly exaggerate the amount of fish bearing waters and leaves the reader with the impression that there are a large number of lakes in the area. This is absolutely false. What the maps should depict is the stream channels which contain or contribute water to fish bearing channels. The scale on the map only makes the exaggeration worse. The situation is particularly bad in the Upper Talarik Creek watershed. This is an example of where the Assessment clearly misleads the public about the nature and character of the streams in the area. The background maps should be revised to accurately depict the stream distribution in the area represented, as related to the three fish species which are the subject of the Assessment.

<u>EPA Response:</u> See response to the fifth part of Comment 4.143.

4.159 The Assessment page 4-31: Section 4.3.8 states: “Weathering of the waste rock and pit walls would release contaminant concentrations of potential concern such as sulfates and metals. Weathering to the point where these contaminants are present in only trace amounts (at levels approaching their pre-mining background concentrations) would likely take hundreds to thousands of years, resulting in a need for management of materials and leachate over that time.” These statements draw a major conclusion without supporting science to document the claim made that sufficient weathering would take “hundreds to thousands” of years to reduce potential contaminates to pre-mine background levels. This conclusion is totally unsupported by any references or analysis to justify the claim. The Assessment should be rewritten to include scientifically defensible documentation that the assertion regarding weathering time is valid.

<u>EPA Response:</u> Appropriate reference is included in the revised assessment.

4.160 The Assessment page 4-31: Section 4.3.8.1 Mine Pit states: “These areas containing sulfide minerals would likely be acid-generating for as long as they remained above the water surface in the pit (if they were not sealed against oxidation), resulting in low-pH water running down the sides of the pit into the water body at the bottom.” This statement is inconsistent with the conclusion earlier in Section 4.3.8 that weathering of the “mine pit” would occur over some undocumented time frame and reduce potential contaminant levels to pre-mine concentrations. The Assessment needs to be rewritten to correct this discrepancy. The Assessment presents conflicting information on pit wall weathering, thus it is impossible to adequately assess the potential ecological impacts, since no documentation is provided in the text. It also ignores the application of effective mine closure measures to ensure no contamination impacts downstream.

<u>EPA Response:</u> The assessment states that it would likely require hundreds to thousands of years to reduce potential contaminant levels to pre-mine concentrations. This does not contradict the fact that oxidation of exposed sulfide minerals would create acid (and other ions) upon addition of water over this time; therefore, we find these statements to be consistent. The discussion of post-closure pit wall leaching has been expanded to clarify that the duration of the problem is uncertain.

4.161 The Assessment page 4-32: Section 4.3.8.2 Tailings Storage Facilities states: “An assumption in the mining industry is that tailings continue to compact, expelling interstitial water and becoming more stable over time. However, a recent analysis of data from oil sands tailings suggests that densification of tailings may stop after a period of time (Wells 2011). Thus, the system may require continued monitoring to ensure hydraulic and physical integrity”. The conclusion reached in this section of the Assessment is not supported by a scientifically defensible argument. The Assessment fails to present any information or analysis to show that the apparent conclusion reached by Wells (2011) is applicable to the type of tailings facility envisioned in the hypothetical mine scenario, that the manner in which the tailings from the oil sands are placed into their tailings facility is similar to what would occur at the hypothetical mine site, and that the particle size distribution in the oil sands tailing facility is identical to those in the mine's hypothetical tailings facility. The reader is given no basis on which to reach the same conclusion as the Assessment. The conclusion as it now is described does not meet any reasonable definition of a scientifically valid assessment. The Assessment should be rewritten to provide evidence that the two situations are comparable in order to support the conclusion that continual monitoring will be required.

EPA Response: The quoted excerpt from the assessment does not state a conclusion with regard to tailings consolidation or any changes in stability resulting from such consolidation. The text suggests that one cannot conclude that the tailings would eventually be stable and that continued monitoring may be necessary. The revised assessment makes it clear that tar sands tailings may not be representative of mine tailings, but there are no studies of consolidation of mine tailings.

4.162 The Assessment page 4-3: Section 4.3.8.5 Premature Closure. This entire section of the Assessment fails to address the requirements of the State of Alaska regarding five-year environmental audits and bonding review. This section as written is nothing more than uninformed, idle speculation and has no place in an ecological risk assessment. If the authors have any specific conclusions that they wish to draw regarding this component of the hypothetical mine scenario, then they should comprehensively document the conditions under which this uninformed speculation could occur. As is, this section adds nothing of scientifically defensible substance to the Assessment and should be deleted as a component of the mine development and operations scenario.

EPA Response: See response to Comment 4.157.

4.163 The Assessment page 4-34: Section 4.3.9.1 Roads states: "…we assume standard practices for design, construction, and operation of the road infrastructure, including design of bridges and culverts for fish passage. Costs for the road would include daily maintenance crew and equipment; crushed road topping every 5 years; culvert, embankment, riprap, guardrail and river training structures; regular bridge and other inspections; dust suppression; snow removal; and avalanche control and removal …"

The Assessment makes the various assumptions outlined in Section 4.3.9.1, but fails to mention the requirements of the Memorandum of Understanding between the Alaska Departments of Transportation and Fish and Game regarding fish passage requirements at road crossings and whether the Assessment assumes that design and maintenance requirements for a private road would be different than that described in the Assessment. The assumption of "standard practices" in design of road crossings is not specific and does not provide the reader any comparison between what the authors assumed a standard practice is and what the State of Alaska requirements might be for a large mining project. Therefore, it is impossible to determine if there is a scientifically defensible comparison between the assumptions made by the Assessment and the reality of what considerations would be included in any "realistic" road design. This issue is particularly important, since the Assessment assumes daily road maintenance and inspection, given the conclusions about the impacts of a transportation corridor on fish passage later in the Assessment. There appears to be a complete disconnect between the assumptions the Assessment presents in this section and the unsupported and inappropriately documented conclusions in the non-failure scenario of the Assessment in Chapter 5.

EPA Response: See response to Comment 4.82.

4.164 The Assessment beginning on page 4-26 presents the assumptions in the mine development scenario relating to water management. Review of the Assessment's pages 4-26 to 4-30, Box 4-2, and Tables 4-3 and 4-5 raise serious concern about the conclusions reached in the Assessment regarding water management and water balance. The Assessment fails to provide an adequate explanation of or sufficient detail on how the values in Table 4-5 were derived. The water balance modeling results in the Assessment are suspect and unreliable.

EPA Response: Section 4.3.7 of the original draft assessment described the components considered in the water balance, and Box 4-2 provided additional details on water balance calculations. The vague assertions in the comment alleging "serious concern about the conclusions" and the "suspect and unreliable" modeling results do not present sufficient specific information on the comment's concerns for us to provide further explanation of the calculations. However, consideration of water balance issues has been expanded and updated in the revised assessment (e.g., Section 6.2.2).

4.165 The Assessment on page 4-26, third bullet states: "Capture of precipitation falling on the mine components. Precipitation on the mine pit, waste rock piles, and TSFs would be collected and stored to use as process water, eliminating it as a source of stream recharge". The Assessment fails to provide any support or analysis of the conclusion that precipitation falling on the mine components would be used exclusively as process water and that some portion, after treatment, could not be used to replace some of the stream flow reductions downstream of the mine footprint.

EPA Response: Figure 18.3.6 in Ghaffari et al. (2011) shows all the mine pit and waste rock pile runoff being directed to the process water pond. The figure shows makeup process water being transferred from the TSF to the process water pond. The figure also shows some of the water from the TSF being treated before discharge. We agree that neither the process water nor water stored in the TSF could be used to mitigate reductions in streamflow unless it was treated to meet the discharge standards.

4.166 The Assessment, page 4-26 Table 4-5 Water Balance Estimates for the Mine Scenario. Table 4-5 appears to present data that is inconsistent with logic and reason. How can facilities that have a total volume of 229% of another have only 4% more pore water volume? Table 4-5 contains a gross error in its water balance calculations and calls into question the accuracy of the modeling and the competence of the modelers, authors and EPA reviewers of the Assessment.

EPA Response: The quantities shown in Table 4-5 of the original draft assessment (and updated in Table 6-3 of the revised assessment) are annual quantities. Based on a constant average production rate over the life of the mine, the annual volumes of tailings produced and of interstitial pore water within those tailings would be relatively constant over the life of the mine.

4.167 The Assessment, page 4-26 Table 4-5 Water Balance Estimates for the Mine Scenario. Table 4-5, under the Start-Up scenario (which is defined in the Assessment as the first few years of operations) shows a pore water volume in TSF 1 as 25,500,000 m^3 which is the same pore water volume as the minimum mine size reported after 25 years of operations. How can this be? The pore water volume from the start-up period and the 25-yr. mine life cannot be the same. The modeling is in error. The Assessment reviewers did not carefully review this table and it is these kinds of ridiculous errors that cast doubt on the modeling results in the Assessment and whether or not they can be trusted and or should be ignored.

<u>EPA Response:</u> The heading in Table 4-5 of the original draft assessment (Table 6-3 of the revised assessment) indicates that the quantities presented for each water management stage are shown as million m^3/year. The annual pore water volume is calculated from the average annual production rate and the physical properties of the tailings.

4.168 The "Mine Scenario" narrows the focus of the assessment inappropriately. The assessment is supposed to be on the effects of mining generally, not on the Pebble Mine alone. Pebble is one of five planning units in the Nushagak and Kvichak drainages specifically set aside in the Bristol Bay Area Plan (2005) for mineral exploration and mining because they have significant resources, either measured or inferred, that may experience minerals exploration or development during the planning period. In addition, there are several existing, developed mines and other mineralized areas and claims identified in the Plan that are not set aside but are ripe for development; some are considerably larger in land area than Pebble and others, though economically viable, are considerably smaller. These other mines and prospects contain a variety of ore types and target minerals, and would have a range of potential development approaches and impacts extending well beyond those reasonably anticipated for the Pebble prospect.

<u>EPA Response:</u> We focused the assessment on porphyry copper deposits because, although we acknowledge that there is other exploration underway in the Bristol Bay watershed, porphyry copper is generating the most interest in terms of claims staked and in our judgment is the most likely to be developed in the near future.

We placed the assessment mine scenarios at the Pebble deposit because of the large amount of information available for that site, given that the Pebble deposit has been the most actively explored deposit and is the most likely site for near term development. Design of the assessment mine scenarios is based on current technology for mining large low grade ores, following the project description published by Northern Dynasty Minerals (Ghaffari et al. 2011). In the revised assessment we have addressed the large size difference between a likely Pebble mine and any other mine in the area by including a mine size scenario similar to the median sized porphyry copper mine, as described by Singer et al. (2008). We also address the cumulative effects of multiple mines in the two watersheds in Chapter 13 of the revised assessment. It is not necessary to evaluate every potential mine in the two watersheds to gain insights into the potential impacts of mining to salmon resources. Additional mines would increase the mine footprint on the ground and the likelihood of accidental or chronic releases of contaminants.

4.169 4-17 §3 This paragraph parrots a common but erroneous assertion that the Pebble deposit is located "in the headwaters of the Nushagak River and Kvichak River watersheds." This is incorrect. The Pebble deposit is located in the headwaters of two modest-sized tributaries of the Nushagak system and the Kvichak system. The headwaters of the 225-mi-long Kvichak system is the source of the Tlikakila River at Lake Clark Pass. This is in the Chigmit Mountain Range, which separates Southwest Alaska from Cook Inlet, approximately 137 watercourse mi upstream of the mouth of Upper Talarik Creek, or 109 mi as the crow flies ENE from the Pebble site. The headwaters of the 315-mi-long Nushagak system is not the upper (named) Nushagak River, but the source of the Mulchatna River above Turquoise Lake. This is approximately 168 watercourse mi upstream of the mouth of the Koktuli River, which is 35 mi downstream of the confluence of the north and south forks of this stream, or 79 mi as the crow flies NE from the Pebble site. This headwater location is also in the Chigmit Mountain Range. Very roughly, there are about a dozen and- a-half drainages as large as or larger than Upper Talarik Creek tributary to the main rivers (Kvichak, Newhalen) and lakes (Iliamna Lake and Lake Clark) in the Kvichak system. This does not count Iliamna Lake or Lake Clark themselves. Again very roughly, there are about two dozen drainages tributary to the main rivers in the Nushagak system (Nushagak, Mulchatna, Nuyakuk) as large as or larger than either the North Fork or South Fork Koktuli. There are many smaller but significant drainages tributary to the main lakes and rivers in both systems.

<u>EPA Response:</u> We define "headwaters" to include all the waters from which a river arises, which includes all tributary systems.

4.170 4-17 §3 This paragraph repeats the misstatement that the Pebble deposit "is similar to other sites in the area where mineral exploration is proceeding (Figure 4-6). This similarity means that much of our analysis is transferable to other portions of the region." In reality, the Pebble deposit is the only copper porphyry deposit of the five mineral deposits identified the 2005 Bristol Bay Area Plan as most likely to be developed within the planning period (see comments above).

<u>EPA Response:</u> We are referring to ecological similarity and have changed the language to reflect this intention.

4.171 4-33 §4 This paragraph states, "Premature closures can range from cessation of mining with continued monitoring of the site to complete abandonment of the site. As a result, environmental conditions at a prematurely closed mine may be equivalent to those under a planned closure, may require designation as a Superfund site, or may fall anywhere between these extremes." This statement is unrealistic and incorrect. The State of Alaska has very strict rules regarding environmental and operational audits which recur on an enforced 5-year cycle. Two closure plans are required in association with each audit cycle, one for end of mine life and another for premature closure within the 7 subsequent five years, when the next environmental and operational audit is due. Furthermore, bonding requirements are re-evaluated, and sufficient bonding is required to satisfy both closure scenarios. The only reasonable premature closure scenario is "cessation of mining with continued monitoring of the site" with environmental conditions "equivalent to those under a planned closure." EPA should have known this and incorporated this firm Alaska policy fully into closure evaluation. This is a serious oversight, and casts question on the adequacy and orientation of the analysis.

<u>EPA Response:</u> We disagree that the statement is unrealistic and incorrect, as the range of conditions under which an unplanned closure may occur is broad. We have noted in the revised assessment that "In the past, however, financial assurance often has not been adequate, and taxpayers have been left with substantial cleanup costs (USEPA 1997). This may be changing, as agencies update bonding requirements to reflect cleanup costs more accurately, but projecting these costs far into the future is a difficult task…" with respect to premature closure (Section 6.3.5). In addition, financial assurance is discussed in Box 4-3 of the revised assessment.

4.172 We identified several issues with the mining background and hypothetical scenarios selected by the EPA for review. The EPA Report claims not to be based on a specific mine permit application, yet draws heavily on and specifically references the Pebble Project throughout the EPA Report. Given that the report was developed as a proposal for all of Bristol Bay, the dedication of an entire chapter to a hypothetical scenario based on the geographic location, type of minerals, and potential design of the Pebble Project is notable. The heavy use of Ghaffari et al. (2011) as a reference for the development of the hypothetical mining scenarios and for Pebble deposit-specific information further suggests that the proposed risks may be specific to the Pebble Project (referred to 26 times in Chapter 4), as it is a technical document prepared by WARDROP (a Tetra Tech Company) that details a preliminary assessment of the Pebble Project. Several statements made in the EPA Report also require corroborating references and/or studies.

<u>EPA Response:</u> We have included a smaller mine size scenario in the revised assessment that reflects the worldwide median porphyry copper deposit size. This size mine would be closer to any others that might be developed in these watersheds. We assume that the Pebble deposit site is sufficiently typical of other likely deposit sites in terms of aquatic resources so as to reflect the impacts.

4.173 "Our mine scenario represents current good, but not necessarily best, mining practices." (pg. 4-17) The current practices in use at some porphyry copper mines are the result of years of the evolution in engineering design. Implementing current best practices at some older sites may be hampered by historic mine development decisions and may therefore be limited to mitigation or remediation efforts. The assumption on the quality of mining practices (i.e., good versus best) that may be applied at a future mine in the Bristol Bay watershed is purely speculative and biases the BBWA. Ultimately, the operational practices will have to conform to a plan approved by the oversight regulatory agencies, and will be designed to meet the unique requirements of the site.

<u>EPA Response:</u> We assume modern conventional mining practices, technologies, and mitigation measures and have revised the text to clarify this point.

4.174 "At each TSF, a rockfill starter dam would be constructed, with a liner on the upstream dam face and seepage capture and toe drain systems installed at the upstream toe, and with perpendicular drains installed to direct seepage toward collection ponds." (pg. 4-21). Such collection systems are basic in their design and operation with few components subject to potential failure. Failure modes such as crushing, blockage, or blinding of the toe drainage systems are known and can be readily accounted for during design and construction. These are typical engineered solutions that have already been developed and approved by regulatory agencies to mitigate these types of failure scenarios. Such solutions appear to have been ignored in the BBWA. Conventional water treatment practices typically involve chemical addition steps to adjust the pH of the water and precipitate metals. Following the chemical addition stages, physical separation of the solids from the water is often achieved through gravity settling or filtration. These processes are mechanically simple and require some, but not extensive, operator control. Due to their simplicity, the opportunity for system breakdown is significantly reduced from the scenarios considered in the BBWA.

<u>EPA Response:</u> We agree that these types of features are simple and not prone to failure. However, they are not failsafe and thus we evaluate the consequences of potential failure.

4.175 "PAG waste rock would be stored separately from NAG waste rock. As noted above, waste rock could be processed if commodity prices rose to the point where it was economical to process it, or if balancing the chemistry of the flotation process made this advantageous. Alternatively, PAG waste rock might be milled at the end of mining to both exploit the mineral content of the rock and to direct acid-generating pyrite to the TSF or the pit, where it might be more easily managed. Waste rock also might be placed back in the pit (e.g., waste rock from the eastern part of the ore body might be placed in the western portion of the pit once it is fully mined)." (pg. 4-23)

This paragraph acknowledges that the management of PAG and NAG rock during the active mining phase cannot be fully determined based on the extent of information presently available. Also, management approaches are likely to change over the active life of the mine as new situations develop and new information becomes available. Although not acknowledged in the BBWA, water collection and treatment systems are also likely to be refined and optimized during the operation of the mine.

<u>EPA Response:</u> We agree. In the assessment scenarios we assume that the PAG waste rock would be fed into the mill to somewhat standardize the mineral content of rock going through the mill. This would eliminate issues associated with PAG waste rock after mining is complete. In the event of premature mine closure, PAG waste rock may remain on the site and have the potential for acid drainage. No change required.

4.176 Biased Use of Selected Case Histories: Two case histories are discussed in the BBWA in relation to failures of water collection and treatment systems.

> "When a mine reopens after premature closure, the owners may change the mining plan, may not implement the same mitigation practices, or may negotiate new effluent permits. For example, the Gibraltar copper mine in British Columbia was permitted as a zero-discharge operation. When it closed, then reopened under new ownership, it was permitted to allow effluent discharge to the Fraser River, and this permit included a 92-m dilution zone for copper and other metals." (pg. 4-33)

The BBWA appears to suggest the reopening of this mine under a new permit was inappropriate. Updates to the permit are appropriate based on new information and an improved understanding of the risks associated with discharge to the receiving environment. Stakeholder consultation and regulatory approval is required before any such alteration of the discharge permit could take place. This statement overlooks the process that is required to obtain approval of any changes to permit conditions, which includes careful analysis by the lead regulatory agency.

<u>EPA Response:</u> **We do not suggest that reopening or changes in management at the mine were inappropriate. Rather, we point out that the operation plan for a mine may change over the mine's life, resulting in different environmental outcomes that cannot be predicted when a mine is first permitted and opened.**

4.177 Precipitation The BBWA assumes annual net precipitation of 803 mm/year, 804 mm/year, and 1,830 mm/yr at the mine site, TSFs and port respectively (Box 4-2, pg. 4-28). The net precipitation estimates are used for both the pre- and post-mine construction scenarios. This implies that evaporation is roughly constant between the two scenarios. As described in the next section, this may not be a valid assumption, raising questions on the validity of the water balance analysis.

<u>EPA Response:</u> **The revised assessment estimates annual net precipitation of 860 mm/yr throughout the mine site. We have not estimated changes in the evaporation rate but have implicitly assumed that the magnitude of the net change over the site would be small compared to net precipitation.**

4.178 Evaporation The BBWA does not account for the reduction in evaporation due to the removal of vegetation and the duff layer that exists in the pre-mine condition. This would likely result in lower evaporation losses in the post-mine construction scenario. It is well known that cleared, compacted, paved, or otherwise denuded areas have lower interception storage and resulting lower evapotranspiration rates.

Prior to mine construction, the site is covered with trees and vegetation as well as an organic duff layer and microtopography that intercept precipitation allowing extended exposure and opportunity for evaporation as compared to a denuded area for which precipitation percolates into the ground and is unable to evaporate. Similarly the pre-mine scenario duff layer acts as a sponge that soaks up water making it available for evaporation over a longer period of time. Finally, plants with roots reaching deep below the surface continue to access water and transpire, resulting in evaporation losses of subsurface water. Extended evaporation and evapotranspiration can lead to significant water losses.

During active mine operations, the mine site will be denuded and the vegetation and duff layer will be gone. Precipitation incident on the site will runoff faster and be diverted into ponds for treatment and release or for storage and reuse. All the ponds will likely have exposed water surfaces providing an extended period over which evaporation can occur in these smaller areas. This could result in additional water that could be managed as part of an overall site water management system to augment reduction of water due to the other site activities.

After mine closure, large areas of the site (TSF, waste rock piles, etc.) will be revegetated and their evapotranspiration potential will increase. The mine-pit will become a large lake subjected primarily to pan evaporation. Not accounting for these changes in evaporation leads to inaccuracies and misinterpretation of the water balance.

<u>EPA Response:</u> **We agree that development of a mine site may cause decreases in evapotranspiration in some areas and increases in other areas, and that changes may**

vary during different stages of the mine life. The assessment does not attempt to quantify these changes but implicitly assumes that they are small relative to the amount of precipitation.

4.179 On-site water use The BBWA includes a water balance that shows 32M m^3/year of water capture and 27M m^3/yr of water use, of which 25M m^3/year is designated as lost because of storage in the TSF. The report does not provide a reference to support their assumption of 46% voids in the tailings material. However the assumption of a void ratio of 46% filled with unrecoverable water is within the range of reported values in literature.

While the quantitative assessment of water lost to entrainment (i.e., unrecoverable) may be within the reported range in the literature, there will be significant variability both within the literature range, and physically over the depth of the TSF as deeper tailings become compressed and release their void water back into the overlying tailings. With the large volume (e.g., 25M m^3/year) of entrained water, variability in the void ratio assumptions will have large impacts on the overall water balance. Conclusions derived from the water balance about reduction in water flow to streams downgradient of the site must consider the uncertainties in the input, and hence the two scenarios presented are likely inaccurate representations.

<u>EPA Response:</u> **We agree that changes in the void ratio will change the amount of water stored in the tailings. The void ratio was calculated from data presented in Ghaffari et al. (2011), specifically the percentages of each type of tailings (bulk tailings – 85% of the ore mined, pyritic tailings 14%, p. 354), the tailings dry densities (bulk tailings – 85 lb/ft^3, cleaner scavenger tailings – 110 lb/ft^3, p. 353), and the specific gravity of the tailings solids (bulk tailings – 2.63, cleaner scavenger tailings – 3.00, pp. 198-199, Table 16.31.1, Flow IDs 178 and 228). We interpreted the following statements from p. 353 of Ghaffari et al. 2011 "The permeability of tailings deposits tends to decrease over time as the deeper tailings consolidate due to progressive loading. The filling schedule for the TSF is based on an estimated average dry density of 85 lb/ft^3 for the bulk tailings and 110 lb/ft^3 for cleaner scavenger tailings, which have a higher specific gravity." to mean that the reported density represented the average density of the tailings in the TSF.**

The original draft assessment did not report a void ratio of 46%. It stated that "about 46% of the [tailings] volume would consist of voids between the solid particles." The volume of voids divided by the total volume, i.e., 46%, equals the porosity. The void ratio equals the volume of voids divided by the volume of solids. The specific gravities of the tailings solids in the final assessments are slightly higher than in the previous drafts, resulting in slight increases in the average void ratio and the volume of water trapped in the tailings pore spaces.

4.180 Ground and surface water dynamics The BBWA is vague on quantifying the impacts of mine development and operations on groundwater and does not account for potential mitigation practices to reduce the impacts of water use at the mine on downgradient streams. The report provides a short discussion of the calculation of the cone of depression around the mine pit (Box 4-2, pg. 4-28). This cone of depression was estimated to extend to approximately 1,200 m and 1,300 m from the perimeter of the mine pit under the minimum and maximum mine scenarios. However, the report does not quantify the impacts resulting from the extent of the cone of depression and simply states that “The balance of surface water and groundwater inputs to downstream reaches would shift, potentially reducing winter fish habitat and making the streams less suitable for spawning and rearing (ES-15).” The report further states that an “unquantifiable area of riparian floodplain wetland habitat would either be lost or suffer substantial changes in hydrologic connectivity with streams”.

Further evaluation needs to be performed to quantify the impacts and to demonstrate the significance of the impacts. This would allow a discussion of the adequacy or inadequacy of the mitigation measures that could be in place at the mine site. Such options for mitigation result in changes in the ground and surface water dynamics include actively managing surface water to better mimic the pre-mine construction water balance by injecting treated waters into the ground as needed to restore groundwater levels and minimize impacts down gradient of the dewatered areas. Ground water injection could also mitigate temperature concerns in the streams from the increased discharge of treated water as well as temperature concerns raised from decreasing groundwater flow.

EPA Response: Chapter 6 of the revised assessment states, “The cone of depression would lower the groundwater table, drying up streams, ponds, and wetlands that depend on groundwater discharge and turning areas of groundwater discharge into areas of groundwater recharge.” The affected area within the cone of depression is included in the mine footprint area and in the quantification of the streams dewatered.

4.181 In discussing the possible tailings dam failures, EPA cites Table 4-8 of the Draft Assessment, which identifies 135 tailings dam accidents and failures as relevant to the supposed risk in the hypothetical mine activity that EPA analyzes. Yet, 93% of these incidents (126 of 135 examples), do not involve the type of dam construction that NDM knows is being studied by PLP, making these accidents and failures wholly inappropriate and irrelevant in the present analysis.

EPA Response: The assessment bases its primary mine elements on the mine described in Ghaffari et al. (2011), as commissioned by Pebble Limited Partnership partner Northern Dynasty Minerals. However, the assessment’s purpose is to evaluate any potential porphyry copper mines in the Nushagak and Kvichak River watersheds. Other mines may propose alternative designs.

In the revised assessment, we have clarified that historic tailings dam failure data were used to set a reasonable upper bound of the dam failure probability. We also acknowledge that the use of modern conventional mining design, practices, and technologies could reduce the failure rate relative to historic rates by an order of magnitude or more.

4.182 NDM is also troubled by the EPA’s erroneous assumption that Pebble’s tailings embankments will allow only 14 inches of freeboard and that tailings water will be immediately below the bank crest. NDM believes it is more realistic that PLP will design for more than 50 feet of freeboard and that under normal operating conditions, tailings water would be set back approximately 1,000 feet from the embankment crest, consistent with Alaska dam safety permitting requirements. EPA’s hypothetical mine would never be permitted given the assumptions used on this point.

<u>EPA Response:</u> It is expected that normal operations would meet appropriate and regulated criteria. The tailings dam failure scenarios assume some system is not meeting minimum requirements and factors of safety are compromised, which subsequently leads to a potential failure mechanism. The comment apparently confuses the meaning of the terms "freeboard" and "precipitation." The assessment discusses the use of the "24-hour probable maximum precipitation" of 14 inches. "Freeboard" is the vertical distance between the crest of the dam and the reservoir level. No change required.

4.183 Comments below are from the tables in Doc. #4611.

- Pg 4-49, Figure 4-12: The y-axis jumps from 10^{-1} (i.e., 0.1) to 10. The 10 should instead have been 1. This may be a typo, but it is misleading in terms of overestimating probability of failure.

<u>EPA Response:</u> This typographical error has been corrected in the final assessment.

- Pg 4-53, Box 4-8, "HEC-RAS inputs included geometry of an inline structure to simulate the dam cross-section and stream channel geometry data, both derived from a 30-m digital elevation model": Per the HEC-RAS manual (USACE, 2010), if an analysis is completed using bathymetric cross sections developed from a 10 meter DEM or coarser are used "then you should not expect to be able to get good model calibration with such poor terrain data." This significant shortcoming and misuse of HEC-RAS is not acknowledged in the Draft Assessment.

<u>EPA Response:</u> We realize the limitations of the 30-m DEM and thus did not attempt to map the extent of flooding or depict inundation. There is no actual event to provide a basis for calibration and none was attempted. The HEC-RAS modeling is intended to review floodwave propagation from a single event storm and dam failure to get a sense of the potential extent of valley floodplain that could become flood conveyance given the limited available data. The results overwhelmingly show that the PMF and dam failure would not be contained within the current channel width and adjacent floodplains (based on the limited DEM data available).

- Pg 4-60, "The failure rate from third-party impacts, such as damage caused by excavating equipment, tends to be steady over time, whereas corrosion failures tend to increase with age of the pipe.": This statement directly contradicts the subsequent statistical analysis and development of an annual probability of pipeline failures, which has an implied assumption of constant failure rate.

<u>EPA Response:</u> The reported aggregate pipeline statistics include pipelines of various ages and both corrosion and mechanical failures. Although the cited sentence from the draft assessment (which has been revised to include the appropriate citation) was included to give the reader some additional perspective on failure rates, the rates for both failure modes are similar and the aggregate statistics were used to develop the presented estimates of failure probability. Based on the cited sentence, one could hypothesize that over the life of a pipeline, the initial failure rate might be lower than the overall average and the later failure rate would be higher than the average as corrosion failures increase. However, the low expected frequency of failures for

pipelines of the length in the assessed scenarios would not be expected to provide enough data to confirm such a hypothesis. No change required.

- Pg 4-62, "Distance to nearest shutoff value of 14 km. This value assumes there would be isolation valves capable of being remotely activated on either side of nine major river crossings along the transportation corridor. This is similar to the plan laid out in Ghaffari et al. (2011), although they call for manual rather than automatic isolation valves.": On the contrary, Wardrop (2011) (i.e., Ghaffari et al. 2011) states that "manual isolation valves are provided on either side of "major" river crossings (pg. 337). There is no basis for the nearest shutoff valve being 14 km away. Wardrop (2011) characterizes major river crossings as 600 feet across.

<u>EPA Response:</u> **The pipeline safety features in the assessment's mine scenarios are more protective than those proposed in Ghaffari et al (2011) and described above in the comment. The assessment includes automatic isolation valves at an estimated nine crossings versus manual isolation valves only at major river crossings greater than or equal to 600 ft across (of which there is only one, the Newhalen River, in the assessment area). In the revised assessment we refined the analysis to consider local topography near specific stream crossings to limit the length of pipe which could drain through gravity flow.**

- Pg 4-53, Box 4-8, "Tailings dam failure via overtopping is expected to have similar effects as failures resulting from other causes (e.g., slope failure, earthquakes).": Mine tailings outflow volume and runout distance is always affected by the mode of failure.

<u>EPA Response:</u> **The assessment says the effects are expected to be similar, not identical. The additional water contributed by the precipitation event would contribute only a small part to the total flow from the TSF. No change required.**

- Pg 4-57, Box 4-9, "We assumed that sediment deposition could occur in the channel and the floodplain of each section at the maximum predicted channel depth during the peak of the flood wave.": When river flows are at their maximum flood stage, river velocities are often at their highest, which is not conducive to sediment deposition. As such, this EPA assumption is not correct.

<u>EPA Response:</u> **This was an attempt to assess the potential maximum depth of highly viscous sediment flow deposition, by reviewing results of a hydraulic model. In the revised assessment, we have adjusted the review and application of the results to better acknowledge that the depth and distribution would not follow the predictions of a 1-D model. Regardless of maximum flow depth, only 1-foot of sediment was "allowed" to deposit in the channel and on the floodplains. Further explanation in provided in the revised text (Chapter 9).**

- Pg 4-57, Box 4-9, "We assume a particle size distribution of 0.1- to 1.0-m diameter for the dam construction material, and less than 0.01- to just over 1.0-mm diameter for the impounded tailings material (Figure 4-13). Based on the Hjulstrom curve—which estimates when a stream or river will erode, transport, or deposit sediment based on flow speed and sediment grain size—all of the mobilized tailings would remain in suspension at water velocities greater than 0.05 m/s (0.16 feet/s).": The Hjulstrom curve was developed based on particles 5 mm and larger while the tailings particle sizes are assumed to range from less than 0.01 mm to just over 1.0 mm. This curve is not applicable to evaluate sediment transport following a dam breach.

<u>**EPA Response:**</u> **The Hjulstrom curve was utilized to better understand how post failure sediment could be mobilized, when reviewing hydraulic model velocity results. It was not applied to floodwave peaks. The Hjulstrom curve has a range of 0.001 mm (clays) to 1 m (boulders). We recognize that finer grain sizes will continue to mobilize at low flow. The curve helped to place a parameter on a larger majority of the released tailings volume.**

- Pg 5-41, "In the upper reaches of the North Fork Koktuli River (upstream of NK119A), the mainstem and tributaries would experience direct loss of habitat to the mine footprint or substantial loss in flow (73% reduction at gage NK199A). Downstream of gage NK119A, flow reductions of 15%, 7%, and 5% at gages NK100B, NK100A1, and NK100A respectively, would be expected (Table 5-6).": As indicated on pg. 5-24, Table 5-6, this paragraph overstates Net Flow Reductions (%) as follows: NK119A = 63% (less than 73%); NK100B = 13% (less than 15%); NK100A1 = 6% (less than 7%).

<u>**EPA Response:**</u> **Tables have been corrected and updated in the revised assessment.**

4.184 The Assessment contains numerous fatally flawed errors in their modeling assumptions with respect to mine operations and the failure scenario, resulting in fatally flawed conclusions regarding mine water balance and impacts to salmon resources downstream of the TSF 1 site. The Assessment provides insufficient detail on the failure scenario modeling that would allow the reader to determine if the impacts as described are "realistic". Critical missing information includes assumptions regarding flood routing, cross sectional information used to develop the depositional profiles presented, an explanation of the physics of why and how the North Fork Koktuli channel could scour to bedrock given that the water passing over is fully saturated with tailings particles, and any model information downstream of the confluence of the North and South Koktuli rivers resulting in unsupported speculation about downstream deposition and a scientifically indefensible conclusion about impacts to Chinook salmon populations in the Nushagak watershed.

<u>**EPA Response:**</u> **A comprehensive sediment transport model of the system has yet to be developed and analyzed. The assessment does describe the use of a 1-D hydraulic model (HEC-RAS) to determine the potential floodwave from a single storm event. The dynamics of sediment transport during a dam failure would be very complex and the scour and depositional patterns of the debris flow would vary as the floodwave moved downstream. Ultimately, the valley morphology could be greatly varied in the short term.**

4.185 The Assessment page 4-45: Section 4.4.2.2 Probability of Tailings Dam Failures and Table 4-8. The Assessment presents information on the probability of tailings dam failures in this section and in Table 4-8. However, the reader is provided with no scientifically defensible information, data, or analysis to demonstrate that the probabilities of failure presented in the Assessment come from tailings dams that are comparable with the type of dam structure assumed by EPA in the mine development scenario. The Assessment should only present failure rates for dams that are constructed essentially identical to that envisioned in the development scenario. Inclusion of any dams built with different engineering designs or construction and maintenance standards should not be presented in the Assessment. What is needed is an "apples to apples" comparison in order to provide a meaningful comparison. The Assessment does not provide a valid or defensible analysis on this topic.

<u>EPA Response:</u> Comment noted. However, the National Inventory of Dams lists only two rockfill dams in the U.S. of the height of those described in Ghaffari et al. (2011), making any meaningful "apples to apples" statistical comparison impossible. No change required.

4.186 The Assessment page 4-60: Section 4.4.3.1 Causes and Probabilities of Pipeline Failures. This entire section of the Assessment is fraught with problems. First, why was the failure rate data from the oil and gas industry used instead of information from the mining industry? Second, is the failure rate of all of the pipelines reviewed in Table 4-14 comparable to the conditions, level of inspection and maintenance, and construction standards that will be applied to the mine development scenario? Finally, is the content of the pipeline responsible for what percentage of the problems that result in pipeline failure? Failure of the Trans Alaska Oil Pipeline was due to corrosion caused by the substance being transported and improper inspection and maintenance. So how could data on this pipeline failure be comparable to what would be expected under the mine development and operations scenario in the Assessment? The Assessment fails to present any credible documentation or analysis that demonstrates to the reader that the selection of pipeline failure rates from the oil and gas industry will be comparable to the mining industry. The Assessment needs to be rewritten using scientifically valid and defensible data and analysis that supports the selection of the probability of failure rate for pipelines carrying the materials outlined in the mine development scenario and receiving the inspection and maintenance anticipated in the Assessment. The current conclusions in the Assessment are not supported by a scientifically defensible methodology, selection of data, or analysis to reach the conclusion regarding pipeline failure rates.

<u>EPA Response:</u> See response to Comment 4.148. The comment makes some valid points, and these issues were considered when preparing the draft assessment. It should be noted that of the four pipelines in the mine scenarios, one would carry diesel fuel and one would transport natural gas, so the use of statistics from the oil and gas industry is justified for these pipelines. The publicly available databases on oil and gas pipelines are much more extensive and comprehensive than available data on mining pipelines and are much more likely to contain reliable failure data because of the regulatory inspection and reporting requirements. The incidence of external corrosion and mechanical failures would not be expected to differ substantially based on the transported product, but internal corrosion and abrasion rates may vary.

4.187 The Assessment page 4-62: Section 4.4.4 Road and Culvert Failures. This entire section of the Assessment is based on a lack of knowledge of the fish passage requirements for salmonid fishes in relation to modern mine road construction and maintenance. In addition, this section fails to mention the fish passage requirements imposed by the Alaska Department of Fish and Game on any project like the proposed mine development scenario. The use of Furness et al, (1991) as a primary reference on the impacts of road construction on streams is a completely inappropriate and scientifically indefensible, since Furness et al. (1991) reviewed mostly temporary roads constructed in the 1950s to 1970s in the Pacific Northwest.

These were mostly temporary access roads to support timber harvest and did not have the design standards or road maintenance requirements that a current day industrial grade mining road would have. The use of this reference alone demonstrates the complete lack of knowledge and ignorance by EPA about modern road design and maintenance requirements. Also, the Assessment asserts that Warren and Pardew (1998) conclude that “Culverts are deemed to have failed if the passage of fish is blocked or if stream flow exceeds culvert capacity, thus resulting in washout of the road (Warren and Pardew 1998, Wellman et al. 2000)”. However, review of Warren and Pardew revealed that they make no such claim in their report. Also, the use of Warren and Pardew as a reference is scientifically invalid, since they tested fish passage on small-streams in Central Arkansas, using fish from the sunfish, minnow, and killifish families as their primary test subjects, not salmonid species found in the watersheds of the Assessment. This reference does not constitute a scientifically valid assessment of the effects of culverts in the Pebble project area or along the hypothesized transportation corridor as described in the Assessment. The impacts outlined in this section again come from Furness et al. (1991) and are completely invalid. The Assessment fails to meet EPA’s own standards regarding ecological risk assessment and data quality. The Assessment needs to be rewritten to professionally and comprehensively present a scientifically defensible and professionally credible description and analysis of the effects of road crossings on streams along the hypothetical road corridor and based on modern mine road design and maintenance. The current description and conclusions based on what’s in the Assessment are totally invalid.

<u>EPA Response:</u> See response to Comment 4.82.

One of the papers referenced in the comment, Furniss et al. (1991), focuses on forest and rangeland roads but is a seminal publication on the potential effects of roads, particularly as they relate to salmon. The general conclusions of that paper should be applicable to the transportation corridor evaluated in the assessment. The failure frequencies cited in the revised assessment are from modern roads and not restricted to forest roads. Reference to Flanders and Cariello (2000) has been deleted in the revised assessment.

It is important to note that modern roads also can have negative effects on the environment. The transportation corridor evaluated in the assessment would traverse varied terrain and subsurface soil conditions, including extensive areas of rock excavation in steep, mountainous terrain where storm runoff can rapidly accumulate and result in intense local runoff conditions (Ghaffari et al. 2011). Although the road design, including placement and sizing of culverts, would take into account seasonal drainage and spring runoff requirements, culvert failures would still be expected. For example, heavy rains in late September 2003 washed out sections of the Williamsport–Pile Bay Road, and culverts on this road have been washed out on numerous occasions.

Reference to Warren and Pardew 1998 has been deleted from the revised assessment.

4.188 Section 4.4.4 describes the problems associated with culverts and cites Furness et al. (1991) among others. What EPA failed to understand is that Furness et al. (1991) assessed temporary roads constructed in the 1950s to 1970s for land management activities in the Pacific Northwest. These roads were often placed in locations designed to access timber sales with little regard for slope stability, proper culvert placement and design, proximity to waterways, or maintenance needs. In fact, some of these roads never received maintenance, except for an occasional grading to smooth out the ruts. This reference is not applicable to a modern mine road alignment and design criteria, especially in Alaska where protection of fish bearing streams is a constitutional requirement.

<u>EPA Response:</u> See response to Comment 4.187.

4.189 The references with respect to culvert failure rates are also inappropriate for this Assessment. The title of the Gibson et al. (2005) paper is Loss of fish habitat as a consequence of inappropriately constructed stream crossings, which in itself describes the outcome of their evaluation, because the culverts were not installed correctly. In fact, only two of the 47 culverts evaluated were of a "squash pipe" design which allows a natural stream bottom to be established and the remaining 45 culverts were straight pipes with a majority not being properly seated into the stream bottom according to agency requirements. Price et al. (2010) report a 30% failure rate 34 among the 77 culverts examined. However, Price et al. (2010) clearly state: "Our results indicated the 30% of culverts (23 of 77) permitted under the HPA process for fish passage were, in fact, barriers. Culverts permitted as no-slope (one of the most common design types) or as an unknown design type were barriers in 45% of cases. Most culvert failures were due to noncompliance with permit provisions, particularly culvert slope, and a lack of critical evaluation of proposed plans in the context of site conditions by permitting biologists."[Emphasis added]. Again, the primary factor in culverts being rated a failure was not because a culvert was installed as a crossing structure, but that it was not installed according to agency guidelines or the permitting biologist did not critically evaluate the proposed plans.

<u>EPA Response:</u> See responses to Comments 4.82, 4.152, and 4.187.

4.190 Flanders and Cariello (2000) report failure rates of 66% for anadromous culverts and 85% for non-anadromous culverts on roads constructed on the Tongass National Forest in Southeast Alaska. However, careful review of the criteria used to determine whether fish passage was achieved reveals a high standard of passage (i.e., weakest swimming juvenile fish able to pass under all flow conditions). In addition, Flanders and Cariello (2000) outline the conditions that caused a culvert to not meet the passage criteria established (see the passage criteria and conditions immediately below).

a. "Adequate fish passage requires that the weakest swimming fish present in a watershed can pass upstream and downstream through culverts at all flow levels when that species would be likely to pass the same point in the stream, absent the culvert. The above results rely heavily on assumptions regarding swimming capability of juvenile fish and estimated stream flow. While some culverts may be complete barriers to both adults or juveniles, many of the culverts on anadromous streams identified in this report as assumed not to be adequate for fish passage most likely only restrict the movement of juvenile salmonid fish.

b. Velocity is the most common cause of fish passage restriction in culverts. If a culvert is installed at too steep a gradient or the culvert width is significantly narrower than the streambed width, the water velocity will be increased within the culvert. Very slight changes in the slope of the culvert and the roughness of the substrate within the *culvert may significantly change velocity and the ability of fish to pass through the culvert during all of the times of year when they normally move upstream or downstream. Other frequent causes of fish passage problems include perching of the culvert outlet above the water surface, blockage by excessive substrate or woody debris within the culvert and structural damage to the culvert. In most cases, multiple factors interact to restrict fish passage."*

What Flanders and Cariello (2000) really documented was improper design, installation, and maintenance not the fact that a culvert was used as a crossing technique.

<u>EPA Response:</u> See responses to Comments 4.82, 4.152, and 4.187.

4.191 The Assessment is fatally and fundamentally flawed in its conclusions regarding the use of culverts and culvert failure rates for several reasons. First, the Assessment used inappropriate literature to quantify culvert failure rates. The results from the references cited all point out quite clearly that improper design or installation of culverts can be the major source of culvert failure or blockage of fish passage. Why didn't the Assessment use culvert failure rates for mining 35 roads constructed and maintained in Alaska, such as Red Dog, Pogo, or Fort Knox? These mines alone have over 105 miles of modern, all-weather road that are used and maintained essentially the same as hypothesized in the routine operations scenario. Second, it is unreasonable for the Assessment to use these references since the assumption for the routine operations scenario is that the transportation corridor would be constructed according to standard engineering practices, appropriate functional mitigation measures, in accordance with state and federal requirements, vigilant inspections during construction to ensure proper installations, and routine daily maintenance inspections. All of these measures would eliminate most of the reasons cited in these references that caused the culvert failures documented. The assertions in Section 6.4.1 regarding failure rates is nothing but scientifically indefensible speculation and simply does not reflect reality. Third, EPA clearly lacks an understanding of the importance of maintaining a fully functional transportation corridor to a large scale mining operation. That corridor is transporting potentially millions of dollars of product and critical operational supplies daily and any disruption of the pipelines or road access is simply not an acceptable situation and repairs or remediation would occur immediately. Fourth, the entire discussion of road and culvert failures in the Assessment in Sections 4.4.4, 5.4, 6.4, and Chapter 8 are based on the use of inappropriate literature, invalid comparisons between the locations and situations evaluated in the literature cited and the hypothetical transportation corridor outlined in the Assessment, and highly speculative and in some cases just plain wrong (e.g., the conclusion in Section 6.4.1 that multiple culvert failures could result in closure of the transportation corridor for "more than a month") assumptions and conclusions that are scientifically indefensible. Finally, the Assessment, by using inappropriate data and references and scientifically indefensible assumptions and conclusion clearly failed to meet EPA's ecological risk assessment and information quality guidelines with respect to data quality, appropriateness of the data and literature used, and disseminating high quality and science based information to the public. The Assessment fails to meet EPA's own standards of scientific quality and professionalism for the products they produce. This Assessment is replete with examples of the same type of problems in many other topic areas, but this is one of the most egregious examples found so far.

EPA Response: **See responses to Comments 4.82, 4.152, and 4.187. We disagree with the assertion regarding the appropriateness of the data and our conclusions with respect to culvert failure. We were unable to obtain information for highly engineered roads or the specific roads mentioned in the comment, but to the extent possible we used recent literature from representative environments. The text noted in the comment—"…multiple failures such as might occur during an extreme precipitation event could require more than a month to repair…"—has been modified in the revised assessment.**

4.192 4-44 Table 4-7 Conspicuous by its absence in this table is the double earthquake that occurred on October 23 (6.7 magnitude) and November 3 (7.9 magnitude; ~2 min duration) 2002 along the Denali fault south of Fairbanks, AK. This pair of seismic events is very relevant to any seismic evaluation of tailings embankments in Alaska because of its close proximity to the Fort Knox Mine tailings and water reservoir embankments and the very detailed data that were collected from seepage monitoring wells and vibrating wire piezometers installed within the embankments for monitoring purposes. After the first event, vibrating wire piezometers and seepage flows were monitored on a daily basis (Gillespie 2002). Enhanced monitoring at the tailings embankment and the water reservoir embankment downstream continued for several weeks after the second event. Inspections revealed no signs of movement, slope or crest deformation or settlement associated with either embankment. Seepage monitored at both embankments remained clear throughout the enhanced monitoring period and beyond and no signs of piping were observed. No changes in suspended solids or other parameters occurred in monitoring wells near interceptor wells below the tailings facility, indicating no change in groundwater flow (Gillespie 2002). All this information is readily available and has been since December 2002. The bottom line is this: in spite of a double seismic event of 6.7 and 7.9 magnitude close to a modern tailings embankment, enhanced monitoring of a suite of critical parameters revealed that nothing happened. In other words, the facility behaved as designed. Omission of this important information, which is directly related to the assessment of seismicity and tailings embankment stability, and reflective of performance of a relatively modern mining facility, built and operated in Alaska, is a serious failure of EPA when engaging in a comprehensive and realistic analysis. This is a serious omission bordering on negligence, and imparts a significant bias to the assessment.

EPA Response: **We appreciate the information related to the monitoring of impacts of two large earthquakes on a relatively modern mining facility. The geologic conditions at the Red Dog Mine are different from the Pebble area and the lack of adverse impacts at that site does not guarantee similar results at Pebble or over the short or very long term.**

4.193 4-53 Box 4-8 This box makes the important point that the "headwaters" location of the assumed TSF mitigates against a large Probable Maximum Flood (PMF). It also states that "[i]f sufficient freeboard is maintained, it would be possible to capture and retain the expected volume of the PMF in the TSF." An important additional point, that EPA failed to present, in their description of the full TSF failure scenario is that the amount of watershed available to contribute to a PMF (sloping toward the TSF) in this scenario is essentially the surface area of the TSF itself. This makes it even more unreasonable to assume that insufficient freeboard would be maintained in the full TSF scenario; even a probable maximum precipitation event (PMP) such as that presented by EPA would not add much to the water surface elevation in the TSF. Strangely, EPA does not disclose what the water surface elevation increase for either the Full TSF or the Partial TSF failure scenario would be; it should have. Furthermore, this box fails to disclose that the State of Alaska requires that sufficient freeboard be maintained in all tailings storage facilities to retain far more than the PMF, plus a sizable safety margin on top of that. The box goes on to say that "to examine potential downstream effects in the event of a tailings dam failure, we assume that sufficient freeboard would not exist and overtopping would occur," in spite of monitoring and maintenance. In other words, EPA is forced to make an unreasonable assumption in order to have something to analyze. This is a significant departure from EPA's own promise to develop a reasonable analysis.

EPA Response: The impacts from a potential tailings dam failure would be primarily from the sudden release of the large volume of stored tailings, not from the additional water that a precipitation event, even the PMP, would contribute. The impacts from a failure would be similar whether the tailings dam failed due to a precipitation event, a slope stability failure, or an earthquake if any such event caused a breach of the crest. We agree that a properly designed, constructed, and operated TSF should be able to manage the PMF. If maintenance in perpetuity or construction practices were not met, a failure during a PMF is considered a possible outcome. However, as Box 8-1 of the revised assessment describes, overtopping can and has occurred at even a recently approved and regulated modern mining operation in Alaska.

4.194 4-50 §3 ff. Tailings Dam Failure via Flooding and Overtopping – The "full-volume failure" TSF embankment failure is unrealistic and unreasonable in the extreme and on several levels. First, there is very little watershed surrounding the TSF to contribute to a PMF; the available watershed is a fraction of the surface area of the TSF itself. Second, given the precipitation model presented later in the report in Table 4-7, the total water contribution to the TSF from direct precipitation is 0.36 m (a little over 1 ft). A reasonable contribution from the available surrounding watershed added to direct precipitation might bring the water surface elevation up as much as 0.5 m (a little over 1.5 ft). To assume that any mine operator or oversight agency would let freeboard fall to this level is completely unreasonable. Tailings impoundments operate by pumping a slurry from the mill through spigots to form beaches, primarily adjacent to embankments, and pumping water back to the mill from a deep portion of the pond. Beaches extend long distances from the spigots, often miles. Water depth over the great majority of the impoundment is either zero (in the areas occupied by beaches) or shallow. The EPA full TSF scenario would unreasonably assume no freeboard represented by tailings beaches adjacent to the embankment. This freeboard, along with the portion of the embankment crest supporting spigots and piping would alone provide sufficient freeboard to capture the PMF at this site. Curiously, EPA never tells the reader how much water surface elevation gain would be produced by the PMF, an important factor in evaluating the reasonableness of the analysis. It should be in the analysis.

EPA Response: See response to Comment 4.193.

4.195 Perhaps most important, however, is the assumed location of the breach in EPA's "full-volume failure" scenario. Once the elevation of the saddle between NK 1.190 and SK 1.190 is reached by the northern embankment of TFS-1, it is unreasonable in the extreme to assume that the southern embankment would ever be allowed to be as high as the northern embankment, where freeboard is an issue. No rational mine operator would allow this to occur, and no rational regulator would, either. The safety value of a "freeze-plug" at the southern embankment, by keeping it at a slightly lower elevation, is much too great. The only logical, albeit still unreasonable, full-volume scenario is to have the failure occur at the southern embankment. The elevation of the saddle between the two watersheds containing TSF-1 is 468 m MSL. The elevation of the northern embankment crest at full status would be ~558 m MSL. The difference between the elevation of the saddle, which would serve as a control in the event of a failure, is ~90 m. Therefore, the only logical, if still unreasonable, failure would involve about 90 m (vertical) of tailings, crest to control, not 208 m. Thus, the "full-volume failure" scenario would be of lesser magnitude than the "partial volume failure" scenario, and would be directed toward the South Fork Koktuli River, not the North Fork. Given the topography at the mouth of SK 1.190, most of the volume of material that would exit the TSF would be directed upstream (east) onto the "South Fork Flats", with some material moving downstream through the narrower valley constriction to the west.

EPA Response: This comment provides additional detail and insight regarding one specific TSF design. We acknowledge the likely lower volume of released tailings if the TSF was designed to overtop at the location of the saddle and if the release was caused by an increase in the tailings pond level. However, impacts from a potential tailings dam failure would be similar whether the tailings dam failed due to a precipitation event, a slope stability failure, or an earthquake if any such event caused a breach of the crest. Such a breach could occur at the northern embankment as modeled. The assessment only evaluated failure at one potential dam face on one potential TSF. There are several TSFs and several dams that could be in place depending on the mine scenario. An actual mining operation should consider failure scenarios for all flood pathways. For any large tailings release, the nature of the effects would be as described in the assessment but, as the comment mentions, the magnitude of the release and the extent of the effects would depend on the specific location of the breach.

4.196 The bottom line is that the "full-volume failure" scenario offered by EPA is not well thought out and unreasonable on several fronts. It fails to consider the relationship between the minor water surface elevation gain produced by the PMF and any reasonable freeboard; it fails to consider the freeboard required for routine operation and maintenance with respect to common wind wave generation, among other factors; it vastly overestimates the volume and average depth of the decant pond prior to overtopping and assumes an unreasonable operating condition; and it fails to consider the strategic maintenance of a lower crest elevation at the south embankment than the north embankment, with the result that the least unreasonable failure would be directed primarily onto the South Fork Flats. For all these reasons, the EPA's "full-volume" TSF failure is unreasonable and not credible.

EPA Response: See response to Comment 4.195. We agree and the assessment states that the failure of a tailings dam is a remote possibility, but tailings dam failures do occur and it would be imprudent not to consider the potential consequences of such a failure.

4.197 4-56 §3 This paragraph states, "over 70% of the released tailings are modeled to remain in suspension at the 30-km model endpoint, indicating that effects would actually extend far beyond the 30-km reach." Given the valley land form and cross-sections at the 30-km reach and the stated depth of deposit, this does not appear to be possible. As stated in the next comment, the entire tailings mass could be deposited several times over in a reach between Station 0.6 and Station 9.4 on the North Fork Koktuli assuming deposit depths given in Table 4-13 and flood routing to available low-velocity areas (see next comment). Either 70% of the tailings would remain in suspension and the depths of deposits along the North Fork Koktuli (and South Fork Koktuli, which was strangely excluded from the model) would be a very small fraction of that estimated by EPA's model, or nearly all of the tailings would settle out in the available North Fork and South Fork flood plains at or before the confluence of the North Fork Koktuli with the South Fork, with very little left to transport. EPA cannot have it both ways. This is an obvious failure of the approach taken by EPA to assess the consequences of an unreasonable if hypothetical failure of a hypothetical TSF. The outcome of this modeling exercise should be completely disregarded until the modeling approach is evaluated and calibrated by a qualified outside expert and tested against actual valley cross-sectional profiles with rational flood routing, including up the South Fork Koktuli flood plain. In addition, any assumed impacts relying on this modeling exercise should be disregarded as resting on a faulty foundation.

EPA Response: The assessment has been revised to consider the water content of the tailings and reflect a depositional depth of 1 foot.

4.198 4-59 Table 4-13 The sediment deposit depths and cross-sectional area values in this table are preposterous, especially in light of the EPA assertion made in the text that 70% of the ~300 million m^3 of material from the TSF remains in suspension past the modeled reach (past the confluence of the North Fork Koktuli and the South Fork). Regardless of the model output, a depth of deposition of tailings in the full TSF scenario of 14m at Station 0.6 km would result in a crosssection of deposition far greater than given in the table.

The channel elevation of the North Fork Koktuli stream bottom at Station 0.6 is approximately 182 m MSL. For a deposition depth of 14 m, the water surface elevation would have to be at least 194 m or higher, assuming this depth of deposit was at the channel bottom, which it could not be, given EPA's velocities. If deposits of this depth were at some lateral distance from the channel bottom, the top of a 14 m deep deposit would have to be at a correspondingly higher elevation. At an elevation of 194 m (the lowest possible albeit unrealistic elevation), the valley flood plain available for deposition is in excess of 4 km, and includes the flood plain of the South Fork. Along a transect at right angles to the valley at this point, the flood plain profile is the shape of a saucer, with a maximum elevation of about 1 m separating the North Fork Koktuli from the South Fork, and with much more than half the product of length and height available for deposition. Given the depth of deposition in Table 4.13 (14 m), the cross-sectional area given in the table of 3,635 m^2 is inconsistent with a saucer-shaped flood plain >4 km across. In the EPA scenario, the South Fork Koktuli would be backwatered, and its entire flood plain would be available for deposition. In reality, an actual cross section at Station 0.6 would easily be capable of receiving >35,000 m^3 of deposited material per lineal m of valley bottom to an elevation of 194 m MSL.

At Station 5.4, the North Fork Koktuli River channel bottom is at elevation ~197 m. According to Table 4-13, deposition would be to a depth of 8.1 m higher than the ground elevation in the deposition area, which would have to be significantly higher than the channel bottom. This would result in a water surface elevation well in excess of 205 m MSL. At this (unrealistically low) elevation, the flood plain available for deposition is in excess of 5.3 km, and again includes the flood plain of the South Fork Koktuli. In spite of a “hump” in the middle of a transect (still considerably lower than flood water elevation) at this station, there is far more sediment storage available in the South Fork Koktuli, which is 9 m lower in elevation than the North Fork in this area, and has a broad, flat profile. Given these relative elevations, flood waters would be routed south to and up the South Fork a distance of at least 11 km, which was not included in the model. Easily more than half the product of length and height along a transect at this station is available for sediment deposition, or >21,400 m^3 per lineal m of valley bottom, which is inconsistent with the depositional cross-sectional area of 4,857 m^2 given in the table.

Finally, at Station 9.4, the channel bottom is at elevation ~213 m MSL. According to Table 4-13, maximum depth of deposition would be nearly 9 m, requiring a water depth to elevation well in excess of 222 m MSL. A transect across the flood plain available for deposition at this station would have a length in excess of 6.6 km and, again, would include the South Fork, which was not included in the model. Along this transect, the South Fork Koktuli channel is more than 10 m lower in elevation and the associated local flood plain contains vastly more sediment storage and flood water routing capacity than the North Fork. Obviously, a significant proportion of the flood wave would be routed into the South Fork Koktuli flood plain, especially since the stream in that area would have trivial flow compared to the hypothetical flood. In this area, about half the product of the lowest possible elevation transect length and height would be available for sedimentation, or >25,000 m^3 per lineal m of valley bottom. EPA neglects to give elevations of the flood crest at each of the stations, making further evaluation of routing difficult, but even without these elevations, it is obvious that routing to the South Fork Koktuli flood plain would occur. This is extremely important information, and EPA was remiss in omitting it from the document. In addition, maps of major sediment deposit areas, at least those associated with the “example” stations along the North Fork Koktuli should have been included in the document. In any event, given the available low elevation flood plain profiles in the lower North Fork and South Fork Koktuli Rivers and obvious routing to the South Fork, there is ample storage capacity away from the main North Fork channel to store the entire mass emanating from the TSF several times over. Another shortcoming of the EPA modeling exercise is the failure to account for flood water routing upstream on the North Fork Koktuli. According to sediment depths given in Table 4-13, water surface elevations over the North Fork Koktuli channel at Station 30.0 would be at least 333 m MSL. This would produce a backwatering of the North Fork Koktuli for a distance of ~5.5 km (as the crow flies), with an average backwater width of ~2.2 km, and would inundate Big Wiggly Lake. This flood routing and associated sediment deposition capacity is significant and should have been included in the EPA model, as well as flood routing up the South Fork Koktuli for a distance of >11 km.

These facts call the entire EPA modeling exercise into serious question. It is likely that unrealistic parameters were entered into the model, and that the surrounding landform was ignored when the model was run. In any event, EPA must explain what cross-sectional profiles for the North Fork Koktuli, including the backwatering upstream as well as flood routing up the South Fork Koktuli were used and what assumptions were made regarding the deposition of tailings in the available valley bottom flood plain. In addition, all of the assumed impacts based on this model's output are cast into serious doubt, and should be regarded very skeptically or disregarded completely until the model is fully explained and independently validated. That EPA itself did not catch any of these errors is astonishing.

EPA Response: See response to Comment 4.197.

4.199 4-60 §1 This paragraph states, "the remaining tailings in the breached TSF, would serve as concentrated sources of easily transportable, potentially toxic material." This statement assumes that no effort would be expended to repair and remediate the tailings embankment rupture, should it occur. This is an unreasonable assumption.

EPA Response: The sentence in the assessment says, "Newly deposited material on floodplains, and the remaining tailings in the breached TSF, would serve as concentrated sources of easily transportable, potentially toxic material." This is correct and would remain the case until repair and remediation could correct the situation. Although repair and remediation efforts would be expected to begin at once if the mine was still in operation and the requisite manpower and equipment were available on site, the situation would not be corrected immediately. If the mine was in the post-closure phase, the response time would be expected to be considerably longer.

4.200 4-62 §8 – 4-63 §1 The data regarding culvert failure in this paragraph is based on studies of logging roads (primarily) built to 50+ year old standards and generally intended to be temporary access. Earlier in the document, the assessment assumes an all-weather, permanent industrial road with daily maintenance. Given the earlier assumption, these data are irrelevant. EPA should have used failure frequency data for hundreds of miles of modern, all-weather, permanent, well-maintained industrial roads in Alaska for its analysis. For example, the Red Dog Mine haul road is a 51+ mile long gravel road from the mine to the coast with many culverts, some very large. There have been no culvert failures (e.g., blockages or wash-outs) in its 23 years of operations (Ott 2012, pers. comm.). The Pogo Mine haul road is 49 miles long with 17 culverts. Although in operation for only a few years, there have been no culvert failures. There are many other examples, including the North Slope Haul Road. Information of this kind is readily available and should have been accessed and used by EPA instead of the agency apparently relying on a literature search focusing on old information related primarily to logging road culvert failures and other poorly designed systems with little or no monitoring and maintenance. Conclusions regarding impacts or failure frequencies for the transportation corridor in this EPA analysis based on these data are likewise irrelevant and meaningless in the context of this analysis, and should be disregarded until the text is corrected according to this comment.

EPA Response: See response to Comments 4.82, 4.152, and 4.187.

4.201 In their assessment of potential impacts of a tailings dam failure, the EPA Report authors use an overly simplistic model and exaggerate potential fish and fish habitat loss projections. The model (HEC-RAS) used to model potential tailings dam failures in the EPA Report is a one dimensional model, and may therefore not provide accurate results in a three-dimensional environment, such as the Bristol Bay watershed. Further, the EPA Report assumes that, following a tailings dam failure, all Chinook salmon will lose access to the South Fork Koktuli and potentially Mulchatna and Stuyahok Rivers; however, the results of modeling do not support this conclusion, and it is likely that any physical blockage resulting from a tailings dam failure would be temporary.

The greatest criticism in this section is surrounding statements about fish access to streams due to sediment transport effects. The authors assume that Chinook salmon will lose access to the South Fork Koktuli, and they say that the deposited tailings material may be deep enough to impede fish access to the Mulchatna and Stuyahok Rivers. These conclusions cannot be supported with the results of modeling or any other available data. It seems unlikely this will be the case as these rivers would likely be temporarily dammed by tailings/debris after water from the TSF dam failure recedes. After these rivers become backed up, it is expected that the temporary dams at their mouths would burst within hours or days, thereby removing much of the material that had been blocking the confluence.

EPA Response: HEC-RAS does not provide calculated results beyond the 1-D environment. 3-D impacts must be interpreted by the user and reviewers. Sediment deposition in the affected reach will have the potential to provide a continuous supply for resuspension and deposition that could continue to impact the immediate habitat, making it unusable for rearing or perhaps blocking migration or turning upward migrating fish back downstream. The revised assessment clarifies that loss of access to the various Nushagak River tributaries would be a likely outcome due to a range of factors, including copper toxicity, sediment, habitat conditions, and other water quality limitations that would follow a catastrophic tailings dam failure.

4.202 In another instance (p. 4-57), the text states "Based on historical tailings dam failure data, it is reasonable to assume that all construction material from the dam break and from 30 to 60% of the impoundment tailings material could contribute to debris flow following a tailings dam failure (Browne 2011)'" however, the impoundment tailings proportion values provided in Browne (2011) are "13 to 60%", which indicates a misuse of information by the EPA.

EPA Response: In the tailings dam failure scenario we assume release of 20% of the impounded tailings, which falls at the conservative end of the 13-60% range cited in the comment.

4.203 The impacts of potential tailings dam failure(s) on Bristol Bay salmon and their ecosystems will be highly dependent on the magnitude, frequency, and timing (e.g., stage in salmonid life cycle, natural seasonal flows) of the event(s), and the baseline resiliency of the affected populations and ecosystems. Based on the demonstrated ability of salmon and their ecosystems to be resilient to catastrophic disturbances, it is possible that they would be able to recover from a tailings dam failure. Further, the high degree of habitat heterogeneity of the Bristol Bay watershed may provide increased recovery opportunities for aquatic organisms by providing refuges for salmon during disturbance events. Bristol Bay sockeye are known for having high resilience due to the within-stock diversity of life history strategies in the region; this has been exemplified in recent history through shifts in high production between life history- and regionally- diverse populations (Hilborn et al. 2003).

EPA Response: We agree with the comment. However, if a population such as Koktuli River Chinook salmon were eliminated by a catastrophic dam failure, recovery of the channel and valley would likely take decades to centuries. The streams and their valleys may have to recover from complete or near complete devastation, including potential

toxicity in sediments that may linger. After this process was sufficiently under way, salmon from other systems would have to stray into the Koktuli River system to provide seed stock for repopulation.

4.204 The case studies summarized in this report demonstrate that physical disturbances can be overcome by salmon and their ecosystems. However, none of these examples explore the impact of contamination and toxicity effects of catastrophic disturbances as this was not within the scope of this report. Such effects are critical to the discussion of the potential impacts of a catastrophic tailings dam failure and other mining-related accidents or malfunctions. Moreover, case studies exemplifying the non-recovery of salmon and their ecosystems from catastrophic disturbances were beyond the scope of this report. Further studies that consider this information should be conducted before a well-informed comparison between the effects of natural vs. anthropogenic disturbances (e.g., the EPA Report's tailings dam failure scenario) can be made.

<u>EPA Response:</u> Potential toxic effects from spilled tailings were assessed in Section 6.1.4 of the original draft assessment and are assessed in Chapter 9 of the revised assessment.

4.205 Notwithstanding the high standards that are anticipated for the design of the Pebble TSF, Box 4-4 of the BBWA presents four examples of historical tailings dam failures that led to significant release of tailings. These case histories are presented to inform the reader of the likelihood of and the potential implications of a significant tailings release. The sections that follow will present each of those cases, and demonstrate how they are either not relevant to the proposed Pebble Project, or how the failure modes can be readily mitigated at Pebble through proper design, construction, operations and management.

The tailings dam at the Los Frailes Mine in Spain failed in 1998 primarily due to foundation instability of clays with low residual shear strength. This foundation failure mode can be mitigated for the Pebble TSFs through proper investigation and foundation preparation. As stated in Wardrop (2011): "Embankment foundations will be prepared by removing all organics and unsuitable materials prior to controlled rockfill placement on competent overburden and/or bedrock foundations."

Two tailings dams failed at Stava, Italy in 1985. The dams were constructed with cycloned sand tailings which separate the coarse and finer fractions of tailings solids. The coarser fraction of tailings was sent to the face of the embankment for staged construction using the upstream method of construction. The two dams were built with overly steep embankments, and the toe of the upper dam was supported on the tailings of the lower impoundment. The stability of this configuration had a very low factor of safety against failure. This slope instability failure mode can be mitigated for the Pebble TSFs through proper investigation and material characterization, and subsequent stability evaluation as input to design. The typical minimum factor of safety under static conditions (i.e., non-seismic) for a modern dam is 1.5, indicating that the forces resisting a slope failure exceed the forces driving failure (e.g., gravity) by 50%. While specific stability analyses have not been reviewed, for Pebble it is likely that seismic criteria will decide the final dam configuration, and static factors of safety will likely be higher than 1.5. Had the Stava tailings dams been designed with appropriate factors of safety, the 1985 failure would not have occurred. As noted in the Wardrop (2011) report, the Pebble TSFs are likely to be built using earth and rockfill as opposed to tailings, and the downstream and centerline methods of construction will be employed instead of the upstream method used at Stava, which is more prone to failure (Wise, 2012).

The Aurul tailings dam failure in 2000 was a result of overtopping of the dams and subsequent breach and tailings release. The overtopping failure mode would be mitigated for the Pebble TSFs primarily through design and operations with sufficient freeboard for extreme events. As stated in Wardrop (2011): “The TSF impoundment is sized to provide additional freeboard for complete containment of all runoff from the inflow design flood, for wave run-up protection, and for any post-seismic embankment settlement.” In addition, the TSF embankment is to be constructed of erosion resistant rockfill, which is much less susceptible to failure from overtopping than the Aurul dam which was constructed of cycloned tailings.

The TVA Kingston tailings dam failure in 2008 had many contributing factors, but can primarily be attributed to poor foundation conditions and slope instability. These failure modes would be mitigated for the Pebble TSFs through proper investigation and material characterization, and subsequent stability evaluation as input to design. Additionally, proper foundation preparation and use of downstream and centerline construction are anticipated to result in adequate factors of safety.

<u>EPA Response:</u> We agree that the TSF would be designed, constructed, and managed to avoid failure. Box 4-4 lists failures that occurred by a variety of mechanisms. We do not contend that a dam failure at the Pebble site would occur by the same mechanism as any particular past failure. Rather, despite using best engineering practices of the time, these structures can and do fail. The purpose of the assessment is to evaluate the likelihood of failure (which is low) and the potential consequences of failure (which may be catastrophic). The case histories are presented to inform the reader of the potential implications of a significant tailings release, not the likelihood of a significant release. No change required.

4.206 Perhaps the most widely quoted reference in relation to the historical record of tailings dam failures is the 2001 ICOLD report which documents accidents and failures at 220 tailings dams reported between 1917 and 2000. In the BBWA, after removing accidents that did not result in a failure with tailings release, Table 4-8 presents a tabulation of 135 TSF failures from the ICOLD database, subdivided based on failure cause and whether the failure occurred on an active or inactive tailings dam. Beyond this basic tabulation, no significant attempt is made in the BBWA to interpret the implications of these failure case histories on the hypothetical mine scenario. Only the total number of failures is used when evaluating probabilities of failure. As such, it is questionable whether there is any purpose to this evaluation of past failures other than to again highlight the several ways in which failures can occur and to raise fears that such failures are inevitable at the Pebble site. While the ICOLD (2001) report is a significant resource when evaluating modes of tailings dam failures and how to prevent them, it is not appropriate to use the database in direct comparison with a modern mining operation that will undergo the rigorous design and permitting process anticipated for the Pebble Project.

<u>EPA Response:</u> See response to Comment 4.150.

4.207 A comparison can be made to the case histories in the ICOLD report as a basis for evaluating whether appropriate measures are being put in place to mitigate against the failure modes described. With this framework in mind, Table 1 presents an alternate evaluation of the case histories in the ICOLD (2001) report.

Description	Number of Case Histories	Pebble Mitigation Measure
Total Studied Tailings Dams	220	N/A
After Removing Accidents	136	N/A
After Removing Upstream Construction Cases	31	Downstream / centerline construction
After Removing Foundation Failures	22	Comprehensive investigation Foundation preparation
After Removing Overtopping Failures	15	Sufficient freeboard
After Removing Improper Construction Failures	10	Good construction practices and Quality Assurance
After Removing Improper Operations Failures	8	Modern operations practices and tailings management
After Removing Mine Subsidence Failures	7	Distance
Remaining Cases	0	Various

EPA Response: The table referenced in the comment illustrates that if you subtract all of the failures there are no remaining failures. However, no mitigation plan is perfectly designed, executed and operated and new failure modes are possible.

We did not depend on the case histories in the ICOLD document to determine the probability of a dam failure. Nevertheless, we agree with the comment that the mitigation measures listed are important and will reduce the likelihood of a tailings dam failure. Important engineering structures are generally designed with the intent that they will not fail—and this includes all or most of the structures alluded to in the comment's table. The designs incorporate factors of safety to provide a margin of security and to allow the structure to survive loads in excess of the design loads.

Nonetheless, important structures can and do fail due to design flaws, construction flaws, material defects, willful malfeasance, operational error, other human error, and extreme natural events. The paradigm for management of tailings dams continues to evolve and there are no guarantees that a tailings dam constructed in the Bristol Bay watershed will not fail. It is a topic of discussion at industry conferences as cited in the assessment. Our purpose in the assessment is to describe the likelihood and potential consequences of failure.

4.208 The probability of failure discussed in the BBWA, where the ICOLD data is used as a basis for claiming the probability of failure, would be one tailings dam failure for every 2,000 mine years. This probability is not relevant to a modern mining project. An analysis that simply utilizes a retrospective failure rate to estimate future failures at a modern mining site significantly exaggerates the risks of a TSF failure, and therefore results in a biased assessment of future outcomes.

<u>EPA Response:</u> See response to Comment 4.150.

4.209 By providing specific analytical model results to describe the tailings flow distance and associated sediment deposition from a hypothetical tailings release, the BBWA dam breach analysis appears credible whereas in fact, the analysis is flawed. Given the significant uncertainty and thus low reliability of the numerical estimates, the findings are equivalent to a statement that scenario releases of 55 million m^3 or 317 million m^3 of fluidized tailings will travel a long way downstream with significant impacts. One need only review local topography to reach that conclusion. The dam breach analysis in the BBWA reinforces the bias of the document rather than informing a scientifically defensible formal risk analysis.

<u>EPA Response:</u> We concur with the conclusion that "releases of 55 million m^3 or 317 million m^3 of fluidized tailings will travel a long way downstream with significant impacts." We also agree that the hydraulic model has limitations. It was used to provide a better sense of potential floodwave distribution and flow velocity capable of transporting sediment downstream of a tailings dam failure. A review of topography can provide bookends, but the model helps to support the valley-volume comparison.

4.210 The Manning's friction coefficient was increased to "better reflect the influence of sediment-rich water during tailings dam failure" (pg. 4-53). The approach using a modified Manning's friction factor (n) is recommended by the HEC-RAS manual (USACE, 2010). However the BBWA does not supply the reader with information as to how they evaluated the appropriate Manning's coefficient, nor do they state the value used. The HEC-RAS Manual provides guidance that the Manning's values are not exact and a range of possible values should be selected, and then multiple model runs should be performed with different values to evaluate the impact in overall flow response. The implications of changes in model parameters would likely be significant given the scale and likely sensitivity of the analysis. Without following the guidance of the HEC-RAS manual or standard engineering practice to evaluate model sensitivity, the results of the analysis cannot be considered reliable.

<u>EPA Response:</u> Manning's n-value of 0.2 was used for the main channel and 0.6 for the floodplain. These coefficients represent sediment-rich flows and are appropriate for review of the potential dam failure flows. We recognize that these high n-values are not typically applied to clear water modeling simulations.

4.211 2. The analysis relies on a very coarse 30 meter digital elevation model (DEM) to develop channel bathymetry (pg. 4-53) The coarse nature of the 30 meter DEMs does not account for channel complexity in the floodplain where side channels or wider braided channels are only activated during floods and are available for sediment deposition. Off channel wetlands and watercourses are also missed. The lack of channel complexity and channel morphology oversimplifies the channel roughness and leads to river channels characterized as too "clean" and "smooth." As a result the coarse model very likely over predicts flows, velocities and sediment transport relative to what would be expected in reality (Crosby, 2006). For the purpose of hydrologic modeling a 30 meter DEM is very coarse and lacks the detail to allow for an adequate calibration of the HEC-RAS model. The HEC-RAS Manual also states that if you are using bathymetric cross sections developed from a 10 meter DEM or coarser "then you should not expect to be able to get good model calibration with such poor terrain data." (USACE, 2010) Poor quality channel bathymetry data can be the source of large instabilities of model performance when performing unsteady flow analysis with HEC-RAS. These instabilities are often attributed to the modeler using land terrain topography data in place of proper bathymetric data. Additionally, wide flat channel beds (similar to the water surface associated with a DEM) cause instabilities because at lower flows the area/depth ratio is high, and when a small increase in flow occurs it is seen as a large relative increase in depth (USACE, 2010).

EPA Response: We agree that coarse terrain data makes hydraulic modeling more difficult. Given the available data (30-m DEM), the hydraulic model presented initial instabilities. This was addressed through application of necessary baseflow to eliminate numerical instabilities. However, the introduction of baseflow was inconsequential when compared to the modeled floodwave. This is typical and acceptable practice, especially when using a model to understand large flow events. The model is not intended to review both low flow and flood flow results, as the available 30-m DEM is not appropriate for low flow calculations.

4.212 The lateral extent of the cross-sections in the HEC-RAS model were likely insufficient, resulting in increased flow depth and higher velocities (Table 4-13, pg. 4-59) The significant deposition depths computed in the HEC-RAS model are inconsistent with the wider floodplain topography of the last approximately 10 km of the analysis. Stations at 9.4 km, 5.4 km, and 0.6 km from the end of the 30 km analysis show maximum depths of 8.8 m, 8.1 m, and 14.0 m. A review of the topography in the vicinity of these stations indicates the flow would have spread out significantly across a very wide area and would never achieve these depths. It is likely that the lateral extents of the model were insufficient, resulting in HECRAS assigning vertical "walls" at the ends of the cross-section. These walls would result in creating an artificial channel to contain the flow, which in turn would result in unreasonable depths of flow, as well as increased velocity. Both of these artificial impacts (increased depth and velocity) would result in an increased runout distance for the modeled flood.

EPA Response: We disagree with the comment. Although a 30-m DEM was used, the geometries of the sections were measured valley wall to valley wall. The tailings dam failure would generate a large floodwave peak, and the flood depths and velocities reported are possible.

4.213 The mine tailings dam breach run-out scenarios are modeled to a distance of only 30 km and the analysis then utilizes a tailings run-out regression equation to calculate total mine tailings travel distances beyond the last segment of the model (pg. 4-57).

The extent of the sediment transport model should be extended to the river reach where the mine tailings are expected to be transported downstream (e.g., beyond the 30 km marker at the confluence of the North and South Koktuli Rivers). Switching from a simplistic sediment transport approach to an even more simplistic regression equation once the mine tailings reach the confluence of the North Fork Koktuli and South Fork Koktuli Rivers only adds to the uncertainty in the estimates of the distance of sediment transport (Rico et al., 2008). Rico et al. (2008) presents three predictive tailings run-out regression equations based on dam height, waste out flow and a combination of both parameters, with R_2 values of 0.16, 0.56 and 0.57, respectively. The BBWA does not state which of the three regression equations were used in their evaluation of the tailing run-out estimates, but regardless, given the low R2 values there is limited statistical reliability in any of these equations. Furthermore, of the 28 case studies used to develop the Rico et al. (2008) regression equations, the largest tailings release volume was 9 million m^3 in volume, which is 16% and 3% of the volume of the partial and full dam release scenario volumes (55 million m^3 and 317 million m^3), respectively. Thus, the regression equations developed by Rico et al. (2008) are insufficient in predicting tailings run-out for the two very large dam break scenarios presented in the BBWA. Additionally, Rico et al. (2008) state that: "the accuracy of these estimations should be approached with great caution." Rico et al. (2008) also describe the nature and magnitude of the errors associated with their regression equations as such:

"These errors result from a large variety of parameters affecting the mine waste flow, including sediment load, fluid behavior (Newtonian or Binghamplastic) which depends on the type of failure (e.g., seismic action, static liquefaction, slide, etc.), particle-dependent rheology of the suspension, topography and valley gradient and presence of obstacles impeding the slurry to flow among others. Another source of uncertainty is related to the lack of data related with the water volume existing at the time of failure either stored at the decant pond or linked to the meteorological causes triggering the dam failure (intense rainfall, hurricanes, rapid snowmelt, ice accumulation in the tailings dam, etc.), which may change indeed the hydrologic conditions (peak discharge, tailings outflow volume) and the run-out distance of the tailings."

The BBBWA does not indicate that the HEC-RAS model was calibrated to demonstrate the model has the ability to predict accurately the river hydraulics in normal stream flow or flood flow conditions. Additional, and more robust, modeling should have been conducted to explore the impacts of the tailings dam breech scenario.

<u>EPA Response:</u> If the intent of the modeling was to understand low flow and flood flow inundation for the downstream valley, the comment would be correct. However, the HEC-RAS model was used to support the comparison of released dam volume distribution to the available valley volume that may be inundated during an initial floodwave and compare that to historic data and predictive references. It is true that more robust modeling can yield additional results that better describe debris flow dynamics.

4.214 5. Sedimentation of the dam break flood wave was calculated when the flood wave was at its maximum predicted depth (pg. 4-57)

It is not clear when the BBWA states: "we assumed that sediment deposition could occur in the channel and the floodplain of each section at the maximum predicted channel depth during the peak of the flood wave," whether they are assuming sediment deposition occurred only at the maximum stage of the flood wave or whether they are assuming sedimentation occurred at these depths in addition to normal sedimentation processes modeled by HEC-RAS. When river flows are at their maximum flood stage, river velocities are often at their highest, which is not conducive to sediment deposition. The majority of sediment deposition occurs on the receding limb of the flood curve, when river velocities are starting to decrease.

<u>EPA Response:</u> See response to sixth point of Comment 4.183.

4.215 6. The Hjulstrom curve was used to evaluate sediment transport velocity (pg. 4-57)

The critical deposition velocities shown on the Hjulstrom curve represent the average channel velocity measured one meter above the channel bed. Furthermore, the Hjulstrom curve was developed while observing the transport of only uniformly sized sediment loads, thus ignoring the effects that a distributed sediment load would have on critical transport velocities. While the Hjulstrom curve is a widely used reference to evaluate sediment transport in streams, it is not well-equipped to be used to evaluate sediment settling in a dense, mostly solid flow such as the scenarios set forth in the BBWA.

When Hjulstrom developed the curve, he used limited deposition velocity data published originally by Friedrich Schaffernak (Self et al., 1988). According to Self et al. (1988) Schaffernak only examined particles 5 mm in diameter and larger. The proposed tailings from the EPA analysis are assumed to have a diameter range of less than 0.01 mm to just over 1.0 mm, so the Hjulstrom curve would provide a less reliable prediction of settling velocities for the mine tailings. Self et al. (1988) reexamined the reliability of the Hjulstrom curve. Instead of correlating channel velocity with sediment transport they measured the critical erosion and critical deposition shear stress for particles ranging from 0.014 – 0.141 mm in diameter.

Self et al. (1988) found the critical deposition shear stress to be 3 orders of magnitude larger for the particles examined than values reported by Hjulstrom. The use of the Hjulstrom curve to evaluate critical deposition velocities underestimates the sedimentation of particles at higher velocities, and thus over estimates the amount of sediment transported by the dam breach scenarios.

<u>EPA Response:</u> See response to seventh point of Comment 4.183.

4.216 7. The TSF 1 drainage area is incorrect and the maximum flood comparison with USGS record and PMF analysis is flawed (pg. 4-50)

The contributing watershed area to TSF 1 is incorrect and this influences the comparative statistics. Page 4-21 of the report states "The surface area covered by the TSF 1 at full volume is estimated to be 14.9 km^2 (Table 4-3, Figure 4-7)." This is in conflict with the report stating on Page 4-50 that the contributing watershed area is only 1.4 km^2. Based on our review of Figures 4-7 and 4-14 the watershed area contributing to the TSF 1 is roughly 17 km^2. In addition, the BBWA states "For comparison, a U.S. Geological Survey (USGS) gage located near the village of Ekwok, Alaska, experienced a record peak flood of 3,313 m^3/s in a 2,551-km^2 watershed." (pg. 4-50) It is unclear which USGS gage was used but the mean daily flow data from the USGS gage on the Nushagak River at Ekwok, AK (15302500) was acquired from October 1st, 1977 to September 30th, 1993. The maximum daily flow during this period was 3,228 m^3/s and the drainage area associated with this gage is 9,850 mi^2 (3,449 km^2). Using this information on a unit area basis (110 $m^3/s/km^2$ for partial release and 701 $m^3/s/km^2$ for full release) the partial-volume failure analysis would result in 117- fold increase (not 1,000-fold) in discharge compared to the flow observed at the USGS gage and for the full volume failure analysis, there would be a 750-fold increase (not 6,500-fold). The BBWA overstated the increase in flow by almost one order of magnitude (i.e., almost 10 times).

In addition the report inappropriately compares the peak flow from a dam failure (partial: 1,862 m^3/s, full 11,915 m^3/s) from a probable maximum flood (PMF) analysis (using the probable maximum precipitation, PMP) with the maximum stream flow at a USGS gage at Ekwok (15302500) from a 16 year record. A PMF is an estimate of the largest flood theoretically possible from a combination of severe hydrologic and meteorological conditions that are reasonably possible for the drainage basin in question. During a PMF event, the stream flow below the TSF dam would already be significantly higher on a unit area basis than a peak measured downstream from a 16 year record. As such, even the corrected 117-fold and 750-fold increases discussed above are overstated, because the baseline flow in the creek would be higher during the PMF.

<u>EPA Response:</u> The final assessment has been revised to clarify that comparison to the flood of record on the Nushagak River at Ekwok provides a frame of reference for the flood magnitude that would result from a tailings dam failure.

4.217 In Box 4-1 (pg. 4-24) the BBWA aggregates multiple worst-case failure scenarios into a single release event scenario which unreasonably overstates the probability of release due to a system failure in the water collection and treatment system. The cumulative effect of four worst-case factors (unlimited oxygen supply, higher concentration of metals in the waste rock, high leaching rates due to small grain size, and high water contact due to the absence of preferential flowpaths) sets an overly conservative bound on the hazardous characteristics of the leachate quality. Use of the additive result of multiple concurrent worst-case factors, represents an unreasonable overstatement of the potential impacts of leachate releases. A risk analysis based on these assumptions cannot be well supported scientifically.

<u>EPA Response:</u> The worst case factors cited in this comment are those of the PLP leaching data. The uncertainties associated with those factors are described in the assessment, but we must rely on the PLP data because there is no other source.

4.218 The inferences drawn in the report also do not account for advances in technology or operational practices between the historical case studies examined and present practices. The assessment acknowledges that some case studies cited incorporated historical and outdated mining practices that would not be allowed under current mining laws. Several passages of text use language that are not technically correct and, as a result, can be confusing or misleading. Some examples follow:

- "…variety of geochemical models ad approaches to understand and predict releases to the environment…" (pg. 4-4)

  The use of geochemical models cannot predict releases to the environment. Geochemical models are useful for predicting chemical reactions that may occur under different environmental conditions; however, the chemical reactions and processes referred to in Section 4.1.2 are only likely to occur if conventional interventions are not utilized.

<u>EPA Response:</u> Chapter 8 of the revised assessment provides a more detailed analysis of the formation, transport, and dilution of leachate.

- "…there are limitations in our ability to make predictions with a high level of certainty because of the inherent complexity of natural materials and their environment." (pg. 4-4)

Although some of the risk factors described such as site geology and climate are naturally occurring and inherently variable, the activities of mining, ore processing, and residuals management methods are within the purview of the mine operations. Water management, including collection and treatment, is expected to be an active part of the mine operations, and adjustments to optimize the processes will be expected throughout the life of the mine, during reclamation, and post-closure. These on-going adjustments to the water management systems and processes are a normal part of managing the "inherent complexity of natural materials."

<u>EPA Response:</u> Adaptive management is a good thing. However, the assessment can only address the starting point of a potential mine plan and not the changes that would result from findings that mining practices are not adequately mitigating the effects. The revised assessment does acknowledge that mining practices would be adapted if standards are not met.

- "One way to predict if acid generation will occur is to perform acid-base accounting tests." (pg. 4-4)

  The acid generation tests do not predict if acid generation will occur, only the potential for it to occur. From the Wardrop (2011) preliminary assessment, it is apparent that active management of the two main mine residual streams, potentially acid generating (PAG) and non-acid generating (NAG) tailings, will be implemented to reduce the potential exposure of the PAG to oxidizing conditions. Approximately 15% to 20% of the tailings are expected to be PAG, with the remaining 80% to 85% being NAG. The submerged discharge of the DRAFT Technical Review of May 2012 Draft Report EPA 910-R-12-004a Final BB Assessment Review - 07-18-12 - R1.docx 19 July 2012 PAG tailings within the tailings storage facility (TSF) is standard practice to reduce the potential for the acid generating chemical reactions to occur. This is another example of implying an outcome (in this case acid mine drainage problems) without accounting for obvious and widely used mitigation measures at modern operating mines.

<u>EPA Response:</u> We have added the words "has the potential to" in place of "will" in the text.

- "Additionally, some toxic elements (e.g., selenium and arsenic) may be released from mining materials under neutral or higher pH conditions…" (pg. 4-5)

  This statement is technically inaccurate and misleading, as a toxic release is not assured in the instance described. Uncontrolled releases to the environment are unlikely to occur in a modern mining operation, as active measures and precautions are taken to prevent this outcome. Similarly, should a release occur, remedial actions can be taken to prevent or minimize the extent of the impacts, with a goal of retaining any releases on site property for proper capture, treatment and management.

<u>EPA Response:</u> This section is a discussion of the environmental chemistry of porphyry copper deposits and does not assume that any releases will occur, but it does recognize the potential exists for releases from the ore. Thus, the statement cited is accurate; no change required.

- “Because premature closure is an unanticipated event, water treatment systems would likely be insufficient to treat the excessive and persistent volume of low pH water containing high metal concentrations.”

  Past experiences with premature closure at mining sites has resulted in requirements for financial assurance as part of the modern permitting process for mine operations. Given the known financial and regulatory safeguards anticipated to be in place, including means for operation of water collection and treatment systems during post-closure, there appears to be no basis or justification for this statement regarding the likelihood that the water treatment systems would be overwhelmed by an “excessive and persistent” volume of water to manage.

EPA Response: The quoted sentence does not occur in the revised assessment, and information on financial assurance is included in Box 4-3.

- “The volume of water that would require treatment by the mine wastewater treatment plant is unknown at this point, but could be very high. To avoid or minimize risks associated with altered streamflows in downstream effluent receiving areas (Section 5.2.2.1), capacity for water storage and release would be required in order to maintain natural flow regimes or any minimum flows required by ADFG. Maintenance of mine discharges in terms of water quality, quantity, and timing, to avoid adverse impacts would require long-term commitments for monitoring and facility maintenance. As with other long-term maintenance and monitoring programs, the financial and technological requirements could be very large, and the cumulative risks (and likely instantaneous consequences) of facility accidents, failures, and human error would increase with time. We know of no precedent for the long-term management of water quality and quantity on this scale at an inactive mine.” (pg. 5-45)

  In this statement, the BBWA illustrates a lack of understanding of post-closure operations at formerly active mining sites. A standard component of modern mines is to provide significant financial assurances for long-term maintenance and monitoring programs. This is a standard component of the permitting process to ensure the long-term program is adequately funded.

EPA Response: We understand the need and mechanisms for financial assurance, and these issues are presented in Box 4-3 of the revised assessment. However, there is no precedent for waste treatment needs, potentially in perpetuity, in an isolated and sensitive environment such as the Bristol Bay watershed.

4.219 Figure 4-9B incorrectly depicts a post-closure scenario with no water management. As described in the Wardrop (2011) report, the closure planning process includes long-term water management and financial sureties to ensure that the closure plan will remain funded.

EPA Response: We understand that for some period of time after mine closure, water management would proceed. However, at some time water management is likely to cease, in which case a scenario such as depicted in this figure is also likely. Regardless, Figure 4-9B has been removed from the revised assessment and ongoing water management is assumed in the scenarios.

4.220 As part of the management and operation of environmental control systems, planning for unforeseen events by having mitigation plans in place is a typical practice. Critical services would also include containment or other countermeasures to be protective of the environment.

- "Failure to properly collect and treat leachate from waste rock piles, TSFs, or other areas of the mine site may allow potentially toxic chemicals, soils, and particulate matter to enter streams. Here, we consider the failure of on-site collection and storage practices at TSF 1 as an example case. Based on the available data, estimation of potential flow through the substrate located under and around proposed TSFs requires several assumptions." (pg. 4-39)
- "With a dam height of 98 m, estimated flow rate at the downstream face of the tailings dam would be 8.14×10^{-4} m^3/s; with a dam height of 208 m, estimated flow rate was 1.15×10^{-3} m^3/s." (pg. 4-39) The BBWA considers the failure of the entire on-site water collection and storage system to be a realistic scenario. In reality, such an outcome would be an unlikely event. The water collection system consists of a well field, not a single monitoring/recovery well.

The use of multiple wells with overlapping zones of hydraulic influence provides redundancy to reduce the probability of failure to capture leachate. The presence of a well field also minimizes the impact from a mechanical or electrical failure at any one well.

Notwithstanding, if the stated estimates of seepage flow under TSF 1 are correct, in the event of a water collection system failure, the range of flows (approximately 13 to 18 gallons per minute) is comparable to that of one or two household garden hoses. In the unlikely event of a complete collection system failure, any seep water can be managed using interim collection and treatment measures. For example, seep water flowing to the surface could be captured in a surface swale and pumped to the top of the TSF by the use of portable gas-powered pumps. The consequences of the failure proposed in the assessment could be effectively mitigated quickly and easily.

EPA Response: Management of unforeseen events is the intention of having mitigation plans in place, but as history shows, plans don't always account for what actually happens. Failures occur that result in adverse impacts. The Exxon Valdez oil spill, the Deepwater Horizon oil spill and the Fukushima nuclear accident are examples of well-planned activities subject to rigorous regulatory programs that did not go according to plan.

We understand that a well field would be used to collect seepage from a TSF and describe this in Section 4.3.5 of the draft assessment and Section 6.1.3.4 of the revised assessment. The flows are estimated to be a little larger in the revised assessment (Table 6-3), but are still not large relative to the total wastewater flow. However, failure of the collection wells to collect groundwater flows would not be so easily corrected as pumping from a surface swale.

4.221 The reported nearly 10-fold difference between the annual water discharge volumes under minimum and maximum mine operations represents an additional opportunity for robust design and continuous improvement to guard against potential failures of the water collection and treatment systems. The treatment system may be constructed in stages utilizing parallel treatment trains as appropriate, which would have the added benefit of providing redundancy and backup during maintenance and repairs.

<u>EPA Response:</u> The assessment assumes that all standards and criteria will be met from the beginning. No change required.

4.222 Assessment of Applicability of References on Pipe Failure Rates

The BBWA uses three sources of pipeline failure statistics to calculate an annual failure rate of 0.0010 per kilometer (e.g., failures per km-yr) of pipeline using the geometric mean of three selected values. Based on this overall estimate of the failure rate and the proposed length of the transportation corridor (139 km), a probability of 14% (i.e., 0.0010 failures per km-yr x 139 km) was calculated for the failure rate in each of the four pipelines per year.

Among several data sources presented in Table 4-14 of the report, the following three data sets were used in the assessment of annual pipeline failure rate:

a. OGP 2010 (oil pipelines) – a failure rate of 0.0010 for onshore oil pipelines with diameter < 20 cm;

b. URS 2000 (56 US oil pipeline operators) – a failure rate of 0.00062 for the 10 smallest operators (< 418 km of pipeline); and

c. Alberta Metal 2011 – a failure rate of 0.0016 reported in Alberta, Canada in 2009.

The validity of the overall failure rate estimate of 14% is questionable due to the following reasons:

- These data sets are not representative of all the conditions in the Bristol Bay watershed. The first and second data sets are based on various oil pipelines throughout the US, while the third is based on a gas pipeline in Canada. None are based on mining industry findings. The direct comparability of oil and gas (O&G) industry failure data to mining industry data, given the differences in regulatory and permitting frameworks, is questionable. Furthermore, O&G distribution pipelines are often under shared ownership for common sections, or alternate ownership for interconnecting sections. The degree of stewardship (inspections, maintenance, etc.) and resulting observed failure rates in these two scenarios may reasonably be expected to differ.
- The geometric mean has been applied to the data without justification. These data sets are dissimilar to each other (i.e., physical, environmental, temporal, and maintenance differences), thereby making it statistically invalid to average over all three. In particular, if an estimate is to be calculated from multiple sources, rather than averaging, the failure rate should be estimated accurately from data pooled across the sources. Averaging across multiple failure rate estimates obtained from different populations can produce misleading estimates, especially if the populations do not have the same underlying structure. In order to pool the data sets to obtain a high quality estimate, each data set must share the same underlying mechanism driving the failure rates. In this case, the failure rates clearly come from three (or more) different populations, and the underlying source data is not readily available for analysis. Hence, the overall estimate of the failure

rate is not only skewed by averaging over these multiple sources, but it is also subject to uncertainty as the source data sets may not be compatible.

- There is little information regarding the methods used to calculate the individual failure rates from each of the aforementioned sources. More specifically, it is unclear whether these failure rates are a sum of all failure types (external corrosion, internal corrosion, mechanical defect, etc.) and failure classes (near miss, small leak, large leak, rupture). Accounting for these factors differently would explain some of the spread in the failure data and potentially limit its applicability, more so in light of the averaging of potentially incompatible data sets described above.
- The validity of the source data itself is questionable. None of the sources in Table 4-14 are properly cited. We have been unable to conclusively identify the "URS 2000" source as of this writing. The "Alberta Metal 2011" reference is a single anecdotal statement in a trade news publication. 5. The possibility of underground pipe routing does not appear to be addressed. The Wardrop (2011) report, which is referenced as the source of the mine scenario in the BBWA, explicitly states on page 331 that the majority of the piping will be buried adjacent to the proposed roadway. Buried piping is at greatly reduced risk of physical impact damage, which is repeatedly cited as one of the chief failure modes of the pipelines. We recognize that there are other challenges associated with buried pipelines (ease of inspection and repair, etc.) but an appropriate relative risk assessment has not been included in the BBWA which would certainly influence the stated failure rates.

<u>EPA Response:</u> See responses to Comments 4.148 and 4.186.

4.223 Assessment of the Statistical Validity of Failure Rate Calculations for Pipelines.

While not stated in the report, our analysis indicates that the BBWA has assumed the pipeline failure rate will follow an exponential distribution. We reach this opinion because with an annual probability of failure of 14% and a 25 year mine scenario, an exponential cumulative distribution function predicts the probability of a pipeline failure occurring in at least one of the four pipes to be approximately 98%, consistent with the value used in the BBWA. This estimated 98% failure rate is considered misleading for the following reasons:

The use of the exponential distribution assumes a constant failure rate which is not realistic in this case. If, as stated in the report, the two major failure modes are physical impact and corrosion, then the first may be expected to vary as a function of time due to construction activity, production increases, seasonal effects etc. The second may be expected to vary directly with time since corrosion is a time dependent phenomenon. Thus, for example, the actual failure rate during the initial period of steady state operation may be far lower than the estimates suggest since corrosion rates will be vanishingly small and vehicle impact risk will be at a local equilibrium. The assumption of a constant failure rate is too simplified for the assessment of the reliability of a complex pipeline system. Failure rates are known to be affected by multiple factors such as third party damage, corrosion, design, incorrect operations, etc. In order to calculate a reasonably accurate probability of pipeline failure, these additional factors must be considered. Consequently, the failure rate trend may change from factor to factor, and furthermore, some may have a decreasing effect if controlled.

The probability of a pipeline failure in 25 years is assumed to be the same for each of the four pipelines. However, in Section 6.2 the BBWA states: "We do not assess failures of the natural gas or diesel pipelines here because such pipelines are common, their risks are well known, and they are not particularly associated with mining." Furthermore, the service conditions, line sizes, and potential failure modes of each of the four lines are very different, which makes the assumption of a single, common failure rate highly questionable. We note that while the BBWA states that "they are not particularly associated with mining," they use failure statistics from the oil and gas industry to develop their statistics for mining pipelines.

The probability of failure is calculated based on a failure rate of 14%, applied uniformly along the entire pipe. This implies that each segment of the pipe is equally susceptible to failure. However, certain areas of the pipeline will be more susceptible to failure than others, e.g., in heavy traffic areas, under certain soil conditions etc. Furthermore, the consequence of a failure is highly dependent on its location. Outcomes will be far different for a failure which occurs inside engineered containment (e.g., a valve vault), vs. at a stream crossing. Proper risk analysis must account for both the likelihood of failure and the consequences of that failure. Finally, areas of high risk would be identified and extra controls put in place during the design phase, to reduce the failure risk at those points to acceptably low levels.

<u>EPA Response:</u> The reported aggregate pipeline statistics include pipelines of various ages and include both corrosion and mechanical failures. Although the cited sentence from the draft assessment was included to give some additional perspective on failure rates, the rates for both failure modes are similar and the aggregate statistics were used to develop the presented estimates of failure probability.

The failure rate is constant with time because no data or models were available to increase the rate over time as the pipelines age. The same rate was assumed for all four pipelines because oil and gas pipeline failure rates are similar and there are no data from the mining industry concerning failure rates for concentrate or return water pipelines. The failure rate used is an average across all types of pipeline segments, so it can be applied to the rate for each pipeline as a whole (including stream crossings, valves, etc.).

Based on the trends in the failure rates, one could hypothesize that over the life of a pipeline, the initial failure rate might be lower than the overall average and the later failure rate would be higher than the average as corrosion failures increase. However, the low expected frequency of failures for pipelines of the length in the assessed scenarios would not be expected to provide enough data to confirm such a hypothesis. It should be noted that of the four pipelines in the mine scenarios, one would carry diesel fuel and one would transport natural gas, so the use of statistics from the oil and gas industry is justified for these pipelines. The revised assessment does assess the environmental impacts of a spill from the diesel fuel pipeline (Chapter 11).

4.224 Assessment of Pipeline Release Scenario

Section 4.4.3.2 of the BBWA presents the scenario of a pipeline failure. Evaluations are performed for the four pipelines, though the primary failure scenario in the assessment is for the concentrate pipeline, with basic components as follows:

- Full pipeline break;

- Pumping rate = 254.8 metric tons/hour;
- Pipe diameter = 20.3 cm;
- Remotely activated shutoff valves, with 2 minute lag from failure to shutdown; and
- Distance to nearest shutoff valve = 14 km.

The volume of release due to a pipeline failure, as described in the report, is heavily dependent on the length of pipeline between two isolation points which define the maximum trapped volume which could be released. In Table 4-15 in the BBWA, for the concentrate pipeline, the volume of flow over 2 minutes is 5.1 m^3, while the volume between isolation valves is 470 m^3. The BBWA characterizes this minimum distance as 14 km based on the need to have isolation on either side of every major river crossing and cites the Wardrop (2011) report as support. However, the Wardrop (2011) report (pg. 332) characterizes major river crossings as 600 ft (0.18 km) wide for design purposes. The 14 km assumption thus produces unrealistically high (14 km vs. 0.18 km) representative release volumes in Table 4-15. Proper design would include more frequent and strategically placed points of isolation, which would work in concert with automatic leak detection to minimize potential leakage along critical stretches of the pipeline.

<u>EPA Response:</u> See response to the fourth point of Comment 4.183. The assessment's pipe break scenario postulates a pipe rupture on the landward side of an isolation valve, allowing the overland length to drain—not the short length crossing the waterway. It also assumes that, on average, the maximum elevation between waterways was at about the midpoint between them and that half the pipe length between valves drained by gravity flow.

4.225 Risk Characterization Based on the Mine Scenario

Seismic Environment

In Section 4.4 of the BBWA, significant attention is given to the seismic environment within the project vicinity and potential seismic impacts. The majority of the discussion is presented in three boxes within the report as follows:

- Box 4-3: The Seismic Environment of Bristol Bay (pg. 4-38)
- Box 4-5: Earthquake Effects (pg. 4-43)
- Box 4-6: Selecting Earthquake Characteristics for Design Criteria (pg. 4-48)

Seismic criteria are a critical component of design of major infrastructure projects. However, many of the concerns raised in the BBWA are overstated and inconsistent with a modern understanding of seismic risks to engineered structures such as the TSF.

Box 4-3 describes the general seismic environment of Southwestern Alaska with a focus on the vicinity of the Pebble Project. The most significant potential seismic hazard to the project is likely to be the potentially active Lake Clark Fault. Box 4-3 states:

- "The western terminus of the Lake Clark Fault was originally interpreted to be near the western edge of Lake Clark, but more recent studies by USGS reinterpreted the position of the Lake Clark Fault further to the northwest, potentially bringing it as close as 16 km to the Pebble deposit (Haeussler and Saltus 2004). Haeussler and Saltus (2004) acknowledge that the fault could extend closer than 16 km, but data are not available to support this interpretation. USGS has concluded that there is no evidence for fault activity or seismic hazard associated with the Lake Clark Fault in the past 1.8 million years, and no evidence of movement along the fault northeast of the Pebble deposit since the last glaciations 11,000 to 12,000 years ago (Haeussler and Waythomas 2011). Recently, the Alaska Division of Geological and Geophysical Surveys and USGS investigated reports of a surface geological feature (the Braid Scarp) near the Pebble deposit that was reported to be a fault scarp, indicating recent movement of a fault (Koehler and Reger 2011, Haeussler and Waythomas 2011). Both agencies independently determined that the feature was a relic of glacial activity and did not represent evidence of recent faulting." (Box 4-3, pg. 4-38)

Following these statements of findings from the literature on the Lake Clark Fault which present a case of low seismic risk, the BBWA goes on to make statements such as the following:

- "Although there is no current evidence that the Lake Clark Fault extends closer than 16 km from the Pebble deposit, and there is no evidence of a continuous link between the Lake Clark Fault and the northeast trending faults at the mine site, mapping the extent of subsurface faults over long, remote distances is difficult and has a high level of uncertainty." (Box 4-3, pg. 4-38)
- "Large earthquakes have return periods of hundreds to thousands of years, so there may be no recorded or anecdotal evidence of the largest earthquakes on which to base future predictions. While geologic analyses and field studies of existing faults can provide evidence of surface rupture and bounding estimates of the age of movement, these data are not unique and are subject to many uncertainties." (Box 4-3, pg. 4-38)

Statements like these do not serve to quantify risks, but rather to raise alarm and bias the assessment. The report is in essence stating that rather than use appropriate design techniques based on the best available knowledge of actual risks, the design should instead be based on hypothetical scenarios that are not supported by actual data. The BBWA is applying a zero-risk framework to the risk analysis of the mine development. This is inconsistent with engineering best practices.

Glacially formed terrain is very useful for evaluating the evidence of faulting, because the glaciers left a clean slate prior to receding over 10,000 years ago. Active faulting within the area north of Lake Iliamna should leave a trace that is visible, such as offsets in stream channels, erosional features, or other surficial geologic evidence that geologists are trained to detect. Geophysical methods (e.g., Haeussler and Saltus, 2004) are available to seek evidence that is not visible at the surface.

This zero-risk framework is evidenced in the Box 4-6 language as well. The box begins with background on the Alaska Dam Safety Regulations (ADNR, 2005), which establishes the operating basis earthquake (OBE) and maximum design earthquake (MDE), where the latter is the larger event and will control the tailings dam design. After the opening discussion, the report goes on to make the following statement:

- “The mine scenario in this assessment includes approximately 25 to 78 years of mineral extraction, with likelihood that additional long-term operations would be required for closeout and maintenance of the mine. This time period is barely within the OBE return period for Class II dams. The MDE analysis presents a potentially greater risk of underestimating the size of a characteristic earthquake. Tailings storage facilities (TSFs) will operate during the active mining period and could have a life expectancy of 10,000 years after operations cease. Because the return period for the MDE is 1,000 to 2,500 years, this could lead to significantly underestimating the largest earthquake that is likely to occur.” (Box 4-6, pg. 4- 48)

Note that the Wardrop (2011) report indicates that the TSF design will be based on the Maximum Credible Earthquake (MCE). The MCE, as defined by ADNR (2005) is “the greatest earthquake that reasonably could be generated by a specific seismic source, based on seismological and geologic evidence and interpretations.” As such, every potential fault that could impact a project has its own MCE, and the design must consider the most critical fault(s) for the project.

Wardrop (2011) indicates that the preliminary hazard classification of the dam is Class II, consistent with ADNR (2005) guidelines. However, use of the MCE confirms that the project engineers view the TSFs as Class I hazard level facilities. In our opinion, this is an appropriate standard for these critical structures. As a Class I facility, the OBE earthquake would have a return period of 150 to >250 years, which is well beyond the operational life of the mine, and the MDE ranges from the 2,500 year event to the MCE.

Box 4-6 of the BBWA finally goes on to discuss their understanding of the seismic design criteria proposed by Northern Dynasty Minerals (NDM) for the Pebble Project. It is not clear why a detailed discussion of the outdated approach described in the 2006 preliminary assessment (NDM, 2006) is presented, and only afterwards is it noted that a more conservative seismic basis is presented in the Wardrop (2011) report. The discussion of the NDM (2006) data is confusing and unnecessary considering that the BBWA states that the Wardrop (2011) report is the basis for their mine scenario.

While the seismic discussion in the three boxes is extensive, the references within the main text of the report are limited and very general. The most significant references to earthquakes in the main text of Section 4.4 include the following:

- “The potential for accidents and failures resulting from earthquakes may be of particular concern in our mine scenario, given that southwestern Alaska is a seismically active region (Box 4-3).” (pg. 4-37)
- “Earthquake. Shaking resulting from earthquakes (Table 4-7, Figure 4-11, Box 4-5) causes additional shear forces on the dam that can lead to a slope instability failure.” (pg. 4-40)
- “This [detailed computer stability] analysis considers the effects of earthquakes based on a site-specific evaluation of seismicity in the area. Box 4-6 describes the selection of earthquake characteristics for design criteria.” (pg. 4-46)

It appears that while the text in the boxes is intended to alarm the reader, the authors of the BBWA are not certain how to incorporate the actual seismic risk into their analyses, and hence as shown in the statements above, they choose not to.

The discussion under "Recommendations for Future Work" at the end of Haeussler and Waythomas (2011) provides a good summary of the USGS position on the current status of seismic knowledge in the vicinity of the Pebble Project.

- "A broader evaluation of potential seismic hazards in this region would be useful prior to preparation for future developments. … most of the deposits near the Braid Scarp are likely 11,000 to 16,000 years old. If there have been surface faulting events within this time period, traces of active faults should be easily observed. Thus far, no active fault traces have been identified in the region, although it is possible that some active fault traces are obscured beneath vegetation, talus, alluvial deposits, and other mass-wasting deposits…" "The only fault that has been identified as having possible Neogene (that is, in the last 23 million years) activity in the region is the Lake Clark fault. Haeussler and Saltus (200[4]) found that the Lake Clark fault has had about 26 km of offset in the last 34–39 million years, but that conclusion does not mean the fault is active today. In their compilation of active and Neogene fault traces in Alaska, Plafker and others (1994) categorized the Lake Clark fault as a fault trace of pre- Pleistocene age. In other words, they found no evidence that there had been offset along the Lake Clark fault within the past 1.8 million years. Several studies that focused on the Lake Clark fault in the region northeast of Lake Clark found no evidence for movement along the fault since the last glaciation, around 11,000– 12,000 years ago (Plafker and others, 1975; Detterman and others, 1976; Reger and Koehler, 2009). Thus, there is no evidence for active faulting or seismic hazard associated with the Lake Clark fault. In summary, if further geologic studies find no evidence for surface faulting, it would be difficult to conclude that a significant seismic hazard exists from crustal faults in the area."

None of this is meant to downplay the hazards associated with earthquakes in Southwestern Alaska and at the Pebble Project. Seismic shaking, deformation, liquefaction, landslides, seiche and other seismic hazards are real and must be accounted for during design. However, based on our review of the Wardrop (2011) report and the Environmental Baseline Document (PLP, 2011), indications are that the project engineers are aware of those hazards, and current design standards provide means to mitigate the impact of seismic events with an acceptable degree of certainty.

Wardrop (2011) indicates that geological and geophysical studies have been performed to further evaluate the possible extension of the Lake Clark fault. Although indications of those studies continue to show a limited likelihood of activity for the Lake Clark Fault, the project is likely to be based on evaluation of both a distant MCE magnitude 9.2 earthquake offshore, and a nearby Lake Clark scenario fault with an MCE magnitude of 7.5. With maximum credible ground accelerations computed by Wardrop (2011) for the Lake Clark scenario in the 0.44g to 0.47g range, we consider that a suitably conservative seismic earthquake scenario has been established.

In summary, the seismic analysis provided in the BBWA:

- is biased by unsupported hypothetical faults rather than relying on the substantial geological, geophysical and seismological evidence of the seismic environment in the vicinity of the Pebble Project;
- does not acknowledge that seismic risks will be evaluated thoroughly by the ADNR and others during the permitting process;
- does not incorporate the seismic risks (real or hypothetical) in their watershed risk analysis; and
- does not acknowledge that modern engineering and science can be used to develop a project that will meet seismic reliability criteria in this environment.

EPA Response: This comment makes four main points which are summarized under the four bullets at the comment's end. Responses to these four bullets are as follows:

- **The assessment accurately describes the state of knowledge and the uncertainties concerning the locations of faults.**
- **We acknowledge that seismic risks and many other issues would be considered by the State during a permitting process, but these risks still need to be considered in a risk assessment.**
- **The third bullet is unclear but it seems to refer to statements above that suggest that risks should be described in more reassuring terms.**
- **The assessment does acknowledge that engineers would consider seismicity in developing a project, but that does not preclude considering seismic risks in this assessment.**

In addition, the Northern Dynasty Minerals (2006) report was referenced in the assessment because it provided a more detailed analysis of the probabilistic and deterministic methods used to select design criteria, whereas Ghaffari et al. (2011) (i.e., the Wardrop 2011 report) provided only a summary of the results.

Alaska Miners Association, Inc. (Doc. #4612)

4.226 **Questionable validity of the document** The draft assessment contains so many inaccurate examples and scenarios that we must question the validity of the document altogether. For example, the concepts of mitigation, minimization, and impact avoidance are frequently avoided, if not ignored altogether. These techniques are key elements of any development permit in Alaska, which the report authors appear to be unaware of, or perhaps chose to overlook.

EPA Response: See response to Comment 4.137.

4.227 The draft assessment chooses to assume that 11 billion metric tons of ore will be mined under the not yet seen Pebble mine plan. This number, which represents the total resource and not the mineable reserve, is inflammatory and seems designed to alarm, as well as exposes the authors' unfamiliarity with mining in general.

EPA Response: See response to 4.37.

4.228 The comparison of a hypothetical dam to structures like the Washington Monument or St. Louis Arch is unreasonable.

<u>EPA Response:</u> **We believe these are reasonable comparisons to illustrate potential dam heights. No change required.**

4.229 In addition, examples of failures to said dam were modeled after case studies from mines that opened in the 1800s. It is absurd to compare the two, considering construction of a dam today would occur over 100 years later with major changes to regulatory, engineering, and environmental standards.

<u>EPA Response:</u> **See response to Comment 4.150. Dam failure was modeled using a current model produced by the U.S. Army Corp of Engineers. Comparisons to recent failed dams were made to portray the potential damage that a tailings dam failure may cause. References to mines that operated in the 1800s were to evaluate the effects of contaminants over a long time frame. We did not compare design or operation of these mines to modern mines.**

The hydraulic model of one potential dam failure, as presented in Chapter 9 of the revised assessment, was not modeled after any specific historic dam failure. The model used dam height, volume, and hydrology from a single modeled storm event to determine a possible floodwave following dam failure.

4.230 Finally, the draft suggests that remediation may occur following a dam failure, but is uncertain. State and federal statutes require remediation in such an example to begin immediately, so designing a scenario that describes otherwise ignores mining standards and regulations in place today.

<u>EPA Response:</u> **All mine sites in Bristol Bay are remote and currently without access. It is likely that a major release from a tailings dam would run down similarly remote rivers. Creating access and removing tailings could conceivably result in more damage than the spill itself, compounding an already severe catastrophe. Thus, it could be decided that remediation is not advisable. The assessment does not say that remediation would not occur, but recognizes that technical, financial, and competing environmental constraints could make the method, timing, and completeness of remediation uncertain, in spite of regulatory requirements.**

4.231 The hypothetical mine used in the draft assessment simply would not be permitted under existing standards. Therefore, the document creates a foregone conclusion about a large-scale mine in the area and causes misconception regarding any associated scenario.

<u>EPA Response:</u> **We disagree. Elements of the mine scenario were proposed by Northern Dynasty Minerals in Ghaffari et al. (2011), which stated for economic disclosure purposes that the mine was permittable. The assessment is not a mine plan to be submitted for permit review. It is an assessment of the relevant and significant elements of a typical porphyry copper mine. The open pit, tailings impoundment, waste rock piles and transportation corridor would likely be the primary features of any similar mine, as is the operation of the mine to the degree described in the assessment. There are many details for design and operation of specific mine facilities that would be included in a mine plan that we do not include in the assessment, but we assume that**

those details would conform to modern conventional mine design, practices, and technologies.

4.232 The document goes as far as to suggest the mine could suddenly close while assuming no state standards such as reclamation bonding and design requirements.

<u>**EPA Response:**</u> **Box 4-3 discussing financial assurance has been added to the revised assessment.**

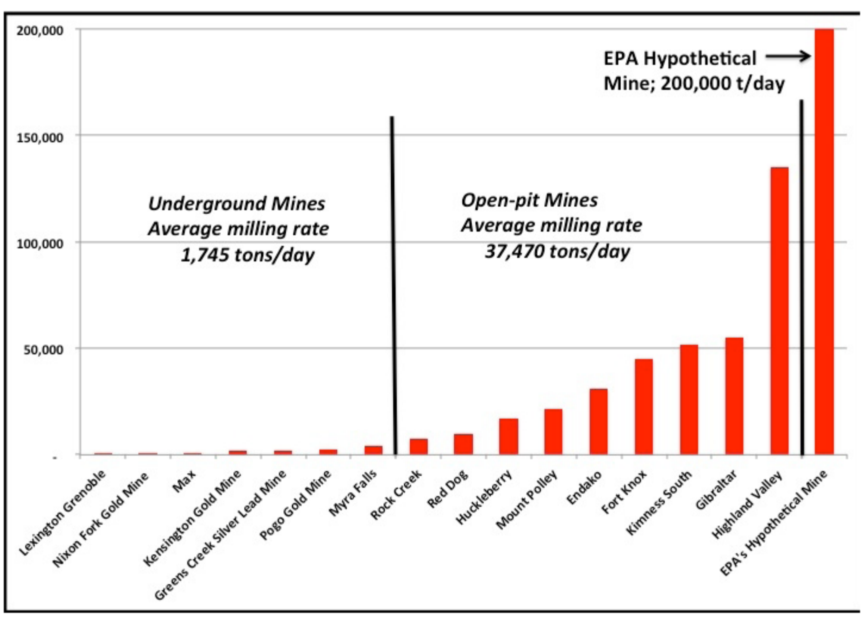
4.233 *Review of Alaska and British Columbia Mines.* To assess the range of likely mine sizes, this technical review researched mine sizes that currently exist in Alaska and British Columbia. Unfortunately, given the short time frame to comment on the Assessment, it was not possible to obtain surface acreage disturbed for these mines. This analysis uses milling rate as a substitute for mine surface acreage.

Figure 1 shows the milling rate for mines in British Columbia and Alaska. (Appendix A explains the data sources for the figure). The figure shows that the Assessment's hypothetical mine is much larger than any mine in Alaska or British Columbia. In fact, the average open-pit mine in the two areas mills an average of 37,470 tons/day. EPA's hypothetical mine assumes 200,000 tons/day, which is more than is five times larger than this average.

British Columbia includes five open-pit mines where Copper is the major or one of the major target minerals. The average milling rate for those mines is 56,120 tons/day. The EPA's hypothetical mine is almost four times that amount.

While it is not possible to estimate the mine size for a ore body that has not yet been discovered, a comparison of mines in British Columbia and Alaska show that the EPA's hypothetical mine almost certainly is a gross overestimate of the likely size for any other yet to be discovered project.

Figure 1. Comparison of Milling Rate for Mines in Alaska/BC & EPA's Hypothetical Mine[13]



EPA Data. EPA's Assessment comes to a similar conclusion. Table 4-1 on page 4-2 of the Assessment compares Pebble to other copper porphyry deposits. The table shows that Pebble's tonnage is over 7 times greater than the 90th percentile of global copper porphyry deposits. EPA concludes that "The well-delineated Pebble deposit is clearly at the upper end of the total size range; any additional deposits found in the Nushagak River and Kvichak River watersheds would be expected to be one or two orders of magnitude smaller"

Summary. EPA's hypothetical mine may or may not accurately represent the disturbance area of Pebble. However, it almost certainly does not accurately represent the disturbance area of any other yet to be discovered large mine in the Bristol Bay watershed. This conclusion is based on a review of British Columbia and Alaska mines. EPA apparently comes to the same conclusion in Chapter 4 of the Assessment; yet the Assessment uses the large hypothetical mine to predict the impacts of other, much smaller, large-scale mines.

<u>EPA Response:</u> The review of mines in British Columbia was not to assess the range of likely mine sizes. It was to evaluate the effects of mines in as similar a climate to Alaska as possible. The listing of Alaska mines was simply to provide the reader with a reference point for past and current mining in Alaska.

We stated in the original draft assessment that other mines in the Nushagak and Kvichak River watersheds would likely be one to two orders of magnitude smaller than a Pebble mine. In the revised assessment, we have added a smaller mine size scenario that reflects that worldwide median-sized porphyry copper deposit.

4.234 *EPA's Hypothetical Mine Uses a Non-Representative Location*

EPA's hypothetical mine covers or blocks between 13.5 and 20.9 miles of anadromous fish streams. A GIS analysis prepared for this technical review tested whether the location for EPA's hypothetical mine was representative of other locations in the watershed. While the analysis prepared for this technical review is simple, it indicates that the location for EPA's hypothetical mine is likely to be a non-representative location. Locations available for other mines, even if they were the same size, may disturb a much lower acreage of anadromous fish stream, or no acreage at all. It is even possible that alterative locations for facilities for a mine at Pebble would significantly decrease the impact on anadromous fish habitat. For that reason, the location of EPA's hypothetical mine cannot be considered to be necessarily representative of a location for potential other mines in the region, and possibly not representative of a mine at Pebble. To determine whether the particular location of EPA's hypothetical mine is representative of potential mining location around Bristol Bay watershed, the authors of this technical review worked with a University of Alaska student to conduct a simple, CIS review of locations in the watershed. The student used an algorithm to place an area that approximates a certain size mine disturbance throughout the watershed (excluding national and state parks). The object is to determine whether it is possible or likely to place a within the Bristol Bay watershed and not disturb significant lengths of anadromous fish streams. To approximate a mine disturbance, the student used two sizes: six and thirteen square miles. The six-square mile area is approximately the size of the disturbance at the Fort Knox Gold Mine, Alaska's largest open-pit mine. The thirteen-square mile area is approximately the size of the EPA's hypothetical mine (25-year mine life). The student found that, statistically, the vast majority of locations where one would randomly place these boxes in the watershed, it was possible to place them without disturbing an anadromous fish stream.

This procedure is obviously extremely rough. A more thorough analysis would have required EPA to extend the comment period. The analysis may exaggerate the frequency o mine locations that do not conflict with fish streams because many anadromous fish streams in the watershed have not been mapped. In addition, the simple analysis did not take into account the fact that tailings facilities are usually in valleys, and there is almost always a stream in the bottom of the valley (though not always an anadromous fish stream). However, it also did not take into account the ability of a mine to move facilities to avoid sensitive areas.

Therefore, while it is not possible to conclude that other mines in the region-even other mines of the same size-would necessarily be located so as to disturb far less anadromous fish habitat, the analysis makes it clear that there is a good chance of that occurring.

EPA Response: We agree that this would be a useful exercise for an activity that could be randomly placed in the watershed. However, mines must be constructed at the deposit locations and, as the comment indicates, mine facilities have certain requirements that restrict their placement. These requirements may tend to limit the ability of mine operators to avoid valuable habitat. The Bristol Bay watershed is rich in high quality fish habitat, so it would be difficult for mines and their infrastructure to completely avoid this habitat. In addition, failures that resulted in downstream effects would almost certainly affect additional habitat. Determination of avoidance by mining in a different location occurs within the regulatory decision making process that is outside the scope of this assessment, but it is assumed that such would have been considered. The purpose of the assessment was to addresses potential risks associated with mining in the location in question. We have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

We conducted a similar GIS exercise but limited our effort to lands that have been staked for mining porphyry copper deposits. We quantified stream density using streams listed in the NHD on these claim blocks and found a range of 1 to 1.4 km per km^2. Wetland information is not available for most of these areas so we were unable to compare those habitats. We describe our effort in Chapter 13 of the revised assessment and conclude that, based on information in the NHD, stream densities are similar among sites. All of the sites evaluated are relatively low gradient (none are in the mountains) and all are listed in the Alaska Anadromous Waters Catalog as being important to the spawning and/or rearing of salmon. Based on these analyses, we conclude that all have similarly high value salmon habitat.

4.235 *EPA's Hypothetical Mine Uses a Non-Representative Geochemical Make-up* There is no "typical" geochemical make-up for a metal ore that is representative of all deposit types within a region. Each deposit type and each deposit is unique. Therefore, the geochemistry of the Pebble deposit cannot be used to represent the geochemistry nor geochemical risks of other deposits in Bristol Bay. In addition, the EPA acknowledges that geochemical risk is dependent on human factors such as how waste rock and tailings are processed and stored. Given the diversity of options for doing so, it is possible that the eventual design for Pebble will choose a different system than EPA's hypothetical mine. Therefore, the geochemical risk and make-up of the hypothetical mine may not even represent Pebble. Courses on geochemistry emphasize that each ore is unique and must be analyzed individually. The courses emphasize geochemistry is influenced not only by natural factors-geology, climate, hydrology, etc.-but also involves human factors such as the processing methods, storage, etc. The EPA Sourcebook for Hardrock mining similarly emphasizes the diversity between deposits, or even within individual deposits, in that it requires that tests must be conducted on each geologic rock unit and each lithological unit. The authors of this technical review have been involved with mine permitting in Alaska. They have participated in state and federal requirements for statistical sampling throughout a mine pit because conditions can change in different locations within a pit or deposit. Indeed, there is no such thing as a typical geochemical make-up that represents all deposits or potential undiscovered deposits in the region.

Evidence of the importance of geochemical diversity can be illustrated by considering the Red Dog Zinc Mine which has enormous acid-generating potential and is reported to have 20% minerals in comparison to the Fort Knox Mine with close to zero reported sulfide minerals within the ore, no acid generating minerals, and limited leachable metals in the tailings water.

In summary, geochemical character of ore deposits are unique. They are different for each deposit type. Even among copper porphyry mines, the geochemical characteristics cannot be predicted. The geochemical characteristics of the tailings, while having some similarities among copper porphyry mines, can vary significantly between deposits and are greatly influenced by the beneficiation techniques used by the mine. For this reason, the concept of a “typical” set of geochemical characteristics that would represent all deposits of various types in Bristol Bay is a fallacy. Such a typical set of characteristics does not exist.

For that reason, the Assessment analyzes only the characteristics of the Pebble Deposit, not of any other deposit in the region. And even for Pebble Deposit, the Assessment focuses on the characteristics of the deposit itself, because it cannot predict the characteristics of the tailings without knowing the milling process-whether pyrite will be separated and how it will be contained-and without testing a synthetic generation of the resulting tailings. Therefore, while it is certain that the Assessment does not represent the geochemical make-up of other mines in Bristol Bay, because of the potential diversity in mine design factors, it may even not represent Pebble.

<u>EPA Response:</u> We agree that different deposits would differ in their exact geochemistries and have acknowledged this in our discussion of uncertainties throughout the assessment (e.g., Sections 14.5 and 14.6 of the revised assessment). However, different porphyry copper deposits in the Bristol Bay watershed are likely sufficiently similar that it is reasonable to use the Pebble deposit geochemistry as a surrogate for other deposits in the area. Furthermore, metals and acid leaching from ore along the entire geochemical range of porphyry copper deposits typically poses hazards.

4.236 *EPA’s Hypothetical Mine Omits Mitigation and Prevention Strategies likely to be used by other large mines in Bristol Bay*; It is not possible to predict the mitigation and prevention techniques that will be used to protect the environment from exploitation of an ore deposit that has not yet been discovered. Given the large variety of techniques - from dry-stack tailings, shipping pyrite off-site, lining tailings impoundments, etc. - it would be unusual if any as-yet undiscovered mine used exactly the set of mitigation/prevention strategies that EPA assumes in its hypothetical mine. Therefore, it would be unusual for any mine to present the same stressors, or potential risk of stressors, for an undiscovered deposit. For that reason, the hypothetical mine is unlikely to present the same potential risks as other, as-yet undiscovered mines in Bristol Bay.

<u>EPA Response:</u> We agree that mitigation strategies will vary from mine to mine. The purpose of the assessment is to evaluate potential effects of a mine that is designed and operated using modern conventional practices and technologies. We assume that appropriate measures are designed into the mine. Nevertheless, it is possible for these measures to fail, and the assessment evaluates potential consequences of such failures.

4.237 *EPA Omits Mitigation and Prevention Strategies that would eliminate or significantly change the impacts it predicts for its hypothetical mine***.** There are a number of changes in mine design that would eliminate or greatly reduce the impacts predicted in the Assessment. I t is wrong to assert that impacts from mining are inevitable when a design change would eliminate or greatly reduce the chance of such an impact. In addition, the hypothetical mine is effectively a pre-permitting design. The permitting process will force other, as yet unknown design changes. Analysis of a mine without those changes included will exaggerate adverse impacts and this is what EPA has done.

<u>EPA Response:</u> In the assessment we assume that modern conventional practices and technologies have been incorporated, and that changes are made as needed in coordination with regulatory agencies. Nevertheless, all mines have a footprint that will eliminate habitat and affect ecological processes that support downstream habitat. In addition, unanticipated problems are likely to arise over the life of a highly complex and long-lived operation such as a mine that will lead to the release of pollutants. The assessment is intended to evaluate the potential effects of these footprints and releases.

4.238 EPA's hypothetical mine is effectively a pre-permitting design. We do not know whether Pebble will propose that design, or anything similar. However, based on experience at other Alaskan mines, it is likely that the proposed design will change and that prevention and mitigation strategies that are as-yet unknown to EPA, other agencies, or even the mining company will emerge. These strategies are usually required by the agencies, because they will significantly decrease environmental impacts. A hypothetical mine, not subject to the permitting discussion, will incorrectly predict impacts.

<u>EPA Response:</u> See response to Comment 4.237.

4.239 *EPA's hypothetical mine does not meet permitting standards. Therefore, it cannot represent realistic mine impacts for the watershed.* EPA assumes that the hypothetical mine would block or cover between 13.5 and 20.9 miles of anadromous fish streams and between 4.7 and 7.1 square miles of wetlands. It proposes no mitigation for these impacts. These non-mitigated impacts are inconsistent with permitting standards. The hypothetical mine also assumes that waste rock would be placed in an anadromous portion of Upper Talarik Creek. Given realistic alternatives, that placement would not be allowed. Thus, the hypothetical mine, as designed, would not be permittable under state or federal laws. A mine that does not meet permit standards cannot be taken as a realistic example of the impacts of mining.

<u>EPA Response:</u> See response to Comment 4.237. We used a mine design proposed by Northern Dynasty Minerals (in Ghaffari et al. 2011). Many mitigation measures are inherent in the design. Consideration of compensatory mitigation is part of a regulatory process that takes place after consideration of unavoidable impacts; however, Appendix J discussing compensatory mitigation has been added to the revised assessment.

4.240 EPA's hypothetical mine design proposes to fill portions of Upper Talarik Creek with waste rock. This waste rock location does not fit the "last resort" practices of Alaska agencies and would not be allowed.

The loss of wetlands without mitigation presents a similar issue. It is simply not realistic to cover between 4.7 and 7.1 square miles of wetlands with no mitigation and imagine that it could be permitted and would comply with Clean Water Act Section 404(b)(l) guidelines.

<u>EPA Response:</u> See response to Comment 4.239.

4.241 *Assumption of a Road*. A road may be required to develop the Pebble Mine. However, it is quite possible that other mines within the watershed would not be developed using a road, would use a shorter road, or would use a road in a less (or more) sensitive area. Thus, the road impacts may not be representative of non-Pebble mines in Bristol Bay.

<u>EPA Response:</u> We believe that road access is a likely part of any mine of the scale considered in the assessment. We used a proposal set forth by Northern Dynasty Minerals in Ghaffari et al. (2011). Geography and land ownership limit modifications to this route. Certain streams and wetlands would be crossed. Although minor changes may be possible, the transportation corridor scenario evaluated in the assessment is realistic for the purposes of evaluating potential environmental impacts. We assume that the road would be designed according to standard engineering and economic practices for roads, including decisions on whether to use bridges or culverts.

4.242 *Omission of Prevention and Mitigation Strategies-design changes for the road.* EPA proposes a specific road alignment and by implication road construction techniques and then disparages them because of the environmental impacts they will cause. The obvious solution is to provide a higher level of design/construction standards and a robust monitoring program to catch problems before they cause these problems. For example, they forecast that culverts will impact 10-14 streams. They omit the potential to install bridges (a prevention strategy). A bridge would eliminate the problems of hydraulic modification by failed or undersized culverts.

<u>EPA Response:</u> See response to Comment 4.82.

4.243 Without detailed road design, maintenance, and inspection specifications, which are not included in the Assessment, it is not possible to determine the prevention and mitigation strategies necessary to eliminate or decrease the problems. However, EPA's pretense that these problems would not be identified during a permitting process and, if warranted, that additional prevention strategies, such as bridges, would not be required is incorrect.

It may be possible that some of the areas that may be crossed by the road to the Pebble deposit are unusually sensitive to road interference. However, if this is the case, it is also likely that the agencies would require more effective prevention and mitigation strategies - i.e., higher road construction and maintenance standards.

<u>EPA Response:</u> See response to Comment 4.82.

4.244 The decrease in mining sites on EPA's NPL list is a measure of success of the changing laws and practices. "Obviously and most importantly from the perspective of evaluating the success of Hardrock Mine regulation, none of the Hardrock Mines on the National Priorities List were approved after 1990."

<u>EPA Response:</u> One reason for the decrease in numbers of mining sites on the EPA's National Priorities List (NPL) is that those on the list are being remediated and removed as completed (or otherwise designated for removal from the list as noted in the law), and many other sites are not yet on the list for a variety of reasons. Many mines approved after 1990 are still active. Of those that have closed, it is not possible at this time to tell if long-term management will be continued, or if it does not, whether it would result in consideration of a given site for the NPL. The mechanisms for placing a site on the NPL are specific and include state concurrence. Just because a site is not on the NPL does not mean that it does not have environmental impacts or is not undergoing cleanup actions. Many cleanups are completed under CERCLA without being placed on the NPL, or are being conducted under other state and federal regulatory programs. There are ongoing cleanups at post-1990 mines, including in Region 10. No change required.

4.245 *The lack of design and the analysis omit prevention and mitigation strategies*. Alaska's mines generally have back-up systems in case effluent escapes from the primary containment mechanism. In some cases, the systems are inherent in the mine design; in some cases they are required by the agency permit process.

At Fort Knox Gold Mine all parts of the mine drain to the tailings lake. Thus, the tailings lake will capture any upstream failure at the mill or the heap leach facility. The lake itself is a zero-discharge facility with downgradient pump-back wells. However, downstream of the tailings lake is a large constructed wetlands complex and a freshwater reservoir that would provide a large amount of dilution in case water evades the pump-back wells. This safe back-up system is inherent in the company's design. Fortunately, the back up has not been needed since the mine began; that is, no leachate has reached the wetlands/reservoir complex since the mine began operation in 1996.

At the Pogo Gold Mine the water treatment system discharges into a constructed off channel treatment works. The system discharges into a constructed lake so that the treatment system water can mix without harming the adjacent Good paster River. This is a system with back-up safety built in. If monitoring the discharge shows a problem, the outlet of the lake can be blocked until the problem is fixed. The lake provides storage in case of a treatment system upset. If mixing is insufficient, more inlet water can be pumped into the mixing lake. The company did not propose this system. In fact, it was forced on the company by the agencies during the permitting process, because it is such a safe system.

At the Red Dog Mine, all of the disturbed area-including the waste rock pile-drain either to the open pit or to the tailings lake. That way, all water can be controlled and treated before discharge. The unused volume in the tailings lake (i.e., freeboard at the dam) provides a margin of safety in case the treatment system must shut down.

The systems in these examples show how the potential for water collection and treatment failure can be minimized. None of these or other back-up system designs are discussed for EPA's hypothetical mine. The hypothetical mine is presented as if government evaluation almost did not exist: that is, the design appears to be a pre-permitting design (a design before government required margins of safety are enforced on the design). An accurate evaluation of water collection and treatment failure for the hypothetical mine must include realistic mitigation and prevention strategies.

<u>EPA Response:</u> We are aware that water treatment backup systems exist at many mines and we assume that they would also occur at a mine on the Pebble deposit or any other mine in the Bristol Bay watershed. However, there are no failsafe engineered systems, and margins of safety are not guarantees of flawless performance. The assessment evaluates potential effects of mine system failures despite modern conventional practices and technologies.

4.246 The Assessment speculates, "At mine closure, it is expected that acid-generating rock would be disposed of in the TSF or the mine pit. However, premature closure could leave waste rock piles in place" (emphasis added; p 6-37). Alaska mine regulations include a system of reclamation bonding that ensures the agencies have the funds to implement the reclamation plan if the mine closes prematurely. I t is an integral part for permitting all mines.

<u>EPA Response:</u> The scenario has been changed in the revised assessment so that acid generating rock would be processed before closure, not left in the pit. We have also added discussion of financial assurance (Box 4-3).

4.247 *Assumption of a Pipeline*. A pipeline may be required to develop the Pebble Mine. However, no other mine in Alaska uses a pipeline. In fact, very few gold mines have a need for a pipeline because the gold is so much more compact than copper concentrate. Thus, it is statistically likely that other mines within the watershed would not use a pipeline. The predicted pipeline impacts are unlikely to be representative of non-Pebble mines in Bristol Bay.

<u>EPA Response:</u> We do not assume all mines will use pipelines, but if and where they do, risks would exist. The comment is correct that there is no record of operation of a product pipelines in Alaska that might provide a failure frequency. Therefore, the assessment uses failure rates for pipelines in general and cites the record of pipeline failures at U.S. metal mines. The Pebble project is the most advanced and likely to be built mine in the Bristol Bay area, so a pipeline is likely. We agree that other mines may use other means of moving product. The primary alternative would likely be by truck. Potential truck spills are included in the revised assessment (Chapter 10).

4.248 *Omission of Pipeline-related Prevention and Mitigation Strategies*. EPA's pipeline design omits obvious prevention and mitigation strategies. EPA assumes that any spill within 100 feet of a stream could flow to that stream. If so, then moving the pipeline further away from the stream should solve the problem. Other strategies might involve building a berm for containment, or other methods to keep a pipeline spill from entering a stream or wetland.

<u>EPA Response:</u> A pipeline between any currently identified mineral prospect in the Bristol Bay watershed and the coast would have to cross streams, so streams would be at risk of a spill. The revised assessment states that pipelines would be constructed to the standards of the American Society of Mechanical Engineers, which includes options for mitigation.

4.249 With respect to dam failure, the Assessment indicates that if the reclamation plan used a dry closure rather than a wet closure, it would essentially eliminate the post-closure dam safety risk (p. 4-48). We do not know what Pebble will eventually propose (or what the governments would authorize), but it is odd for the EPA to propose a hypothetical mine with certain risks and ignore design changes that would eliminate the risk. It is incorrect to assume that a risk that could be eliminated is "typical" of large-mine risks for Bristol Bay.

Similarly, the Assessment assumes that product from a pipeline break within 100 feet of a stream will enter the stream. The Assessment also routes the pipeline within 100 feet of a stream for a significant portion of its length (i.e., not just at stream crossings). This seems self-evidently wrong. If it were such a problem, why would a mining company or a government-permitting agency not move the pipeline further from the stream? These and other design changes would significantly reduce or eliminate the impacts that the Assessment predicts. These and other examples are explained further in Sections 3 and 4 of this technical review.

<u>EPA Response:</u> The assessment describes a modern conventional mine based on what has been described for this site in Ghaffari et al. (2011), our experience with porphyry copper deposits around the country, and the mining and scientific literature. Each design element that we describe presents risks. A drained tailings impoundment may reduce the risk of catastrophic failure but it increases the risks associated with acid drainage. As we are not assessing a single mine, we chose mine scenarios representing comment industry practices. We understand that any specific mine may be designed or operated differently.

Any transportation corridor to Cook Inlet would cross streams, and other considerations may require that pipelines be within 100 feet of streams. In this assessment, all of the pipeline failures that would contaminate streams, and thus affect salmon, are assumed to occur at crossings. No change required.

4.250 The Assessment acknowledges this possibility. "After mine closure, TSF can be drained, eliminating the consequences of tailings dam failures (p. 4-48; emphasis added)." Despite this potential to eliminate the risk, the Assessment uses a wet closure to represent what they expect to be typical of large-mine impacts in Bristol Bay. They decline to impose a dry closure, which would eliminate the risk. For reference, Alaska has permitted four open-pit mines in the modern era: Red Dog, Fort Knox, Illinois Creek, and Rock Creek. Only one of the four mines-Red Dog-is proposing a wet closure in its reclamation plan.

Therefore, it is quite likely that the Dam Failure scenario is not generally representative of large mine impacts in the Bristol Bay watershed. In addition, it may not be representative of

Pebble. Neither the EPA nor the authors know whether Pebble will propose a wet or dry closure.

EPA Response: **Of the four mines referenced in the comment, only Red Dog will have reactive tailings at closure. The Rock Creek tailings impoundment has been decommissioned and reclaimed. Illinois Creek is a heap leach operation and so has no tailings slurry. Fort Knox has tailings with no acid generating potential. However, Kensington Mine is also proposing wet closure of tailings, though it is not an open pit mine.**

A porphyry copper mine in the Bristol Bay watershed is likely to have potentially acid generating tailings. A dry closure is more likely to result in acid generation over the long term, so a wet closure is more likely to be proposed. No change required.

Millrock Resources Inc. (Doc. #4828)

4.251 **Failure to consider Modern Best Practice and Minimizing Limitations**: The Assessment ignores modern-day mining practices and takes extreme liberties in minimizing the study's identified limitations. Rather than addressing the limitations, the Assessment proceeds to perform unrealistic analyses on sensationalized scenarios for hypothetical mining projects.

EPA Response: **The assessment uses mine scenarios based on a preliminary mine plan developed by Northern Dynasty Minerals (in Ghaffari et al. 2011), which assume the use of modern conventional mine design, practices, and technologies. Uncertainties associated with different aspects of the assessment are discussed fully and candidly throughout the document (as summarized in Sections 14.5 and 14.6).**

4.252 Secondary prevention, mitigation and reclamation measures are not even considered in the Assessment.

EPA Response: **Secondary prevention and mitigation are assumed to be incorporated into the mine design. We have also evaluated consequences of these systems failing.**

4.253 The Assessment does not utilize sensible mining practices. For example, the Assessment, which depicts a hypothetical TSF for Millrock's Humble prospect directly over Napotoli Creek -something a mining company or regulatory agency would not seriously consider.

EPA Response: **All streams draining the Humble prospect support anadromous fish. No scenario in this area that includes a tailings impoundment could avoid anadromous streams.**

The Pebble Limited Partnership (Doc. #4960 and #4962)

4.254 Inexplicably, EPA's Assessment barely acknowledges the likelihood that extensive mitigation efforts will eliminate or reduce the probability of adverse effects. Of course, any modern mining project that would ultimately be permitted would implement extensive mitigation measures, many of which are not and cannot be anticipated in the Assessment. The uncertainty about mining operations and mitigation at this stage compels the conclusion that the Agency does not (and cannot) know whether any potential impacts will necessarily occur should mining of the Pebble prospect ultimately take place.

<u>EPA Response:</u> The assessment uses mine scenarios based on a preliminary mine plan developed by Northern Dynasty Minerals (in Ghaffari et al. 2011). We assume that many mitigation measures not described in detail in Ghaffari et al. (2011) are included in the scenarios. However, there are no failsafe systems so the possibility of adverse effects cannot be eliminated. The purpose of the assessment is to identify the remaining risks and describe the associated uncertainties.

4.255 *Tailings dams.* Tailings dams in Alaska must be designed and constructed to the highest standards, as required: (a) by a strict regulatory process that is already in place through the Alaska Dam Safety Program; (b) by the use of appropriate hazard classification processes to assign appropriately conservative design criteria; and (c) by corporate commitments for meeting or exceeding all regulatory requirements. State-of-the-practice engineering design methods need to be applied along with appropriate construction methodologies, coupled with regulated requirements for oversight and quality control. Dam safety inspections, on-going monitoring, and regular reviews are required to continue well after mine closure to ensure that these objectives are satisfied. The Assessment mistakenly suggests that these fundamental permitting requirements will not be applied to a potential development within the Bristol Bay watershed. This is a fundamentally flawed premise. It is also extraordinary that an EPA document would suggest that this is a reasonable basis for its impact assessment, because it assumes that a federal regulatory process would completely ignore modem standards for tailings dams. The Assessment does not take into account these modern design criteria.

<u>EPA Response:</u> See response to Comment 4.26.

4.256 *Waste rock piles.* The design and construction requirements for waste rock piles include the development and evaluation of a hazard rating for the rock pile. The disposal of waste rock in Alaska is regulated by the Alaska Department of Natural Resources (DNR) under Alaska Statute 27.19. The regulations address stability, acid rock drainage, and long term reclamation requirements. Furthermore, the EPA and RCRA also provide guidelines for: Waste rock pile configuration options Preliminary design considerations, such as waste rock characterization and site characterization Stability factors, such as foundation stability and waste rock pile Stability Construction and operation methodologies Monitoring methods, and Closure and reclamation requirements. These standards and regulatory guidelines should be the building blocks for the development of any hypothetical mine scenario, yet the Assessment ignores them.

<u>EPA Response:</u> See response to Comment 4.145.

4.257 *Water Management and Mitigation*. The Assessment indicates that the assumed mining operation would modify natural runoff and infiltration, but fails to highlight the extensive studies that are required to understand baseline conditions and to determine the changes to flow conditions during construction, operation and after mine closure. These studies are fundamental requirements for the permitting process, and are required to determine appropriate mitigation measures to ameliorate potential impacts. The Assessment Report fails to incorporate reasonable mitigation measures and therefore does not represent a realistic mine development scenario. The Assessment is written as if these well-established standards did not exist.

<u>EPA Response:</u> We agree that extensive studies are required to establish a detailed water management plan. We assume that such studies are an inherent part of any mine design. The design mitigation measures proposed within the assessment's mine scenarios are those that could reasonably be expected to be proposed for a real mine, many of which were presented as appropriate for the Pebble deposit in Ghaffari et al. (2011).

4.258 *Roads and culverts*. As described in detail in several state and federal sources, modern stream crossing and culvert standards foster designs that are self-sustaining, durable, and provide continuity of geomorphic processes such as the movement of debris and sediment. National Marine Fisheries Service (NMFS) design criteria require that all fish passage facilities be designed for the 100-year flood event (2001) and that any potential damage to the crossing be addressed as part of the design process. These design criteria reduce the potential for culvert failure, both from blockage of fish passage and road washout, and promote habitat and fluvial process continuity.

<u>EPA Response:</u> We agree that these standards would reduce the potential for culvert failure. However, the standards established by the State of Alaska do not meet these more protective criteria. The assessment assumes that standard practices, as required by the State of Alaska, would be applied (see response to Comment 4.82). No change required.

4.259 *Reclamation bonding*. The Assessment implies that mine closure will be inadequate and that the owner will not be responsible for environmental liability. This assumption is not realistic: comprehensive analyses and adequate bonding to maintain the site in perpetuity, including monitoring, maintenance, and upgrading or replacement of treatment systems as new technologies are developed, would be necessary before any development could be permitted to proceed.

<u>EPA Response:</u> We assume that mine closure will proceed according to an approved plan and will be successfully implemented. We agree with the comment that financial assurance will be required to ensure adequate closure, and we have added language to Chapter 4 of the revised assessment to better address financial assurance. However, we also assume that post-closure maintenance will not last forever and note that financial assurance covers closure, but not significant remediation costs

4.260 Section 4.3.8.5, page 4-33, paragraph 3. This text implies that environmental protection requirements imposed when a mine is opened may not be required when it is re-opened. While the permitting requirements may change, they will not change without evidence provided to state and federal authorities that the changes will not result in significant environmental impacts. Over time, in fact, environmental standards typically become more stringent.

<u>EPA Response:</u> We agree with the comment in principle. However, policies and priorities vary between administrations so that environmental standards, as implemented, do not always become more stringent. For example, the Fort Knox Mine in Alaska, which was initially constructed as a non-discharge facility and has been in continuous operation since 1997, recently received a wastewater discharge permit from the State of Alaska.

4.261 Section 4.3.7, Page 4-26, first paragraph. The likely impacts of a mine on hydrology will vary with the location of the mine, the local topography and hydrologic patterns, and the mitigation activities undertaken to minimize or avoid impacts to hydrology. The assessment ignores these realities.

EPA Response: **We agree that impacts of a mine on hydrology would be site-specific. However, there are general principles that would apply anywhere in our area of interest. For example, mines consume water and therefore reduce downstream flows, and mines have a footprint upon which hydrology will be altered. Determination of avoidance by mining in a different location occurs within a regulatory process that is outside the scope of this assessment. It is assumed that such avoidance would have been considered. The purpose of the assessment is to addresses potential risks associated with mining in the location in question. We have included a discussion of compensatory mitigation in Appendix J of the revised assessment.**

4.262 Section 4.3.7, Page 4-27. Last paragraph, 1st sentence. The statement assumes that surface water flows would be reduced. The reduction in water flow will be dependent on the location of the mine, the sources of water used in the mine, the connectivity between surface and groundwater sources, etc. The assessment fails to convey clearly how these and other related factors, some of which are unrelated to mining activities, influence surface water flows.

EPA Response: **The purpose of Section 4.3.7 of the original draft assessment was to qualitatively describe the nature of streamflow changes at the site. In the revised assessment, downstream flow effects are evaluated in Chapter 7.**

The sentence referenced in the comment says, "Because the mining operation would always consume some water, there would always be less water available in the streams during active mining than there was before the mine was present." We stand by that statement. At the very least, water trapped in the void space of the deposited tailings would be a new consumptive loss, effectively removing water from the system. Unless the mining company took the unprecedented step of bringing in an equivalent quantity of water from outside the area, this water would come from precipitation, surface water, or groundwater. Water withdrawn from any of these sources would reduce the amount of water available for streams.

4.263 Section 4.3.8, paragraph 1, sentences 2, 3, and 4. The discussion of other possible mitigation options and discussion of the effect of location, surface and groundwater quantities, and topography on the potential effects is inadequate. The text in this section, as well as in other sections, fails to address the positive effects that prevent or minimize the types of environmental risks that the assessment has focused on.

EPA Response: **We assume that sufficient mitigation is included in design of the facilities. Our purpose is to identify the residual adverse effects on salmon after mitigative design features are implemented, due to both unavoidable impacts of the mine footprint and potential failures of mining systems.**

4.264 Section 4.3.8.1, page 4-31, second paragraph, sentence 2. This section makes assumptions regarding the composition of the ore and also assumes that the ore will not be sealed against oxidation. This may or may not be accurate. There is insufficient information in the document explaining what is known and not known about the ore and why it is reasonable to assume the ore will not be sealed against oxidation. If significant effects are anticipated, it is reasonable to assume that restoration activities will likely require actions to mitigate this effect.

<u>EPA Response:</u> This section simply states what would happen if the pit were not sealed against oxidation. We feel that there is sufficient information about the geochemistry of the pit to make this description.

4.265 Section 4.3.8.2, page 4-32, paragraph 2, sentences 5, 6, and 7. This discussion is based on the assumption of an absence of mitigation measures and a failure to address long-term impacts in the restoration plan. This is an incorrect assumption and is contrary to current mining practices and long-term planning requirements. This incorrect assumption negates the overall analysis.

<u>EPA Response:</u> We disagree. Unless a new technology that will reliably isolate the body of a TSF forever is developed in the future, then water will percolate through the tailings into the ground. This leakage will require monitoring, collection, and treatment until it meets state standards or in perpetuity.

4.266 Section 4.3.8.4, page 4-33, first paragraph, first sentence. Specific mitigation and restoration requirements are likely to require restoration of downstream flows; the statement in the assessment is based on an assumption that may not be correct. There is insufficient information in the assessment to support this assumption.

<u>EPA Response:</u> The paragraph addresses this issue. It states that water may be diverted to the pit or may be discharged downstream (a mitigation measure). We do not presume one measure or the other.

4.267 Section 4.3.8.5, page 4-33, paragraph 2. The text assumes that a mine owner can abandon a site with no consequences. While this may have been the case in the last century, it is no longer the case today. The State of Alaska requires a bond to cover the cost of restoration actions in the event the mine owner defaults. The bond assures that monies are available for restoration. Sections of the text that assume it is possible to abandon a mine site without consequences need to be revised in light of State of Alaska bond requirements {see e.g., Alaska Statute 27.19 &Alaska Administrative Code Chapter 97).

<u>EPA Response:</u> The assessment does not state that a mine could close with no state standards such as reclamation, bonding, or closure design requirements. Section 6.3.5 of the revised assessment addresses some of the areas of uncertainty associated with premature closure. We have noted in this section that, "In the past, however, financial assurance often has not been adequate, and taxpayers have been left with substantial cleanup costs (USEPA 1997). This may be changing, as agencies update bonding requirements to reflect cleanup costs more accurately, but projecting these costs far into the future is a difficult task…" with respect to premature closure (Section 6.3.5). We have also added discussion of financial assurance in Box 4-3 of the revised assessment.

4.268 Section 4.3.9.2, 1st paragraph, 1st sentence; Table 4-6; page 4-37 paragraphs 1 and 2. The majority of this paragraph needs to be restated as an assumption; the source of information is not specified, and the information needs to be presented as assumed.

EPA Response: We state early in the assessment that the scenarios are hypothetical for the purposes of the assessment. We have included four pipelines as part of the scenarios. There is no other assumption implied here.

4.269 Section 4.3.9.1, page 4-36, last Sentence. The fact that culverts washed out may not be pertinent to the assessment since it is not clear that the culverts that washed out were constructed in accordance with today's standards and best management practices. This is another example of reliance on invalid assumptions and inappropriately applied mine scenarios.

EPA Response: The Williamsport-Pile Bay Road is a State of Alaska road, so we assume it was constructed and maintained to state standards. We feel that this is a reasonable assumption.

4.270 Section 4.3.7. This section makes numerous statements regarding the expected impacts of a mine on hydrology. Citations are missing describing the source of these assumptions.

EPA Response: Water balance and water management are described in more detail in the revised assessment (e.g., Sections 6.2.2 and 6.3.4).

4.271 Section 4.3.7, Page 4-26, 3rd bullet. Other approaches to managing precipitation are possible; the absence of a consideration of other options to manage precipitation and the supporting literature describing possible actions should be corrected in order to facilitate evaluation of the significance of the assumption.

EPA Response: See response to Comment 4.270.

4.272 Section 4.3.8.1, page 4-31, sentence 1. Citations are missing describing the source of these assumptions.

EPA Response: This sentence is not included in the revised assessment.

4.273 Section 4.3.8.4. Several references are made to Table 4-5; the information in Table 4-5 is not supported by references or any discussion regarding data analysis.

EPA Response: See response to Comment 4.270.

4.274 *Mine Scenario* The Assessment Report presents a mine scenario and assumptions that fail to meet the standards for mine development and environmental assessment in the State of Alaska and the United States of America. The Assessment Report includes a flawed risk assessment that draws false conclusions based on past examples from other jurisdictions and mining practices that are not permitted in the State of Alaska. The Assessment Report states that "the assessment largely analyzes a mine scenario that reflects the expected characteristics of mining operations at the Pebble deposit". In fact, the EPA grossly underestimates the high standard to which a mine in the Bristol Bay watershed would have to be designed and engineered in order to obtain permits to operate in the watershed. It also underestimates the role of various federal and state regulatory agencies in the permitting process that will help ensure that a technically advanced mine would be designed and operated. The Assessment Report is based on a fundamentally flawed premise that a faulty mine design, inadequate mine development and inappropriate mine operations would be permitted to occur within the State of Alaska, and specifically within the Bristol Bay watershed. The Assessment Report has misrepresented the likelihood of tailings dam failure for any proposed mining development in Alaska. It has also utilized unrealistic and erroneous extrapolations to develop questionable predictions of potential impacts of mining operations within the Bristol Bay watershed.

<u>EPA Response:</u> EPA is routinely involved in the review of modern mines, including mines in Alaska. We feel that the details of the mine scenarios, drawn primarily from the preliminary plan laid out by Northern Dynasty Minerals in Ghaffari et al. (2011), are consistent with other mine proposals up to the current time. We believe that a mining company would likely submit a scenario with major elements substantially like this one and expect regulatory agencies to either accept it with no major modifications or reject it as too environmentally damaging.

4.275 *Permitting In Alaska* Tailings dams in Alaska must be designed and constructed to the highest standards, as required by a strict regulatory process that is already in place through the Alaska Dam Safety Program; by the use of appropriate hazard classification processes to assign appropriately conservative design criteria; and by corporate commitments for meeting or exceeding all regulatory requirements. State-of-the-practice engineering design methods need to be applied along with appropriate construction methodologies, coupled with regulated requirements for oversight and quality control. Tailings impoundments must be designed, constructed and operated to achieve and maintain performance objectives and to form stable long-term landforms in perpetuity. Dam safety inspections, on-going monitoring, and regular reviews are required to continue well after mine closure to ensure that these objectives are satisfied.

The Assessment Report suggests that these fundamental permitting requirements will not be applied to a potential development within the Bristol Bay watershed. This is not only a fundamentally flawed premise, but it is also somewhat confusing that an EPA document would suggest that this is a reasonable basis for their impact assessment, since they are suggesting that a federal regulatory process would allow an inappropriate or inadequate development to proceed.

<u>EPA Response:</u> See response to Comment 4.26.

4.276 *4.3.8.2: 4-32.* We assume that water in the TSFs would be drawn down to prevent flooding, but that a small pond would be left to keep the core of the tailings hydrated and isolated from oxidation. Sulfide-rich materials that would generate acid if exposed to oxygen would have been placed in the core of the tailings impoundment. As long as a stagnant cover of water is maintained, oxygen movement into the tailings would be retarded, minimizing acid generation. Drawing down the level of water in the TSF would also provide capacity for unusual precipitation events, reducing the likelihood that a storm would provide enough precipitation to overwhelm capacity and cause tailings dam failure or overtopping.

This is an example of how to prevent overtopping failure from the Assessment Report that contradicts the summary and conclusions of the study.

<u>EPA Response:</u> We agree that the post-closure TSF would be managed to prevent overtopping. The assessment did not evaluate failure of the TSF post-closure, but rather when the TSF was both half and completely full (i.e., during the operational phase and before closure activities when water would have been drawn down, as described in the scenario). Therefore, there is no contradiction and no change required.

4.277 *4.3.8 Post-Closure Mine Management: 4-31* Weathering to the point where these contaminants are present in only trace amounts (at levels approaching their pre-mining background concentrations) would likely take hundreds to thousands of years, resulting in a need for management of materials and leachate over that time. We assume that, as part of post-closure operations, the existing seepage collection and treatment system would be maintained to capture and treat potentially toxic runoff and groundwater originating from the remaining facilities. Such a seepage collection and treatment system might need to be maintained for hundreds to thousands of years. There are no examples of such successful, long-term collection and treatment systems for mines, because these time periods exceed the lifespan of most past large-scale mining activities, as well as most human institutions. Throughout this section, we refer to the need for treatment for extended periods of time. The uncertainty that human institutions have the stability to apply treatment for these timeframes applies to all treatment options.

This implies that mine closure will be inadequate and that the owner will not be responsible for environmental liability - this is not realistic as comprehensive analyses and adequate bonding to maintain the site in perpetuity, including monitoring, maintenance, and upgrading or replacement of treatment systems as new technologies are developed, would be needed before any development could be permitted to proceed.

<u>EPA Response:</u> See response to Comment 4.259. Though efforts are underway to address the issue of perpetual treatment, and new technologies will undoubtedly be developed that will improve on existing technology, the mining industry's ability to guarantee continued treatment in perpetuity remains unproven.

<u>Alaska Oil and Gas Association (Doc. #4974)</u>

4.278 NEPA requires the analysis of various alternatives as well as the use of mitigation measures to minimize environmental impacts. Instead, EPA analyzed the impacts of a single hypothetical mine project, with little to no discussion about specific mitigation measures, based on a very small amount of information compared to the vast amounts of science available for Pebble. The law also requires EPA to consider the benefits of proposed projects, which it did not do here.

<u>EPA Response:</u> The assessment explicitly describes some mitigation measures (e.g., water collection and treatment in Chapter 8 of the revised assessment) and assumes modern conventional mitigation measures are incorporated into mine design and operation.

<u>Bristol Bay Regional Seafood Development Association (Doc. #4151)</u>

4.279 We note and agree that even under a No-Failure scenario, the fisheries suffers significant impact from the hypothetical mine. Regarding that hypothetical mine; we also note that the document is erratic in referring to the size of the Pebble-based hypothetical mine. This is significant because the impacts of large-scale mining are proportionate to a mine's size. Applying a smaller size understates potential impacts. In many instances the Assessment's mine scenario is based on a 6.5 billion ton mine. Yet in other sections (e.g., Section 4.1.1.), the document refers to the more likely 10.8 billion ton mine – an estimate created by Northern Dynasty in their 2011 Wardrop report. We believe, therefore, that the document's sound but appropriately cautious approach to mine size significantly underestimates probable impacts on salmon. Regardless, even under a "smaller" but still giant 6.5 billion ton mine – the impacts are enormous and promise severe consequences to the salmon resource upon which our businesses and jobs depend.

EPA Response: We intentionally limited the scope of the assessment to direct effects of a mine on salmon in two watersheds draining to Bristol Bay, because fisheries are directly identified as a target resource in Section 404(c) of the Clean Water Act. However, we acknowledge throughout the revised assessment (most notably in Chapter 2) that other effects are likely. We also have expanded our consideration of multiple mines and induced development in Chapter 13 of the revised assessment.

Alaska Marine Conservation Council (Doc. #4112)

4.280 While the Assessment accurately characterizes the nature and location of the deposit, we are concerned that the 6.5 billion ton maximum mine scenario used in the assessment is significantly smaller than the total 10.78 billion ton resource estimate of the Pebble Prospect as described by Northern Dynasty in their 2011 Wardrop Report. The Assessment clearly underscores, utilizing the best available data, including that from the PLP, that the wastes from mining the Pebble deposit will likely generate acid, which will dissolve copper and pose serious risks to Iliamna Lake, aquatic habitat, and the waters of Bristol Bay. By using the lower resource estimate, the Assessment underestimates the potential long-term risk to fish.

EPA Response: We were intentionally conservative to avoid overstating adverse effects in the absence of an actual mine plan. It is likely (and common) that a smaller mine would be a starting point and then expansion planned in later years, and it is difficult to predict the state of the technology for mining in the future.

4.281 Mine scenarios also underestimate cumulative impacts that would occur with the build-out of a single mine, as the study scope was limited and did not include impact assessment of power, port, transportation, and human infrastructure development that would likely occur.

EPA Response: We agree that the assessment understates the totality of impacts that could result from a single mine, but the issues mentioned were defined as outside the scope of the assessment during problem formulation. The scope of the assessment is clarified in Chapter 2 of the revised assessment.

4.282 The Assessment does a good job of noting earthquakes as a potential trigger for failure over the short or long-term. However, in box 4-3 describing the seismic environment of Bristol Bay, they overstate the strength of our current scientific knowledge about seismic risk in the area, implying that the lack of evidence for past earthquakes is evidence that no such earthquakes have ever occurred. This section fails to reference the most current and appropriate publication on the largest nearby fault by Koehler and Reger 2011, Reconnaissance Evaluation of the Lake Clark Fault, Tyonek Area, Alaska. This publication makes clear seismic uncertainties: "The paleoseismic history of the [area near Pebble] remains unknown."

<u>EPA Response:</u> The revised assessment references the seismic uncertainties stated in the conclusions of Koehler and Reger (2011).

<u>Fisheries Research and Consulting (Doc. #4580)</u>

4.283 The maximum mine scenario is conservative. Pebble mine proponents consistently base job projections and economic benefits of mining Pebble on the full exploitation alternative (11 billion metric tons). This alternative would result in a mine almost twice as large as the EPA maximum scenario, which would have a greater impact on aquatic resources. To fully disclose potential impacts to policy makers and the public, it is reasonable to consider a third mine scenario based on exploitation of the estimated 11 billion metric ton Pebble deposit.

<u>EPA Response:</u> See response to Comment 4.280.

4.284 Comments taken from table listing specific issues:

- P 4-6, Figure 4-2: In 2005 Northern Dynasty published a graph of acid generating potential of samples from Pebble West in Chapter 8 of their 2004 progress reports. The graph showed that the majority of samples had high potential for acid generation.

<u>EPA Response:</u> This is a background section on mining in general. Our purpose here was to discuss porphyry copper mining in the world at large, not specifically at the Pebble deposit. We use the well-documented Bingham Canyon mine as an example of this type of deposit. Reorganization of the revised assessment should help clarify what is background material (Chapter 4) and what is specific to the scenarios (Chapter 6).

- P 4-16, Table 4-4: Add Pebble.

<u>EPA Response:</u> Pebble has been added to this table (Table 4-1 in the revised assessment).

- P 4-18, Figure 4-6: Legend and figure are mismatched.

<u>EPA Response:</u> This figure has been removed in the revised assessment.

- P 4-21, "much higher than most existing tailings dams": Can you add an average tailings dam height for other dams worldwide and/or in the US? It would be helpful throughout this chapter as well as associated figure.

<u>EPA Response:</u> Tailings dam heights at other dams in Alaska are presented in Table 4-1. We don't feel that an average height would be particularly useful; our point is that these would be among the largest dams constructed.

- P 4-23, "In a TSF, the low solubility of oxygen in the water (less than 15 mg/L) limits the access of oxygen to unreacted sulfide minerals in the tailings, reducing dissolution reaction rates and thus the concentration of solutes": What about PLP's data indicating saturated groundwater? What if that is upwelling into TSF?

<u>EPA Response:</u> This is possible but the large head within the tailings would likely counter flow into the tailings. In addition, the oxygenated ground water would have to make its way through tailings to the sulfide materials against the flow of water, which seems unlikely.

- P 4-23, "carbonate or silicate minerals will partially neutralize acid": This is not the case at Pebble, if I understand.

<u>EPA Response:</u> There will be some carbonate and silicate minerals which will act to neutralize acid, but not enough to completely offset acid production.

- P 4-42, Figure 4-11: Has an earthquake closer to the Pebble deposit been recorded here?

<u>EPA Response:</u> This figure (Figure 3-15 in the revised assessment) identifies earthquakes with a magnitude greater than 5.0, which are identified by USGS as "significant earthquakes." As shown in Table 3-5 of the revised assessment, smaller earthquakes have occurred closer to the Pebble deposit.

- P 4-54 to 4-59, Tables 4-10 to 4-13: Would be nice to have a map/graphic for visualizing 'downstream extent of model,' failure volumes, and/or some of the depth and volume scenarios.

<u>EPA Response:</u> Depths, volumes, and velocities are presented in Chapter 9.

- P 4-60, "We limited our model to 30 km above the confluence of NFK and SFK": Isn't that AT the deposit practically?

<u>EPA Response:</u> This statement has been reworded to clarify that we are addressing the 30 km between the mine site and the confluence of the North and South Fork Koktulis.

- P 4-60, "The probability of a pipeline failure occurring over the duration of the minimum mine scenario (i.e., approximately 25 years) would be 98% for each [of the four] pipelines": Virtual certainty of pipeline failure.

<u>EPA Response:</u> No change required.

- P 4-64, Figure 4-14: Move up to refer to text; clarify – figure is confusing.

<u>EPA Response:</u> This figure has been removed in the revised assessment.

<u>Ground Truth Trekking (Doc. #3772)</u>

4.285 Comment 1: The Watershed Assessment does not describe the general seismic environment of Bristol Bay. In Box 3-4 [note commenter means Box 4-3], the first paragraph lists off some major faults, and the second paragraph provides some information on studies of the Lake Clark Fault. What is missing is the broader geological context. The region surrounding Bristol Bay is potentially impacted by as many as four independent and actively moving blocks of crust (Haeussler 2008). The most dramatic motion in the region is likely driven by subduction of the Pacific Plate to the south under North America to the north. A fragment of the North America Plate called the Southern Alaska Block is sliding west along the Denali Fault and others, driving earthquakes east of Bristol Bay and its impact on the Bristol Bay Region is unknown. Finally, a section of rotating crust called the Bering Block may be shearing along the western edge of Alaska, possibly impacting Bristol Bay (Macket et al., 1997). This complex tectonic context makes it difficult to extrapolate tectonic trends from elsewhere in the state to the area.

<u>EPA Response:</u> A brief, broader discussion of the tectonic setting has been added to the revised assessment (Section 3.6).

4.286 Comment 2: Some inaccurate characterizations and irrelevant material obscure the general status of research on seismic hazards. Box 3-4 states, “The western terminus of the Lake Clark Fault was originally interpreted to be near the western edge of Lake Clark, but more recent studies by USGS reinterpreted the position of the Lake Clark Fault further to the northwest, potentially bringing it as close as 16 km to the Pebble deposit (Haeussler and Saltus 2005).” No scientific work has been done to ascertain the terminus of the Lake Clark Fault. The terminus is explicitly unknown. No evidence discovered to date has suggested or been interpreted as a terminus. Haeussler and Saltus map the fault to about 16 km short of the Pebble deposit, but their results do not suggest it terminates there. On the contrary, they show that there is about 26 km of offset on the Lake Clark Fault, similar to what is seen further northeast. This offset implies the fault must go further or transition into some other unknown fault system. Likewise, the characterization of the length of the fault as 225 km long is inaccurate. As an important distinction, the length mapped is 225 km. Additionally, Box 3-4 includes discussion of the “Braid Scarp” feature. This is just a single ancient riverbank that, though it was investigated as a possible fault trace, is not in fact a fault. This has no implications as far as the broader tectonic behavior of the area, and has no relevance in the document.

<u>EPA Response:</u> The discussion of the length and terminus of the Lake Clark Fault has been revised to correct inaccuracies and better describe the uncertainty of the terminus (Section 3.6 of the revised assessment).

4.287 Comment 3: The Watershed Assessment does not make the uncertainty about seismic hazards clear. The most recent scientific literature (Haeussler & Waythomas 2011, Koehler & Reger 2011) on seismic hazards along the Lake Clark Fault and in Bristol Bay clearly equivocates. Little is known, the hazard is thus undetermined, and the researchers make carefully worded statements to reflect this. This is a key factor when assessing future developments in the area. Published research suggests that seismic hazard may be low, but the extent of this research is limited, and seismic hazard may be high. We found this important scientific distinction was lost in Watershed Assessment. Perhaps the most relevant and recent paper on the subject, is Koehler and Reger, 2011. Koehler & Reger conclude that they did not find evidence for activity on the Lake Clark Fault in the Tyonek area in the recent past, paralleling the results summarized by Hauessler & Waythomas (2011). In addition, they clearly articulate the state-of-knowledge of the western end of the Lake Clark Fault, near Pebble: “The paleoseismic history of the western part of the Lake Clark fault remains unknown.” Koehler & Reger also clearly describe some of the limitations to knowledge of the Lake Clark Fault’s activity level. For instance: “…distributed slip on unrecognized structures and dense vegetation that might obscure tectonic features along the Lake Clark fault could limit assessment of tectonic activity.” Together, Koehler & Reger (2011) and Haeussler & Waythomas (2011) well-characterize the overall state-of-knowledge, but this requires careful reading. There is no currently public evidence to suggest recent activity on the Lake Clark Fault, but there is also little scientific knowledge on the subject, and broad conclusions about the seismic stability or history of the area are preliminary. Koehler & Reger 2011 is actually cited in the current version, but this is an accidental mis-reference: the paper referred to in the current version is actually Koehler 2011, which is Rich Koehler's review of the Braid Scarp.

EPA Response: The text in Box 4-3 (now in Section 3.6 of the revised assessment) adequately describes the uncertainty inherent in interpreting seismic hazards in the area of the Pebble deposit. The reference to Koehler and Reger (2011) has been corrected in the revised assessment.

4.288 Comment 4: Minor technical correction on small & induced earthquakes. Box 3-4 states that earthquakes may occur "…outside of pre-existing faults." It would be more accurate to say such earthquakes can occur on previously unidentified, minor, or otherwise inactive faults, but it's very unusual for manmade stresses to cause the formation of new faults.

EPA Response: This inaccuracy has been corrected in the revised assessment (Section 3.6).

Alaska Conservation Foundation (Doc. #4120)

4.289 While the Assessment accurately characterizes the nature and location of the deposit, I are concerned that the 6.5 billion ton maximum mine scenario used in the assessment is significantly smaller than the total 10.78 billion ton resource estimate of the Pebble Prospect as described by Northern Dynasty in their 2011 Wardrop Report. The Assessment clearly underscores, utilizing the best available data, including that from the PLP, that the wastes from mining the Pebble deposit will likely generate acid, which will dissolve copper and pose serious risks to Iliamna Lake, aquatic habitat, and the waters of Bristol Bay. By using the lower resource estimate, the Assessment underestimates the potential long-term risk to fish.

EPA Response: See response to Comment 4.37.

4.290 The Assessment does a good job of noting earthquakes as a potential trigger for failure over the short or long-term. However, in box 4-3 describing the seismic environment of Bristol Bay, they overstate the strength of our current scientific knowledge about seismic risk in the area, implying that the lack of evidence for past earthquakes is evidence that no such earthquakes have ever occurred. This section fails to reference the most current and appropriate publication on the largest nearby fault by Koehler and Reger 2011, Reconnaissance Evaluation of the Lake Clark Fault, Tyonek Area, Alaska. This publication makes clear seismic uncertainties: "The paleoseismic history of the [area near Pebble] remains unknown."

EPA Response: See response to Comment 4.287.

National Resources Defense Council (Doc. #4608)

4.291 *Subsidence Caused by the Block Caving Will Change Water Flow and Decrease Fishery Productivity.* Precise details of the Pebble Mine design have not yet been disclosed, but block caving has been proposed for the Pebble East deposit. Though sometimes thought to be less environmentally damaging than open pit mining, large-scale underground mining can cause "catastrophic" impacts to overlying material and cause wide-ranging ecosystem effects.

Underground mining operations are particularly prone to subsidence. Under EPA's analysis, a block caving method in the Pebble east side deposit would initially occupy a smaller surface area than the maximum mine site, but subsidence would ultimately increase the footprint. In block caving, subsidence and collapse are encouraged: a series of tunnels are dug under a deposit, forcing the collapse of overlying substrate. As ore falls and is subsequently removed, the material in higher levels will crack, which can lead to large surface subsidence. Most hard-rock deposits contain faults and intrusions, hydrothermal alteration of rocks, and many clays and clay-like minerals, all of which reduce rock strength and make subsidence more likely. Finally, water is removed from mine sites in order to facilitate the mining process — further weakening the surrounding area.

Subsidence can have large impacts on surface and ground water and can cause them both to be redirected. The overlying strata is fractured – often to the surface – allowing contact between water and the mineralized material not removed by mining. Subsidence also leads to increased acid production and transportation from the mine. Both the redirection of water flow and the increase of acid can have large impacts on local fisheries.

It is unlikely that subsidence can be mitigated. Mining companies have not managed to successfully reclaim or re-vegetate subsidence areas surrounding a block cave mine, and one researcher concluded that "[n]o evidence was found that subsidence effects at underground hardrock mines using block caving can be managed or mitigated short of not mining." Subsidence is therefore an issue that should be included in the final Watershed Assessment.

<u>EPA Response:</u> The assessment focuses on the potential impacts from large-scale porphyry copper surface mining, although block caving is discussed briefly in Section 4.2.3.1 of the revised assessment. Many of the impacts of a combined surface and underground mine would be similar in nature to those of a surface mine. The primary differences would be that block caving would result in smaller waste rock piles and a smaller open pit than a surface mine. Although subsidence would occur over the block caving area, the surface depression would not be expected to be larger than the open pit created by exploiting the deposit through surface mining. Therefore, the precipitation falling into the open pit or depression, the groundwater flow into the open pit or depression, and the impacts to streams buried or blocked by the block caving mining alternative would be no greater than those described in the assessment for the surface mine.

4.292 EPA's Assessment, if anything, actually underestimates potential risks due to its explicit exclusion of important risk factors. If included, those risk factors would unquestionably increase the intensity and duration of significant harm to the region and its resources, including most notably the Bristol Bay wild salmon fisheries. For example, EPA's maximum mine scenario only estimates 6.5 billion tons of waste when, if fully developed, the waste at Pebble Mine would exceed 10 billion tons. In addition, EPA's baseline analysis assumes no accidents, failures, or other releases of mining products or wastes, with reliable collection of all water from the site and effective treatment of effluents. This is deliberately and unrealistically conservative given that, in EPA's words, "accidents and failures always happen in complex and long-lasting operations." Equally important, the Watershed Assessment does not consider the impacts that would result from the development and operation of a deep-water port in Cook Inlet, secondary development, and increased evapotranspiration, precipitation, and other likely consequences associated with climate change. It also severely underestimates the amount of tailings likely to be released during failure and the distance these tailings would travel. Taken together, these additional foreseeable risk factors unquestionably support a conclusion that EPA's assessment of risk underestimates the actual harm attendant to large-scale mining in the Bristol Bay watershed.

<u>EPA Response:</u> The comment reflects several misunderstandings of the purpose and scope of the assessment:

- **The scenarios do not include removal of all ore from the Pebble deposit, because it would likely require techniques other than open pit mining.**
- **The no failure alternative in the original draft assessment was intended to highlight the inevitable effects of mine development, even in the absence of accidents or failures. The assessment was reorganized and revised to clarify this intent.**
- **Cook Inlet is not in the Bristol Bay watershed.**
- **The 20% tailings release is not the maximum possible but it is a realistic case. The distance modeled reflects the extent of the model, not the distance traveled.**

4.293 The Watershed Assessment is also notable for what it omits. EPA elected to exclude consideration of certain significant mining-related environmental stressors from which additional and likely *greater* impacts will result. Indeed, undervaluations of potential harm pervade the report. For instance, the Watershed Assessment estimates the maximum mine scenario at 6.5 billion tons, which is significantly smaller than the over 10 billion ton resource estimate in the Wardrop report. In addition, the development and operation of a deep-water port in Cook Inlet, secondary development, and increased evapotranspiration, precipitation, and likely other consequences of climate change are all absent from the analysis. This intentionally conservative approach only serves to bolster the Assessment's significance as a directive for proactive EPA action in Bristol Bay because, despite its conservatism, the report identifies substantial impacts of mining that will cause unacceptable adverse effects on the Bristol Bay environment.

<u>EPA Response:</u> We intentionally took a conservative approach to avoid potentially overstating adverse effects. Many of the issues raised in the comment were defined as outside the scope of the assessment during problem formulation; the scope of the assessment is now clarified in Chapter 2 of the revised assessment.

4.294 The inevitable and the likely adverse effects identified in the Watershed Assessment, while each individually significant and adverse, do not reflect the full extent of probable harm. EPA's judicious Assessment is by design a conservative underestimation of projected environmental damage that would result from mining in Bristol Bay. These undervaluations range from data considerations such as maximum mine scenario, stream length of anadromous fish habitat, spawning salmon abundance, and salmon olfactory sensibility, to the blanket exclusion from analysis of the significant infrastructure that would be associated with mine development. Though power generation and transmission, secondary development, and – critically – construction and operation of a deepwater port at Cook Inlet "could have significant repercussions for the Bristol Bay ecosystem[,]" they were not considered.

EPA Response: **See response to Comment 4.293.**

4.295 Furthermore, no matter how the mine is built and operated, the post-closure results are likely catastrophic. There are simply no examples of successful long-term treatment systems for inactive mines. A review of recent pipeline spills in North America found that neither existing technology nor contemporary practice assure against catastrophic spills. Today Bristol Bay is a watershed of superb quality, diverse aquatic habitats, high surface and subsurface water connectivity, and diverse and stable fish habitats, "untouched by human-engineered structures and flow management controls." Our urgent concern is for the Bristol Bay of tomorrow should the region be opened to large-scale mining development.

EPA Response: **Comment noted; no change required.**

4.296 First, it is fairly standard practice for the mining industry to secure a permit for a smaller mine and then later request permits for expansion. NDM's original plan was to extract 2.5 billion tons of ore, but PLP announced in 2010 that the Pebble deposit contains almost 11 billion tons of mineral resources. It is therefore reasonably foreseeable, and indeed virtually inevitable, that the mine will expand far beyond the initial 2.5 billion tons. EPA estimates a minimum of 2 billion tons and maximum of 6.5 billion tons, which is also significantly smaller than the total resource estimate. Next, once the mine is built – introducing critical infrastructure for development – it will open the region for industrial scale mining even beyond Pebble. In evaluating environmental impacts, the development of a new road is "often only the first step toward industrial or commercial development of the landscape in general, including the proliferation of additional roads." The initial infrastructure facilitates and "subsidizes" additional large-scale development, most notably when the initial road connects to a possible trade hub, such as a deepwater port.

EPA Response: **Comment noted; no change required.**

4.297 Furthermore, the Bristol Bay Area Plan lays out a network of roads and highways in the Bristol Bay region, including "regional transportation corridors" that would connect Cook Inlet to the area of the Pebble prospect, as well as King Salmon, Naknek, Egegik, and Port Heiden, and to Chignik and Perryville on the southern Alaska Peninsula. This is in addition to the Plan's "community transportation projects," which would create extensions, improvements, or new roads within or adjacent to the Bristol Bay watershed (Chigniks Road Intertie, King Cove-Cold Bay Connection, Newhalen River Bridge, Iliamna-Nondalton Road Intertie, and Naknek-South Naknek Bridge and Intertie), and three potential trans-peninsula transportation corridors. Longer roads and pipelines, and the corresponding increase in aquatic area crossings, would increase the probability of each of the mine risks described above, such as culvert failures and pipeline breaks, further damaging the aquatic systems.

EPA Response: **Consideration of the cumulative effects of multiple mines has been expanded in Chapter 13 of the revised assessment.**

4.298 A final impact that the Assessment excludes, but which is "likely to be more significant" than the analyzed salmon-mediated effects, are the mine's impacts on Alaska Native cultures. Dramatic impacts on the traditional culture will result from a shift to a market economy, as well as increased access to the area.

<u>EPA Response:</u> Direct effects of large-scale mining on Alaska Native cultures were defined as outside the scope of the assessment, as detailed in Chapter 2 of the revised assessment.

4.299 Potential Effects of a Tailings Dam Failure Are Significantly Greater than EPA Estimates

As an initial matter, EPA underestimates the amount of tailings. The Assessment uses a 6.5 billion ton maximum mine scenario, which is considerably smaller than the over 10 billion ton resource estimate described in the 2011 Wardrop report. In addition, EPA has based its analysis of tailings dam failure risk on four assumptions, each of which leads to significant underestimations of the effects that a failure would have on the Bristol Bay environment. As described in detail in the comments prepared by Professor Johnnie N. Moore, Ph.D., the Watershed Assessment underestimates the amount of tailings potentially released during failure, the run-out distance of these tailings, their immediate and long-term physical and geochemical effects, the duration of toxicity, and impacts associated with climate change.

<u>EPA Response:</u> See response to Comment 4.37. We took an intentionally conservative approach to avoid overstating potential adverse effects.

4.300 Next, run-out from a tailings dam failure in the Pebble area would extend much farther than EPA assumptions predict. EPA conservatively estimates that partial dam failure run-out would reach 30 km to the mainstem Koktuli River, and tailings from a full volume failure would extend 307 km to the waters of Bristol Bay. But again, calculations drawn from a leading study of historical impoundment failure data suggest significantly larger run-out distances of 150-300 km for EPA's partial failure scenario, and from 450-1000 km at full volume – still assuming only a 20% tailings release. When the more likely 38% rate is analyzed, run-out jumps to 460 km and 1800 km for partial and full releases, respectively. Under any of these scenarios, "a spill would likely deposit a large amount of contaminated material into Bristol Bay as well as in the floodplain along all streams leading from the tailings site to Bristol Bay."

A scientific study specific to the proposed Pebble Mine is consistent with Moore's analysis, finding that a failure of a tailings dam could lead to the release of billions of tons of mine waste and hundreds of billions of gallons of contaminated water. Depending on which dam failed, even a modest "lower than expected" failure could have "extraordinary" run-out distances, and reach 270 km to Bristol Bay itself. This run-out distance is an estimate based only on the original 2.5 billion tons mining proposal – an amount much less than the mine may actually produce.

<u>EPA Response:</u> 30 km is the extent of the model simulation, not an estimate of extent. The 307 km to Bristol Bay is not a runout distance, but rather the distance that tailings could be carried by suspension and transport during high flows.

4.301 Finally, climate change should be an important consideration in assessing the stability of tailings structure and other infrastructure, as well as transport flow of contaminants in the event of a release. Hydraulic modeling in a watershed to the east of Bristol Bay predicts substantial change to runoff. South-central Alaska has been designated as a region of disproportionate changes in "heavy" and "very heavy" precipitation, and annual average temperatures in the region are also on the rise. The potential impacts that these changes could have on mine structure and rates of failure were not, however, included in EPA's Assessment – and represent yet another example of EPA's conservative underestimation of the risks associated with mining in Bristol Bay.

<u>EPA Response:</u> Although a full consideration of how climate change could affect mining-related impacts is beyond the scope of the assessment, we have included discussion of potential climate change in the region in Chapter 3 (Section 3.8), and consideration of climate change and mining interactions in Chapter 14 (Box 14-2).

4.302 The EPA report analyzes the impacts of two tailings dam size failures at TSF 1 in which a conservative 20% of impounded tailings would be mobilized. The first scenario considers a partially full dam of 98 m and 227-million m^3 tailings volume, and the second (after approximately 25 years) at full volume of 208 m and tailings of 1,492 million m^3. Immediately following a failure of either magnitude, suitable spawning and rearing habitat for salmon and other native fish would be completely eliminated in the North Fork Koktuli River downstream of the tailings dam. A partial-volume failure would send discharge surging at a more than 1,000-fold increase in magnitude compared to a record flood; full volume failure would result in a 6,500-fold increase. EPA conservatively estimates that partial dam failure runout would reach 30 km to the mainstem Koktuli River, and, at full volume, runout would extend 307 km to the currently pristine waters of Bristol Bay. Suitable salmon habitat in the North Fork Koktuli mainstem would be completely lost for the first ten years after failure, followed by decades of very low-quality spawning and rearing habitat. These projections reflect uncertainty only with respect to potential underestimations of downstream habitat impacts and true salmon abundance, because the projections assume only a 20% failure. As discussed more fully in Section VI.D.4 below, these projections are overly cautious: if failure occurs it will likely release more than 20% of the tailings and runout distance will extend significantly farther. The failure scenarios are therefore conservative in that they consistently underestimate the maximum level of impact that could be expected in a worst-case failure scenario. As a result, the Assessment understates the impacts from a worst-case failure.

<u>EPA Response:</u> See response to Comment 4.300. The 20% tailings release is not the maximum possible but it is a realistic case.

4.303 Even understated, these impacts would be devastating. The damage from a dam failure would constitute "a near-complete loss" of the mainstem North Fork Koktuli fish populations for multiple salmon life cycles. It would affect even the salmon that are at sea during the failure, because they would lose spawning and rearing habitat to which to return. Furthermore, tailings persist in streams as sources of metal exposures for decades, and even centuries, causing severe toxic effects and toxic dietary risks to organisms. In fact, "the effects of tailings deposition in streams and floodplains persist for as long as they have been monitored at analogous sites." Dilution of toxicity would take an especially long time in Bristol Bay because the relatively undisturbed nature of the watershed means that background levels of total suspended solids are low. And remediation raises its own set of concerns. Despite net benefits, it would create long-term impacts on aquatic habitat, particularly because new roads would be required to transport equipment and tailings through the currently roadless Bristol Bay environment.

EPA Response: Comment noted; no change required.

4.304 Dam failures can be triggered by such events as high rains, hurricanes, rapid snow melt or ice accumulation. Impoundments are also susceptible to erosion and landslides, and – in the Pebble area in particular – permafrost and earthquakes. First, the proposed dams would lie within a zone of sporadic permafrost. Permafrost can cause underground movement, which may pose major problems for tailings impoundments.

Second, dams in the Pebble area would face a particularly serious threat from earthquakes. The proposed Pebble Mine is located 125 miles from the Alaska Aleutian megathrust, which has been responsible for several of the largest earthquakes ever recorded, including the 1964 Prince William Sound earthquake (magnitude 9.2) and the Aleutian earthquake (magnitude 9.1). Earthquakes can have far reaching impacts: in 2002, the 7.9 Denali earthquake ruptured surfaces over 200 miles away, and caused shocks 2,000 miles away. Seismic mapping of the Pebble area is incomplete, and there is evidence that the nearest fault may be from only sixteen to less than five miles from the mine. The proposed Pebble Mine tailings facilities were designed in 2006 to withstand a 7.8 earthquake 18 miles from the fault. The energy from a "floating earthquake" of the same magnitude at 5 km under the site would be significantly greater, and if an earthquake occurred five miles away, the force at the mine site would be three times greater than the structures were intended to support. Earthquakes can cause dam failures via several mechanisms. Outright dam collapse due to shaking or dam overflow from a landslide can occur. Earthquakes can also cause static liquefaction, a process by which soil loses its strength and is rendered fluid-like, seriously damaging or causing the collapse of structures built upon it. Earthquakes can also cause subsidence near underground mine workings, risking collapse or leakage. And the cumulative effects of smaller earthquakes can lead to problems over time.

EPA Response: Comment noted; no change required.

4.305 *The Impacts of Climate Change Will Increase the Risks Associated with Mining in Bristol Bay:* EPA's Assessment of the potential environmental impacts of mining in Bristol Bay excludes consideration of the added uncertainty and risk associated with future climate change. This is a significant omission. The data reveal that climate change in the region is a large concern, as substantial changes in temperature have taken place over the last 50 years. Annual average temperatures have increased by 3–5°F, and winter temperatures by 6–9°F. Scientific modeling predicts an increase in frost-free days throughout south-central and south-east Alaska over the next century.

Though predictions of the impacts of climate change on the Bristol Bay watershed are inevitably imprecise, models of a watershed to the east of Bristol Bay anticipate sizeable change by the year 2090. These include dramatic increases in average annual evapotranspiration, decreases in snow pack, 43–640% increases in winter streamflows, and 7-73% reductions in summer streamflow.

As detailed below, failure to consider the effects of climate change in the Bristol Bay watershed underestimates the risk of mining in three areas: (1) the stability of tailings impoundments and other infrastructure, (2) potential flows of contaminants away from the mining site during both catastrophic and non-catastrophic releases, and (3) the stressing and forcing of change on surface and ground water – and resulting effects on ecosystems.

Without an evaluation of the effects of regional climate change on these and all aspects of long-term mining development, the Assessment underestimates the full extent of potential risk. For example, changes in evapotranspiration, precipitation, and runoff will modify plant cover, erosion, flow regimes, flooding and sediment transport. This will in turn affect ecosystem function and carrying capacity. Changes in freshwater delivery, nutrients and sediments may also have profound effects on Bristol Bay itself. These long-term increased risks are important to consider since, once constructed, a mine would exist — and need to withstand the demands of a changing climate — for centuries.

EPA Response: See response to Comment 4.301.

Bristol Bay Heritage Land Trust (Doc. #4524)

4.306 The mine scenarios analyzed by the Bristol Bay Assessment show the development of large scale metallic mines in the watershed is unlikely to comply with the Standards and Practices for Responsible Mining in the Nushagak River Watershed adopted by the Nushagak-Mulchatna Watershed Council.

EPA Response: Comment noted; no change required.

4.307 Unlike the assessment justifying ADNR's adoption of MCO 393 EPA's Bristol Bay Assessment does consider likely build-out scenarios for a mine in the drainages of the Koktuli River and Upper Talarik Creek. These scenarios indicate that mining the Pebble Prospect will likely result in the destruction and dewatering of anadromous portions of the Koktuli River and Upper Talarik Creek. As such the Bristol Bay Assessment confirms the Pebble prospect cannot be mined without violating current Alaska law.

MCO 393 reflects a long established State policy to protect the fisheries of Bristol Bay and prohibit mining that could conflict with those fisheries. If the EPA should invoke Section 404(c) to protect the fisheries of Bristol Bay it will not be abrogating state authority so much as strengthening that authority. In MCO 393 the State articulated well the features of Bristol Bay that needed protection, features no less important today:

The existence and future success of the Bristol Bay salmon fishery depends on the maintenance of anadromous stream habitat for salmon spawning and rearing. Essential conditions for successful salmonid spawning, egg, and fry development are clear, cool, well-oxygenated water, and gravel that is free of sediment, highly permeable and stable. Salmon are a renewable resource and the continued propagation and production of Bristol Bay salmon for commercial, sport, and subsistence harvest constitutes a significant surface use of stream waters and stream bed gravel in the Bristol Bay area. Through maintenance of water quality, stream habitat, and fishery management practices, the Bristol Bay salmon fishery should continue to prosper in the future and contribute to the regional and state economy. (MCO 393 Attachment 2: Justification for Stream Closures p. 1).

EPA Response: Comment noted; no change required.

4.308 If the mine scenarios analyzed by the Bristol Bay Assessment are accurate for the Pebble Prospect then the development of that prospect would run contrary to the Standards and Practices for Responsible Mining in the Nushagak River Watershed adopted by the Nushagak-Mulchatna Watershed Council.

EPA Response: **Comment noted; no change required.**

Center for Science in Public Participation (Doc. #4106 and #4122)

4.309 In this section the minimum and maximum mine scenarios (2 billion tonnes and 6.5 billion tones respectively) for the Pebble Project used in the Draft Assessment are described. Northern Dynasty Minerals has published a total resource estimate (measured, indicated, and inferred) of 10.78 billion tonnes. Since this estimate is used in part to attract potential investors in the project, it must be a legally defensible mineral resource estimate. This 'maximum' Pebble Project is mentioned in the Section 4.3.2 of the Draft Assessment, but many readers will only view the Executive Summary.

EPA Response: **See response to Comment 4.280.**

4.310 It is noted that: "Dry stack tailings management, in which tailings thickened to a paste and filtered are "stacked" for longterm storage, is a newer, less commonly used tailings disposal method. Dry stacked tailings require a smaller footprint, are easier to reclaim, and have lower potential for structural failure and environmental impacts (Martin et al. 2002)." (Draft Assessment, p. 4-13, emphasis added). In the terminology that is in common use today, "filtered" and "paste" tailings are two different things. Filtered tailings have enough moisture to allow the majority of pore spaces to be water filled but not so much as to preclude optimal compaction of the material. Water is removed from filtered tailings with vacuum or pressure filters. Paste is simply dewatered tailings with little or no water bleed that are non-segregating in nature. Paste tailings typically utilize a thickener-type dewatering process which is less expensive than filters, but removes less water. The water content of paste tailings lies in between conventional slurry tailings and "dry" or filtered tailings.

EPA Response: **Dry stacking was not part of Northern Dynasty Mineral's preliminary plan (Ghaffari et al. 2011) and was not included in the assessment scenarios because it was considered to be less likely than tailings impoundments. "Thickened to a paste" has been removed from this sentence to provide clarity that we are discussing dry stack tailings here.**

4.311 It is noted that: "Water leaving the site via surface runoff or through groundwater would require capture and treatment for as long as it does not meet water quality standards." (Draft Assessment, p. 4-31) A key aspect of post-closure hydrology is that groundwater flow will be away from the pit, waste rock, and tailings (as shown in Figure 4-9). Seepage collection systems are notoriously inefficient (even ineffective), and expensive to operate if pumping is involved. This vector often leads to long term contamination of downgradient surface waters, and could impact these waters for centuries. Although it is implied in this statement, it is not explicitly stated that groundwater flow from the mine pit, waste rock, tailings (and underground workings), at Pebble would most probably be away from the mine workings (because of the location of the mine workings at the top of the hydrologic divide, and because there is little evaporation at this location).

EPA Response: **Sections 6.3.4 and 8.1.3 of the revised assessment provide expanded discussions of water flows in the mine pit area after closure.**

4.312 The mine scenario is set up well, with the exception of data gaps in discussion of water treatment and underground mining. These data gaps deserve fuller discussion, provided in separate sections after the "Mine Scenario" comments below.

Add to make more complete. The "identities of ore processing chemicals are unknown, so potential toxicity is not considered" ("Uncertainties", Assessment Section 5.3.4) EPA is setting up a hypothetical mine scenario, and includes chemical "storage and transport" in the conceptual models. Ghaffari et al 2011 Sections 16.4.3 and 16.9.4 mentions specific chemicals that will likely be utilized at Pebble, and it is reasonable to assume they would also be used at other mines. It is worth providing a list of likely chemicals. Limiting the risk assessment by not including the chemicals again underscores the conservative approach of the Assessment.

EPA Response: Scope of the assessment has been clarified in Chapter 2, and conceptual models have been revised to more accurately reflect those issues considered within the assessment's scope. That said, we took an intentionally conservative approach to avoid overstating potential adverse effects. We have included xanthates in our evaluation of pipeline spills in the revised assessment.

Good visual of ore processing (Assessment Figure 4-4)

EPA Response: Comment noted; no change required.

The figure of the tailings dam (Assessment Figure 4-8) could include comparison to dams at mines in Alaska (e.g., Fort Knox, 111m, Red Dog 63m; Levit and Chambers 2012), or common Alaska landmarks (Conoco-Phillips Building 90m, Atwood Building 81m; www.emporis.com).

EPA Response: Comment noted; no change required.

A legend should be placed on each of the conceptual model figures

EPA Response: Legends have been added to all the conceptual model figures.

Assessment Section 4.3 references Table 4-4, a comparison of a Pebble-sized mine to other mines in Alaska. Another table should be developed that compare the ore body to global copper porphyry mines, former and existing (Cooke and Hollings 2006; www.resourceinvestor.com/2010/06/28/sizing-up-the-worlds-mega-coppergold-projects)

EPA Response: Figure 4-1 in the revised assessment shows the relative size of porphyry copper deposits (including Pebble) across the world.

4.313 There is a data gap concerning Water Treatment. Despite discussions of mine/waste facility sizes and details, there is no discussion of water treatment plant options and methods, outside of a very cursory summary in Appendix I. While the Northern Dynasty report that much of the Assessment details are drawn from (Ghaffari et al 2011) is weak on details of a water treatment plant, a plant is essential to the operation of a mine, and the broader subject should be discussed in Appendix I.

Add to make more complete. A discussion of water treatment options is warranted to allow the reader to understand constraints (EPA 2006a). This should include a discussion of passive treatment (EPA 2006 Section 4.2.3; EPA 2006b). While passive treatment was mentioned in Appendix I2, this method is not an option at a large scale sulfide mine, which will have high flows and metal concentrations much too large for passive treatment to handle.

<u>EPA Response:</u> A mine would not be permitted to discharge water that did not meet water quality standards. Therefore, the assessment assumes that an effective water treatment strategy is included in the mine design. In the revised assessment, chemical precipitation and reverse osmosis are described as possible treatment technologies.

4.314 Comment on presentation. Assessment Section 4.3 mentions that water quality in operations will be a mix of mill slurry supernatant, background (represented by the North Fork Koktuli) and oxidation leachate, and references the reader to Assessment Appendix H. The tables in Appendix H should be summarized in tables or boxes in this section.

<u>EPA Response:</u> We decided it might be more confusing for a reader to include partial components of the water here, as we did not attempt to predict the composition of this mixed water. Actual data important to the risk portion of the assessment from Appendix H were presented and discussed in Chapter 6.

4.315 It is noted that: "Northern Dynasty Minerals (NDM) also reports that the preliminary design incorporates additional safety factors, including design of storage facility embankments to withstand the effects of the MDE and a magnitude 9.2 event. In 2011, the NDM Preliminary Assessment Report states that an MCE of magnitude 7.5 with 0.44g to 0.48g maximum ground acceleration was used in the stability calculations for the tailings dam design." (Draft Assessment, p. 4-48, Box 4-6. Selecting Earthquake Characteristics for Design Criteria) In addition to determining the magnitude of the Maximum Design Earthquake/Maximum Credible Earthquake, the other critical factor in determining the maximum ground acceleration is the distance of the event from the mine. The energy from an earthquake 18 miles away (PLP's current assumption) is significantly less than the energy from a "floating earthquake" of the same magnitude at 5 km under the site.

<u>EPA Response:</u> The text notes that "floating earthquakes" are generally smaller and less frequent than those associated with faults and would result in lower energy imparted to the surface. No change required.

4.316 It is noted that: "Time to pipeline shutdown of 2 minutes" (Draft Assessment, p. 4-62) It is reasonable to assume pipeline shutdown in 2 minutes, if the safety measures work as designed. However, it seems like this is often not the case. Is data available on the average shutdown time for a tailings pipeline spill?

<u>EPA Response:</u> In the revised assessment we modified the analysis by increasing the shutdown time to 5 minutes based on a review of case histories that included shutdown times. In January 2013, the U.S. General Accountability Office (GAO) published the report *Pipeline Safety, Better Data and Guidance Needed to Improve Pipeline Operator Incident Response*. The study concluded that the data collected by the Department of Transportation's Pipeline and Hazardous Materials Safety Administration on incident response times are not reliable. The study reported shutdown times for four incidents that ranged from 1 minute to 7 days. Two of the reported incidents were similar to the pipeline failure scenarios in the assessment, in that they involved control room

monitoring, evaluation of the situation, and a decision to shut down the pipeline. These incidents had response times of 3 minutes and 8 minutes.

Stratus Consulting (Doc. #4973)

4.317 **Estimating the geochemistry of tailings and waste rock (pp. 4-23–4-24).** The Draft Watershed Assessment states that the leachate compositions from tailings humidity cell tests (HCTs) are a worst-case scenario because the tests are conducted in an aerobic environment. However, the subaqueous column tests, which were not conducted under aerobic conditions, showed that material that oxidized before the tests were conducted had low pH values and elevated concentrations of cadmium, copper, nickel, and zinc even when submerged (see Appendix A, p. 14 and Figure 7). These results suggest that if acid generation starts, submerging the mined materials (waste rock, tailings, or pit wall rock) under water (in a non-aerobic environment) might not be successful in stopping it. In addition, discussion of tailings leachate chemistry in the Draft Watershed Assessment does not seem to consider the HCT results from the one pyritic tailings HCT sample. In that sample, although the pH did not drop below 7 for the length of the test, the pyritic tailings had the highest leaching rates and concentrations of beryllium, cobalt, nickel, selenium, silver, thallium, and zinc of any of the 2008 tailings HCT samples (PLP, 2011, Appendices 11L and M; Appendix A, p. 9). Including the results from the one pyritic tailings sample HCT is important because Ghaffari et al. (2011) estimate that pyritic tailings will comprise approximately 14% of the tailings waste stream.

EPA Response: It is true that material that has already oxidized will release acidity and ions from salts formed during oxidation when they are exposed to water. However, a system that is continually exposed to oxygen would be expected to be a worst-case scenario compared to an anaerobic environment, which is what this was meant to convey. In an anaerobic environment with sulfate-reduction occurring, released ions would be expected to be sequestered as immobile sulfides over time; the sulfate reduction process also consumes protons. The subaqueous tests in the EBD were conducted on rock material and meant to represent pit wall and waste rock material rather than processed waste materials (tailings). It also is of note that the subaqueous tests reported in the EBD were not conducted anaerobically.

The information in the EBD was used as representative for porphyry copper mining but the assessment is not an evaluation of the EBD or a mining plan. Results from a single sample may or may not represent what could be expected from a different deposit and therefore is not necessary to be included in our scenario. However, this information is important for any future consideration of mining the Pebble deposit.

4.318 *Assumptions about pit water quality (p. 4-32).* The Draft Watershed Assessment assumes that covering of acid-generating wastes or pit walls with water during closure will eventually stop acid generation below the water level in the open pit during and after closure (p. 4-32). Two observations argue against this assumption: the results of the submerged column tests, as discussed in the previous bullet; and the water quality of the Berkeley Pit in Butte, Montana. The potentially acid-generating portions of the walls of the open pit will be exposed to oxygen and runoff for decades before closure. Therefore, they are highly likely to be oxidized before being submerged. The submerged column test samples conducted on the two most abundant Pre-Tertiary rock types, mudstone and granodiorite (which had only moderate sulfide contents) went acidic quickly and leached high concentrations of metals and acidity, as noted above. For comparison, the Berkeley Pit in Montana, which was created from the mining of another porphyry copper deposit, has low pH values (< 2.8) at all depths and copper concentrations between 50 mg/L in surface waters of the lake and ~ 200 mg/L at depth (Davis and Ashenberg, 1989; Gammons and Duaime, 2006; Gammons et al., 2006). At low pH values (below approximately pH 3.5), such as those generated by leaching of Pre-Tertiary mudstone and granodiorite, ferric iron (Fe^{3+}) is present and is a stronger oxidant than oxygen; ferric iron can exist under low or no oxygen conditions at these pH values (Nordstrom, 1982; Plumlee, 1999). In contrast to the low pH and high copper concentrations of Berkeley Pit water, the adjacent underground workings have near neutral pH values, and copper concentrations have been decreasing over time to low parts-per-billion levels (pumps were turned off in 1982). Values are somewhat higher in the Kelley Shaft (~ 100 µg/L), which connects with the pit, was block caved, and likely received acidic inputs from copper dump leaching operations (Gammons et al., 2006). These results suggest that neutralizing acidic waters after closure by submerging under water would be more successful in the underground workings than in the pit lake. The final Watershed Assessment should revisit assumptions about the effectiveness of submerging mine wastes and pit walls under water when these materials have already been oxidized. Another qualitative analysis of pit water quality on p. 6-40 seems to contradict the assumptions on p. 4-32, and these two pit water quality assumptions should be made more consistent.

<u>EPA Response:</u> It is expected that acid generation from materials kept below the oxic zone would cease over time and that anaerobic processes will result in sequestration of ions and consumption of protons. Pit walls will continually oxidize and be washed into the pit that is being pumped out during the operational phase, so some acid produced will be removed over this time. The purpose of this assessment was not to evaluate whether or not subaqueous disposal is sufficient for retardation of acid generation. We also did not evaluate risk from pit water quality, rather we presented a likely scenario for the mine. In the revised assessment, we include some other mitigation options in our scenario for post-closure related to any potential for acidic pit water (Section 6.3).

<u>A. Sutton-Grier (Doc. #3806)</u>

4.319 I know the mine description is hypothetical at this point. But I am very concerned about the size of this mine. The sheer size of this mine means there will be an enormous amount of tailings. Properly dealing with those tailings is going to be a challenge, but it is absolutely key that tailings be handled in as careful a way as possible using the most advanced technologies available for protecting nearby habitats and water quality. This means ensuring there is no leakage by using the best available technology for lining the drainage and storage ponds and planning for extreme events that may not currently be occurring but may occur in the future. I have concerns that the size of the waste stream from this mine will mean that the waste, including the tailings, will be very challenging to deal with them using the utmost safety requirements including fully lining any storage basins. So, I am very concerned about the idea that the tailing ponds might be unlined (p 4-21 "The TSF would be unlined other than on the upstream dam face, and there would be no impermeable barrier constructed between tailings and underlying groundwater.") I believe the size of this mine may actually make it very difficult to make the conditions necessary for safe mining to exist.

EPA Response: Comment noted; no change required.

J.P. Tangen (Doc. #4583)

4.320 Copper Porphyry deposits are not representative of the mineral deposits in the Bristol Bay watershed. There are other significant deposits in the area that have been documented by BLM and the USGS as well as a number of undiscovered deposits USGS deems probable. Their analyses estimate that there is 50% probability that there are 14 non-copper-porphyry deposits within the watershed.

EPA Response: See response to Comment 3.16.

4.321 EPA purports to be analyzing the impacts of large-scale mining in the Bristol Bay watershed. Since the Pebble Project has not released a mining plan, the analysis ostensibly is not about Pebble; however, the thinly veiled hypothetical mine that is discussed unmistakably is the evil shadow of what a Pebble proposal might look like. In brief, however, the hypothetical mine neither resembles anything Pebble could ever imagine – an unpermittable project – nor does it correspond with any other imaginable project in southwest Alaska or anywhere else in the country.

EPA Response: See response to Comment 3.9.

4.322 EPA's hypothetical mine over-estimates the size of likely mines in Bristol Bay by more than 5 times the average open-pit mine in Alaska and British Columbia, and more than 4 times the average copper mine.

EPA Response: In the revised assessment we have added a mine size scenario that reflects a worldwide median porphyry copper deposit size.

4.323 EPA's hypothetical mine uses a non-representative geochemical make-up. There is no typical geochemical make-up for a metal ore that would be representative of all ores within a region; therefore, the geochemistry of one deposit cannot be used to represent the geochemistry or geochemical risks of other deposits in the area.

EPA Response: See response to Comment 4.235.

4.324 EPA's hypothetical mine omits mitigation and prevention strategies that necessarily will be used by any large mines in the Bristol Bay watershed. Given the large variety of mitigation and prevention techniques available to today's mining industry, it would be an extra-ordinary coincidence if any as-yet undesigned mine used exactly the set of mitigation/prevention strategies that EPA assumes in its hypothetical mine.

EPA Response: See response to Comment 3.9.

4.325 EPA omits mitigation and prevention strategies that would eliminate or significantly reduce the impacts it predicts for its hypothetical mine. These include such strategies as dry tailings closure and moving the product by pipeline.

EPA Response: See response to Comment 4.11.

4.326 EPA's hypothetical mine does not meet minimum permitting standards because the design used by EPA includes no mitigation provisions for eliminating anadromous fish habitat and wetlands impacts. Waste rock cannot be placed in such a creek under state or federal regulatory standards. Accordingly the hypothetical mine as proposed by EPA could not be permitted.

<u>EPA Response:</u> See response to Comment 4.137.

4.327 EPA overestimates the realistic mine size. The habitat modification description in the Assessment is a direct consequence of the mine size and location. As EPA over-estimated the mine size for other mines, the habitat modification impacts are significantly overestimated.

<u>EPA Response:</u> We estimated the potential size of a mine at the Pebble deposit, which is the one well-defined deposit in the region, based on information from Northern Dynasty Minerals (Ghaffari et al. 2011). Mines of this size are described as plausible and permittable (Ghaffari et al. 2011). Thus, the potential impacts evaluated in the assessment are also plausible. However, to extend the scenario to smaller deposits, a new mine scenario has been added that approximates the worldwide median of porphyry copper deposits.

4.328 EPA's lack of design details makes its analysis of water collection and treatment failure events meaningless. The agency does not evaluate any specific failure modes or present data on similar failures at other mines.

<u>EPA Response:</u> The specific mechanism of failure is irrelevant to the risks from a prescribed release. The revised assessment does cite the record of water collection and treatment failures at U.S. mines in Chapter 8.

4.329 A pipeline may be required to develop a mine at Pebble, but no other mine in Alaska uses a pipeline. Because most mines do not use a pipeline, the predicted pipeline risks are unlikely to be representative of a mine other than at the Pebble Project in the Bristol Bay watershed.

<u>EPA Response:</u> See response to Comment 4.247.

4.330 EPA's hypothetical pipeline omits obvious prevention and design strategies. In fact, some components of a mine are fixed and are difficult to change, but pipelines can be designed to different standards. It is unclear why EPA would design a pipeline with an unacceptable risk and not include design changes to decrease the risk.

<u>EPA Response:</u> The assessment did not specify design standards for the pipeline except to improve upon the descriptions in Ghaffari et al. (2011) by adding more shutoff valves and by requiring that they be remotely operable. The assessment evaluates the consequences of failure of a pipeline constructed and operated to standard levels of practice. Use of this information to determine whether additional safety measures are required to protect the local environment would be part of a later process and is beyond the scope of the assessment.

4.331 EPA came to a different conclusion for a potential mine pipeline at the Red Dog Mine where EPA recommended a pipeline. In that case the agency concluded that "it is highly unlikely that the pipelines would be compromised."

<u>EPA Response:</u> This assessment is based on the risk estimates for pipeline failures rather than on EPA's opinion with respect to another mine. The assessment comes to no conclusions for a pipeline in the context of permitting a mine such as Red Dog because the assessment is not a decision document. The assessment describes the probability and the effects of failure. Decisions on whether to build the pipeline and whether additional safety measures, beyond standard construction and operation practices, must be employed is beyond the scope of the assessment. Such decisions would be made during a subsequent process.

<u>D. Shepard (Doc. #4825)</u>

4.332 Unknown unknowns are not included. With examples in the assessment to multiple 100-year floods causing one failure, a magnitude 6.5 earthquake causing pipeline damage, and this area of Alaska receiving frequent earthquakes, consideration for such unknowns should be included.

<u>EPA Response:</u> There are an infinite number of possible, unknown scenarios. We selected a subset of potential failure scenarios that we considered possible in the timeframes considered here. Actual "unknown unknowns" are by definition unknown and cannot be assessed. No change required.

4.333 Design goals are used for predictive analyses rather than data from historical experience.

<u>EPA Response:</u> Both design goals and historical experience are useful in estimating the likely range of failure probabilities. Important engineering structures are generally designed with the intent that they will not fail. Their designs incorporate factors of safety to provide a margin of security and to allow the structure to survive loads in excess of the design loads. Nonetheless, important structures can and do fail due to design flaws, construction flaws, material defects, willful malfeasance, operational error, other human error, and extreme natural events.

<u>P. Riggert (Doc. #4845)</u>

4.334 Specifically, I'd like to call your attention to the seismic risks. Chapter 4 ("Mining Background and Scenario") discusses seismic risk. I am concerned that (as it states in Box 4-3) that the USGS data being used is from 1980. Methods of mapping of faults and other seismic assessments, records, etc. are more refined than 32 years ago. While it states in the report (p. 4-38) there is "a high degree of uncertainty in determining the location and extent of faults," this is not a strong enough warning about using data that is not current. In addition, even if the data is improved and brought up-to-date, the future will continue to bring a more refined understanding of the seismic risk.

<u>EPA Response:</u> We also reference more recent work, though we agree that additional recent information would be useful for assessing the risks associated with earthquakes. For the purposes of the assessment we are limited to existing information and account for any uncertainties left by the information. This does not affect the outcome of the assessment because we include a catastrophic failure such as might result from a severe earthquake.

4.335 However, even with improved seismic risk data, the fact remains that the Bristol Bay watershed is an area with high seismic activity and risk. As discussed in Box 4-6 (“Selecting Earthquake Characteristics for Design Criteria”), mining companies use fault data and seismic risk assessments for developing such criteria as Maximum Credible Earthquake (MCE) and Maximum Design Earthquake (MDE) in designing facilities, including Tailings Storage Facilities (TSF). The MCE and MDE cannot be realistically determined, and the 2006 preliminary assessment by Northern Dynasty Minerals is not adequate.

<u>EPA Response:</u> We agree that there is considerable uncertainty that ought to be addressed should any mine development move forward. This does not affect the outcome of the assessment because we include a catastrophic failure such as might result from a severe earthquake.

<u>D. Kohlmoos (Doc. #4848)</u>

4.336 Effects of vibration and sound on fry in rearing habitats along the pipeline and access road routes.

- The influence of stress caused by the non-stop vibration and sound frequencies coming from activities associated with the pipelines and road warrants a more thorough investigation.
- The influence of pipe break and spill on fry use of rearing habitat.
- How many cubic feet of rearing habitat are lost just with the proposed pipeline and road routes?
- How much rearing habitat can this sustainable fishery afford to loose? What are the limits or justification for loss?

<u>EPA Response:</u> These questions are beyond the scope of the assessment.

<u>S. Gerdes (Doc. #4856)</u>

4.337 The transportation corridor from Cook Inlet to the mine site is anticipated to be 86 miles long and, once inland from Cook Inlet, would cross 34 spawning rivers and streams. How wide would this corridor be and how much additional surface area would be disturbed by the borrow pits needed for the construction of the corridor? What would be the total loss of wetlands and spawning streams because of the borrow pits and access roads leading to the pits? How would pipeline piers or supports be anchored and what effect would permafrost have on these structures and on any under ground sections of the pipelines?

<u>EPA Response:</u> Dimensions of the transportation corridor considered in the assessment are provided in Section 6.1.3 of the revised assessment. The area of aquatic habitat filled would depend on the exact route of the road. Other than mention that material sources for road embankment fill, road topping, and riprap (e.g., borrow and gravel pits and rock quarries) would be available at regular intervals along the road route, the revised assessment does not provide an estimate of the number or size of borrow pits. Designs for components of the mine and road infrastructure would need to consider the natural cold region conditions and incorporate appropriate design features and safety factors to achieve an acceptable level of performance. Permafrost in the study area is

generally sporadic or absent. If sporadic areas of permafrost are discovered, the designs would need to address the interactions between infrastructure (including pipelines) and permafrost.

The Pebble Limited Partnership (Doc. #3797, #4960, #4962, and #5416)

4.338 Last, the Assessment's hypothetical failure and post-closure scenarios do not show that adverse effects "will" occur as the result of mining at the Pebble site. To illustrate, the Assessment is unable to determine any realistic probability of a tailings dam failure, instead concluding that one might be expected to occur once every 10,000 to 1 million mine years. 61 The Assessment goes on to observe that "[a]ctual failure rates could be higher or lower than the estimated probability. In other words, EPA has little idea what the probability is of such a failure. This is but one of the many examples where EPA references potential impacts, but the information used does not support an opinion on the probability or even extent of those potential impacts. Thus none of the failure scenarios or long-term contingencies contemplated by the Assessment justify the exercise of EPA's Section 404(c) authority.

EPA Response: Comment noted. The purpose of this assessment to evaluate potential impacts of mining on salmon resources in the region of interest, not to determine if information exists to justify a 404(c) action. The assessment, in part, estimates the range of probabilities for various potential failures and describes the foreseeable impacts from those failures, should they occur.

4.339 Pipelines. The pipeline failure rates used in the assessment are based on aggregated information from several countries spanning a wide range of construction techniques and pipe sizes. It is not clear what design standards those pipelines were constructed to. The estimate of expected pipe failure rate in the hypothetical mining scenario should be based on failure rates of pipelines of similar size and modern construction designs (e.g., anticorrosion/erosion inner HDPE lining, a surrounding steel pipe, insulation) that would be built and maintained to U.S. standards.

EPA Response: See response to Comment 4.148.

4.340 EPA relies on tailings facilities built in the late 1800s and modern engineering that would have prevented these historical dam failures was ignored. The Assessment presents a mine scenario and assumptions that fail to meet the standards for mine development and environmental assessment in the State of Alaska and the United States of America. The Assessment Report includes a flawed risk assessment that draws false conclusions based on past examples from other jurisdictions and mining practices that are not permitted in the State of Alaska. The Assessment Report states that "the assessment largely analyzes a mine scenario that reflects the expected characteristics of mining operations at the Pebble deposit". In fact, the EPA grossly underestimates the high standard to which a mine in the Bristol Bay watershed would have to be designed and engineered in order to obtain permits to operate in the watershed. It also underestimates the role of various federal and state regulatory agencies in the permitting process that will help ensure that a technically advanced mine would be designed and operated.

EPA Response: The mine scenarios are based on preliminary plans put forth by Northern Dynasty Minerals (a PLP partner) in Ghaffari et al. (2011). The assessment

does not ignore modern engineering, and acknowledges multiple times that improved modern design and practices can reduce historic failure rates by an order of magnitude or more. Examples that include historic tailings releases from mines do not consider the mine itself. They reference data from spills to act as lessons about the behavior of contaminants over time. Although a similar cause of a spill might be prevented by modern technology, once released into the environment contaminants would likely behave in a similar manner. No change required.

4.341 EPA's conclusions are based on outdated information. The Assessment presents a general assessment of roads and culverts that implies that the installation of culverts (which represent a large fraction of typical stream crossings) "may" or "could impose a negative impact on the physical and biological resources of streams and wetlands within the Bristol Bay study area. The Assessment supports this conclusion with outdated references and information that assess the potential impacts of proposed stream crossings on deficiencies of existing structures that may have been designed using obsolete methodologies, are improperly maintained, or both. In the past decade, stream crossing design at roadways has changed to address the deficiencies that the draft Assessment cites as having the potential impacts in the study area. The conclusions in the Assessment Report are therefore inaccurate and not based on the best available scientific and engineering information.

<u>EPA Response:</u> The assessment assumes that current road standards developed by the State of Alaska have been applied and maintained (see response to Comments 4.82 and 4.152). We have clarified this in Chapter 10 of the revised assessment.

4.342 Modern design standards for road culverts will prevent the fish impacts that the Assessment erroneously predicts. Road culverts are designed for two primary situations: 1) drainage without fish passage; and 2) drainage with fish passage requirements. Culvert design for fish passage has become progressively more sophisticated in the past decade, resulting in culverts that address fish passage, habitat continuity, and channel stability. The new design criteria for fish passage culverts typically produce a culvert with a much greater flow capacity, resulting in lower failure potential. The analysis of road and culvert failure in the Assessment does not address the distinction between the two culvert types, or describe adequately the advances in design criteria for fish passage, and therefore overstates the potential for failure of project culverts on fish bearing streams.

<u>EPA Response:</u> See response to Comments 4.82 and 4.152.

4.343 The BBWA Assessment contains an analysis of the negative impacts of roads and culverts that is inconsistent with current construction practices, as well as state and federal requirements. The authors appear to be unfamiliar with modern road building design and culvert placement requirements. Assumptions that culverts would block access to large portions of the existing natural habitat is unwarranted if modern road building techniques are adopted that meet current state and federal construction requirements.

<u>EPA Response:</u> See response to Comments 4.82 and 4.152. Even culverts installed by the Alaska Department of Transportation and Public Facilities, with guidance from standards aimed at maintaining fish passage, still become perched (e.g., the Nicolaevask Road on the Kenai Peninsula). No change required.

4.344 The input assumptions used in the hydrological modeling are incorrect. For instance, an SCS-Type IA storm was used in developing one of the models used in the assessment. Based on known data for Alaska, a different SCS Type I distribution should have been used. Applying a different distribution would change the results of the analysis and reduce some of the greatly exaggerated results.

<u>EPA Response:</u> See response to Comment 4.154.

4.345 The pipeline failure rates used in the assessment are based on aggregated information from several countries spanning a wide range of construction techniques and pipe sizes. The estimate of expected pipe failure rate in the hypothetical mining scenario should be based on failure rates of pipelines of similar size and construction that would be used in the hypothetical mine and built and maintained to U.S. standards. The failure rate number on Table 4-14 of the BBWA Assessment that would be more applicable to USEPA's analysis is the average reported for U.S. oil pipeline operators, which is roughly 1/4 of the rate assumed in the assessment.

<u>EPA Response:</u> See response to Comment 4.148. The failure probability suggested in the comment represents an average failure rate for U.S. pipelines, but does not consider that small diameter pipelines and pipelines in cold climates have a higher reported failure rate. We consider the value presented in the assessment to be a reasonable estimate of the failure rate under the assessment's mine scenarios.

4.346 In the past decade, substantial changes in requirements for road culvert design have been adopted across the United States, including in Alaska, in response to studies that analyzed fish passage barriers and culvert failures. EPA's BBWA Assessment must assume that the current standards for culvert design and placement will be implemented. Failure rates for road culverts that do not meet current standards are not relevant, but that is precisely the data USEPA relied on in its report. To be scientifically valid, the assessment should be based on current road and culvert design and engineering standards.

<u>EPA Response:</u> See response to Comments 4.82 and 4.152.

4.347 Section 4.4.2.4, Box 4-7, page 4-52. It appears that a SCS-Type IA storm category was used in developing the probable maximum flood (PMF). The SCS map and many other maps clearly show that only SCS Type I distribution should be used in Alaska. Applying different distribution will change results of the analysis, and reduce the impacts described in the analysis.

<u>EPA Response:</u> See response to Comment 4.154.

4.348 Section 4.4.2.4, p. 4-59, Table 4-13. The sudden increase in the volume of deposition at RM 0.6 under the full failure scenario does not appear to be correct. The analysis in this section appears to be in error.

<u>EPA Response:</u> This apparent rapid increase in sediment as one moves upstream (i.e., from RM 0.0 to RM 0.6) is an artifact of 30-km limit to our model. Sediment deposition would continue downstream of the model limits, since there would still be available sediment in the flow downstream of RM 0.6. These analyses are now included in Chapter 9 of the revised assessment.

4.349 Section 4.4.2.1. All of the listed causes of failure can be avoided through proper design of the project. Failures should not be assumed in the assessment. Rather, the assessment should assume that the mine design will appropriately address the potential for dam failure, which is consistent with current practices in the mining industry.

EPA Response: The assessment assumes that any tailings dam would be constructed to modern conventional standards, including mitigation measures. However, all engineered structures are subject to the risk of accidental failure, as discussed throughout the assessment. The assessment does not assume that these structures will fail, but does consider potential impacts should a failure occur. No change required.

4.350 Section 4.4, page 4-38, Box 4-3. The overall intent of this box is unclear. The text suggests that earthquakes may occur in the region and that activity may or may not be significant. The summary in Box 4-3 describes local faults (near Lake Clark and in the lliamna Lake region) and the known activity on those faults, indicating that activity on major faults has been minimal and that smaller faults in the area have "very limited capability to produce damaging earthquakes". However, the next paragraph discusses, in general terms, unpredictable "floating earthquakes" and stress induced earthquakes. The assessment fails to explain the significance of earthquake risks relative to mine operations. The information that is provided in the assessment is contradictory.

EPA Response: The text in Box 4-3 is included in Section 3.6 of the revised assessment. This text describes existing conditions in the Pebble area and the uncertainty associated with estimating seismic hazards based on current data. Floating earthquakes and stress induced earthquakes would likely be smaller than those produced by large faults.

4.351 Section 4.4.2.1, page 4-43. Box 4-5 (paragraph 3) states "Such displacement is not likely to occur in the Bristol Bay watershed because of the absence of large faults, but there is a potential for a small amount of ground spreading and cracking from larger earthquakes". This statement contradicts the final paragraph in Box 4-3, which emphasizes that there is a significant amount of uncertainty around predicting seismic activity in the Bristol Bay area. In addition, Box 4-3 notes that while there is no evidence of the Lake Clark Fault extending close to the hypothesized mine site, "mapping the extent of subsurface faults over long, remote distances is difficult and has a high level of uncertainty." The assessment fails to explain the significance of earthquake risks relative to mine operations, and the information that is provided is contradictory.

EPA Response: As shown in Section 3.6 of the revised assessment, there is a potential for seismic hazard in the Pebble deposit area. These seismic hazards are one of the potential causes for tailings dam failures, as described in Section 9.1.1 of the revised assessment.

4.352 Section 4.4.4, 2nd paragraph. In the past decade, substantial changes in requirements for culvert design have been adopted across the country in response to studies documenting passage barriers and culvert failures. The assessment must assume that the current standards for culvert design and placement will be implemented. Failure rates of culverts that do not meet current standards are not applicable in the assessment. This section should include a discussion of the current standards and the expected failure rate of culverts installed using current standards.

EPA Response: **See response to Comments 4.82 and 4.152.**

4.353 Section 4.4.2, page 4-40, paragraph 1, last sentence. The international examples of tailing dam failures do not appear to be relevant given the differences between US standards and standards in the cited countries.

EPA Response: **See response to Comment 4.150. Effects of tailings dam failures, which is what the assessment is concerned with, are independent of dam design standards, cause of failure, or failure probability.**

4.354 Section 4.4.2.2, page 4-44, both Paragraphs. The use of the tailing dam failure information worldwide from 1917 to 2000 is inappropriate. A large proportion of the failures were likely due to construction that did not incorporate modern standards used in the U.S.

EPA Response: **See response to Comment 4.150.**

4.355 Section 4.4.3.1. The pipeline failure rates used in this section are based on aggregated information from several countries spanning a wide range of construction techniques and pipe sizes. The estimate of expected pipe failure rate should be based on failure rates of pipelines of similar size and construction that would be used in the hypothetical mine and built and maintained to U.S. standards. The number on Table 4-14 that may be most applicable to the assessment is the average reported for U.S. oil pipeline operators, which is roughly 114 of the rate assumed in the document. The citation for URS (2000) is missing, thus the analysis and assumptions could not be evaluated. Still, if older pipelines built to an older standard are included in the average number, then the expected failure rate of a modern pipeline would be expected to be even lower than the average reported by URS. This section needs to be revised. Failure rates must be used that are, in fact, comparable. This section also needs to discuss the types of failures. What proportion are catastrophic failures and what portions are leaks? The type of failure affects the likely impacts of the failure.

EPA Response: **See responses to Comments 4.148 and 4.186. There are no U.S. standards for metal concentrate pipelines and no available statistics on failure rates of such pipelines.**

The value used in the assessment is less than 36 times the average of U.S. pipeline operators reported in URS (2000). It is unclear how the 114 value was derived. The missing reference, which has been added to the assessment, is: URS. 2000. Final Longhorn Pipeline Environmental Assessment, Volume 4 Responsiveness Summary, Appendix D, Leak Frequencies of Other Pipeline Operations.

4.356 Section 4, page 4-38 (PDF page 127). Citations are missing describing the source for the statements in this section, many of which are overly simplified.

EPA Response: **The comment does not identify what specific citations are missing. No change required.**

4.357 Section 4.4.2.1, page 4-43 (PDF page 132). Citations are missing describing references for the following statements: (a) "…because these deposits are typically in low gradient reaches they are less susceptible to liquefaction damage." (b) "Such displacement [along a fault]" (i.e., several meters) "is not likely to occur in the Bristol Bay watershed because of the absence of large faults, but there is a potential for a small amount of ground spreading and cracking from larger earthquakes”.

<u>EPA Response:</u> **The reference to liquefaction is a general statement based on accepted geotechnical engineering principles, and is not specific to the Bristol Bay area. The discussion of displacement is based on comparison of known large faults and their large displacements to the conditions at the Pebble deposit, where there is no evidence of faults of the same magnitude. No citations are required.**

4.358 Section 4.4.4, 2nd paragraph. There are no citations or data presented to support this section.

<u>EPA Response:</u> **Citations are included in this paragraph. No change required.**

4.359 Section 4.4.2.4, page 4-55, third paragraph. The numbers in the text do not match the numbers on the tables.

<u>EPA Response:</u> **We checked the text in that section against the relevant tables and found no discrepancies.**

4.360 Section 4.4.2.2, page 4-48 (PDF page 137). Citations are missing describing the source of information used to support the analysis described in this box. Without adequate supporting references and citations, the analysis is weak and unsupported. For example, reference is made to Alaska dam safety guidance, but no citation is provided. No other Alaska (state) or Federal regulations for design criteria are cited in this box. Citations are required where specific requirements or examples are cited (e.g., “For a Class II dam, the return period that must be considered for the OBE is 70 to 200 years-that is, the OBE represents the largest earthquake likely to occur in 70 to 200 years”). This statement requires documentation.

<u>EPA Response:</u> **The appropriate citation, Chapter 6 of Guidelines for Cooperation with the Alaska Dam Safety Program (ADNR 2005) has been added to the revised assessment.**

4.361 Section 4.4.2.2, page 4-48 (PDF page 137). The citation NDM 2006 is not listed in the references.

<u>EPA Response:</u> **This citation has been added to the revised assessment.**

4.362 Section 4.4.3.1, first 3 paragraphs. These paragraphs include many numbers with no units. Based on the text, we assume the unit is number of failures per km per year. Units need to be added to the text.

<u>EPA Response:</u> **The text states that these numbers are a rate of failures per kilometer-year. No change required.**

4.363 Section 4.4.3.1, page 4-61 (PDF page 150). Several documents are cited that are missing in the reference section. The information cited in the document could not be verified. For example: (a) OGP 2010 - Is the correct citation the document found at http://www.ogpageorg.uk/pubs/434-4.pdf ? (b) Caleyo 2007 - Is the correct citation the document found at http://iopscience.iopageorg/0957- 0233/18/7/001/ ? (c) URS 2000 -What is the correct citation for this document? (d) Alberta Metal - Is the correct citation the document found at http://www.albertametal.ca/resources/alberta-metal-aicles/lS2-pipeline-failure-rate-is-improving.html?

<u>EPA Response:</u> Appropriate citations have been added to the revised assessment.

4.364 Section 4.4.3.1, page 4-61 (PDF page 150). OGP 2010: See comment above about lack of proper citation. It is assumed that the source being referenced is this: http://www.ogpageorg.uk/pubs/434-4.pdf. The data included in Table 4-14 generally matches the information provided in the article assumed to be the source, except: -Failure rates for various wall thickness values (e.g., <5 mm) presented in Table 4-14 are listed under the oil pipeline category, while the source document only presents failure rates for gas pipeline wall thickness values. -The wall thickness presented does not match what is in the source document: “Wall thickness 5–10mm” should be Wall thickness S< - 10mm.

<u>EPA Response:</u> The current URL for OGP 2010 is http://www.ogp.org.uk/pubs/434-04.pdf. The comment is correct that the failure rates presented in the table for different pipeline wall thicknesses pertain to gas pipelines, not oil pipelines. Also, the row labeled “Wall thickness 5–10 mm” refers to failure rates for pipelines with wall thicknesses greater than 5mm and less than or equal to 10 mm; this has been changed in the revised assessment. These changes do not alter any of the discussion or conclusions in the assessment.

4.365 Tailings Dam Failure The Assessment Report has misrepresented the likelihood of tailings dam failure for any proposed mining development in Alaska. The International Commission on Large Dams (ICOLD) tailings dam failure statistics are extensively referenced in the Assessment Report, either directly or indirectly through selectively citing other technical articles. However, these ICOLD statistics do not support the premise that tailings dam failure is a reasonable hypothesis for a modern mine operation in the Bristol Bay watershed. Examination of the ICOLD statistics on tailings dam failures shows that the vast majority of historical tailings dam failures resulted from tailings impoundments constructed using the upstream method (Figures 1 and 2), which would not be permitted in Alaska.

<u>EPA Response:</u> It is unclear to what document the comment refers as containing “Figures 1 and 2.” Figure 1 in ICOLD (2001) presents data on the number and types of water storage dam incidents. Figure 2 in ICOLD (2001) presents data on the number and dates of tailings dam incidents. The comment may have intended to refer to Figure 6 of ICOLD (2001), which presents data on the number of dam incidents and the types of tailings dam construction. In this figure, less than half (not “the vast majority”) of failures are attributed to dams constructed with the upstream method. The proportion of failures attributed to dams constructed with the upstream method is not statistically relevant without also knowing the proportion of dams constructed with that method. The assessment does not state a premise “that tailings dam failure is a reasonable hypothesis” but does recognize that despite advances in dam engineering, dams do fail. The assessment does not state or derive a failure probability based on the ICOLD data. No change required.

4.366 The Assessment Report also provides numerous references from various technical publications to reinforce their flawed ‘tailings dam failure premise’. Most of the publications include confirmation that tailings dams can be constructed and operated in a stable and responsible manner. The COLD document provides some summary statistics on the frequency of tailings dam failures and states the following; "In highlighting accidents, the aim is to learn from them, not to condemn". Similarly, other authors have studied and expanded the database of tailings dam failures in an effort to prevent future incidents. These authors generally do not suggest that these statistics represent a probability of failure for any specific tailings dam, but rather they indicate that the objective is to essentially eliminate such events with an industry-wide commitment to correct design and stewardship practices.

Conversely, the Assessment Report incorrectly implies that generalized statistics for worldwide tailings dam failures can be applied to individual tailings dams to suggest a high potential for failure over an extended period of time. This premise is erroneous and misleading, as it is incorrect to imply that any particular proposed or actual dam structure is more or less likely to fail based solely on extrapolation of general dam failure statistics. The integrity and stability of any dam structure should rather be ascertained by suitably qualified and competent professionals, whose assessment must take into consideration all relevant aspects of the specific site conditions; the details of the design; as well as the construction, operating and closure parameters that are relevant to the evaluation. The Assessment Report fails to take into account these critical analyses and cannot be used to reasonably predict how an actual mine would perform in the Bristol Bay region.

EPA Response: See response to Comment 4.150. The assessment does not state a "tailings dam failure premise" but does recognize that, despite advances in dam engineering, dams do fail. The assessment estimates a range of tailings dam failure probabilities and describes the foreseeable environmental impacts from those failures, should they occur.

4.367 Hydrology and Dam Breach Model The Assessment Report includes a questionable dam breach assessment where the high uncertainty associated with the peak flow estimate and modeling predictions is not presented, and where the relative magnitude of the dam breach flood is speciously presented.

Dam breach modeling involves a number of assumptions and approximations, and the results are highly dependent on the selected input parameters, such as the total volume of material released, the size of the dam breach, the rate of breach development, and the magnitude of the breach triggering flood. Only the triggering flood was discussed in the Assessment Report, and it was referred to as "a reasonable runoff hydrograph," which implies normalcy. In fact, the flood was due to the probable maximum precipitation (PMP) event, which is so extreme and unlikely that no probability can be assigned to it.

In an effort to illustrate the extreme magnitude of the dam breach flood, it was compared to a natural flood in the region, but errors were made in the calculations and the comparison was done in a spurious manner that exaggerates the result. The errors were in the drainage areas stated for both the dam breach flood and the regional flood, and we suspect that they stem from an inability to simply convert from imperial units to metric units (sq. miles to equivalent sq. kilometers). The speciousness of the assessment stems from the inappropriateness of the flood chosen for comparison with the dam breach flood. Firstly, it is not valid to compare an extreme theoretical flood with a common historical flood. The dam breach flood results from an event so extreme that it reasonably can never be expected to occur, while the selected historical flood is only the largest event in a 16 year flood record, and has a return period of between 20 and 25 years, which corresponds to a probability of occurrence in any year of approximately 4% to 5%. Secondly, it is not clear why this particular regional flood was selected, since far more extreme floods are available in the relatively short-term historical flood record for the region. The 2004 flood on the lliamna River, for instance, is 35 times greater on a unit area than the selected flood. And thirdly, it is well known that peak flows typically have a non-linear scaling relationship, with small basins in a region having higher unit flows than large basins, so it is not valid to directly compare unit peak flows from the TSF with those from a basin that is 1821 times greater in area. All of these factors result in an exaggeration of the relative magnitude of the dam breach flood.

The lack of rigor used in these analyses results in misleading statements concerning the potential impacts of mining development in Bristol Bay.

<u>EPA Response:</u> The comment does not appear to challenge the size, intensity, or effects of the dam breach event, only the manner of comparing it to a natural flood. This comparison was made to provide perspective on the size of a peak flood that could be generated if a tailings dam failure occurs. No change required.

4.368 Earthquake and Seismic Activity The potential for accidents and failures resulting from earthquakes is represented as a particular concern for the hypothetical mine scenario presented in the Assessment Report, which also implies that the seismic activity of the region means that dam failures are ‘likely to occur’. This is incorrect, as the mine development would not be permitted or allowed to proceed if this were true. The assessment of earthquake probabilities and the development of appropriate site specific seismic parameters for the design of the various project components is a normal part of the design, review and permitting processes. It is improper and incorrect to imply that ‘failures are likely to occur’ simply because earthquake probabilities must be taken into account. Tailings and water dams have been, and continue to be, successfully designed, constructed and operated in seismically active regions in Alaska and elsewhere in the world.

<u>EPA Response:</u> Accidents and failures are likely to occur in a highly complex engineered facility that must be operated over many decades to more than a century. Such an operation in a seismically active region is of even greater concern. Thus, it is reasonable to address the potential risks posed by seismic activity. No change required.

4.369 Box 4-8. Modeling Hydrologic Characteristics of Tailings Dam Failures: 4-53 If sufficient freeboard is maintained, it would be possible to capture and retain the expected volume of the PMF in the TSF. However, to examine potential downstream effects in the event of a tailings dam failure, we assume that sufficient freeboard would not exist and overtopping would occur. This may be less likely when the TSF would be actively monitored and maintained, but may be more representative of post-closure conditions.

- At post-closure the facility would have a spillway that would safely convey the peak flow of the PMF, so it is not possible that this event would occur as assumed.
- On-going monitoring and maintenance is inevitable and the Assessment Report assumption of site abandonment is not realistic because it is illegal (and/or non-permitable).

<u>EPA Response:</u> The assessment assumes that a tailings dam would be designed to function effectively for as long as it is maintained. However, it is possible that the dam and reservoir would not function as intended. In addition, the structure must last in perpetuity, which is longer than a permit is likely to be enforced. In the very long term, it is reasonable to acknowledge the possibility that the dam, including any safety measures built into the structure, may fail. We present probabilities of dam failure, but we do not assume that a dam would fail. However, we do evaluate potential consequences in the event of such a failure. No change required.

4.370 The failure mechanism is clearly stated as avoidable, but in a subtext box and only once. It also states that overtopping is "more representative of post-closure conditions"; however in a discussion about closure it states that post-closure the likelihood of failure from overtopping is reduced. The statements are inconsistent and contradictory.

<u>EPA Response:</u> As the comment indicates, we state that it is possible to design a structure to handle the probable maximum flood, but we then consider an overtopping scenario "to examine potential downstream effects in the event of a tailings dam failure" (Box 4-8, p. 4-53 of the original draft assessment). We further state that loss of sufficient freeboard and overtopping "…may be less likely when the TSF would be actively monitored and maintained, but may be more representative of post-closure conditions," when site surveillance and monitoring is less intensive. Although the failure mechanism would be reduced in a post closure state, it would be more likely that water control systems could fail and cause overtopping more frequently than other failure mechanisms in a closed and unmonitored scenario.

4.371 4.4 Mine Scenario: Failure: 4-37 Our mine scenario assumes that engineering controls would be designed to capture and treat all surface and groundwater runoff from the site, and that no discharges would exceed existing water quality standards. However, human-engineered systems are imperfect: based on the experience of most large engineering projects, accidents and failures are likely to occur over the decades that a mine is in operation, and over the centuries that a TSF remains in the post-closure period and requires maintenance and monitoring. The potential for accidents and failures resulting from earthquakes may be of particular concern in our mine scenario, given that southwestern Alaska is a seismically active region.

This implies that failures are "likely to occur" which is not correct. The mine development would not be permitted if this were true. This seismic activity assessment is part of a "normal" review and permitting process and cannot be assumed arbitrarily in advance of any particular and site-specific mine design. Earthquakes must be considered in the design phase of mining projects, but it is entirely improper to imply that "failures are likely to occur" simply because earthquake probabilities must be taken into account.

<u>EPA Response:</u> We disagree that "mine development would not be permitted if this were true." Permits are issued or denied based on the best available information at the time, but accidents happen and agencies continue to have to enforce permit conditions. We understand that seismic considerations are a normal part of the mine design. However, the science of seismology is imprecise and information from the area is incomplete. Thus, as stated in the assessment, the potential for accidents or failures

resulting from earthquakes is of particular concern, particularly over the very long term that a TSF would be in place. No change required.

4.372 Box 4-3 Seismic Environment: 4-38 USGS has concluded that there is no evidence for fault activity or seismic hazard associated with the Lake Clark Fault in the past 1.8 million years, and no evidence of movement along the fault northeast of the Pebble deposit since the last glaciations 11,000 to 12,000 years ago (Haeussler and Waythomas 2011). Recently, the Alaska Division of Geological and Geophysical Surveys and USGS investigated reports of a surface geological feature (the Braid Scarp) near the Pebble deposit that was reported to be a fault scarp, indicating recent movement of a fault (Koehler and Reger 2011, Haeussler and Waythomas 2011). Both agencies independently determined that the feature was a relic of glacial activity and did not represent evidence of recent faulting. Geologic mapping conducted by consulting firms for the Pebble Limited Partnership (PLP) identified numerous faults in the area of the Pebble deposit. The mapped faults shown in both these sources are all considerably shorter than the Lake Clark Fault, and therefore by themselves have a very limited capability to produce damaging earthquakes.

This is an example from the Assessment Report indicating that several independent investigations have concluded that risk of seismic activity is less significant than implied elsewhere in the Assessment Report.

EPA Response: This section has been revised. The assessment references the USGS findings cited in the comment, and also discusses the uncertainties in the data (Section 3.6 of the revised assessment).

4.373 Box 4-3 Seismic Environment: 4-38 Interpreting the seismicity in the Bristol Bay area is difficult because of the remoteness of the area for study, lack of historical records on seismicity, and complex bedrock geology that is overlain by multiple episodes of glacial activity. Thus, there is a high degree of uncertainty in determining the location and extent of faults, their capability to produce earthquakes, whether these or other geologic features have been the source of past earthquakes, and whether they have a realistic potential for producing future earthquakes.

This summary discounts the previously stated studies, and illustrates a demonstrated tendency to discount the evidence contrary to EPA’s overall perspective promoted in many sections of the assessment report.

EPA Response: The statement does not dismiss the previously cited reports, but qualifies the confidence that a reader should place in the conclusions of those reports. No change required.

4.374 Box 4-6: 4-48. The Northern Dynasty Minerals Preliminary Assessment (NDM 2006) identified the following design criteria for the tailings storage facility. OBE return period of 200 years, magnitude 7.5. MDE return period of 2,500 years, magnitude 7.8, with maximum ground acceleration of 0.3g, based on Castle Mountain Fault data.

These appear to be minimum criteria based on requirements stipulated in Alaska dam safety regulations. These criteria should be recognized as a minimum requirement, and it is actually much more likely that more stringent criteria would be required and implemented for the detailed design of the tailings storage facility.

<u>EPA Response:</u> Comment noted, but we have no information upon which to change this statement. No change required.

4.375 Case Histories Box 4-4 Examples of Historical Tailings Dam Failures: 4-41 Aznalcollar Tailings Dam, Los Frailes Mine, Seville, Spain, 1998. A foundation failure resulted in a 45-m-long breach in the 27-m-high, 600-m-long tailings dam, releasing up to 6.8 million m^3 of acidic tailings that traveled 40 km and covered 2.6 million ha of farmland (ICOLD 2001).

This example of foundation failure resulted due to the presence of a weak underlying marl (mudstone). Site investigations for this example were inadequate; this is not relevant for the Pebble Deposit as these geological materials are not present in the region and because extensive geotechnical investigations have and will be conducted to prove the suitability of the foundations.

<u>EPA Response:</u> Box 4-4 (Box 9-1 in the revised assessment) describes four recent and well-known tailings dam failures and provides information on the size of the failures and their consequences. We do not contend that a dam failure at the Pebble deposit would occur by the same mechanism as any particular past failure, and there is no statement or implication in the assessment that environmental characteristics at these sites are the same as in the Bristol Bay region. The comment provides additional details on this failure and on potential errors in dam design and site investigation. Box 4-4 lists failures that occurred by a variety of mechanisms.

4.376 Stava, Italy, 1985. Two tailings impoundments were built, one upslope from the other, in the mountains of northern Italy. The upslope dam had a height of 29 m; the downslope dam had a height of 26 m. A stability failure of the upper dam released tailings, which then caused the lower dam to fail. The 190,000 m^3 of tailings, traveling at up to 60 kml hour, reached the village of Tesero 4 km downslope from the point of release, in 5 or 6 minutes. The failure killed 269 people (ICOLD 2001).

This example is of decant failure causing a rise in the phreatic surface resulting in rotational slips on the downstream slope. The dams were developed using upstream and centerline construction by uncompacted, hydraulically placed cyclone sand material. This is old and poor technology that is not relevant to the tailings dam concept presented in the assessment report.

<u>EPA Response:</u> See response to Comment 4.375.

4.377 Aurul S.A. Mine, Baia Mare, Romania, 2000. A 5-km-long, 7-m-high embankment on flat land enclosed a tailings impoundment containing a slurry with high concentrations of cyanide and heavy metals. Heavy rains and a sudden thaw caused overtopping of the embankment, cut a 20- to 25-m breach, and released 100,000 m^3 of contaminated water into the Somes and Tisza Rivers. Flow continued into the Danube River and eventually reached the Black Sea. The contamination caused an extensive fishkill and the destruction of aquatic species over 1,900 km of the river system (ICOLD 2001).

This is an example of poor operation and inadequate regulations at a gold mine operation in Romania. The failure resulted from overtopping which caused rapid erosion and failure of an erodible cyclone sand tailings dam. This example is not relevant to a major mine development in Alaska as regulations and ongoing design/operations review processes are more sophisticated than those implemented at the Aurul mine in Romania. This failure example is not relevant for the rockfill dam concept presented in the assessment report.

<u>EPA Response:</u> See response to Comment 4.375.

4.378 Tennessee Valley Authority Kingston Fossil Plant, Roane County, Tennessee, 2008. After receiving nearly 20 cm of rain in less than 4 weeks, an engineered 18-m-high earthen embankment of a 34-ha storage impoundment failed, producing a 14-m-high surge wave and releasing 4.1 million m^3 of coal fly ash slurry. The release covered over 121 ha with slurry containing arsenic, cobalt, iron, and thallium. Over 2.7 million m^3 of coal ash and sediment were dredged from the Emory River to prevent further downstream contamination (AECOM 2009).

The failure of this earthen (fly ash) upstream construction dam that was founded on silt and clay is not comparable to a major mine development in Alaska. The failure was attributed to the foundation, construction rate, construction material, and placement method (lack of compaction). None of these factors are relevant for the tailings dam concept presented in the assessment report

<u>EPA Response:</u> See response to Comment 4.375.

4.379 References to dam failures

There are 186 references to dam failure in the Assessment Report (including headings, figures, and appendices). This illustrates a biased perspective. The Assessment Report relies heavily on the premise that "it is not a matter of if but when a tailings dam failure will occur". Multiple attempts to justify this false premise are presented by repeated assertions that failure "could" occur and by quoting several technical papers out of context. EPA's assertions lack scientific foundation and do not reflect reality. As such, the conclusions contained in the Assessment Report regarding dam failures are invalid.

<u>EPA Response:</u> The premise quoted in the comment does not appear in the assessment. The quoted statement refers to the fact that no structure lasts forever, which is reality. However, we have provided estimates of the annual probability of failure, which are low, in the assessment.

4.380 Executive Summary: ES-22 Multiple, simultaneous failures could occur as a result of a common event, such as the occurrence of a severe storm with heavy precipitation (particularly one that fell on spring snow cover) or a major earthquake. Such an event could cause one to three tailings dam failures that would spill tailings slurry into streams and rivers, road culvert washouts that would send sediments downstream and potentially block fish passage, and pipeline failures that would release product slurry, return water, or diesel fuel.

The premise that failures "could occur" or "have the potential to occur" is based on the fact that isolated tailings dam failures have occurred in the past and implies that all tailings dam have and will be constructed and operated using similar standards and methods. It is also implied that the less conservative tailings management practices that led to dam failure in the past would be applied for future projects in Alaska. This premise is wrong. Suitably qualified and competent professionals would not design for failure nor would it be allowed by a diligent regulatory process. The examples of tailings dam failures in the Assessment Report are not applicable as they were due to design features that would not be applied in a current mine design. It is also useful to note that some sections of the Assessment Report depict a more balanced perspective. In particular, it is useful to review appendix 1 for a better technical perspective than is presented elsewhere in the assessment report.

<u>EPA Response:</u> The assessment does not state or imply that "all tailings dam have and will be constructed and operated using similar standards and methods", "that the less conservative tailings management practices that led to dam failure in the past would be applied for future projects in Alaska", or that qualified and competent professionals would design for failure. The statement in the assessment is based on the premise that, in spite of best intentions, constructed systems can and do fail. No change required.

4.381 4.4.2.1 Causes of Tailings Dam Failures: 4-44 Perhaps most noteworthy is the relatively high number of accidents or failures for active tailings dams relative to inactive tailings dams, primarily resulting from slope instability failure (Table 4-8). This suggests that the stability of tailings dams and impoundments may increase with time, as dewatering and consolidation of the tailings occurs and with the cessation of the application of additional loads (however, see Section 4.3.8.2).

These two statements from the Assessment Report are contradictory. If the stability of tailings dams and impoundments increases over time (as evidenced by the low number of failures at inactive dams), then the assumption that the probability of failure increases over time is inconsistent, and incorrect.

<u>EPA Response:</u> The statement says that stability is suggested to increase with time, not failure, so there is no contradiction. No change required.

4.382 Table ES-1 Summary of Probability and Consequences of Potential Failures: ES-16

Failure Type: Tailings dam

Probability: $l0^{-4}$ to $l0^{-6}$ per dam-year = recurrence frequency of 10,000 to 1 million years Consequences: More than 30 km of salmonid stream would be destroyed and more streams and rivers would have greatly degraded habitat for decades.

This statement suggests that it is reasonable and appropriate to assign a 'recurrence frequency' for tailings dam failure. This is incorrect and misleading. It could also be noted that even if this hypothesis were correct, it is somewhat ridiculous as extrapolation of such a failure event to a period of time 10,000 to 1 million years in the future is pointless. For comparison purposes, looking back about 10,000 years would show that the entire Bristol Bay area was covered by massive glaciers and therefore devoid of any salmonid streams.

<u>EPA Response:</u> An important part of risk assessment is to determine the likelihood of an event, as well as its consequences. Even if the probability of an event occurring is low, it is important to assess that probability. The final assessment explains that objective probabilities of individual events such as a tailings dam failure are derived from properties of populations such as the frequency of tailings dam failures.

4.383 Executive Summary: ES-18 The range of estimated probabilities of dam failure is wide, reflecting the great uncertainty concerning such failures. The most straightforward method of estimating the annual probability of failure of a tailings dam is to use the historical failure rate of similar dams. Three reviews of tailings dam failures produced an average rate of approximately 1 failure per 2,000 dam years, or 5 x $l0^{-4}$ failures per dam year. The argument against this approach is that it does not fully reflect current engineering practice. Some studies suggest that improved design, construction, and monitoring practices can reduce the failure rate by an order of magnitude or more, resulting in an estimated failure probability within our assumed range. The State of Alaska's guidelines suggest that an applicant follow accepted industry design practices such as those provided by the U.S. Army Corps of Engineers (USACE), Federal Energy Regulatory Commission (FERC), and other agencies. Both USACE and FERC require a minimum factor of safety of 1.5 against slope instability, for the loading condition corresponding to steady seepage from the maximum storage facility. An assessment of the correlation of dam failure probabilities with safety factors against slope instability suggests an annual probability of failure of 1 in 1,000,000 for Category I Facilities (those designed, built, and operated with state-of-the-practice engineering) and 1 in 10,000 for Category II Facilities (those designed, built, and operated using standard engineering practice). This spans the failure frequency used in our failure assessment. The advantage of this approach is that it addresses current regulatory guidelines and engineering practices.

The statistics for tailings dam failure probability in the Assessment Report are flawed, thus they must be ignored. Even if it were accepted that this approach is reasonable, then a logical conclusion would be to assign the 1 in a million probability (i.e., the lowest probability that Silva et al. (2008) could ascribe i.e., negligible risk).

<u>EPA Response:</u> The comment does not indicate how the probabilities are flawed or what evidence mandates the lower probability. We believe it is useful to use existing information from the mining industry and government bodies to attempt to determine dam failure probability. We have added text to the revised assessment to reinforce that historical failure frequencies are used as an upper bound. Silva et al. (2008) also rely on the historic record: "The failure base frequency of 10^{-4} for an annual probability of failure for dam slopes provides an anchor based on historic probabilities. We used this historic value for the curve corresponding to above average facilities (Category II) because earthen dams considered by Baecher et al. (1980) were typically designed and operated with good conservative engineering practice."

4.384 Executive Summary Tailings Dam Failure: ES-15 to ES-18 The range of estimated probabilities of dam failure is wide, reflecting the great uncertainty concerning such failures. The most straightforward method of estimating the annual probability of failure of a tailings dam is to use the historical failure rate of similar dams. Three reviews of tailings dam failures produced an average rate of approximately 1 failure per 2,000 dam years, or 5 x $l0^{-4}$ failures per dam year. The argument against this approach is that it does not fully reflect current engineering practice. Some studies suggest that improved design, construction, and monitoring practices can reduce the failure rate by an order of magnitude or more, resulting in an estimated failure probability within our assumed range.

The author clearly states a review of "similar dams': however similar in this sense refers to "all tailings dams" and includes tailings dams constructed by the upstream construction method. This is incorrect and misleading. Failure probability in the assessment report has been extrapolated from a data set that is not relevant to a realistic proposal for development of a tailings dam in Alaska.

<u>EPA Response:</u> Because we do not have a proposed dam design, we assume that all designs are possible. An upstream dam was added to the Fort Knox Mine dam in the past year, so it is clear that all types of dam design must be considered. No change required.

4.385 Executive Summary Tailings Dam Failure: ES-15 to ES-18 An assessment of the correlation of dam failure probabilities with safety factors against slope instability suggests an annual probability of failure of 1 in 1,000,000 for Category I Facilities (those designed, built, and operated with state-of-the-practice engineering) and 1 in 10,000 for Category II Facilities (those designed, built, and operated using standard engineering practice). This spans the failure frequency used in our failure assessment. The advantage of this approach is that it addresses current regulatory guidelines and engineering practices. The disadvantage is that we do not know whether standard practice or state-of-the practice dams will perform as expected, particularly given the large size of potential dams. In addition, slope instability is only one type of failure; other failure modes, such as overtopping during a flood, would increase overall failure rates.

This excerpt from the executive summary is based on a flawed interpretation of the Silva et al. (2008) paper. This paper by Silva, Lambe, and Marr presents a methodology to allow geotechnical engineers to evaluate "tolerable risk". They provide a specific example for a tailings dam where "corporate management wanted to increase the level of safety of the fluid retention system to reduce the risk of release … That could contaminate the pristine river downstream of the mine surface facilities." They describe this method as a tool to justify increasingly conservative and more costly design solutions to reduce the risk to an appropriate level. Direct extension of the concepts in the Silva paper would lead to the conclusion that tailings dams in the Bristol Bay Watershed would be designed and constructed to have an extremely low risk of failure. If the consequences of failure are high then the designs can be adjusted to ensure that the likelihood of failure is very low. Silva et al. (2008) do not imply that this tool can be used to assign a probability of failure to a hypothetical structure that has not yet been designed.

<u>EPA Response:</u> The comment is incorrect. Silva et al. (2008) clearly state, "Fig. 1 shows relationships between factor of safety and annual probability of failure based on actual engineering projects and developed through quantified expert judgment." More specifically, Silva et al. (2008) explain, "To estimate the annual probability of failure using Fig. 1, the engineer first determines the category for the earth structure under consideration using Table 1 as a guide. With a compatible calculation of factor of safety (see recommendations above), the engineer looks vertically to the appropriate curve, Categories I–IV, and reads the corresponding annual probability of failure horizontally."

4.386 4.4.2.2 Probability of Tailings Dam Failures: 4-46 Silva et al. (2008) reported on over 75 earth dams, tailings dams, natural and cut slopes, and some earth retaining structures to illustrate the relationship between the annual probability of slope failure in earth structures and factors of safety. They grouped projects into four categories based on the level of engineering applied to the design, site investigation, materials testing, analysis, construction control, operation, and monitoring of each project.

Category I: Facilities designed, built, and operated with state-of-the-practice engineering. Generally these facilities are constructed to higher standards because they have high failure consequences.

Category II: Facilities designed, built, and operated using standard engineering practice. Many ordinary facilities fall into this category.

The tailings dams in our mine scenario would be classified as either Category I or Category II, both of which require a detailed computer stability analysis with verification by other methods, and may require more sophisticated finite element analyses in special circumstances.

Both USACE and FERC require a minimum factor of safety of 1.5 for the loading condition corresponding to steady seepage with the maximum storage pool (FERC 1991, USACE 2003).

Combining the required factor of safety with the correlations between slope failure probability and factor of safety (Figure 4-12) derived from Silva et al. (2008) yields an expected annual probability of slope failure between 0.000001 and 0.0001. This translates to one tailings dam failure every 10,000 to 1 million mine years. The upper bound of this range is lower than the historic average of 0.00050 (1 failure every 2,000 mine years) for tailings dams, in part because slope failure is only one of several possible failure mechanisms, but also suggesting that past tailings dams may have been designed for lower safety factors or designed, constructed, operated, or monitored to lower engineering standards. Because 90% of tailings dam failures have occurred in active dams (Table 4-8), the probability of a tailings dam failure after TSF closure would be expected to be lower than the historical average for all tailings dams. However, Morgenstern (2011), in reviewing data from Davies and Martin (2009), did not observe a substantial downward trend in failure rates over time.

The Assessment Report seems to base comments on a hypothetical dam that has been designed to probably fail. They erroneously assume that this flawed dam design concept could be permitted and allowed to proceed into construction and operation. They then suggest that this would relate to "ant" dam in the Bristol Bay Watershed. It would have been more realistic to assume that any tailings dam constructed in the Bristol Bay Watershed would need to be consistent with Silva's category 1 dams. The annual failure probability of a dam structure designed to achieve a factor of safety of 1.5 (which is the minimum) is 1 in a million, i.e., this is implied to be negligible by Silva et al. (2008). It would also be more reasonable to assume that any tailings dams constructed within the Bristol Bay Watershed would be expected to be designed to achieve an even higher factor of safety and thus would achieve an even lower probability of failure. The assessment report is therefore incorrect.

<u>EPA Response:</u> An annual failure probability between 0.000001 and 0.0001 translates to between a 99.9999% and a 99.999999% chance that the dam would not fail in any given year. This can in no way be construed as a "dam that has been designed to probably fail." Although we do not know what factor of safety or what level of engineering the State of Alaska would require for any future proposed dams, the comment appears to

be recommending that the State of Alaska require that such dams be "designed, built, and operated with state-of-the-practice engineering" (i.e., Category I in Silva et al. 2008) with "an even higher factor of safety" than 1.5 and with "an even lower probability of failure" than 1-in-a-million. Based on the Alaska Dam Safety guidelines, the category of the potential dam is open to interpretation given the risk of loss to property and human life. There would need to be an official determination as to the category of the proposed facility and the corresponding required level of design, construction, and monitoring. EPA would not make that determination.

4.387 4.4.2.2 Probability of Tailings Dam Failures: 4-45 An estimated 0.00050 failures per dam year, based on 88 failures from 1960 to 2010 (Chambers and Higman 2011). This translates to 1 tailings dam failure every 2,000 mine years.

The authors incorrectly imply that generalized statistics for worldwide tailings dam failures can be applied to individual tailings dams to suggest a high potential for failure over an extended period of time. Chambers and Higman (2011) indicate by means of flawed logic that "the failure rate of tailings dams has remained at roughly one failure every 8 months … Over a 10,000 year lifespan this implies a significant and disproportionate chance of failure for a tailings dam" (p. 4). This premise is erroneous and misleading, as it is incorrect to imply that any particular proposed or actual dam structure is more or less likely to fail based solely on extrapolation of general dam failure statistics. The integrity and stability of any dam structure should rather be ascertained by suitably qualified and competent professionals, whose assessment must take into consideration all relevant aspects of the specific site conditions; the details of the design; as well as the construction, operating and closure parameters that are relevant to the evaluation.

EPA Response: **See responses to Comments 4.150 and 4.386. The cited paragraph from the assessment accurately reflects the data and conclusions presented in Chambers and Higman (2011), and the comment's undocumented assertions do not address the content of the cited paragraph.**

4.388 4.4.2.2 Probability of Tailings Dam Failures: 4-45 An estimated 0.00049 failures per dam year, based on 3,500 appreciable tailings dams that experienced an average 1.7 failures per year from 1987 to 2007 (Peck 2007). This translates to 1 tailings dam failure every 2,041 mine years.

Peck (2007) cites no reference for his figure of 1.7 failures per year but it is assumed to be sourced from information presented in ICOLD bulletin 121 and possibly other sources as well. The Assessment Report also appears to be drawing reference to Davies with the stated total of 3,500 tailings dams worldwide which is based on a conservative estimate. Thus, this reference is used out of context. Irrespective of the incorrect representation of the source material the dam failure data set needs to be filtered for construction method and material before making any comparisons to the hypothetical dam (centerline constructed rockfill embankment) that is presented in the Assessment report. Close examination of the ICOLD information indicates that none of the historical tailings dam failures can be directly compared to the dam concept presented in the assessment report. Thus, proper application of dam failure statistics indicates that dam failure is not only improbable but impossible for the example used in the assessment report.

<u>EPA Response:</u> Dam failure statistics cannot prove that failure of a dam is impossible. The cited paragraph from the assessment accurately reflects the data and conclusions presented in Peck (2007). The original draft assessment (p. 4-45) explains that "Low failure frequencies and incomplete datasets also make any meaningful correlations between the probability of failure and dam height or other characteristics questionable." The comment's unsubstantiated assertion that "Thus, proper application of dam failure statistics indicates that dam failure is not only improbable but impossible for the example used in the assessment report" reflects a dangerous naiveté regarding dam safety. Section 9.1 of the revised assessment provides a balanced evaluation of the potential risk of failure.

4.389 4.4.2.2 Probability of Tailings Dam Failures: 4-45 An estimated 0.00057 to 0.0014 failures per dam year, based on a database including many unpublished failures that showed 2 to 5 major tailings dam failures annually from 1970 to 2001 (Davies 2002, Davies et al. 2000). This translates to 1 tailings dam failure every 1,754 to 714 mine years.

Davies et al. (2000) presents summary statistics of "major" tailings dam incidents and suggests that, based on a tenuous extrapolation to a worldwide inventory of 3500 tailings dams, that "2 to 5 failures per year equates to an annual probability of between 1 in 700 to 1 in 1750" (p. 4). It is important to note that 3,500 worldwide tailings dams is likely an underestimate, as there are 1448 tailings dams in the USA alone. Davies et al. (2000) also do not suggest that these statistics represent a probability of failure for any specific tailings dam, but rather indicate that "there is the potential to essentially eliminate such events with an industry-wide commitment to correct design and stewardship practices."

<u>EPA Response:</u> In his concluding remarks, Davies (2000) continues "An optimistic response, e.g., a B trend, is possible with a commitment from the entire industry to an adherence to fundamentally sound design and operating concepts; the authors are cautiously optimistic, as this commitment appears to be growing. The optimism would be further increased if those in the industry who believe there has not been a significant problem from tailings dam failures would take the time to review and acknowledge the less than perfect history. These individuals should also understand that the current scrutiny under which the industry currently finds itself is largely a result of this history."

In the revised assessment, we have clarified that historic tailings dam failure data was used to set a reasonable upper bound for the dam failure probability, and that improved modern design, construction, and monitoring may reduce the historic failure rate by an order of magnitude or more.

4.390 Box 4-7. Modeling the Probable Maximum Flood Hydrograph at TSF1 4-52 We used the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) to generate a reasonable runoff hydrograph based on a 24-hour probable maximum precipitation (PMP) event of 356 mm (14 inches) (Miller 1963).

The use of the phrase "a reasonable runoff hydrograph" implies normalcy. The flood resulting from a PMP is anything but "normal". It is so extreme and unlikely that no probability can be assigned to it.

<u>EPA Response:</u> Use of the probable maximum flood (PMF) is an engineering practice and does not imply normalcy. It is a best guess by the engineering profession of the stresses that a structure may have to withstand. We use it here consistent with standard engineering practice. However, in the final assessment the PMF is not used to initiate tailings dam failure.

4.391 Box 4-8. Modeling Hydrologic Characteristics of Tailings Dam Failures 4-53 Under both partial and full TSF volume conditions, results were modeled for 30 km (18.6 miles) downstream-from the face of the hypothetical dam to the confluence of the North Fork Koktuli and South Fork Koktuli Rivers (Figure 4-14)-because extension of the simulation beyond this point would have introduced significant error and uncertainty associated with the contribution of the South Fork Koktuli flows.

This is the only mention of significant error and uncertainty pertaining to the dam breach modeling, and the omission of further discussion implies that the analysis has a reasonably high level of uncertainty. The uncertainty in the estimation of the peak flows resulting from the tailings dam breach modeling is extremely high. Many key assumptions that the model results are very sensitive to are not discussed, including the total volume of material released, the size of the dam breach, and the rate of breach development, to name a few. Therefore the, dam breach model presented in the Assessment Report is flawed, the reported results are dubious and the conclusions are unsubstantiated.

<u>EPA Response:</u> The dam breach model was developed to provide a simplified understanding of a single event potential floodwave and the potential distribution of released tailings during that initial failure. This was not a sediment transport analysis intended to review transport potential for categorical grain sizes throughout the watershed. The decision to not extend any modeling beyond the confluence was to limit the predictive function of the model and not overextend the results.

The dam breach itself relies on 1-D hydraulic flow and compares the floodwave volume to the potential of the tailing slurry volume that could become mobile. This volume most likely would respond in a different manner than what the HEC-RAS model predicts. However, the HEC-RAS model does represent a single potential flood volume and its areal extents, and the volume of tailings slurry available for transport fits within that potential flood volume. The results create one possible answer that could occur, to give the reader an idea of the magnitude of one potential failure.

4.392 4.4.2.4 Tailings Dam Failure via Flooding and Overtopping: 4-50 For comparison, a U.S. Geological Survey (USGS) gage located near the village of Ekwok, Alaska, experienced a record peak flood of 3,313 m^3/s in a 2,551 km^2 watershed. Under the partial volume dam failure, the peak flood is estimated at 1,862 m^3/s immediately upstream of the TSF 1 dam, where the watershed area is 1.4 km^2. Thus, on a unit area basis, the tailings dam area in the partial-volume failure analysis would result in a more than 1,000-fold increase in discharge compared to that observed in a record flood; for the full-volume analysis, there would be more than a 6,500-fold increase.

The Assessment Report uses watershed areas that are incorrect. The watershed area for their assumed tailings impoundment is more in the order of 14 km^2 than 1.4 km^2, and the drainage area for the Nushagak River is 25,550 km^2 rather than 2,551 km (USGS published area is 9850 sq. miles).

<u>EPA Response:</u> The watershed area discrepancy was a typographical error that has been corrected in the revised assessment.

This is a spurious comparison. Peak flows typically have a non-linear scaling relationship, with small basins in a region having higher unit flows than large basins (cathcart 2001), so it is not valid to directly compare unit peakflows from the tailings impoundment area with those from a basin that is 1821 times greater in area.

Also, the "record peak flood" quoted is the largest event for a sixteen year flood record for the Nushagak River at Ekwok (USGS station 15302500), and has a return period of between 20 and 25 years. It is not valid to compare this flow to a flow resulting from a dam failure triggered by the probable maximum precipitation, which is an events severe and unlikely that theoretically one cannot assign a probability to it.

Finally, peakflows vary substantially according to the characteristics of the drainage basin, including the climate. The quoted record peakflow is for an area that is relatively dry and flat, and when corrected for the proper drainage area, has a unit runoff of 0.13 $m^3/s/km^2$. Another river in the region, the Iliamna River, has a peak flow that corresponds to a unit runoff of 4.5 $m^3/s/km^2$, which is 35 times greater. It is not valid to use the flows from the Nushagak River for comparison without qualification. If the Iliamna River values were used as the basis of comparison, which in itself is not particularly valid, the 1000-fold and 6500 fold increases would reduce to 29-fold and 186-fold, respectively. These ratios are still very large, as would be expected when comparing a theoretical PMF dam breach flood with a historical flood, but they have far less shock value than the ratios quoted in the assessment report.

<u>EPA Response:</u> See response to Comment 4.216.

4.393 4.4.4 Road and Culvert Failures: 4-63 "The mine access road would traverse varied terrain and subsurface soil conditions, including extensive areas of rock excavation in steep mountainous terrain (Ghaffari et al. 2011). Thus, although the road design, including placement and sizing of culverts, would take into account seasonal drainage and spring runoff requirements, road and culvert failures would be expected. Thus, two of the remaining 16 streams with less than 5.5 km of upstream habitat might be bridged, leave 14 salmonid streams with culverts. Assuming typical maintenance practices after mine operations, roughly 50% of these streams, or 7 streams, would be entirely or partly blocked."

It is not clear how this conclusion is reached. Provided the road crossings are properly engineered and constructed to appropriate standards, road and culvert failures would not be expected. Culverts commonly operate successfully in steep mountainous terrain.

<u>EPA Response:</u> These analyses have been explained in greater detail in Chapter 10 of the revised assessment.

4.394 The current industry standard for the design and installation of conveyance structures (including culverts, bridges, and fords) in fish bearing streams requires maintenance of the physical and biological processes of the subject stream or river. A properly formulated culvert design maintains sediment, debris, and flood flow, and aquatic organism conveyance (both upstream and downstream) similar to that of the natural stream. Design techniques such as the "Stream Simulation" approach have been developed and successfully employed over the past two decades in Alaska, California, and the Pacific Northwest. As many reports have described in detail, this approach incorporates a continuous streambed that mimics the slope, structure, and dimensions of the natural streambed (WDFW 201 1; FHWA 201 0, 2007; CDFG 2009; USDA 2008). Water depths and velocities through and around the conveyance structures are as diverse as those in the natural channel, providing passageways for all aquatic organisms (USDA 2008) and maintaining sediment and debris continuity. Installation of such structures would likely result in less potential impact than assumed in the draft Assessment Report.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152, and also note that the Stream Simulation approach is not standard practice in Alaska.

4.395 Section 4.4.4 Page 4-62, Last Paragraph: "Reported culvert failure rates vary throughout the literature but are generally high …Thus, although the road design, including placement and sizing of culverts, would take into account seasonal drainage and spring runoff requirements, road and culvert failures would be expected." Note: Failure is defined in stated paragraph as: "if the passage of fish is blocked or if streamflow exceeds culvert capacity, thus resulting in washout of the road."

Current design techniques for streams with resident or anadromous fish include evaluating more than "seasonal drainage and spring runoff requirements." Modem standards foster designs that are self-sustaining, durable, and provide continuity of geomorphic processes such as the movement of debris and sediment (CDFG 2009). National Marine Fisheries Service NMFS) design criteria require that all fish passage facilities be designed for the 100-year flood event (2001) and that any potential damage to the crossing be addressed as part of the design process. These design criteria reduce the potential for culvert failure, both from blockage of fish passage and road washout, and promote habitat and fluvial process continuity.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

4.396 The Assessment is based almost completely on assumptions and hypothetical scenarios; however, every mine is very different in terms of its design and operations. In addition, EPA appears to have focused almost exclusively on past mine failures in its Assessment rather than on mine successes, particularly those currently operating under modern engineering design standards. This approach suggests an inherent bias in EPA's Assessment that undermines its utility and would certainly lead to arbitrary and capricious agency action if the information contained in the Assessment is used in support of future decision-making.

Due to the Agency's reliance on uninformed assumptions, disregard for current mine practices and neglecting required mitigation measures, the attached collection of technical papers is intended to serve as a primer on some of the basic principles of current mine development within the regulatory and permitting framework in Alaska. It is clear that EPA lacks that basic understanding. The white paper series therefore has two primary objectives: (1) to share knowledge of key technology issues related to modern mine design and mitigation options; and (2) to provide additional scientific citations for consideration as part of the Assessment.

EPA Response: We agree that the assessment is based on assumptions and hypothetical scenarios, as are all assessments of risks from a future action. Even a mine plan submitted for permitting is hypothetical. It would be changed during the permitting process and continue to change as mining progressed. However, we believe these scenarios are realistic representations of what could be expected in a mine plan. We assume that the primary elements of a mine would follow modern conventional mine design and practice, as described in the Ghaffari et al. (2011) report commissioned by Northern Dynasty Minerals. We disagree that these assumptions are uninformed, as a great deal of detail is provided in Ghaffari et al. (2011) and in the generally available literature on mining. We appreciate receiving additional information that may further inform our assessment. No change required.

National Mining Association (Doc. #4109)

4.397 The Draft Assessment is also filled with unlikely scenarios and assumptions that are not sufficiently placed in proper context. For example, section 5.2 of the Draft Assessment attempts to quantify the impact that development may have on stream-flow rates, but later acknowledges that doing so accurately is not feasible. Similarly, Section 4.4.3.1 makes unrealistic assumptions about the volume of material that could flow from a failed pipeline due to EPA's failure to take into consideration the fact that flow rates reduce during shut downs, thereby reducing the volume of material spilled.

EPA Response: The uncertainties in streamflow reduction are acknowledged. The pipeline failure scenario reduces pumped flow to zero following shutdown. After that, gravitational flow continues until the pipeline uphill to the next valve has drained. Gravitational flow is actually more rapid than pumped flow.

Earthworks (Doc. #4125)

4.398 Comment: Please consider including a scenario that reflects full build---out of the mine (10.78 billion tones) to provide a full range of potential impacts from developing the Pebble deposit. The Assessment clearly underscores, utilizing the best available data, including that from the PLP, that the wastes from mining the Pebble deposit will likely generate acid, which will dissolve copper and pose serious risks to Iliamna Lake, aquatic habitat, and the waters of Bristol Bay. By using the lower resource estimate, the Assessment underestimates the potential long---term risk to fish. It is also important to clarify that the maximum mine scenario analyzed in the assessment does not represent full build out of the Pebble deposit. It isn't immediately clear in the executive summary that the maximum mine scenario represents the development of only 60% of the Pebble deposit.

EPA Response: See response to Comment 4.37.

4.399 The assessment identifies failure scenarios based on pipeline spills, tailings impoundment failures and water collection and treatment failures. The track record of operating copper porphyry mines in the U.S. demonstrates that these failure scenarios have frequently resulted in significant water quality impacts. The top five copper--- producing mines in the U.S., based on the most current U.S. Geological Survey (USGS) commodities survey (2010), are all copper porphyry deposits. All five of these mines have experienced major pipeline spills and water collection and treatment failures. Two of the five mines have also experienced a partial tailings impoundment failure.

- Bingham Canyon Mine, UT

  Pipeline Spills: In 2011, a report of malfunction of equipment that allowed the release of approximately 145,424 gallons of copper tailings. In 2011, a pipeline overflowed onto soil with estimated 100,000 – 290,000 gallons of copper tailings material released from pipeline.

  Tailings Impoundment: No tailings impoundment failure, but multiple tailings spills.

  Water Collection and Treatment: In February 2008, the United States Fish and Wildlife Service took legal action against Kennecott for the release of hazardous substances from the mine's facilities, including selenium, copper, arsenic, lead, zinc and cadmium. Groundwater contaminated by mine operations has been released from the mine site through artesian springs into areas that serve as fish and wildlife habitats. According to the federal biologists, the release of these hazardous pollutants has harmed natural resources, including migratory birds and their support ecosystems, which includes wetlands, marshes, freshwater wildlife habitats, playas and riparian areas and freshwater ponds. Wastewater from the mine has escaped the site's collection system, contaminating groundwater with acid, metals and sulfates. The groundwater plume extends towards the nearby Jordan River and covers more than 72 square miles. Water treatment in perpetuity will be required for contaminated groundwater. There have been multiple tailings spills.

- Morenci Mine, NM

  Pipeline Spills: 2008: Pipeline spill released 186,000 gallons of sulfuric acid and heavy metals into a tributary (Chase Creek) of the San Francisco River, resulting in a $150,000 settlement with the State of Arizona. The highly acidic material traveled downstream more than 2 miles. The pollutants in the discharge exceeded Arizona surface water quality standards for copper, zinc and pH in Lower Chase Creek. 1996: An unknown amount of pregnant leach solution spilled from pipeline, affecting Chase Creek, leading to San Francisco River. At the time of report, 20 gpm were being released. 1993: An unknown amount of copper sulfate released into San Francisco River due to storm event.

  Tailings Impoundment Failure: None

  Water Collection and Treatment: In 2012, the U.S. Dept. of Justice and the State of Arizona released a consent decree which found that "mine tailings exposed to air and precipitation released hazardous substances on the surface of the tailings or that can percolate through the tailings to groundwater." The consent decree found that "releases of hazardous substances at or from the Morenci mine site have occurred and allege that such releases have caused injuries to natural resources at and in the vicinity of the site including surface water, sediments, soils, terrestrial habitats and terrestrial receptors." The consent decree followed an investigation, which found that the main ore minerals are sulfide minerals, which have resulted in the development of acid mine drainage. According to the report, "Surface water has been, and most likely continues to be, exposed to hazardous substances released from the Morenci Mine through a variety of pathways." Concentrations of hazardous substances measured in groundwater at the

Morenci Mine and measured in the San Francisco and Gila Rivers downstream of the mine provide further indications that hazardous substances present in the source materials at the Morenci Mine have been released to the environment. The report found that "Concentrations of total and dissolved zinc have exceeded 1,000 µg/l in the Gila River and concentration of dissolved copper have exceeded 100 µg/l in the San Francisco River." Contaminated groundwater is also released to surface water via seeps and springs.

- Ray Mine, AZ

  Pipeline Spills: In 2012, potable water line ruptured, which washed tailings into the Gila River. 12 In 2007, A leak from a coupling in a tailings pipeline spilled tailings onto the banks and into the Gila River. A $20,000 civil penalty was paid.

  Tailings Impoundment Failure: In 2011, a report of 6,000---8,000 tons of copper ore tailings released from one of the tailings pond due to a breach in the dike. In 1993, heavy precipitation caused the Gila River to flood, and breach the AB---BC tailings impoundment containment dike. The total discharge was approximately 292,000 tons of tailings" Sampling of the river showed that elevated concentrations of pollutants occurred at least 11 miles downstream of the spill. The tailings formed bank and bottom deposits in the river, impairing both recreational uses and the quality of habitat for plants and animals.

  Water Collection and Treatment Failure: In 2012, seepage from the tailings impoundment was released into two catch basins and into a tributary of the Gila River. At the time of the report, seepage into the tributary was estimated at 75 gpm. From 1988 – 1997, 47 separate releases of hazardous substances into Mineral Creek from the Ray Mine were reported. According to a 2012 ecological risk assessment prepared by the State of Arizona, "A large portion of these releases were uncontained and eventually entered Mineral Creek and the Gila River. Hazardous chemicals released included copper sulfate, copper tailings and leachate." In addition, the report found that multiple groundwater wells downgradient of the Ray Mine were found to be highly contaminated by a common leachate solution which was attributed to releases to shallow groundwater along Mineral Creek, and it concluded that "it is likely that the hazardous substances present in shallow groundwater will represent an ongoing source of chronic contamination to Mineral Creek (Lipton 2009)."

- Bagdad Mine, AZ

  Pipeline Spills: In 2009, a report of a broken pipeline causing a release of 2,378,500 gallons of sulfuric acid. Impacts unknown. In 1999, 12,000 gallons of process water with residual chlorine spilled into Bridle Creek.

  Tailings Impoundment Failure: None

  Water Collection and Treatment Failure: In 1996, the EPA and the state of Arizona announced that Cyprus Bagdad Copper Corp., a subsidiary of Cyprus Mineral Corp., paid penalties totaling $760,000 for discharging contaminated water from the Bagdad Copper Mine. The discharges involved various facilities including tailings ponds, leach dumps, and a sewage treatment plant, but by far the major discharges came from the Copper Creek Leaching Basin, in which acidic, copper-tainted underground seepage entered

Boulder Creek. According to an EPA report, seepage of pregnant leach solution from the Copper Creek Leaching System was discovered in a receiving pool in Boulder Creek in 1991.25 Studies indicated that instead of being contained by the Copper Creek Flood Basin, the heavily contaminated solution seeped under the dam. The concentration of total copper in samples collected in the pool in Boulder Creek were as high as 76.4 mg/l. On March 29, 1993, U.S. EPA issued a Finding of Violation and Order against Cyprus.

- Mission Mine, AZ

  Pipeline Spills: In 2011, a backup of a tailing line resulted in release of tailings into a dry wash. In 2002, a violation involving the discharge of primarily copper laden stormwater runoff and process water discharge to ephemeral tributaries of the Santa Cruz river near Tucson in violation of the facilities. Multi Sector General Permit Case # 09---2002---0064. In 2001, a 36-inch distribution tailings line developed a break causing a release of 200 tons of tailings into a dry stream channel.

  Tailings Impoundment: Surface drainage from a break in a tailings pond dike in 1990 released large volumes of material into wash complexes.

  Water Collection and Treatment: According to EPA fact sheet released in 2008, discharges from mine (outfall 001A) contain significant levels of copper and lead, and TSS, which have been out of compliance since October, 2003.30 Outfalls from the Mission complex discharge to ephemeral streams that are tributaries to the Santa Cruz River. Three large tailings ponds and several mine dumps are located on land leased from the Indian landowners approximately 1 mile south of the Arroyos project area. Leachate from these tailings has contributed to elevated levels of sulfate, TDS, and hardness in the aquifer below and adjacent to the ponds.

- Tailings Impoundments Failures Partial tailings impoundment failures have occurred at four out of sixteen operating U.S. copper porphyry mines. These failures occurred at the Pinto Valley Mine (1997 and 1991), Ray Mine (2011 and 1993), Tyrone Mine (1980), and Mission Mine (1990):

Tailings Impoundment Failures (Operating U.S. Copper Porphyry Mines)		
Pinto Valley Mine, AZ	1997	A partial tailings failure occurred at the Pinto Valley Mine, depositing an estimated 276,000 cubic yards of tailings in Pinto Creek.[32] It buried 8.1 acres of creek bed and surrounding upland with material as deep as 42 feet.[33]
	1991	Another incident occurred in which the face of Tailings Dam No. 3 failed, allowing 150 to 250 tons of tailings to enter Pinto Creek.[34] The tailings discharge was accompanied by approximately two million gallons of water, which were released over a period of 16 hours.
Ray Mine, AZ	2011	6,000-8,000 tons of copper ore tailings released from one of the tailings ponds due to a breach in the dike.[35]
	1993	Another incident occurred in which heavy precipitation caused the Gila River to flood and breach the tailings impoundment at the Ray Mine, carrying pollutants 11 miles downriver. The tailings formed bank and bottom deposits in the river, impairing both recreational uses and the quality of habitat for plants and animals.[36]
Tyrone Mine, NM	1980	2.6 million cubic yards of tailings were released at the Tyrone mine due to a breach in the tailings wall, and flowed 8 kilometers downstream.
Mission Mine, AZ	1990	Surface drainage from a break in a tailings pond dike in 1990 released large volumes of material into wash complexes.[37]

EPA Response: Comment noted. Important engineering structures are generally designed with the intent that they will not fail. Nonetheless, important structures can and do fail due to design flaws, construction flaws, material defects, willful malfeasance, operational error, other human error, and extreme natural events. No change required.

4.400 *Comment*: The rate of tailings impoundment failures at operating U.S. copper porphyry mines (3 out of 16) underscores the conservative failure rate associated with the failure mode in the assessment.

Since this is a seismically active area, it might be appropriate to say on p. 17 (executive summary): “In addition, slope instability is only one type of failure; other failure modes, including overtopping during a flood and dam failure during an earthquake, would increase overall failure rates.”

EPA Response: The assessment emphasizes data for all tailings dam failures rather than isolating U.S. porphyry copper mines, because the number of cases is so small for that subset.

4.401 Pipeline Failures There is ample evidence from the performance record at operating U.S. copper porphyry mines that pipeline spills and other accidental releases are a common failure mode. Please see the attached report that reviewed fourteen out of sixteen operating U.S.

copper porphyry mines, representing 89% of U.S. copper production, which documents pipeline spills and/or other accidental releases at all fourteen mines.

The Bristol Bay watershed assessment focuses on the potential for failure of the pipeline that carries concentrate and return water along the road corridor. This makes sense given the significant length of the pipeline and the frequent stream crossing. However, it would be useful to note in the assessment that the mine will also transport tailings to the impoundment, and failure of the tailings pipeline would result in additional impacts.

Here are just a few example of operating U.S. copper porphyry mines that have experienced tailings pipeline spills in the last 13 years. Please note that most of these mines are located in the arid southwest, where surface water is limited. More frequent spills into waters of the U.S. could be expected in wetter climates like those at Bristol Bay.

Examples of Tailings Pipeline Failures (Operating U.S. Copper Porphyry Mines)		
Ray Mine, AZ	2012	Potable water line ruptured, which washed tailings into the Gila River. [38]
	2007	A leak from a coupling in a tailings pipeline spilled tailings onto the banks and into the Gila River.[39]
	2000	80.95 pounds of copper sulfate spilled from basin/dam into Mineral Creek.[40]
Mission Mine, AZ	2011	A backup of a tailing line resulted in the release of tailings into a wash.[41]
	2011	A 36-inch distribution tailings line developed a brake causing a release of 200 tons of tailings into a dry stream channel.[42]
Chino Mine, NM	2000	480,000 gallons of tailings slurry discharged, with 93,000 gallons entering Whitewater creek.[43]
	1999	3.25 million gallons of tailings spilled into Whitewater Creek.

Comment: The assessment focuses its evaluation on the potential impacts of a spill from the pipelines transporting concentrate and wastewater along the road corridor. This makes sense given the significant length of those pipelines, and the number of stream crossings. The track record of operating copper porphyry mines in the U.S., however, indicate that numerous tailings spills have also occurred due to pipeline breaks at mine operations. It would be useful to specify in the executive summary and within the report that a pipeline transporting tailings to the impoundment will be required, and that a spill from the tailings line could result in additional impacts.

<u>EPA Response:</u> The assessment describes the tailings slurry pipeline as part of the scenario, but its risks are not assessed because it is less of a concern than the product concentrate pipeline. In addition to these major on-site pipelines, there would be smaller pipelines for water supply, firefighting, and process flows within the plant. In

this assessment, we make an optimistic assumption that any leakage from pipelines in the process plant area would be captured and controlled by the plant's drainage system and either treated prior to discharge or pumped to the process water pond or the TSF. Failures of these on-site pipelines and collection systems could result in uncontrolled releases within the mine site, but these failures are not evaluated in this assessment. No change required.

4.402 Water Collection and Treatment Failures: The attached report chronicles the track record of this failure mode at 14 out of 16 operating copper porphyry mines in the U.S., representing 89% of U.S. copper production. It demonstrates that this failure mode is common, and has resulted in severe impacts to water resources at most of the currently operating U.S. copper porphyry mines. Here are ten examples:

- Bingham Canyon, UT: Wastewater from the mine has escaped the site's collection system, contaminating groundwater with acid, metals and sulfates. The groundwater plume extends towards the nearby Jordan River and covers more than 72 square miles. Water treatment in perpetuity will be required for contaminated groundwater. In February 2008, the United States Fish and Wildlife Service took legal action against Kennecott for the release of hazardous substances from the mine's facilities, including selenium, copper, arsenic, lead, zinc and cadmium. Groundwater contaminated by mine operations has been released from the mine site through artesian springs into areas that serve as fish and wildlife habitats. According to the federal biologists, the release of these hazardous pollutants has harmed natural resources, including migratory birds and their support ecosystems, which includes wetlands, marshes, freshwater wildlife habitats, playas and riparian areas and freshwater ponds.

- Morenci Mine, AZ: In 2012, the US Department of Justice and US Department of Interior jointly announced that Freeport McMoRan has agreed to pay $6.8 million to settle federal and state natural resource damages related to the Morenci Mine. According to the complaint, the hazardous substance release, which included sulfuric acid and metals, injured, destroyed or led to the loss of "surface waters, terrestrial habitat and wildlife, and migratory birds."

- Ray Mine, AZ: According to a report by the U.S. EPA, at least 19 spills of hazardous materials were reported at the Ray Mine from August 1990 through November 1993. The majority of spills were from dams, pipelines, and ponds. The discharges typically resulted from either accidental discharges associated with heavy rain or from chronic seepage from leaching facilities into the ground water, which then entered the creek. The report found that, "surface water quality has been significantly affected." A total of 41 violations of total copper, dissolved copper, and beryllium numeric surface water quality standards were documented by the Arizona Department of Environmental Quality (ADEQ), EPA, and ASARCO in Mineral Creek below the Ray Mine. The most recent incident was reported in 2012, when seepage from the tailings impoundment was released into two catch basins and into a tributary of the Gila River. At the time of the report, seepage into the tributary was estimated at 75 gpm.

- Bagdad Mine, AZ: In 1996, the EPA and the state of Arizona announced that Cyprus Bagdad Copper Corp., a subsidiary of Cyprus Mineral Corp., paid penalties totaling $760,000 for discharging contaminated water from the Bagdad Copper Mine. The discharges involved various facilities including tailings ponds, leach dumps, and a sewage treatment plant, but by far the major discharges came from the Copper Creek Leaching Basin, in which acidic, copper---tainted underground seepage entered Boulder Creek.

- Mission Mine, AZ: According to EPA fact sheet released in 2008, discharges from mine (outfall 001A) contain significant levels of copper and lead, and TSS, which have been out of compliance since October, 2003. Outfalls from the Mission complex discharge to ephemeral streams that are tributaries to the Santa Cruz River. Three large tailings ponds and several mine dumps are located on land leased from the Indian landowners approximately 1 mile south of the Arroyos project area. Leachate from these tailings has contributed to elevated levels of sulfate, TDS, and hardness in the aquifer below and adjacent to the ponds.

- Tyrone Mine, NM: In 2011, the U.S. Department of Justice and State of New Mexico issued a consent decree for damages to natural resources from hazardous substances from the Tyrone, Chino, and Cobre mines. The settlement followed an investigation of natural resource injuries related to the release of hazardous substances into the environment from acid mine drainage and process solution, among other sources. According to the investigation, “groundwater in both the regional aquifer and the perched groundwater aquifers at the site have been exposed to hazardous substances through a variety of pathways.” The Supplemental Groundwater Study at the Tyrone Mine identified 14 different mine area sources that have affected water quality, including seepage from tailings impoundments, leach stockpiles and waste rock stockpiles. The areal extent of the contaminated groundwater plume at the Tyrone Mine is 6,280 acres. A 2007 Closure Plan developed for the mine, estimates that 1 billion gallons of year of acid and metals contaminated seepage from the mine, will require water treatment in perpetuity.

- Sierrita Mine, AZ: According to a 2011 report, seepage from an unlined tailings pond at Phelps Dodge’s Sierrita mine has sent a plume of contaminated groundwater toward the city of Green Valley, causing drinking water wells to record high levels of sulfates. In 2006, the company signed a mitigation order on consent with the State of Arizona to address sulfate in drinking water. It requires the company to develop a mitigation plan to be submitted in 2009.

- Chino Mine, NM: In 2011, the U.S. Department of Justice and State of New Mexico issued a consent decree for damages to natural resources from hazardous substances from the Chino, Tyrone and Cobre mines. The settlement followed an investigation of natural resource injuries related to the release of hazardous substances into the environment from acid mine drainage and process solution, among other sources. It found that “surface water and associated sediments are exposed to hazardous substances released from the Chino Mine through a variety of pathways, including leaks and spills of process water, tailings spills; runoff, and infiltration or percolation from tailings and waste stockpiles. Sampling at the Chino mine has indicated ongoing exposure of ephemeral surface water to hazardous substances.” According to the closure plan for the Chino Mine, roughly a half billion gallons of acid and metals contaminated groundwater will require water treatment in perpetuity.

- Silver Bell Mine, AZ: According to a 2000 report on native fish populations by Pima County, "The loss of native fish along Cocio Wash is a good example of the potentially damaging effects that mining can have on aquatic ecosystems. Summer floods in July and August 1981 swept gray clay sediments from a Silverbell Mine tailings pond into the wash. BLM biologist Bill Kepner later reported, "Our studies indicate that the Cocio Wash topminnow population is now extinct in that habitat due to recurrent mine spills and inundations by mine tailings… (Fonseca, 2000)."
- Mineral Park Mine, AZ: According to a 1995 report by the Arizona Geological Survey, water quality samples were taken of streamflow just below the Mineral Park mine and of mine water seeping through a dam at the southwest end of the tailings. Both samples showed extremely low pH values (3.2, 2.6), extremely high TDS values (5,549 and 6,625 mg/L) and extremely high sulfate contents (4,500 and 6,000 mg/L). According to the report, "the cadmium concentration of the stream flow just downstream of the Cyprus Mineral Park Mine place is 75.4 times higher than the standard, copper exceeds the standard 51 times and zinc 17.2 times."

Comment: The track record of operating U.S. copper porphyry mines demonstrates that water collection and treatment failures are a common occurrence, resulting in severe impacts to water resources. It is clearly appropriate to consider this failure mode a likely occurrence. (p. 3-10)

<u>EPA Response:</u> The revised assessment cites the Earthworks document with respect to water collection and treatment failures, now that the document has been peer reviewed.

4.403 Section 4.3.8 Post-Closure Site Management: The assessment states that: "Water leaving the site via surface runoff or through groundwater would require capture and treatment for as long as it does not meet water quality standards." (Draft Assessment, p. 4-31) A key aspect of post-closure hydrology is that groundwater flow will be away from the pit, waste rock, and tailings (as shown in Figure 4-9). Seepage collection systems are notoriously inefficient (even ineffective), and expensive to operate if pumping is involved. This vector often leads to long-term contamination of downgradient surface waters, and could impact these waters for centuries. Although it is implied in this statement, it is not explicitly stated that groundwater flow from the mine pit, waste rock, tailings (and underground workings), at Pebble would most probably be away from the mine workings (because of the location of the mine workings at the top of the hydrologic divide, and because there is little evaporation at this location).

Comment: It may not be apparent to many readers that the report concludes that post-mining groundwater flow would be away from the pit (and underground workings) as shown in Figure 4-9. It would be helpful to state this explicitly in this section.

<u>EPA Response:</u> This point is made in the final assessment text. For example, the final assessment says, "If water in the pit required treatment, the final pit level would be maintained below the level that allowed natural outflow by pumping water to the WWTP. We assume that this drawdown would result in drainage toward the pit for about 100 m beyond the pit perimeter. If or when the pit water and other sources met the discharge criteria, all flows could be discharged without treatment and the pit water level would be allowed to rise until natural discharge was established at the low point of

its perimeter." It also states, "After closure, the time required for the mine pit to fill with water would range from approximately 20 years (in the Pebble 0.25 scenario) to more than 200 years (in the Pebble 6.5 scenario). Eventually, the pit water would be a source of leached minerals to streams, if it were not collected and treated."

4.404 Section 4.4.3 Pipeline Failures: The report also analyzes spills based on an assumption of pipeline shutdown within 2 minutes (Draft Assessment, p. 4-62). If the safety measures work as designed, this is a reasonable assumption. However, it often seems like this is not the case. Is data available on the average shutdown time for a pipeline spill?

Comment: You might also consider evaluating two pipeline failure scenarios, one with a 2 minute shutdown time, as second with an 'average' pipeline failure shutdown time.

<u>EPA Response:</u> See response to Comment 4.316.

4.405 Section 4. Seismic Risk: The Assessment does a good job of noting earthquakes as a potential trigger for failure over the short or long-term. However, in box 4-3 describing the seismic environment of Bristol Bay, they overstate the strength of our current scientific knowledge about seismic risk in the area, implying that the lack of evidence for past earthquakes is evidence that no such earthquakes have ever occurred.

Comment: This section should reference the most current and appropriate publication on the largest nearby fault by Koehler and Reger (DNR, 2011): Reconnaissance Evaluation of the Lake Clark Fault, Tyonek Area, Alaska. This publication makes clear seismic uncertainties: "The paleoseismic history of the [area near Pebble] remains unknown."

<u>EPA Response:</u> See response to Comment 4.282.

<u>Alaska Wilderness League (Doc. #5397)</u>

4.406 The threat to mining operations structural integrity was not given enough attention in the earthquake analysis in the Assessment. Seismic risk and lack of data within this region along the Lake Clark Fault (LCF) line requires further investigation and analysis. Lack of seismic evidence does not constitute non-activity on the LCF. We advise the EPA turn to Koehler's 2011 publication which states "the paleo-seismic history of the western part of the Lake Clark fault remains unknown. The fault is a major topographic feature, and understanding its behavior has important implications for seismic-hazard assessments related to resource infrastructure in the Cook Inlet region and seismic safety in the greater Anchorage metropolitan area."

<u>EPA Response:</u> See response to Comment 4.282.

<u>Stratus Consulting (Doc. #4772)</u>

4.407 **Chapter 4. Mining Background and Scenario** "We used outputs from the one-dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) hydraulic model (Box 4-8) to estimate tailings deposition along the stream network (Figure 4-14), based on calculated water depths and the assumption that tailings would settle at these depths as the velocity of sediment rich water decreased across the floodplain."

This analysis is based on using HEC-RAS to model flood routing over a 30-meter resolution digital elevation model (DEM). There are likely to be very high uncertainties associated with using such a low-resolution DEM to model a flood wave in this way (e.g., Casas et al., 2006), which EPA acknowledges on p. 4-56. However, the depth of fine-grained sediment deposition also may not be as crucial as its spatial extent, as habitat degradation can be expected wherever fine-grained sediments are deposited (e.g., Suttle et al., 2004). Given the high uncertainties in modeling the depth of the flood wave and the depth of sediment deposition, this analysis should be removed or replaced with an evaluation of the downstream extent of fine-grained sedimentation in the affected streams. It is ultimately this fine-grained sedimentation that is likely to affect salmon habitat.

EPA Response: We agree that the extent of fine sediment deposition is important to assess effects on fish. The HEC-RAS modeling is not appropriate to accurately predict the distribution of fine-grained sediment, especially given the resolution of the 30 m DEM topographic data. However, the model does provide the initial potential of sediment distribution following the tailings dam failure event and resulting flood. The model cannot be calibrated because no such event has occurred, so it relies on typical methodologies and interpretation of results to determine how sediment can distribute.

K. Barbery (Doc. #4110)

4.408 I would like to suggest a possible improvement in the EPA Watershed Assessment regarding reservoir and mine induced seismicity. I am appreciative of the efforts of the EPA in giving some credence to the risk of induced seismicity in Chapter 4, yet I would like to see the addition of a few current resources on the subject. There is more recent data available that addresses the relationship between mining and tailings impoundments, and induced or triggered seismic activity (McGarr, Simpson, and Seeber 2002, in addition to the other resources listed below, has beneficial information as well as additional references worth considering).

- Mining, mine-pit dewatering, and tailings storage may increase pore pressure, plate lubrication, tectonic stress and fault slip around a mine site. Even at low magnitudes, induced or triggered earthquakes could lead to increased liquefaction, tailings pond failure, leaching from tailings impoundments, and chronic contamination of Bristol Bay waters.
- Considering the potential combined size of the tailings impoundments and mining operations at the proposed Pebble Mine, the shift in water balance across the landscape could have serious implications for the tectonic stability of the mine and the surrounding region.
- Although the Lake Clark Fault itself is considered inactive (according to the PLP 2011 EBD), and the precise terminus of the fault line is unknown, a 2002 study suggests that triggered earthquakes are just "as likely in stable as in active tectonic settings" (McGarr 2002 p659). No studies address the compounded impacts of a vast mining district on induced seismicity, and vice versa.

- Though Bristol Bay communities might not be at direct risk in the event of induced seismicity, such an event may increase the probability of tailings impoundment failure that could have lasting degrading impacts on the surrounding ecosystem (Chambers and Higman 2011) and the communities who rely upon the vitality of the regions renewable resources for income and subsistence. The risks of triggered or induced seismicity must be considered alongside other seismic data and I encourage the EPA to add to the existing report with a more thorough assessment of the associated risks.
- Mining, mine-pit dewatering, and tailings storage all stand to alter hydrologic regimes, pore pressure, plate lubrication, and tectonic stress around a mine site. Both mining and reservoirs, including open-pit mining and tailings impoundments, are linked to induced seismicity—in which these circumstances speed up or induce the occurrence of an impending earthquake—as well as triggered seismicity—wherein such activity triggers earthquakes in areas otherwise not associated with seismic activity. Cases of reservoir-induced seismicity have had devastating impacts, including the loss of lives and livelihoods and the impairment of ecosystems and waterways (see LaFraniere 2009 and McGarr, Simpson, Seeber 2002).
- Although the Lake Clark Fault itself is considered inactive (according to the PLP 2011 EBD), a 2002 study suggests that earthquakes can be triggered by minute stress changes and triggered earthquakes are just "as likely in stable as in active tectonic settings" (McGarr 2002 p659).
- I'd like to suggest a possible improvement to the EPA watershed assessment regarding the reservoir and mine induced seismicity. I'm appreciative of the efforts of the EPA and giving some credence to the risk of induced seismicity in the assessment, I believe on page 4-38, yet I'm a little disappointed to find that it warranted only one paragraph and a single citation from a 1976 study. Additional and more current data is available that addresses the link between mining, tailings activity and seismic activity. Mining, mine pit dewatering and eventual refilling of the mine pit, as well as tailings storage, may increase pore pressure beneath the site and lubrication, tectonic stress and fault slip in a mine site. Even at low magnitudes, current triggered earthquake could lead to increased liquefaction, tailings pond failure and chronic contamination of the Bristol Bay watershed. The size of the proposed operations at the Pebble Mine site, along with the potential development of other adjacent mineral deposits could significantly impact the water balance across the landscape and have serious implications for the tectonic stability of the proposed mine and the surrounding region. Although the Lake Clark fault is considered inactive, a 2002 study which I can provide you with citations, suggests that triggered earthquakes are just as likely in stable as in active tectonic settings. Induced seismicity may increase the probability of tailings impoundment failure, and that is something that we cannot risk here in BB. For that reason, I think it warrants further study by the EPA. Risks must be thoroughly addressed to protect BB resources and its vibrant communities.

<u>EPA Response:</u> We are aware of the recent references on induced seismicity and believe that an induced earthquake would likely be smaller than the one used for seismic design of the tailings storage facility. However, given the uncertainties in characterization of

the seismicity of the area, as the comment notes, the assessment indicates that earthquakes could be a failure mechanism.

V. Mendenhall, Ph.D. (Doc. #4113)

4.409 "The pyrite-rich tailings would be encapsulated in non-acid-generating tailings" (EPA 2012, p.4-19). But it is not clear how these tailings would be sealed permanently from the overlying water. Pond water is likely to reach acid-forming, metal-contaminated tailings through crevices in the "encapsulating" layer; as ion concentrations equalized, contamination of the pond would gradually increase. Oxidation of contaminants in pond water would be assured, due to regular mixing of this water (see next paragraph).

EPA Response: **We agree that water would reach the acid generating tailings through the overlying layers of material. However, water would move very slowly through these materials and would be very low in oxygen by the time it reached the pyrite-rich tailings. We expect acid generation to be effectively retarded by this method. Nevertheless, containment and treatment of all water leaking from this system would require management in perpetuity to maintain water quality in downstream waters. No change required.**

4.410 Tailings would be covered "with a water cap maintained in perpetuity to retard oxidation of sulfide minerals" (EPA 2012, p.4-19). However, it is not clear how this cap of clean water could be maintained. Sediment-laden water will be added continually to the pond during operations. Even though it "would be discharged below the water surface" (EPA 2012, page 4-21), this inflow will create constant turbulence in the pond. Oxidation of these sediments will proceed rapidly in the well-mixed water; and birds and other wildlife will have access to the pond. No clean "water cap" will remain on the pond after mine closure, under foreseeable conditions. All water bodies are mixed by the wind, which occurs often in Alaska. Furthermore, all water bodies undergo seasonal overturn, which mixes them top-to-bottom as deep as several hundred feet (Smith 1973, Schultz 2012). It can be assumed that these conditions will apply to Pebble's tailings ponds.

EPA Response: **During operation we assume that most of the water seeping from the TSF would be monitored, captured, and, if needed, treated. After closure, a water cap, groundwater monitoring, and potentially groundwater capture and treatment would be required in perpetuity. We agree that, although it would be the intention of an operator to maintain the system as long as it is needed, it is not clear that this would indeed occur. The system could produce low pH water in the future if maintenance was not continued. No change required.**

4.411 "In a TSF…trace amount [sic] of carbonate or silicate minerals will partially neutralize acid" in mine waters (EPA 2012, page 4-23). But the capacity of water in the Pebble area to neutralize sulfuric acid is limited, since it is "soft" water with very low concentrations of buffering salts.

EPA Response: **We agree that water on the site is soft, but the sentence quoted in the comment refers to trace amounts of minerals in the tailings. The quoted statement was not intended to suggest that acid water in the TSF would be neutralized; it was**

acknowledging that there may be some buffering capacity in minerals left in the tailings. No change required.

4.412 Water in the mine pit would be acidic and would be contaminated with metals (EPA 2012, page 4-31). This water would leach into the surrounding groundwater, especially as the water level rose over the long term. EPA states that oxidation (i.e., acidification) would be minimized as the pit filled. However, filling would take many decades; in any case, acidification would continue indefinitely (Eisler and Wiemeyer 2004). Although the quality of pit water varies widely, examples of toxic pit lakes are numerous (Braun 2002).

<u>EPA Response:</u> We agree that pit water quality is uncertain and the potential impacts of an acid pit lake could be significant. During pit filling, groundwater flow would be expected to be into the pit. No change required.

4.413 Flocks of waterfowl regularly land in water bodies, including mine-created ones. Birds are unable to detect contamination when landing on hazardous ponds, and they may remain long enough to ingest lethal levels of acid and metals. Even if birds fly away before they are killed outright, internal injuries may reduce their survival under natural conditions (Hooper et al. 2007). In addition, tailings ponds may attract more birds if they incorporate “beaches” on their perimeter (EPA 2012, page 4-10). Although waterfowl often land in ponds with steep shorelines, the “beaches” will make the ponds accessible shorebirds and land birds.

<u>EPA Response:</u> We agree that if pit lake water quality is poor it could pose a hazard to waterfowl, but this is beyond the scope of the assessment as detailed in Chapter 2 of the revised assessment.

Chapter 5: Risk Assessment—No Failure

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

5.1 *Report Section Identification*: Abstract – and Elsewhere in the Document.

Comment: The document states that the hypothetical scenarios used would “result in the direct loss of 87.5 to 141.4 km of streams and 10.3 and 17.3 km^2 of wetlands.” This does not adequately put the projected impact in perspective because there is no attempt to relate this to a percentage of the entire watershed. An abstract should be an overview or big picture and in this case the big picture is the entire Bristol Bay Watershed.

Recommended Change: Express the hypothetical stream and wetland loss as a percentage of the entire Watershed.

<u>EPA Response:</u> Table 2-1 of the revised assessment presents the relative size of the different geographic scales considered in the assessment. The goal of the assessment is to estimate effects and their likelihoods of occurrence, not to minimize them by expressing them as proportions of the entire watershed. To express results as proportions of the entire watershed would imply that the loss of a kilometer of stream is less important in the entire Bristol Bay watershed than in smaller watersheds. However, the scales are presented so that the reader can make comparisons they consider appropriate.

5.2 Rather than using best available fish abundance data, the assessment uses the highest index counts with an unsupported justification that it is "likely" to be representative. By applying the highest index count across an entire stream system, or even across large areas or reaches of the stream where spawning may or may not occur (because spawning is generally restricted to particular reaches or habitat conditions that do not exist everywhere in the stream), the assessment may have overestimated the number of potentially impacted fish.

EPA Response: In Section 5.1 we emphasize the uncertainty associated with spawning salmon abundance estimates, and we state that index counts are "very likely underestimates." We do not claim that these are likely to be representative. Additionally, we do not apply index counts across entire stream systems to estimate total spawner abundance. Escapement estimates, when provided in the assessment, are derived from other sources (e.g., ADF&G reports, published manuscripts, etc.).

5.3 *Comment*: EPA discusses impacts on fisheries from normal operations and the probability of tailings dam failures and potential negative impacts from single and multiple mines, but fails to compare those statistics with probabilities of other potential negative impacts such as disease, blights, drought, or over-fishing. Consequently, there is no frame of reference for understanding the magnitude of the risk from the mine compared to other impacts to the area.

EPA Response: The purpose of the assessment is to evaluate potential effects of large-scale mining on salmon—not to evaluate effects of all potential stressors, such as disease, drought, or overfishing, on the region's fisheries and rank them. No change required.

5.4 *Comment*: EPA fails to consider reclamation and closure scenarios where mines have successfully operated and closed without major, adverse environmental impacts. No potentials of success for wildlife/mining coexistence, wildlife habitat enhancement, or adaptable species such as sheep and fish incursions into active mining areas. For example, the Fort Knox Mine and the Red Dog Mine are the locations of the two of the most productive grayling habitats in the state. A Dall sheep ramhas taken up residence on the organic stockpile from the Walter Creek Heap Leach Pad construction at the Fort Knox Mine. Exploration operations at the Pebble prospect were recently delayed because of migratory song bird nesting in a drill rig.

EPA Response: Chapter 5 of the draft assessment did address the case in which mine operation is successful in avoiding environmental mitigation and engineering design failures. In response to public and peer review comments, the revised assessment no longer contains that "no-failure" scenario. The assessment does not address the potential for post-closure use of the site by adaptable species such as sheep, nor does it address constructed habitats for grayling or other species. Our objective was to characterize potential risks to the natural fish populations associated with the best mining practices (Chapter 5) and with accidents and spills that have been observed at other (but certainly not all) mines (Chapter 6). Those risks are addressed in Chapters 7-13 of the revised assessment.

Remarkable and serendipitous recolonizations may occur, and would be enhanced by reclamation of the mine footprint. However, given the size and depth of the tailings ponds and mine pits likely to be constructed in the Nushagak and Kvichak River

watersheds, the assessment assumes that these facilities will have to be managed and contaminated water will have to be treated in perpetuity. In this case, any impacts resulting from the foot prints of these facilities and the risks of failures or accidents will continue on into perpetuity.

5.5 *Section 5.1 Fish Distribution, Page. 5-1*

Comment: In regard to standard risk assessment format, descriptive sections such as 5.1 Fish Distribution are usually part of Problem Formulation. As commented above, and again related to risk assessment format, the actual Problem Formulation section is too general and sections 2, 3, and portions of 4, 5, and 6 provide more specific analysis that could be made part of problem formulation. The purpose being to focus the conceptual models and risk assessment on critical issues. This does get done to some extent, but just not in the problem formulation. The Bristol Bay Watershed Assessment as a whole does not follow a typical risk assessment format. Rather, individual sections are each generally formatted each as their own risk assessments.

Recommended Change: Section 5-1 applies to multiple sections of the report and should be moved to the Problem Formulation section of the report, to augment the very general information currently provided. Alternatively, make a specific problem formulation part of each of Sections 5 and 6, keeping a general conceptual model in Section 3 related to potential impacts, and then refine that broad conceptual model with a conceptual exposure model that better fits the scenarios in each of Sections. Problem Formulation is supposed to focus the assessment on the most important endpoints requiring assessment or investigation. As it is written there is this long laundry list of potential endpoints scattered throughout Sections 2, 3, and 4. The Risk Assessment portions need focus.

<u>EPA Response:</u> All endpoints are listed and described in Section 3.3 of the draft assessment. This problem formulation chapter addressed the entire scope of the risk assessment, and it would be inappropriate to include specific data used in analyses, such as fish occurrences at the Pebble site, in the problem formulation part of the assessment. Further, it would make it more difficult for the reader to understand the analyses. However, in the interest of helping the reader to understand each section, separate conceptual models have been created for each chapter, as suggested.

5.6 *Section 5.2 Fish Distribution, Page. 5.2*

Comment: Blanket statements are provided for fish with priority habitats (spawning, rearing, etc.) under the proposed footprint of the storage facilities, but for chum the habitat area under the storage facility is not shown, and for other salmon the relatively small area of the impacted priority habitat is not mentioned…rather a blanket statement is made that the habitat will be impacted. Making this statement without qualification or reference to further analysis, leads the reader to an initial conclusion of “impact” without understanding extent of that impact.

TSF 2 and TSF 3 are often referenced, but are not included on Figures 5-1 through 5-7.

Frying Pan Lake and Koktuli Mountain are referenced for, but not included on, Figure 5-6.

Recommended Change: A qualifier or some reference to further analysis in Section 5.2 should be added to provide readers with an understanding of the general size of the impact. It doesn't have to be really specific, or the reader should be referenced to Section 5.2 for further insight to the level of impact. Add TSF 2 and 3 to Figures 5-1 through 5-7. Add Frying Pan Lake and Koktuli Mountain to Figure 5-6.

EPA Response: TSFs 2 and 3 have been added to figures illustrating the footprints of the various mine sizes, and species distribution maps in relation to the mine footprints are now explicitly presented in Chapter 7. The length of streams listed in the Anadromous Waters Catalog impacted by the various mine footprints are also tabulated in the revised assessment.

5.7 *Section 5.1, Page. 5.2*

Comment: The assessment refers the reader back to Figure ES-3. This figure should be provided in the appropriate section.

Recommended Change: Figure ES-3 should be presented as part of Section 5.1.

EPA Response: The revised assessment includes more detailed figures showing salmon species diversity in the Nushagak and Kvichak River watersheds (Chapter 5 of the revised assessment). The original Figure ES-3 is no longer in the assessment.

5.8 Section 5.2 Fish Distribution, Pages 5-2 through 5-7, Figures 5-1 through 5-5 (and ES-4, Figure ES-2) Reported Salmon in the North Fork, South Fork Koktuli and Upper Talarik Creeks.

Comment: The figure comment states that life-stage-specific reach designations are likely underestimates, given the logistical constraints on the ability to accurately capture all streams that may support life-stage use at various times of the year. The limitations in collecting data on fish populations in an expansive in a remote setting. Are there other methods or techniques that could be used to estimate fish habitat populations for areas with higher uncertainty, or less available data?

Recommended Change: Recommend considering a method (or model) for estimating fish habitat (possibly using template reaches, geomorphologic river and stream characteristics) and projecting population based on habitat type for all drainages in the Bristol Bay Watersheds. Understanding impacts of the overall fish population impacts will be needed if assessing the entire Bristol Bay watershed fisheries.

EPA Response: Chapter 3 now provides a comprehensive characterization of the Nushagak and Kvichak River watersheds with regard to reach-specific attributes (gradient, mean annual streamflow, and an index of floodplain potential) that influence salmon habitat potential. Summaries of habitat attributes are also provided at smaller geographic scales (mine scenario watersheds, mine footprints, transportation corridor) within their respective risk assessment chapters.

5.9 *Section 5, Pages 5-3 through 5-7.*

Comment: When reading the text in the Executive Summary, Chapter 2, Chapter 5, Appendices A through F, much discussion is based on the entire Bristol Bay region.

However, unless there is a water quality issue downstream or a dam break, the effects to the entire Bristol Bay region would be minimal. The Figure on page 5-3 shows that there is no rearing or spawning area of pink salmon anywhere near the mine disturbance. The Figure on page 5-4 shows that there is no rearing or spawning area of chum salmon near the mine disturbance. The Figure on page 5-5 shows that there is no rearing or spawning area of sockeye salmon in the mine disturbance (although it is close).The Figure on page 5-6 shows that there is minor rearing or spawning area of Chinook Salmon in the mine disturbance, and the Figure on page 5-7 shows that there is definite rearing or spawning area of coho salmon in the mine disturbance, but it is small in extent and at the head of the watersheds compared to the rest of the entire Bristol Bay region. The Figure on page 5-8 shows significant use by Dolly Varden fish, but this fish does not appear to be of great value in the Bristol Bay region. It appears that the Bristol Bay Watershed Assessment is constantly citing the overall value of Bristol Bay region fisheries but downplays the actual amount of these stream lengths (that have the valuable fish) which would be affected by the mine.

Recommended Change: Depict more accurately the amount of stream segments that are rearing and spawning areas for the valuable fish and which could be affected by the mine and compare them to the total length of rearing and spawning lengths for the Bristol Bay region. It will be seen that the amount of blocked and eliminated segments are a very small percentage of the total for the region.

EPA Response: The assessment has been revised to provide a better sense of context within the larger geographic region. The AWC and AFFI databases are the best, most consistent record of reported fish distributions, and are the basis for the depictions of rearing and spawning areas for fish, as shown in Figures 5-4 through 5-10 in the revised assessment. Tables 7-5 and 7-8 summarize the total length of AWC streams and the length impacted by the footprint.

5.10 *Section 5.1.2 Spawning Salmon Abundance, Page 5-10*

Comment: The repetition of the fact that fish numbers were underestimated, similar to the report-wide repetition of the importance of groundwater-to-surface water interactions, seems to be an attempt to influence the reader, without adequate supporting data. In the last sentence of the first paragraph of this section it says true spawner abundance is underestimated by a "…large and unknown factor." It is unclear that this is true for the Pebble Mine area where a large number of headwater streams are present.

Recommended Change: Use site-specific data instead of broad generalizations. Provide the data, summarize, and move on. Remove repetition. Address in uncertainty section if needed.

EPA Response: The recommendation to reduce repetition and focus discussions of estimation errors in uncertainty sections has been adopted. Site-specific data for aerial observer efficiency (e.g., mark-recapture, weir counts) were not provided in the EBD, thus we generalized the best available information from peer-reviewed literature regarding aerial observer efficiency.

5.11 *Section 5.1.2, Page 5-10*

Comment: It is stated that the abundance counts "…underestimate true abundance by a large and unknown factor" and "…true spawner abundance is probably substantially higher than the values presented…" However, by using the "highest" index counts, it is likely to be representative, or possibly an overestimate of average, and applying this "highest" index count across an entire stream system, or even across large areas (i.e., reaches) of the stream where spawning may or may not occur (because spawning is generally restricted to particular reaches or habitat conditions that do not exist everywhere in the stream), could very well overestimate impacted numbers of fish.

In addition, the values presented in Table 5-1 seem to be consistent with the reported numbers of sockeye and Chinook by the ADFG counts since 1955. With over 30 years of data, apparently consistent with the 4 years of data collected for the Pebble Limited Partnership Environmental Baseline Data, using the highest index count may result in an overestimate of the number of impacted salmon.

Further, the Northern Dynasty Tailings Impoundment A Initial Application Report by Knight Piesold (September 2006) clearly states that TSF areas were selected because of a measured lack of significant populations of anadromous fish. Some level of verification between the EPA estimated direct fish impact and the Northern Dynasty fish data would seem to be needed.

Recommended Change: Provide discussion on similarity/differences between Pebble Limited Partnership Environmental Baseline Data (2004-2008) data and ADFG (1955 on) data, and be clear and correct on likelihood of over or under estimation of numbers, particularly across stream reaches/areas. It would be prudent to more clearly separate out discussion of effects into those caused by habitat lost under/upstream of the mine and TSF areas (e.g., direct), and those downstream from the mine area (e.g., indirect). Edit language to refrain from broad statements of significance of impact without site-specific data analysis to show it.

<u>EPA Response:</u> The highest index count was used because it is mathematically closer to the true number of salmon using a given survey reach in a given year than is the average of a series of counts. Salmon show up in the survey reach over several weeks and each spends 1-3 weeks spawning. Each of the periodic surveys only counts a fraction of the fish using the survey reach because none of the individual fish are present for the entire spawning period. Therefore, the peak count is closest to the true number and it is theoretically impossible for it to exceed the true number. Averaging a series of survey counts, especially when some of the surveys were conducted at a time when few or no spawning salmon were present, will only serve to reduce estimates and move them further from the true number. The comment implies that index counts are somehow being extrapolated to areas outside of the survey reaches, but that is not correct.

We did not state or imply that ADF&G data were inconsistent with or better or worse than PLP data, nor are we judging the significance of fish populations under the TSFs. We are simply presenting available fish abundance data along with the appropriate caveats.

5.12 *Section 5.1.2 and 5.1.3, Pages 5-10 and 5-11*

Comment: Pebble Limited Partnership Environmental Baseline Available reports on spawning and juvenile numbers counted by biologists on and near the proposed mine site.

However, the assessment does not present the numbers, locations, or "reaches" where the counts were made. The actual location of the counts is not provided, thus impacts within particular reaches of the streams cannot be calculated/estimated from data provided in the assessment.

Recommended Change: Provide a figure or table that document where fish count data was collected and where peak counts were located. Provide a better understanding of where the fish are using the habitat and would be directly or indirectly impacted by mine development and operation.

<u>EPA Response:</u> We have added Table 7-2 and accompanying text to present PLP's reach-by-reach spawner survey data from 2008.

5.13 *Section 5.2 Habitat Modification, Page 5-12*

Comment: As an example of the influential tone of the report, in the first sentence of this section tells the reader what "would" happen as a result of ongoing mine operation before any data or rationale is provided. This happens again in 5.2.1. This approach is common in the Bristol Bay Watershed Assessment and is contrary to technical writing where the evidence is provided first to support any conclusions made.

Recommended Change: Start with what is possible or "may" happen to habitat, present the data, then draw conclusions/make rationale using data.

<u>EPA Response:</u> Many writing manuals and courses recommend stating the conclusion and then providing the evidence, so that the reader knows what to look for in the evidence and inferences and can judge whether they support the conclusion. No change required.

5.14 *Section 5.1.3 and Table 5-2, Page 5-12*

Comment: Text as written is that highest reported density of spawners as 25,000 arctic grayling and 16,000 coho, but Table 5-2 reports these as 2,500 and 1,600, a factor of 10 lower. The Pebble Limited Partnership Environmental Baseline Data figures used as sources are consistent with Table 5-2, not with the written text values. Table 5-2 also reports sources for the fish densities as "Tables" when in fact they are "Figures".

Also, there is no information provided in the Bristol Bay Watershed Assessment in regard to where these "maximum" fish densities were recorded. The implication being that these numbers are found throughout the potentially impacted area, when in fact, particularly for the North Fork Koktuli, many of the stream reaches within the area of the mine pit and TSF have much lower densities, or no andronmous fish at all, as clearly shown in other tables, figures, and text of the Pebble Limited Partnership Environmental Baseline Data.

Recommended Change: Correct text to match table numbers. Correct table Source column from "Table" to "Figure". Clearly state that the North Fork Koktuli numbers come from the main stem of the North Fork Koktuli, not within the pit or TSF footprint.

<u>EPA Response:</u> In the revised assessment we have converted units in the text to match the table, corrected the table source column from "Table" to "Figure", and clearly stated that all densities reported come from mainstem habitats.

5.15 *Section 5.2. Habitat Modification, Pages 5-12 through 5-45*

Comment: Section 5.2 Habitat Modification begins to elaborate on the complexities of inter-related impacts and effects on fisheries that were first presented in problem formulation, Section 3.6 Conceptual Models.

Recommended Change: Correct text to match table numbers. Correct table Source column from “Table” to “Figure”. Clearly state that the North Fork Koktuli numbers come from the main stem of the North Fork Koktuli, not within the pit or TSF footprint.

EPA Response: See response to Comment 5.14

5.16 *Section Main Report, Section 5.1.3, Juvenile Salmon and Resident Fish Abundance, Page 5-12*

Comment: The data reported in the text and Table 5.2 differs for Arctic grayling and coho salmon for Upper Talarik Creek.

Recommended Change: EPA needs to report the correct relative abundance numbers in both the text and the table.

EPA Response: See response to Comment 5.14

5.17 *Section 5.2.1.1, Pages 5-12 through 5-162*

Comment: The Bristol Bay Watershed Assessment predicts about 10 to 17 square kilometers of wetland losses and 88 to 107 km of stream losses under the direct footprint. The Pebble Limited Partnership Environmental Baseline Data measured wetlands and streams and determined approximately 10 square kilometers of both wetlands and streams are present within and downstream of the minimum mine/TSF footprint. Thus, the general scale of the wetland/stream impact under the minimum mine/TSF footprint is similar between the two documents, but the Pebble Limited Partnership Environmental Baseline Data area of potential impact would be less than the EPA predicted impact area.

The 88 to 107 km of stream losses predicted in the Bristol Bay Watershed Assessment cannot be compared directly to Pebble Limited Partnership Environmental Baseline Data data because the Pebble Limited Partnership Environmental Baseline Data reports watershed areas, not km of stream.

Recommended Change: If possible, incorporate actual wetland acreages measured in Pebble Limited Partnership Environmental Baseline Data.

EPA Response: The Pebble Limited Partnership EBD data for wetlands were not made available to EPA in a comprehensive or transferable way that allowed comparison of their results to the results presently shown in the assessment. We have based our results on the National Wetlands Inventory, which is currently the best known, most widespread, publicly available dataset for this region.

5.18 *Section 5.2.1, Pages 5-13*

Comment: This section provides a discussion about TSF 2 and 3 but these facilities are not on the map within this section.

Recommended Change: Put TSF 2 and 3 on Figure 5-8.

<u>EPA Response:</u> Figure 6-11 in the revised assessment shows stream gage locations and the three TSFs.

5.19 *Box 5.1, Page 5-13*

Comment: NWI wetland mapping is based on aerial photo interpretation that is large scale and is not accurate at the scale being used here, particularly for road impacts. Also, NWI data is often 20 to 30 years old. Therefore, while it is appropriate for a large scale screening, it is not acceptable for predicting site-specific impacts without a large potential for error.

It is a bit confusing, but it seems 100 meters along rivers and 200 meters along NWI wetlands were set aside as buffers. If the roadway in the mine site passed within these buffers, a hydrological impact was tallied. In addition the road impacts were based on a 200 ft wide road corridor, while "direct fill" was based on a 9.1 m wide roadway. These buffers are quite large and likely overestimate the hydrological impact. This overestimation offsets at least a portion of the purported "conservative" estimate resulting from inaccurate stream and fish presence maps.

Recommended Change: Most regulatory wetland and river buffers are equal to or less than 150 feet. Reducing the buffer to this more accurate area of "impact" would produce a more accurate estimate of impacts to wetlands and rivers along the road corridor.

<u>EPA Response:</u> We used the National Wetlands Inventory (NWI) to identify wetland areas potentially at risk. Despite its limitations, the NWI represents the most widespread, publicly available dataset for characterization of wetland habitats within this region. A more accurate estimate of impacts on a site-specific basis would be possible with a more precise wetland delineation.

For potential impacts from the transportation corridor, we provide estimates of the length of roadway within either 100 m or 200 m of both streams and wetlands, as well as estimates of the acreage of wetlands within either 100 m or 200 m of the road (now explained in Box 10-1). In this context, "buffer" is not a regulatory determination but is used as a mapping term that applies to the technique used to determine the lengths and acreage within those distances. We then describe impacts that have been documented within similar proximities.

5.20 *Section 5, Pages 5-15 and 5-18*

Comment: The two maps on this page show many very minor stream segments which, according to the maps on pages 5-3 through 5-7, simply do not contain the rearing and spawning areas of the fish. It is interesting to note that all the stream segments shown on Page 5-15 are not shown on the maps on pages 5-3 through 5-7.

Recommended Change: Either remove all these smaller segments from the maps on page 5-15 or add the segments to the maps on pages 5-3 through 5-7. Revise Table 5-4 on page 5-18 to include a new column showing the total kilometers of each stream blocked or eliminated by the mine.

EPA Response: **Figures 5-3 through 5-7 listed in the comment correspond to Figures 7-2 through 7-8 in the revised assessment, which show streams and wetlands lost under each mine scenario. We have retained all NHD streams in those figures, similar to what is shown in the original draft assessment. Figures 5-3 through 5-8 in the revised assessment show the distribution of the various fish species and don't include smaller tributaries that weren't listed in the AWC or the AFFI.**

5.21 *Section 5.2.1.2, Page 5-16*

Comment: The claims of spawning habitat are very broad and undefined. Pebble Limited Partnership Environmental Baseline Data quantifies at least some of this information. Very few sockeye occur in these upper stream reaches. Mostly resident grayling and Dolly Varden. The assessment cannot define or quantify the level impact from this information.

In addition, most of the stream reaches within the mine/tailings/TSF are ephemeral/intermittent, reducing anadromous and resident fish use of the streams, possibly making permanent ponds important in the area.

Recommended Change: Incorporate site-specific data. Provide consideration of the intermittent flow regimes.

EPA Response: **The potential importance of ponds is included in the discussion, and we now include some reach-specific spawner count data. We disagree with the assertion that year-round use is required to consider habitat "important." Seasonal habitats often provide important complementary habitat and can expand habitat capacity of a system.**

5.22 *Section 5.2.1.1, Page 5-16*

Comment: Text states that loss of headwater habitats will have indirect impacts on fishes and their habitats in downstream mainstream reaches of each watershed. However, it is not prefaced that this assumption does not take into consideration any risk mitigation measures such as stream diversions.

Recommended Change: Preface that this assumption is based on no mitigations measures implemented to reduce potential impacts.

EPA Response: **Acknowledgement that total stream loss is not necessarily unavoidable is included in the revised assessment (Section 7.2.4).**

5.23 *Main Report, Section 5.2.1.2, Implications of Headwater Stream and Wetland Loss for Fish, Page 5-16*

Comment: At the bottom of the page, EPA uses the Anadromous Waters Catalog (Johnson and Blanche, in press) as a reference to the presence of resident fish. The catalog lists anadromous fish only.

Recommended Change: Throughout the entire watershed assessment, EPA needs to use references appropriately. In particular, the Anadromous Waters Catalog (Johnson and Blanche, in press) should not be used to support the presence of resident fish.

EPA Response: **References have been updated.**

5.24 *Section 5.2.1.2, Page 5-19 and 5-20*

Comment: This subsection has almost nothing specific to hypothetical mine impacts. Rather it is general discussion of potential fish/stream impacts due to various habitat changes.

Recommended Change: Make discussions/claims of impact specific to the mine scenario.

<u>EPA Response:</u> This discussion (now Section 7.2.3.2) provides context on the importance of headwaters streams to salmon and potential impacts from the loss of these streams.

5.25 *Section 5.2.1.2; Table 5-3 and 5-4, Page 5-17 and 5-18*

Comment: Based on available data, many of the stream kilometers within the footprint of the mine/waste rock/TSF do not have anadromous fish, and some do not have any fish. Providing the complete list of streams in a table with the column of species present is a drastic oversimplification of any decent measure of actual impact. For example, while sockeye have been found in the mine footprint, there are very few present. This nuance is lost in the assessment analysis.

Also, there is no analysis of what percentage of the river kilometers is spawning areas versus rearing, nor of what percentage of the sub-basin and entire basin these river reaches represent.

There is no way for reviewers to translate the EPA information into an actual impact on fish nor on the economy of Bristol Bay.

Recommended Change: Provide site-specific analysis and detail of the estimated number of each species (spawners and juveniles) of importance that would be lost, and relate that to total number of fish returning and escapement in the basin.

<u>EPA Response:</u> Due to lack of comprehensive estimates of limiting factors across the impacted watersheds, our ability to estimate population-level effects was limited to situations that were assumed to completely eliminate habitat productivity and capacity in an entire watershed for which escapement estimates could be inferred. For this assessment, these conditions are only met in the TSF failure scenario that completely eliminates and blocks access to suitable habitat in the North Fork Koktuli River. In that case, we estimate that the entire Koktuli portion of the run (~28% of Nushagak escapement) could be lost. Higher proportional losses would occur if significant downstream effects occurred due to transport of toxic tailings fines beyond the Koktuli, as modeled under the larger TSF failure scenario.

Chapter 7 of the revised assessment quantifies the lengths of streams impacted and which of these are AWC-documented streams. Distribution maps for the endpoint species in the footprint area are now presented, which indicate documented life stage where it is reported.

5.26 *Section 5.2.2.1, Page 5-21 to 5-27*

Comment: There is no discussion of the fact that much of the South Fork Koktuli is dry in summer under current natural conditions, and as described in the Pebble Limited Partnership

Environmental Baseline Data, that much of the lost water in the mid South Koktuli flows underground to the Upper Talarik in the vicinity of UT100B.

Basically, the actual dynamics of surface water and groundwater flow and water needs for the mine are so potentially variable that it is currently not reasonable to estimate the actual stream dewatering downstream of the mine pit/waste rock/TSF.

Regardless, even under EPA essentially worst case dewatering, the North Fork Koktuli and Upper Talarik are within about 8% of their natural capacity before they reach a major confluence. The South Fork Koktuli is more impacted, but it is also naturally dry (a losing stream) in many portions of its upper reaches so the impacts to fish may not be as dramatic.

The Pebble Limited Partnership Environmental Baseline Data stream flow data shows that best fish conditions are below high flows. Thus, a slight reduction in flow along some reaches may actually increase favorable spawning and rearing conditions during some portion of the year.

And finally, there is inadequate accounting for water that is “upstream” of the TSFs or the mine pit.

There is no way for reviewers to translate the EPA information into an actual impact on fish nor on the economy of Bristol Bay.

Recommended Change: A better grasp on groundwater flow dynamics and water provided into the mine pit, get better design information on TSF and TSF dam to determine potential flow through/under tailings and dam. Use site-specific information on fish presence and stream flow to calculate likely potential impacts to fish, and then relate these impacts to the watershed fish population.

<u>EPA Response:</u> Water balances for the mine scenarios are now comprehensively characterized, and account for groundwater transfer between the South Fork Koktuli and Upper Talarik Creek, seepage and loss through TSFs, and routing through the water treatment facility. Figures and tables are now included to show water routing through the mine infrastructure and stream network (e.g., Figure 6-5 and Table 6-3). Figures 7-15 through 7-17 provide mapped estimates of flow modifications, and Tables 7-16 through 7-18 provide water balance summaries. These flows can now be related to the fish distributions in Figures 7-2 through 7-8.

5.27 *Section 5.2.2 Effects of Downstream Flow Changes, Page 5-21 through 5-27*

Comment: Section 5.2.2.1 Streamflow (Loss or Reduction) section estimates percent loss in stream flow and qualitatively discusses impacts on stream, floodplain and wetland habitat as a result of reductions in streamflow. Page 5-31, Section 5.2.2.3 discusses flow alteration thresholds for assessing fish habitat impacts.

Recommended Change: Include flow alteration thresholds, or refer to streamflow alteration thresholds, as part of streamflow loss discussion in Section 5.2.2.1, rather than in 5.2.2.3 (or cross reference).

<u>EPA Response:</u> Risk analysis and characterization chapters are now organized into an exposure, exposure-response, and risk characterization framework for consistency purposes.

5.28 *Section 5.2.2.1, Page 5-25*

Comment: The "start-up" assumption that all precipitation is "consumed" by the mine seems very conservative. Even if they used it all, a significant portion would seem to be discharged somewhere. If into the TSF, then groundwater will either flow out of the TSF or have to be captured, treated, and released.

<u>EPA Response:</u> As explained in Chapter 4 of the draft assessment (Chapter 6 of the revised assessment), water is used in the mining process. Water in the tailings impoundment, process plant, and pipelines would not be discharged. Water in the TSF would be either pore water or covering water. Section 6.1.2.5 and Chapter 8 of the revised assessment discuss water management and treatment.

Also on this page under the "minimum mine size" paragraph, 1% to 15% of the water is assumed to be returned to the streams. Yet, the most impacted stations have a higher effect than under the start-up conditions. There is no explanation of this increased impact at some stations when water is being returned to the streams.

In addition, all of the predicted stream dewatering is dependent on water balance for the mine, which is critically dependent on how much water actually is removed from the mine pit. No information is provided related to this critical groundwater flow through the subsurface to the mine pit, or through the subsurface underlying the TSFs. If not enough water coming into pit, then where will water come from? If too much water coming into pit, then there may be treatment and discharge into streams.

Recommended Change: If using a worst-case or "Reasonable Maximum" scenario, clearly state such, and provide some description of the conservative nature of the estimates of water extraction from the stream systems. Provide better summary understanding of the assumptions related to where water is coming from and going to.

<u>EPA Response:</u> Water balances for the mine scenarios were extensively revised. The TSFs will retain substantial volumes of water. Tables in Chapter 7 are now presented that account for water routing, storage, leakage, and release.

5.29 *Section 5.2.2 Effects of Downstream Flow Changes, Pages Starting 5-21*

Comment: There has obviously been some thought put into the potential changes in flow around any potential mine site. At this point, this examination can only be theoretical, but putting it in the assessment document makes it seem like the worst possible outcome. The interactions of the ground and surface water hydrology in that area are extremely complex. The uncertainty of the impacts from any disturbance should be emphasized. The importance of the surface and subsurface flow to spawning and rearing salmon cannot be understated. The theoretical treatment of this in the assessment suggests it can predict a possible outcome that in actuality cannot be predicted.

Recommended Change: Explicitly state the theoretical nature of these possible outcomes and emphasize the uncertainty.

<u>EPA Response:</u> The water balance calculations take into account observed streamflows and now include a comprehensive accounting of water routing, drawdown, retention, leakage, and release via the water treatment facilities. We acknowledge in Section 8.2.5 that groundwater connectivity is high and the hydrology is complex, and that this contributes a significant amount of uncertainty to the analysis.

5.30 *Section 5.2.2.3 Table 5-13, Pages 5-41*

Comment: The concepts behind this table provide some evidence of the potential for stream flow changes as a result of the proposed mine. However, the distance between stream stations used makes accurate predictions are problematic, and the text provides repeated warnings about the variability likely to be involved in the predictions. Thus, without better definition of site conditions, and incorporation of the site-specific stream flow data collected and reported for the Pebble Limited Partnership Environmental Baseline Data, the EPA analysis presented in Table 5-13 is inaccurate. In addition, there is no direct correlation made between the predicted reduced stream flows and actual impacts to fish, rendering the stream flow analysis ineffective.

The most that can be said under the assumptions provided is that some level of stream flow reduction would be realized, and this would have some an unquantified impact on fish populations.

Recommended Change: Incorporate better site-specific mine and stream flow conditions and relate directly to measured fish/salmon presence and impact.

<u>EPA Response:</u> The water balance calculations are based on observed flows collected and reported in the PLP Environmental Baseline Document. Maps of the study area showing both endpoint fish distributions and projected streamflow alterations are included in Chapter 7, allowing direct correlation of streamflow changes and fish occurrence.

5.31 *Section 5.2.3, Pages 5-45*

Comment: Thirty five pages of text, tables, and figures leads to the statement that the volume of water needed to maintain reasonable stream flows is unknown. And no relationship is provided between stream flow and fish impact. This is not really a risk characterization because there is no actual quantification of risk to stream flow or fish.

Recommended Change: At a minimum provide some risk summation for stream flow. Ideally, get more site-specific information to reduce uncertainties and then relate stream flow alteration to a quantified fish impact so it can be compared to overall fish population numbers in the sub-basins, basins, and overall watershed.

<u>EPA Response:</u> The risk characterization in the revised assessment clearly highlights the length of streams impacted by severe flow alteration and corresponding projected adverse effects for fish and aquatic life. Impacts to fish populations cannot be further

quantified due to lack of information on abundances, limiting factors, and habitat capacities.

5.32 *Section 5.2.3 Risk Characterization, Pages 5-45*

Comment: Section 5.2.3 discusses hydrologic flow regime and water quality mitigation (avoidance) requirements for maintaining downstream flow rates and timing, water quality and temperature for fish. The section generally refers to a water storage and release system for maintaining downstream flow conditions. The section implies that this may be technologically significant, costly and possibly infeasible. Unless the discussion is expanded, the validity of this statement is unknown. The discussion should expand on what this structure is, the likely size and components (i.e., a water storage dam and pipe release system). There are risks associated with operation of this structure that could impact downstream fisheries resources that need to be discussed. Also, mitigation alternatives to the water storage system, i.e., stream and wetland mitigation, are not discussed but should be referred to as mitigation alternatives.

Recommended Change: Expand discussion of what type of structure would be necessary for on-site water storage flow mitigation, the risks associated with this structure, and potential alternative off-site stream and wetland mitigation. Also tie the flow regulation discussion to regulatory requirements under the Clean Water Act, Alaska Pollutant Discharge Elimination System (APDES) permits, Corps 404 permits and other State of Alaska permits.

<u>EPA Response:</u> An expanded discussion of water quantity management is included in Appendix J of the final assessment. This appendix discusses the regulatory context for mitigation, and includes a section specifically addressing water flow storage alternatives (e.g., impoundments, ice fields, upstream pumping).

5.33 *Section 5.3.1, Pages 5-48*

Comment: It is reported that between 5 million and 48 million cubic meters of water exceed mine needs. Why isn't this brought into the analysis or risk characterization of stream flow reductions in the previous section? It seems likely this amount is adequate to keep impacted stream flows at levels protective of fish in the reaches downstream of the mine pit/waste rock piles/TSFs.

Recommended Change: Incorporate potential water returns to the streams in Section 5.2.

<u>EPA Response:</u> See response to Comment 5.29.

5.34 *Section 5.3.1, Pages 5-48 to 5-52*

Comment: While this section does discuss some preliminary "Exposure" issues, it doesn't examine and/or exclude exposure pathways for particular species or stream reaches, nor does it quantify exposure. The discussion is solely limited to aquatic life.

Recommended Change: Incorporate discussion of exposures of resident versus anadromous species. Elaborate on concern for anadromous egg and juvenile fish survival.

<u>EPA Response:</u> This section (Section 8.2.1.2 in the revised assessment) has been expanded to address the routes of exposure, including the differences between

anadromous and resident species in life stages exposed. Exposure to copper is discussed in detail in Section 8.2.2.

5.35 *Section 5.3.2, Pages 5-53*

Comment: The biotic ligand model is used to derive criteria on page 5-49 despite not being introduced until page 5-53. The values for copper derived from the biotic ligand model in Table 5-14 and 5-15 do not match the values in Table 5-19. East and West Pre-Tertiary values are swapped.

Table 5-19 shows the acute criterion for the biotic ligand model for Pebble West Pre-Tertiary to be 0.43 μg/L. Table 5-15 on Page 5-50 shows it as 0.043 μg/L. All the biotic ligand values derived for copper need to be verified and accurately labeled in Tables 5-14 through 5-16 and Table 5-19. These values are used to derive dilution calculations highlighted on page ES-21.

Furthermore, the chronic criteria are 10 and 90 times more stringent for the biotic ligand model than the state's water quality standards for the West and East Pre-Tertiary waste rock respectively. This is a significant difference. The lead in sentence to Table 5-19 should provide table references for the mean chemistries of the waste rock leachates. See comment for pages 5-53 to 5-37.

Recommended Change: Move Tables 5-14 through 5-16 to after Table 5-19 or remove the biotic ligand model derived criteria from Tables 5-14 though 5-16. Provide a footnote for the column header "Average Value" indicating number of leachate tests performed. Review inputs and outputs from the biotic ligand model and correct errors in values and references to East and West Pre-Tertiary waste rock in Tables 5-14, 5-15, 5-16, and 5-19.

<u>EPA Response:</u> The tables appear with the exposure section because they contain the potential exposure concentrations. Typographic errors identified in Table 5-19 have been corrected. The copper values from the BLM do not match because water chemistries of the leachates and ambient waters differ.

5.36 Section 5.3.2, Page 5-53

Comment: This section is a simple risk-based screening comparing average untreated waste rock leachate metals concentrations to water quality criteria. This assumes 100% exposure of all aquatic species in all streams. The results were a predicted potential for risks due to aluminum, copper, and zinc, with the greatest indicated concern being copper. Using the biotic ligand model significantly increases the predicted risks for copper.

<u>EPA Response:</u> This does not assume 100% exposure, and dilution is discussed. Risks due to zinc and aluminum were not indicated. Using the best available science and the current water quality criteria for copper does indeed increase predicted risks because of the pure water at the site.

The screening concentrations predicted by the biotic ligand model are strongly related to the amount of organic material in the water. The assessment set dissolved organic carbon to 1 mg/L but provided no specific reasoning as to why, other than that dissolved organic carbon is expected to be low and 1 mg/L was the lowest possible in the model calculations.

Background levels of dissolved organic carbon were measured in the Pebble Limited Partnership Environmental Baseline Data to be approximately 1.5 mg/L.

<u>EPA Response:</u> The BLM-derived values are national ambient water quality criteria based on site specific water quality, not just screening values. The DOC level for waste rock leachate was set at 1.0 mg/L because there was no measureable DOC in the leachate. Hence, the 1.0 mg/L value is a little high and thus results in a benchmark that is a little high. Toxicity would actually be greater, but the BLM does not allow lower values. Ambient DOC is not relevant to the toxicity of the leachate, only to the toxicity of ambient waters, which is presented in Table 5-18.

Regardless, the screening suggests the potential for effects to aquatic life if untreated waste rock leachate were discharged to streams.

<u>EPA Response:</u> This comment is in agreement with the assessment.

Recommended Change: Clearly justify use of 1.0 mg/L dissolved organic carbon. Discuss or provide evidence of how toxicity may change downstream as concentrations of metals decrease and organic matter concentration likely increases. May be able to use data from Pebble Limited Partnership Environmental Baseline Data as dissolved organic carbon was measured, and in the North Fork Koktuli ranged from 0.5 to 4.55 mg/L.

<u>EPA Response:</u> The comment confuses ambient water chemistry and leachate chemistry. Criteria values for ambient baseline chemistry are included in the assessment. No change required.

5.37 *Section 5.3.2.2, Pages 5-53 to 5-57*

Comment: This analysis of copper toxicity shows that the biotic ligand model provides a "protective" risk-based screening concentration. This method is likely overprotective as calculated because of the sensitivity of stream invertebrates used to develop the model/criteria. A site-specific investigation could provide a more accurate and meaningful evaluation of water quality criteria that would be protective of aquatic life.

<u>EPA Response:</u> As explained in Sections 5.3.2.2 and 5.3.4, peer-reviewed literature indicate that it is more likely that criteria are under-protective. The model and criteria are not based on stream invertebrates, and in fact stream invertebrates have been found to be more sensitive than the species that were used. Further, protecting stream invertebrates is necessary to support salmonid fish and to meet the mandates of the Clean Water Act. No change required.

5.38 *Comment:* This analysis of copper toxicity shows that the biotic ligand model provides a "protective" risk-based screening concentration. This method is likely overprotective as calculated because of the sensitivity of stream invertebrates used to develop the model/criteria. A site-specific investigation could provide a more accurate and meaningful evaluation of water quality criteria that would be protective of aquatic life.

<u>EPA Response:</u> See response to Comment 5.37.

5.39 *Vol 1 Section 5.3.2.2, Page 5-57*

Comment: Third line states "bioconcentration factor of 2,000 L/kg". Bioconcentration factors are unitless. 2000 also seems very high, so is it what it says it is?

<u>EPA Response:</u> The factor is unitless since a liter of water weighs a kg. The value is also correct. No change required.

5.40 *Section 5.3.2, Page 5-53*

Comment: The section on "analogous" sites is too general to be of use in risk determination. It raises the issue of the adequacy of current water quality criteria, but there is not enough information provided on conditional differences between analogous sites and the Pebble Mine site to make any inferences. Water quality, leachate parameters, acidity, water flow, stream substrate, stream invertebrate assemblages, among other conditions all may be different.

The research cited in this section also suggests that there may be impacts to stream macroinvertebrates at concentrations below the water quality criteria, but essentially there is no quantification of the potential impact or the level below the criteria that is unacceptable. One article suggests a factor of 10 below the criteria provided acceptable protection. This argument would seem to be more appropriate in setting new criteria, and until such criteria are provided, there doesn't seem to be any basis for requiring concentrations below EPA approved Alaska Water Quality Criteria, apart from an APDES permitting process that takes into account site-specific conditions.

No discussion is provided on any "acceptable" level of impacts to stream invertebrate populations while maintaining healthy fish populations.

Siltation of the streams with contaminated sediment should be a principal concern in any mine development/permitting and effects determination.

Recommended Change: Further examination of site-specific mine conditions and potential impacts should include stream invertebrate sampling, enumeration, and analysis to establish baseline conditions.

<u>EPA Response:</u> Baseline community characterization is being performed and was used in the assessment. However, it does not resolve the issue of what level of copper would protect aquatic biota. A risk assessment is not limited to state standards or national criteria. Rather, it brings to bear the best available science. The issue raised by the literature cited is the sensitivity of stream insects relative to the planktonic crustaceans used to set the criteria, not water chemistry. That issue is relevant to Alaskan streams as well as those in the Rocky Mountains. No change required.

5.41 The Assessment inappropriately uses the output from a toxicity calculation method (biotic ligand model) on pre-Tertiary waste rock leachate to infer site-specific, downstream impacts without necessary consideration of kinetics, downstream mixing and pH changes. Instead of using field-collected data available from the EBD, the Assessment uses the most conservative input criteria in the model, leading to even a more conservative result.

<u>EPA Response:</u> As stated in Table 5-17, the assessment uses mean values reported by the PLP EBD to derive copper values, not the most conservative inputs. Lowest model

values were used only when the reported value of a water quality parameter was zero or less than the lowest model value. This results in higher, not lower, copper criteria because those model parameters are competing ions or ligands. The results are low because the water is pure. Because the State of Alaska does not allow mixing zones in these waters, the undiluted potential effluent is relevant.

5.42 *Section 5.3.2.2, Pages 5-57 to 5-58:* The "uncertainties" section just states that the existing criterion may not be protective. It does not state that it also may be overly protective, depending on stream conditions at the mine. Invertebrates in many of the streams may already be impacted by naturally high metals concentrations….or the natural intermittent flow regimes of many of the streams and minor tributaries. Sensitive invertebrate species may not be present.

Consideration of only the possible non-protective nature of water quality criteria, without discussion of many, many other uncertainties biases the report.

Overall, Section 5.3.2.2 is a very simplified assessment of potential impact. Hence the need for site-specific analysis.

<u>EPA Response:</u> The copper values are site-specific or waste specific. The point that receptors may be resistant where copper is naturally high has been added to Chapter 8. There is no reason to expect that intermittent flow makes invertebrates (the sensitive receptors for copper) less sensitive to metals. The "many, many other uncertainties" referenced in the comment are not specified and therefore cannot be addressed.

5.43 *Volume 1, Section 5.3.4, Page 5-59:* The first bullet says "Some leachate and process water constituents have no water quality criteria (e.g., sulfate), or the criteria and standards are based on old literature." There is an Alaska water quality standard for sulfate; it may not exceed 250 mg/L (see 18 AAC 70.020) What is the definition of "old"? Would it be better to say that for some criteria new information supersedes the current standard (if that is the case?).

<u>EPA Response:</u> The state standards for sulfate and chloride are for "drinking, culinary and food processing" water supplies, not aquatic life. Therefore, they were not used in this ecological risk assessment. The statement has been expanded to make this point.

5.44 *Section 5.3.1, Pages 5-48 to 5-52*

Comment: Essentially, the opening paragraph for this section says "Roads are nearly always bad for streams" supported by a 40 year old citation. Whether intentional or not, the authors portray a biased approach to the Bristol Bay Watershed Assessment.

Roads CAN be bad for fish and streams, especially lots of roads. One well-designed and managed road/bridge/culvert across/near a stream would seem to be unlikely to result in significant biological impacts to fish and wildlife populations, but traffic levels, traffic timing, road design, and other factors all play into the impacts. Management of these factors may be necessary. One road may lead to other roads and more human presence. This should be a consideration in approving/denying road/mine permits.

Recommended Change: Move first two paragraphs to an appropriate subsection on impacts. Move third paragraph up to be the introductory paragraph.

<u>EPA Response:</u> Risks to fish habitats and populations associated with the transportation corridor are considered in Chapter 10 of the revised assessment. Information in the paragraphs noted in the comment is now contained in Section 10.3. The first use of the "old" citation (Darnell et al. 1976) noted in the comment was incorrect and has been changed to Furniss et al. (1991).The information in that publication is still true today.

Along any feasible route, the proposed transportation corridor would cross many streams, rivers, wetlands, and extensive areas with shallow groundwater, including numerous mapped (and likely more unmapped) tributary streams to Iliamna Lake. Secondary development is described in Chapter 13 of the revised assessment.

5.45 *Section 5.4 Roads and Stream Crossings, Page 5-59*

Comment: The opening section has several general and broad sweeping statements regarding roads impacts on stream and river conditions. In particular, the statements are phrased such that it implies roadway impacts are broad and can propagate significant distances upstream and downstream. The following statement needs some sideboards "The physical effects of roads on streams and rivers often propagate long distances from the site of a direct road incursion, as a result of the energy associated with moving water (Richardson et al. 1975)." For instance, a culvert located on a steep stream (say greater than 6% slope) will not likely have extensive (several kilometer) upstream and downstream effects on the stream and floodplain due primarily to the steep valley slope.

Recommended Change: Rephrase sentence to emphasize that improperly designed road crossings and road crossings on flat, alluvial channels and floodplains could potentially affect and impact streams for significant distances upstream and downstream.

<u>EPA Response:</u> The statement referred to in the comment is a general statement that does not require further detail.

5.46 *Section 5, Pages 5-59, 5-65 and 5-74*

Comment: The pages state that the transportation corridor crosses 34 streams and rivers. As stated in the Executive Summary "The most likely serious failure associated with the transportation corridor would be blockage or failure of culverts". This is readily avoided through either small bridges or very large culverts or a series of culverts designed to handle extremely large events. Given the sensitivity of the rivers and streams to the fisheries, the company should be required to build long lasting crossings that would not plug up. It will cost additional money to build these crossings but they would avoid the type of plugging impacts discussed on these pages.

Recommended Change: Add language that these impacts would most likely be avoided in the permit process by requiring significant long lasting crossing designs.

<u>EPA Response:</u> See response to Comment 4.82. We disagree that impacts would most likely be avoided in the permit process by requiring long-lasting crossing designs. With

respect to the use of bridges, they would generally have less impact to salmon than culverts, but can result in the loss of long riparian side channels if they do not span the entire floodplain. Scenarios is which the majority of crossings would be bridges would probably not be realistic. The actual decision as to what type of structure (bridge versus culvert) would be constructed at each crossing would be made by industry engineers in consultation with Alaska permitting staff.

5.47 *Section 5.4.1 through 5.4.6, Pages 5-59 to 5-64*

Comment: These subsections are not risk assessment. There are no set conditions defined that, if met, would constitute risk or no risk. There is no comparison of likely conditions to acceptable conditions. Thus, there is no assessment of risks. Rather, there is just a litany of potential effects listed.

Essentially, the risk characterization for these subsections reiterates that any and all of the bad things related to roads "could" happen. It does not provide that any specific risks would, or are likely to, occur. Without this, the section is just saying, "there is a risk of these things happening", without any likelihood estimation. Without some form of likelihood or some thresholds, any decision making or conclusions become based on individual interpretation and not a shared basis of understanding.

Recommended Change: Add language that these impacts would most likely be avoided in the permit process by requiring significant long lasting crossing designs. Conditions or design thresholds, or a range of such, must be described that, if not met, could/would result in ecologically unacceptable conditions.

<u>EPA Response:</u> See response to Comment 5.46.

Where possible, subsections on the potential impacts of the transportation corridor contain information on the probability and severity of specific impacts in the revised assessment (e.g., the number of stream- and wetland-contaminating spills over 25- and 78-year mine scenarios, the inability to mitigate a stream-spill of a toxic contaminant such as sodium ethyl xanthate, rough estimate of dust production from the transportation corridor).

5.48 *Main Report, Section 5.4, Roads and Stream Crossings, Page 5-59*

Comment: The assumptions regarding the number of culverts and bridges may be inaccurate. On numerous occasions, ADF&G has communicated to the Pebble Limited Partnership the desire for bridges at all stream crossing locations. Bridge designs, not culverts, will be the starting point for each considered road crossing.

Recommended Change: The watershed assessment should reflect ADF&G's preference for bridges instead of culverts and the roadway risks/impacts discussion should focus on possible effects of bridges on stream habitat and fish resources.

<u>EPA Response:</u> See response to Comment 5.46. The assumption in the draft assessment regarding number of bridges (20) came from Ghaffari et al. (2011). In the revised assessment, crossings that would be bridged (18) are based on mean annual streamflows as explained in the text.

5.49 *Section 5.4 Road and Culvert Failures, Stormwater Runoff, Page 5-59*

Comment: The narrative implies that only roads can have negative effects on stream passage. Flood events can have substantive changes in the natural stream environment in regards to ‘modification of drainage networks, acceleration of erosion processes, which, in turn, can lead to changes in streamflow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and the stability of slopes adjacent to streams.

The assumption that roadway salts would be used for general winter maintenance is a considerable jump. BMPs for roadway maintenance in winter climates depend largely on the temperatures, existing road surface, type and rate of vehicle travel, and other considerations. In colder climatic conditions, salts are not utilized for winter maintenance. If salts/brines are used for winter maintenance they are typically used on paved roadways. Given the heavy vehicle traffic this road would carry, this writer assumes a non-paved surface for the major roadways.

<u>EPA Response:</u> It was not our intent to imply that only roads can have negative effects on stream passage, but the narrative referred to in the comment is part of the chapter describing risks to fish habitats and populations associated with the transportation corridor.

The revised assessment contains the following text: “Roads are treated with salts and other materials to reduce dust and improve winter traction. In Alaska, calcium chloride is commonly used for dust control and is mixed with sand for winter application.” This is a realistic scenario. According to the Alaska DEC (http://www.dec.state.ak.us/air/anpms/Dust/topten_dustctrl2.htm), calcium chloride has been tested and used as a dust control palliative in Alaska in many places over several years.

5.50 *Section 5.4.2, Page 5-60*

Comment: “During runoff events, traffic residues produce a contaminant “soup” of metals (especially lead, zinc, copper, chromium, and cadmium), oil, and grease, which can run off road surfaces, enter streams, and accumulate in sediments (Van Hassel et al. 1980) or disperse into groundwater (Van Bohemen and Van de Laak 2003).”

There is no mention of whether this report related metals to runoff from highway traffic roads or traffic similar to that expected at the Pebble project. The source of metals in the sediments may be from other sources than traffic if the findings of two other studies are considered; see information at the links:
http://www.sciencedirect.com/science/article/pii/S0043135498003960 and
http://www.sciencedirect.com/science/article/pii/S0160412096000803.

<u>EPA Response:</u> The reports referenced in the comment relate to metal runoff from road traffic in general, though they contain discussion of specific road types. We acknowledge that road traffic is not the only source of metals in runoff or sediments, but the cited reports indicate that road traffic contributes to metals in runoff.

5.51 *Section 5.4.1 Roads and Stream Crossings, Page 5-60*

Comment: The following statement needs revision. “This can lead to increased channel scouring and down-cutting, streambank erosion, and undermining of the stream crossing structure and fill.”

Recommended Change: Revise statement “This can lead to localized increases in channel scouring and down-cutting, streambank erosion, and undermining of the stream crossing structure and fill.”

EPA Response: The sentence referenced in the comment reads as follows in the revised assessment: “This can lead to increased channel scouring and down-cutting, streambank erosion, and undermining of the road.” The use of the word “can” implies that the listed impacts may not occur in all instances and are thus localized. No change required.

5.52 *Section 5.4.4 Road Crossings as Barriers to Fish Movement, Pages 5-60 & 5-61*

Comment: The risks and impacts to fish passage may be overstated using new culvert design standards that are designed to accommodate fish passage. Also, many of the culvert impacts described (such as erosion and floodplain connectivity are very localized).

Last sentence of the section states “These potential reductions in downstream habitat quality and inhibited fish passage could occur in the 14 culverted streams that support salmonids.” Previously in the section on Page 5-60, it states that there are 17 culverted streams supporting salmonids.

The report then again refers to 14 culverted streams on page 5-74.

Recommended Change: The culvert and impacts should attempt to estimate aerial and spatial extent of fish impacts using current fish passage design standards for culvert design. The reason for this is that if fish passage is provided a majority of the time (with the exception of flood peak periods, washouts and blockages), then secondary effects of culverts including erosion and floodplain connectivity will be minor in the grand scheme and can likely be mitigated for. Reconcile the difference in the number of culverted streams supporting salmonids.

EPA Response: See response to Comment 5.46. Also, the comment seems to discount “flood peak periods, washouts, and blockages,” but in a realistic scenario the secondary effects of culverts would probably not be minor.

The draft assessment did not state that there would be 17 culverted streams supporting salmonids. Rather, it noted that there are 17 anadromous streams. In the draft assessment, of the 34 streams supporting migrating and/or resident salmonids that would be crossed by the transportation corridor, 20 would be bridged and 14 culverted. The number of streams known or likely to support migrating and/or resident salmonids has been updated to 53 in the revised assessment.

5.53 *Section 5.4.2, Page 5-61*

Comment: “Fish mortality in streams has been related to high concentrations of aluminum, manganese, copper, iron, or zinc, with effects on populations recorded as far as 8 km downstream (Forman and Alexander 1998). This report can be found at http://www.edc.uri.edu/nrs/classes/nrs534/NRS_534_readings/FormanRoads.pdf.

The statement of impacts 8 km downstream actually comes from the reference in Forman and Alexander's report, i.e., Morgan E, Porak W, Arway J. 1983. Controlling acidic-toxic metal leachates from Southern Appalachian construction slopes: mitigating stream damage. Transp. Res. Rec. 948:10-16s.

Why this is quoted is not obvious when the Assessment continues with "Although this is an important issue for streams near highways, it is unlikely that a mine access road would have sufficient traffic to significantly contaminate runoff with metals or oil."

Recommended Change: Just state realistic issues, as the sentence in 5.4.2 says: "the salts or other materials used for winter treatment of roads could present a significant issue". If this was done it would remove any perception that a bias is being presented in the report, which is to provide information on possible impacts, not impossible or improbable impacts. Even this statement about salts is brought into question when in Section 5.4.6.1 it says "Roads are treated with salts and other materials to reduce dust and improve winter traction. In Alaska, calcium chloride is commonly used for dust control and is mixed with sand for winter application. During periods of rain and snowmelt, these materials are washed off roads and into streams, rivers, and wetlands, where fish and their invertebrate prey can be directly exposed. We found no relevant data for chloride levels in streams treated in this way."

<u>EPA Response:</u> The comment is correct that the statement of impacts 8 km downstream comes from the Morgan et al. (1983) reference. The revised assessment contains the corrected citation, and notes that the source of the minerals causing mortality was from highway construction activities in geological formations containing pyritic materials. The statement regarding the likelihood of traffic on a mine road contaminating runoff with metals or oil precedes the text relating to contamination from road construction activities in the revised assessment. It reads as follows: "It is unclear if the transportation corridor would have sufficient traffic to contaminate runoff with significant amounts of metals or oil (although stormwater runoff from roads at the mine site itself are more likely to contain metal concentrations sufficient to affect stream water quality)." For the sake of completeness we feel it is necessary to mention the potential impacts from traffic residues and construction, though these risks are not considered further.

We disagree that the potential significance of salts for winter road treatments is brought into question due to a lack of data for chloride levels in streams from roads treated with a calcium chloride/sand mixture. Chloride salts are known to cause toxicity to vegetation and aquatic species, and—based on a study cited in the revised assessment—the toxicity of the calcium chloride commonly used in Alaska would be expected to be a little greater than the more studied sodium chloride given chlorine concentrations.

5.54 *Page 5-61*

Comment: EPA references the Memorandum of Understanding (MOU) between ADF&G and ADOT&PF as a statewide standard for culvert installation on fish-bearing streams. This

MOU is not a statewide standard for all entities; rather, it simply serves as an agreement between the two agencies that establishes a tiered approach to culvert installation and some minimum design requirements.

Recommended Change: The watershed assessment should make it clear that statewide standards for culvert design and installation currently do not exist. ADF&G evaluates each proposed culvert installation on a case by case basis.

EPA Response: The assessment does not reference the MOA between ADF&G and ADOT&PF as a 'state' standard, but rather as containing standards for culverts on fish-bearing streams. The procedures, criteria, and guidelines described in the MOA are used by ADF&G for permitting culvert related work in fish-bearing waters, and represent the state-of-the-art methodologies for Alaska. The culvert-design approaches are summarized in Box 10-2 of the revised assessment.

5.55 *Section 5.4.6.3, Page 5-63*

Comment: Says "Additionally, 19.4 km of roadway would intersect wetlands within and beyond those mapped by the National Wetlands Inventory (NWI). Runoff from these segments of roadway could have a significant impact on these wetlands." Are there any examples or studies that can back up this statement?

EPA Response: The statement, "Runoff from these segments of roadway could have a significant impact on these wetlands," has been changed to the following in the revised assessment: "Runoff from these road segments could have significant effects on fish and the invertebrates that they consume, particularly if sensitive life stages are present." This statement refers to road segments intersecting streams (noted earlier in the paragraph) as well as those intersecting wetlands. References for the toxicity of de-icing salts and dust suppressants are provided in the previous section (Section 10.3.3.2) in the revised assessment.

5.56 *Section 5.4.8.2 Stream Length Upstream and Downstream from Crossings, Page 5-65*

Comment: Last sentence states "The length of stream upstream of the transportation corridor likely to support fish, based on a stream gradient higher than 10%, is 240 km." The sentence should state "gradient less than 10%…"

Recommended Change: Reconcile sentence and Table 5-22.

EPA Response: The comment is correct, though in the revised assessment we use <12% as the criterion and cite a relevant source. Information in the text and related table are now reconciled.

5.57 *Section 5.4.7.3, Page 5-65*

Comment: Filling of wetlands would definitely impact wetlands, but it would not necessarily eliminate habitat for salmonids unless the wetland was directly connected to a salmonid-bearing stream, or was a salmonid-bearing wetland. Placement of roads and stream crossings is, no doubt, critical in any such impacts. But, there are already rules for mitigation requirements related to wetland impacts. Thus, any such impacts would require mitigation for lost area, functions, and values, according to federal rules/regulations.

The level of mitigated impact cannot be assessed from information provided within the Bristol Bay Watershed Assessment.

Recommended Change: Use site-specific road alignment data to predict level of impact, required mitigation, and any remaining impact/risk.

<u>EPA Response:</u> Not every wetland is salmon-bearing, but in general filling wetlands would eliminate habitat for salmonids and would indirectly alter wetlands in ways that could reduce the quality, quantity, and accessibility of habitat for fish. In the assessment, the alignment of the transportation corridor was used as a starting point for estimating potential risks to fish habitats and populations associated with the corridor. However, any formal determinations regarding compensatory mitigation can only take place in the context of a regulatory action. This assessment is not a regulatory action, and thus a complete evaluation of compensatory mitigation is considered outside the scope of the assessment. Nevertheless, Appendix J, which discusses potential compensatory mitigation measures, has been added to the revised assessment.

5.58 *Section 5.4.8.1, Page 5-65*

Comment: The first sentence of this subsection is overstated.

In the third sentence, should this be rephrased to "potential" high impact areas?

According to Pebble Limited Partnership Environmental Baseline Data, there is already a road along Chinkelyes Creek from the coast to the Iliamna. If so, Pebble Limited Partnership actions may improve current road conditions.

Recommended Change: Edit text to eliminate overstatements and acknowledge there is no current impact and changes might be able to be made to alleviate some/all of the purported impacts.

Note where there is any existing roadway along or near the proposed road, and what the impacts have been. Existing roads provide empirical evidence of direct impacts. They do not account for increased use-related potential impacts.

<u>EPA Response:</u> The first sentence noted in the comment has been deleted from the revised assessment. With respect to the sentence containing the phrase "high impact" areas, we believe that term is correct as is.

With respect to the first recommended change, the assessment acknowledges that best management practices or mitigation measures would be used.

With respect to the second recommended change, the draft assessment noted the existence of a few road segments, but more detail is contained in the revised assessment (Section 6.1.3.1). We also make reference to impacts that have occurred on existing segments, for example heavy rains in late September 2003 that washed out sections of the Williamsport-Pile Bay Road (the road referenced in the comment). As the comment notes, Pebble Limited Partnership actions may improve conditions on that road to meet design standards.

5.59 *Section 5.4.8.2, Page 5-65*

Comment: Similar to section 5.4.8.1, total potential worst-case impact is implied and assumed. The assumption that significant impacts occur on every crossed stream both upstream to non-fish bearing conditions, and downstream to an outlet, grossly overstates and misrepresents likely impacts.

It is not clearly stated how upstream portions of streams will be impacted. In earlier portions of the Bristol Bay Assessment it is stated impacts MAY extend to 200 meters away from the road. However, later in the assessment, it implies the impact can be measured miles downstream and upstream. The mileage represented in Tables must be qualified such that is does not imply impacts to the entire mileages listed.

Recommended Change: Provide discussion about the level of impacts close to the road and account for the distance downstream where impacts are ameliorated, particularly for those streams that are crossed only once and/or do not have any fish in them near the road crossing.

EPA Response: The assessment does not assume that significant impacts occur on every crossed stream along its entire length, downstream to an outlet or upstream to non fish-bearing conditions. The revised assessment states that the transportation corridor could affect 290 stream km between its road crossings and Iliamna Lake, and that fish may also be affected in the approximately 830 km of stream upstream of the transportation corridor that are likely to support salmonids (based on surveys and stream gradients less than 12%, Table 10-8). Upstream portions of streams would be impacted through potential blockage of fish passage (e.g., culverts plugged by debris, or stream flow exceeds culvert capacity resulting in overtopping and road washout).

We delineated the proximity of the transportation corridor to National Hydrology Dataset streams and National Wetlands Inventory wetlands. The 200-m road buffer for effects outward from the road was derived from an estimate of the road-effect zone for secondary roads (Forman 2000), as noted in the revised assessment. Impacts from the road over water (i.e., at stream crossings) would be expected over much longer distances. As noted in the revised assessment, the physical effects of roads on streams and rivers often propagate long distances from actual stream crossings due to the energy associated with moving water. Alteration of hydrology and sediment deposition by road crossings can change channels or shorelines many kilometers away. Tables in the assessment document upstream lengths of streams likely to support salmonids and downstream lengths to Iliamna Lake. We do not feel it is necessary to qualify these distances.

With respect to the recommended changes, discussion about the level of impacts is contained in the risk characterization section of specific potential impacts. We do not have enough information to postulate about the downstream distance from crossings where impacts may be ameliorated.

5.60 *Figure 5-15, Page 5-67*

Comment: Question: Why is the road shown going into and out of lakes?

EPA Response: In the draft assessment, water bodies were incorrectly shown as overlying the proposed transportation corridor. This has been corrected in the revised assessment (i.e., the road now overlies the water bodies).

5.61 *Section 5.4.10, Page 5-74*

Comment: Because a stream by stream assessment has not been done and actual stream crossings have not been designed or located, it is impossible to determine the actual impacts. The purported "likely" diminished production on 510 km of 30 streams is likely a significant overestimate of potential impacts.

Recommended Change: Examine width of stream versus width of flood plain and determine whether culverts would be adequate to maintain stream function and fish passage and where bridges are required to do the same. Given use of appropriate culverts, bridges, and road construction practices, estimate damages downstream, within the most likely length of impact, (200 meters?).

EPA Response: The revised assessment assumes that crossings over streams with mean annual streamflows greater than 0.15 m^3/s would be bridged. However, the actual decision as to what type of structure (bridge versus culvert) would be constructed at each crossing would be made by industry engineers in consultation with Alaska permitting staff. We do not have enough information to estimate the most likely length of impacts downstream from crossings.

5.62 *Section 5.4.10 Overall Risks to Transportation Corridor to Salmon Populations, Page 5-74*

Comment: Section states that magnitude of changes in fish populations cannot be estimated at this time. Estimates of effects and impacts on physical habitat (such as length of stream, areas of wetland loss, and percent time of fish passage barriers) could be summarized, similar to other sections where physical habitat effects are reported rather than estimated effects on fish populations.

Recommended Change: Recommend summarizing physical habitat effects, where feasible.

EPA Response: In the revised assessment we summarize the number of streams in which salmonid spawning migrations may be impeded, the number that contain restricted upstream habitat, and the number that would be entirely or partly blocked at any time. We then note that: "As a result, salmonid passage—and ultimately production—would be reduced in these streams, and they would likely not be able to support long-term populations of resident species such as rainbow trout or Dolly Varden. Approximately 290 km of stream downstream of road crossings also could be affected." We also summarize the fish species, abundances, and distributions that could be affected by construction and operation of the transportation corridor.

5.63 *Section 2.2.3 Salmon-Mediated Effects on Wildlife, Page 5-74*

Comment: Salmon reductions caused by mining are speculated to "cause roughly proportionate declines in bears, wolves and bald eagles". The amount of decline would not likely be proportionate as salmon only constitute a portion of these species' diet. In the case of wolves, salmon may be a rather small component of the diet. The effects of reduced salmon would depend on the amount of the reduction of salmon in the diet and the relationship between salmon intake and vital rates. In addition, predators and scavengers utilizing salmon resources may interfere with each other resulting in imbalanced effects on different populations.

Recommended Change: Quantify the salmon-mediated effects better.

<u>EPA Response:</u> The assessment has been revised to acknowledge the complex relationships between salmon and predators/scavengers. There is insufficient information to allow quantification of salmon-mediated effects on wildlife.

5.64 *Section 5.5, Page 5-75*

Comment: Without some quantification of impacts to fish, it is impossible to quantify impacts to salmon-mediated effects on wildlife. It is not clear that impacts on wildlife would be proportional to impacts on salmon caused by the road because much wildlife can move long distances…as stated in the early sections of the Assessment.

No analysis is made of roadway corridor effects on wildlife. This is purposeful, keeping impacts related to salmon, but may underestimate actual risks to wildlife. This could be stated in this section of the Assessment.

Recommended Change: Rewrite the Assessment with site specific information, or allow Pebble Limited Partnership to provide detailed permitting documents, then review/estimate likely impacts to fish and wildlife.

<u>EPA Response:</u> We agree with the comment and have not attempted to quantify salmon-mediated effects on wildlife. The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on wildlife in the mining area and transportation corridor.

5.65 *Section 5.6, Page 5-75*

Comment: The text states that any negative impact on fish could lead to negative impact on the health and welfare of Alaska Natives. Yet, of the 40,000,000 (high range) fish returning to the Bristol Bay region, it was stated earlier that approximately 150,000 are taken for subsistence. The assessment assumes that "any" impact to fish populations would necessarily result in a proportional impact to Alaska Native subsistence fish use although the relative taking of subsistence fish is small relative to the taking of commercial fish.

Recommended Change: Present a more detailed or at least report more precisely the numbers of salmon used for subsistence versus the total number of fish, and discuss the balance that could be adjusted between escapement, commercial, and subsistence fish harvest, particularly if a more detailed economic analysis shows the mine is more economically valuable than slight losses to the commercial fish industry.

<u>EPA Response:</u> The comparison of subsistence with commercial fisheries is not within the scope of this assessment. Likewise, the assessment is not an economic cost-benefit analysis of mining versus the fishery. Although the subsistence fishery is small relative to the commercial fishery, it sustains a way of life for local residents and is integral to social and spiritual aspects of Alaska Native cultures in the region.

5.66 *Section 5.6, Page 5-76*

Comment: The statement that "some" residents use the area of the road corridor, and "some" negative effects on salmon habitat "would" result in displacement of subsistence users is unfounded. As presented in the next sentence, the road may actually bring more subsistence users to easily accessible streams, resulting in a bigger impact than the road itself. If 500 salmon return each year to a stream, and subsistence users only collect 50, then a 2% decrease in salmon populations returning to the river will not have any impact on subsistence use. In fact, it may go unnoticed. The road itself may have a positive impact to subsistence culture by increasing access in contrast to the direct negative impact to fish and wildlife of the road corridor.

Recommended Change: Provide quantification of salmon impact, use subsistence road use information to determine if it preferentially brings more subsistence users to the easier accessed rivers. Discuss whether Native Alaskans use roads and the positive and negative impacts roads may have on subsistence culture. Overall, this section is poorly substantiated. Need to define what is likely, and then provide a range of variation around what is likely.

EPA Response: The assessment has been revised to acknowledge the complexities of predicting future subsistence usage of the area around the transportation corridor. The scope of the assessment is limited to potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, although we do recognize the complexity of potential direct, secondary, and cumulative effects resulting from large-scale mine development in the region.

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5.67 Biological threats, there wasn't any mention of biologic threats to an environment that development brings, such as invasive plants. There are invasive plants in Alaska that add to the degradation to salmon habitat.

EPA Response: Invasive plants are discussed in the revised assessment (Chapter 10).

5.68 Drinking water, large mining projects remove important elements of the best water filtration for drinking water, how can this mine impact the watersheds drinking water?

EPA Response: Potential effects on drinking water from large-scale mining are outside the scope of this assessment as defined in Chapter 2 of the revised assessment. However, reliance on surface and groundwater for drinking water in the watersheds is acknowledged in Section 12.2 of the revised assessment.

5.69 Fresh water seals, Lake Iliamna is one out of two places on earth that harbor fresh water seals. We did not see impact studies done on them, or a species of fish called Black Fish that live in swampy marshland around the Lake Iliamna region.

EPA Response: The assessment identifies the freshwater harbor seal population in Iliamna Lake as one of two in North America. Blackfish are listed in Appendix B of the assessment. The comment is correct that neither of these species is the focus of the assessment. The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, although we do recognize potential effects on other species.

5.70 Cultural impacts, if the fish are impacted there will be actual cultural impact on local residents, not maybe.

<u>EPA Response:</u> **The assessment text has been expanded to elaborate on the potential complexity of impacts on culture from the loss of fish.**

<u>Bristol Bay Native Corporation (Doc. #4382 and #4145)</u>

5.71 The Draft Assessment underestimates the amount of habitat that would be lost under the hypothetical mine scenario[2]. It does this in part by excluding certain areas from the mine footprint and, consequently, from the calculation of habitat acres lost to the mine footprint. In addition, the Draft Assessment bases its estimate of stream losses on the Alaska National Hydrography Dataset (ANHD), which uses a coarse scale and therefore underestimates the reach and extent of streams in the vicinity. Finally, the Draft Assessment bases its estimate of wetland losses on National Wetlands Inventory (NWI) maps, even though Pebble Limited Partnership (PLP) delineated substantially more wetland and aquatic areas within its "mine mapping area" than are shown in NWI maps of the same areas. As a result of this underestimation of habitat losses, the risks associated with such habitat loss are understated. EPA could expand its habitat, stream and wetland estimates as detailed in Attachment A (Comments of Thomas G. Yocom).

<u>EPA Response:</u> **Our estimates of stream and wetland losses are likely underestimates. This issue is presented in the revised assessment (Box 7-1), where we discuss stream and wetland data limitations.**

The comment suggests expanding our analysis as described in their Attachment A, which is largely a comparison of the data sources we used with data available in the Pebble EBD. The Pebble EBD data would represent one possible source of improved, higher-resolution mapping and data collection. However, Pebble has not made those data sources available to us in a conveniently usable form for quantification, nor have they been subject to peer review, points that are acknowledged in the attachment. Therefore, despite their limitations, the National Wetlands Inventory and National Hydrography Dataset represent the best available, most widely known available datasets for this area. As improved datasets become available, we support reanalysis of the stream and wetland impacts.

5.72 In most ecosystems, plant species are the primary producers of bio-mass on which all members of the trophic web directly or indirectly rely. Vegetation also plays an important role in water and nutrient cycling, ecosystem energy flow, water quality and flow regimes and other beneficial ecosystem functions. To the extent the Draft Assessment includes information about vegetation, for example on page 5-19, it relies heavily on studies from PLP's EBD. This reliance should be exercised with caution. The results reported in the EBD cannot be verified because the underlying data and photo signature guides used to generate

[2] See Comments of Thomas Yocom, attached as Attachment A. Thomas G. Yocom is a former National Wetlands Expert for the U.S. Environmental Protection Agency, serving at EPA from 1984 until retiring in 2005. He also served as a fishery biologist for the U.S. Fish and Wildlife Service and the National Marine Fisheries Service from 1971 until 1984. He has been a Wetlands Regulatory Scientist for the Huffman-Broadway Group since 2006.

the vegetation maps are not provided[3]. In addition, the study lacks complete vegetation type descriptions and photographs[4], the mapping is presented in a manner and scale that precludes meaningful interpretation[5] and omits critical information about invasive species[6]. These omissions are significant and, as such, the vegetation information contained in the EBD must necessarily be viewed with some skepticism. Nevertheless, the conclusion of the Draft Assessment related to vegetation – "[t]he presence of both willow and alder in the headwater stream riparian zones implies high-quality basal food resources for stream fishes in the mine area" – is well-founded and supported by other sources of information about vegetation in the watershed.

EPA Response: **This comment is consistent with the assessment. No change required.**

5.73 The Draft Assessment does not squarely address the challenges of constructing and operating a modern day mine that could possibly meet the "no failure" scenario with respect to wastewater treatment. In addition to the unprecedented quantity of contaminated water that would require treatment (over 130 million gallons per day), State of Alaska water quality criteria (WQC) would have to be met end-of-pipe without the benefit of dilution (all other Alaska hardrock mines rely on dilution to meet WQC).

EPA Response: **The "no failure" scenario is no longer included in the revised assessment. The possibility of water treatment failure is now included and evaluated in Chapter 8.**

5.74 Furthermore, the water balance significantly underestimates the volume of contaminated wastewater that would require treatment during operation and post-closure, and it does not account for extreme events such as peak storm runoff. The Draft Assessment does not address the porous nature of the surficial deposits and fractured bedrock in the project area as well as other information that places in serious doubt the ability of a conventional, unlined tailings impoundment to capture toxic tailings leachate before it enters the local groundwater system. Finally, the Draft Assessment does not adequately address the fact that the enormous amounts of wastewater could be discharged only during the five months of the year when receiving waters are not frozen, greatly increasing the magnitude of the water management challenge. We recommend that in the Final Assessment EPA at a minimum acknowledge that

[3] For a more thorough critique of PLP's Vegetation Studies see Michelle Sturdy, "Review of Pebble Mine Project Environmental Baseline Document Chapter 13: Vegetation" (2012), attached as Attachment C.

[4] The appendices to the EBD include vegetation type descriptions and photographs, but these generally lack important site characteristic information such as elevation, slope, aspect, landscape position, soil types, etc. This is important information that was not presented because it had not been through quality control review (EBD, Chapter 13, page 9).

[5] The vegetation-type polygons in the vegetation maps obscure the underlying vegetation. This makes it impossible to compare the vegetation in the imagery to the assigned vegetation type. The scale of the maps is too also small for any meaningful interpretation.

[6] Although the EBD study objectives indicate the incidental observations of plants considered weeds were to be documented, such information is missing although five species are listed in the mine mapping area plant list. One of these is Canada thistle (Cirsium arvense). This species is of particular concern because an aggressive, highly invasive plant that is common to disturbed sites and difficult to eradicate. Observations of this species would be highly important and should have been given more attention in the EBD.

the result of this approach is an understatement of both the water management challenge and the potential for water management failures associated with its hypothetical mine scenario.

<u>EPA Response:</u> The assessment did not state that the water would be discharged only during five months of the year. It is possible to treat water during the winter months and it is common for treatment facilities to be contained in structures to prevent freezing of the treatment plants; thus our assessment assumes that water would be treated and discharged as necessary. However, Chapter 8 evaluates potential risks associated with unforeseen events and accidents. Extreme flows are assumed to be temporarily stored for treatment, but failure mechanisms discussed in Section 8.1.2 include the possibility that storage may be inadequate, resulting in releases of untreated water. The inability to capture all leachate is now explicitly recognized and incorporated into the assessment.

5.75 As documented here, the Draft Assessment underestimates both the abundance and importance of the watershed's resources and the risks posed by large-scale mining, and despite its significant findings of potential adverse impacts, actually present a conservative view of those potential impacts.

<u>EPA Response:</u> Summary statement; no change required.

5.76 In estimating impacts of the Pebble 25-year mining project to wetland and aquatic areas, EPA relies upon National Wetlands Inventory (NWI) maps for the Bristol Bay watershed. These maps are produced from aerial photo interpretation of high altitude imagery, and are accompanied by little or no actual on-the-ground verification. EPA's reliance on the NWI maps likely leads to conclusions about potential impacts of large-scale hardrock mining operations on wetland and aquatic areas that are substantial underestimates. In fact, field studies by the Pebble Partnership (EBD Chapter 14: Wetlands) suggest that the reach and extent of wetland and aquatic areas that are shown in NWI maps within the proposed mine footprint may be 30% or more too low.

<u>EPA Response:</u> See response to Comment 5.71.

5.77 EBD Chapter 14 characterized roughly a third of its 29,430-acre "mine mapping" area as wetlands or aquatic habitats (9,826 acres). Using this ratio for illustrative purposes only, the roughly 9,400-acre combined footprint of the 25-year Pebble mine, waste rock disposal area, and tailing storage facility (that EPA estimates covers 8,330 acres) would result in the loss of over 3,100 acres of wetland and aquatic habitats, or roughly 600 acres more than the 2,520 acres EPA estimates would be lost.

<u>EPA Response:</u> See response to Comment 5.71. The EBD represents a different, more precise resolution of wetland mapping than was publicly available from the NWI. The differences in wetland area between the NWI dataset and other possible datasets referenced in this comment are addressed in Box 7-1 of the revised assessment.

5.78 EPA should expand its BBWA to provide some assessment of the risks/probabilities that water quality standards could be met even under its "no fail" scenario, as well as the risks/probabilities that habitat losses could be offset through compensatory mitigation measures. EPA should provide examples if they exist, or explicitly acknowledge the lack of such examples. If such measures have never been achieved previously, it seems inappropriate for EPA to presume that it will be accomplished under a “no-failure” scenario.

EPA Response: The assessment has been reorganized to better distinguish between effects associated with the direct habitat and water lost to potential mine footprints (Chapter 7) from other effects resulting from contaminated leachate, water treatment failures, and other types of failures. In the original assessment, it was not clear that “no failure” represented a best-case scenario where all mitigation measures worked properly to eliminate all impacts other than direct habitat and water losses, and that “failure” then considered other potential (and in some cases likely) impacts. Chapter 8 of the revised assessment addresses water collection, treatment and discharge in terms of expected operating conditions and potential failures.

5.79 The Draft Assessment is understated in its appraisal of the effects of a large-scale mining operation on wildlife resources. More attention should be focused on the impacts that loss of or damage to the salmon resource would have on these other wildlife resources – either as a food source or, more generally, as a source of nutrients for their habitat. In addition, the Draft Assessment does not address the potential for noise pollution or fugitive dust resulting from the mining infrastructure and what effects this might have on the behavior of key subsistence species like caribou, moose, and migratory bird and waterfowl. The Draft Assessment also does not examine the effects the transportation corridor might have on the movement and behavior of these species.

EPA Response: The assessment text has been expanded to acknowledge a broader range of potential salmon-mediated impacts. The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on wildlife in the mining area and transportation corridor.

5.80 The Draft Assessment includes very useful and informative information about subsistence. At the same time, it does not adequately discuss the very important socioeconomic impacts to local communities that would likely result from the potential environmental impacts of the development of the hypothetical mine scenario[7]. There is substantial literature documenting the adverse impacts of mining and energy development on small indigenous communities, such as increased inflation, overwhelming demands on existing services, and increases in social problems like domestic violence. The Assessment would benefit from greater attention to this literature and a more thorough and prominent discussion of these threats.

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[7] Don Callaway, Comments on Draft Bristol Bay Watershed Assessment: Subsistence Impacts (2012), attached as Attachment E. Don Callaway, Ph.D., University of Michigan (anthropology), was also a postdoctoral fellow in statistics at the University of California, Berkeley. Dr. Callaway served as Senior Cultural Anthropologist with the National Park Service Alaska Region for 27 years. He conducted extensive fieldwork in over 50 Alaska rural indigenous communities and nearly a dozen indigenous communities in the Russian Far East. Dr. Callaway’s research focuses on subsistence issues, climate change, and the social and cultural impacts of regulatory, mining, and energy initiatives.

EPA Response: See response to Comment 5.79. At the request of the peer reviewers, we have added information on effects of resource extraction industries on Alaska Native cultures to Chapter 12 of the revised assessment.

The Pebble Limited Partnership (Doc. #3797, #4962, and #5416)

5.81 EPA's charge questions should ask whether the draft Bristol Bay Assessment should consider information about other modern regulated mines, such as: (a) those on the Fraser River salmon fisheries in British Columbia, including the Highland Valley Copper Mine; (b) the Thompson Creek Mine in Idaho, which is within the Salmon River fishery; (c) the Red Dog Mine in Alaska; and others. If that data were not used by EPA in formulating its Assessment or EPA does not plan on providing that data to the peer review panel, EPA should immediately explain why and ask the peer review panel whether such data would be useful to a scientific assessment of the effects of mining in the Bristol Bay watershed.

EPA Response: This comment concerns the charge question to the peer reviewers. The charge questions included a request for additional information regarding the mine scenario and mitigation measures. The peer reviewers had access to all public comments, including this one.

5.82 Estimated stream flow analysis is poor science. Flow is but one metric for evaluating fish habitat change; instream flow related studies have repeatedly shown that flow changes do not correspond on a 1:1 basis with fish habitat. To thoroughly understand the effects of stream flow changes, studies must also consider the effects of flow alteration on temperature, sediment transport and channel form, connectivity to side and off-channel habitats, and ice processes. EPA's statements regarding flow reduction effects on salmonid populations are unsupported by the published literature. More importantly, EPA's failure to review and consider the data provided in the PLP Environmental Baseline Document (EBD, 2011) to conduct this analysis is a serious omission and a failure to apply "best available science."

EPA Response: Observed streamflows at gaging stations from PLP's Environmental Baseline Document were used as the basis for the streamflow alteration analysis. We agree that streamflow is just one aspect of habitat that would change under the mine scenarios presented, but it is a fundamentally important one. Detailed flow-habitat studies like those begun by PLP contractors will be useful for managing streamflows, as acknowledged in the assessment. Until such studies have been validated and verified and can be linked to a detailed flow management plan, our use of the precautionary environmental flow approach is supported by the scientific literature and provides a conservative perspective for targeting flow management toward flow regimes likely to be protective of fish communities and habitats in the project area.

5.83 Stream flow impacts (habitat and fish loss) are based on unrealistic assumptions. The method EPA used for judging the degree of impact on salmonid populations is essentially hydrologically based and has no direct linkage to salmonid fish populations and salmonid fish habitat. Indeed, none of the four case studies reviewed by Richter et al. (2011) involved Pacific coast anadromous species, and none involved detailed field data collection. Furthermore, the four case studies were from Florida, Michigan, the United Kingdom, and Maine. The method is a Percent of Flow (POF) based method that, as the authors indicate

"…is intended for application only where detailed scientific assessments of environmental flow needs cannot be undertaken in the near term. "

<u>EPA Response:</u> See response to Comment 5.82.

5.84 *Section 5.2*

Theoretical impacts on habitat are calculated in percentages, or in some cases, based on fractions of percentages. This encourages two misconceptions. First, the impacts are real when, in fact, the technical foundation is based on speculation and unsubstantiated assumptions. Second, the impacts have been scientifically and defensibly calculated, which is not correct. Neither of these conditions are true. There is no mining project from which one could make valid impact assessment statements and no data has been collected from which one could actually calculate real or projected impacts. This raises questions regarding the validity of this and other assumptions and analyses used throughout the document.

<u>EPA Response:</u> The comment's objections to expressing results as percentages are not fully explained. The assumptions underlying analyses in the assessment are clearly presented. No change required.

5.85 *Section 5.2.2, pages 5-40 and 5-41*

The assessment states that "the SFK watershed will experience a 78% reduction in flow at gage SK100G." which exceed the 20% flow alteration allowed by the Richter et al. (2011) sustainability boundary approach. The assessment also states that "with projected reductions in streamflow, the frequency and duration of periods of zero flow would be expected to increase, resulting in increased habitat fragmentation for fish including salmon. Alteration to the natural flow regime of this magnitude would have a very significant adverse effect on salmonid populations and overall ecosystem functioning in these portions of the watershed." The gage that USEPA cites (SK100G) is located in the upper reaches of the SFK watershed and above Frying Pan Lake. These areas support primarily resident fish species. Very few anadromous fish have been found in the reach extending from SK100C upstream to Frying Pan Lake (EBD, 2011). Thus USEPA's assertion about a very significant adverse effect on salmonid populations is overstated. Moreover, the extent of the flow reduction decreases substantially downstream (as shown in EPA Table 5-13) such that the flow alteration estimated to occur at SK100C is only 12%.

<u>EPA Response:</u> This comment assumes that because "very few" anadromous fish have been found in a reach, any impacts to that reach cannot be considered substantial. We disagree with the assertion that year-round use or high abundances at some specific point in time is required to consider habitat "important." Habitats occupied at low densities during certain times of year or during certain years can provide important habitats at other times of year or in other years. Seasonal habitats often provide important complementary habitat and can expand habitat capacity for a system.

5.86 *Section 5.2.2.1, p 5-27, lst sentence under post-closure*

This is an assumption and should be stated as such. The reclamation plan may call for a different strategy which could significantly alter the effects. Alternative strategies should be discussed.

<u>EPA Response:</u> The scenario presented (the cessation of pit dewatering after the mine is closed) is a likely and common approach to mining the site, although alternative scenarios may be possible. No change required.

5.87 *Section 5.2.1.2, page 5-16, 3rd paragraph*

Chum do not technically rear in rivers and streams. They may be present for a short time after hatching as they migrate to their rearing habitats. Northern pike live primarily in lakes and may move into lower reaches of adjoining rivers where the gradient is very low. The presence of northern pike in the headwaters of these basins is highly doubtful. The reference cited is in press and could not be reviewed.

<u>EPA Response:</u> Chum salmon, particularly up-river stocks, are not purely transient. All habitat requirements, including spawning, incubation, hatching, and early fry migration and feeding are important for salmon survival, and could be impacted by mining activities and habitat changes. Chum salmon are not immune. Northern pike, even if restricted to low-gradient streams, are likewise not immune.

5.88 *Section 5.2.2.1, page 5-21, first paragraph*

The report assumes that impacts to stream flow will not be mitigated. In assuming no mitigation, the report assumes a mine scenario that cannot be permitted. There is no value in assessing a "hypothetical" mine design that would not be permitted.

<u>EPA Response:</u> The scenario does acknowledge the possibility of mitigating effects by storing and distributing effluent water, although we recognize the challenges this would pose in terms of the research, engineering, water management, and long-term monitoring required for successful implementation. The water management scenarios considered are consistent with those published by Northern Dynasty Minerals in Ghaffari et al. (2011), which include water withdrawals.

5.89 *Section 5.2.2.2, paragraph 1*

The report assumes that no mitigation will be undertaken to control the temperature of the return water. Any process water will be required to meet State of Alaska water quality standards, which includes temperature standards. The document fails to take state regulatory requirements into consideration.

<u>EPA Response:</u> The assessment clearly states that measures will be taken to meet temperature standards. No change required.

5.90 *Section 5.2.2.3*

Due to the failure to consider approaches to mitigate reductions in flow, this section overstates the likely impacts of a project.

<u>EPA Response:</u> See response to Comment 5.82

5.91 *Section 5.2.2.3, page 5-30 to 5-31, discussion on sustainability boundary approach*

The sustainability boundary approach discussed in this section is generally considered a very simplified approach to assessing effects of modifications of flow on fish habitat. The assumptions are also oversimplified. For instance, decreases in flow could reduce fish habitat by decreasing the wetted area OR it could increase fish habitat by increasing the area that has suitably low flows for rearing fish. This approach is not a standard assessment method, and it has not been widely adopted as an assessment tool.

<u>EPA Response:</u> **See response to Comment 5.88. We use the best available and applicable science, not necessarily the most widely adopted science.**

5.92 *Section 5.2.1.2 and Appendix C*

The assessment states that the loss of upstream waters (pg. 5-21, pg. 1) would “greatly reduce inputs of organic material, nutrients, water, and macro invertebrates to reaches downstream …” The report also state that 65% of the nitrogen flux is attributed to headwater contributions. Appendix C (p 16-18) documents the tremendous importance of marine-derived nutrients to the Bristol Bay Watersheds coming in from salmon swimming upstream. These two statements are contradictory and inconsistent.

<u>EPA Response:</u> **These statements are not contradictory. Headwater streams provide important inputs to downstream waters, including the many streams that do not have documented anadromous fish populations. Where anadromous fish occur, marine derived nutrients can play an important role, but this does not negate the contributions of headwater nutrient sources, particularly for streams without large runs of salmon. No change required.**

5.93 *Section 5.2.1.2*

This section provides an incomplete analysis of whether organic inputs and nutrients from areas upstream of the proposed mine site provide a large quantity of materials to downstream third and fourth order streams. Drifting macroinvertebrates directly downstream may or may not diminish, but the amount of the reduction would be a direct result of the footprint size and location, and what types of vegetation, etc. would be removed. The assessment fails to consider avoidance, minimization, and mitigation techniques that could reduce or eliminate the impact.

<u>EPA Response:</u> **The original assessment assumed many mitigation measures, although they often were not called out as such. The revised assessment includes more direct discussion of mitigation measures. Compensatory mitigation scenarios are outside of the scope of the assessment. Nevertheless, because of public comment and peer review input, we have provided additional information about compensatory mitigation in Appendix J of the revised assessment.**

5.94 *Section 5.2.1.2 Section 5.1.1, p. 5-2, paragraph 2, sentence 3*

The text refers to figure 5-2, indicating that chum are present in the footprint of TSF 3. TSF 3 is not indicated on the figure.

<u>EPA Response:</u> **The distribution of chum salmon within the footprint is now provided in Figure 7-5.**

5.95 *Section 5.4.1, paragraph 1, last sentence*

The cited sources are flawed because they do not adequately evaluate the failure rates of culverts installed to modern standards.

EPA Response: The discussion of culverts has been revised.

5.96 *Section 5.1.1, Table 5-1*

The information contained in the table requires citations to the relevant supporting literature. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: The source, as was clearly indicated in a footnote, is the PLP EBD. No change required.

5.97 *Section 5.2.2.1, page 5-22, paragraph 1*

The references cited as support for the methods for estimating drawdown caused by groundwater backflow do not support the conclusions. The methods used for estimating the drawdown effect are not supported by references to the scientific literature. In the absence of technical references to the relevant literature supporting the choice of analysis method, the basis for the method and any statements, assumptions, and conclusions deriving from the results of the method cannot be evaluated.

EPA Response: The method for estimating drawdown is described in Box 6-2. As stated, drawdown was calculated "using the Dupuit-Forcheimer discharge formula for steady-state radial flow into a fully penetrating well with a diameter equal to the average mine pit diameter" on a vertically transformed section. Box 6-2 provides sufficient detail to evaluate the method and the results, including details on the hydraulic conductivity and boundary condition assumptions.

Northern Dynasty Minerals Ltd. (Doc. #4611)

5.98 Dr. John Boyle, Hunter Dickinson Inc. Vice President - Environment and Sustainability, has prepared comments on the assessment methodology employed here by EPA (Attachment 2). He, along with all the other experts NDM asked to review the Draft Assessment - Bailey Environmental, Buell & Associates, Ecofish Research Ltd. and Geosyntec Consultants, Inc. - conclude that EPA did not abide by regulatory and statutory guidelines in preparing the Draft Assessment. Dr. Boyle's comments note that EPA's analysis:

- fails to use all of the data and information publicly available for the work;
- fails to adequately assure the quality of the data and information it did use in the work;
- employs numerous scientifically unsupportable assumptions and analyses;
- uses the results from cited references selectively or inappropriately;
- fails to adequately estimate ecological risks or likelihoods, or provide any analysis of the degree of confidence in the results; and
- fails to put the results of the various analyses and conclusions into context for the fish populations of the region defined for the work - the Nushagak and Kvichak watersheds,

meaning that EPA fails to consider the entire ecosystem that was presented as the intended scope of the Draft Assessment.

<u>EPA Response:</u> This is a summary of specific comments that are addressed elsewhere in this document (e.g., see responses to Comments 5.1, 5.9, 5.11, 5.25, 5.85, 5.93, and others).

5.99 NDM and PLP are acutely aware of the President's Council on Environmental Quality (CEQ) Guidelines as they relate to project development and mitigation, and have been from the earliest efforts to produce a viable project design that could be permitted. NDM and PLP have also been acutely aware of the requirements of the Clean Water Act (CWA) and all that it implies when it comes to environmentally responsible project development. EPA, on the other hand, has ignored the clear mandates of the CWA and the CEQ Guidelines in the production of its Watershed Analysis, both in the "no-failure scenario" and in the "failure scenarios". This stark contrast in the basic assumptions surrounding project concepts, PLP on one hand and EPA on the other, is disturbing.

<u>EPA Response:</u> This assessment is based on EPA guidance for ecological risk assessment, and its purpose is to inform EPA's deliberations under the Clean Water Act (CWA). EPA has not made a final decision regarding use of its 404(c) authority under the CWA. The assessment assumes that any mine would be built and operated consistent with the CWA and the CEQ guidelines.

5.100 PLP has shared much of its mitigation approach, including specific examples of local and more remote mitigation opportunities, with EPA and other state and federal agencies of jurisdiction. EPA has apparently chosen to ignore these communications. On the contrary, the agency assumed in its mine development scenario that nothing meaningful would be done. This becomes apparent in EPA's own "no-failure" scenario, which assumes many significant unmitigated project impacts, to fish, their habitats and wetlands.

- The "no-failure" scenario assumes outright unmitigated loss of about 100 km of "potentially anadromous fish spawning and rearing habitat" within the project footprint.
- It assumes unavoided and/or unmitigated adverse temperature impacts associated with treated site water release.
- It assumes unavoided and/or unmitigated degradation of resident and anadromous fish habitat downstream of the mine development. It assumes unavoided and/or unmitigated fragmentation of wetlands along the transportation corridor and the cutting off of shallow groundwater to known spawning areas.

<u>EPA Response:</u> The personal communications mentioned in this comment are not public and were not considered to be citable. As described above, compensatory mitigation is considered after an assessment determines whether it would be needed. Appendix J in the revised assessment addresses the potential for compensatory mitigation.

5.101 The assumed project does not meet the environmental standards that would be imposed today on a real project.

The Assessment implies that mine closure will be inadequate and that the owner will not be responsible for environmental liability. This assumption is not realistic: comprehensive analyses and adequate bonding to maintain the site in perpetuity, including monitoring, maintenance, and upgrading or replacement of treatment systems as new technologies are developed, would be necessary before any development could be permitted to proceed.

EPA Response: We did not make this assumption in the assessment, but it is a possibility given the history of mining and institutional failures in general. No change required.

5.102 The analysis [“Active Metal Mines of the Fraser River Basin and Fish – Case Studies” by Oscar Gustafson (2012] identifies several reasons for its conclusion that the four active metal mines studied present very low risks to fish, fish habitat, and fisheries resources of the Fraser River watershed.

> The disturbance footprints of the four mines examined do not directly impact fish habitat that is critical to fisheries, and thus these mines have been sited appropriately. Any direct impacts to fish habitat at these mines are addressed by regulation under the federal Fisheries Act and application of the no-net-loss of fish habitat policy of Fisheries and Oceans Canada.
>
> (6) Salmon are a resilient species that originate from multiple reproducing populations, have a high reproductive capacity, display variable life histories, opportunistically colonize new habitats, and can recover from disturbance provided natural processes and variability are restored. Mines, including those assessed in this paper, have a finite life and closure plans to restore pre-disturbance conditions. Salmon that may have been displaced by mining have the potential to recolonize areas following mine closure or a temporary disturbance such as an accidental spill.

EPA Response: The comment states that mines have “closure plans to restore pre-disturbance conditions.” It does not explain how the pit, waste rock piles, and tailings storage facilities would be restored to pre-disturbance conditions.

5.103 “Summary Review of Fish Habitat: Flow Dependencies and Methods for Evaluating Flow Alteration Effects” by Dudley W. Resier, Ph.D. (2012)

Determining the amount of water needed to maintain and protect aquatic ecosystems and important fish populations has been an ongoing debate among fish ecologists and water resource users for over 50 years, Fundamentally, there are two different functions that streamflow serves relative to fish and fish habitat: 1) streamflow provides physical space within which fish and other aquatic organisms can live, and 2) streamflow provides the necessary energy and forces to create and maintain physical structures and ecological function in and along the channel including pools, riffles, spawning areas (deposition of new gravels and flushing of fine sediments within existing gravels), off-channel habitats, and riparian communities. Both functions are important relative to promoting stream conditions conducive to salmonid production.

In 2008, the Instream Flow Council (IFC) reviewed and described eight case studies that provided real-world examples of how instream flow issues have been addressed under different geographic settings and for different purposes. Three are summarized in this paper to demonstrate just how flow regulation issues have been and can be successfully addressed through application of appropriate instream flow methods.

Terror Lake Hydroelectric Project, Alaska - provides an example of how an instream flow prescription can be designed to achieve no net loss of salmonid habitat. A series of ambitious studies were undertaken that considered the habitat needs of three species of Pacific salmon, as well as hydrology, water temperature, sediment transport and channel morphology. The focus of the fish related studies was on assessing the needs for salmon spawning, egg incubation, and juvenile rearing, which are all flow dependent.

Monitoring results indicated that the construction and operation of the project did not have any adverse effects on salmon production. In fact, post-project salmon returns tended to be higher than pre-project levels. Salmon were also documented spawning further upstream than under pre-project conditions. As a result, there were no changes to the instream flow regime proposed as a result of the postproject monitoring.

This study clearly demonstrates that when the needs of fish are carefully considered and factored into the development and operation of a project, project effects can be avoided and conditions even enhanced over those occurring preproject.

Cedar River, Washington - Instream Flow Agreement and Habitat Conservation Plan - located in western Washington and like many urbanized systems, has been subjected to a long history of engineering actions designed to promote development. The Cedar River maintains populations of sockeye salmon and historically likely supported runs of Chinook and coho. In 1979, the State of Washington adopted instream flows for the Cedar River, although the quantification methods were questioned by several stakeholders.

In 2000, an Instream Flow Agreement and Habitat Conservation Plan were officially signed and implemented. These agreements have resulted in the implementation of numerous flow and non-flow prescriptions designed to protect, mitigate for, and/or enhance habitat conditions of the fish species. An important element of these plans was the development and initiation of an extensive monitoring and research program and adaptive management process designed to provide a feedback loop that allows for modification to the flow actions based on monitoring results.

Trinity River, California - Restoration Program - Trinity River is located in California and has been subjected to various water resource developments since the 1930s all focused around the diversion of flows as part of California's Central Valley Project for irrigation purposes, but have also included construction of several dams and a hydroelectric facility on one of the dams. This led to the subsequent decline of salmon and steelhead populations leading to the formation of the Trinity River Basin Fish and Wildlife Task Force in 1971.

The focus of the task force was to halt degradation of fish and wildlife populations and to formulate a long term restoration plan for the river.

Studies culminated in a Record of Decision for the Trinity River Restoration Program in 2000. One of the key actions specified in the Record of Decision was the provision of variable instream flows based on forecasted hydrology for protection of the fish resources.

EPA Response: Please see response to Comment 5.32.

5.104 The reliability and credibility of the Draft Assessment is highly questionable given the inappropriate use of scientific data available, failure to use applicable fish resource data that was known to the authors, use of scientifically indefensible and unsupported conclusions and assumptions, and the general lack of knowledge of the streams in the hypothetical project area - Bailey makes clear that the Draft Assessment's overall quality, misuse of data, failure to incorporate publically available data that is relevant to the analyses, failure to understand the geomorphology of the stream channels and their relationship to salmon distribution and relative importance have resulted in an analysis that is not defensible scientifically and violates many of EPA's guidelines for development of risk assessments and data quality for information disseminated to the public.

EPA Response: See response to Comment 5.98.

5.105 *General Comment 5:* The Assessment asserts that the alternative scenarios evaluated are "reasonable" and that the impacts described are based on these reasonable scenarios. This statement is demonstrably false; the Assessment does not present or evaluate a reasonable scenario. The best example is the no-failure scenario where EPA assumes that all impacts are mitigated and operations are running smoothly with no major problems. This scenario violates current policy and regulations with respect to mitigation requirements. For example, the scenario assumes the loss of stream channels within the mine footprint, but provides no description or indication that these channels are ever the subject of any mitigation actions. This is simply not possible under current regulations and in fact, the mitigation requirement for the loss of these channels would probably require some multiple greater than one to meet the mitigation requirements of the various agencies.

EPA Response: Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. Nevertheless, in response to public and peer review comments we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

5.106 The Assessment on pages 5-1 and 5-2 states: "*These data [fish distribution] are captured in the Alaska Department of Fish and Game (ADFG) Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes—Southwestern Region (Anadromous Waters Catalog [AWC]) (Johnson and Blanche in press) and the Alaska Freshwater Fish Inventory (AFFI) (ADFG 2012). The AWC provides the State of Alaska's official record of anadromous fish distribution and life-history information (spawning, rearing, or present but life stage unspecified) documented by individual stream reaches"… "AWC and AFFI designations should be interpreted with care because not all streams could be sampled, and there are potential errors associated with fish identification or mapping. Caveats and uncertainties concerning interpretation of AWC and AFFI data are discussed in Section 5.2.4.*"

Comment: The Assessment relies nearly exclusively on the AWC and AFFI databases for the information on fish distribution presented in the document. What the EPA failed to understand or account for in developing the assumptions, analysis, and conclusions presented in the Assessment is that distribution does not account for changes in fish density or more specifically juvenile dispersal behavior. The Assessment's failure to account for these two factors creates a fatal flaw by overestimating the importance of many miles of stream channel to anadromous fish and relies on distribution data that is of poor quality or poorly documented in direct violation of EPA's ecological risk assessment guidelines and information quality guidelines. Specific examples of how EPA failed to understand the limitations and quality of the data they were using are presented within these comments. By overestimating the hypothetical impacts to anadromous fish populations and the failure to determine if the hypothetical loss of stream channel really contributed to population effects, the Assessment fails to provide scientifically defensible analysis and conclusions regarding the impacts of the hypothetical mine development project on the endpoints identified for the ecological risk assessment. Also, EPA failed to heed their own warnings about the potential errors and uncertainties contained in the AWC and AFFI.

<u>EPA Response:</u> The mechanisms of fish dispersal and changes in density are excellent points, and reflect that information on fish distributions in the study area must rely on intermittent site visits during periods when the region and its streams are accessible and suitable for effective sampling. Given the logistical challenges of sampling fish in this environment, it is reasonable to conclude that the current databases provide an incomplete description of the complete distribution and abundance of fish in the study area, and may well be an underestimate. We have explained these limitations in the assessment.

5.107 The Assessment on page 5-2 states: "Chum salmon have been found in all three site watersheds and in the stream [coded as SFK 1.190] under the footprint of tailings storage facility (TSF) 3…"

Comment: While this statement in the Assessment is technically correct, the authors failed to put the chum salmon distribution in SFK 1.190 into proper scientific context. What the Assessment should have stated is that 28 chum salmon were counted in the lower ~4 km of the channel during a 7/15/2008 aerial survey. Aerial surveys and some ground surveys in the same stream in 2004-2007 failed to document any chum salmon. The 2008 sighting was the first documented observation of adult chum salmon in this stream. The statement as written in the Assessment leaves the reader with the impression that chum salmon are a routine part of the fish assemblage in SFK 1.190, but in fact the evidence would suggest that chum salmon are not a routine species found in this stream and therefore, the ecological implications to chum salmon from building the hypothetical TSF 3 are unknown.

<u>EPA Response:</u> We did not use the AWC or the AFFI to estimate abundance for several reasons. These reasons include the lack of sufficient detail to extrapolate robust population estimates from observations and the recognition that, even if available, abundance can provide a misleading indicator of habitat quality or importance. This comment assumes that if low numbers of fish are documented for a site, the habitat is somehow of low or lesser importance. This is a faulty assumption for several reasons:

- **Sampling in the study area is difficult. Information on fish distributions in the study area must rely on intermittent site visits during periods when the area and its streams are accessible and suitable for effective sampling. Given the logistical challenges of sampling fish in this environment, it is quite reasonable to conclude that the current databases provide an incomplete description of the complete**

distribution and abundance of fish in the study area, and may well be an underestimate.

- **Some habitats are seasonally important. Fish may be absent from a site during portions of a year, but present in high abundances at other times. Low abundances at one point in time do not necessarily equate to low abundances at another point in time, nor does this mean that the habitat is not important.**
- **Sites with low abundances during years with low adult escapement may have high abundances during years with higher survival or escapement, allowing populations to respond to favorable conditions. .**
- **Sites with low apparent abundances of target species (e.g., salmon) may provide habitat for other fish species, macroinvertebrates, or other components of the food web essential for ecosystem function.**
- **Sites with low abundance may provide important services to downstream waters, including regulation of water quality or flows, or supplies of materials.**

Given these factors, it is not possible to conclude that streams with low fish abundances observed under a particular sampling regime are somehow unimportant. They can in fact be very important, as is well known and documented within the ecological and fisheries literature detailed in the assessment.

5.108 The Assessment on page 5-2 states: "*Sockeye salmon also use the mainstem reaches of all three site watersheds for spawning and rearing, including a portion of Upper Talarik Creek that is within the waste rock footprints of both the minimum and maximum mine sizes (Figure 5- 3). Chinook salmon spawning has been documented throughout the mainstem reaches of the site watersheds (Figure 5-4). Chinook salmon are known to use small streams for rearing habitat, and juveniles have been observed in streams that are in the TSF 1 (North Fork Koktuli River), TSF 3 (South Fork Koktuli River), and waste rock pile (Upper Talarik Creek) footprints (Table 5-1, Figure 5-4). Coho salmon have the most widespread distribution of the five salmon species in the site watersheds, making extensive use of mainstem and tributary habitats (Figure 5-5). Coho salmon rear in the majority of the headwater streams that would be eliminated or blocked under both mine sizes (Figure 5-5). Dolly Varden are found even further upstream than Coho salmon, and fish surveys indicate that they are commonly found in the smallest streams (i.e., first-order tributaries) throughout all three site watersheds (Figure 5-6). Their occurrence is limited above Frying Pan Lake, although they have been found in high-gradient streams draining the west side of Koktuli Mountain*".

Comment: While Figures 5-3, 5-4, and 5-5 accurately duplicate the information from the AWC and AFFI, and the statements made are technically true, they mislead the reader about the importance of streams in the hypothetical mine area to anadromous fish. While the text appropriately explains that the distribution of Dolly Varden is limited upstream of Frying Pan Lake, the paragraph fails to place similar caveats on the distributions of sockeye, Chinook, and Coho salmon which in turn misleads the reader about the importance of these areas to anadromous fish populations.

While the AWC shows sockeye salmon juvenile rearing in the mid-watershed of the South Fork Koktuli and the southern portion of Frying Pan Lake, the authors of the Assessment were insufficiently familiar with the sockeye data to determine that the distribution of sockeye in the vicinity of the hypothetical mine site is highly questionable. The distribution in the AWC is based on the capture of four juveniles in 2004 that were probably misidentified. The voucher specimens were lost and the fish captured were young-of-the-year (yoy) with a single one-year old juvenile. These fish were captured in Frying Pan Lake, which is loaded with northern pike. Only an occasional spawning sockeye has been observed upstream of the "South Fork Springs" area in the vicinity of SFK 1.190, miles downstream of Frying Pan Lake. Also, no explanation was provided by the capturing entity as to how yoy sockeye made their way to Frying Pan Lake and how a one-year old juvenile exists in a river system that supports a "river type" sockeye run where the yoy fish leave the river in late spring and early summer.

The AWC reports the distribution of Chinook salmon, but the Assessment fails to recognize that Chinook are only occasionally observed spawning upstream of the South Fork Springs, with a maximum of about 20 adults and that the distribution of juvenile Chinook in the South Fork Koktuli River upstream of the Springs area is limited to an occasional single or few individual juvenile fish. Also, the Chinook distribution in the TSF 1 watershed is also limited to a few juveniles, with no spawning documented in that watershed. Chinook salmon spawning in the upper portion of the Upper Talarik Creek watershed is limited to a few individual adults.

Coho salmon distribution, while accurate, fails to place the distribution in an ecological context. For example, the Assessment concludes that "Coho salmon rear in the majority of the headwater streams that would be eliminated or blocked under both mine sizes …". However, what the Assessment fails to do is realize that the Coho distribution in the South Fork Koktuli River in and upstream of Frying Pan Lake is limited to less than about 20 juveniles captured during years of sampling effort. Adult Coho are occasionally observed spawning in a spring area a mile or so downstream of Frying Pan Lake on the main stem South Fork Koktuli. The assertion in the Assessment that Coho rear in a majority of headwater streams needs to be placed into the proper ecological context for the reader. The Assessment fails to do this and as a result is fatally flawed because it erroneously exaggerates the inferred risk/impacts to fish.

The Assessment failed to recognize several fundamental facts, which results in fatally flawed and scientifically indefensible assumptions and conclusions. These problems start with the EPA's lack of knowledge regarding fish distribution and density in many of the streams in and adjacent to the hypothetical mine facilities. The lack of knowledge that much of the anadromous fish distribution reported in the AWC and AFFI is based on the capture of a single individual juvenile or a few juveniles that periodically occupy some stream segments. Lacking such knowledge, the Assessment then ASSUMED that what was in the AWC constituted fully seeded anadromous fish habitat. This is far from factual and using this assumption results in the Assessment overstating the anadromous distribution's relative ecological contribution to the overall anadromous fish population in the hypothetical mine area. Also, in the South Fork Koktuli, EPA is apparently unaware of a reach of stream, upstream of the South Fork Springs to about where the main stem channel turns north towards Frying Pan Lake; that periodically becomes ephemeral in the summer and may freeze solid during the winter. This feature limits anadromous fish distribution upstream of the “Springs” area and explains the general lack of anadromous fish spawning and rearing upstream of the Springs and the erratic spatial and temporal distribution of a few anadromous fish juveniles in this upper portion of the South Fork watershed. The same general lack of EPA knowledge regarding anadromous fish density in the North Fork Koktuli and Upper Talarik Creek watersheds have led to the same faulty assumptions and conclusions. The EPA’s general lack of knowledge about the area, reliance on the AWC and AFFI, faulty assumptions regarding fish densities, and failure to scientifically assess the ecological importance of these factors to the overall anadromous fish population results in the very foundation of the Assessment being fatally flawed.

The EPA’s lack of knowledge regarding the physical setting of the hypothetical mine development area, failure to properly vet the quality of the information contained in the AWC and AFFI (and heed their own warnings about data quality and limitations), failure to use voluminous and publically available data on fish distribution and density that would have properly informed the Assessment, and failure to place the appropriate fish distribution and density information into an ecological context that would have changed many of the faulty assumptions and conclusions reached in the Assessment and results in an Assessment that has no scientifically defensible foundation on which to base an ecological risk assessment.

Because of these fatal flaws, the Assessment fails to meet EPA’s ecological risk assessment and data quality guidelines and as a result presents only part of the available data; contains numerous faulty assumptions, which in turn reaches faulty conclusions; and ultimately results in an ecological risk assessment that is not based on scientifically defensible data or analyses.

EPA Response: See response to Comment 5.107.

5.109 The Assessment on page 5-10 states: “*Some aerial index counts of spawning salmon are available. These are primarily used as a crude index to track variation in run size over time, and we report values here recognizing that they tend to underestimate true abundance by a large and unknown factor (Jones et al. 2007)*”.

Comment: The Assessment misrepresents the conclusions of Jones et al. (2007). While Jones et al. (2007) does state that aerial surveys that are conducted sporadically or as peak counts only can produce estimates that are highly questionable, they also state that good spawning escapement estimates can be made using multiple counts throughout the spawning run, having good estimates of stream life, and using the area-under-the-curve methodology.

EPA Response: Neither of the data sources that we reported (ADF&G and PLP) used area-under-the-curve methodology. PLP used multiple counts throughout the spawning period, but was unable to quantify stream life and observer error, so they reported raw survey counts. We revised our language to indicate that repeat survey counts can be used for population estimates in cases where estimates of stream life and observer efficiency are available.

5.110 The Assessment on page 5-10 states: “*It must be stressed, however, that surveys coinciding with the peak of spawning activity underestimate true abundance because (1) an observer in an aircraft is not able to count all of the fish in dense aggregations and (2) only a fraction of the fish that spawn at a given site are present at any one time (Bue et al. 1988, Jones et al. 2007). Additionally, surveys intended to capture peak abundance may not always do so.*

Thus, we present the ADFG data recognizing that the true spawner abundance is probably substantially higher than the values presented here".

Comment: The Assessment misrepresents at least one of the references cited (Jones et al. 2007) with respect to the problems associated with peak counts. While Jones et al. (2007) does acknowledge that fish density does create more potential error for the counter, what Jones really states is: "Many programs use peak counts for index purposes, but it is well understood that these counts do not represent the total escapement due to variability in run timing and stream life. [Emphasis added]. At best, observers will get an index (an unknown proportion) [Emphasis added] of the adult salmon returning to spawn, even if corrected for the changing population." What Jones et al. (2007) really states is that peak counts are influenced by myriad factors including: observer experience, species being counted, water clarity and overhanging vegetation, run timing, stream life, and fish behavior to name several. Contrary to EPA's statement, Jones et al. (2007) does not conclude that "… true spawner abundance is probably substantially higher…" What Jones et al. (2007) concludes is that at best you will get an index of an unknown proportion of the spawning run. The Assessment draws an unsubstantiated and scientifically unsupportable conclusion that peak counts substantially underestimate spawner abundance.

<u>EPA Response:</u> We did not state or imply that Jones et al. (2007) made the above conclusions. Our conclusions are supported by the text and data presented in Jones et al. (2007) and Bue et al. (1998). We revised the text regarding systematic underestimation of spawning abundance by aerial index counts, but we stand by the assertion.

Jones et al. (2007) discuss the uncertainty associated with spawner survey counts, mention that "humans are overly conservative and tend to underestimate versus overestimate when counting objects," and state that "At best, observers will get an index (an unknown portion) of the number of adult salmon returning to spawn…" Our choice of the word "substantial" was based on the site-specific multipliers that managers use to convert aerial index counts into escapement estimates (i.e., 1.5 and 5.2 for helicopter surveys of Chinook salmon, 2.5 for fixed-wing surveys of pink salmon; see Jones et al. 2007).

Bue et al. (1998), working with fixed-wing surveys, state, "Our study indicates that aerial observers tend to under-count pink salmon in Prince William Sound spawning systems." They showed that aerial surveys counted, on average, only 44% of the fish counted in food surveys.

Finally, we included some examples in the text showing the magnitude to which aerial counts can underestimate abundance relative to more reliable census/survey methods.

5.111 *The Assessment on page 5-10: Table 5-1*

Comment: The Assessment needs to explain why there are zero counts presented in Table 5-1. Given the tendency for fish to be present in each year, the Assessment needs to be rewritten to explain to the reader why or how these zero counts were obtained.

<u>EPA Response:</u> The table (Table 7.1 in the revised assessment) has been clarified to indicate that these are years during which no counts were conducted.

5.112 The Assessment on page 5-10: Table 5-1 contains a footnote that concludes: "*a Values likely underestimate true spawner abundance by a substantial amount*".

Comment: The Assessment needs to be rewritten to provide a scientifically defensible argument and rationale as to why the "highest reported index spawner counts" would "… underestimate true spawner abundance by a substantial amount". This nothing more than uninformed speculation by the Assessment and certainly does not meet any acceptable scientific standard of rationale and documentation.

<u>EPA Response:</u> We removed mention of "substantial" and included examples from the literature showing the extent to which aerial counts can underestimate abundance relative to more reliable census/survey methods. There is considerable support in the literature for systematic underestimation of spawning populations by aerial index surveys. See responses to Comments 5.11 and 5.110.

5.113 The Assessment on page 5-11 states: "*Because of difficulties in establishing reliable estimates of observer efficiency, the EBD [Environmental Baseline Document prepared by PLP] reports the average of each year's index counts as an abundance index for each population. Instead, we report the highest of each year's index counts for each population (Table 5-1), because this number is closer to the true abundance, and the averaged estimates reported in the EBD are often pulled downward by counts outside of the spawning period when no fish were counted …*"

Comment: The Assessment fails to provide a scientifically defensible rationale and documentation of why the Assessment continues to reach the conclusion that information obtained from aerial spawning survey counts "substantially underestimates the true abundance". Since no information is presented in the Assessment regarding the methodology or condition under which the information displayed in Table 5-1 was obtained, no scientifically defensible conclusion may be reached regarding the values presented in Table 5-1 and whether they are fairly accurate, have a high variance, or are either high or low. Also, the Assessment provides no rationale or scientifically defensible argument as to why the authors can reach the conclusion that "…the highest of each year's index counts for each population (Table 5-1), because this number is closer to the true abundance…". The Assessment, by failing to present a coherent presentation of the logic and rationale used to reach the several conclusions regarding adult salmon abundance in the hypothetical mine project area, violate EPA's ecological risk and data quality guidelines and instead presents information that is both misleading and scientifically unsupportable.

<u>EPA Response:</u> See response to Comment 5.112.

5.114 The Assessment on page 5-11 states: "*The overall highest count was for sockeye salmon in Upper Talarik Creek in 2008, when approximately 82,000 fish were tallied. For the reasons discussed in the previous paragraph, the reported index values probably underestimate true spawner abundance by a substantial amount*".

Comment: Again the Assessment fails to present a coherent presentation of the logic and rationale used to reach this conclusion. This is particularly true since the Assessment is stating that the absolute maximum count under represents the spawning run, without presenting any information about the methodology or quality of the data being evaluated. It is abundantly clear that the EPA lacks even a rudimentary understanding of the methods and limitations used to estimate adult salmon spawning population levels.

<u>EPA Response:</u> See response to Comment 5.112.

5.115 *Section 5.1.2 page 5-10: Spawning Salmon Abundance*

Comment: This is a General Comment regarding this specific section. Although the Assessment claims to be an ecological risk assessment on the effects of a large-scale mine development scenario on the Bristol Bay or Kvichak/Nushagak watersheds (take your pick on which area is really being evaluated, depending on which section of the Assessment you are reading), the information presented in this section on spawning salmon abundance only discusses some unknown portion of the Koktuli River (ADFG counts) and Upper Talarik Creek and the North and South Fork Koktuli's in the vicinity of the Pebble deposit. The Assessment fails to put the numbers from this limited discussion of the area into context with the remainder of which ever watershed you choose. There is no context in which to place the information presented in terms of the ecological risk to the salmon populations of the entire Kvichak or Nushagak watersheds. Also, there is no information regarding the genetics of the anadromous populations near the proposed mine site, which would inform the endpoints for the ecological risk assessment outlined in Chapter 3 of the Assessment. No comparison is shown between the various spawning streams within a particular watershed from which the reader could make a reasoned evaluation of the relative importance of the salmon populations in the vicinity of the hypothesized mine area with the watershed as a whole. For example, inclusion of the number of miles of stream channel used for spawning in the hypothetical mine development area and the number of miles that would be eliminated by the hypothetical mine development should be compared with the total miles of stream used as spawning areas in the watershed. In other words, all of the spawning population numbers should be placed in the context of the entire watershed and presented in the Assessment. It is only in this manner, that a true understanding of risks to watershed fish production and harvest can be achieved. Such a standard has not been met by EPA.

<u>EPA Response:</u> In the revised assessment we now provide a quantification of streams and rivers at geographic scales ranging from the Bristol Bay watersheds to the mine footprints and transportation corridor. These characterization results provide insights into the distribution of broad-scale habitat conditions within the watersheds against which specific stream losses (e.g., to the footprint, or transportation corridor) can be evaluated.

5.116 The Assessment on page 5-11: *Section 5.1.3 Juvenile Salmon and Resident Fish Abundance*

Comment: The Assessment implies that information presented in the EBD is only qualitative and densities are expressed as counts per 100 m reach. The Assessment also concludes that the only quantitative density estimates from the general area come from (O'Neal and Woody 2012). However, EPA should have evaluated the quantitative data presented at a Fish Technical Work Group meeting in 2008 and information from the 2004 Annual Progress Report for Fish and Aquatics distributed by Northern Dynasty in 2005. This information is publically available and contains site specific quantitative fish density estimates that were from the mine footprint and not used in the Assessment.

EPA Response: The revised assessment now includes fish density information (e.g., see Section 7.1.3).

5.117 *Section 5.1.3 page 5-11 Juvenile Salmon and Resident Fish Abundance*

Comment: Same as Spawning Salmon Abundance

EPA Response: See response to Comment 5.115.

5.118 *Figure 5-8*

Comment: Figure 5-8 does not list all of the stream gages in the three watersheds. Numerous other stations associated with the Pebble area are in place, but not depicted in Figure 5-8. The title of the figure should either be corrected or the map should be revised to reflect the title of the figure.

EPA Response: This figure has been replaced and is no longer part of the revised assessment. Gage locations are incorporated into Figures 6-8 through 6-10 and Figures 7-15 through 7-17; data sources are indicated in the captions of these figures.

5.119 *Section 5.2.1 Habitat Lost or Blocked in the Mine Footprint: Entire Section pages 5-12 to 5-21*

Comment: This entire section of the Assessment is based on inappropriate use of information contained in the AWC, failure of EPA to assert an appropriate level of QA/QC to the data they were using to develop the assumptions and conclusions in direct violation of EPA's Ecological Risk Assessment Guidelines, failure by EPA to heed its own warnings regarding the reliability of the information contained in the AWC and AFFI, failure by EPA to understand and correctly interpret the information available on salmon distribution and relative abundance, failure by EPA to appropriately determine the importance of various streams in relation to salmon spawning, failure by EPA to acquire even a rudimentary knowledge of the ecology and life history patterns and population level implications of salmon associated with the mine footprint, incorporates totally inappropriate and scientifically invalid examples as to the importance of adjacent land areas (reference to Northeast U.S. studies) to stream inputs, failure by EPA to assess the limiting factors for fish production (e.g., water chemistry and climate) and a failure by EPA to place any of the information used (even that which is correct) in an ecological context with the salmon populations and available habitats in the Kvichak and Nushagak watersheds.

As a result of these failures, the Assessment greatly overestimates the kilometers of stream channel that are truly used by salmon and even more importantly fails to determine the kilometers of loss of channel that are ecologically important to salmon. The Assessment also overstates the importance of these headwaters channels to the overall salmon population and the ecological importance of these channels to salmon. Listed below are some examples of the kinds of information that EPA should have obtained and evaluated before this section of the Assessment was written:

The information contained in the AWC is not reliable and the information displayed in some instances does not meet the requirements of the Alaska Administrative Code (AAC) with respect to the AWC. The AAC states: *"5 AAC 95.011. Waters important to anadromous fish* *(a) An Atlas to the Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes, and the Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes, as revised as of March 2009, are adopted by reference. The six volume atlas is a compilation of topographic maps upon which are specified, as provided in AS 16.05.871(a), the various rivers, lakes, or streams, or parts of them, that are important [Emphasis added] for the spawning, rearing, or migration of anadromous fish."* What EPA should have determined, if they had followed their own Ecological Risk Assessment Guidelines regarding data quality and the process and examples cited on how EPA will determine the quality of the data used in an assessment, is that the information in the AWC does not include waters that are "important" to anadromous fish in this area. What the authors would have discovered is that the AWC currently includes, in many cases, just the mere presence of a single individual, without a considered assessment by ADFG as to the importance of the location to the anadromous fish population.

- Coho spawning habitat lost by hypothetical TSF 1 is true. However, what they would have discovered is that generally less than 10 fish have been observed spawning in this stream. They would have been able to place this fact in context with the thousands of coho spawning in the North Fork Koktuli and in the ecological context of coho in the Nushagak watershed as a whole.
- No spawning by any salmon has been documented within the mine footprint on the South Fork Koktuli.
- Sockeye spawning in the vicinity (upstream of tributary UT 1.350, Northeast Tributary) of the waste rock storage facility on Upper Talarik Creek has generally consisted of less than 100 fish, with one documented instance of approximately 500 fish, when over 50,000 fish were counted in the main stem Upper Talarik Creek. It appears that an increase in sockeye spawning density in the upper portion of the watershed is density dependent.
- Chinook salmon spawning in the vicinity (upstream of tributary UT 1.350, Northeast Tributary) of the waste rock storage facility on Upper Talarik Creek has generally consisted of less than 20 fish.
- Sockeye salmon distribution in the South Fork Koktuli in Frying Pan Lake consisted of four (high probability of misidentification) individuals 70 mm or less in length.
- Coho and Chinook salmon found in the South Fork Koktuli upstream of Frying Pan Lake have consisted of a single juvenile or less than 20 individuals.
- If EPA had used all of the publically available habitat data, they would have discovered that every channel in the TSF 1, South Fork Koktuli upstream of Frying Pan Lake, and Upper Talarik Creek upstream of tributary stream UT 1.350 has been surveyed for habitat conditions and fish distribution. This knowledge would have prevented the Assessment from making the scientifically indefensible statement that the number of kilometers of channels is underestimated. This fatal flaw in the methodology and general lack of understanding of the relevant data from the area clearly demonstrate that the Assessment is not based on good science or even on all of the publicly available information.
- Key water chemistry parameters (alkalinity, hardness, and nutrients) are limiting fish production in these portions of the three watersheds. The Assessment's failure to evaluate

the water chemistry in relation to the hydrology of the area and impacts on primary productivity lead to false conclusions about the productivity of the streams and the importance of allochthonous inputs from adjacent riparian areas. Also, an examination of the water chemistry data available would have enlightened the authors about the diluting influence that groundwater has on surface waters in the vicinity of the hypothetical mine development.

EPA Response: The main points of this comment and our responses to these points are summarized below. It is also important to note that even if abundance data are available, they can provide a misleading indicator of habitat quality or importance. Contrary to our position, this comment assumes that if low numbers of fish are documented for a site, the habitat is somehow of low or lesser importance. This is a faulty assumption for several reasons (see response to Comment 5.107).

- ***Comment: Data quality of AWC does not meet EPA's risk assessment guidelines.***

  Response: We rely on the expertise of the ADF&G biologists that review nominations for inclusion in the AWC. The limitations of the AWC have been included in Section 7.24.

- ***Comment: Data contained in the AWC are not important to salmon.***

  Response: Headwater streams comprise a large proportion of the stream network and provide habitat important to different life stages for multiple stream fishes. See next response for a discussion of the limitations of the existing data for determining differences in abundance between stream reaches or habitats.

- ***Comment: EPA did not include PLP data on the numbers of fish found in the mine footprint areas.***

  Response: The available data for the area were not adequate to conduct a population assessment that could be used to quantify the numbers of fish lost under the mine footprint. Relative abundance estimates from PLP's sampling programs do not meet data quality guidelines due to the variety of fish sampling methods used, all of which have different biases in fish capture probability, the lack of capture efficiency information for any methods, different timing of sampling from year to year, and non-probabilistic sampling design limiting extrapolation to the larger stream network.

- ***Comment: Water chemistry is limiting fish production.***

  Response: Examination of factors limiting salmon production was not an objective of the risk assessment. Cold stream temperatures and low nutrient concentrations may affect production of food resources for stream fishes, but this is true throughout the watersheds and not limited to just the mine footprint area [Pebble EBD on water quality shows that nutrients do not increase downstream (9.1-25]).

- ***Comment: All of the salmon habitat has been mapped, thus the AWC is not an underrepresentation of the available salmon habitat.***

<u>Response</u>: Section 7.2.4 acknowledges that fish distributions in the mine footprint area reflect a large amount of sampling effort, but accurate observations of fish distribution are biased due to many factors, such as fish migration patterns during different times of the year, the relationship between the hydrologic regime at the time of sampling and habitat availability, the success rate of the returning year class, and the capture probability given the sampling method used. In addition, despite the surveying efforts of PLP biologists, other surveys in small streams have added significant mileage to the AWC in the area of the Pebble deposit (Woody and O'Neal 2010).

- ***Comment: Fish populations impacted by mine footprint were not placed in the context of the entire Nushagak and Kvichak watersheds.***

<u>Response</u>: Since a population assessment does not exist for the mine footprint area, these fish resources could not be compared to the population assessments for the Nushagak and Kvichak conducted by ADF&G for the important sport and commercial species.

Background data on water chemistry is now presented in Chapter 3. Information on fish distribution and abundance near the Pebble deposit, and potential effects of mining, are presented in Chapter 7. Evaluation of potential effects of mining on water quality, and potential for dilution by groundwater, is addressed in Chapter 8.

5.120 The Assessment on page 5-22 states: "*The alteration in stream flows resulting from mine operations was estimated by reducing the flows recorded at existing stream gages (Figure 5-8, Table 5-5) for the site watersheds by the percentage of the expected surface area lost to the mine footprint and the area of any drawdown caused by groundwater flow back to the mine pit or locations of dewatering operations (Table 5-6, Box 4-9)*".

Comment: The Assessment provides no documentation or scientifically defensible logic or rationale to support the assumption that stream flows downstream of the mine footprint would be reduced in proportion to the area of watershed reduced. This assumption has no foundation. What if flow reductions are less than a 1:1 ratio or what if the reductions are greater? The assumption is simply not valid without specific documentation or a site-specific analysis to support the conclusion. Without such an analysis, the information and analyses presented in Tables 5-5 and 5-6 are not scientifically defensible. The flow reduction analysis for Upper Talarik Creek presented in Tables 5-5 and 5-6 is fatally flawed and invalid. Table 5-5 fails to include watershed and flow information from gaging station UT100A, which is much lower in the watershed than UT100B and includes inflow from a major tributary stream, UT 1.60. By failing to use flow information from this station, the Assessment overstates the effects of flow reduction in the Upper Talarik Creek watershed.

<u>EPA Response:</u> The revised assessment includes a more comprehensive water balance accounting of water use, storage, and flow among mine components and water sources and sinks.

5.121 The Assessment on page 5-23 and 5-24: *Tables 5-5 and 5-6*

Comment: The Assessment uses mean annual flow to support the assumptions and conclusions regarding flow reduction impacts as presented in the two tables. What the authors failed to understand is that mean annual flow is absolutely meaningless from an ecological perspective as related to fish production. The mean annual flow does not provide a basis for evaluating the impact of flow reductions on the life history and survival of salmon populations. What is important to salmon is the flow volume and water velocity in spawning areas, the associated water temperature, the amount and quality of water supporting egg incubation and emergence from the gravel, the presence of upwelling or downwelling areas, and the associated water temperature regime in the gravel during egg incubation. It is obvious that the Assessment displays no functional knowledge of salmonid ecology and life history requirements. This portion of the Assessment should be rewritten and the analysis re-done at the appropriate geographic scale in order to provide any scientifically defensible information to inform the ecological risk assessment.

EPA Response: We concur that flow is only one aspect of the habitat requirements for salmon. Also see response to Comment 5.82.

5.122 The Assessment on pages 5-28 and 5-29: *Section 5.2.2.2 Stream Temperature*

Comment: The Assessment presents general information on the importance of water temperature to salmon, but never provides any data or analysis to support any conclusions regarding the mine development scenarios on water temperatures. In fact, the Assessment states on page 5-29: “Projecting specific mining-associated changes to groundwater and surface water interactions in the mine area is not feasible at this time”. This statement appears to be in direct conflict with the conclusion reached in the conceptual model presented in Figure 3-2A which shows a decrease in winter temperatures and an increase in summer temperatures. How are these conclusions justified in the conceptual model, when the text of the Assessment concludes that no projections in water temperature changes are possible at this time? The Assessment appears to be internally inconsistent and scientifically indefensible because no temperature analysis was conducted, yet the conceptual models provide input to the endpoints based on no credible information or analysis. The remainder of the water temperature section of this Assessment is just filler and provides no useful information to the reader upon which they might reach a conclusion regarding the risk of changes, if any, to the salmon populations in the hypothetical mine area and certainly no information to inform an ecological risk assessment for the Kvichak and Nushagak watersheds.

EPA Response: Chapter 8 of the revised assessment provides a description of current thermal regimes in the mine scenario watersheds and discusses risks associated with potential alterations due to WWTP discharges under routine operations. The conceptual models have been updated and now indicate change to thermal regimes, with no inference of direction.

5.123 The Assessment on pages 5-29 to 5-45: *Section 5.2.2.3 Fish Populations*

Comment: The Assessment in Section 5.2.2.3 presents an analysis of altered stream flow on fish populations in the hypothetical mine development area. The Assessment also uses the sustainability boundary approach described by Richter et al. (2011) in order to establish hypothetical impacts to fish populations using a 0-10, 11-20, and 20+ percentage changes in daily flows. The use of this approach is fundamentally and fatally flawed and scientifically invalid for a number of reasons. First, Richter et al. (2011) clearly state that the sustainability boundary approach they propose is a “default placeholder” in lieu of site specific data. They make no claims that their range of percentage changes in daily flows apply to Pacific salmon or Alaska in specific. In fact, the case studies cited as examples and the supporting documented studies range from Australia to Central America, to Maine, and the upper Midwest of the U.S. They do cite one U.S.G.S. study that evaluated flow changes in the 0-25% range, but provide no specific data from this particular study. Second, the Assessment provides no data or analysis to support the selection of the ranges in daily flow reduction from Richter et al. (2011) as being applicable to Alaska, to salmon in general, and certainly not specific to the hypothetical mine development area. The fact that the Assessment fails to mention or develop a rationale or scientifically defensible logic as to why Richter’s recommendations were chosen invalidates this entire portion of the Assessment. Third, the Assessment simply used the ranges of daily flow alteration proposed by Richter et al. (2011) and then speculate that stream flow changes in these ranges will have the same level of impact as proposed by Richter et al. (2011) with respect to salmon populations in the hypothetical mine development are, completely ignoring the life history requirements and sensitivity of salmon populations to mortality factors. Fourth, the Assessment failed to recognize that salmon eggs in the gravel do not require surface water flowing over the top of the gravel substrate in which the eggs are buried in order to successfully incubate and provide habitat for egg-sack fry. It is only at emergence from the gravels that salmon require surface water to facilitate emergence into the water column. Fifth, the Assessment displays mean monthly flow rates in Tables 5-8 to 5-12 and Figures 5-10 to 5-12, which are meaningless in terms of protecting salmon. The time period is inappropriate, since it is daily flows that matter. The Assessment also fails to present the benefits of groundwater inflow in reducing impacts, except as it may be reflected in flows at stream gaging stations.

The Assessment presents a fatally flawed and scientifically indefensible basis and analysis of the potential impacts of flow reductions on fish populations in the hypothetical mine development area. Since the flow reduction analysis is fatally flawed, it cannot be used to support a scientifically defensible ecological risk assessment. Finally, once again, the use of inappropriate data and analysis clearly demonstrates that EPA apparently lacks the professional expertise and scientific credibility to professionally and scientifically develop this ecological risk assessment in accordance with their own guidelines for ecological risk assessment and data quality.

EPA Response: Please see response to Comment 5.82.

5.124 The Assessment on pages 5-45 to 5-47: *Section 5.2.4. Uncertainties and Assumptions*

Comment: This entire section of the Assessment needs to be rewritten given all of the fatal flaws, scientifically indefensible, inappropriate, and unsupported assumptions and conclusions in this chapter of the Assessment. Earlier comments have documented just the major problems associated with the Assessment and its fatally flawed assumptions, analyses, and conclusions. This section of the Assessment should be written by individuals who understand the geography, hydrology, and ecology of the area in the vicinity of the hypothetical mine site. Also, since there is no scientifically valid connections established between the ecological risks within the mine area watersheds and the ecological risk of the whole Kvichak and Nushagak watersheds, this section describing uncertainties and assumptions should be expanded to incorporate those requirements outlined in EPA's ecological risk assessment guidelines and data quality guidelines.

EPA Response: The assessment has been revised to more clearly follow the ecological risk assessment guidelines. The data quality objectives guidance addresses the generation of new data, but this assessment uses existing data.

5.125 *Page 5-48 §3:* This paragraph states, "[d]uring the start-up phase, all water from the site would be collected and used in operations." This assumption is unwarranted and unlikely.

EPA Response: The discussion of hydrology and water management has been revised and expanded. It no longer contains the statement referenced in the comment.

5.126 *Page 5-53 §5:* This paragraph deals with the EPA's new National Ambient Water Quality Criteria for Cu, which incorporate the use of a "biotic ligand model" (BLM), which accounts for the observed effects of Cu on aquatic organisms as a function of the amount of *free* metal (and, to a lesser extent, $Cu(OH)_2$) present that is bound competitively (with Ca and other cations) to organic ligands or receptors on exposed sensitive tissues of an aquatic organism (*e.g.*, fish gills). EPA correctly asserts that their new model is an advance over the older hardness-based criteria. Several investigators have recently confirmed that the EPA's BLM is protective of olfactory impairment in salmon, but that further refinements, including application to salt water, are warranted. See, for example, Meyer *et al.* 2010, DeForest *et al.* 2011 and Meyer *et al.* review MS 2012. These investigators concluded that the olfactory-based BLM should use Ca and Cu binding constants that are 16 and 4 fold higher than the branchial model, but the Na and Mg binding constants should be 32- and 126-fold lower than in the branchial model. EPA should consider revising its model to take account of the results of this research.

EPA Response: Those studies were already cited and discussed in the assessment. Their conclusion is that the EPA's BLM model for copper need not be changed. No change required.

5.127 Page 5-58 §3: Risk Characterization – The EPA's Biotic Ligand Model has been shown independently to be fully protective of salmonids in a large number of waters of the western United States and British Columbia, but could be improved further. See comment immediately above (5-53 §5).

EPA Response: See response to Comment 5.126.

5.128 Most assessments included in the report lack discussion of effect magnitude, frequency, duration, and reversibility. These principles are fundamental to effects assessments in Canada;

EPA Response: Commented noted, but it includes no specific citations or suggested revisions; no change required.

5.129 Throughout their evolutionary history, Pacific salmon have been confronted with various disturbance ranging in magnitude, frequency, duration, and predictability. Disturbance types include, but are not limited to, volcanism, landslides, floods, and anthropogenic impacts. Although salmon population extinctions are also a part of their history, on the whole, salmonids have evolved biological and distribution characteristics, such as existence of numerous, semi-discrete breeding populations, high reproductive capacity, high genetic, phenotypic, and life history plasticity, and opportunistic habitat use that have allowed them to persist following disturbances (Healey 2009, Waples et al. 2009). However, there is no certain definition of the capacity of salmon resilience to anthropogenic disturbances, especially for those that fall outside the bounds (i.e., magnitude, frequency, duration, and/or predictability) of natural perturbations (Waples et al. 2009).

Ecosystem responses to acute disturbance vary as a function of the regional characteristics which maintain salmon habitat, including climate, topography, and vegetative composition (Benda et al., 2004, Montgomery 1999). Thus, disturbance comparisons between regions may be variable in their predictive utility. The EPA (2012) Report authors acknowledge the natural resiliency of salmon populations in the Bristol Bay watershed, and provide a general assessment of the potential decrease in salmon population resiliency that may result from catastrophic mining-related disturbances. This report will expand upon this be exploring the topic of salmon resiliency to disturbance in greater detail.

<u>EPA Response:</u> Comment noted; no change required.

5.130 The source of the hydrology data used for modeling in the EPA Report is not given. For example, Figure 5-8 @ 5-13) indicates “existing stream gages” but there is no information presented on the source of the information, the length of record, or the availability and reliability of these data. The specific locations (i.e., latitude and longitude, or UTM coordinates) of gages used in the analyses are not presented in the report. The approximate gage locations are provided in Figure 5-8, on p 5-13.

In general, the hydrologic analyses presented and discussed are accompanied by insufficient information on the quality of data, and effect of potential errors. The methods for estimating effects of flow interception from mine footprint are only vaguely described, as follows on p, 5-22: “Using geographic information system (GIs) data, the footprint of each major mine component (e.g., pit, TSF, waste rock piles) was determined (Figure 4-7) and divided as appropriate across the boundaries of the three watersheds (Table 5-6). Assuming that no natural flow or uncontrolled runoff would be generated from the mine footprint, the gage record was reduced by the percentage of area lost to mining.”

Figure 2-7 indicates that runoff patterns vary substantially among watersheds in close proximity. Furthermore, the topography, wetland distribution, and hydrology mapping also indicate that seasonal runoff is likely to vary considerably throughout each watershed (e.g., Figures 2-2, 2-4, 5-9). This implies that unit runoff rates likely also vary substantially within watersheds, particularly in large watersheds. The text quoted above, and Figures 5-10 to 5-12 imply that the same unit runoff rates are applied throughout the watershed, though this cannot be confirmed from the test. Implications of assumptions of equal unit runoff are not discussed in the text.

<u>EPA Response:</u> Water balance calculations are described in greater detail in the final assessment. Stream gage data included data provided by the Pebble Limited Partnership (see Table 7-9 for a list of stream gages and gage-specific unit runoff rates). In the revised assessment, we used the three known USGS gages draining the Pebble deposit site to calculate monthly mean flows at each gage over their period of record.

Monthly mean flows for each gage were summed across the year and then averaged across the three gages weighted by their watershed area to produce an area-weighted average net yearly runoff of 860 mm/year for the general deposit area. These data represent the best known publicly available data for the region.

5.131 One potentially large source of error is winter flow measurements. It is not uncommon in northern locations with substantial winter ice, to experience considerable errors in hydrometric measurements due to backwatering, ice cover, over ice flow, device malfunction and high rating curve error. The magnitude and frequency of such errors in this region, or their potential effect on conclusions, is not discussed in the report.

EPA Response: The streamflow data used in the assessment are derived from data provided by the Pebble Limited Partnership (PLP) and USGS. For USGS data, only data approved for publication were used, and USGS data during the winter months are often subject to revision and estimation due to the aforementioned ice cover. As cited in the PLP's EBD, stream gages run by PLP also estimate winter discharge by scaling USGS station hydrographs (see Appendix 7.2A of the EBD). These data represent the best known publicly available information on streamflow in the study area.

5.132 The EPA Report identifies the potential for substantial flow reductions over a relatively short distance downstream of the project footprint, but does not describe how the analysis indicates that the effect quickly attenuates downstream, and does not adequately discuss the magnitude of the impact or its significance to the local populations of salmonids.

The assessment of the effects of flow diversion is based upon a number of key assumptions, such as the particular location of project infrastructure, specific water recapture efficiencies, and the use of watershed area to estimate the loss of inflow from tributaries within the hypotlietica1 project footprint. The assumptions and uncertainties around them are described in some cases, but the specific results and conclusions are not adequately tempered by a description of uncertainty. The report correctly identifies a number of potential effects but does not present an adequate discussion of the potential mitigations, or the magnitude, likelihood, reversibility, or significance of the effects to the productive capacity of the various fish populations. The sustainability boundary approach (Richter et al. 2011) is used as a general tool for exploring the implications of the rate of flow reduction. This method is proposed by Richter et al. (2011) for use in situations where detailed data are limited, and is but one of many potential assessment methodologies. However, in the case of the Pebble project, detailed data are available (e.g., PLP 2011), and detailed assessment methods would be more appropriate. An instream flow study using detailed habitat models would typically be used to quantify the effect of flow diversion on the amount of useable habitat for the species and life stages of fish that inhabit the area that would be affected by flow withdrawal.

EPA Response: We concur with this statement and agree that more detailed flow-habitat studies like those begun by PLP contractors will be useful for managing stream flows; this is acknowledged in the text. Until such studies have been validated and verified, and can be linked to a detailed flow management plan, our use of the precautionary environmental flow approach is supported by the scientific literature and provides a conservative perspective for targeting flow management toward flow regimes likely to be protective of fish communities and habitats in the project area.

5.133 Detailed environmental flow analyses are likely to be required as part of any large mine development, and the conclusions reached by these assessments are likely to differ from the results of a standard-setting approach. Therefore, the provision of mitigation and compensation to offset the effects of flow withdrawals beyond the sustainability boundaries identified by Richter is not considered in a standard-setting exercise, and this likely resulted in an overestimate of effects in the EPA Report.

<u>EPA Response:</u> See response to Comment 5.132.

5.134 A critical component of the presumptive standard is that it is "intended for application only where detailed scientific assessments of environmental flow needs cannot be undertaken in the near term." In the case of the Pebble Project, a great deal of data has been collected, and more -id1 likely be collected in future. We are unsure if detailed instream flow measurements have been taken in the vicinity of the Pebble deposit but, if these data exist, the EPA Report was remiss in not incorporating these into a more sophisticated method of assessment potential impacts of flow on fish and fish habitat. One likely effect of additional data would be to highlight differences among seasons. The Richter (2009) sustainability boundary approach does not account for differences in water needs among seasons, which is an important part of the assessment of the effects of flow withdrawal on streams.

<u>EPA Response:</u> See response to Comment 5.132.

5.135 Another weakness of the EPA Report is that it does not consider how mitigation through flow supplementation might reduce flow alteration. The Richter et. a1. (2011) approach provides presumptive standards assuming that mitigation has not been applied They "urge water managers and engineers to employ innovative options for water storage-such as off-stream reservoirs or groundwater storage" to meet the presumptive standard, thus encouraging mitigation of steamflow alteration.

Richter et al. (2011) are cited four times in the EPA document: pp. 5-30, 5-31, 5-43, and 5-47.

Also missing from the EPA Report's analysis is a geographic analysis of the effects and how this may translate into effects on different species and life stages. For example, the results clearly show that the greatest effects are in the upper portions of the watershed, and that effects on stream flow are quickly attenuated with distance downstream. Since different species and life stages preferentially use different portions of the watersheds, the effects of flow alteration are likely to differ substantially among species. The EPA Report does not provide adequate detail on partitioning the likely effects on different species and life stages, nor does it attempt to place some of the potential effects in a broader context of overall fish production within each affected watershed.

<u>EPA Response:</u> See response to Comment 5.132.

5.136 The BBWA analysis exaggerates the magnitude and complexities of technological strategies to address water collection and treatment and management in postclosure mining operations. Water treatment systems for managing low pH waters are widely used and standard industrial wastewater treatment technologies are widely available. The systems are not technically complex and include such basic treatment steps as pH adjustment, the addition of chemical settling aids, and gravity sedimentation for solids removal. Effluent filtration can also be used to further polish the wastewater to meet discharge permit requirements for suspended solids. The BBWA implies a much higher degree of risk of failure than is justified for the operation of standard technologies in managing wastewaters generated from leachate.

EPA Response: We expect that post-closure water treatment would be required to meet water quality criteria for copper, which would entail a more complex treatment system than is suggested by this comment.

5.137 References were not provided in the report to support the discussion of cumulative risks. The cumulative risks may increase with time, but no discussion is offered on the likely significance of those risks. Similarly, the report refers to "likely instantaneous consequences" which are not supported by references. Standard design and operational procedures will ensure that the failure of any one component of the water collection, treatment, and discharge system will not result in unacceptable discharges to the environment. Standard equipment would include sufficient redundancy to respond quickly to any component failure. This is in contrast to the BBWA implication of inevitable failure of the systems and significant releases to the environment.

EPA Response: The assessment does not state that any failure is inevitable, despite the likely size and complexity of mine development in the Bristol Bay region. The revised assessment describes uncertainties in greater detail.

5.138 One option for the project would be to include such measures as: Creation of spawning channels to increase areas for salmon spawning. These systems have successfully resulted in increased salmon production on river systems such as the Fraser River in Canada.

EPA Response: Opportunities for and limitations of compensatory mitigation are more thoroughly discussed in Appendix J of the final assessment.

5.139 Continuation of "Trinity River, California - Restoration Program" case study presented previously.

- Coupled with results from channel and sediment studies and temperature modeling, three flow-related objectives were identified: 1) flow releases should provide suitable spawning and rearing habitats; 2) flow release should mimic the timing of natural runoff processes; and 3) flow releases should provide temperature objectives for holding and spawning adults.

EPA Response: Comment noted; no change required.

5.140 Pg. 5-61. "Standards for culvert installation on fish-bearing streams in Alaska target road safety and fish passage, but not the physical structure of the stream or habitat quality (ADFG and ADOT&PF 2001)."

The reference cited to support this statement (ADFG and ADOT&PF 2001) is the culvert design standard itself rather than a reference that supports the statement. The standard contains several provisions targeted at stream stability and habitat quality which makes the EPA statement incorrect.

EPA Response: The statement referenced in the comment was based on the following text in ADF&G and ADOT&PF (2001):

> **“This agreement extends solely to the design, permitting, and installation of culverts in fish-bearing waters. … Additional factors unrelated to fish passage (such as unique environmental considerations, locating culverts in anadromous fish spawning or high-value rearing habitat, or other public safety, engineering, or economic issues) will be addressed on a project specific basis during preparation of the ADOT&PF environmental document.”**

The State of Alaska standard allows culverts that are smaller than the channel (90%) and allows for no floodplain flow during floods. The standard is for fish passage. Unlike the Stream Simulation method for culvert placement, it does not effectively protect stream morphology, and thereby habitat quality, from the increased velocities caused by a culvert smaller than the channel.

Text has been added to the final assessment to indicate that additional factors such as the physical structure of the stream or habitat quality are addressed on a project-specific basis during preparation of the Alaska Department of Transportation and Public Facilities environmental document.

5.141 The Assessment presents a general assessment of roads and culverts that implies that the installation of culverts (which represent a large fraction of typical stream crossings) “may” or “could” impose a negative impact on the physical and biological resources of streams and wetlands within the Bristol Bay study area. The Assessment supports this conclusion with outdated references and information that assess the potential impacts of proposed stream crossings on deficiencies of existing structures that may have been designed using obsolete methodologies, are improperly maintained, or both. The conclusions are inaccurate and not based on the best available scientific and engineering information.

<u>EPA Response:</u> **We disagree with the assertions regarding the use of outdated literature containing obsolete methodologies. To the extent possible we used recent literature from representative environments. Information cited from older publications is still valid today. Information on current design standards (from recent literature) is included in Chapter 10 of the revised assessment.**

5.142 Other discussion in the Draft Assessment about calcium chloride further adds to NDM’s concern over the validity of EPA’s analysis. Buell points out that contrary to EPA’s suggestion, calcium chloride is not toxic to fish and other aquatic life when used for dust suppression. It is a benign chemical that is used to aggregate fine particles together and is hygroscopic, helping to stabilize gravel road surfaces and reduce fugitive fine particles. This should be good news to those in EPA who are animated over potential fine sediment derived from the transportation corridor. Calcium (or magnesium) chloride is recommended by the U.S. Department of Transportation in their Gravel Roads Maintenance and Design Manual, (readily available on the EPA website) for gravel road stabilization and reduction of erosion and fine particle loss. Studies by the University of New Hampshire sponsored by the State of Maine and the Federal Highway Administration on the migration of calcium chloride after application to gravel roads, including movement into groundwater, found that calcium chloride is resistant to leaching and tends to bind to fine particles (hence its effectiveness) and stay where it is placed when used for roadway stabilization. This study also concluded that there is no indication that negative environmental impacts have occurred from the use of calcium chloride for dust control. EPA should become aware of these facts especially since much of this material is posted on the EPA web site, and temper or eliminate its statements concerning potential adverse impacts of calcium chloride application for dust control and road surface stabilization.

<u>EPA Response:</u> **Calcium chloride reduces the generation of road dust, but chloride salts can be toxic to vegetation and aquatic species and—based on a study cited in the revised assessment—the toxicity of the calcium chloride commonly used in Alaska would be expected to be a little greater than the more studied sodium chloride given chlorine concentrations. Calcium chloride is discussed in the document cited in the comment (Gravel Roads Maintenance and Design Manual) but it is not recommended over any other stabilizer. With respect to leaching, the revised assessment notes the following: "Rainwater tends to leach out the highly soluble chlorides (Withycombe and Dulla 2006), which can degrade nearby vegetation, surface water, groundwater, and aquatic species (Environment Canada 2005)."**

5.143 General Comment 2: The Preface of the Assessment on page xiv states: "*The USEPA has reviewed and considered information and data from a variety of sources, including environmental groups that oppose mining development and mining companies that are mining proponents. Where possible, we have relied on peer-reviewed, published data and information. However, much of the information on Bristol Bay has not been published in the peer-reviewed literature. We have used established guidelines for the use of those data, which include evaluating collection and analytical methods and identifying data limitations*."

Some of the assertions in this paragraph are demonstrably false and another fails to adequately describe the use of peer-reviewed, published literature. For example, the peer-reviewed literature relied upon heavily in the Assessment with respect to the impacts of a transportation corridor on streams and wetlands along the corridor, is based on road design and construction techniques from the 1950's and for roads that were mostly used as temporary access for timber harvest in the Pacific Northwest. The use of this literature is not only inappropriate, but misleading to the reader and the public in general. Use of this literature is scientifically not justified and the assumptions and conclusions derived from this improper use of the literature are not a valid comparison to modern day high volume mine road design, construction, and maintenance standards.

<u>EPA Response:</u> **The assessment assumes the use of modern conventional mine design, practices, and technologies. Information on current design standards that would be used along the proposed transportation corridor is included within text boxes throughout Chapter 10 of the revised assessment.**

Many of the references in the assessment relate to the Pacific Northwest, because much work on culverts and potential impacts on salmon has been performed there. However, to the extent possible we used recent literature from representative environments. One of the papers used for general information, Furniss et al. (1991), focuses on forest and rangeland roads, but it is a seminal publication on the potential effects of roads, particularly as they relate to salmon. The general conclusions of that paper are relevant to the assessment's transportation corridor. The failure frequencies cited in the revised assessment are from modern roads and not restricted to forest roads. Reference to

Flanders and Cariello (2000) has been deleted in the revised assessment. The comment did not provide suggestions of additional technical references.

5.144 *Continuation of General Comment 5 previously presented.* The Assessment also assumes fish passage problems associated with the transportation corridor, with no consideration of the internally inconsistent assumption of blocked culverts and fish passage in the routine operations scenario versus an assumption of daily maintenance inspections and proper design and avoidance measures associated with modern mine road construction techniques in the same scenario. The Assessment cannot present different conclusions, based on the same assumptions.

<u>EPA Response:</u> See response to Comment 4.82

5.145 The Assessment states on page 1-2 "*Because mine claims in Bristol Bay are remote and substantial transportation corridors would need to be developed to remove minerals from the area, we also assembled background information on the potential impacts of road and pipeline crossings on aquatic systems*." While it may be true that "background information on the potential impacts of road and pipeline crossing on aquatic systems." was assembled, the authors used inappropriate and irrelevant literature as the basis for their assumptions and conclusions. For example, the Assessment uses Furness, et al, (1991) as a primary source to describe the impacts of road construction on aquatic systems. The problem is that this reference is not appropriate for this Assessment. Furness' assessment was based on temporary roads, built primarily in the 1950's or 60's to facilitate timber harvest in the Pacific Northwest. These roads suffered from poor design, locations that invited triggering of landslides, inadequate drainage, and inadequate maintenance. Comparing the documented impacts found in this source reference to a modern high traffic mining transportation corridor highway is not only intellectually dishonest; it is not even a scientifically valid comparison. The Assessment failed to accurately represent modern industrial road design and maintenance requirements and failed to recognize the differences between the temporary roads used for resource extraction back then and now with respect to the type of use and the design and maintenance requirements of a modern mine road. No matter what the case, this portion of the Assessment fails to meet EPA's guidelines for an ecological risk assessment and data quality for dissemination to the public.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.187.

5.146 The Assessment on pages 5-59 and 5-60: Section 5.4.1 Culverts; states: "Culverts are the most common migration barriers associated with road networks. Hydraulic characteristics and culvert configuration can impede or prevent fish passage. Where flow restrictions such as culverts are placed in stream channels, the power of stream flow is increased. This can lead to increased channel scouring and down-cutting, stream bank erosion, and undermining of the stream crossing structure and fill. Although the well planned installation of culverts allows natural flow upstream and downstream of crossings, failure rates are generally high (Sections 4.4.3.3 and 6.4)."

Comment: The implications of the paragraph quoted above are that culverts have the potential to cause channel changes and impede or block fish passage. It also indicates that "…well planned installation of culverts allows natural flow upstream and downstream of crossings …", which indicates that if a culvert is properly sized, installed, and maintained that few changes in the channel or impacts to fish passage can be anticipated. However, the paragraph also indicates that "… failure rates are generally high (Sections 4.4.3.3 and 6.4)". The paragraph refers to two sections of the Assessment to support the conclusion regarding culvert failure rate. First, the Assessment contains no Section 4.4.3.3, so for this comment it is assumed that the authors are referring to Section 4.4.4. Review of Sections 4.4.4 and 6.4 reveal that the Assessment has used inappropriate data and references to support the culvert failure rates shown in Sections 4.4.4 and 6.4 and calculation of culvert failure rates presented in Box 8-1 and Table 8-1.

EPA Response: The failure frequencies cited in the revised assessment are from modern roads. References to Flanders and Cariello (2000) have been deleted from the revised assessment.

Culvert failures take into account the use of best management practices (BMPs) or mitigation measures that are discussed in text boxes throughout Chapter 10. Environmental characteristics along the transportation corridor would likely make standard and "state-of-the-art" mitigation measures less effective. Further discussion on this is contained in Box 10-5 of the revised assessment.

The comment was correct in that the authors were referring to Section 4.4.4 in the draft assessment instead of Section 4.4.3.3.

5.147 The Assessment on pages 5-59 and 5-60: Section 5.4.2 Stormwater Runoff; states: "However, because the salts or other materials used for winter treatment of roads could present a significant issue, these are addressed below (Section 5.4.4)."

Comment: The section of the Assessment cited (Section 5.4.4) to discuss road salts and other material used for winter treatment of roads does not discuss this topic. This section of the Assessment presents information on "Road Crossings as Barriers to Fish Movement" not road salts. Information on road salts is contained in Section 5.4.6.

EPA Response: The comment is correct in that information on road salts is contained in Section 5.4.6 of the draft assessment.

5.148 The Assessment on page 5-60: Section 5.4.3; Near-Surface Groundwater and Hyporheic Flows states: "*The high incidence of seeps and springs noted on glaciolacustrine, alluvial, and slope till deposits in the mine area (Hamilton 2007, Woody and O'Neal 2010) and the abundance of wetlands testify to the pervasiveness of shallow subsurface flow processes and high connectivity between groundwater and surface water systems in the areas traversed by the transportation corridor (Appendix G). The construction and operation of roadways and pipelines can fundamentally alter connections between shallow aquifers and surface channels and ponds by intercepting shallow groundwater flow paths, leading to further impacts on surface water hydrology, water quality, and fish habitat (Darnell et al. 1976, Stanford and Ward 1993, Forman and Alexander 1998, Hancock 2002).*"

Comment: The two sentences quoted above come directly from Appendix G. The first sentence states in part: "The high incidence of seeps and springs noted on glaciolacustrine, alluvial, and slope till deposits in the mine area (Hamilton 2007, Woody and O'Neal 2010) …" A word search (query for: seeps, spring, glaciolacustrine, alluvial, and slope till deposits) of the electronic copies of Hamilton and Woody and O'Neal found none of these words used in the text of the documents cited. Hamilton's map did contain the words glaciolacustrine and alluvial as major map unit headings, but the descriptions of the geology associated with these mapping units did not contain the words seeps or springs. Paper copies of these two references were reviewed page by page and again no reference to seeps or springs or any of the three geological types found. It appears that the authors of Appendix G and the authors of the Assessment failed to carefully check the references cited. This is another example of the poor quality and unreliable information presented in the Assessment. How much of the material presented in Appendix G can be considered scientific and reliable?

<u>EPA Response:</u> Both sources cited above provide direct, field-verified empirical support for the contention that the western two-thirds of the transportation corridor would traverse lands that are rich in near-surface groundwater. The text cited in the comment has been revised as follows: "Field observations in the mine area (Hamilton 2007, Woody and O'Neal 2010) are descriptive of terrain with abundant near-surface groundwater and a high incidence of seeps and springs associated with complex glaciolacustrine, alluvial, and slope till deposits (Appendix G)."

5.149 The second sentence in the quote above states: "The construction and operation of roadways and pipelines can fundamentally alter connections between shallow aquifers and surface channels and ponds by intercepting shallow groundwater flow paths, leading to further impacts on surface water hydrology, water quality, and fish habitat (Darnell et al. 1976, Stanford and Ward 1993, Forman and Alexander 1998, Hancock 2002)." What the Assessment fails to mention is another quote from Appendix G which states: *"Rudimentary groundwater studies at roads traversing moderate slopes of conifer forest and muskeg in southeast Alaska (Kahklen and Moll 1999) revealed there could be either a bulge or a drawdown in groundwater level near the upslope ditch, while immediately downslope of the road the water table was most often depressed. These effects appeared for distances between 5 and 10 meters on each side of the road prism. The effect of observed water table deformation on the downslope flux of groundwater remains unknown."*

It appears that the discussion presented in Volume I of the Assessment is incomplete and that information and quotes from Appendix G have been selectively presented to the public. The Assessment should present all of the information relevant to a particular topic or issue in order to be scientifically credible. This example, again points out the inadequacy of the Assessment with respect to its presentation and credibility as an ecological risk assessment document.

<u>EPA Response:</u> The above quote was not included in the main text of the assessment because the condition it represents is not typical of the range of conditions observed along the transportation corridor.

5.150 The Assessment on page 5-61: Section 5.4.4.3 Risk Characterization; states: "*The mine scenario assumes that culverts would be installed along the transportation corridor with adequate size for the streams crossed, and that the roadway would be monitored daily to ensure that failures could be rapidly identified and repaired. Even with these assumptions, inhibition of fish passage and reductions in habitat still could occur. The behavioral responses to culverts of the up-migrating and down-migrating life stages of the salmonid species that use the potentially crossed streams are uncertain.*"

Comment: The conclusion that "inhibition of fish passage and reductions in habitat still could occur." is totally without merit. If the culverts are properly installed and maintained, then fish passage and sediment deposition or scouring downstream of the culvert will not occur. Daily maintenance inspections will discover any situations that could turn into a major problem. The Assessment provides no scientifically defensible documentation to support the assumption and conclusion. Second, the Assessment concludes that the behavioral response of salmonids to culverts is uncertain. This statement is utterly preposterous and has no scientific basis at all. It is laughable. There are thousands of examples of the effects of culverts on salmonid fish passage in the Western U.S. and Canada alone. What the studies show is that adult and juvenile salmonids readily move up and down through culverts if they are properly designed, sized, installed correctly, and maintained. It is obvious that EPA has no understanding of salmonid behavior and the professional literature related to culverts and fish passage. Just a minor point, but any professional salmon biologist would know that the terms "up-migrating" and "down-migrating" are not applicable to salmonids. The correct terms are migrating and emigrating salmon.

<u>EPA Response:</u> See response to Comment 4.82. The revised assessment notes that "Culverts are not always built to specifications and the behavioral responses of migrating salmonid life stages to culvert-induced changes in flow are not always anticipated correctly." The uncertainty of behavioral responses to culvert-induced changes in flow is supported by text in the memorandum of agreement (MOA) between the Alaska Department of Fish and Game and the Alaska Department of Transportation and Public Facilities (ADF&G and ADOT 2001), which alludes to the need for comparative field data (i.e., data from different species).

The terms up-migrating and down-migrating have been deleted in the revised assessment.

5.151 The Assessment on page 5-70: Section 5.4.9 Fish Populations along the Transportation Corridor

Comment: The Assessment in this section provides little useful information regarding the fish populations along the transportation corridor. While some information is provided for certain sockeye salmon spawning populations, little information is provided regarding other salmon species or the resident species that can be found in many of the streams that the hypothetical transportation corridor would cross. This fatal flaw in the Assessment could have been avoided if EPA would have used all of the publicly available information. For example, the 2004 Northern Dynasty Fish and Aquatic Resources progress report contains information about the transportation corridor as envisioned at that time. Also, the fish collection data made available to the agencies at a 2008 Fish Technical Working Group meeting in Anchorage contained site specific crossing data on fish presence from 2004 and 2005 sampling efforts. All of this information was offered to the agency representatives, but none requested a copy. As a result, the Assessment is deficient in its characterization of the fish populations along the transportation corridor and only underscores the fact that EPA failed to follow its own ecological risk assessment guidelines.

<u>EPA Response:</u> In the revised assessment, additional published information characterizing fish populations along the proposed transportation corridor is included

in Section 10.2. The revised assessment summarizes the reported species, abundances, and distributions that would potentially be affected by the transportation corridor. The primary sources of information were the 2012 AWC and AFFI. We found both of these sources to be complete for fish observations reported along the transportation corridor in the PLP EBD (2011). However, published fish presence information was scarce for the transportation corridor. The revised assessment also places the streams along the corridor into the context of the entire Nushagak and Kvichak River watersheds with respect to important attributes affecting fish use such as discharge, channel gradient, and floodplain potential. The 2004 progress report cited in the comment provides little if any quantitative fish data for the transportation corridor, and the report emphasizes that data are "preliminary and subject to change." It does provide some macroinvertebrate data.

5.152 *Page ES-14 §3:* Eliminated or blocked streams **–** This paragraph is extremely misleading, to the point of being incorrect. It states that mine development "would result in the loss of 87.5 to 141.4 km… of possible spawning or rearing habitats" for anadromous and resident salmonids. This assertion vastly overestimates the number of km of stream that could reasonably support salmonids. Many if not most of the km of streams shown on the accompanying figure are ephemeral and inaccessible, some with poorly defined channels or no discrete surface flow channel. EPA has obviously extrapolated far beyond the information used in preparation of the assessment and has ignored readily available information on fish distribution in the Pebble area, including migration barriers in smaller tributary streams.

EPA Response: See response to Comment 5.85.

5.153 The cited losses of known salmonid habitat (8, 24, and 35 km of streams) are based on the Anadromous Waters Catalog. The additional lengths of streams lost cited in these statistics and illustrated in the accompanying figures provide supporting functions to salmonid habitat downstream. *Page ES-14 §4:* Reduced flow **–** This paragraph is based on the assumption that the only factor driving fish production in the Pebble area is stream flow. This approach is not credible, and completely ignores the importance of conducting a reasonable limiting factors analysis to put stream flow into perspective with respect to other factors that are likely driving fish production in Pebble streams. For example, absence of a nursery lake and very low organic and inorganic nutrient levels in the Koktuli forks, along with harvest in the same management zone as contains fish from the far more productive Wood River, is much more likely driving the population of sockeye spawners in these streams than stream flow. It is irresponsible for EPA to proceed with the analysis in the way they have done.

EPA Response: The conceptual models incorporate many (but not all) factors influencing the endpoints. We agree that streamflow is just one (albeit very important) aspect of habitat. It may not be the most limiting factor in all cases, but lack of water is inarguably a limiting factor should it occur.

Section 7.3.2.1 of the revised assessment explains the importance of flow to habitat quantity and quality. The assessment discusses the sustainability boundary approach as a way to balance the maintenance of aquatic ecosystems with human demands on the system. Under this approach, flow alteration greater than 20% is considered sufficient to result in moderate to major changes in ecosystem structures and functions.

Increasing alteration beyond 20% would cause significant losses of ecosystem structure and function.

5.154 *Page 5-61 §1:* This paragraph states, "[c]ulverts designed to meet the State of Alaska's requirements and regularly maintained should not block fish passage; however, hydraulic characteristics such as low water depth or high water velocities and culvert configurations can impede or prevent fish passage." This statement is incorrect. The State of Alaska's criteria for culverts in fish-bearing waters, which represent a variance from the default requirement for a bridge, specifically address low flow conditions as related to fish passage, as well as high flow hydraulics as related to fish passage. Any culvert permitted for a road crossing of a fish-bearing stream, especially crossings of anadromous fish streams, must undergo a 3-tiered set of hydraulic analyses, which become more conservative for streams where hydrologies are uncertain. Since EPA has cited the MOA on this subject between ADFG and ADOT, the agency should be familiar with these requirements.

<u>EPA Response:</u> This statement has been modified in the revised assessment. Where flow restrictions such as culverts are placed in stream channels, stream power increases. This can lead to increased channel scouring and down-cutting, streambank erosion, and undermining of the road.

Requirements of the memorandum of agreement between ADF&G and ADOT (2001) regarding fish passage requirements at road crossings are summarized in Box 10-2 in the revised assessment. This includes the 3-tiered approach noted by the reviewer.

Even with the above requirements, inhibition of fish passage and reductions in habitat still could occur. The estimates of risk to fish habitats and populations take into account the use of BMPs or mitigation measures that are discussed in text boxes throughout Chapter 10 of the revised assessment. Although culverts would be designed to certain specifications (Box 10-2), they are not always installed correctly or do not stand up to the rigors of a harsh environment.

5.155 *Page 5-61 §2:* This paragraph discusses the tendency of culverts to concentrate surface (and presumably shallow groundwater) flows at the expense of surrounding aquatic and wetland features. While this can occur in poorly planned and executed alignments, these phenomena are well known to ADFG, DNR and other regulatory and permitting agencies in Alaska. It is unreasonable to assume that provisions for under-drains, supplemental culverts for wetlands connectivity and other accommodations will not be required as part of permitting for the Pebble transportation corridor. EPA should acknowledge and take account of this.

<u>EPA Response:</u> The estimates of risks to salmonids and the ecosystems that support them take into account the use of best management practices (BMPs) or mitigation measures that are discussed in text boxes throughout Chapter 10 in the revised assessment. Although culverts are designed to certain specifications (Box 10.2), they are not always installed correctly or do not stand up to the rigors of a harsh environment. Environmental characteristics along the transportation corridor would likely render the effectiveness of standard or even "state-of-the-art" mitigation measures highly uncertain. Further discussion on this is contained in Box 10-5 of the revised assessment.

5.156 Page 5-61 §2: This paragraph states that “the roadway would be monitored daily to ensure that [culvert] failures could be rapidly identified and repaired” but that “inhibition of fish passage and reductions in habitat still could occur.” This is, at best, a stretch. Daily monitoring and maintenance would surely identify and correct the vast majority of culvert issues before or at the beginning of any passage or erosion problems. The ADFG/ADOT MOA is technically based and is currently working very well in preventing the kinds of problems EPA is apparently concerned about. Where risks of culvert inadequacy based on MOA criteria and hydraulic analyses are identified, it is reasonable to assume that both the mining company (which would certainly not want to experience a road failure) and Alaska regulatory and permitting agencies will call for either a bridge or much more conservative culvert design. The very low significance of this risk should be acknowledged by EPA and taken fully into account in the analysis. See comment on pp. 4-62 §8 – 4-63 §1.

EPA Response: We disagree, because the potential for blocked or reduced fish passage exists even under an assumption of best management practices and daily maintenance inspections. Under such surveillance, a single erosional failure of a culvert that damaged the road would likely be identified soon after it occurred and temporary repairs would be made to protect the road and possibly provide fish passage. However, long-term fixes may not be possible until conditions are suitable to replace a culvert or bridge crossing. After mine operations end, traffic would be reduced to that which is necessary to maintain any residual operations on the site, and inspections and maintenance would likely decrease.

With respect to the use of bridges, they would generally have less impact to salmon than culverts, but can result in the loss of long riparian side channels if they do not span the entire floodplain.

5.157 Page 5-63 §2 – 5-63 §3: This paragraph discusses the potential use of calcium chloride (CaCl2) for road dust suppression. Calcium chlorideis not toxic, as suggested by the first sentence in this paragraph, to fish and other aquatic life when used for dust suppression. It is a benign chemical that is used to aggregate fine particles together and is hygroscopic, helping to stabilize gravel road surfaces and reduce fugitive fine particles. This should be good news to those in EPA who are animated over potential fine sediment derived from the transportation corridor. Calcium (or magnesium) chloride is recommended by the US Department of Transportation in their Gravel Roads Maintenance and Design Manual (Skorseth and Selim 2000; available on the EPA website: http://water.epa.gov/polwaste/nps/gravelroads_index.cfm) for gravel road stabilization and reduction of erosion and fine particle loss. Studies by the University of New Hampshire sponsored by the State of Main and the Federal Highway Administration on the migration of calcium chloride after application to gravel roads, including movement into groundwater, found that calcium chloride is resistant to leaching and tends to bind to fine particles (hence its effectiveness) and stay where it is placed when used for roadway stabilization. This study also concluded that there is no indication that negative environmental impacts have occurred from the use of calcium chloride for dust control. EPA should become aware of these facts especially since much of this material is posted on the EPA web site, and temper or eliminate its statements concerning potential adverse impacts of calcium chloride application for dust control and road surface stabilization.

<u>EPA Response:</u> See response to Comment 5.142.

5.158 *Page 5-64 Table 5-21:* Given the tendency of calcium chloride to stay put, bound to fine particles, and its benign nature (see comment immediately above), this table is largely irrelevant and should be removed from the document.

<u>EPA Response:</u> We disagree, as chloride salts are known to cause toxicity to vegetation and aquatic species (see response to Comment 5.142). No change required.

5.159 *Page 5-64 §1 – 5-65 §2:* These paragraphs are an exercise in hyperbole by EPA. Although some wetlands will be filled or altered, the Pebble road alignment has been carefully planned to avoid or minimize these impacts, especially as they might affect fish or fish habitat. The State of Alaska regulatory and permitting agencies are acutely aware of the needs to protect wetlands and fish habitat along this transportation corridor, including along that portion of the Iliamna Lake shoreline used by sockeye salmon for spawning. Assuring connectivity between wetland polygons and among aquatic and wetland elements, and especially shallow groundwater flows to shoreline spawning areas, will certainly be incorporated into the road design and permitting process, and it is unreasonable to assume otherwise. The salt issue is moot (see above).

<u>EPA Response:</u> We disagree regarding the avoidance or minimization of impacts from the road alignment. The assessment's transportation corridor is based on the alignment in Ghaffari et al. (2011). It would cross many streams, rivers, wetlands, and extensive areas with shallow groundwater, including numerous mapped (and likely many more unmapped) tributary streams to Iliamna Lake (Figures 10-1 and 10-2 in the revised assessment). Although this route is not necessarily the only option for corridor placement, the assessment of potential environmental risks would not be expected to change substantially with minor shifts in road alignment. Also see responses to Comments 4.82 and 5.142.

5.160 *Page 5-65 §4*: This paragraph is factually incorrect. The existing (and proposed) road alignment is not parallel to or in close proximity to that portion of Chinkelyes Creek to which sockeye (or any other) salmon currently have access. Anadromous access is blocked by a series of three impassible falls and several bedrock cataracts. Large numbers of sockeye spawn in the lower reach of Chinkelyes Creek which is not adjacent to the road alignment.

<u>EPA Response:</u> We disagree regarding the proximity of the proposed road alignment to the anadromous portion of Chinkelyes Creek. Although a portion of the road parallels Chinkelyes Creek upstream of the impassable falls, a portion of the road is parallel and adjacent to the downstream, anadromous portion of Chinkelyes Creek before the creek enters the Iliamna River. Furthermore, the paragraph in question does not just relate impacts from the corridor to anadromous waters adjacent to the road, but is also intended to describe potential impacts of runoff from the corridor that may flow downstream to anadromous waters.

5.161 *Page 5-70 §2 ff.:* Fish Populations along the Transportation Corridor – This section gives some interesting fish occurrence data, but apparently has failed to use any of the readily available fish occurrence data generated by Pebble. EPA should have used Pebble data as well as other available data when generating this section of the analysis.

<u>EPA Response:</u> We used all available data in this section of the analysis (which has been updated in Chapter 10 of the revised assessment). Pebble data were not explicitly cited in this section because they did not add to what was available in the Anadromous Waters Catalog.

5.162 *Page 5-73 §2:* This paragraph states that "[little] is known about the occurrence or abundance of other salmon species in streams and rivers crossing or adjacent to the transportation corridor. Chinook, coho, and chum salmon are present in the Kvichak River watershed, but data for spatial occurrence are for isolated points in the system (ADFG 2012). Chinook and coho salmon are reported in the Newhalen River; Chinook, coho and chum salmon are reported in the Iliamna River; and coho salmon are reported in Tomkok and Youngs Creeks." If EPA had looked at readily available Pebble fish occurrence data for the transportation corridor, this section of the report could have presented it. As it is, EPA overlooked or chose to ignore this relevant information.

<u>EPA Response:</u> The first sentence cited actually states that "<u>Less</u> is known about the … corridor." Information in this paragraph has been updated in the revised assessment (Chapter 10). Pebble fish occurrence data were examined but were not explicitly cited in this paragraph because they did not add to what was available in the Anadromous Waters Catalog.

5.163 *Page 5-73 §4*: This paragraph purports to summarize overall risks of the transportation corridor to salmon populations. It concentrates on very low probability occurrences (e.g., filling of wetlands, hydrologic modification) and very low level impacts (e.g., siltation, road salts) and concludes that these factors "are likely to diminish the production of anadromous and resident salmonids in more than 30 streams." This conclusion is unwarranted and irresponsible without specific links to quantitative analysis, especially with respect to siltation and the possible use of calcium chloride for road stabilization. The paragraph goes on to speculate that "[s]almonid migrations and other movements may be impeded by culverts in 14 streams. The habitat potentially affected below the road crossings totals 270 km of stream, and an additional 240 km of stream upstream of the crossings would be affected if culverts impede fish movement." These speculations are unreasonable and unwarranted in light of the standards and specifications that will certainly be applied conservatively to stream crossings along this transportation corridor and in light of the EPA assumption of daily monitoring and maintenance.

<u>EPA Response:</u> We do not agree that filling of wetlands and alteration of hydrology are "very low probability occurrences" given the abundance and extent of wetlands along the transportation corridor. Any elevated road bed will alter surface flow. The assessment addresses this qualitatively because the state of the science does not support a quantitative analysis of siltation or calcium chloride effects.

We also do not agree that the statements cited in the comment are unreasonable (see response to Comment 4.82).

5.164 The report uses inadequate culvert standards for consideration in the assessment (pg. 5-61). The culvert standards in Alaska target road safety and fish passage, "but not the physical structure of the stream or habitat quality (ADFG and ADOT&PF 2001)." (pg. 5-61) The reference cited to support this statement (ADFG and ADOT&PF 2001) is the culvert design standard itself rather than a reference that supports the statement. The standard contains several provisions targeted at stream stability and habitat quality which makes the above statement incorrect.

EPA Response: **See response to Comment 4.152.**

5.165 The report does not discuss or consider mitigation options for addressing the impacts of road salts. Several options exist for eliminating or suppressing dust on roads. Some of the suppression options include the use of chlorides as cited in the references; however, paving and other applications of road oils can significantly suppress or eliminate dust. According to Anderson and Gesford (2006): "Although paving the road is the only permanent solution to dust problems, using effective controls can significantly reduce dust and cut required maintenance. Various studies show that control measures can reduce dust by 30% to 80% and cut aggregate loss by 25% to 75%." In addition to paving and road oils, active snow removal and the use of chains are mitigation practices that could reduce or eliminate the need for road salts.

EPA Response: **Best management practices or mitigation measures that would be used to minimize potential impacts to salmon ecosystems from construction and operation of the proposed transportation corridor are discussed in text boxes throughout Chapter 10 of the revised assessment. However, we do not feel it is within the scope of the assessment to present all possible mitigation options.**

5.166 In evaluating risks, consideration should also be given to the timing of traffic volumes and use of deicing agents. One option for mitigation may be to minimize winter road travel such that the requirement for use of deicing agents is minimized. Risks are also lower during winter months as there would likely be little to no spawning activities under scenarios where deicing would occur.

EPA Response: **Minimizing winter road travel might decrease the need for deicing agents, but the greatest exposure to salmonids would likely to be in the spring when melting occurs.**

5.167 One option for the project would be to include such measures as (…) Conversion of gravel pits for roads into Coho Salmon rearing habitat. On the Harding River in Southeast Alaska small gravel pits for road materials in the flood plain were converted to Coho salmon habitat via a simple diversion of flows to and from the pit. Significant use of the pits was studied by the US Forest Service.

EPA Response: **Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. Nevertheless, in response to public and peer review comments, we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.**

Alaska Miners Association, Inc. (Doc. #4612)

5.168 EPA overestimates the realistic mine size. The analysis in Section 1 of this technical review shows that EPA selects a mine size that is unlikely to represent mines developed in Bristol Bay. EPA picks a mine that is four times the average size of open-pit copper mines in British

Columbia, more than seven times the average size of open-pit mines in Alaska, and over 100 times the size of an the average underground mine. A smaller mine would have significantly less impact, and would allow the mine designers much more latitude in designing a mine to avoid impacts to anadromous fish habitat.

EPA Response: See response to Comment 4.327.

5.169 EPA uses a particular location that over-estimates impacts to anadromous fish habitat The analysis in Section 1.D. of this technical review indicates that the particular location of EPA's hypothetical mine may not be representative of other locations in the Bristol Bay watershed with respect to anadromous fish habitat. Therefore, it is very likely that the location for the hypothetical mine would exaggerate habitat modification impacts for other mines in the watershed. It may even exaggerate habitat modification impacts relative to alternative locations for some of the facilities for a mine at Pebble.

EPA Response: The comment is correct that the fish habitat would inevitably differ at other mine sites in the watershed. However, there is no reason to believe that habitat quality is better at the Pebble deposit than at other potential mine sites. The assessment of other potential mines is detailed in Chapter 13 of the revised assessment.

5.170 The Watershed Assessment lacks a realistic water budget The Watershed Assessment did not include a realistic water budget for the mine. A water budget is one of the most important documents a mine produces. It is influenced by the mining rate, tailings grind, and many other mine-design details. Agencies scrutinize water budgets during the permit process. A water budget typically goes through many iterations before the mine developer has confidence in it and before the agencies are willing to accept it, Until a water budget is final, and until the Department of Natural Resources proposes a water right volume, how much water the mine will need is unknown. Therefore, there is a lot of uncertainty about the impacts to downstream fish populations, until the water budget process is complete.

EPA Response: The revised assessment contains expanded discussion of the water balance for the assessment mine scenarios (Section 6.2.2). Like any component of a risk assessment, the water balance is uncertain and that uncertainty is described.

5.171 The authors of this review cannot follow EPA's water budget. Therefore, we cannot comment on EPA's assertion of water withdrawal problems downstream of the mine. In addition, many groups have applied for instream-flow water rights on the Upper Talarik Creek, South Fork Koktuli River, and the North Fork Koktuli River downstream from the EPA's proposed location. EPA implicitly assumes that DNR will decide in favor of EPA's perception of the mine's water needs, and turn down the other applicant's for instreamflow water needs. We have no idea whether such an assumption is warranted. But neither does EPA. If EPA's unstated assumption is wrong, then the analysis is incorrect.

In addition, water budgets are mine-specific. They are influenced by mine size, rainfall, processing method, etc. A water budget for a particular mine, hypothetical or not, is not representative of the water budget for another mine. Therefore, the water budget for the EPA's hypothetical mine (which is not produced adequately so that these authors can follow it) is unlikely to be representative of other mines proposed for Bristol Bay or elsewhere.

EPA Response: See response to Comment 5.170.

D. S. Braund (Doc. #0859)

5.172 Salmon play a critical role in maintaining the structural integrity of freshwater ecosystems. Returning salmon transport millions of tons of nutrients from the nutrient-rich marine environment to the nutrient-poor ecosystems of the Pacific Rim (Woody 2011). Salmon are the keystone species for these generally nutrient-poor temperate and northern ecosystems because the entire ecosystem depends on the marine-derived nutrients that are released from the carcasses of the spawned-out salmon (Schtickzelle and Quinn 2007; Hauser 2007).

EPA Response: Comment noted; no change required.

5.173 Decomposing carcasses release nutrients that originated in marine waters to stimulate the food chain in streams, ponds, and lakes (Hauser 2007). The nutrients are transported through the watershed and into the groundwater to the benefit of riparian vegetation (Hauser 2007). A myriad of insects, birds, small and large mammals also directly and indirectly utilize the carcasses (Hauser 2007). Flooding and the action of bears and other animals move these nutrients to the nearby terrestrial ecosystems, further expanding the ecological influence of salmon (Schtickzelle and Quinn 2007).

In the Nushagak-Mulchatna and Kvichak river drainages, salmon species directly affected by the proposed Pebble mine would include Chinook, sockeye, Coho, chum, and pinks (E&E 2010). The stream segments closest to the proposed mine site also support large numbers of other high-value resident fish species including Arctic grayling, Arctic char, Rainbow trout, Dolly Varden, and Northern pike (E&E 2010). Although the several species of salmon and other fish species co-exist in the watershed, they exploit and share different niches within the habitats that serve to minimize competition for available resources (Hauser 2007).

EPA Response: Comment noted; no change required.

5.174 In North America, sockeye salmon range from the Klamath River in Oregon to Point Hope in northwestern Alaska (ADFG 2011c). Like all species of Pacific salmon, sockeye salmon are anadromous, living in the ocean but entering fresh water to spawn (ADFG2011c). Each summer, sockeye salmon migrate from the North Pacific and Bering Sea back to the freshwaters of their birth to spawn (Woody 2011; AD FG 2011c). At maturity sockeye reach an average size of 24 inches and an average weight of six pounds (ADFG 2011c). Sockeye salmon spend one to four years in fresh water and one to three years in the ocean (ADFG 2011c).

EPA Response: Comment noted; no change required.

5.175 At least four glacial advances left an imprint on Bristol Bay in the form of coarse, porous, layers of alluvial sediments, which can both store and transmit large volumes of groundwater (Woody and Higman 2011). In the Bristol Bay watershed, groundwater aquifers are typically recharged during annual spring and fall flood events. When dry conditions prevail in summer and winter, stream water levels drop below the water table and stored groundwater contribution to stream flow increases (Woody and Higman 2011; E&E 2010). Groundwater flow dynamics in the area have important implications for fish habitat and water quality. In the upper reaches of the watershed, groundwater can comprise most or all water feeding surface streams and rivers during low flow periods in July and August when sockeye are spawning, and from January through March when incubating eggs and over-wintering juvenile salmon require a constant inflow of groundwater to survive (E&E 2010; Woody and Higman 2011). Because the sediments in Bristol Bay are permeable, they discharge and recharge with seasonal cycles and this supports aquatic communities, including salmon, through drought and freezing (Woody and Higman 2011).

Groundwater from the proposed mine area is an important contributor to the stream flow in the headwaters of the Nushagak and Kvichak rivers. Flow rates affect all salmon life stages including upstream migration of adults, survival of eggs, the emergence and viability of fry, and timing of smolt out-migration (E&E 2010). Flow rates also affect stream temperature, which is one of the primary controls on fish survival, growth and reproduction (E&E 2010). Thus, water flow levels in streams affect all aquatic life, and there is a definite relationship between the annual flow regime and the quality of salmon riverine habitat (E&E 2010).

At present, the only publicly-available surface and groundwater data in the proposed Pebble mine area are the Draft Environmental Baseline Studies conducted by Northern Dynasty Mines, Inc. (NDM) in 2004 and independent fishery surveys contracted by the Nature Conservancy, Alaska (NDM 2005, 2005b, 2005c, 2005d; Moran 2007; Woody and O'Neal 2010). The preliminary NDM surface and groundwater reports describe a mountain groundwater system in hydrogeologic connection with the rivers (Moran 2007). Shallow, weathered bedrock is permeable and transmits groundwater to local streams in some locations, causing local stream flow to increase (Moran 2007). Movement of groundwater in the mine area is relatively rapid (E&E 2010). Lastly, the ground waters are extremely dilute, clean and uncontaminated (Moran 2007).

Woody and O'Neal (2010) conducted fish and habitat surveys in headwater streams of the Nushagak and Kvichak drainages. They evaluated basic water quality and habitat parameters, indicating generally pristine conditions throughout the area. Water temperatures were cool, well below upper tolerance limits for all species and life stages of salmon. Conductivity was low, indicating low nutrient levels and minimal human disturbance. Sites where pH was measured, values were near neutral. Finally, physical habitat parameters suggested abundant spawning gravel, and depths appropriate for both spawning and rearing.

<u>EPA Response:</u> Comment noted; no change required.

5.176 The Pebble prospect contains about 36.3 million tons of copper, which occurs with sulfides (Woody 2010). Many other elements on the EPA's list of priority pollutants including antimony, arsenic, chromium, lead, nickel, selenium, and zinc are present in the ore body (E&E 2010). These other metals are also toxic to salmon and other fish at low concentrations. To understand how mining-related pollutants impact salmon, copper has been examined. However, the risks associated with the introduction of copper would be similar to other potentially harmful metals in the region.

<u>EPA Response:</u> Arsenic, chromium, lead, nickel, selenium, and zinc were considered in the draft assessment (see Tables 5-14 through 5-16). Antimony has been added to the updated versions of those tables in Chapter 8.

5.177 The potential risks to the salmon resources of Bristol Bay as a result of large-scale mining and its associated facilities include physical destruction and alteration of salmon habitat. In addition probable effects from changes to water chemistry and other supporting habitat caused by acid mine drainage and the influx of metals within the aquatic ecosystem from various sources are definite concerns (E&E 2010). A dilemma for the public is that mining companies, such as PLP, routinely claim they can operate a modern metal mine without environmental impacts. The environmental aspects of modern metal-mines are generally improved, qualitatively, when compared to similar operations 20 to 30 years ago (Moran 2007). Claims similar to PLP's public relation slogan "not your grandfather's copper mine" have been made for most of the last century, yet there are still significant environmental problems (PLP 2011; Moran 2007). Most modern, open-pit base and precious metals mines are now constructed on a scale significantly larger than 30 years ago; hence the quantities of wastes produced and magnitude of impacts are greater than in the past.

EPA Response: Comment noted; no change required.

5.178 Moran (2007) authored a report regarding the hydrogeology and geochemistry issues at the Pebble deposit. Dr. Moran holds a doctorate of geological sciences and has more than 38 years of domestic and international experience conducting and managing water quality, geochemical and hydrogeologic work for private investors, industrial clients, tribal and citizen groups, NGO's, law firms, and governmental agencies at all levels (Moran 2011). After reviewing all relevant portions of the NDM water, water quality, geology and geochemical reports, he concluded: Even when a mine is well run, it is unavoidable that chemical contaminants will be released into the nearby environment. I know of no comparable [to the Pebble mine], large-scale copper-molybdenum-gold ore body that has been mined without release of significant concentrations of contaminants into the nearby surface and or ground waters, over the long-term. In addition, it is unlikely that a similar copper molybdenum- gold mine has ever been operated in an area with such a valuable and potentially-vulnerable fishery - anywhere in the world.

EPA Response: The comment is correct in stating that all routine releases, discussed in Chapter 5, were assumed to meet criteria and standards. In Chapter 8 of the revised assessment, that assumption has been eliminated.

Center for Science in Public Participation (Doc. #4122)

5.179 Add to make more complete. End of pipe discharges from a water treatment plant that fully meet all current Alaska water quality criteria would result in lower water quality than currently exists. The concentration of copper in ambient waters is often < 0.5 µg/L (PLP 2012; Zamzow 2012; Zamzow 2011), while hardness-based water quality criteria for discharge water is likely to be near 2.5 µg/L (ADEC 2008). Under a No-Failure scenario, aquatic life could still potentially be exposed to higher concentrations of copper than it currently is.

EPA Response: The assessment is clear that water at the site is pure and that standards and criteria are higher than background. No change required.

5.180 The waters in the Nushagak-Kvichak area targeted by large scale mining are of extraordinary quality and generally better than Alaska water quality criteria (PLP 2012; Zamzow 2012; Zamzow 2011). Discharges that meet all water quality criteria will cause downstream water quality to be lowered.

Add to make more complete. The high quality of water in the area could be more fully indicated by moving Table 5-17 to Chapter 2, and by expanding the list of analytes with baseline data (available in PLP 2012 and Zamzow 2011).

EPA Response: Table 5-17 contained water quality data for the area near the Pebble deposit that was used to derive site-specific criteria for metals. It would not be appropriate to move it to Chapter 2 (now Chapter 3), which describes the wider Bristol Bay region. No change required.

5.181 Add to make more complete. Add a column(s) in Assessment Table 5-17 that show the most stringent water quality criteria, noting which are based on aquatic life criteria (ADEC 2008).1 An example can be found in Ghaffari et al 2011, Table 18.3.4.

EPA Response: The listed criteria are the acute and chronic aquatic life values, and no criteria are more stringent. No change required.

5.182 Comment on relevancy. Sections 5.3.2.2 and 6.1.4.4 note that the water quality criteria used in the Watershed Assessment may not be protective of all macroinvertebrate taxa. Given the high quality of ambient water, this is relevant.

> "*Studies of streams receiving mine effluents and laboratory studies suggest that the abundance of important insect taxa could be reduced even if criteria are met.*" (Assessment Section 5.3.4)

EPA Response: Comment noted; no change required.

Fisheries Research and Consulting (Doc. #4580)

5.183 While potential impacts to wetlands are based on the best available information, impacts are underestimated in the current draft of the Watershed Assessment. Wetlands data for Pebble are based on coarse scale, 1:63,360 National Wetlands Inventory (NWI) data without documental ground truthing. The basemap standard for all states except Alaska is 1:24,000/1:25,000 over twice the resolution of that used in the Assessment. Even at the higher, 1:24,000/1:25,000 resolution, the USFWS recognizes limitations of "remotely sensed information as a primary data source" and indicates that using remotely sensed data excludes some wetland types including ephemeral habitats which occur in the area of interest. Wetland characterization forms a basis for potential 404(c) action as wetlands provide critical habitat for both anadromous and resident fish species.

EPA Response: See responses to Comments 5.19 and 5.71.

5.184 ES-16, page 28: "*More than 30 km of salmonid stream would be destroyed and more streams and rivers would have greatly degraded habitat for decades*." Seems surprisingly low, doesn't include full buildout.

EPA Response: The 30 km distance is based on the range of the model, as is explained more completely in Chapter 9 of the revised assessment.

5.185 ES-16, page 38: "*Most failures would occur between stream or wetland crossings and might have little effect on fish*". What about cumulative impacts? Certainly these contaminants would ultimately end up downstream into the lake or some other waterbody.

<u>EPA Response:</u> We believe that pipeline failures would be sufficiently infrequent that cumulative impacts need not be considered. No change required.

5.186 Section 5-1, page 154: "*The potential effects of routine mine operations…and failures…depend on the abundance and distribution of the salmonid fish species that occur in the potentially exposed streams and rivers*." This is inaccurate--regardless of the numbers of salmonids, the amount of organic matter, invertebrates, and other fish species are critical to salmon populations downstream.

<u>EPA Response:</u> The comment is correct in stating that effects at the mine site influence salmon populations downstream. However, that does not contradict the statement that the abundance and distribution of salmonids in the exposed populations determine effects. No change required.

5.187 *Section 5-2, page 155: Slimy sculpin*. Coast range sculpin need to be added.

<u>EPA Response:</u> The distribution of fish within the deposit area is known to be underestimated, and lists of non-salmonid species in particular are likely to be incomplete.

5.188 *Section 5-3 and 5-7, pages 156-160, Figures 5-1 to 5-5:* Colors are difficult to discern (especially if you're color blind).

<u>EPA Response:</u> Colors have been altered in the revised assessment to increase contrast and make them easier to see.

5.189 *Section 5-5, page 158, Figure 5-3:* At least Kaskanak spawning distribution does not appear to match with interactive mapping in AWC http://gis.sf.adfg.state.ak.us/FlexMaps/fishresourcemonitor.html?mode=awc

<u>EPA Response:</u> The revised assessment relies on the 2012 AWC database.

5.190 *Section 5-6, page 163, Figure 5-4:* At least Upper Talarik spawning distribution does not match with interactive mapping in AWC

<u>EPA Response:</u> See response to Comment 5.189.

5.191 *Section 5-10, page 163, Table 5-1:* The table relies on invalid methodology (see Woody report 2012).

<u>EPA Response:</u> We highlight the uncertainties associated with these data, and use them with caution as the best available data.

5.192 Page 5-10, page 163: "*No quantitative estimates of spawner abundance are available for any fish species in the site watersheds*." Ridiculous given the amount of money they spent on 'science' out there.

<u>EPA Response:</u> Comment noted; no change required.

5.193 Section 5-11, page 164: "*Instead, we report the highest of each year's index counts for each population, because this number is closer to the true abundance and the averaged estimates reported in the EBD are often pulled downward by counts outside of the spawning period when no fish were counted*."

Comment: Umm.

EPA Response: See response to Comment 5.11.

5.194 Section 5-12, page 165: "*Downstream flow changes have complex effects, including reducing the amount of aquatic habitat, changing water temperatures, and affecting fish populations*."

Comment: Insert 'directly' between 'and' and 'affecting'.

EPA Response: This sentence no longer appears in the revised assessment.

5.195 *Section 5-13, page 166, Figure 5-8*

Comment: This should move down to flow section (5.2.2 Effects of Downstream Flow Changes).

EPA Response: This section has been substantially revised.

5.196 *Section 5-14, page 167, Box 5-1*

Comment: WETLANDS NEED MORE THOROUGH/BETTER ANALYSIS!!

EPA Response: The revised assessment has attempted to place the impacts to wetlands at various scales of influence ranging from site-specific impacts (where possible) to watershed wide impacts.

5.197 Section 5-16, page 169: "*Species known to rear in habitats within and upstream of the mine footprint are chum salmon, sockeye salmon, Chinook salmon, coho salmon, Dolly Varden, rainbow trout, Arctic grayling, slimy sculpin, northern pike, and ninespine stickleback*."

Comment: Coast range sculpin need to be added.

EPA Response: See response to Comment 5.187.

5.198 Section 5-16, Page 169: "*No information on spawning populations of resident fish was found, but in other areas use by anadromous and resident forms of Dolly Varden has been observed in the most upstream and high-gradient habitats available for spawning, indicating that headwaters may be important source areas for downstream populations*".

Comment: Inconsistent with previous descriptions of Dolly Varden as residents (but this one is accurate, previous description is incomplete).

EPA Response: Anadromy/residency in Dolly Varden has been clarified throughout the document.

5.199 *Section 5-16, page 171, Table 5-4*

Comment: No Dolly Varden in North Fork Koktuli? This is incorrect according to freshwater inventory.

EPA Response: This has been corrected in the final assessment.

5.200 Section 5-20, page 173: "*The best available information on groundwater inputs to headwater streams draining the mine footprint is from two aerial surveys of the site watersheds (PLP 2011, Woody and Higman 2011). Results from the PLP seep inventory indicate that no* *groundwater sources in these headwater streams would be affected by the TSF1 and 2 footprints…*"

Comment: Open water identified by AIR UNDER estimates actual over wintering habitat as groundwater fed regions of streams can be flowing underneath the ice.

EPA Response: The comment is correct. These sources highlight areas of documented groundwater influence and don't preclude the strong influence of groundwater in other regions of the watershed.

5.201 Section 5-21, page 174: "*The losses of headwater streams and wetlands from the mine footprint would greatly reduce inputs of organic material, nutrients, water, and macroinvertebrates to reaches downstream of the mine footprints, but the effect on fish cannot be quantified.*"

Comment: The DIRECT effect on fish cannot be quantified.

EPA Response: We believe that neither the direct nor indirect effects can be quantified. No change required.

5.202 Page 5-21. "The inputs of groundwater-influenced streamflow from headwater tributaries likely benefit fish by moderating mainstem temperatures, resulting in reduced freezing in winter and reduced heating in summer. PLP collected temperature data from stream sampling sites using in-situ field meters according to the procedures outlined in their Quality Assurance Project Plan. Maximum summer (June through August) water temperatures recorded at gage NK119A, which drains the TSF 1 footprint, were approximately 5 deg-C colder than the mainstem reach that it flows into. This differences was not as pronounced for the maximum summer water temperatures recorded at gage SK119A, which drains the TSF 2 footprint and was approximately 2 deg-C colder than the mainstem reach that it flows into. Longitudinal temperature profiles for the North Fork Koktuli River and South Fork Koktuli River watersheds from August and October indicate that the mainstem reaches (NFK-C and SFK-B) just downstream of the tributaries draining TSF 1 and TSF 2 experience significant cooling in the summer and warming in the winter compared t the adjacent upstream reaches. Headwater streams in the North Fork Koktuli River and South Fork Koktuli River watersheds may provide a temperature-moderating effect, providing temperatures beneficial to fishes in summer and possible winter as well."

Comment: This is great.

EPA Response: Comment noted; no change required.

5.203 *Sections 5-25 and 5-27, page 178:* "From 1-15% of the water captured would be returned to the respective stream as treated water…"

Comment: Will have unquantifiable impacts to fish which is not indicated here.

EPA Response: In the revised assessment, the contributions of treated and untreated water to water quality are modeled and used to estimate toxic effects on fish and invertebrates.

5.204 *Section 5-47, page 200:* “Under routine operations, our mine scenario presumes that all runoff water, leachate, and wastewater would be collected and properly treated to meet state and federal criteria before release.”

Comment: This seems a spurious assumption.

<u>EPA Response:</u> The revised assessment still assumes that the water treatment plant will be designed to achieve relevant criteria and standards. However, it no longer contains a scenario in which all water is collected and treated.

5.205 In addition to copper, which is thoroughly addressed by the Assessment, effluent from Pebble will include a mixture of other metals and metalloids such as aluminum, zinc, lead, cadmium, cobalt, and others. While the Watershed Assessment addresses copper toxicity, it does not indicate metal mixtures can have synergistic effects. For example interactions between copper and zinc can cause higher rates of mortality in fish than expected based on each element alone.

<u>EPA Response:</u> Combined effects of metals were addressed by the additivity model used to derive the “Sum of Metals” quotients in Tables 5-14 through 5-16 and are addressed in the equivalent tables (Tables 8-4 through 8-8) in the revised assessment. Zinc concentrations are very low relative to toxic concentrations and relative to copper, so synergistic effects would be expected to be negligible. Due to the concern for non-criteria metals, benchmarks have been added.

5.206 Copper should not be considered the only contaminant of concern as it is in the risk assessment.

<u>EPA Response:</u> Copper is not the only contaminant of concern. The identification of contaminants and other stressors of concern is clarified in Chapter 6 of the revised assessment.

5.207 *Section ES-26, page 48:* “Standard leaching test data…results are uncertain predictors of the actual composition of leachates”

Comment: This is not my understanding.

<u>EPA Response:</u> Small-scale laboratory tests are inevitably uncertain estimators of actual large scale field processes. No change required.

5.208 *Section 5-52, page 205:* “…as would be expected for a metalliferous site, the levels of sulfate and some metals (copper, molybdenum, nickel, and zinc) are elevated, particularly in the South Fork Koktuli River”

Comment: I believe this is VERY limited to areas around the deposit.

<u>EPA Response:</u> This has been edited for clarity in the revised assessment.

5.209 *Section 5-53, page 206:* “ …copper is the major resource metal and is particularly toxic to aquatic organisms. Hence, it is the most likely to cause toxic effects…”

Comment: This is inaccurate; there are several metals of concern with potentially synergistic effects (zinc, cadmium, etc.)

<u>EPA Response:</u> The statement is correct as is. Zinc and cadmium concentrations are too low to significantly modify copper effects.

5.210 *Section 5-58, page 211:* " Although effects of permitted effluents are not expected to be significant"

Comment: This seems a spurious assumption; regardless of chemical composition of effluent, it will not be the SAME chemistry or temperature as pre-mining water.

<u>EPA Response:</u> Not all changes in water chemistry have significant effects. No change required.

5.211 *Section 5-60, page 213:* "…it is unlikely that a mine access road would have sufficient traffic to significantly contaminate runoff with metals or oil."

Comment: My understanding from Ghaffari report is that they expect a TRUCK AN HOUR, some of which will be transporting fuel, etc. That seems like plenty of traffic for potential impacts.

<u>EPA Response:</u> A truck an hour is considered a low traffic rate.

5.212 *Section 5-64, page 217: Wetland Filling and Alteration*

Comment: A lot of information depends on wetlands, but they are NOT well characterized.

<u>EPA Response:</u> Wetland delineation is never precise, but we believe that this is a relatively minor source of uncertainty in the assessment.

5.213 *Section 5-64, page 217:* "The loss of wetlands can result in the loss of resting habitat for adult salmonids and of spawning and rearing habitat in ponds and riparian side channels."

Comment: Needs citations, but I couldn't find anything to support 'resting and spawning' habitat for adults.

<u>EPA Response:</u> Text has been revised to clarify (Section 10.3.1.2).

5.214 *Section 5-65, page 216:* "The transportation corridor has the potential to affect 270.3 km of stream between the road crossings and Iliamna Lake. This is based on the length of streams below crossings…"

Comment: Shouldn't it include the length of stream ABOVE crossings, since many fish will lose access at least some of the time?

<u>EPA Response:</u> Stream lengths below the road are distinguished from those above because the potential effects are quite different. No change required.

5.215 *Section 5-74, page 227:* "…For example, the 1960 survey for Knutson Bay reported 1 million adults. Sockeye salmon spawn along the north side of Knutson Bay, adjacent to the transportation corridor."

Comment: !!

<u>EPA Response:</u> Comment noted; no change required.

Stratus Consulting (Doc. #4772 and #4973)

5.216 *P. 5-22:* "The alteration in streamflows resulting from mine operations was estimated by reducing the flows recorded at existing stream gages (Figure 5-8, Table 5-5) for the site watersheds by the percentage of the expected surface area lost to the mine footprint and the area of any drawdown caused by groundwater flow back to the mine pit or locations of dewatering operations (Table 5-6, Box 4-9)."

Comment: The approach used to make these estimates is reasonable, but it is overly simplified for these catchments for two reasons. First, groundwater-surface water interactions in these streams complicate simple discharge-drainage area relationships, such that lost acreage may not always be a good proxy for lost flow. This may be particularly true where leachate from tailings impoundments or waste rock piles could leak and ultimately be transported through groundwater to downstream locations. Second, the flow losses described are calculated based on annually averaged flows. In reality, flow losses will be seasonally variable depending on the complex interactions among flow losses in the mine area, baseflow changes in streams, and surface inputs. As a result, flow reductions during certain times of the year could be substantially greater than EPA predicts (see Appendix B). The Final Watershed Assessment should describe in more detail how changes to seasonal or daily flows may be more significant than the changes in annual averages that are currently described.

EPA Response: The revised assessment includes a more comprehensive water balance accounting, including incorporation of inter-basin groundwater transfer. The implications for transfer of leachate is now included.

5.217 *P. 5-28:* "Simple mixing models can be used to estimate stream temperatures below the confluence of multiple sources with known temperature and discharge. However, we cannot use such models here, because we cannot account for all contributions, particularly groundwater (Leach and Moore, 2011). In the absence of models, we have relied on available literature to identify the most likely risks to fish associated with projected changes in the mine area."

Comment: EPA is correct that groundwater is an important contributor to the thermal regime, and that this cannot be adequately modeled without an integrated surface water groundwater model. Based on our hydrologic modeling, a large-scale mine at the Pebble deposit would substantially alter the relative contributions of groundwater and surface water entering streams at different locations during different times of the year. Because the resulting changes in thermal regime could be an extremely important impact of the mine on salmonids, EPA should more fully explore ways to quantify these impacts.

EPA Response: Such an analysis would be useful, but is beyond the scope of this assessment.

5.218 *P. 5-44:* "Mine operations that reduce surface water contributions in the natural drainage course, or that lower groundwater tables, may influence groundwater paths and connections within and among streams in the mine area in ways that are unpredictable, but that could have significant impacts on fish."

Comment: This is a key point. The surficial geology of large portions of the watersheds draining the Pebble deposit (i.e., coarse glacial outwash material) has created an integrated groundwater-surface water system. One consequence of this, as demonstrated by our modeling (Appendix B), is that flow alterations are substantially more variable than the annually averaged estimates relied on in the Draft Watershed Assessment. For example, we find that the absolute and percentage reductions in the magnitude of spring flows are typically much larger than the annual average reductions reported in the Draft Watershed Assessment, resulting in less flow variability overall. Such changes to the natural flow regime could significantly alter the ecology of these streams (e.g., Bunn and Arthington, 2002), resulting in additional impacts to ecological resources. The Final Watershed Assessment should make an effort to more explicitly address these potential changes in flow regime.

EPA Response: The final assessment recognizes that flow modifications may differ from the projections shown. Key uncertainties and assumptions are discussed in Section 7.3.4.

5.219 Issue: *No-failure scenario assumptions* (p. ES-14). The no-failure scenario is unrealistic because it assumes that "no significant human or engineering failures occur during or for centuries after operation" (p. ES-11) and that there will be 100% capture of all mine waste leachate, even though the tailings and the waste rock facilities are assumed to be unlined (see pgs. 4-21 and 4-23). Therefore, mine waste leachate impacts under the nofailure scenario could be larger than assumed. An additional uncertainty bullet should be added to Summary of Uncertainties in Mine Design and Operation (p. ES-24) to cover this issue, or engineered liners over the tailings and waste rock footprints, and leachate collection systems, should be added to the no-failure scenario.

EPA Response: The revised assessment does not contain a "no-failure" scenario.

5.220 *p. 5-47:* "Under routine operations, our mine scenario presumes that all runoff water, leachate, and wastewater would be collected and properly treated to meet state and federal criteria before release."

In this and other places in the Draft Watershed Assessment, there is some confusion between "routine operations" and "no failure." The hydrogeology of the Pebble area is characterized by extremely high hydraulic conductivities, extensive groundwater-surface water interactions, and complex flow paths that would make it highly unlikely that all of the mine water could be collected and properly treated. Given the track record of other hard rock mines (even those built on less permeable substrates), EPA should consider using a more realistic "routine operations" scenario in which some fraction of the leachate and runoff from mine operations escapes.

EPA Response: The "no-failure" scenario was intended to separate the inevitable footprint effects of operating a large mine from those that would result from unintended events. We did not intend to state that a no-failure situation would prevail. However, because this was not clear to many readers, the no-failure scenario has been eliminated. Chapter 8 of the revised assessment addresses water collection, treatment and discharge in terms of expected operating conditions and potential failures.

American Fisheries Society, Western Division (Doc. #3768)

5.221 Mining and sensitive fish species do not mix. Essleman in Chambers et al. (2012) reported that one mine per 5 km2 limited sensitive fish taxa (like salmonids) to less than 15% of the assemblage, and that is based on all mines. A copper mine is likely to be more toxic to salmonids, and a mining district is vastly more disruptive than a single mine.

EPA Response: The revised assessment includes expanded discussions of toxic effects and cumulative effects.

Earthworks (Doc. #4125)

5.222 Potential impacts to wetlands are underestimated in the current draft of the document. Wetlands data for Pebble are based on coarse scale, 1:63,360 National Wetlands Inventory (NWI) data without documented ground truthing. The basemap standard for all states except Alaska is 1:24,000/1:25,000, over twice the resolution of that used in the Assessment (USFWS. 2004. National standards and quality components for wetlands, deepwater and related habitat mapping. 18 pp.).

Even at the higher, 1:24,000/1:25,000 resolution, the USFWS recognizes limitations of "remotely sensed information as a primary data source" and indicates that using remotely sensed data excludes some wetland types (Ibid.) including ephemeral habitats which occur in the area of interest (Pebble Limited Partnership. 2011. Pebble Project environmental baseline document, 2004 through 2008).

Comment: The current wetlands data, based on a coarse scale 1:63,360 National Wetlands Inventory (NWI) data likely underestimates the amount of wetlands present in the region, and therefore, the likely impacts to wetlands from mine development. It might be useful to consider a higher resolution wetland analysis.

EPA Response: See responses to Comments 5.19 and 5.71.

5.223 The Assessment evaluates impacts during average flow conditions. Since natural flows have large seasonal variations, flow reductions resulting from a mine can be substantially more severe than predicted by this averaging approach. For example, the degree of dilution from receiving waters will vary seasonally, so that the assessments based on averages are almost certain to underestimate water quality impacts under low flow conditions.

Comment: Please consider incorporating the findings of this study (McIntyre et al. 2012) in the final assessment reference this study, and modifying the discussion accordingly. We also recommend incorporating information concerning the existing conditions in Bristol Bay headwaters streams (low hardness and low dissolved organic carbon conditions, and the increased sensitivity of aquatic biota to metal concentrations as a result.

EPA Response: During seasonal periods of low flow, the dilution volume is reduced but so is the amount of leachate generated by the waste rock piles, the most important sources of toxic effluents. Therefore, we believe that average conditions provide a reasonable scenario. The work of McIntyre and others was incorporated as was the influence of water chemistry on metals toxicity.

Natural Resources Defense Council (Doc. #4608)

5.224 If a mining project such as the Pebble Mine is permitted in Bristol Bay, even idealized failure-free operations would inevitably cause severe impacts on salmon habitat. The mine would eliminate headwater streams within and upstream of the mine footprint[8] and degrade downstream habitat through loss of headwater streams and wetlands[9]. Under the EPA minimum mine size scenario, 87.5 km of first- through third- order streams and 10.2 km^2 of wetland habitat would be eliminated or blocked. At maximum size, the mine would eliminate 141.4 stream kilometers and 17.3 km^2 of wetlands. These numbers reflect uncertainty only to the extent that they may undervalue stream length and wetland area affected. Degradation at this level would eliminate or block 7% (minimum mine scenario) to 10% (maximum mine scenario) of the watershed's total anadromous stream kilometers, home to coho salmon, sockeye salmon, Chinook salmon, and Dolly Varden spawning and rearing habitats.

<u>EPA Response:</u> Comment noted; no change required.

5.225 Large scale flow reductions in the watershed would be part and parcel of any mining operation undertaken in Bristol Bay. With the documentation for its 2006 water permit applications, NDM requested the use of up to 35 billion gallons of water each year. This would require that all surface and ground water within the area be redirected to mine use, consistent with the EPA water capture scenario at start-up. During operation, EPA's analysis of the downstream effects of mining found streamflow reductions of up to 32% (maximum mine scenario) and 63% (minimum mine scenario), even factoring in operational flow return to streams. Once the mine is closed, treated water from the pit would not be available for streamflow for at least 100-300 years.

Above the mine, fish stocks would be completely destroyed; downstream from the mine stream, flow reductions would diminish and degrade fish habitats. Since the number of fish produced is determined by the quality and quantity of habitat available, this loss of flow is likely to cause reductions in resident and anadromous fish populations.

Salmon are invaluable to the ecosystem as a food source. Numerous species consume salmon at all life stages, from salmon eggs to spawned-out carcasses. Salmon provide food sources to all types of terrestrial mammals, including carnivores and "herbivores," many types of birds, and a wide variety of fish. They are also an important food resource to several marine species, such as beluga whales and sea lions, which will follow salmon hundreds of kilometers upstream. Salmon are important to more than megafauna; algae, fungi, bacteria, and many populations of invertebrates feed on salmon carcasses and in turn affect the greater ecosystem. Scientists believe that the presence of salmon, and the seasonal nature of their availability, has shaped the evolution of aquatic and terrestrial consumers, including in many cases a co-evolution between predators and prey.

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[8] The mine footprint consists of the area devoted to mining, including the mine pit, waste rock piles, TSFs, ore processing facilities, and other mine-related constructs. Id. at Vol. 1, 5-12.

[9] A wetland is classified as eliminated if it falls within the boundaries of the mine pit, waste rock pile, or tailings storage facility. Id. at Vol. 1, 5-14.

Salmon are also crucial to the ecosystem because they transport nutrients into freshwater ecosystems. Salmon serve as a "conveyor belt," carrying nutrients to these ecosystems. They accumulate over 95% of their biomass in the ocean, and, when they return to freshwater, a "large fraction" of their marine-derived nutrients ("MDN") are incorporated into freshwater and terrestrial food webs. Because salmon can migrate over 1,000 kilometers inland, these nutrient gains benefit a wide geographic area.

Any reduction in salmon populations might severely impact this conveyor belt, as it has been predicted that the presence of salmon creates a positive feedback loop. Nutrients brought by spawning salmon enhance juvenile salmon growth and survivorship because, in aquatic salmon ecosystems, primary production is often severely nutrient-limited.

Declining numbers of spawning salmon can thus impede juvenile salmon survival, reducing yet further the nutrients in affected ecosystems.

Returning and spawning salmon are also important to wildlife because their MDN "fuel much of the productivity of the Bristol Bay watershed." Salmon predators such as bears deposit those MDN on the landscape, where they increase plant production that supports moose, caribou, song birds, and other terrestrial wildlife. Non-mammals such as birds and insects are also responsible for transporting salmon away from streams, and the transported carcass is consumed by a variety of scavengers in the terrestrial ecosystem. Nutrients leach into the soils by excretion and decomposition, and are taken up by the vegetation. It is thought that salmon play a significant role in the productivity of riparian ecosystems.

Salmon's contributions extend yet farther and deeper into the surrounding ecosystem. For example, since bear densities are correlated with salmon availability, and bears are important seed dispersers, the presence of salmon leads to better dispersal of seeds. As another example, salmon can cause higher densities of insectivorous birds, which eat insects that destroy vegetation. Increased salmon, then, often leads to increased vegetation.

Finally, salmon act as ecosystems engineers. They are an important source of mechanical energy, and intensively and regularly disturb benthic communities. This alters the composition of sediments and changes the topography of the substrate, which has many effects on the ecosystem, including increasing the survival of salmon eggs. In this multitude of ways, salmon strengthen – and their decline would degrade – the surrounding wildlife.

"Depending on the size, time and location of a pipeline spill, a slurry pipeline break could impact thousands to hundreds of thousands of adult salmon and high-value resident fish – and hundreds of thousands to millions of juvenile fish."

<u>EPA Response:</u> Comment noted; no change required.

5.226 Though not addressed in the Assessment, a mine in the Pebble area would utilize a wide variety of ecologically harmful substances, such as explosives, fuels and oils, antifreeze, water treatment chemicals, herbicides and pesticides, and road de-icing compounds, any of which may be released into surface and ground water. Spills of these chemicals could cause "critical" impacts if they occurred in spawning or rearing habitats, or cause particular harm when occurring simultaneously with other mine impacts.

EPA Response: The revised assessment addresses spills of chemicals from truck accidents (Chapter 10) and of diesel oil from pipeline failures (Chapter 11).

5.227 Furthermore, cyanide is often used during mining of copper, gold, and molybdenum. Much of the information on cyanide indicates that it breaks down quickly and mostly harmlessly—but this is neither complete nor correct. Cyanide should be listed as a potential concern whenever it is used in mining, because it reacts readily with almost any other available chemical and can form hundreds of compounds, many of which can persist in the environment. These compounds can accumulate in plants and can be chronically toxic to fish. As a result, it is "likely that the negative impacts to aquatic organisms, especially sensitive fish populations, from releases of cyanide…is underestimated and undetected…."

EPA Response: The revised assessment acknowledges the possibility of the use of cyanide as a process chemical (Chapter 4).

S. Wehmeyer (Doc. #3486)

5.228 In section 5.2, study authors attempt to quantify the impact development may have on streamflow rates, but later remind the reader that to do so is not feasible.

EPA Response: We have used the best available scientific information and acknowledged uncertainties in our analyses. The comment does not indicate what better information was available that was not used. No change required.

G. A. Beischer (Doc. #4372)

5.229 In section 5.2, study authors attempt to quantify the impact development may have on streamflow rates, but later remind the reader that to do so is not feasible. The following is a quote from EPA's website which lists the Mission of the EPA "national efforts to reduce environmental risk are based on the best available scientific information". The quality of work in the EPA Draft Assessment is not using the best available scientific information. In fact, it has completely ignored or excluded the best available information. This is inconsistent with the core mission principles of EPA.

EPA Response: See response to Comment 5.228.

R. Goodman (Doc. #1761)

5.230 There are a few issues that concern me that I did not see addressed:

- Dust – created by road traffic. How will this affect the water and fish?
- Permafrost – great ground shifts could cause damage to structures. How could this effect the water? For ex. The "new road" in Iliamna already has a lot of cracks and heaves easily visible from the air. My home in Pedro Bay shifts more than a few inches every winter.

EPA Response: Dust is considered in Section 10.3.5 of the revised assessment. A rough estimate of dust production from the transportation corridor is provided that indicates it could be substantial. The main impact of dust from the transportation corridor on salmonids would likely be reduced habitat quality due to a reduction in riparian

vegetation and subsequent increase in suspended sediment and fine bed sediment, especially during road construction. (Potential effects of increased sediment loading are discussed in Section 10.3.4.)

We have expanded our characterization of the soils and permafrost distribution in the Bristol Bay watershed in Chapter 3 of the revised assessment. As part of this expansion, we summarize the nature and distribution of permafrost by physiographic region. The occurrence of an extreme hydrological event such as heavy rainfall on frozen soil could produce unusually heavy runoff and higher than normal stream flows. The designs for components of the mine and road infrastructure need to consider the natural cold region conditions and incorporate appropriate design features and safety factors to achieve an acceptable level of performance. Permafrost in the study area is generally sporadic or absent. If sporadic areas of permafrost are discovered, designs will need to address the interactions between the infrastructure and the permafrost.

National Mining Association (Doc. #4109)

5.231 Section 5.3 of the Draft Assessment addresses water quality, and presumes that mining operations will meet applicable water quality standards. However, in spite of the fact that water quality standards are presumed met, the Draft Assessment nevertheless implies that unacceptable adverse stream impacts would occur as a result of mining. For example, despite the fact that "the copper criterion…is one of [EPA's] best supported criteria," the Draft Assessment states that "it is always possible that it would not be protective in particular cases due to unstudied conditions or responses." Similarly, the Draft Assessment states that "chemical criteria and standards do not address…unusual sensitivities of the biotic community…Therefore, meeting all criteria could still result in toxicity resulting from combined effects." Likewise, EPA states that "criteria for chemicals other than copper…may be inaccurate estimates of threshold concentrations for toxic effects in these highly pure waters," and that "the water quality criteria and standards used in this assessment may not be protective of all macroinvertebrate taxa that are important prey for fish." Such assertions amount to the second-guessing of EPA-approved water quality standards, and it is highly inappropriate for EPA to imply in a draft watershed assessment that state and federal water quality standards are not protective of aquatic life. There are very specific regulatory processes – indeed, many of which EPA mentions when describing the federal criteria – designed to develop state and federal water quality requirements. It is improper for EPA to claim in a hastily conducted study that mines meeting those scientifically sound, legally developed standards may nevertheless cause unacceptable harm to water quality.

EPA Response: **We appreciate the NMA's endorsement of the national ambient water quality criteria. However, we have been clear that the national criteria are not protective of all biota in all situations, so site-specific and endpoint-specific considerations are appropriate. The State of Alaska has not adopted the BLM-based copper criteria, which is the latest EPA-recommended criteria. No change required.**

5.232 NMA is also concerned that EPA will use this draft document as support for imposing a de facto conductivity water quality standard on any proposed mine site in Bristol Bay. Specifically, EPA states that "dissolved salts (expressed as conductivity or total dissolved solids) are a potential risk to stream biota…However, there are not applicable criteria and the actual salinity and the mixture of ions in the effluent are highly uncertain. For these reasons, any discharge permits for mines in the Bristol Bay watershed should include relevant whole-effluent toxicity testing and monitoring of biotic communities in receiving streams." Proposed mining operations in the Bristol Bay area will have to meet all applicable water quality standards, which are contained in Alaska's EPA-approved permitting program. The State of Alaska is responsible for establishing water quality standards under CWA Sec. 303, and implementing those standards through the CWA Sec. 402 permitting process. Such implementation includes making determinations as to whether discharges have a reasonable potential to cause or contribute to an excursion above an applicable water quality standard. EPA cannot simply pre-determine that mining will cause adverse water quality impacts and superimpose a water quality requirement not included in the approved state standards by means of the Draft Assessment, and EPA should remove this language from the Draft Assessment.

<u>EPA Response:</u> This is a risk assessment. Therefore, it must address risks such as the risk that the national criteria and state standards used in permitting would not be fully protective. The quoted statement about whole-effluent testing is a recommendation concerning potential mitigation and not a "de facto conductivity water quality standard" or a permit requirement. No change required.

<u>M. Buckley (Doc #1651)</u>

5.233 Earlier research showed that copper impacts a salmon's sense of smell. Other research showed that when a salmon's sense of smell is affected, its behavior changes." McIntyre used concentrations of between 5 and 20 parts per billion but has sampled highway runoff with 60 times as much copper. Copper's effect is mediated by organic matter, which can make the metal unavailable to living things.

<u>EPA Response:</u> These points were made in the assessment. No change required.

<u>American Fly Fishing Trade Association et al. (Doc. #4615)\</u>

5.234 The proposed Pebble Mine in Bristol Bay poses numerous significant and potentially long-lasting threats to one of the world's foremost sport fishing and hunting regions. Specifically, fish habitat (including spawning and breeding grounds), wildlife habitat and recreational areas are all threatened by several hard rock mining proposals - most notably, the Pebble Mine. The potential impact from this type of activity could be severe. It is estimated that the Pebble Mine would produce between 2.5 and 10 billion tons of waste containing elements, such as copper and other heavy metals, that would threaten several fishery areas including spawning and breeding grounds for world-renowned populations of salmon.

<u>EPA Response:</u> Comment noted; no change required.

<u>Alaska Marine Conservation Council (Doc. #4112)</u>

5.235 The Assessment might also perform an assessment of how natural stream waters will change from the discharge of treated mine water under a No Failure scenario. In particular, water treatment plant effluent hardness values would be expected to significantly increase the level of total dissolved solids in Bristol Bay watershed streams near proposed discharge locations, and the impacts of these changes, even though they might meet water quality standards, are not clear.

<u>EPA Response:</u> **If chemicals that increase hardness are added to the effluent during treatment, they would increase TDS. The issue of increased dissolved ions was discussed in the assessment. Since there are no relevant standards or criteria and since toxicity would be dependent on the ionic composition, which is unknown, the assessment recommends that whole effluent toxicity tests be performed. Hence, this comment cannot be adopted given current information.**

<u>Alaska Conservation Foundation (Doc. #4120)</u>

5.236 Further, EPA appropriately addresses mill waste tailings, including a section on why paste tailings will not be an option. The assessment might also benefit from a discussion of how other water treatment options could affect the quality of waters downstream even under a best practices, No Failure scenario.

<u>EPA Response:</u> **The revised assessment does not contain a "no failure" scenario. However, it does model the contribution of treated waste water to water quality under the assumption that criteria and standards would be met.**

5.237 Regarding risks to the fishery, the laboratory toxicity tests for copper under-estimate impacts to sensitive macroinvertebrates and algae and under-represent the effects of copper toxicity on salmon, especially olfaction dependent behaviors such as spawning, migration, and avoidance of predators. The results of a recently published study by McIntyre et al. (2012) add to the growing body of literature regarding the impacts of sub-lethal concentrations of dissolved copper to juvenile coho salmon. The study concludes that low levels of dissolved copper (5-20 mg/L disrupts olfactory processes and decreases the ability of juvenile coho smolt (Oncorhynchus kisutch) to detect predators, thus increasing mortality by predation (McIntyre et al. 2012). The final assessment can reference this study and modify its discussion accordingly.

<u>EPA Response:</u> **Effects on olfaction were described in the first draft and are discussed at greater length in the revised assessment. This includes estimation of the stream lengths in which olfactory effects are expected to occur under the scenarios in Chapter 8. Studies of olfactory effects by McIntyre and other NOAA scientists were performed in the laboratory.**

5.238 Finally, most laboratory tests used to set standards do not evaluate the combined low hardness and low dissolved organic carbon conditions that are common in Bristol Bay headwater streams. This combination makes aquatic biota even more sensitive to increased metal concentrations, and this point could be added to the assessment.

<u>EPA Response:</u> **Both the draft and revised assessments corrected the copper effects levels for the effects of water chemistry using the biotic ligand model.**

5.239 When evaluating water quality and hydrologic impacts of mine development, the Assessment evaluates impacts during average flow conditions. Since natural flows have large seasonal variations, flow reductions resulting from a mine can be substantially more severe than predicted by this averaging approach. For example, the degree of dilution from receiving waters will vary seasonally, so that the assessments based on averages are almost certain to underestimate water quality impacts under low flow conditions.

EPA Response: See response to Comment 5.223.

The Nature Conservancy (Doc. #4606)

5.240 Table 5-13 of the Draft Watershed Assessment tabulates the percentage reductions in streamflow resulting from a 25-year mine plan, and compares these reductions to impact thresholds of 10% (measureable alteration of ecosystem structure) and 20% (moderate to major alteration of ecosystem structure and function) described by Richter et al. (2011). Based on this table, only gages UT100D, SK100G, SK100F, and NK119A exceed the 20% flow alterations that could have "moderate to major changes in natural structure and ecosystem functions" (Richter et al., 2011).

Our model results generally confirm the average annual flow alterations predicted by EPA in the Draft Watershed Assessment (Table 1). However, integrated modeling with MIKE SHE demonstrates that daily flow alterations in these gages can substantially exceed these annual averages depending on the season: because mine infrastructure is primarily in steeper headwater portions of the watershed, peak flows following rainfall events are typically more significantly affected by mining than are longer-term, average flows. Thus the percentage flow reductions vary temporally depending on what portion of the hydrograph is being modeled.

As an example, the average flow reduction at gage SK100C as calculated by EPA is only 12%; this average annual value is corroborated by our modeling, which predicts an annual average flow reduction of approximately 14%. However, MIKE SHE also predicts maximum daily flow alterations, and at SK100C this maximum daily flow reduction is approximately 63%. Similarly, average annual flow reductions in the lower reaches of Upper Talarik Creek (UT100B) are projected to be approximately 3–5% in the Draft Watershed Assessment and in our model, whereas our model indicates that maximum daily flow reductions in this gage may be as high as 44% during the spring freshet.

EPA Response: See response to Comment 5.218.

5.241 While the average annual flow reductions projected by our model generally agree with the average annual estimates from EPA for the South Fork Koktuli, there are differences for the North Fork Koktuli and the uppermost Upper Talarik that arise due to differing treatments of waste rock and tailings leachate. In particular, EPA assumed in their "No Failure" scenario that leachate from the tailings impoundment would be captured before it reached the surface water system. In our modeling, we modeled infiltration of leachate from TSF 1 into weathered bedrock, which is then free to migrate downstream. As a result of this groundwater leakage, our model estimates an average annual increase in flow at gage NK100 of approximately 81%, compared to a 63% decrease in flow projected by EPA. Similarly in gage UT100D, where waste rock leachate forms a substantial fraction of the total flow, winter baseflow increases in our model lead to strongly positive flow alterations, which nearly balance strongly negative runoff reductions in the wetter months. Thus our modeling predicts a negligible change in annual average flows, but a maximum daily reduction of 56% (Figure 7).

Based on these results, we conclude that while EPA used generally sound methodologies for estimating average annual flow alterations in systems downstream of a proposed mine, temporal variation in the hydrologic system could lead to increased exposure to risk factors. In the South Fork Koktuli where our assumptions are most consistent with those used by EPA, we arrive at approximately the same predictions for average annual flow reductions. However, because EPA did not apply a dynamic groundwater-surface water flow model, they significantly underestimated the maximum daily flow alterations from this large-scale mine scenario. In addition, we believe that the EPA assumption in the Draft Assessment of no leakage beneath TSF 1 or waste rock piles may not be conservative enough. As demonstrated by our modeling, if some or all of this leachate were to escape through the floors of these waste streams, downstream flow changes could be significantly more variable than the Draft Watershed Assessment predicts. Depending on when in the salmon lifecycle these flow alterations occur, changes of this magnitude could cause substantial harm to biota or aquatic habitats downstream of a large-scale mine at the Pebble deposit, including alteration of both peak flows and base flows (e.g., Bunn and Arthington, 2002).

<u>EPA Response:</u> See response to Comment 5.218. The inability to capture all leachate is now included in the water balance calculations.

5.242 Based on our review of the Draft Watershed Assessment and ongoing hydrological modeling of the hydrologic system surrounding the Pebble deposit, we find that the conclusions in this assessment regarding risks to salmonids are largely supported: a hard rock mine such as the Pebble Mine would pose significant adverse risks to salmon downstream. However, our fully integrated model provides a more detailed evaluation of risk factors, in particular: 1. Explicit consideration of daily and seasonal changes in flow demonstrates that estimation of flow alterations in the Draft Watershed Assessment in some cases may significantly underestimate the risk to aquatic ecological structure and functions of the watersheds under consideration.

<u>EPA Response:</u> The revised assessment now includes a more detailed and comprehensive accounting of water balance among mine components.

<u>The Pebble Limited Partnership (Doc. #4962)</u>

5.243 *Section 5.4.7:* This section assumes that the requirements under Section 404(b) of the Clean Water Act will not apply to the project. This is not an accurate assumption. For example, if impacts to wetlands are unavoidable, then mitigation will be required.

<u>EPA Response:</u> We do not assume that Section 404(b) Clean Water Act (CWA) requirements would not apply to the proposed project. This assessment is not a regulatory action, and thus a complete evaluation of compensatory mitigation is considered outside its scope. Because public and peer review comments suggested an array of compensation measures that could potentially offset impacts on wetlands, streams, and fish, we included Appendix J in the revised assessment. This appendix provides an overview of CWA Section 404 compensatory mitigation requirements for unavoidable impacts on aquatic resources and discusses the likely efficacy of these measures at offsetting potential adverse impacts.

5.244 *Section 5.4, page 5-59, b 2nd sentence:* Poorly designed roads, such as those built before roughly 1990, can have negative effects on the environment. Roads built to modern standards are designed to, and do, avoid the majority of the described effects.

EPA Response: Modern roads also can have negative effects on the environment. The estimates of risk in this assessment take into account the use of best management practices or mitigation measures that are discussed in text boxes throughout Chapter 10 of the revised assessment. The proposed transportation corridor would traverse varied terrain and subsurface soil conditions, including extensive areas of rock excavation in steep, mountainous terrain where storm runoff can rapidly accumulate and result in intense local runoff conditions (Ghaffari et al. 2011). Although the road design, including placement and sizing of culverts, would take into account seasonal drainage and spring runoff requirements, culvert failures would still be expected.

5.245 *Section 5.4.5:* The first cited document was one of the studies that caused a major revolution in the design and construction of roads. It is no longer representative of expected effects of well-designed and constructed roads on sediment inputs. Modern construction techniques are designed to avoid and mitigate impacts to streams. The assessment fails to take this reality into account.

EPA Response: We agree that modern construction techniques are designed to avoid and mitigate impacts to streams, and the assessment does take this reality into account. The estimates of risk in this assessment take into account the use of best management practices (BMPs) or mitigation measures that are discussed in text boxes throughout Chapter 10 of the revised assessment. However, even with the use of BMPs, inhibition of fish passage and reductions in habitat still could occur. Environmental characteristics along the transportation corridor would likely render the effectiveness of standard or even "state-of-the-art" mitigation measures highly uncertain. Further discussion on this is contained in Box 10-5 of the revised assessment.

5.246 *Section 5.4.6:* The same construction techniques used to control sediment delivery to streams will also be effective in controlling salts and dissolved solids.

EPA Response: We agree. Potential mitigation measures for stormwater runoff, erosion, and sedimentation are discussed in Box 10-3 of the revised assessment.

5.247 *Section 5.4.8:* This section assumes that roads will not be constructed to current standards and that Section 404(b) of the Clean Water Act protecting wetlands will not be adhered to during permitting. Current regulations require that these impacts are avoided through implementation of modern standards for road and culvert construction. A mine plan/scenario based on the assumptions in USEPA's assessment is not permittable, and, therefore, is not an adequate basis for the assessment.

EPA Response: Section 5.4.8 assumes that Clean Water Act requirements would apply to the proposed project and that modern construction techniques designed to avoid or mitigate impacts to streams would be used. Also see response to Comment 5.245.

5.248 *Section 5.4.10:* This section assumes that culverts and roads will be poorly designed and culverts will block fish migration. Current State of Alaska and federal regulations require that these impacts are avoided through implementation of modern standards for road and culvert construction.

<u>EPA Response:</u> See response to Comment 5.245.

5.249 *Section 5.4, Page 5-59, Paragraph 1, First Sentence: "Only rarely can roads be built that have no negative effects on streams (Darnell et al. 1976)* : Design for low impact roads which address sedimentation, erosion, flood and habitat concerns have progressed since 1976. "The U.S. Forest Service, the National Park Service, the USDA Natural Resources Conservation Service, California Department of Forestry and Fire Protection [CDFG], and many forest and ranch landowners have all endorsed some form of the road design approach commonly referred to as 'Low Impact to Hydrology' (LITH). The goal of the LITH design approach is to make roads less disruptive to natural watershed runoff processes" (Dashiell and Lancaster n.d.). Techniques used in LITH road design are outlined in Road Design Guidelines for Low Impact to Hydrology (Dashiell and Lancaster n.d.) as well as Roadway Design Guidelines: Pacific Region (USFWS 201 1). These techniques are known to significantly reduce the effects of road construction on ecological resources.

<u>EPA Response:</u> The use of Darnell et al. (1976) was incorrect and has been changed to Furniss et al. (1991) in the revised assessment. Furniss et al. (1991) is a seminal publication on the potential effects of roads, particularly as they relate to salmon. The general conclusions of that paper are relevant to the assessment's transportation corridor. Information on current design standards that would be used along the proposed transportation corridor is included within text boxes throughout Chapter 10 of the revised assessment. Box 10-3 discusses stormwater runoff and fine-sediment mitigation, and Box 10-2 mentions the ADOT 1995 *Alaska Highway Drainage Manual*.

It is important to note that the proposed transportation corridor would traverse varied terrain and subsurface soil conditions, including extensive areas of rock excavation in steep, mountainous terrain where storm runoff can rapidly accumulate and result in intense local runoff conditions (Ghaffari et al. 2011). Environmental characteristics such as these would likely render the effectiveness of standard or even "state-of-the-art" mitigation measures highly uncertain. Further discussion on this is contained in Box 10-5 of the revised assessment.

5.250 *Section 5.4.1, Page 5-59, Paragraph 1, First Sentence: "Culverts are the most common migration barriers associated with road networks.":* Culverts designed using modern design guidelines developed by ADOT&PF, CDFG, NMFS, USDA, FHWA, Washington Department of Fish and Wildlife (WDFW), and others have been be constructed that allow aquatic and terrestrial organisms unhindered movement up and down aquatic corridors such as streams and rivers. Examples of such installations have been constructed within the Municipality of Anchorage, Matanuska-Susitna Borough, and Kenai Peninsula Borough, and are supported with funds from the U.S. Fish and Wildlife Service and are permitted by the various resource agencies.

<u>EPA Response:</u> See response to Comment 4.82. The revised assessment states, "Free access to spawning and early rearing habitat in headwater streams is critical for a number of fish species, and culverts are common migration barriers."

5.251 *Section 5.4.1, Page 5-60, Paragraph 1, Last Sentence: "Although the well-planned installation of culverts allows natural flow upstream and downstream of crossings, failure rates are generally high (Sections 4.4.3.3 and 6.4).":* Modern culvert design standards foster designs that are self-sustaining, durable, and provide continuity of geomorphic processes such as the movement of debris and sediment (CDFG 2009). NMFS design criteria require that all fish passage facilities be designed for the 100-year flood event (2001) and that any potential damage to the crossing be addressed as part of the design process. These design criteria significantly reduce the potential of culvert failure, both blockage of fish passage and road washout, and promote habitat and fluvial process continuity.

<u>EPA Response:</u> See responses to Comments 4.82, 4.152, and 4.187.

5.252 *Section 5.4.4.2, Page 5-61, Paragraph 1, Sentence 2: "Culverts pose the most common migration barriers associated with road networks. Persistent barriers to fish movement are assessed in Section 6.4, because they are considered to constitute maintenance failures. Culverts designed to meet the State of Alaska's requirements and regularly maintained should not block fish passage; however, hydraulic characteristics such as low water depth or high water velocities and culvert configurations can impede or prevent fish passage":* As described in detail in several sources (WDFW 201 1, CDFG 2009, USDA 2008, ADOT&PF 2001) modern approaches to culvert design incorporate a continuous streambed that mimics the slope, structure and dimensions of the natural streambed. Water depths and velocities are as diverse as those in the natural channel, providing passageways for all aquatic organisms (USDA 2008) and maintaining sediment and debris continuity. Water depth through culverts is maintained during low flow through incorporation of a constructed channel to concentrate flow and maintain stream thalweg continuity. Design criteria require evaluation of velocities during flows that occur during key migration periods (e.g., low flows) so as not to impede fish passage. Failure in such properly formulated stream crossings is limited and the long term biological benefits of such stream systems can be maintained over time.

<u>EPA Response:</u> See responses to Comments 4.82, 4.152, and 4.187.

5.253 *Section 5.4.4.2, Page 5-61, Paragraph 2, Sentence 2: "Culverts can reduce flow to these habitats by directing low from the entire floodplain through the culvert into the main channel. High water velocities in a stream channel may result from storm flows being forced to pass through a culvert rather than spread across the floodplain. Higher velocities cause scour and down cutting of the channel downstream of the culvert, hydrologically isolating the floodplain from the channel and consequently blocking fish access to floodplain habitat."* While old and inadequate culvert installations do occur in sensitive habitats across the United States, modern industry design approaches reduce the physical and biological impact to streams and rivers. Chapter 6.5.1.1 of USDA, 2008 describes a number of stream simulation type culvert design strategies which can be used in wide, active floodplain scenarios. These design techniques can be used to protect and/or restore floodplain processes and habitats (USDA, 2008).

<u>EPA Response:</u> See responses to Comments 4.82, 4.152, and 4.187.

5.254 *Section 5.4.4.3, Page 5-62, Paragraph 1, Sentence 3: "The behavioral responses to culverts of the up-migrating and down migrating life stages of the salmonid species that use the potentially crossed streams are uncertain.":* The behavioral responses to culverts of upstream and downstream-migrating salmonid species of all life stages are well understood. Modern stream simulation type design techniques evolved from decades of field studies related to culvert passage evaluation. One such example is the document titled Improving Stream Crossings for Fish Passage prepared by the Humboldt State University Foundation for NMFS in 2004. This document emphasizes watershed hydrology, fisheries biology, and culvert hydraulics. The document conclusions are based upon years of monitoring juvenile and adult salmonid passage. Other examples are readily available in the literature.

EPA Response: See responses to Comments 4.82, 4.152, and 4.187. The revised assessment notes, "Culverts are not always built to specifications and the behavioral responses of migrating salmonid life stages to culvert-induced changes in flow are not always anticipated correctly." We do not deny that important research has been performed related to culvert fish passage. Nevertheless, uncertainty of behavioral responses to culvert-induced changes in flow is supported by the memorandum of agreement between the Alaska Department of Fish and Game and the Alaska Department of Transportation and Public Facilities (ADF&G and ADOT 2001), which alludes to the need for comparative field data (i.e., data from different species).

5.255 *Section 5.4.4.3, Page 5-62, Paragraph 1, Sentence 4: "Standards for culvert installation on fish-bearing streams in Alaska target road safety and fish passage, but not the physical structure of the stream or habitat qualify (ADFG and ADOT&pF 2001) … Floodplain habitat and floodplain/channel ecosystem processes be by entrenchment of the channel resulting from culvert-induced erosion. These potential reductions in downstream habitat quality and inhibited fish passage could occur in the 14 culverted streams that support salmonids.":* The ADF&G and ADOT&PF 2001 MOA requires users of these design criteria to consider stream conditions upstream and downstream of the culvert installation as well as the impact of the culvert on the stream stability and function. Some specific examples of such guidance include the following: "In addition to engineering considerations, siting considerations can include the location of spawning habitat, location of drainage divides, proximity to natural slope breaks, stream widths versus flood plain widths, icing problems…"(Section 2 General Planning, 8) "Tier 1 design [stream simulation] most closely replicates natural stream conditions". (Section 4 Culvert Guidelines, 12) "The erodability of channel material at culvert outlets should be evaluated. Appropriate materials such as rip rap, energy dissipation pool, or other suitable materials may be necessary to avoid outlet perching." (Technical Notes, G, 17) "To minimize upstream and downstream channel change m(e.g., head cutting), and need for additional treatments, culverts generally should be aligned with the gradient of the natural stream. "

EPA Response: Though the ADF&G and ADOT (2001) MOA provides factors other than those relating to fish passage that may be considered, its main emphasis relates to fish passage. The document states:

> **"This agreement extends solely to the design, permitting, and installation of culverts in fish-bearing waters. …Additional factors unrelated to fish passage (such as unique environmental considerations, locating culverts in anadromous fish spawning or high-value rearing habitat, or other public safety, engineering, or economic issues) will be addressed on a project specific basis during preparation of the ADOT&PF environmental document."**

Text has been added to the final assessment to indicate that additional factors such as the physical structure of the stream or habitat quality are addressed on a project-specific basis during the preparation of the Alaska Department of Transportation and Public Facilities environmental document.

<u>A. Sutton-Grier (Doc. #3806)</u>

5.256 These aging roads pose a huge problem for salmon habitat because the culverts fail and the roads increase erosion and silt degrades or destroys key salmon egg-laying and fry habitat. So, I have concerns that both the short and long-term impacts of the roads for the mine will have very negative impacts on salmon and on other ecosystem services. I think it is important that the cost of road maintenance into the foreseeable future be included somehow in the analysis of the impacts of this project because without a budget to maintain those roads after the mining operations are completed, the roads will weaken with age and cause major negative impacts to salmon habitat.

<u>EPA Response:</u> The concern related to future road maintenance is reflected in the following statement in the revised assessment: "After mine operations end, traffic would be reduced to that which is necessary to maintain any residual operations on the site, and inspections and maintenance would likely decrease." However, specific discussion of road maintenance costs is outside the scope of the assessment.

<u>Anonymous (Doc. #4613)</u>

5.257 There is an assumption that the impacts from a threat are the same some distance from the source of the threat as they are adjacent to the threat, which is unrealistic. On page 5-69, the impact from a transportation corridor 100-200 meters from a wetland is counted the same as a corridor passing directly through a wetland. There are many examples of mine roads adjacent to or through wetlands (e.g., Red Dog Port Road) that show these assumptions to be untrue.

<u>EPA Response:</u> Filling a wetland (a direct effect) and modifying its hydrology (an effect that extends for some distance from roads) are not considered to be the same. No change required.

5.258 Page 5-65 contains a statement that the transportation corridor has the potential to affect 270.3km of stream between the road crossings and Illiamna Lake, based upon the length of streams below the crossings. This is totally simplistic, as it completely ignores the dissipation of the impact as distance increases from the source of the impact.

<u>EPA Response:</u> The comment is correct that effects tend to diminish downstream. However, the quoted statement refers to "the potential to affect," which is correct.

<u>The Pebble Limited Partnership (Doc. #4962)</u>

5.259 *Section 5.2.1.2:* The report refers to Vanote et al., 1980 (p 5-19) to support the importance of headwater streams. The River Continuum Concept, as developed by Vanote, was developed using a completely different kind of river system in the Rocky Mountains. USEPA's use of this concept for assessing the Bristol Bay watershed leads to inaccurate conclusions because these two regions differ significantly in sources of hydrology, sources of organic material, chemical constituents of substrate, nutrient composition, macroinvertibrates, freeze / thaw cycles, and temperatures and precipitation amounts in the different regions. The analysis based on this concept is, therefore, fundamentally flawed.

EPA Response: The river continuum concept is a general concept of the changes in stream characteristics as stream order increases. It is not specific to the Rocky Mountains. No change required.

5.260 *Section 5.2.1.2:* This section makes statements (e.g., p5-20) about the certainty of the loss of specific habitats or resources. For example, it is stated that “Several active beaver colonies were mapped in streams that would be eliminated or blocked by mine pit and waste rock piles…” There is no proposed mine project upon which to draw these conclusions. Statements such as this are highly speculative and without merit.

EPA Response: The conclusion is based on the mine scenarios, which were derived largely from the preliminary plan put forth by Northern Dynasty Minerals preliminary plan in Ghaffari et al. (2011). No change required.

5.261 *Section 5.5:* This section assumes that impacts to fish described in the previous section will occur. The prior comments on those sections need to be addressed and this section needs to be re-written to correct the analysis errors identified in the prior sections.

EPA Response: See response to Comment 5.98.

5.262 *Section 6.6, page 6-45, paragraph 1:* This paragraph states, “…any negative impact on salmon quality and/or quantity resulting from failures or accidents should be assumed to cause a negative impact on human health and welfare, …” No supporting evidence is presented to support this assumption and the section assumes that there are no mitigation measures in place.

EPA Response: The language in the assessment has been expanded to provide evidence of the close connection between salmon and human health and welfare. It also discusses the challenges of mitigation for loss of subsistence resources.

5.263 *Section 5.2.1.2 Section 5.6, page 5-77, paragraph 4:* This paragraph states, “Increased full-time employment in mining and secondary development could decrease subsistence activities and social relationships derived from these activities …” [Emphasis added]. No supporting evidence is presented and no sources are cited. In the absence of technical references to the relevant literature upon which these statements, presumably, are made the basis for these statements cannot be evaluated.

EPA Response: The assessment text has been revised to elaborate on the potential effects from disruption of subsistence activities and includes references and case studies (Chapter 12).

V. Wilson III (Doc. #4149)

5.264 While the draft Assessment looks at how mining could impact terrestrial-based wildlife and fisheries, perhaps it is important for EPA or another agency to consider how it could impact marine based wildlife and fisheries as well. For example, if salmon runs are lower due to mining activities that could mean less food sources for predators of salmon such as both Cook Inlet and Bristol Bay Beluga whales. This can have an impact on marine mammals, birds and fish, as salmon are a huge part of the food web in both terrestrial and marine ecosystems. Furthermore, mining can have an impact on important invertebrates in both the marine and terrestrial ecosystems, so it's important to understand those impacts as well on Bristol Bay's ecosystems and wildlife. Perhaps the National Oceanic and Atmospheric Administration should weigh in on if and how a mine could impact marine fisheries and wildlife, if mining activities in the watershed are allowed to move forward.

EPA Response: See response to Comment 3.27.

5.265 While the draft Assessment looks at potential impacts of mining on Alaska Native peoples and culture, it is also important for regulators to understand the potential impacts on the marketing of Alaska salmon and seafood as well as tourism in the state overall. Many citizens in the region, both Alaska Native and non-native, depend on the tourism and salmon industry that may be negatively impacted by mining activities. EPA should consider this if it truly wants to understand how mining could impact Alaska Native cultures, since many Alaska Natives depend on these activities for economic stability.

EPA Response: The text of the assessment has been expanded to acknowledge the complex interaction between the subsistence way of life and the market economy, including tourism and commercial fishing.

5.266 Furthermore, if the EPA decides to forego any prohibition of mining in the region, it's important for regulators to understand the potential human health impacts for Alaska Natives and other residents of the region. This includes potential mining impacts on municipal water supplies and fisheries that people depend on for food. Since wild salmon is considered by many nutritionists as a "superfood" that is full of heart-healthy omega-3s and a great source of protein, it's important to understand how this would affect the health and wellbeing of people in the region and consumers worldwide. For example, if the mining company has an accident and damages the salmon runs, the Food and Drug Administration may have to issue warnings for people to not eat as much salmon from the Bristol Bay watersheds. Therefore it is important to understand the risks that mining could bring to human health and both the current integrity and marketing of wild Alaska salmon.

EPA Response: See response to Comment 3.27. The assessment does not include an analysis of potential effects on drinking water supplies or other direct effects on human health, although we acknowledge that local communities depend on both surface water and groundwater for drinking water supplies and include additional information about community water sources in Appendix D.

The assessment does include an acknowledgement of the nutritional value of salmon and the potential local health effects if there are negative effects on salmon. Additional information on this topic has been included in the revised assessment. We also acknowledge that potential effects from loss of salmon would extend well beyond these two watersheds. However, evaluation of loss of salmon from these watersheds as a worldwide food source is outside the scope of the assessment.

V. Mendenhall, Ph.D. (Doc. #4113)

5.267 If contaminants leached from mine impoundments into streams (EPA 2012, page 6-38) even at low levels that did not injure birds directly, it could be lethal to prey populations. In addition, waters of ponds, lakes, and streams interchange frequently with groundwater, which can carry contaminants from a considerable distance (Woody and Higman 2011). Contamination would not be confined to water bodies; tundra streams flood in spring (ABR, Inc. 2012, page 16.1-36) and could contaminate "terrestrial" food webs.

Preys of aquatic birds (fish and invertebrates) are highly sensitive to metal contaminants and have been eliminated below many mines in the past (EPA 2012, page 6-41). If prey populations were reduced, or eliminated, this would impact birds.

EPA Response: See response to Comment 5.64.

Chapter 6: Risk Assessment—Failure

Alaska Department of Natural Resources (Doc. #4818)

6.1 The Assessment has estimated the likelihood of failure of the hypothetical mine dam using historic records of dam failures recorded in the years 1960 to 2010. Many were constructed in periods prior to current regulatory, engineering, and oversight requirements.

EPA Response: Tailings dam failure probabilities are not based on the record of past dams. Historic failure frequency is provided only as a baseline against which to compare the risks based on current design specifications. The failure probabilities are based on Alaska's dam classification and required safety factors applied to the method of Silva et al. (2008). The discussion of failure probabilities has been expanded in the revised assessment to clarify this issue.

6.2 The dam failure analysis assumes an extreme event while the probable maximum flood (PMF) is occurring, and that the dam failure is the worst possible (a full breach of the dam), and the breach results in loss of the maximum reasonably anticipated amount of tailings (20%). This is at the extreme limit of possible concurrent consequences, and the absolute worst for salmon impacts. The likelihood of the PMF is extremely low. High hazard dams are all equipped to contain or pass the PMF. Hence there is also an extremely low probability that the dam will fail if the PMF did occur. There are also a number of failure consequences other than the extreme consequence of a breach and 20% tailings discharge, should 'a failure' occur. Thus the combination of a failure of this particular type with this particularly severe consequence is a very special case of failure with a probability much, much less than the failure probability derived from historic dam failure records. No examples of a failure of a tailings dam constructed by the downstream method with a height of over 150 meter under any circumstances are in recent literature.

EPA Response: We agree that the PMF is unlikely, which is why the probabilities of a dam failure are so low. Loss of 20% of tailings following a dam failure is a conservative value based on the literature.

6.3 *Section 6.1, Page 6-1*

Comment: What evidence is there regarding the 20% volume of tailings that would mobilize during a failure?

Recommended Change: Provide justification for the 20% or whatever percentage is most likely.

<u>EPA Response:</u> 20% is a conservative value based on the literature. The explanation has been expanded in the revised assessment.

6.4 *Section 6.1, Page 6-1 and 6-2*

Comment: The tailings dam failure scenarios evaluate the partial and full, breach, flood and sediment transport scenarios. Reading further into the report, such as Box 6-2, Page 6-15 the Nixon Fork Mine release highlights the variability in scale and types of failures that could occur with the tailings facilities. In order to have a comprehensive understanding of risks, a failure mode analysis should be performed on each of the major structures. For instance, the TSF facilities may have failures such as minor overtopping (as compared with the full breach scenario) on fairly frequent basis that cause chronic aqueous and sediment transport related contaminant exposure events that over the long term cumulatively have significant impacts to the downstream reaches. There are likely several other "failure" modes that are much more probable to occur (such as dam drainage and treatment equipment failures), and would have fairly significant impacts to downstream ecosystems. The assessment does not provide relative quantification of impacts, which will eventually be needed to fully evaluate the project or any proposed development in the Bristol Bay watershed.

Recommended Change: Sections 4.3, 4.4 and Section 6.1 should expand the mine failure modes to understand the more common and more likely failure mechanisms and potential impacts, in addition to the bookend No Failure and Failure. Recommend using probabilistic risk and failure assessment methods to identify Likely Failures.

<u>EPA Response:</u> The comment is correct that the "no failure" scenario and the large (but not worst-case) failures were intended to bound the reasonable possibilities. We do not believe that it is necessary to evaluate additional failure modes in this assessment.

6.5 *Section 6.1.1, Page 6-2*

Comment: A tailings storage facility dam failure is the single most significant potential impact of the dam. Yet no site-specific sediment volumes are estimated or calculated and no site-specific sediment transport study was completed. The generalized discussion provided in these "failure" sections may provide some good description, but there is no substantiating evidence provided to support the hypotheses provided.

Recommended Change: Calculate likely site-specific sediment volumes that would be mobilized during dam failure and do a site- and stream-specific sediment transport study.

<u>EPA Response:</u> The tailings dam failure scenarios include site-specific estimates of the tailings volume released and of sediment and soil mobilized from the North Fork Koktuli watershed, based on an estimate of 20% of tailings spilled and modeled estimates of the mobilization. It is not clear what site- and stream-specific sediment

transport study or substantiating evidence should be added, given that no spill has occurred. No change required.

6.6 *Section 6.1.1, Page 6-3*

Comment: Here the "long winter season" would not allow access, but the long winter and freezing conditions are not mentioned or evaluated in the water balance or fish use discussions.

Recommended Change: Incorporate effect of freezing conditions during the long winter season on water balance and fish use of small shallow streams and lakes.

<u>EPA Response:</u> The discussion of hydrology has been revised to clarify the role of freezing conditions.

6.7 *Section 6.1.2, Page 6-2*

Comment: Lower dam height is listed as 107 meters here but is 98 meters in the introduction to this section.

Recommended Change: Use consistent facts and figures.

<u>EPA Response:</u> Correction made. The dam height is now consistent.

6.8 *Section 6.1.2.1, Page 6-42*

Comment: The use of Mt. St. Helens as an example is incomplete. There is no discussion of the presence, impact, or return of fish to the streams. In addition, the discussion of transport of fine sediment into the main stem Koktuli, Mulchatna, and Nushagak is inadequate.

Recommended Change: Provide a more detailed analysis of the short-term and long-term impacts of Mt. St. Helens on fish and wildlife resources and a full analysis of sediment transport downstream to the larger tributaries. This analysis should then be applied to the area of study of the assessment.

<u>EPA Response:</u> In response to a comment by peer reviewers, Mount St. Helens has been removed as an example of the fate and effects of a large release of fine mineral particles.

6.9 *Section 6.1.2.3, Page 6-8*

Comment: The personal communication reference is incorrect. River-rearing sockeye salmon can contribute 20% or more of the total sockeye return to the Nushagak district; these fish are not "sea-type" sockeye as the report indicates. In the Nushagak River, there is a significant contribution of sockeye that are not associated with a lake but may be rearing in side channels, sloughs, or oxbows.

Recommended Change: Edit the personal communication reference to accurately reflect the conversation.

<u>EPA Response:</u> The revised assessment now uses the term "riverine type" to refer to these fish.

6.10 *Section 6.1.2.3, Pages 6-8 to 6-10*

Comment: Chinook effects are discussed on a Koktuli River-wide effect, but the primary impact areas are in the North Fork Koktuli. No discussion or analysis is provided of North Fork Koktuli Chinook effects versus overall Koktuli River effects.

Effects are unquantified for sockeye, the primary economy-driving species. The conclusions that 28% of Chinook salmon would be impacted are not well supported. It is not necessarily "likely" given the limited level of evaluation provided. It may be possible, but is not presented as just "possible". The further statement that over 50% of Chinook population could be impacted in the Mulchatna/Nushagak Rivers is completely unsupported in the Exposure/Response and Risk Characterization sections as the extent of primary sediment transport is discussed only for the North Fork Koktuli. There is a disconnect between the broader conclusions based on limited areal analysis and limited level of the analysis. The level of such effect is what is unclear because of the limited analysis/evaluation provided within the Assessment.

Recommended Change: Do not rely on this Assessment for decision making, unless it is expanded significantly to provide significantly more detail on the actual or likely extent of physical and chemical impacts. However, as noted, Assessment can be used to identify areas of concern that require further analysis during the permitting process.

<u>EPA Response:</u> Comment noted. The assessment is a scientific document, not a policy or decision document.

6.11 *Section 6.1.2.4, Page 6-9*

Comment: The first sentence of this section sums up everything provided in the Assessment on dam failure. After nine pages of analysis, no new information is provided.

<u>EPA Response:</u> We believe that it is valuable to summarize uncertainties. No change required.

6.12 *Section 6.1.2.3, Page 6-10*

Comment: The proportion of spawning Chinook salmon in the Koktuli River is likely skewed high because of difficulties counting Chinook salmon in other systems and the relatively good counting conditions in the Koktuli River.

Recommended Change: Add sentence describing the identified bias.

<u>EPA Response:</u> Section 7.1.2 of the revised assessment discusses the acknowledged limitations of aerial counts. Also see responses to Comments 5.11 and 5.110.

6.13 *Section 6.1.2.4, Page 6-10*

Comment: Section 6.1.2.4, Uncertainties, indicates that while it is "certain" that a tailings dam failure would have "devastating effects", the "timeframe for geomorphic recovery" could be "decades". However, given that EPA has assumed that because of the infinite life of the project that the dam has failed, a consistent perspective would be to assume that several decades for recovery from a very low probability event is a relatively short period of time over infinity.

<u>EPA Response:</u> We do not assume that the dam will fail and do not agree that several decades is a relatively short period of time relative to salmon life cycles or human needs for subsistence and commercial fisheries resources. The time to recovery relative to perpetuity is irrelevant to the effects on salmon.

6.14 *Section 6.1.3.1, Page 6-11*

Comment: It is questionable as to whether deposition of volcanic ash from Mount St. Helens is representative of tailings.

Recommended Change: Provide rationale as to how ash deposition is comparable to that of tailings (e.g., particle size, constituents, etc.).

<u>EPA Response:</u> See response to Comment 6.8.

6.15 *Section 6.1.3, Page 6-11 to 6-12*

Comment: This section provides thresholds for suspended sediment, and thus, is closer to a risk assessment than many other sections of the Bristol Bay Watershed Assessment, comparing site conditions to threshold effect conditions. However, while this Assessment does some modeling of sediment transport, there are no actual modeled suspended sediment concentrations predicted. So, the Assessment lists the threshold values, and then qualitatively estimates that site-specific suspended sediment concentrations would exceed the thresholds. The lack of site-specific values renders the any derived conclusion to be a qualitative comparison that is subject to uncertainty and opinion.

Recommended Change: Calculate estimated suspended sediment loads over time. Provide an analysis of how long and/or how often site-specific suspended sediment loads would be greater than the threshold.

<u>EPA Response:</u> Available data and models were not adequate to estimate suspended sediment concentrations. Such calculations may be available for future assessments.

6.16 *Section 6.1.4.1, Page 6-13*

Comment: Section 6.1.4.1 mentions the 2012 overtopping incident at the Nixon Fork Mine as an example of a winter failure, incidental to their example of an overtopping event during seasonally high flows. Box 6-2 (p. 6-15) is an inaccurate description of the 2012 overtopping incident at the Nixon Fork Mine, as reported to the "State Mine Safety Engineer" by the mine operator. EPA fails to note the huge disparity in size between the Nixon Fork tailings dam and the very large tailings dam used in their hypothesis. EPA also fails to mention that there were no impacts to the environment as a result of the discharge from the Nixon Fork incident.

<u>EPA Response:</u> The mechanism of overtopping is not a function of dam height. The incident was used to illustrate that due to human error, overtopping can occur. It was not used to make any inference about effects. No change required.

6.17 *Section 6.1.4.1, Page 6-14*

Comment: Box 6-1 uses case histories to extrapolate the impacts to the current study. However, all three examples are historical mines initially developed in the 1800s that are now Superfund sites. None of the examples would have had tailings dams or mill processes based on current geotechnical, metallurgical and environmental engineering principles or current regulatory standards. EPA states, “These brief descriptions provide background information and support the use of evidence from these cases in analyzing risks from a hypothetical tailings dam failure in the Bristol Bay watershed”. The descriptions of three sites which had typical/historic operations which occurred decades ago does not support an “analogous” relationship with what “may” occur at the Pebble site. For instance it is hard to compare mining in the Coeur d’Alene River where “tailings were dumped into gullies, streams, and the river until dams and tailings impoundments were built beginning in 1901”, with a modern mining facility designed and permitted under much more stringent regulations than existed over a decade ago. Similarly, analysis of a tailings dam failure in 1950 at Soda Butte Creek in Montana and Wyoming is hardly an analogous situation to what may occur in the Bristol Bay region.

<u>EPA Response:</u> The cases were used to illustrate the fate of tailings in streams and floodplains. The means by which they were released is irrelevant. The text of the revised assessment has been modified to make this point clear.

6.18 *Box 6.2, Page 6-14*

Comment: The examples provided in the assessment, such as Soda Butte Creek should be noted that much of the damage is the result of mining practices of the late 1800 and early 1900s, and related to acid mine drainage mobilization of metals. These issues may not apply as directly to the Pebble Mine under currently regulatory permitting and oversight conditions.

Recommended Change: Provide an analysis of the examples, comparing them with the proposed mine, identifying conditions that are most relevant to the Pebble Mine.

<u>EPA Response:</u> The relevance of the cases to the assessment has been explained further in the revised assessment.

6.19 *Section 6.1.4, Page 6-18*

Comment: It is uncertain that higher flows would increase leaching rates. While higher flows bring more “uncontaminated” water across the contaminated substrate, the water is moving much faster, and thus has less contact time with contaminated sediments. Then, if flow is high enough to suspend particulates, then contact could increase. The relationship between high flow, sediment contact, and chemical concentrations is not linear.

Recommended Change: Remove or provide conditions for this statement regarding higher flows increasing leaching rates.

<u>EPA Response:</u> It is basic physical chemistry that higher flows would increase leaching rates. Leaching rates are different from leachate concentrations. The bioavailable contaminants are those that are dissolved in the pore water of the deposited tailings. Thus, exposure is determined by the rate of leaching of the tailings and the rate of dilution of the leachate, which depend on hydrological conditions.

6.20 *Table 6-4, Page 6-19*

Comment: First use of TEC and PEC not previously discussed in the text.

Recommended Change: Define these terms in the context in which they are used in the text prior to presentation in the table.

<u>EPA Response:</u> TEC and PEC are defined in the "Acronyms and Abbreviations" section and when first used in the text and the tables. No change required.

6.21 *Section 6.1.4.1, Page 6-21*

Comment: Note that in the absence of a bioaccumulation factor (BAF) in the peer reviewed literature, a default value of 1 is used. The referenced studies therefore reinforce the use of this default BAF. However, an inverse relationship between BAF and media concentrations has been demonstrated in the majority of test species as reported by David K. DeForest et al.

Recommended Change: Include more recent studies of BAFs.

<u>EPA Response:</u> The BAF of 1 is an average from the peer reviewed literature and is not a default. No change required.

6.22 *Section 6.1.4.2, Page 6-22*

Comment: Terms probable effect concentration (PEC) and threshold effect concentration (TEC) are not defined in the context in which they are discussed.

Recommended Change: Define these terms.

<u>EPA Response:</u> See response to Comment 6.20.

6.23 *Section 6.1.4.2, Page 6-22*

Comment: Biotic ligand model is not defined in the context in which it is discussed.

Recommended Change: Define this term and its relevance to the discussion.

<u>EPA Response:</u> The biotic ligand model was defined and explained in Section 5.3 of the draft assessment. It is discussed in Section 8.2.2.1 of the revised assessment, in the context of copper standards and criteria.

6.24 *Section 6.14.2, Page 6-23*

Comment: The text states that the "consensus TECs and PECs are used to evaluate tailings as potential sediments because they are the best supported values". However, it may be unclear to the nontechnical reader what is meant by consensus values and whom and what basis of evaluation makes these values the best supported for use.

Recommended Change: Describe what is meant by consensus values and why these values are deemed the best supported values. According to what/whom? Also discuss the level of conservatism the use of these values implies.

<u>EPA Response:</u> The consensus nature and support for the TELs and PELs were discussed in the next section, where they are most relevant. This discussion is in Section 9.5.2.2 of the revised assessment.

6.25 *Section 6.1.4.3, Page 6-24*

Comment: This is the first instance in the report in which an attempt is made to define the hazard quotient. The text defines the hazard quotient as “the relative degree of toxicity of leachate constituent or as an indication of the degree of dilution required to avoid significant toxic effects”. This interpretation is somewhat simplistic and does not provide insight into what the value means.

Recommended Change: Provide EPA’s definition. EPA defines the HQ as the ratio of estimated site-specific exposure to a single chemical from a site over a specified period to the estimated daily exposure level, at which no adverse effects are likely to occur. Provide an interpretation of the HQ as HQs < 1.0 indicate acceptable risks, while HQs > 1.0 indicate unacceptable risks while also taking into consideration the inherent uncertainty in the estimate.

EPA Response: EPA may define a term differently for different uses in different contexts. The definition quoted in the comment is not relevant to the context of this assessment, because the exposures are not daily and the effects benchmarks are not all “no effect” levels. The text in the draft assessment is stated to be an interpretation, not a definition. A definition has been added in Section 9.5.2.3 of the revised assessment.

6.26 *Section 6.1.4.3, Page 6-25*

Comment: Contrary to the statement in the text, a quotient of 1.1 does not explicitly imply that the undiluted tailings would produce toxic prey for fish given the inherent uncertainty in the estimate.

Recommended Change: Discuss the interpretation of the hazard quotient recognizing the inherent uncertainty in the estimate.

EPA Response: The text has been expanded to clarify this point in Section 9.5.2.3 of the revised assessment.

6.27 *Section 6.1.4*

Comment: This section is relatively well written and has a different tone from much of the rest of the document. It provides available evidence, compares possible site data with effect thresholds, discusses the uncertainties and provides a summary based on the data and analysis. In summary, sediment/tailings exposure is the media/pathway of most concern. However, the quality/availability of input data is low as presented in Table 6-6.

Recommended Change: More site-specific data and/or analysis are needed to define site conditions and likely results of various failure scenarios.

EPA Response: More data are always desirable, but we were limited to the data available. No change required.

6.28 *Table 6-6, Page 6-28*

Comment: Showing a “+” for the quality of exposure-response is misleading. The toxicity data, without exposure, has little meaning in regard to the potential effects at the site. The table is very confusing.

Recommended Change: Find a better way to portray information related to the weight of evidence.

EPA Response: The quality of exposure-response and exposure information is scored separately so that the reader can see the quality of each (Table 9-11 in the revised assessment). Both are needed to estimate risk, but their quality is not the same. The scoring system used here is common in weighing evidence. No change required.

6.29 *Section 6.1.6, Page 6-29*

Comment: A catastrophic TSF dam failure would seem to be the most significant impact to the environment. However, given the lack of definition of the probability and likely actual size of a potential spill under the hypothetical mine scenario, the conclusions stated in this section are likely overstated.

Recommended Change: Some understanding of the assumptions should be summarized here in summary form to give readers. The text should reflect that under the hypothetical assumptions it seems the described result would occur but under different conditions, a different level of impact would occur.

EPA Response: We agree that if assumptions were different the results would be different, but a spill of only 20% of the tailings volume is not an overstatement. The probability of failure is estimated as a range, which is reasonable given the lack of experience with such large earthen dams, particularly in the sub-Arctic. The assumptions are clearly identified in Chapter 9 of the revised assessment.

6.30 *Section 6.2, Page 6-30*

Comment: The last paragraph on this page makes statements about what "would" happen. The implication here is that contaminated sediment would reach Iliamna Lake at concentrations that would impact fish, fish food, and/or fish habitat. While it is possible that smaller sediment particles will travel downstream, a vast majority could become entrained in stream sediment and permanently buried in depositional areas. And, there is a strong potential for dispersion along the stream. Thus, depending primarily on distance downstream to the lake and stream gradient, the amount/density of spilled "sediment" would vary greatly and would be attenuated with distance from the spill site.

Recommended Change: The dispersion/streambed entrainment should be mentioned here, and some further discussion of this issue should be added to the next paragraph (Page 6-32) regarding the probabilities of spills in rivers/wetlands.

EPA Response: We disagree that a vast majority of stream sediments are permanently buried in depositional areas. Stream beds are highly dynamic and gradients in the streams crossed by the pipelines are high. However, it is certainly true that movement to Iliamna Lake would depend on distance and gradient, which vary among streams. The assessment clearly states that the concentrate would be diluted. Discussion of this issue has been expanded in the revised assessment to include analyses of the relationship between stream velocities and movement of product-sized particles. It also clarifies that some of the product would be retained in local low-velocity areas.

6.31 *Section 6.2, Page 6-30 to 6-35*

Comment: These pages address the potential effects of a concentrate spill in the transportation corridor, with its many stream crossings. Page 6-30 states that a concentrate spill would be limited to 475 cubic meters due to automatic shutoff, and it states that all or part of this mass could enter the stream. If the concentrate slurry volume is 475 cubic meters, the concentrate itself is probably 50% of that amount. It is stated that a concentrate spill into a stream or wetland would result in acute exposure of fish and invertebrates to toxic water. This is very doubtful for a few reasons: 1) the slurry concentrate consists of approximately 50% water (at a pH of likely greater than 7.0), and sulfides of copper as chalcopyrite, some pyrite and bornite. These minerals take a significant time, probably years, to fully oxidize and produce acid. The assessment does not consider that there will be time to clean up the concentrate spill before any major oxidation would take place. There may still be some stream damage or wetland damage but it is not likely that toxic water would be present, 2). There is also no mention that the vast majority of the length of the pipelines is on land and may never reach a stream and 3) the concentrate is very valuable and the Company will have a major economic incentive (as well as permit requirements) to clean up any spills to the best extent possible.

Recommended Change: Present a more unbiased view of the likelihood of a concentrate spill entering a stream and discuss that the oxidation of the sulfides occurs at a potentially very slow rate, thus lessening the impacts to water quality over time. Also, these impacts could be mitigated by requiring a detailed Spill Mitigation Plan in the permit process.

EPA Response: Spill mitigation would not mitigate acute effects of the spill due to the aqueous phase of the slurry. Concerns about dissolution kinetics are addressed by using an analysis of actual product concentrate slurry from an operating mine similar to the proposed Pebble mine and USGS analyses of leachate from product concentrate from the Atik mine. Those materials had leached rapidly, not over years. The comment does not suggest an alternative analysis. Finally, the collection of spilled concentrate would cause physical damage to receiving streams and Iliamna Lake deltas and require remediation, as well as mitigation.

6.32 *Table 6-7, Page 6-31*

Comment: There is no discussion of the value for dissolved organic carbon used to calculate the biotic ligand values for copper. Given the inaccuracies in reporting other biotic ligand values (see comment on pages 5-49 through 5-55), the inputs and outputs for these values should be verified.

EPA Response: DOC was listed in Table 5-17 along with the other water quality parameters. No change required

6.33 *Section 6.2.1.1, Page 6-32*

Comment: Says that 2,567 L/s of product concentrate would be spilled. This is 308,040 L in 2 minutes. This is 308 m^3. On Page 6-30 it says 475 m^3 would be spilled. It also says 1,767 L/s of leachate would be spilled; this is 212,040 L in two minutes. In Section 6.2.1.3 on Page 6-34 it says 366,000 L of leachate would be spilled.

EPA Response: **As the comment notes, there was some ambiguity and apparent inconsistency in the draft assessment concerning the amounts of concentrate, concentrate slurry, and concentrate leachate/aqueous phase of the slurry released in this scenario. This issue has been addressed in Chapter 11 of the revised assessment.**

6.34 *Section 6.2.1.1, Page 6-33*

Comment: The last paragraph of this section, just below Table 6-8 is likely incorrect. Not all invertebrates will die at the probable effect concentration (PEC), and only predicted concentrations of copper notably exceed the PECs. Invertebrates would colonize the fine-grained sediment resulting from a pipeline spill, just not those sensitive to the metals contained within the pipeline slurry.

Recommended Change: More accurately represent what is likely to occur.

EPA Response: **Because of the very high copper levels in the copper concentrate, toxic effects would be expected for nearly all benthic invertebrates, not just those that are particularly sensitive. However, the sentence has been edited to clarify the conclusion in the revised assessment.**

6.35 *Section 6.2.1.2, Page 6-33*

Comment: The biotic ligand -based criteria sensitive to particular water quality parameters (i.e., pH, hardness, and dissolved organic carbon).

Recommended Change: Provide a brief statement of how water quality parameters impact biotic ligand-based criteria and whether the impacts result in an overestimation or underestimation of predicted risks and how those risk determinations are influenced by kinetics and downstream mixing.

EPA Response: **This issue was discussed in Section 5.3.2 and is now discussed in Chapter 8. Because of water quality considerations, criteria based on biotic ligand modeling (BLM) are as correct as the state-of-science allows. However, the state standards consider only hardness and thus may not be as protective as the BLM-based criteria. Because organic matter is extremely low in ambient water, leachates, and treated water, kinetics and mixing are not an issue. pH should be neutral in wastewater as well as ambient water. pH may be low in waste rock leachates but we assume that its effects on ambient pH are negligible, which possibly underestimates risks. Hardness is expected to be low in all waters. Other water quality parameters are less influential.**

6.36 *Section 6.2.1.3, Page 6-34*

Comment: Why are Liters used in this section? 366,000 Liters sounds like a very large amount number, but is about 100,000 gallons or 366 cubic meters which is a relatively small volume. Also it is unclear whether this is liters of water entrained in the slurry or total volume of slurry, in which case, the water volume would be significantly less. The statement that “None of the river or streams …could provide enough dilution to avoid the acute criterion” is misleading. Acute criteria are generally based on 48 hour or 96 hr LC50 or similar. As soon as the two-minute spill ended, the water within the slurry would begin to be diluted by clean stream water. Similarly, but more slowly, the pore water within the slurry would be infiltrated and diluted by clean stream water. Over some relatively short period of time the water concentrations outside of the slurry would likely rapidly decrease below acute criteria. This could be minutes to hours. Thus, it is unlikely flowing water would have metals concentrations raised up to the criteria for more than a few minutes or hours. It is also likely that within days, the pore water within the spilled slurry would be notably diluted. Longer term high concentrations could be possible in a small pond or wetland where there is no significant flow. A very small 5-liter per second stream provides 18,000 L per hour and 432,000 L per day. So in one day 5 L/s stream could provide clean water volume of 100% of the total spill volume.

Recommended Change: Provide a more accurate description/understanding of the dynamics of a slurry spill entering moving water.

EPA Response: A liter is a standard metric unit for liquids. Although the tests for acute toxicity last 48 to 96 hours, the effects typically occur much more rapidly, except for chemicals that must bioaccumulate to achieve toxicity or for large animals. Copper is rapidly toxic due to its effects at the portal of exposure on the respiratory surfaces, and the sensitive organisms are small invertebrates. Further, the rate of toxic response is a function of concentration and copper concentrations in the leachate are high. The assessment accurately states that the toxicity "may be sufficient to cause acute injury or lethality to invertebrates or fish." The assessment already makes the point that a 2-minute spill duration is actually an underestimate. The pumped flow would continue for 2 minutes and then passive drainage would continue for some time. In the revised assessment, the response time was revised to 5 minutes in response to peer review comments. Effects would be greater in low flow areas such as ponds and wetlands. The analysis has been expanded in the revised assessment to provide more details and include actual concentrate leachate analyses from a porphyry copper mine.

6.37 *Section 6.2.1.3, Page 6-34*

Comment: It was calculated that only one pipeline spill was likely into a stream over the 78 years of mine operation and such a spill would be in one location. This information is not provided until after all the discussion of impacts. Similar to much of the document, this discussion of potential impacts is provided before assumptions and conditions giving readers the impression effects are definite, or imminent, when in fact they may be severely limited in impact and extent.

Recommended Change: Move the summary of spill potential to the start this section, add in a discussion of the fact that a stream spill would only occur in one location or stream, and add a caveat to the beginning of the effects discussion that…"IF" a pipeline spill occurred in a water-body, then these effects were predicted to occur under the assumptions provided above. (p. 82)

EPA Response: Derivation of the spill frequency was discussed early in the section on pipeline failures, in Section 6.2.1.1. Its results were mentioned again in Section 6.2.1.3. No change required.

6.38 *Section 6.2.1.3, Page 6-35*

Comment: It is concluded that a slurry spill "…would certainly cause long-term local loss of fish and invertebrates"…"…for many years…". The provided assumptions and the myriad of potential stream crossings in the transportation corridor do not necessarily indicate that this is as certain as stated here. In fact, such a statement could only be made under some quite specific receiving water body conditions, and as calculated, only in one water body throughout the entire life of the mine.

Recommended Change: Adjust the conclusions to reflect either a broader range of potential effects, or define specific conditions under which these conclusions may occur.

EPA Response: The magnitude of effects is unspecified so the range of effects is already broad. However, the discussion has been expanded in the revised assessment to clarify this point.

6.39 *Section 6.3, Page 6-36 to 6-41*

Comment: The topic of this section is unclear whether the assumptions provided are adequate and/or provide reasonable estimates of potential risk for very long term effects.

Recommended Change: A more site specific analysis of water balance and treatment/collection failure needs to be completed for likely mine conditions and operations.

EPA Response: The water balance has been expanded and clarified in Chapters 6 and 8 of the revised assessment.

6.40 *Section 6.3.1, Page 6-37*

Comment: States "At mine closure, it is expected that acid-generating rock would be disposed of in the TSF or the mine pit. However, premature closure could leave waste rock piles in place". Comment: A bond would be available to put this rock back into the pit if there was sufficient room in the pit for this rock.

EPA Response: See response to Comment 4.157.

6.41 *Section 6.3.3, Page 6-38*

Comment: There is an incorrect reference to Table 5-12. The correct reference is Table 5-14. "Failure of collection and treatment of leachate from Tertiary waste rock could cause acute lethality in sensitive invertebrates and chronic toxicity to invertebrates at up to two times dilution."

EPA Response: Misnumbered table call-outs have been corrected.

6.42 Add after "up to two times dilution" based on the biotic ligand model".

EPA Response: The phrase "based on water quality criteria" has been added, which is more accurate since the BLM was used only for copper.

6.43 *Section 6.3.3, Page 6-38*

Comment: Invalid reference to Table 5-12 for water quality criteria. The document does not provide a comprehensive list of water quality criteria for all mining chemical constituents of concern.

Recommended Change: Provide a table that includes applicable water quality criteria for all mining chemical constituents of concern.

<u>EPA Response:</u> Table numbering has been corrected. All available national ambient water quality criteria and state standards are included in the Chapter 8 tables that screen potential leachate concentrations (Tables 8-4 through 8-8 in the final assessment).

6.44 Section 6.3.3, Page 6-39

Comment: For the biotic ligand model Pre-Tertiary waste rock leachates would require from 2,900- to 52,000-fold dilution. To meet state chronic water quality criterion the leachates would require from 280- to 580-fold dilution. See comment for pages 5-53 to 5-37.

<u>EPA Response:</u> The value was based on achieving the chronic national ambient water quality criterion. The calculations were done using the standard BLM software. However, the revised assessment contains a more realistic assessment of risks from waste rock leachate in Chapter 8.

6.45 *Section 6.3.3, Page 6-40*

Comment: Says "Oxygen levels are expected to be lower in the pit than in the tests, but oxygen would be provided in the pit by atmospheric diffusion from the surface, precipitation, shallow groundwater, and vertical mixing of water in the pit during turnover."

Comment: It should be noted that some deep mine pits can be meromictic, i.e., they do not turn over to the very bottom where there may be a layer of dense mineral-rich water.

<u>EPA Response:</u> This comment is not supported but it is plausible. However, it does not require a change in the quoted sentence, since it does not say that turnover is complete.

6.46 *Section 6.6, Page 6-45*

Comment: Effects in human welfare and Alaska Native culture will be evaluated in the Health Impact Assessment (HIA) process.

Recommended Change: Acknowledge that the effects in human welfare and Alaska Native culture will be evaluated in more depth in the Health Impact Assessment (HIA) process.

<u>EPA Response:</u> Comment noted. Effects on human welfare and Alaska Native culture are considered only in terms of fish-mediated effects in the assessment; other effects are outside the assessment's scope.

6.47 Chapter 6 evaluates risk of engineered structure failure but not according to current industry and regulatory standards. The Assessment fails to recognize these basic risk management tools used by industry and regulators.

<u>EPA Response:</u> No standards or other supporting information was provided with this comment. No change required.

6.48 Current practice across a broad spectrum of engineering and industry for risk management is to conduct a form of risk evaluation referred to as a Failure Modes and Effects Analysis (FMEA). The FMEA process is used to identify and focus in on aspects of the design with the highest relative probability of failure and the greatest consequences. An integral part of an FMEA is the identification of mitigation measures that must be implemented to ensure that any failure modes for which there is a significant consequence and risk are mitigated to the extent necessary to reduce risk to tolerable limits. These aspects are then reviewed in additional detail and measures to mitigate the risk by reducing the probability of failure are designed into the feature. For significant projects, the risk evaluation may be advance to a formal engineering risk assessment that quantifies the risk in more detail. The Assessment fails to recognize these basic risk management tools.

<u>EPA Response:</u> We recognize that more detailed site-specific processes may refine the risk management process if a mine is proposed and assessed in the future. We do not address the specific engineering methods that would be employed by the mining companies; rather, modern conventional mine design, practices, and technologies, particularly those described by Ghaffari et al. (2011), were assumed in the mine scenarios.

6.49 Since the performance of Failure Mode and Effects Analyses (FMEAs) and the requirement to implement risk mitigation measures to reduce risks is the practice in Alaska, and therefore Bristol Bay, the risk to salmon ecosystems should be included in the FMEA for any dam on a mine of any size or nature. If appropriately applied the risk to salmon ecosystem habitat should be addressed on a mine by mine and/or cumulative mines basis (for actual cases) and should ensure that only mines which meet the test of acceptable risk are permitted to be developed. If the mitigation measures required to render tolerable risks result in unfavorable project economics, then development of the mine would need considerable re-evaluation.

<u>EPA Response:</u> We assumed a range of risks of tailings dam failure consistent with the policies of the State of Alaska.

6.50 The EPA assessment appears not to recognize the FMEA process or the benefits and consequences of applying the FMEA process and subsequent requirement for the implementation of the risk reduction measures to reduce risks to acceptable levels. Certainly the generic treatment of a 'mining scenario' which has not been thoroughly tested and optimized through the application of the FMEA and risk mitigation, together with the extreme size and extreme consequences assumed in the assessment results in a biased and unrealistic characterization of the true risk.

<u>EPA Response:</u> See response to Comment 6.48.

6.51 Why would the failure of a tailings slurry pipeline not be considered a significant risk to fish?

<u>EPA Response:</u> The potential for a failure of a tailings slurry pipeline is mentioned in the revised assessment (Chapter 11) but not evaluated since our mine scenarios optimistically assume that leakage from on-site pipelines would be captured and controlled. However, the lack of analysis of this potential failure does not imply that it could not happen or that there would not be impacts to salmon. Rather, the risk to salmon is considered small relative to the pipeline failure scenarios that were analyzed.

6.52 *Section 6.4, Page 6-42*

Comment: The definition of culvert failure is excessively broad and the citations of the literature need further clarification. Well designed culvert installations allow for fingerling fish passage during most annual high water events, are oversized, and are typically submerged to allow for water presence during low flow periods.

Only having time to review one literature citation (Langill and Zamora, 2002), the risk assessment approach to culvert installation used by Nova Scotia (identified in the study) is not applicable to Alaska's standards for culvert installations. Within the Nova Scotia program, the majority of culverts are installed without design and without involvement or approval authority by the Canadian equivalency of ADFG. The large majority of the culverts that are observed to not allow fish passage are perched. Rudimentary implementation of culvert design BMPs would alleviate this problem and is already addressed at Alaska projects.

EPA Response: The risks and impacts to fish passage described in the revised assessment use current fish passage design standards for culvert design. These specifications are described in Box 10-2. Also see response to Comment 4.82.

6.53 *Section 6.4, Page 6-42 to 6-44*

Comment: Simply using bridges over smaller streams would essentially eliminate the potential for culvert failures. Proper culvert design and conservative over-sizing, would significantly reduce potential for culvert failure.

Recommended Change: Provide more detailed analysis on culvert failure rates for well designed or oversized culverts for the size of streams most likely to be culverted along the corridor.

EPA Response: See responses to Comments 4.82, 4.152, and 4.187.

National Mining Association (Doc. #4109)

6.54 Furthermore, in addition to not addressing any of the potentially positive impacts of mining development in the Bristol Bay area, the Draft Assessment also inexplicably fails to address mitigation and impact avoidance or minimization actions that would undoubtedly be included in any mine plan, thereby unfairly overstating and sensationalizing the potential impacts of any proposed mine. In its description of a major tailings pond failure, EPA merely states that "remediation may occur following a tailings spill, but it is uncertain." This statement, which EPA bases its findings of potential impacts on, is misleading and not based in fact, as immediate remediation in the event of a tailings pond failure is prescribed by both state and federal laws. Similarly with respect to a tailings dam failure, EPA examines scenarios where dams are not built to specification despite the fact that it is outside the realm of possibility that a dam of this size would be permitted if it did not meet designated criteria. EPA also only after describing in detail the potential for various tailings accidents points out that the likelihood of a tailings dam failure is "one…every 10,000 to 1 million mine years." In another example, Section 6.4 assumes inadequately sized and poorly constructed culverts, despite the fact that Alaska has culvert design requirements aimed at eliminating the potential impacts discussed in the Draft Assessment. EPA does not give a reason as to why Alaska's standards were not given consideration in the Draft Assessment. Likewise, the case studies noted in Box 6.1 of the Draft Assessment include scenarios where mining began in the late 1800's, and no notation is made of the establishment of and changes to the regulatory, environmental and engineering standards that have since been developed over the last hundred years and which any proposed mining in Bristol Bay would employ.

EPA Response: The discussion of mitigation has been expanded in the revised assessment. Immediate remediation is uncertain for the reasons discussed in the assessment. The tailings dam design is taken from Northern Dynasty Minerals' specifications, which are described as "permittable" (Ghaffari et al. 2011); we believe that they are correct. Section 6.4 of the draft assessment describes culverts built to state standards that fail. Meeting standards does not preclude failure of a structure. The cases in Box 6-1 of the draft assessment are not used to assess the means by which tailings are spilled, so engineering standards are not relevant. They are used to describe what happens to tailings after they are spilled. Text has been added to the revised assessment to emphasize this point.

6.55 [T]he risk assessment sections, which discuss things that might go wrong at a mine site, are not noted in a proper and explanatory context as they would be in a typical risk assessment document. Such issues undermine the scientific credibility of the Draft Assessment and call into question the fundamental fairness of the process itself.

EPA Response: This is a broad and vague assertion; no change required.

Northern Dynasty Minerals Ltd. (Doc. #4611)

6.56 "*Water collection and treatment failures may be acute or chronic. A recent example is the overfilling of the tailings impoundment at the Nixon Fork, Alaska, mine that resulted in overtopping of the dam (Box 6-2).*" (pg. 6-36)

The Nixon Fork example serves as a warning of the important of water management at mine sites. Inadequate or inappropriate instrumentation was used to monitor the level in the tailings impoundment. Staff elected to not monitor the freeboard level as the gage was frozen in ice. Additionally, a major change was made to the production process (moving from batch to continuous operation) without an adequate understanding of the consequences to the site water balance and water management. Note that, as described in Box 6-2, for this release it was found that water from the tailings impoundment was not likely to have reached nearby streams.

EPA Response: The fact remains that the accident was not predicted.

6.57 Example case histories of TSF failures are either not relevant to Pebble, or their failure modes can be readily mitigated through proper design, construction, operations and management.

EPA Response: The examples of tailings dam failure indicate that design, construction and operation methods have changed. The lessons learned are reflected in the very low probabilities of tailings dam failure estimated for the mine scenarios. However, we would be remiss if we published a risk assessment that did not acknowledge that tailings dams have failed and did not describe the consequences.

6.58 However, instead of reviewing appropriate comparatives like these, the Draft Assessment uses inappropriate comparatives like the impacts of the eruption of Mount St. Helens, see Draft Assessment at 6.1, or the impact of mines that were originally developed over a hundred years ago before the development of modern mining techniques or environmental regulations, e.g., Clark Fork. See Draft Assessment at 3.5. If there is anything instructive from the Mount St. Helen's eruption, EPA should note that it created debris flows and impacts that were orders of magnitude larger than any conceivable failure at a modern mine like Pebble. While the eruption of Mount St. Helens certainly created fish habitat and population impacts that were surely significant, they also proved to be transitory and ultimately demonstrate salmon ecosystem resilience. The comparatives used by EPA are hardly useful. Attempts to draw similarities between proposed mining activity in the Bristol Bay watershed and monumental natural disasters like the Mount St. Helens eruption or decades-old operations like Clark Fork are strained at best and only add to the questionable analysis that EPA presents in the Draft Assessment. Rather, EPA should place the focus of its assessment on calculating the actual risk of a specific proposed mining activity, the potential impact of such risk, and determining whether that is an acceptable risk.

<u>EPA Response:</u> The cases of spilled tailings in Box 6-1 are not used to assess the means by which tailings are spilled, so changed engineering standards are not relevant. Those cases are used to describe what happens to tailings after they are spilled. Text has been added to emphasize this point.

The Mount St. Helens data were used strictly to address the rate of benthic habitat recovery from a massive deposition of fine mineral particles. We have removed references to Mount St. Helens in the revised assessment to eliminate concerns expressed by the peer reviewers.

6.59 The Dam Breach Model is flooded with bad assumptions and with uncertainty that makes highly questionable EPA's estimate of environmental impacts following dam failure. The Assessment includes a questionable dam breach assessment where the high uncertainty associated with the peak flow estimate and modeling predictions is not presented, and where the relative magnitude of the dam breach flood is wrong. In an effort to illustrate the extreme magnitude of the dam breach flood, it was compared to a natural flood in the region, but errors were made in the calculations and the comparison was done in a manner that exaggerates the result. The errors were in the drainage areas stated for both the dam breach flood and the regional flood, and appear to stem from an inability to convert from imperial units to metric units.

<u>EPA Response:</u> The TSF surface area was a typographical error and it has been corrected in the revised assessment. The presentation of the actual stream gage data and comparison of the gaged watershed to the ungaged TSF watershed were included to illustrate the magnitude of potential expected runoff from an extreme precipitation event on a unit area basis. It also was presented to give perspective on the size of a peak flood that could be generated in the mine area relative to an actual gaged flood event. The recommended methods of hydrologic analyses for this region in the State of Alaska call for a 14-inch rainfall event, based on published data. Updated regional hydrologic data and estimates of climate change patterns may better inform hydrologic modeling data input, but these data have yet to be published as such guidance.

6.60 Approximately two-thirds of the impact assessment section of the Draft Assessment focuses on the potential failure of tailings storage facilities (TSFs). The document estimates that the probability of occurrence of a tailing pond failure is extremely low. If the analysis of that probability excluded dams that do not conform to current mining practices and U.S. regulatory requirements, then the estimated probability of occurrence would be significantly lower. The analysis also assumes that no cleanup or remediation activities would be required upon the failure of a TSF, which is a highly unrealistic assumption.

<u>EPA Response:</u> We agree with the stated position regarding "current mining practices and U.S. regulatory requirements." In both the original and revised assessments, we acknowledge that the use of current dam engineering and construction methods may reduce the failure rate by an order of magnitude or more. The assessment does not assume that remediation would not be required but does address some of the challenges posed by the remote nature and climatic conditions of the study area and addresses the uncertainty of an adequate response far into the future.

6.61 The Draft Assessment contains multiple instances where apparently contradictory statements are made about the same topic - Bailey points to, among other examples, page 6-10 of the Draft Assessment, where an estimate of the loss of Chinook salmon resulting from a hypothetical dam failure is more than half. On page 6-1 1, the Draft Assessment states that the impacts on fish habitat in the North Fork Koktuli and downstream would occur for some significant distance downstream in the main stem Koktuli River and possibly further. However, the authors were unable to quantify those effects. Bailey notes that the estimate of loss of about half of the Nushagak River Chinook salmon is actually based on loss of access to the Mulchatna, Stuyahok, and Koktuli rivers. This contradiction is glaring and representative of a number of such contradictory statements found within EPA's analysis.

<u>EPA Response:</u> There is a difference between the estimate of potential loss of Chinook salmon and the inability to estimate losses of "most other fish species." No change required.

6.62 In a focus on Chapter 6, Buell states that the failure scenarios, especially the "full-volume failure" scenario, are unreasonable on several levels. The scenario consequences presented by EPA are not credible given the land form available to receive sediment deposition, and the full-volume failure scenario itself is patently unrealistic. Consequently, none of the consequences of TSF failure outlined have any credibility. Even if an overtopping event were to occur, which is unreasonable on its face, the consequences would be very much smaller than described here.

<u>EPA Response:</u> This is a summary of Buell's comments, which are addressed separately in this response to comments document (under Doc. #4611). Basically, our more detailed responses state that the failure event is improbable, but do not agree that it is not credible. In the final assessment, the tailings dam failure scenario is no longer specified as an overtopping event. No additional change required.

6.63 Buell's complete submission warrants significant consideration. The review demonstrates that the Draft Assessment is a strongly biased analysis that relies heavily on selected, incomplete or inappropriate information and seriously flawed analytical methods to reach tortured conclusions, many of which are patently incorrect. Buell notes that in order to reach these conclusions, much relevant and correct information that would tend to nullify or refute them was excluded from the analysis. As such, the Draft Assessment does a great public disservice and offers nothing to further the rational, scientifically-based protection of the environment.

EPA Response: This is a summary of Buell's comments, which are addressed separately in this response to comments document (under Doc. #4611).

6.64 In their assessment of potential impacts of a tailings dam failure, the Draft Assessment authors use a potentially overly simplistic model and exaggerate potential fish and fish habitat loss projections. The model (HEC-RAS) used to model potential tailings dam failures in the Draft Assessment is a one dimensional model, and may therefore not provide accurate results in a three-dimensional environment, such as the Bristol Bay watershed. Further, the Draft Assessment assumes that, following a tailings dam failure, all Chinook salmon will lose access to the South Fork Koktuli and potentially Mulchatna and Stuyahok Rivers; however, the results of modeling do not support this conclusion, and it is likely that any physical blockage resulting from a tailings dam failure would be temporary.

EPA Response: See responses to Comments 4.184 and 4.201.

6.65 The report contains multiple instances where contradictory statements are made about the same topic – A good example is on page 6-10 where an estimate of the loss of Chinook salmon resulting from the dam failure is more than half of the population, but on page 6-11 in the first partial paragraph the report states that the impacts on fish habitat in the North Fork Koktuli and downstream would occur for some significant distance downstream in the main stem Koktuli River and possibly further down the Koktuli River, but the Assessment was unable to quantify those effects. The estimate of loss of about half of the Nushagak River Chinook salmon population (Page 6-10) is based on loss of access to the Mulchatna, Stuyahok, and Koktuli rivers, whereas on Page 6-11 it is stated that the impacts could not be quantified. The Assessment is internally inconsistent with its conclusions.

EPA Response: See response to Comment 6.61.

6.66 *Page ES-26 §5*: This bullet states, "It is clear that [tailings and concentrate] would have harmful physical and toxicological effects on salmonid larvae or sheltering juveniles." This is incorrect. It is far from clear that tailings supernatant would be toxic to salmonids. A geologic analogue of Pebble near Williams Lake in British Columbia supports thriving populations of rainbow trout in both its *active* tailings pond and in its seepage pump-back pond. Tissue samples from these fish show no elevated levels of Cu or other trace metals when compared to fish from other pristine lakes in the area. EPA should have known this and taken this and other examples fully into account when developing both non-failure and failure scenarios. This is a significant shortcoming of the EPA analysis.

EPA Response: The conclusion is based on site-specific information from PLP's EBD. The comment provides no documentation for the unnamed mine near Williams Lake and does not indicate whether the trout are reproducing or are stocked. Our review of British Columbia mines found that little to no environmental monitoring data are available.

6.67 *Page 6-1 §3 – 6-2 §2:* The failure scenarios, especially the “full-volume failure” scenario, are unreasonable on several levels, as noted in comments on related sections of Chapter 4 (see comment, 4-50 §3 ff, and subsequent comments). The scenario consequences presented by EPA are not credible given the land form available to receive sediment deposition, and the full-volume failure scenario itself is patently unrealistic. Consequently, none of the consequences of TSF failure outlined in this part of Chapter 6 have any credibility. Even if an overtopping event were to occur, which is unreasonable on its face, the consequences would be very much smaller than described here, and the “event” would likely be in another watershed (the South Fork Koktuli).

<u>EPA Response:</u> See response to Comment 6.62.

6.68 *Page 6-3 §1:* This paragraph states, “[i]n the case of a tailings dam failure at TSF 1, the flood itself would mobilize existing sediments in the North Fork Koktuli River watershed. The volume of sediment mobilized would supplement the tailings released and could leave meters of material deposited in the floodplain.” This speculation, which is amplified upon later in the document, displays an alarming lack of understanding on the part of EPA of the basics of sediment transport. The flood waters pulling sediment out of the TSF would be, by definition, and given the decreasing velocities proceeding downstream (Table 4-11), fully burdened with fine sediment. EPA supports this by describing deep sediment deposits resulting from the event. Aside from some local scour that may occur in the immediate vicinity of the embankment due to kinetic action of the failure jet crossing the North Fork Koktuli valley, the event would be completely depositional. No scouring of the existing bed or valley bottom would be possible. In a depositional mode, and from an energetics perspective, water with a decreasing velocity cannot trade a fine particle for a larger one. While large sediment deposits would be produced if this unreasonably improbable event could occur, the underlying landform would not be scoured. Subsequent stream flows would transport deposited sediments from the existing stream channel quickly, especially considering grain size. Deposited sediments would be transported from the existing meander corridor, which would be a very small proportion of the depositional flood plain, according to sediment depths in Table 4-13, by natural high flows over a longer period, and as the river meanders within that corridor at a rate roughly similar to its current rate. All remaining sediments would remain perched, with slow erosion due to precipitation, mediated by re-vegetation. EPA’s description of the potential for scour of existing materials from the bed and flood plain of the North Fork Koktuli is not credible.

<u>EPA Response:</u> Although in-channel sediments would be transported more quickly, the massive quantities of sediment that would be deposited across the valley floor in the tailings dam failure scenarios would constitute a long-term source of fine sediments that would continue to scour and be transported downstream. The assessment does not address effects on terrestrial vegetation, as these effects are outside the scope of the assessment.

6.69 *Page 6-3 §2:* This paragraph again erroneously refers to scour of the North Fork Koktuli valley. This could not occur, given the depositional mode described by EPA. See the comment immediately above.

<u>EPA Response:</u> See response to Comment 6.68.

6.70 *Page 6-3 §3:* This paragraph states, “we assumed that the velocities calculated during the tailings dam failure flood event (Table 4-11) would result in a nearly complete reworking of the existing North Fork Koktuli channel and much of the valley.” This could not occur, given the depositional nature of the event described by EPA (see above). The paragraph goes on to say, “[g]iven the volumes of material that would be exported from the TSF, we assumed that the new valley floor would be predominately tailings material with particle sizes ranging from less than 0.01 mm to just over 1.0 mm, of which 70% would be finer than 0.1 mm. Following the recession of the tailings dam failure flood event, we assume that the bed and bank would be primarily tailings material, with incorporated dam fill and valley fill material accounting for less than 20%.” Since scour and “reworking” of existing materials in the North Fork Koktuli could not occur in a completely depositional event, this subsequent consequence could also not occur. Again, EPA is exhibiting an alarming lack of knowledge of the fundamentals of sediment transport and deposition in an event hypothecated by this document. This should have been caught by EPA’s internal peer review process, but was not, demonstrating an inadequacy of that process.

<u>EPA Response:</u> See response to Comment 6.68.

6.71 *Page 6-4 §1:* This paragraph uses recoveries of streams affected by the Mount St. Helens eruption in terms of sediment yield to describe reductions through time. EPA concludes that recovery of “suitable structural habitat… would likely take decades given the volume of sediment that would potentially be delivered under the tailings dam failure.” Apart from the unreasonableness of the EPA scenario, the agency failed to consider here and elsewhere the biological recovery in streams receiving the brunt of the Mount St. Helens blast. Recovery of fish (salmon and resident fish) and aquatic/terrestrial invertebrates was very rapid, astonishing most investigators, and productivity (fish and invertebrate biomass gain per unit time and area) was also very high. Bisson *et al.* (1988) monitored habitat use and summer production of young-of-the-year (YOY) coho in three affected streams (one on a mud-flow terrace) starting three years after the blast. Although temperatures were in excess of commonly-regarded incipient lethal limits, and cover and pool habitats were essentially absent, average tissue production ranged from 2.3 to 21.6 g/m^2 over an average 150-d summer period, equal to or in excess of production rates for similar-size streams in the region. By 6 years after the blast, coho salmon production was found to be twice the value reported for nearby old-growth forested streams. Lowest production occurred where coho juveniles were in sympatry with large numbers of rearing juvenile steelhead, which had re-invaded the streams earlier. High abundance of aquatic and terrestrial invertebrate food items was noted, and growth was rapid even at temperatures at which food conversion by coho is usually inefficient. In their compilation of information related to recovery of fish populations in Mount St. Helens streams, Bisson et al. (2005) state, “[i]n the absence of harvest, steelhead returns rebounded much more rapidly in these rivers than many managers and biologists had predicted… The remarkable recovery of the wild steelhead population in the South Fork Toutle River during the mid-1980s exceeded all expectations.” These authors attribute rapid (within three years) recovery of resident fish species, including sculpin and non-anadromous salmonids, to unaffected stream refugia from which “seeding” of affected areas could occur. The bottom line here is that the conclusions reached by EPA in this assessment regarding the recovery rates of salmon and resident fish species following an albeit unreasonable TSF failure scenario are speculative, unreasonable, and contrary to the best available scientific evidence.

EPA Response: **The Mount St. Helens analogy has been removed from the assessment at the suggestion of the peer reviewers.**

6.72 *Page 6-4 §2:* This paragraph states, "[t]he volume of sediment remaining in transport at the confluence following the 208-m (full) tailings dam failure would range from 15.9 to 239.3 million m^3 (Table 4-13)." Given deposit depths given in Table 4-13, realistic flood routing (to the South Fork) and the width of the flood plain actually available for deposition (>4 km), this is impossible. As indicated in the comment on pg. 4-59 Table 4-13, the actual flood plain available for deposition to the depths in the table could contain the entire mass from EPA's hypothecated failure several times over; there would be nothing left to transport if deposits were to be as deep as described by EPA and if their model allowed routing of flood waters into the South Fork. If this much material is actually still in suspension at the North Fork – South Fork Koktuli confluence, the deposits along the North Fork Koktuli, and into the lower elevation South Fork Koktuli, would have to be a small fraction of the values given in Table 4-13. Again, EPA cannot have it both ways; either the material is deposited to depths in Table 4-13, with little left to transport, or it isn't.

EPA Response: **See response to Comment 6.68.**

6.73 *Page 6-7 §1:* This paragraph describes EPA's albeit unreasonable and unsupportable view of sediment deposition (see earlier comments), and then states, "[a]s a result of these habitat changes, suitable spawning environments and overwintering habitats for salmon would be greatly diminished in this watershed. This would likely lead to severe declines in salmon spawning success and juvenile survival." This is all speculation, not based on the best available scientific information, arguably the experiences following the eruption of Mount St. Helens. Given the unexpected but real fish population recovery rates following the blast, EPA's speculation is unwarranted.

EPA Response: **See response to Comment 6.71.**

6.74 *Page 6-7 §3:* Although an event such as that hypothecated by EPA would surely wipe out aquatic invertebrate populations within the area of deposition, recovery would likely be rapid. Based on the Mount St. Helens experience, recovery of salmon food supplies would likely occur within 3-4 years, if not sooner.

EPA Response: **See response to Comment 6.71.**

6.75 *Page 6-8 §2:* This paragraph begins, "[t]he complete loss of suitable salmon habitat in the North Fork Koktuli mainstem in the short term (less than 10 years), along with the likelihood of very low-quality spawning and rearing habitat in the long term (decades), would result in near-complete loss of the mainstem North Fork Koktuli fish populations downstream of the tailings dam. These impacts would persist for multiple salmon life cycles, so salmon cohorts that are at sea during the tailings dam failure would eventually return to find degraded spawning and rearing habitat." This is speculative and not supported by the best available scientific information, the recovery of the Toutle and Lewis rivers and their affected tributary streams following the Mount St. Helens blast. Recovery of the affected area would likely begin and rapidly build within 3-4 years. See comments on pg. 6-4 §1.

<u>EPA Response:</u> See response to Comment 6.71.

6.76 This paragraph also summarized information on Chinook salmon distribution and abundance in the Nushagak River and major contributing tributaries. This information is misleading. Although the "total inshore run" of Chinook salmon to the Nushagak District is on the order of 160,000 fish, the escapement to the Nushagk River itself is half that amount or about 80,000 fish (Jones, et al. 2012). Of these, according to Figure 6-1 (pg. 6-9), about 16,000 fish (20%) were observed during peak counts in various Nushagak-Mulchatna drainage streams as reported in Dye et al. 2006. Although not directly comparable to ADFG escapement estimates, peak counts conducted in the North Fork Koktuli from 2004 through 2008, making adjustments for underestimates, suggest that the North Fork Koktuli supports somewhere around 3-5% of the Nushagak-Mulchatna system escapement. Given the serious problems with the EPA scenario for TSF failure outlined in other comments, this is likely the maximum habitat at significant risk from an albeit extremely unlikely failure. Finally, based on the experiences with Mount St. Helens streams and the salmon and steelhead runs they supported, and similar responses to the Mount Chaginigak lahar and acidification of Mother Goose Lake and the King Salmon River in 2005, the most reasonable expectation is that fish bound for the North Fork Koktuli would simply head elsewhere nearby and spawn and reproduce successfully. Based on real data, not EPA's speculation, this entire paragraph is hyperbole and has no business appearing in this document.

<u>EPA Response:</u> This comment assumes that habitat elsewhere would be accessible to displaced fish, currently unoccupied by other salmon populations or at least well below capacity, and suitable to the specific local adaptations of Koktuli River populations—all unfounded speculations. These uncertainties are now clarified in Chapter 9 of the revised assessment. We disagree with the conclusion that effects should be limited to the North Fork Koktuli. As discussed in responses to other comments, the TSF failure scenarios would impose a host of water quality limitations for salmon and other fish that would extend well beyond the North Fork Koktuli.

6.77 *Page 6-8 §2:* The data in this paragraph are incorrect and misleading. Annual escapements of sockeye salmon to the Nushagak River system averages (20-year) 528,000 fish, of which about 150,000 fish are bound for the Nuyakuk River, a modest-sized tributary which drains Tikchik Lake and Nuyakuk Lake, large sockeye producers. This EPA data discrepancy was also noted in the comment on pg. ES-18 §3. The Nushagak system without its Nuyakuk component contributes only about 15% of the sockeye to the Nushagak District and only about 8.5% of the total Bristol Bay run. This is a very important consideration when analyzing the potential impacts of mining in one of nine watersheds on sockeye salmon runs in Bristol Bay, but it was inappropriately ignored by EPA (see comment on pg. 2-20 §5).

<u>EPA Response:</u> Data reported in the cited paragraph are total annual runs (catch plus escapement) of sockeye salmon to the Nushagak River system. We reported total run by river system (not district, as the Nushagak District includes the Igushik, Wood, and Nushagak River systems). This is a more accurate measure of contribution of the Nushagak River to Bristol Bay sockeye than simply escapement. Run size information has been updated in the revised assessment from ADF&G published reports containing estimates of total run and escapement. The Nushagak District contributes nearly 10 million fish on average, or 26% of the Bristol Bay run (2002 to 2011 average reported in

Fair et al. 2012). The Nushagak River system contributes on average approximately 2.0 million fish, 20% of the Nushagak District run or about 5% of the total Bristol Bay run.

6.78 *Page 6-9 §2:* This paragraph states, "[s]uccessful re-colonization of the North Fork Koktuli by resident fish would depend on whether unimpaired tributary habitats function as suitable refugia and source areas for re-colonization of the North Fork Koktuli following disturbance." Based on experiences with streams affected by the Mount St. Helens blast, re-colonization by both resident fish and anadromous species would be rapid.

<u>EPA Response:</u> See response to Comment 6.76.

6.79 *Page 6-10 §2*: The EPA's speculative leap that there would be a "near-complete loss of the North Fork Koktuli fish populations" ignores the fact that significant spawning and rearing of sockeye, coho and Chinook salmon occurs upstream of NK 1.190, the stream from which the EPA's failure scenario would emanate (some sockeye rearing occurs in Big Wiggly Lake; coho and Chinook rearing occurs throughout this area). The rapid channel recovery that would occur (EPA's erroneous speculations notwithstanding; see comments above) would allow fish to proceed past any unsuitable channel segments to areas which would be unaffected, according to EPA's failure scenario. Furthermore, as noted above, and in accordance with the best available comparative information (e.g., Mount St. Helens blast, Mount Chaginagak lahar), any fish bound for the North Fork Koktuli but "offended" by stream conditions, would bypass this part of the system or fall back to spawn successfully elsewhere, with little or no loss of production. EPA should have been familiar with this well-documented behavior of salmon and steelhead, and should have folded it into their analysis. As it is, this part of the document exhibits a strong negative bias, as do other parts. This paragraph appears to be speculation on the part of uninformed authors and is inappropriate and unrealistic. This paragraph also states, "downstream transport of sediment to the Koktuli mainstem, and the subsequent loss of access to the South Fork Koktuli would affect, on average, 28% of the Nushagak River Chinook salmon run in a given year. If the deposited tailings material is deep enough to impede fish access to the Mulchatna and Stuyahok Rivers, then a tailings dam failure could affect more than half of the Nushagak River Chinook salmon population" This is preposterous. Even at the depths of deposited sediment given in Table 4-13, blocking of the South Fork Koktuli River would be impossible. As pointed out in comments above on Table 4-13, there is ample volume in the combined flood plains of the North Fork and South Fork Koktuli to contain the entire mass (unrealistically) assumed by EPA to emanate from the full TSF failure scenario, if deposits would be to the depths given in the table *for just the lower 9.4 km*. Where would the water in the South Fork Koktuli go? The channel would likely be cleared to its approximate original elevation in a matter of days, with the vast majority of deposited sediment remaining perched on higher elevations. Where would the Stuyahok River water go? Velocities would be far more than ample to continue transport of any materials that would reach its confluence with the Mulchatna. Where would the Mulchatna River water go? Furthermore, as pointed out in comments on Table 4-13, it is physically impossible to produce deposits as deep as given in the table and as wide as the available flood plain (which includes the lower South Fork Koktuli) and have anything left to transport. Finally, it is physically impossible do dam a river with sediment it is transporting. If that could occur, every glacial stream in Alaska would have dammed itself and the Yukon River would have long since contained itself behind a self-imposed dike (but where would *it* go?). This paragraph demonstrates an astonishing ignorance by EPA of the fundamentals of sediment transport and is speculative in the extreme on the part of some author or authors who are out of their element. This entire paragraph, indeed the entire failure scenario, is completely unrealistic.

EPA Response: See response to Comment 6.76. The assessment does not assume that sediment would physically block the South Fork Koktuli at the confluence with the North Fork Koktuli. The assessment does consider the potential for the river to find an alternate course after a dam failure, as flows scour a new channel and resuspend deposited material. The assessment also considers how the distributed tailings and metal concentrations in those tailings could inhibit migratory behavior (Section 9.5.2.1), and how high proportions of fines could alter selection of spawning habitats. Migration of salmon can be inhibited by adverse conditions, and salmon may attempt to go elsewhere to spawn. However, it is invalid to assume that little or no loss of production would occur.

6.80 *Page 6-10 §4:* This paragraph states, "[w]e estimate that recovery of suitable structural habitat in the mainstem North Fork Koktuli and offchannel [*sic.*] areas would likely take decades, given the scouring action of the flood wave and the volume of fine-grain sediment that would potentially be delivered under the tailings dam failure… Recovery of suitable gravel substrates and development of channel morphology suitable for salmon habitat could be delayed even further if the flood wave were to scour much of the North Fork Koktuli valley to bedrock, which would then be buried under massive deposits of tailings fines." Again, this paragraph displays an alarming ignorance on the part of EPA of the physical processes that would be put in place in the event of an albeit unrealistic TSF failure they invoke. As pointed out in comments on 6-3 *§*, existing sediments cannot be mobilized in what would be a fully depositional event. Once again, this paragraph is the result of incorrect speculation by an EPA author who lacks understanding of the basics of sediment transport and deposition. The recovery periods speculatively presented in this paragraph are fanciful, at best, and have no place in an unbiased, and supposedly realistic assessment.

EPA Response: The comment suggests that scour and deposition cannot occur during the same flood event. The processes of scour and deposition are clarified in Chapter 9 of the revised assessment.

6.81 *Page 6-11 §2:* This paragraph states, "[w]e estimate that the combined effects of direct losses of habitat in the North Fork Koktuli, downstream in the mainstem Koktuli and beyond, and impacts on macroinvertebrate prey for salmon could adversely affect 30 to 50% of Chinook salmon returning to spawn in the Nushagak River watershed." Please review comments above. The estimates given here are an exercise in hyperbole and are unrealistic, based on the unrealistic outcomes of an unrealistic failure scenario posited by EPA and experiences elsewhere (e.g., Mount St. Helens blast, Mount Chaginagak lahar, among others). A more realistic estimate of returning Chinook salmon "at risk" would be approximately one-tenth that put forward by EPA for their albeit unrealistic scenario, with behavioral accommodation not taken into account.

EPA Response: See the response to Comment 6.79.

6.82 *Page 6-11 §5:* Surprisingly, EPA has forgotten or ignored ice scour and "plowing" during break-up. This is a very important element in existing sediment movement and re-organization processes in both the North Fork and South Fork Koktuli. This may be another example of EPA authors being unfamiliar with the system they are attempting to analyze or out of their technical depth.

<u>EPA Response:</u> The comment is correct that ice damming and associated dam-break outbursts would likely contribute to additional channel avulsion in the highly-modified, fine sediment-laden river valley. It is unclear what revision is suggested here.

6.83 *Page 6-11 §6:* This paragraph states, "based on studies of volcanic ash deposition at Mount St. Helens, reduction of suspended sediments to natural levels is expected to take decades (Section 6.1.1)." Please see comment on 6-4 §1.

<u>EPA Response:</u> See response to Comment 6.71.

6.84 *Page 6-12 §2:* This paragraph states, "if the dam was eroded or overtopped by a flooding event, as in a tailings dam accident (Section 4.4.2), the pore and surface water could be diluted by fresh water." While this is true, it is also trivial, according to the scenario presented by EPA. For the full-TSF failure scenario, the PMF would add only ~0.5 m of depth to the pond at most, which is trivial compared to the volume of pore water that would be present in >300 million m^3 of tailings.

<u>EPA Response:</u> Text has been edited in the revised assessment to eliminate the reference to freshwater dilution, because we agree that it is trivial.

6.85 *Page 6-12 §4:* This paragraph begins, "[o]nce in the stream, toxic constituents dissolved in the water, unlike the tailings, would not settle out." This sentence assumes facts that are not supported by any relevant evidence, and are contradicted by evidence of which EPA should be aware. Both the *active* tailings pond and the seepage pump-back pond at the Gibraltar mine near Williams Lake, BC (7 mi from the Fraser River), a geologic analogue of Pebble, support thriving (rapid growth rates) populations of rainbow trout. Tissue samples from these fish show no elevated levels of Cu or other trace metals when compared to fish from other pristine lakes in the area (*pers. obs.*, Patterson and Errington 2005, Anon. 2007, Andison 2008, Akins 2009). This is hardly reflective of a "toxic" tailings pond or "toxic" pore water. EPA should have known this, since they cite the Gibraltar mine in another part of this analysis. At another group of four geologically similar copper mines in British Columbia, the Highland Valley Mine (4 mi from the Thompson River, which supports a robust population of sockeye salmon; Mathew 2010), a reclaimed tailings pond (Trojan Pond) supports a self-sustaining population of Kamloops rainbow trout that are subjected annually to a trophy fishing contest (proceeds going to the hospital in Kamloops, BC) (Hamaguchi et al. 2008). Fry from the small feeder stream to this pond, where adult fish successfully spawn, are out-planted to other water bodies in disturbed areas on the mining property, where they do well. The bottom line is that not all copper porphyry tailings ponds are toxic. While the expected chemical make-up of the Pebble tailings pond water has not been firmly established, it is inappropriate for EPA to blithely assume toxicity that would preclude fish (and food item) life when there is relevant evidence that such an assumption could easily be false. This is another significant shortcoming of the EPA analysis.

<u>EPA Response:</u> The statement in the assessment was based on site-specific leachate data from PLP's EBD. Information from the British Columbia mines indicates that trout can live in the ponds but not that they reproduce. Finally, the assessment addresses the potential toxicity of the aqueous phase of a tailings spill, not the toxicity of surface water in a tailings impoundment.

6.86 *Page 6-14 – Box 6-1:* Background on Relevant Analogous Tailings Spill Sites – None of these "tailings spill sites" is relevant to the EPA hypothetical development and failure scenario for Pebble. The Clark Fork (MT) site(s) resulted from mines and smelter operations dating from periods when there was little understanding or regulation of the potential consequences of mining activities. The mineralization in this area is not like the Pebble deposit, and other metals (lead, silver) are generally much more toxic than Cu (or Zn). Milling and metal extraction processes were not like those anticipated for Pebble. Pebble tailings, and the tailings pond itself (and porewater) would be alkaline, not acid. This is an irrelevant and unrealistic choice for an analogue, and EPA should know this.

The South Fork Coeur d'Alene River was the recipient of particularly noxious tailings and smelter slag, much of which was simply bulldozed into the river to be washed downstream at high water. The rich mineralization of this area was nothing like the Pebble deposit (copper is not a pollutant of concern), and mining, milling and smelting activities bear little if any relevant similarity to activities anticipated for Pebble (nobody is proposing "plank tailings dams" for Pebble). The Bunker Hill smelter fire and toxic smoke plume spread wind-borne toxic materials great distances with terrible consequences. Nothing like this is anticipated for Pebble; there will be no smelter. This, too, is an irrelevant and grossly unrealistic choice for an analogue, and it is disturbing that EPA did not recognize this.

The Soda Butte Creek tailings embankment failure resulted from a dike retaining tailings from operations that began in nearly 80 years ago and continued for 20 years. Originally, tailings were placed directly in the creek meander corridor on an oxbow behind a low dike (that could never be permitted for a modern mining operation in Alaska). The dike failed in high flows in 1950 spilling "a large amount" of tailings into the creek (Boughton 2001). The spilled tailings apparently did not move far, because the stream was re-routed around the deposit, which was capped and re-vegetated by EPA and Kennecott in 1969, nearly 20 years after the "spill" (Boughton 2001). The total amount of tailings originally deposited was 115,000 m^3, minute in comparison to the EPA scenario for pebble. The actual source for much of the contamination of Soda Butte Creek itself is also problematic. USGS has stated in its evaluation of this site and the surrounding geology that "[a]lthough the impacts of mining are documented, differentiating between natural and human-induced sources of metals is extremely difficult because the geologic units in the watershed are highly mineralized." Numerous other historical mining operations and streamside tailings deposits in the area have likewise contributed to the uncertainty surrounding true sources of contaminant loading of Soda Butte Creek. In its intensive tracer-injection and synoptic-sampling study of the McLaren mine tailings, USGS was able to detect copper and other metals in seeps emanating from the McLaren tailings, but was unable to calculate loads for cadmium, copper, lead and zinc for the stream itself because these trace elements were below detection limits in stream water synoptic samples. The USGS concluded, "[t]he lack of detection of these elements in the downstream mainstem synoptic samples is probably because of sorption (coprecipitation and adsorption) to metal colloids in the stream" and that some loading of Soda Butte Creek came from Republic Creek and another unnamed tributary (Boughton 2001). It is noteworthy that it is dissolved ("free") copper that is the toxic moiety in the aquatic environment. Finally, the McLaren mine was not a geologic analogue of Pebble and the milling and extraction process used a cyanide heap-leach method, not a floatation circuit such as would be used at the Pebble mill. This is an irrelevant and unrealistic choice for an analogue for the Pebble prospect and it is surprising that EPA would have identified it as such.

<u>**EPA Response:**</u> **As explained in the assessment, these cases were used only to illustrate the fate of tailings spilled in rivers. The sources and the mechanisms by which the tailings entered the streams and rivers are irrelevant.**

6.87 *Page 6-18 §2:* This paragraph states that "the tailings leachate to which biota would be exposed could resemble leachates from supernatants and humidity cells." This would be true only absent dilution. According to Tables 6-2 and 6-3, the only dissolved constituent of concern for aquatic life (approaching or exceeding aquatic life water quality standards) would be copper. This element would exceed the most protective standard, the Biotic Ligand Model (BLM) standard, but would not exceed the federal or State of Alaska hardness-related standard; the Cu concentration would be approximately equal to the acute BLM standard and would be 1.8 times the chronic BLM standard (CMC and CCC quotients are the same for both supernatant and humidity cell waters). Thus, a 2:1 dilution of the inferred tailings supernatant or porewater concentrations would bring Cu concentrations below BLM chronic criteria. One critical factor in this scenario is the relative leaching rate of tailings material once mobilized and re-deposited and the percolation rate of local precipitation and uncontaminated (up-gradient) shallow groundwater through re-deposited tailings. Another critical factor would be the delivery rate of already diluted (by up-gradient groundwater and precipitation) porewater to surface waters supporting fish and aquatic invertebrates relative to uncontaminated stream flow from other parts of watersheds. EPA gives no clue of these critical rates, even though they are crucial to forming conclusions regarding the toxicity, or lack of toxicity, of surface waters in affected streams. This is a critical shortcoming of the analysis, because it profoundly affects the credibility of claims of impairment of aquatic life down-gradient of the event.

<u>**EPA Response:**</u> **The importance of dilution is discussed in the assessment, to clarify that relatively little dilution is required to render the leachate non-toxic. The critical rates called for in the comment are not available for the receiving stream and are hardly relevant given the relatively low toxicity of the leachate.**

6.88 This paragraph also states, "high flows would be expected to increase leaching rates." This statement is specious. The dilution effects of high flows would vastly overwhelm any increase in leaching rates, which would depend on chemical kinetics and the solubility product constant governing co-precipitants and complexes of copper in the associated substrate. The fact that USGS was unable to detect Cu in surface water samples in Soda Butte Creek (an EPA tailings spill example; see comments on Box 6-1), which they attributed to "sorption (coprecipitation and adsorption) to metal colloids in the stream" suggests that the effects of leaching of Cu from perched or other redeposited tailings would be trivial to non-existent.

<u>EPA Response:</u> The importance of dilution is discussed in the assessment. Increased leaching with increased flows is not specious, it is basic physical chemistry. Metal colloids would not be expected to occur in significant amounts unless the tailings are acidic, which is not expected.

6.89 *Page 6-18 §3:* In this paragraph, EPA re-introduces Soda Butte Creek as an example of disseminated tailings. It is important to note, but EPA does not make it entirely clear, that the copper concentrations to which they refer are for sediments, not water. EPA fails to note that the readily available USGS tracer and synoptic sampling study (Boughton 2001) could not detect Cu in stream water, although this element was readily detectable in seep water from tailings deposits, and that USGS attributes this to adsorption and co-precipitation of Cu onto metal colloids in the stream. EPA also fails to point out that Cu has very high affinities to fine particulates, dissolved and particulate organic matter and other chemical constituents in water, and it may be as likely to be removed from water by fine particles than be leached into water from them, depending on pH and a host of other considerations. This is a serious omission by EPA in the discussion of the fate and effect of Cu associated with tailings in their TSF failure scenario.

<u>EPA Response:</u> This paragraph is about sediments, not water. Sorption of copper is considered in the assessment and is modeled in the BLM; it is not an omission. However, metal colloids are not expected in this scenario because the tailings are not expected to be acidic, so sorption to colloids would be negligible.

6.90 *Page 6-19 §1:* This paragraph states, "rain and snowmelt would run across and percolate through tailings deposited on floodplains, leaching metals and carrying them into the stream. Leachate would also form during lateral groundwater movement through tailings, particularly where tailings deposited in wetlands." This is highly speculative, and such occurrences would depend greatly on site-specific conditions and relative rates of leaching (in turn dependent on porewater chemistry) and percolation. See comment immediately above.

<u>EPA Response:</u> These processes are not speculative, since they have been observed at other sites as described in the cited references. If tailings are deposited on floodplains, these processes are inevitable.

6.91 *Page 6-20 §1:* This paragraph states, "[c]oncentrations [of copper] in Bristol Bay would probably be lower than for the acidic Clark Fork tailings and [soluble copper] salt accumulation on the surface would be less as a result of greater precipitation." This statement is specious and an exercise in extreme hyperbole. It has no place in this document. The chemical origins and modes of transport and deposition in the Clark Fork area were radically different than anything that could be associated with the Pebble deposit. Furthermore, given the combined flows of the Nushagak watershed streams, along with the other eight major rivers feeding Bristol Bay, and the affinities of copper for colloids, particulates, dissolved and particulate carbon and its tendency to form co-precipitates and adhere to substrates, it is questionable that any differences in concentrations of copper in Bristol Bay water from pre-event background could be detected. Although it varies greatly, the generally accepted concentration of copper in seawater is about 0.25 ppb (Blossom c. 2001).

<u>EPA Response:</u> Language has been revised to make it clearer that the reference is to a spill in the Bristol Bay watershed, not in Bristol Bay itself, so the comment about sea

water is irrelevant. The reference to sorption to metal colloids is irrelevant to this site and the expected tailings chemistry. Also, the PLP's EBD shows very low organic carbon so that mechanism is also largely irrelevant.

6.92 *Page 6-20 §2:* This paragraph re-introduces the South Fork Coeur d'Alene River as a comparative example of "metal-enriched tailings" by flood waters. This is an inappropriate example. See comments on pg. 6-14 – Box-6-1. Copper was not a significant factor in the South Fork Coeur d'Alene site

<u>**EPA Response:**</u> **The paragraph is about the physical transport of tailings in floods. The copper concentration is irrelevant. No change required.**

6.93 *Page 6-20 §3:* This paragraph states, "bedload transport… could release sediment pore water (leachate) into the water column. First, copper could leach from the tailings and accumulate in sediment pore water during lowflow [sic.] periods. Then when flows increase sufficiently to mobilize the sediment, pore water would mix with surface water, resulting in exposure of aquatic biota and downstream copper transport." This is highly speculative and likely incorrect. Copper has extremely high affinities for colloids, fine particulates, dissolved and particulate carbon, periphyton (for which it is a micro-nutrient, as it is for virtually every form of life on the planet) and forms complexes with other chemical constituents in water with much lower bio-availability. Again, the inability of USGS to detect copper in water (as opposed to sediment) samples from Soda Butte Creek, and the attribution of this failure by USGS to adsorption and co-precipitation suggests that the speculation of EPA in this paragraph is incorrect.

<u>**EPA Response:**</u> **This comment suggests that copper is never dissolved and that because it is a micronutrient it should not be of concern, both of which are clearly not true. The mention of Soda Butte Creek confuses sediment pore water and its mixing surface water during high flows with the sampling of free water in a creek during normal flows. It also relies on co-precipitation, which is not expected to be a significant process in a tailings spill unless the material is more acidic than the PLP data suggest. No change required.**

6.94 *Page 6-21 §2 ff:* Dietary Exposures **–** This section of the analysis discusses potential dietary exposures of fish to aquatic invertebrates that constitute food supplies. The clear implication of this section is that there will be some negative impact to salmon and resident fish that consume aquatic invertebrates in an area affected by the EPA-postulated TSF failure. This discussion is both deficient and, in several respects, incorrect. Copper is important for animals as it is involved in the activity of enzymes such as cytochrome oxidase, superoxide dismutase, lysyl oxidase, dopamine hydroxylase and tyrosinase. In addition, copper-proteins and chelates also have metabolic roles. The National Research Council (NRC) gives *minimum* dietary requirements of copper for rainbow trout as 3 mg/kg/day and for Atlantic salmon as 5 mg/kg/day (*note*: the units are ppm, whereas water concentrations discussed in the EPA analysis are µ/l or ppb, one one-thousandth of the ppm used in discussions of dietary requirements). Dietary studies on salmon and trout, among other fish species, have concluded that minimum dietary requirements for trout and salmon can be met by copper concentrations in food from 3 – 5 ppm on the low end to 500-600 ppm on the high side of the range, with no adverse affect on Rainbow Trout (Watanabe *et al.* 1977). However, concentrations over 730 ppm reduced growth rate (Lano 1985). Much of the effect of dietary copper depends on its bio-availability; in most salmonid fish nutrition studies, copper is far more bio-available (as, *e.g.*, $CuSO_4$•5 H_2O) than in the natural environment (Berntssen *et al.* 1999). Very strong homeostatic mechanisms are at work in salmonids when it comes to copper metabolism and dietary exposure. Berntssen *et al.*(1999) confirmed the work of others that gut concentrations reflect dietary exposure levels and found that whole-body minus intestine Cu concentrations were significantly increased in Atlantic salmon only at dietary copper regimens of ≥900 mg/l. Kamunde *et al.* (2001) found that dietary copper exposure up to 1,000 ppm (as $CuSO_4$•5 H_2O) for 28 days (4% wet body weight/day) had no effect on growth, condition factor or food conversion efficiency. They also found that plasma copper concentrations were not different from controls, but that bile copper was greatly elevated for fish fed higher concentrations of copper in their diet, confirming the role of liver and bile excretion (via the gut) in homeostatic control of body burdens of copper, even at greatly elevated dietary exposure. Finally, these authors showed that pre-exposure to dietary copper decreased the uptake of waterborne copper across the gills, "providing the first evidence of homeostatic interaction between the two routes of uptake." EPA should have included this or similar information in its discussion on dietary exposures, with emphasis on homeostatic control and metabolic pathways for copper, noting that organisms accumulate this essential micronutrient from waters and food when ambient concentrations are low and excrete (depurate) it when dietary sources exceed metabolic needs. This is a fundamental of fish and invertebrate physiology, and EPA is remiss for not including these facts in this discussion, with the result that the entire discussion is misleading. It is interesting that in EPA's worst case analysis, (inappropriately) inferred copper concentrations of copper in aquatic invertebrates (683 mg/kg or ppm) is near the albeit high end of the no-effects range of dietary exposure of highly bio-available copper for salmonids, whereas copper in the natural environment is generally far less bio-available. EPA should have pointed this out, but failed to do so, resulting in a biased presentation of available information.

EPA Response: The comment presents some selected nutritional and toxicity studies that suggest a high level of copper tolerance and ignore the many other available studies and the consensus of the Pellston Workshop that were used in the assessment. No change required.

6.95 *Page 6-22 §2:* Persistence of Exposures – This paragraph sites a review of the persistence of "high metal content sediment in streams after 10 to 100 years" without specifying which metals were considered in the review. This is an extremely important omission by EPS, since different metals have different affinities for particulates and other materials, and accordingly may be more or less persistent in sediments. Copper has very high affinities for particulates and colloids, and can be expected to persist in deposits for long periods. However, and importantly, this is inconsistent with EPA's persistent view that copper would readily and rapidly leach from sediments and enter surface waters at concentrations sufficient to adversely affect fish and aquatic invertebrates. Either copper would leach rapidly enough to impair aquatic biota, or it will persist. It cannot do both. Again, evidence of the persistence of copper in sediments, but its lack of appearance in the water column, is given by EPA's own Soda Butte Creek case, as reported by USGS (Boughton 2001). This paragraph also cites the South Fork Coeur d'Alene River case, but does so inappropriately. Copper was never an actor in the South Fork Coeur d'Alene River (Moberly *et al.* 2009); Cd, P b and Zn were the culprits, but have very different behaviors. Copper should be the only metal of interest in the EPA scenario involving the Pebble deposit, given the agency's own assumptions on tailings and porewater concentrations of other constituents.

EPA Response: **This comment confuses a statement about the persistence of high metal sediment (i.e., the particles persist in the streams) with the rate of dissolution of metals from the particles. No change required.**

6.96 *Page 6-23 §3:* This paragraph sites Borgmann et al. (2005) and states, "[a] dietary chronic value for rainbow trout derived from multiple studies is 646 μg/g ([ppm or] micrograms of copper per gram of dry diet), at which survival and growth are observed to decline in multiple studies." This is a biased misrepresentation of the information in Borgmann et al. In fact, the "no-effect" concentrations in the eight studies cited by Borgmann et al. ranged from 458 to 895 ppm, with most of them using highly bio-available copper in dietary regimens, which would not be the case in the natural environment. In the same chapter, which deals with the issue of dietary metals exposure in the regulatory environment, Borgmann et al. write the following, which may serve as a caution to EPA: Although models have a considerable potential for application in the development of guidelines that incorporate dietborne [sic.] metal exposure, we emphasize that the current state of knowledge is insufficient to allow full use of this approach. More experimental data are required demonstrating the relationship (or lack of relationship if none exists) between toxic effects and metal concentrations in food. We need to know for which species and for which metals toxic effects correlate well with metal bioaccumulation and whether critical body or tissue concentrations for metals accumulated from food are similar to, greater than, or less than critical concentrations for the same metals accumulated from water. We need to be able to quantitatively link accumulation from water and food to effects. Then the modeling approaches discussed in this chapter need to be tested for applicability and reliability and modified if necessary. Although full use of the modeling approach in a regulatory framework cannot be recommended at this time, the approach has considerable promise.

EPA Response: **The 646 μg/g is taken directly from the workshop volume. This is a scientific assessment that uses the best available science to estimate risks, not a regulatory document. One of the peer reviewers of the draft assessment is an expert on metal toxicity to fish and was a participant in the Pellston Workshop. He stated that our use of the method was appropriate. No change required.**

6.97 Although the EPA Report states that: ''This assessment reviews, analyzes, and synthesizes available information on the potential impacts of large-scale mining development on Bristol Bay fisheries and subsequent effects on the wildlife and Alaska Native cultures of the region", we found few references in the EPA. Report to coarse estimates of risk to fisheries resulting from mining-related impacts. The authors state that, "Consequences of the loss and degradation of habitat on fish populations could not be quantified because of the lack of quantitative information concerning salmon, char, and trout populations. T he occurrence of salmonid species in rivers and major streams is known, but information on abundances, productivities, and limiting factors within each of the watersheds is not available." The absence of this information precluded quantitative assessment, thus assessments were, in most cases, restricted to qualitative inferences of potential mining impacts to fisheries (but see: e.g., estimate of tailings dam failure-related losses of Nusliagak and North Fork Icoktuli

River Chinook salmon on p. 6-10 and 6-11, respectively). These qualitative assessments are not valid in all cases. For example, the authors state that, “Additional roads and pipelines would increase the number of sites across the landscape where failures affected habitat quality, incrementally affecting fisheries on which wildlife and humans depend.” Although the number of sites where failure could occur would increase, the risk of failure greatly depend on the mitigation applied, which affects die probability of failure, and the specific location of the site, which affects the consequences of a failure. If road and pipeline crossings have effective mitigative and/or compensatory measures, effects on habitat quality (and subsequently on fisheries) may be negligible. This example illustrates the weakness of extrapolating the findings of a risk assessment to occasions where there is little knowledge of the mitigation to be employed or the specific location of project features; such a hypothetical qualitative assessment will inevitably inflate the perceived risk.

EPA Response: The absolute probability of failure depends on the mitigation employed, but that does not negate the fact that more roads and pipelines means a greater risk of failure. This comment concludes that “qualitative assessment will inevitably inflate the perceived risk” without any evidence or logical support. No change required.

6.98 In developing scenarios for the risk analysis in Chapter 6, the BBWA relies on historical failures of TSFs reported in the literature with the implication that the likelihood of such failures at the Pebble Project can be predicted based on these case studies. Causes of tailings dam failures have been documented and studied over the years (e.g., Davies et al., 2000; ICOLD, 2001) and the primary modes of failure presented in Section 4.4.2.1 of the BBWA are valid and need to be considered in any design of tailings dams. The failure modes in the report are restated below.

- Overtopping
- Slope instability
- Earthquake
- Foundation failure
- Seepage
- Structural failure
- Erosion
- Mine subsidence

Despite the impression from the BBWA that failure of the TSFs at the Pebble Project appears inevitable, each of these potential failure modes can be mitigated through a combination of proper site investigation, design, construction, operations, and maintenance. For example, overtopping can be mitigated through evaluation of the probable maximum flood (PMF) and consideration of the construction and operation sequencing of the tailings storage facility (TSF) to ensure sufficient freeboard is provided. Foundation failure can be mitigated through proper investigation of foundation conditions and subsequent preparation of a competent subgrade, including removal of poor quality materials, prior to constructing the overlying the dam. In the case of mine subsidence, location of the TSF at sufficient distance from the mine excavations is sufficient to mitigate. However, none of these mitigation strategies are evaluated in the BBWA.

Based on a review of the Wardrop (2011) report, and of the prior and ongoing investigations described in the Environmental Baseline Document (PLP, 2011) it is apparent that the TSF for the Pebble Project is currently undergoing investigation and design consistent with a Class I (high) hazard potential dam as defined by the Alaska Department of Natural Resources (ADNR, 2005). Following the methodology for design of Class I dams, it can reasonably be expected that each of the potential failure modes discussed above will be thoroughly evaluated during the design and permitting phase of the project.

EPA Response: The assessment estimates that there would be between a 99.9999% and a 99.999999% chance that a dam would not fail in any given year. This cannot be construed as the assessment claiming that a "failure of the TSFs at the Pebble Project appears inevitable." We agree that the TSF would be designed, constructed, and managed to avoid failure. However, in spite of the best efforts of TSF engineers and operators, tailings dams do fail. Our purpose is to evaluate the likelihood of failure (which is low) and the potential consequences of such a failure (which may be catastrophic).

The assessment does not rely on historic failure rates to estimate the likelihood of a tailings dam failure. It presents probabilities of failures based on both Class I and Class II design safety factors. These issues are discussed in detail in Chapter 9 of the revised assessment.

6.99 *Page. ES-20*: "If concentrate spilled into a stream, it would settle and form bed sediment predicted to be highly toxic based on its high copper content and acidity."

Comment: The concentrate water is alkaline, and oxidation of the concentrate will not occur for many years. This condition results in very little "free" copper, the toxic moiety. This being the case, the toxicity of a pipeline rupture and accompanying "spill" would be much less than represented in this paragraph.

EPA Response: The only available analysis of concentrate leachate for the first draft was acidic and the level of freely dissolved copper was high (Table 6-8 in the original draft). Analyses of concentrate leachate from an operating porphyry copper mine was available for the revised assessment and the results were alkaline. Copper concentrations in the concentrate slurry water presented in the revised draft were high enough to be toxic, despite the fact that the leaching period was short. The statement cited in the comment refers to concentrate settled in the stream. That material would be leached by neutral ambient water similar to the water used in the USGS leach test that yielded high copper concentrations and low pH quickly, not after many years. No change required.

6.100 *Page. 6-10:* "The near-complete loss of the North Fork Koktuli fish populations and long-term transport of fine sediment to downstream locations would have significant adverse effects on the Koktuli and Nushagak salmon, Dolly Varden, and rainbow trout populations."

Comment: This is speculation and ignores the fact that significant spawning and rearing of sockeye, coho and Chinook salmon occurs upstream of NK 1.190, the stream from which the EPA's failure scenario would emanate. The rapid channel recovery that would occur would allow fish to proceed past any unsuitable channel segments to areas which would be unaffected.

<u>EPA Response:</u> See response to Comment 6.79.

6.101 *Page 6-30***:** "We do not assess failures of the natural gas or diesel pipelines here because such pipelines are common, their risks are well known, and they are not particularly associated with mining."

Comment: This statement contradicts pg. 4-62, Table 4- 15: "Estimates are provided for the four pipelines that would connect the mine to the Cook Inlet port." The four pipelines evaluated in Section 4.4.3 include natural gas and diesel.

<u>EPA Response:</u> There is no contradiction between describing the potential pipeline failures in Chapter 4 and assessing the risks to the endpoint fish, wildlife and culture in Chapter 6, which is the "here" in the quoted sentence. The revised assessment does include an assessment of diesel pipeline failures.

6.102 *Page 6-35*: "Further, the 2004 spill provides a case of an accident that was more severe than assumed in our hypothetical accident, in that the spill lasted less than 2 hours rather than 2 minutes."

Comment: The 2-hour duration event describes spill containment, i.e., isolating and containing the affected area by means of berms or similar control structures. No statement is made about the duration of the release itself which may be used to confirm or refute the 2 minute assumption.

<u>EPA Response:</u> The quoted statement about 2 hours versus 2 minutes has been deleted.

6.103 While the primary modes of pipeline failure presented in the Draft Assessment are valid, it presents a misleading evaluation of the probabilities and consequences of a pipeline failure along the four primary pipelines (concentrate, reclaim water, diesel fuel, and natural gas) that will run the length of the 3 9 km long transportation corridor for the mine scenario used in the Draft Assessment.

<u>EPA Response:</u> Comment noted; no change required.

6.104 *Page: ES-18 §6:* Pipeline failures **–** This paragraph exhibits ignorance of porphyry processing methods and the chemistry of metal concentrates and accompanying waters that are produced by these processes. Concentrates are alkaline, not acid, and so is the accompanying water. This condition results in very little "free" copper, the toxic moiety. This being the case, the toxicity of a pipeline rupture and accompanying "spill" would be much less than represented in this paragraph. In addition, cleanup would be mandated by the State of Alaska, with stream restoration as part of the cleanup process in the event concentrates reached a stream. Regardless of the risk of rupture, the outcome of such an event would be much less dire than represented by the analysis. EPA appears ignorant of copper concentrates chemistry from a deposit like Pebble and is either unaware of the requirements of the State of Alaska, or failed to take them into account. Either way, these are significant misstatements and omissions of important information.

<u>EPA Response:</u> See response to Comment 6.99. The discussion of spill mitigation has been expanded in the revised assessment. Mitigation would be difficult because stream velocities are high enough to carry the material downstream.

6.105 A central assumption of Section 6.2 of the BBWA is that "Iliamna Lake is described as the receptor for spills, because the portion of the pipelines that is within the scope of this assessment is within the watershed of the lake." (pg. 6-30) This assumption ignores the probability that a subset of potential releases will be sequestered and cleaned up before entering the lake. The report states: "For 16% of their length (20.7 km), the pipelines would be within 100 m of a stream or river (Table 5-21), creating the potential for spilled slurry to flow into surface waters either directly or by overland flow." (pg. 6-30)

It is asserted that concentrate entering a waterway will form sand-like sediment, spreading downstream by erosion "over time". This assumes that the spill and associated sediments would not be remediated after detection, which would remove or greatly mitigate the risk of spreading. Similarly, it is later stated that a spill could contaminate up to 34 km of stream bed before entering the lake, once again ignoring the likelihood, or at least the possibility, of remediation before this worst case outcome occurs. This worst case assumption is repeated throughout Section 6.2, demonstrating the bias inherent in this failure scenario.

<u>EPA Response:</u> The discussion of concentrate spill mitigation has been expanded in the revised assessment to clarify the distinction between risks with and without mitigation. However, rapid flows in most of the streams crossed make it unlikely that remediation could occur before material spilled into a stream reached the lake.

6.106 The first statement in Section 6.2.1.3 is "A pipeline failure and spill would be expected to release 366,000 L of leachate (Table 4-16)." (pg. 6-34) This assertion is problematic as a baseline for risk characterization because, as discussed in Section 4.3, the release volumes are potentially overestimated based on isolation valve considerations.

<u>EPA Response:</u> The spill scenario has been replaced in the revised assessment with more detailed scenarios (Chapter 11).

6.107 The risk characterization discussion based on an analogy begins with references to a slurry pipeline failure due to an earthquake (pg. 6-34) at the Alumbrera mine in Argentina. One of the two supporting references (Claps, 2004) makes no mention of an earthquake. The second reference (Mining Watch Canada, 2005) states that the earthquake occurred on September 17, 2004, coincident with a release of material from a concentrate line failure at the mine, and goes on to question why the mine operator does not mention the earthquake when relating the incident in their 2004 Sustainability Report. However, an independent search for earthquakes in that time frame yields several public news references to an area earthquake on September 7. It is unclear why it was considered necessary in the report to connect this release to the earthquake.

<u>EPA Response:</u> Mechanisms of failure are relevant to a risk assessment. However, as the comment suggests, the critical fact is that the pipeline failure occurred irrespective of the cause.

6.108 The BBWA also states the pipeline release was less than 2 hours in duration, and subsequently state that this case "was more severe than assumed in our hypothetical accident, in that the spill lasted less than 2 hours rather than 2 minutes." (pg 6-35) This may be an inappropriate comparison because the 2-hour duration event describes spill containment, i.e., isolating and containing the affected area by means of berms or similar control structures. No statement is made about the duration of the release itself which may be used to confirm or refute the 2 minute assumption. Also noted in the report is that the "automatic shutoff did not function," although none of the supporting references make any note of an automatic shutoff, functional or otherwise.

<u>EPA Response:</u> The quoted statement about 2 hours versus 2 minutes has been deleted. Although Minera Alumbrera refers to its automatic shutoff working in the other spills, it does not mention how the shut-off system functioned in the 2004 spill. That sentence has been corrected in the revised assessment to avoid the inference that the difference between the large and small spills was the functioning of the shut-off system.

6.109 Two additional failures are discussed as referenced in the 2006 and 2007 Sustainability Reports for the mine. Both of these releases are of relatively small quantities, were detected by automatic monitoring systems, were promptly remediated, and were reported to have no lasting impact to the environment. While the line failures are undesirable, the balance of the discussion would seem to suggest that the consequences of a failure are correctable in the short term and do not generally represent the type of long term chronic impact discussed in detail elsewhere in the BBWA.

<u>EPA Response:</u> The assessment clearly states that these spills were reported to be small. No change required.

6.110 When summarizing the risk characterization section the Report states: "The experience with pipelines in general and with the Alumbrera copper concentrate pipeline suggests that pipeline failures and product spills would be likely in the maximum size of mine scenario." (pg. 6-35) The Alumbrera data presented, as discussed above, are wide ranging and unfocused, and do not appear to offer justification for this categorical statement. Furthermore, this is only a single mine presented without any justification for its selection and its applicability to the Pebble Project, and with underlying regulatory and engineering design standards which are not comparable to those required in a present day North American permitting environment.

<u>EPA Response:</u> Minera Alumbrera states that they use best practices and are ISO 1400 certified. The comment provides no evidence that the pipeline is different from those used in North America. No change required.

6.111 Based on a review of the Wardrop (2011) report, most, if not all, of the measures described in Appendix I are proposed for the transportation corridor pipelines at Pebble. Although the Wardrop report does not represent the final project plan, it is anticipated that the project would take significant steps to implement modern practices to mitigate against the potential pipeline failures described in the BBWA. While mitigation measures are referenced in Appendix I, by not incorporating the application of mitigation practices that would significantly reduce the likelihood of pipeline failures into the risk analysis, the BBWA provides a flawed and inaccurate assessment of the pipeline failure concern.

<u>EPA Response:</u> The assessment assumes that a mine operator or pipeline manager would implement modern conventional practices. In fact, the assessment assumes automatic shut-off valves that were not described in Ghaffari et al. (2011) (i.e., the Wardrop report), and the pipelines from which pipeline failure statistics were derived also incorporated modern safety features and mitigating measures. The comment identifies no mitigation measures that should have been included but were not.

6.112 *Page 6-63:* "Failure of the water collection and treatment system during the operation or planned post-closure periods would, like failures of any water treatment system, be a relatively common occurrence of limited duration."

Comment: A simple component malfunction would not usually imply or cause a system-wide failure or a release to the environment. Instead, NDM believes that PLP - in line with typical practice - would have a modular water treatment system with redundant capability. If there was a malfunction in one part of the system, such a system would have the capability to continue storing and treating water such that there would be no releases of untreated water. Any project design that would allow release of untreated water would not be permitted or allowed to operate.

<u>EPA Response:</u> We do not agree that a fail-safe water treatment system is possible. No project is designed or permitted to fail; nevertheless, even systems with redundancies fail in practice.

6.113 The first inadequacy in the BBWA analysis is the lack of a clear definition of what constitutes a "failure" of the water collection and treatment system. The examples and language used throughout the document suggest that the temporary loss of a system component is considered a "failure" and the report presents such a failure as a virtual certainty. The report overlooks the fact that failure of a minor system or component (e.g., a mechanical pump breakdown or an electrical instrumentation failure) can be quickly and relatively routinely addressed, and is thus unlikely to cause a release of hazardous substances or result in any material environmental impact. Also, no distinction is made between a minor release that causes no environmental impacts outside of the site boundaries and a major release that could result in potentially environmentally significant impacts beyond the site.

<u>EPA Response:</u> The revised assessment is clear that the failure scenario is a release of untreated wastewater at the operating flow rate.

6.114 "Following the termination of mine operations, collection and treatment may cease immediately (premature closure) or may continue for some period (planned closure), but eventually will cease (perpetuity). If the water is nontoxic, in compliance with all criteria and standards, and its composition is stable or improving, the collection and treatment system may be shut down under permit. Otherwise, treatment would continue until institutional failures ultimately resulted in abandonment of the system, at which time untreated leachate discharges would occur." (pg. 6-36)

This statement assumes that institutional controls will fail at some time and management of water residuals would cease, when considering "perpetuity". First, this is a contingency outcome that would be evaluated in the permitting process. All closures, referred to in the report as both "planned" and "unplanned," are planned for during the permitting process.

This statement is misleading because it does not differentiate between leachate that is collected during mine operations and that which may be generated during the "in perpetuity" timeframe. If institutional failures result in the eventual abandonment of the water collection and treatment systems, a reasonable expectation is that by this time the site would have executed the closure plan and that the leachate quality would be stable or improving each year. In contrast, the BBWA implies that it is inevitable that untreated leachate will eventually be discharged to the natural environment, resulting in a significant environmental impact. Such speculation on future outcomes is not consistent with accepted risk analysis practice, as a "reasonable" time frame must be considered.

EPA Response: Accepted risk analysis practice does not preclude consideration of "in perpetuity" timeframes. The comment presents the innovative concept that a permitting process will include a plan for unplanned events or for failure of institutional controls and seems to suggest that unplanned events would not occur until after they pose no risk. The assessment assumes that unplanned events may not have been planned for, and therefore mentions the possibility but does not include them in the mine scenarios.

6.115 "During mine operation, collection or treatment of leachate from mine tailings, pit walls or waste rock piles could fail in various ways. This water collection and treatment failure could be continuous (e.g., failure to collect all leachate from the tailings storage facility) or episodic (e.g., failure due to a power loss). In such cases, leachate might enter groundwater and not be collected by the pit sumps or the tailings impoundment's collection system, or could discharge to surface waters directly or through a non-functioning water treatment system." (pg. 6-36)

No supporting documentation or references are listed in the assessment to support the claims relating to water collection and treatment failure. Neither the "continuous" nor the "episodic" failures mentioned represent current "best practices" for operating mines. For example, a failure to collect all leachate could result from an inadequate design of the leachate interception system or an episodic equipment malfunction. Both of the failures just described can be corrected quickly and remedial measures taken to prevent a recurrence. The use of preventative maintenance programs to inspect and maintain equipment is known to reduce unscheduled downtime and prevent the types of catastrophic failures presented in the BBWA. Instrumentation and controls are available to signal water system operators in the event of a malfunction so they may initiate appropriate repairs and remedial action.

EPA Response: Failures are not part of best practices, but they do occur. The revised assessment contains additional justification for the statements.

6.116 The BBWA states that "there are no data on failure rates for wastewater management at mines." (pg. 6-41) However, in speculating on failure scenarios the report presents a biased view of the potential risks from water management systems.

EPA Response: The comment presents no evidence of bias or specific instances of biased analyses. However, a study of failure rates (Earthworks 2012) became available for the revised assessment and is now cited in Chapter 8. No change required.

6.117 "Failure of the water collection and treatment system during the operation or planned post-closure periods would, like failures of any water treatment system, be a relatively common occurrence of limited duration. Loss of power, mechanical failures, pipeline breaks, operator errors, or other events could result in the release of untreated wastewater to a stream." (pg. 6-38)

This statement overlooks best practices for operation and maintenance of water treatment systems. As discussed previously, a simple mechanical, electrical, or instrumentation malfunction is unlikely to cause a system-wide failure or a release to the environment. It would be standard practice for redundant systems or safeguards to be in place for critical installations where a malfunction could result in a discharge. This section is also misleading because the report combines the ideas that failures are "common occurrences" and suggests that failures "…could result in the release of untreated wastewater to a stream." This statement fails to account for the low impact of minor failures, which can be quickly mitigated, avoiding any significant release.

EPA Response: See response to Comment 6.115.

6.118 Alternatively, water collection and treatment failure could be a result of an inadequately designed water treatment system which could result in the release of inadequately treated water as at the Red Dog Mine, Alaska (Ott and Scannell 1994, USEPA 1998, 2008). In that case, the failure could continue for years until a new or upgraded treatment system is designed and constructed." (pg. 6-38)

This is an example of raising fears of improper management of the water collection and treatment systems. The report does not provide a basis for assuming that "failure could continue for years," given that modern process engineering practice is clearly focused on reducing the frequency of these outages and ensuring that the consequences are minimal. The water treatment system, in particular during early phases of operation, would need to incorporate a sufficient safety factor to mitigate against unforeseen variability in the raw wastewater characteristics.

EPA Response: The statement is based on an actual case of an inadequately designed water management and treatment system at a modern mine in Alaska. The peer reviewers suggested other instances.

6.119 The Draft Assessment contains an analysis of the negative impacts of roads and culverts that is inconsistent with current construction practices, as well as state and federal requirements. The authors appear to be unfamiliar with modern road building design and culvert placement requirements. Assumptions that culverts would block access to large portions of the existing natural habitat is unwarranted if modern road building techniques are adopted that meet current state and federal construction requirements.

EPA Response: See responses to Comments 4.82 and 4.152.

6.120 The Assessment on pages 5-59 and 5-60: Section 5.4.1 Culverts; states: "Culverts are the most common migration barriers associated with road networks. Hydraulic characteristics and culvert configuration can impede or prevent fish passage. Where flow restrictions such as culverts are placed in stream channels, the power of stream flow is increased. This can lead to increased channel scouring and down-cutting, stream bank erosion, and undermining of the stream crossing structure and fill. Although the well planned installation of culverts allows natural flow upstream and downstream of crossings, failure rates are generally high (Sections 4.4.3.3 and 6.4)."

Comment: The implications of the paragraph quoted above are that culverts have the potential to cause channel changes and impede or block fish passage. It also indicates that "…well planned installation of culverts allows natural flow upstream and downstream of crossings …", which indicates that if a culvert is properly sized, installed, and maintained that few changes in the channel or impacts to fish passage can be anticipated. However, the paragraph also indicates that "… failure rates are generally high (Sections 4.4.3.3 and 6.4)". The paragraph refers to two sections of the Assessment to support the conclusion regarding culvert failure rate. First, the Assessment contains no Section 4.4.3.3, so for this comment it is assumed that the authors are referring to Section 4.4.4. Review of Sections 4.4.4 and 6.4 reveal that the Assessment has used inappropriate data and references to support the culvert failure rates shown in Sections 4.4.4 and 6.4 and calculation of culvert failure rates presented in Box 8-1 and Table 8-1.

EPA Response: See responses to Comments 4.82, 4.152, and 4.187.

6.121 *Page ES-21 §4:* The analysis states that the most serious "failure" associated with the transportation corridor would be blockage of culverts at any of the anadromous stream crossings. The clear implication is that many of the anadromous stream crossings would involve culverts. EPA should be aware of State of Alaska policy regarding anadromous and resident fish crossings (especially since the analysis cites the ADFG/ADOT MOA dealing with this policy), the default method for which is a bridge. If a culvert would be used, each individual crossing must undergo an extremely conservative 3-tiered hydraulic analysis to assure that culverts will have sufficient capacity, with an ample margin, to pass high flows. Furthermore, the document assumes that maintenance will be performed on the road crossings on a daily basis. This is inconsistent with the road failure scenario as described by EPA. The actual likelihood of culvert failure is a small fraction of that used by EPA in this assessment, and any failure would be remedied promptly.

EPA Response: See responses to Comments 4.82, 4.152, 5.46, and 5.48

6.122 Cited failure rates for culverts on the order of 30-66% (pg. 6-42) are not applicable. The BBWA cites literature supporting culvert failure rates of 30-66% (30% from Price et al. 2010, 53% from Gibson et al. 2005, 58% from Langill and Zamora 2002, and 66% from Flanders and Gariello 2000). In these studies the authors note the issues observed could have been prevented with proper design, installation and/or maintenance. Therefore a project being designed and constructed under current regulations with stringent environmental standards and regulatory oversight should be expected to be executed with much greater care such that fish passage standards are met at each crossing. The failure rates in the above studies therefore are not applicable for this project. Failure rates cited are for typical culvert installations, and are not applicable for partially buried culverts, natural bottom culverts and other culverts designed specifically for fish passage and channel stability that could be utilized.

EPA Response: See responses to Comments 4.82, 4.152, and 4.187.

6.123 Road culvert failure modes do not consider existing state of the practice guidance (pg. 6-42) The BBWA states: "Road crossings often fail because of outfall barriers, excessive water velocity, insufficient water depth in culverts, disorienting turbulent flow patterns, lack of resting pools below culverts, or a combination of these conditions (Furniss et al. 1991)." The culvert failure modes presented in the report are comprehensive and relevant. Guidance exists for fish friendly designs that mitigate each of the failure modes, such as the Memorandum of Agreement between Alaska Department of Fish and Game and Alaska Department of Transportation and Public Facilities for the Design, Permitting, and Construction of Culverts for Fish Passage (ADFG and ADOT&PF, 2001).

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

6.124 Impacts identified in the Draft Assessment are calculated in percentages, or at times fractions of percentages. This gives the reader two illusions: 1) that the impacts are real, and that 2) the impacts have been scientifically and defensibly calculated. Neither of these conditions is true. There is no project from which one could make valid impact assessment statements and no data has been collected from which one could actually calculate real or projected impacts.

<u>EPA Response:</u> We certainly did not state that the impacts are real—this is a risk assessment of potential mines, so these are potential impacts. We disagree that risk assessment is impossible because there are no data, and the assumptions underlying analyses in the assessment are clearly presented.

6.125 The Draft Assessment conceptualizes the important components of a large mining project, but fails to provide a risk analysis that: is based on data applicable to the hypothetical mine scenario; yields reasonably accurate estimates of probability and implications of failure for all the mine components; and accounts for modern mining design and operations strategies that would reduce the probability and consequences of failure. These limitations raise significant concerns on the appropriateness of using this document to inform stakeholders on the future of mining in the Bristol Bay watershed. As with the other consultant reports presented, the Geosyntec submission should be studied closely in its entirety to further understand the shortcomings and errors in the Draft Assessment's analysis.

<u>EPA Response:</u> This is a summary of specific comments that are addressed elsewhere in this document (e.g., see responses to Comments 6.57, 6.60, 6.66, 6.98, 6.105, and others).

<u>Alaska Miners Association, Inc. (Doc. #4612)</u>

6.126 The draft assessment, again which was supposed to focus on development in general and not specific to mining, showcases an obvious lack of understanding of the mining industry as well as Alaska. It is confusing as to why a geologic event such as the eruption of Mount St. Helens is used as an analogy of sediment loading from a potential tailings dam failure. Alaska has had many geologic events that would more appropriately apply to potential scenarios reviewed in the draft assessment. Using events from an entirely separate region completely removes reality from the equation.

<u>EPA Response:</u> The hydrology of particle transport is not region-specific. The Mount St. Helens data were used strictly to address the rate of benthic habitat recovery from a massive deposition of fine mineral particles. The hydrological processes that determine

the recovery of substrate texture and the requirements of fish or aquatic invertebrates are not known to depend on whether mineral particles result from a natural or an anthropogenic event. We have reviewed the literature on known mine failures. They studied tailings spills in terms of toxicity but not in terms of physical habitat effects, which is why we used Mount St. Helens data. Nevertheless, we have removed most references to Mount St. Helens in the revised assessment to address this concern.

6.127 The lack of design details makes the EPA's failure analysis meaningless. This section of the Watershed Assessment does not follow ecological risk analysis methodology. That methodology required that the details of design be known, stressors identified, and determinations whether the stressors will change a particular endpoint. This section has none of that.

<u>EPA Response:</u> The guidelines for ecological risk assessment do not require a particular level of detail in designs or any other aspect of the assessment. Stressors (the leachates) are identified. Effects on the endpoints are determined as far as is possible.

6.128 There is no specific failure mode that is evaluated. There are no specific design details, monitoring system, or back-up catchment system to evaluate. In places, the section admits the lack of knowledge.

<u>EPA Response:</u> The risks depend on the discharges, not on the specific failure mode that causes the discharges. The failure scenario presented in the revised assessment (release of average untreated water into average dilution flows) is a reasonable upper bound case but not a worst case. All risk assessments admit to lack of knowledge.

6.129 As another way of analyzing the EPA's presentation of risks posed by culverts along mine roads, the authors checked to see if other analyses not associated with the Pebble mine controversy reached similar conclusions. Those include the Red Dog Mine Extension EIS (2009), the Pogo Gold Mine Project EIS (2003), and third-party audits for the Pogo and Greens Creek mines. Note that the EPA was the lead agency for the two analyses.

<u>EPA Response:</u> The failure of prior assessments of other projects to address culvert failures does not negate the results of this assessment. No change required.

6.130 Overall, a significant incidence of culvert failure along existing mine roads does not appear to have been an issue with government agencies, including EPA. Thus, in other circumstances, EPS, or other agencies, and 3rd-party auditors have not identified the types or magnitude or road impacts to streams that EPA indicates in this Assessment.

<u>EPA Response:</u> See response to Comment 6.129.

6.131 The Assessment relies on statistics gained from legacy mines to predict the operation of their hypothetical mine. Given the changes in practices and regulations explained above, this error is bound to overestimate the probability of failure. The Assessment appears to make this error throughout the document but especially in the dam failure, and possibly the water treatment and collection failure (though in that section, they do not discuss, explain, or display the data used for their conclusion.)

<u>EPA Response:</u> Estimates of dam failure risks are based on design goals. The assessment used operational practices described in Ghaffari et al. (2011), not legacy mines. Reference to legacy mines is not in the context of mine operation, but in the fate of specific pollutants once they have been released (which is independent of mine operation).

The dam failures evaluated could result from plausible natural events. Modern conventional mining technologies and mitigation measures are assumed in the assessment scenarios. An error in predicting the probability of an event happening (or not) does not change the evaluation of impacts from such an event should it happen, which is the focus of this assessment.

Water collection and treatment failure rates are not quantified from historic rates.

<u>The Pebble Limited Partnership (Doc. #4962)</u>

6.132 The Assessment has misrepresented the likelihood of tailings dam failure for any proposed mining development in Alaska. The International Commission on Large Dams (ICOLD) tailings dam failure statistics are extensively referenced in the Assessment Report, either directly or indirectly through selectively citing other technical articles. However, these ICOLD statistics do not support the premise that tailings dam failure is a reasonable hypothesis for a modern mine operation in the Bristol Bay watershed. The ICOLD document provides some summary statistics on the frequency of tailings dam failures and states the following; "In highlighting accidents, the aim is to learn from them, not to condemn". Conversely, the Assessment incorrectly implies that generalized statistics for worldwide tailings dam failures can be applied to individual tailings dams to suggest a high potential for failure over an extended period of time. This premise is erroneous and misleading, as it is incorrect to imply that any particular proposed or actual dam structure is more or less likely to fail based solely on extrapolation of general dam failure statistics based on dissimilar dams.

<u>EPA Response:</u> See response to Comment 4.150. It would be negligent for the assessment to ignore that tailings dams have failed. However, the historical failure rate was not used to estimate failure rates in the scenario, but as supporting information.

6.133 The Dam Breach Model is flooded with bad assumptions and with uncertainty, so EPA's estimate of the environmental impacts of (an unlikely) dam failure is drowning in bad science. The Assessment includes a questionable dam breach assessment where the high uncertainty associated with the peak flow estimate and modeling predictions is not presented, and where the relative magnitude of the dam breach flood is wrong. In an effort to illustrate the extreme magnitude of the dam breach flood, it was compared to a natural flood in the region, but errors were made in the calculations and the comparison was done in a manner that exaggerates the result. The errors were in the drainage areas stated for both the dam breach flood and the regional flood, and appear to stem from an inability to convert from imperial units to metric units (sq. miles to equivalent sq. kilometers). The lack of rigor used in these analyses results in misleading statements concerning the potential impacts of mining development in Bristol Bay.

<u>EPA Response:</u> The cited area values no longer appear in the assessment. Uncertainties associated with the tailings dam failure analysis are explicitly discussed in the final assessment.

6.134 Approximately two-thirds of the impact assessment section of the BBWA Assessment focuses on the potential failure of tailings storage facilities (TSFs). The document estimates that the probability of occurrence of a tailing pond failure is extremely low. If the analysis of that probability excluded dams that do not conform to current mining practices and U.S. regulatory requirements, then the estimated probability of occurrence would be significantly lower. The analysis also assumes that no cleanup or remediation activities would be required upon the failure of a TSF, which is a highly unrealistic assumption. Most, if not all, of the TSF failure scenarios identified in the BBWA Assessment can be prevented through proper engineering design, and through the implementation of current Best Management Practices.

<u>EPA Response:</u> It is not correct that the tailings dam failure rates in the scenario are based on historical failure rates and that the assessment "assumes no cleanup or remediation activities." The discussion of tailings spill remediation has been expanded to emphasize these points.

6.135 *Section 6.1.2.1, Page 6-4, last paragraph, last sentence*. The methods or the logic used to develop the conclusion that recovery would take decades are not provided. Many of the streams on Mt. St. Helens were also low flow streams, yet they recovered relatively rapidly.

<u>EPA Response:</u> The Mount. St. Helens analogy has been removed from the assessment at the suggestion of the peer reviewers. However, it is relevant to note that channel recovery is still ongoing at Mount St. Helens, decades after the event.

6.136 Given current state and federal law, it is entirely implausible to assume that the impacts of a major tailings pond failure would not be immediately remediated. This assumption affects all the analysis in Section 6. The overall impacts of this extremely unlikely event are entirely overstated because the assumption is invalid. Any tailing pond failure will require an immediate remedy response.

<u>EPA Response:</u> See response to Comment 6.134. Based on the significant volume of tailings that would be released (even in a conservative scenario) and the lack of access to the region, "immediate" remediation would be impossible. Large-scale sediment remediation and restoration projects typically take decades, even in areas that already have the infrastructure and access for these major remedial engineering projects.

6.137 This paragraph needs to restate the low probability of occurrence that was addressed earlier in the document.

<u>EPA Response:</u> The low failure probabilities are discussed in Chapter 4 of the draft assessment and Chapter 9 of the revised assessment.

6.138 Citations are missing describing the rainbow trout median lethal concentrations of copper (10 and 39 μg/L). In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

<u>EPA Response:</u> This information was presented in Chapter 5 and was not repeated in Chapter 6 of the draft assessment. In the revised assessment, all of this material has been moved to Chapter 8.

6.139 The statement that acute or chronic toxicity to invertebrates through exposure to tertiary waste rock leachate could occur at up to two times dilution is not supported. If this statement is supported in a previous section, that section should be noted and Table 5-14 should be referenced.

<u>EPA Response:</u> Dilution zones are discussed in Section 8.2.3.5 of the revised assessment.

6.140 The pipeline failure rates used in the assessment are based on aggregated information from several countries spanning a wide range of construction techniques and pipe sizes. It is not clear what design standards those pipelines were constructed to. The estimate of expected pipe failure rate in the hypothetical mining scenario should be based on failure rates of pipelines of similar size and modern construction designs (e.g., anticorrosion/erosion inner HDPE lining, a surrounding steel pipe, insulation) that would be built and maintained to U.S. standards.

<u>EPA Response:</u> See response to Comment 4.148. The data used are the best available. The mining industry has not provided failure rate data for their pipelines. However, concentrate pipelines have failed at Bingham Canyon, an analogous modern U.S. mine.

6.141 This section assumes that roads and culverts would be built to standards that have long been abandoned and has no application to a modern day mine design. The analysis is incorrect and will remain incorrect until it is conducted with the correct assumption that roads and culverts will meet or exceed current engineering standards and current regulations.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

6.142 *Section 6.4.3: page 6-43:* Thus, two of the remaining 16 streams with less than 5.5 km of upstream habitat might be bridged, leave 14 salmonid streams with culverts. Assuming typical maintenance practices after mine operations, roughly 50% of these streams, or 7 streams, would be entirely or partly blocked.

Comment: It is not clear how this conclusion is reached. Provided the road crossings are properly engineered and constructed to appropriate standards, road and culvert failures would not be expected. Culverts commonly operate successfully in steep mountainous terrain.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

6.143 *Section 5.4.4.2, Page 5-61, Paragraph 1, Sentence 2:* "Culverts pose the most common migration barriers associated with road networks. Persistent barriers to fish movement are assessed in Section 6.4, because they are considered to constitute maintenance failures. Culverts designed to meet the State of Alaska's requirements and regularly maintained should not block fish passage; however, hydraulic characteristics such as low water depth or high water velocities and culvert configurations can impede or prevent fish passage."

Comment: As described in detail in several sources (WDFW 201 1, CDFG 2009, USDA 2008, ADOT&PF 2001) modern approaches to culvert design incorporate a continuous streambed that mimics the slope, structure and dimensions of the natural streambed. Water depths and velocities are as diverse as those in the natural channel, providing passageways for all aquatic organisms (USDA 2008) and maintaining sediment and debris continuity. Water depth through culverts is maintained during low flow through incorporation of a constructed channel to concentrate flow and maintain stream thalweg continuity. Design criteria require evaluation of velocities during flows that occur during key migration periods (e.g., low flows) so as not to impede fish passage. Failure in such properly formulated stream crossings is limited and the long term biological benefits of such stream systems can be maintained over time.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

6.144 *Section 6.4.3, Page 6-43, Last Paragraph, Last Two Sentences:* "Thus, two of the remaining 16 streams with less than 5.5 &1 of upstream habitat might be bridged, leaving 14 salmonid streams with culverts. Assuming typical maintenance practices after mine operations, roughly 50% of these streams, or 7 streams, would be entirely or in part blocked. As a result, salmon spawning would fail or be reduced in the upper reaches of the streams and the streams would likely not be able to support long-term populations of resident species such as rainbow trout or Dolly Varden."

Comment: This conclusion is based the assumption that all culverts are designed similar to those case studies implemented in the past three decades, which do not adequately account for the natural geomorphic and biological processes of sensitive stream habitats. Culverts designed using modern design guidelines developed by ADOT&PF, CDFG, NMFS, USDA, FHWA, WDFW, and others can be implemented to reduce potential impact to the physical and biological resources of streams and rivers.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

6.145 This section is wholly inadequate for addressing the possible effects on wildlife following a failure. This illustrates a lack of supporting data and adequate analysis. There are no scenarios for the size of the "projected failure", nor the timing of any failures. Current mining methods and practices have greatly reduced the potential of said failures. The magnitude of any potential failure would also greatly influence an impact analysis on wildlife. Additionally, the conceptual models and the endpoints of such models have not adequately taken into account the diverse habitat range of higher order predators. Thus, a failure that might result in an impact to one stream, may have no significant impact on species that can forage from within a very large home range. Further, the report states that "all terrestrial wildlife in the Bristol Bay watershed depend upon the enhanced aquatic and terrestrial production provided by the marine nutrients that are brought into the watershed by returning and spawning salmon." This a very large, unreferenced, unsubstantiated statement intended to lead the reader to conclude that if any of the nutrients carried by salmon were to be blocked in any way from reaching these upper streams, then all terrestrial wildlife would be impacted. There is no analysis in the assessment to support such a broad implication.

<u>EPA Response:</u> The projected failures were described in Section 4.4, and this has been expanded in the revised assessment for clarity. The timing of failures is not specified because failures, by their nature, are not scheduled.

We agree that the magnitude of any failure would influence the magnitude of impacts on wildlife. The focus of the assessment is on salmon-mediated effects on wildlife, but we recognize that failures would also result in direct effects, which are mentioned but not evaluated in the assessment.

The importance of marine nutrients is a well-known phenomenon that is described, with references, in Chapters 5 and 7 of the revised assessment. The assessment of potential salmon-mediated effects on wildlife has been edited for clarity. The discussion of how a decrease of marine derived nutrients could affect wildlife has been expanded and is now in Chapter 12. The available data do not allow for a quantitative analysis of effects on wildlife from loss of salmon.

6.146 This paragraph states, "While a large-scale mining industry would inject some market-based economic benefits for some time, it would likely employ a small fraction of Alaska Natives. Even these jobs would not be permanent, because mines have a finite lifespan." There is no source cited for these statements. In the absence of technical references to the relevant literature upon which these statements, presumably, are made the basis for these statements cannot be evaluated. Furthermore, information is not provided such as how long the jobs would stay in the area and why Alaska Natives would not "likely" be employed by the mine operations. This is contrary to experiences at other mines in Alaska. For example, an analysis of native corporation shareholder employment at the Red Dog Mine, one of the world's largest zinc mines located in Northwest Arctic Borough, found in 2010 that 53% of the workforce were Native Alaskan shareholders and of all the employees on the Red Dog property, 58% were shareholders from NANA, the regional Native Corporation. Construction of the Red Dog Mine began in 1987 and operations are expected to continue for several decades. The mine is providing locally based and sustainable employment for Alaskan Natives living in the region.

<u>EPA Response:</u> The language in the assessment has been clarified to indicate that a large-scale mine would likely employ a relatively small fraction of residents (including Alaska Natives) from these watersheds. We did not mean to imply that Alaska Natives would not be employed by the mining industry. Information about Alaska Native employment in resource extraction industries, including Red Dog, was added to the assessment, along with references.

6.147 Impacts are calculated in percentages, or at times fractions of percentages. This gives the reader two illusions: 1) that the impacts are real, and that 2) the impacts have been scientifically and defensibly calculated. Neither of these conditions is true. There is no project from which one could make valid impact assessment statements and no data has been collected from which one could actually calculate real or projected impacts. These flaws make all percentage-based analysis used throughout the document scientifically deficient.

<u>EPA Response:</u> See response to Comment 5.84.

<u>J. Breiby (Doc. #1711)</u>

6.148 Another area in the assessment that has been insufficiently emphasized is the question of tailing dam failure. In discussion of post mining monitoring the EPADA states that it "…would continue for centuries and potentially "in perpetuity" " (Page 3, Page 15, EPADA).

In perpetuity? That's a long time. Has any mine ever maintained its tailing pond into its "post-closure phase"? Perpetuity could mean thousands of years. In a very short and incomplete internet search of about one-half hour, I found several articles on the London based Anglo-American the Canadian based Northern Dynasty, each 50% partners in the Pebble Limited Partnership.

EPA Response: The post-closure phase of mining begins when reclamation is completed and monitoring and maintenance commences using the controls put into place during closure. Exactly how long the site would require monitoring and maintenance is unknown, and thus may be "in perpetuity." It is unknown if any human structure has lasted that long; however, routine maintenance may be able to stabilize the dam for very long periods of time. No mine in Alaska has maintained a tailings pond into post-closure, although one small mine did maintain a pond during a many year hiatus from operations. Maintaining a water cover over the tailings is a part of the reclamation and closure plan for the Red Dog Mine. No change required.

Laborers International Union of North America, Local 341 (Doc. #5418)

6.149 Many of the examples used throughout the draft assessment are inaccurate or misleading and therefore need to be questioned. Section 6.1.1 states that "Remediation may occur following a tailings spill, but it is uncertain." This statement assumes that remediation might occur as a result of a major tailings pond failure when in fact remediation would immediately commence. As a result, Section 6 as a whole is flawed and misleading since the basis of the impacts are overstated due to the assumption of no remediation.

EPA Response: See response to Comment 6.136.

Audubon Alaska (Doc. #4121)

6.150 Tailings are likely to have high concentrations of copper, which is among the most toxic of the heavy metals to fish, wildlife, and invertebrates in freshwater and marine systems. If a large tailings dam broke somewhere like at the proposed location of the Pebble Mine, in addition to the Nushagak River and Kvichak River watersheds, toxic waste waters could easily impact avian populations using the estuarine and marine waters of Bristol Bay, specifically by disrupting/destroying the food web that birds rely on that is connected to the nutrient-rich waters that flow down through the Bristol Bay watersheds.

EPA Response: The loss of estuarine and marine foods for birds is not specifically addressed in the assessment because it is beyond the range of reasonably defensible modeling given currently available data and models. However, discussion of foodweb complexity in the watershed and possible effects on wildlife has been supplemented in the revised assessment.

6.151 Using assumptions regarding waste rock leachate concentrations from PLP leachate testing, we find that copper toxicity due to a leachate collection system failure would most likely exceed water quality standards at least to the middle Upper Talarik Creek, and at least to the junction of the North Fork and South Fork Koktuli rivers at gage site SK100A. Substantial portions of these watersheds would therefore be impacted by a leachate collection system failure.

EPA Response: The waste rock leachate scenario has been completely revised in the revised assessment.

Earthworks (Doc. #4125)

6.152 It is noted in the assessment that: "If the operator was no longer present at the site or was no longer in existence, the response would, at best, be further delayed." (Draft Assessment, p. 6-2). Most people do not understand that the financial assurance (bond) required by regulatory agencies for a mine does not cover a dam failure. As is described, securing funding for dam repair and tailings cleanup would take time. Since the financial assurance (bond) required for mines does not cover dam failures, funding to fix a dam after failure and for cleanup would need to be secured either through litigation of a responsible party, or through taxpayer support.

Comment: It might also be mentioned that under present regulatory practices at both a federal and state level there is no existing funding for a dam failure cleanup.

EPA Response: Box 4-3 in the revised assessment provides background information on financial assurance requirements and clarifies that financial assurance requirements do not include remediation of chemical or tailings spills.

6.153 It is noted in the assessment that: "The toxic effects of exposure to a tailings spill can be estimated from aquatic toxicity data." (Draft Assessment, p. 6-22). Toxicity criteria are based on tests of individual contaminants, assuming no interaction with other contaminants. It is known that contaminants can also act synergistically and antagonistically. Copper and zinc are synergistic, and since there is some zinc in the deposit it is possible that the lethal levels might be even lower than that estimated in the Biotic Ligand Model, since the Biotic Ligand Model does not consider multiple metal toxicity.

Comment: You might mention that exposure estimates are based on the presence of one metal only.

EPA Response: Total metals toxicity based on a concentration additivity model was presented in Table 5-14 to 5-16 and Tables 6-2 to 6-4. Zinc concentrations are very low, so synergism would be negligible. No change required.

Natural Resources Defense Council (Doc. #4608)

6.154 PLP initially proposed to extract 2.5 billion tons of ore from the Pebble deposits, which would require two tailings ponds with five total dams, but later announced that the deposit contains nearly 11 billion tons of ore. Since mines are commonly expanded after operations begin, it is probable that PLP will seek to extract much more than the initial 2.5 billion ton estimate from Pebble Mine – and more perhaps even than the latest, much larger estimate. If fully mined, the Pebble deposit could process more than 10 billion tons of ore, making it the largest mine of its type in North America. Nonetheless, EPA cautiously estimated the maximum mine scenario at 6.5 billion tons. Whatever the volume of ore mined, over 99% of it will be waste material to be stored in tailings facilities forever.

EPA Response: **We do not disagree with this comment. However, the chosen scenarios do not include removal of all of the ore body, which would likely require underground mining.**

6.155 [T]he Watershed Assessment evaluates two failure scenarios, a "partial-volume failure" (227 million m^3 tailings volume) and "full-volume failure" (1489 million m_3 tailings volume), based on an assumption that a maximum of 20% of total volume of tailings would be released from the impoundment. The seminal study of the relationship between total amount of tailings stored and the amount released, however, predicts, based on a strong regression relationship, a much higher value of 38%. EPA acknowledged that the 20% figure is low ("[b]ased on historical tailings dam failure data, it is reasonable to assume … from 30 to 66% of the impoundment tailings material could contribute to debris flow…"), but – consistent with its overarching conservative approach to this Assessment – chose a value "less than measured historical release volumes." As Moore explains, 20% is an arbitrarily low value, more typical of much smaller tailings impoundments, and does not accurately reflect the likely effects of a tailings dam failure at Bristol Bay.

EPA Response: **The comment is correct in its characterization of the historical record of tailings dam failures. However, we took an intentionally conservative approach to avoid overstating potential adverse effects.**

6.156 [A]lthough EPA recognizes in its Watershed Assessment that an impoundment failure would deposit large amounts of material on the floodplain, it does not estimate the likely aerial coverage and thickness that would result from such an event – or calculate the duration of toxicity. Based on a review of the literature and historical impoundment failures, it is likely that a tailings dam release "would lead to complete burial of extensive areas of the immediate floodplain between the tailings and Bristol Bay." Deposition of sediment can alter fundamental biological and physical processes and river function, and tailings are especially damaging because they are enriched in toxic reactive metals. Furthermore, these metal-rich wastes can remain for hundreds to thousands of years, "pos[ing] a continuing hazard to human and ecosystem health."

EPA Response: **Comment noted; no change required.**

6.157 A spill could occur at any point of the pipeline. There is a 16% probability that it would enter a stream within the Kvichak watershed, and a 23.4% probability of entering a wetland. If entering a stream, the concentrate would kill fish and invertebrates both immediately and in the long-term. Physical effects could include embeddedness in riffle and spawning areas and increased stream turbidities. A spill could also lead to long-term bio-uptake and transfer of metals within the food chain. Settled concentrate turned toxic sediment would spend years making its way through streams and finally to Iliamna Lake, where it could be toxic to the eggs and larvae of sockeye salmon. Though the precise composition of the product concentrate and its leachate is uncertain, it would certainly be high in copper and sulfur, making it "implausible" that it would be nontoxic to aquatic biota. "Depending on the size, time and location of a pipeline spill, a slurry pipeline break could impact thousands to hundreds of thousands of adult salmon and high-value resident fish – and hundreds of thousands to millions of juvenile fish.

EPA Response: **The comment provides no data or estimates concerning failure rates of the pipeline described. We used the best available data.**

6.158 Tailings management is often considered the "most significant environmental challenge associated with mining projects." Tailings impoundment dams fail at about ten times the rate of water retention dams, and the rate of failure has actually increased in recent years. Many of the dams that fail are relatively young (5-20 years old), and have been built in the "modern age" of engineering. Since the 1970s, tailings dam failures in the United States have caused a cumulative volume of 10 to 179 million gallons of spillage every year. Yet under present federal and state regulatory practices, there is no existing funding for a dam failure cleanup. The bond required for mines does not cover a dam failure, and "funding to fix a dam after failure and for cleanup would need to be secured either through litigation of a responsible party, or through taxpayer support."

EPA Response: **See response to Comment 6.152.**

American Fisheries Society, Western Division (Doc. #3768)

6.159 The failure scenarios consistently underestimate and understate the maximum impact expected in a worst case failure scenario.

Whereas it is incorrect to say that a worst case failure will occur, given the perpetual life of the mine site and the performance record of existing mines (Chambers et al. 2012; Kuipers et al. 2006; Woody et al. 2010) there is a substantial probability that one or more of the failure scenarios will happen. Kuipers et al. (2006) reported that no modern permitted mine collection and treatment system was predicted to fail—but a majority did, especially when acidic drainage and ground and surface water were involved.

No dam will persist forever, especially when abandoned. For example, among 18 stone-walled Roman dams studied in southern Portugal, all those that were abandoned held water for only 100-200 years after abandonment (Quintela et al. 1987). However, water dams can be drained and repaired when they begin to malfunction—but dams holding toxic wastewaters cannot be drained without building another reservoir and transferring the contents from the first reservoir to the second. The TSFs—and their leachate collection and treatment systems--must persist for tens of thousands of years, not hundreds of years.

The risks of a TSF failure and recurrence frequencies are underestimated by a factor of 10 when multiple TSFs in the mining district, seismic threats, and rain on snow flood events are considered. We recommend including worst case estimates as well as best case estimates of TSF failures.

Explain that a TSF >200 m tall and containing billions of tons of liquefied tailings will perpetually leak at the bottom and all sides through valley walls to ground water, and that eventually the mine pit will fill with ground water and begin to pass contaminated water to surface waters.

Ghaffari et al. (2011) estimated that the Pebble resource is 11.9 billion tons, not 6.5 billion tons; that means much larger mines and TSFs than estimated in the report or by the mining firms.

EPA Response: **We limited the largest scenario to the resource that could be readily extracted by open pit mining.**

A 20% tailings release from a TSF and a 30 km limit for the tailings flow are both modeling underestimates; we suggest modeling a 50% release and flow to the sea as well. We acknowledge that this is tricky, but model confidence intervals and probabilities can and should be estimated.

EPA Response: **We used a conservative value because of the tailings reservoir is much larger than nearly all past failed dams, and we wanted to avoid any appearance of exaggerating risks. Flow of tailings to the sea is discussed but could not be credibly modeled with available models and data.**

6.160 Emphasize that ground water movement--and TSF and mine seepage—will be away from the mine and TSF. This means that such water must be collected, pumped, and treated perpetually. There is no evidence of any industry or society successfully doing so for tens of thousands of years. The classic Egyptian pyramids are less than 5,000 years old and occur in the air in an arid climate atop a relatively seismically inactive zone, yet they have been eroded substantially. A rock dam TSF in a humid climate, surrounded by unstable soils and geological faults is highly likely to develop substantial leaks within that time horizon.

EPA Response: **The need for collection and treatment of seepage and the potential need to continue collection and treatment indefinitely are mentioned in the draft assessment. That discussion is expanded in Chapter 8 of the revised assessment.**

6.161 Greater attention should be paid to the threats of spills to Illiamna Lake, especially the nearshore spawners and lake zooplankton and phytoplankton, which are sensitive to Cu and sediment levels above background.

EPA Response: **The risks of spills of product concentrate slurry to Iliamna Lake are discussed in greater detail in Chapter 11 of the revised assessment.**

Center for Science in Public Participation (Doc. #4106 and #4122)

6.162 It is noted that: "The TSFs and their component dams are likely to be in place for hundreds to thousands of years, long beyond the life of the mine." (Draft Assessment, p. ES-15) It is generally assumed that tailings dams will need to stay in place and be maintained in perpetuity. While there is no universal definition of "perpetuity," a time frame of "hundreds" of years is probably too short to fit the time requirement necessary to approximate perpetuity.

Recommendation: It would be more appropriate to say "… thousands to tens-of-thousands of years …" instead of the "hundreds" of years when discussing tailings dam life.

EPA Response: **Because perpetuity is limitless, the revised assessment no longer sets a limit in terms of hundreds or thousands of years.**

6.163 It is noted that: "If the operator was no longer present at the site or was no longer in existence, the response would, at best, be further delayed." (Draft Assessment, p. 6-2) Most people do not understand that the financial assurance (bond) required by regulatory agencies for a mine does not cover a dam failure. As is described, securing funding for dam repair and tailings cleanup would take time. Since the financial assurance (bond) required for mines does not cover dam failures, funding to fix a dam after failure and for cleanup would need to be secured either through litigation of a responsible party, or through taxpayer support.

Recommendation: It might also be mentioned that under present regulatory practices at both a federal and state level there is no existing funding for a dam failure cleanup.

EPA Response: See response to Comment 6.152.

6.164 It is noted that: "The toxic effects of exposure to a tailings spill can be estimated from aquatic toxicity data." (Draft Assessment, p. 6-22) Toxicity criteria are based on tests of individual contaminants, assuming no interaction with other contaminants. It is known that contaminants can also act synergistically and antagonistically. Copper and zinc are synergistic, and since there is some zinc in the deposit it is possible that the lethal levels might be even lower than that estimated in the Biotic Ligand Model, since the Biotic Ligand Model does not consider multiple metal toxicity.

Recommendation: You might mention that exposure estimates are based on the presence of one metal only.

EPA Response: See response to Comment 6.153.

6.165 Tailings

If a tailings facility seepage failure occurs due to abandonment of the site, but after the tailings facility has been drained down, the tailings could experience wetting/drying cycles similar to the conditions in humidity cell testing. Therefore using the humidity cell test results in an exposure-response assessment (Assessment Chapter 6.3.3) is reasonable.

The use of dam failures at other sites to indicate the potential exposure (but not the probability) of a failure is a good use of these examples (Chapter 3.5, Chapter 6). Mitigation works until it doesn't, at which point the resulting impacts on the environment are the same whether "state of the art" or "old" techniques were used to develop the mitigation.

EPA Response: Comment noted; no change required.

6.166 Tertiary Waste Rock. Assessment Chapter 6 refers to Tertiary waste rock as "neutral". This underestimates the risk of rock that could be used in construction materials. Change to make more accurate. PLP data shows that some Tertiary rock is PAG (Day and Linklater 2012)

EPA Response: We used the leachate data, which show that the mean pH of tertiary waste rock leachate is neutral (Table 5-14). No change required.

6.167 Tertiary rock leachate exceeds aquatic life criteria for cadmium and copper (Assessment Table 5-14). If used in construction material or placed without cover on the surface, this rock could experience wetting/drying cycles similar to the conditions of humidity cell tests. It is reasonable to use humidity cell tests to conclude that leachate collection failure would result in acute and chronic toxicity (Assessment Section 6.3.3).

EPA Response: Comment noted; no change required.

6.168 The approach of using old tailings dam failures to determine the impacts (but not the probability) or dam failure is a good one. Mitigation works until it doesn't -- at which point the results on the environment are the same, whether "old" methods or state-of-the-art methods were used to develop the mitigation.

<u>EPA Response:</u> Comment noted; no change required.

6.169 No mention of the low buffering ability of the natural waters, and how that could affect metal toxicity if metal concentrations increase. Very brief mention in 6.3.1 -- if WR leachate collection fails, will take a long time to neutralize due to low alkalinity.

<u>EPA Response:</u> The issue of acidity and buffering capacity is most relevant to waste rock, so buffering was mentioned in the correct subsection of the draft assessment. However, the issue is discussed in Chapter 8 of the revised assessment, which includes all water quality issues.

6.170 If tailings are not completely saturated, they could experience wetting/drying cycles similar to the conditions in humidity cell testing. Seepage water quality might be better than humidity cells, due to movement through a reducing zone, but there are conditions under which water similar to humidity cells could be released -- for example, if water is drawn down to release pressure on dams or at closure, or if a precipitation event wets tailings beaches and consequently overtops or seeps above the reduction zone. Therefore using the humidity cell test results in an exposure-response assessment (Assessment Chapter 6.3.3) is reasonable.

<u>EPA Response:</u> Comment noted; no change required.

6.171 Discussion of the release of inadequately treated water at Red Dog (Assessment Section 6.3.3) is relevant. This section should mention that Red Dog continues to deal with high total dissolved solids, and, based on Tables 5-14 to 5-16, 6-2, and 6-3 this is likely to be an issue at the hypothetical mine in the Assessment as well.

<u>EPA Response:</u> TDS was not reported for the leachates and it is believed to be much less important than copper at this location, so it was not assessed. No change required.

6.172 It is noted that: "After mine operations end, … , if the road was adopted by the state or local governmental entity, the frequency of inspections and quality of maintenance could decline to those provided for other roads." (Draft Assessment, p. 6-42) The review in this section is a good, but conservative, analysis of potential road impacts. Secondary roads are not considered in this analysis. These roads would almost inevitably spread from the main mine road, but the extent and timing of secondary road construction is admittedly difficult to quantify. As noted, secondary roads would probably not receive the same level of regulatory scrutiny or benefit from the same level of maintenance provided by the mining company.

Recommendation: You might mention in this section that secondary roads could add significantly to the potential road impacts predicted in this report.

<u>EPA Response:</u> Secondary development was outside the scope of this assessment. However, additional roads related to other potential mines and to secondary (induced) development are discussed qualitatively in Chapter 13 of the revised assessment.

<u>Fisheries Research and Consulting (Doc. #4580)</u>

6.173 *Section ES-21:* Our evaluation looked at the realistic possibility of leachate escaping at the base of TSF 1.

Comment: Isn't this a certainty?

<u>EPA Response:</u> The scenario in the first draft included a mitigation measure, leachate collection and treatment, which was described as partially effective. Chapters 6 and 8 of the revised assessment contain a more developed assessment of leakage from tailings dams and their contribution to changes in water quality. In this scenario, leakage occurs.

6.174 *Section ES-21:* Test leachates from the tailings and non-ore-bearing Tertiary waste rocks…but they are not expected to be toxic to salmonids.

Comment: Is this correct?

<u>EPA Response:</u> Correct. No change required.

6.175 *Page 6-1:* Diesel fuel spills are not considered in failure risk assessment.

Comment: There has already been a diesel spill…seems concerning.

<u>EPA Response:</u> Chapter 11 of the revised assessment contains a diesel spill scenario and risk assessment.

6.176 *Page 6-7:* the EBD…describe broadly similar [aquatic macroinvertebrate] communities that are consistent with those reported from other regions of Alaska.

Comment: That is inaccurate; they document bugs that have never been documented in Alaska (see review).

<u>EPA Response:</u> The communities are broadly similar despite the EBD's occasional misidentifications. No change required.

6.177 *Page 6-9:* Populations of resident and anadromous fishes present in North Fork Koktuli headwaters and tributaries at the time of the tailings dam failure would not immediately suffer loss of habitat…

Comment: I don't think we can say this with certainty given the rates of gw/sw exchange in the region, etc.

<u>EPA Response:</u> Chapter 9 of the revised assessment clarifies that this statement refers to habitat upstream and upgradient of the TSF.

6.178 *Page 6-19:* Once in a stream, leached metals could remain dissolved or precipitate or be sorbed to clays or organic matter, depending on the conditions.

Comment: Could be better informed by site specific chemistry data.

<u>EPA Response:</u> The sentence has been expanded to clarify the importance of local water chemistry.

6.179 Elevated metals would persist for decades to centuries.

<u>EPA Response:</u> Comment noted; no change required.

<u>The Nature Conservancy (Doc. #4606)</u>

6.180 Chapter 6 of the Draft Watershed Assessment describes the potential risk to salmonids due to leachate releases from waste rock piles, and concludes that a release of waste rock leachate could render all of Upper Talarik Creek toxic to fish and invertebrates. The Draft Watershed Assessment concludes that dilution factors of between 2,900 and 52,000 would be required to meet the Biotic Ligand Model-predicted lethal concentration of 10–30 μg/L for salmonids, whereas average Upper Talarik flows would provide dilution factors of only 20–36 μg/L (U.S. EPA, 2012). Using MIKE SHE, we find that a more realistic set of assumptions regarding waste rock leachate leads to approximately the same result, but that the risk to salmonids again varies depending on the flow conditions present at the time that escaping leachate reaches the creeks.

<u>EPA Response:</u> The movement of PAG leachate to Upper Talarik Creek is no longer part of the scenario. In the revised assessment, PAG leachate enters the South Fork Koktuli.

6.181 The Draft Watershed Assessment did not make predictions for the South Fork Koktuli; however, using similar model assumptions for the South Fork Koktuli, we predict that copper concentrations would exceed chronic hardness-based criteria if a release occurred at nearly any time of the year (Figure 10). Concentrations could exceed chronic hardness-based standards by more than 4 μg/L (e.g., time A), or fall below standards by 1-2 μg/L (e.g., time B). Thus a leachate collection system failure – which could occur by mechanical failure (e.g., collection pumps not working) or the escape of waste rock leachate through pathways that were not captured in the collection system – could lead to toxic conditions in the Upper Talarik and/or the South Fork Koktuli. Based on our modeling, these concentrations would have a high probability of exceeding chronic hardness-based standards in both river systems, depending on the time of the release.

<u>EPA Response:</u> The revised assessment includes PAG leachate effluents to the South Fork Koktuli River and concentrations are estimated to exceed copper criteria and standards.

6.182 Using assumptions regarding waste rock leachate concentrations from PLP leachate testing, we find that copper toxicity due to a leachate collection system failure would most likely exceed water quality standards at least to the middle Upper Talarik Creek, and at least to the junction of the North Fork and South Fork Koktuli rivers at gage site SK100A. Substantial portions of these watersheds would therefore be impacted by a leachate collection system failure.

<u>EPA Response:</u> Comment noted. The assessment does not include a leachate collection system failure scenario, so the results mentioned in the comment cannot be compared to the assessment.

Stratus Consulting (Doc. #4772 and #4973)

6.183 *Page ES-19*: "Failure of the dam at TSF 1 would result in the release of a flood of tailings slurry into the North Fork Koktuli River, scouring the valley and depositing tailings several meters (yards) in depth over the entire floodplain of the river."

Comment: The assumptions that EPA used to make these calculations may not be well suited to estimating the depth of sedimentation resulting from a tailings storage facility (TSF) failure. However, this sedimentation depth analysis may also be misguided, as described in the detailed comment immediately below.

EPA Response: The 30 km limit of the tailings run-out model does not imply that tailings do not flow further. Both drafts of the assessment discuss the movement of tailings beyond the model limit and the potential effects of suspended tailings beyond 30 km. The assessment mentions that multiple dam failures are possible, and the scenario failures in the North Fork Koktuli are qualitatively representative of failures in the South Fork.

6.184 *Page 6-5:* "Bryce et al. (2010) found that even slight increases (exceeding 5% fines or 13% sands and fines) in streambed fine sediments were associated with declines in sediment sensitive aquatic vertebrates, including salmonids. Exceedance of fine sediment standards in the entire North Fork Koktuli River would be a likely outcome for years to decades."

Comment: As noted above, relatively small amounts of fine-grained material in these streams could result in substantial habitat degradation. As written, the analysis of a dam failure scenario underestimates the spatial extent of this potential habitat degradation, because the flood model domain used by EPA was limited to the North Fork Koktuli River above its confluence with the South Fork Koktuli River. As noted in the Draft Watershed Assessment, a flood wave from a tailings impoundment failure would travel far beyond this confluence, carrying fine-grained sediments with it. In addition, the final mine buildout would have tailings impoundments in both the North Fork and South Fork Koktuli rivers, posing risks to both systems. The dam failure analysis in the Final Watershed Assessment should evaluate the full downstream extent of fine sediment deposition, rather than the depth of sediment deposition in the upstream end of the catchment, and it should examine potential failure scenarios in both watersheds.

EPA Response: See response to Comment 6.183.

6.185 *Page ES-21:* "Pre-Tertiary waste rocks, which would be excavated to expose the ore body, are acid-forming with high copper concentrations in test leachates and would require 2,900 to 52,000-fold dilution to achieve water quality criteria… The total flow of Upper Talarik Creek would provide only 18-fold dilution, so failure to prevent leachate releases could cause the entire creek and a potentially large mixing zone in the lake to become toxic to fish and the sensitive invertebrates upon which they feed."

Comment: The calculations used to support these estimates rely on a number of simplifying assumptions. In particular, EPA uses leachate concentrations from a mix of pre-Tertiary and Tertiary waste rock that does not take into consideration the segregation of potentially acid generating (PAG) and non-acid generating (NAG) waste rock piles; they do not model how the leachate interacts with groundwater prior to entering receiving waters; and they use average (rather than temporally variable) stream flow values to calculate the dilution of this leachate. We have modeled the escape of leachate from the waste rock piles using much lower leachate copper concentrations (210 μg/L vs. ~ 1,500 μg/L used by EPA), and our results confirm that copper concentrations would exceed acute hardness-based criteria for the Upper Talarik and South Fork Koktuli rivers (see Appendix B). However, to increase the rigor of the water quality analysis, the Final Watershed Assessment should more fully consider the range of variables that could interact to determine water quality downstream of a waste rock leachate collection failure. For example, calculations could be repeated using a broader range of potential leachate concentrations, and a broader range of potential flow conditions at the time of leachate release. These calculations would result in a more complete characterization of potential risks to receiving waters.

<u>EPA Response:</u> The revised assessment explicitly addresses waste rock segregation. Mean streamflows are still used because low dilution flows are largely balanced by low leachate flows. Mean leachate concentrations are used for each category of waste rock because the leachates from waste rock piles would be a mixture that is reasonably represented by the mean concentrations.

6.186 Water collection and treatment failure scenario assumptions (p. ES-20). Here and throughout the document, the assumption is made that leachate from Tertiary rocks is benign and would not harm salmon. This assumption is based on average copper concentrations in Tertiary rock leachate. However, the majority of the Tertiary leachate samples had selenium concentrations well in excess of aquatic life criteria (see Appendix A, Figure 5, p. 12), and in fact selenium concentrations are at their highest in Tertiary (rather than Pre-Tertiary) rock leachate and are most elevated under neutral and higher pH values. The final Watershed Assessment should broaden its analysis of Tertiary rock leachate to include selenium and adjust its assessment of the toxicity of Tertiary waste leachate, which would be a major component of "non-potentially acid generating (non-PAG)" waste rock leachate.

<u>EPA Response:</u> Selenium is estimated to not exceed water quality criteria in either Tertiary or pre-Tertiary waste rock leachate (Tables 8-6 and 8-7 of the revised assessment).

6.187 Assumptions used in water collection and treatment failure scenario (p. 6-36). EPA conducts a rough calculation of the effect of escaping waste rock leachate on Upper Talarik Creek and Lake Iliamna (p. 6-39). In this analysis, they assume that the waste rock leachate is untreated Pre-Tertiary waste rock leachate escaping from one-half of the waste rock piles under the 25- and 78-year mining scenarios for less than one day. They further assume that the leachate is mixed equally with the less toxic Tertiary waste rock leachate, which has much lower copper concentrations, and that there is further mixing into the entire flow of Upper Talarik Creek. Using these assumptions, the Draft Watershed Assessment concludes that the entire length of Talarik Creek and a potentially large mixing zone in the lake could be toxic to fish and invertebrates, based on a comparison of copper concentrations to the chronic criterion value for copper (p. 6-39). We conducted a similar analysis using the integrated groundwater-surface water code MIKE SHE (Graham and Butts, 2005) and a mix of 50% Pre-Tertiary and 50% Tertiary mean leachate copper concentrations (Tables 5-14–5-16 in the Draft Watershed Assessment) and found very similar results. We also modeled an alternative scenario for the 25-year plan only (see Appendix C). For non-PAG waste rock, located on the south and east sides of the pit, we assumed that only 5% of the waste was generating PAG leachate (Pre-Tertiary leachate) and 95% was generating non-PAG leachate (Tertiary leachate) (Ghaffari et al., 2011).1 For the PAG waste rock, located on the western side of the 25-year pit and entirely in the South Fork Koktuli drainage, we assumed all leachate was generated by PAG rock. As input concentrations, we used mean copper and hardness values from the waste rock leachates plus one standard deviation (Draft Watershed Assessment, Appendix H, Table 4) and mixed these into mean background Upper Talarik Creek and South Fork Koktuli stream water (Table 5-17) at two locations in Upper Talarik Creek and three in the South Fork Koktuli. We used the relative proportion of waste rock in each drainage to calculate the percentage of total leachate entering each stream. The output included estimated copper concentrations and hardness values over time, using average daily streamflow and taking into account any changes in flow from the presence of mine waste in the upper portions of the drainages under the 25-year mining scenario. Although EPA might have overestimated risk in this instance, when the resulting stream concentrations were compared to hardness-based chronic and acute dissolved copper criteria, we found that, although the exceedence factors were lower than those for the EPA scenario, the upper portion of Upper Talarik Creek (UT100D) exceeded chronic copper criterion values under nearly all possible flow conditions. The middle portion of Upper Talarik Creek (UT100B) exceeded chronic copper criterion values under approximately 50% of the possible flow conditions. The South Fork Koktuli exceeded chronic copper criterion values at all times for most of its length and under approximately 85% of possible flow conditions at the mouth (see Appendix C). Because acute criterion values are only 1–2 mg/L higher at the resulting stream hardness values, these locations also exceeded acute criterion values under similar flow conditions. Assuming that the Biotic Ligand Model (BLM) copper standards approach would generate even lower copper standards (Table 5-18), estimated copper concentrations would cause acute toxicity in Upper Talarik and South Fork Koktuli locations under even more possible flow regimes using the BLM approach.

We present this analysis to assist EPA in their evaluation. We believe that our modeling approach represents a more accurate portrayal of the 25-year mining scenario, uses more realistic concentrations of waste rock leachate, and accounts for seasonal variability in flows and stream concentrations of copper and hardness. Our approach, like EPA’s, assumed no adsorption of copper in the aquifer downgradient of the waste piles or in the streams; applying adsorption values would reduce the predicted stream dissolved copper concentrations. On the other hand, our analysis added only one standard deviation to mean leachate copper concentrations (resulting in a copper concentration of 4.2 mg/L in PAG leachate) and therefore used considerably less copper than a worst-case scenario. Measured maximum copper leachate values in Pre-Tertiary leaching tests were as high as 1,000 mg/L (see Appendix A, p. 11 and Figure 4). Our results confirm that uncontrolled releases of waste rock leachate from the piles to nearby Upper Talarik and South Fork Koktuli creeks could cause acute toxicity to aquatic biota over a wide range of flow conditions and stream reaches.

<u>EPA Response:</u> The waste rock leaching, release to streams, mixing, and transport have been completely revised in the revised assessment. Waste rock leachate no longer enters Upper Talarik Creek, but instead enters the South Fork Koktuli. The hydrologic modeling in the assessment is not as elaborate as the modeling described in this comment, but it is appropriate to this assessment.

6.188 *Page 6-42:* "Under such surveillance, a single erosional failure of a culvert that damaged the road would likely be identified soon after it occurs and repaired within a week. However, multiple failures such as might occur during an extreme precipitation event could require more than a month to repair."

Comment: This speaks to the need to ensure that extreme hydrologic events are well characterized. Although the characterization of hydrologic extremes is highly relevant to many aspects of mine facility/infrastructure design and failure scenarios, the Draft Watershed Assessment makes very little mention of these extremes. EPA should consider a more rigorous treatment of hydrologic extremes/uncertainties in its Final Watershed Assessment, including at least a discussion of climate change and how a changing climate could alter historical flow regimes during mine operations.

EPA Response: **Altered timing and magnitude of peak flows is recognized as a potential outcome of climate change in the assessment, but more specific modeling of projected peak flows is beyond the scope of the assessment.**

6.189 Issue: Missing failure mode: Transport of mine water along faults to streams. One failure scenario that was not examined in the Draft Watershed Assessment was the potential movement of contaminated mine water from the pit or underground workings to downgradient groundwater and streams. This failure scenario has occurred at Kinross' Buckhorn Mine (an underground gold mine) in northern Washington State. The mine was issued a notice of violation and fine for violating their NPDES permit by failure to maintain a capture zone in 2008 and 2009 and again in July 2012 ($395,000 fine issued; Washington State Department of Ecology, 2012). One of the bases of the violation was increasing concentrations of nitrate (ultimately from blasting) in a stream near the mine. The Washington Department of Ecology interpreted the data as an indication that seepage from the mine workings was detected in groundwater monitoring wells, streams, and springs downgradient from the mine. After further investigation, the increases were attributed by Golder Associates, Kinross' consultants, to movement of stored mine water along one of the large faults near the mine. The issue emerged less than a year after operations began (late 2007/early 2008) and continues to this day, although concentrations are decreasing. Therefore, movement of mine water along faults to streams is a viable failure mode at modern hard rock mines.

EPA Response: **During operation, we expect that mine water would be captured and treated. The possibility of flow from a filled mine pit to streams is discussed qualitatively in Section 6.3.1 of the revised assessment.**

C. C. Hawley (Doc. #1286)

6.190 Further data should be considered in Tailing Impoundments. No failures were reported in the extensive recent Chilean earthquakes and the Chilean dams are of immense size and in seismic risk zones as high as in Alaska. Anglo was the operator for some of the deposits.

EPA Response: **The risk of failure is based on design specifications rather than failure histories. A specific event is not used to estimate frequencies, given the larger historic data record. However, two Chilean tailings dams failed as a result of the 1985**

earthquake, and in the 2010 earthquake five tailings dams experienced some degree of failure, including one failure that killed four people downstream.

6.191 Waste-rock dumps: There seems to be room for more mitigation also general push toward more underground mining (caving). If Pebble could cave, much of waste -rock problem could go away. Mitigation can also be in conjunction with grinding-flotation-location of sulfide-rich tails in tailing impoundments. In studies at Andina and Teniente (Chile), tails were found to oxidize rapidly and then were available for remaining.

<u>EPA Response:</u> The assessment focuses on the potential impacts from large-scale porphyry copper surface mining, although block caving (including the potential for subsidence) is discussed briefly in Chapter 4 of the revised assessment.

<u>Moore Geosciences, LLC (Doc. #2714)</u>

6.192 Any of the tailings release scenarios presented in the Bristol Bay assessment would result in distributed, long---term metal sources over large areas that would be physically and economically impractical to remove. This then would likely create a metal source for hundreds of years that would have wide ranging toxic effects.

<u>EPA Response:</u> The leaching of spilled and deposited tailings and the difficulty of remediation are discussed in both drafts of the assessment (Chapter 9 in the revised assessment).

<u>J. D. Copp (Doc. #4152)</u>

6.193 Because of their toxic contents, tailings dams are supposed to be able to last "in perpetuity." In Sweden, that means 1,000 years. The tailings dams associated with Pebble Mine are unlikely to last a fraction of the time.

<u>EPA Response:</u> Comment noted; no change required.

<u>J.P. Tangen (Doc. #4583)</u>

6.194 Not all mines have dams and, as the Assessment states "[a]fter mine closure, [tailings ponds] can be drained eliminating the consequences of tailings dam failures." Despite the potential to eliminate the risk, EPA's hypothetical mine uses a wet closure to represent what it expects to be typical of large-mine impacts in Alaska. The predicted impacts from EPA's hypothetical mine most likely do not represent other as-yet-to-be designed mines in the watershed, and may not represent the risks from a mine at the Pebble Project.

<u>EPA Response:</u> The scenario is consistent with available plans from Northern Dynasty Minerals (Ghaffari et al. 2011). A porphyry copper mine in the Bristol Bay watershed is likely to have potentially acid generating tailings. A dry closure is more likely to result in acid generation over the long term, so a wet closure is more likely to be proposed. No change required.

6.195 A pipeline may be required to develop a mine at Pebble, but no other mine in Alaska uses a pipeline. Because most mines do not use a pipeline, the predicted pipeline risks are unlikely to be representative of a mine other than at the Pebble Project in the Bristol Bay watershed.

EPA's hypothetical pipeline omits obvious prevention and design strategies. In fact, some components of a mine are fixed and are difficult to change, but pipelines can be designed to different standards. It is unclear why EPA would design a pipeline with an unacceptable risk and not include design changes to decrease the risk.

EPA Response: See response to Comment 4.247.

6.196 It is quite possible that mines within the watershed would not be developed using a road. Therefore, the predicted impacts from road construction and operation cannot be taken as representing an impact of large-scale mining in the watershed.

EPA proposes a specific road alignment and by implication construction techniques and then disparages them because of the environmental impacts they will cause. The obvious solution is to provide a higher level of design/construction standards to eliminate the impacts. EPA, incidentally, failed to reach the same conclusions as in the Assessment with regard to two other mine roads it has approved.

EPA Response: See response to Comment 4.241. The comment alludes to previous assessments, but this assessment stands on its owns.

S. Wehmeyer (Doc. #3486)

6.197 [P]ages 6-3 and 6-11 of the draft Assessment use Mt. St. Helens as an analogy of sediment loading from a potential tailings impoundment failure. However, the more accurate analogy may be found in the 2007 lahar flow at Mt. Chiginigak in the Egegik fishery district of Bristol Bay, or Alaska's Novarupta, which deposited huge amounts of sediment across Southwest Alaska. These examples provide study controls for other development impacts on natural stream rehabilitation and reality-based Alaskan environmental conditions.

EPA Response: Recovery from the Alaska events has not been studied and documented as Mount. St. Helens was. At the suggestion of the peer reviewers, the use of Mount St. Helens ash flows as an analogue of spilled tailings has been deleted from the assessment.

6.198 Section 6.1.1 states that "Remediation may occur following a tailings spill, but it is uncertain." It is irrational to assume that the impacts of a major tailings pond failure would not be immediately remediated, as prescribed by state and federal statute. This assumption affects all the analysis in Section 6. The overall impacts of this extremely unlikely event are overstated due to the assumption of no remediation.

EPA Response: The assessment included cleanup or remediation activities, but discussion of tailings spill remediation has been augmented in the revised assessment. See response to Comment 6.136.

6.199 Box 6.1 (page 6-14) provides case-studies of three tailings spills in the US, and reference is made to these sites throughout chapter 6. The case studies noted in box 6.1 began mining in the late 1800's, and are used as examples without consideration of changes to regulatory, environmental and engineering standards that have been developed in the last 100 years.

EPA Response: The examples are used to illustrate what happens to tailings once they are in a stream. Regulatory and engineering standards are irrelevant to that use. No change required.

6.200 There seems to be no coordination or discussion with Alaska regulators in the document to verify State standards – assumes NO state standards in project development. For instance, section 6.4 assumes culverts will be inadequately sized and poorly constructed. The State of Alaska has culvert design standards that should ensure the impacts discussed in this chapter do not occur – standards which are not considered in this draft Assessment.

EPA Response: See responses to Comments 4.82 and 4.152.

G. A. Beischer (Doc. #4372)

6.201 [P]ages 6-3 and 6-11 of the draft Assessment use Mt. St. Helens as an analogy of sediment loading from a potential tailings impoundment failure. However, the more accurate analogy may be found in the 2007 lahar flow at Mt. Chiginigak in the Egegik fishery district of Bristol Bay, or Alaska's Nova Rupta, which deposited huge amounts of sediment across Southwest Alaska. These examples provide study controls for other development impacts on natural stream rehabilitation and reality-based Alaskan environmental conditions.

EPA Response: See response to Comment 6.197.

6.202 Section 6.1.1 states that "Remediation may occur following a tailings spill, but it is uncertain." (emphasis added). It is irrational to assume that the impacts of a major tailings pond failure would not be immediately remediated, as prescribed by state and federal statute. This assumption affects all the analysis in Section 6. The overall impacts of this extremely unlikely event are overstated due to the assumption of no remediation.

EPA Response: See response to Comment 6.198.

6.203 Box 6.1 (page 6-14) provides case-studies of three tailings spills in the US, and reference is made to these sites throughout chapter 6. The case studies noted in box 6.1 began mining in the late 1800's, and are used as examples without consideration of changes to regulatory, environmental and engineering standards that have been developed in the last 100 years.

EPA Response: See response to Comment 6.199.

6.204 There seems to be no coordination or discussion with Alaska regulators in the document to verify State standards – assumes NO state standards in project development. For instance, section 6.4 assumes culverts will be inadequately sized and poorly constructed. The State of Alaska has culvert design standards that should ensure the impacts discussed in this chapter do not occur – standards which are not considered in this draft Assessment. Table 4-2 also provides for "premature" closure. Due to the reclamation bonding requirements in the State of Alaska (which requires timely reviews and updates), it is unrealistic to consider any closure that does not also include some form of "planned site management." That, of course, is the primary purpose for States requiring a reclamation bond.

EPA Response: See responses to Comments 4.82 and 4.152.

S. Gerdes (Doc. #4856)

6.205 The effects of the construction of a roadway and pipeline paralleling Iliamna Bay and leading to the deepwater terminus. How many spawning streams would be affected? Would a rupture of one of the pipelines damage not only the immediate water shed but also the spawning grounds along the shoreline of Cook Inlet? What happens to the slurry water not returned to the mine site? What would be the potential toxic effect on Cook Inlet if not properly treated or contained?

EPA Response: Cook Inlet is outside the scope of this assessment. As the assessment explains, the fourth pipeline is to return slurry water to the mine. The assessment also describes and enumerates the stream crossings that drain to Iliamna Lake. No change required.

6.206 Underground seepage from tailings storage facilities and mine pits would apparently be captured, treated and returned to the existing drainages. Is there adequate understanding of the underlying geology so as to allow for realistic anticipation of underground water movement to provide for capture of contaminated water before mingling with surface waters or Lake Iliamna?

EPA Response: For the purposes of this assessment, we used existing data to put forth scenarios, then identified potential failure paths given those scenarios. Additional geotechnical work is beyond the scope of this effort.

Borell Consulting Services LLC (Doc. #4111)

6.207 The Executive Summary conclusion in Table ES-1 lists the probability of problems with water collection and treatment as "High" during operation and "High" during post-closure. However, this contradicts Section 6.3.4 of the Assessment which concludes that one cannot quantify or predict risk of collection or treatment failure which is a reasonable conclusion given the uncertainties described. It reads, "The risks from water collection and treatment failures are highly uncertain. The range of failures is wide and the probability of occurrence of any of them cannot he estimated from available data." (p. 6-41). It is arbitrary and capricious for the Executive Summary to make a statement that is in direct opposition to the conclusions within the Assessment.

EPA Response: The probability that water collection and treatment failures will occur is high. The probability of any particular failure is highly uncertain. There is no contradiction.

6.208 The Executive Summary (p. ES-21) reads "Based on a review of historical and currently operating mines, some failure of the collection and treatment systems is likely during operation of post-closure periods." It then goes on to describe toxic effects that would likely kill thousands of fish. But the analysis in Section 6 of the Assessment indicates that the probability "cannot be estimated form the data." The Executive Summary also summarizes the analysis by saying that EPA reviewed the data and found the probability "High." The Assessment includes no data about frequency of failure.

EPA Response: See response to Comment 6.207.

Alaska Marine Conservation Council (Doc. #4112)

6.209 The final assessment could provide a range of water quality conditions under the examined Failure scenarios. Although the need for treatment is mentioned extensively in the Assessment, the general type of treatment needed is not discussed. The leach test results do indicate that metals removal will be necessary, and because of the low baseline concentrations in streams and the lack of allowed mixing zones, the discharge of treated effluent will need to protect aquatic life in surface waters. The assessment could explicitly discuss, at least in a general sense, the possible types of treatment needed.

EPA Response: The revised assessment does mention that reverse osmosis has been proposed as a treatment method and describes some failure modes for that technology.

National Park Service and U.S. Geological Survey (Doc. #4607)

6.210 Culverts and Bridges: Culverts and their potential to negatively affect the salmon ecosystem of the Kvichak and Nushagak drainage are extensively discussed (page 4-63, page 5-61 and elsewhere). The high failure rate (30-66%) with resulting negative impacts to salmon and all other fishery resources may generate questions as to why culverts would be permitted, especially if the risks would appear to far outweigh any benefits. Bridges may present a lower risk alternative than culverts. The report should consider expanding the Assessment to include the risks associated with bridge construction at stream crossings and compare the risks associated with bridges to those risks the Assessment identified as being associated with culverts.

EPA Response: Failure rates of culverts have been revised. Crossings of larger streams and rivers are assumed to be bridged and bridges are assumed to be designed so as to not block fish passage. The assumption in the draft assessment regarding number of bridges (20) came from Ghaffari et al. (2011). In the revised assessment, crossings that would be bridged (18) are based on mean annual streamflows as explained in the text.

The Pebble Limited Partnership (Doc. #3797)

6.211 The peer reviewers should be asked to analyze the support for EPA's estimated culvert failure rate, and whether EPA adequately considered long-term operation and maintenance activities associated with an active mining operation and post-operational use of the transportation corridor. The peer reviewers should be asked whether EPA adequately considered all viable engineering options (such as bridges) in estimating a large failure and blockage rate associated with the transportation corridor.

EPA Response: The peer reviewers did consider culvert failures and provided several comments.

Wild River Guides Co. (Doc. #1353)

6.212 I am very experienced with road construction across boreal forest lands, road construction across tundra lands, and roads through wetlands or waterways (including ice roads). Undertaking road construction across salmonid streams or recharge wetlands in the Bristol Bay is extraordinarily shortsighted. I question the data used, which models a 33-60 percent chance of road culvert failure. In the sub arctic region of Alaska we have only been maintaining culverts for fish passage for fifty years and in that period I estimate that 100% of the culverts in salmon rearing streams have failed at least once affecting salmon fry survival.

EPA Response: Comment noted, but no supporting information was provided in this comment; no change required.

V. Mendenhall, Ph.D. (Doc. #4113)

6.213 Many "land birds" would be exposed indirectly to habitat changes or contaminants as a result of mining. The Assessment mentions that loss of fish could affect raptors such as Bald Eagles, but actual impacts could be far more widespread. Several predatory birds recorded near the Pebble area depend on aquatic species. Raptors such as the Bald Eagle and Osprey, which prey on fish, would be impacted by changes in fish stocks or contaminants in their prey. Bald Eagles, Ravens, and gulls scavenge dead fish and could be similarly affected. Other raptors depend heavily on ducks and smaller birds as prey, including the Bald Eagle and Merlin (ABR Inc., page 16.3-5, Tables 16.3-3, 16.3-4).

EPA Response: The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on birds.

Kachemak Resource Institute (Doc. #4617)

6.214 The worst cases arising from the variety of possible system failures in large mine infrastructure would include not only the sum of failures from water collection and waste water treatment; pipeline failures; tailings dam catastrophic failures; road, bridge and culvert failures; and the cumulative effects of failure events through time immemorial reversed, to time forward in perpetuity.

EPA Response: Comment noted; no change required.

D. Shepard (Doc. #4825)

6.215 Some of the data exist to quantify error bars (uncertainties) for the results produced in this assessment, yet error bars are unknown (Ch 6 and 8).

EPA Response: As the comment states, only some of the data exist to quantify error bars. We decided not to use subjective judgment to provide the rest of the data required to do a formal uncertainty analysis. Instead, uncertainties are treated primarily by defining bounding cases.

The Pebble Limited Partnership (Doc. #5416 and #4962)

6.216 HDR, Inc. 2012. White Paper No. 5 Offsetting Potential Wetlands Impacts through the Environmental Permitting Process.

The hypothetical scenario developed for the Assessment failed to take into consideration any potential mitigation measures that would offset predicted potential impacts from large scale mining in the Bristol Bay watershed. This failure is striking. Throughout Alaska, there are numerous important development projects currently being planned, including mines, renewable energy sources, oil and gas facilities, and public infrastructure. Mitigation will be relevant to each and every one of those developments.

The purpose of this white paper is to summarize various approaches for offsetting potential impacts on wetlands and related water bodies. Wetlands are ubiquitous in Alaska and most development projects will be required by law to have mitigation plans to offset unavoidable impacts to wetlands. Thus, this paper focuses on the regulatory requirements and mitigation options for projects in Alaska and provides examples of possible compensatory mitigation opportunities that could result from mining and other development in the Bristol Bay region.

Any resource development project in Alaska will have to go through a thorough and complex permitting process. This process incorporates specific requirements to ensure that each project addresses potential impacts to wetlands resources, including a wetlands mitigation plan, closure and reclamation plan, and payment of bonds for financial assurance for closure throughout the life of the project. Through this process, the co-existence of important development projects and protection of valuable ecosystem services can be obtained.

EPA Response: Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. However, in response to public and peer review comments we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

6.217 Knight Piesold. 2012. White Paper No. 1 Mitigating Risk in the Design and Construction of Tailings Dams in Alaska

This paper summarizes the regulatory process of the Alaska Dam Safety Program (ADSP), which is the central governing body responsible for dams in Alaska. The intent of the paper is to provide some background information regarding the requirements to construct a dam in Alaska, and to provide information regarding oversight and corporate responsibility as it relates to dam construction and operation.

It is important to note that tailings dams for large-scale mining operations are major structures that have been constructed, operated and closed successfully in many parts of the world. The success and long-term stability of these structures are greatly enhanced by adherence to strict regulatory requirements. The current state-of-the-art practice for tailings dam design and operations incorporates lessons learned from the analysis of past tailings dam failures and the successful performance of other large dams and tailings embankments. Some key findings as presented in the paper include the following:

- The performance of tailings dams constructed by the centerline or downstream methods has been markedly better than dams constructed by the historically common upstream method. Accordingly, downstream and centerline constructed tailings dams are the current preferred methods of construction.
- Tailings dams can be built to stand indefinitely provided the right procedures, protocols, checks and monitoring are in place throughout all phases of a dam life, including design, construction, operation, closure, and post closure.

- Embankments constructed with compacted earthfill and rockfill materials have a proven performance record during seismic loading conditions.

Large embankment dams have a proven performance of successful operation for a variety of extreme events, such as very cold weather conditions, extreme floods, and large earthquakes.

EPA Response: This comment is not contradictory to the assessment. We state that dam failure is improbable and that monitoring and maintenance would be required, including post-closure. No change required.

6.218 Knight Piesold. 2012. White Paper No. 2 Development of Stable Waste Rock Piles in Alaska

This paper presents an overview of the design, construction, and operation methods for the development of stable waste rock piles, with a discussion of cold region and other specific considerations relevant to the Bristol Bay region.

Waste rock piles are developed to store non-economic rock and overburden materials for open pit mining operations. Waste rock piles are potentially large structures that are progressively constructed during mine operations in accordance with relevant Alaska statutes, regulations, and guidelines. Well established investigation methods, design procedures, operating requirements, and monitoring practices have been developed on the basis of experience at other large mining operations in North America. Some of the key considerations for the development of stable waste rock piles at Alaska mines are summarized in the paper, along with requirements for establishing stable permanent reclaimed landforms after mine closure.

EPA Response: The conclusions of this white paper are consistent with the assessment. No change required.

6.219 R2 Resource Consultants. 2012. White Paper No. 6. Summary Review of Fish Habitat: Flow Dependencies and Methods for Evaluating Flow Alteration Effect

The method EPA used for judging the degree of impact on salmonid populations in the Assessment is essentially hydrologically-based and has no direct linkage to actual salmonid fish populations and salmonid fish habitat in the watershed. In fact, EPA's statements regarding flow reduction effects on salmonid populations are unsupported by the published literature; the Assessment therefore fails to apply the "best available science" regarding this critical issue.

Many states, including Alaska, have long recognized the importance of their fishery resources, both from a recreational and commercial perspective and as a trust resource for tribal interests.

As such, those states have focused on ensuring sufficient streamflows to maintain population viability. Programs for defining instream flow needs to protect such resources have been implemented in many states (including Alaska, Washington, Oregon and others) using a variety of methodologies.

The purpose of this paper is to address EPA's lack of sound science in its evaluation of flow reduction and fish resources in the Assessment by providing a technical review of: 1) the importance of streamflow on fish and aquatic habitats in streams; 2) the methods and models that are currently used to assess the effects of flow regulation on fish habitats; and 3) key case studies where flow regulation was an issue. The paper reviews the specific methods employed in those case studies in developing instream flow release schedules designed to protect aquatic resources and mitigate for potential flow modifications resulting from project development.

This paper demonstrates the importance of flow to the functionality of various fish life stages and that flow regulation can have significant biological impacts on fish and aquatic resources depending on a number of factors, including the type, magnitude, timing, and duration of the flow regulation. Fortunately, there are a variety of methods and models that have been developed that can help to understand and define these effects and provide guidance in formulating instream flow prescriptions designed to protect, mitigate for and even enhance habitat conditions. The case studies described in the paper provide real-world examples of where and how the impacts associated with flow regulation on fish habitats have been successfully addressed. In all cases, the key ingredients leading to success include the careful design of studies and application of sound scientific methodologies for identifying and quantifying impacts and deriving appropriate instream flow measures.

EPA Response: Section 7.3.3 of the revised assessment clarifies the importance of instream flow requirements and the long-term monitoring commitment and extensive engineering and water management that would be required to maintain suitable flows under a highly-modified mining water regime.

6.220 R2 Resource Consultants. 2012. White Paper No. 7 Aquatic Habitat and Fish Population Recovery in the Toutle River following the 1980 Eruption of Mount St. Helens.

The Assessment uses the eruption of Mount Saint Helens as an analogy to a tailings dam failure. This is a completely unrealistic and unscientific analogy to large scale mining in the Bristol Bay watershed.

However, having an adequate understanding of aquatic habitat and fish population recovery and the inherent components and processes contributing to recovery of such an ecosystem is important. With that objective in mind, this paper provides a review of Toutle River ecology in the wake of the 1980 Mount Saint Helens' eruption. Although the Toutle River aquatic habitat experienced extensive damage with entire headwater tributaries and localized fish populations lost, recovery processes began soon after the perturbation and within a few years habitats and aquatic populations had started to rebound. Processes contributing to the recovery of the river ecosystem included:

- Flushing flows that moved unimpeded sediments downstream and cleaned out spawning gravels.
- Aquatic microbes that utilized new sources of nutrients provided from tree fall and ash deposits, which established new trophic regimes.
- Seed banks that supported reestablishment of riparian communities which in turn contributed to improved water quality.

It was the complexity and behavioral plasticity inherent to the Toutle River fish populations that facilitated population recovery. The ongoing recovery of the Toutle River has provided a living laboratory for understanding aquatic system recovery and highlights the processes inherent to natural aquatic systems that support persistence in an unpredictable environment while demonstrating the resiliency of natural systems.

<u>EPA Response:</u> At the suggestion of the peer reviewers, the use of Mount St. Helens ash flows as an analogue of spilled tailings has been deleted from the assessment.

Chapter 7: Cumulative and Watershed-Scale Effects of Multiple Mines

<u>National Park Service and U.S. Geological Survey (Doc. #4607)</u>

7.1 Section 7.3, Figure 7-1, Potential Mine Sites: Consider adding community locations to the map to make potential mine location in relation to nearby communities relevant (e.g., upstream or downstream). Additionally, consider labeling the Chulitna River; it is the northeastern most drainage depicted on the map.

<u>EPA Response:</u> This figure has been replaced by Figure 13-1 in the revised assessment and now shows claim blocks with more than minimal recent exploration in the Nushagak and Kvichak River watersheds. Community locations have been included in the figure.

7.2 Page 7-6, Section 7.3.2, Big Chunk Prospect: The last sentence misidentifies the location of Lake Clark: "Big Chunk is approximately 116 km (72 miles) upstream of New Stuyahok and approximately 114 km (71 miles) upstream of the village of Nondalton (with Lake Clark located in between." This statement should be corrected to reflect that Lake Clark is located upstream of Nondalton.

<u>EPA Response:</u> Sections 13.2.2.1 and 13.2.3.1 of the revised assessment state that Big Chunk South and Big Chunk North are approximately 24 km and 48 km northwest of the village of Nondalton, respectively. Other geographic references were deleted.

7.3 Page 7-7, Section 7.3.3, Groundhog Prospect: The second sentence should be corrected as follows: "The village of Nondalton lies approximately 88 km (55 miles) downstream of the ~~Chulitna River~~ <u>Sixmile Lake, which flows out of Lake Clark and into the Newhalen River</u>. Igiugig lies approximately the same distance downstream on ~~the Upper Talarik Creek and across Iliamna Lake~~ <u>on the Kvichak River near the outlet of Iliamna Lake</u>."

<u>EPA Response:</u> Section 13.2.4.1 of the revised assessment states that the Groundhog claim block is approximately 10 km west of Nondalton and 20 km north-northwest of Iliamna. Other geographic references were deleted.

<u>Bristol Bay Native Corporation (Doc. #4145 and #4382)</u>

7.4 One reason that EPA appears to identify the Fraser River watershed as an analog to the Bristol Bay watershed is that mining proponents claim that the Fraser River watershed is an example of the co-existence of mining and healthy fisheries (Chapter 7, Box 7-1, page 7-2). In fact, the Gibraltar mine in British Columbia has been cited specifically by the Pebble Partnership as an example of hardrock mining being compatible with large salmon runs. However, this mine is considerably smaller than that proposed by the Pebble Partnership at the Pebble Deposit, and although originally designed as a zero-discharge facility, the Gibraltar copper-molybdenum mine has been permitted since June 2009 to discharge effluent directly into the Fraser River. EPA reports “episodes of low pH and frequently elevated dissolved copper” in waters at the Gibraltar mine (Chapter 7, Box 7-1, page 7-2).

It may be worth noting that the Gibraltar mine is operated by Taesko Mines Limited, which, like Northern Dynasty Minerals, is a subsidiary of Hunter Dickenson. Taesko’s directorate includes managers of Northern Dynasty Minerals as well, and the President and CEO of Northern Dynasty Minerals is President and CEO of its parent corporation, Hunter Dickenson. In other words, the claims about the compatibility of mining and fisheries in the Fraser River appear to be coming from sources that not only operate that facility, but that are proposing a much larger mining operation in the Bristol Bay watershed. At best, what can be concluded is that the Pebble Partnership’s claim that copper mining and maintenance of healthy salmon resources are compatible within a watershed is unsupported by the example it has provided.

<u>EPA Response:</u> Box 8-4 of the revised assessment explains that the Fraser River is not a good analogue for Bristol Bay and why.

7.5 In Section 7.4.1.1 (Habitat Eliminated Under the Mine Footprint), EPA appears to estimate the reach and extent of streams that would be eliminated or blocked by potential mining operations using State of Alaska data that is analogous to that shown on USGS quadrangles and/or the blueline streams depicted therein. Such maps may grossly underestimate the existence and length of stream reaches given the means by which the maps were produced (high altitude imagery, often with little or no on-the-ground verification). For example, Figure 1 compares EPA’s depiction of stream impacts (Chapter 7, Figure 7-2, page 7-11) in the North Fork Koktuli River drainage (TSF1) with the depiction of the same drainage as shown in Northern Dynasty Mines’ 2006 water rights applications.

EPA estimates that approximately 9.2 miles of stream would be eliminated by TSF1. Simple inspection of Northern Dynasty Mine’s depiction suggests that EPA’s estimate is likely to be at least 50% low.

<u>EPA Response:</u> Box 7-1 of the revised assessment explains the calculation of streams and wetlands affected by mine scenario footprints. The scale of the data sets available for this analysis was 1:63,360. Box 7-1 notes that the estimates of stream length and wetland area affected reflect a lower bound, and that these estimates could be enhanced with improved, higher-resolution mapping.

7.6 EPA’s assessment of the direct habitat losses associated with TSF1 also appears to be low. EPA’s estimate of the area of the TSF1 appears to measure from the top of the tailings dams rather than the outer perimeter of the toe of these dams, and may underestimate the footprint of TSF1 by more than 300 acres (Figure 2). And, EPA’s estimates do not include a number of additional measurable impacts to wetland and aquatic areas that would result from a number of detention dams and sedimentation reservoirs that are depicted in the Wardrop report

(2011)10, as well as direct losses resulting from construction and operation of the power plant, mill site, roads, support buildings, and associated infrastructure.

EPA Response: See response to Comment 7.5. Box 7-1 also explains that the area covered by facilities associated with mine site development (e.g., housing, crushing plant, WWTP) is not considered in the calculation of eliminated and blocked streams and wetlands due to lack of knowledge about the specific size, orientation, and placement on the landscape of these structures. The values reported in the assessment are thus conservative estimates, as additional development on the landscape would likely impact additional wetland area and stream length due to abundance of aquatic habitat in this region.

7.7 EPA does not provide a frame of reference for such magnitudes of losses of wetland and aquatic habitats, even for the underestimates that EPA presents. If possible, EPA should augment its risk assessment with examples of any hardrock mines in any watersheds in the United States whose impacts to wetland and aquatic habitats have been similar or greater, as well as examples where such impacts have been successfully offset with compensatory mitigation measures.

EPA Response: We are unaware of any permitted hard rock mines with aquatic resource impacts of the magnitude estimated in this assessment or of any compensatory mitigation of this magnitude. We believe that the losses of streams and wetlands in the mine footprint would be unprecedented among U.S. permitted hard rock mines due to the potential size of the mine, the amount of waste generated, and the abundance of aquatic resources at the site.

7.8 Finally, EPA assumes in its cumulative impacts analysis that other potential mines at the Sill and 38 Zone prospects would use the mill and TSFs built for the Pebble mine. EPA should also consider the potential additional cumulative impacts if that joint usage does not occur. Similarly, EPA assumes that the transportation corridor and perhaps some of the other associated facilities and power might also be used by other mining operations as part of a "mining district." These assumptions are conservative with regard to potential cumulative direct impacts, and would underestimate cumulative impacts of multiple mines if the assumptions prove not to be valid.

EPA Response: In the revised assessment we estimated potential cumulative impacts with and without joint usage of mills and TSFs in those cases where joint usage appears to be possible. Chapter 7 in the draft assessment was not meant to be definitive, but to give a conservative (not worst-case) estimate of the potential impacts of additional mines. We have added discussion to Chapter 13 of the revised assessment about the cumulative effects of secondary development that results from introducing industry, roads and infrastructure to the region. We also added discussion in Chapter 6 of the revised assessment about the cumulative footprint of a single mine.

[10] Wardrop. 2011. Preliminary Assessment of the Pebble Project Southwest Alaska.

7.9 The Draft Assessment appears to underestimate habitat losses in the cumulative case, just as in its risk assessment proper.[11] In addition, the Draft Assessment makes a number of assumptions about joint use of facilities by multiple mining operations that may not be valid and that may result in an understatement of the risks of multiple mine development, a possibility that EPA should at a minimum acknowledge in the Final Assessment.

EPA Response: We assumed the sharing of infrastructure wherever it was plausible as a conservative assumption to represent a lower bound of cumulative impacts. Because the sharing of facilities is uncertain and may understate the risk, the revised assessment estimates the potential cumulative impacts with and without shared use of mills and TSFs in those cases where joint usage appears to be possible (Section 13.2).

The Pebble Limited Partnership (Doc. #3797)

7.10 Since this scenario is not an actual mine plan and it lacks detailed mine development alternatives, the peer reviewers should be asked about these fundamental assumptions made by EPA and how they affect the assessment's reliability.

EPA Response: The peer reviewers were asked a number of questions about the mine scenarios, including "Given the type and location of copper deposits in the watershed, was this hypothetical mine scenario realistic and sufficient for the assessment?"

7.11 Related to this issue, the peer reviewers should be asked whether EPA's projections of cumulative impacts from "multiple mines" beyond the Pebble Project (see Assessment Chapter 7) is scientifically valid since EPA "cannot predict what mining activities would occur in the future, in what order mines would be developed, or what their specific impacts would be."

EPA Response: The peer reviewers were asked a number of questions about the cumulative assessment, including "Does the assessment appropriately describe the potential for cumulative risks from multiple mines?" and "If not, what suggestions do you have for improving this part of the assessment?"

National Mining Association (Doc. #4109)

7.12 "Cumulative impacts" from various sites, such as the Groundhog property, are discussed, despite the fact that resources at those sites are unproven and in some instances no geologic exploratory drilling has even been conducted.

EPA Response: The revised assessment only considered development of additional mines at potential sites where there was notable activity or investment in drilling or other exploration in 2011 to 2012 (see Section 13.2). The draft assessment acknowledged that we could not predict exactly which mining projects would move forward in the future. However, the expansion of mining in the two watersheds is likely. A number of land management units in each watershed are designated by the State for mineral development, and a large number of claims and mineral deposits exist. To recognize the

[11] Comment # 4145, pg. 5 – Thomas G. Yocum, Comments on EPA's Draft Bristol Bay Assessment, also attached to Comment # 4382 as Comment # 4382.3

uncertainty inherent in this prediction, we made conservative estimates of cumulative effects. Other comments provided lists of mineral deposits and mining regions that we did not include in the assessment (e.g., Buell and Associates 2012). They explained that other mines and prospects in the region "would have a range of potential development approaches and impacts extending well beyond those reasonably anticipated for the Pebble prospect."

Northwest Mining Association (Doc. #4119)

7.13 The Assessment states that Pebble would be the largest mine of its type in the U.S. (which is not a true statement – the Bingham Canyon Mine has operated for more than 140 years and at some periods during its mine life has milled up to 500,000 tons per day as compared to the EPA Assessment use of 200,000 tons per day) and then utilizes the hypothetical mine focused on Pebble to represent all other large mines that could ever be developed in the Bristol Bay Watershed. This approach is blatantly wrong. If Pebble will be the largest, how can any others also be this large?

EPA Response: **If the Pebble deposit exceeds 11 billion tons of ore as predicted (Ghaffari et al. 2011), it would be the largest mine of its type in North America in terms of the total amount of ore. The assessment does not use the largest mine size scenario to represent the other potential mines in the two watersheds. We assumed that other ore bodies in the area would be smaller than the Pebble deposit, with an average size of 200 to 250 million tons—well below the minimum size of 2 billion tons considered in the original draft assessment. In the revised assessment we include a 250 million ton scenario to represent the size of the additional mines (Section 13.2).**

7.14 The Assessment is fatally flawed when it assumes all other large scale mines in the region will look the same as the EPA hypothetical mine. Every mineral deposit is different and must be evaluated based on its particular geology, geochemistry, metallurgy, environmental setting, etc.

The result is that every mine layout is different, every mine plan is different, every mill is different, every tailings impoundment is unique, etc.

In no case can a programmatic EIS be used for permitting an individual mine. Every mine is required to have a site specific EIS based on the specific design details and environmental data for all aspects of the mine. Yet, the EPA Assessment uses a hypothetical design to evaluate the potential impacts on the entire Bristol Bay region, an area larger than the State of West Virginia.

EPA Response: **The assessment does not predict the mine configurations that would be constructed at mineral deposits in the two watersheds. The mine scenario used at each of the sites reflects activities typically associated with porphyry copper mining. The assessment is not an environmental impact statement and the comparison is inappropriate. This assessment is not intended to compare alternatives or definitively predict the impacts of any specific mine alternative. The purpose of the assessment is to determine the significance of Bristol Bay's ecological resources and identify potential impacts to those resources from mine developments typically associated with porphyry copper mining.**

Northern Dynasty Minerals Ltd. (Doc. #4611)

7.15 NDM also takes issue with the Draft Assessment's failure to recognize the environmental success of many modern hard rock mines and their co-existence with significant salmon fisheries when it projects how its hypothetical mine will impact the Bristol Bay watershed.

British Columbia's Fraser River offers an important example that EPA gives inadequate attention to and does not consider in a comprehensive or scientific manner. The Fraser is among the world's most productive salmon rivers and supports commercial, recreational and aboriginal fisheries. Despite significant mining activity over many decades throughout the drainage basin starting with the Cariboo Gold Rush in the 1850s, there is strong evidence that demonstrates hard rock mining has not had a deleterious impact on the Fraser River fisheries. Salmon in the Fraser have increased in abundance since the Hell's Gate slide in 1913 up through the early 1990s, while at the same time production of precious and base metal mines has significantly increased.

Review of existing empirical evidence demonstrates that mining activity in the Fraser River watershed over the last 50 years has not had a negative effect on salmon populations or the commercial salmon fishery. Also, there have been no large scale effects from mining on salmon habitat. Further, the existing evidence shows no real relationship between salmon price and mining activity.

Evidence from other hard rock mining sites in Alaska is also important in a comparative analysis, but has been entirely overlooked in the Draft Assessment. Environmental performance records for all of Alaska's existing hard rock are exemplary. In fact, three of the state's most significant mining operations have actually improved fish habitat and productivity outside the mine gate:

- Red Dog Mine – zinc-lead mine located in Northwest Alaska, near Kotzebue, in operation since 1989.
- Greens Creek Mine – silver, zinc, gold and lead mine on Admiralty Island in southeast Alaska, first discovered in 1975.
- Fort Knox Mine – gold mine northeast of Fairbanks, Alaska, first permitted in 1994.

Also, case studies of other active hard rock mining sites in the Fraser River watershed – Highland Valley, Gibraltar, Endako, and Mount Polley – indicate no evidence of a past, present or future risk to fisheries resources in that watershed. They are also important comparatives because of their large size and relative proximity to salmon habitat.

- Highland Valley Mine, Logan Lake, British Columbia – operating since 1962, targets copper and molybdenum in a site that covers about 7,000 ha with 120,000 tons of throughput per day. The Highland Valley deposit occurs in a tributary of Guichon Creek and the tailings facility is in a creek drainage that is a tributary of the Thompson River. Several small lakes and ponds are around the perimeter of the mine site. Fish species present near or downstream of the mine include rainbow trout, largescale sucker, longnose dace, peamouth chub, northern pike minnow, burbot, redside shiner, mountain whitefish, steelhead, chinook salmon, and coho salmon. Geographically, the mine is within several kilometers of productive salmon habitat. Mitigation measures and monitoring measures in place at the mine help to ensure that area fisheries are protected. Indeed, the Buell & Associates report discussed below notes that a reclaimed tailings pond (Trojan Pond) at the mine supports a self-sustaining population of Kamloops rainbow trout that are subjected annually to a trophy fishing contest. Fry from the small feeder stream to this pond, where adult fish successfully spawn, are out-planted to other water bodies in disturbed areas on the mining property, where they do well.

- Gibraltar Mine, McLeese Lake, British Columbia – operating since 1972, targets copper and molybdenum in a site that covers 2,000 ha with 55,000 tons of milling throughput per day. The mine is situated within the upper Cuisson Creek drainage, a tributary of the Fraser River. The tailings facility overlaps the headwaters of a tributary to Cuisson Creek starting upstream from the Fraser River. Fish species present near or downstream of the mine include rainbow trout, bridgelip sucker, white sucker, largescale sucker, longnose sucker, longnose dace, peamouth chub, chinook salmon, and coho salmon. Risk to fisheries from this mine's operation is very low. Geographically, the mine is within several kilometers of productive salmon habitat. Further, there are healthy rainbow trout living in the mine's tailings pond and downstream seepage pond. They are tested from time to time and show no elevated metals or other indication of negative effects.
- Endako Mine, Endako, British Columbia – operating since 1965, targets molybdenum, copper, zinc, tungsten and bismuth in a site that covers about 2,000 ha with 55,000 tons of throughput a day. The mine is located on a plateau near Francois Lake, Fraser Lake, and Endako River, three important tributary systems in the Fraser drainage. Its footprint overlaps headwaters of Sweetnam Creek, Watkins Creek, Higginbotham Creek, and several tributaries on Francois Lake and the Endako River. Its tailings facility is sited on the upper portion of a tributary to the Endako River. Fish species present near or downstream of the mine include rainbow trout, peamouth chub, longnose sucker, burbot, lake chub, leopard dace, longnose dace, mountain whitefish, northern pike minnow, prickly sculpin, rainbow trout, redside shiner, kokanee, sockeye salmon, and chinook salmon. Evidence demonstrates that risks to fisheries from the Endako mine are extremely low. Geographically, it is within several kilometers of productive salmon habitat.
- Mount Polley Mine, Likely, British Columbia – operating since 1997, targets copper, gold and silver in a site of about 800 ha with 20,000 tons of throughput per day. The mine site is on the slopes of Mount Polley in the upper headwaters of Hazeltine Creek, a tributary of Quesnel Lake. Bootjack Lake and Polley Lake flank the east and west side of Mount Polley and the mine site. Fish species present near or downstream of the mine include rainbow trout, bull trout, longnose dace, mountain whitefish, northern pike minnow, peamouth chub, redside shiner, burbot, kokanee, chinook salmon, coho salmon, and sockeye salmon. Evidence shows that the risks to overall fisheries from the mine are extremely low.

In summary, these mines are all examples, with proven track records, of sustainable low impact operations adjacent to important fish habitat in the Fraser River drainage.

<u>EPA Response:</u> The mines described in this comment differ from the Pebble prospect scenarios in many ways, including hydrology, climate, location with respect to fish-bearing streams, estimated waste streams, and other factors that can greatly influence

the degree of comparability. Although these mines provide useful case studies, our assessment focuses on mine scenarios based on descriptions provided in Northern Dynasty Minerals' planning documents. These scenarios, in the context of specific features of the Bristol Bay watershed that are potentially affected, provide a more appropriate basis for calculating potential exposure and risk in this assessment.

We see sufficient evidence that mining in the Fraser River watershed has affected salmon runs. Salmon runs have declined, but available evidence is insufficient to quantify the extent to which mining has contributed to the decline. As the original draft assessment described, elevated levels of copper and other metals and episodes of low pH have been associated with mines in the Fraser watershed. There is also a reported failure of a tailings impoundment at the Pinchi Lake Mine (see Box 8-4 of the revised assessment).

Although it can be said that Red Dog, Greens Creek and Fort Knox mines improved water quality, all three situations vary greatly from the Bristol Bay situation. At Red Dog the creek flowed over the mineral deposit and had high natural levels of metals. By managing and treating water at the mine site, the mine has improved the water quality in terms of metals concentrations. However, Red Dog is also an example of the difficulty mining companies have in predicting and planning for mine impacts. For example, as a result of a number of unforeseen environmental factors, the mine tailings impoundment filled with water runoff at a much faster rate than expected, requiring the construction of surface water bypass facilities and enlargement and modification of the impoundment. The tailings impoundment also was predicted to be frozen over and not in need of perpetual treatment after mine closure, but due to the high concentrations of acid generating materials in the impoundment, the temperature has risen sufficiently for it to remain open and in need of water management and treatment in perpetuity. The project was also plagued by unforeseen contaminated dust problems.

Greens Creek is another example of a mine site with poor natural water quality that was improved by water management and treatment at the mine. At Fort Knox, aquatic resources were severely impaired by previous placer mining activities. Some of the impaired areas were covered by the mine footprint and by pass of clean water around the footprint also helped improve water quality below the facility. Furthermore, Fort Knox is in a much drier climate than the Bristol Bay watershed and until this year did not have a permit to discharge wastewater from the tailings impoundment. Fort Knox also provides examples of unforeseen accidents that can occur during the life of large scale mines, having suffered two pipeline leaks releasing cyanide to the environment, which fortunately was controlled before reaching aquatic resources.

7.16 As noted in the comments provided by Buell & Associates[12], there are several existing, developed mines and other mineralized areas and claims identified in the Bristol Bay Area Plan that are not set aside but are ripe for development, including some that are considerably larger in land area than Pebble. These other mines and prospects contain a variety of ore types and target minerals, and would have a range of potential development approaches and

[12] This particular comment in this letter is referenced from Comment # 4611.6, p. 5 – 6

impacts extending well beyond those reasonably anticipated for the Pebble prospect. In order to be a comprehensive and reasonable assessment of mining in the "Bristol Bay Watershed," the Draft Assessment must consider these other prospects and analyze how they may be developed within the existing Bristol Bay area planning process and according to the existing Alaskan permitting process.

EPA Response: The assessment focused on the Nushagak and Kvichak River watersheds because they represent 50% of the Bristol Bay watershed and are identified as mineral development areas by the State of Alaska. The assessment focused on the Pebble deposit because it is the most likely site for near-term development due to its size and extent of characterization. Chapter 13 of the revised assessment considers development of additional mines at six potential sites where there was notable activity and/or investment in drilling or other exploration in 2011 to 2012.

7.17 There were 25 active mines operating in the Fraser River Watershed in 2010. Mining operations are known to have the potential to affect water quality and fish habitat, however, a review[13] of the literature on mining in the Fraser River watershed shows that there does not appear to be a noticeable effect on the overall salmon population. Since the mid-1950's there has been an upward trend in both mine production and salmon escapement. When the landed value of sockeye salmon was compared to amount of ore mined, both have had an increasing trend.

EPA Response: Our review of the literature shows that there is an effect on salmon populations of the Fraser watershed. The Canadian government charged the Cohen Commission to investigate the declines in salmon after the sockeye fishery was closed for three straight years. Salmon runs have declined but available evidence is insufficient to quantify the extent to which mining has contributed to the decline (see Box 8-4 of the revised assessment).

7.18 Buell[14] observes that the "Mine Scenario" discussed in EPA's analysis narrows the focus of the Draft Assessment inappropriately. The Draft Assessment is supposed to be on the effects of mining generally, not just a PLP mine. Pebble is located in one of five planning units in the Nushagak and Kvichak drainages specifically set aside in the Bristol Bay Area Plan (2005)[15] for mineral exploration and mining because they have significant resources, either measured or inferred, that may experience minerals exploration or development during the planning period. In addition, there are several existing, developed mines and other mineralized areas and claims identified in the Plan that are not set aside but are ripe for development; some are considerably larger in land area than Pebble and others, though economically viable, are considerably smaller. These other mines and prospects contain a variety of ore types and target minerals, and would have a range of potential development approaches and impacts extending well beyond those reasonably anticipated for the Pebble prospect.

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[13] Sarachuk, Jennifer. 2012. Fraser River Salmon and Mining Review

[14] This particular comment in this letter is referenced from Comment # 4611.6, p. 5

[15] Alaska Department of Natural Resources. 2005. Bristol Bay Area Plan for State Lands. Available online at http://dnr.alaska.gov/mlw/planning/areaplans/bristol/pdf/bbap_complete.pdf

<u>EPA Response:</u> See response to Comment 7.16.

7.19 Many of the failure risk scenarios described in Chapters 6 and 7 of the Draft Assessment are either unrealistic or wholly irrelevant to PLP's mine development.

<u>EPA Response:</u> The comment does not provide specific information or identify specific inaccuracies. No change required.

7.20 Not only is EPA's report premature because it uses a hypothetical mine plan rather than waiting for an actual mine plan to evaluate, it is important to point out that EPA has chosen to evaluate a hypothetical plan that a number of federal and state agencies would never have permitted in the first instance. Among the many reasons why this is the case, NDM observes:

The "routine scenario' (i.e., everything working as intended including standard mitigation practices) analyzed in EPA's report shows an impact of about 100 krn of lost "potentially anadromous fish spawning and rearing habitat" in the mine footprint and waste rock piles areas. Even assuming this estimate of habitat loss is correct (and it is not, as evidenced by detailed comments below), a project would never be permitted that did not mitigate for the loss of an equivalent (usually a multiple of the actual loss) amount of similar habitat either being created, or preserved. Thus, there would be a net gain in productive fish habitat and greater contribution to the fisheries.

<u>EPA Response:</u> To receive a permit for the mine described in the assessment, the applicant would have to perform compensatory mitigation for aquatic resources impacted by the project. More area is generally required for mitigation than is affected by the project. This mitigation is required not just for streams that are "potentially anadromous fish spawning and rearing habitat" but would be required for <u>all</u> aquatic resources lost to the mining project.

The assessment was intended to identify potential impacts to fish from mining. It was not intended to be the definitive prediction of aquatic resource loss, and it was not intended to identify potential specific mitigation projects available in the Nushagak and Kvichak River watersheds. It may be true that a mine similar to the scenario would be unpermittable because insufficient opportunities for mitigation would be available, but predictions regarding future permitting are outside the scope of the assessment. In response to public and peer review comments we have included a discussion of compensatory mitigation in Appendix J of the revised assessment.

7.21 The routine scenario also assumes that only water that is surplus to mining operations would be available to release to surface waters downstream of the mine footprint area. The projected impacts are a decrease in winter water temperature, an increase in summer water temperature, and a loss of the quantity and quality of fish habitat downstream of the mine footprint. These impacts would not be allowed to occur unless appropriate mitigation was implemented. Mitigation could include: creating a storage reservoir to provide additional surface flow so that the impacts to downstream flows were lessened or eliminated; putting the water from the water treatment plant into groundwater as a surcharge and reducing water temperatures to natural conditions and supplementing surface water flows by maintaining groundwater inflow to the main channel; or installing wells to supplement surface flows in order to eliminate or lessen the downstream flow impacts. Moreover, removing natural barriers to un-utilized fish habitat (like beaver dams/rock falls, etc.) opens up significant amounts of habitat and related fish production. All of these measures are easily implemented, but EPA chose not to even consider any of this "mitigation" measures and did not include them in the Draft Assessment.

EPA Response: **We assume that all appropriate mitigation measures would be included in the design and then evaluate potential effects on salmon. We did not include mitigation that involves tapping nearby resources because of the expanded impact footprint that would cause. We consider those types of features unlikely to be permitted. Compensatory mitigation would be considered as part of a regulatory process to offset effects identified in completion of the assessment; nevertheless, we have added Appendix J to address compensatory mitigation issues.**

7.22 Page 7-13: "At the Red Dog mine, near Kotzebue, in Northwest Alaska, treatment of waste rock wastewater for metals resulted in excessive total dissolved solids requiring that water be directed to the TSF rather than discharged. Compounding this problem, failure to implement planned surface water diversions early in mine development resulted in unpredicted rapid filling of the TSF."

Comment: The compounding problem was poor understanding of the hydrologic and climatologic environment due to insufficient baseline data, which lead to an underprediction of precipitation (Dames & Moore, 1992). The problem was not failure to construct planned surface water diversions as suggested by EPA.

EPA Response: **The water treatment failure at Red Dog was the result of an unintended failure to design a plant that was adequate for the mine and site. The passage has been expanded to clarify the nature of the failure.**

7.23 Page 7-14: "Closure would typically include hundreds to thousands of years of monitoring, maintenance, and treatment of any water that may flow off site. However, over these timeframes we would expect multiple and more frequent system failures."

Comment: This is speculation. There are no supporting references as to why "multiple and more frequent system failures" would be expected over a longer timeframe.

EPA Response: **We have modified the language to reflect that the cumulative probability of system failures increases after closure due to relaxed oversight and attention over time as well as additional mines going into closure status. This is a precautionary approach, reflecting the relatively ephemeral nature of human institutions, and is appropriate in order to prepare for and prevent future impacts, in perpetuity.**

7.24 The analysis ["Active Metal Mines of the Fraser River Basin and Fish – Case Studies" by Oscar Gustafson (2012] identifies several reasons for its conclusion that the four active metal mines studied present very low risks to fish, fish habitat, and fisheries resources of the Fraser River watershed.

No engineering design related failures that resulted in significant downstream effects to the receiving environment at any of these four mines were identified. The engineered structures located at these mine sites are the result of modern engineering design and construction standards that are determined by professional practice and legislation. They are no more likely to fail than modern high rises, hydroelectric dams, or highway bridges.

Each of the four open pit mines utilizes a tailings storage facility, waste rocks dumps, diversion ditches to collect site runoff, and water collection ponds. Each of these four mines has comprehensive waste and water management and reclamation plans in place.

The four mines examined have extensive engineered water management systems in place to contain mine site seepage and surface runoff and to recirculate it as process water. Mitigation is effectively accomplished by collecting mine site seepage and surface runoff from disturbed areas and recirculating it as process water within a closed system. No evidence was identified indicating that these mines release contact water to the receiving environment other than under specific circumstances in accordance with issued permits.

The Gibraltar Mine and Endako Mine periodically release contact water to the receiving environment under effluent discharge permit conditions. Both mines are subject to regulation under the Metal Mining Effluent Regulations. The Highland Valley Mine and Mount Polley Mine do not release contact water.

Salmon are a resilient species that originate from multiple reproducing populations, have a high reproductive capacity, display variable life histories, opportunistically colonize new habitats, and can recover from disturbance provided natural processes and variability are restored. Mines, including those assessed in this paper, have a finite life and closure plans to restore pre-disturbance conditions. Salmon that may have been displaced by mining have the potential to recolonize areas following mine closure or a temporary disturbance such as an accidental spill.

There is considerable regulatory oversight concerning the operation of mines in the Fraser River watershed. As these mines are all located in British Columbia, Canada, the author noted that the BC Ministry of Energy and Mines and the BC Ministry of Environment have jointly developed policies and guidelines on the management of mine effluent and ARD.

<u>EPA Response:</u> There is not sufficient evidence to claim that mining in the Fraser River watershed has not affected salmon runs. Salmon runs have declined but available evidence is insufficient to quantify the extent to which mining has contributed to the decline. As the draft assessment described, elevated levels of copper and other metals and episodes of low pH have been associated with mines in the Fraser watershed. There is also a reported failure of a tailings impoundment at the Pinchi Lake Mine (see Box 8-4 of the revised assessment).

The four mines described in the white paper differ from the mining scenario in the Bristol Bay assessment in a number of important ways:

1. **They are much smaller mines. The mine scenarios at the Pebble deposit would process 200,000 tons of ore a day. One of the example mines processes only 20,000 tons per day, two others process 55,000 tons, and the largest one processes 120,000 tons per day.**
2. **Apparently only one of the mines has acid generation potential. The largest mine has no acid generation problems.**

3. **Two of the mines, including the largest one, are closed systems with no discharge of mine wastewater to aquatic resources.**
4. **All of the mines are sited in locations with "limited" to "very low" fishery potential. In contrast, the assessment mine scenario footprints would eliminate, block or dewater up to 36 km of documented anadromous waters and up to 115 km of additional headwater streams (see Section 7.4 of the revised assessment for a summary discussion). Furthermore, the three streams immediately downstream of the footprint have considerable adult salmon returns (see Section 7.1.2 and Table 7-1 for discussion of salmon spawning abundance in the mine scenario watersheds).**

7.25 Concerning water quality issues, the Draft Assessment: discounts the effectiveness of established sediment and erosion control practices for road construction and operation; has not considered mitigation strategies for addressing concerns over road salts for dust and ice control; has not considered mitigation strategies for addressing concerns over sediment contribution and effects; has not considered mitigation strategies for addressing concerns related to shallow groundwater impacts; has not considered the role of mine reclamation to mitigate habitat loss during the post-closure period; and overstates the risk to salmonids from copper in mine operations leachate.

EPA Response: Many of the water quality impacts described in the assessment can be reduced or eliminated by best practices, mitigation strategies and post closure reclamation, so it is appropriate to focus attention on these issues early in the process. The discussion of the risk to salmonids from copper in mine operations leachate has been expanded in the revised assessment.

7.26 Lessons learned at other sites will be incorporated into any new mine development and mine operation. The use of simple mass balance techniques can predict the accumulation of dissolved salts within the recycled water system at the site. Similarly, water management failures at other sites only serve to highlight the need for vigorous water management from the outset of any project of this size.

We note that the Red Dog Mine case history can be shown as a learning example. A case study prepared by Dames & Moore (1992)[16] for the U.S. Bureau of Mines provides additional details on the start-up challenges at Red Dog Mine:

> "As it turned out, design of the mine tailings impoundment did not include a number of critical design issues due to a lack of adequate hydrologic, geologic, and climatologic baseline information, e.g., ground water monitoring wells were not included in the baseline data program. As a result, mining activities along Red Dog Creek intercepted an unexpected ground water aquifer at the mine zone containing toxic levels of heavy metals which, once intercepted, discharged directly into Red Dog Creek. This resulted in unscheduled construction of a bypass to carry unpolluted waters of upper Red Dog Creek around the mining operation to a point downstream of the mine. Additionally, the Company constructed a system to route all surface water runoff and intercepted ground water to the tailings impoundment. It is also clear that site-specific precipitation data and

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[16] Dames and Moore. 1992. Regulatory Processes Associated with Metal-Mine Development in Alaska – A Case Study of the Red Dog Mine. Available online at http://www.dggs.alaska.gov/webpubs/usbm/ofr/text/ofr093_92.PDF

runoff considerations associated with mine development in arctic conditions was not adequately addressed. Precipitation was greater than expected and infiltration of precipitation into the ground was much less than expected due to permafrost conditions. This, combined with additional surface and ground water being routed to the tailings impoundment, resulted in surface and ground water discharges into the tailings impoundment being much greater than anticipated. As a result the mine tailings impoundment filled with water runoff at a much faster rate than expected, thus necessitating the acceleration of impoundment development and engineering design changes."

While we have not performed a thorough review of the Environmental Baseline Document for the Pebble Project[17] (PLP, 2011), it is safe to say that baseline information being incorporated into the Pebble design far outweighs the amount available at a similar stage of the Red Dog Mine development in the early 1980's. We also note that according to the Dames & Moore (1992) report, the compounding problem was poor understanding of the hydrologic and climatologic environment leading to underprediction of precipitation rather than failure to construct planned surface water diversions.

EPA Response: See response to Comment 7.15.

Alaska Miners Association, Inc. (Doc. #4612)

7.27 While the Alaska Miners Association generally concerns itself with issues affecting the mining industry, we feel the negative impacts that would assuredly result from the assessment would stretch much further than just the mining sector in Alaska. These impacts would certainly pertain to more than the proposed Pebble Project and implied effects on salmon habitat, which the assessment is obviously aimed at, despite the commitment in the EPA's original press release that states, "EPA's assessment is not limited to examining the effects of hardrock mining projects, but will consider the effects of large-scale development in general." The assessment narrowly focuses on a large-scale mine. The fact that EPA did not adhere to its original commitment causes us to question the credibility of the entire assessment in general.

EPA Response: Our original intent was to focus on large-scale development generally. Early in the process we evaluated potential large scale developments in the Nushagak and Kvichak River watersheds and concluded that only mineral mining presented a likelihood of large-scale development in the near future, so the scope was modified accordingly. EPA announced the assessment in February 2011. In August 2011, when we met with the Intergovernmental Technical Team made up of tribal, state and federal experts, we reviewed the change of scope and the conceptual models of impacts from large-scale mining and received input on the new scope and approach to the assessment. This information was posted on EPA's web site and discussed at outreach events during the development of the assessment.

[17] Pebble Limited Partnership. 2011. Pebble Project Environmental Baseline Document 2004 through 2008. Available online at http://www.pebbleresearch.com/ebd/

This information was posted on EPA's web site and discussed at outreach events during the development of the assessment.

The Pebble Limited Partnership (Doc. #4960 and #5416)

7.28 Instead of assessing the full scope of present and potential watershed risks, the Assessment "focuses on the Pebble deposit area," considers only those stressors associated with a potential Pebble mine, and addresses only those cumulative effects associated with multiple mines. By focusing so narrowly on the Pebble deposit and future mining operations, the Assessment ignores other stressors, impacts, and activities of concern. Such a narrow focus conflicts with Agency policy. It fails to deliver on EPA's "commitment to addressing water quality problems in a comprehensive, holistic fashion."

EPA Response: The assessment includes conceptual models illustrating potential pathways by which large-scale mining activities can lead to proximate stressors and ultimately impairment of fish resources. We focused on stressors based on their potential likelihood and severity. It was clear from the beginning that this was a focused assessment, initially on large-scale development but modified to large-scale mining because it has the greatest potential to move forward and was the subject of requests for EPA action. The assessment focuses on the Pebble deposit because it is the most likely mine to be developed in the near future and a great deal of information about how it could be developed has been made publicly available.

7.29 White Paper No. 3 **–** Active Metal Mines of the Fraser River Basin and Fish **–** Case Studies[18]

Mining has a long history in the Fraser River Basin starting with the Cariboo Gold Rush in the 1850s. Similar to the Bristol Bay Watershed, the Fraser River is among the world's most productive salmon rivers and supports commercial, recreational, and subsistence fisheries. Due to its long history, mining has historically been met with some concern with respect to fisheries conservation due to potential negative effects to the land base, water quality, water quantity, and fish habitat. Those concerns, however, can be addressed through modern mine design and construction.

This paper presents case studies from four active metal mines on the Fraser River watershed as a means to assess the risk of mining operations to fisheries. Information concerning mine engineering, operating details, and environmental setting are identified and assessed for this purpose. While these mines have some minor localized effects to fish and fish habitat, there is no evidence to suggest these mines present a current or future risk to the fishery resources of the overall Fraser River watershed. The four active metal mines assessed in this white paper are all examples, with proven track records, of sustainable low impact operations adjacent to important fish habitat in the Fraser River discharge.

EPA Response: Many environmental concerns from large-scale mining may be addressable through modern mine design and construction. If so, it is appropriate to raise those concerns early in the process. It is also important to use analogous mine sites when making comparisons. The four mines described in the white paper differ from the

[18] Report by Knight Piesold.

mine scenarios in the assessment in a number of important ways (see response to Comment 7.24). A truly important and helpful mine for comparison purposes would be one as large as the potential mine at the Pebble deposit, in an area with similar hydrogeology, with acid-generating waste and discharges of large amounts of treated wastewater to a very productive salmon ecosystem. We have not been able to find an operating mine with these conditions.

7.30 White Paper No. 4 – Fraser River Salmon and Mining Update through 2010[19]

This paper provides a review and summary of the existing data on salmon stocks and resource development within the Fraser River watershed with a focus on evaluating the effects of mining activities on the watershed. Although the Fraser River watershed is an urbanized ecosystem and is subject to multiple influences, it still supports a robust commercial, native and recreational salmon fishery. As such, the Fraser River can provide valuable lessons for development within Bristol Bay.

In fact, it is highly unlikely that the Bristol Bay watershed will ever see the population level and degree of urban and industrial development that is present in the Fraser River watershed. This means that with proper management of resources and development, the Bristol Bay watershed can continue to support healthy salmon runs while supporting other resource developments that will further enhance the economic potential of the region. In fact, development within the Bristol Bay watershed would have the benefit of more sophisticated planning and knowledge of prior resource development in other regions. With that sophisticated planning, sustainable development within the watershed can be ensured, such as that development (including mining) today won't compromise the health and balance of future salmon populations within the overall watershed.

<u>**EPA Response:**</u> **The Fraser River mines described in detail were much smaller than the known Pebble deposit. Three of the four did not have acid mine drainage. Two of the four are closed systems with no wastewater discharge and a third had no discharge from 1972 to 2009. There do not seem to be any examples of successful mines that handled the challenges faced in the Bristol Bay watershed: very large ore deposits, acid mine drainage, very wet conditions, a pristine ecosystem, and the largest sockeye salmon fishery in the world.**

<u>Fisheries Research and Consulting (Doc. #4580)</u>

7.31 *Section: Executive Summary:* It would help readers to see mine claims in the region immediately in the document to provide an idea of the scale of mining that could occur in the two drainages in the Watershed Assessment.

<u>**EPA Response:**</u> **This information is provided in Figure 13-1 and discussed in Chapter 13 of the revised assessment.**

7.32 *Section 7-7:* Check on distribution (esp. Chulitna).

[19] Report by AECOM.

<u>EPA Response:</u> The comment does not provide specific information or identify inaccuracies. No change possible.

<u>A. Seitz (Doc. #5313)</u>

7.33 Box 7-1 is not entirely accurate and should be revised to reflect the full complexity of the Fraser River sockeye run decline.

<u>EPA Response:</u> The comment does not provide specific information or identify specific inaccuracies, so no change is possible.

<u>National Park Service (Doc. #1362)</u>

7.34 Correction needed on page 7-7, section 7.3.3 Groundhog Prospect. The village of Nondalton is not located 88 km downstream on the Chulitna River. It's located east of Pebble on Sixmile Lake, which flows into the Newhalen River. Igiugig is on the Kvichak River near the outlet of Iliamna Lake.

<u>EPA Response:</u> See response to Comment 7.3.

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

7.35 *Executive Summary Fish-Mediated Risk to Wildlife*

Draft Comment: Aside from fish mediated risks to wildlife, it might also be pertinent to discuss other issues impacting wildlife including elimination or change in habitat due to avoidance or attractive nuisances of the mine.

Draft Recommended Change: Discuss elimination or change in wildlife habitat due to avoidance or attractive nuisances of the mine.

<u>EPA Response:</u> We agree that the assessment is not a complete evaluation of all direct and indirect effects of large-scale mining on wildlife.

7.36 *Section 5 through 9, Page 5.0 to 9.0*

Comment: Quantitative chemical risk estimates are presented without an initial discussion of the basic risk assessment process of data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization. Of particular importance, the hazard quotient (HQ) method used to describe chemical risks is not clearly defined. Without such introduction, the concept to significant chemical risk may not be easily determined by the nontechnical reader. For instance when presenting hazard quotients of 0.11 versus 1.3 or 190, the reader may deduce that the HQ of 190 presents the greatest risk, but they may not have a clear understanding of the bright line defining risk.

Recommended Change: Provide a summary discussion of the chemical risk assessment process to include defining key terms such as hazard quotient (HQ) and how to interpret such risk estimates.

<u>EPA Response:</u> A paragraph has been added as suggested to explain HQs and their interpretation.

7.37 *Section 7.0, Page 7-1 through 7-16*

Comment: Cumulative impacts are a potential concern, and the development of infrastructure for the Pebble Mine does make it more likely for other roads and infrastructure. However, assessing the impacts of these extremely hypothetical mines is even more difficult than for the Pebble Mine deposit. It would seem to be important to better predict the risks from the Pebble Mine before cumulative effects are examined.

EPA Response: Potential risks from development of a large mine at the Pebble deposit are evaluated in greater detail throughout the revised assessment. We agree that cumulative impact assessment is important and difficult. Prediction of cumulative impacts may improve with additional data from both the Pebble deposit areas and other mining claims. The assessment of cumulative risks is not intended to be a quantitative risk assessment; it provides an evaluation of impacts based on available information. A more quantitative analysis of both cumulative impacts and impacts at the Pebble deposit will have to wait until more information is available.

Nondalton Tribal Council (Doc. #5465)

7.38 The Assessment views cumulative effects in terms of additional mines and additional impacts on habitat. The Assessment would benefit from a greater discussion of cumulative impacts of increased population on the uses of fish and game, particularly with respect to subsistence and sport hunting and fishing.

EPA Response: A qualitative discussion of the potential secondary effects of large-scale mining has been added to Chapter 13 of the revised assessment.

G. Y. Parker (Doc. #4115)

7.39 In Chapter 7, section 7.4.5 states briefly and in a summary fashion that the secondary effects include the effects of increased population, access, and competition for fish and game resources, particularly with respect to subsistence and sport hunting and fishing. Section 7.4.5 then states that these secondary effects are beyond the scope of the assessment.

However, I am concerned that some readers may infer that the brevity of the discussion of secondary effect implies less significance of the secondary effects. I doubt that EPA would intend such an inference. I suggest that the assessment needs a disclaimer of such an inference and a clear statement that secondary effects are, in all probability, certain to occur, although they may be unquantifiable at this point in time.

EPA Response: Chapter 7 of the draft assessment was meant to give a conservative estimate, rather than a worst-case estimate, of the potential impacts of additional mines and development. We have added discussion to this section about the cumulative effects of secondary development that would result from introducing industry, roads, and infrastructure to the region.

Western Business Roundtable (Doc. #4148)

7.40 "While the Bristol Bay fishery provides important commercial and subsistence benefits, fishing alone has not provided the needed support to improve the region's economy. Fishing by its nature is seasonal, and a majority of those employed in the fishery live outside Alaska. People in the region are leaving and schools are closing, while Pebble has the potential to diversify the local economy, providing thousands of year-round jobs."[20]

One of the major failings of the Assessment is its lack of consideration for potential benefits that a major mining project would have to the human health, safety and welfare of Alaskans.

Southwest Alaska is experiencing a decline in both population and subsistence activity, and has a high rate of poverty. The Assessment ignores the positive benefits of a major economic project like Pebble in a region without a diverse economy. New infrastructure in the area would provide access to more affordable energy. Infrastructure and dependable energy supplies combined would help support a diversified economy and year-round employment.

EPA Response: The assessment is intended to develop information about impacts to fish and fish-mediated effects to wildlife and Alaska Native cultures. The assessment is not intended to be a complete study of the impacts and benefits of large-scale mining to the Bristol Bay watershed.

The Pebble Limited Partnership (Doc. #4962)

7.41 *Section 7.4 - 7.4.7, Page 7-9 to 7-16*

Comment: Section 7.1 - 7.3 discusses the probability that additional mining deposits would be developed in such a way as to make use of the existing Pebble deposit infrastructure (e.g., TSF, pipelines, roads, etc.) thus creating an economy of scale of development in the area. The reports' discussion of the potential for other mine developments to combine resources and share infrastructure is highly speculative; yet, the conclusions in the report fail to recognize that uncertainty.

EPA Response: The development of additional mines in the Nushagak and Kvichak River watersheds is a reasonably foreseeable event that should be evaluated in an assessment of cumulative effects. The ability to share infrastructure would probably make development of smaller mines more economically feasible and thus more likely to happen. We assumed the sharing of infrastructure wherever plausible, as a lower-bound of cumulative impacts. The inability to share infrastructure could have the effect of increasing the potential for cumulative impacts. The revised assessment illustrates this point by estimating potential cumulative impacts with and without shared use of mills and TSFs in those cases where joint usage appears to be possible (Section 13.2).

7.42 "Closure would typically include hundreds to thousands of years of monitoring, maintenance, and treatment of any water that may flow off site. However, over these timeframes we would expect multiple and more frequent system failures. And, as mentioned above, given the relatively ephemeral nature of human institutions over these timeframes, we would expect that eventually monitoring, maintenance, and treatment would cease. The water quality of leachate at that time would control the effect of downstream waters."

[20] Comment #3774, pg. 2 – Resource Development Council for Alaska comments in response to "An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska" Review Draft (EPA 910-R-0049, May, 2012)

The implication here is that mine closure will be inadequate and that the owner will not be responsible for environmental liability; this is not realistic as comprehensive analyses and adequate bonding to maintain the site in perpetuity, including monitoring, maintenance, and upgrading or replacement of treatment systems as new technologies are developed, would be needed before any development could be permitted to proceed.

<u>EPA Response:</u> There is a risk that closure would be inadequate or would become inadequate over time and that the owner, or any human institution, would not be responsible into perpetuity. That risk increases as time goes on. Given that closure may not happen for a hundred years or more after start-up and that management will likely be required over long timeframes, that risk is probably significant.

<u>Consumer Energy Alliance Alaska LLC (Doc. #5308)</u>

7.43 From a local energy consumer's perspective, the environmental benefits associated with bringing a major new, clean power source such as natural gas to the area, potentially displacing diesel and heating fuel emissions, reducing fuel storage risks to the marine environment, and reducing costs to consumers, should be incorporated into the analysis. It is unclear how the authors of the report determined that this and other infrastructure development will inevitably not have positive ecological impacts or impact Alaska Native cultures in the area; the agency should add a section to the report to address these issues.

<u>EPA Response:</u> Air quality impacts and benefits and fuel storage risks are outside the scope of the assessment.

<u>Alaska Conservation Foundation (Doc. #4120)</u>

7.44 Mine scenarios also underestimate cumulative impacts that would occur with the build out of a single mine, as the study scope was limited and did not include impact assessment of power, port, transportation, and human infrastructure development that would likely occur.

<u>EPA Response:</u> See response to Comment 7.6.

<u>Natural Resources Defense Council (Doc. #4608)</u>

7.45 It is no secret that interest in the Bristol Bay industrialization extends beyond the Pebble Mine. The Wardrop report describes several "high priority exploration targets outside the Pebble deposit. Each additional facility would increase the likelihood of collection and treatment failures and, as a result, the frequency of untreated leachate discharges and incremental impact on the Nushagak and Kvichak watersheds – and the chance of long term adverse downstream effects.

<u>EPA Response:</u> Consideration of the cumulative effects of multiple mines has been greatly expanded in Chapter 13 of the revised assessment.

7.46 In the wake of a permit being issued for Pebble mine, numerous other mining claims that have already been staked out in this pristine, now-undeveloped region, and whose success or failure depend on the industrial foundation of a first mine, would resurface. With additional structures also comes a heightened likelihood and frequency of failures – from small to catastrophic.

<u>EPA Response:</u> We agree that additional mines would result in cumulative risks. The cumulative risk discussion has been expanded in Chapter 13 of the revised assessment.

<u>National Parks Conservation Association (Doc. #4827)</u>

7.47 We request that, moving forward, our national park resources receive specific, deliberate analysis regarding risks associated with development of the potential Pebble mining district, including Big Chunk, Groundhog, and other claims, and associated infrastructure.

<u>EPA Response:</u> We calculated a conservative estimate of cumulative impacts to gain insights into the likely severity of those impacts. Available information at this time is not sufficient to perform a more definitive assessment of cumulative mining impacts on national parks.

<u>V. Mendenhall, Ph.D. (Doc. #4113)</u>

7.48 Widespread loss of bird habitats appears inevitable if Pebble (and other mines) are permitted, which would impact bird populations. Dewatering and associated habitat impacts would be most severe if water tables were kept artificially low in order to minimize contamination of groundwater.

Marshes, ponds, lakes, and streams would be altered or eliminated if streams were blocked and the water table was lowered. Water birds depend on these habitats to feed themselves, raise their young, as refuge during molting, and to rest and feed during migration.

Dewatering of groundwater would reduce or eliminate shrub habitats of riparian and moist areas. This would reduce shrub-dependent bird populations. Shorebirds that feed and nest on moist tundra also would be impacted.

<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we recognize the complexity of potential direct, secondary, and cumulative effects on birds.

Chapter 8: Integrated Risk Characterization

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

8.1 *Executive Summary and Throughout*

Comment: In regard to the impacts of the proposed mine on streams and fish, the Bristol Bay Watershed Assessment is too general to determine actual impacts of the proposed mine.

Recommended Change: A detailed and site-specific EPA review of the Pebble Limited Partnership Environmental Baseline Document and application of their considerable data to the issues raised by EPA in the Bristol Bay Watershed Assessment would have gone much further to understanding the actual impact.

<u>EPA Response:</u> We included data from PLP's Environmental Baseline Document throughout the assessment (despite the fact that this document has not yet undergone a

complete peer review), because it does represent a wealth of data for area surrounding the Pebble deposit. However, the document itself does not tell us anything about potential impacts of mining on the region's salmon resources—it only provides summary glimpses of the physical, chemical, and biological characteristics of the region.

8.2 *Executive Summary and Throughout*

Comment: While there is an economic assessment of the current conditions in the Bristol Bay area (Bristol Bay Watershed Assessment Vol 3), there is no economic analysis related to the potential fish impacts of the mine, nor of the potential recreational opportunities that develop due to the road, and other economic issues. While such an evaluation may not be possible with the level of analysis provided by the EPA in the Bristol Bay Watershed Assessment, it would seem possible that a minimal mine-related economic impact on the fisheries could be off-set by mine-related economic benefit of greater proportion.

Recommended Change: Do an economic cost-benefit analysis.

EPA Response: See response to Comment 2.17. We are aware of the report cited in the comment, but have not included because economic activity surrounding mine development is not dependent on a healthy ecosystem and thus is outside the assessment's scope.

8.3 *Executive Summary and Throughout*

Comment: No one can refute that some level of impacts to fish, wildlife, and their habitat(s) will result if the mine is built and operated for many years. The question is "what are the risks". The Bristol Bay Watershed Assessment repeatedly emphasizes the "possible" effects, but other than the simple risk based screening of leachate concentrations to water quality criteria, there is essentially no other site-specific assessment of the impacts to species and the quantification of lost habitat. The conclusions are oversimplified to the extent that it is not applicable to individual species or their populations.

Pre-emptive action by the EPA in an area designated by a state as a potential mining area is unprecedented.

Recommended Change: Pebble Limited Partnership has collected a massive amount of relevant site-specific data, made public in their Pebble Limited Partnership Environmental Baseline Data, that has not been incorporated into any ecological risk assessment of the potential mine impacts. Unless there is a pre-emptive political decision to disallow development of the mine because of the "pristine" nature of the Bristol Bay Watershed, then Pebble Limited Partnership should be allowed to use their data to develop a mine development and management plan, and a risk assessment/mitigation plan for the proposed mine. Then, agencies responsible for environmental impact and permitting review can better assess the degree of impact and either request further mitigation/assurances or deny the permit.

Or, if the EPA wants to continue engagement in this process, then they could do the site-specific study, but it would seem that any EPA work would then have to be subject to interaction and review by the permittee.

<u>EPA Response:</u> Data from PLP's EBD were used throughout the assessment and risks are addressed. The only recommendations in this comment have to do with hypothetical future assessments, data generation, and decisions that are not relevant to this assessment.

8.4 *Comment*: The Pebble Limited Partnership Environmental Baseline Data provides a substantial amount of site-specific data and detail, but the data have not been incorporated into a risk assessment type of document, as likely would be done through the permitting process. On the other hand, the Bristol Bay Watershed Assessment does a risk assessment with essentially no site-specific data. Neither the Pebble Limited Partnership Environmental Baseline Data nor the Bristol Bay Watershed Assessment allows a clear understanding of the potential risks to the environment, fish, wildlife, or Alaska Natives.

Recommended Change: The details provided in the Pebble Limited Partnership Environmental Baseline Data and other site-specific documents must be used to more accurately and more elaborately evaluate and predict risks.

<u>EPA Response:</u> See response to Comment 8.1.

8.5 *Executive Summary and Throughout*

Comment: Throughout much of the document, the normal approach to technical reporting is reversed. Rather than starting a section or subsection with an understanding/discussion of the issues to be addressed then addressing/evaluating the issues before reporting results of the evaluation, the Bristol Bay Watershed Assessment provides conclusive statements in the introduction to many, if not all sections and subsections. In some cases these conclusions are completely unsubstantiated in the following subsections. In other cases, there are some simple to extremely incomplete analyses that appear designed solely to support the conclusions stated in the introductory paragraphs.

It is as if the report is written to convince people of the opinions of the authors, without the level of detail or evaluation necessary to support the conclusions. It is disconcerting to see this in a Technical Document from the USEPA.

Recommended Change: Do not rely on the Bristol Bay Watershed Assessment as a technical document. Rather, allow technical documentation to be developed by the applicants with good data and detailed analysis. Use the detailed analysis and evaluation to evaluate the likely impacts of the Pebble Mine.

<u>EPA Response:</u> This stylistic comment was not incorporated. Most readers benefit from knowing the conclusion and then reading how it was derived.

8.6 *Executive Summary, Summary of Uncertainties and Limitations in the Assessment*

Comment: Overly simplistic to believe that "Estimated effects of mining on habitat become the available surrogate for estimated effects on fish populations." There are many examples showing fish habitat is not a good measure of fish abundance or population dynamics.

Recommended Change: Consider including ways to assess and/or gather insights into fish abundance and population dynamics that are less cumbersome than those stated in the report and better than habitat surrogate.

<u>EPA Response:</u> The assessment endpoints include salmon abundance, productivity, and diversity. The comment is correct that habitat is not always a *complete* measure of fish abundance, productivity and diversity—but habitat is *essential*. The conceptual frameworks and associated discussions presented in subsequent chapters acknowledge the many other factors influencing these salmon endpoints. Many of the pathways identified cannot be quantitatively linked to salmon endpoints, given the available data, without making unsupportable assumptions. Given these limitations, and given that salmon abundance, productivity and diversity inevitably depend on the availability of habitat, we believe that habitat is an appropriate surrogate for evaluating impacts to these endpoints.

8.7 *Section 6.3.3. Page 6-39 (Pg 269 of 339), Page 8-7 (Pg 300 of 339)*

Comment: Need to verify the 2,900 to 52,000-fold dilution required as determined by the biotic ligand model.

<u>EPA Response:</u> The value was based on achieving the chronic national ambient water quality criterion. The calculations were done using the standard BLM software. However, the revised assessment contains a more realistic assessment of risks from waste rock leachate in Chapter 8.

8.8 *Section 8.1.1 Routine Operations*

Comment: Here and throughout the document when referring to the risk due to routine operations, there is a general lack of assessment of risk of loss of fish habitat relative to the total amount of available habitat in the two drainages. For example, on page 8-1 the document states that 21.7 to 33.8 km of fish habitat will be lost due to the footprint of the mine, but there is no comparison made to the total amount of available fish habitat against which to measure the level of risk. Similar statements are made relative to loss of wetlands (page 8-2) and fishless headwaters (page 8-2) with no corresponding estimate of the total amount of available wetlands or fishless headwaters in the two drainages from which to measure risk.

Recommended Change: Quantify the percent of available fish habitat, wetlands, and fishless headwaters potentially lost relative to the total available amounts of these quantities so that relative risk can be estimated.

<u>EPA Response:</u> We know of no data concerning the total amount of salmon habitat, wetlands, or headwaters in the watersheds. Without that information, comparison is impossible.

8.9 *Section 8.1.1 Routine Operations*

Comment: Bullet number 2 of the list at the bottom of page 8-1 and continuing to the top of page 8-2 characterizes a loss of streamflows and then alludes to a reduction in production of salmon and resident species. This allusion is a mischaracterization of the overall assessment of risk, in that loss of fish production was not directly quantified, but the loss was indirectly quantified through potential losses in fish habitat (see section 8.5 concerning uncertainties and use of fish habitat loss as a surrogate for loss of fish production). This mischaracterization needs to be checked throughout the document for consistency.

Recommended Change: Throughout the document, remove all statements that characterize the risk in terms of loss of fish production and ensure all statements of risk are in terms of potential loss of fish habitat in keeping with the uncertainties presented in Section 8.5 – bullet 5.

EPA Response: Given that fish production inevitably depends on the availability of habitat, it is not improper to allude to that relationship. No change required.

Northern Dynasty Minerals Ltd. (Doc. #4611)

8.10 The following comments are summarized from tables that can be found in Doc. #4611, p. 8, relating to Pg. 8-3, Table 8-1 Probabilities of Failure:

Product concentrate pipeline: 98% chance per pipeline in 25 years"; concentrate spill into stream: "1.5 stream contaminating spills in 78 years"; concentrate spill into wetland: "2 wetland contaminating spills in 78 years"

Comment: Sources of pipeline failure rates are not directly applicable to mining and application of statistics to the data set is flawed.

EPA Response: Pipeline failure rates are based on the best available data. The comment provides no basis for assuming that a diesel pipeline at a mine would be more or less likely to fail than one associated with any other industry. However, the revised assessment contains more documentation of pipeline failures at mines.

Culvert, post-operation: "$3x10^{-1}$ to $6x10^{-1}$ per culvert – instantaneous = 4 to 10 culverts"

Comment: Sources of culvert failure rates are not applicable to modern road design, construction, and maintenance criteria.

EPA Response: The culvert failure rates are based on the best available data. The comment provides no alternative failure rates.

Water collection and treatment, operation: "High"; water collection and treatment, planned closure: "High"; water collection and treatment, premature closure or perpetuity: "Certain"

Comment: This is speculation. There are no supporting references as to why probabilities of failure are "High" or "Certain." In the event of a partial system failure a release is not certain. Similarly, in the event of a total system failure, a release of environmental significance is not certain.

EPA Response: The revised assessment contains more documentation of water treatment failures. The comment assumes statements about the probability of significant releases that were not in the assessment.

8.11 The Assessment's assumed mine footprint impact on fish habitat is unrealistic. Its assumed impacts upstream of the mine footprint ignore mitigation and management techniques. The Assessment's estimate stream flow analysis demonstrates poor science. EPA's statements regarding flow reduction effects on salmonid populations are unsupported by the published literature. EPA's failure to review and consider the data provided in the PLP Environmental Baseline Document to conduct this analysis is a serious omission and a failure to apply best available science. In addition, the method EPA used for judging the degree of impact on salmonid populations is essentially hydrologically based and has no direct linkage to salmonid fish populations and salmonid fish habitat.

EPA Response: See response to Comment 8.1. The comment does not specify what mitigation or management actions should have been considered.

8.12 8.1: The Assessment on page 8-1, 8.1.1 Routine Operations states: "Routine operations are defined as mine operations conducted according to conventional practices, including common mitigation measures, and that meet applicable criteria and standards."

Comment: This statement is simply not true. The routine operations scenario as described in the Assessment is not reasonable and the scenario does not include "common mitigation measures, … that meet applicable criteria and standards" For example, the Assessment concludes that 87.5 to 141.4 km of streams in the mine footprint area would be lost because of mine development. This conclusion is invalid because current policies and regulations would never permit a project that did not mitigate fur the loss of these stream channels. The Assessment provides no description of any mitigation measures that would be implemented under the routine operations scenario that would mitigate for these impacts. There are numerous opportunities within the three primary watersheds to provide alternate mitigation for the loss of these channels. It is an example like this that reinforces the conclusion that EPA's assertion that the mine development scenarios are "realistic" is simply not credible. It is abundantly obvious that EPA does not even understand the policies and regulations with respect to resource development. How can the routine operations scenario be considered "reasonable" when it fails to meet even the minimum mitigation requirements for such a project?

EPA Response: Habitat loss is inevitable if a pit is dug and wastes are stored on-site as described in Northern Dynasty Minerals' preliminary plan (Ghaffari et al. 2011). However, neither that plan nor this comment includes a description of how compensatory mitigation could be accomplished in this undisturbed area. Compensatory mitigation was not discussed in the first draft, but it is discussed in the in Appendix J of the revised assessment.

8.13 8.2: The Assessment on page 8-1, 8.1.1 Routine Operations states: "*Adverse effects on fish caused by habitat loss and modification would be directly and indirectly induced*."

Comment: This conclusion in the Assessment simply is not possible and inconsistent with assertions made earlier in the same paragraph from which this quote is taken. First, current policies and regulations would not allow habitat loss to occur without mitigation (usually at some multiple of the actual loss), so this "effect" is not allowed for a permitted project.

EPA Response: See response to Comment 7.20.

8.14 Second, indirect downstream effects are generally described in the Assessment as resulting from flow reductions. However, the Assessment fails to describe any mitigation measures that could be used to reduce or eliminate the habitat impacts of flow reductions, even though numerous opportunities exist to reduce or eliminate these impacts. One can only conclude that EPA either deliberately attempted to bias the conclusions reached in the Assessment in order to show adverse impacts or that EPA lacks even a rudimentary understanding of the policies and regulations governing the federal and state permitting requirements for the type of project hypothesized for the routine operations scenario. The routine operations scenario is not "reasonable" because, as described in the Assessment, the hypothetical project would never have been allowed to be developed under current policies and regulations.

EPA Response: The purpose of this assessment is to describe the risks associated with mine scenarios based on those published by Northern Dynasty Minerals (Ghaffari et al. 2011), which are described as permittable. Conventional mine mitigation practices would not mitigate the loss of streams and wetlands in a region with no destroyed or damaged aquatic ecosystems to be restored. Whether it would be permittable in practice is a question that is beyond the scope of this assessment.

8.15 8.3: The Assessment on page 8-1, 8.1.1 Routine Operations, 1. Removal of 87.5 to 141.4 km of streams; states: "Removal of 87.5 to 141.4 km of streams in the footprint of the mine pit and waste storage areas, under the minimum and maximum mine sizes, respectively, would result in the loss of 21.7 to 33.8 km of streams that provide spawning or rearing habitats for coho salmon, sockeye salmon, Chinook salmon, and Dolly Varden."

Comment: For the purposes of this comment it is assumed that " …the footprint of the mine pit and waste storage areas …" means the mine pit proper, the associated waste rock piles, and the tailings storage facilities. The Assessment is misleading in its conclusions regarding the ecological significance of the streams lost under the mine infrastructure. The Assessment is misleading in that implies that the stream channels described are in fact streams and leaves the reader with the impression that these channels are ecologically functional anadromous fish streams. This is simply not true. In fact, many of the channels are not ecologically functional at all and contain no fish or only indigenous resident species like slimy sculpin. The sentence quoted implies both spawning and rearing habitat would be lost for the species listed throughout each km of "stream". However, the Assessment, by relying on the AWC and AFFI failed to understand that the "streams" under the mine infrastructure are not as they are portrayed in the Assessment. Several facts will illustrate this point:

Dolly Varden are ubiquitous throughout the entire upper watershed areas in the three major streams (North and South Fork Koktuli rivers and Upper Talarik Creek) associated with the mine infrastructure. Both adults and juveniles are present and adults (approximately 150 mm in length) have been captured with spawning coloration. So this conclusion regarding Dolly Varden habitat loss is true.

In the watershed associated with TSF 1 (coded as NFK 1.190) no spawning Chinook or sockeye salmon have been documented spawning in this watershed, except for a few fish downstream of the hypothetical dam location for TSF 1, with none reported in the AWC database. A few juvenile Chinook salmon have been captured in the stream, but certainly these few individuals are not of ecological significance to the Chinook salmon population in the North Fork Koktuli. The same applies for sockeye. A few coho salmon have been documented in this watershed, but the number of adults observed has been sporadic and less than 10 individuals counted. Juvenile coho rearing does occur in the watershed, but again the ecological significance of these few fish to the overall coho population in the North Fork Koktuli is highly questionable.

In Upper Talarik Creek, the hypothetical waste rock pile would eliminate access to known spawning areas for Chinook and occasionally a few sockeye salmon. The number of Chinook observed in this portion of the watershed had generally been less than 10 fish and confined to two tributary streams entering the main stem from the west and south. Sockeye salmon spawning generally is less than 50 fish upstream of the Northeast Tributary (coded as UT 1.350), with one count of 500, but the percentage of the observed population in the stream is less than 1%. Sockeye salmon spawning is not reported in the area covered by the waste rock pile, according to the AWC database. Coho do spawn in considerable numbers in this portion of the watershed.

In the South Fork Koktuli watershed, no adult salmon have been observed spawning in the areas identified for the mine pit or waste rock piles. A few adult coho salmon have been sporadically observed in the stream associated with TSF 3 (coded as SFK 1.240), with the middle portion of the channel dry in some years, but generally less than 20 adult fish have been observed. The AWC database does not report coho spawning in this stream. The ecological significance of the coho salmon associated with this stream is highly questionable. Coho salmon are known to spawn in the lower portion of the watershed associated with TSF 2 (coded as SFK 1.190), but again the adult counts are relatively small and the ecological significance of these individuals to the coho salmon population in the South Fork Koktuli is highly questionable. Sockeye salmon juveniles are reported to have been found on one occasion in Frying Pan Lake, but the likelihood of misidentification is high given the habitat and predatory fish found in the lake and the distance from reliable locations (> 20 km downstream) where sockeye are known to spawn. The juvenile rainbow trout and coho and Chinook salmon that have been captured upstream of Frying Pan Lake have been individual fish or groups of less than about 20 individuals. The presence of sockeye salmon in this portion of the South Fork Koktuli River watershed should be dismissed.

Many of the channels claimed in the Assessment as potential spawning and rearing areas simply are not capable of being functional spawning or rearing habitats for anadromous fish. First, many of the channel segments are ephemeral and do not provide consistent habitat for juvenile fish. Second, many of the channels are simply too narrow or lack sufficient water depth to accommodate spawning salmon. Third, if EPA had reviewed the water chemistry data associated with these channels, they would have found that the alkalinity, hardness, and nutrient concentrations are so low that stream productivity is low and insufficient to support anadromous fish populations. Fourth, since these areas are not major spawning areas or in the case of the South Fork Koktuli River lacking spawning salmon, they would have concluded that the hypothetical influx of Marine Derived Nutrients (MDN) is simply not applicable to those portions of the watersheds associated with mine infrastructure. Fifth, if the authors had examined the water chemistry data, they would have discovered that groundwater primarily flows into the main stem channels and produces a dilution of water chemistry and nutrient constituents in downstream areas.

Since the AWC and AFFI do not provide estimates of relative abundance, the authors concluded that the stream channels were fully functional as part of the salmon ecosystem in the watersheds associated with mine infrastructure. By failing to follow EPA's ecological risk assessment guidelines with respect to verifying data quality, the

Assessment reached scientifically unsupportable assumptions and conclusions regarding the ecological significance of anadromous fish populations in the watersheds associated with the mine infrastructure.

Given the failure of EPA to understand that the portions of the watersheds associated with the mine's infrastructure are not ecologically significant to anadromous fish (with the possible exception of coho salmon in Upper Talarik Creek) and their failure to use publically available data that would have demonstrated this situation, the Assessment uses scientifically unsupported assumptions, analyses, and conclusions to reach scientifically unsupportable impacts to anadromous fish populations. If all of the publically available data had been used, the authors would have realized that anadromous fish do not play a major role in the portions of the watersheds associated with mine infrastructure and that the distribution information is unreliable and based on the capture of a few juveniles that are not ecologically significant to the salmon populations or their overall genetic diversity. Also, the Assessment fails to place the number, distribution, and genetic diversity of anadromous fish in the three primary watersheds in context of the anadromous fish populations in the Nushagak and Kvichak watersheds as a whole. Without this comparison, determination of "ecological risk" to the watersheds is impossible and scientifically unjustified.

<u>EPA Response:</u> Low abundances of fish do not indicate lack of importance to salmon (see response to Comment 5.107).

As the comment acknowledges, neither the data from the State of Alaska nor the PLP EBD provide good quantitative evidence concerning fish production in the streams that drain the site, either in absolute terms or relative to the Nushagak and Kvichak River watersheds as a whole. Because of that lack of data, it is not possible to express potential effects in terms of lost productivity or salmonid populations. Therefore, it was necessary to express results in terms of habitat loss and the species that were reported to occur in the streams by the State data sets and the PLP EBD.

Examination of the factors limiting salmon production was not an objective of the risk assessment. Cold stream temperatures and low nutrient concentrations may affect production of food resources for stream fishes, but this is true throughout the watersheds and not limited to just the mine footprint area.

8.16 8.4: The Assessment on page 8-1, 8.1.1 Routine Operations, 2. Reduced stream flow states: "Reduced stream flow resulting from water retention for mine operations, ore processing, transport, and other processes would reduce the amount and quality of fish habitat."

The Assessment assumes a reduction in the quantity and quality of fish habitat resulting from mine development and routine operations. This assertion is not supportable for five reasons.

First, the Assessment fails to identify any mitigation measures that could reasonably be implemented that would reduce or eliminate impacts to stream channels downstream of the mine infrastructure.

Second, the fact that the Assessment considers this a "reasonable" assumption is not valid. Current policy and regulations would not permit this type of impact to go unmitigated.

Therefore, the Assessment's assertion that this impact would be reasonably certain to occur is not supported by any demonstrable mechanism that would allow such an impact to occur.

Third, the Assessment fails to provide any documentation or analysis to show that the quality of fish habitat would decline because of stream flow reductions.

Fourth, as mentioned in more detailed discussion regarding the transportation corridor elsewhere in these comments, many of the assumed impacts from construction and operation of the transportation corridor are simply not true. Assumptions and conclusions regarding the transportation corridor are based on scientifically inappropriate literature and analysis, are internally inconsistent with the assumptions regarding road maintenance during routine operations, make inappropriate and ridiculous assumptions regarding road design and construction with respect to fish passage considerations as required by the ADFG. All of these fatally flawed assumptions result in conclusions regarding potential impacts to salmon populations along the transportation corridor that are not scientifically defensible.

Fifth, elsewhere in these comments there is specific documentation showing that the water balance assumptions, modeling and calculations are in error. Therefore, the Assessment provides no scientific basis on which to even assess the magnitude of any potential stream flow reductions, more or less the impacts of those reductions on fish habitat quantity or quality.

<u>EPA Response:</u> Habitat loss is inevitable if a pit is dug, wastes are stored and water is used and retained on-site as described in Ghaffari et al. (2011). However, neither that plan nor this comment includes a description of how compensatory mitigation could be accomplished in this pristine area. Compensatory mitigation was not discussed in the original draft assessment, but it is included in Appendix J of the revised assessment. The mechanisms by which habitat loss could occur are clearly described. The descriptions of risks from the road have been expanded and include greater descriptions of State of Alaska requirements. Water balance analyses and assumptions have been revised and expanded.

8.17 8.5: The Assessment on page 8-1, 8.1.1 Routine Operations, 2. Reduced stream flow; states: "Reductions in stream flow exceeding 20% would adversely affect habitat in an additional 1.8 to 9.5 km of streams, reducing production of coho salmon, sockeye salmon, Chinook salmon, rainbow trout, and Dolly Varden."

Comment: Detailed discussion is presented elsewhere in these comments regarding the use of the sustainability boundary approach described by Richter et al. (2011). These detailed comments point out that the approach described by Richter et al. (2011) is not appropriate for a site specific evaluation and is intended only as a surrogate placeholder in lieu of actual data, that the approach is based on daily flow data while this Assessment uses annual averages, or that the Assessment fails to present any scientifically defensible data or analysis that demonstrates that the approach is applicable to Alaska or to the anadromous fishes found in the hypothetical mine area. Also, given the fatally flawed water balance modeling and analysis, also documented elsewhere in these comments, it is scientifically indefensible for this Assessment to make and defend the conclusion that additional impacts to production of anadromous fish will occur at sustainability boundary levels exceeding 20%. In fact, the Assessment has not validly documented that any of the hypothetical effects exceed 20%.

<u>EPA Response:</u> It is impossible to document that any of the potential effects exceed 20%, since they have not occurred. The Richter et al. approach is approximate, but so is any predictive model of the effects of reduced flow. Neither the comment nor the EBD proposes an alternative.

8.18 8.6: The Assessment on page 8-2, 8.1.1 Routine Operations, 3. Removal of 10.2 to 17.3 km^2 wetlands states: "Removal of 10.2 to 17.3 km^2 wetlands in the footprint of the mine would eliminate off-channel habitat for salmon and other fishes. Wetland loss would reduce availability and access to hydraulically and thermally diverse habitats that can provide enhanced foraging opportunities and important rearing habitats for juvenile salmon."

Comment: The Assessment fails to point out to the reader that a majority of the stream channels in the vicinity of the "footprint of the mine" do not have off-channel habitat for salmon or other fishes. In fact many of the channels are deeply incised upstream of Frying Pan Lake in the South Fork Koktuli River. Also, ecologically functional off-channel habitats for salmon are very limited in the watersheds associated with the three tailings storage facilities and the tributaries associated with Upper Talarik Creek. Only the main stem channel of Upper Talarik Creek contains any reasonably functional off-channel habitats. The Assessment fails to provide any scientifically defensible data or analysis that supports the conclusion that "Wetland loss would reduce availability and access to hydraulically and thermally diverse habitats that can provide enhanced foraging opportunities and important rearing habitats for juvenile salmon." In fact, the Assessment specifically states that it was impossible to determine the impacts of mine development on water temperatures, except for the highly speculative conclusion that winter water temperatures might decrease and summer water temperatures might increase. However, this conclusion was in reference to stream channels and did not mention anything about water temperature and "thermally diverse habitats" in wetlands. No scientifically defensible discussion of foraging opportunities or important rearing habitats with respect to juvenile salmon and wetlands are presented in the Assessment. In short, the conclusions presented in this portion of the Assessment are speculative and not supported by any scientifically defensible data or analysis.

<u>EPA Response:</u> Since the EBD does not document the use of wetlands by fish, it is necessary for the assessment to make general statements about the way wetlands are used based on research conducted elsewhere and published in the scientific literature.

8.19 8.7: The Assessment on page 8-2, 8.1.1 Routine Operations, 4. Indirect effects of stream and wetland removal; states: "Indirect effects of stream and wetland removal would include reductions in downstream habitat quality in the three headwater streams draining the mine site, affecting the same species as the direct effects. Modes of action for these effects include the following."

Comment: The Assessment, as noted elsewhere in these comments fails to provide any scientifically defensible data or analysis that documents reductions in habitat quality downstream of the mine site. It simply is not credible for the Assessment to make this assertion and conclusion without any valid basis.

<u>EPA Response:</u> The quoted statements are based on general knowledge in the scientific literature concerning the functions of headwater streams and wetlands with respect to downstream fish habitat. It is not possible in a risk assessment performed before

development of a mine to "document reductions in habitat quality downstream of the mine site."

8.20 8.8: The Assessment on page 8-2, 8.1.1 Routine Operations, 4. Indirect effects of stream and wetland removal; states: "A reduction in food resources would result from the loss of organic material and drifting invertebrates exported from the 87.5 to 141.4 km of streams lost to the mine footprint."

Comment: The Assessment fails to identify that food resources are a limiting factor to anadromous fish production in the mine footprint area. This is particularly true since most of the channels hypothesized to be lost because of mine development do not contain or provide habitat for anadromous fish. Many of the channels are upstream of Frying Pan Lake and thus any nutrients or organic matter are incorporated into the lake's ecosystem and not available to anadromous juvenile fishes. Also, if EPA had reviewed the publically available information on nutrients, water chemistry, and total organic carbon concentrations from the multitude of sampling stations associated with the EBD and the PLP website, they would have discovered that the concentrations of water quality constituents necessary to support a large population of aquatic macroinvertebrates are too low to support high levels of primary productivity. Also, since many of the channels contain no spawning adult salmon, the import of MDN is not occurring. Finally, if EPA had examined the aquatic macroinvertebrate data in the EBD and the 2004 Northern Dynasty Minerals Fish and Aquatic Resources progress report, they would have discovered that the quantity of drift organisms in the mine infrastructure area is relatively low. These low drift rates are a direct reflection of the high quality/low productivity of the surface waters in the area and the lack of substantial riparian vegetation from which the drift organisms would fall. Lacking a limiting factors analysis and any data or analysis to scientifically document the ecological significance of organic matter and food resources to anadromous fish from the specific channels hypothesized to be lost by mine development, the Assessment cannot reach a scientifically defensible conclusion that the "reduction in food resources would result from the loss of organic material and drifting invertebrates" has any ecological significance to anadromous fish.

<u>EPA Response:</u> The EBD water quality results indicate that the streams are nutrient poor. For that reason, the loss of nutrient input from headwater streams and wetlands is more important than it would be in less oligotrophic systems.

8.21 8.9: The Assessment on page 8-2, 8.1.1 Routine Operations, 4. Indirect effects of stream and wetland removal; states: "The balance of surface and groundwater inputs to downstream reaches would change. Shifting the source water flow from groundwater to surface water could reduce winter habitat and make the streams less suitable for spawning and rearing."

Comment: The Assessment concludes that water from the water treatment plant will be discharged only to surface waters. This conclusion is the basis for the hypothetical impacts quoted above. However, any "reasonable" consideration of mitigation measures related to water management would also consider using water from the water treatment plant to recharge area groundwater aquifers. Given the importance of groundwater to mediate water temperatures and create upwelling at anadromous fish spawning locations, it would be routine for groundwater recharge to be a standard consideration for any project. The Assessment failed to even consider groundwater discharge as an alternative for water treatment plant discharge. In fact, the Assessment did not present a coherent and scientifically defensible water balance model and proposed only a surface water discharge from the water treatment plant. The EPA should have recognized the importance of groundwater to anadromous fish and included groundwater recharge as a potential mitigation strategy. The Assessment did neither.

<u>EPA Response:</u> The hydrologic modeling has been updated in the revised assessment, but it still does not include discharge of wastewater to groundwater aquifers. We know of no precedent for that practice in the mining industry and it is not part of the scenarios published by Northern Dynasty Minerals (Ghaffari et al. 2011).

8.22 8.10: The Assessment on page 8-2, 8.1.1 Routine Operations, 4. Indirect effects of stream and wetland removal; states: "Water treatment and discharge, resulting in reduced passage through groundwater flow paths, could increase summer water temperatures and decrease winter water temperatures, making streams less suitable for salmon and char."

Comment: The Assessment concludes that water from the water treatment plant will be discharged only to surface waters. This conclusion is the basis for the hypothetical impacts quoted above. However, any "reasonable" consideration of mitigation measures related to water management would also consider using water from the water treatment plant to recharge area groundwater aquifers. Given the importance of groundwater to mediate water temperatures and create upwelling at anadromous fish spawning locations, it would be routine for groundwater recharge to be a standard consideration for any project. The Assessment failed to even consider groundwater discharge as an alternative for water treatment plant discharge. In addition, EPA did not consider any mitigation strategy that would ensure that water discharged to the environment from the water treatment plant would be ecologically acceptable to the regulatory agencies. There are numerous techniques (e.g., cooling towers or water storage reservoirs) that could be easily used to meet a water temperature regime in the event a surface discharge was desired. As mention elsewhere, groundwater recharge would result in water temperatures that would reflect pre-project levels. Given the fact that the routine operations scenario assumes that all normal mitigation measures are implemented and functioning as intended, it would be impossible for the hypothesized impact on summer and winter water temperatures to occur. The Assessment presents no data or analysis to show what the water temperatures from the water treatment plant might be in this scenario, so it is impossible for the reader to determine if the conclusion regarding summer and winter water temperature changes is scientifically defensible. The conclusion is unsubstantiated speculation on the part of the Assessment. The EPA should have recognized the importance of groundwater to anadromous fish and should have included groundwater recharge as a potential mitigation strategy and been fully cognizant of the potential impacts of higher summer water temperatures on fish production and the impacts of lower winter water temperatures on egg development and emergence timing. The Assessment did neither. This entire line of reasoning in the Assessment is tortured and fatally flawed and certainly undermines the representation of potential impacts displayed in the conceptual models in Chapter 3 and the resultant conclusions regarding the endpoints for this ecological risk assessment.

<u>EPA Response:</u> Chapter 7 of the final assessment acknowledges that on-site storage could allow management of environmental flows to the degree possible, but also

recognizes potential limitations to this approach. An extended discussion of the significant challenges associated with manipulating groundwater and surface water using various storage options is included in Appendix J in the final assessment. Also see response to Comment 8.21.

8.23 8.11: The Assessment on page 8-2, 8.1.1 Routine Operations, 4. Indirect effects of stream and wetland removal; states: "These indirect effects cannot be quantified, but it is likely that one or more of these mechanisms would diminish fish production downstream of the mine in each watershed."

Comment: Given the earlier comments regarding the Assessment's lack of scientifically defensible analysis to support any of the conclusions reached in this section of the Assessment, that EPA failed to present a routine operations scenario that even meets current policy and regulations with respect to mitigation requirements for this type of project, and that EPA failed to consider even the most elementary mitigation strategies to address the ridiculous hypothetical impacts of mine development clearly demonstrates that the Assessment is not based on the policy and principles in EPA's ecological risk assessment guidelines and information quality guidelines.

EPA Response: Compensatory mitigation measures are discussed in Appendix J of the revised assessment. The quoted passage is simply a statement about mechanisms that would diminish fish production and is not inconsistent with EPA's ecological risk assessment guidelines.

8.24 8.12: The Assessment on page 8-2, 8.1.1 Routine Operations; states: "*Diminished habitat* quality in streams below road crossings would result primarily from runoff of road salts and of soil, leading to sedimentation of spawning habitat and reduced invertebrate prey. Because the road skirts Iliamna Lake, sockeye salmon are particularly at risk."

Comment: The Assessment failed to understand that road salts are used to remove snow and to provide a means of dust suppression. The conclusion about road salts diminishing habitat quality downstream is not based on any reputable or scientifically defensible analysis. No estimate of the amount of soil that would hypothetically be delivered to the stream is presented in the Assessment. Also, EPA is apparently unaware of the scientific literature related to the concentrations of salt that would be necessary to cause harm to juvenile salmon in the stream downstream of the transportation corridor prism. The Assessment presents no scientifically defensible data or analysis to support the conclusion that "Because the road skirts Iliamna Lake, sockeye salmon are particularly at risk." This comment is utterly absurd. No mechanism or analysis is presented in the Assessment that would demonstrate how the minor levels of soil or road salt from the transportation corridor could present even a minor risk to sockeye salmon in Iliamna Lake. This statement about risk to sockeye is scientifically unfounded and unsupportable.

EPA Response: We agree that data specifically relating road salt use and levels in Alaska to salmon production are not available. For that reason, the assessment is limited to qualitative statements that salt and silt in runoff constitute a risk to fish. However, the discussion of salt use and associated risks has been expanded in the revised assessment.

8.25 8.13: The Assessment on page 8-2, 8.1.1 Routine Operations; states: “Inhibition of salmonid movements could result from culverts that may block or diminish use of the full stream length.”

Comment: This statement is inconsistent with the assumptions of the routine operations scenario in which it is assumed that the culverts along the transportation corridor are correctly installed and maintenance inspections are completed on a daily basis. The Assessment fails to provide a scientifically credible mechanism or documentation to support this conclusion.

EPA Response: The assessment clearly states that the proposed maintenance inspections from Ghaffari et al. (2011) would minimize risks of culvert failure. However, following mine closure such maintenance may not be continued.

8.26 The BBWA repeatedly presents the likelihood of a failure of the water collection and treatment system as having a “high probability” and “certain” (pg. 8-3) events while admitting a lack of “…data on the frequency of failures to fully collect and properly treat waters from mining operations.”(pg. 8-4) Hence, the report relies on qualitative probabilities without supporting documentation. Similarly, the report concludes that failures are “highly likely” to result in releases of untreated leachate for up to months at a time (Table 8-1, pg. 8-3). These assumptions are not valid and fail to consider applications of modern process engineering systems used in mining operations today for water collection and treatment.

EPA Response: Supporting documentation has been added to Chapters 8 and 14 in the revised assessment.

8.27 Probability of failure estimates for culverts during mine operation and after closure are inaccurate and not applicable to the Pebble Project (Table 8-1, pg. 8-3).

Table 8-1 of the BBWA shows a low probability of failure for culverts during the operation of the mine and cites frequent inspections and regular maintenance as the reasons. Post-operation failure probability is indicated as 0.3 to 0.6, which has already been shown to not be applicable. The failure probability does not account for the use of bridges, box culverts and fish friendly culverts in place of typical culvert designs. The surveys of road culverts used as justification for the high failure rates were rarely designed for fish passage. Additionally, the report does not account for the possibility of decommissioning (removal) of some or all of the culverts post-operation.

EPA Response: The assessment assumes that culverts will not be decommissioned post-operation. It is not clear how this would be done unless the road was decommissioned, which seems unlikely.

The Pebble Limited Partnership (Doc. #4962)

8.28 *Section 8.1.2.4, Page 8-8*

The integrated risk characterization discussion in this section relating to road and culvert failures is illogical and not supported by current literature. USEPA has improperly evaluated impacts to aquatic habitat from blocked culverts and road crossings because it has ignored modern road construction standards. The Agency has inappropriately assumed that new road construction in the Bristol Bay watershed would use outdated technology and construction methods. This is an indefensible assumption and invalidates USEPA's entire analysis of this issue.

<u>EPA Response:</u> See responses to Comments 4.82 and 4.152.

<u>J. Breiby (Doc. #1711)</u>

8.29 EPADA states that a "[f]ailure of the dam at TSF 1 would result in the release of a flood of tailings slurry into the North Fork Koktuli River, scouring the valley and depositing tailings several meters (yards) in depth over the entire floodplain of the river." (Page 17, EPADA). It goes on to say that such an occurrence would scour and result in the complete loss of salmon habitat along at least 30 km of stream habitat, and states that this environment (though it is not clear whether "this environment" is intended as only the 30 kilometers destroyed, or a larger length of stream) "…would not support salmonid fish in the short term (fewer than 10 years)", but that the copper content would be toxic to "benthic macroinvertebrates." It goes on to say that "…existing data concerning toxicity to fish is less clear."(Page 17-18, EPADA). This statement by the EPADA seems to contradict other sources, again found in a very brief internet search, and does not mention that the slurry contained within the tailing dams will also contain, in addition to the copper, other heavy metals such as zinc, cadmium, mercury, iron, lead, and aluminum, all of which are often released at hard rock mining sites and all of which are toxic to salmon and other aquatic life (Renewable Resources Coalition Report "The Effects of Copper on Salmon – A review of the Scientific Literature" Carol Ann Woody). This slurry of heavy metals, if released into any of the salmon stream headwaters of Bristol Bay, would not stop at the first 30-kilometer scour, but would continue to flow downstream, eventually making its way into the tidal areas of the bay itself, perhaps permanently destroying one or more migration years of fish.

<u>EPA Response:</u> The 30-km distance is the limit of modeling, not the limit of flow of the tailings. The screening analysis of metals in Section 8.1 of the revised assessment shows that any toxicity from tailings would be dominated by copper and that other metals would be at most minor contributors.

<u>American Fisheries Society, Western Division (Doc. #3768)</u>

8.30 8.1, line 2. The omissions of tailings slurry, diesel, and gas pipelines should be corrected. They are common occurrences at mines and other industrial facilities, and their cumulative effects can be considerable.

<u>EPA Response:</u> Pipelines on the mine site, such as the tailings slurry pipeline, are believed to be relatively minor sources of risk compared to other pipeline risks. An analysis of the diesel pipeline from Cook Inlet to the site has been added to the revised assessment (Chapter 11). The assessment explains that leaks from gas pipeline would not pose a significant risk to fish.

8.31 8-2 another reference to road salts; no assumption that tailings facility would leak/degrade water quality.

<u>EPA Response:</u> The first draft did contain an analysis of tailings storage facility leakage and water quality effects. The revised assessment includes an analysis of the potential fate and effects of tailings leachate leakage (Chapter 8).

8.32 8-3, table 1 Use a 2000 y recurrence frequency here.

<u>EPA Response:</u> The comment suggests the historical recurrence frequency, which the we believe is too high for a new dam (as discussed in Chapter 9 of the revised assessment).

8.33 8-4, box 1. Given the 8 TSFs likely in the mining district, the risks rise to $8X10^{-4}$ to $8X10^{-6}$, or recurrence frequencies of 1200 to 120,000 years. Depending on maximum flows and seismic threats (vs. steady seepage at a 1.5 safety factor) it could be closer to $1X10^{-3}$ and a recurrence frequency of 120 y). By thinking best cases here, the underestimates of risk are considerable. At least provide a best and worst case range. Regarding treatment failures, USEPA can use data from known failure rates from other mines and calculate a mean or range.

<u>EPA Response:</u> The risk summary in Chapter 8 (Chapter 14 of the revised assessment) is based on a potential mine at the Pebble site, and now includes a summary of cumulative risks from multiple mines. Estimating the failure probabilities for a future tailings impoundment is difficult. Both the range of estimates of historic failure rates and design goals were considered, but design goals were used to estimate failure probabilities.

8.34 8-11, line #5. Also state that there is error in the stream lengths mapped and in salmonid occurrence in them.

<u>EPA Response:</u> Chapter 7 of the revised assessment acknowledges that stream mapping and fish surveys are incomplete.

8.35 8-11, line #6. Also consider other ore treatment chemicals and their synergistic effects.

<u>EPA Response:</u> Ore processing chemicals are considered in greater depth in Chapters 8, 10, and 11 of the revised assessment.

8.36 8-12, line #1. Also consider effects on nonindigenous commercial and recreation fisheries.

<u>EPA Response:</u> The scope of the assessment is limited to potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife. It does not include impacts to commercial or recreational fisheries, although Appendix E provides information on these fisheries.

8.37 8-12, line #3. Secondary development should also be included. It will be detrimental to salmon as well. It has not taken a toxic metal mine to decimate salmonids elsewhere in the world.

<u>EPA Response:</u> Secondary or induced development is discussed in Chapter 13 of the revised assessment.

8.38 Page 8-13, line 24-25. Failure to collect and treat leachate WOULD not “could” cause releases.

<u>EPA Response:</u> A failure would cause a release only if it occurred. However, the revised assessment includes seepage as an expected component of the scenario.

8.39 Page 8-15, line 3. Earthquakes and floods WOULD not “could” cause failures.

<u>EPA Response:</u> Neither earthquakes nor floods would inevitably cause dam failures.

Center for Science in Public Participation (Doc. #4106)

8.40 Section 8.1.2 Failures Box 8-1. Failure Probabilities It is noted that: “However, we may assume that failure of one dam would relieve pressure on other dams on the same TSF.” (Draft Assessment, p. 8-4)

This assumption bears more discussion. If a ruptured dam were repaired; (1) it would logically be repaired only to the level of remaining tailings; (2) a repaired dam would not necessarily have the same structural integrity as the structure that was initially designed, since it is now a “patch job” on a dam that has probably been structurally weakened; and, (3) even if it is safe to assume that failure of one dam would “relieve pressure” on other dams on the same TSF, it is not clear how to quantify that effect in the dam failure statistics used in this document.

<u>EPA Response:</u> The quoted statement refers to events associated with a dam failure. The consequences of a “patch job” were not included.

Bristol Bay Native Corporation (Doc. #4382)

8.41 The Draft Assessment also does not adequately assess the challenges (risks) of mitigating these stream and wetland losses, which we believe are substantial. We recommend that EPA address in the Final Assessment the risks/probabilities that such losses could be adequately offset through compensatory mitigation measures. This discussion should include examples of large hardrock mining operations that have excavated and/or filled large areas of fisheries habitat and wetlands where those direct impacts have been either benign or offset by compensatory mitigation measures.

<u>EPA Response:</u> Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this assessment. Nevertheless, Appendix J has been added to the revised assessment to address compensatory mitigation.

8.42 Appendix C to the Draft Assessment appropriately makes it clear that marine derived nutrients from salmon are likely to have at least some effect on important subsistence resources, including caribou and moose. As the Draft Assessment discusses, the Nushagak and Kvichak watersheds support a bounty of wildlife resources that are important to both subsistence and commercial users in the region. Indeed, the Draft Assessment correctly identifies that caribou, moose, bear, ducks, geese and other shorebirds provide a sizeable portion of subsistence protein crucial to the communities within the affected watersheds. Salmon that leave the river drainages to feed in marine ecosystems bring marine-derived nutrients to freshwater and terrestrial ecosystems when they return to spawn.

<u>EPA Response:</u> Comment noted; no change required.

Natural Resources Defense Council (Doc. #4608)

8.43 EPA's Deliberately Conservative Assessment Underestimates or Excludes Additional Larger Impacts of Mining to the Ecology of the Region. EPA has presented a judiciously conservative assessment that underestimates the environmental impacts associated with mining the Pebble deposit. Limiting its analysis to direct effects on salmon and salmon-mediated impacts, with a clear delineation of inevitable and possible harm, EPA's analysis starkly reveals that even a best-case mining scenario would trigger unacceptable impacts on the Bristol Bay environment. And yet, this conservative analysis omits or understates much of the most severe harm that a mine would cause.

The Proposed Port Presents a Significant Threat to Endangered Cook Inlet Beluga Whales

In addition to the pit, block caving, and tailings storage facilities, a Pebble Mine would require a range of other structures that will disrupt the natural environment of Bristol Bay. The proposed Pebble Mine and EPA mine scenarios call for construction of a port in Cook Inlet's Iniskin Bay – which would devastate a distinct stock of a highly endangered and geographically isolated species of beluga whales living in Cook Inlet. PLP has proposed to build a permanent deepwater port at Iniskin Bay to serve as a product load-out facility and to facilitate in-bound fuel, equipment, and supply shipments. According to the 2011 Wardrop report, the port facility would be designed to accommodate shipping of at least 1.1 million tons of concentrate per year in 28 vessels, as well as 50 million gallons of fuel and 31 container barges per year. Energy requirements for the proposed Pebble Mine would be met with a 378-megawatt natural gas-fired turbine at the mine site, as well as an 8-megawatt natural gas-fired generation plant at the port site. PLP plans to transport liquefied natural gas from the Kenai Peninsula and across Cook Inlet to the port site via a 60-mile sea-bottom pipeline, and then to the mine site via a 104-mile pipeline buried along a road corridor. A 104-mile road corridor (consisting of 86 miles of new road and 18 miles of existing road) would be constructed to connect the mine site to the port. Four pipelines would be constructed between the mine site and the port to transport slurry, diesel fuel, and natural gas. The road and pipelines alone are estimated to disturb approximately 12.5 square miles.

The Cook Inlet beluga whale is the smallest population of beluga whales currently recognized in Alaska and is a genetically distinct and geographically isolated population that lives only in Cook Inlet. In recent years, the population has plummeted from approximately 1,300 to 284 whales. The National Marine Fisheries Service ("NMFS") predicts that beluga whales have a 26% chance of extinction within 100 years and a 70% chance of extinction within 300 years. If the current population of beluga whales disappears, it is "highly unlikely" that other belugas would repopulate Cook Inlet.

NMFS has taken various actions over the past decade in an attempt to halt the decline, but the effort has not been successful. NMFS listed Cook Inlet beluga whales as endangered under the Endangered Species Act in 2008 and designated critical habitat in 2011. NMFS designated more than 3,000 square nautical miles of Cook Inlet "critical" to the species' survival, including much of Iniskin Bay. Despite these protections, however, the belugas' numbers have continued to decline. The 2011 stock assessment found a 20 percent decline since 2010 alone.

Pebble Mine would threaten the whales in several ways. First, the dredging necessary to create the port in Cook Inlet has the potential to re-suspend contaminants in the water; and dredging elsewhere has "seriously impacted" other populations of belugas. Second, the port will cause higher traffic in the area, leading to increased water pollution and contaminants, vessel traffic, and noise. In addition to the increased risk to belugas of ship strikes associated with significantly increased vessel traffic, the noise generated by this increase – resulting both from engine noise and cavitation around the propeller – is a particular threat.

Like all marine mammals, Cook Inlet beluga whales depend on sound for vital life functions – such as to navigate, find food, locate mates, avoid predators, and communicate with one another. Artificial man-made noise introduced into their environment can disturb beluga whales and interfere with these important biological behaviors. NMFS has found that anthropogenic noise may impact the survival – and recovery – of the species. For example, beluga whales have been observed reacting to ice breaking ships at distances of over 80 km, the effects of which have lasted more than two days following the event. The inevitable increase in both ambient noise and acute exposure to noise associated with port construction and operation associated with the proposed Pebble Mine would pose a serious risk to this already endangered population.

The risk from noise will only increase as ports expand, ship traffic increases, and development moves into previously undisturbed sites in Cook Inlet, including Iniskin Bay, the proposed Knik Arm Bridge and the Port of Anchorage Redevelopment Project. For a small, geographically isolated population of cetaceans, any limitations on range could endanger the animals' recovery. As NMFS correctly observed, "[d]estruction and modification of habitat may result in 'effective mortalities' by reducing carrying capacity of fitness for individual whales, with the same consequence to the population survival as direct mortalities." This risk is further exacerbated by other development activities in Cook Inlet, including oil and gas exploration, coastal development, construction, toxic contaminants, noise disturbance, military operations, competition with fisheries for prey, habitat modifications, waste discharges, urban runoff and climate change. The cumulative impact of these activities on Cook Inlet beluga whales is significant – and potentially deadly.

<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale mining and resulting fish-mediated effects to indigenous culture and wildlife in the Nushagak and Kvichak River watersheds, although we recognize the potential effects from a port and related development.

8.44 EPA places the annual probability of failure at 1 in 1 million years for "state-of-the-art" mines, and 1 in 10,000 for standard mines. Multiple dams – a feature of both EPA scenarios and the Pebble Mine 2006 water rights application– increase the probability to a recurrence frequency of 3,000 to 300,000 years. Furthermore, two structural features specific to the proposed Pebble Mine, in addition to the area's geological features described below, could render failure significantly more likely. Analyses of tailings dam failure relative to dam height show that around 56% have occurred in dams over 15 m, with 22% of incidents in dams higher than 30 m. The Pebble Mine proposal envisions three dams of over 200 m in height.

EPA Response: **Those probabilities are design goals. Designing to achieve those goals would require consideration of the geologic features of the site.**

8.45 Second, very high impoundments and those that contain large volumes of water – both required to mine the Pebble deposit – are particularly likely to fail if, also like Pebble, they are constructed upstream. Moreover, even if a containment dam remains relatively stable, the facility can still fail from an environmental perspective; dams can generate significant amounts of dust and impact groundwater quality due to seepage.

EPA Response: **The discussion of seepage has been expanded in Chapter 8 of the revised assessment.**

8.46 A breach of a tailings dam would unquestionably and irreversibly ravage the Bristol Bay environment through several waves of impacts. The initial flood wave and toxic run, moving at up to 6.1 m/s, would obliterate biota in its path, overtaking and altering the channel and floodplain landscape. The downstream area would be buried in meters of fine-grain sediment, leaving aquatic habitat and biota devastated. Finally, a silt plume would smother benthic organisms, followed by long-term metal oxidization that would release acid and heavy metals.

EPA Response: **Comment noted; no change required.**

Kachemak Resource Institute (Doc. #4617)

8.47 The extensive draft review did not include enough sociological data regarding inevitable developments of services for mining employees and families. These new residents will expect to hunt and fish, educate children, draw permanent fund dividends and have the usual array of recreational facilities.

EPA Response: **See response to Comment 8.43.**

The Pebble Limited Partnership (Doc. #4960)

8.48 Unacceptable Levels of Uncertainty. Sweeping uncertainty renders the Assessment's analysis and conclusions meaningless. Because the uncertainties in the Assessment (1) are insufficiently accounted for; and (2) extend beyond any scientifically supportable bounds, the Assessment is contrary to Agency policy and practice. First, EPA is required to properly identify and account for sources of uncertainty. The Region 10 Primer instructs that risk assessments are properly shaped by the scope of assessment constraints, including uncertainties in the data and analysis. 1 Ultimately, "[n]o matter what technique is used, the sources of uncertainty … should be addressed. While EPA purports to do this, its attempt fails to satisfy this requirement. EPA is bound to rely on precise, accurate data to the fullest extent possible, and must not rest its conclusions on uncertainty of a nature and scale that belies scientifically-supportable risk assessment. Unlike EPA's other watershed risk assessments, even others with predictive components, the Assessment focuses entirely on future, hypothetical stressors and activities, with no site-specific historical data to support its conclusions. The unprecedented over-reliance on unknown and speculative information and data clearly exceeds the limits of uncertainty contemplated by guidance.

EPA Response: The comment makes broad accusations that are not supported by any specifics. No change required.

8.49 The Assessment is riddled with uncertainty. For example, EPA's guidance explains the importance of quantifying impacts, yet very few of the predictive effects analyzed in the Assessment are capable of being quantified, and many of the impacts are not even conducive to meaningful qualitative description. Even where the Assessment attempts to estimate impact levels, it often cannot do so with any degree of certainty. 36 The lack of specificity as to mining in particular also conflicts with EPA's guidance. As to mining specifically, the Region 10 Primer requires that "[a] ssessment methods … be tailored to the type of mining and impacts that are taking place" and further instructs that an assessment evaluate specific characteristics of the site for the purposes of developing an appropriate monitoring program. Because this Assessment is focused on hypothetical mining activities, such tailoring is impossible. Both because of the extent of uncertainty and EPA's failure to properly account for it, the Assessment deviates impermissibly from Agency guidance. The Primer has recognized: Predicting the future effects of current changes is … hampered by lack of data. Each watershed is unique, and projecting future impacts of management changes may be most accurate when based on the watershed's responses to impacts in the past. Without accurate records, impact prediction becomes guesswork.

EPA Response: The term "assessment" is ubiquitous in the environmental realm and can be used to describe evaluations of opposite sides of an issue. The Primer referred to in the comment (*A Watershed Assessment Primer*, EPA 910/B-94-005) has the expressed intent to "present an array of strategies with which to assess both non-point source and point source pollution at the watershed level," with the goal that "With implementation and adaptive management, we can achieve improved water and habitat quality." This assessment, on the other hand, seeks to determine how future mining impacts may decrease water and habitat quality. Although the methodology described in the Primer may not be appropriate for this task, an apt conclusion was "There is no single correct way to analyze a watershed." The fact that EPA Region 10 has provided guidance on assessments of ongoing mining activities does not preclude assessment of potential future mining activities. Predictive assessment is more uncertain, but it is necessary.

Alaska Conservation Foundation (Doc. #4120)

8.50 The failure scenarios are conservative in that they consistently underestimate the maximum level of impact that could be expected in a worst-case failure scenario. As a result, the impacts from a worst-case failure are understated by the findings of the Assessment. While it is not possible to say that a worst case failure, or that the failure scenarios of the Assessment will occur, the Assessment does identify the type and magnitude of failures that might occur over the long (perpetual) life of the mine site. Based on the performance record of existing mines there is a significant chance that one of more of these failure scenarios will happen.

EPA Response: We believe that the failure scenarios are neither conservative nor worst case. They are designed to cover reasonably possible serious accidents.

Millrock Resources Inc. (Doc. 4828)

8.51 The Assessment identifies and evaluates early-stage exploration projects, such as Humble, as potential mines under Cumulative Effects and excludes them from the Summary of Uncertainties. The material depth of the Summary of Uncertainties stands alone as proof that the Assessment makes unrealistic suppositions.

EPA Response: We acknowledge in Chapter 13 of the revised assessment that few or none of the prospects currently being explored may be developed as mines. This does not invalidate consideration of potential impacts if they are to be developed.

Trout Unlimited (Doc. #4579)

8.52 Approach to Uncertainties in Mine Design and Operation: In light of the fact that the Assessment is not focused on a particular development proposal, the EPA properly relies on existing information and general knowledge related to the features and characteristics of the Bristol Bay watershed and associated mineral deposits as well as information related to relevant mining operations worldwide to inform its assessment of potential impacts in Bristol Bay. In the absence of a specific detailed development proposal, this is an appropriate and reasonable approach to assessing the certain, likely and possible relationships between existing resources and future mining related activities. The Assessment's hypothetical mining scenarios provide a realistic - albeit conservative - representation of the potential for mining and mining impacts on the salmon ecosystems of Bristol Bay.

EPA Response: Comment noted; no change required.

D. Shepard (Doc. #4825)

8.53 *Chapters 6 and 8*

Page 8-11. "The estimated annual probability of a tailings dam failure is uncertain and based on design goals rather than historical experience.

Page 8-12. "Further, unforeseen events or events that are more extreme than anticipated can negate the apparent wisdom of prior decisions (Caldwell and Charlebois 2010). "

Page 8-12. "Accidents are inherently unpredictable."

Page 6-35. "Further, the 2004 spill provides a case of an accident that was more severe than assumed in our hypothetical accident, in that the spill lasted less than 2 hours rather than 2 minutes. Hence, it suggests that concentrate pipeline failures are common at a modern copper mine and they can result in spills that are potentially more severe than our assumptions indicate. "

Areas for improvement and increased credibility that should be included and addressed are:

- Some of the data exist to quantify error bars (uncertainties) for the results produced in this assessment, yet error bars are unknown (Ch 6 and 8);

EPA Response: Where possible and appropriate estimates are bounded, although they are presented as numerical limits and not error bars.

- Previous EPA and literature failure rate predictions combined with failure results for those predictions are not provided;

<u>EPA Response:</u> The only relevant published analysis of failure rates relative to predictions is the Kuipers et al. (2006) report.

- Without the qualifications, experience in probabilities and predictive analyses, and the predictive results (prediction versus failures) of those making the predictions (indicators of prediction success and capability) to back up the selection of the authors, analysis results are less credible than normal published literature requires and this reviewer would allow;

<u>EPA Response:</u> We are unaware of any publication that requires or includes all of that information for the authors.

- Without reviewing the actual calculations (seemingly unavailable, but not without interest to this potential reviewer), reasonableness of assumptions, completeness of equations, and accuracy cannot be reviewed and should be assumed to be flawed; and

<u>EPA Response:</u> The comment is correct that the actual calculations are not included. However, the models and assumptions are described. That is conventional practice when publishing risk assessments. More detail is provided in the revised assessment.

- With consideration for significant figures seemingly overlooked, some of the quantification has lowered credibility.

<u>EPA Response:</u> The use of significant figures has been made consistent in the revised assessment.

Appendix A: Fishery Resources of the Bristol Bay Region

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

A.1 Section: Appendix A, Management of sport fisheries, Page 16

Comment: There are four, not three, local management plans guiding management of sport fisheries.

Recommended Change: Add the Nushagak-Mulchatna Coho Salmon management Plan (see 5 AAC 06.368), which is not included here. Additionally, although it is used as a guiding tool, the Southwest Alaska Rainbow Trout Management Plan is not adopted as regulation.

<u>EPA Response:</u> Text has been revised to include Coho Salmon Management Plan and to clarify that the Southwest Alaska Rainbow Trout Management Plan is guidance and not regulation.

A.2 Section: Appendix A, Management of sport fisheries, Page 17

Comment: Stating sport fishing is “banned” is not a good descriptor.

Recommended Change: Use closed rather than "banned". In addition, in the Kvichak drainage upstream from the outlet of Iliamna Lake, lake waters further than ¼ mile from inlet or outlet streams, remain open to sport fishing during April 10 – June 7.

EPA Response: We replaced "banned" with "closed" and clarified that sport fishing closures apply only to flowing waters.

A.3 *Section: Appendix A, Table 6, Page 29*

Comment: Estimates of run size for Canadian Yukon Chinook salmon are incorrect. The numbers for this stock might be escapements, but are not run sizes.

Recommended Change: Check and correct the run sizes for Canadian Yukon Chinook salmon per the cited reference. Perhaps these are escapements and the catch needs to be added in to estimate the run size.

Draft Comment Reference: Run sizes for Canadian Yukon Chinook salmon can be estimated from data available in Howard, et al. 2009 as per the Appendix A, Table 6 citations.

EPA Response: The Canadian Yukon Chinook estimates are based on summing the harvest and escapement numbers in the listed reference to come up with total runs.

A.4 *Section: Appendix A, Pages 32-36*

Comment: This section does not seem relevant to the stated scope of this assessment. There are no endangered species of salmon in Alaska, including Bristol Bay. Policies in regulation (e.g., 5AAC 39.222, 5 AAC 39.223) and philosophy of assessing and managing the State's salmon stocks as dictated in statutes and the State Constitution provide mechanisms to detect and to be proactive to address dramatic declines in salmon abundance.

Recommended Change: Delete pages.

EPA Response: We agree that Alaska's policies are directed toward salmon stock protection and maintenance. This section is relevant because the history of salmon endangerment elsewhere provides important context for present and future management.

The Pebble Limited Partnership (Doc. #4962)

A.5 *Section: Appendix A, Table 3, Page 24*

Comment: Citations are missing supporting the escapement data in this table. The timeframe during which these data were collected is missing. The inability to understand the foundation or source of the data makes it impossible to determine whether the assumptions, data, and analysis are valid or invalid.

EPA Response: These are not escapement data; they are current ADF&G escapement goals, so no timeframe is needed. The source is now provided in the text that references the table.

Nondalton Tribal Council (Doc. #5465)

A.6 Appendix A of the Assessment addresses the history of managing the Bristol Bay fisheries and does so as background to the Assessment and the issues related to mining metallic sulfide deposits in the Kvichak and Nushagak drainages. However, the Assessment does not address the parallel history of land management as background to these issues.

EPA Response: Information on commercial fisheries management has been moved into the body of the assessment (Box 5-2).

Northern Dynasty Minerals Ltd. (Doc. #4611)

A.7 The Appendices provided in Volume 2 of the Draft Assessment (Appendices A – D) have several inconsistencies and weaknesses. In general, the discussion of the factors supporting the exceptional productivity of the Bristol Bay area appeared to conflate cause and effect.

EPA Response: No specific information regarding inconsistencies or weaknesses was provided in this comment. No change required.

Appendix B: Characterizations of Selected Non-Salmon Fishes Harvested in the Fresh Waters of Bristol Bay

Northern Dynasty Minerals Ltd. (Doc. #4611)

B.1 This fact aside, and perhaps even worse, EPA has yet to explain or justify its outright refusal to acknowledge and properly consider relevant data made publically available long before PLP's submission of the EBD. As detailed by NDM consultant Randy Bailey in his critique (see Section III.A., infra), specific examples of data publically available but not used include:

- data on fish distribution and abundance from the fish collection permit reports provided each year by PLP to the Alaska Department of Fish and Game;

EPA Response: Information PLP provided the Alaska Department of Fish and Game (ADF&G) was posted by ADF&G on their Fish Resource Monitor website. This website:

1. **delineates the waters specified by the ADF&G as being important for the spawning, rearing and migration of anadromous fishes (i.e., the "Anadromous Waters Catalog") and provides access to supporting field data and observations; and**
2. **provides a portal to the Alaska Freshwater Fish Inventory (AFFI). The AFFI identifies locations where particular freshwater fish species and life stages have been observed and provides access to supporting field data and observations.**

In the development of the original draft of Appendix B, information provided by the ADF&G Fish Resource Monitor, including all of the PLP data posted there (e.g., data for survey projects HDR04, HDR05, HDR07, PEB91, and 08163) , was carefully and thoroughly examined. The same detailed analyses of the ADF&G Fish Resource Monitor, including all of the PLP data posted there, was extended in the development of the revised Appendix B.

- a compilation of all data submitted by PLP to the Alaska Department of Fish and Game from a June 2008 Fish Technical Work Group meeting in Anchorage in which an EPA representative was present and declined a paper copy of approximately 200 pages of fish distribution, fish density, snorkel counts, electrofishing surveys;

EPA Response: See above. All the PLP data posted by the ADF&G on the Fish Resource Monitor was carefully and thoroughly examined, both in the original and revised drafts of Appendix B.

- salmon escapement estimates presented by PLP at each of the agency meetings;

EPA Response: This comment is not applicable to Appendix B.

- Northern Dynasty Minerals' 2004 progress report on fish and aquatic studies, which contained information on fish distribution, relative abundance, salmon escapement counts, aquatic invertebrate information among other topics;

EPA Response: See above. All the PLP data posted by the ADF&G on the Fish Resource Monitor was carefully and thoroughly examined, both in the original and revised drafts of Appendix B.

- 1991 and 1993 fish survey reports prepared by Dr. James Buell for Cominco for streams associated with the Pebble prospect area; and

EPA Response: Dr. Buell's reports in the Pebble prospect area (e.g., survey project PEB91) are posted on the ADF&G Fish Resource Monitor website and were carefully evaluated as described above. Dr. Buell's fish survey reports cited in Appendix B (the freshwater distribution and habitats section for humpback whitefish), which reads in part: "In late August, apparently mature and perhaps larger immature fish were collected in small upland lakes draining to the upper North Fork Koktuli River (ADF&G 2011, sites PEB91NK011, PEB91NK019)." Sites PEB91NK011 and PEB91NK019 are sites sampled by Dr. Buell. In addition, new material in the latest revision of Appendix B describing the freshwater distribution and habitats of pygmy whitefish specifically refers to sites PEB91CH001 and PEB91CH007. These are sites sampled by Dr. Buell.

- The 2005 freshwater fish inventory completed by the Alaska Department of Fish and Game for several streams in the Pebble project area including the specific watershed under the hypothetical TSFs 1 and 2 discussed in the Draft Assessment.

EPA Response: Information collected by the ADF&G 2005 freshwater fish inventory (survey projects FSN05 and FSM05) is compiled on the ADF&G Fish Resource Monitor and was carefully and thoroughly evaluated in the same manner described for the PLP data. Further, Michael Wiedmer, author of Appendix B, was the Principal Investigator for the 2005 ADF&G field projects, as well as 2003 (FSB03), 2006 (FSN06), 2010 (FSN10), and 2011 (FSN11) field projects in the Nushagak and Kvichak river drainages, and he drew extensively on that field experience in crafting Appendix B.

B.2 The Appendices provided in Volume 2 of the Draft Assessment (Appendices A-D) have several inconsistencies and weaknesses.

EPA Response: No specific information regarding inconsistencies or weaknesses was provided in this comment. No change required.

B.3 NDM strongly encourages the peer review panel and EPA to review the Ecofish submission in its entirety to gain a better understanding of the many concerns surrounding EPA's analysis.

EPA Response: Comment noted; no change required.

Kachemak Resource Institute (Doc. #4617)

B.4 We do have background in the biological and sociological implications. As to the first, it is obvious that the more effort expended to discover evidence of fish presence, the more fish presence is always found. The Anadromous Catalogue is far from complete. In the Bristol Bay watershed, significant habitat is still unknown. If it were known, the extent of perturbances for which mitigation would be required would still be indescribable, except in theoretical scenarios of miscellaneous failures and risks associated with pollution.

EPA Response: The limitations of the AWC for characterizing full fish distributions are acknowledged in the assessment; no change required.

A. Seitz (Doc. #5313)

B.5 While most of the fisheries and aquatic habitat sections are well-written and informative, Appendices B and F are less so. Appendix B is difficult to read because of excessive regurgitation of less germane detail.

EPA Response: The comment provides no specific examples of excessive regurgitation, or which details contained in Appendix B are less germane; no change required.

Appendix C: Wildlife Resources of the Nushagak and Kvichak River Watersheds

NOTE ON RESPONSES: Comments pertaining solely to Appendix C were forwarded by EPA to the U.S. Fish and Wildlife Service.

Since the release of the May 2012 draft of this assessment, Appendix C has been published as a U.S. Fish and Wildlife Service report (available at http://alaska.fws.gov/fisheries/fieldoffice/anchorage/environmental.htm):

> **Brna, P. J. and L. A. Verbrugge (eds). 2013. Wildlife resources of the Nushagak and Kvichak River watersheds, Alaska. Final Report. Anchorage Fish and Wildlife Field Office, U.S. Fish and Wildlife Service, Anchorage, AK. 177 pp.**

The USFWS website includes a response to peer review and public comments on the draft report.

The Pebble Limited Partnership (Doc. #4962)

C.1 Appendix C contains several flaws. Most notably, (a) the methodology is based on one endpoint, salmon; and, (b) the assessment emphasizes the importance of marine derived nutrients, yet also states that nutrients derived from headwater streams are a driving factor in nutrient load and distribution in the terrestrial environment. Furthermore, the inherent uncertainties associated with the predictive assessment approach are, in fact, unreasonable because the assessment is based on worst case mining scenarios using outdated mining practices, some of which occurred over a century ago. On this basis alone, the predictive assessment is fundamentally flawed.

EPA Response: See response from U.S. Fish and Wildlife Service at http://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/pdf/peer_public_review_summary_watersheds_april_2013.pdf

C.2 *Appendix C, page 28.* An example of one of the weaknesses of predictive models that are not validated with local data is presented on this page. The brown bear population estimates are extrapolated from population densities obtained from other watersheds. Using bear population estimates derived from another location (as well as population estimates derived for any other species) to represent conditions in the Bristol Bay watershed can severely under- or over- estimate population densities. Information is lacking in the assessment to evaluate whether it is reasonable to assume that wildlife populations estimates derived from outside the Bristol Bay watershed are applicable. (p. 28)

EPA Response: See response from U.S. Fish and Wildlife Service at http://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/pdf/peer_public_review_summary_watersheds_april_2013.pdf

Nondalton Tribal Council (Doc. #3116)

C.3 Our tribe's reliance on the salmon fisheries for subsistence has become even more acute in recent years with the decline in big game and winter fish harvests. Our people continue to hunt big game within our tribe's traditional territory. However, moose populations have shrunk and the Mulchatna caribou herd, once a dependable source of game during the fall and winter hunting season, has dwindled in size and largely moved out of the area. Recently, hunts have required traveling up to fifty miles to reach herds on snow machines or all-terrain vehicles. Soaring gas prices mean that each hunt can cost hundreds of dollars for gas and other supplies, which is prohibitively expensive for many individuals. At the same time our big game hunting yield has diminished, the warming climate has limited our winter fishing because the increase in temperature leaves ice too soft and thin to safely traverse. As a result, many community members can no longer depend on this harvest to supplement their salmon catch. Instead, they have been forced to either set higher goals for the salmon harvest or augment their subsistence diet with expensive store-bought food.

EPA Response: Comment noted; no change required.

C.4 The Draft BBWA explicitly states that the construction of the mine itself would result in the destruction of important fish and wildlife habitat. Though the assessment does not analyze the effects of this habitat loss it does make clear that it would deplete critical non-salmon subsistence resources as well as important salmon spawning grounds. Moreover, the disruption caused by regular mine operations will likely push moose and caribou populations further from the Nondalton area, making hunting more costly and less viable for our subsistence hunters. Without this subsistence resource, we will need to rely even more on the salmon harvest to meet our nutritional needs. Increased reliance on salmon makes the protection of the salmon fishery even more important, and the risk of water contamination even more of a pressing concern for our members.

EPA Response: Comment noted; no change required.

V. Mendenhall, Ph.D. (Doc. #4113)

C.5 Aquatic birds that should be considered. ABR, Inc. reported on all bird species in the study area; however, since the EPA's focus is on wetlands, I will focus on wetland birds and other avian species that depend on them. ABR recorded 38 species of aquatic birds that use streams, lakes, and/or ponds in the immediate area of the Pebble prospect. Breeding in the area was confirmed for 22 species, including Tundra Swan, 5 species of dabbling ducks, 5 diving ducks, Red-breasted Merganser, 2 species of loon, Red-necked Grebe, Sandhill Crane, 5 shorebirds, and two species of gull (ABR Inc. 2012, Table 16.4-2). Additional species use water bodies in the Pebble area during migration to rest renew their energy resources. ABR surveyed lakes over several days in spring and fall; maximum numbers of individuals seen in single surveys included over 950 ducks, 80 gulls and terns, and 40 shorebirds. Just outside the Pebble area on the Nikabuna Lakes, 357 swans and 954 ducks were recorded at one time (ABR, Inc. 2012, Tables 16.4-3, 16.4-10). Many waterbird species that use the Pebble have healthy populations; however, several are "Species of Special Concern" because populations are declining throughout their range. These include the Harlequin Duck, Long-tailed Duck, Black Scoter, and Surf Scoter (ABR Inc., page 16.4-1).

EPA Response: The US Fish and Wildlife report (Appendix C), used as the primary resource for characterization of wildlife, includes an extensive discussion of waterfowl and shorebirds, as well as bald eagles and landbirds.

C.6 Water birds would be at risk of ingesting lethal levels of contaminants if they came in direct contact with tailings ponds or pit lakes (discussed below). If water bodies in the area of Pebble Mine were contaminated, birds could ingest contaminants from the water or their prey. Mallards suffered internal injuries or were killed when they drank typical mine water that was acidic (pH of 2) and that contained copper at concentrations of 594 milligrams per liter or higher (among other metals; Hooper et al. 2007). Contamination would probably be diluted in natural waters, but long-term exposure of birds to mine contamination has not been evaluated. The prey of aquatic birds are much more sensitive to metal contaminants than are the birds themselves. The acute toxic level of copper to amphipods is only 9.6 micrograms per liter (EPA 2007).

EPA Response: The scope of the assessment is focused on potential risks to salmon from large-scale mining and fish-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on wildlife, including water birds.

C.7 Non-aquatic birds also could be exposed to loss of habitat due to changes in the water table, or if groundwater and streams are contaminated. Shrub habitats are necessary for many "land bird" species, and their highest diversity was found in shrubs of moist and wet ground (ABR Inc. 2012, Figure 16.1-3). Fifteen species of shrub-dependent songbirds and the Willow Ptarmigan were recorded near Pebble; the Gray-cheeked Thrush and Blackpoll Warbler are Species of Special Concern (ABR Inc. 2012, page 16.1-34, Table 16.5-3). Several shorebird species also inhabit moist tundra habitats.

EPA Response: See response to Comment C.6.

C.8 The Assessment contains no evaluation of the potential impacts of Pebble Mine on birds, other than a narrow category of indirect impacts through changes in fish prey. The Assessment should include birds for the following reasons:

- Birds are a major component of wetland and upland ecosystems.
- Bird populations are sensitive to changes in habitat and to contaminants from mines.
- Among the reasons for denying a permit to dredge or fill, the Clean Water Act includes
- Protection of wildlife from unacceptable adverse impacts. Wildlife includes birds.
- Migratory birds as a group are "Trust Species" of the federal government. The U.S. Fish and Wildlife Service is supposed to ensure their population stability and has taken legal action in cases of outright bird mortality associated with mines.
- Some species in the Pebble area are "Species of Concern" of government agencies and/or NGOs, because of declining populations in Alaska or worldwide.
- Bird kills are a known problem associated with pit lakes and tailings ponds.
- The Assessment should consider various impacts on birds:
- Physical loss of habitats, due to alterations of stream flow and "dewatering" of the water table
- Indirect effects on birds from reductions in prey populations, due to habitat changes or contamination
- Direct ingestion of contaminants by water birds, via (a) contamination of groundwater and streams and (b) contact with toxic tailings ponds and pit lakes.

Reduction in bird populations would impact predators that depend on birds for food, such as Bald Eagles in the case of waterfowl, and Merlins in the case of small birds.

Aquatic birds consume fish and invertebrates, which could expose them to contaminants in the watershed. The prey of land birds are most abundant on moist tundra; shorebirds feed exclusively on insects and arachnids, and these are the principal foods of young songbirds and ptarmigan. Levels would probably be low, except in the vicinity of the mine; but effects of long-term exposure are not known. Raptors in the Pebble area, such as Bald Eagles and Ospreys, are predators on fish and could be exposed to contaminants via their prey. Scavenging birds such Bald Eagles, Ravens, and gulls could be exposed via dead fish.

EPA Response: See response to Comment C.6.

C.9 The Assessment considers the possible toxicity of tailings storage ponds, including the dangers of leaching into groundwater. However, there is no assessment of direct impacts of toxic water on wildlife, including birds. Hazards to birds should be added to the Assessment. Although the Assessment's scenario (Chapter 4) includes methods to reduce acidity and toxicity in pond water, major factors are overlooked. Unless these concerns can be met, it should be assumed that tailings ponds at the Pebble mine would have dangerously low pH and high levels of dissolved metals.

<u>EPA Response:</u> See response to Comment C.6.

<u>Northern Dynasty Minerals Ltd. (Doc. #4611)</u>

C.10 The Appendices provided in Volume 2 of the Draft Assessment (Appendices A-D) have several inconsistencies and weaknesses. In general, the discussion of the factors supporting the exceptional productivity of the Bristol Bay area appeared to conflate cause and effect.

In Appendix C there are several instances where statements and conclusions are not substantiated with supporting evidence. For example, the text states that "Southwest Alaska, including the Nushagak and Kvichak watersheds, possesses intact, naturally functioning terrestrial ecosystems that still support their- historic complement of species, including large carnivores. Such ecosystems, containing historic levels of biodiversity, are becoming extremely rare globally." The author's comparison of historical to present levels of biodiversity is not supported by baseline historical data on regional species assemblages and diversity.

<u>EPA Response:</u> See response from U.S. Fish and Wildlife Service at http://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/pdf/peer_public_review_summary_watersheds_april_2013.pdf

C.11 The EPA Report presents contradictory information in several instances. For example, on p. ES-23, the authors state that "Salmon predators deposit [marine] nutrients on the landscape, thereby fertilizing the vegetation and increasing the abundance and production of moose, caribou, and other wildlife that depend on vegetation for food." This statement contradicts text in Appends C p. 17): "As far as we can determine, there has been no research conducted on the MDN links between salmon and moose or caribou. However, we believe that while it is reasonable to assume that MDN transported to the Nushagak and Kvichak watersheds by salmon may be detectable in tissue of animals, especially those preferentially feeding in riparian areas (e.g., moose), this does not necessarily mean there would be any detectable benefit to these herbivores. In order for there to be a direct effect, salmon would have to have a strong fertilizing effect on forage, resulting in additional biomass on the landscape, and ungulates would have to be forage limited in order for the increased biomass to matter (Adams, personal communication)", and Appendix C (p. 37): "While it is plausible that MDNs might contribute to increased plant productivity and thus benefit moose, evidence of this h e c t impact was not located in the scientific literature."

<u>EPA Response:</u> The assessment has been revised to remove the statement regarding the link between MDN and caribou and moose. Moose are riparian species and would be more susceptible to a loss of riparian vegetation, but additional research is needed in

this area. Caribou are much less dependent on riparian vegetation, but again there is a lack of data. The documented link between MDN and brown bears is much stronger.

Appendix D: Ecological Knowledge and Cultures of the Nushagak and Kvichak Watersheds, Alaska

The Pebble Limited Partnership (Doc. #4962)

D.1 *Appendix D Section II.B-3, Page 33, paragraph 2*. Citations are missing describing the following statement: "These population changes resulted in shifts in salmon harvesting, when population remnants regrouped by joining other villages." In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: This statement was deleted from the revised appendix.

D.2 *Appendix D Section II.B-4, Page 36, paragraph 3*. Citations are missing describing the statement: "The loss of population (especially Elders), the disruption of families, the plethora of orphans, and subsequent rearrangements of the social order created a social and cultural upheaval that the Yup'ik struggled to overcome." In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: The citation is provided in the revised appendix.

D.3 *Appendix D Section III.C-2, Page 108, paragraph 2*. Citations are missing describing the studies of other Yup'ik populations in the nearby Kuskokwim River villages. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: Citations were provided in this paragraph in both the draft and revised appendices.

D.4 *Appendix D Section III.E-4, Page 131, paragraph 3*. Citations are missing describing the following statement: "The primary value passed on at fish camp is respect for nature and, particularly, respect for salmon." In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: A citation was added in the revised appendix.

D.5 *Appendix D Section I.A, Page 14, paragraph 1*. Citations are missing describing the University of Alaska Institutional Board Standards. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated

EPA Response: The UAA IRB guidelines have been inserted into the appendix and the consent form and methodology provided in an appendix.

D.6 *Appendix D Section II.A-2, Page 20, paragraph 1*. Citations are missing describing the archeological surveys conducted by BIA archeologists in connection with Native allotment assessments. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: The AHRS database is cited as a reference. This database contains verified information and conclusions regarding surveys.

D.7 *Appendix D Section II.A-2, Page 21, paragraph 1*. Citations are missing describing the surveys conducted by the Lake Clark National Park on the Mulchatna River and areas above tree line.

EPA Response: This text was deleted from the revised appendix to avoid confusion.

D.8 *Appendix D Section II.A-2, Page 21, paragraph 1*. Citations are missing describing the surveys conducted by the Alaska Office of History and Archeology. In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: The AHRS is the federally authorized historic and prehistoric site database for the State of Alaska overseen by the State Historic Preservation Officer through the Office of History and Archaeology and it is the citation. The underlying information regarding location, age, work done, cultural affinity etc. is not available to the public to prevent looting and trafficking of artifacts. Archaeologists can obtain access to the database for research purposes.

D.9 *Appendix D Section II.A-2, Page 21, paragraph 5*. Citations are missing describing the Alaska Heritage Resources Survey (AHRS). In the absence of technical references to the relevant literature upon which this information is presented, the basis for statements, assumptions, and conclusions cannot be evaluated.

EPA Response: See response to Comment D.8.

D.10 *Appendix D Section II.A-3, Page 26, paragraph 2.* Define D2c haplogroup.

EPA Response: The definition was added in a footnote in the revised appendix.

D.11 *Appendix D Section II.A-3, Page 26, paragraph 2.* Define haplogroup A.

EPA Response: See response to Comment D.10.

J. Kari (Doc. #3771)

D.12 Several times Boraas and Knott state that the Dena'ina/Yupik interface dates to about 4000 years. This is a complex subject and there is no single source that can be cited that draws together the strands of evidence. I would clarify this statement: the Athabascan/Eskimo interface in general region of Western Alaska dates to 4000 years. The Athabascans have been present in Alaska perhaps three-times longer, i.e., for 12,000 years. Boraas and Knott can provide a short summary of key points, such as: a) The Dena'ina have long term ties to the Htsaynen area. More sources can be cited to amplify this. (Balluta 2008, Kari 2007, Kari

Fall 2003, Kari forthcoming). b) In early prehistory (perhaps 3000 to 5000 years ago there are hints of non-Athabascan/non-Eskimo peoples being in the region. The people known in Dena'ina as Ułchena are one candidate (Kari forthcoming). These are hinted at via a non-Athabascan/non-Eskimo linguistic substraum in Dena'ina (Kari 2007 has some examples). c) The large sites at Old Kijik may have developed rapidly 1000 years ago upon the colonization of sockeye in streams there. d) A group of Nondalton/Lake Clark Dena'ina war stories, known as the Ts'enhdghulyał war stories (Kari forthcoming), provide significant evidence on regional dynamics for a period of about 1000 to 600 years BP. The Dena'ina adversaries of 900 to 1000 years ago were Yupik who were based on the Alaska Peninsula in the Naknek drainage. e) At the time of the Ts'enhdghulyał war stories, there was little or no Yupik presence on the middle and upper Mulchatna River. f) Dena'ina-Yupik bilingualism was asymmetrical; the Dena'ina could speak Yupik far better than the Yupik could speak Dena'ina (Coray 2007). g) The Yupik -Dena'ina interface in the general Pebble Mine area on Iliamna Lake and the lower Mulchatna River has been in place for about 150 years (since about the 1870s). The Schanz map of 1891, the first sketch map of Lake Clark/Iliamna, has some details on Yupik and Dena'ina place names. This map suggests that the Dena'ina/Yupik boundary in the Pebble Mine area was in place in the 1890s, and has remained much the same through modern times.

<u>EPA Response:</u> Appendix D was revised to expand the description of what is known of the place name list and cites the commenter's work more extensively. A summary of the work by the Nature Conservancy, which is the only place name documentation for the Nushagak River, was also inserted in the Appendix (TEK section).

The Appendix does not say that the Dena'ina/Yup'ik interface dates to 4,000 years ago, only that intensive salmon harvesting dates to that period. The scope of the Appendix is the importance of salmon and water in the lives of the people of the Nushagak and Kvichak and does not hinge on precise definition of territorial boundary shifts through time.

D.13 Some sources that are cited are not cited often enough. Andrew Balluta's 2008 book has thoughtful and highly detailed "verbal essays" on topics such as Dena'ina ethics, sacred places, fish behavior, and travel through the region. This book should be quoted from more frequently.

<u>EPA Response:</u> Additional references to the book were added and the book is summarized in the Traditional Ecological Knowledge section of Appendix D.

D.14 The Dena'ina ethnogeographic materials are among the best for any Alaska Native language. The attractively formatted book, Evanoff 2010 has accurate Dena'ina place name lists and maps on a color land-sat base image (Kari 2010). These maps were prepared by National Park Service. Some map plates from that book could be added to Appendix D. See attached Map 1, Nondalton area (p. 123 in Evanoff 2010), Map 2, Nikabuna & Frying Pan Lake Area (p. 128 in Evanoff 2010), and Map 3, Newhalen and Iliamna Area (p. 132 in Evanoff 2010). I think that Lake Clark National Park would give permission to these map plates to be added to Appendix D.

<u>EPA Response:</u> A discussion of this information was added to Appendix D.

The Pebble Limited Partnership (Doc. #3797 and #4962)

D.15 The peer reviewers should be asked about the future of the Alaska Native subsistence culture in the region in the absence of mining. Recent trends demonstrate declining human populations near Bristol Bay, and dismal economic prospects. Mine development might provide long-term opportunity for improved employment, better infrastructure (including schools), lower energy costs, and better means to access the salmon fishery. The peer reviewers should be asked whether subsistence cultures can be expected to thrive, or even survive in the region without new, non-fishery economic development. They should be asked whether EPA too narrowly framed its analysis of impact on subsistence cultures, and whether EPA's assumptions regarding current and future population and viability trends are valid. The peer reviewers should also be asked whether EPA's draft Assessment adequately takes those factors into account.

EPA Response: Charge questions for the peer reviewers pertained to the scope of the assessment, and did not include any questions related to a speculative cost-benefit analysis of mining, which was outside of the scope of the assessment. However, the peer reviewers were provided with a summary of public comments and access to all public comments, including this one.

D.16 *Appendix D Executive Summary, Page 5, paragraph 2 (1st bullet on page 5).* Citations are missing describing the relevant state and federal laws.

EPA Response: Citations were added to the revised draft appendix.

D.17 *Appendix D Section III.B-7, Page 100, paragraph 2.* The link provided for the Census unemployment rate data is inactive.

EPA Response: The correct link was included in the revised draft appendix.

National Resources Defense Council (Doc. #4608)

D.18 The six villages that first petitioned EPA all depend on a subsistence lifestyle. Nondalton gathers an average of 358 pounds of subsistence per person in the village each year. New Stuyahok gathers 700 pounds per person, Levelock gathers 884 pounds per person, Ekwok gathers 797 pounds per person, Curyung (Dillingham) gathers 242 pounds per person, and Koliganek gathers 830 pounds per person. All but one of these villages gathers substantially more subsistence than the area's average of 300 pounds per person.

EPA Response: The language in the revised assessment (Chapter 5) was expanded to identify differences in subsistence use among villages.

American Fisheries Society, Western Division (Doc. #3768)

D.19 The report indicated that developing a quantitative relationship between development and cultural effects is not possible. However, although it may be difficult to quantitatively evaluate the relationships between salmon and health/culture, this would be possible by identifying indicators of human activity in the area that have cultural significance. For example, given that salmon are critical to the entire way of life in these Alaska Native cultures (both as a subsistence resource and as the foundation for their language, spirituality, and social structure), quantitative indicators could include socio-demographic and economic structure variables such as unemployment rates, the ratio of unemployment rates of Native and non-Native populations, occupational structure, health/disease, and the possibility to live in the area on present and projected income (or resources). Such a socioeconomic evaluation should not be limited to the Yup'ik and Dena'ina Alaska Native cultures in the Nushagak River and Kvichak River watersheds; rather, it should encompass the total population in the Bristol Bay Basin.

<u>EPA Response:</u> The scope of the assessment is limited to potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.

D.20 Regarding the treatment of Alaska Native culture, subsistence, and tradition, the intent of the authors is both appreciable and valid--to characterize in as strong a way as possible the importance of salmon to local peoples. However, they root too much of this discussion within an imaginary realm of indigenicity that locks native culture into something historical and unchanging. Take for example on page ES-8 where they lament, "two of the last *intact* sustainable salmon cultures in the world," or page ES23 where they argue that "indigenous culture *will decline*" should there be negative impacts on salmon, or finally page 2-19 where they claim that "salmon as the basis for Alaska Native Cultures are inseparable." We agree with these statements in general because salmon have historically been and continue to be very important to many Alaska Natives, as reflected in economies, traditions, story, art, etc. As such, loss of salmon resources would have significant nutritional, psychological, social, economic, and cultural impacts on residents of Bristol Bay and elsewhere. But it is problematic to make too direct a link between one resource (salmon) and indigenicity itself, because the hallmark of these cultures, if there is one, is flexibility and innovation, not some static reliance on one resource (see e.g., Loring and Gerlach 2010b). Also, consider the implications should the resource in fact be compromised by some failure. Would we then be forced to consider these cultures as "dead", precluding their ability to adapt, innovate, and self-determine? Certainly there is value that should be appreciated in the cultures and livelihoods as they are now; an additional way to argue this, and one that seems relevant to existing policy, would be from the perspective of water security, food security, and food sovereignty, as the Clean Water Act and Magnuson-Stevens already provide existing protections to fishing communities and livelihoods at the federal level.

<u>EPA Response:</u> Comment noted; no change required.

<u>National Park Service and U.S. Geological Survey (Doc. #4607)</u>

D.21 Appendix D, Page 11, Tribal Consultation, Introduction: The Assessment makes reference that "Port Alsworth did not respond to the government to government request." Several tables within the document reference Port Alsworth with other federally recognized Tribes. Tanalian Incorporated is not a federally recognized Tribe and should not be treated as such in the document.

<u>EPA Response:</u> The appendix has been revised to clarify that there is no federally recognized tribal government in Port Alsworth.

D.22 Appendix D, Page 20-21, Cultural and Historical Background Introduction: The third sentence in the introduction paragraph states: "In the 1960s James Van Stone conducted an archaeological survey…; Lake Clark National Park has conducted various survey projects on the Mulchatna River and areas above tree line; the Pebble Partnership…" Please correct the survey sites. The Lake Clark National Park and Preserve were located in a range of habitat types from alpine to deciduous forest to mixed conifer forest.

<u>EPA Response:</u> The appendix has been revised to correct this information.

D.23 Appendix D, Page 23, Figure 3, Cultural and Historical Background: Figure 3 depicting the geographic areas within the Nushagak / Kvichak Watershed should denote that radiocarbon dates exist for all timeframes presented in the graph for Lake Clark, additional radiocarbon dates exist back to 10,000 BC for the Lake Clark area, as well.

<u>EPA Response:</u> The primary reason for including the archaeological information was to establish the time-depth of intensive salmon harvesting in the area. A comment from one of the tribes said our chart was misleading because it started at 4,000 years ago so the entire time-depth to 12,000 years ago was included. On the chart "selected radiocarbon dates" indicate those that would establish the 4,000 year old salmon sites. To add all of the radiocarbon dates would be very time consuming and would not add to the primary objective of the appendix which is to evaluate the importance of salmon in the Alaska Native cultures.

<u>Nondalton Tribal Council (Doc. #3116)</u>

D.24 But subsistence is not a welfare system or a nutrition program; it forms the core of our culture, society and spirituality and is therefore essential to the community's well-being. Harvesting and preserving subsistence resources promotes the passing down of traditional knowledge, bonding among our members and fosters traditional values like sharing, generosity, hard work, respect, gratitude, cooperation, humor and pride.

<u>EPA Response:</u> The assessment has been expanded (Chapters 5 and 12 in the revised draft) to bring forward more information on the psychological, cultural, social, and spiritual connections between Alaska Native cultures and fish.

<u>Northern Dynasty Minerals Ltd. (Doc. #4611)</u>

D.25 The geographic focus of the EPA Report on Alaska Native cultures in the Nushagak River and Kvichak River watershed's is selective (as scope of the cultural assessment is at the scale of Bristol Bay) and the rationale for this approach is not presented. There are members of these cultures that hold pro-development (e.g., mining) perspectives, which are identified in the Appendices but not Volume 1.

<u>EPA Response:</u> See response to Comment 2.3. The revised assessment (e.g., Executive Summary, Chapter 2, Chapter 12) acknowledges that some residents hold pro-mining perspectives.

D.26 The use of certain survey numbers is biased and misleading, considering that moose and caribou were deemed 'significant subsistence food sources' for all Bristol Bay residents based on the fact that 86% and 88% of respondents had consumed moose or caribou meat over the past year, respectively (i.e., the quantity/proportion of consumption is not provided).

<u>EPA Response:</u> **The assessment has been revised to more accurately reflect the available information about subsistence use and diet. Although we have statistics from ADF&G for percentage of residents using subsistence resources and per capita harvest of subsistence resources in these watersheds, we do not have any dietary studies. The per capita subsistence harvest is quite high, leading to the conclusion that subsistence accounts for a major part of the diet of most residents. The text has been revised to clarify these distinctions and references a dietary study from a nearby watershed (Johnson et al. 2009).**

The language in the revised assessment (Section 5.3.2) also has been revised to state that a significant number of respondents harvest moose or caribou. Currently available data on harvest of dressed meat is presented in Appendix D.

D.27 Appendix D provides descriptive qualitative and quantitative information pertaining to the Yu'pik and Dena'ina Alaska Native cultures. Much of this information is not utilized in Volume 1, likely due to the often subjective nature of the content (e.g., personal values, opinions, etc.). Rationale, context, and adequate explanation of the applied methodology and conclusions are not always provided. For example, seven of fourteen villages in the Nushagak and Kvichak Watersheds were selected to participate in comprehensive interviews. The rationale for this, aside from limitation of time and resources, was not provided. Further, context regarding why certain villages are undergoing such dramatic population shifts was not provided (e.g., can it be determined if residents are relocating for economic opportunity, community, etc.?). For instance, Portage Creek has dropped from 48 residents (1980) to 2 residents (2010), while others such as Kokhanok have more than doubled from 83 (1980) to 170 (2010). The view of certain village-members that are pro-development in the region was also captured in Appendix D, but not clearly represented in the EPA Report- Volume 1. Finally, certain aspects presented in Appendix D, such as emerging challenges associated with subsistence-living, were not presented in Volume 1 (e.g., rising gasoline costs are increasingly placing pressures on the use of mechanized boats, ATVs and snow-machines, all of which are heavily utilized for travel to fish camps and general subsistence-related activities).

<u>EPA Response:</u> **The section on methodology in Appendix D has been expanded to explain the process used to identify interviewees.**

The census population statistics for each village are provided in Appendix D. The census data are summarized in the assessment and show, as the comment notes, increases in some villages and decreases in others. As a whole, the villages in the watersheds experienced significant growth after 1970 and had a smaller decline of population from 2000 to 2010. The assessment has been revised (Chapter 5) to acknowledge some villages have declined in population, while others have increased.

The assessment text has been expanded (Section 5.4.2.2 of the revised draft) to acknowledge the complex interaction between the subsistence way of life and the market economy.

Appendix E: Bristol Bay Wild Salmon Ecosystem Baseline Levels of Economic Activity and Values

AK State Legislature – C. Giessel (Doc. #0779)

E.1 The unprecedented action by the EPA, shutting down a resource project, on state land, before it was permitted, will have a devastating effect on Alaska as a whole. The area in which the minerals exist is experiencing poverty and declining population.

Since 1999, twenty-seven Alaska schools in rural communities have closed, in accordance with state law requiring a minimum of 10 students for school funding. Four Alaska schools are slated to close this fall because of enrollment less than 10 students … one of those schools is in Clark's Point, Bristol Bay. School closings have a ripple effect in a community, as the families of remaining children move to communities with schools or to the cities, where parents can find work. In the case of a particular village, the community health aide is leaving to take her child to another community with a school; this leaves no healthcare available to the remaining residents.

The cost analysis of this potential application of 404(c) must be calculated in the lives of rural residents who have no economy at this time. For many, the sole economic support is in the form of government assistance.

EPA Response: We appreciate the concerns raised in this comment, and Appendix D includes a brief description of the population dynamics of communities in Bristol Bay. However, an analysis of current and potential future economic opportunities for Bristol Bay residents is outside the scope of this assessment. This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy salmon ecosystem. It is not a cost-benefit analysis.

Alaska Department of Natural Resources (Doc. #4818)

E.2 The Assessment acknowledges the economic, social, and cultural benefits that the fish and wildlife resources provide to the residents of the region and the State. The Assessment does not consider any potential benefits of mine development to human health, safety, and welfare, including for those individuals who live in the region. The Assessment presents a limited and biased picture of only adverse impacts of a hypothetical mine, and fails to disclose to the public those benefits to the region and State that might result from large mine development.

References available from the State and PLP could have been used to describe additional economics regarding the positive impacts this type of development has already had in the region. The annual Alaska Mineral Industry Reports includes annual reported expenditures by the PLP on the Pebble project for 2006 -2010.

EPA Response: Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. Any mine development in the region is not dependent on a healthy ecosystem, and thus is outside the scope of this assessment.

E.3 *Comment*: These pages discuss the value of the fishing, subsistence fishing, hunting and recreation industries for Bristol Bay and list the part and full time jobs that are provided by these industries. By the nature of the weather, most of these jobs are part time. Also, no discussion of the high paying full time jobs is provided for the mine operation. A reader of the Bristol Bay Watershed Assessment Executive Summary and Appendix E versus one reading the Northern Dynasty Minerals, Ltd. report of 2011 will arrive at two different conclusions. The Northern Dynasty Minerals, Ltd. report states that the area has significantly dropped in population (16% since 1997) due to lack of jobs and that the price of sockeye salmon has dropped from an inflation adjusted peak of $3.75 in 1988 to $0.60 after the year 2000. Data presented in the Assessment on pages 81 and 82 of Volume 3 Appendix E show that prices are on the rise again although the graphs show fluctuations over time. However, none of this valuable information seems to have been included in the Executive Summary. The Executive Summary fails to state that the price has not recovered to what it was in the 1980's. The Northern Dynasty Minerals, Ltd. report fails to state that the price has made somewhat of a comeback since 2006.

Recommended Change: Include some of the fisheries statistical data that is in Appendix E in the Executive Summary. Also, it should be stated in the Assessment that the mine would provide 2500 jobs during a 4 year construction period and 1100 full time jobs over the life of the mine. All of these jobs are full time and high paying.

<u>EPA Response:</u> This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures; an assessment of potential economic benefits of mine development is outside its scope. The material about the commercial fishery included in the Executive Summary provides a picture of the economic activity the commercial fishery is supporting presently, using data from 2009. Although the detailed information presented in Appendix E provides important historical information on the commercial fishery, the material in the Executive Summary is intended to characterize the current fishery and detailed historical information is not needed.

E.4 *Comment*: The entire Appendix E provides statistics on the entire Bristol Bay region, where many drainages have no contact whatsoever with the mine. An example of this is on page 58 where the annual harvest in millions of fish is shown for various drainages. The Ugashik, Egegik and Togiak drainages are completely unaffected by anything that could happen at the mine.

Recommended Change: To be fair and unbiased, either revise Appendix E to remove drainages that could in no way be affected or very openly state in Appendix E and the executive Summary that these drainages could not be affected by the mine.

<u>EPA Response:</u> Appendix E characterizes economic activity that depends on the entire Bristol Bay salmon ecosystem. We recognize that the Nushagak and Kvichak River watersheds are only a portion of the Bristol Bay watershed, but characterizing economic activity that depends on the Bristol Bay salmon ecosystem allows one to compare activity in the Nushagak and Kvichak River watersheds to other watersheds in Bristol Bay.

Resource Development Council (Doc. #3774)

E.5 EPA's assessment fails to address or acknowledge the potential positive economic impacts a project in the area could provide to the Southwest Alaska region, and across the state. The region is experiencing a decline in both population and subsistence activity, and has a high rate of poverty. The assessment ignores the positive benefits of Pebble in a region without a diverse economy.

EPA Response: Appendix E is intended to provide a baseline evaluation of current economic activity and related ecosystem services values dependent on a healthy salmon ecosystem. It is part of our characterization of the salmon fishery. It is not an economic impact assessment and, as discussed in Appendix E, it does not attempt to evaluate any costs or benefits associated with mining activity in the region.

The Pebble Limited Partnership (Doc. #4960 and #4962)

E.6 EPA's Assessment includes an inappropriate and biased economic analysis. The Clean Water Act addresses environmental concerns. It does not confer on EPA the authority to assess a project's predicted adverse economic impact, especially where the Agency fails to assess that project's economic benefits.

Even assuming that Section 404 of the Clean Water Act authorizes EPA to predict economic impacts at all, the Assessment's consideration of economic costs would be patently biased. A balanced watershed assessment would not consider claimed economic costs and while ignoring economic benefits, Yet, that is precisely what the Assessment does by addressing only the value of commercial and other fisheries, while ignoring the jobs, community resources, tax base, improved infrastructure, and other economic benefits that would accompany new mining development in the region. This is the mark of a biased report, not a scientific one.

EPA Response: See response to Comment E.1.

E.7 *Appendix E, Table 3, page 18*

There is inadequate discussion regarding the assessment of wetlands and other habitats, and their extent and value to the ecosystem (e.g., water quality, water retention, wildlife habitat, sedimentation control, and other functions and values). Unlike the section title, there is no discussion regarding the quality of water, or diversity of wildlife uses, or any potential degradation of aquatic habitats in the ecosystem. This section simply assumes negative impacts to the ecosystem without an appropriate consideration of the services and characteristics of the environment under examination.

EPA Response: Appendix E does not attempt to quantify any impacts to the ecosystem, but instead provides a baseline evaluation of current economic activity dependent on a healthy Bristol Bay ecosystem.

Northern Dynasty Minerals Ltd. (Doc. #4611)

E.8 NDM does not object to EPA's conclusion that the ecological resources of the Bristol Bay Watershed generate considerable value - by their account, some $480 million in direct and indirect economic expenditures and annual employment for some 14,000 full and part time workers. Bristol Bay represents the largest sockeye salmon fishery in the world. This fishery is economically significant, such that NDM and PLP have long stated that fully protecting the fisheries resources of the region is a principal goal of mineral development at Pebble. However, NDM strongly objects to the EPA's suggestion that this entire resource (or even a significant portion of it) "could be at risk from extractive resource development in the region." When developed, the Pebble Project is expected to occupy an extremely small portion of two of the nine major drainages that contribute to the Bristol Bay economic values quoted above. The other seven drainages, as well as the fisheries, wildlife and other ecological values they support, will be wholly unaffected by Pebble. Even within the two drainages in which the Pebble Project is expected to have a footprint - the Nushagak-Mulchatna and the Kvichak - the project will likely occupy about one-tenth of 1% of the total area. Given strict permitting, monitoring and regulatory oversight in Alaska, it is not reasonable to assume that a project on this scale could meaningfully impact ecological resources over such a broad area - and certainly not within drainages to which it is not hydrologically connected. Further, NDM is aware that the goal of the Pebble Partnership is to design, build and operate a mine at Pebble that fully protects and preserves local and regional fisheries and other ecological values, such that the Pebble Project serves to co-exist with and supplement the existing local economy. NDM is disappointed that no serious attempt was made by EPA to provide convincing evidence to establish what adverse economic consequences, if any, there may be to the Bristol Bay fishery as a result of mineral development. This is an important question in light of requirements that any project like Pebble be fully and functionally mitigated, especially with respect to fish habitat and fish production.

<u>EPA Response:</u> **Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy salmon ecosystem. As discussed in Appendix E, this analysis does not attempt to "predict adverse economic consequences" or evaluate costs or benefits associated with mining activity in the region.**

We appreciate the commitment to ecosystem protection from Northern Dynasty Minerals and the Pebble Limited Partnership. We disagree with the assumption that impacts to small parts of an ecosystem "could not meaningfully impact ecological resources" of the broader ecosystem. The assessment's mine footprints would eliminate tens of miles of streams and thousands of acres of wetlands. The removal of these streams and wetlands would result in reductions in the quality of downstream habitat in addition to other indirect effects (detailed in Chapter 7 of the revised assessment). The failure scenarios included in the assessment outline additional impacts that could occur during mine operations or after mine closure.

E.9 Further, EPA has entirely ignored the economic and diversification benefits that mine development would bring to the local region, the State of Alaska and the United States. Rather, what is provided in the Draft Assessment's Appendix E (Bristol Bay Wild Salmon Ecosystem Baseline Levels of Economic Activity and Values) is a hastily compiled economic baseline, presented by EPA as a "a relatively comprehensive estimate of the total economic value that could be at risk from extractive development in the region." Unfortunately, EPA has failed to advance any credible evidence to confirm that any portion of the current economy supported by the ecological resources of Bristol Bay would be put at risk as a result of development of the Pebble Project.

<u>EPA Response:</u> Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. This purpose has been clarified in the revised Appendix E and the language identified in this comment has been removed. Note that any mine development in the region is not dependent on a healthy ecosystem and thus is outside the scope of the assessment.

E.10 NDM is concerned that the Draft Assessment's overly broad focus on economic activity throughout the Bristol Bay region will lead some readers to incorrectly conclude that a mine such as Pebble could affect fisheries in watersheds in which Pebble is not located. For instance, inclusion of the Togiak, Ugashik and Egegik districts and their associated fisheries is irrelevant to the study and therefore misleading. Similarly, the Draft Assessment's extensive focus on the Nushagak and Naknek-Kvichak districts (rather than focusing on the Nushagak and Kvichak river systems) in reporting salmon harvest figures may lead some readers to incorrectly assume that all of the fisheries production in these districts could be put at risk by Pebble. In reality, large segments of the Nushagak and Kvichak river systems are dozens and even hundreds of miles away from the Pebble site, while many other segments of these systems are tributaries to the Nushagak and the Kvichak that are actually upstream from tributary streams on which Pebble is located. The Naknek River (which EPA considers within its discussion of the Naknek-Kvichak district) is an entirely different drainage system feeding Bristol Bay well to the west of the mouth of the Kvichak River, such that none of its fisheries production could be affected by Pebble. Similarly, the Wood River (which EPA considers within its discussion of the Nushagak district) and Alagnak River (which EPA considers within its discussion of the Naknek-Kvichak district) are also entirely separate drainage systems, such that none of their fisheries production could be affected by Pebble.

<u>EPA Response:</u> The assessment evaluates the risks and potential impacts from large-scale mining in the Nushagak and Kvichak River watersheds. Although the Pebble deposit is used as a case study, Pebble is not the sole focus of the assessment. Appendix E characterizes economic activity that depends on the entire Bristol Bay salmon ecosystem. We recognize that the Nushagak and Kvichak River watersheds are only a portion of the Bristol Bay watershed, but characterizing economic activity that depends on the Bristol Bay salmon ecosystem allows one to compare activity in the Nushagak and Kvichak River watersheds to other watersheds in Bristol Bay.

In identifying potential mines to include in the assessment, we limited the search to the Nushagak and Kvichak River systems. Potential mines on the Naknek, Wood and Alagnak Rivers are not included. Impacts to those river systems are not included except to the extent that they could be influenced from potential transportation corridors for mines. However, note that the Wood River is a tributary of the Nushagak River and the Alagnak River is a tributary of the Kvichak River. Contamination that affects the length of the Nushagak or Kvichak Rivers could expose fish trying to return to these tributaries.

The time to identify and consider all potential impacts is before mining projects are designed, so that avoidance, minimization and compensation can be incorporated into those mine designs.

E.11 Similarly conspicuous by its absence in Appendix E is any reference to unemployment and poverty data. Unemployment data is a very basic economic baseline parameter on which to report in order to characterize economic health. In NDM's view, such an omission serves to obscure the importance of economic development benefits that mining and related economic diversification could provide to Alaska and in particular, the local residents of the Bristol Bay region. On the other hand, the EBD prepared by PLP goes to significant lengths to provide a complete overview of the economic status of the region, including supporting data. The EBD highlights that the population of the Lake and Peninsula Borough declined by 15% between 2000 and 2009, while school enrollment dropped 36% from 1997 to 20 10. Furthermore, the EBD suggests that a substantial proportion of the population in Bristol Bay is living below the poverty level. While this statistic is only available for 1999 (at 19%), it is likely that percentage increased up through 2009, attributable to the economy being almost wholly dependent on the Bristol Bay salmon fishery. The significant out-migration of local people from Bristol Bay communities (a majority of whom are Alaska Natives), in addition to the relatively low income and high poverty levels prevalent in the region, are important economic factors wholly overlooked by EPA. This is surprising, particularly when you consider that one of the defined endpoints for the Watershed Assessment is effects on Alaska Native culture.

<u>EPA Response:</u> We appreciate the concerns raised in this comment, and Appendix D includes a brief description of the population dynamics of communities in Bristol Bay. However, an analysis of current and potential future economic opportunities for Bristol Bay residents is outside the scope of this assessment. This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy salmon ecosystem.

E.12 EPA also makes unsupported and misleading suggestions that economic drivers of sport fishing, sport hunting and non-consumptive tourism expenditures may be at risk should the Pebble Project be developed. While these are all significant economic sectors in the Bristol Bay region, estimated by EPA to generate $60 million, $8 million and $1 00 million annually in expenditures respectively, the portion of these expenditures directly related and potentially impacted by a mine development at Pebble have not been quantified or studied in any depth by EPA in Appendix E, and are likely to be exceedingly small. It must be remembered that the broader Bristol Bay region totals some 40,000 square miles, of which the Pebble Project would occupy about one-twentieth of one percent.

EPA correctly acknowledges that most recreational visits to the Bristol Bay region occur during the summer months and that recreational activity takes place almost exclusively outside the Pebble Project area. EPA notes that recreational activity is concentrated in Katmai National Park and Preserve, Lake Clark National Park and Preserve as well as the National Wildlife Refuges of Alaska Peninsula/Becharof, Ixembek, and Togiak. All of these parks and refuges are far from the Pebble Project area and well clear of its zone of influence. EPA also acknowledges that sport fishing occurs mainly in the Nushagak and Naknek River watersheds, whereas sport hunting occurs predominantly in the Mulchatna River watershed. However, no attempt is made by EPA to identify those areas used for recreational activity that would in any way be affected by mine development. This is a gross oversight that perpetuates the view that all recreational activities within the entire 40,000 square mile Bristol Bay watershed could be affected by the Pebble Project. In reality, the opposite is true.

<u>**EPA Response:**</u> **Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. Because this is a baseline assessment, any changes in economic activity due to ecosystem impacts are outside the scope of this analysis. The comment asserts that mine development would not affect recreational activity, but we also have received comments from the sportfishing industry asserting that development will affect the fish, habitat, and quality of the fishing experience.**

E.13 Finally, NDM believes that EPA's application of the Net Economic Value approach for measuring the economic value of Bristol Bay ecological resources in Appendix E is fundamentally flawed and serves to significantly inflate the study's findings, particularly for the commercial and subsistence fishery. Using a range of alternative discount rates from the standard "intragenerational" rates of 7% and 3% to "intergenerational" rates of 1.75% and 1.0%, EPA concludes in Section 5.0 of Appendix E that the net present value of the Bristol Bay ecosystem is between $2.4 billion and $32.7 billion. Of this amount, EPA estimates that subsistence activities account for 50% of the total Net Economic Value on the low estimate and up to 59% on the high estimate. It also notes (p. 213) that these estimates "are likely quite conservative as they do not include estimates of passive use values, but are limited to direct economic uses of the wild salmon ecosystems services."

EPA has made several misleading assumptions in deriving these estimates, most notably for the commercial and subsistence fisheries. This follows from EPA using long periods of historically high permit values to inflate averages in deriving a total current permit value where current permit values are both available and more relevant but significantly lower than historical amounts. EPA has also inconsistently applied current data (e.g, current permits issued) with historical permit values (i.e., 1990 to 2010 average) to achieve as large a total value as possible. It has also used inconsistent discount rates of 13.52% and between 1% and 7% to convert back and forth between total permit values, annual values of permits and net present (perpetual values) of permits. Finally, EPA has at least doubled the risk of estimation errors by assuming fish processor economic values are equal to the calculated economic value of fishermen permits. Each of these methodologies is inappropriate in and of itself, and together serves to compound the errors made by EPA and grossly over-inflate the economic values estimated for the commercial fishery.

<u>**EPA Response:**</u> **The comment states that "EPA [uses] long periods of historically high permit values to inflate averages in deriving a total current permit value…." The average permit value for the period 1990-2011 used in the EPA analysis for drift permits is $149,000 (95% confidence interval [CI] of $105,500-$192,700). The most current year (2011) average sale price for these permits is $143,900. For set net permits the average permit value for the period 1990-2011 used in the analysis is $42,200 (95% confidence interval $28,700-$55,700). The most current year (2011) average sale price for these permits is $35,900. In the case of both permit types, the current permit value**

falls well within the 95% CI given in the report for the 1990-2011 period. Because current permit prices fall within these values, these confidence intervals appear to offer an accurate estimation of the current market value of permits.

The comment also states that the analysis "has used inconsistent discount rates of 13.52% and between 1% and 7% to convert back and forth between total permit values, annual values of permits, and net present (perpetual values) of permits. The analysis recognizes that the discount rates (13.52% and 1%-7%) are used in fundamentally different contexts in order to derive different values. 13.52% is a rate used to estimate the annual private profit margin as a percentage of permit value. 1%-7% values are used as social discounting rates to calculate the net present value to society of that annual profit margin into perpetuity. The choice and use of these rates as well as applicable citations are discussed extensively in Section 5.6 of Appendix E.

The comment also states "finally, EPA has at least doubled the risk of estimation errors by assuming fish processor economic values are equal to the calculated economic value of fishermen permits." The analysis in Appendix E explicitly recognizes and notes the lack of information regarding the profitability of the processing sector for salmon. The analysis relied on a general assumption that processor net income was likely to equal harvester net income. This assumption was based on the market power of the processors to set salmon prices. Since the release of the draft assessment, an additional source of information on harvest and processing profitability in the Bristol Bay has been identified (Link et al. 2003). To demonstrate the reasonableness of the method used, and provide a second estimate of harvester and processor net income, an additional estimate of the average profitability of the Bristol Bay commercial fishing and processing sectors has been developed based on the data presented in the Link et al (2003) report. This new analysis has been inserted into Section 5.1 of Appendix E. Based on sector-level data from 1990-2001, this second analysis supports the original economic values estimated for the commercial fishery.

E.14 Furthermore, while NDM certainly accepts that there is significant value in a subsistence fishery over and above profits, wholesale and retail fish prices, or measurable expenditures, the conclusion reached by EPA that the subsistence fishery has an annual value greater than the entire commercial fishery and 14 to 32 times its estimated annual expenditure is not supportable. The exclusion of such findings on Net Economic Value in the Draft Assessment's Executive Summary may be indicative of EPA's lack of confidence in its own conclusion and the underlying data assumptions. This entire section of the study should be removed or significantly refined to be more consistent with other areas of Appendix E.

<u>EPA Response:</u> **In comparing values calculated for the commercial and subsistence fisheries it is important to note a few points highlighted in Section 5.6:**

- **The commercial sector is narrowly tailored to salmon harvest while the subsistence sector presents the value for all subsistence resources used (fishery, mammal, etc.).**
- **While subsistence values are "average" values, commercial permit-based values are "marginal" values based on the least highly-valued permit sales prices.**

- **The market for commercial salmon is highly competitive, thus profits and net economic value are kept relatively low in the sector when compared to a non-competitive sector such as subsistence.**
- **Subsistence harvest is a year-round activity within the Bristol Bay region. Conversely, the commercial salmon harvest in Bristol Bay takes place only during a few weeks in the summer.**

In comparing subsistence expenditures and subsistence net economic values it is important to note that there is no specific expected relationship between expenditures and net economic value from an activity such as subsistence harvest. The comment cites a ratio of 14 or 32 to one for estimated net economic value for subsistence activities compared to subsistence-related expenditures to be "not supportable." It should be noted that the ratio of the simple market replacement value of the resources harvested through subsistence activities to expenditures is nearly eight to one for Bristol Bay. Additionally, as noted in the report, it is likely that expenditures may be underestimated.

A relevant comparison of the reasonableness of the subsistence net economic value estimates would be to look at what share of total per capita personal income for Bristol Bay residents the estimated net economic value represents. For the low-end estimate of net economic value ($84.3 million), the value from subsistence harvest is about 22% of total per capita personal income for the region. Put another way, the estimates suggest that subsistence harvest NEV constitutes roughly one-fifth to one-quarter of personal income earned through the cash economy. Based on the high-end estimate from the EPA analysis ($193.7 million), subsistence harvest is valued at roughly 40% of cash personal income. For an area and population where even just the market value of subsistence harvest is roughly equal to 13% of cash personal income, it is not unreasonable to conclude that these activities that entail significant time and for some residents are a central part of a strong cultural tradition, would be one-fifth to two-fifths as valuable to BB residents as the cash portion of their livelihood.

E.15 Statements such as "because of its location at the headwaters of the Nushagak and Kvichak rivers, which have accounted for about 60 percent of the total Bristol Bay commercial sockeye fishery over most of the past decade" leads one to erroneously conclude that Pebble could impact up to 60 percent of the fishery in any given year. Such statements and emphasis by EPA are categorically false. Data provided by the Alaska Department of Fish and Game (ADF&G) indicate the total contribution of the Nushagak and Kvichak systems to Bristol Bay sockeye salmon production to be just 19% over the past 10 years for which 10 year averages are published (2001 - 2010). Moreover, and as explained above, the vast majority of this production is unlikely to be affected by mineral development at Pebble because it is supported by habitat dozens and even hundreds of miles distant from the project site, or in upstream tributaries to the Nushagak and Kvichak.

<u>EPA Response:</u> We could not find the quoted phrase in the document, but the document states in several places (e.g., see p. 15, 60 and 146) that the "combined Nushagak and Naknek-Kvichak districts (not rivers) have accounted for about 60% of the total Bristol Bay commercial sockeye harvest." The document also states (e.g., see p. 60) "that both

districts include other major rivers besides the Nushagak and Kvichak rivers. For example the Kvichak River generally accounts for less than half of the Naknek-Kvichak District Harvests.

It is true that Pebble is located in the headwaters of the Nushagak and Kvichak Rivers but we disagree with the contention that mentioning these facts in the same document or the same sentence is an attempt to mislead readers. The reference to ADF&G data is not cited. Appendix E's conclusion that about 60% of the Bristol Bay sockeye harvest comes from the two districts is based on ADF&G data (located at www.adfg.alaska.gov/index.cfm?adfg=commercialbyareabristolbay.salmon).

E.16 The EPA's contention that the Nushagak and Kvichak systems account for 60% of the Bristol Bay sockeye fishery is also contradicted by data provided in the Environmental Baseline Document (EBD) published by PLP. Unfortunately, and as previously noted, this comprehensive and exhaustive source of data about the fish and other ecological resources of the Pebble Project area was generally not considered by the EPA in preparing its Draft Assessment. The EBD indicates that in the 10 year period from 1999 to 2008, both the Kvichak and Nushagak systems accounted for some 7% of Bristol Bay sockeye salmon harvested for a total of 14%. When correctly described in this context, the percentage of Bristol Bay commercial sockeye fisheries produced in rivers hydrologically connected to the Pebble Project is actually about 15 - 20%, rather than 60 percent as cited by EPA.

<u>EPA Response:</u> **We did utilize the non-peer reviewed EBD reports to the extent that we could. The comment did not provide a citation to the EBD and we were unable to verify the information presented.**

E.17 Perhaps more importantly, the Draft Assessment fails to provide any estimate of the fisheries supported by the three main tributaries of the Nushagak and Kvichak systems that are located within a 400 square mile area surrounding Pebble. These include the North and South Forks of the Koktuli River (tributaries of the Nushagak-Mulchatna) and Upper Talarik Creek (tributary of the Kvichak). NDM believes it would have been highly relevant for EPA to provide such an estimate inasmuch as any effects on fisheries resources associated with development of the Pebble Project is likely to be isolated within this 400 square mile area surrounding the project. Based on a 20-year average, ADF&G data indicate these three streams produce less than one-half of one percent of Bristol Bay sockeye salmon (or 0.4%). While PLP is committed to fully protecting the fisheries supported by these three local streams when developing the Pebble Project, NDM believes readers of the Draft Assessment would have benefitted from the knowledge that less than one half of one percent of the world's largest sockeye salmon fishery is dependent on streams within 400 square miles of the Pebble Project.

There is very little quantified information available on salmon resources in the three tributaries located in the Pebble deposit area, but the assessment does discuss these resources and points out that abundant spawning sockeye runs in Upper Talarik Creek (82,000 sockeye on one day) and Chinook Runs in the Koktuli River would be at risk from mining accidents at the Pebble site. The document also discusses the importance of head water streams to the ecosystem. It is important to keep in mind that the entire river systems downstream of the mine would be at risk from spills and accidents as discussed in the failure scenario. Several issues were identified in Appendix E; these are primarily associated with what or how data was utilized from Appendix E in the EPA Report Volume 1. For example, Appendix E notes that it is difficult to quantify the value of the proportion of Bristol Bay's fisheries resources that is derived from the Nushagak and Kvichak Watersheds. The underlying assumptions and relative confidence levels in the economic values assigned to fisheries in these watersheds were presented in Appendix E, but not provided in the EPA Report - Volume 1. This is inconsistent with a major goal of the EPA Report, which is to quantify and present the potential effects of mining operations on fisheries.

EPA Response: The material included in the Executive Summary is intended to provide baseline information regarding the regional economic activity dependent on a healthy salmon ecosystem, which is consistent with the purpose of Appendix E. None of the values presented are attributed specifically to the Nushagak and Kvichak River watersheds. As is appropriate for an executive summary, significant detail regarding the estimates is not included but is available for the reader in Appendix E.

E.18 While the EPA study contains some informative content and corresponding data on the challenges the Bristol Bay commercial fishing industry has faced over the decades - including the impact of farmed fish on salmon prices, overall quality concerns and reputation, the high costs of processing, and the economic crisis experienced leading up to 2002 - such economic risks and historical trends are noticeably omitted from the Draft Assessment's Executive Summary, where the overall health and value of the industry and the economy it supports are highlighted. NDM believes such exclusions serve to underemphasize the inherent cyclicality and vulnerability of the commercial fishing industry. This portrayal also ignores the economic and social benefits that a region so substantially dependent on a single industry could gain through economic diversification and the development of other industries - notably resource development. Appendix E of the Draft Assessment establishes that local residents of the Bristol Bay region have historically been the group to benefit least from the commercial salmon fishery. EPA notes that most of the harvest is processed by ten large companies that employ mostly nonresident seasonal workers, noting that fewer than 5% of workers employed in fish processing are local. Bristol Bay residents also control a small and diminishing percentage of total Bristol Bay commercial fishing permits, and have the lowest average earnings per permit fished as a result of older and smaller vessels with lower average horsepower and fuel capacity than those owned by fishermen from other parts of Alaska, other states or countries. Further, a much smaller share of the vessels operated by Bristol Bay residents have refrigeration capacity, which directly affects product quality and price. All of these differences may reflect the fact that local residents have less access to capital than their competitors from other parts of Alaska or other states and countries. Unfortunately, none of these important findings are highlighted in the Executive Summary, nor are the potential financial opportunities that local residents might experience from mineral resource development in providing greater access to capital to increase their participation and competitiveness within the fishery.

EPA Response: See response to Comment E.17.

<u>Alaska Oil and Gas Association (Doc. #4974)</u>

E.19 The watershed assessment fails to mention the important social and economic benefits a developing and producing mine would bring to a region facing severe hardships of economic opportunities. Briefly, responsible development of the Pebble project would generate a multi-billion dollar capital investment, 1,000 high-skill, high-wage jobs over the life of the project (more during the construction phases) as well as tens of millions of dollars in tax revenues to the state and local governments and associated multiplier effects including new business opportunities in the region and statewide. By failing to include this information in the study, the EPA's analysis appears biased and one-sided.

<u>EPA Response:</u> See response to Comment E.5.

<u>Ahold USA, Inc. (Doc. #1742)</u>

E.20 Pursuant to the ERA Guidelines (Guidelines) published by the EPA, ERAS provide "a critical element for environmental decision making by giving risk managers an approach for considering available scientific information along with the other factors they need to consider (e.g., social, legal, political, or economic) in selecting a course of action."' As such, we urge inclusion of a detailed review of the potential economic impacts to communities which depend on Bristol Bay's salmon production and other renewable resources dependent on a healthy ecosystem. Any socioeconomic impact assessments should also account for potential impacts to other links in the supply chain (e.g., retailers, restaurants, and consumers). As an engaged stakeholder with a vested interest in the health and sustainability of Bristol Bay resources, we are particularly concerned that partial or total loss of salmon production from Bristol Bay will adversely affect those directly tied to the resource as well as end-user markets through factors such as supply constraints and price increases.

<u>EPA Response:</u> Appendix E evaluates the economic sectors dependent on salmonid fish. An analysis of any supply chain impacts was deemed outside the scope of this effort.

<u>New England Aquarium (Doc. #0888)</u>

E.21 Sustainable wild salmon is a critical commodity within the US and international seafood industry. As one of the top three most popular seafood choices among US consumers, more than 100,000 metric tons of Pacific salmon is consumed annually. The Bristol Bay fishery, one of the last truly wild salmon fisheries in the world, is highly valued throughout the industry. It is also the primary economic driver for the region, providing more than 12,000 jobs and generating $450 million a year. Likewise, the Bristol Bay salmon fishery is critically important to businesses and consumers worldwide including the major seafood buyers with whom the Aquarium has partnered to advance seafood sustainability.

Pursuant to the ERA Guidelines (Guidelines) published by the EPA, ERAs provide "a critical element for environmental decision making by giving risk managers an approach for considering available scientific information along with the other factors they need to consider (e.g., social, legal, political, or economic) in selecting a course of action." As such, we urge inclusion of a detailed review of the potential economic impacts to communities that depend on Bristol Bay's salmon production and other renewable resources dependent on a healthy ecosystem. Any socio-economic impact assessments should also account for potential impacts to other links in the supply chain (e.g., retailers, restaurants, and consumers). As an engaged stakeholder with a vested interest in the health and sustainability of Bristol Bay resources, we are particularly concerned that partial or total loss of salmon production from Bristol Bay will adversely affect those directly tied to the resource as well as end-user markets through factors such as supply constraints and price increases.

<u>EPA Response:</u> See response to Comment E.20.

<u>S. Wehmeyer (Doc. #3486)</u>

E.22 Appendix E includes author-selected quotes by anti-mining residents that introduce bias into the report.

The report does not consider any positive effects of mineral development in a region of Alaska facing severe hardships and a lack of economic opportunity.

<u>EPA Response:</u> Appendix E cites to material included in Appendix D to illustrate the cultural value of salmon to Bristol Bay residents. For further detail on these viewpoints, please refer to Appendix D.

<u>M. Dieni (Doc. #3826)</u>

E.23 It would be useful to get a more concrete assessment of the overall economic cost-benefit. Assuming a mine operating as designed within the state and federal rules, what will be the cost in the form of fish and wildlife. It may be crude, but does this mean a lost of 2 percent, 5 percent, 20 percent, for example of sockeye (red) salmon in the Bristol Bay region. And what does this mean in dollars – what percentage of the annual sockeye industry will be lost, and what is it worth compared to the positive economic impacts of the mine.

The focus of the economic impact of the mine, solely as a negative impact on nearby native peoples, is skewed and makes the report seem incomplete and imbalanced. This tiny group of natives is only a small percentage of the people who will be economically impacted by a successful mine. There are small native groups that will benefit greatly from the mine.

Furthermore, this is a statewide economic event and it would be a more honest statement to include a chapter summarizing the positive impacts on nearby labor, which includes other indigenous peoples that are dying out due to a shrinking economy and sociological changes.

Also, there are suppliers and contractors ranging from the small to mid-size entities in various cities statewide that will benefit from a successful mine. As a cultural phenomenon, miners and other overland adventurers are every bit as much of the Alaska historiography as the ancient subsistence native.

<u>EPA Response:</u> Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy salmon ecosystem. It is not a cost-benefit analysis or an economic impact analysis. Note that any mine development in the region is not dependent on a healthy ecosystem and thus is outside the scope of the assessment.

American Sportfishing Association (Doc. #1128)

E.24 Members of the sportfishing industry, including manufacturers and fishing retail operators, overwhelmingly support the protection of Bristol Bay from mining development. Our industry depends on clean, unimpeded waters and healthy sportfish populations and invests significant funds in fishery conservation. In 2011, through the manufacturers excise tax on fishing equipment and the purchase of fishing licenses, the sportfishing community invested more than $38 million in Alaska's fishery resources and almost $1 billion nationwide.

EPA Response: Comment noted; no change required.

American Fly Fishing Trade Association et al. (Doc. #4615)

E.25 Sport fishing in Bristol Bay generates $60 million annually; anglers looking for "once in a lifetime" experiences on rivers such as the Nushagak, Mulchatna, Koktuli and Kvichak support more than 800 full- and part-time jobs. Mining activity and increased development associated with mining will detrimentally impact these areas by direct impacts to fish and habitat. Development will also negatively impact opportunities for sport fishing and hunting operations in the area by diminishing the quality of the experience.

EPA Response: Comment noted; no change required.

Bristol Bay Native Corporation (Doc. #4525)

E.26 The prospect of a massive metallic sulfide mine in the headwaters of the key feeder streams for the Bristol Bay salmon fishery is beginning to create uncertainty in the market. Core customers such as restaurants and supermarkets are asking questions about the future of the fishery and what will happen to it if the mine is developed. Seafood processors wonder whether to make new investments whose long-term returns require a strong fishery in the future. All the way along the fish production-consumption chain, people are asking questions about how Bristol Bay salmon will be affected if large-scale mining is allowed to proceed in the fishery headwaters.

These questions will begin turning into decisions if permit applications are actually filed for the Pebble Mine or any other large metallic sulfide mine in the Bristol Bay region. If a permitting process is initiated for the Pebble Mine, instead of simply asking questions about the future of the fishery, customers and consumers will begin to look at other supply sources and some will switch suppliers on the presumption that permits will eventually be granted. Instead of simply wondering whether a particular investment is warranted, seafood processors will hold off on making new investments until the market effects of the mine become more clear. Fishermen will begin factoring in the mine as they consider whether to make new investments. As the prospect of a mine becomes more real, major uncertainty will be created throughout the fishery, from production through consumption. In effect, the mine is a massive contingent liability for fishermen and everyone else involved in the commercial fishery.

EPA Response: Comment noted; no change required.

The Pebble Limited Partnership (Doc. #4962)

E.27 *Appendix E, Section 3.13, page 143, paragraph 3*

Citations are missing describing the statement, "We do not know the rate of return demanded by permit holders. However, it is likely that it is between 5% and 20%." The report provides no evidence to support the statement. In the absence of technical reference to the relevant literature upon which this information is presented, the basis for the statements, assumptions, and conclusions cannot be evaluated.

EPA Response: This statement is based on Huppert, Ellis, and Nobel (1996); a direct citation has been added to the statement in Section 3.13. This document is also discussed extensively in Section 5.1.

E.28 *Appendix E, Section 3.13, page 142, Table 44*

The estimated total nominal value of permits is stated to be calculated as the average permit price times the number of permanent permits issued. No source is cited for the average permit price.

EPA Response: Table 44 identifies the source of the information as the Commercial Fisheries Entry Commission, Salmon Basic Information Tables. A link to this material is included in Section 3.15: Data Sources, as well as in the bibliography for Appendix E. A link has also been added to this table in the revised document for the reader's convenience.

E.29 *Appendix E, Section 3.4, pages 85-90*

The text describes the dramatic changes in world salmon markets, with a sharp decline in prices paid to Alaska processors and fishermen, followed by prices recovering in 2001, indicating the cyclical and volatile nature of the industry. Nonetheless, the text goes on to state that "the future outlook for Bristol Bay salmon prices is promising but uncertain." While it is clear that future prices are uncertain, it is less clear that the future prices of salmon is promising, especially since the report states that there are quality problems in the Bristol Bay fishery.

EPA Response: The comment cites quality problems in the Bristol Bay fishery as a source of uncertainty for the future prices of Bristol Bay salmon. Appendix E details some of these historical quality problems, including a lack of refrigeration and handling practices. However, the comment fails to mention the Bristol Bay Regional Seafood Development Association. This organization was founded in 2005, is financed by permit holders, and focuses on increasing quality within the Bristol Bay fishery. The Bristol Bay Regional Seafood Development Association is encouraging proper fish handling and refrigeration through education efforts, and annual processor surveys funded by the organization indicate the number of chilled fish being delivered to processors is increasing (for more information see Appendix E, Section 3.5). Although the future of salmon prices is uncertain, efforts to improve practices that are achieving results paints an optimistic picture.

E.30 *Appendix E, Section 3.7, pages 102-104*

The estimate of the costs of fishing is difficult to characterize, as admitted by the authors. One summary of costs was provided for the year 2008 to show the kinds of costs important to the fishing industry, as well as the potential magnitudes of each kind of cost relative to the same years' earnings. It is important to remember that there is a great amount of uncertainty in fishing costs, which needs to be taken into consideration when attempting to determine impact assessments. These high uncertainties are not conveyed adequately in the assessment.

EPA Response: Throughout Appendix E, including in Section 3.7, uncertainties are emphasized. In Section 3.7 there is a detailed discussion of the lack of data and challenges in characterizing fishing costs. Because these uncertainties are described in detail throughout the document, we believe they are adequately conveyed.

E.31 *Appendix E, Section 3.8, page 107, Table 31*

Cost estimates in Table 31 are nearly 20 years old. These costs should be escalated using an appropriate index in order to compare to current prices for a complete analysis. The relevance of the cost estimates to this assessment is unclear.

EPA Response: These costs are included to provide the reader with information regarding the salmon processing industry, including costs and profits. Costs per pound vary between product forms, and may also vary widely from year to year as fixed costs are spread over different volumes of salmon. However, salmon ex vessel prices are highly variable and not directly tied to general changes in price levels. Thus, the Table 31 data are provided as a picture of two specific years, and not indexed to current price levels.

E.32 *Appendix E, Section 4.1, page 173, paragraph 2*

This paragraph describes the limitations of the economic analysis. From what is described in this section, the study is not an economic impact analysis and should not be used as such.

EPA Response: In the paragraph cited in the comment, Appendix E explicitly recognizes that this analysis is different than an economic impact analysis and does not attempt to quantify the economic impact of any potential changes in the environment.

E.33 *Appendix E, Section 4.2, pages 174-175*

The model used in the analysis, ISER Input-Output model, is stated to have several limitations including overstating local jobs multipliers in rural areas and lacking certain kinds of data along with other uncertainty that requires the reader to "interpret the estimated impacts as suggestive rather than definitive." Another limitation of the ISER Input-Output model is that it is only focused on market values. The model is unable to determine the economic significance of subsistence in terms of direct jobs and incomes. These limitations are significant; another model should have been used in the assessment.

EPA Response: In response to this comment we have revised Section 4.2 in Appendix E to include a more detailed explanation of methods. As with all economic analyses that rely on models, the model results are not definitive, but rather provide predicted values. Models are typically designed to capture market activities. Direct jobs and income for

subsistence fisherman occur outside of traditional markets, and thus there is not an input-output model available that can determine the economic significance of subsistence activities. The strengths and weaknesses of the ISER Input-Output model are discussed in greater detail in Section 4.2.

E.34 *Appendix E, Section 5.3, pages 206-207*

Paragraph 4 and Table 70 appear to include inconsistent information regarding the willingness-to-pay for sport fishing trips by both residents and non-residents. According to paragraph 4, non-residents are willing to pay about $450 more than they actually paid and residents would be willing to pay an additional $320. According to Table 70, the values are $500 million, and $352, respectively. This needs to be clarified.

<u>EPA Response:</u> This was clarified in the revised assessment.

E.35 *Appendix E, Section 5.6, page 211*

Non-use value estimates are based on a willingness-to-pay study used in the Exxon Valdez oil spill case. This is not a relevant study to base these values. The purposes and methods in the two studies are very different.

<u>EPA Response:</u> The non-use value estimates presented in Section 5.6 are not based on the willingness-to-pay study used in the Exxon-Valdez oil spill case. Rather, the number of U.S. households determined to hold passive use values determined as part of the Exxon-Valdez case are used in the Goldsmith (1998) analysis cited in Section 5.6.

The Goldsmith (1998) analysis of passive use values associated with Bristol Bay-area wildlife refuges and preserves relies on a range of passive use studies from the economics literature as a basis for the "per household values" used in his calculations. Goldsmith (1998) only uses the Exxon Valdez oil spill research to estimate the share of U.S. households who might reasonably hold these passive use values. The limitations and uncertainties associated with applying the Goldsmith (1998) analysis are explicitly outlined in detail in Section 5.6.

E.36 *Appendix E, Section 5.2, page 203, paragraph 1*

The subsistence analysis includes an assumption that the same relationship between per capita income and net economic value exists today as it did 30 years ago, which forms the upper bound of the range. This is a large leap to make and is likely an invalid assumption. This assumption needs to be evaluated further and supported by technical literature. As written, the analysis is unreliable.

<u>EPA Response:</u> Recognizing that the subsistence values presented in the analysis were from a dated model, the analysis is quite conservative in its interpretation of these values by reporting a range of values. The lower-bound value presented is the model's point estimate in 1982 dollars ($32.89 per pound) and the upper bound is the model values updated with an index for Alaska income to 2011 dollars ($75.58 per pound). Of course, this is a rather coarse approach at conservative estimation.

Since publication of the draft Bristol Bay Assessment, the authors of Appendix E undertook an effort to build a new subsistence database and re-estimate the subsistence

model on current data. The new model differs somewhat in that the income measure used is per capita personal income from US Census data, while the earlier was based on Alaska Department of Revenue adjusted gross income(AGI). Alaska Department of Revenue AGI data is not readily available. Adjusted Gross Income incorporates more deductions as it is meant to more closely represent taxable income rather than total income. Total per capita personal income is recorded by the census. AGI averages about 70% of the census income. In general, the census definition of income is a better fit to the theory of valuation.

Using the new model and census data, a current estimate for subsistence value is around $86 per pound in 2011 dollars, which is fairly close to our indexed value ($75.58 per pound) from the old model. Accordingly, a model estimated on current data is generally consistent with the earlier (30 year old) model. While the census definition is a better fit to the theory of valuation, if one wanted to complete this analysis using income measure similar to the old model, the current model suggests a point estimate of around $60.

We have incorporated information from this new model into the revised document.

G. Y. Parker (Doc. #4115)

E.37 EPA should review and edit the appendices for occasions when an expert may address peripherally a topic outside of his or her expertise. For example, Appendix E is on economics, That appendix, at p. 173, states peripherally that "the construction of roads would result in marginal changes to the current condition of natural resources in the region," but could have significant effects on the values associated with public uses of fish and game. Many biologists would likely say that roads can have significant biological impacts, and in fact the assessment says as much.

EPA Response: We agree with the observation that this is outside the expertise of the authors of Appendix E, and this statement has been edited appropriately.

D. Callaway (Doc. #5282)

E.38 ***Income***: A more detailed analysis of the potential impacts to income and employment to Bristol Bay households from the establishment of the Pebble mine will be demonstrated in the next deliverable. However, Tables 29 through 33 and Charts 5 through 8 provide a substantial descriptive picture of the economic characteristics of households in Bristol Bay. As a standard for comparison, the median income for households in Anchorage in 2009 was about $73,000, while the per capita income was about $33,500. The mean household income in Anchorage was an astounding $87,500, but some truly wealthy households skew this figure so we will use the "median" for our comparisons. Similar parameters for the state of Alaska show a median household income of $67,000 and a per capita income of around $29,000 [***figures and tables have been deleted here for copyright purposes; see original public comment for figures and tables***].

In summary, the following tables and charts indicate that Alaska Native households in Bristol Bay have slightly more than half the incomes of Anchorage households and about 60% of a typical statewide Alaska household. Non-Native households do slightly better than the typical Alaska household and slightly worse than an Anchorage household. This of course does not factor in the higher cost of living for households in the Bristol Bay region, where fuel and energy costs and access to retail stores and so forth are quite restricted. Some indices have the cost of living in rural Alaska twice that of Anchorage.

In addition, these summary parameters disguise some other economic disparities both for Alaska Native and non-Native households. For example, Alaska Native per capita income in Bristol Bay is about $12,000, is only about 40% of the per capita income for Alaska as a whole. Non- Native individuals have only about two-thirds the per capita income of a typical Alaskan.

Finally, slightly more than 9% of households in Alaska are below the poverty level (Anchorage = 7.6%). Bristol Bay households, using incomes measured earlier than these parameters and thus may be a slight overestimation of the actual proportion by no more than 5% has dramatically different proportions. Nearly 40% of Alaska Native households are below the poverty threshold and nearly 18% of non-Native households find themselves in a similar situation (see Table 33).

Chart 5, below graphically illustrates the considerable contrast in wage income between Alaska Native and non-Native households. In addition, non-Native total household income is more than 40% greater the Alaska Native households.

As noted in Table 31, below, while two-thirds of non-Native households have incomes greater than $44,000, nearly 60% of Alaska Native households have incomes of less than $44,000. In addition, as indicated in charts 6 and 7 below, non-Native households depend on wage income for more than 90% of their total income, whereas Alaska Native households have a greater dependence on entitlements and other sources of unearned income. Non-wage sources of income often provide a steady source of cash in extended families, which helps support these households where wage income is seasonal or part-time. In current national economic circumstances, state and national programs that provide transfer payments can also be brittle in the sense that they seldom keep pace with inflation and are at the funding whim of political and budgetary forces far beyond local control.

As Table 32, below indicates the eight communities identified either as harvesting a wide diversity of wildlife species (Clark's Point, Igiugig, Koliganek, Lime Village, Manokotak, and New Stuyahok - and/or also harvesting large amounts of wildlife resources - Kokhanok, Newhalen and Nondalton) have, with the exception of Manokotak, modest household incomes, with the vast majority of their households falling in the first three columns (i.e., with household incomes of less than $44,000). These communities with the highest dependence on wildlife resources, while at the same time having the most modest of backup financial resources, are most likely to suffer substantial impacts should the Pebble mine, in a variety of ways, limit their access to wildlife resources. Analysis of this topic is one of the primary subjects of the next report.

Poverty Threshold Table 33 shows the number of households below the poverty threshold (for a household of their size) highlighted in yellow. Alaska Native household counts are in parenthesis.

We have sufficient economic data to determine poverty levels for a total of 507 households out of 510. Out of the 507 households in this table, 409 were Alaska Native and 98 were non-

Native. Of the 507 households captured in the Table 33 below, 35.5% (180 households) were below the poverty line. Of the 409 Alaska Native households, 162 or 39.6% were below the poverty line, while 18/98 non-Native households, or 18% were below the poverty line. Given that households were interviewed over a five-year period and the thresholds are from only a one- year period (2008) these proportions may overestimate Alaska Native rates at the time of their interview by a maximum of 5% and the non-Native rate by 2%.

Employment The description of the employment profile for the 17 communities in Bristol Bay is complex. Table 34 below is derived from the Demographic Master File, where each row of 174 variables in the data matrix represents an individual person. However, using a script within the SPSS program, many of these details are aggregated and transferred to the Household Master File. The intent of this transfer is to take advantage of the much more comprehensive information within the household file that contains extensive variables on harvest, income, and population characteristics.

Table 34 shows age in five-year intervals and provides some numerical standard as to who could be in the workforce. Utilizing the discussion of dependency ratios mentioned in an earlier section, we subtract the 0-14 years of age cohort and those individuals 65+. This leaves 244 non-Native individuals and 835 Alaska Native individuals 15-64 years of age (see Table 35). Now there are some difficulties with this breakdown of age cohorts. We could have used the age interval 18-64, however we chose not to for two reasons: 1) there are Alaska Native individuals 15-19 who are in the workforce (usually as crew members on commercial fishing boats) and 2) to be consistent with the standard worldwide dependency ratios discussed earlier in this report.

Also, we recognize that there are a number of individuals 65+ who are still in the workforce, and many 15-64 who are not (perhaps for reasons of school attendance or health etc.).

So of the 1633 individuals in this sample for which we have both age and ethnicity data, about 900 (actual 896) are in the workforce in some capacity. Table 34 shows the distribution of individuals in five-year intervals by ethnicity. Table 35 summarizes Table 34 and shows the breakdown of the population into traditional “workforce” (15-64) and “dependency” cohorts (0-14 & 65+).

Table 36 is derived from Tables 34 and 35 above, and from additional statistical runs not included in this report. Essentially, this table reconciles the 15-64 “labor force” status between that reported in the Household Master File with Tables 34 and 35, which are derived from the Demographic Master File. In addition, the final row in Table 36 calculates the unemployment rate by ethnicity. If these rates seem unrealistically low, this is partially due to a definitional outcome. Anyone reporting any employment during the year was coded as employed. However, as indicated in Table 37, the majority of Alaska Native employment was part-time or seasonal (“irregular”) and perhaps “underemployment,” rather than “unemployment” characterizes the Alaska Native demographic.

Essentially Table 37 shows that about 60% of all non-Native employment is full time, with the other 40% of the workforce employed either as part-time or seasonal work. These proportions are reversed for Alaska Native individuals, where only 40% have found or have chosen to work a full-time job.

Employment by Sector Table 38 clearly demonstrates the dependence of Alaska Natives on employment in local government and commercial fishing as the two most critical industrial sectors, and accounts for over 70% of all their employment. These two sectors, as will be developed in the next report, are also extremely vulnerable to the impacts of industrial mining. Non-Native employment is concentrated in three industrial sectors: local government, transportation, communication and utilities, and services which also account for about 70% of all non-Native employment. Note that these sample results do not include data from Dillingham, which is the community hub for the region and its results might strongly affect the generalizations made in this section.

Note that the totals differ between Table 38 above and Table 39 below. These discrepancies are the result of coding, programming and data entry incongruities between the various waves of survey research. The five Standard Occupational Classification (SOC) categories highlighted in the Alaska Native column account for about 70% of all employment. The three SOC codes highlighted under the non-Native column account for slightly less than 50% of all their employment. Note the high dependence on fishing occupations for Alaska Natives which is not reflected in non-Native employment; although, non-Natives employed in the fishing industry have, on average, substantially higher incomes.

Wage Income

A brief discussion of wage income was included in the introductory paragraphs to the income section. What is most striking about Table 40 is the great disparity between Alaska Native and non-Native wage income, with Alaska Native households, on average, receiving less than half the wage income of non-Native households. Of more concern, as indicated in Table 41, is that these discrepancies occur in the same occupational categories.

In the most important employment industries for Alaska Natives their income is one-third that of non-Natives in fishing and less than half in local government and services. Table 42 and Chart 8, below, details these differences by ethnicity for each Standard Industrial Classification (SIC) code.

There may be a number of reasons for these discrepancies, including differentials in education, high proportions of part-time and seasonal employment, and the skill set and experience required for higher paid administrative and technical positions. The data set contains the specific name of most occupations for each individual, but they have not been included here for reasons of time and concerns about anonymity; although, details from this variable may be included in the next report should a reasonable way (i.e., through re-aggregation) be found to protect anonymity. An interesting aspect of Table 41 is the results from the mining sector. All ten jobs in this sector are held by Alaska Natives with remuneration slightly better on average than fishing. However, the fishing sector accounts for nearly two million dollars in revenue (for the sample, the amount for the regional population will be considerably higher) while mining currently provides about $150,000 in income.

Finally, Table 41 and Chart 8 also provide the sum total of wages for each SIC code an aggregation that will prove useful for the analysis should the initiation of the Pebble mine have a substantial impact on salmon fisheries in the region. For example, loss of income from commercial fishing and canneries ($2.5 million in the ADF&G sample), plus the replacement cost of subsistence salmon (well above $5 million for just the 17 communities included in this report), may make it difficult to justify the mine on strictly economic terms for local residents.

EPA Response: **This sort of detailed demographic information is outside the scope of Appendix E, which is focused on providing a baseline estimate of the economic activities in Bristol Bay dependent on a healthy ecosystem.**

American Fisheries Society, Western Division (Doc. #3768)

E.39 Although some census and economic data associated with subsistence is provided in Appendix E, EPA stated that quantifying impacts to Native cultures was not attempted in the report. We believe that the scale of the projected mining development warrants a detailed quantitative evaluation of potential impacts to Native cultures that extends beyond risks posed by a potential decline in fish and wildlife. No discussion is provided on broader mine-mediated risks such as the introduction and assimilation of a subsistence-based community into a market based economy and the potential for culture clash between the Native population and newcomers. A comprehensive evaluation should take into account the large body of research and literature that addresses the impacts of extraction-based economies on small rural communities. An evaluation framed within this larger body of literature would suggest that, regardless of the magnitude of fish population declines caused by the mining development, the Native cultures will experience substantial negative impacts led by their incorporation into a mining based market economy that as noted by EPA has a finite lifespan and follows "boom-bust" cycles. What will be left of these cultures after the bust can be assessed from what has occurred elsewhere. See Chambers et al. (2012) for additional insights.

EPA Response: **Appendix E is focused on providing a baseline assessment of the economic activity dependent on a healthy ecosystem. Thus, the sort of analysis described in the comment is outside the scope of this assessment.**

H. Robin Samuelson Jr. – Chief Curyung Tribal Council (Doc. #3781)

E.40 As EPA acknowledges in the assessment itself, moreover, the economic analysis is quite conservative in its assumptions and scope. Nevertheless, even EPA's conservative approach demonstrates that the economic value of the intact ecosystem and sustainably managed fishery is very high and extremely important to the communities of the Bristol Bay region and to the State of Alaska, as well as to consumers, businesses, and the general public throughout the nation and the world.

EPA Response: **Comment noted; no change required.**

D. Callaway (Doc. #5282)

E.41 The harvest of subsistence resources has economic implications both in the sense of the cash required to purchase technology (e.g., boats and motors) and the need to replace the nutrition provided by subsistence harvests should subsistence resources be damaged or destroyed. Both expenses are considerable and would require a majority of a household's disposable income. Appendix D equivocates somewhat on the relationship between subsistence and income but it does address both issues. In contrast, the EBD fails entirely to discuss the potential dramatic impact to local household incomes should families be forced to purchase food as replacement for subsistence harvests.

- **Subsistence***:* Although Alaska Native and non-Native households seem to participate in many subsistence activities in similar proportions, the intensity of effort varies considerably between the two groups. On average, Alaska Native households harvest many more species of wildlife than do non-Native households; 65% of non-Native households harvest less than 13 species of wildlife while two-thirds of Alaska Native households harvest more than 13 species, with about 1 in 5 households harvesting more than 25 species. In addition, Alaska Native individuals have per capita harvests of about twice the amount of salmon (roughly 300 pounds (lbs) versus 150 lbs) and more than twice the per capita harvest of all species (roughly 500 lbs versus 200 lbs) when compared to non-Native individuals. Also while Alaska Native households harvest high amounts of a broad range of species, more than three quarters of non-Native harvest come from salmon stocks. Alaska Native households also share a greater variety and amount of subsistence resources than do their non-Native congeners.
- **Income:** There are dramatic differences in income between non-Native and Alaska Native households and individuals and significant differences between Bristol Bay Alaska Native households and the average income for households within the state of Alaska. Table 1 and Table 2 highlight some of these differences [***figures and tables have been deleted here for copyright purposes; see original public comment for figures and tables***].

  In addition, more than a third of Alaska Native households were below the poverty line, and nearly 1 in 6 non-Native households were in a similar position. These rates are far higher than the state of Alaska at 9.1%, with the U.S. national rate at 7.6%. (#5282.2, p. 3 to 4)
- **Employment**: Two sectors, local government and commercial fishing, account for 70% of all employment for Alaska Natives in the Bristol Bay sample. Although non-Native commercial fishers earn high incomes, they represent only around 10% of the total employment by sector.
- **Conclusion**: Alaska Native households in the Bristol Bay region are particularly vulnerable to any impacts that the Pebble mine may bring to salmon stocks. With low incomes and high rates of poverty, and high dependency on employment in commercial fisheries, high harvests, and salmon for subsistence needs, these households have very little buffer or resources to adapt if significant interruptions in salmon runs occur.

  The mining industry provided few local jobs, only ten in the data aggregated and analyzed in this study. Average remuneration for those mining jobs is $15,000 per year, which is slightly better on average than for fishing ($14,000/year). However, the fishing sector accounts for nearly $2 million in revenue (only for this sample, regional population figures will be considerably higher), while mining currently provides about $150,000 in income (may be considerably more if results from Dillingham were available).

  Potential income losses from commercial fishing and canneries in the communities in the Alaska Department of Fish and Game sample would be approximately $2.5 million. The potential loss of the subsistence salmon resource would exceed $5 million (685,210 lbs salmon across all communities priced at $7.50/lb). Accordingly, the potential dollar loss of salmon to these communities exceeds $7.5 million.

- ***Harvest Quantities***: Alaska Native households, on a per capita basis, harvest about twice (Table 21) the salmon and nearly two and a half times the total of all wildlife resources (Table 22) when compared to non- Native individuals in the region. A typical U.S. individual would consume slightly over 200 pounds of meat, fish, and poultry products in a year, almost all of which is purchased.

  The big differences in consumption between Alaska Native and non-Native households in Bristol Bay occur in the salmon, finfish, and big game categories. In addition, non-Native families consume almost no marine mammals, or wild birds or their eggs. Of course, Non-Native households have almost no legal access to marine mammals, unless these resources are gifted to them. It is key to realize that Alaska Native households, which average slightly under four household members, would have to replace a considerable proportion of their diet should their access to wildlife resources be interrupted. Animal protein, given shipping and other expenses, is extremely expensive to purchase in small rural communities. For example, to replace their salmon consumption by purchasing store-bought meat at $7.50/lb would be $7,500 for a typical family. As we shall see in a later section, average household income for Alaska Native families in the Bristol Bay region is a little under $40,000. So the replacement cost for salmon would be about 20% of their total household budget. The average household income for non-Native families is nearly $70,000. Replacement cost for non-Native households would be slightly over $4,000, which represents about 6% of their total household budget. Of course, at this point, none of these calculation currently fold into the budgetary impacts to household income from commercial fishing losses should salmon populations face substantial impacts.

- ***Sharing***: About 40% of non-Native households in the Bristol Bay sample give away no subsistence resources. This is about twice the proportion of Alaska Native households who give away no subsistence resources. Of those households that do share subsistence resources, all but one Non- Native household (i.e., 99%) share less than 8% (.08) of the total available resource species (Table 25). In contrast, more than a quarter of the Alaska Native households share 8% (.08) or more of the available subsistence resources. Although the total of available resources varies by community, i.e., coastal communities usually have access to a greater number of resources, the total number of resources (as enumerated on the ADF&G questionnaire) available to any one community is about 125, so 8% represents about 10 species of fish (salmon, finfish), mammals (moose or caribou), marine invertebrates, berries, and so forth.

  Table 26, below, indicates that far more households receive (are gifted) subsistence resources than give them away. Whereas, about 40% of the non-Native households did not give away resources, this proportion drops to less than a quarter for the reception of wildlife resources. On the Alaska Native household side, the proportion of non-givers, at around 17%, drops to 6% for the proportion of recipients. This means that more than 80% of non-Native households and nearly 95% of Alaska Native households are gifted wildlife resources (most often fish) by some other households in their community. What these variables do not measure is the amount of subsistence resources that are shared.

The ADF&G, given time constraints and an already extensive questionnaire, often find it difficult to ascertain the amount of subsistence shared. In addition, documenting sharing networks requires an additional module to the questionnaire and an increased burden on community respondents. However, several ADF&G studies in other parts of the state have addressed the issue of sharing networks in great detail. The results of this research and a more detailed consideration of the importance of sharing in Alaska Native and rural American culture will be contained in the second and final report in this series. In general, this other research indicates that considerable quantities of wildlife resources are shared between households in rural communities. In these rural communities, and especially among Alaska Native households, about 70% of the resources gifted are harvested by about 30% of the households. The research also indicates that non-Native households tend to be recipients and that Alaska Native households tend to share a far greater amount of a wider variety of resources than do their non- Native congeners.

Although the issue of sharing subsistence resources will be addressed in much greater detail in the next deliverable, Table 27 seems to suggest an expected pattern. For Alaska Native households, priority in sharing subsistence resources first goes to the elderly and then to households headed by younger women or other individuals who lack active harvesters in their household. Nearly three-quarters of households headed by younger non-Native women receive little if any subsistence resources, while nearly 80% of Alaska Native households headed by younger women with their children receive high numbers of subsistence species.

Households with older Alaska Native women (61+) receive by far the highest amount of subsistence species, with nearly 80% of these households receiving 10-40 different species. In contrast, no non-Native household with elderly females receives this amount, although as Table 28 indicates, the sample size is quite small for this cohort.

Table 28, below indicates there are only 5 non-Native female household heads 61+, whereas there are 54 Alaska Native Households headed by women 61+. Of these 54 Alaska Native households 47 (87%) receive substantial numbers of subsistence species while none of the non-Native female 61+ households receive this high proportion of subsistence species.

EPA Response: See response to Comment E.38.

McDowell Group (Doc. #4107)

E.42 There is little doubt the Bristol Bay salmon resource has great value to the people who earn income or subsist off that resource, as well as those who enjoy it from a recreational perspective. However, the array of numbers presented in Appendix E serve better to confuse than inform. Measures of the economics of subsistence range from $6 million to $327 million (one being estimated actual spending and the other "net economic value" per year), and estimates of the net present value of the Bristol Bay ecosystem range from $2 billion to $32.7 billion. Imagine the lay-person or public policy-maker trying to make sense of these numbers.

The scope of the analysis in Appendix E is sweeping (with 200-plus pages of material), including economic significance and net economic value calculations for commercial fisheries, subsistence, sportfishing and hunting, wildlife viewing, and tourism. Net economic value analysis in particular is a complex and poorly understood concept among the general public, and subject to misinterpretation and misuse. It is critical that accurate and professionally defensible data, based on generally accepted and clearly articulated research and economic modeling techniques, be developed to support the public discussion around this critical issue. The information provided in Appendix E is not sufficient to meet those objectives.

<u>EPA Response:</u> Appendix E is intended to provide a baseline analysis of economic activity in the Bristol Bay region dependent on a healthy salmon ecosystem. In developing a vigorous analysis it is necessary to consider all sectors that may be affected as well as examine and value activities in a variety of ways; as a result, there are a numerous calculations included in Appendix E. Each value in Appendix E is presented with detailed information as to how it was developed and what it represents. We agree that net economic value analysis is poorly understood among the general public, and Appendix E provides an explanation as to what this sort of analysis is intended to portray in order to help educate the reader. The appendix uses a range of factors to estimate economic values so the reader can understand the effect of various assumptions and factors on the estimated net economic value.

E.43 In conclusion, if economic analysis and related data are to be used to support public policy decision-making around management of the Bristol Bay watershed, we strongly suggest that rather than relying on a patchwork approach incorporating a mix of old and new analysis from a variety of different authors, the EPA have original, up-to-date, and peer-reviewed economic analysis performed, with the results presented in a clear, concise and objective report.

<u>EPA Response:</u> The economic analysis in Appendix E of the assessment describes the economic activity in Bristol Bay that is dependent on a healthy salmon ecosystem. It is part of our effort to characterize the existing fisheries. However, we appreciate this comment and have considered all comments that assist in presenting a clear, concise and objective report.

Appendix F: Biological Characterization: Bristol Bay Marine Estuarine Processes, Fish, and Marine Mammal Assemblages

<u>Curyung Tribal Council (Doc. #4821)</u>

F.1 You explain the fishery fairly well but leave out another major contributor to the world's fish consumption market. The nutrients from the Bristol Bay Watershed not only takes care of those within the watershed but also out in the Bering Sea for the numerous variety of crabs, Pollock, mussels, clams, herring, seals, whales, walrus and other migratory wildlife of the area. The Bristol Bay Watershed is the life food for all the above and is not described within your assessment.

<u>EPA Response:</u> The section in the report entitled "<u>Salmon Contribution to Trophic Levels</u>" (p. 8), highlights an evaluation conducted by NMFS scientists to assess the

contribution of salmon to the eastern Bering Sea and North Pacific marine ecosystems as prey (biomass and forage fish) for other marine species. The section in the report entitled "Marine Mammals" (p. 9), discusses those marine mammal species known to inhabit Bristol Bay and prey upon salmon (at various life stages) in marine, estuarine or nearshore zones. In the closing section of the report, "Discussion" (p. 12), "Trophic Contribution" (p. 15), and "Summary" (p. 17), the role of salmon smolts and salmon-derived nutrients is presented as a nutritional source to invertebrate and juvenile fish species in estuaries and nearshore zones. These nutrient sources fuel and support complex trophic and food chain interactions to a variety of other marine populations throughout the eastern Bering Sea and North Pacific.

Distribution and contribution of the Bristol Bay salmon fisheries to the watershed is addressed in the body of the main document (Volume 1, Chapter 5; more specifically Section 5.2.2.1). There is also a discussion on the subsistence value to Bristol Bay Indigenous Cultures in Appendix D, and a discussion on the economic value of the Bristol Bay salmon fisheries in Appendix E.

Northern Dynasty Minerals Ltd. (Doc. #4611)

F.2 We identified several issues in Appendix F. Firstly, it is unclear how the authors chose the study area boundaries. Their study area is substantially larger than marine areas assessed in other support documents (e.g., Appendix C, p. 12, Figure 1).

EPA Response: NMFS concurs that the size of the study area defined in Appendix F is larger than those in other support documents, such as Appendix C. However, NMFS also recognizes it is smaller than other literature sources define. For the purpose of this discussion, NMFS needed to consider several other factors in defining the area to be discussed from a marine ecosystem perspective.

- **In describing the "No Trawl Protected Area," the North Pacific Fisheries Management Council and NMFS have defined Bristol Bay as marine waters east of the West 162° longitude line.**
- **The seasonal freshwater influence from watersheds discharging into Nushagak and Kvichak bays is recognized to extend beyond Cape Constantine into Togiak Bay.**
- **It is well documented seasonal migrations of salmon populations from Nushagak and Kvichak watersheds influence marine mammal behavior beyond Cape Constantine.**

F.3 Further, the authors oversimplify their estimate of salmon-derived nutrient contributions to the estuarine environment by stating "More recent investigations conducted in Alaskan waters estimate that the contribution of MDN to marine estuarine processes may be as high as 60%, or two thirds of potential nutrient transported back to the estuary (Johnston et al. 2004, Mitchell and Lamberti 2005). In the Nushagak and Kvichak Bays, MDNs liberated from tens of millions of decomposing adult salmon likely have a significant influence on trophic interactions and biodiversity." The proportion of salmon nutrients contributed to an estuary is dependent on various mechanisms of watershed nutrient dynamics, including instream habitat/retention characteristics, stream discharge, timing and magnitude of flooding events, extent of inland penetration of spawning salmon, terrestrial nutrient transfer, etc.

<u>EPA Response:</u> NMFS agrees with the comment. The volume of salmon derived/marine-derived nutrients flushed into an estuary is dependent on several factors. The studies cited in this report were conducted in Alaska and clearly suggest that carbon from terrestrial sources, and nitrogen and nutrient sources from salmon, influence estuarine and nearshore productivity in a bio-chemical manner.

The size of the watershed and number and size of the salmon runs is also an influential variable. Additionally, NMFS reiterates that although no studies have been conducted in estuaries or watersheds supporting salmon runs of this magnitude, the literature supports that smaller watersheds and estuaries which experience smaller seasonal salmon runs are influenced by salmon-derived/marine-derived nutrients. The Nushagak and Kvichak River watersheds influence the biochemical signals in those estuaries. Therefore, nutrients deposited in the watersheds by much larger runs of salmon may similarly influence those estuaries.

F.4 The report referred to the rare distribution of particular species within the area; however, it is important to note that these instances do not refer to the status of the species, and that this is misleading. An example of this can be found in appendix A which discusses the abundance of Arctic Char: "Russell (1980, p. 48, 49) considered them common in some lakes in the Lake Clark area, but absent or rare in lakes of the upper Mulchatna River watershed and Lake Clark itself." In Appendix F, the EPA made 2 direct references to the rare or endangered status of marine mammal species in Bristol Bay.

<u>EPA Response:</u> NMFS did not reference Appendix A in Appendix F. NMFS does refer to the western distinct population segment (DPS) – called "western stock" under the Marine Mammal Protection Act – of Steller sea lions. This DPS is listed as endangered under the Endangered Species Act (ESA). These animals are known to inhabit marine waters of Bristol Bay and to consume salmon. In the report, NMFS noted that, depending on seasonal range and migratory patterns, salmon ranked high as a selected prey species in Steller sea lion diets (Sinclair and Zeppelin 2002). Since the report was written, Sinclair et al. (2013) [Sinclair, E.H., D.S. Johnson, T.K. Zeppelin, and T.S. Gelatt. 2013. Decadal variation in the diet of Western Stock Steller sea lions (*Eumetopias jubatus*). U.S. Department of Commerce, NOAA Tech. Memo. NMFS-AFSC-248, 67 p.] provided a more recent update of temporal and spatial patterns of variation in the frequency of various prey species in the diet of western DPS Steller sea lions. With respect to the range sampled in their study, Sinclair et al. (2013) summarized that "Salmonids…occur at 28% FO (frequency of occurrence) across the range, but more frequently in summer diets (35% FO) than in winter (20% FO)." The % FO of salmonids was higher in some subareas than others.

NMFS recognizes two DPS of Steller sea lions: a western and an eastern DPS. The western DPS consists of all Steller sea lions from breeding colonies located west of 144 °W longitude and the eastern DPS consists of all Steller sea lions from breeding colonies located east of 144 °W longitude. Recently (78 FR 66140), NMFS published a final rule to remove the eastern DPS from the List of Endangered and Threatened Wildlife under the ESA. The delisting took effect on December 4, 2013. Federal agencies are no longer required to consult under section 7 of the ESA when activities they authorize, fund, or carry out may affect the eastern DPS. However, as noted above, the western DPS

remains listed as endangered under the ESA. There is regular movement (Jemison et al. 2013) [Jemison, L.A., G.W. Pendleton, L.W. Fritz, K.K. Hastings, J.M. Maniscalco, A.W. Trites, and T.S. Gelatt. 2013. Inter-population movements of Steller sea lions in Alaska with implications for population separation. PLoS ONE 8(8):14 p.] of Steller sea lions across the DPS boundary and there have been photo-confirmed sightings of eastern DPS Steller sea lions in parts of the southeastern Bering Sea (see Figure 3 of Jemison et al. 2013). Thus, eastern DPS animals may be present in this area. However, the vast majority of the Steller sea lions in areas of the Bering Sea that could be affected by the actions of concern here are endangered western DPS animals.

Natural Resources Defense Council (Doc. #4608)

F.5 The port alone would threaten a highly endangered, genetically distinct, and geographically isolated species of beluga whales. The mine and new road would also increase traffic to the region and undoubtedly spur industrialization and development as major infrastructure is introduced. This would enable not only the Pebble Mine but other large-scale mining in the region, as well as secondary development – *the most significant* of impacts for Bristol Bay – to further compound the impacts to fragile fish and wildlife populations.

EPA Response: NMFS recognizes concerns about impacts from the proposed mining development. The purpose of EPA's assessment is to provide a characterization of the biological and mineral resources of the Bristol Bay watershed and increase understanding of the potential impacts of large-scale mining on the region's water and fish resources. NMFS input into EPA's assessment responds to EPA's request to NMFS to provide information on our understanding of the range and distribution of salmon originating from the Nushagak and Kvichak River watersheds, the marine mammal, fish and invertebrate species assemblages in Bristol Bay, the trophic contribution of salmon to these marine systems, and the estuarine and marine processes that influence the nearshore zone. NMFS input does not discuss or recommend policy, legal or regulatory decisions, nor does it outline or analyze options for future decisions.

Regarding impacts to Cook Inlet beluga whales, NMFS recognizes that there may be direct, indirect, and cumulative impacts to living marine resources from the proposed Pebble mine project, or a future mining district.

American Fisheries Society, Western Division (Doc. #3768)

F.6 The lack of rigorously collected fish assemblage and salmonid population data seriously limit modeling accuracy and likely produce gross underestimates of the effects of the mine site, pipelines, and haul road. A carefully designed survey, implemented over multiple years and seasons, is needed to provide scientifically defensible fish distribution, abundance, spawning, and production data.

Although the laboratory toxicity tests for Cu may be state of the art, they poorly represent sensitive macroinvertebrates and algae and the ambient effects of Cu toxicity on salmonid mechanosensory systems, olfaction dependent behaviors, growth, and migration (Marr et al. 1998, Linbo et al. 2009, Tierney et al. 2010). Nor do such tests adequately evaluate the potential synergistic effects of Cu and Zn (which is not projected to be recovered from the Pebble ore; Lorz and McPherson 1976; 1977). A recently published study (McIntyre et al.

2012) documented decreased predator avoidance by, and increased predation rates on, juvenile salmonids exposed to low levels of Cu. Thus the state and federal Cu criteria are under protective of macroinvertebrate assemblages (major salmonid prey) and salmonid populations (Chambers et al. 2012; Mebane & Arthaud 2010).

EPA Response: See response to Comment 5.237. NMFS recognizes the concerns expressed in these comments. The purpose of this report (Appendix F of the assessment) is not to address the rigor of current fisheries studies, the potential toxicity of copper on salmon sensory systems, or the toxicity of metals on salmon or invertebrate species. This report responds to EPA's request to NMFS to provide information on our understanding of the range and distribution of salmon originating from the Nushagak and Kvichak River watersheds, the marine mammal, fish and invertebrate species assemblages in Bristol Bay, the trophic contribution of salmon to these marine systems, and the estuarine and marine processes that influence the nearshore zone. However, these items would need to be addressed in the future for any large scale mining proposal.

Bristol Bay Native Corporation (Doc. #4382)

F.7 Appendix F could be expanded to include more of the considerable available information about the importance of Bristol Bay as a rearing area for several species of commercially important fishes.

EPA Response: NMFS agrees that additional information could have been presented. The focus of our input was to address the known range and distribution of salmon originating from Nushagak and Kvichak watersheds, and the trophic role and contribution of these salmon populations at various life stages. NMFS however, did present a list of all known fish species identified in Bristol Bay to date and a brief discussion of representative groundfish and invertebrate species (walleye pollock, yellowfin and rock sole, and king crab), that represent species groups which are abundant and an economically important commercial species that use these nearshore waters as part of their nursery range at larval and juvenile phases. Also refer to response to comments received, September 2012 (below).

Appendix G: Foreseeable Environmental Impact of Potential Road and Pipeline Development on Water Quality and Freshwater Fishery Resources of Bristol Bay, Alaska

National Park Service and U.S. Geological Survey (Doc. #4607)

G.1 Roads and Pipelines: While authors need to prioritize risks, the development of ports, roads, and pipelines in addition to mine facilities themselves will require the use of equipment and personnel brought in from outside the region. This would lead to the potential introduction on invasive species and new, exotic pathogens to wildlife. We recommend these potential impacts evaluated further.

<u>EPA Response:</u> Invasive species are discussed in Section 10.3.6 of the revised assessment.

<u>Alaska Department of Natural Resources (Doc. #4818)</u>

G.2 Overstatement of risk from road runoff based on literature describing environmental problems with residues from urban hard surface roads such as road salting, metals, oil and grease, high volumes of traffic, and other impacts. Mine project roads and traffic could have very different impacts. The State technical comments provide more applicable and recent literature to consider.

<u>EPA Response:</u> Risk from road runoff is not overstated in the assessment. Section 10.3.3 of the revised assessment discusses spillage or runoff of contaminants and fed sediment, but also notes, "It is unclear if the transportation corridor would have sufficient traffic to contaminate runoff with significant amounts of metals or oil (although stormwater runoff from roads at the mine site itself is more likely to contain metal concentrations sufficient to affect stream water quality)." State technical comments referenced in the comment did not refer specifically to runoff from mine project roads.

G.3 The information on the roads and pipeline do not point out that some road sections out of Williamsport and around Pedro Bay have already been constructed. This omission may lead readers to assume that only a mining project would necessitate roads and road building in the study area.

<u>EPA Response:</u> Existing roads are indicated on maps in the assessment (e.g., Figures 2-7 and 13-1).

<u>Nondalton Tribal Council (Doc. #3116)</u>

G.4 The proposed Transportation Corridor will threaten critical fishing areas in the Newhalen River, which it crosses on its way between the Pebble deposit and the Cook Inlet Moreover, pollution from the Transportation Corridor, the mine, and any mine wastes could devastate the local salmon and fish populations, or leave them unsuitable for subsistence consumption. These pollutants also threaten the quality of our drinking water. The compound result of these risks means that Nondalton's proximity to the mine puts it at ground zero of any spills, leaks or mine failures.

<u>EPA Response:</u> Potential effects of the transportation corridor are evaluated in Chapter 10 of the revised assessment.

<u>Northern Dynasty Minerals Ltd. (Doc. #4611)</u>

G.5 Appendix G does not estimate the level (e.g., low, moderate, high) of potential ecological effects that may arise as a result of construction of the road and pipeline, as would be expected from a risk assessment. Further, Appendix G does not estimate the level of potential ecological effects that may arise or discuss uncertainty in such an estimate, which one would expect from a risk assessment. The principal assessment endpoint for the risk assessment is the quantity, quality and genetic diversity of salmon populations (Volume 1, Section 3.3, pg.

3-4). Given this, what effect is the road estimated to have on the Iliamna Lake sockeye population? Is it expected to lead to a 5% decrease in sockeye abundance, or a 10% decrease? Are there studies from other remote areas where roads have been constructed that can be used to provide a reasonable estimate of potential effects? There is also some inconsistency between Appendix G and Volume 1 regarding the potential amount of wetland habitat intersected by the road corridor.

<u>EPA Response:</u> Appendix G is not a risk assessment. Risks associated with the potential transportation corridor required for mining at the Pebble deposit are considered in Chapter 10 of the assessment.

G.6 The BBWA has not considered mitigation strategies for addressing concerns related to shallow groundwater impacts (pg. 5-60) The report raises concerns about the impact of road and pipeline construction on shallow groundwater and localized surface runoff channels: "The construction and operation of roadways and pipelines can fundamentally alter connections between shallow aquifers and surface channels and ponds by intercepting shallow groundwater flowpaths, leading to further impacts on surface water hydrology, water quality, and fish habitat." This assessment does not consider possible mitigation for these impacts or state of the practice methodologies for minimizing impacts and mitigating inevitable impacts. Groundwater impacts can be included as a design consideration in the planning and selection of alignment of the roads and pipelines to minimize impacts. Areas of shallow ground water can be avoided to the extent possible to preserve shallow groundwater flow paths.

<u>EPA Response:</u> The transportation corridor evaluated in the assessment is based on that described by Northern Dynasty Minerals (in Ghaffari et al. 2011). Potential mitigation measures are described in Chapter 10 of the revised assessment.

G.7 The EPA Report misleads readers by discussing certain mitigation measures in detail but not incorporating all of these measures into their assessment of potential mining effects in all assessments of potential effects. The authors' (Appendix G) statement that actions taken to prevent copper effects are likely to mitigate effects from co-occurring metals may be over-simplistic. Further, we do not agree with the Appendix G author's conclusion that many of the mitigation measures are mutually exclusive and will be ineffective. Several of the reviewed mitigation measures could be expanded upon. For example, a spill containment plan could be included in the mitigation for the 'secondary containment pipe ("encased in a protective layer") for overhead stream crossings on bridges' and 'manual isolation valves on either side of major river crossings'.

<u>EPA Response:</u> Potential mitigation measures for the transportation corridor and associated pipelines are described in Chapters 10 and 11 of the revised assessment.

G.8 The BBWA discounts the effectiveness of established sediment and erosion control practices for road construction and operation (Appendix G) The report by Frissel and Shaftel (2011) in Appendix G of the BBWA states:

> "Unfortunately the scientific and professional literature on the subject of the effectiveness of environmental mitigation measures for water and fish is sparse and poorly synthesized. There are lists of standard practices and there are a scattering of short-term, site-specific

> studies of efficacy of mitigation measures for roads and pipelines (e.g., assessment of mitigation of the delivery of sediment and its local impact on biota). Some report showing adverse impact, or ineffectiveness of mitigation measures, and others report not detecting adverse effects, which is often taken as circumstantial evidence that mitigation measures were effective. Exceedingly few of these studies extend to medium- or long-term evaluation of mitigation effectiveness, and fewer still have been published in accessible peer-reviewed forums. Therefore, evaluating the effectiveness of proposed mitigation measures remains a process of best professional judgment and logical evaluation of premises, specific environmental context, and likely operational circumstances."

The BBWA does not appear to recognize that state-of-the-art practices in erosion and sediment control and stormwater best management practices (BMPs) can mitigate the impacts attendant to construction of the Pebble Project transportation corridor or at the active mine site. By contrast, the State of Alaska, specifically, the Alaska Department of Transportation and Public Facilities, appears to believe that the design and implementation of environmental mitigation measures (i.e., erosion and sediment control BMPs) are effective for water quality protection during highway construction and for public projects. Like California and other states, AKDOT&PF has recently developed an education, training and certification program called the "Certified Erosion and Sediment Control Lead" (AK-CESCL). AKDOT&PF states that the course is applicable to commercial and residential builders, project engineers, natural resource managers and anyone responsible for creating, maintaining or evaluating a stormwater pollution prevention plan(s). The AKDOT&PF routinely offers certification training that explains the erosion and sedimentation process and how to comply with the EPA NPDES Construction General Permit. NPDES compliance is required for all projects that disturb a total of one acre or more of soil, and in Alaska, a Certified Erosion and Sediment Control Lead-trained person is required on all USACE and ADOT&PF projects as of January 1, 2008. The BBWA appears to discount the effectiveness of established sediment and erosion control practices for road construction and operation developed to comply with its NPDES permitting program.

<u>EPA Response:</u> Potential mitigation measures for the transportation corridor are described in Chapter 10 of the revised assessment.

G.9 The BBWA has not considered mitigation strategies for addressing concerns over sediment contribution and effects (pg. 5-62) The BBWA states:

> "The sediment contribution per unit area from roads is often much greater than that from all other land management activities combined (Gibbons and Salo 1973)." The report makes the case for the impacts of sediment loading to streams on aquatic habitat and states "Sediment loading from roads can severely affect streams below the right-of-way (Furniss et al. 1991)" and that: "[i]ncrease[d] loading of road-derived fine sediments linked to decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, increased predation on fishes, and reduced benthic organism populations and algal production (Newcombe and MacDonald 1991, Newcombe and Jensen 1996, Gucinski et al. 2001, Angermeier et al. 2004, Suttle et al. 2004)." Lastly, the report notes: "…accelerated sedimentation could have an impact on the concentrated spawning populations of sockeye salmon in the lake's shallow waters (Woody 2007)."

The report presents a comprehensive array of sediment impacts that are relevant and need proper consideration and mitigation. If, as the language of the report appears to dictate, the only acceptable solution is a zero-risk scenario, then sediment impacts from the road will be an issue. However, to our knowledge no state transportation agencies currently adopt a zero-risk approach for permitting of construction projects.

Sediment contributions from construction and operation of roads can be reduced significantly through proper application of Best Management Practices (BMPs) (Anderson and Gesford, 2006). Effective construction site BMPs are usually comprised of a “treatment train” of measures that complement each other and focus on control of sediment and other pollutants at their sources. For example, there are numerous dust palliatives that are more ecologically-friendly than calcium chloride for dust suppression and most have been shown to have little, if any, water quality impact. Used in combination with other stormwater BMPs such as bioretention swales, vegetated channels and other perimeter controls, dust palliatives have proven highly effective in reducing sediment impacts to off-site water resources. According to EPA (1999) vegetated swales provide 81% removal of TSS, and bioretention provides 90% removal of TSS (1999).

In the last decade, a great deal of laboratory and field research has been conducted to quantify the erosion control performance characteristics of a myriad of storm water BMPs. These studies include data on erosion control effectiveness, cost and water quality impacts based on research at the National Soil Erosion Research Laboratory (Purdue University); the Texas Transportation Institute at Texas A & M University; and the Soil Erosion Research Laboratory at San Diego State University. These studies have focused primarily on temporary BMPs such as hydraulic mulches, erosion control blankets and other practices used to temporarily control surficial erosion until they are replaced by permanent, stabilizing vegetation.

<u>EPA Response:</u> Mitigation measures for reducing sediment impacts are included in Box 10-3 of the revised assessment.

<u>The Pebble Limited Partnership (Doc. #4962)</u>

G.10 While numerous citations are provided in Appendix G, the appendix does not reflect current construction standards for roads and culverts. In the past few decades, great strides have been made in the development of BMPs that substantially reduce runoff from roads. The standards for culverts have changed such that the probability of washout has become minimal. Culverts are now sized to permit both upstream and downstream migration of fish and are also sized to permit the movement of debris under the road. Most of the impacts described in this appendix are easily avoided or mitigated using modern construction methods and standards. In light of current regulatory requirements, the reliance upon documents that address the effects of historical construction techniques are not pertinent. Although the assessment indicates that literature documenting the effectiveness of BMPs could not be found, there is actually a very large number of documents available that address BMP effectiveness. USEPA’s analysis in this area is remarkably weak and unfounded.

EPA Response: BMPs for roads and culverts are included in Chapter 10 of the revised assessment. Failure frequencies cited in the revised assessment are derived from modern roads and are not restricted to forest roads.

Natural Resources Defense Council (Doc. #4608)

G.11 The mine and new road would also increase traffic to the region and undoubtedly spur industrialization and development as major infrastructure is introduced. This would enable not only the Pebble Mine but other large-scale mining in the region, as well as secondary development – the most significant of impacts for Bristol Bay – to further compound the impacts to fragile fish and wildlife populations.

EPA Response: Increased secondary development is addressed in Appendix G. It is mentioned briefly in the revised main assessment text, although full consideration of secondary development was considered outside the scope of the assessment (as defined in Chapter 2). However, the potential for cumulative development of multiple mines is evaluated in Chapter 13 of the revised assessment.

G.12 Operation of a Transportation Corridor Would Fragment and Diminish the Quality of Salmonid Habitat The Bristol Bay watershed is located in "one of the last remaining virtually roadless regions in the United States," and development of a mine there would be impossible without dramatic transportation infrastructure expansion. The 2011 Wardrop report discussed plans to construct an 86-mile access road connecting the mine to a proposed port at Iniskin Bay in Cook Inlet. According to several studies, this road would cross at least 89 streams and require up to 120 stream crossings. Twenty-four of these streams are documented to provide 1,200 acres of spawning habitat for sockeyes and other salmonids. EPA's mine scenario similarly provides for an 86-mile permanent access road connecting the mine site to a new port in Cook Inlet. This road is estimated to cross 34 streams and rivers that support salmonids within the Kvichak River watershed, including 17 streams designated as anadromous waters at the location of the crossing.

EPA Response: Potential effects of the transportation corridor are discussed in Chapter 10 of the revised assessment.

American Fisheries Society, Western Division (Doc. #3768)

G.13 If the entire mining district is developed, the mining footprint would double from that estimated in the report and additional haul roads, pipelines, and infrastructure would be needed. The models should model the entire district, as well as the proposed Pebble mine, because of the increased damage and failure risks and to inform the other mining companies.

EPA Response: The potential for development of multiple mines is evaluated in Chapter 13 of the revised assessment.

G.14 The report explicitly disregards the absolutely inevitable and necessary infrastructure development for a mining district of this scale. The numbers of employees, roads, structures, recreationalists, and their effluents will also threaten the character of the fisheries in, and outside, the mine district footprint—just as those activities have degraded salmonid populations elsewhere. Stanfield et al. (2006) and Stranko et al. (2008) found that 4-9%

impervious catchment cover sufficed to eliminate salmonids from streams. Many of these infrastructure development processes will have very substantial effects on the fish and wildlife and the subsistence use by Native communities, and also the economic value of the resource such as recreational fishing lodges. Given the number of people likely to use the road and expand into the area, increased legal and illegal take of fish and wildlife, litter, water use and contamination, interference with subsistence uses, and other forms of interaction are inevitable.

EPA Response: See response to Comment G.11.

Natural Resources Defense Council (Doc. #4608)

G.15 Culverts Are Likely to Fragment Habitat and Impede Salmon Movement Though listed as a "possible" failure by EPA, the Assessment's projections reveal that culvert interference with fish movement is in fact a highly likely result of mining – projected by EPA to eventually impact 50% of culverts. Under any mine scenario, many stream crossings will likely be culverts instead of bridges; EPA anticipates fourteen. Culverts can serve as a barrier to fish, restrict or eliminate fish movement to upstream habitat, and isolate or modify populations. Such habitat fragmentation increases the chance that fish populations will be extirpated due to a lack of genetic diversity or chance events. Culvert interference with fish movement can occur in several ways. The crossings can create excessive water velocities and disorienting turbulence — or the water running through the culvert can be too shallow for fish to traverse. Culverts can further block fish movement as a result of outfall barriers, channel scouring and erosion, lack of resting pools below culverts, or a combination of conditions.

In a healthy watershed, salmon often move into seasonal floodplain wetlands and small valley floor tributaries to escape main-channel flood flow stresses. The existence of culverts reduces flow to these safe havens because flow is instead directed into the main channel. And even if fish can physically swim through a culvert, there may be "behavioral barriers" that prevent fish from attempting passage, as fish will often avoid long culverts, darkness, confined spaces, and shallow depths.

Even assuming compliance with fish passage guidelines at installation, culverts will likely threaten salmon migration in the future. Blockages and erosional failure are common features of culverts, and without prompt repair can cause the loss of a year class if they occur during migrations. Road maintenance during mine operation should generally catch such failures in a timely manner, but without "continual and proper" maintenance, culverts fail and become barriers to fish passage. Because "typical" road inspection and maintenance practice declines post-closure, the likelihood of partial or entire culvert blockage after mining ends jumps to a dramatic 50%. This means that seven of the fourteen potential salmonid-supporting streams with culverts in the risk area would experience post-closure blockage, resulting in the likely loss of the streams' ability to support long-term populations and resident species such as rainbow trout or Dolly Varden.

EPA Response: Comment noted; no change required.

G.16 Siltation, sedimentation, and other stream modification impacts are likely to disrupt anadromous and resident salmon production siltation, hydrologic modification, filling of wetlands, and road salts are "likely to diminish" anadromous and resident salmonid production in more than 30 streams. The habitat potentially affected below the road crossings totals 270 km of stream, plus an additional 240 km upstream, if culverts impede fish movement It is "well-recognized" that management of roads in the type of terrain found in the Pebble prospect area can be "unpredictable and challenging," due to difficulty anticipating the "extent and nature of disruption" to subsurface flow paths, and because "the effects of water table deformation can project hundreds of meters from the road itself." Roads can impact the connectivity between groundwater and surface water systems and, along with pipelines, fundamentally alter the "intricate connections between shallow aquifers and surface channels and ponds," causing further impacts on surface water hydrology, water quality, and fish habitat.

Furthermore, the sediment contribution from roads frequently far surpasses that from all other land management activities combined. Road-derived fine sediments have been linked to decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, increased predation on fishes, and reduced benthic organism populations and algal production. It could render otherwise suitable spawning gravel useless, and impact the concentrated spawning sockeye salmon populations in the shallow waters of Lake Iliamna. Salts and other materials used to treat roads can also wash off into streams, rivers, and wetlands, causing direct exposure to fish and their invertebrate prey.

EPA Response: Comment noted; no change required.

C. A. Woody, Ph.D. (Doc. #5680)

G.17 The estimate of potential impacts to fisheries from roads and culverts is well founded in the Watershed Assessment, but also underestimated because no secondary development is considered. Just 10% increase in impervious surfaces due to secondary development can eliminate salmonids from streams.

EPA Response: See response to Comment G.11.

Appendix H: Geologic and Environmental Characteristics of Porphyry Copper Deposits with Emphasis on Potential Future Development in the Bristol Bay Watershed, Alaska

Alaska Miners Association, Inc. (Doc. #4612)

H.1 The geologic characterization of the area is limited to a few paragraphs in Appendix H. That characterization indicates, "The geological setting of the Nushagak and Kvichak watersheds have characteristics that indicate that the region is favorable for several different mineral deposit types. These deposit types include porphyry copper deposits, copper and iron skarn deposits, intrusion-related gold deposits, epithermal gold---silver vein deposits, hot spring mercury deposits, placer gold deposits…. Of these deposit types, porphyry copper deposits and intrusion-related gold deposits are represented by prospects within the area that could prompt large-scale developments. Copper sarn deposits hold less potential…." The Appendix goes on to conclude, "The Pebble deposit is the most advanced among the mining prospects in the Bristol Bay watershed in terms greatest for porphyry copper deposits. Accordingly, the remainder of the report will focus exclusively on this deposit type - porphyry copper deposits.” [21]

This logic is important to understand, and it is a contradiction. The Assessment is clear: it is not intended to represent only Pebble but to represent the effects of large-scale mining in the watershed. Yet the Assessment indicates that the watershed is favorable for several different deposit types. However, the Assessment focuses only on porphyry copper deposits, because Pebble is close to permitting.

In contrast, the U.S. Bureau of Land Management recently assessed the mineral resources in Bristol Bay as part of the three---year planning process for their Bay Resource Management Plan (Bay RMP). BLM identifies 11 mineral terrains, and 17 mineral deposit types containing a number different mineral commodities. [22, 23]

The Bay RMP and its accompanying Environmental Impact Statement was the product of a three year process that stretched from 2004 to 2007.[24] Unlike the Watershed Assessment, BLM’s planning process includes multiple stages of review, including 15 public meetings and multiple public comment periods.[25] The boundaries of the Bay Plan and EIS are similar to that of the Assessment.

The EIS for the Bay RMP describes the affected environment, including locatable minerals:[26] “The Bay planning area is underlain by eleven Mineral Terrane units whose geologic settings are considered highly favorable for the existence of metallic mineral resources…. Specific mineral deposit types and associated commodities are more likely to exist within each terrane based on a terrane’s particular geologic nature. Just because a geologic terrane is more likely to contain certain mineral deposit types does not necessarily mean that economic deposits exist within that rock unit.”

The EIS goes on to list the various terranes and the mineral deposit types for which the terrane is favorable. Together, the terranes are listed as favorable for the following metals: copper, gold, molybdenum, tin, tungsten, uranium, thorium, rare-earths, nickel (with byproducts of platinum and cobalt); chromium, platinum group elements, lead, zinc (with by-product silver and gold).

The existence of terranes that could potentially contain these deposits does not guarantee that metals exist in concentrated quantities. However, the area is underexplored so that future exploration may identify deposits or minerals that are not now known. Specifically, according to the EIS, “The area is not as well mapped as other parts of the state, and contains very little detailed geologic information. Many of the geologic maps for this region are old and have not been updated…subsurface geology for much of this region is largely unknown.”

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[21] Information in this paragraph is taken from Watershed Assessment, Appendix H, pages 2 and 4.

[22] Bay Proposed Resource Management Plan/Final Environmental Impact Statement, 2007. U.S. BLM. Page 3-78.

[23] BLM’s work is not included as a reference in the EPA Assessment. Despite the recent comprehensive nature of BLM’s mineral assessment, it does not appear to have been used.

[24] Bay Proposed Resource Management Plan/Final Environmental Impact Statement, 2007. U.S. BLM. Page 1-3.

[25] Ibid, Page vii.

[26] The remainder of this information in this subsection is from BLM’s 2007 EIS, pages 3-80 through 3-82.

The EIS does describe the existence of a number of lobe deposits, in addition to Pebble and in addition to copper porphyry prospects that exist in the area. "There are numerous known lode deposits with in the planning area that have never seen mineral production, including deposits of gold, copper gold, tin/tungsten, and iron/titanium." The EIS describes the following:

- Kasna Creek, a copper/lead/zinc skarn deposit with 10 million tons of ore;
- Sleitat Mountain, a large high-grade tin/tungsten deposit with inferred resources for 64,000 to 106,000 tons of tin with 29 million tons of ore;
- Kemuk Mountain, a magmatic iron/titanium deposit with inferred reserves of 2.4 billion tons of ore that average 15-17 & iron and 2-3% titanium;
- Shotgun, a gold/copper deposit with inferred resources of 980,000 ounces of gold contained within 36 million tons of ore which is reported to be amendable to recovery by cyanide leaching;
- The Red Top Mercury Mine near Aleknagik which produced between 1953 and 1959.

Most of the deposits described above are not referenced in the Watershed Assessment.

In addition to ignoring the information summarized in BLM's Bay RMP, the Assessment references but does not use information prepared for the Bay RMP. Specifically a USGS publication that uses a probabilistic model to estimate the number of undiscovered deposits in the area. That report estimated that at the 50% probability level there are 14 undiscovered non-copper porphyry deposits within Bristol Bay (excluding placer deposits). At the 90% probability level there may be 4 deposits, and at the 10% probability level there may be 40 deposits.[27]

The obvious and only near-term deposit in the region is Pebble. No other prospect has been explored to the same extent nor is any other prospect close to potentially submitting permits. Because no other prospects are in advanced exploration, it is unlikely that any project other than Pebble will apply for permits to operate a major mine within the next decade. However, the nature of mineral exploration is that companies find deposits that are not otherwise identified. The underexplored nature of the Bristol Bay watershed, plus the existence of known lode deposits that are not copper porphyry, plus mineral terranes that are favorable to the existence of deposits that are not copper porphyry, all argue for a more comprehensive review of mineral deposits in Bristol Bay. It is unreasonable to conclude that copper porphyry deposits are characteristic of all future large-scale mining Bristol Bay, or are typical of all potential large-scale mining in Bristol Bay.

<u>EPA Response:</u> The scope of the project was defined to focus exclusively on porphyry copper deposits with an emphasis on the Pebble deposit. Aside from other targets within the PLP land block, limited detailed information was available for citation. The section entitled "Mineral Resource Potential of the Nushagak and Kvichak Watersheds" in the

[27] "Undiscovered Locatable Mineral Resources in the Bay Resource Management Plan Area, Southwestern Alaska: A Probabilistic Assessment." 2007. USGS Scientific Investigations Report 2007-5039. J.M. Schmidt, T.D. Light, L.J. Drew, F.H. Wilson, M.L. Miller, and R.W. Saltus. Page 4.

original Appendix H and the current version, which includes Table 1 and citation of Schmidt and others (2007) was written to acknowledge potential for other porphyry copper deposits and other mineral deposits types in the watershed. A slightly expanded description of the Humble or Kemuk Mountain prospect has been added.

H.2 EPA's watershed assessment recognizes different copper porphyry deposits can also have diverse geochemical characteristics. The Assessment's Appendix H discusses the geologic and environmental characteristics of porphyry copper deposits. The appendix recognizes the potential diversity in the ore, tailings, and waste rock. "Factors that influence the environmental characteristics of mineral deposits range from geologic setting (both local and regional), hydrologic setting, climate settings, and mining methods, to ore beneficiation methods."[28]

<u>EPA Response:</u> Comment noted; no change required.

H.3 The EPA Appendix H is quite clear that the acid-generating and metals leaching characteristics of waste rock cannot be predicted in general: "…[T]he acid-generating potential of the waste rock can span the range from potentially acid-drainage generating (PAG) to non-PAG. The ability of leachate generated from waste rock to mobilize metals and oxyanions will vary, depending in part, on the pH of the resulting solution, which largely is a function of the pyrite content of the waste rock."[29] While the Appendix indicates that copper porphyry deposits are more typically acid producing, it recognizes that some rock types are non-potentially acid-producing (Figure 5 and 6 on pages 11 and 12), and that acid-generating characteristics can be significantly reduced or eliminated if the sulfide-laden pyrite's are separated and disposed of in a different waste stream.[30]

In summary, geochemical character of ore deposits are unique. They are different for each deposit type. Even among copper porphyry mines, the geochemical characteristics cannot be predicted. The geochemical characteristics of the tailings, while having some similarities among copper porphyry mines, can vary significantly between deposits and are greatly influenced by the beneficiation techniques used by the mine. For this reason, the concept of a "typical" set of geochemical characteristics that would represent all deposits of various types in Bristol Bay is a fallacy. Such a typical set of characteristics does not exist.

<u>EPA Response:</u> See response to Comment 4.235. The acid-generating potential of mine waste can be predicted on a site-specific basis given the appropriate data. The purpose behind doing a "global" compilation of the environmental characteristics of porphyry copper deposits was to assess the range of values that this class of deposit has for any given parameter. Based on this compilation, parameters such as NPR vary widely.

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[28] Assessment, Appendix H, Page. 10.

[29] Assessment, Appendix H, Page 13.

[30] Specifically, Appendix H reads in part: "The most profound influence that beneficiation of ore can have on mine tailings derived from froth flotation centers on the fate of pyrite (Fuerstenau and others, 2007). At many porphyry copper mines, the pyrite is discharged with the waste tailings, thereby contributing to the acid- generating potential of the tailings. However, the option exists to produce a pyrite concentrate to manage more effectively the acid-generation risks associated with tailings, to extract gold associated with the pyrite, or both. The production of a pyrite concentrate will decrease the acid-generating potential of the tailings." Pages 11 and 12.

Thus, a "typical" set of geochemical characteristics that is representative of the class as a whole is not a fallacy. Instead, the range observed for any given parameter may be too wide to permit any definitive inclusions to be made, and site-specific data should be used. It is essential that the range or uncertainty of a given parameter be considered when using "global" compilations rather than merely using a mean, median, maximum or minimum value. No change required.

Alaska Department of Natural Resources (Doc. #4818)

H.4 Report page 10/11 comment: The range in which there is uncertainty of AMD is between 1 and 3, and non-PAG material has an NNP > 3. Note: Page 2 of Appendix I suggests the range of uncertainty would be between 1 and 4.

<u>EPA Response:</u> **I believe the reviewer meant to write "NPR > 3" rather than "NNP > 3", and I will address the comment assuming that NPR was the intent. There is not universal consensus on what NPR value ensures no acid generation (published values range from 1 to 4); instead, the technique is used as a screening tool. Mine-waste management decisions are generally based on more extensively characterization using additional techniques, such as kinetic or humidity-cell tests. Several sentences have been added to the "Acid Generating Potential" section describing the lack of consensus and providing a better context for the use of NPR values. A reference (White and others, 1999) was also added.**

H.5 *Report page 19-21*

Comment: The following comment is an example of how could significantly alter the conclusions of impact if the mine plan used in the assessment had been vetted through the environmental and permitting review processes.

There are actual humidity cell test results for the Pebble tailings, which were started in 2005 and 2008; however, it appears that these tailings are the rougher tails (85% of the total) and not the pyritic tails (14% of the total). Table 7 on page 21 shows pH average of 7.8 for the rougher tails. No specific data is presented for the pyritic tails. It is likely that these tails are extremely acidic due to: a) a fine size of 80% passing 30 μmeters, and b) the pyrite content will range from 50% to 80% of these tails. This information came from the Northern Dynasty Minerals, Ltd. 2011 Waldrop report. The applicant may state that the acid producing potential of the pyritic tails are irrelevant since they plan to encapsulate them in the TSFs with inert rougher tails and the combination of these tails and a large water height will prevent the pyritic tails from oxidizing. It is still important to know what the potential is of the pyritic tails to produce acid, since the worst case is that these tails may oxidize.

Recommended Change: Get SPLP and/or humidity cell tests on the pyritic tails and evaluate the results.

<u>EPA Response:</u> **This is a valid suggestion, but the Pebble Limited Partnership did not include any data for their pyritic tails (also known as concentrate). No change required.**

Alaska Marine Conservation Council (Doc. #1239)

H.6 The mining deposits in the upper Bristol Bay Watershed have a very high concentration of sulfur, which is highly likely to generate acid mine waste.

Acid mine waste can exist for thousands of years, has no known half life and is highly toxic for cold water anadromous fish and other aquatic life. The significant risks posed by the Pebble prospect with its estimated 10 billion tons of toxic mine waste jeopardize the region's clean waters and abundant natural resources. Additionally, numerous other mining claims in the region largely depend on the mining infrastructure to be developed by Pebble, and could usher in a much larger and more dangerous mining district in the region.

EPA Response: Comment noted; no change required.

Bristol Bay Heritage Land Trust (Doc. #4524)

H.7 Nushagak River Watershed Environmental Standards and Practices for Responsible Mining: A mine should not generate acid (acid mine drainage) during operation or closure unless risk is eliminated by methods proven effective at a similar location.

EPA Watershed Assessment: Acid mine drainage will result. Uncertain whether a mine can be constructed in the NTK watershed that will contain acid mine drainage in perpetuity.

Mine will likely violate Standards: Yes.

EPA Response: Comment noted; no change required.

Center for Science in Public Participation (Doc. #4106)

H.8 It is noted that: "Underground block caving of ore requires that a shaft or decline be sunk to facilitate mining. The amount of waste rock removed for block caving is much less than that removed in a typical open pit operation." (Draft Assessment, Appendix H, p. 12)

Underground mining would almost certainly be used at some point at Pebble, perhaps even during the initial mining phase. As implied in this report, block caving is the only mining method that is economical for mining low grade underground ore (primarily copper and molybdenum deposits). The primary objective of block caving is to destabilize the ore zone so that it fractures, rubbilizes, and is then able to be drawn into ore collection points underneath the deposit. One aspect of this 'destabilization' process is that the overlying strata is also fractured, often to the surface, allowing water (and oxygen) to come into contact with the mineralized material that is not removed by mining. In one sense, a block caving operation is essentially creating an open pit from the bottom up, and filling the pit with waste rock. When the mine is closed, and pumping to keep the mine dry ceases, the mine will fill with water. Once the groundwater table has stabilized, it is possible that flow from the now water-filled mine will carry contaminants downgradient and into surface waters.

Recommendation: It might also be mentioned that block caving produces subsidence, providing a pathway for water and oxygen to reach the 'rubblized' material remaining after mining ceases.

EPA Response: The assessment focuses on the potential impacts from large scale porphyry copper surface mining, although block caving (including the potential for subsidence) is discussed briefly in Section 4.2.3.1 of the revised assessment. Many of the impacts of a combined surface and underground mine would be similar in nature to those of a surface mine. The primary differences would be that block caving would result in smaller waste rock piles and a smaller open pit than a surface mine. Although subsidence would occur over the block caving area, the surface depression would not be expected to be larger than the open pit created by exploiting the deposit through surface mining.

H.9 It is noted that: "The Tertiary volcanic rocks were deposited after mineralization, and therefore should be lacking sulfide minerals as a source of acidity and metals." (Draft Assessment, Appendix H, p. 14, emphasis added)

There is some pyrite present in the Tertiary rocks,[31] so care would need to be taken to insure that Tertiary rock with elevated levels of sulfide is segregated for placement with other potentially acid generating material.

EPA Response: Two parts of the appendix were modified to indicate that the volcanic rocks contain "minor" or "limited" concentrations of sulfide minerals.

H.10 It is noted that: "Zinc commonly occurs in base-metal hydrothermal systems, but typically not in economic concentrations in porphyry copper deposits." (Draft Assessment, Appendix H, p. 14)

Zinc is also synergistic with copper as an ecological stressor.[32] As noted, zinc is not present in sufficient quantity in the Pebble deposit to warrant recovery, so most or all of it would remain in the tailings and waste rock, and accessible to leaching with residual copper.

EPA Response: Total metals toxicity based on a concentration additivity model was presented in Table 5-14 to 5-16 and 6-2 to 6-4. Zinc concentrations are very low, so synergism would be negligible. No change required.

Fisheries Research and Consulting (Doc. #4580)

H.11 Site specific water quality seems to be overlooked; Important b/c of lack of buffering capacity to neutralize acid mine drainage and very low organic material with which copper/metals could bind.

EPA Response: The relationship of water chemistry to the toxicity of various trace elements is discussed in Chapter 8 of the revised assessment.

Stratus Consulting (Doc. #4973)

H.12 Issue: Interpretation of geochemical sampling results. Appendix H, written by Bob Seal of the U.S. Geological Survey, provides a good summary of some of the geologic and

[31] See Geochemical Characterization, Stephen Day and Claire Linklater, Pebble Environmental Baseline Document Agency Presentations, January 31 to February 3, 2012, Anchorage, Slide 13 "ARD Potential"

[32] Metal Poisoning in Fish, Elsa Sorensen, 1991, ISBN 0-8493-4268-6, Chapter IX – Interactions, pp. 335-339

environmental characteristics of porphyry copper deposits in general and the Pebble deposit specifically. However, there are a number of instances in which the implications of geochemical characterization results do not comport with recent best practice in the industry and tend to underrepresent risk. For example:

> Interpretation of acid-base accounting (ABA) results (p. 10-11). The report states that if the net neutralization potential [NNP, which is the neutralization potential (NP) minus the acid production potential (AP)] is > 0, the sample is "net alkaline," and samples with NNP below zero are "net acidic." No reference is provided. Similarly, samples with NP/AP ratios < 1 are described as PAG, those with NP/AP ratios between 1 and 2 as possibly acid generating ("uncertain"), and those with NP/AP ratios > 2 (the value is actually missing, but presumably the author meant to write NP/AP > 2) as non-PAG. Again, no references for these statements are presented. Using these categories, the author concurs with PLP (2011, Chapter 11) that all the Tertiary waste rock is non-PAG. The NP/AP ratio criteria noted in Appendix H are only rough guidelines, and other site-specific factors must be considered (INAP, 2012). For example, the Global Acid Rock Drainage (GARD) Guide (Chapter 5.0; INAP, 2012) recommends that the criteria be used only if there are no errors in the estimation of effective NP and AP. One of the most important errors in assuming that samples with NP/AP ratios > 2 are non-PAG is that the NP produces less acid neutralization than calcite or is incapable of maintaining a near-neutral pH (GARD Guide, Chapter 5.0; INAP, 2012). The evaluation of this error requires mineralogic analysis and long-term kinetic testing. One of the shortcomings of the PLP geochemical characterization program is that not enough mineralogic analysis was conducted to conclusively evaluate the identity of the neutralizing minerals (e.g., calcite or less effective carbonates such as dolomite or siderite or even less effective silicates) (Appendix A, p. 5). Given these uncertainties, and until additional mineralogic analysis or HCTs are conducted, it is prudent to identify more of the samples as having uncertain acid-generation potential. Using an NP/AP ratio of 3 as the non-PAG cutoff, more of the Tertiary rocks would be in the "uncertain" category (Appendix A, p. 10). Regarding the existing HCT samples, very few were from Pre-Tertiary rocks with uncertain NP/AP ratios or non-PAG rocks, and there was an underrepresentation of rocks with higher percent sulfur and total copper concentrations (PLP, 2011, Appendix 11-F). Although nearly all the Pre-Tertiary rocks are considered PAG, maximum copper concentrations could be underrepresented by the HCT data. Because of the potential errors identified herein, I recommend that the characterization of ABA results in Appendix H be reevaluated for the final Watershed Assessment.

<u>**EPA Response:**</u> **Appendix H has been revised for clarity. The NP/AP > 2 omission has been corrected. The terms "net alkaline" and "net acid" have been removed and replaced with a discussion about NNP values greater than zero represent samples where the theoretical acid-neutralizing potential is present in excess of the theoretical acid-generating potential, and vice versa for NNP values below zero. Also see response to Comment H.4.**

H.13 b. Describing Tertiary rocks as having no acid-generation potential (p. 12-17). In places in Appendix H, the Tertiary rocks are described as having no acid generation potential or no pyrite. These statements are not supported by the available data and should be reevaluated.

For example, approximately 25% of the Pebble East Tertiary volcanic samples have NP/AP ratios ≤ 2 (PLP, 2011, Appendix 11-F) and would be considered PAG, pending the results of additional geochemical characterization. Only four samples from Pebble East Tertiary volcanic rocks were selected for HCTs; two had NP/AP ratios > 10 and two had NP/AP ratios < 0.5 (PLP, 2011, Table 11-12). This breakdown does not reflect the distribution of NP/AP ratios of the Tertiary volcanic rocks as a whole and increases uncertainty in the results of the HCTs. Very little mineralogic analysis was conducted on any of the samples, which further increases uncertainty.

Therefore, indications are that certainly some of the Tertiary rocks, including the volcanics, are in the PAG and uncertain categories, and this information should be reflected in the final Watershed Assessment.

<u>EPA Response:</u> Appendix H has been revised. The Tertiary rocks are now described as having "limited concentrations of sulfide minerals" rather than "lacking" them. The section from p. 12-17 is discussing the humidity-cell test results, yet the comment discusses acid-base accounting results, which has not discussed here. The purpose of Appendix H was to provide an overview of porphyry copper deposits, whereas the comment is making a more specific statement about Pebble, which is not the intent of Appendix H.

H.14 Issue: Interpretation of geochemical sampling results. Appendix H, written by Bob Seal of the U.S. Geological Survey, provides a good summary of some of the geologic and environmental characteristics of porphyry copper deposits in general and the Pebble deposit specifically. However, there are a number of instances in which the implications of geochemical characterization results do not comport with recent best practice in the industry and tend to underrepresent risk. For example:

Potential composition of waste rock and tailings leachate (Figures 7 and 8, pp. 16 and 22). Figures 7 and 8 are described as portraying the range of potential compositions of Pre-Tertiary and Tertiary waste rock seepage (Figure 7) and tailings water (Figure 8). However, both figures use average concentrations from HCTs, and the maximum values are considerably higher than the average concentrations. Therefore, the figures do not portray the range of potential compositions. Also, it is not clear why North Fork Koktuli river water is used as one end member when no waste rock would be deposited in that drainage, and any tailings deposited in the drainage would cover the upper portion of the streambed, thereby eliminating streamflow. Further, the HCT leachate represents mixing of wastes with essentially distilled water (approximating precipitation falling on the samples), and concentrations used are only from stable leaching rates; therefore, the low-concentration end member for waste rock and tailings seepage is represented by HCT leachate itself. The basis for the figures should be reevaluated for the final report, and the description of what the figures portray should be revised to be more accurate.

<u>EPA Response:</u> The description and discussion of Figures 7 and 8 have been modified to provide more background about the intent and limitations of these diagrams. Average values from Pebble Limited Partnership's Environmental Baseline Document were used because of the impracticality of transcribing all of their individual analyses for a rigorous statistical analysis. Clearly, averages do not reflect the variability in the data,

but the standard deviations associated with the averages Tables 4, 6, and 7 at least acknowledge that the ranges are significant. The North Fork of the Koktuli River was selected to represent generic uncontaminated surface water in the vicinity of the Pebble deposit without any implications for the various risk scenarios being evaluated in the main assessment report. Further, the fields shown Figures 7 and 8 are meant to shown, in a general sense, the potential range of compositions of surface waters downstream of tailing and waste rock piles. Where the hypothetical composition falls in the assessment exercise will depend upon the water-balance parameters used in the assessment exercise, which is outside of the scope of Appendix H.

Northern Dynasty Minerals Ltd. (Doc. #4611)

H.15 The disposal of waste rock in Alaska is regulated by the Alaska Department of Natural Resources (DNR) under Alaska Statute 27.19. The regulations address stability, acid rock drainage, and long term reclamation requirements. The regulatory environment in the state of Alaska for waste rock management from mining operations relates to the unique conditions that occur in parts of the state, including a fragile environment, high seismicity, high precipitation, and permafrost conditions.

EPA and RCRA also provide guidelines for: waste rock pile configuration options; preliminary design considerations, such as waste rock characterization and site characterization; stability factors, such as foundation stability and waste rock pile stability; construction and operation methodologies; monitoring methods, and closure and reclamation requirements.

The PLP EBD provides an overview of the topography, geology and seismicity of the site along with extensive site specific data on the climatic conditions, hydrology and hydrogeology. Extensive details are also provided for other environmental and social components that are relevant for the siting and development of stable waste piles.

EPA Response: Comment noted; no change required.

H.16 In Appendix H, the author states that "The goal of the assessments is to help understand how future large-scale development in this watershed may affect water quality and salmon fishery." This is not specifically discussed in Appendix H.

EPA Response: No change required. The end of the paragraph that contains the above mentioned quote already distinguishes the scope of Appendix H from that of the main assessment report.

Appendix I: Conventional Water Quality Mitigation Practices for Mine Design, Construction, Operation, and Closure

Northern Dynasty Minerals Ltd. (Doc. #4611)

I.1 The short-term and long-term stability of a mine waste rock pile is considered during the design process. Waste rock pile stability is dependent on the quality of the waste materials, the configuration of the pile (dump height volume), pile slope, foundation slope, foundation conditions, degree of confinement, pore pressure conditions (phreatic surface) in the waste pile and foundation, climatic conditions, rate of placement, seismicity, and the construction method. The stability of the waste rock pile can be increased by improving foundation conditions, enhancing drainage, flattening pile slopes, including buttress fills, selective encapsulation of weaker materials within more durable materials, and by progressively updating the designs based on operational performance.

<u>EPA Response:</u> Comment noted; no change required.

I.2 The ongoing management of water at the site will be a large part of the closure plan required as part of the permitting process. Standard practices cited by the BBWA (Appendix I, Section 1.1.2 and 2.2.2) include measures to reduce the long-term risk from waste rock piles and tailings facilities.

<u>EPA Response:</u> Mitigation measures were included in the original draft assessment and are present in the revised assessment. No change required.

I.3 Many mine closure plans include a move towards long-term passive management of mine water systems, including surface grading and vegetation to minimize infiltration. These passive methods to reduce leachate generation are sufficiently simple in nature that long term maintenance and the risk of failure can be minimized. The management of tailings and waste rock is expected to stabilize during the active post-closure period such that minimal active management would be required.

<u>EPA Response:</u> Suggested measures for closure were included in the original draft assessment and are present in the revised assessment. No change required.

I.4 The first three time frames are part of the usual planning process, which includes mine reclamation and closure. The BBWA creates an additional, fourth timeframe, which is beyond the "limited lifetime of human institutions." In discussing these time frames as it relates to water collection and treatment, the report does not account for operational procedures and closure planning widely used in modern mines to minimize environmental risks of system failures.

<u>EPA Response:</u> No change required. The assessment included operational procedures and closure planning to minimize risks of system failures; however, there are no such systems using modern technologies that have existed long enough to evaluate whether they would continue to be monitored and maintained after all initially involved parties were no longer present.

I.5 Appendix I provides an overview of mitigation measures against failure of pipelines, and is repeated here: Pipelines that might be necessary for mining operations include those for transport of slurry, return water, and fuel for the mining site. Standard practices for construction, operation, and monitoring of slurry pipelines are available from the American Society of Mechanical Engineers (American Society of Mechanical Engineers (ASME) 2003). Mitigation measures for pipelines include using the proper pipe material, protection against leaks, breaks, and corrosion, containment drains or sumps along the corridor, and secondary containment of the pipeline where crossing a river or transportation route. Protection includes increased wall thickness, corrosion inhibitors, and internal linings or coatings. Joints, welds, valves, etc. are designed to accommodate expected stress, as based on flows desired for the pipeline. Pipelines may be equipped with monitoring systems to detect flow, temperature, or pressure changes, along with alarms and automatic shutoffs. Pipelines are stress-tested for leaks and weaknesses prior to being placed into operation; and they require routine inspections over the course of their use. Mitigation of construction impacts, such as soil erosion and turbid storm water runoff caused by pipe installation (e.g., excavation and boring), can include silt fences, ditches, or other temporary diversions. Pipelines that are constructed near water bodies require containment and may or may not be placed above ground on bridge structures. Based on a review of the Wardrop (2011) report, most, if not all, of the measures described in Appendix I are proposed for the transportation corridor pipelines at Pebble. Although the Wardrop report does not represent the final project plan, it is anticipated that the project would take significant steps to implement modern practices to mitigate against the potential pipeline failures described in the BBWA. While mitigation measures are referenced in Appendix I, by not incorporating the application of mitigation practices that would significantly reduce the likelihood of pipeline failures into the risk analysis, the BBWA provides a flawed and inaccurate assessment of the pipeline failure concern.

EPA Response: See response to Comment 4.148. The revised assessment references ASME when discussing the pipelines (Section 6.1.3.2), so the interested reader can access additional information that was too extensive to list out for the assessment. Although the likelihood of a failure would be reduced by engineering mitigation measures, the human component in following through with closely monitoring and maintaining these measures is not predictable and has been the cause of several recent pipeline failures.

Center for Science in Public Participation (Doc. #4106 and #4122)

I.6 It is noted that: "When stored in the TSF pond, the cyanide concentrations should be such that there would be no adverse effects to wildlife, such as birds landing on the pond." (Draft Assessment, Appendix I, p. 10) The International Cyanide Management Institute recommends (and requires of its signatories) that the cyanide concentration in open water in TSFs, leach facilities and solution ponds does not exceed 50 mg/l WAD cyanide. This is usually a significant consideration at gold operations, but cyanide can be a concern a base metal mines where cyanide is often used as a pyrite depressant – and cyanide might also be used for gold extraction at Pebble, as noted in the Draft Assessment.

EPA Response: This section referred to is a general discussion of how gold could be recovered and how a pyrite concentrate could be done, however, it is not what was proposed for the scenario. The revision separates background information into the new Chapter 4 and our scenarios into the new Chapter 6 to help with clarity. In our revised scenarios, gold will be present in the copper concentrate and either recovered off-site or recovered via a cyanide leach in a vat with a widely used cyanide destruction unit at the end of the process (Section 6.1.2.2), with water treated to meet standards.

I.7 It is noted that: "When processing ore from ***Zn, Cu, or Pb sulfide porphyry deposits***, two tailings streams are created, …" (Draft Assessment, Appendix I, p. 10, ***emphasis added***) Zn & Pb are typically mined from volcanogenic massive sulphide deposits, not from porphyry deposits. Copper and molybdenum are typically mined from porphyry deposits.

Recommendation: It would be more correct to say "… processing ore from Cu (or Cu/Mo) sulfide porphyry deposits …"

EPA Response: This was an error in sentence structure from information derived from the reference cited. The sentence has been changed to "The flotation process used to produce metal sulfide concentrates from porphyry deposits results in two tailings waste streams: one from the rougher circuit (to remove gangue material comprising silicates and oxides) and one from the cleaner circuit (pyrite-rich)."

I.8 It is noted that: "… the upstream method for dam construction was found to be more prone to failure as compared to those constructed via the downstream method, most likely due to their being constructed with residual coarse tailings materials." (Draft Assessment, Appendix I, p. 12) Although tailings used for dam construction are more erodible than other dam construction materials, I believe it is the fact that upstream dams use potentially unstable (when saturated) tailings as a foundation that presents the greatest threat.

EPA Response: The sentence has been changed to "Additionally, the upstream method for dam construction was found to be more prone to failure as compared to those constructed via the downstream method, most likely due to embankment material generally having a low relative density and high water saturation (USEPA 1994)." The appropriate citation for USEPA 1994 is listed in Chapter 15.

I.9 Add to make more complete. Mine Pit. Appendix I, Section 3 regarding the open pit contains no "Closure" section. There is no assessment of pit lake water quality other than the statement "modeling can assist in identifying if a pit lake will become acidic at closure". Parts of Assessment Section 4.3.8.1, which has some discussion of pit wall chemistry, could be reiterated in Chapter 6/Appendix I, with mention that pit lake water quality can be difficult to predict.

EPA Response: The discussion in Appendix I for the pit has been separated in the revision into the operational phase and the closure phase. Although the appendix is not specific to any particular mine, some general material from Section 4.3.8.1 of the original draft assessment has been incorporated into that discussion, as well as some other information from the literature. The risks from pit water contaminants are considered in Section 8.1.3 of the revised assessment.

I.10 It is noted that: "Compensatory mitigation refers to the restoration, establishment, enhancement, and/or preservation of wetlands, streams, or other aquatic resources." (Draft Assessment, Appendix I, p. 19). Since there is little wetland and stream disturbance in the Bristol Bay watershed 'restoration' is probably not a viable mitigation option for this region. The mitigation issues for mines in Bristol Bay will probably be center on: (1) whether it is possible to restore salmon habitat; and, (2) whether 'enhancement' through hatcheries, by engineering stream improvements, etc., are viable mitigation options for habitat destruction.

EPA Response: Appendix I is not meant to be specific to any particular location, as it presents a number of options that might be applicable and appropriate depending on a site's specific conditions and regulatory decisions. Appendix J has been added to the revised assessment to address compensatory mitigation specific to the Bristol Bay watershed.

C. C. Hawley (Doc. #1286)

I.11 Tailings impoundments. Too much is made on graphic comparisons-i.e., Washington Monument, St. Louis Arch. Modern tailing impoundments should have limited correlation with conventional hydroelectric-irrigation dams: Standing water columns in tailings impoundments are minimal (25m) and tailings are deposited are 50–60°lo slurries. They are further unwatered so thixiotrophic failure is much less likely than with older dams.

EPA Response: The comparisons made to the Washington Monument and the St. Louis Arch were to give readers a sense of the height of the largest embankment in the assessment scenarios, compared to things with which they would be more familiar. It is unlikely that the majority of readers would have seen a tailings dam previously. We do not contend that conventional hydroelectric irrigation dams are similar to tailings dams.

National Park Service and U.S. Geological Survey (Doc. #4607)

I.12 Also Appendix I, page 10, refers to "ore from Zn, Cu or Pb sulfide porphyry deposits." Zn porphyry or Pb porphyry deposit do not exist. We recommend removing these from the report.

EPA Response: The error in Appendix I was due to sentence structure from information derived from the reference cited. The sentence has been changed to "The flotation process used to produce metal sulfide concentrates from porphyry deposits results in two tailings waste streams: one from the rougher circuit (to remove gangue material comprising silicates and oxides) and one from the cleaner circuit (pyrite-rich)."

The Pebble Limited Partnership (Doc. #4962 and #5416)

I.13 *Potential Effects on Wildlife, Appendix I, page 8, paragraph 2,* When discussing fragmentation or isolation of wildlife populations, these can be mitigated for, or avoided entirely. Examples include the wildlife migration underpasses and overpasses that have been built in Canada, California, Oregon, Washington and Alaska. Current practices pertaining to the construction of wildlife crossings have improved greatly over the past few decades, as illustrated in the referenced 2001 document.

EPA Response: Although the comment refers to Appendix I, it actually relates to Appendix G. The number and density of streams, zones of near-surface groundwater, and associated wetlands in the area of the potential transportation corridor (as noted in Chapter 10 of the revised assessment) would likely make the construction of wildlife migration underpasses/overpasses infeasible. No change required.

I.14 *Appendix I: 11* Traditionally, water in TSF ponds has been drained as completely as possible prior to closure to reduce potential for overtopping and erosion of the embankments; raising water levels in large dams could cause considerable long-term risk. However, water covers might be used when feasible to maintain a submerged condition, such as in regions where the hydrology is well-understood and the terrain is flat, such as has been used and encouraged in Canada (Martin et al. 2002).

This is another example of a correct statement in Appendix I that is ignored and contradicted in other areas of the Assessment Report and in the Executive Summary.

<u>EPA Response:</u> This was not ignored or contradicted in the assessment. The assessment states that water in the pond would be drawn down at closure to a level sufficient to mitigate introduction of oxygen into the PAG portion of the tailings. Lowering the water level in a TSF does decrease the probability of occurrence of overtopping and erosion; however, it does not eliminate the potential that overtopping and/or erosion could occur should a very large and/or lengthy storm cause rising water levels to result in damage to a dam, either before or after closure. The purpose of the assessment is to evaluate risks that would result from such a scenario if it occurred; the assessment does not claim that such an event would definitely occur.

I.15 *Appendix I: 11* Closure requires the TSF to have either a continuous water cover or an engineered cover to prevent oxidation of tailings. Sufficient capital is required to finance inspections, maintenance, and repairs in post-closure for as long as the tailings exist. Closure of a TSF includes containment/encapsulation, minimization of seepage, stabilization with a surface cover to prevent erosion and infiltration, diversions and collection of precipitation, and design of final landform to minimize post-closure maintenance (the final landform desired should be considered during the planning phase). Regardless of the type of reclamation used for closure, the reclaimed facility must be monitored and maintained to ensure stability over time. Post-closure monitoring for contaminant transport is the same as during the operational phase, with piezometers for assessment of ground water mounding and monitoring wells for groundwater quality. The reclaimed facility should be monitored for any deformations, structural changes, or weaknesses, and the surfaces should be inspected for intrusion by animals, humans, or vegetation, any of which could compromise long-term stability.

This is another example of a correct statement in Appendix I that is ignored and contradicted in other areas of the Assessment Report and in the Executives Summary.

<u>EPA Response:</u> This was not ignored or contradicted in the assessment. The assessment discussed that monitoring and treatment would be required for a very long time, perhaps in perpetuity. Suggested options for reclamation measures have been made clearer in the revised assessment.

I.16 *Appendix I: 8* Although upstream construction is considered unsuitable for impoundments intended to be very high or to contain large volumes of water or solids (State of Idaho 1992), this method is still routinely employed (Chambers and Higman 2011, Davies 2002). *Implementation of conventional upstream construction methods is generally not appropriate in Alaska due to concerns relating to the seismicity of the region*.

For comparison, the seismicity in Chile has led to the development of Chilean regulations that prohibit the use of the upstream construction method for tailings dams.

<u>EPA Response:</u> Appendix I is not meant to be specific to any given region, but discusses options that are possible and notes that constraints of site specifics, such as seismicity, need to be considered. The two examples provided in the comment would be useful to include in the appendix for other examples of when an upstream design is

inappropriate, but the comment did not provide citations so they cannot be included. No change required.

The Pebble Limited Partnership (Doc. #4962)

I.17 *Appendix I: 12* As reported in Davies (Davies 2001), upstream constructed dams are more susceptible to liquefaction flow events and are solely responsible for all major static liquefaction events; the author also states that earthquakes are of little concern for non-upstream dams.

This is an additional example from Appendix I that tends to contradict the Assessment Report assertion in the remainder of the document that "failures are likely to occur" as a result of earthquakes.

EPA Response: **The draft assessment stated that accidents and failures are likely (page 4-37), but does not specify a means of their occurrence. Davies (2001) does state that earthquakes are of little concern for non-upstream construction type dams, but does not state that they are of no concern. Given that Alaska is a seismically active area, it is noted in the assessment as a concern. However, a failure caused by an earthquake was not included specifically in the risk assessment portion of the document, although consequences of such an event could be similar to the assessment's overtopping scenario. No change required.**

I.18 Appendix I: 13 Azam and Li (Azam and Li 2010) report that failures in all but Europe and Asia have decreased since 2000; this is attributed to improved engineering practices, with none from 2000-2009 being due to subsidence of the foundation or to overtopping. *Overtopping is stated as a theoretical failure mechanism for the tailings dam presented in the Assessment Report. This excerpt is an example of how information in the appendix has not been included in the main text, presumably as it does not reinforce the pervasive premise that the dam "could" fail.*

EPA Response: **Because Azam and Li (2010) did not find this to be a mode of failure from 2000-2009 does not mean that it is no longer a potential mode of failure, especially in light of more recent storm intensities and patterns observed across the globe. The point was to evaluate the risks following a failure, not to indicate that one was or was not imminent. A failure of the dam, whether due to overtopping or some other factor, would result in release of tailings and water to the environment. No change required.**

I.19 Appendix 1: 14 Data presented indicate that failures peaked to about 5 per year in the 1960's through the 1980's and has dropped to about 2 per year over the last 20 years, with the frequency of failure occurrences shifting to developing countries.

Again information provided in the appendix is not represented in the main text. While Morgenstern (2011) did not observe a downward trend, information provided in Appendix I clearly does.

EPA Response: **It is quite common for different studies to come to different conclusions and this depends on a number of factors, not the least of which is whether they were using identical data to reach said conclusion(s). The Azam and Li (2010) observation**

has been added to the revised assessment in Section 9.2.2 to demonstrate the contrasting conclusions.

I.20 *Appendix I: 14* The authors also estimate that, on average, one fifth of the stored tailings are released resulting from tailings dam failure. (Azam and Li 2010)

<u>**EPA Response:**</u> **The assessment assumed mobilization of 20% of the tailings stored, which is 1/5, so our scenario estimate is consistent with this estimate by Azam and Li (2010) presented in the appendix, as well as within the range (20-40%) presented by another reference in the appendix (Dalpatram 2011). No change required.**

I.21 *Appendix I Accidents and Failures: 13* The failure rate of tailings dams depends directly on the engineering methods used in design and the monitoring and inspection programs in the other mine-life stages. According to Witt et al. (Witt et al. 2004), with an assumption of 3500 worldwide tailings dams and failure rates of 2-5 dams per year, the annual probability of a TSF failure is between 1 in 700 to 1 in 1750, in contrast to < 1 in 10,000 apparent for conventional water dams. Using data obtained from the World Information Service of Energy (WISE, www.wise-uranium.org/mdaf.html) for the 10 years prior to March 22,2011, Chambers and Higman (Chambers and Higman 2011) report that the worldwide failure rate of tailings dams has remained at 1 failure every 8 months (i.e., two failures every 3 years). Azam and Li (Azam and Li 2010), using databases from the United Nations Environmental Protection (UNEP), the International Commission on Large Dams (ICOLD), the World information Service of Energy (WISE), the United States Commission on Large Dams (USCOLD), and the United States Environmental Protection Agency (U.S. EPA), found that causes of observed failures occurring in the years of 2000-2009, regardless of country (e.g., North American, South American, European, Asian, African, and Australian), were unusual weather, management, seepage, instability, and defect, in order of decreasing percentage contribution. Weather causes were observed to have increased by 15% from pre-2000 failures and management issues by 20%. Azam and Li (Azam and Li 2010) report that failures in all but Europe and Asia have decreased since 2000; this is attributed to improved engineering practices, with none from 2000-2009 being due to subsidence of the foundation or to overtopping. Additionally, seismic liquefaction was not a causal mechanism in failures between 2000 and 2009, but accounted for 14% of failures prior to 2000. Data presented indicate that failures peaked to about 5 per year in the 1960’s through the 1980’s and has dropped to about 2 per year over the last 20 years, with the frequency of failure occurrences shifting to developing countries. The authors also estimate that, on average, one fifth of the stored tailings are released resulting from tailings dam failure. Dalpatram (Dalpatram 2011) presented a slide at a recent Workshop on Dam Break Analysis that indicated volumes released range from 20-40% of the stored tailings.

This excerpt exaggerates both the likelihood and the consequences of a hypothetical dam breach in order to exaggerate risk in the Assessment Report. The premise that the modern tailings dam example presented in the Assessment Report can be directly compared to ‘worldwide tailings dams’ is incorrect as discussed previously. Thus the implied likelihood of dam failure is greatly exaggerated.

Based on the size of the ultimate impoundment presented in the Assessment Report, and typical consolidation characteristics of the tailings (deeper and denser tailings will not *liquefy and flow out of a hypothetical breach), it is actually more likely that the proportion of tailings solids that "would spill" should be significantly less than 20% rather than more. Thus the Assessment Report is also exaggerating the consequences of a hypothetical tailings dam breach.*

EPA Response: This excerpt from Appendix I does not exaggerate risks. This section presents the data and conclusions of the authors cited. The probabilities for dam failure used in the assessment were not derived from the historical record, but rather the historical failures were presented as supporting background information. The failure probabilities used in the assessment are based on Alaska's dam classification and required safety factors applied to the method of Silva et al. (2008). The discussion of failure probabilities in Chapter 9 of the revised assessment has been expanded to try to clarify this issue.

Natural Resources Defense Council (Doc. #4608)

I.22 *Fugitive Dust Generated by the Mine Will Degrade Aquatic Habitats, Damaging Fisheries*

The proposed Pebble Mine would negatively impact the ecology of the region through the generation of fugitive dust. Fugitive dust can be blown from many mine surfaces, including the mine itself, access roads, and tailings ponds, and can also be generated by moving and storing mine materials. One study predicted "conservatively" that fugitive dust would impact over 33 square miles surrounding the mine, but commented that the effects could be much wider. Within the area impacted by the mine are 33 miles of ephemeral, intermittent, and perennial streams, including ten miles of anadromous waters designated by the Alaska Department of Fish and Game. Over the life of the mine, this area would be "significantly degraded," and the dust would impact both streams and vegetation. Impacts caused by fugitive dust can be long-lasting, and ecosystems may be slow to recover.

When fugitive dust is generated, it covers surrounding vegetation, causing increased mortality in plants. This can result in devegetation of large areas surrounding the mine, including areas that support salmon. When vegetation is lost, surface runoff increases, which in turn leads to increased stream turbidity and sedimentation. Fugitive dust can also settle in water and smother both salmon eggs and organisms that serve as food for salmon. Furthermore, fugitive dust can transport heavy metals into the surrounding water, air, and soil. This can be especially problematic in an area that is also exposed to acid mine drainage — which increases the bioavailability of copper and harms sensitive salmon.

As the mine ages, copper from fugitive dust could affect benthic invertebrates, including mayflies, caddis flies, and stoneflies. Such impacts to these populations would be "crucial" and most likely "long term." These species are important food resources for salmon and other fish, so declines in these populations will negatively impact salmon species. Furthermore, copper could accumulate to concentrations that would cause acute or chronic effects in salmon directly. As one study found: "a certainty exists that, even with mitigation measures employed at the mine, copper and other metals will likely be mobilized in runoff or leached into the surface and/or groundwater" over the life of the mine. Given the potential impacts of fugitive dust, the final Assessment should address this issue.

EPA Response: See response to Comment 3.44.

Bristol Bay Heritage Land Trust (Doc. #4524)

I.23 The Bristol Bay Assessment should include an analysis of the potential impacts from fugitive dust.

EPA Response: See response to Comment 3.44.

I.24 Unlike the TNC Risk Assessment the Bristol Bay Assessment did not evaluate impacts from fugitive dust. Ore extraction, transport, stockpiling, and other handling will generate fugitive dust. Although such an evaluation would not likely alter the overall conclusion of the Bristol Bay Assessment, fugitive dust represents a significant risk that could carry the impacts of a large mine far beyond the immediate area of the mine footprint. Precise estimates of dust production will need to be developed by the Pebble Partnership based on its proposed operations scenarios and meteorological studies. The TNC Risk Assessment addresses both the physical stress (page 49) and the chemical stress (page 65) of fugitive dust. The TNC Risk Assessment predicts that fugitive dust could impact 33.5 square miles, or 21,440 acres distributed over three zones with varying impacts depending upon the distance of the zone from the mine footprint (pages 51 – 53) Pending the Pebble Partnership's detailed studies of dust production and dispersal, a general approximation of the volume of fugitive dust that may be produced by the Pebble Mine can be made using typical values for copper and other metallic mining operations from the Western Regional Air Partners (WRAP) Fugitive Dust Handbook, www.wrapair.org/forums/dejf/fdh/content/Ch11-MineralProductsIndustry_Rev06.pdf. The WRAP Handbook provides a high and low estimate (based on low soil moisture and high soil moisture). The low estimate of emissions from all activities associated with metallic ore mining is about 50 pounds of total suspended particulates (TSP or dust) per ton of ore processed, which is equivalent to about 2.5% of the tonnage excavated and processed. Using this value, over the 78 year life of the larger mine scenario used by the Bristol Bay Assessment, the Pebble Mine extraction and processing of 7,165,000,000 tons of ore (6.5 billion metric tons) could be expected to result in dust emissions of 179,125,000 tons over the operating life of the project: TSP = 0.025 x 7,165,000,000 tons = 179,125,000 tons of suspended particulates; or Approximately 2,296,000 tons of dust per year (179,125,000/78); or Approximately 6,292 tons of dust per day (2,296,000/365). To put this dust production into context, if we assume the dust settles back to earth within the 33.5 square miles, or 21,440 acres predicted by the TNC Risk Assessment then this 21,440 acres of land could cumulatively receive about 8,355 tons of dust per acre (179,125,000 tons/21,440 acres = 8355 tons/acre), or about 393 pounds of dust per square foot over the life of the project (8355 tons/acre/43560 ft^2/acre = 0.191 tons per ft^2 x 2000 pounds/ton = 393 pounds/ft^2). This is roughly equivalent to placing five 80 lb standard bags of concrete on each square foot of the affected land. Much of this dust will settle out on snow or nearby bodies of water, and will be washed into streams and rivers during heavy rains. Minerals in the dust will be similar in metal content to the minerals in the ore. If we assume dust emissions are dispersed over a larger area, then the "pounds per square foot" would be lower. Dispersal of the dust produced by the mining operation over a larger area would mean, however, that the total volume/tonnage of dust falling on areas outside of the mined area would increase.

EPA Response: See response to Comment 3.44.

Bristol Bay Native Corporation (Doc. #4145, #4382, and #5549)

I.25 Similarly, the BBWA does not assess the challenges (risks) of offsetting habitat losses through compensatory mitigation. Whereas Appendix I discusses mitigation practices (including mine design, operation, and closure) and descriptions of mining industry standard practices, this 24- page report offers no specifics about the Bristol Bay watershed or mitigation practices therein. Appendix I cites the compensatory mitigation regulations under Section 404, but provides no assessment of what measures could actually be considered or implemented to offset losses in the Bristol Bay watershed, such as those associated with the Pebble project.

EPA Response: Appendix I is not meant to be specific to any particular location, as it presents a number of options that might be applicable and appropriate depending on a site's specific conditions and regulatory decisions. Mitigation to compensate for effects on aquatic resources that cannot be avoided or minimized by mine design and operation would be addressed through a regulatory process that is beyond the scope of this appendix, which provides practices for minimization or avoidance measures. However, Appendix J has been added to the revised assessment to address compensatory mitigation in the Bristol Bay watershed.

The Pebble Limited Partnership (Doc. #4962)

I.26 *Appendix 1: 17* Mitigation of stormwater begins with designing components using an accurate site water balance to assure adequate storage and treatment capacity. Conventionally, runoff and seepage are diverted through ditches and diversion channels to a treatment pond, or to a settling pond if the water source is solely from precipitation. The *Appendix I in the Assessment document again specifies technical aspects of design that are not represented in the main text. In this example, standards to prevent hydrological issues identified in the main text are presented in the Appendix.*

EPA Response: Water management is presented more clearly in Chapter 6 of the revised assessment (e.g., Section 6.1.2.5).

Alaska Department of Natural Resources (Doc. #4818)

I.27 In the Assessment, there is no discussion of the mitigation requirements that could be imposed by the Army Corps of Engineers (Corps) relative to the placement of roads and stream crossings or mitigation to and avoidance of wetlands. Additionally, the Alaska Department of Environmental Conservation (ADEC) reviews all Corps permit applications to determine if there are reasonable and appropriate assurances that water quality standards will be met to protect aquatic life.

EPA Response: Specific mitigation requirements that could be imposed by the Army Corps of Engineers would be addressed through a regulatory process and are beyond the scope of this assessment. Nevertheless, Appendix J has been added to the revised assessment to address compensatory mitigation as it might apply in the Bristol Bay watershed.

Consumer Energy Alliance Alaska LLC (Doc. #5308)

I.28 Unfortunately, we could find no section of the report describing potential mitigation strategies, new mining technologies, engineering methods, alternative applications of older technologies, or proposals unique to the Bristol Bay Watershed that might be deployed in conjunction with the hypothetical mining operation. The Assessment should include a separate section on technologies that might be brought to bear to mitigate negative effects mining might have on fish populations. It should also include a review of things that might be done when infrastructure is deployed to enhance the sustainability and abundance of fish populations beyond those that currently exist or describe why such plans are not feasible.

EPA Response: See response to Comment I.27. The assessment is not an evaluation of a mining plan or a permit application; thus, detailed evaluation of alternatives, new technologies, etc. is outside the scope. No change required.

Earthworks (Doc. #4125)

I.29 It is noted that: "Compensatory mitigation refers to the restoration, establishment, enhancement, and/or preservation of wetlands, streams, or other aquatic resources." (Draft Assessment, Appendix I, p. 19)

Comment: Since there is little wetland and stream disturbance in the Bristol Bay watershed 'restoration' is probably not a viable mitigation option for this region.

EPA Response: See response to Comment I.27.

APPENDIX 1. MASS-MAILERS AND EPA RESPONSES.

The majority of comments submitted to the docket during the public comment period were from mass-mailing and petition campaigns. This appendix contains the text of each mass-mailing and petition letter campaign and EPA's response. The number of duplicates of each mailer received and the sponsor (where known) are noted. Mass-mailers with minor modifications to the title or content were included in the number count.

EPA-HQ-ORD-2012-0276-0002 [7,034 on-time duplicates]

I am writing to urge the EPA to initiate the 404c process to prohibit the disposal of mine waste in the pristine waters of the Bristol Bay watershed. Bristol Bay supports the world's largest remaining wild salmon fishery. It is the economic engine for the region, supplying over 10,000 jobs and generating an estimated $500 million in annual revenue.

The science demonstrates that large-scale mining, such as the Pebble Mine, represents a long-term risk to the sustainability of this important fishery – and all the people and businesses that rely on it.

Once again, I urge the EPA to take immediate action to initiate Section 404c of the Clean Water Act to protect the world's greatest wild salmon fishery!

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-0003 [6,131 on-time duplicates]

The Draft Bristol Bay Watershed Assessment documents the incredible value and diversity of Bristol Bay's wildlife and fisheries. It recognizes the Bristol Bay sockeye salmon run, with its up to 40 million fish annually, as one of the most important fisheries in the world and a one-of-a-kind resource in the United States. It also addresses the importance of Bristol Bay's lands and waters as the cultural and economic backbone of the region, supporting a thriving commercial fishing industry and more than 14,000 jobs. The region is a national example of renewable

natural resources that create jobs and sustain communities as the direct result of a healthy, productive watershed.

The mining deposits in the upper Bristol Bay Watershed have a very high concentration of sulfur, which is highly likely to generate acid mine waste. Acid mine waste can exist for thousands of years, has no known half life and is highly toxic for coldwater, anadromous fish and other aquatic life. The significant risks posed by the Pebble prospect with its estimated 10 billion tons of toxic mine waste jeopardize the region's clean waters and abundant natural resources.

Additionally, numerous other mining claims in the region largely depend on the mining infrastructure to be developed by Pebble, and could usher in a much larger and more dangerous mining district in the region.

The EPA has the power under Section 404(c) of the Clean Water Act to prohibit or restrict the discharge of dredged or fill materials if they pose an unacceptable adverse effect on natural resources, fisheries, wildlife, waters or recreational areas. The EPA's Assessment clearly demonstrates that large-scale mining would have unacceptable adverse affects on the watershed.

As a concerned citizen, I urge the Obama Administration, in its first term, to use section 404(c) of the Clean Water Act to protect Bristol Bay's singular resources, habitat and industry. The value of this fishery is too great to the nation and the people of Bristol Bay.

> **EPA Response: Comments have been noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-0448 [1,464 on-time duplicates]

As one of the nation's 60 million anglers, I thank you for completing the comprehensive draft study on the Bristol Bay watershed and the scope of its natural resources. This assessment overwhelmingly supports what the sportfishing community has been advocating for – denial of Pebble Mine permits under the Clean Water Act.

I urge you to use your authority under section 404(c) of the Clean Water Act to protect the region's unmatched salmon fishery and recreational fishing from water quality impairment and habitat degradation.

Sportsmen and women care deeply about protecting Bristol Bay's fisheries and fish habitat, and have a strong heritage and legacy of conservation. Bristol Bay is one of the world's great recreational fishing destinations, mainly because the bay's freshwater habitat is largely untouched by development, with a tradition that has been passed down for generations. It supports the world's largest sockeye salmon runs, healthy runs of king, coho, chum and pink salmon and provides habitat for important sportfish species such as rainbow trout. All told, annually, the Bristol Bay fisheries generate more than $450 million dollars for the state's economy and provide over 12,000 jobs.

The operations at Pebble Mine will create up to 10 billion tons of toxic waste, which will need to be contained in perpetuity because of their acidic byproducts. The millions of tons of waste will be held back from the pristine waters of Bristol Bay by the world's largest earthen dam, which could be destabilized by one of the region's frequent earthquakes. If the byproducts of Pebble Mine contaminate the surrounding waters, the impact on the region's fish and wildlife populations will be devastating. Not only will the contamination affect fish and wildlife but also recreational and commercial fishermen, Alaska's native populations, local businesses and others that rely on and enjoy Bristol Bay.

I urge you to leave no stone unturned in the EPA's efforts to accurately assess the situation and use all current scientific data available to determine what impact the proposed Pebble Mine, and other large scale development projects, will have on Bristol Bay's waters, fish, wildlife and recreational opportunities there.

I'm just one voice among a broad and diverse group of people who value this region and want to conserve its natural resources. I encourage you to exercise your authority under the Clean Water Act to protect it for generations to come.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

<u>EPA-HQ-ORD-2012-0276-0668</u> [8,070 on-time duplicates]

I am writing to voice my strong opposition to the recently released draft watershed assessment for Bristol Bay Alaska because it sets a dangerous precedent, is wholly unnecessary, and the extremely short public comment period is inadequate to allow for substantive comments.

It is clear that this assessment is simply a precursor for the EPA to take unprecedented action to preemptively deny permits for its targeted project-- the Pebble deposit in Alaska-- before they have even been applied for and before the project even has a plan in place.

The study was rushed and did not follow standard scientific procedures and relies on hypothetical impacts" from a "hypothetical mine" that does not account for real mitigation efforts that would be developed as part of a mine plan. Most disturbingly this premature and insufficient assessment and planned permit veto sets a dangerous precedent. Use of an preemptive 404C permit veto will set a dangerous precedent that will devastate an already shaky U.S. economy, and would have a chilling effect on over $200 billion in annual investment that relies on such permits—logging, manufacturing, construction, infrastructure, energy, mining and more.

This watershed assessment and threatened preemptive permit denial are wholly unnecessary. The EPA will have its fair say on the Pebble project, along with other state, local, and federal agencies, through the course of the established permitting process. There is no reason for the EPA to rush to judgment before a mine plan has been submitted that will show how the company will avoid and mitigate potential impacts—that is what the permitting process is designed to do.

Furthermore, there is no environmental impact made by simply allowing a project to proceed through the permitting process, but there will be devastating impacts from preemptively vetoing it.

The extremely short public comment period provided fails to allow adequate time for the public to adequately evaluate the voluminous report. As such, I join with the State of Alaska is requesting a 120 day extension of the public comment period.

> **<u>EPA Response:</u> Comments have been noted. The mine scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used.**
>
> **The document is a scientific risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).**

<u>EPA-HQ-ORD-2012-0276-0963</u> [53,281 on-time duplicates]

Your recent risk assessment of large-scale mining in Alaska's Bristol Bay demonstrates the significant and unacceptable effects that the proposed Pebble mine would have on this wilderness paradise.

Bristol Bay's pure waters and healthy habitat sustain the world's largest and most productive commercial salmon fishery, flourishing wildlife populations, and the centuries-old subsistence lifestyle of Alaska Natives. The Pebble copper and gold mine--planned for the headwaters of Bristol Bay--would be the largest open pit mine in North America. It would generate up to 10 billion tons of toxic mine waste that would be held behind massive earthen dams located just 20 miles from an active fault line. This is a disaster waiting to happen, and has the potential to devastate one of the last remaining strongholds for healthy salmon populations in the world.

I urge you to exercise your authority under section 404 of the Clean Water Act to prohibit Pebble Mine from dumping dredged and fill materials into the rivers and waters of Bristol Bay in order to safeguard the region's unique waters and the people and wildlife that depend upon them.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-1415 [318 on-time duplicates]

We the undersigned constituents ask that you request the EPA to extend the time they have put forth for review and response to the recently released Watershed Assessment. The suggested June hearing schedule is not sufficient for a meaningful review by region residents. Beginning now and throughout the summer, we are focused on traditional summer activities in addition to our regular work schedules. We're asking our congressional representatives to respect our Alaskan traditions in the summer months and move the hearings to late October.

> **EPA Response: EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

EPA-HQ-ORD-2012-0276-1737 [84,644 on-time duplicates, sponsored by the Natural Resources Defense Council]

I applaud you for undertaking a scientific assessment of the Bristol Bay watershed, which concluded that large-scale mining in such an ecologically sensitive region would jeopardize this natural treasure and its communities. I urge you to now exercise your authority under the Clean Water Act to prohibit the construction of massive mining projects in this location -- including the Pebble Mine.

The Pebble Mine would gouge one of the world's largest gold and copper mines out of the headwaters of the Bristol Bay. It would generate billions of tons of contaminated waste, destroy thousands of acres of wetlands and threaten the area's legendary salmon runs – the lynchpin of the Bristol Bay ecosystem on which Alaskan Native culture have subsisted for thousands of years.

Building a mine of this scale in this location is a reckless and destructive venture. No matter how extensive the environmental review or how comprehensive the mitigation, the far-reaching risk to our environment cannot be eliminated. There are no examples of successful, long-term collection and treatment systems for mines. Mining would produce acidic and metals-laden waters that would degrade water quality downstream with virtual certainty, and there is a 98 percent likelihood of pipeline failure per 25 years of operation.

We shouldn't gamble what we can't afford to lose -- and we can't afford to lose the Bristol Bay fishery. I understand that you are under pressure from global mining companies to open up this extraordinary ecosystem to large-scale mining for the sake of corporate profits. I urge you to use your authority under Section 404(c) of the Clean Water Act to proactively protect the Bristol Bay watershed and the communities that depend on it for survival.

EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

EPA-HQ-ORD-2012-0276-2073 [30,365 on-time duplicates, sponsored by the National Parks Conservation Association]

Wild Alaska is a precious place to me. Regardless of whether I've been lucky enough to visit, or hope to someday, I cherish the dream of discovering myself "Alone in the Wilderness" like Lake Clark National Park pioneer Dick Proenneke. I want my great-grandchildren to share this dream, to enjoy Alaska salmon on their dinner tables, and have boundless opportunities across vast, American landscapes where nature still runs free.

I am alarmed that development of a massive, industrial mining district is being considered in the fragile headwaters of Alaska's Bristol Bay, adjacent to Lake Clark National Park & Preserve. Mining operations have a long history of polluting drinking water and destroying habitat worldwide. Please, don't let that happen in Bristol Bay, home to our largest, most diverse, and sustainably managed wild salmon fishery and residents whose traditional ways-of-life are closely tied to the healthy environment.

Lake Clark National Park and Preserve, located just miles from the proposed Pebble Mine site, was created in 1980, "to protect the watershed necessary for the perpetuation of the red salmon fishery in Bristol Bay." Today, waters that feed Lake Clark have been staked with mining claims and several remote copper-gold deposits have been found on lands west of the park. An extensive road system south of the park would be needed for access to the minerals.

Lake Clark National Park and Preserve, one of our country's "best ideas," is at risk of becoming an island in a sea of development. Thank you, EPA, for conducting the Bristol Bay Watershed Assessment. You now understand the remarkable economic and cultural values of the wild salmon fishery, as well as the serious threats posed by a massive mining district.

As you move forward in exercising your authority under the Clean Water Act to protect Bristol Bay, we urge you to defend our national park resources and secure the jobs, families, and creatures that depend upon these wild salmon.

Go fish, go!

EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

EPA-HQ-ORD-2012-0276-2074 [2,064 on-time duplicates, sponsored by the Sierra Club]

As a professional biologist who is well aware of the effects of sediments, heavy metals and acids associated with mining on organisms at molecular level, I am writing to oppose establishment of the Pebble Mine in Alaska.

The recently released Draft Bristol Bay Watershed Assessment accurately demonstrates the significance of Bristol Bay to the ecosystem and the community. Bristol Bay has the largest sockeye salmon run anywhere in the world and provides an unparalleled economic resource to the region and the entire United States. The 14,000 jobs, the $480 million annually in direct economic activity, the thriving commercial and recreational fishing industry, and the subsistence livelihoods are all simply incompatible with Pebble Mine.

Pebble Mine would be the largest open pit mine in North America. It would generate up to 10 billion tons of mine waste, mine waste that can exist for thousands of years and is highly toxic for coldwater, anadromous fish.

The EPA has the authority under section 404(c) of the Clean Water Act to prohibit Pebble Mine from dumping dredged and fill materials into the rivers and waters of Bristol Bay based on adverse effects to natural resources, fisheries, wildlife, waters, or recreational areas. Based on the Draft Assessment it is beyond doubt that large-scale mining of this type would have extremely adverse effects on the watershed. I urge the EPA to exercise that authority and save a region that is economically and biologically supported by renewable natural resources.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-2075 [203 on-time duplicates]

As an Alaska citizen deeply concerned about our state's economic future, I'm proud to stand with Alaska's leading industry groups-Alaska Associated Builders and Contractors, Alaska Chamber of Commerce, Alaska Miners Association, Alaska Oil & Gas Association, Council of Alaska Producers, Resource Development Council, and The Alliance to call on the EPA to stop its rush to judgment in Alaska.

Alaska's abundant mineral, oil and gas resources are not only the foundation of our state's economy but also provide crucial resources for the entire nation. EPA endorsing the conclusions of the grossly inadequate draft watershed assessment and threatened first of its kind preemptive 404 permit veto will risk our economic livelihood and America's domestic resource supplies.

Alaska resource development depends on investment from state, national and international companies to fund exploration, development and operation. This investment creates a substantial number of jobs.

EPA action will result in total uncertainty in the permitting process, sending a chilling effect through industry, drying up investment and killing jobs. There is no need for this rush to judgment. There is absolutely no environmental harm created by simply letting a project navigate the rigorous state and federal environmental review process. But there is substantial economic harm from EPA's current course of action. Therefore, I respectfully request that you support the established permitting process and refrain from making any preemptive 404 (c) actions.

> **EPA Response: Comments have been noted. The mine scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used.**
>
> **The document is a scientific risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).**

EPA-HQ-ORD-2012-0276-2076 [12 on-time duplicates]

Thank you for your attention to the proposed Pebble Mine in Bristol Bay Alaska.

I am writing today to urge you to use your authority under the Clean Water Act to consider how this proposed mine will impact our nation's biggest wild salmon fishery and untouched ecosystem, the commercial fishermen and Alaska Natives who depend on it, and the local businesses who make their living off of this wild landscape in Southwestern Alaska.

The Bristol Bay ecosystem is the cornerstone on which Alaskan Native cultures have subsisted for thousands of years. Building a mine of this scale in this location would jeopardize one of the largest salmon runs in the world which provides over $100 million in revenue to the local economy and supports thousands of Alaskan jobs.

There are no examples of successful, long-term collection and treatment systems for mines.

However, if built, Pebble Mine will produce between 2 and 10 billion tons of toxic waste that would degrade water quality downstream with virtual certainty, and there is a 98 percent likelihood of pipeline failure per 25 years of operation. So, no matter how extensive the environmental review or how comprehensive the mitigation plans may be, any short term and unsustainable financial gain is not worth the environmental damage and economic loss that will certainly take place.

I understand that you're under pressure from global mining companies to open up this extraordinary ecosystem to large-scale mining for the sake of corporate profits. But I urge you to use your authority under the Clean Water Act to proactively protect the Bristol Bay watershed and the communities that depend on it for survival.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-2383 [14,153 on-time duplicates, sponsored by the Pew Environment Group]

In the coming months, your administration will make an important decision that could determine whether the proposed Pebble Mine or other vast, open pit operations will be built in Alaska's Bristol Bay watershed. The area's pristine mountains, meadowlands, rivers, and lakes are home to world-class salmon runs that support recreational sport fishing and allow Native Alaskans to maintain their centuries-old way of life.

The Environmental Protection Agency is conducting an assessment under the Clean Water Act to determine the potential impact that such large-scale industrial operations would have on fisheries and wildlife, Native cultures, and the $480 million in direct economic activity annually estimated for the region. Whether this mine and others are approved will depend on you.

The proposed Pebble Mine--larger than Manhattan in area, containing dams as high as Hoover Dam, and holding 7 billion tons of waste—does not belong in the heart of one of America's last great wild places.

Please take action to protect Bristol Bay and its watershed for the people and the wildlife depending on it.

EPA Response: **Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-2716 [494 on-time duplicates]

As a person of faith concerned with both the health of God's Creation and the well-being of all of God's people, I write in response to the recent scientific assessment of large scale development in Bristol Bay, Alaska.

Your assessment highlights the impact that the proposed Pebble Mine would have on the health of the Bay which is also the world's largest remaining sockeye salmon fishery. At a minimum, the Pebble Mine would include a 1300 acre mine and an 86 mile road that would cut through the heart of fragile salmon spawning ground. Any significant impact on salmon spawning ground will threaten the ability of the Alaskan Native community to maintain their subsistence lifestyle that has been in place for more than 4000 years.

The impacts are known and will be devastating. I urge you to take the next step and use the authority of the clean water act to protect God's Creation and God's people from the irreversible impacts of large scale development in Bristol Bay.

EPA Response: **Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-2717 [107 on-time duplicates]

I'm writing to express my strong concerns over the EPA's draft Bristol Bay watershed assessment and its potential use of 404(c) to veto mining development in the region based on this seriously flawed report.

The mining industry has proudly make tremendous strides in the past few decades developing environmentally sound mines based on continually improving state-of-the-art technology and best practices. Yet, this assessment fails to account for this progress and the very real success stories happening in mines throughout Alaska today. It's no surprise the assessment fails to account for this progress, as the rushed study's authors never availed themselves of the industry and state regulators' expertise while developing this document.

The authors in fact appear to have very little knowledge or understanding of basic mining industry techniques. As a result, the assessment does not address any impact avoidance, minimization or mitigation measures. The document further fails to meet basic standards of scientific research as it appears to be based solely on conjecture and relies to a great degree on the writings of individuals with stated positions opposing development of a mine in the region. This flawed study of a hypothetical mine provides little scientific value and must not be used as a rationale for the EPA to issue a first-of-its-kind preemptive 404(c) veto under the Clean Water Act.

The EPA's preemptive action and the unnecessary and premature watershed study could cripple America's crucial mining industry as uncertainty increases investment risk and dries up investment in exploration and mine development. I respectfully request that you disregard this assessment's findings. Start over and follow established scientific method-or simply allow the NEPA and permitting process to work.

EPA Response: Comments have been noted. The mine scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used.

The document is a scientific risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).

EPA-HQ-ORD-2012-0276-3282 [824 on-time duplicates]

The EPA's recent release of a premature and insufficient watershed study of mining activity in Bristol Bay Alaska, in addition to the agency's threat to preemptively veto permits under the Clean Water Act, is a dangerous precedent and brazen power grab that will send shockwaves through the American economy.

The EPA released this watershed study in stark opposition from the entire Alaska Congressional delegation and with the strenuous legal opposition of the Alaska's Attorney General, who decried the EPA's efforts as a violation of both federal law and the Alaska Statehood Act. Additionally, the EPA released its study despite failing to fully answering the tough inquiries put to it by the House Oversight Committee. The devastating reverberations of preemptive EPA action would go far beyond Alaska. There are over $200 billion per year in domestic and foreign investment in U.S. projects that rely on similar Clean Water Act 404 permits. The vast uncertainty created by the EPA's arbitrary and capricious action would create a devastating impact on these billions in investment dollars.

It is urgent that the EPA's bogus and unconstitutional power grabs are brought to an end. Otherwise, these unfair rules will leave our nation's entire resource, energy, farming, and home building industries, vulnerable to premature denial of permits before they are allowed their full due process.

I urge you to protect the vitality of American resource industries by taking a stand against the EPA's massive power grab.

EPA Response: Comments have been noted. The document is a scientific risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c). This process includes requirements for public notice and comment on any proposed determinations.

EPA does have authority to conduct risk assessments of this nature under Clean Water Act Section 104(b).

EPA-HQ-ORD-2012-0276-3283 [90 on-time duplicates, sponsored by American Rivers]

As a supporter of American Rivers, Nunamta Aulukestai and the Alaska Native communities they represent, and the Alaska Conservation Foundation, I appreciate that the Environmental Protection Agency (EPA) has initiated a scientific assessment of the Bristol Bay watershed,

including the Kvichak, Talarik, Nushagak, Mulchatna, and Koktuli Rivers, to better understand how future large-scale development projects may affect water quality and Bristol Bay's salmon fishery.

I am writing to request that you initiate the Clean Water Act's §404(c) process for the Pebble Mine project. While I am not opposed to responsible development, I believe that the size and location of the proposed Pebble Mine are such that it will have severe impacts on wild salmon, the rivers surrounding the deposit, and other natural resources of the region, and that these risks far outweigh any potential benefits. Due to the mine's potential impact on fisheries, wildlife, and the local communities, American Rivers has named the Bristol Bay Rivers one of America's Most Endangered Rivers™ of 2011.

As you know, the EPA has authority under Section 404(c) of the Clean Water Act to withdraw this area from future designation as a mine disposal site due to the unacceptable adverse impact on fisheries, wildlife, municipal water supplies, and recreation. Currently, the EPA is assessing how large scale mining development, including Pebble Mine, might impair the robust salmon fishery in Bristol Bay. The impact to already declining fisheries and water quality worldwide is not worth the risk or the economic benefits! We must protect these diminishing resources for the future of humanity and ecology.

I believe that EPA must employ their §404(c) authority proactively, withdrawing specific areas from future designation as disposal sites. Please consider the cumulative impacts that this project will have on the salmon, the tribes, and the broader community that depends on this beautiful area of Alaska. Thank you for considering my request.

> **<u>EPA Response:</u> Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

<u>EPA-HQ-ORD-2012-0276-3284</u> [70 on-time duplicates]

The EPA is currently attempting to overstep Congressional and state authority by bestowing itself with unprecedented and unconstitutional powers to preemptively deny or add premature conditions on environmental permits under the Clean Water Act. This nuclear option will undoubtedly send shockwaves through the American economy.

The National Environmental Priority Act (NEPA), enacted by Congress and promoted by the environmental community, created a balanced process to measure science and socioeconomic impacts of development projects. Preemptive permit denials would not only nullify the NEPA process, tramples Congressional authority and makes a mockery of state's rights.

Today, the EPA is undergoing an unprecedented watershed study in Alaska that would lay the groundwork for a preemptive denial of a water discharge and dredging permit (under section 404c of the Clean Water Act) for the Pebble deposit that would override the NEPA process.

Pebble sits on state land that was specifically designated for mining. As one of the largest mineral deposits ever discovered in North America, its development in an environmentally-sound manner would provide good jobs for remote rural communities and create a stable domestic source of critical mineral resources for manufacturing and national defense.

But the devastating reverberations of preemptive EPA action would go far beyond Pebble. There are over $200 billion per year in domestic and foreign investment in U.S. projects that rely on similar environmental permits. The vast uncertainty created by the EPA's arbitrary and capricious action would create a devastating impact on these billions in investment dollars. A decision on the Pebble project now would be premature. However, it is urgent that the EPA's bogus and unconstitutional power grabs are brought to an end. Otherwise, these unfair rules will kill the Pebble project before the permitting process even begins, leaving our nation's entire resource, energy, farming, and home building industries, vulnerable to a similar fate.

I urge you to protect the vitality of American resource industries by taking a stand against the EPA's massive power grab. And it isn't just this issue. The EPA is an agency totally out of control acting as a predator on our economy and the people of our great nation. The air, water, and soil will never be clean enough for these power hungry zealots.

They are going after carbon dioxide even though there is no valid or provable evidence that it is responsible for global warming. This organization needs to be reined in.

> **EPA Response: Comments have been noted. The document is a scientific risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c). This process includes requirements for public notice and comment on any proposed determinations.**

EPA-HQ-ORD-2012-0276-3285 [68 on-time duplicates]

Thank you for your attention to the proposed Pebble Mine in Bristol Bay Alaska. I am writing today to encourage you to use your authority under the Clean Water Act to take a hard look at how this proposed mine will impact our nation's biggest wild salmon fishery, the commercial fishermen and Alaska Natives who depend on it, and the local businesses who make their living off of this wild landscape in Southwestern Alaska.

If built, Pebble Mine will produce between 2 and 10 billion tons of toxic waste that will have to be treated for hundreds of years. This waste will threaten Bristol Bay, an area widely recognized as one of the last remaining strongholds for healthy salmon populations in North America and the world. The region provides pristine spawning grounds for trophy rainbow trout and all five species of Pacific salmon, including the largest sockeye salmon runs on Earth, and a variety of other fish and wildlife species that depend on the nutrients from salmon, clean water, and undisturbed habitat.

I urge you to initiate a Clean Water Act 404(c) process in Bristol Bay immediately. Alaska Natives, sportsmen, commercial fishermen, churches, and conservation organizations deserve a public and science-based process to determine if the Pebble Partnership's plans to build the biggest open pit mine in North America will harm one of our nation's greatest fisheries.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-3286 [15 on-time duplicates]

Thank you for the opportunity to comment on EPA's draft scientific Watershed Assessment of the Bristol Bay watershed. It clearly demonstrates that large-scale mining would have unacceptable adverse effects on waterways and salmon spawning habitats of Bristol Bay.

As a commercial fisherman the past eight years, I urge you to establish all appropriate restrictions, including possible implementation of section 404(c) of the Clean Water Act, to protect Bristol Bay's salmon runs and thousands of good commercial fishing jobs.

<u>EPA Response:</u> Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

<u>EPA-HQ-ORD-2012-0276-3683</u> [176 on-time duplicates, sponsored by the Commercial Fishermen of Bristol Bay]

As commercial fishermen, we understand what happens when fisheries and watersheds are not cared for, and as members of the Bristol Bay fishing fleet, we know firsthand that America has no more valuable watershed than this one.

When American fisheries are damaged due to inappropriate development, it is extremely difficult to restore them. Attempts to reverse damage are less effective and more expensive than prevention. Here in Bristol Bay, our salmon season is getting underway. In Dillingham, Naknek, Egegik, and a dozen smaller communities, boatyards are humming and the excitement in the air is palpable.

Bristol Bay has been called "our last chance to get it right the first time." We thank the Environmental Protection Agency for the scientific assessment of this amazing watershed and for carrying out a public comment process. The assessment reinforces what those of us who make our living here consider self-evident; that large-scale mining in the headwaters of the Kvichak and Nushagak watersheds poses an unacceptable risk to the waters of Bristol Bay.

We respectfully ask that that EPA invoke Section 404(c) of the Clean Water Act, and bestow on Bristol Bay the protection it needs from Pebble Mine-style large-scale developments that can devastate fisheries, either through catastrophic events or chronic habitat degradation over time.

<u>EPA Response:</u> Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

<u>EPA-HQ-ORD-2012-0276-4036</u> [8,586 on-time duplicates, sponsored by the World Wildlife Fund]

The watershed assessment recently released by the U.S. Environmental Protection Agency provides compelling evidence that Pebble Mine is a threat to Bristol Bay. Not only does Bristol Bay provide irreplaceable habitat for hundreds of species of birds, fish, shellfish and marine mammals, it also supports a world famous wild salmon fishery that generates $480 million annually and provides more than 14,000 full and part-time jobs.

I urge the administration to listen to the science and stand up to protect Bristol Bay, an invaluable treasure that provides thousands of fishing jobs and sustains local communities.

I urge the EPA to move forward to protect Bristol Bay through the authority granted to it under section 404(c) of the Clean Water Act.

<u>EPA Response:</u> Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

<u>EPA-HQ-ORD-2012-0276-4521</u> [280 on-time duplicates]

I applaud you for undertaking a scientific assessment of the Bristol Bay watershed, which concluded that large-scale mining in such an ecologically sensitive region would jeopardize this natural treasure and its communities. I urge you to now exercise your authority under the Clean Water Act to prohibit the construction of massive mining projects in this location-- including the Pebble Mine.

The Pebble Mine would gouge one of the world's largest gold and copper mines out of the headwaters of the Bristol Bay. It would generate billions of tons of contaminated waste, destroy thousands of acres of wetlands and threaten the area's legendary salmon runs -- the lynchpin of the Bristol Bay ecosystem on which Alaskan Native cultures have subsisted for thousands of years.

Building a mine of this scale in this location is a reckless and destructive venture. No matter how extensive the environmental review or how comprehensive the mitigation, the far-reaching risk to our environment cannot be eliminated. There are no examples of successful, long-term collection and treatment systems for mines. Mining would produce acidic and metals-laden waters that would degrade water quality downstream with virtual certainty, and there is a 98 percent likelihood of pipeline failure per 25 years of operation.

We shouldn't gamble what we can't afford to lose -- and we can't afford to lose the Bristol Bay fishery. I understand that you are under pressure from global mining companies to open up this extraordinary ecosystem to large-scale mining for the sake of corporate profits. I urge you to use your authority under Section 404(c) of the Clean Water Act to proactively protect the Bristol Bay watershed and the communities that depend on it for survival.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-4523 [19 on-time duplicates]

The Center for the Celebration of Creation thanks the EPA for concern being shown about proposed large-scale mining in Bristol Bay, Alaska. **We specifically oppose any mining development at the Pebble Mine site.**

We are called as people of faith to protect God's sacred and irreplaceable gift of creation. We are also to seek justice for the vulnerable among us. Thus we seek to protect Bristol Bay. For thousands of years, Alaska natives have called Bristol Bay home. Their identity and culture are entwined with the land and water there.

As noted in the EPA's scientific assessment, the salmon that return to Bristol Bay each year, along with the elk, caribou, and bears, are central to the Alaska natives' subsistence culture. If the proposed Pebble Mine were to be developed, it would be a huge threat to the health of the Bay and the Alaska native way of life. The headwaters of Bristol Bay are no place for what would be North America's largest open pit mine. The very infrastructure needed to create the mine would have devastating impacts on salmon spawning grounds and the tribes.

We stand in solidarity with the tribes and those who have called on the EPA to do all they can to protect this place and these people. More than eighty five percent of people living around Bristol Bay oppose the mine. As Genesis calls us to serve and protect God's creation, the EPA is called to serve and protect this community and this place. **We urge you to use the authority granted to you under the Clean Water Act to protect Bristol Bay, Alaska.**

In closing, Administrator Jackson, we express our deep and sincere gratitude for your leadership in working to protect God's creation.

As a person of faith, I am called to serve as a steward of God’s great Creation and seek justice for all of God’s children; Bristol Bay is an irreplaceable piece of Creation whose bounty and beauty are home to a diverse and healthy community both human and non-human. The millions of salmon that return to Bristol Bay each year provide a livelihood for the thousands of Alaska Natives that live in the area and are the pulse of the Bay.

A recent study by the EPA shows that even the smallest possible mine in this area would destroy a minimum of a 3600 acre tailings impoundment and an 86 mile road just to make the mine possible. These actions, in addition to others would result in the elimination or blockage of 55 miles of streams, prime salmon habitat.

This is unacceptable. I urge you to protect this place - its people, thousands of years of subsistence culture, animals and the whole of creation that make it special. Please use section 404c of the Clean Water Act, preemptively, to protect Bristol Bay for future generations.

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-5396 [200 on-time duplicates]

I have worked here for (various) years and my position here is (various). In my time here, I have benefitted economically from the wild Bristol Bay salmon resource and have been privileged to work and live in a beautiful place with a thriving ecosystem. The proposed Pebble Mine, at the headwaters of the Nushagak and Kvichak Rivers, puts this ecosystem, and the livelihoods of all who depend on it, at risk.

I am writing to urge you to use the EPA’s authority under the Clean Water Act to initiate a 404(c) process to protect the Bristol Bay watershed from mining development that would impair the region’s water quality and adversely affect its natural resources. I commend your agency for undertaking its recent science-based, objective, and thoroughly researched Draft Bristol Bay Watershed Assessment.

The Draft Assessment makes it clear that mining poses many risks to the Bristol Bay watershed and ecosystem. Among other things, mining of the Pebble deposit would: “ Eliminate or block between 87.5km and 141 .4 km of 1 S’ and 3rd-order streams, eradicating the populations of salmon that spawn there year after year.” Destroy between 10 .2 km^2 and 17.3 km^2 of wetlands, eliminating habitat used by salmon for resting, rearing, and over-wintering. “Include construction of an 86-mile transportation corridor, which could cause stream sedimentation and blockage, resulting in elimination of salmon spawning habitat. “ Include construction of four 86-mile pipelines, which have a probability of experiencing two stream-contaminating spills over a projected 78-year life of a mine. “Alter the thermal characteristics of stream water and change the ratio of groundwater to surface water, affecting salmon metabolism, behavioral cues, and survival. “Potentially result in an accidental tailings dam spill that could bury entire streams, unleash contaminated sediment as far downstream as the waters of Bristol Bay, and impact salmon and wildlife in ways that would take decades or more to reverse.

The watershed of Bristol Bay is not only a pristine ecosystem but a jobs creator. Anticipated ecological impacts from mining pose an excessive risk to the 11,000 fishery workers whose livelihoods depend on the salmon resource. We must not jeopardize this sustainable, renewable, and profitable resource; please use the 404(c) process under the Clean Water Act to protect the Bristol Bay watershed from the harmful effects of mining.

> **<u>EPA Response:</u> Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

<u>EPA-HQ-ORD-2012-0276-5417</u> [908 on-time duplicates, sponsored by the Natural Resources Defense Council]

July 23, 2012
Office of Environmental Information (OEI) Docket (Mail Code: 2822T)
Docket # EPA-HQ-ORD-2012-0276
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20460
Email: ORD.Docket@epa.gov

Re: NRDC's Online Petition to "Stop the Pebble Mine and Protect Alaska's Bristol Bay!"

Dear Administrator Jackson:

In an attempt to better reach constituents affected by and/or concerned with proposed large-scale mining in the Bristol Bay watershed in Alaska, the Natural Resources Defense Council ("NRDC") has created an online petition using the advocacy platform SignOn.org.

NRDC applauds the U.S. Environmental Protection Agency ("EPA") for undertaking a well-researched and thorough scientific assessment of the impacts of large-scale mining on the Bristol Bay watershed's natural resources and believes that the Bristol Bay Watershed Assessment ("Watershed Assessment" or "Assessment") and the record on which it is based support a determination that large-scale mining of the Pebble deposit is irreconcilable with the health and integrity of the fisheries, waters, wildlife, and recreational resources of the Bristol Bay watershed.

NRDC's online petition—"Stop the Pebble Mine and Protect Alaska's Bristol Bay"—urges the EPA to use its authority under section 104 of the Federal Clean Water Act ("FWPCA" or "Clean Water Act") to prohibit the specification of the proposed Pebble Mine in Bristol Bay, Alaska as a disposal area for the discharge of dredged or fill material.

To date, the petition has garnered 908 signers—713 of which (almost 79%) are from Alaska.

Please find, attached, the petition, as well as a list of individual signers along with their comments.

Very truly yours,

Joel Reynolds
Senior Attorney
Program Director

NRDC's Online Petition to "Stop the Pebble Mine and Save Alaska's Bristol Bay!"
Page 2 of 2

Stop the Pebble Mine and Protect

Alaska's Bristol Bay!

By Joel Reynolds (Contact)

To be delivered to: Lisa Jackson, EPA Administrator

Stop the Pebble Mine, a proposed large-scale open-pit gold and copper mine in Bristol Bay, Alaska, that jeopardizes some of the world's largest salmon runs, by exercising your authority under the Clean Water Act to prohibit the construction of massive mining projects in this natural treasure.

Global mining giants want to gouge one of the world's largest gold and copper mines – an open-pit 2,000 to 5,000 ft-deep behemoth – into the headwaters of Bristol Bay, generating an estimated 10 billion tons of contaminated waste – 3,000 pounds of waste for every person on earth! The U.S. Environmental Protection Agency (EPA) has found that large-scale mining in the area would jeopardize the region's legendary salmon runs – the lynchpin of the areas world-class ecosystem that supports Native communities' subsistence fishing as well as a $445 million annual commercial and recreational fisheries economy.

The EPA has the authority under the Clean Water Act to block terribly destructive projects like Pebble Mine. Your signature and comment will urge EPA administrator Lisa Jackson to save Bristol Bay by banning large-scale mining in the area, including the Pebble Mine.

July 23 is the due date for public comments on the EPA's scientific assessment of Alaska's Bristol Bay watershed and the risks posed by large-scale mining there.

NEW goal - We need 1,000 signatures

There are currently 908 signatures

Dear Lisa Jackson, EPA Administrator,

We are pleased to present you with this petition affirming one simple statement:

"Stop the Pebble Mine, a proposed large-scale open-pit gold and copper mine in Bristol Bay, Alaska, that jeopardizes some of the world's largest salmon runs, by exercising your authority under the Clean Water Act to prohibit the construction of massive mining projects in this natural treasure."

Attached is a list of individuals who have added their names to this petition, as well as additional comments written by the petition signers themselves.

Sincerely,
Joel Reynolds

EPA Response: **Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-5442 [22 on-time duplicates, sponsored by the Theodore Roosevelt Conservation Partnership]

As a sportsman, I am writing to express my opposition to the proposed Pebble Mine in Alaska. This gigantic open pit mine is bad for American anglers and hunters and the world-class fish and wildlife populations of southwest Alaska. Placing common-sense restrictions on mining in this region will guarantee the long term sustainability of these fish and wildlife resources.

Sportsmen depend on publicly owned lands for hunting, fishing, trapping and shooting, yet the proposed mine could permanently degrade these ecosystems and impact the biggest wild sockeye salmon run on the planet as well as ducks, geese, brown bear, black bear, caribou, and moose.

The proposed Pebble Mine would also provide the infrastructure needed to develop seven other mines with thousands of acres of additional claims nearby. Mining in Bristol Bay would impact irreplaceable salmon streams and potentially jeopardize 14,000 jobs and the region's $600 million sport and commercial fishing economy.

The magnificent lands and waters of southwest Alaska are available for enjoyment by all Americans. Sportsmen travel from around the nation to enjoy the region's unique fish and wildlife resources. If the Pebble Mine is permitted, these resources could be lost forever. This is too great a risk for sportsmen to accept.

To safeguard Bristol Bay's fish and wildlife resources, I encourage you to:

* Adhere to the existing timeline for the watershed assessment process, including the comment period deadline.

* Initiate a Clean Water Act 404(c) action for the Pebble Mine proposal in support of America's economy, our fish and wildlife populations and our cherished hunting and fishing traditions.

> **EPA Response: Comments have been noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

EPA-HQ-ORD-2012-0276-5458 [7,500 on-time duplicates, sponsored by Earthworks]

"I urge the EPA to protect the world's greatest wild salmon fishery from the Pebble Mine's toxic mine waste. The Bristol Bay salmon fishery is an internationally significant resource, and the lifeblood of the region."

> **EPA Response: Comments have been noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

APPENDIX 2. PUBLIC MEETING COMMENTS.

Public meetings were an important part of the public involvement process for the draft assessment released in May 2012. The comments presented at these meetings helped highlight local and regional concerns during the assessment process.

As a result of the input received, the assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life throughout the Bristol Bay region. We also learned that some people in the Bristol Bay region are very concerned about their economic future and the fate of their villages, and see mining of the Pebble deposit as an opportunity to bring jobs to the area.

Eight public meetings were held at the start of the 60-day public comment period, so that people could speak directly to EPA managers and staff. Meetings were held in six communities within the Bristol Bay watershed of Alaska: Naknek, Igiugig, Dillingham, Nondalton, New Stuyahok and Levelock. Meetings also were held in Anchorage, Alaska and Seattle, Washington. At these meetings EPA heard directly from residents of Alaska, residents of the Bristol Bay region, tribal Elders and members, elected officials, mining industry representatives, fishers, concerned citizens, and other stakeholders, who offered a range of perspectives and information relevant to the assessment.

At the Anchorage, Dillingham, and Seattle meetings, certified transcripts were provided by court reporting services. A written record of oral comments was transcribed by an EPA employee from audio recordings taken at the Levelock, Igiugig, New Stuyahok, Nondalton and Naknek meetings. Every effort was made to transcribe the testimony accurately, but there may be errors or omissions due to background noise and the sound quality of the recording. Commenters were encouraged to send written or e-mailed comments to support their testimony, especially at meetings where a time limit was used to allow more people to speak.

The full text of each spoken comment was read and considered by EPA as they revised the draft assessment. For purposes of this response to comments document, one or more sentences that capture the essence of the comment were restated, along with a brief response or acknowledgement from the authors of the assessment. Several people attended more than one meeting; their comments were treated as a unique comment for each meeting location. The full transcripts and meeting records from all eight of these meetings are available under docket EPA-HQ-ORD-2012-0276 at www.regulations.gov.

EPA thanks those who shared their knowledge on the importance of the intact salmon ecosystem to Alaska Native culture and the subsistence way of life, and those who offered heartfelt remarks on how a proposed mine might affect their communities and livelihoods in the future. We also thank those who shared concerns regarding the future economy of the region, those these issues are outside the scope of the assessment. All comments were read and considered and are now part of the assessment's official record.

Dillingham Public Meeting – June 5, 2012

THOMAS TILDEN: I'd like to discuss some of the weak points of the assessment. I believe that it's weak in regards to when discusses the seismic activity in that particular area. I think it's also weak in regards to the Native people that live in the region that depends on fishery. I cannot say that our society is not like any other society, that we've lived here for anywhere from fifteen to 150 generations, depending on what anthropologist you talk to. And I believe that we're going to live here continued for a lot longer. And I hope that you put a lot of emphasis on our independence of salmon. And not only to our economy but to our culture. I believe that we need to put a little more emphasis on, and that is climate change.

> **EPA Response: The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. The assessment is not an economic cost-benefit analysis of mining and the fishery. The subsistence fishery sustains a way of life for local residents and is integral to the social and spiritual aspects of the Alaska Native cultures in the region. The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife. Although a full consideration of how climate change could affect mining-related impacts is beyond the scope of the assessment, we have included discussion of potential climate change in the region in Chapter 3 (Section 3.8), and consideration of climate and mining interactions in Chapter 14 (Box 14-2).**

ROBERT HEYANO: Our members of fishing and salmon resources in the waters, assists food as our wildlife resources present the watershed. Our members are also very dependent on commercial salmon fishery. For many of our members, it is the sole source of cash income for any given year.

> **EPA Response: Potential effects on commercial and recreational fisheries were not evaluated as part of this assessment. We recognize that any impacts to salmonid and other fishery resources would affect these sectors. We also recognize, but do not evaluate in detail, the complex relationships among subsistence, commercial, and recreational fishing.**

BILLY MAINES: Bristol Bay watershed is alive, vibrant, sensitive, clean pristine ecosystem. It's water rich. It provides for everything on everyone who depends on that system. It's a gift from God, it's Mother Nature's presence. It's father times endowment to people of Bristol Bay. It always has been, always will be; if left alone. The true definition of the people who live here and who come to visit here lives within the Bristol Bay watershed.

> **EPA Response: Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

GARY STEVENS: My concern is the dam; the earthquakes; the possibility of the waste rocks; the fact that we contain this material forever, that's a long, long time

> **EPA Response: Comment noted; no change required.**

BRYCE EDGMON: Lastly, in terms of any shortcomings for the study, and I know it's outside the scope of the agency but study legislature we were also going to look at the social economic aspects of bringing in several hundred, if not thousands, of large work force into the region, what those effects could be.

> **EPA Response: Comment noted, but these effects were defined as outside the scope of the current assessment.**

ANNA MAY FERGUSON: We are of the fish people. We are the salmon people. We go to other places and people introduce themselves as they are from here -- in clan is their descendants of this and we have in the Bristol Bay Region, lived -- there are thousands of years. I cannot fathom thinking about open pit mine. Money is good for jobs, but the livelihood of your commercial fishermen is in jeopardy. Our foods are in jeopardy, our future is in jeopardy.

EPA Response: Comment noted; no change required.

MOSES KRITZ: Our people, our grandparents have told us how important water has always been for us. And then western culture came around and the doctor started telling us how important water is to our lives. When I came to -- I remember and thought we were the only people on the planet and know that we were not isolated and didn't know that we were poor because we had all the resources that we had -- had from the land, the sea, and the waters around us that we need to sustain our way of life. And with our culture we did not know that we were heathens, because we have always been. We are still who we are and will be -- and will be who we are for centuries to come, because our children and grandchildren are still carrying on what we eat, how we hunt, gather, all the resources that are there that will sustain us for more centuries to come.

EPA Response: Comment noted; no change required.

ISO MONTALVAN: I come from a very large family that really depends on fishing here in Bristol Bay. We put up a lot of king salmon that we use, it's our that -- we make salmon strips out of and Koktuli is one of the rivers that is a major spawner of the king salmon, and people wait for the kings and get them as they come in; and sometimes we miss them, sometimes we don't fill our smokehouse as well as we -- for the winter because of lack of king salmon at certain times. We need to get this assessment completed and then we need to go on to make sure that the 404(c) can be taken as the next step

EPA Response: We recognize the importance of king salmon to people in the Nushagak River watershed, as reflected in tribal consultations and public comments. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

JEFF SKRADE: We have truly a natural treasure here, folks. Please keep in mind this is the last wild stocks wild salmon fishery here on the planet, the very last one. When Alaska became a state years ago, the fisheries in this area were depleted. Evidence suggests that this was due to a number of factors, including high seas, overfishing, and a very unresponsive system of manager. That is has all been changed.

EPA Response: Comment noted; no change required.

ROBERT NICHOLAI: And that he's been hearing about the Pebble and the adverse impact may have on the fish and game in the region if that is -- if that is allowed to many people within his village said that they would not have what they've had in the past from the land and sea. And he urges that we need to protect what we have lived on. Many of them don't have any jobs; but hunting and fishing is -- is just like a job to many folks who live in the village because from continued doing that with the salmon, they can be assured that they will have Something to eat.

EPA Response: Comment noted; no change required

DAN NUNALOOK, SR.: [Speaking in Yup'ik] He started commercial fishing in 1936; he fished until 2008. The concern that he's concern has been fish in Bristol Bay and then the major area that he is concerned about is the habitat that is already gone -- for the smolt and fish

EPA Response: **Comment noted; no change required.**

JOHNATHAN FORSLING: …if our mine was to go through, it will decimate our culture and decimate our people.

EPA Response: **Comment noted; no change required.**

MEL BROWN: My family is a five generations at one time. We've taught our children and our grandchildren to be fishermen. And we've depended on the food for all of those years. And we plan, as our grandchildren are taught, to honor and respect the fish that we depend on so much here in Bristol Bay. It's the richest and the largest fishery in the whole world, and we want to keep it that way. The healthiest food is where the salmon knows to go; to lay their eggs, and spawn so future generations can continue to have this food, not only commercially, but culturally, but for ongoing future generations. It's gone this way for year after year.

EPA Response: **Comment noted; no change required.**

NORMAN ANDERSON: The Alaska people have belief in several generations scenario as a reaction to all generations taking care of the land and share today what they enjoyed then. We must take care -- will have some generations from now.

EPA Response: **Comment noted; no change required.**

FLOSSIE ANDERSON: Because the mine would have the potential of impact on the fishery and all animals and consequently destroy a 4,000-year-old culture and people, I ask the department of interior advisor protect the lives of our Native people and our resources and help us stop the possibility of destruction of our people and resources. The federal government has a duty to do so since the government has a Native trust responsibility to us.

EPA Response: **Comment noted; no change required. EPA acknowledges our government to government relationship with federally recognized tribes and takes our trust responsibility seriously.**

HJALMAR OLSON: We subsist a lot, but the salmon and the commercial fishery provides us with the cash, cash that we need for other products, ammunition, flour, and all the other things we need for -- to -- to exist out here.

EPA Response: **Potential effects to commercial and recreational fisheries were not evaluated as part of this assessment. We recognize that any impacts to salmonid and other fishery resources would affect these sectors. We also recognize, but do not evaluate in detail, the complex relationships among subsistence, commercial, and recreational fishing.**

ANECIA KRITZ: I have practiced our subsistence way my entire life and I'm proud to say I teach my grandchildren and my children our traditional subsistence way of life. Passing on our traditional ways can help if we let pollution destroy our lands and water. I don't want any big mines like Pebble to contaminate my subsistence food. Our culture cannot survive if we don't take care of our lands. Our ancestors passed on this beautiful place to us. And we must do everything we can to protect it for our grandchildren and children.

EPA Response: **Comment noted; no change required**

RUSSELL NELSON: Being one of thousands of cannery workers following the life of salmon, I come back season after season to earn a living so others can bounty from the great industry of Bristol Bay has brought the life of hunter gatherers to commercial lives -- really want -- catch salmon to homes, schools, and tables around the globes, this substance of life. Fathers taught us to love the land, land for our bodies, land provides homes, land provides crops for women and children, land provides rivers for our fish and mountains for our hunting skills. We love this land, we respect this land, we protect this land.

EPA Response: Comment noted; no change required.

DAVE EGDORF: Subsistence lifestyle here is the important thing, culture needs to be considered immensely. I don't know what else to say, but we just don't need a mine here. These people can't be subjected to the possibilities of the loss of their culture, their home, their heritage.

EPA Response: Comment noted; no change required.

THOMAS R OLSEN, SR.: I grew up on fish, eating fish, and I'm a commercial fishermen my whole life. My boy is right behind me, he did the same. He'd ask at dinner, "What's for dinner, dad?" I'd say, "Fish," and he'd say, "Oh, yum, I can't wait to eat fish, dad." Fish is good. Fish cut the fat. Everyone talks about how to live a long life, my dad always told me, the fat from the oil in the fish make you live longer. And I'm here today as a commercial fishermen about the Pebble Mine, it'll hurt our land, it'll hurt our people, and it'll hurt many generations to come.

EPA Response: Comment noted; no change required.

BONNIE GESTRING: it should be clear that storing mine underwater slow -- not stop acid generation and evidence of hundreds of operating mines around the world. Lots of industry document indicate that all impoundment leak to some extent over time. So the bottom line seems very clear, managing for the wild sustainable productive fishery or the visual likelihood of managing for water pollution and perpetuity and assessment makes a very compelling scientific case for 404(c).

EPA Response: Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

DANIEL SCHINDLER: They are incredibly complex ecosystems. And that complexly hurdle toward environment of assessment development. Whether you can do proper assessment in one of 10 years is almost irrelevant. What we need to be able to do is draw information and experience from other places where mining has been developed, and we also need to be able to use common sense. It appears that the EPA review of potential impacts over this mine is -- is objective. And draws fairly from other places as well as the existing information that's been produced from Bristol Bay salmon. so in general, we support your report and objective and fair assessment of potential risks.

EPA Response: Comment noted; no change required.

PAUL FRISS-MIKKELSEN: I've been a commercial fisherman all my life. I've fished in every ocean in this world. And I have never -- when I came to Bristol Bay, I was just completely awed by the amount of wildlife. The strength of this place is just amazing. And the sensitivity of this place is just so unique. How these fish find their way back will start altering the composition of the water and the elements in this water they use to navigate, they'll be lost. And all these people will be lost. The culture will be lost. The -- the decision that we have to make now is not just for subsistence and Native culture and the commercial fishermen and hunters and the sport fishermen, everyone else is involved up here, it is an issue – it speaks to the values that we want to leave to our children. And --

and the country and the world. What are we going to leave to this people, what will they inherit? This place is so special that, to me, mining Bristol Bay is pure and simple, a risk we cannot take.

EPA Response: Comment noted; no change required.

DYLAN BRAUND: There's one rule that I think is relevant to this whole issue and it's overlooked, it is the temporal issue. Namely, how this decision impacts future generations. This should be a standard by which all decisions should be based in this watershed. First consider that the margin of error in the testing of the sulfite, and if you apply that margin of error couple percent to 10 billion tons of waste, that's a significant margin of contamination of the watershed compliance. Next, how will this withstand seismic activity? Is seismic in the watershed assessment. The next 25-year and 70-year mine scenario severely understates the probability of other mine development [**note: transcript is not accurate – will rely on submitted paper comments**]

EPA Response: The potential for cumulative development of multiple mines is evaluated in Chapter 13 of the revised assessment. The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site.

ANIE WYSOCKI: The --rights, nutures we need for generations; we care for our water, and it provides for us. My family has been commercial fishermen fourth generation and grandparents fifth generation. I'd like to continue this as part of who we are. I'd like to say that my people have been -- are natural scientists. We always watch the animals, we watch the land, we watch how the fish do stuff; and every time when we came back and we notice anything, talk amongst ourselves and say, "This is happening," or we'll say, "Looks at the beaver," and say, "Oh, they're doing this," and that's a sign that -- that -- that will help us determine what kind of winter we're going to have, what is coming in; and all that stuff we look at these things like water and water travels. It doesn't stay just in one place because it's traveling down from river and ocean and right back, and it's just like a cycle that continues.

EPA Response: Comment noted; no change required.

KENNY WILSON: Why would anybody want to threaten their food -- our food source? We live in a known ring of fire of earthquakes.

EPA Response: Comment noted; no change required.

PETER ANDREW: On behalf of my cultural background and generations of subsistence, ask for the support of your assessment. Along with BBNC and 31 villages passed the resolution and that is asking the EPA to act on the assessment and also act on the 404(c) process.

EPA Response: Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

CHRISTOPHER WANG: …salmon formed the art work backbone of this community by nourishment, financial stability, culture, multi-generation interactions, families working together to harvest and store enough food to keep them through the winter. Take this away not only as a cultural backbone but a main source of food is lost.

EPA Response: EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

TYONE RAYMOND: I support the draft assessment and am hopeful that due process the EPA will vote the 404(c) based on some science, common sense, and a vision of future that understands the meaningful difference between the abstract of wealth and true wealth the Bristol Bay Region is wealth in body.

EPA Response: **EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

MATT BECK: I consider myself extremely fortunate to be a first generation fisherman and surrounded by these great people who have built generations of life around these resources. The last nine years of life have been built around this world. I can only hope that I -- all that I can, children my grandchildren can stand here surrounding by these family and generations. All these generations are amazing people who I am sure know the true essence of life and survival. I wonder how many miners can say the same thing.

EPA Response: **Comment noted; no change required.**

DEBBIE HOSETH: I realized that we - living off the land and living traditionally with advice from my Elders, we have to take care of our land in order for our land to take care of us. So the more I learn about the pebble, it's very, very personal to me to be against it, to take care of our land and our land will take care of us in return.

EPA Response: **Comment noted; no change required.**

JACQUELYN WILSON: We value our commercial fisheries, the only one of its kind worldwide. We value our subsistence way of life and our culture.

EPA Response: **Comment noted; no change required.**

TERRY HOFFERLE: The international commission on large dams bulletin 121 addresses tailing dam failures. And the three most prominent reasons for fail tailing dam failures arises from overtopping unusual rain fall, seismic liquefaction, and important of institutional of failures. And I'd like to address each one of those if I could. First of all, I would like to say that the values you use when you're addressing seismic failures I think is inadequate, the data base is mines from 2000-mile from all over the world. I think your data base ought to be addressing specifically mines from seismically active areas, and I think that would change the probabilities of what's going on. In terms of overtopping, a couple of years ago, this was springtime; I saw the whole Basin from black coin all the way up that was underwater. And in terms of management of tailings facilities or institutional stuff, we don't have any human institutions that go back even a thousand years. I think that you need to assess -- reassess roots.

EPA Response: **The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the relationship of seismic features to the proposed mine site. However, it is also important to consider the history of earthen dam failures and Chapter 9 discusses many reasons why dams fail and why they must all be considered when estimating risks.**

MARK LISAC: Even without failure, a large open pit mine will have unacceptable impacts, fugitive dust alone are -- is great harm to people in the environment. Open pit mining is not rocket science, the technologies safeguards have been around a long time. Around the world all take leave and have caused water quality on issues, mostly open pit mines are a desert of mines, which Bristol Bay is pretty much a swamp. So even under the blown failure scenarios is not a question of if or when the impacts of the ecosystem will occur.

<u>EPA Response:</u> Comment noted; no change required.

EMM WASSILLIE: I'm the proud mother of five children, and my husband is a commercial fisherman; and two of my sons also fish. Our subsistence way of life is really important to my father and mother. We all work together after to make sure we have subsistence. Without clean water and healthy environment, we wouldn't be able to live off the land like our people always have. I always oppose the Pebble Mine; because I want our lands and water protected so my grandchildren can live a subsistence land life as well. I've always have way of life to my children and grandchildren to know how important for them to do the same and not only ensure culture, but so we can survive. Even with a job the cost of living in our villages is high and our traditionally are what keep food on our tables and our culture -- cultures thriving.

<u>EPA Response:</u> Comment noted; no change required.

PATRICIA TREYDETTE: I think it's extremely conservative. I -- I think there's probably more threat than what you're seeing, but I appreciate you're recognizing the fact that Pebble doesn't have to put a mine plan for us to know what they have to do to make it economically and physically develop. So you guys definitely did the right thing here.

<u>EPA Response:</u> Comment noted; no change required.

STEVE WASSILY, JR.: Help us keep our quality, quality of fish, quality of the animals, the water we drink. It's very important; because if the mine goes through, throw all that quality out the window. Even farm fish can't compare to the quality of fish that we catch commercially and subsistence. And we need the birds, everything all the -- you know, depends on water.

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

PATRICIA TREYDETTE: The land and the water sustain lives for many of thousands for years.

<u>EPA Response:</u> Comment noted; no change required.

ROBIN SAMUELSON: If that mine goes through and there's damage to the water quality, we will lose our customers. You guys hold the key. We don't get a fair deal from the State of Alaska. We feel that there was 67 permits that needs to be issued to be Pebble Mine votes, 66 of them are going to come from the State of Alaska and one from you guys, it is EPA.

<u>EPA Response:</u> Comment noted; no change required.

JULIUS HENRY: As you know, the waters that came and everything when it really changed the way of life. It will not only change the fish, but it allows effect the wildlife and the mammals of areas

<u>EPA Response:</u> Comment noted; no change required.

JOHN BOUKER: About 45 years ago I used to work for a mining company in Bristol Bay. And this was a mining company that used to dredge. The -- the dredge pond, which is behind the dredge, was upstream of the dredge, and the out roll from that, which I think was called the salmon river, flowed about a mile and a half into the crest near Bristol Bay. And the river itself was muddy and the bay for a half a mile out was just pure yellow, and obviously we had no fish.

<u>EPA Response:</u> Comment noted; no change required. The assessment considered large-scale surface mining of porphyry copper deposits. Suction dredge mining was not evaluated in the assessment.

ANNIE FRITZE: I am a small business owner relying on the beaver, river otter and on fur bearing animals to help sustain my small business. I am also a lifelong subsistence user and a mother of three children and four grandchildren who enjoy our salmon, moose, caribou, edible plants, and berries. Since time, this magnificent and mostly untouched region has been home to my ancestors, peoples residing on the rivers for centuries; they followed a traditional way of life in pursuit of subsisting off the land. And most importantly, its valuable natural resource is salmon. Each year more than one million salmon return to the rivers and streams where the salmon hatch and spawn for the next cycle of life. This is such an ancient behavior that has supported hundreds of generations of humans. So long as a salmon return to the river to nourish its land and waters and its people, all other animals find the haven and subsistence here too. The spawning and dying of salmon help create the soils for the berries, plants, grasses, shrubs, and trees to take root and complete the cycle of life. Water is very important to us. Without clean water there is no life.

<u>EPA Response:</u> Comment noted; no change required.

CABELLA FRITZE: I help my grandmother in the smokehouse. Once the fish is done, it is very yummy. I also like moose and caribou. Please protect the -- our waters.

<u>EPA Response:</u> Comment noted; no change required.

PHYLLIS AYOJLAK: I want to say that the subsistence is my livelihood and I'm also a commercial fisherwoman in Togiak. My grandmother was also a commercial fisherwoman, and I now fish the permits she passed down to me. I'm so thankful I'm able to live a subsistence way of life like my ancestors, and I feel very threatened by the Pebble -- Pebble project. Our traditional way of life isn't possible without our land and water being clean.

<u>EPA Response:</u> Comment noted; no change required.

DAN DUNAWAY: In the assessment, you generally use the open pit mines in the area. But I know there's a lot of talking about block caving touching on that full report; I think that needs to be explored further. Frankly, I'm more concerned about block caving where you don't know what's going on underground. And you don't know what's going to happen when things subside. So I hope that -- that could be expanded more.

<u>EPA Response:</u> The mine size scenarios have been updated to three sizes in the revised assessment. For each of these scenarios, we have considered open-pit mining methods. We discuss underground mining issues qualitatively in Chapter 4 of the revised assessment.

DON LATSHA: I'm worried that, again, whether there is a fault or not a fault, the farm fishery community has a very available reason to say, "Hey, guys, community – world community, you guys might be eating tainted fish here." I'm worried about is what might take place if the mine is installed.

<u>EPA Response:</u> Perception of contamination is mentioned in Chapter 12 of the revised assessment, but full evaluation of the perception of tainting and its relationship with the seafood market is outside the scope of the assessment.

JOE CHYTHLOOK: Subsistence impacts culture, our culture, our primary food source and our long standing sustainable economy the mine will affect us now and in our future. I would simply urge that EPA take action under the 404(c) to protect the Bristol Bay salmon

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

HENRY STRUB: …it seems to be far easier to reserve renewal resources than to regenerate one that's become ruined.

<u>EPA Response:</u> Comment noted; no change required.

JOHN FRISS-MIKKELSON: You know we can talk about dollars and cents and cost benefit analysis, fishery versus the mining; but we have very unique jobs here. We have owner/operator businesses and immense opportunities, very low cost. So if people want to get any businesses and build their businesses, and I think that's incredible, and not only that, but it's a value that you know the politicians look to small businesses in the country and how much that means to our economy, and this is really an example of where we have those small businesses. This is a small business Mecca here in Bristol Bay.

<u>EPA Response:</u> Comment noted; no change required.

JENNIFER ROBINETTE: I had an opportunity to come back and learn my culture from my relatives. Two years ago I had never cut salmon. Now, I live off the subsistence food. There was times after winter year that we ran out of food because we ran out of fuel and a cold -- the house went cold in the winter because we didn't have enough money to buy fuel. But that didn't worry us because we had salmon we put up the summer before. I hope that you can add to your assessment something that addresses clean drinking water; I didn't see that. There is another thing that I did not find I -- after looking through the three volumes. The biological threats to an environment that development brings such invasive plants there are invasive plants here in Alaska that add to the degradation of the salmon habitat, there are also invasive plants documented by -- that have killed the moose in Anchorage.

<u>EPA Response:</u> Comment noted; no change required. Drinking water and sanitation operation and maintenance are of concern to many Alaska Native villages. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources. Invasive plants are discussed in Chapter 10 of the revised assessment.

SHARON CLARK: I was born and raised in Clarks Point. And for many years and centuries my family occupation as commercial fishermen and gathers and subsistence user. We catch over 3,000 fish annually and pick over four hundred gallons of berries per year. We're people of the tundra and of the river. We are nomadic people, and we gather from one location to another. We travel for 20,000 something miles in our area to gather our subsistence needs; we're social culture people. And the risk is too heavy, that risk is not one century come or time. You cannot replace a culture or people or places when we were gone.

<u>EPA Response:</u> Comment noted; no change required.

KRISTINA RAMIREZ: I know for a fact that whenever you build something around a place where mammals are present, the animals disappear because of what you built is taking on their habitat. These salmons are a very important local resource to us; they can't be replaced by anything else.

<u>EPA Response:</u> Comment noted; no change required.

KIM WILLIAMS: As a leader here in my community, my tribe conducts culture camp every year so that we maintain a sustainable salmon based culture for our children and future generations. Page 2-19 touches on this, and I need a course on the section. However, on page E4-9 we don't believe that the section that identifies us, maintaining our ties is 4,000 years. We believe it more to be 10,000 years. It is not only that the salmon from my food on the table for generations in the past and today, but we recognize through the assessment salmon that we want to maintain our future. After all, we were only borrowing all this land, water and air from the future that is yet to come. My children, like my generation, are subsistence, sport, and commercial fishermen. My children check the subsistence net on the beach with their grandparents, just like I did 40 plus years ago with my parents. My children love going up to the lake or up in the river with their grandparents to sports fish or fresh water fish and salmon, just like I did.

<u>EPA Response:</u> We agree that indigenous culture may extend further back than 4000 years, but we maintained this figure in the assessment because it is supported in literature.

KENNETH NANALOOK: Protect the fish population.

<u>EPA Response:</u> Comment noted; no change required.

KATHERINE CARSCALLAN: You can ask anyone what the concern for future is, overall it's about worrying about losing their livelihood or way of life, all to mining development that we don't want and thus has been out of our power to stop.

<u>EPA Response:</u> Comment noted; no change required.

TINA TINKER: Now, that Pebble is doing exploration, we are now seeing the pike population is affected. We ask Bristol Bay residents, fish resources, whether it's salmon or other and fish that has kept our Native culture alive. We also take great pride in teaching our children our way of life by living off our resources like fish, caribou, and moose. Which gold and cooper will never teach our Native way of life or even feed our children.

<u>EPA Response:</u> Comment noted; no change required. Current exploration activities are outside the scope of the assessment.

THOMAS HIRITSUKI: I've been fishing all my life. And, you know, and we want our grandkids to enjoy that, you know, enjoy our fish, enjoy our wildlife, and – good fresh water we have. There's fish fresh water, it goes back whether they're going to drink when they go up river.

<u>EPA Response:</u> Comment noted; no change required. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources.

DANIEL CHEYETTE: That the fish and other wildlife are essential to the culture, structure, and economies of the region. And that subsistence harvest are essential to the people, on average obtain 80 percent of protein from these resources, yes, yes, yes. More attention should be focused on social economics of the fishermen and on other resources mean to the personnel economy economies of families. The roles the subsistence plays to the cultural fabric of these families and communities. The social cost to the communities if these resources disappear. The assessment should focus on how Bristol Bay would change if a mine or mines were to be developed, the additional social services that would be necessary, the stresses that would be introduced by the necessary expansion that would inevitably occur.

<u>EPA Response:</u> The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.

FRIAR VICTOR NICK: I've always had fishing net ever since we were little children. A few years ago our -- our leaders in the church, known as the Bristol Bay Church, came together to allow the rest of us TO discover the uniqueness and the people within our church to bless the waters of the lake. And to sand they -- the waters, and so they the -- the -- the fish and moose, caribou, and everything that touches these -- touched by the waters, including all our communities. And that's something we've done a few years ago, but that's what we've within doing for the past 200 years. Once the orthodox missionaries landed in the soil of Alaska, they've always do the blessings of waters. So this one realized that not just the orthodox enjoy these blessings, but everyone here in the -- in the town of Dillingham, in the villages up river and Togiak and all of us are touched by the waters; therefore, we're all touched by the blessings.

<u>EPA Response:</u> Comment noted; no change required.

ALANNA HURLEY: I was born and raised here in Bristol Bay, and I'm fortunate to live a subsistence way of life. I'm also a commercial fisherwoman. You cannot set a price tag to define yourself as subsistence, some people of -- attempting to assign a price tag to life itself. Listen to us, as you've heard all day from all these people with the culture and way of life is priceless. The last point, the executive summary states that the actual response of Alaska impacts is uncertain. And it isn't possible to predict specific changes in demographics, cultural practices, or physical and mental health. You can get the answer to this question by simply looking into history of many of the innocent people now impacted negatively by mining like the -- whose cultures existence has been and continues to be affected by the mining industry. And as you've heard today from every single person who stood up and is connected to Bristol Bay, we will tell you what will happen to our people if miners were -- you destroy our home. Our culture will die. Our fishing economy will crash, and our thriving Bristol Bay will be a haunting memory of what we used to have.

<u>EPA Response:</u> Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

DANIEL CHYTHLOOK: Salmon has been part of our Native spiritual food; and without the food and waters we will die slowly, we'll be here existing, but our spirit will be gone. We'd like to see our salmon continue to return and the waters remain healthy so they can spawn and other places that, of course, clean waters are needed to help our moose, caribou, fresh water fisheries all to survive.

<u>EPA Response:</u> Comment noted; no change required.

CURRY CUNNINGHAM: I wonder if the risk -- that risk probability that is generated is underestimated, they come from the literature review of other mines around the world is one of the most unstable places on the earth. Another question that proposed to me after reviewing the document was the cost of maintaining the mines for long time, forever is a long time. Much longer life span of most corporations, so then who's going to foot the bill in the long run?

EPA Response: **Box 4-3 in the revised assessment provides background information on financial assurance requirements and clarifies that financial assurance requirements do not include remediation of chemical or tailings spills. The risk summary in Chapter 8 (Chapter 14 of the revised assessment) is based on the potential mine at the Pebble site, and now includes a summary of cumulative risks from multiple mines. Estimating the failure probabilities for a future tailings impoundment is difficult. Both the range of estimates of historic failure rates and design goals were considered, but design goals were used to estimate failure probabilities.**

TODD RADENBAUGH: (The UAF Dillingham campus had a symposium and) A lot of people who are in this room presented all kinds of data that abstract books, and I guess you call it literature. We'd like to see some of that information maybe to be included in this next version of the document. I'd love to see a real definition of the word perpetuity. The second generations pay the -- to me it says seven million years, 100 million years, all this has implications of scale. So I'd like to see scale issues as well, individual scale, individuals going up to the communities, and both the social aspects as well as the major or natural aspect, ecosystems services; there is nothing like that in the document.

EPA Response: **Comment noted, but because no specific data were presented for consideration into the revised assessment and because we relied on peer-reviewed literature, no change is required. Perpetuity refers to a time period of indefinite duration that extends to the end of responsible human institutions.**

GLADYS LIND: My only critique surrounds the portion of the assessment which is titled "fish mediated risk to indigenous culture." I want to point out that indigenous -- and the daughter of a culture for over 88 years -- I read it with great indifference, because what is lacking is how can one remain scientific and predict the effects having the main stay of our subsistence culture taken away from us? To attempt to document any predictions or produce any scientific hypothesis could not be able to describe the devastation to our way of life could not be captured in two paragraphs.

EPA Response: **Comment noted. Chapters 5 and 12 were expanded to bring forward more information on the psychological, cultural, social, and spiritual connections between Alaska Native cultures and fish. The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects on indigenous culture and wildlife, although a qualitative discussion of potential impacts from secondary development is now included in Chapter 13. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users, as well as wildlife, in the region.**

SUSAN JENKINS-BRITO: We were concerned about the king salmons freely stopping being a species, and we were concerned about protecting the other four species of salmon. We need to protect our clean water sources from contamination and as well as our fresh water, salt water, and salmon stocks or fish stocks. Not to mention all the water fowl in the area that rely heavily on catches to feed our family year around and commercial salmon fishing.

EPA Response: **Comment noted; no change required.**

KEVIN McCANABLY: I feel that not only the fish and the wildlife that depend on them, myself included, are too important to risk for any economic reason that the mine could bring.

EPA Response: **Comment noted; no change required.**

DOROTHY B. LARSON: And it's pretty astonishing to see in black and white what we know what -- happen to our renewable resources if any little mishap happens at the mine. We requested that the EPA utilize their authority to enforce the 404(c) on the Clean Water Act to protect the watershed that request still stands

> **<u>EPA Response:</u> EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

JOHN MONTECUCCO: And in perpetuity in essentially I think look like from giant -- either it seems like, you know, that eventually there will be an earthquake

> **<u>EPA Response:</u> The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site.**

PANSY ALAKAYAK: Here we have our subsistence lifestyle. We eat the food; fish all the animals in the -- on the land. And we set the mouth and help to feed the rest of the human population out on the earth here on this globe. And I appreciate the assessment that you bring here. And the one word that stands out when I see the assessment is the word "forever."

> **<u>EPA Response:</u> Comment noted; no change required.**

AH-BY-YOU MOORE: Let's face it, without clean water; our chances to live our subsistence lifestyle are slim. Like the salmon, I plan on spawning out here in Bristol Bay. My daughter will be raised eating subsistence food, she's four months and I'm feeding her dried fish. Please protect our lifestyle and our culture.

> **<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

SUEANNE ROEHL: Pollution of the water won't just affect the animals in Bristol Bay, but it will affect all wildlife that eats and drinks from the bay.

> **<u>EPA Response:</u> We agree that secondary effects on indigenous culture from large-scale mining could be significant. The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, although a qualitative discussion of potential impacts from secondary development in now included in Chapter 13. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users, as well as wildlife, in the region.**

JOSEPH FAITL: I also ask that you consider -- or continue to consider, if you have our cold temperatures and recovery rates of our plants, fish, water and so forth when considering mitigation measures or damages to the area. The recovery rate in Alaska, I believe, is very slow. We were at very cold temperatures, 30 below temperatures for weeks. I also was pleased to see that assessment considered rain falling on top of spring snow.

> **<u>EPA Response:</u> Appendix J, which has been added to address the potential for compensatory mitigation, does state that the cold conditions make potential mitigation activities more difficult than in temperate regions.**

KATRINA MOWER: If this Pebble Mine goes around, could -- never be able to fish the same way as we do now. I'm sure that people going along with this will try not to pollute our fish, but it's very, very sure they can't.

EPA Response: Comment noted; no change required.

CHENITA SORENSON: Throughout Alaska. Fish is a huge resource. If you think of the children and what they will do when they are all older and generations to come. Please stop the Pebble Mine and use your 404(c) authority to protect Bristol Bay and my future.

EPA Response: Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

CRYSTAL NIXON-LUCKHURST: Throughout the year we might fish and gather from the land. The majority of my food in my house is the fish; it's frozen, canned, salted or smoked. Salmon is important to me culturally and spiritually. I prepare fish for my mom and my grandmother and my aunties; and we're all teaching my children how to prepare fish, and they're ages 2 to 13. Besides fish, we are very active with other subsistence food from this home. When I grew, I looked in the freezer you would find blueberries, red berries blackberries, huckleberries, chicken, duck, goose, smelts wild greens, and if we're lucky, a moose and caribou, along with king salmon, red silver, and my favorite is dog salmon. I will believe that proposed Pebble Mine would hurt our subsistence way of life. And it would directly hurt my family and our future generations of the people of Bristol Bay. And it would -- it would literally kill our way of life here.

EPA Response: Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

DELORES LARSON: I consider myself a rich Native resident, but not because of money and -- but of the food in my freezer; the food that comes from my land; the food that comes with every season all year long; whether it's salmon, wild plants; berries in the summer; moose, pike, whitefish in the fall; caribou, geese, and ducks in the spring. You name it, we eat it. Our fish and wildlife are not only fresh and abundant, but also very lean and healthy. Bristol Bay supplies the largest wild salmon fish left on earth. Already there are concerns about mining exploration going on, we were noticing a change in our caribou that usually come straight through or near my community. We have also noticed in our -- very concerned with fresh water, fish like our pike and whitefish. I'm not certain that these are results from the mining explorations but certainly will not help it. I speak on behalf of my family and community in Bristol Bay, For future generations will not have the best of both worlds that is the money and jobs that come from mining and in the salmon and wildlife that coming from the very land. I mean no disrespect, but it is common sense that mining and salmon cannot co-exist. I choose salmon, I choose Bristol Bay. We have been concerned with the Pebble for many years and asking the EPA to please use your authority under section 404(c) of the Clean Water Act to protect our watershed and everything that goes with it.

EPA Response: Comment noted; no change required. Current exploration activities are outside the scope of the assessment, but are mentioned briefly in Box 2-2 of the final assessment. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

FRITZ JOHNSON: In Bristol Bay -- telling you experience it's difficult to comprehend what right described salmon runs here -- biblical hoards. It's the last on the planet and the protection of places like this is -- is the very reason that the Environmental Protection Agency exists.

<u>EPA Response:</u> Comment noted; no change required.

JODY SEITZ: The city of Dillingham depends on serving as a major hub and import for the world's largest salmon fishery. And on the commercial wild salmon fishery has been the backbone of many people's livelihoods and subsistence for many generations. There are 297 commercial in the world watersheds here in watershed of those 156 drift, 112 near Dillingham. Multiply that by three, that's the number of jobs created. You can see that Dillingham hosts one of the last working fisheries in the nation.

<u>EPA Response:</u> Comment noted; no change required.

WASSILLISA BENNS: I'm a subsistence user first and foremost. My family will be fishing both for commercial and subsistence. We hunt for moose, caribou, and birds. I also harvest berries and plants. It breaks my heart to think my grandchildren's children may not be able to do the same thing and have the great resource we have in Bristol Bay. I practice and I teach my children and grandchildren how to process fish. We smoke, we salt, we can, and we freeze. We pick berries. We have black, blue, red berries that we all pick together. And we also process as a fundamentally moose, caribou, and birds. The life -- the lifestyle we have here in Bristol Bay has taught my family to be productive citizens, commercial fishing, working as a family or to work all together. All my family members, including my brothers and sisters, live here in Dillingham. We grew up eating fish, and we will die eating fish. And -- and we'll continue to live off the land. Please protect our resources.

<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

DANNY WASSILY: I'm a commercial fishermen and subsistence user. I love subsistence, I love to hunt, I love to put up fish, I love to hunt moose and caribou, I love to pick berries. I'm against the Pebble Mine; I like you guys to join them. The watershed is a very important part of life, it does feed the fish, it brings fish back to spawn and bring the small fish and also to the birds and the life of animals. To take away the water we have nothing.

<u>EPA Response:</u> Comment noted; no change required.

RACHEL MUIR: The people of Bristol Bay have supported themselves on the land and water for thousands of years through subsistence and commercial fishing, and this community in balance.

<u>EPA Response:</u> Comment noted; no change required.

COLLETTE MERAZ: And every year we freeze, smoke, salt, and can fish. We do this because this is who we are. My children know how rich our future is from the net. They help process the fish and store it for the winter months. This way of life was passed down to me from my mother and my grandparents. And I am passing my way of life to my children. And the thought of my children not being able to pass our way of life to their children makes my heart hurt. I come to you today for my children and my grandchildren's way of life to continue to be passed on to the future generations.

<u>EPA Response:</u> Comment noted; no change required.

STAN SMALL: Outside the fish travel down there like the trade they don't swim against the tide, they come back up – tide comes with them. All the toxins would go right along with them.

<u>EPA Response:</u> Comment noted; no change required.

JERRY LIBOFT: Thanks for endorsing the 404(c) and for setting the issues, and I really appreciate it. My concerns outline your draft assessment at two levels of uncertainty. The first level of uncertainty is the uncertainty the inconclusiveness of the existing knowledge that we have in the ecology region. We still don't know -- very little of the geology, biology, seismology, and their interactions in the sensitive area that we call Bristol Bay. We need science and setting up the area before we risk large scale mining. My second level of concern on the uncertainty is the extent of our ability to quantify and effectively mitigate potential failing on operation and closures of mines the size of the Pebble. Experts have proved the operations were three times in the last couple of years. We were told that they somehow leaked; and they said it never happen, and if it did, it could be effectively vague; that the experts were wrong on both counts.

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

HEIDI DUNLAP: Bristol Bay salmon could quite possibly be the largest most sustainable wild food base resource in the world. Why risk something so great? If our salmon stopped returning for some other reason, then maybe we could consider extracting these resources. In another hundred years these minerals will still be here, and my bet is that the industry will have a better method of extraction by then.

<u>EPA Response:</u> Comment noted; no change required.

<u>Igiugig Public Meeting – June 6, 2012</u>

MARY OLYMPIC: She recalls her grandfather talking about things that are going to take place in the future. One of the things that he used to mention was gold and minerals were going to cause a lot of problems for many people. How did her grandfather know that things like this were going to happen? In reference (I guess) to the Pebble Mine from what she has observed and heard there is potential for toxic drainage for both sides of the mine into the Nushagak and Iliamna or Kvichak River. One of the concerns her grandfather used to have is to tell the white folks that there are effects that any mine could have on the people. It is a concern she heard from her grandfather that is if there are any problems or tragedies from mining that happens it could have a devastating effect on salmon, and even though there is money in gold, it doesn't last as long as what we have in the salmon resource. She says that in her mind, subsistence way of life is more valuable than what the mine has to offer, because in the end, it will still be there when the mine is gone. A concern she shares with her grandfather says that it will not only affect the fish, but it will affect the bears and the animals in the area will also be affected

<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

RANDY ALVAREZ: Our villages our dying. In our school district, the Lake and Peninsula School District, we had two schools close, one two years ago due to lack of enrollment. People are moving away due to lack of economic opportunity. I wasn't asked anything on this assessment on subsistence or anything. I served on the Bristol Bay federal subsistence committee for a few years – I represented the whole Bristol Bay area and I wasn't asked anything and I was concerned about that. What I would like to see EPA do is wait till they submit a proposal and then take action. Don't wait until the permitting goes through I would like to see what they plan on doing. I am going to be too busy to make an intelligent comment. I looked at it for about an hour but there is a lot of information to digest and I won't be putting my boat away until the end of July. I won't be able to comment on anything until August or September, so I would like to see the comment period extended.

> **<u>EPA Response:</u> Appendix D includes a brief description of the population dynamics of communities in the Bristol Bay watershed. However, an analysis of current and potential future economic opportunities for the region's residents is outside the scope of this assessment. This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures. EPA maintained the original public comment deadline for the 2012 assessment. However, after incorporating public and peer reviewer comments, EPA released the revised assessment for additional public input in April 2013. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

JOE CHYTHLOOK: The traditional knowledge that you very aptly spoke about is in total agreement with many of the things that are expressed in the report as I read it. BBNC board always had a truth first policy and one finding that suggests that salmon is the foundation of our culture I support 100%.

> **<u>EPA Response:</u> Comment noted; no change required.**

PETE HILL: I wondered about the drinking water because we get our drinking water from Iliamna Lake.

> **<u>EPA Response:</u> Comment noted; no change required. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources.**

SHARON WILSON: If this development up there is developed, I think the potential for a disaster is imminent. It will affect the spawning beds for the salmon. Wherever you start in the lower 48, the Columbia River, Sacramento River. High development has destroyed the salmon industry out there and talk to a lot of fisherman from the lower 48 that come up here to fish and they say take care of our fishery up here you've got a golden opportunity. Another thing I want to tell you is that I don't think you should extend that comment period.

> **<u>EPA Response:</u> Comment noted; no change required. EPA maintained the original public comment deadline for the 2012 assessment. However, after incorporating public and peer reviewer comments, EPA released the revised assessment for additional public input in April 2013.**

PETER ANDREW: Help us save our culture. Help save our economy thank you guys for coming and I hope that the future will be as bright as bright sockeye salmon.

> **<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

AMY RIDDLE: This subsistence way of life is a key element of identity. It is all I've ever known since I was a little girl. It's all our daughter has known. A key element to our identity, yes. A salmon based existence is integral to our life. Even with no failures at the mine there are major problems. I understand that my 44 years of subsistence is small when compared to 10,000 years of residence of Bristol Bay.

> **<u>EPA Response:</u> Comment noted; no change required.**

GEORGE RIDDLE: In the scenario, you did mention terrestrial use and possible loss of habitat, but one of the things that I didn't see was waterfowl and upland game habitat loss mentioned and the migratory waterfowl that are an important part of subsistence.

> **<u>EPA Response:</u> We acknowledge that upland game and waterfowl are important to subsistence users and that habitat loss would result from large-scale mining. The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on upland game and waterfowl in the region.**

KRISTINA RAMERIZ: I didn't see anything in the report about the permafrost and about how the ground when it freezes, it heaves. I guess my concern is that this dam if this dam is not covered and then the ground heaves, then the tailings would be able to seep into the ground as you know the wetlands here - it is all water underneath and it is all soppy. I wish you would look more into the permafrost and how the ground would change levels. I know from personal experience around here, the houses, they shift, the buildings they shift, s that is something that they should really, really consider even if they could do this 100% perfect okay they should look into it. Everything around here is lopsided because of it

> **<u>EPA Response:</u> Chapter 3 now includes a map showing permafrost extent in the region, and Table 3-1 indicates that, as reported in Warhaftig (1965), permafrost is sporadic or absent in the Nushagak-Bristol Bay Lowland physiographic division. The revised assessment outlines the type of dam used in the mine scenarios.**

DON SHEPARD: most importantly to carry through with all of your studies a review of history. When EPA did their study in 1990-something on a dam somewhere. What was the result of that study and how did it compare to fact. Show your error bars from error bars from specific documented cases. If you could carry that through it would be very useful.

> **<u>EPA Response:</u> Only some of the data exist to quantify error bars. We decided to not use subjective judgment to provide the rest of the data required to do a formal uncertainty analysis. Instead, uncertainties are treated primarily by defining bounding cases.**

COLTER BARNES: I guess what I just want to ask the EPA is just to take the local comments very seriously. The people that are here today are the best scientists that you have. They might not have the titles or degrees and the agencies and NOAA. These are the people who live here. This environment has sustained culture for thousands of years. It sustained jobs and commercial fishing for hundreds of years, and recreation and sport fishing and everything. For years the conservation was controlled by the people, but now this responsibility has been farmed out to the agencies. Fish and Game, Forest Service, EPA and that worries me. It's hard to take care of things when you are not living it.

> **<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

RENEE ZACKER: I feed my five kids, my husband and my mother-in-law subsistence food. We put up salmon in the summer and hunt moose in the winter. My husband commercial fishes and my son just started this year. I know of the importance of salmon to our way of life. It looks like they are polluting already. I want EPA to look into what they are already doing with the drill holes and the mud. It looked like pollution and like maybe there was already acid coming up from the drill holes. I would like that to be looked into and seeing maybe if it is polluting and already happening.

> **<u>EPA Response:</u> Current exploration activities are outside the scope of the assessment, although they are mentioned briefly in Box 2-2 of the final assessment.**

BRIAN KRAFT: information that is available from Northern Dynasty minerals, from Pebble Partnership and from other state agencies as to what resources already exist in the region is monumental. The assessment has taken those data into consideration and has looked at what a potential mine would look like in the region and in that area and it has accurately determined on a minimal basis that there is going to be an impact to the area to the fishery and the habitat. I've also looked at the assessment through the eyes of this region and the jobs that are talked about extensively. It is not EPA's job to create jobs. It is EPA's job under the CWA to protect the waters of the US. The state of Alaska has failed to do so. I strongly urge to stay on time and stay on target and make a final determination with the final assessment.

> **<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

JOHN BOUKER: I own a mine. When is the last time someone came up and checked storm water at my mine? Try never. There is all kinds of time. It's all about mines. I make more money with hard rock mine than I make fishing, but the fish are important for my kids who are Manokotak. Fish are first.

> **<u>EPA Response:</u> Comment noted; no change required.**

ROY ANDREW: But put a mining operation out there in no place, although the damages are acceptable for an industrial complex, they are unacceptable for our type of life and culture. On Lake Iliamna you can find north winds on the Kokhanok winds you find east wind. Think of all the machinery exhaust that will blow over and fall on the Scott River side. That is unacceptable. When you have a shift of wind, it will fall right in the middle of Iliamna. Look at before during after pictures of large scale mining and if you keep that as true,

> **<u>EPA Response:</u> Air quality impacts were outside the scope of the assessment.**

BONNIE GESTRING: I am particularly concerned by the likelihood that the mine waste will become a severe and lasting source of acid mine drainage to the rivers and streams below the mine. Acid mine drainage is like opening Pandora's Box. There is no fix for it. The assessment estimates that there are waste rock piles alone could generate up to 2.8 billion gallons of contaminated seepage every year and that the copper concentration of that seepage could be so high that the entire flow of upper Talarik Creek couldn't provide enough dilution to meet water quality standards. So failure to contain those releases could cause the entire creek and possibly portions of Iliamna Lake to become toxic to fish. There has been talk about storing the acid generating waste rock under water or in the tailing impoundment or in the open pit after the mine has been closed. I would like to stress the importance that storing mine waste under water will only slow the process it doesn't stop acid generation and there is ample documentation even with industry records of hundreds of operating mines around the world. These records say that all these mines leak to some extent over time. The bottom line in terms of my take away is that there is a bit of a choice between managing for a sustainable a fish population in perpetuity or managing mine waste and contaminated water in perpetuity. The assessment makes a compelling case for initiating a 404c process.

> **<u>EPA Response:</u> Comment noted. The revised assessment contains a more detailed analysis of acid drainage. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

TODD CALITRI: I have 11 guides on staff at the lodge. Each one of the guides has had sufficient time to read over the assessment and make comments. I would like to request that the comment period not be extended.

> **<u>EPA Response:</u> Comment noted; no change required. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

TIEL SMITH: BBNC and the village corporation have a long proud history of doing economic development in the region and we want to continue to be able to do that. However, I could not speak more eloquently than my BBNC board members have done in making their request to EPA. The point I would make on behalf of the landowners, is that there is sustainable development that will need to happen even as we increase the protections for the development of such projects. We do appreciate all of the science and effort that has gone into the assessment. Considering not just the corporations but other private land owners as well who are impacted by such significant decisions. The renewable resource of fish is priority and is not matched anywhere in the world and we want to continue to support that.

> **<u>EPA Response:</u> Comment noted; no change required**

SANDRA ALVAREZ: This won't be the first time we have had things like this go under the radar. In my brief overview, I would say that the one thing that stood out is that you compare apples and oranges. In looking at the sockeye salmon you are looking at Bristol Bay and your document name is Bristol Bay assessment. Possibly 2/3 of the runs don't come within 100 miles of this system. Back when I fished Egegik they were looking for 10 million, now they are looking for 5. When you say 82,000 are in the system that doesn't seem like a lot. A decent fisherman will catch 20,000. What I would like to see more of in the assessment itself is percentages and rates and what the impact would exactly be on the resource. It speaks also to acres and miles, but it doesn't speak to the system itself.

> **<u>EPA Response:</u> The assessment cannot quantify the change in the fishery resources because the necessary data and models are not available. To the extent possible, the**

assessment addresses the potential extent of contamination of streams from potential treatment failures and accidents.

ROZ GOODMAN: I've lived in Alaska for 30 years and I moved here by choice. My experience of living in this area is that people choose to be here whether born or coming here. It is a choice. It is not a scientific fact, but three reasons people choose to be in Bristol Bay is because clean water, the fishery and the lifestyle. I think if any of those change big time then Bristol Bay is going to be totally different and will not be the Bristol Bay we know now.

> **<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

GIL JACKO: Any time you put a road in a natural environment especially a hillside or a mountainside, all the downhill side of that road is going to be severely affected. It is like putting a noose on the vegetation below the road.

> **<u>EPA Response:</u> Comment noted. Potential impacts from the transportation corridor are discussed in Chapter 10 of the revised assessment.**

TANYA SALMON: I've grown up here. I never commercial fished in my life. My dad wanted us girls to stay away from the boatyards. But we did subsistence fishing and we have subsistence fished in our family for over 10,000 years. It is a cycle that is always repeated. It is amazing to see four generations at the splitting table. My gram, my mom, my sister and her kids. It is a tradition that keeps getting passed on and on. I keep getting worried about the water quality if the mine does open. Here we have running water, but nobody likes to drink it. Everybody would rather go down to the river and pack water and I am one of those people who would rather pack water to drink river water. My daughter grew up on it. I gave my niece a glass of well water and she spit it out. Then I gave her river water and she was bouncing around like it was really good stuff. I think it is important that we keep our water quality.

> **<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

BRAD WAITMAN: I thought if they dig a hole, it is a natural artesian river and the water from Upper Talarik is going to flow into that hole. They will have to divert the water back out so that it doesn't destroy the stream. It is going to totally contaminate the smell of the water. The fish won't like the smell of the water and they won't come back.

> **<u>EPA Response:</u> Effects on salmon olfaction were described in the first draft and are discussed at greater length in the revised assessment, including estimation of the stream lengths in which olfactory effects are estimated to occur under the scenarios in Chapter 8. Management of water from dewatering the mine pit is included in the mining scenarios.**

AARON SHUGAK: Mistakes get people hurt or worse. If the mine goes through and an accident does happen a lot of salmon will disappear and it will be like a chain reaction. The bears their main food source is the salmon and if they don't have a source of food, there are dangers for locals from bears coming to towns and going into dumpsters and go after people

> **<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on bears and people. However, discussion of the complexity of salmon foodwebs in the watershed and possible effects on wildlife has been supplemented in the revised assessment.**

<u>Levelock Public Meeting – June 6, 2012</u>

RAY APOKEDAK: I am a commercial fisherman, and I want my son and my grandsons to enjoy what we have today and I don't want it to be lost. Like subsistence fishing now, mostly, I don't want anything to happen to our way of life. The way I grew up and the way I want my family to be.

> **<u>EPA Response:</u> Comment noted; no change required**

PETER APOKEDAK: All my life I been doing subsistence fishing myself. I am a salmon fisherman. I know the area where the mining is going to be. I went to school in Newhalen. That is why I know the country from subsisting. Caribou, moose, porcupine, ptarmigans, and we drink out of the creek. We didn't have bottled water then. Pure water. What I don't like about this mine is that it is in the wrong place.

> **<u>EPA Response:</u> Comment noted; no change required. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources.**

DANIELLE DAWKINS: I urge you to pay especially close attention to the voices of our elders all across Bristol Bay. They have instilled in them the deepest of our roots, and our God given way of life; our culture that has been slowly fading away. It is the adaptation to modern civilization that we have embraced so far, that it is causing our cultures to become lost. Figure 5-14 on page 566 and figure 5-16 on page 573 illustrates the proposed transportation corridor and the distribution of salmon, Dolly Varden, rainbow trout and the sockeye spawners that use this area. What, if any areas of similar construction can you provide regarding the overall risk of this type of destruction to the spawning population? The destruction and the risks of this making it are far too great for me to just sit back and not inquire if whether or not the proposed Pebble mine, our existing fisheries and our subsistence way of life can really coexist? Natural disasters are unknowable, unstoppable and unpredictable in most cases. I ask that you please delve deeper into these natural occurrences and the potential it plays on the withstandings of the proposed pit, and things to be built, especially the seismic activity around the proposed Pebble site. It is my understanding that perhaps the fault lines run closer than what is illustrated in the figure 4-11 on page 442. I urge you to take necessary action under 404(c) and protect our Bristol Bay wetlands, streams and our subsistence way of life. Regardless of some opinions, my subsistence way of life is a necessity and not just done for pleasure. I save thousands of dollars a year by smoking, canning, salting and freezing fish that our mighty Kvichak provides. Along with the berries, and caribou, moose, rabbits and plentiful birds that my sons bring home to me. Nothing makes me more proud than knowing that these traditions have been passed on to us for thousands of generations. Our subsistence way of life plays a substantial role in our health both spiritually and physically.

> **<u>EPA Response:</u> Chapters 5 and 12 of the revised and final assessments recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay. The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. Fault lines shown in Figure 3-15 have been updated in the revised assessment. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

OLGA CHUKWAK: The elders used to tell her that the mine would ruin all our fish.

> **<u>EPA Response:</u> Comment noted; no change required.**

GEORGE WILSON, JR.: Just as everyone has a home here in Levelock, everyone has fish and game in it because of the rich resource we have here. Its pristine and healthy environment is why our elders moved here and stayed here. I have two young fishermen who fish with me, and they are both from Levelock. I teach them the craft of being a fisherman and I hope someday that I can see them in their own boats fishing alongside me. You talk about what would happen up there if there was a large failure and what the effect would be on salmon on just on these two river systems. What would it do to the surrounding area such as the birds and the animals? Everything has a secondary effect. Second, the Pebble Mine site, you talk about the footprint, but as you said earlier, it's completely surrounded by leases. If Pebble was to get started it would bring in infrastructure, power, and roads that would make it more viable for the smaller leases to start up or go into partners with Pebble. All of a sudden the picture gets a whole lot bigger.

> **<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife. However, qualitative discussion of potential impacts from secondary development is included in Chapter 13. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.**

MOSES KRITZ: I am from Togiak and it is the furthermost west of Bristol Bay. Definitely, we will be affected because the most recent trade I did was with herring roe and seal oil with a person from Koliganek for Whitefish. This is culturally our way of life.

> **<u>EPA Response:</u> We acknowledge that potential effects from loss of salmon would extend well beyond the Nushagak and Kvichak River watersheds.**

NORM ANDERSON: we have always pursued sustainable economic development to ensure the fact that as we over the years have appreciated the seven generations scenario, to assure into the future what we have today as our generations before us. We must be sure to gingerly take care of our lands. When I was in college, I once read where the Native Alaskan people carved a living out of a harsh environment. I felt proud, and then I thought that is BS. We live in harmony with the land. The way we take it and we see it. We know how to read the land; we know how to read the waters, because that was handed down to us one generation to the next. In several meetings I have been to, I see where the argument always comes up about putting a price on our subsistence foods and they say they cannot do that. I agree because of the fact that it is priceless to us. It cannot be replaced. If anything was to come about where there was a natural or manmade (disaster), we would not be able to replace that. What we learned from the elders we teach to the youth. The elders shared with us the fact that we only take what we need and they taught us how to prepare it.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 in the EPA assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

RUSSELL NELSON: The king salmon is a very important part of our fishery. If you cover that portion of the king salmon spawning beds, it is going to make it very hard to for us to maintain our culture of people who eat king every year. It’s the first fish of the year, it’s a very important fish for us and we can’t have that huge loss.

<u>EPA Response:</u> Comment noted; no change required. We recognize the importance of king salmon to people in the Nushagak River watershed, as reflected in tribal consultations.

SERGIE CHUCKWAK: My grandson will be the 5th generation commercial fisherman. My point is that fishing for my family and I is our life, whether it be subsistence or commercial fishing. All of my family lives in the Nushagak and Kvichak drainage. You contaminate or take away of their subsistence lifestyle is unacceptable. To tell the elders that they cannot eat the salmon because there is contaminated and you can only have 8 ounces a day of contaminated farm fish, or you can die of cancer. The elders, to tell them that they can’t eat fish and change their lifestyle. They are going to do it anyway.

<u>EPA Response:</u> Comment noted; no change required.

ARTHUR BLOOM: Oops is not an acceptable outcome in the world’s most productive salmon habitat. The likelihood of spills, contaminated discharges and other failures is considerable. Minute concentrations of copper affect salmon, not to mention acid production and all the other potential impacts of monumental size construction activity. Witness the demise of the Alaska coastal zone management program and the formation just the other day of groups to oppose the reinstitution of the ACZMP. Based on that I personally believe that the state of AK permitting process which has been tweaked in recent years to favor dollar based development, is not capable of assessing the risks of this unique situation that involves unique life styles, unbelievable natural resource productivity and hugely valuable economic productivity that when managed properly can be sustained in perpetuity.

<u>EPA Response:</u> Comment noted; no change required.

ANNA MAE BARTHOLOMEW: Our traditional knowledge is our salmon. For generations, we have put up roughly 5,000 pounds of salmon each and every year to provide for our families. In our traditional ways and traditional knowledge, we do not waste. We use nearly every inch of that salmon that we catch. We use the heads, the tails, the stomach linings and the eggs. From the meat from our salmon we freeze it, can it, smoke it, dry it, pickle it. Half smoke it, three day smoke it and then can it, we bake it, we dehydrate it, we salt it, we jerky it and we boil it. Our traditional ways also include the spawned out salmon. In our families and our traditional ways we call them [Yup’ik word], and actually (this fish) is a delicacy. You can’t wait for that time of the year to have that (fish). Where you have pork, chicken or beef, we replace it with salmon. Your pork, beef, chicken and other meats are your staple. Our traditional knowledge and way of life is salmon. When that goes away, and is wiped out, our traditional knowledge and ways are gone. We cannot replace that salmon.

EPA Response: Comment noted; no change required. Chapters 5 and 12 in the EPA assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

GOLDA JUNE WEILAND: My heritage is rich in abundance with the knowledge to survive. It is rich in the economic opportunity that the salmon bring to our region each year. Our traditional way of life has been preserved for hundreds of years. The main law of the land is preservation. Preserve the berries, preserve the game, preserve and protect our salmon. We have a right to continue our subsistence way of life and a right to continue to make our living from salmon.

EPA Response: Comment noted; no change required.

THOMAS GARDINAR IV: From traditional knowledge we keep our culture going. My subsistence life is with my family, which consists of four boys and my wife. I also help my grandmother, grandfather, mother, father and our other family members. I hold a Bristol Bay drift permit, my family fishes with me both commercially and subsistence. My family has been doing the same for generations and I hope we can keep passing it on. My family processes approximately 4,000 pounds of salmon, kings, reds, slivers, etc. We start when the fish first come into the river, all the way to the very end. My family and I smoke, dry and freeze the salmon. I brought you some canned salmon to share that we keep year round. If the salmon go away, my family would have to buy more food from the store.

EPA Response: Comment noted; no change required. Chapters 5 and 12 in the EPA assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

STEVE SCARBO: Many years ago, a wise old man once said to me, if that gold were meant to be had, it wouldn’t be buried where it is. At the very least, it is an integral part of a vast and rich ecosystem, such as the birds and bees and flowers and trees, etc. Perhaps, even the very source or nectar that feeds and nourishes this very region couldn’t that be a hoot if modern science figured that out. If so, those minerals should be preserved in perpetuity and protected as is, not mined.

EPA Response: Comment noted; no change required.

ANDRIA AGLI: We support the science of this document as it in turn supports what the elders of this area and their traditional knowledge have said all along. We are preparing our boats, we are mending our nets, we are cleaning our smokehouses and we are sharpening our knives. However, by testifying at these meetings and missing out on one day or maybe several days of preparation for those who attend multiple meetings here in the region, we hope that this will prevent, with the help of the EPA, missing out on a lifetime of salmon and missing out on a way of life that we have treasured for thousands of years.

EPA Response: Comment noted; no change required.

ROBIN SAMUELSON: If that mine goes through, you might as well fly over Levelock and drop a bomb. These people are not going to survive. Today they will not survive. They will not afford food from the store. They eat from the land and they eat from the water. We eat millions of dollars worth of subsistence foods.

> **EPA Response: Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

JOHN ANDERSON: They are scaring us, because they are trying to take away our lifestyle. Everyone mentioned salmon, but it goes a lot further than salmon.

> **EPA Response: The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.**

DANIEL CHEYETTE: Bristol Bay is much different. Everyone who lives here has a deep and strong sense of place. There is a powerful connection to the lands and waters and the resources of Bristol Bay. It is a connection that starts before birth. It is genetic. It is handed down through the generations and it is also learned from a very young age. A connection told in stories from parents and elders and experienced firsthand. Toddlers accompany parents and grandparents fishing, hunting, berry picking. They participate at home to store that food and save it. It is part of the family experience for anyone who grows up in Bristol Bay, and as a result, this land its water and its resources become a part of who you are. This is a connection without a price tag and it cannot be replaced. If it is lost, it is lost forever.

> **EPA Response: Comment noted; no change required. Chapters 5 and 12 in the EPA assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

KENDELL BARBARY: Additional and more current data is available that addresses the link between mining, tailings activity and seismic activity. Mining, mine pit dewatering and eventual refilling of the mine pit, as well as tailings storage, may increase pore pressure beneath the site and lubrication, tectonic stress and fault slip in a mine site. Even at low magnitudes, current triggered earthquake could lead to increased liquefaction, tailings pond failure and chronic contamination of the Bristol Bay watershed. The size of the proposed operations at the Pebble Mine site, along with the potential development of other adjacent mineral deposits could significantly impact the water balance across the landscape and have serious implications for the tectonic stability of the proposed mine and the surrounding region. Although the Lake Clark fault is considered inactive, a 2002 study which I can provide you with citations, suggests that triggered earthquakes are just as likely in stable as in active tectonic settings. Induced seismicity may increase the probability of tailings impoundment failure, and that is something that we cannot risk here in Bristol Bay.

> **EPA Response: The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. We are aware of the recent references on induced seismicity and believe that an induced earthquake would likely be smaller than the one used for seismic design of the tailings storage facility. However, given the uncertainties in characterization of the seismicity of**

the area, as the comment notes, the assessment indicates that earthquakes could be a failure mechanism.

GREG ANDREW JR: I like what I see in the assessment about how important the supply of fish and wildlife and the land are to the natives of the area, who depend on it for their subsistence lifestyle that we so choose to live. I do not believe that we are poor, I believe that we are rich and we are blessed with plenty of fish and wildlife to enable us to live on an in the Nushagak and Kvichak, Lake Iliamna, Bristol Bay area. The fish, wildlife and land that we may not have if the Pebble Mine is allowed to operate. The Pebble Mine would be a short term economic gain for only a handful of people, most of whom are not from the country, at the expense of long-term stability for the local people who will be affected by the mines impact. They talk of seeing the mine go through to give people in the region jobs. But if the mine were to go through and the area is devastated, due to an accident or something, then what reason is there for anyone to stay in the Bristol Bay area? Without life sustaining fish and wildlife for subsistence and commercial use that we depend on and enjoy today and hopefully for generations to come.

EPA Response: Comment noted; no change required.

JANICE CHUKWAK: The waters of the Kvichak and Nushagak Rivers are the cleanest, purest, sweetest water that our salmon come back to each and every year. Other species of fish live in the river year round. We know that the salmon come up our rivers to spawn. We depend upon them for food during our long cold winters. We can predict each year the salmon’s return, but Pebble cannot predict the magnitude of a natural disaster or if and when it will strike.

EPA Response: Comment noted; no change required.

HANS APOKEDAK: I am a fourth generation commercial fisherman, but a people of the fish for thousands of years. I am against the mine because it threatens my way of life. I am a subsistence user. I can go catch fish without hardly any cost versus going to the store where it is 20-some bucks a pound. I could not afford to go to the store then. There might not be a major spill today, but tomorrow there might be. No amount of money or “oops, I’m sorry” will make it better, because you can’t bring back the fish. It takes years for Mother Nature to bring something back. With the world and everything that is going to crap and getting contaminated, one day we are going to need this fish. We don’t need copper to survive.

EPA Response: Comment noted; no change required.

ALEXANDER TALLEKPALLEK: I am a strong believer of our heritage in Levelock on the Kvichak River. This is my place and subsistence home. I am a commercial fisherman and I depend on seasonal earnings to prepare for fall and winter months, which helps my family of nine a whole bunch. There is one thing to me that is unacceptable. It stands out nationwide. Contaminating the salmon forever. Allowing the chance will destroy our culture, not now, but for the people 10, 20 or 50 years from now. Our future will only read on how our way of life had been before a mine developed. Our culture is fading fast enough without the mine. I have a huge concern about losing family heritage not only ours, but Alaskan cultures as well.

EPA Response: Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

GARY CLINE: I was fortunate to come from a family that taught me the traditional knowledge of ecology. Not only to live in respect and harmony with the environment, but we did that because our people believed in [Yupik word] which means from up above. The person or universe or spirit that lives within the universe, but also lives within Mother Nature. We felt that within our dead animals or plants that they were always among us. Living through our spirit and with their spirit and if you were to misuse or mistreat that animal or plant their kind would not allow their spirit to return to earth to be born again or return to your family to allow it to be harvested the next year. So that is why we always have taught to respect animals, and why we [Yupik word] to clean the rest of the meat of the bone to show our respect to the animal who gave itself to our family. Like I said, I am fortunate to have elders who taught me these ways. I want to be able to pass this on to my nephews and cousins.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

GUSTIE TALLEKPALLEK: I'm a long time resident. I'm not speaking for myself. I'm speaking for people who can't speak for themselves. This is proof that we need clean water for the baby bottle. I'm sure you have grandchildren also. You need clean water for their baby bottles. You let the Pebble Mine come in and contaminate the water and kill the fish, you think about their future the kids here. You kill the fish, you hurt our babies. This is very precious here. We need our future to continue and to keep the water clean and safe.

> **<u>EPA Response:</u> Comment noted; no change required.**

<u>Naknek Public Meeting – June 5, 2012</u>

JOE CHYTHLOOK: Our traditional knowledge is in total agreement with what many have expressed regarding your findings. BBNC board has always had a salmon first policy. One finding that the salmon are the fundamental foundation of our cultures supports this 100%.

> **<u>EPA Response:</u> Comment noted; no change required.**

BRYCE EDGMON: I'd like to say that in terms of the diversity of the habitat and the complexity involved and the genetic makeup of the salmon species and how interrelated and interdependent they are on each other, in terms of if you go and do damage to one of the six river systems, you may be doing damage to all six of the river systems. I think that the document will help us understand the cumulative impacts.

> **<u>EPA Response:</u> Comment noted; no change required.**

PETER ANDREW: BBNC, along with BBNA and the 31 villages have passed supporting resolutions asking EPA to take action on 404(c) to protect our waters. On behalf of my cultural background, generations of subsistence use, I urge you take care of our people and our cultural ways of life. We have invited you, we have asked you to come, our region has asked because you are the only people and the only agency that may be able to help us with this. We do not need to trade this resource for a resource that is nonrenewable and will only enrich foreign mining companies.

<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

MOSES KRITZ: The three quarters of the economy that sustain us is the subsistence way of life. We are also teaching what we are taught to our children to carry on or pass on what we have learned from our parents and grandparents. When to hunt and fish. When not to hunt and fish. What to expect from season to season. How to survive in different seasons. Our cultural people have taught us very well since we are from the western most part of Bristol Bay, it does not mean that we will not be greatly affected. We have always traded for shared with other villages.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

BELLA HAMMOND: The people of Bristol Bay and other concerned fisherman and subsistence users and as far as I'm concerned I think more enlightenment about the Pebble project will only help smooth the waters for better understanding of what our loss in that salmon area could be. Not just that area, but the ripple effect that in so many ways. I encourage people to take more of an interest and also express more concern about the environment. Many many times over the past few years, I have asked people why you support the Pebble project. The first thing I hear is "well, it will provide jobs," which is true. However, I don't hear enough about concern for the environment and long term effects, or no concern for the environment and this is very, very troubling. I want to remind people that EPA is doing what they should do, what they were requested to do, and I can't thank them enough for that.

<u>EPA Response:</u> Comment noted; no change required.

HJALMAR OLSON: My main concern about the development up there is the spawning grounds. Whenever you touch the spawning grounds, whether it is in the lower 48 or wherever, the salmon got less and less. Why do you suppose that Bristol Bay has the last great wild salmon in the world? We have five river systems and each one of them requires large spawning grounds. Also the caribou and the moose.

<u>EPA Response:</u> Comment noted; no change required.

MEL BROWN: Yet, it is unbelievable that the largest proposed mine is going to attempt to build this huge mine that has the lowest grade ore that possibly will create serious problems for us in the future. We have depended on the food source. The area that is located for the site itself is right smack in the middle of salmon producing habitat. It takes care of the salmon and the cycles of salmon that we depend on as subsistence users, commercially, cultural dependency on this covers this whole Bristol Bay area with the 37 villages that exist here.

<u>EPA Response:</u> Comment noted; no change required.

PAUL HANSEN: Your agency with authority and responsibility to protect Bristol Bay now you have the science to prove it. The development of the Pebble prospect would have unacceptable adverse impacts on the Bristol Bay fisheries and wildlife.

<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

VIOLET WILSON: I totally oppose the Pebble Mine because I have been involved with fishing for 51 years myself. My grandfather started in the 1800's and I have my children, grandchildren and great grandchildren involved in fishing today. Fishing has been very important to me and also subsistence fishing. I lost my first husband when I have five little children. If it wasn't for commercial fishing and subsistence fishing I would have had a very hard time. I am very proud to say that I can stand here tonight and say that I have never drawn a welfare check. I would do anything to try and keep our waters clean, because I feel this is a very touchy situation.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

SERGIE CHUCKWAK: Fishing is our life and our livelihood. It's what we do for healthy communities, healthy lifestyles. Going out and catching the subsistence fish, smoking these. Passing the traditional cultural knowledge on to the younger generations. You hear about how they will make you free, the fish. We have been doing this for 6,000 years and we will want to do it for 6,000 more. The short life of a sulfide mine that lasts 50-70 years and maybe a little longer 75 years, but one that activity is done the mine is just going to sit there with all of the chemicals and continue to kill off more of the rivers and streams, and then instead of just 24% of the Nushagak and the Kvichak river contaminated it is going to be 100% and that is going to be death of 37 communities in Bristol Bay.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

ANNA HOOVER: The generations that are coming who can be fed from this resource and this land and it's a beautiful interaction and it's one that we are losing around the world. When we realize that we have lost it we strive to get it back, but it is taking a long time for this beautiful balance between human, animal and subsistence lifestyle to come about and evolve.

<u>EPA Response:</u> Comment noted; no change required.

DONNE FLEAGLE: I would like to request a 120 day extension on behalf of the APC and Wetaviiq.

<u>EPA Response:</u> EPA maintained the original public comment deadline for the 2012 assessment. However, after incorporating public and peer reviewer comments, EPA released the revised assessment for additional public input in April 2013.

LLOYD MONTGOMERY: I really appreciate the EPA and their assessment, what they have done on Bristol Bay.

<u>EPA Response:</u> Comment noted; no change required.

NORM VAN VACTOR: Elsewhere around the world, hundreds of millions of dollars are being spent to restore habitat that has been destroyed. Here it is ours to protect, not destroy.

EPA Response: **Comment noted; no change required.**

TIEL SMITH: We have a long history of economic development projects in the region including docks like you see here in Naknek. They play a pivotal role in transportation of goods and services and the like. We support good business and jobs. The entire commercial fishermen who are joining us today, as well as tourism business. We also support conservation easements. We purchased easements that are strategic to salmon habitat. We also listen to our shareholders including 81% that oppose this project.

EPA Response: **Comment noted; no change required.**

FREDERICK ANDERSON: For the last couple of years I've been doing a study with the Bristol Bay Times local newspaper. The employment ads. Every day there are 30-50 jobs, some of them starting at $39,000 dollars. Many of the affected areas like Pebble they can't find people for these jobs. Who are these jobs for? Everyone who is willing to work is working. My main concern, if Pebble is allowed to their baseline research and is doing test drilling, because of the impact of studies like that on natural resources and the environment.

EPA Response: **The assessment is not an economic cost-benefit analysis of mining and the fishery. The subsistence fishery sustains a way of life for local residents and is integral to the social and spiritual aspects of the Alaska Native cultures in the region. The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects on indigenous culture and wildlife. Current exploration activities are outside the scope of the assessment, although they are mentioned briefly in Box 2-2 of the final assessment.**

KRISTINA RAMIREZ: …even if Pebble could safely build the mine, they would have to build 89 miles of roads over salmon habitat and through them. This is scary to me, because as we are all aware, when manmade structures are built, the wildlife around them suffers. Please use the 404(c) to protect the wildlife.

EPA Response: **Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

RICHARD RUSSELL: I am opposed to any large scale industrial development in the Iliamna Lake watershed due to the impacts that are certain to follow on the waters, fish and the wildlife of the drainage; both by the development itself and the associated infrastructure. Particularly roads, landfills, sewage and chemical disposal systems, water reservations, holding ponds, tailing storage etc. Numerous stream crossings of the 70 or so streams that you identified are very problematic. A couple of those streams, one of them in Knutson River and the other one is Canyon Creek, routinely change their channel. Any kind of structure put across them that carries a slurry or anything else is very likely to be washed out periodically and heavy equipment will have to be in there mucking up the stream as well as replacing whatever was there to begin with.

EPA Response: **Comment noted; no change required.**

ROBERT BONAMMO: I believe that any and all information concerning the impacts of any mining in such a diverse area such as Bristol Bay is not only necessary, but imperative to ensure the continuation of its pristine existence and diverse way of life for both man and enough.

<u>EPA Response:</u> Comment noted; no change required.

GEORGE WILSON: We are currently seeing a slow rebound in fish prices. Quality improvement due to handling and refrigeration are improving the marketability of our fish. The marketing is augmented by the fact that our salmon are wild, renewable and pristine. The waters where they regenerate is clear, clean and pristine. The Pebble project, if permitted, represents a huge threat to the rearing waters of two of the largest fish producing drainages left on earth. If sulfuric acid and copper leachate dissolve in surface and ground water, along with other pollutants, are more than likely going to make their way through the earthen dam constructed to hold them back. Ad infinitim is a long time. It won't matter if the salmon get confused as to where their natal stream is. The pollution may not kill the salmon outright. As a matter of fact the salmon may return every year, somewhere. But the perception that these salmon are tainted food sources is all that it will take to drive prices down to a point where the industry will not survive. 15,000 jobs and hundreds of millions of dollars annually are at stake.

<u>EPA Response:</u> Comment noted; no change required.

ISO MONTALVAN: The seasonal industry offers a way for hunters and gathers and commercial fishers to bring salmon to homes, schools and tables around the globe. This is subsistence life in the global level. The subsistence ways of hunting, berry picking and trapping get underway to prepare for the long days of winter. This is survival. The Yup'iks of SW Alaska do not have alternatives of buying and raising livestock as a way to survive.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

ANDRIA AGLI: This risk is too great for us to accept for our culture and our long term sustainable food source. I ask EPA to quickly take 404c action to protect our salmon and our way of life as well as our land and the future of generations to come.

<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

NORMAN C. ANDERSON: Native Alaskan people have believed in the seven generation scenario as our ancestors have always gingerly taken care of the land to assure that we today can enjoy what they had then. We must take care to ensure that our descendants will have seven generations from now.

<u>EPA Response:</u> Comment noted; no change required.

DANIEL CHEYETTE: I encourage EPA to add layers to the assessment and look at underlying and indirect impacts that mines would cause to Bristol Bay families and communities. The socioeconomic impacts to individuals and families, the cultural loss of communities and the additional community needs that large mines would bring. The assessment is appropriately focused only on large scale mining development. Thank you for not focusing on other infrastructure development that is critical to the regions survival. The assessment is not about roads, the assessment is not about runways and airports. The assessment is not about small property owners.

<u>EPA Response:</u> Secondary development is beyond the scope of the assessment, as detailed in Chapter 2. The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife. However, qualitative discussion of potential impacts from secondary development is included in Chapter 13. We recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.

DAN BARR: I believe the economic impacts can be vastly greater than is portrayed in the report. I read from ocean news and technology from May 2012, the worldwide demand for seafood is expected to more than double in the next 10-15 years. However the amount of seafood being harvested from our oceans is expected to decline due to overfishing. I suggest that in ten years, the value of this fishery could be 600 million and could be potentially $900 million.

<u>EPA Response:</u> Comment noted; no change required.

SHARON WILSON: The Pebble Partnership views the watershed assessment as rushed and inadequate. Rushed because EPA has only spent 11 months on preparing the assessment. Rushed because the first meeting was held on this 1,100 page document are being held only two short weeks after the draft of the report was released and rushed because EPA is allowing only 60-days when the people of Alaska are being asked to comment in the middle of summer. The current draft of the assessment is inadequate because EPA spent only 11 months studying and area of 20,000 square miles, while the Pebble Partnership has spent eight years studying approximately 1,500 square miles. Inadequate because the Pebble Partnership study is almost 30,000 pages for this acreage and the EPA study is about 1,100 and inadequate because their environmental studies were gathered and analyzed by scientists on the ground and field research and EPA by their own admission did not spend time analyzing the field data.

<u>EPA Response:</u> PLP's Environmental Baseline Document (EBD) and the assessment had different purposes, so it is not useful to compare the duration of the two studies. The EBD focused on collecting and reporting environmental data, whereas the assessment evaluates the potential impacts of mining on the region's salmon resources. We used existing data, including information from the EBD, because it provided a wealth of data for the area surrounding the Pebble deposit, even though it had not been completely peer reviewed. The only additional data we collected was interviews with Elders.

SARA O'NEILL: Most of the information in the assessment is based on the low resolution national wetlands inventory data, and vastly underestimates the area impacted by mining in a landscape where I personally sank into the saturated tundra up to my thighs more times than I wish to recall. Given their importance to fish and wildlife, more effort is essential to accurately estimate the wetland area in the region.

<u>EPA Response:</u> We used the National Wetlands Inventory (NWI) to identify wetland areas potentially at risk. Despite its limitations, the NWI represents the most widespread, publicly available dataset for characterization of wetland habitats within this region. We recognize in the assessment that our estimates of wetland area affected are likely underestimates.

RICK HALFORD: The State of AK is acting like a development partner of Pebble. Whether it is temporary water use permits, dumping directly of drilling material into the groundwater, artesian slime running down the hill. Your watershed assessment, one area I think can be stronger is that you underestimate the size of potential damage. You are buying the argument that there is no plan. There is a plan, for a water rights application in 2006 where there is approximately 2.5 billion tons. It has to be a plan, or they have to give up their water rights application, because the law requires to have the priority date, you have to have a plan of appropriation of the water. They can't have it both ways

EPA Response: Comment noted; no change required.

EVERETT THOMPSON: The state seems like they give the EPA a hard time, but the state allocated a million dollars to do this same study a few years back - an independent scientific review. Nothing was done. In the Pebble Partnership, they talk about socio-economics and how we need this mine and we need jobs and we need this and that. But where are we going to be in 100 years when this boom and bust economy has wore itself out and exhausted itself out and our fisheries is to suffer. So I would like you guys to do a 404(c) process and have a sustainable economy in this area like we have had for thousands and thousands of years.

EPA Response: Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

SHARON THOMPSON: Even if there weren't any accidents or catastrophic failures, common sense and now science tells us that development and operation of a mine this big would affect our fish populations and water quality. I am worried that even their exploratory drilling over the last few years has degraded water quality. We drink from a well at our house, and the kids enjoy clean safe water from the ground. I don't believe that Pebble can guarantee that acid, metal and other contaminants won't be released upstream from us over the life span of that mine. They might not even be able to detect that, which puts us all at risk. I would rather see the statue of liberty be recycled for its copper than see the Pebble extract low grade mineral deposit here in Bristol Bay because our thriving fishery is just as much a symbol of our liberty, giving us freedom to enjoy clean water, a good environment and the subsist off the land. It is equally important that we defend our national treasure. The last and greatest salmon fishery.

EPA Response: Comment noted; no change required. The final assessment references drinking water supplies and Appendix D now includes information about local drinking water sources.

MELANIE BROWN: As you can see, the commercial fishery in Bristol Bay, it is economic support to my family. But more importantly, the salmon, they have provided countless meals over the years. The salmon have been at the center of our table for generations. The salmon have indirectly fed the mammals that are also part of our meals throughout the winter.

EPA Response: Comment noted; no change required.

OLAF HANSON: We have grandkids, we have grandparents, and we have moms, dads, uncles, aunts that live in this community. They eat the fish, they pick the berries, they eat the berries, and they take pictures. You eat moose, you eat caribou, this is very very important to our community. I am a subsistence user myself and you guys to help us out would be appreciated. We are asking as one voice, even though there are a lot of us in here, we are one voice.

<u>EPA Response:</u> Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

JODIE McDONNELL: We make our living because the Bristol Bay fishery. We also subsistence fish for salmon each year. Filling our freezer for the winter with salmon and our cupboards with canned and smoked salmon.

<u>EPA Response:</u> Comment noted; no change required

JOE KLUTSCH: There is more here involved than just the salmon fishery with all due respect. It's an entire ecosystem. Its birds, game, plants, it's the cultural dimensions of this that are at stake.

<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on the ecosystem.

GEORGE WILSON, JR.: I feel like I need to speak on behalf of my ancestors that raised me and my parents that we have to respect this area as planned for the water and the salmon and the birds and the wildlife. Also, for myself now as a commercial fisherman and also for future generations. My kids, I hope that someday they can partake of this great fishery, one of the last great salmon fisheries in the world. There have always been jobs for the people who want to work. Even when we were not actually employed, we have been able to live off of the salmon and the wildlife.

<u>EPA Response:</u> Comment noted; no change required.

RICKY COOKE: We fight for water quality constantly. This is the best clean thing I've seen in my whole life. You have created in the past to do this now. Use the history of mining to stop this and save what is here.

<u>EPA Response:</u> Comment noted; no change required.

FRED PIKE: They have not built a containment pond that does not leach.

<u>EPA Response:</u> Comment noted; no change required.

GREG HARRIS: the last thing I want to see is this damn mine here. It's a toxic waste spill waiting to happen and people in this room are here for a reason, because they want to continue to come here and see the sustainable and whole fishery.

<u>EPA Response:</u> Comment noted; no change required.

MATTHEW JOHNSON: I want my children to be able to know this and I definitely don't want the Pebble Mine to destroy this unbelievably beautiful and natural environment.

<u>EPA Response:</u> Comment noted; no change required. The assessment recognizes the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledges the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

LARRY VANDERLIN: I live between the Rogue and the Klamath Rivers. Those are nice rivers, but severely degraded, and they will never recover in spite of millions of dollars that have been thrown at recovery of the salmon that once resided there. They are always imperiled. We understand full well what damages are, what Pebble is proposing here is larger than anything that we know of.

EPA Response: Comment noted; no change required.

CHRIS WHITE: I hope that 100 years from now in June, when my, and all of our future generations show up here, that they are not living under a giant hammer of toxic ponds upriver from us.

EPA Response: Comment noted; no change required.

RICHARD WILSON: The elders have been telling me they haven't really had a chance to sit down and talk about it yet. I think that out of respect for the elders and the indigenous people here and the land holders, that just for that reason alone we should be able to go over some of this stuff so that we could make great decisions. They feel like they are being pressured.

EPA Response: Comment noted; no change required.

CAPTAIN CHARLEY GORDON: This fishery supports a variety of lifestyles. My particular one is direct marketing of Bristol Bay wild salmon. The perception of my customers, primarily natural foods stores and restaurants, food coops and their customers perceive the fish that come out of this area to be absolutely the highest in the world for salmon. There is a growing demand for wild salmon. The reasons are obvious. Nutritional. If the perception, such as in the case of the Exxon Valdez, comes that the fish are tainted, then damage is done.

EPA Response: Perception of contamination is mentioned in Chapter 12 of the revised assessment, but full evaluation of the perception of tainting and its relationship with the seafood market is outside the scope of the assessment.

ANISHA ELBE: First, in the assessment you interview 53 elders and it looks like the data on subsistence indigenous culture and impact are region wide. Shouldn't your [inaudible]. Who determined the list of 53 elders? How did your questions be determined? If you want these elders testimony included to help you make a decision, then why was there only one indigenous culture expert on your scientific peer review panel?

EPA Response: The TEK methodology is outlined in Appendix D of the assessment, which includes the process by which the Elders and Culture Bearers were selected to be interviewed. The peer reviewers needed to represent wide range of disciplines, and the primary endpoint was salmon resources.

TIM COOK: This area sits in one of the most geologically active zones anywhere in North America. The impact of a sizeable earthquake is unknown, especially when you take into consideration what happened to Japan.

EPA Response: The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site.

MARK CONNOR: My understanding is that this mine will require hundreds of millions of gallons of water to transport some 200 billion tons of crushed ore 87 miles to the coast. Further, the mine will require hundreds of millions of gallons of water from the water table for settling ponds for these mines. I just want to state that I'm not sure if we know what our water tables are here and what they will be 25 years from now. Our climate is changing and the water table is changing also, so what we change our predictions on today may not be true 25 years from now.

> <u>EPA Response:</u> **Although a full consideration of how climate change could affect mining-related impacts is beyond the scope of the assessment, we have included discussion of potential climate change in the region in Chapter 3 (Section 3.8), and consideration of climate and mining interactions in Chapter 14 (Box 14-2).**

DYLAN BRAUND: The subject of impacts of copper on the salmon are well documented, include, but are not limited to the seminal effects on salmon, liver damage, retarded growth among others. Additionally, existing water quality standards for the state of Alaska are not sufficiently protective of salmon function. Therefore, the mine could meet water quality standards and still have a detrimental effect on the fishery. One aspect of this issue that gets overlooked is the temporal aspect of this issue. Mainly, how this issue will impact future generations.

> <u>EPA Response:</u> **The protectiveness of water quality standards is discussed in Chapter 8 of the revised assessment. Chapters 5 and 12 in the EPA assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

GARY CLINE: I'm particularly worried about the 87 miles of spawning streams and gravels will disappear. This is unacceptable. In particular, I'm worried about Chinook and Coho that reside in the Koktuli River, which branches off the Mulchatna and Nushagak. I am also concerned about the caribou, something that is often disregarded when speaking about this issue. We are lucky that this resource feeds thousands of families and generates 400 or 500 million a year to the economy. This will result in more jobs according to your assessment that the mine would create if Pebble is development.

> <u>EPA Response:</u> **The assessment has been expanded to acknowledge a broader range of potential salmon-mediated impacts. The scope of the assessment is focused on potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on wildlife in the mining area and transportation corridor.**

RALPH ZIMIN: The section that almost everyone is familiar with here in Alaska is Exxon Valdez. Again, the experts all put their minds together and said this was a safe thing. We all know what a disaster that ended up being.

> <u>EPA Response:</u> **Comment noted; no change required.**

BONNIE GESTRING: I am particularly concerned about the likelihood that the mine waste that is generated will become a severe and lasting source of acid mine drainage to the rivers and streams below the mine. I look at acid mine drainage as opening Pandora's Box, because there is no fix to acid mine drainage it becomes a matter of trying to manage it. The assessment estimates the waste rock pile alone could generate up to 2.8 million gallons of contaminated seepage every year and estimates the copper concentration in the seepage to be so high that the entire flow of Upper Talarik Creek could fail to meet water

<u>EPA Response:</u> Comment noted; no change required.

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WILL EVANOFF: I would like to say thank you for initiating this study and focusing on the part that documents the subsistence, nutritional, social and spiritual importance of salmon to the Dena'ina people and other native groups in the region. This information is vital to the survival of our culture and we appreciate having our voice and perspective be heard at a local level. The survival of our culture directly depends on the health of our land, the fish and the wildlife. No amount of money or jobs can replace our way of life and our culture.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

JACKIE HOBSON: A lot of things depend on water, even in the water there are things that depend on the nutrients that come from salmon. The salmon swims up the stream and they die, they go to the bottom of the lakes and streams and then they feed other invertebrates and microorganisms that feed fish and other stuff. As you all know, fish have been important to us all our lives. Not 4,000 lives but a millennium. That is what we are trying to do is protect our way of life our culture and the fish for the next generations to come. These are renewable resources that will always be around as long as we take care of it. Another thing, these fish and animals they can't speak for themselves and that is why we are here. We are the caretakers of the land. Our ancestors took care of it for us and now we have to pass it on to the next generation. What we do and how we do it will affect the next generation. We don't want to leave them with things that they are going to end up fighting forever. That is not the native way.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

HARRY KASHNIKOFF: We have lived here all our lives and we don't want to lose it. I think our ancestors the people up there dealt with the same thing and we want our kids to live the same kind of life we did. Fishing, hunting, drinking the water and we don't have to worry about pollution.

> **<u>EPA Response:</u> Comment noted; no change required.**

NANCY DELKITTIE: I am a Dena'ina, an Athabascan Indian. This village is my home. We are very rich people in our culture, our resources, plants, animals and salmon. They all need clean water. That is including us, the Dena'ina people of the land. But only because we are so blessed to have clean water. Salmon have been a great part of our diet for generations and will be in the future. We also have a water holiday. On this day we show respect celebration to the water. It is a day we give the water a rest. We can't travel on water. On that day we give thanks for water the life giving gift, not only to the people but to the fish, plants and animals that need water. Salmon is known after 60 years that I know of, they are still in our diet today. Salmon will be here for the next generation to come.

Without these we cannot exist as Dena'ina people. Are village will die. People will move. Our salmon will be no more. Our clean water will be polluted for mining.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

CLARA TREFON: There isn't enough information on other fish in the study such as rainbow, Dolly Varden, white fish and pike and other fish that we eat that use the mine area up there. And, migratory birds, that is really important to us. The place where they have the Pebble site is caribou calving ground and also used to be a spring fish site for our people. Can you look at the University of Alaska Fairbanks information on our culture and our people the Dena'ina people on how we use the land, where we fish, where we hunt and how we live and I don't think there is enough information on the culture? Because the state doesn't recognize tribes, we have limited input on the process for the permitting process because it is a state function. We are not recognized, so we don't have a voice in the state system. That should be noted in your study too. We have no recognition from the state and limited from Pebble. It is just based on the state regulations that don't include us. It is important to note that.

> **<u>EPA Response:</u> The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife. Information on Alaska Native cultures and subsistence practices was included in Appendix D and Chapters 5 and 12 of the assessment. The US Fish and Wildlife report (Appendix C), used as the primary resource for characterization of wildlife, includes an extensive discussion of waterfowl and shorebirds, as well as bald eagles and land birds. assessment text has been expanded to acknowledge a broader range of potential salmon-mediated impacts.**

KRISTI JEFFERIES: I am intimately connected to this region and I am concerned about our ancestral lands. I want to make sure that my children and grandchildren will be able to use the lands abundant resources for subsistence in the future and that they retain their culture. As a Nondalton Tribal council member, it is my responsibility to preserve the land and water for future generations. The land, water, fish and wildlife have allowed us to live in this area for thousands of years. This land is our home it is the land of our ancestors. It is our right as residents of this region to protect and preserve our traditions, culture and spirituality. I ask you to please take into consideration what is at stake here. Not just the environment we live in but also the welfare of our people and our traditional and cultural way of life is on the line. I know mine proponents want to delay the assessment because it is well done and underestimates the likely impacts and is based on good science.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

AGNES PETROWSKI: As a grandmother it is my responsibility to fight for and preserve our traditional rights for my grandchildren and future great grandchildren so they can practice subsistence way of life for generations to come. While I applaud the assessment as a beginning, by all means it will not be the end, especially when the people of Newhalen continue to live off the land. Our ancestors told us that water has sustained our way of life for thousands of years.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

COURTNEY GOMEZ: We feel very strongly that the timeline is sufficient and everyone who cares enough to comment has taken time out of their day.

> **<u>EPA Response:</u> Comment noted; no change required. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

OLGA BALLUTA: I just want thank all the people who are working so hard for the water, the fish and the plants and thinking of what our next generation is going to need.

> **<u>EPA Response:</u> Comment noted; no change required.**

WILLIAM TREFON, SR.: We have been in this area for thousands and thousands of years and we lived off the water and the water was kept clean. That is how we want the environment to keep. Our people are an environmentally concerned people, so I just want to say that I am for clean water and clean land. I am also for economic development where our people can go to work and have a place to work in this live in this area. Do I see it now, there are no jobs and a lot of people are moving out to where they can find work. So there are getting lesser and lesser people here because there is no economic base. Subsistence wise, we subsist, but it is not subsisting anymore, it is an allocation from the state. In the past we got what we wanted when we wanted it. Now the state tells us when the seasons open and to get it now. Subsistence is not like it used to be. Still we depend on fish, we put up a lot. We must keep the environment like it is.

> **<u>EPA Response:</u> Comment noted; no change required.**

GLADYS EVANOFF: I have actually cried that our home might be destroyed and I want to save our fish and wildlife. I want my grandchildren to be able to fish like I did. I want to be using my fish camp and living off the fish and subsistence every traditional way. I've lived this way my whole life and I'm 77 years old. I don't like people being against each other over this mine. We should all live together and love one another as neighbors. It seems like it is pulling us apart. Money should not take people apart. We should all respect each other and allow that we are who we are. Our land and waters are like you hear a lot of these people talk about how we live. It is still continuing today. We would like to see that it stays protected. That it is not only going to affect the people around here. It affects everybody from all over. If the large-scale mining goes on, it's going to hurt us physically and spiritually. There is going to be a lot more like now - gold mining brought prostitution and drinking and alcohol and all that stuff. Throughout the years we have had to learn how to deal with all that stuff. It will be harder for us and who is going to help us.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources**

in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

VALERIE ENGEBRETSON: I work for Pebble. I have a big family who loves the outdoors and enjoy their subsistence way of life. Subsistence is good, but it is not paying for my bills and does not clothe my kids.

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. No change required.

KAREN EVANOFF: This area and our way of life is the last few of remaining cultures that rely on salmon not only for food, but as the core of our culture and our identity. The traditional ecological knowledge and characterization study which is this one, that documents the importance of salmon to the people of the region, is a vital part of the overall assessment. It is vital because it portrays the voice and the spirit of the people, and the social relationship with the fish and the wildlife, and between people in our community and between each community. We shared with each other. That is part of our custom. It also documents the sacredness of our area and the inner biological clock that keeps us in tune with the land and the abundance that it provides. Right now, this clock is ticking in each one of us as we anticipate the coming of the salmon. If we are part of the generation that has lived here for centuries and this intimate interconnection with salmon is within all of us, no matter how dependent we have become on the material world, or how immersed we have become on the western society. The remaining of the study besides this one needs to incorporate the voice and the science of the people in order to be complete. Local input into the scientific research is beneficial for many reasons. We know the land best where the fish and wildlife are. The kinds of fish, the movement and change of wildlife, the habitat area, reasons for decline, water quality, just to name a few. Western science is only one part. Our ancestors knew about the minerals back in our sacred mountains. They made a conscious choice not to talk about it openly because they knew that outsiders would come and hardship that would cause to our land and our people. The spring season we are in now, in our culture, is the most powerful season of the year. Everything is waking up and coming back to life. We believe that everything on earth is alive and has a spirit. This is called [Yup'ik word]; it means it is saying something. It is crying out in pain because of the destruction.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

CAROL LOFTFIELD: There is an inexpressible beauty here. A beauty that is part of a profound relationship. The black bear, the brown bear, the red berries, the aqua water, the powder blue sky. These are the colors of my home. The colors of this land. This is the beauty. But the beauty, its color, its motion and meaning is much more. To wax poetic, it is a great flowing design, with creatures' lives and habits all interwoven. The black bear munches on red berries, and then drops the plants tiny seeds on trails far and wide. The tiny seeds take root and start anew. Both mundane and marvelous, it is all in concert. Every life form singing its part in this great song of beauty and interdependence.

<u>EPA Response:</u> Comment noted; no change required.

CHRISTOPHER GAY: The rivers are sensitive and touchy to the salmon migration. The change of the smell from a small project like this should be considered in the fact of how large that is going to be. It is going to have such a major impact for generations. Our children are not going to have anything left when it is all done.

> **<u>EPA Response:</u> Comment noted; no change required.**

CLYDE TREFON: My family does subsistence. We like our fish. But still, nobody is going to give my boys jobs. Nobody is going to pay my bills. I'm not for or against. I want clean water, but we need jobs around here. Who is going to pay for my bills?

> **<u>EPA Response:</u> Comment noted; no change required.**

CHARLOTTE BALLUTA: my mother was a chief's daughter and this is what she taught me. To respect the fish. I would like to thank the EPA for doing this assessment, because what you are doing is very important to me, our people and our future generations. We have to protect our culture, our environment from the proposed Pebble Mine. It would threaten our culture, water, fish and everything we value. The fish are very important to us. The first fish that comes in, we give it to the elders. Everyone comes together and we share the fish. To respect the first fish of the season we eat and when we are done we take the bones and put it back in the water. That is thanking the fish for giving its life to us. I'm a grandmother of three and I want to pass this tradition on to my grandchildren as my mother taught me. So that in my future, my grandchildren will be able to eat fish, because it is a most healthy food. I'm proud to say that our water is the most pure, clean, healthy water.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

DONNE FLEAGLE: I am wondering if it is possible in the world that we live in now to do a comparison. If it is in the continental US or in south America, or someplace where there is a small isolated culture that has experienced mining and we can look at the benefits and also the adverse impacts. Just to get an idea.

> **<u>EPA Response:</u> We have added information on effects of resource extraction industries on Alaska Native cultures to Chapter 12 of the revised assessment.**

CAROL ANN WOODY: I think your assessment of the potential impacts of mineral development to fisheries resources actually is very conservative, almost too conservative. The reason I think this is that you assume that the Pebble prospect would only develop 6.5 tons of their 10.8 billion ton estimated resource. Because all estimates of the mineral wealth, jobs and benefits from that particular resource are based on full exploitation of the 10.8 billion tons. The watershed assessment should consider impacts of expansion to the 10.8 billion ton Pebble Mine scenario. Mines will generally expand and expand as long as they are economically viable, as do the impacts. One thing that I didn't see in the assessment is that waters in the region are very low hardness. They cannot inputs of acid. Pebble Limited Partnership's own data indicate that it will be an acid generating mine. The majority of the ore in there is acid generating. Because the waters have very low hardness and very low dissolved organic carbon, and I studied this, which means there is high potential for rapid impacts. It will start with the algae and then the invertebrates, then the fish and it is something that is very important to consider. The information on wetlands in the region is not well characterized. I've spent a lot of time on the ground at Pebble, the Koktuli and Talarik, and it is very very wet. I think it is even wetter than has been characterized and the impacts will be much greater than have been characterized. As most of you know, of all of the fish bearing streams in Alaska, fewer than half of our streams have ever been surveyed. Many streams in the region have never been surveyed and looked at. Just a few years ago I went out and we added 105 miles of anadromous waters that no one had ever identified, including streams on top of the Pebble deposit. In the cumulative impacts section of your assessment, it indicates about 200 miles of streams or rivers could be blocked or destroyed Over 20 hundred acres could be converted to toxic waste dumps, which would require constant vigilance and maintenance into the future, possibly forever. I think it would be good to add to the cumulative effects section, a comprehensive table that adds to 10.8 billion scenario of development for Pebble along with the Groundhog scenario and three others, I can't remember the names right now. But I think that putting a table together so that people could see how many lost streams, how many blocked streams, how many areas of wetlands or estimated areas would be covered, all the way to the scenario, because frankly I think that if the Pebble Mine has 10.8 billion tons and they have potentially more based on new maps that they have, then they will develop all of it. I think it is only fair to the people who live here that they have a good idea of what they may lose. Despite some of the underestimates of likely impacts to fisheries, I think the watershed assessment and also the preponderance of scientific evidence on mining, indicated that Bristol Bay fisheries would be irreparably harmed by large-scale mining due to how large the mines are; the type, because copper sulfide mines can create acid and copper is the most toxic to aquatic life. Also, where it is located in the headwaters, in a very wet region down the Talarik into Lake Iliamna, which is the world's largest sockeye salmon rearing lake, where hundreds of millions to even billions of sockeye salmon rear 1-2 years before they go to sea. If there were to be an impact in Iliamna, it would destroy the Kvichak run. In the Nushagak run, impacts there as you have indicated, it would harm not just the Chinook, but many of the other species.

> **<u>EPA Response:</u> A mine is likely to expand to take advantage of the resources available, but to avoid overstating potential adverse effects we used the largest scenario described in Ghaffari et al. (2011). No change required. Both the draft and revised assessments corrected the copper effects levels for the effects of water chemistry using the biotic ligand model.**

TINA ANDERSON: BBNC, Nunamta and Trout Unlimited and people who live in Dillingham, EPA can impose it on their lands. All these organizations do not speak for us. Dillingham, Nondalton and all the special interest groups are going to create cultural and economic genocide for us. We do not live on subsistence, we need an economy.

> **<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. No change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

HEATHER NUDLASH: As far back as I can remember we always had fish. My earliest memory as a child is down here in a fish camp. Playing in the water and helping my great grandmother and the rest of my family put up fish. Salmon is a renewable sustainable resource that will last forever if we take care of it, versus a mine that will last a few decades and leave toxic waste forever. Don't ruin it for short term gain. Salmon is about 75% of my food. I look forward to putting up subsistence every year. I hope that my son is able to enjoy the way of life, putting up salmon, doing the whole subsistence thing, and taking care of the land. I hope that he can enjoy clean water the rest of his life, along with my grandkids, his grandkids. Salmon is a super food. Clean water is always good to have.

<u>EPA Response:</u> Comment noted; no change required.

JUNE TRACEY: All of my chadas and chidas have brought us from generation to generation on how to survive, how to live off the land, how to do things in the area. Every season has something to do with survival. I am proud of who I am, I am proud to say I am from here, and this is something that everybody has been talking about. This is our land. This is our life. This is thing here has been going on for the last eight years. The people come here and they interview. They want to know how we live. They want to know how we talk and they want to know how we think. But it is up to us as people who live here year round to make this decision. At first I thought, they say, we are poor, but I don't think there is such a thing in our Dena'ina ways as poor. We are rich in every which way that you could think of. We don't worry about homelessness. We don't worry about somebody who don't have a home. We don't worry about starvation. This is something that this land gave us. This is our supermarket.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

HEIDI KRITZ: Growing up in a traditional family, I was taught how to tell the difference in fish at a very young age and how to process them. My sister and I started with trout, like my grandma says, as you got older you graduated to better eating fish like reds, and more recently kings. If this mine goes through, we would be devastated, because it runs the risk of destroying the most important part of our culture and our livelihood. Destroying the land we come from won't only affect my generation, it will affect many generations that come after mine.

<u>EPA Response:</u> Comment noted; no change required.

JASMINE KRITZ: The fish has been a very big part of my life. At a young age, I was taught by my grandparents how to split fish and the process of drying fish. Unfortunately, if the Pebble Mine is approved and carried through with, I will no longer be able to continue to split or put away fish, let alone teach my own children or grandchildren one day. Because, no matter how safe they say Pebble Mine could be, there is always the possibility of an earthquake or any other kind of natural disaster that can cause a leak from the waste made from the mine and there is no way to protect the rivers. I am afraid that my generation could be the last to see the beautiful fish that our Bristol Bay has

<u>EPA Response:</u> Comment noted; no change required.

MELISSA BLAIR: We encourage you to use the Clean Water Act to protect Bristol Bay. This fight has gone on long enough and it is time for people to have a chance to begin to heal. While the watershed assessment does examine the possibility of not just one massive mine, but a massive mining district being built right alongside Lake Clark National Park, we don't think it goes quite far enough to understand risks that a massive mining district would pose to the National Park, especially the mining plans that are in the headwaters of the Susitna River, a freshwater tributary of the Clark. You would think that living downstream from of a 4 million acre national park, especially one of the best and vast in the country would guarantee that you would have clean water and a clean environment to sustain you for generations. Unfortunately, as you have heard today and you have heard throughout the bay, that is just not the case with what looms just over these hills.

EPA Response: EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

RICK RAU: There are citations that need to be annotated a lot more thoroughly. I don't see a correct reference to anything that is cited in there and realize that it is draft and you say do not quote or cite anything from that source, but in my professional opinion the writing needs to be absolutely detailed.

EPA Response: Comment noted. Specific suggestions for additional citations or details that should be included or revised are not provided, so a more detailed response is not possible.

LUTHER HOBSON, JR.: I want to thank the EPA for coming here and listening to everybody who has something to say. There are so many people that eat from Bristol Bay all over the world and they pay cash money to eat all the different kind of food that comes from Bristol Bay.

EPA Response: Comment noted; no change required.

TIEL SMITH: We celebrate that and have done a tremendous assessment of our oil and gas opportunity and our hard rock mineral potential over the past forty years. But as you can see, if you look carefully in our region, there is not a development that we have found and we have spent thousands and millions of dollars looking for something to develop. We have never overlooked the fact that salmon and game have been so much as priority in our region. We recognize that. Especially in light of Pebble project being looked at so closely. We not only know about that, we have studied it and we know about many other prospects and exploration targets in the region, none of which today make any sense to develop, based on the necessity to look for increased protections to the fish and game. I would conclude this thought by saying; this is significant, because we own the most land in the region as a private landowner, 3 million acres.

EPA Response: Comment noted; no change required.

RUSSELL NELSON: When you look at the Pebble seismic data in that big pile of paper that they sent out, they put in about seven pages of seismic data and two of them they copied from someone else. They make this assumption that the Lake Clark fault comes straight down the lake, which aims at Pebble and all of the other faults just keep on going although they know there are fault lines that run right through Pebble, and in their data they make the assumption that the fault line goes either to the right or to the left very quickly and that it goes around Pebble. I don't see how they can come to that conclusion making an assumption like that. So that kind of data needs to be added.

EPA Response: The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. No change required.

KIM WILLIAMS: While AK regulators have permitted industrial scale exploration, they have never asked the public to comment on whether the state should permit in the headwaters of the world's premier sockeye salmon fishery, nor have they asked the tribal governments who the federal government recognizes. Nor have they asked the indigenous people who are Yup'ik and Dena'ina, who are real people with an intact and thriving sustainable salmon based culture. I thank EPA for sitting down with my tribe in government to government consultation. It is too bad that the state of AK can't do the same. The state attorney general Geraghty complains that 60 days is inadequate. He had the audacity to ask for four months for the public and state to address the technical and legal merits of this assessment. For the last 24 years, the mining companies have been exploring for copper and gold on state lands in the headwaters of Bristol Bay, hoping to develop the largest mine of its type in North America. They have drilled 1200 bore holes, some more than a mile deep and used fragile tundra and wetlands as their waste dump; criss-crossed subsistence areas with tens of thousands of helicopter flights. Removed millions of gallons of water from streams and ponds that support spawning salmon and other freshwater fishes. They have done all that with the states permission. Without public notice, without inviting public comment and without public hearings. Thank you for gathering the science and a potential mining scenario to address the potential impacts that a large scale mine will do to our salmon streams and the impact it will have on us as a people. We are represented by trustees for AK, and we went to court seeking an adequate opportunity to address the technical and legal merits of the state exploration permit. The issue is on appeal to the Alaska Supreme Court and the state adamantly insists that the public has no right to even know about such permits in advance, let alone comment on them. The state systematically avoids any public notice and any hearing before it grants mining exploration and water permits. Do they give 60 days?

> **<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

PETER ANDREW: Yesterday, June 6 was a pretty important day that not everybody recognizes. Yesterday, 100 years ago, my father was awakened by mother. This was 1912. Katmai had just blown off. It was dark for three or four days. He said it was something that he would never, ever forget. I ask you guys to take another look at the seismic and volcanic activity which is fairly close to this particular project. I'd also like to remind you that the BBNC had not taken a position on Pebble or large scale mining lightly. We studied it for a few years. We agonized over it. With the support of our people, we feel very very, very, confident that a major part of our people want us to take this position and we did. So we are asking EPA along with the BBNC, which in March passed a unanimous resolution asking EPA to come in and do the assessment and get it done. We will be asking again to use section 404(c).

> **<u>EPA Response:</u> The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. Recent volcanic activity has not been identified in the Pebble deposit area. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

<u>New Stuyahok Public Meeting – June 7, 2012</u>

DENNIS ANDREWS: This country is our dinner table. We have been surviving from way back, from early 1900's, from our old fishermen from sailboat days, all the way back. Our same fish still come back to these waters. To top it off, this salmon here, all the five species here, feeds the ocean also, not just the rivers. There are 40 million salmon. …not just fish we are talking about our caribou and our moose, our ptarmigan, our berry picking. As we speak today, herring season has gone by. Bird season. They have been gathering eggs and stuff and now we are waiting on the kings to show up to survive through the winter.

<u>EPA Response:</u> Comment noted; no change required.

MARY HANSON [presented in Yup'ik]: She recounts many years ago living above the Mulchatna. She recounts moving around to many places like the Swan River area. They lived off the land and they ate everything from it, and they used water. They gathered wild ferns, sour duck, wild celery and when berries were in season, they berries that were first harvested were the blueberries, followed by the black and red berries. They harvested in the springtime, April, they harvested ducks and woodland birds, geese. And in the spring time, before they migrated, upriver, they gathered pikes from creeks and streams and they also gathered whitefish and these were prepared, dried. They also gathered beaver and ground squirrels and she said we are here because our land and water were so pure. When my six children were young, we used to go to Lewis Point and there I subsisted salmon. Back then the pay was very little, but her Dad got basic necessities such as flour, sugar, coffee and tea. She mentioned also that the reason they are here today is because they lived off the land and today her children and grandchildren still live off the land.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

NATASHIA NEKETA: She worked very hard and worked hard on salmon. All of Stuyahok know, most of Koliganek and Ekwok know of this strong woman. She could run skiffs, we call boats with motors skiffs. She could go anywhere and gather wood. She put up fish and even went back and forth to Lewis Point with her family. She did that because she worked on salmon, she subsisted and she commercial fished. After commercial fishing was over there would still be fish she would return back to the fish campgrounds and quickly work to subsistence fish. She would fillet them, hang them, the works. She has a very heavy heart for our future on account of Pebble Mine, because she doesn't want Pebble Mine to go through. Many of us who work on salmon, we work really hard to keep our way of life. If Pebble goes through, we will have no fish to keep us alive. Most of us are alive because our salmon kept us alive. We didn't have jobs many years ago, but we were rich if we had fish. We ice fished too.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

GUST BUNKA: As long as I could remember, my parents relied on fish. My kids are adults now; they work on fish, salmon.

<u>EPA Response:</u> Comment noted; no change required.

MASSA GUMLICKPUCK: As long as I could remember we ate fish as children. I lived here and when there was no school, we would migrate upriver and above the Mulchatna in search of food. Our salmon made us who we are now. …we used to transport to Lewis Point. We would put up salmon there… …we would put up dried pike, beaver, dried moose meat. My husband gathered from the land on foot. He was a fisherman back then and he commercial fished. Today, because my children watched me put up fish they follow our footsteps.

<u>EPA Response:</u> Comment noted; no change required.

NICK WYAGON: We are in perilous times in regard to the Pebble Mine. What our ancestors talked about is here. Greed. Those people talked about how we will have to pay for our water. It's here. Water is so important - we dig wells now for water. Me and my family spent many years putting up fish, salmon. I was a sailboat fisherman. My wife was a subsistence person. We survived on salmon. I was born in Nunamchuck [?] in 1923 and I was raised there. We used to relocate up the main river or anywhere above Mulchatna. I have a cabin up at the Mulchatna. It is used by my sons and great-grandsons when they gather fish and game. My ancestors had full access to all of Alaska. We lived, gathered and survived on this land, even to this day.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

NATALIA WASSILLIEY: That is why I am sitting here now, to keep our lands and rivers the way that God gave them to us. The way they have been for generation to generation so that we could do our subsistence way of life. Berry picking, moose and caribou hunting, mostly fishing. Right now we are getting excited for the kings to come up our river. For everyone works together cutting fish. To dry, salt or vacuum pack for the winter. We do not waste anything, because we fish. Around here it is gold, gold to us which we treasure. When we fill our dry rack, we go walking and help one another. If Pebble Mine goes through, we might as well kiss our subsistence way of life away. Even though they say nothing will affect our land or water, it will. Drainage will go to our water, which comes down the Mulchatna. Fish and the wildlife drink water and use water. Like right now. It's been raining for two days and the river has gone up. Our creeks will overflow. Nobody can say fish don't go to this or that river. It can't be stopped it can't be fixed. If the Pebble Mine goes through and the drainage goes down to our water, nothing will stop it. It will go all over. In the future I hate to see a big ugly empty pit, which they leave once they take out the entire gold etc. Since it's not their land, they don't care how they leave it, because they are not from the surrounding area.

<u>EPA Response:</u> Comment noted; no change required.

SACALLY WONHOLA: Back in 1963 he went over to Newhalen, There were caribou and moose in abundance in that area. Now lately, there isn't any more moose to be seen in that area. He mentioned that we had five Russian guests who came down, and the salmon runs that they had and the bears that they had back in their day were was mining projects going on in Russia. But since they started development in that area, they no longer see salmon or bears. He also mentioned that our youth today are brought up in the technological world. They are taught the subsistence way of life, but today, most them o longer speak the Yup'ik language, and we should return to that.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

TIMOTHY WONHOLA: One thing we really want is well being of our families and well being of our surroundings and well being of our nature that we walk in for many years. We have kept it clean from our parents that gave it to us and thought about it. We learned from our parents how to take care of things and they in turn take care of us. We need to do that to the younger generations yet to come. I cherish the water so much. Because once the mine goes through there will be so much banging of the dynamite that is blasting and for what 100 years. And if those things happen there will be nothing around the mining areas. Zero. The subsistence way of life that I cherish so much would be gone. For the younger generations yet to come we need to have that in place. the Nushagak and the Kvichak and it would be so ugly to see that big mountains of tailings go, because the others used to tell me, one of these days this river will turn red and I know what red is - it is the orange color of tailings. That is what they used to speak about the elders. Even in our church systems, our religion, water is blessed everywhere. We need clean water.

EPA Response: **Comment noted; no change required.**

JASMINE KRITZ: The fish has been a very big part of my life. At a very young age I was taught by my grandparents how to split fish and the process of drying fish. Unfortunately, if the Pebble Mine is approved and carried through with, I will no longer be able to continue to split or put away fish, let alone teach my own children or grandchildren one day.

EPA Response: **Comment noted; no change required.**

HEIDI KRITZ: Growing up in a traditional family, I was taught how to tell the difference in fish and how to process them properly. My sister and I started with trout and as my grandmother said, as you got older, you graduated to better eating fish like reds and more recently kings. If this mine goes through our people would be devastated, because it runs the risk of destroying the most important part of our culture and our livelihood. Destroying the land we come from won't just affect my generation, it will affect many generations that come after mine.

EPA Response: **Comment noted; no change required.**

KIM WILLIAMS: [During 24 years of Pebble exploration] they have never asked the public to comment on whether the state should permit in the headwaters of the world's premier sockeye salmon fishery, nor have they asked the tribal governments who the federal government recognizes. Nor have they asked the indigenous people who are Yup'ik and Dena'ina, who are real people with an intact and thriving salmon based culture,

EPA Response: **Comment noted; no change required.**

LUKI AKELKOK: In the olden days, the old people used to say [speaks in Yup'ik]. They talk about the salmon and it's already declining in the water of the Koktuli River. I've been travelling around up there a lot. It has been declining slowly. When I started there used to be so much sockeye and king salmon up there. I have a cabin up there where they spawn. You could hear the fish splish splashing all night. Now you can't even hear them anymore. Getting dropped off at Frying Pan Lake. It's changing. There are no more trout and no more kings and you look up there and there is no more testing of salmon. No more of those fish around where they used to be. You don't see so much bears anymore fishing at the river there. When there used to be a lot of fish the beach used to be just lay down with fish and you would see nine or 10 bears up there fishing. Now it is just going away. They call that the place that was a calving area for the caribou. Now I never see a caribou up there in the last four or five years. Our land is our food. I heard some of the elders were talking way back. They used to fish salmon and the salmon weren't worth much. $100 would buy a whole worth of grubstake but now days it don't. If the mine ever goes through, how are the people going to survive in the winter? Everybody stock up with salmon and moose and freshwater fish. Freshwater fish was never talked about much. They get the those fish, the white fish, and they put them in a cave and get them soft and it gets soft and sour like Tillamook cheese and then they are delicious to eat.

EPA Response: Comment noted; no change required.

RICHARD KING: We should do a 404(c) now and I read your assessment and I have a couple of quick points. On the water reserves for what the mine takes out - and puts back in there - that is not enough for us to navigate the river. On low water years we won't be able to traverse our boats across the sandbars because it's only ankle deep. One other thing I notice is that you don't declare king salmon as an endangered species. They are the rarest of all salmon. In your own comments, you stated that 30% of them would be affected. Well a lot of them go up into the Koktuli and they spawn there. To lose that species even more would be a bad thing.

EPA Response: Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act. We recognize the importance of king salmon to people in the Nushagak River watershed, as reflected in tribal consultations.

BRYCE EDGMON: I would argue that if you came out to get local testimony that you couldn't have come out at a better time, because you got everybody before both commercial and subsistence fishery season starts and this is the ideal time to get the testimony. If the Pebble Partnership gets to the permitting stage this fall, we want this assessment done to have the ability to have your agency and all of its resources, technical and otherwise, to have had that broad brush look at the whole area, and to look at it, not only from a cumulative risk standpoint, but also from the ecological value. What is the value of this region, and how does it tie in on this perhaps small footprint that could have devastating impacts all over the entire area if it is allowed to go forward and there is some kind of catastrophe.

EPA Response: Comment noted; no change required.

JIMMY HURLEY: I own land (listed several places) and also up close to mines. My concern is that when you implement something, you have to look at the land adjacent to it in this assessment. I have land that is going to be valuable that I will pass on to my kids.

EPA Response: Comment noted; no change required. EPA assessed the risks of mining beyond the potential mine site.

NORM ANDERSON: All of these people who do come in [to work on the mine] are going to be wanted to be subsistence or commercial hunters, and that will impact us as the competition for moose and caribou and fish increases. Everyone wants to come to Bristol Bay and the draw for those who don't come out here to make it their mainstay, do so for commercial or support reasons. We are home to some of the largest animals and their numbers are significant, because we as native people were only taught to take what we need, as we live a subsistence lifestyle. It is crucial; it is the way we were taught. The reason we have plenty of lean water and berries and stuff is because we gingerly and carefully live in harmony with the land and only take what we need. We don't destroy the land where we get our berries, because we know that is where the animals feed. We can go back to the traditional places and hunt culturally for what we see around us. The abundance of food we shared today was what we referred to as our country food. It is a main part of our lives.

> **<u>EPA Response:</u> Chapter 13 of the revised assessment mentions the potential for increased pressure on subsistence fishing and hunting.**

JOE CHYTHLOOK: I want to say that ever since I was 2-3 years old I was scared of white people. It's nothing new. Anyway, we have a right to be afraid of what is happening, because we live in this land. Any risks to our livelihood, our lifestyle and our subsistence foods, our commercial fishing foods and all of our other foods that these people have shared with you today are all part of our culture. This river here is the main producer of king salmon in Bristol Bay. If anything were to happen up in the headwaters to destroy that, a major subsistence food that we all love up and down river, even from Aleknagik where I am a tribal member, would be lost. This is a concern that we all share.

> **<u>EPA Response:</u> Comment noted; no change required.**

FATHER WALLY GUST: Should this mine goes through, the water that we drink when we go out hunting and ice fishing we will not be able to dip into the water and to drink it. We live a simple lifestyle. We drink the waters of the river. Think what it would look like if the tailings were to go into the river. This (bottle) is what we would be drinking out of. The money that we get from wages or from other means will be spent on water containers. We will be drinking water out of plastic. I have notes here from 2007 from some of the youth that you see here. These are notes that they had written to the state of AK. You heard Kim say and I will say again, the state is not listening, so EPA I am going to ready briefly if I can go through these quickly and if I can't I will let you know. Dear representatives, I am in second grade. I want our land left alone. "Dear state representatives, don't hurt our animals and our fish and our land. Don't run our waters because we want to drink our water and we want animals to eat. Hi. My name is Malia (?) and we live in New Stuyahok. We don't want the state to let the Pebble Mine come here at New Stu, because we could eat and because we cook all of our stuff and have water and just get big if we have water from the river. I am a student at New Stuyahok; I know you want the mine to go through because of the money. Dear State Representatives, Please don't ruin our water and our animals. We could swim in the water we could dive in the water. Please don't ruin our fish and our land. Even the moose and the animals. Please don't ruin our land. We want to go hunting for moose and so I can have some fish. I get emotional. These are from kids from five years ago and the reason that I bring this up is because the state is not listening to us. As a government to government relationship here, I ask that EPA exercise their authority to use their veto power so that we can put a halt to what is happening in our backyards. I will read one more here. Dear State, Why do you want to ruin our land in Alaska? If you ruin our land, we won't have any animals in Alaska. We will miss our fish and I will miss ice fishing and hunting. We won't be able to make animals. We live in New Stuyahok in Alaska. Why do you want to have the mine to come to Alaska and have money? I will miss picking berries in Alaska." These are testimonies from our kids back then.

> **<u>EPA Response:</u> Comment noted, no change required. The assessment estimates risks to water quality, focusing on salmon, which are more sensitive than humans to the pollutants associated with copper mining. EPA acknowledges our government-to-government relationship with the tribes and takes our trust responsibility seriously.**

EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.

ANNIE FRITZE: I am a small business owner, relying on the beaver, river otter and other fur bearing animals to help sustain my skin sewing business. I am also a lifelong subsistence user and a mother of three children and four grandchildren who are here today with me, who enjoy our salmon, moose, caribou and other animals and plants. Since time immemorial, this magnificent and mostly untouched region has been home to many of its indigenous peoples residing along the streams and rivers for centuries and even the millennia. They follow the traditional way of life in subsisting off the land and mostly it's valuable natural resource, its salmon. Each year more than one million salmon return to the rivers and streams, where the salmon hatch and spawn for the next cycle of life. So long as the salmon return to the Nushagak River to nourish its land and water and its people, all other animals will find haven and sustenance here too. The spawning and dying salmon help create the soils for berries, plants, grasses, shrubs and trees to take root and complete the miraculous circle of life. Water is very very important to us. Without clean water, life would not live. Of concern, is the development of one of the world's largest open pit mines located near Iliamna and Lake Clark. This mine will lay on the headwaters of the Koktuli River, which flows into the Mulchatna, which flows into this beautiful Nushagak River, which then flows out to the Bristol Bay. Land and water have always been central to the lives of the people, providing a life of subsistence, opportunities and largely responsibility. Everything it boils down to is that this water is important to us. We go up every year and we go caribou hunting, me and my cousins. We don't take water with us because we know we can drink right out of the river. We go up the Mulchatna. Since we were 14 we have been travelling like this. We don't need to bring water with us. We could get it straight out of the ground as long as there is not beaver. Water is so important. It makes our fish and our food.

<u>EPA Response:</u> Comment noted; no change required.

RANDALL HASTINGS: Since I have lived here, 32 plus years, travelling up and down the river, I have noticed that ever since the mine started doing exploration up in the Koktuli, the fish and game have been depleting more and more every year. So there has been some point of effect from exploration. It tells me that if the mine goes through it is going to kill everything. It will be devastating. Most everybody in this community and everyone I know who lives in rural areas live off the land as I do. Fish and game, berries and vegetation is our main staples of food.

<u>EPA Response:</u> Current exploration activities are outside the scope of the assessment, although they are mentioned briefly in Box 2-2 of the final assessment.

ANUSKA AYALUK: That way of my life. I like to eat native foods. I grew up like this when I was a little girl. I did not want to hear about any more copper mine. I am really against the copper mine. I think about more fish and animals that are all over. We used to help our elders many years ago until I grow up. Sometime, we think about having our fresh, clear water. That is our way of life and it is lost in a dark cloud. Please try to keep the clear water here in New Stuyahok

<u>EPA Response:</u> Comment noted; no change required.

EVAN WONHOLA: One of the deceased elders said - and it finally came to me after he was gone - that he used to say this is in Yup'ik [speaks in Yup'ik]. Our land here, even though there is a lot of money there is no value to the land [Yup'ik]. There is no comparison to money. This land is precious. We were on our way to Lewis Point, I love to go there every year and bring my family. The grandkids that I have are looking forward to splitting fish, looking forward to packing fish. We do our subsistence way of life down there. I feel that if the mine went through, this village [New Stuyahok] will be one of the first ones to be affected. It is only 15 air miles from here to the mine. That is of concern for this community. Greg Moxie - now deceased - his very words before he got deceased - God's country up there. Around here is trash. Up there is God's country there is wildlife abundant. A lot of caribou, moose and spawning areas.

EPA Response: Comment noted; no change required.

SALLY GUMLICKPUCK: I am testifying for my grandson who lives in the city of Anchorage, but just lives his subsistence food. As soon as he came, he was eating fish in seal oil, and seagull eggs and (?) strips. We have practiced our subsistence ways for generations and want to continue doing that for the next seven generations to come. To keep on doing that, we rely on the clean water and the environment.

EPA Response: Comment noted; no change required.

WASSILLIE ANDREWS: I am a born and raised fisher and hunter and commercial fisherman like my dad was. He was my first teacher in subsistence and commercial fishing. I and my members here in New Stuyahok are very concerned about preserving our traditional and cultural lifestyle. We enjoy using this lifestyle that goes back thousands of years. Hunting for moose and caribou just to name a few. Fish for king salmon and to make trips to hang, smoke and salt fish to be used for cold winter months. Gathering spring plants and also berries. I still use my teachings about this lifestyle

EPA Response: Comment noted; no change required.

SARAH McCARR: The Pebble Partnership views the watershed assessment as rushed and inadequate.

EPA Response: Comment noted; no change required.

PETER CHRISTOPHER: I have done summer research of the little fry's that come to the mouth of the Koktuli and Stuyahok and Old Man River. The science group from Fairbanks out of the university were able to catch silver salmon, red salmon and king salmon fry's. The little salmon that hatch up there. They stay up in those rivers for three seasons, three years. On the third year at the breakup, these young salmon go out with the ice. On this trip with the scientists it was successful and they applauded me for showing them where to do the samples and where the little fish are. It is not only that, as an elder said earlier, our Mulchatna caribou herd has moved away from the Pebble exploration because of the noise factor. It was already stated during the report that the cause of the herd moving away was because of the noise. We are the true people of Alaska who live here. We haven't moved. Bishop Gregory said we had the best resources on this river. You didn't need to go to the store to buy meat and fish. We have it here. That is what we want to protect and preserve.

EPA Response: Comment noted; no change required.

PETER GUMLICKPUCK: Glance outside and see how beautiful it is. A renewable resource that goes every year and with this mining that is coming up, will you see that if you come back in ten years? Will you see the renewable resource out there, that girl? We have heard about water, about how precious it is. Anybody that doesn't drink water will die. Our plants will die. Our animals will die. Our little fish that depend on little bugs will die. They call it a hard name that I can't pronounce - they are microinvertebrates. When they die, our little fish will die. When it is developed you hear about hydrology. These microinvertebrates live there and our salmon depend on them. If the mining goes through, we will have nothing. Little bugs that I study all the time, when I sample and check the creek, will be no more. I fear for my little grandchildren that are growing up.

EPA Response: Comment noted; no change required.

MOXIE ANDREW, JR.: Our lifestyle it maybe subsistence, commercial or sport fisherman, but in the long term it's beneficial rather than the short term profit interest of a big company which profit won't come to Alaska it will go to foreign companies. Before, our ancestors, they were somewhat nomadic, they moved up the Mulchatna and here and there. One of the reasons they moved to this location was flooding up in the upper Mulchatna and Koktuli. There is a lot of precipitation and a lot of snow in winters. One of the reasons the elders picked this area is because it was rich environment. There are trees, willows, big game, small game. Salmon is the main source it's why we have such a rich environment. On your assessment one thing I saw that was lacking is about whitefish. When there are low numbers in salmon, the people eat a lot of whitefish. It is sometimes called humpback. We get those during the spring. They are a migrating fish, maybe freshwater, there are little studies. Some people say they are more sensitive than the salmon when they run up their streams to go spawning. This is by word of mouth. Also, I barter and trade with people who live on the coast for seal oil and herring, clams. People mention caribou, and my concern is migration in calving grounds of the caribou in this area. In this area there are five areas where they have caribou. They are S Peninsula, N Peninsula, Mulchatna, Nushagak and there is one more. There is also one more herd in the Naknek area. The calving grounds are in the upper Mulchatna and the small groups that calve in the Koktuli area, and they are not very far from the mine site. My concern is with calving, because in the 1980's the population was 18,000. In the 1990's it went up to 200,000, and now in 2008, the last time I looked, they are down to 30,000.

EPA Response: Information on whitefish is included in Appendix B. The assessment itself focuses primarily on Pacific salmon, rainbow trout, and Dolly Varden, in part because distribution data for other species are lacking. However, information was added to Chapter 5 of the revised assessment to indicate reliance on non-salmon fish, including whitefish. We acknowledge that potential effects from loss of salmon would extend well beyond these two watersheds, however the discussion of the barter and trade network is outside the scope of this assessment.

RACHEL PANIMARIOFF: Every year, my family, my daughters, we get excited to move to fish camp. My whole life, ever since I was a baby, I go. There we are taught our family values through our tradition of cutting fish, and just being there at fish camp. My two older girls, one is 14, the other is 10, already know how to split fish. I do expect my 8 and 4 year old to do as well. Even though my family and I will leave for the school year, we will come back home for the summers more excited than ever to go to fish camp.

EPA Response: Comment noted; no change required.

LUCY A. WEEDMAN: I am an avid subsistence user of the Nushagak River, the fish that it provides and all the other animals that we subsist for here. Our lifestyle, especially today with our economy, everything is getting higher and more expensive. I know we pay for our food that we pay for triples all the time year after year. My family, as well as other families, depends on this watershed. Our watershed is pure and pristine and it holds all five species of the salmon we subsist for. It sustained my family as well as other families year round. I want to point out that not only does the salmon rely on the watershed, the other animals that we subsist for; moose, caribou and other wildlife we gather is in jeopardy of becoming extinct with the Pebble Mine coming through. We, the indigenous people of this river here will also be jeopardized. Our lifestyle, our way of life, and it won't be no more. I'd also like to reflect today on Luki Akelkok's testimony. He said that the exploration that is going on right now and he mentioned that the other animals out there. My husband and family, we use the upper Mulchatna to hunt. I'd like to reconfirm that the animals and fish that used to be up there are already disappearing. Every bend of that river we used to come across some form of game up there. Now there is nothing.

EPA Response: Comment noted; no change required.

GREGORY CHUNAK: I used to see all kinds of fish. Rainbows, sockeyes, any kind of fish because I have the cabin, way up the Mulchatna below Luki's cabin. I used to see all kind of game. Any kind of animal. Now they are getting lesser and less. Hardly any, maybe come from after that big quake. It's really changed. Before that earthquake there used to be lots. Then we start watching before. If the mine goes through, everything is going to be gone. I used to work with Pebble looking for oil. I used to work down the coast looking for oil. They use water from the lakes. They do the same thing with these mines they will use even more. Pebble will use lots of water. It is no good. If it is bad. We have lots of little creeks up there.

EPA Response: Comment noted; no change required.

GUST CHOKNAK: He is a tribal elder. He told the translator that where the Pebble Mine is located is where the caribou migrated. Now that isn't happening. The water will be contaminated. We all live on water, beaver, muskrats and many other animals rely on this fresh water. He noticed now days - he is a moose hunter too - moose liver getting holes. Some of these he is bringing up because it might be the exploration. In the past he didn't see this. In the many years the exploration has been going on, he wonders if it is affecting the moose from the Mulchatna area. We speak to preserve what we have for our children and future generations. Gold comes and goes and that is it. Salmon comes every year. If mining happens it will be like the gold and it will come and go forever.

EPA Response: Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

OKALENA ANDREW: I don't want our land spoiled by machines. When I die I want our ways to continue. My husband was a reindeer herdsman. He roamed free all over this area, because he took care of reindeer.

EPA Response: Comment noted; no change required.

MARGIE HASTINGS: We respect our land, water and people. We take only what we need.

EPA Response: Comment noted; no change required.

THOMAS WEEDMAN: I am a subsistence user pretty much since the day I was born. This goes beyond my time. I can relate to my grandmother who passed on at least ten years ago. It was believed that she was 105 and I can relate to the lifestyle she had. I think she was a reindeer herder like some of these elders were saying. I can only imagine how did our elders live so long, so long that they live up to 80 to 100 years. It is very obvious that they were drinking pristine water and the lifestyle of food. Those fish and habitat were untouched by mankind.

> **<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.**

FATHER ALEXIE ASKOAK: I am the Priest at the church here in New Stuyahok. What I want to share with you on January 19, we go down to the river to bless the water. For us it is very important that we maintain and keep our waters clean. Another part that I want to share is that every summer, we participate in subsistence gathering with fish. Even my two grandsons are excited to help us out when we are working on fish.

> **<u>EPA Response:</u> Comment noted; no change required.**

CHIEF MOXIE ANDREW: I have a celebration for Pentecost if you could read it. It says blessed art thou oh Christ our God who has revealed the fisherman as most wise, by sending down on them the Holy Spirit. Through them thou didn't draw them into your net oh, lover of men. Glory to thee. That is the blessing of the nets and blessing them for people to use.

> **<u>EPA Response:</u> Comment noted; no change required.**

RYAN BRENNAN: We are opposed to the Pebble Mine simply because of the natural resources and wildlife that sustain us, help save us quite a bit of money that we can't afford for food and what not, our way of life for thousands of years. The wide variety of fishes we have here, reds, kings, dogs, chums, whatever, and trout, grayling, pike, white fish, trout, chums, and all the other animals the wolves foxes and bears and everything that sustain off that. This watershed feeds other nutrients into and other nutrients like berries too. If the Cyanide chemicals, sulfuric acid, whatever they use to strip all that, gets into our environment it's going to kill everything off. So, It's not going to be very economically positive for us, it's going to be Environmentally damaging in severe ways, if there is a natural disaster, this is the last and largest fishery that's left that's not contaminated and other kinds of things. So, I am not looking forward to the Pebble Mine, at all.

> **<u>EPA Response:</u> Comment noted; no change required.**

<u>Anchorage Public Meeting – June 4, 2012</u>

BELLA HAMMOND: I grew up in the Bristol Bay area and fished for many years. I'm very familiar with the area where the proposed mine goes. And I asked a number of people today if they'd ever been to that area and most of them said no. And I think if you -- those who are involved who haven't been to that area should take the time to see the beauty and this beautiful fishery that we have. Other renewable resources and -- and I think I understand that as more time goes on there is more concern about the Pebble Project. And becoming enlightened I think is crucial for people to understand what we might lose. And so I really hope people will learn more about the Pebble Project.

> **<u>EPA Response:</u> Comment noted; no change required.**

TREFON ANGASAN: APC owns about 200,000 acres of land adjacent to the Pebble Project. We -- we really don't know what impact the studies are to have, the assessment or any action that EPA takes on what it's going to do to the Alaska Peninsula Corporation lands. We are asking for more time so that we can look at what the full impact is going to be so that we could then make meaningful comments to the study. At this time we find that we're unable to fully get the message out to our shareholders to have consultations with them because they're getting ready -- as we all know are getting ready for the upcoming season.

> **EPA Response: The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region. Appendix E provides a baseline evaluation of current economic activity dependent on a healthy ecosystem. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

THOMAS TILDEN: I'm a fisherman. I started fishing in 1965. My grandmother always told me that we were very rich. I want to point out some weak points in regards to the EPA assessment. I believe that you were weak on history. I believe that you have got to take a look at the Native people that live out in that area. There's been 50 to 180 generations of people that have lived in that area, depended on that salmon and want to continue to do so. There has to be more emphasis in regards to how the people survive out there. That is not only economics but that is subsistence to the folks that live out there. The other part that you're weak on is in regards to the freshwater fish that is in the area. The people depend on it greatly. Pike, whitefish, suckers, that all come up into the freshwater area. And EPA needs to take a look at how that contributes to the people. Our people that have lived in this area for centuries want to continue to live there. We believe that we have a right. We believe that the subsistence lifestyle is very important. We believe that our culture is important. When you come out to Bristol Bay and you take a look at who we are, we are people of fish. Fish is in our art. Fish is in our music. Fish is in our dance. Fish is who we are. That is in your economy. So please come back out, study the people that live there, that are going to die there, that are going to be buried there that depend on this fish

> **EPA Response: Comment noted, no change required.**

AGNES RYCHNOVSKY: I don't support large-scale open-pit mining within the largest salmon spawning grounds in the world. Also the only lake in Alaska that has freshwater seals. I'm glad to see that EPA has made attempt to do a watershed assessment. All efforts be recognize including the – all efforts should be recognized including the Pebble baseline environmental studies. As a village leader it is our job to preserve and protect the traditional use routes and subsistence use areas for hunting, fishing and gathering because today we are the keepers of the land. I am concerned about our traditional lands eventually being closed due to wetland status. I've heard EPA's response assuring us that that will not occur; but with any governmental structure people change, policy change, treaties are broken; and I'm hesitant about taking anyone or any agency at full faith and credit in light of historical behavior patterns. It is my responsibility as a grandmother to fight for the preservation of our traditional rights for my grandchildren and my future great grandchildren.

> **EPA Response: Comment noted; no change required. We included data from PLP's Environmental Baseline Document throughout the assessment (despite the fact that this document has not yet undergone a complete peer review), because it does represent a wealth of data for the area surrounding the Pebble deposit.**

CHARISSE MILLETT: I want to say shame on you for having the first meeting in Washington State. We're talking about a project that's within the State of Alaska. The Pebble deposit is located on State land that is open for mineral development. The State through our AG office and the Governor's office has expressed strong objection to this entire process the EPA, your agency, is doing. It falls against every agreement that we took with the federal government on statehood, not to mention the complete and utter arrogance this agency has displayed about our State policies. There hasn't even been a plan of development introduced to NEPA, to the State or to anybody. What you have done is taken an opinion and taken things that were prospective in nature from the development -- from the developers and decided this is what it's going to be. As a State legislator what I'm concerned about is the precedents you're setting today. As a State legislator when I talk to folks about growing our economy, extracting resources from the state of Alaska and getting people to invest and create jobs and wealth for the residents of the State of Alaska you have just scared away every potential investor for the State of Alaska when it comes to mineral resource development. Now I want to talk about the assessment. I'm not going to talk about Bristol Bay because we all love Bristol Bay. It's beautiful. You can't repeat it. There's no other place -- there's no other world-class fishery in the world. Your process is premature. Your process is short, fast. The size of the Pebble Project is the size of Virginia. Your last study that you did in Chesapeake Bay took you five years.

> **<u>EPA Response:</u> EPA added a meeting in Seattle at the request of commercial fishers. It was scheduled early in the comment period due to the imminent departure of the fleet for Bristol Bay. Early comments are given no more weight than later comments.**
>
> **EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places. The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on Alaska Native and other subsistence users in the region.**

PETER ANDREW: I'm from the village of New Stuyahok, tribal member. Also BBNC board of director. I want to thank the EPA for doing the assessment. It follows and mirrors what we feel culturally. We need to protect our resources. We also need to make sure that we keep to the time line. We are a very busy people. We need to stick to the time line that you have laid out. And I want to make sure that the people in the region that cannot be here be heard. I ask that you make available to everybody that's available in the region

> **<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

RUSSELL NELSON: I'm a director of the Bristol Bay Native Corporation. I also spent six years on the Alaska State Board of Fisheries. I have a large Yup'ik family in Bristol Bay who depend on King salmon and Sockeye salmon for subsistence. The economy -- or the Bristol Bay commercial salmon fishery is the economic agent of our region. The environmental damage from large-scale mining by placing tailings in salmon streams as you are documenting in your assessment will make our culture, subsistence and regional economy suffer. Your time line for comments is sufficient. Please complete it in a timely manner and follow it up with the 404(c) action.

> **<u>EPA Response:</u> Comment noted, no change required. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public**

and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

ABE WILLIAMS: I was born and raised in King Salmon, Alaska. I'm the president of the Paug-Vik Corporation which has 120,000 acres of land adjacent to the Kvichak and Naknek River system. I'm here to ask the EPA, again, for an extension in this process. It's very important to the people of southwest Alaska not only to protect our resource, to make sure it's protected, but at the same time protect our people. We all love our salmon. I respect everybody here that is respectful to those salmon resources; but our communities have seen a drastic decrease in population, school closures and big, big issues that we have as Alaskans abroad in western Alaska and all our communities. And to preemptively strike projects down like this through the EPA and the watershed assessment process is ludicrous. Absolutely ludicrous. Do not extinguish our Native people's opportunities through fear and emotion. Let's sit down and discuss science-based information, and let's have a dialogue that has sideboards on it; and let's have a dialogue that means everything to the people of Alaska.

EPA Response: Appendix D includes a brief description of the population dynamics of communities in Bristol Bay. However, an analysis of current and potential future economic opportunities for Bristol Bay residents is outside the scope of this assessment. This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy salmon ecosystem.

SHARON CLARK: The Alaska Native culture has presented in the Nushagak and Kvichak watershed, one of the last two intact sustainable salmon-based cultures in the world. Forty-four years ago the Bristol Bay Native Association board of directors passed a resolution stopping the Cominco Mine from coming into our area, Northern Dynasty and then Pebble Mine. What I wanted to read today is something that my dad had published in his book. And I want to leave two copies here for the record. "Oftentimes I think that in this day and age we make decisions for the short term without thinking about the long-term impact. Everybody nowadays seems to want to do things in a hurry. For example I oppose the development of the Pebble Mine, previously called Cominco, near Iliamna. Creating such a huge open-pit mine could destroy the land and pollute the waters and streams. The streams proceed to the ocean and therefore salmon. Poor resource development can be deadly to fish and to the spawning and rearing of the fish. It can also pollute our drinking water. We need to look at the short-term development carefully and we need to protect the resources that will support us for a long time."

EPA Response: Comment noted; no change required.

PAT KVASNIKOFF: I remember growing up, this is back in the dog team days before the snow machine come over there. We go out there and we'd hunt geese, ducks, et cetera. Now how do they migrate? They hop kind of like rabbits. They drink water here, they drink water there and they get food, they lay the eggs. Guess what? We eat the birds, we eat the eggs. And then the fish depend on all this migration too from different parts of the world. I've been overseas two different times in the Lower 48 and I've seen places that are polluted. There's no solution for the pollution once it gets there. It's devastating.

EPA Response: Comment noted; no change required.

CATHY GIESSEL: Rural Alaska where there are few jobs and few paychecks. In fact schools are closing in rural Alaska. In one of the local papers yesterday it cites four more rural schools slated to close this year. One of the schools is actually in Bristol Bay. There's a ripple effect. Not only is the school closing but the health aide will also move out of that community because she has a child that needs schooling. So she's leaving the village and that will leave the village without a clinic. This is about people. People are not an invasive species in the State of Alaska. We belong here. The resources are here for us to use and conserve. Conserve means use what we need, just like we conserve energy by turning off lights when we leave a room. It is unconscionable that the EPA would hastily write a report like this and put it forth as science. Even worse that a federal agency would insert itself into an issue that belongs to the State of Alaska. Alaska is not an internal colony of the United States. It is a sovereign state with a careful, credible and competent permitting process. The unprecedented preemptive action by the EPA will destroy Alaska's future as a resource utilization state. You're destroying jobs and future opportunities for our citizens.

> **<u>EPA Response:</u> Appendix D includes a brief description of the population dynamics of communities in Bristol Bay. However, an analysis of current and potential future economic opportunities for Bristol Bay residents is outside the scope of this assessment. This assessment is focused on the salmon fishery and salmon-mediated effects on wildlife and Alaska Native cultures.**

BRAD ANGASAN: I'm a lifelong commercial fisherman. Been doing it all my life. My son who comes out on the boat with me in the summertime, he's a fifth-generation commercial fisherman. Not a lot of people can say that. God willing he'll be raising a sixth-generation commercial fisherman and I look forward to that. Many of my family reside between the communities of South Naknek, Naknek and King Salmon. My mother lives in the community of Kakhonak on the eastern shore of Lake Iliamna. Because of that I'm really concerned about the amount of time that you've allotted for the public comment period. And I'm going to ask that you extend that out to the end of fall until people have a chance to come back from their subsistence, commercial money-making period and they can provide some meaningful input

> **<u>EPA Response:</u> Comment noted; no change required. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

RICHARD FREISINGER: There's a lot about the Clean Water Act on these mines. If you look -- I've heard a lot of comments on TV from the anti-Pebble people. And you look at the Fort Knox Mine, Red Dog, Kennecott. Kennecott Mine existed years ago right on the shores of the Copper River. No problem. Fort Knox, they have a mine up there that they -- I don't know if it's EPA or who it is that checks their water supply. The water is cleaner than it goes into the mine, it goes out of the mine cleaner. And the Red Dog Mine the same way. Now the people over in Iliamna, this mine provides jobs, security, a hope and a future. And like that lady just said, medical help and schools. We've heard a lot of narrow-minded comments against the mine itself.

> **<u>EPA Response:</u> Comment noted; no change required.**

MARTHA ANELON: I have three beautiful daughters I will look out for. I strongly believe that I am their voice for their future with their input. Decisions that we make today will affect them tomorrow. It is up to us to provide community development opportunities for a younger generation to thrive, succeed and continue to live in our communities. I have a few questions for you. Does EPA honestly think that residents of the Bristol Bay region truly understand what the 404(c) is? Is it truly directed to shut Pebble down? What other projects throughout the region will be affected by the 404(c)? Who is pushing to have a 404(c) go through? Who are the supporters? Is EPA receiving funds to travel throughout the region? From who? Why has this been expedited? If I have all these questions do you think other regional residents have questions also that can't be here today? Why was Dillingham and Naknek not included on the 404(c) watershed assessment? They are in the Bristol Bay region just as we are. They want development and opportunities for their residents and restrict us in the villages. We as residents in the villages need opportunities just as they do. We have outside interest groups such as the EPA coming to our region to make decisions for us when we are here to voice our opinion. We do live in the region and this is our home and you don't live out there, we do.

> **EPA Response:** **The assessment is an ecological risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).**

LISA REIMERS: We do not support the 404(c) because we are not sure what the impacts will be on our Native lands. Unless you can give us a written statement that it would not impact our Native lands The Iliamna Village Council is the tribal government for Iliamna and we look at things a little differently because our people do not depend on commercial fishing. We have to make a different decision because a lot of people had to sell their permits because the commercial fishing does not sustain them. And the subsistence is a choice. And a lot of people and a lot of our kids are depending on the western society. They don't depend on the western society anymore. So we have to look at this a little differently. I also want to mention that BBNC owns the sub-surface of the land. They don't own the surface in our area. They do not speak for us. Trout Unlimited does not speak for us. Nanunkta does not speak for us. The people from Dillingham, 150 miles, do not speak for us. And if they want the 404(c), they can have it on their lands. And I think you need to extend the time for this period for the comments.

> **EPA Response:** **Comment noted. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

BILL JEFFRESS: I support a public process established and promulgated for federal and State administrative procedures, not what appears to be a pseudo-political hatchet job on Alaska resource development that's clearly disguised as scientific assessment. I'm saddened and disheartened to have to comment on the external review draft as it highlights how far EPA has strayed from the mission established by Congress in 1970 to protect human health and the environment. Once upon a time EPA prided itself on conducting thorough and objective scientific evaluations based on sound technical principles of science and engineering. The draft document proposed to have completed the comprehensive assessment of an area of approximately 20,000 square miles in 11 months. Impossible. Evaluations and statistics reported by third-party consultants who have been opponents of mining for 30 years. Each of those biased assessments are referenced to a greater extent than those federal and State agencies that have been mandated by Congress and the Legislature to design and build dam structures. The U.S. Army Corps of Engineers, Bureau of Reformation and State Dam Safety Departments who have designed, built and regulated such structures are only incidentally referenced.

> **EPA Response:** **EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other**

places. The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife in the Nushagak and Kvichak River watersheds.

JOHN STURGEON: The permit process will explain the vacancies to the public, people like me, how they plan on developing the Pebble Mine. I do however strongly support Pebble being able to go through the permitting process to explain how they can mine while protecting other affected resources like the fish and the water quality. I strongly object to grant the assessment the EPA has done on the Pebble Project without knowing what Pebble's plans really are. Currently Alaska's economy is dangerously dependent on oil production. That production's declining at a rate of 7 percent annually. We should be doing whatever possible to diversify our economy. The EPA's pre-judging a resource development project before permits are even submitted sends a very negative message to future investors in Alaska. I also would like to request that the comment period be extended.

EPA Response: The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments, using the best available science. The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011). EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

SARAH McCARR: At the very least I am requesting for more time to be spent on the assessment. I think that many people in the region do not fully understand the potential impacts to the region. The majority is being told that it only concerns large-scale mining in the -- I can say that currently New Stuyahok is looking into planning to build a road connecting the communities. Can you tell me that the -- connecting the community adjacent to the Nushagak River. Can you tell me that the controversy will not affect this project?

EPA Response: The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region. Future land use and non-mining development are outside the scope of the assessment. EPA has spent three years developing the assessment.

RACHAEL PETRO: The Alaska Chamber supports predictable regulatory and permitting processes. And it's upon such a baseline that businesses evaluate the risk and cost of investing their dollars in any business endeavor. For this reason the EPA's watershed assessment action and the potential to initiate a 404(c) process on a project that has not initiated permitting is extremely disconcerting. Please extend your comment period to at least 120 days to allow for public review of the document and its sources. The current assessment and any preemptive action will deprive government agencies and stakeholders in this room of the specific information, size and rigorous reviews that will come out of a multi-year NEPA process. It's interesting that the project proponent has spent eight years and $120 million studying 1,500 square miles. They've not yet even applied for permits because they continue their environmental studies. It's outrageous that the EPA has spent less than a year assessing 20,000 square miles, an area about the size of West Virginia. This is a disgrace to Alaskans. The project in question is on State land designated for mining. Alaska's permitting and regulatory systems are the best in the United States supporting responsible resource development while protecting our awesome environment.

> **<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

LESIL McGUIRE: I express my concern, one, that the public comment period be extended. As a State lawmaker sitting on the resources committee spent a lot of time on this issue. My family owned a lodge in King Salmon, Alaska, for my formative years, for 22 years. I spent time fishing in the area. I know many of the Elders that live there and many of the people that make their livelihood from the salmon and other resources. So I think I join many Alaskans in saying that this is a very complex problem. There are competing resource issues and we're all moving through it together as an Alaska family. But what's so offensive is to have the EPA come in without any permit authority, as we've stated earlier by the previous testifier, without a 404(c) application even being made and usurping the rights that we have in this state to go through this process. The process is under way through our large mining act. There are intense analyses that are going on and I think if we allow this to go forward as Alaskans, whether you're for or against Pebble Mine, we're setting a very dangerous precedent. The lands that are at stake are State lands and they were selected in our statehood act and as part of the gift that we were given at statehood. So to have a premature decision come in I believe would thwart the objectives

> **<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

BRYAN CLEMENZ: As an Alaskan and a board member of the Alaska Support Industry Alliance. I am representing over more than 400 Alaska member businesses that support the mining, oil and gas industries employing approximately 35,000 people in the state. Our membership is not necessarily for or against any given mining development in the subject watershed area, but instead we all support responsible resource development. Our minds will not be swayed by entering speculative assessment based on a fictional model but instead deciding in due time and with due process through the well-established permitting process where the best available technologies at the time of the permit may be employed and the actual proposed mitigation plans can be appropriately considered. We further believe that the time taken to study the issue of this assessment is insufficient as is the comment period for the public to review and comment on this issue. The precedent set by this assessment for future projects will have an adverse effect on the economy of our great state and our nation.

> **<u>EPA Response:</u> Comment noted. The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011). EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

TIM ANELON: I'm from Iliamna, Alaska. I'm -- the mining is 17 miles away from my village and it's surprising to see EPA here. They're from Seattle. I've been to Seattle. I've been -- you know, I've been there. I've seen bridges all over the place. I'm surprised to hear you say that, oh, yeah, we might stop if there's a few culverts across some cricks. I'm the caretaker of Kvichack Salmon. I am the caretaker of Kvichak Salmon. If there's salmon that can't go up a crick I will call the Fish and Game of Alaska. Do you guys hear me? Fish and Game of Alaska to come and help clear our streams. You know, that's what you guys – you guys never came to Iliamna to talk to my parents because my parents are Elders. We have to invite you guys to come to our village. You guys say you're -- I'm -- I'm a vice president of Iliamna Village Council, it's a federally recognized tribe. And you guys have never come to talk to my Elders there.

> **<u>EPA Response:</u> EPA scheduled a public meeting in Iliamna during the public comment period, but the tribal council cancelled the meeting. EPA has made several visits to Iliamna to hear from tribal government representatives, stakeholders, and community members. Iliamna Village Council had representation on the Intergovernmental Technical Review Team and also selected Elders to participate in the TEK study conducted for this assessment.**

AVES THOMPSON: The Alaska Trucking Association urges that the EPA not make any premature judgments on the Pebble Project until the permitting process is complete. The Pebble mineral deposit is not located on federal land nor is it inside a refuge or a park. It is located on State land designated for mineral exploration. The State of Alaska depends on the development of its natural resources on its lands to diversify and support its economy. Every project no matter the size or location should have an opportunity to be reviewed by the process. In the case of mining there are more than 60 major permits and hundreds more from local, state, and federal agencies that must be successfully obtained. Please extend the comment period to adequately allow for public review.

> **<u>EPA Response:</u> Comment noted. The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

JASON METROKIN: The EPA is not an intruder to Bristol Bay but rather an invited guest by tribes and Bristol Bay Native Corporation. I'm here to tell you that the assessment is a welcome balance to the science needed to test the co-existence of the world's largest and potentially last wild salmon fishery and development of hard rock minerals. BBNC believes in the end the science will show that Bristol Bay salmon are worth protecting and the vast majority of our Native shareholders will agree. Our study last fall indicated that 81 percent of BBNC shareholders oppose development of the Pebble Mine. To my knowledge this may be the first time the proponents are in the minority for a large-scale development project in Alaska. The voice of the people must be heard on this issue. Who better to dictate the future of resource use than the very people who represent 10,000 years of caretaking. Our results show 68 percent of Iliamna Lake shareholders, 74 percent of Naknek/King Salmon area shareholders, 75 percent of Chigniks, 86 percent in the Ugashik area, 90 percent in the Togiak area and 93 percent in the Nushagak area villages oppose this project. These numbers represent families who recognize the need to protect the fishery and the risks associated with the proposed Pebble Mine are far too great.

> **<u>EPA Response:</u> Comment noted. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

DOROTHY LARSON: It is a critical document which reinforces Bristol Bay's commitment to the shareholders and tribal members of our region. We make sure that our position reflected the position of our people. They do not want a humongous hard rock mine amidst the salmon streams, lakes, rivers, wetlands and neighboring lands which would impact and destroy our way of life. The subsistence, commercial and the sport fishers must be protected and be held risk free. The risks and impacts to our salmon culture are formidable and unacceptable. We cannot afford to speculate on the success or non-success of the Pebble Project going forward. We cannot afford either. We too have conducted our own studies at BBNC. And we have worked with the scientific community. Please review the BBNC's Pebble Watch publications which provide much scientific information. We will submit these as part of the record for our technical comments. We are pleased that the EPA has reviewed the indigenous and traditional knowledge and had consultation with village Elders. However, when do hundreds of years of what the western scientific community referred to as anecdotal become hard science? We must give credence to the observations and the experience of the indigenous perspectives. Please maintain your time line

> **<u>EPA Response:</u> The BBNC's Pebble Watch publications were read and considered by EPA. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

DAVE ATCHESON: I am an ex-commercial fisherman and a lifelong sport fisherman who's been lucky enough to experience the awe and wonder of catching a variety of fish in the Bristol Bay drainage. What I would ask of the EPA is to take into account that most of those studies are done on mines like the Bingham Canyon Mine which is comparable to a mine of this sort are done in relative arid environments compared to the Bristol Bay drainage with a huge amount of rainfall, ground water that's only 30 inches, in some cases, below the surface. And it's inconceivable to do something like this if you look at the science and you look at the other studies that are long term that have been done. And I would ask you to take into account how wet this region is. The analysis simply doesn't bode well for an area like Bristol Bay. It's unconscionable to think that this could happen. 350 runs of wild salmon are extinct in the Pacific Northwest and it's happened in my lifetime. That is a terrible legacy would be to leave to our children and our grandchildren.

> **<u>EPA Response:</u> Our use of Bingham Canyon is in the context of a generalized discussion of porphyry copper deposits around the world and is not a direct comparison to the Pebble deposit. No change required.**

BRETT VEERHUSEN: I'm concerned about the Pebble Mine because I am 26. I'm likely to feel the effects of this mine longer than most people here. I employ three people along with myself every year through my commercial fishing business. And I'd like to keep it that way for as long as I'm a fisherman and for as long as I'm a small business owner. I'm not against mining. I'm not against jobs. I'm not against economic impact. But the 14,000 renewable jobs and the $480 million impact commercial and sport fishery provides to Alaska and the nation is not worth sacrificing for a short-term goal and a copper mine. I'd like to remind the EPA that 82 percent of the commercial fishermen in Bristol Bay are against the Pebble Mine. I'm here to say that I hope to keep fishing, whether it's myself or my family, forever. And to keep Bristol Bay's water pristine and thriving forever. And I'd like the EPA to thoroughly examine the future of our fisheries and the impact a mine like the Pebble Mine could have on up-and-coming young captains who want to provide a clean, renewable food for Alaska, the United States and the world.

> **<u>EPA Response:</u> Comment noted. The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.**

NANCY HILLSTRAND: My background is in remote Alaska salmon culture for all five species of salmon and for critical life stage histories from spawn to migration. And if we damage something as absolutely immense as the Bristol Bay salmon resource it's just absolutely unconscionable. Please expand the assessment on the sensitive life stage histories for all and each of the salmon and trout and all the freshwater fish species to include prior and during the eyed-egg stage which is a very, very fragile stage of salmon which I didn't see in the assessment. And also upon the hatch while the alevins are below the substrate and the rearing smolt habitat of vertebrates.

> **<u>EPA Response:</u> Risks to eyed-eggs and other early life stages are considered with respect to the loss of spawning habitat, toxic effects and burial by spilled tailings in the event of a dam failure.**

VERNER WILSON: This fishery, as you know, is a renewable resource. It's been here for thousands of years and we want to protect that. And, you know, this mine -- the Pebble Mine but also the infrastructure and other mines that it can lead to are fine but they'll only last for a few decades. And so I'm very disappointed in the State of Alaska for not taking the leadership to assess the -- all the impacts that it could have on the residents of the state of Alaska but also the people of Bristol Bay. It's sad that we have to hear -- depend on the federal government to help protect our resource. The marketing of our seafood industry in Alaska, how it could affect future taxpayers by placing the burden on all the taxpayers in the future to upkeep this mine. And I want to remind everyone that Pebble may be on State land but this is an international resource. This is a national resource. And this is a resource that is for local people. And so it could affect federal land, State land, local land. And so I hope that -- I'm glad that the EPA's taking the leadership to protect our fishery

> **<u>EPA Response:</u> Comment noted, no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

STEVEN GOSUK: Given the factual information within the time EPA conducted its scientific research which was roughly a year I am convinced with the releasing of the data -- I am not convinced with the releasing of the data that has been published. In giving this food for thought and thinking about it, getting potential evidence from a vast location of the proposed mine site area, a year's worth of data collection is not sufficient enough for a report. I would also like to ask if the EPA is taking into consideration postponing community hearings within the busy time of the summer season.

> **<u>EPA Response:</u> We used data from the Pebble Limited Partnership, the State of Alaska and many other sources, and data were not limited to a single year's data. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

REED CHRISTENSEN: In the case of the Sackett family the EPA unsuccessfully tried to overwhelm them with their position of having all the knowledge and knowing all the facts. Now in the case of the possible Pebble Mine Project it would appear the EPA's trying a different tactic. In this case the EPA is facing an organization that does know about the environment. In this case the EPA's dealing with an organization that has done a tremendous amount of research and has the technical ability as well as the financial wherewithal to go toe to toe with the scientists of the EPA. The Pebble Project scientists have done and continue to do their homework. They have jumped through hoops and they continue to go well above and beyond the normal requirements in order to address concerns and to mitigate the risks associated with this project. So what does the EPA do now? It appears that they are preemptively trying to brush aside the science and research and tell us that this whole concept is not a good idea.

> **EPA Response: The assessment was specific to Bristol Bay, is not a regulatory action, and does not establish precedents for other types of development or large-scale mining in other places. We included data from PLP's Environmental Baseline Document throughout the assessment (despite the fact that this document has not yet undergone a complete peer review), because it does represent a wealth of data for the area surrounding the Pebble deposit.**

SIDNEY NELSON: I live in Dillingham, Alaska. My family and I are subsistence users. We put up king salmon for family use every year. We also put up a lot of sockeye and harvest moose each year. The time line is sufficient. Don't let mining in Bristol Bay hurt our culture by instituting 404(c) action.

> **EPA Response: EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

RICK HALFORD: I have to apologize to all my friends in the mining industry, I've only opposed one mine, just this one. So I'm sorry, but this one is different. This one is unique in all the history of Alaska in that all the mines in all Alaska's history would fit in the hole. But the bottom line is you're here because, sadly, of the State's failures. And that bothers me because it is my state and I care what it does. But the fact is that the State lacks enforcement of water quality standards, of water use permits. The State's joining with those who work against and work against the citizens who tried to sue and go to court. We see the Pebble Mine and the State of Alaska against Alaska citizens in numerous lawsuits. We see the State of Alaska changing the primary designation of this plan of this area in the area of the plan in 2005, years after the claims were filed. The delegation in the State Legislature representing this region is unanimously on record asking you to be here asking you to review this. You are not here as someone coming from Outside. You're here at the request of the original people of the area and the overwhelming majority of the population. If there's anything short in your report it's that you've understated the size and potential

> **EPA Response: Comment noted; no change required.**

MICHAEL SATRE: The Council of Alaska Producers strongly believes the development of our natural resources should be accomplished through a permitting and regulatory framework that is rigorous, science based, transparent and predictable. We also encourage and support local input and involvement through the currently established permitting processes that are initiated once a project has been proposed. This ensures that health, safety and the environment are properly protected through the completion of all required impact studies before a decision can be made to permit or restrict development. Unfortunately the EPA's decision to issue the draft watershed assessment that uses a hypothetical mining project to outline potential impacts in the Bristol Bay area usurps a currently established process. While we support the collection of baseline scientific data in the region to use and evaluate future permit applications we cannot support the use of this data in premature, speculative and hypothetical scenarios that attempt to assess the impacts of large-scale development. Furthermore, the possibility of these assumed impacts could then be used to justify preemptive section 404(c) actions that prohibit development and lack scientific credibility. The development of our natural resources here in Alaska must be carefully balanced to ensure that our environment is protected and the resources are not put in conflict, that modern mining industry in Alaska and communities that surround it have benefit from the process while permits be filed, impacts measured and appropriate mitigation protections put in place before operations can begin. I'll be asking to halt this assessment until permits can be filed.

> **<u>EPA Response:</u> EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments, using the best available science. The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

JOHN SHIVELY: I'm the CEO of the Pebble Limited Partnership. I want to make a couple quick points. First of all we certainly recognize the EPA has a right to do a watershed assessment. We don't think the way you've done this one is correct particularly if it's going to be a precursor to using the 404(c). We think the report is inadequate. We've spent eight years and $120 million studying a much larger area than you've studied in less than a year. We have an environmental and social report that's over 27,000 pages compared to your relatively short report. It's rushed. Why a hearing only two weeks after the report is out? Why only 60 days to comment? What is the rush? I mean, if your science is good people should have the time to look at it. And then lastly I'd just like you to think about this: If this report is being used by EPA to issue permits for Pebble to mine, the people that oppose Pebble will be yelling and screaming about the process, that the report was inadequate and that the timing was wrong and that it needed to be done better. They'll be doing that and they will be absolutely right.

> **<u>EPA Response:</u> The PLP's Environmental Baseline Document presents the results of site monitoring and testing, whereas the assessment is an ecological risk assessment that uses those data and others to estimate potential effects. In addition, the scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife. Therefore, comparisons of the lengths of the documents and the times taken to produce them are meaningless. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA**

requested additional public comment and peer review on the revised assessment in April 2013.

CHIP TREINEN: United Fishermen of Alaska strongly supports the rigorous peer review that can further establish credibility for the final report. While some may find fault within the assessment before specific projects have been submitted, general geologic, biologic, hydrologic and engineering realities are not by any means unknown. As noted by EPA, this study is not a regulatory action and does not pre-judge consideration of proposed mining activities through the normal permitting process. UFA hopes that this assessment will provide a useful foundation for analyzing the economic and ecological values of the Bristol Bay region and can be a touchstone to help guide decision-making on specific large-scale mine proposals.

<u>EPA Response:</u> Comment noted; no change required.

JOHN MacKENZIE: I'm here today to express Anglo American's significant concerns about the draft Bristol Bay watershed assessment. The United States and Alaska have rigorous systems for evaluating mine application. As a global mining company I can say that they're amongst the most rigorous in the world. We strongly encourage the application of these well-established and fair processes, rather than this hasty approach which is without any precedence and that could shortcut the due process. Meaningful judgment about the Pebble Project and the effects that it may have on fish and water in southwest Alaska cannot be made before this project is fully designed, submitted and evaluated under the National Environmental Policy Act. Approximately two years ago we experienced an 8.8 magnitude earthquake, one of the largest ever recorded. None of the tailings facilities at operations in Chile was damaged by the earthquake. The watershed assessment must take into account the modern engineering that goes into planning, building and operating tailings facilities today before making its final assessment.

<u>EPA Response:</u> The assessment was based on the preliminary plan submitted to financial regulators by Northern Dynasty Minerals (Ghaffari et al. 2011) and on other sources relevant to current mining practices. There was a tailings dam failure following the earthquake in Chile that resulted in loss of life; it is now cited in the final assessment.

KENDRA ZAMZOW: Geology, habitat and geography provide the basic constraints within risk and mitigation were examined. The EPA looked at a reasonable scenario, not a worst-case scenario. They were clear about uncertainties, and despite the uncertainties it is clear that significant damage will occur even under best mine management practices. Damage will occur because the network of surface and subsurface waters provide diverse and essential habitat. And the pattern of mining copper porphyry severely disrupts hydrology. Damage will occur because massive waste facilities must be managed to prevent chemical damage to aquatic habitat. But treatment cannot go on day in and day out forever.

<u>EPA Response:</u> Comment noted; no change required.

DEANTHA CROCKETT: The watershed assessment isn't about mining at all. It's not about the proposed Pebble Project or effects on salmon habitat. It's about frantically stopping the project before it even enters the permitting process. When our nation, state or community tries to stop projects before they even submit plans for review we lose our ability to manage the economy to provide jobs for our people. Let me be clear. A preemptive decision on a project, whether it's approval or denial, is unacceptable to the Alaska Miners' Association. Our mines provide full-time, high-paying jobs with an average wage of $100,000 to Alaska residents right in communities where the mines are located. Who better to take care of the environment than the ones who call it home. In regards to the assessment, spending less than a year to assess an area 20,000 square miles is irresponsible.

<u>EPA Response:</u> The assessment required nearly three years to complete and was based on data collected over many decades. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act. EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places.

MATTHEW FAGNANI: What I find amazing about the EPA Bristol Bay watershed assessment report it's based on a conceptual hypothetical mine project. This is junk science. The EPA would never accept a conceptual or hypothetical application for a project from a resource industry developer nor should you have produced a report that's not based on facts and not supported by permit application. This action is a disservice to Alaska and especially rural Alaskans with high unemployment and whose communities need jobs and economic diversification. As you know there is ample time for the EPA to weigh in during the established committee process to I also support the State in asking for the 120-day extension of the public comment period.

<u>EPA Response:</u> All risk assessments are hypothetical, in that they estimate the future consequences of a scenario. The scenarios in this case are based on the preliminary mine plan provided by Northern Dynasty Minerals (Ghaffari et al. 2011). EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

TOM LAKOSH: So, yes, it was quite helpful to raise the debate; and it is absolutely necessary at this point now to follow through to get exact numbers to discern exactly how much we will have to put aside for the in perpetuity treatment of waste and possibly the further scenarios that were mentioned. So it's that type of information that we need to properly fashion legislation to protect the long-term interests of Alaskans to make sure that these developments are done in a responsible manner if at all.

<u>EPA Response:</u> Comment noted; no change required.

RICK ROGERS: And we would request that comment period be extended 120 days It is simply not the EPA's role to dictate to Alaskans appropriate uses of State land outside the specific confines of reviewing permit applications for fill and discharges for specific projects. Alaskans don't need the EPA to remind us of the importance of our fisheries for both commercial, sport and subsistence uses in our economies. We also don't need the EPA to talk about the negative impacts of unregulated mining.

<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

TIM TROLL: A few observations supported by this research and your assessment: Large open pit mines in this region cannot be built without destroying salmon habitat. In fact some habitat the State has already protected is mineral lands. What we understand about the natural system in this area that would be destructed by an open pit mine is dwarfed by what we know we don't understand. In all likelihood a copper mine in this region, even one built with best intention and modern method would require post-closure active management, power for pumps, constant treatment and human vigilance to prevent pollution forever. For many of these reasons I don't really believe this is a decision for our generation. And one technical comment: I don't believe the EPA assessment really adequately addressed the issue of fugitive dust during operation and during construction.

> **EPA Response: The assessment text has been expanded to acknowledge a broader range of potential salmon-mediated impacts. The effects of fugitive dust were estimated for the transportation corridor but not the mine site, because we found no good data or models for dust from a mine like the one proposed.**

CARL PORTMAN: While the Clean Water Act gives the EPA authority to veto every agency's approval of permits, it is unprecedented that the agency would prepare a watershed assessment in advance of any permit application for a project development plan. The agency has never used its veto authority in advance of permits being issued by other agencies.

> **EPA Response: The assessment is a scientific document. It is not a regulatory action and does not constitute a veto under 404(c).**

NELLI WILLIAMS: Part of my job is working with a crew of sport fishermen, guiding operators, guides that depend on Bristol Bay's healthy fisheries. Many of these folks are out in Bristol Bay right now shuttling their gear, getting their staff ready for the upcoming tourist season; and they aren't able to be here in full force. But in talking with them they were particularly impressed and liked that in the watershed assessment you looked at the impacts that large-scale mining would have on the watershed even if nothing went wrong. I think that's a really important point that you did include in the watershed assessment. These small business owners will be directly impacted by a development like Pebble. They won't be able to take visitors to the 87-plus miles of streams that would either be dug up or dewatered. They will have to apologize to their visitors as helicopters fly overhead while they're fishing and they can't give them a true Alaska backcountry experience. So thank you for pointing out that even if nothing goes wrong there will still be impacts.

> **EPA Response: Comment noted; no change required.**

JOHN MacKINNON: And shouldn't the peer review be done before public comment? The watershed assessment, potential 404(c) action is premature in the absence of an actual permit application. A permit application describing the potential project will occur after a thorough review of all the issues that have been glossed over here with this watershed assessment. This steps outside of well-established regulatory processes and represents another unwarranted federal incursion on the management of Alaska's lands. The 60-day comment period in place is insufficient and should be extended by 120 days to allow commenters ample time to provide feedback. All of this after a thorough peer review.

> **EPA Response: It is common practice to give the peer reviewers access to public comments so that they can consider them in their deliberations. The public was also given another chance to respond after the first peer review. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating**

public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

INEZ WEBB: I'm originally from Dillingham. I grew up in the same area that both of my parents grew up in and both of my grandmothers. I'm a member of the Curyung Tribal Council, Choggiung Limited and Bristol Bay Native Corporation. I want to thank you for being here. I also want to thank you for scheduling the hearings that you have in the Bristol Bay region. I think it's very important for those who cannot and don't have the means to come here to have an opportunity to speak. I think your time line is great. And with all due respect I think that the cart is in the right place. I thank you for your time.

<u>EPA Response:</u> Comment noted; no change required.

AARON STRYK: So before you continue to move forward I ask you to stop all further work on this assessment process until the Pebble Project has been fully designed, has presented an environmental mitigation study for protecting the aquatic resources in the area, has completed an economic benefit study and finally has submitted a formal permit application to the federal government and begun the lengthy permitting process.

<u>EPA Response:</u> Comment noted. EPA continued with the assessment process and issued a final assessment in January 2014.

ANDERS GUSTAFSON: We've been screaming at the top of our lungs for years asking somebody to look and see what we're about to do to future generations to one of the greatest fisheries in the world.

<u>EPA Response:</u> Comment noted; no change required.

KATI CAPOZZI: Extend the comment period to 120 days. I really think you should drop this assessment altogether until an actual permit is applied for, and then that would be maybe the more necessary time to step in and conduct an assessment.

<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

JEFF PARKER: I do think you need to address fugitive dust from mining operations. You've addressed it only in the context of the roads. From mining operations you have -- in that fugitive dust you can have acid drainage. Second, you do address the management of -- the history of the management of the fisheries. And you address also the 4,000 years of history of trying to protect the drainages by the Native people. I think you should also address the more recent history of State and federal efforts to protect these drainages and that's been outlined. Thirdly, I encourage you to take a more expansive view of cumulative impacts. You addressed cumulative impacts only in the context of additional potential mines. I would address it as the regulations do in terms of secondary effects such as population growth, that sort of thing that may have increased competition for use of resources, use of fish and game. You addressed it only in terms of habitat. Fourth, I think you should clarify the statements about tailings dam failure. The results only -- it relates only to slope failure not other sources such as overtopping. And, finally, fifth, I think you should edit carefully your appendixes for the moments in which your experts talk outside their expertise, sometimes inconsistent with other portions of the documents.

<u>EPA Response:</u> Dust as a stressor is considered in Section 6.4.2, but was not included in the scope of the assessment (other than in terms of roads) because it was not judged to be a significant factor for fish populations. We clarify in Chapter 9 of the assessment that slope failure only represents one way in which a tailings dam may fail. Chapter 13 of the revised assessment expands the evaluation of cumulative impacts.

TOM MALONEY: At the present time there is no project development plan for Pebble or various other possible resource projects in this area. Therefore, it is premature for any agency to reach any conclusion on potential environmental impacts which may never arise based on the future project plan.

<u>EPA Response:</u> There are preliminary mine plans for the Pebble deposit (Ghaffari et al. 2011), and the Pebble Partnership and Northern Dynasty Minerals have been clear about their intention to develop a large-scale mine.

KARA MORIARTY: We oppose the EPA Bristol Bay watershed assessment because of the dangerous precedent it sets for all Alaska industries including especially our industry, the State's largest economic driver. The primary concern expressed by my members is the EPA's unprecedented action of preparing its assessment in advance of any permit application. Moreover, the fact that the agency has rarely used its veto authority and never in advance of permits being issued by other agencies is especially troubling.

<u>EPA Response:</u> The assessment is not a regulatory action by the EPA.

SUZANNE ARMSTRONG: The assessment is premature, inadequate and the effect of a 404(c) action could have a detrimental impact on all resource development and jobs for Alaskans. The draft watershed assessment attempts to assess the potential environmental impacts associated with mining activities and at a scale that is yet to be determined by the project developer and without environmental mitigation factors that have yet to be defined by the project developer and Corps of Engineers. It is unreasonable that the EPA could develop a thorough assessment of potential impacts after spending less than one year studying an area the size of West Virginia especially after the project developer has spent over eight years and over $120 million conducting environmental studies.

<u>EPA Response:</u> The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments, using the best available science. The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011). The assessment required nearly three years to complete and was based on data collected over many decades.

SAM SNYDER: Pebble's data, Pebble's own data, makes it quite clear and your assessment helps to add to that clarity couple of things: Bristol Bay is the world's largest and most diverse sockeye salmon fishery on the planet on which jobs, economies depend. More importantly Pebble's data shows a complex system with clean water, little ability to buffer against metals toxicity or acid mine drainage. More importantly this mine will generate acid in periods of decades to months, therefore could pose great risk to the fishery and to the communities that depend upon it. I urge you to stick with the time line.

<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

DAWN FRY: Tedi Mine (New Guinea) is in an area of subsistence people who don't wear shoes and don't have schools; they lost all their fish when the tailings dam failed.

<u>EPA Response:</u> Comment noted. Case studies were used to illustrate the fate of tailings in streams and floodplains.

TERRY SEVY: I can't tell you just how important Bristol Bay and the salmon I catch, the industry are to me, to my family, my friends, the state of Alaska and our country. For that matter, the world. Pebble Mine threatens not just my way of life but a way of life for generations to come. The mine would set the foundation for ecological and economical disaster. I urge the EPA to use their authority and the 404(c) to protect Bristol Bay.

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

LIZ SNYDER: My concerns with the Pebble Mine are related to food security in Alaska. With respect to a western diet we are a state experiencing a serious degree of food insecurity in terms of healthy food availability, access and utilization. It's been estimated that we import 95 percent of our food and that only three days' worth of food are on the shelves in grocery stores in cities like Anchorage and Fairbanks. However, in rural Alaska for many the store is literally right outside the door, and I understand that most would like to keep it that way. The environmental threats of the Pebble Mine are also human health threats in that reductions in the real but foreseen numbers and quality of wild foods can contribute to decreases in subsistence activities, increases in food insecurity and a continued increase in costly diet-related conditions such as obesity, diabetes, heart disease and cancer.

<u>EPA Response:</u> Comment noted, no change required.

DAN OBERLATZ: In May of 2010 the New Zealand government conducted a study of mining's impact on tourism. Their conclusion: Quote, the risks to tourism arise from both derogation of key landscapes and from damage to the nation's clean, green and 100 percent pure branding in overseas markets. As a result an important segment of the international tourism market will simply switch to alternative destinations in the event policies are adopted which downgrade the brand image. The resulting projected damage to GNP could be in the order of one percent of New Zealand's GNP.

<u>EPA Response:</u> Comment noted. The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.

PETER MACKSEY: I'm testifying in protest of what I see as an attempt to circumvent the process. No permits have been applied for. No mine plan was submitted. The real review begins after the application happens. What did this cost, if I could ask? What was its purpose? I think you should wait till a permit process happens and move ahead then.

EPA Response: The purpose of the assessment is to evaluate potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife.

MAYNARD TAPP: We need to go back and follow the process that's been established in law and by State and federal law. The other thing -- and basically I'll just -- let me say give it over to whatever John Shively said. I know the folks that work over at Pebble and they would not do this project unless they can do it right. The other thing, this is a process within your own system in your report. If you do a risk assessment and you have a no failure policy or result you also need to include in that result the risk of new jobs, new revenues to the state and new health and educational facilities that would be brought to the state by way of a project like this.

EPA Response: Comment noted. The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy.

PAIGE KRICHBAUM: I would like to read our youth resolution to protect wild Alaska salmon. Whereas wild Alaska sustains our lifestyle, economies and our Alaskan identities. Whereas living off of salmon is our way of life and we want future generations to have the same great experience as us and our ancestors. Whereas Alaska commercial wild fisheries provide 50 percent of the seafood consumed in the U.S. and 44 percent of the seafood exported by the U.S. Whereas of all Alaska major industries including construction, oil and gas, mining and forestry, the wild seafood industry employs the highest number of Alaska workers. Whereas genetically engineered fish are a threat to human health, wild fish stocks and Alaska's economy. Whereas the proposed Pebble Mine threatens to devastate the economic, cultural, and environmental viability of the Bristol Bay region along with the state of Alaska. Whereas Alaska is the last stronghold of wild salmon in the world. Now, therefore, be it resolved that Alaska youth recognize the importance of preserving and protecting wild Alaska salmon and ask our leaders to preserve and protect the habitat and integrity of Alaska's wild salmon against irreversible harm. This was signed by teens all over Alaska including Anchorage, Cordova, Fairbanks, Homer, New Stuyahok, Seward, Yakutat, Newhalen, Kenai, Dillingham, Togiak, Elim, Bethel, Emmonak, Golovin Bay, Koliganek and Palmer.

EPA Response: Comments noted; no change required.

KEITH WALTERS: I can tell you that our existing regulators are very thorough and know what they're doing. I think that you should give them a chance to do their job and do it correctly. And I would urge the EPA to postpone or drop the watershed assessment and any possible use of 404(c) in the future.

EPA Response: EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act. EPA continued with the assessment process and issued a final assessment in January 2014.

CHARLES HAWLEY: The EPA did not ask for comments on the economics of the Pebble Project or any other copper deposit. The EPA is contracted to make a professional analysis of the complex model but it is not in the model produced. The EPA did not and perhaps should not adjust items outside of its jurisdiction to have a general interest and arguably equal value in environmental analysis that was made. It did not seek information on the non-subsistence economy of the project area or the importance to the State of Alaska even though this project was on State land with favorable minerals.

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.

KRIS WARREN: You know the mining industry has a long history in Alaska. And at least in the most recent years has had an outstanding environmental track record. While providing a thousand good-paying jobs throughout the state there's numerous examples of large and small operations in Alaska which have protected and in some cases even improved the natural environment, the Red Dog Mine being one example in particular. There's no valid reason to believe that a copper mine in the headwaters of the Bristol Bay watershed would have a negative effect on that fishery especially given today's stringent regulatory oversight and modern mining methods. Quite the contrary, the mine will produce an immense amount of materials -- minerals which we all need for everyday life while producing thousands more badly needed and good-paying jobs in southwest Alaska.

<u>EPA Response:</u> The assessment finds that there would be significant impacts the salmon fishery from mining development. The mine scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used.

VALERIE CONNOR: I know everyone in this room would agree that our salmon resources are vital. Whether -- where we seem to disagree is whether or not large-scale industrial mines belong in the headwaters of one of the most productive salmon systems in the world. Mining has historically caused damage, sometimes catastrophically, to watersheds around the globe. And Bristol Bay watershed deserves this extra level of scrutiny. The cumulative impacts caused by a mine of this scale will have negative impact on Bristol Bay fisheries. Please continue to do your hard work protecting the waters of Alaska. And we hope you'll use your authority using the 404(c).

<u>EPA Response:</u> Comment noted. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act

CHARLES ENGLAND: In fact, the application and the process has not been submitted. And that's why I find it personally offensive as a citizen of the United States of America and also an Alaska citizen that the EPA would step in before and circumvent the State's rights, the due process on State land concerning the mining area that was designated to be able to do so.

<u>EPA Response:</u> EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places. The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife.

HENRY OLYMPIC: Do we really want Pebble in our backyard? And I'm not for Pebble; I'm not against Pebble. I'm neutral. We talked about development within our communities, opportunities for ourselves and our younger generations. I think about my community, Newhalen, the communities around Newhalen, my boys that are growing up and being raised in Newhalen. We as community members need development and opportunities for us to become independent and to grow within our community,

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.

NICK PEPPERWORTH: I think you guys should go back home to Washington, Oregon or wherever.

<u>EPA Response:</u> Comment noted; no change required.

BONNIE TISLER: I'm a fourth-generation Alaskan that came -- our family came here for mining. I'm a miner. I'm a member of the Gold Prospectors of Anchorage, Alaska. I agree with the comments of Alaska Chamber of Commerce. I think we really need to listen to those people. They're our economy.

<u>EPA Response:</u> Comment noted; no change required.

AMY SNYDER: These individuals and their families are currently culturally and economically dependent on helping marine and coastal environments. We have the world's largest wild salmon fishery in Bristol Bay and watershed to nearshore habitat needed to support subsistence productivity. So with regard to the protection of clean water and healthy marine ecosystems it's not just a natural world that must shape your deliberations but also the people, economies, cultures and traditions. This is life in coastal Alaska. U.S. policy should seek to support our communities. The EPA has properly acknowledged the need to protect clean water and healthy marine ecosystems. The significant risks posed by the Pebble Project jeopardize the region's clean waters and abundant natural resources. The EPA has the power under section 404(c) of the Clean Water Act to prohibit or restrict the discharge of dredge or flow materials if they pose an unacceptable adverse effect on natural resources, fisheries, wildlife, waters or recreational areas.

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

BEAU OBRIGEWITCH: And here we are beginning a fight against the threat that the EPA will shut down Pebble under the auspices of the Clean Water Act before the permitting process has been given an opportunity to play itself out. You asked at the beginning of this what needs to be added to the assessment. More time. Wait and evaluate the permits that are eventually applied for.

<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

DAVE APLIN: And if I might just add, fugitive dust is important. Additional look at seismic activity is important and looking at the infrastructure that will develop and the secondary and tertiary impacts is all important work to do.

<u>EPA Response:</u> The assessment text has been expanded to acknowledge a broader range of potential salmon-mediated impacts.

GAIL PHILLIPS: Other than trying to do an end run on well-established permitting processes at both the State and federal levels, why are you so afraid of the outcome that you have chosen this preemptive measure to try to stop the Pebble Mine without even knowing the benefit or parameters of a mine plan? How can you intend to separate any potential restrictions in your 404(c) findings as they relate to any State or local development project in the Bristol Bay watershed unrelated to the Pebble Mine? What legal justifications will you use to excuse blatant prejudices against the mine versus another project such as a community water source project? How do you plan to justify your actions or findings that may be in conflict with NEPA, the Clean Water Act or the Alaska Statehood Act?

> **<u>EPA Response:</u> The assessment is an ecological risk assessment, not a regulatory action, and it does not propose or recommend restrictions on mining. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).**

NANCY WAINWRIGHT: I urge you to look carefully at the State's ability to monitor and to carry out its permitting process and conduct rigorous permitting that you have heard about tonight. Because in my organization we represent people that have attempted to get information just about Pebble exploration, not the development, from the State. And we had to use litigation and the discovery process to gain information about what the State was authorizing at Pebble and what Pebble had done at the site at just the exploration stage. The State has still done no analysis of the cumulative effects of that exploration that has occurred for 24 years at the Pebble site. And no analysis of the impacts of the discharges of drilling muds on the tundra

> **<u>EPA Response:</u> Comment noted. Current exploration activities are outside the scope of the assessment, although they are mentioned briefly in Box 2-2 of the final assessment.**

RENEE REEVE: Further, any preemptive decision on any project or permit should be unacceptable to those who respect the process in place. EPA should absolutely extend the comment period

> **<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.**

RICHARD KOLLER: I support responsible resource development in Alaska. I'm appalled that nine federally recognized entities invited a federal agency to change the page -- of the legitimate permitting process for resource development citing hypothetical problems with tragic consequences unfounded by any evidence-based effort, information.

> **<u>EPA Response:</u> Comment noted; no change required.**

DON McEWEN: I've always been for the Pebble Mine. But because of you folks' report I think that there should be no processing of any abstracting materials at the mine site because of the potential disastrous results, that it all should be loaded on a rail line and taken to the tidewater in Cook Inlet, processed there, or put on freighters and taken elsewhere to be processed. And there's a potential side effect to having a rail line to that area. It would be a safe secure way of transporting boats from Cook Inlet to Bristol Bay area.

> **<u>EPA Response:</u> Comment noted; no change required.**

APRIL FERGUSON: And good job on the watershed assessment which as I understand it did take into account Pebble data and State of Alaska data. So it's good to know that a half a billion dollars in study they did is going to be used for something. I would ask you to stick to your time line, please. I believe personally it's in America's national security interest to protect the genetically diverse salmon stocks of a major food source of 46 percent of the world's red salmon come from the Bristol Bay region, and it's all protein. It's something we need to husband and take care of. You're here because the Bristol Bay region is a wetland, and some people would call it a swamp. It's this hydrologic connectivity of rivers and ponds that the assessment speaks of. This area is so porous and saturated that the salmon smolt can swim underground from the rivers through the sand literally to the inland ponds and lakes there. Out of the research data that Pebble provided there's a glaring lack of seismic data. I wanted to mention that. And please take in account the Mulchatna caribou herd.

> **<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. The assessment, specifically Appendix C, does include information about the Mulchatna caribou herd but does not include an evaluation of risks to the herd from large-scale mining.**

DONALD STEVENS: The adverse consequences of the EPA's Bristol Bay watershed assessment are far too great to be based on a rushed, incomplete, pseudo-scientific, premature and biased effort.

> **<u>EPA Response:</u> The assessment is based on the best available science, evaluates all available information, and was conducted in an open and transparent manner using established and rigorously reviewed scientific inquiry. EPA spent three years developing the assessment.**

DAN SADDLER: There's a fair process where we decide whether there should be a Pebble Mine or not. The NEPA process, State permitting, large permit mining process. There's lot of ways to do that. I'm afraid that the 404(c) action is taking place outside a permitting process. It's just not fair. At the very least, extend the comment process and at best toss this out and do it again right the first time.

> **<u>EPA Response:</u> EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

CHRIS WILSON: The negatives of this potential project is unproven engineering on a scale that has never been attempted before in the history of mankind located in an earthquake-prone and volcanic area that is remote and environmentally fragile. Elimination of up to 4,000 acres of pristine wetlands and lost habitat.

> **<u>EPA Response:</u> Comment noted; no change required.**

JUDITH BERTNER: And I think you might want to include in your assessment that not only villagers depend on subsistence fish, but many of us in Anchorage do too, and other cities. I'm asking you, the EPA, to use your authority to protect this valuable resource.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

AMES LUCE: I thought that any analysis, and this may be beyond your particular charge, should be a risk/benefit analysis. And in a risk/benefit analysis I came upon an article, mining taxes and revenue in Alaska.

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.

CARL WASSILIE: And my Yup'ik name is Angut'aq. And I'm a Yup'ik biologist. I will speak on behalf of Alaska Big Village Network. And I do want to thank the EPA for this watershed assessment. It's extremely important to have a scientific analysis of the impacts to do the watershed. And the salmon, just one of many species, including the human beings that rely on the water -- the freshwater in the watershed. So the far-reaching impacts, as many people have mentioned before, from the region were not just economics, the cultural impacts are significant. If we go back to the time of -- in which many of the creation stories which are -- which allow for the cultural vitality of the protection of the ecosystem, services that provide these current economic benefits for hundreds of years in the industry, fishing. But the benefits of the cultural vitality are just as important because it's that respect that is given to the land. So traditional knowledge, it's a tough one. It's a tough one to look at, looking at the creation story and mythology, it's just as critical as looking at genetics of that salmon that we eat.

<u>EPA Response:</u> Comment noted; no change required.

SHARON COX: I believe the EPA in all of its wisdom is wrong in not allowing the permitting process to unfold in the normal fashion as any other large-scale mine or small-scale mine in the state of Alaska.

<u>EPA Response:</u> Comment noted. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

STEPHANIE SCHMIDT: I'm simply here as a fishery research biologist in support of your scientific study. Many of the criticisms of the study tonight focus on hastiness, yet no one has provided any explicit examples of how the science is bad or junk. No one has provided empirical evidence that would negate or disagree with what the EPA has put out tonight. I'd also like to thank you for not doing a risk/benefit analysis because you cannot put a monetary value on a loss of culture and a loss of subsistence in Alaska. One last point is I'd like you to consider looking at the changing environment that we face today. Climate change,

<u>EPA Response:</u> Although a full consideration of how climate change could affect mining-related impacts is beyond the scope of the assessment, we have included discussion of potential climate change in the region in Chapter 3 (Section 3.8) and consideration of climate and mining interactions in Chapter 14 (Box 14-2).

MARLEANNA HALL: The EPA must stop undermining existing regulatory processes and avoid setting dangerous precedent for projects in Alaska. Investment in Alaska should not be further jeopardized by federal overreach. extend the comment period by a minimum of 120 days.

<u>EPA Response:</u> EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to Bristol Bay and does not establish precedents for other types of development or large-scale mining in other places. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

SCOTT BLAKE: I think it's important to note that the Alaska seafood industry is a multibillion dollar industry. At the heart of it is two primary resources. One is pollock and one is salmon. At the heart of the salmon industry is the Bristol Bay salmon. You take that away and it'll affect our entire salmon industry in the state. It will be a crushing blow to all of us to be able to compete globally with the resources that we have being much more limited.

> **<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.**

CHUCK BECKER: EPA should table the assessment until such time as the permitting process is complete, then reintroduce the process.

> **<u>EPA Response:</u> Comment noted; no change required.**

CESAR MARTINSON: Conduct more thorough analysis on the tailings pond and the dust that this mine is going to create. I would encourage you to look at the health impacts that this mine is going to have on the people of Alaska.

> **<u>EPA Response:</u> The assessment text has been expanded to acknowledge a broader range of potential salmon-mediated impacts. The scope of the assessment is focused on potential risks to salmon from large-scale mining and salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on human health in the mining area and transportation corridor.**

VIVIAN MENDENHALL: A major risk to the environment that is not being considered in this assessment is direct toxicity of the mine's ponds and lakes to the wildlife in the area of the mine. There are going to be two types of water bodies. One is the lake or lakes that will fill the open mine pit. All open mine pits fill with water because they go down deeper than the water table. And some, not all, are filled with toxic water. You must manage the water forever to keep it out of the water table. The tailings pond is the other kind of water body. And they are always toxic because they're on top of metal and acidic rocks. They can be treated but that'll be to perpetuity. Northern Dynasty CEO said in 2006 that clean water would cover all the tailings. But that was the ignorance of the fact that lakes and ponds always mix top to bottom at least twice a year.

> **<u>EPA Response:</u> The scope of the assessment is limited to potential risks to salmon from large-scale surface mining and resulting salmon-mediated effects to indigenous culture and wildlife, but we do recognize the complexity of potential direct, secondary, and cumulative effects on wildlife.**

TOM BUNDE: If we have a permitting process that's valid, it should be allowed to work.

> **<u>EPA Response:</u> Comment noted; no change required.**

CHRIS BRANHAM: When you look at the size of this particular mine and the devastation it can do I said, "You know what, I don't care if I'm the last person here, this is not good." One of the things that hasn't been mentioned here is that people don't realize it, one of the things that's important if you go to the -- I don't know how many people have actually seen the area where the Pebble Mine is. You see pictures, you see all these fancy rivers and lakes and all this, all this flat country, there's nothing there. But unless you've actually been there you don't know what you're going to be destroying. One of the other issues that's also important is this scientific data. I don't need any scientific data to tell you that when you start digging a mine at Pebble you are going to destroy the fishing and all the salmon in that area.

> **<u>EPA Response:</u> Comment noted; no change required.**

PAULA WILLIAMS: One thing I'm not really clear from the report is whether the EPA has had the advantage of acid rock drainage reports out of Pebble Mine. I think that if you're talking about science those are very clear that the ores from the samples that they've taken, the last time I saw those on the State Web site was in 2008. But the ores are very high in sulphides and very low in buffering compounds. They will produce a significant amount of acid which will then release sulfuric acid which will then release a lot of chemicals into the water. So I am hoping that the EPA has in fact gotten ahold of those studies and taken a look at that. The tailings failure being toxic to invertebrates but that the toxicity to fish is less clear. I think there are plenty of studies that show that non-lethal levels of copper in the waterways do in fact have significant impacts on fish including their olfactory abilities, et cetera.

> **<u>EPA Response:</u> We used available geochemical data from the Pebble Partnership as part of the assessment. Effects on salmon olfaction were described in the first draft and are discussed at greater length in the revised assessment, including estimation of the stream lengths in which olfactory effects estimated to occur under the scenarios (Chapter 8).**

BEN MOHR: You guys mentioned a handful of projects in the assessment, specifically Groundhog Mountain or the Groundhog project and Humble prospect. Humble if I understand correctly had their first drill hole completed last week. The folks at Groundhog have only done surface exploration. I encourage the EPA to go back and do a more thorough assessment, give the residents in the state the time to actually read and understand the document and compare it to what they know.

> **<u>EPA Response:</u> Potential effects from Humble, Groundhog, and other mining claims are discussed in Chapter 13. We acknowledge that these explorations are in the early stages compared to the Pebble exploration.**

DAVID FARRING: No one is going to allow the fisheries to be destroyed. No one will allow that kind of project. What we need to find out is how can we develop this without destroying the fishery. That's the challenge. And if there's -- somebody mentioned a railroad. Well, how did they mine all that copper in the Copper River over at Kennecott without destroying the Copper River? One of the biggest king salmon runs in the state.

> **<u>EPA Response:</u> Comment noted; no change required.**

MICHAEL JESPERSON: You incorporate into your report studies without having time to fully vet them, let alone study them or come to decent conclusions. You incorporate studies into your draft proposal without the time to decide why those studies have the conclusions they were without the time to check the methodology of those studies and without the time to verify the results. How therefore can your study be scientific or fair?

> **<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA**

requested additional public comment and peer review on the revised assessment in April 2013.

DONNE FLEAGLE: The designated 60-day comment period would be ideal if it was in the dead of winter.

<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

LAURA GORMAN: The Pebble Mine people will come, and they'll rape the area; they'll walk out with dollars in their pockets, smiling. The land will be butchered. There will be acidic fallout, and it will affect the land. That's where the salmon spawn and come back and have come back for 4,000 years. It is a subsistence area.

<u>EPA Response:</u> Comment noted; no change required.

VAL ANGASAN: I'm -- the best and the worst-case scenario instead of July 23rd would be at least after, you know, hunting season which would be in October. So I would highly recommend that you let the 65 permits that are required to be done done. And then go ahead and implement and override Army Corps of Engineers as you see fit at that point.

<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

BARBARA WINKLEY: A similar mine at Queenstown, Tasmania went into operation over a hundred years ago. And the King River, which was recipient of much of the mine's sludge is only just now starting to recover. I come today to voice my opposition and oppose the permit for the biggest urban dam in North America and the Pebble Mine.

<u>EPA Response:</u> Comment noted; no change required.

JIM WHITLOCK: All I can ask is you allow that process to take place and all that to be answered in due time. extend the comment period for another 120 days.

<u>EPA Response:</u> EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

KAREN MATTHIAS: It sets a dangerous precedent to prohibit a project before it has even made a permit application.

<u>EPA Response:</u> EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

JOEL STEFANSKI: EPA takes -- talks about hypothetical mining scenarios like -- words like "likely, could, potential, low probability of failure." Questions for EPA are: What are the possible effects on Alaska for not developing a large-scale mineral site? This is a State issue, not a federal issue. If this 404(c) goes through, it will stop all resource industries including the fishing in Bristol Bay.

<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.

MIKE REDMOND: I'm going to keep my comments to the science used in the draft watershed assessment only, and specifically on section 6. My review of section 6, it looks like the people that wrote it had natural resource background, were biologists or chemists. And you need to have engineers be a part of the assessment team because they need to look at the structures and all the structural integrity and all of the engineering aspects that go along with this assessment. When Pebble ends up submitting their request they have one of the most sophisticated mines that engineering event -- project that's ever been done. And you need the proper team on board at the EPA in order to provide a proper scientific assessment of that.

<u>EPA Response:</u> The Bristol Bay assessment team included mining engineers and risk assessors as well as fisheries experts.

<u>Seattle Public Meeting - May 31, 2012</u>

REIDAR SOLBERG: And with the management of Alaska Department of Fish and Game, it magnified to runs as high as 60 million a year. This was made possible because of the water quality and the habitat in the region. We're again looking to the Federal Government for help to preserve the most powerful salmon-producing river systems in the world. I will be passing the fishery on to my son, with the hope that he will be able to pass it on, as a third-generation fisherman, on to his son or daughter in generations to come.

<u>EPA Response:</u> Comment noted; no change required.

DOROTHY LARSON: And my sons and my grandchildren and other family members are still involved in the fishery as commercial and subsistence fishers. They rely upon the economic benefits of the salmon, as well as the cultural and subsistence value of the salmon and other resources from the land and the sea. We do it by taking care of our land and our resources from the sea, as well as the land, from the abundance of the natural resources that feed us throughout the year. It's not just during the salmon season; it's throughout the year. It also provides an economic base with the commercial fishing and other economic interests we invest in. We want to sustain our subsistence lifestyle, while blending the western way of living, which we must adapt to.

<u>EPA Response:</u> Comment noted; no change required. Chapters 5 and 12 of the assessment recognize the strong relationship local communities have with the resources in the Nushagak and Kvichak River watersheds and acknowledge the importance of subsistence hunting and fishing and the traditional way of life in Bristol Bay.

ANNE MOSNESS: I started in 1973 up there. My son started coming on the boat when he was ten, and there was 70 years between the oldest and the youngest on our fishing boat for four summers. my father realized that we were a part of that great cycle of nature. We were harvesting this fabulous fish that was being eaten by people all over the world. We had a lot of pride in the family business. It was not short-term wealth, which is what his gold mine would have brought him. We have too many things happening that are destroying the economy of the fisheries, but I want folks to know that there's many of us here working to keep the value up.

> **<u>EPA Response:</u> Comment noted; no change required.**

BOBBY ANDREW: I'd like to see you take another look at the subsistence portion where you have 342 pounds of food. I think it's a lot more than that, what we fish for the season. In addition, many of the tribes do support the timeline that was given through July 23rd.

> **<u>EPA Response:</u> The assessment has been revised to more accurately reflect the available information about subsistence use and diet. Although we have statistics from ADF&G for percentage of residents using subsistence resources and per capita harvest of subsistence resources in these watersheds, we do not have any dietary studies. Chapter 5 of the revised assessment notes that the subsistence way of life is irreplaceable in the Bristol Bay region. The July 23 timeline was maintained for public comments on the first draft, but the public was given a second opportunity to comment when the second draft was released in 2013.**

JIM KLUG: For the record, our industry is completely united in its opposition to the development of the Pebble Mine project, and we believe that Bristol Bay watershed, as the home to the largest salmon runs in North America and the world, is a one-of-a-kind resource that cannot be put at risk. The American Fly Fishing Trade Association agrees with the EPA's scientific review findings that Pebble Mine is a threat to Bristol Bay. To construct and dig one of the world's largest open-pit mines in the heart of such an ecologically sensitive and economically significant area is the worst possible nightmare for the Alaskan wilderness, for the people who live and work throughout the area, and for the countless businesses and jobs that are directly and indirectly linked to the Bristol Bay region.

> **<u>EPA Response:</u> Comment noted; no change required.**

DENNIS ANDREW, SR: The population of New Stuyahok is 510, and 110 percent is subsistence users. We depend on our land there; the water, the game, the berries. We depend on it. This Pebble Mine is very, very unacceptable. It's not acceptable for biggest fishery in the world. Up and down the Nushagak, a lot of villages and stuff, we depend on subsistence, hundred and ten percent or more for years, from way back from sailboat fishing days. Now we're improving our salmon (inaudible), cooling our fish down. Market is coming back up. We need that salmon to continue so our grandchildren could --

> **<u>EPA Response:</u> Comment noted; no change required.**

JOEL WEBSTER: All the serious anglers I know in Montana dream of fishing for trophy rainbows and Dollys and salmon in the Bristol Bay area of Alaska. And those who have been there know that this resource is too special to be developed. And Bristol Bay area is also important for big game. This mine poses threats for bear, moose, and caribou hunting. Future development that would result in a maze of roads that would fragment important habitat and impact hunting for generations to come. And as pointed out by the Bristol Bay watershed assessment, this mine would do serious harm for this fishery, and it's time for the Obama administration to basically use its authority under the Clean Water Act to protect Bristol Bay.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

JASON METROKIN: I'm a shareholder, as well as president and CEO, to Bristol Bay Native Corporation. Salmon is the lifeblood of our region. In 2009, after several years of information gathering, BBNC took a position to protect the fishery by opposing the Pebble Mine project. The risk associated with the project have estimated as having nearly eleven billion tons of mine waste located at the headwaters of the world's largest and potentially last wild salmon run. This are far too great a risk for us to accept. Your role is to ensure that dredge and fill material permits are regulated to prohibit discharge into salmon spawning habitat that is toxic to aquatic life and would require perpetual treatment. You have that legal authority, and this draft study supports it.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

GASPAR PERRICONE: I'm here today to say, however, though, the Bristol Bay fishery and the proposed Pebble Mine is not one of those areas that can coexist in a manner in which both will flourish. We as sportsmen and the sportsmen community have come together for a single ask for EPA and Obama administration, and that ask is respectfully this: that you guys implement commonsense solutions that would regulate the proposal of the Bristol Bay mine and utilize your authority under 404(c) of the Clean Water Act. I think surely the guiding philosophy and the guiding thought has got to be that of a faithful devotion to that unwritten statute that we hand down the state of our natural world to our grandchildren improved and not impaired in value.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

PETER ANDREW: I will be asking the EPA to please do the 404(c) on behalf of all the fish, on behalf of the people, on behalf of our culture, on behalf of the people that are not here yet; our kids' kids and their kids. We've had a wonderful commercial fishery that has been happening for at least 135 years, and we've also, my people, have depended on resource for over 10,000 years.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

ROB MASONIS: Trout Unlimited commends EPA for the draft watershed assessment, which is a solid scientific analysis that is corroborated by the independent scientific analysis the TU and the Wild Salmon Center released in February. Both analyses show clearly the large-scale mining would destroy salmon travel habitat, water quality, and present a significant risk of catastrophic destruction to Bristol Bay's prolific salmon and trout populations. With the Bristol Bay Native Corporation, we've developed a detailed proposal that identifies the conditions under which responsible development could occur that does not put Bristol Bay salmon and its salmon-fueled economy at risk.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

GEORGE KEEFE: A tailings dam must last forever. Seismic mapping is incomplete in the Pebble Mine region. Two U.S. Geologic Survey publications differ in where they map the fault, but both suggest the Castle Mountain/Lake Clark fault may run within five miles of Pebble Mine. However, the mine developer claims the fault is 18 miles away and the structures are currently designed to withstand an earthquake at that distance. If the fault runs five miles from the mine, the force can be three times greater from the same earthquake.

> **<u>EPA Response:</u> The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. Recent volcanic activity has not been identified in the Pebble deposit area.**

RICARDO RUBY: I think a very significant element for the EPA to consider and everybody to consider is that your study encompasses an enormous area, and the Pebble property is just a fraction of that. There are mining claims outside the Pebble area, and they could multiply things dramatically.

> **<u>EPA Response:</u> The assessment has been revised to include the consideration of multiple geographic scales and multiple mine scenarios. The potential for cumulative effects of multiple mines is evaluated in Chapter 13 of the revised assessment.**

CARL BEVIS: Until such time that failure rates of such enormous systems and structures can be shown to be on the order of magnitudes of public transportation, where human life is definitely at risk, it shouldn't be even be considered.

> **<u>EPA Response:</u> Comment noted; no change required. EPA does not agree that the frequency of accidents in public transportation is an appropriate standard of acceptability.**

LARRY BARRETT: In aggregate, Far Bank employs 250 people and we manufacture fly rods across the Sound on Bainbridge Island and fly line in Idaho Falls, Idaho. If the Pebble Mine is constructed, my business in the lower 48 and others will be negatively impacted and jobs will be lost. I want to urge our leaders and EPA to protect this one-of-a-kind resource that drives economic value well beyond Alaska. Please keep to the timeline and maintain the July 23rd deadline for public comment. Timely progress towards finalizing the assessment is critical.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision regarding the use of 404(c) authority under the Clean Water Act.**

KIM WILLIAMS: In Section 8, on the integrated risk characterization chapter, tailings dam failure, I guess the question that I have is, you put 28 percent, 30 percent impact at the Koktuli River and 10 to 20 percent loss in the Mulchatna, but as the mine life continues -- or the mine scenario continues, as you have hydrology [inaudible] to other streams, I think your number is slightly low. It should be a little bit higher, and so I ask that you take a look at that section. Another section on the report, Section 2, Alaska native cultures, where you list 14 communities in 2.2.5, I counted 16 communities. And some in Bristol Bay will say Dillingham, of which I live in, is not a part of the watershed, but I am here to tell you, my council believes we are part of this watershed, and we are not going away in giving you our comments.

> **<u>EPA Response:</u> In the revised and final assessments we have clarified the number of communities within the Bristol Bay watershed (as defined in the assessment) and within the Nushagak and Kvichak River watersheds.**

ELAINE PACKARD: I chair the Water and Salmon Committee for the Washington State chapter of the Sierra Club. And one of our primary concerns is to protect our iconic salmon, their habitat, and the Bristol Bay residents who rely on the salmon for their livelihood and cultural heritage. Because of this, we are an ally in opposing the proposed mine. We strongly support EPA's protection under 404(c).

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act**

CHRISTINA SALMON: Standing here in front of you today, talking about a mining giant threatening my entire way of life wasn't what I ever could have planned for, but I do know that being here is where I need to be. We weren't raised with a lot of money. We would technically be labeled by the western society as poor, but never once growing up did that thought ever cross our innocent little minds. We had food in the freezer, we had hand-me-down clothes, and we had the basics for survival. Don't be fooled into thinking that we are poor people who can't exist without Pebble. We have managed just fine for the past 10,000 years without them. To those of us who have lived there for over 10,000 years, each and every one of those "maybes" is not a risk we are willing to take for future generations and the survival of our culture.

> **<u>EPA Response:</u> Comment noted; no change required.**

TYLER EDGAR: The scientific evidence you have provided reaffirms that protecting Bristol Bay is in keeping with our Christian call to protect creation and seek justice for the most vulnerable and for our neighbors. Your assessment provides conclusive evidence that the proposed Pebble Mine and other large-scale mining in its least intrusive form will devastate significant portions of salmon habitat, significant portions of God's creation that provides jobs and livelihoods for thousands. In light of your scientific findings, we urge you to do all that you can to protect Bristol Bay in a quick and timely fashion, using the authority provided to you by the Clean Water Act.

> **<u>EPA Response:</u> Comment noted; no change required.**

BRUCE HAM: I grew up in northeastern Oregon, and in northeastern Oregon, we used to have many streams with lots of salmon, lots of steelhead, and now you can count on one hand the number of reds in the Lostine River; maybe more than a couple of hands the number of reds in the (inaudible) River. And these are areas that have had relatively low impact. I don't think that historically we've done a good job of protecting ourselves by government, and I would hope that we could actually put some kind of it into the report that looks at this from a historical perspective.

> **<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of porphyry copper mining on salmon resources of the Bristol Bay region. Historical perspectives on fisheries protection outside Alaska are outside the scope of the assessment.**

ROBERT METZGER: In my life, I have lived in the mountains of Montana and Colorado for 16 years and have seen firsthand the damage to the environment operating mines have and are still doing (inaudible). Alaska is our last mostly untouched land, and the Pebble Mine would do irreversible damage to another beautiful state and harming ancient way of life in the Alaska Native American that depends on the clean watershed that Pebble Mine would destroy.

> **<u>EPA Response:</u> Comment noted; no change required.**

MICHAEL McDONALD: This is a very valuable mineral deposit, and as we continue to develop our country, we're going to demand these resources, especially as we continue to explore new opportunities of renewal land resources. Wind turbines take a tremendous amount of copper. If we want to keep continuing down the road of exploring those technologies, I think that this would be something we should definitely look into, especially with the track record that other countries have with their environmental track record. I think, you know, as Americans, we hold that very near and dear to our heart, and with all the rules and regulations in place, that this can be done in a safe and efficient manner.

> **<u>EPA Response:</u> Comment noted; no change required.**

MICHAEL O'LEARY: 35 years ago, my father and grandfather taught me how to fish in the tributaries above the coastal fork of the Willamette River. In 1990, Oregon State University researchers started to connect the idea that fish tissue that was sampled out of that area had elevated levels of arsenic and mercury. A very short period of time later, it was tied specifically up to the Black Butte mine, which, in 2010, was finally declared as an EPA Superfund site, as the owners had abandoned it. Tailings were washed out downstream and were collected. In the year 2000, my grandfather passed away with many years of onset of neurological conditions which were diagnosed as a combination of Alzheimer's and Parkinson's, which are also indicative of periods of exposure to mercury -- or associated with that. In the assessment, you describe a great number of potential impacts that are catastrophic -- tailings ponds washing down the stream, pipelines, failing – at predictable rates, for predictable reasons. It's unacceptable, in my opinion, to put such a beautiful area at risk with such -- risks of such elevated levels. Please protect Bristol Bay. Please say no to the Pebble Mine.

> **<u>EPA Response:</u> Comment noted; no change required.**

SEAN MAGEE: The draft Bristol Bay watershed assessment study is a fundamentally flawed document that reflects more on the state of politics and advocacy than on science, and that's a terrible shame. By the EPA's own admission, it has evaluated the ultimate hypothetical project, a project has that not been defined and for which key environmental litigation strategies have not been presented. You don't have to be a scientist to understand that you cannot assess what you do not know.

> **<u>EPA Response:</u> The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments, using the best available science. The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011).**

TREFON ANGASAN: We are very concerned that the timelines that you have submitted for public comment are not in sync with the needs that are apparent in Bristol Bay at this point. we, as a land representative of an organization that owns 400,000 acres of surface land in the Bristol Bay region, 200,000 of those acres that are adjacent to Pebble prospect, we're very concerned that we don't know enough about what the impact is going to be on the holdings of the Alaska Peninsula Corporation.

> **<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. The purpose of this assessment is to evaluate potential impacts of large-scale porphyry copper mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.**

RON ARNOLD: We feel that this report -- and you asked for comments about the science -- the science is supposed to be impartial. And a risk/benefit assessment, which your study is, is only half done. We've seen the risks, but I don't recall anything about the benefits. I would hope that EPA will finish this report by turning out a benefits section that is as extensive and hypothetical as the present one.

EPA Response: This assessment is an ecological risk assessment, not an economic cost-benefit analysis of mining and the fishery.

MARY ANN PEASE: The Pebble project, if allowed to go through a rigorous permitting process, is a project based in Alaska that positively impacts our economic future, jobs, revenues to our state, and represents responsible resource development. The draft Bristol Bay watershed assessment process and any potential 404(c) actions which may result from it are of concern at this time because not only is the process rushed and premature, but there is not even a single permit application regarding development of Pebble in front of the state or federal governments, nor has the NEPA process been initiated. The design for Pebble, including the very important environmental mitigation strategies, have not been finalized. A preemptive veto of the Pebble project is no different than a preemptive approval. Should the EPA be successful in this effort, it could become a mechanism to squelch large-scale projects in all sectors; projects that are now quite needed for private sector job creation and economic vitality.

EPA Response: The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments. It is not a regulatory action, and it does not propose or recommend restrictions on mining. EPA regulations establish a clear process for EPA to follow when taking action under the Clean Water Act Section 404(c).The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011).

KATHY McDONALD: I request that you extend the comment period at least 120 days to give this 300-plus page report time to be digested by many people. I don't know if everybody understands the long-term impact for development; not just for the Pebble Mine but all developments everywhere in all states. This opens up the potential for the largest land grab in the Federal Government we've ever seen. Or should I say, the EPA is opening this and not elected bodies of officials.

EPA Response: The public was given a second opportunity to review the report in April 2013. EPA has authority to conduct risk assessments of this nature under Clean Water Act Section 104(b). The assessment was specific to the Bristol Bay region and does not establish precedents for other types of development or large-scale mining in other places.

MICHAEL McDONALD: I think it's very important you open the window for this hearing period. I think you ought to consider opening that window so that those that are out there fishing don't have to make the choice between working for a living or coming to a hearing like this.

EPA Response: Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013.

LISA REIMERS: I think that you need to take into consideration they would like this time extended. what I find very odd is that we're here in Seattle, and a lot of the commercial fisherman from Seattle, Oregon, are dictating our lives and they're not thinking about the human factor. There are people that live in these villages that need jobs. How would they like it if we came down and dictated in their lands and their waters? This is very emotional for me because at the end of the day, our people are up there trying to figure out how to survive. We don't depend on commercial fishing, subsistence. It's a choice. We still need a cash economy, and we'd like you to extend the time period.

> **<u>EPA Response:</u> Comment noted. EPA maintained the original comment deadline for the 2012 draft assessment. However, after incorporating public and peer reviewer input, EPA requested additional public comment and peer review on the revised assessment in April 2013. The assessment an ecological risk assessment, not an economic cost-benefit analysis of mining and the fishery.**

MICHAEL SCHUT: Bristol Bay is a place of rare beauty and abundance that can only be found in this part of God's creation. Alaska natives have sustainably coexisted with creation for thousands of years. Our faith tells us Bristol Bay is important, important as a part of God's creation, important to Alaska native culture, and important if we are to live out our call as Christians to keep, protect, and care for God's earth and the neighbors. We urge you to use Section 404 of the Clean Water Act, as you travel around Bristol Bay, to preempt, provide protection from inappropriate development in this watershed.

> **<u>EPA Response:</u> Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act**

BOB WALDROP: In Bristol Bay, the nation's waters include some of the best remaining salmon habitat in the world. Significantly, this is also good habitat for jobs and economic development, supporting an estimated 14,000 jobs in Bristol Bay. Holders of 2700 of those jobs reside here in Washington State. So this truly is a national issue by that measure. in Bristol Bay, the natural and the cultural and seafood business environment are the same. You protect one, you protect the other. Good stewardship of the natural environment is necessary to maintaining the existing and thriving fishery.

> **<u>EPA Response:</u> Comment noted; no change required.**

MARK WASHBURN: As an electrician, I have greatly seen the effects of copper and other natural resources and their prices in the construction industry, and I'm glad someone from the construction industry can talk about this, because having a mine of this magnitude, mining for copper, will really affect the amount of jobs incoming into our industry. Also, I think the EPA should try and work with the Pebble Mining companies to develop instead of just trying to stonewall them and stop the whole process.

> **<u>EPA Response:</u> The assessment is an ecological risk assessment, not a cost-benefit analysis of mining and the fishery.**

ABE WILLIAMS: I really would like EPA to focus on putting accurate science into the watershed assessment. And when I read through the executive summary here, it really frightens me that they have taken the steps that we see out there currently in our communities right now that have -- they just monger fear to folks to completely oppose projects like this. And our region is economically challenged, to the point where our people is moving away, our native cultures are moving away. And when your folks in the native communities move away, that is when a culture dies. Okay? And we have this problem currently. We have schools shutting down. We have things taking place that is necessarily bad for our area. So I really want sideboards put back into this process and I want due process to take place here.

<u>EPA Response:</u> The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments. It is based on the best available science, evaluates all available information, and was conducted in an open and transparent manner using established and rigorously reviewed scientific inquiry.

JONATHAN YOUNG: Is the report going to change when it becomes peer-reviewed? And if it changes, will we again have a chance to comment on it? I would like to talk about it again after you peer-review it.

<u>EPA Response:</u> We revised the draft assessment based on input received from peer reviewers and the public, and a revised draft assessment was made available for review in April 2013. This revised assessment was again revised in response to peer review and public comments, and the final assessment was released in January 2014.

MARK RUTHERFORD: I offer my opinion that the EPA findings significantly underestimate degradation of the mine development on freshwater resources by as much as an order of magnitude. The EPA did not adequately address pipeline construction and management, electrical grid construction, and road construction. My family and I depend upon the Bristol Bay salmon for our livelihood. For more than 30 years, we've depended upon salmon for our personal subsistence, commercial harvest, and today for the sport fish guiding business we own. I question the scientific data used, which models a 33 to 60 percent chance of culvert failure. In my opinion, it is closer to a hundred percent.

<u>EPA Response:</u> We agree that the development of a large-scale porphyry copper mine could have many other significant effects in the region, as well as effects beyond the region, in addition to those evaluated in the assessment. The scope of the assessment is clearly stated in Chapter 2. The failure rates cited in the assessment are based on the best available science.

JASON BRUNE: I should also say at the outset, that Anglo American accepts that the right to develop any mining project must be earned. This is done over the course of the project's development and in particular during the course of permitting. Permitting is, thus, a critical process and should never have any preordained outcome, positive or negative. Anglo American accepts this. We are trying to understand whether the EPA does. As was said in (inaudible) testimony, the combination of mining a hypothetical mine plan to assess project effects, leaning heavily on environmental activists or scientific information, and refusing to consider the scientific work completed by Pebble as a part of its environmental baseline document, has contributed in no small part to the deep flaws inherent in the draft report. Meaningful judgments about Pebble and its effects it may have on fish and water in Alaska cannot be made before the project is fully designed, proposed, and evaluated under NEPA. The EIS that will be prepared for Pebble under NEPA will be fully informed by Pebble's proposed development plan, its mitigation strategy

<u>EPA Response:</u> The assessment is an ecological risk assessment and it has been prepared following EPA's guidelines for such assessments. It focuses on the risks of large-scale porphyry copper mining on the region's salmon resources. The assessment has not been prepared for the same purposes as a National Environmental Policy Act (NEPA) document.

The scenarios presented in the assessment are based largely on preliminary plans put forth by Northern Dynasty Minerals in Ghaffari et al. (2011), and assume that modern

conventional mining practices and technologies are used. Proposed mitigation measures are those that could reasonably be expected to be proposed for a real mine in this area, and are described as "permittable" in Ghaffari et al. (2011). The assessment is based on the best available science and evaluates all available information, including that in the PLP's Environmental Baseline Document as well as other sources. Northern Dynasty Mineral's preliminary mine plan (Ghaffari et al. 2011) and PLP's Environmental Baseline Document are both used extensively as sources in the assessment.

BENJAMIN BLAKEY: My family and I have worked in Bristol Bay for my entire life and we hope to for many years to come. And basically, this EPA assessment that we are talking about today is, at its core, a risk assessment. And if we're asking whether or not the potential benefits of mine development in Bristol Bay watershed will outweigh the risks, I just want to make this very clear that on behalf of myself, my family, and the hundreds of other Bristol Bay fisherman that could not be here today, we are adamantly opposed to any mine development activity that would put our salmon at risk.

<u>EPA Response:</u> Comment noted; no change required.

JORDEN GREINER: Working on my Yupik father's charter boat, I have deckhanded for the majority of my existence, as a family tradition and to finance my education. Starting with knowledge gained on the boat and continuing with high school reports and my college senior thesis, the proposed Pebble Mine has influenced my academic and personal life in Alaska and here in Washington. And just last year, Homer's 82 Bristol Bay commercial fishermen contributed nearly $9 million of gross earnings from the Bristol Bay's 2011 season alone. Inevitably, the proposed mine has cast a dominant shadow on my life and has propelled me to passionately take action against it. Earlier this week, when I was attempting to organize my testimony, I found it difficult to narrow down the list of scientific and economic data posed against the mine, not to mention the threat it poses my family's way of life. The abundance of negative claims makes it clear that whether the mine should be developed isn't even a question. It can do so by using the authority granted to the EPA under Section 404(c) of the Clean Water Act to halt the development of this mine.

<u>EPA Response:</u> Comment noted; no change required.

DAVID HARSILA: AIFMA endorses the EPA 404(c) process and the watershed assessment of potential mining impacts on salmon ecosystems of Bristol Bay, Alaska. The Bristol Bay fishery and related industries substantially contribute to the economy of the state of Washington. The economics of Bristol Bay are well established and have been sustainable over time. Clearly the risk of damage by the mining industry to the freshwater habitat that salmon depend upon is too great, as most likely the damage will be certain. Some specific reasons: perpetual care and storage of acid-generating rock waste and tailings; massive dewatering of groundwater affecting streams; and the inevitable releases of contamination, including dam failure seepage, slurry, and fuel pipeline failures.

<u>EPA Response:</u> Comment noted; no change required.

JOEL REYNOLDS: The notion that the 404(c) process or the 104 process enacted by Congress does not comply with principles of due process is just not supportable as a matter of law. Large-scale mining like the proposed Pebble Mine would pose an unacceptable and unavoidable risk of harm to the people, the communities, and the wildlife of the Bristol Bay watershed. Building a massive mine in this location at the top of the watershed of the world's greatest wild salmon fishery is a reckless idea, a dangerous venture for which significant risk to protected resources cannot be eliminated, no matter how extensive the environmental review or comprehensive the mitigation regulators might impose.

<u>EPA Response:</u> Comment noted; no change required.

BRENDAN FLYNN: I saw on the pie chart you had there that the southern B.C. and U.S. stocks make up one of the more significant portions of Sockeye salmon in the world other than Bristol Bay. Well, that is the case some years. We've had the misfortune of fishing every other year, every third year here, every fourth year at times. It's immensely inconsistent, and that is the beauty of Bristol Bay. It happens every year. I really support you to protect this place under the 404(c). It is a national treasure and there is nothing like it in the world.

<u>EPA Response:</u> Comment noted; no change required.

JENNIFER GISH: The proposed Pebble Mine which would be situated in the heart of Bristol Bay watershed produces an unacceptable risk for the fly fishing industry, which relies on the health and vitality of hunting and fishing ecosystems. Sports fishing contributes $1.4 billion annually to the Alaska economy and more than $60 billion to Bristol Bay alone. Many visitors spend up to a thousand per week to stay at well-appointed lodges and fly in small planes to some of the most exclusive and celebrated trout and salmon waters in the world. These are our customers.

<u>EPA Response:</u> Comment noted; no change required.

JIM WADDELL: One of the problems I find with the report is, you don't go into enough detail explaining the consequences of the -- well, basically the assumptions that you're making about failures and operations and so forth. What you really need to explain, though, is, the probability of failures is sort of, I think, underestimated, frankly. Having experienced these kind of projects, having dealt with these kind of projects, nothing is ever built like the plan says it's going to be. The mitigation plans are rarely followed, and there's various reasons for this. What we need to be doing is understanding what it takes to manage these projects and explain it to the public in these documents, because without that, they're not -- you're never going to appreciate the complexity and what it takes to actually construct and operate these things safely.

<u>EPA Response:</u> The analyses of accidents and failures were revised and more detail is provided in the final assessment.

JON FRANKLIN: There's 10,000 years of history that can go on 78 years of a mine. What's going to happen in 78 years? The jobs are all going to be gone in 78 years, except for the people that have to sit there and look over the toxic landscape and say, "That's my legacy." Do not let corporate interests run over the population of Bristol Bay.

<u>EPA Response:</u> The assessment discusses risks in perpetuity, and addresses how risks will change as mine operations cease.

TOBY HALTER: I just think that in this assessment, I just -- you know, the adverse effects of mining and what they do to a human population is a (inaudible) native people. There's a lot of native Alaskan people that are going to stay living in that area. Like the gentleman said before, 78 years of mining, you know, and you're looking at maybe five, ten thousand years, if we can even hold on that long, of having to deal the negative effects and the carcinogens and all the nasty chemicals that are associated with mining. So I just didn't see that very clearly in your report.

EPA Response: **The assessment discusses risks in perpetuity, and addresses how risks will change as mine operations cease.**

LELAND MIYAWAKI: We send a lot of people to Alaska and to Bristol Bay to go fishing. There's a lot of them that go there, a lot spend a lot of money. I urge you to, under your authority, to – excuse me -- under your authority to go forth with 404(c) and the Clean Water Act and stop this mine in its tracks.

EPA Response: **Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act**

ANDREW BENNETT: I run a sport fishing lodge on the Kanaktok and (inaudible) Rivers just northwest of Bristol Bay. I employ 20 people each summer and host 250 guests from all over the world who come to experience the incredible unique fishery in southwest Alaska. I'm opposed to large-scale mining in Bristol Bay because I feel that the risks that a large-scale mine has an adverse impact on this healthy, unique fishery is too great.

EPA Response: **Comment noted; no change required.**

KAREN REED: I think that the ecology there is so fragile and the impacts from the haul road construction and the pipeline construction really need to be looked at more seriously in your 404(c) study. What I was young, we would speak frequently with fisheries research people that had a base on Porcupine Island in Lake Iliamna, and they told us that the beach on Knutson Bay was the largest Sockeye spawning salmon ground in the world. And right now there's no roads in that area, there's no other cabins, there's no power lines. There's nothing. And to think about putting the haul road right past the most prolific Sockeye spawning beach in the world is sort of incomprehensible.

EPA Response: **Risks associated with the transportation corridor are evaluated in greater detail in Chapter 10 of the revised assessment. Risks associated with potential pipeline failures are evaluated in greater detail in Chapter 11 of the revised assessment.**

RON RICHARDS: One suggestion in your economic analysis. The Valdez oil spill showed us that not only will an adverse environmental impact in a certain area affect the income of the people that are impacted directly, but it will impact all of the Alaska fish market. We Alaska fisherman who were not directly impacted by the oil spill saw the value of our catch plummet. The same thing will happen in a Bristol Bay disaster, where some pollutant affects the fish. It will tarnish the reputation of all of us.

EPA Response: **Potential effects to commercial and recreational fisheries were not evaluated as part of this assessment. We recognize that any impacts to salmonid and other fishery resources would affect these sectors.**

THOMAS QUINN: I have been studying ecology and conservation of salmon and trout ever since, including the last 25 years in the Kvichak watershed. The research has taught me two things about conservation and salmon and natural resources. Two pillars. The first is the restoration of that which is damaged but salvageable, and the second is the preservation of that which is valuable and still functioning. an ounce of prevention is worth a pound of cure. And in Bristol Bay, we have the opportunity to prevent destruction of something which is already functioning perfectly as it is. We're counting on you to live up to your name: protect our environment.

EPA Response: **Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

CHARLES TREINEN: you may want to look at a little further is to reevaluate or to continue to evaluate the value of commercial fishing to people throughout your Region 10.

> **<u>EPA Response:</u> Potential effects to commercial and recreational fisheries were not evaluated as part of this assessment. We recognize that any impacts to salmonid and other fishery resources would affect these sectors.**

EDWARD DAVIS: You really should be looking at a further study, a larger one. Look at the boundaries of the watershed area.

> **<u>EPA Response:</u> The assessment focuses on the Nushagak and Kvichak River watersheds because they are the most likely to be affected by large-scale mining. However, the cumulative risks from mining in the Bristol Bay watershed are addressed in Chapter 13 of the revised assessment.**

FRED HARNISCH: The experience I've gained over the years in various areas of the world concerning large industry, and of what I've read -- I'm strongly against the proposed Pebble Mine.

> **<u>EPA Response:</u> Comment noted; no change required.**

ERIC FORRER: The collapse of the fishery there (Yukon) has been accompanied by a relentless economic and social stress that foreshadows the fate of Bristol Bay under the influence of a generations-long mine. I make three arguments regarding Bristol Bay. First, I join those and see that culture and place will be destroyed by the mine. Basically, Pebble developers will push everything I know and love right out of the frame. Second, given the destruction or massive damage to every salmon system from the Sacramento to the Yukon, I argue that this last reasonably healthy system should have the benefit of a sense of cumulative protection.

> **<u>EPA Response:</u> Comment noted; no change required.**

RICHARD LEEDS: Based on my experience, I believe that the hydrology and air interconnections within and outside the proposed mine site have potential poisonous flows with their susceptibility to seismic events and the resulting catastrophic long-term damage are understated in the report. Let me repeat: I've been up there and I think it understates the level of interconnectivity. Large-scale mining is too risky to be permitted in this important natural resource, as has been identified in this EPA assessment.

> **<u>EPA Response:</u> The assessment recognizes that the area is prone to seismic activity, and describes the seismicity of the Bristol Bay region and the proposed mine site. Recent volcanic activity has not been identified in the Pebble deposit area.**

SALLY SHORT: Any people or any industry would woefully threaten to destroy what I spent my life defending.

> **<u>EPA Response:</u> Comment noted; no change required.**

ANN KROEKER: Please don't add economic values or job values or other disputed trade-offs to your study, which, if you can keep it as factual and bio/eco/regional as possible, we would absolutely appreciate that.

> **<u>EPA Response:</u> The purpose of this assessment is to evaluate potential impacts of mining on salmon resources of the Bristol Bay region—not to evaluate the relative economic benefits of mining versus the existing salmon-based economy. Appendix E is**

intended to provide a baseline evaluation of current economic activity dependent on a healthy ecosystem.

STU SMITH: The people that are proposing mining in this part of the world, such as the Pebble Mine, they don't see their purpose as providing human kind or mankind with a useful product like iron and gold. Their interest is in money.

EPA Response: **Comment noted; no change required.**

ROBERT WISSMAN: I've studied with Tom in Alaska in the Bristol Bay area, as far as wetlands, streams and lakes. And these systems, we know how fragile they are, but we do not know how resilient they are, but I'm afraid they do not have the resilience to take the insult that the industry is proposing in these landscapes.

EPA Response: **Comment noted; no change required.**

DAVID KERLICK: You need to have some civil engineers onboard, as well as the fisheries people, when you're trying to make estimates of failure analysis.

EPA Response: **Expertise in failure analyses is not the particular purview of civil engineers. The assessment team included mining engineers and risk assessors as well as fisheries scientists.**

JUANITA CARLSON: I am so proud of my family's connection to Bristol Bay and our heritage. I love my visits to Dillingham, the people; the culture, the fishing, the pristine, quiet beauty. Everything about the area. I don't want a large-scale mine to affect adversely this area. My fear is that salmon fishing in the Bristol Bay region will change and disappear.

EPA Response: **Comment noted; no change required.**

AMY GULICK: Today, the lower 48 has just 2 percent of its historic wild salmon runs. Are we really going to repeat the same mistakes we made here in the lower 48 and destroy Bristol Bay, a place with some of the last and most productive wild salmon habitat in the world? we know what wild salmon need: unobstructed spawning ground, clean water, clean gravel to spawn, the right amount of water at the right time, the right water temperature at the right time.

EPA Response: **Comment noted; no change required.**

PETER MARSHALL: My own particular concern is over the long-term fate of wild salmon on the earth as a whole. I believe EPA should use its authority to protect those conditions in perpetuity.

EPA Response: **Comment noted; no change required. EPA has not made a final decision concerning the use of 404(c) authority under the Clean Water Act.**

PATRICIA SUMPTION: As you just heard, salmon runs in Washington and the rest of the lower 48 are in very deep trouble. So it is insane to put a mine in the headwaters of Bristol Bay, considering that it is a huge gift that we are given and that we need to protect.

EPA Response: **Comment noted; no change required.**

HEATHER LOWE: I'm hoping that we're entering this time of enlightenment where we know we're connected. So I don't live in Alaska, but what Alaska does connects to me in my daily life. I'm the daughter of one of the worlds -- he just passed -- geotechnical engineers who was involved with building the world's largest earth dam in Pakistan, three miles wide. My father was brilliant and the plans were brilliant, and it was funded by the World Bank, and the best engineers in the world were commissioned to be part of this project. They had gotten the entire thing completed and they were testing the intake tunnels, and somebody forgot a bolt and the doors didn't shut and the tunnel failed. And the dam was taken off course for the next five years.

EPA Response: The assessment recognizes that these risks exist and evaluates their potential impacts. No change required.

JANNA TREISMAN: I'd like to talk about your provisions on water collection and treatment operations, where we have a high probability of possible failure; water collection and treatment post closure, where we have a high probability of failure; and the leaching and the amount of water. There's a big range there, 2,000 to almost 60,000 gallons. I'd like to see, you know, more work on that.

EPA Response: Evaluation of water collection and treatment failures has been revised and expanded in Chapter 8 of the revised assessment.

THEO ROE: Bristol Bay has served as a coming of agery for generations of young people. Bristol Bay provides the priceless opportunity for young people to be humbled by the sea, to rise to the challenges, to persevere and ultimately put food in people's bellies. I'm proud to have spent my life providing such a healthy food for the people of the world. I'm proud to be associated with the people of Bristol Bay, past and present. Don't let Pebble Mine steal the opportunity for future generations to build character, to become confident and productive members of society.

EPA Response: Comment noted; no change required.

PETE MODOFF: Make sure that the concerns of the fishing industry, much of which is based here in Washington State, is continued to be listened to by the EPA and the other federal regulators as they consider this mine proposal.

EPA Response: Comment noted; no change required.

SHANNON FORD: The economy spreads all over the entire country. If people from Alaska don't come out here and promote the fish and the area, the economy doesn't develop. You have to be able to sell the fish and have the tourism and all those kinds of things bringing from the rest of the country. So it is a nationwide issue.

EPA Response: Comment noted; no change required.

DAVID ROWE: When Pebble Mine fails -- not if; when. In perpetuity, this is guaranteed. It's not a possibility. That's one big error in your study. In perpetuity, this is guaranteed to fail. They will pack their bags and wash their hands, and Alaska will be left with the results of this disaster.

EPA Response: The need to consider risks in perpetuity is discussed in the revised assessment.

APPENDIX 3. TECHNICAL COMMENTER INDEX.

This appendix presents comment information (Commenter and Docket Number) for the technical public comments submitted to the federal docket for the May 2012 draft of the assessment. The sections of this response to comments document in which the text of each comment document can be found are indicated in the Chapters & Appendices column.

COMMENTER	DOCKET NUMBER	CHAPTERS & APPENDICES
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Alaska Marine Conservation Council	4112	4-6, H
Alaska Miners Association, Inc.	4612	3-7, H
Alaska Oil and Gas Association	4974	4, E
Alaska State Legislature—C. Giessel	0779	E
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American Fly Fishing Trade Association et al.	4615	5, E
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Anonymous	4613	5
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K. Barbery	4110	4
G. A. Beischer	4372	2, 4, 6
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Bristol Bay Regional Seafood Development Association	4151	4
M. Buckley	1651	5
D. Callaway	5282	E
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Igiugig Native Corporation	4116	5
Kachemak Resource Institute	4617	6, 8, B
J. Kari	3771	D
D. Kohlmoos	4848	4
Laborers International Union of North America, Local 341	5418	6
Lake and Peninsula Borough	4108	2
McDowell Group	4107	E
V. Mendenhall, Ph.D.	4113	4-7, C
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Moore Geosciences, LLC	2714	6
National Mining Association	4109	4-7
National Park Service and U.S. Geological Survey	4607	2-4, 6, 7, D, G, I
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Natural Resources Defense Council	4608	4-8, D, F, G
New England Aquarium	0888	E
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Northern Dynasty Minerals Ltd.	4611	2-8, A-I
Northwest Mining Association	4119	4, 7
G. Y. Parker	4115	3, 4, 7, E
Pebble Limited Partnership	3797, 4960, 4962, 5416	2-8, A, C-E, G, I
Resource Development Council	3774	E
P. Riggert	4845	4
H. Robin Samuelson, Jr.	3781	E
A. Seitz	5313	7, B
D. Shepard	4825	4, 6, 8
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V. Wilson III	4149	2, 5
C. A. Woody, Ph.D.	5680	G