Copperas Creek Watershed Based Plan

June 1, 2018

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Two additional references of great benefit in the watershed planning work were the "Guidance for Developing Watershed Action Plans in Illinois," developed by Chicago Metropolitan Agency for Planning and Illinois EPA, and USEPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters."

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Joe Gates: District Conservationist
Ivan Dozier: State Conservationist

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CHAPTER 1 INTRODUCTION

1.1 WATERSHED-BASED PLAN SCOPE AND PURPOSE

This watershed-based plan for the Copperas Creek Watershed is a comprehensive overview of the water quality conditions in the watershed and measures that need to be implemented to restore and protect water quality. This document assesses current conditions, predicts future conditions, and makes recommendations to improve future water quality conditions by taking appropriate actions. The appropriate actions come in a wide variety of forms but include education and outreach to people and communities within the watershed, and strategies for applying Best Management Practices (BMPs) to control sources of water pollution. The negative consequences of actions or inactions over the years have caused significant degradation in areas, and the reality is the watershed cannot be restored overnight. However, with proper planning and funding, and determined efforts by civic leaders, businesses, local farmers and residents, appropriate steps can be taken to markedly improve water quality in the watershed. This plan identifies nonpoint source control measures to improve water quality.

The location of the Copperas Creek Watershed is shown on Figure 1.1-1 as it relates to northwestern Illinois and eastern Iowa.

Figure 1.1-1 Copperas Creek Planning Area in Relation to NW IL and Eastern IA

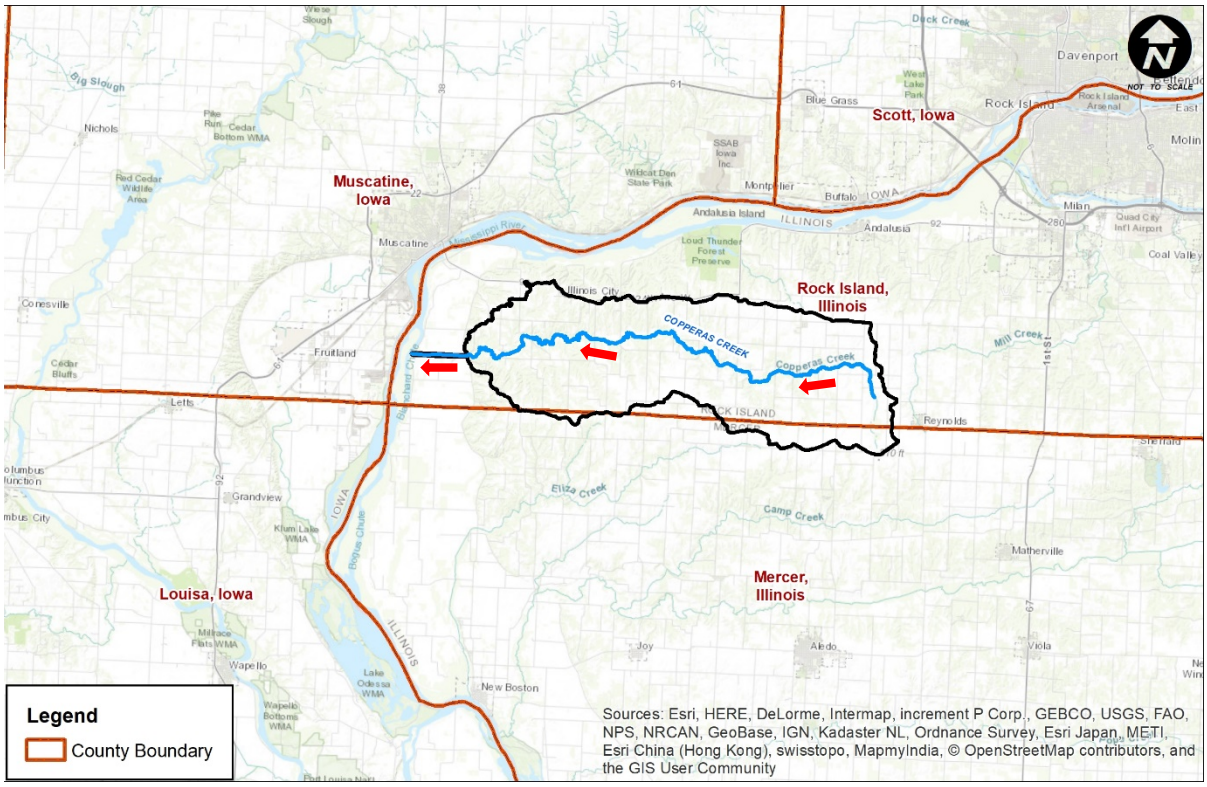


Figure 1.1-2 Copperas Creek Planning Area in Rock Island County (flow direction in red)

Runoff from the approximately 73 square mile Copperas Creek watershed drains to the Creek which generally flows from east to west toward the Mississippi River. Copperas Creek originates near 105th Street and the Rock Island/Mercer County border, approximately 1.3 miles west of the Village of Reynolds, as shown on Figure 1.1-2. There is one major tributary to Copperas Creek and several small gullies to the main stem. The watercourses north of Copperas Creek generally flow south and the watercourses south of the mainstem flow north. The Tributary of Copperas Creek flows in a westerly direction before combining with the mainstem. The mainstem and the Tributary of Copperas Creek are shown on Figure 1.1-3. Details of these two watercourses and the approximate 73 square mile drainage area are provided in Sections 3.1 and 3.13. Physical Stream Conditions are detailed in Section 3.14 and the Water Quality Assessment is discussed in Section 3.17. This plan identifies the pollutant loadings and causes of impairment in Chapter 4. Watershed protection measures are discussed in Chapter 5 and Plan Implementation and Evaluation are covered in Chapters 6 and 7, respectively.

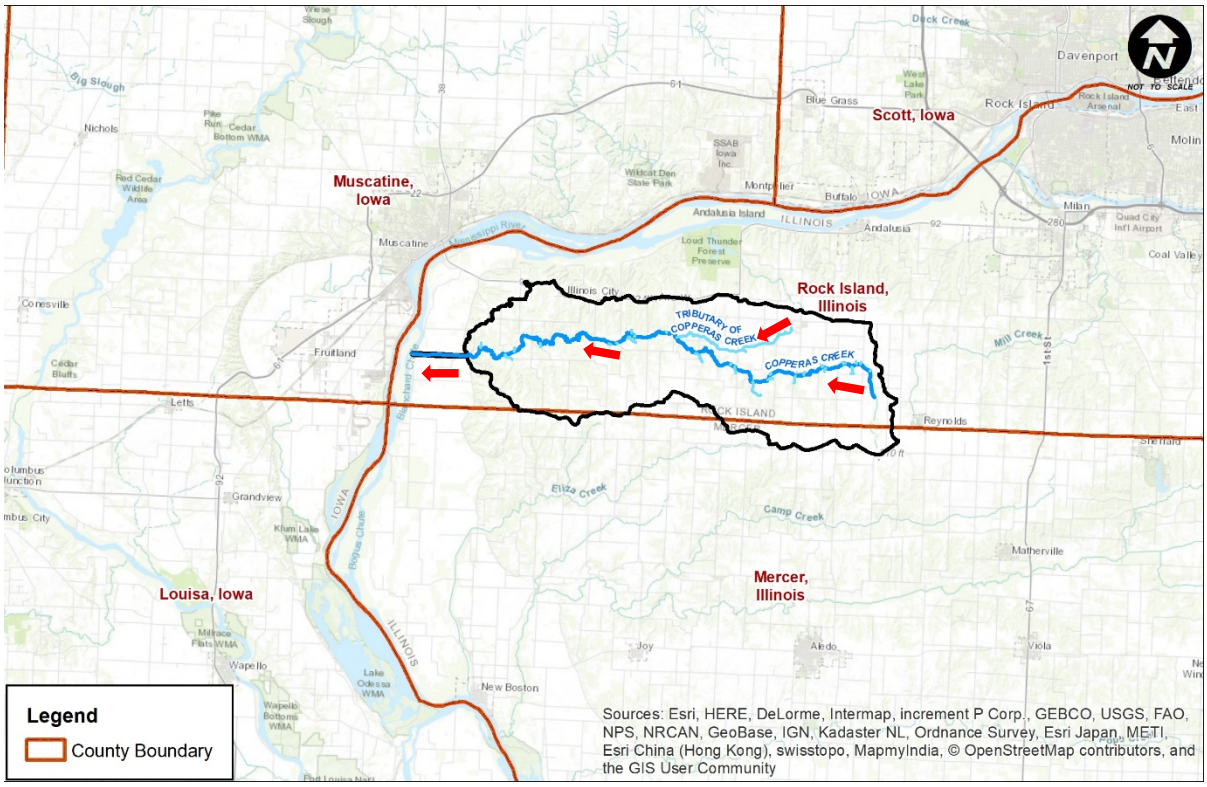


Figure 1.1-3 Copperas Creek and its Major Tributary (flow direction in red)

1.2 UPDATE TO THE 2013 COPPERAS CREEK WATERSHED RESOURCE PLAN

This plan serves as an update to the previously approved Copperas Creek Watershed Resource Plan prepared by the Rock Island Soil and Water Conservation District (RISWCD). This plan update includes the Illinois Environmental Protection Agency (IEPA) federal grant fund guidelines requiring watershed based plans to meet the nine minimum elements as described in Section 1.3. The BMPs recommended for this watershed have been identified based on the needs of watershed and Mississippi River basin. The intent of this plan is not to set new ordinance requirements with respect to BMPs recommended and existing watershed management ordinances or water quality; however, any BMP identified in this plan should work in concert with any existing watershed management ordinance to better manage stormwater and restore and protect water quality.

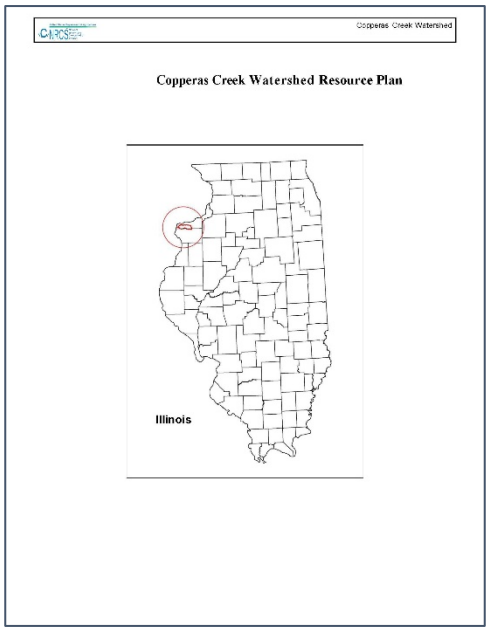


Figure 1.2-1 Copperas Creek Watershed Resource Plan

1.3 THE NINE MINIMUM ELEMENTS OF A WATERSHED-BASED PLAN

The United States Environmental Protection Agency (US EPA) has identified nine key elements that are critical for achieving improvements in water quality. The IEPA requires these nine elements be addressed in watershed plans funded with Clean Water Act Section 319 funds. Following are the nine key elements:

1. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (2) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed.

2. An estimate of the load reductions expected for the management measures described under paragraph (3) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (1) above.

3. A description of the Nonpoint source (NPS) management measures that will need to be implemented to achieve the load reductions estimated under paragraph (2) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

4. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. Possible sources of funding, include Section 319 project grants, the State Revolving Fund, United Sates Department of Agriculture's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant federal, state, local and private funds that may be available to assist in implementing this plan.

5. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

6. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

7. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS Total Maximum Daily Load (TMDL) has been established, whether the NPS TMDL needs to be revised.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (8) above.

This watershed planning document addresses the nine elements.

1.4 WHO SHOULD USE THIS PLAN AND HOW SHOULD IT BE USED

This Watershed Plan should be used by landowners, watershed stakeholders, county and state agencies, and other entities that are charged with or have an interest in restoring and protecting water quality in the watershed. Often local interest groups comprised of citizens that are active in the watershed can have the biggest impact of improving the water quality because of their influence on elected officials. They are the people who see and deal with the water quality daily. The Copperas Creek Planning Committee, other watershed groups and private conservation organizations will also have important roles. Support through funding from county, state and federal agencies can assist local agencies and private organizations to complete more or larger projects.

This plan can be used by an individual or groups identified above to help plan water quality projects. This Watershed Plan discusses in detail specific BMPs to improve certain water quality constituents. Similarly, it can be used by government agencies to establish additional water quality parameters for the watershed or to target improvements to water quality through new developments, whether it is a new or improved roadway corridor in the watershed or a new residential or commercial development.

1.5 IMPACTS OF DEVELOPMENT WITHIN THE WATERSHED

The water quality of the Copperas Creek watershed is greatly influenced by the various land uses in the watershed. While agriculture dominates the watershed, there are other areas, including hay/pasture and forested areas which comprise the second and third most land usage. Understanding the impacts of agriculture practices on water quality and the use of BMPs to offset those impacts is critical to address the sources of pollutant loadings in the watershed.

Chapter 5 discusses ways to counteract the impacts of agriculture practices with various BMP implementation types. Chapter 6 discusses in more detail ways to attain water quality goals.

1.6 FUNDING FOR THE WATERSHED PLAN

Funding for this Watershed Plan was provided through the IEPA Section 319 Nonpoint Source Pollution Control Grant Program. Section 319 grants are available to local units of government and other organizations to protect water quality in Illinois. A request was made by the RISWCD to the IEPA for the Section 319 grant.

CHAPTER 2 WATERSHED PLANNING AREA, VISION, GOALS AND OBJECTIVES

2.1 WATERSHED ISSUES BASED ON STAKEHOLDER INPUT

The scope of this project is the development of a comprehensive watershed plan for the Copperas Creek watershed that identifies actions to improve water quality, and protect and enhance natural resources. A key purpose is to help stakeholders better understand the watershed and spur implementation of watershed improvement projects and programs that will accomplish the water quality goals for this watershed. Another key purpose of the project is to identify projects and project

types that can be carried out by watershed stakeholders that will fit into a larger picture and contribute to the restoration and protection of water quality. Nonpoint source control projects identified in a State-approved watershed plan are potentially eligible for Section 319 funding to support project implementation. Having a watershed-based plan will allow Copperas Creek partners to access Section 319 grant funding for restoration projects recommended in this plan.

Water quality issues/challenges and goals for restoration and protection have been established considering stakeholder input. RISWCD and CBBEL have coordinated with the Copperas Creek Planning Committee to discuss the watershed planning work. Dialogue will continue as the watershed planning work is wrapped up and plan implementation is undertaken.

2.2 VISION

Surface water bodies (i.e., lakes, rivers, and streams) must meet water quality standards set out to achieve designated uses. Many of the problems identified in the watershed are associated with land use and land cover. The wide expanse of cropland and associated disturbed surfaces in most of the subwatersheds produce a myriad of pollutants. Best management practices, including on-the-ground practices as well as new or improved policy initiatives, need to be implemented by landowners, land tenants and other watershed stakeholders.

The water quality vision for the Copperas Creek watershed is to implement strategically planned and located BMPs that will meaningfully reduce pollutant loadings, which will then be reflected in improved ambient water quality that supports aquatic life and recreational uses. The types of BMPs that are appropriate in the watershed and a targeted implementation level are described in ensuing sections of this plan.

2.3 GOALS AND OBJECTIVES

The goal for implementation actions in the Copperas Creek watershed is to improve water quality so that designated uses can be supported. To improve water quality, we need to reduce pollutant loads. In-depth analysis of the sources of water pollution and pollutant loadings revealed that stormwater runoff is the most significant source of pollutant loadings in the watershed. Stormwater BMPs need to be implemented to reduce stormwater discharges and pollutant loadings from runoff to restore and protect water quality. The plan identifies a target level of BMP implementation which will result in the following load reductions:

Nitrogen Reduction	Phosphorus Reduction	BOD Reduction	Sediment Reduction
(lbs/yr)	(lbs/yr)	(lbs/yr)	(tons/yr)
23%	25%	17%	33%

These loading reductions will noticeably contribute to water quality improvement. Two other factors will also contribute to water quality improvement:

- Many of stormwater BMPs that will be implemented will help reduce stormwater runoff volumes. For example, practices such as saturated buffer strips will result in water being absorbed into the

ground versus running off, will reduce stormwater volumes providing significant water quality benefits. The stormwater volumes and energy that cause stream channel/ streambank erosion will be reduced with BMPs, thus avoiding increased loadings of sediment and other pollutants.

- It is anticipated that the water quality of flows going to the Mississippi River from Copperas Creek will improve over time. The IEPA has created a plan for reducing nitrogen and phosphorus levels in our lakes, stream, and rivers with the main objective to improve water quality.

The combination of these factors and the measures set out in this plan is expected to result in significant progress toward attainment of the watershed improvement goals set forth by IEPA. Objectives related to this implementation goal are summarized below.

2.4 WATER QUALITY

A primary objective for this plan and for implementation actions is to improve water quality in the Copperas Creek mainstem and its tributaries such that aquatic habitat and recreational uses are supported within the watershed and its receiving watershed, the Mississippi River. Many residents within the watershed rely on groundwater for their drinking water and contamination from agricultural practices can degrade the water quality. With reduced pollutant loadings to the water bodies, water quality will rebound. Education and outreach efforts can highlight the efforts being made to restore water quality and communicate in an understandable way about water quality conditions and any risks. The result should be more confidence in using and enjoying these water resources.

2.5 NATURAL RESOURCES

There are valuable natural resources in the watershed, including forested areas. However, some of the open space is in deteriorated condition. An objective for this plan is to restore and protect forested areas and open space to increase habitat and recreational value. Implementing green infrastructure practices on the downstream ends will help improve stormwater management and reduce pollutant loadings, and provide habitat for some species. Efforts to protect and restore these areas will help reduce fragmentation and enhance connectivity.

Priority areas for creation and restoration of greenspace will be riparian areas. Improvements in these areas will produce direct water quality benefits, in addition other natural resource-related benefits.

2.6 STORMWATER MANAGEMENT

As discussed throughout this document, stormwater is a significant source of pollutant loadings in the watershed, and the volumes of stormwater released to water bodies during and after storms produces erosion and other physical impacts to riverine environments. A significant objective of this plan is to improve stormwater management in the watershed. This may include use of manufactured devices or other point-source type controls in some areas, but the majority of stormwater management improvements needed are nonpoint source controls – capturing rainwater near where it falls. Nonpoint source control practices can trap pollutants, reducing the amounts of pollutants delivered to water bodies, can slow down the surge of stormwater that occurs during peak runoff periods, and can help reduce the overall stormwater discharge volumes.

2.7 GREEN INFRASTRUCTURE

It is envisioned that many or most of the stormwater management measures implemented to reduce stormwater impacts and improve water quality will be green infrastructure practices. At the landscape scale, green infrastructure practices help restore and expand greenspace. At the site or local scale, green infrastructure practices remove pollutants and reduce the volume of stormwater discharges through infiltration, evapotranspiration, or harvesting and reusing stormwater. Where green infrastructure is well-designed and properly-maintained, the practices can provide significant co-benefits.

2.8 RESPONSIBLE LAND PRACTICES

Population projections for the watershed predict a population decrease over the next 15 years. In addition, the Midwest is abundant with fertile farmland, making it one of the most intensely farmed regions in the world. Illinois ranks 2nd in the sales of corn and soybeans in the United States. Implementing BMPs will improve the stormwater quality within the watershed by capturing the stormwater runoff, which contains nutrients, that in high concentrations, can produce anaerobic conditions in addition to negatively affect the downstream watersheds. While practices such as cover cropping has increased in the watershed, a 2010 survey by the USDA shows farmers in the Midwest were least likely to use cover crops and have the most room for improvement on nitrogen management. The BMPs laid out in this plan in addition to cover cropping and spoon-feeding nitrogen are examples of farm technology that will improve water quality. More participation and consistent efforts by the landowners and tenants is required

2.9 EDUCATION

Education and outreach will be crucial to support plan implementation and promote regional, local, and individual decision-making that helps improve water quality. Outreach to community leaders about the goals of the watershed plan, types of projects that would be valuable, as well as partnerships and funding opportunities, will substantively advance plan implementation. Additionally, outreach and education to landowners, land tenants, and households will promote implementation of beneficial practices, such as rain gardens and sensible fertilizing techniques, and will build support for policy decisions and budgets that advance water quality improvement. An objective of the plan is to communicate to these audiences the contents of the plan and catalyze implementation of the plan, but also to receive feedback on the plan and implementation measures, so that adaptive management concepts can be applied and plan components and implementation can improve over time. A related objective is to capitalize on local buy-in to enhance intergovernmental coordination for achieving progress toward water quality goals.

Figure 2.9-1 Copperas Creek Watershed

CHAPTER 3 COPPERAS CREEK WATERSHED RESOURCE INVENTORY

3.1 WATERSHED BOUNDARIES

Copperas Creek is a natural channel extending 27 miles with its confluence at the Mississippi River. The majority of the watercourse flows through agricultural land.

Previous studies completed for the Copperas Creek watershed include the Copperas Creek Watershed Resource Plan prepared by the RISWCD, dated June 2013. The scope of the 2013 Watershed Based Plan was to address the regional problem associated with contaminants in the watershed, primarily as a result of agricultural practices. The watershed area is primarily used for agricultural purposes with minimal ways to capture the discharge from subsurface tile systems. The Copperas Creek (IL_MZA) area addressed in this watershed based plan is part of a larger area that is defined by the following United States Geological Survey hydrologic unit code (HUC) 0708010105 and is shown on Figure 3.1-1.

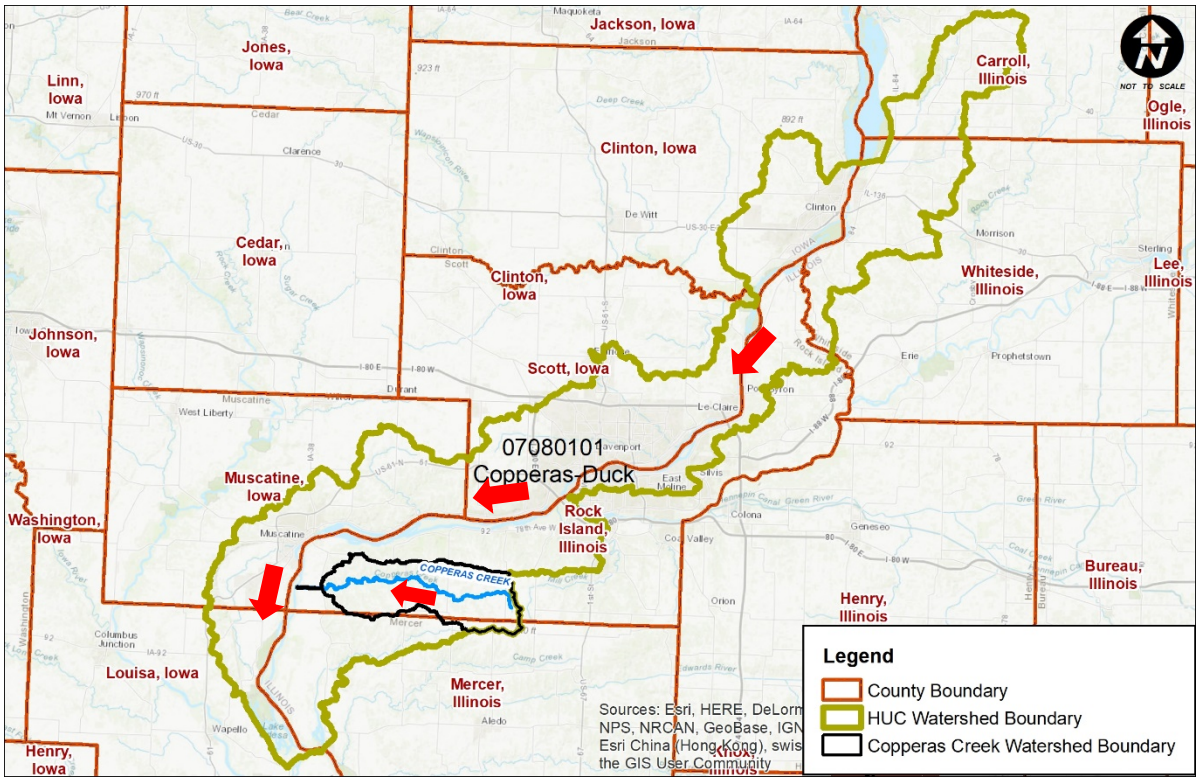


Figure 3.1-1 Copperas Creek Planning Area HUC (flow direction in red)

For this watershed-based plan, the studied watershed within the HUC, has been subdivided into 16 *watershed planning units* based on stream confluences and overall watercourse topography. The watershed planning units are shown in Table 3.1-1 and on Figure 3.1-2.

	ID	Area (acres)	Area (square miles)	Watercourse
1	CC1	110.3	0.1	Copperas Creek-1
2	CC2	916.2	1.43	Copperas Creek-2
3	CC3	2,213.2	3.46	Copperas Creek-3
4	CC4	3,145.3	4.91	Copperas Creek-4
5	CC5	2,107.9	3.29	Copperas Creek-5
6	CC6	2,755.4	4.31	Copperas Creek-6
7	CC7	3,908.3	6.11	Copperas Creek-7
8	CC8	3,001.7	4.69	Copperas Creek-8
9	CC9	2,689.1	4.20	Copperas Creek-9
10	CC10	884.1	1.38	Copperas Creek-10
11	CC11	3,118.2	4.87	Copperas Creek-11
12	CC12	4,116.5	6.43	Copperas Creek-12
13	CC13	4,582.8	7.16	Copperas Creek-13
14	CC14	4,785.7	7.48	Copperas Creek-14
15	CC15	2,988.3	4.67	Copperas Creek-15
16	CCT1	5,566.1	8.70	Tributary of Copperas Creek
	Total	**46,889.0**	**73.26**	

Table 3.1-1 Copperas Creek Watershed Planning Unit Identification and Area.

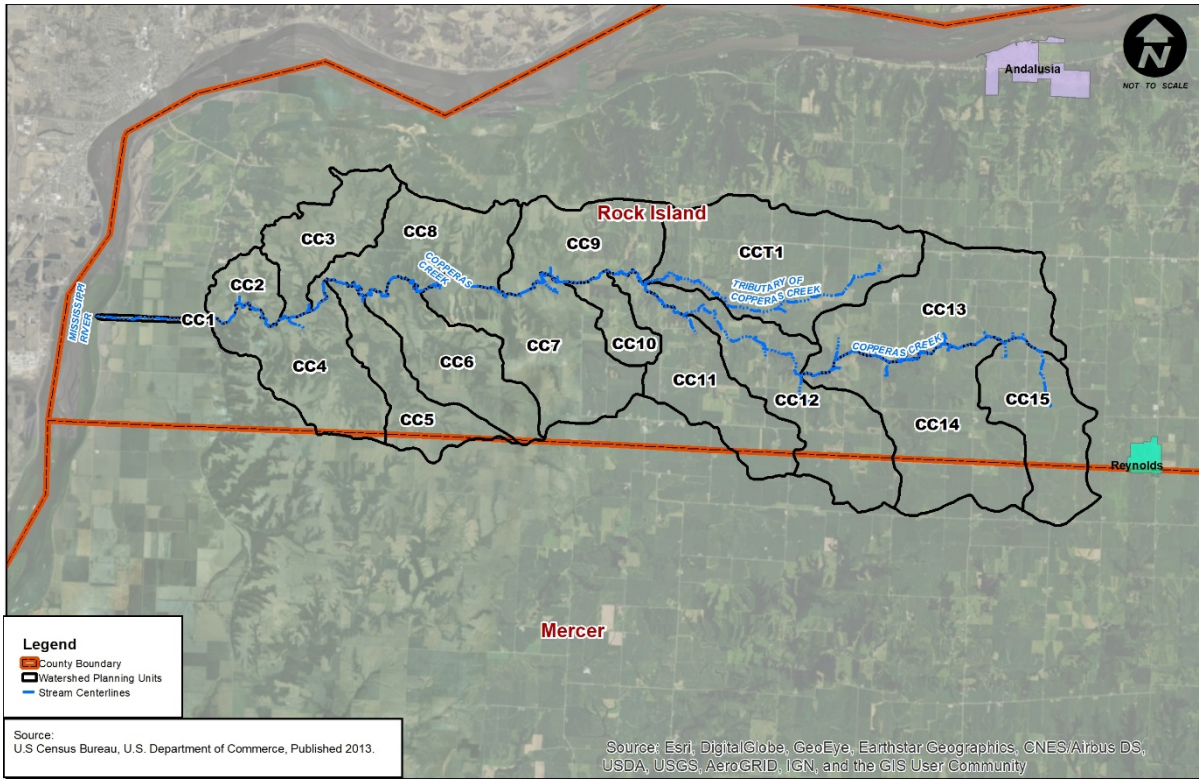


Figure 3.1-2 Copperas Creek Watershed Planning Unit Identification and Area.

The gullies north of Copperas Creek flow typically flow from north to south, with the exception of the Tributary of Copperas Creek which flows from east to west to the confluence with Copperas Creek

mainstem. Topographically, the elevation difference between the headwaters of each northern watershed planning unit and the confluence with Copperas Creek is approximately 170 feet. The elevation difference between the headwaters of each southern watershed planning unit and the confluence of Copperas Creek is approximately 165 feet. Flow in the mainstem Copperas Creek is from east to west with approximately 200 feet of elevation change between the beginning of the creek at the east end and the Mississippi River on the west end (Figure 3.1-3). Further discussion of each tributary of the Copperas Creek watercourse connectivity is provided in the watershed drainage portion of this inventory in Section 3.14.

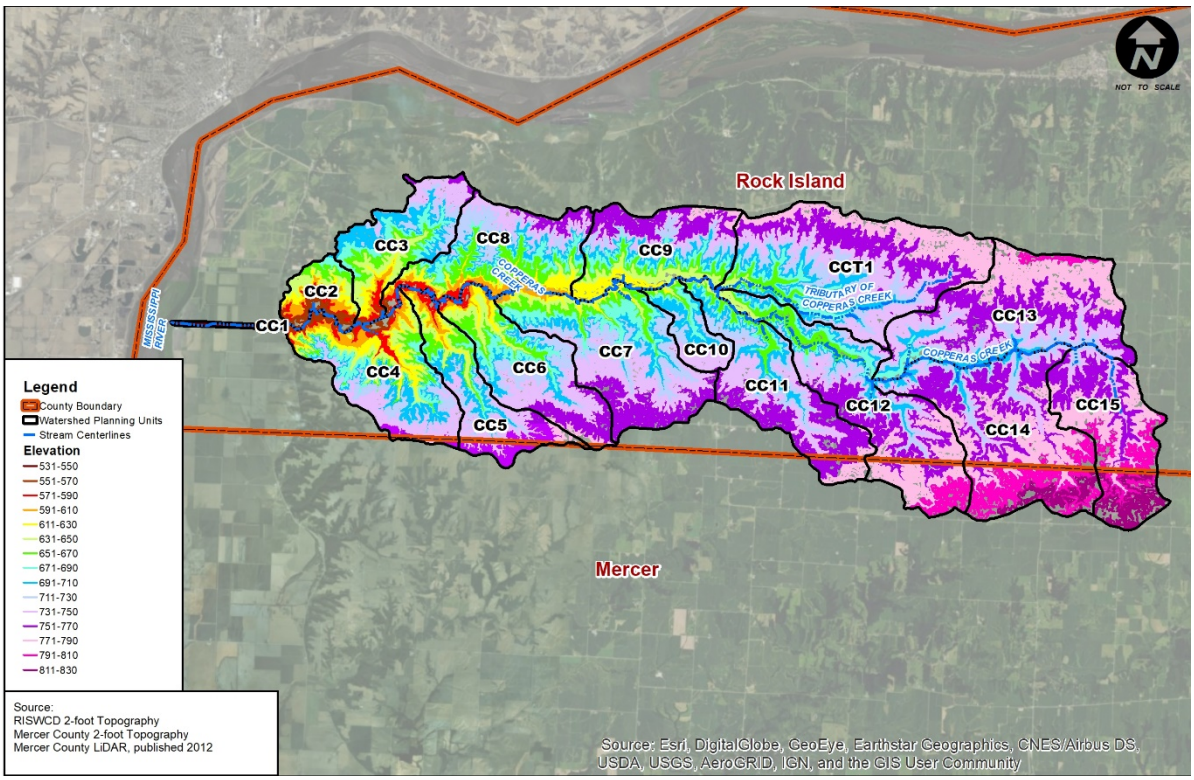


Figure 3.1-3 Copperas Creek Planning Area Topography

3.2 POPULATION AND DEMOGRAPHICS

The Illinois Department of Public Health (IDPH) projects the population from 2015 to 2025 based on the 2010 U.S. Census Bureau and is supplemented by the Illinois Department of Commerce & Economic Opportunity (IDCEO), which projects the population numbers through 2030. The difference in population over the intervening 20 years translates into a (linear) negative growth rate of approximately 4.1 percent per decade or 0.04% per year. This population negative growth rate is less than the current Illinois negative growth rate of 0.17% per year. However, the IDCEO predicts a population growth of 0.3% in Rock Island County and 7.1% in Mercer County. The following statistics were collected from United States Census Bureau and Zillow for the watershed:

- Average Home Value = $91,918
- Average Income = $51,020
- Average Age = 41 years old

Employment forecasts are similarly relevant in that growth will impact land use change, water use, water quality, and other factors. The planning area primarily consists of agricultural production. The long-term employment rate for this industry in the region is negative 0.41 percent, which is just slightly higher than the statewide negative growth rate of 0.45 percent.

3.2.1 Future Land Use Projections

The watershed planning area outside of the forest is currently agricultural and sparsely populated. Areas that are not used for cropland are either hay/pasture or forest. The Midwest is abundant with fertile farmland and one of the most intensely farmed regions in the world. It is anticipated that the land use will not significantly change in the near future. According to the Natural Resource Conservation Service (NRCS), soil erosion on cropland affects both soil quality and its off-site impacts on water quantity and quality, air quality and biological activity. The economic impact of mitigating soil erosion significantly burdens the agri-business sector and nation as a whole. Dust contributions to the atmosphere and delivery of sediment, nutrients, and chemicals to water resources are primary environmental concerns addressed by public policy makers and the stewards of our working lands. Understanding and managing these processes has important long-term implications for cropland sustainability, natural resource condition and health, and environmental quality; however, it should be noted that between 1982 and 2007 soil erosion has decreased 43 percent.

The watershed planning units that are currently priority areas for BMP implementation are discussed in ensuing sections of this watershed plan. It is expected that the areas that are currently priority areas for implementing BMPs to control stormwater will continue to be priority areas in the future. Measures can be planned and implemented with confidence that they will help improve and protect water quality now and in the future. Likewise, goals for nonpoint source water quality improvements will remain unchanged based on future land use projections.

3.3 JURISDICTIONS, LOCAL GOVERNMENTS AND DISTRICTS

Illinois has over 8,000 units of local government as of April 2018 (Illinois Comptroller, April 2018), including 1,428 townships. Portions of 6 townships, are included in the Copperas Creek Planning Area (Table 3.3-1) covering 100% of the planning area. There are no incorporated areas within the watershed. The largest township in the watershed is Buffalo Prairie Township containing nearly 39% of the area of the watershed.

Jurisdiction for stormwater management and water quality in the watershed is regulated by the Rock Island Zoning and Building Safety Department, in Rock Island County. Rock Island County adopted a Stormwater Ordinance (Ordinance) in February 2008 to develop controls and plan to prevent problems before they occur. The County has set forth best management practices that address widespread water quality problems as a result of point and non-point source pollutants. Any development that takes place within the planning area must incorporate both stormwater management and best management practices. The Ordinance also addresses soil erosion and sediment control during and after construction of all developments within the County. The enforcement of these provisions greatly reduces loadings of sediment and other pollutants. Jurisdiction for development in Mercer County is regulated by the Department of Zoning. While there is no specific stormwater management ordinance in Mercer County, agricultural land uses are one of the principal resources of Mercer County.

Therefore, it is recommended that both counties work together on implementing the best management practices for agricultural land.

The State and the Soil and Waters Conservation Districts help residents conserve, develop, manage, and wisely use land, water, and related resources. As noted above, townships can work with the respective county on the enforcement of the County-wide ordinances. This may include reviews of plans for new developments and redevelopments, and/or the inspection of sites during construction.

Many stormwater BMP projects identified in this watershed-based plan will likely be planned and carried out by the RISWCD (possibly in some cases with County technical or financial assistance). BMP projects may also be implemented by a township, a school district, or a non-governmental organization.

In addition to townships, the Copperas Creek Watershed governmental bodies include:

- Illinois State Representative Districts (72nd District, 74th District)
- Illinois State Senatorial Districts (36th District, 37th District)
- US Congressional Districts #17

The governmental units in the watershed are shown in Table 3.1-1.

Jurisdictional Body	Acres	% of Watershed	Acres of Rock Island County	% of Rock Island County	Acres of Mercer County	% of Mercer County
Rock Island County	43,151	92.0	43,151	100.0	0.0	0.0
Mercer County	3,738	8.0	0.0	0.0	3,738	100.0
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*
Landowners						
Unincorporated Rock Island County	43,151	92.0	43,151	100.0	0.0	0.0
Unincorporated Mercer County	3,738	8.0	0.0	0.0	3,738	100.0
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*
Townships						
Buffalo Prairie	16,670	35.6%	16,670	38.6	0.0	0.0
Drury	15,335	32.7%	15,335	35.5	0.0	0.0
Duncan	595	1.3%	0.0	0.0	595	15.9
Edgington	11,146	23.8%	11,146	25.8	0.0	0.0
Eliza	351	0.7%	0.0	0.0	351	9.4
Perryton	2,792	6.0%	0.0	0.0	2,792	74.7
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*
U.S. Congressional Districts						
17th Congressional District	46,889	100.0	43,151	92.0	3,738	8.0
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*
State Representative Districts						
State Representative District – 72nd	43,151	92.0	43,151	100.0	0.0	0.0

Jurisdictional Body	Acres	% of Watershed	Acres of Rock Island County	% of Rock Island County	Acres of Mercer County	% of Mercer County
State Representative District – 74th	3,738	8.0	0.0	0.0	3,738	100.0
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*
State Senate Districts						
State Senate District – 36th	43,151	92.0	43,151	100.0	0.0	0.0
State Senate District – 37th	3,738	8.0	0.0	0.0	3,738	100.0
Total	*46,889*	*100.0*	*43,151*	*100.0*	*3,738*	*100.0*

Table 3.3-1 Copperas Creek Planning Area Jurisdictions

As shown in Table 3.3-1, the entire planning area is unincorporated and there are no incorporated landowners in the watershed. The Copperas Creek watershed is fortunate in that it has its own planning committee. Watershed meetings are convened during which the landowners and townships and other watershed stakeholders are invited to discuss stormwater issues.

One of the challenges with stormwater management is that a project or change in one location can affect another location in a separate jurisdiction, especially a downstream jurisdiction. This is especially important since the entire watershed is unincorporated, as shown in Figure 3.3-1. The watershed council meetings allow participants to learn about proposed changes in stormwater requirements, proposed stormwater and water quality projects, and discuss problems or suggestions regardless if it is local or multijurisdictional problem. The resources of many landowners and agencies can benefit the watershed when working together.

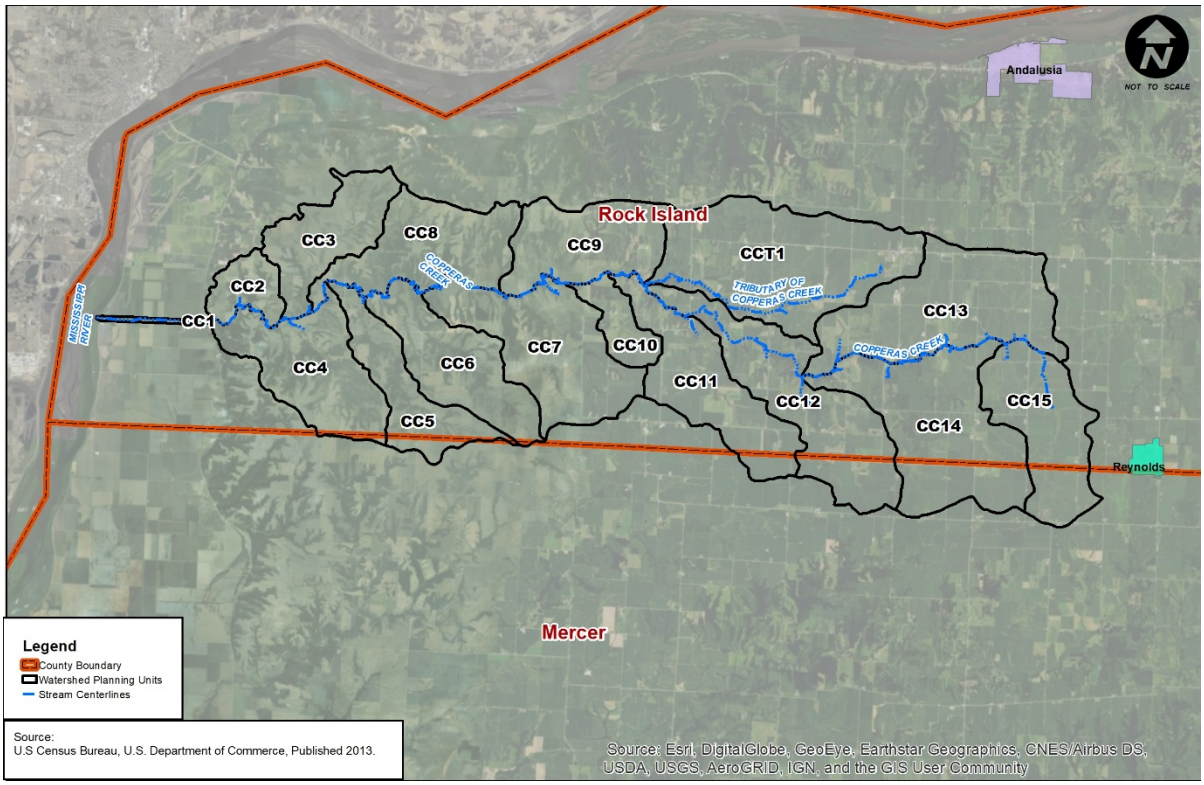


Figure 3.3-1 Landowners within the Copperas Creek Planning Area

3.4 CLIMATE AND PRECIPITATION

Illinois is situated midway between the western Continental Divide and the Atlantic Ocean, and is often under the polar jet-stream, which creates low pressure systems that bring clouds, wind, and precipitation to the area. There are other environmental factors that affect the climate of Illinois, including solar energy and latitude (reflecting the amount of solar input). National Oceanic and Atmospheric Administration publishes "Climate Normals" for various climate data, including precipitation over 30-year periods for stations throughout the country. The most recent data was for 1981-2010. Specifically, for precipitation data, the mean number of days per year with various amounts of precipitation is reported.

The planning area has a continental climate with hot, wet summers and cold, snowy winters. The seasons' average temperatures are 35˚F in the winter and 75˚F in the summer. Annual rainfall averages 36 inches and snowfall of 29 inches. Consistent with a continental climate, there is no pronounced wet or dry season (according to Illinois State Water Survey).

The winter season features the four driest months (December 1.92 in., January 1.27 in., and February 1.29 in., and March 2.43 in.) while summer features the wettest rainfall months (June 4.43 in., July 4.21 in., and August 4.28 in.). Spring (April and May) and fall (September through November) are similar for their average seasonal precipitation totals, 7.61 in. (3.81 in./mo.) and 8.5 in. (2.85 in./mo.), respectively.

The climate in the watershed planning area is notable for at least two reasons: 1) the threat of rain storms and resultant nonpoint source pollution is a year-round phenomenon, and 2) the lengthy winter

season in combination with extensive agricultural practices result in large amounts of applied nitrate whose fate has a negative impact on both local surface waters and groundwater. Also, erosion within receiving watercourses can be exacerbated by intense storm events which cause sudden increases in water surface elevations and harshly fluctuating water levels (i.e., flashiness) in streams and gullies. This suggests properly-sized BMPs to capture rainfall runoff will be increasingly important for the control of nonpoint source pollution.

Water quality impacts relative to a changing climate have not been thoroughly investigated, but many impacts are related to soil water excesses. Shifts in precipitation patterns to more spring precipitation coupled with more intense storms creates the potential for increased water quality (sediment, nitrate-N, and phosphorus) problems. In an analysis of the Raccoon River watershed in Iowa, Lucey and Goolsby (1993) observed nitrate-N concentrations were related to streamflow in the river. Hatfield et al. (2009) showed that annual variations in nitrate-N loads are related to the annual precipitation amounts because the primary path into the stream and river network was leaching through subsurface drains. The Midwest is an extensively subsurface drained area. These drains carry nitrate-N from the fields across farms and discharge into waterways. The current cropping patterns need to be revised to avoid the high nitrate-N from being conveyed into the waterways (Hatfield et al., 2009). Increased intensity of spring precipitation has the potential for increased surface runoff and erosion in the spring across the Midwest. Potential increases in soil erosion with the increases in rainfall intensity show that runoff and sediment movement from agricultural landscapes will increase (Nearing, 2001). Water movement from the landscape will transport sediment and nutrients into nearby water bodies and further increases in erosion events can be expected to diminish water quality.

3.5 SOILS

For purposes of this watershed resource inventory, hydrologic soils groups, hydric soils, soil drainage class, and highly erodible soils will be discussed. A combination of physical, biological and chemical variables, such as topography, drainage patterns, climate, erosion and vegetation, have interacted over centuries to form the variety of soils found in the watershed. It is important to consider these types of soil classifications as they relate to land use/change and water quality. Soils determine the water-holding capacity and include both the erosion potential and infiltration capabilities. Soil characteristics indicate the way soils in a particular area will interact with water in the environment, and therefore are useful in watershed planning. These can help to guide where restoration and best management practices are likely to be successful and where there may be constraints to project implementation. The soils data are obtained from the Soil Survey Geographic (SSURGO) Database produced by the United States Department of Agriculture (USDA) – NRCS.

3.5.1 Hydrologic Soil Groups

Hydrologic soil groups (HSGs) are categories of soils which feature similar physical and runoff characteristics. Along with land use, management practices, and hydrologic conditions, HSGs determine a soil's associated runoff curve number which is used in turn to estimate direct runoff from rainfall. This information is particularly useful to planners, builders, and engineers to determine the suitability of sites for projects and their design. Projects might include, for example, stormwater management systems and septic tank/field location or more broadly, new neighborhood design.

The four HSGs are described as A – soils with low runoff potential when wet / water is transmitted freely through the soil, B – moderately low runoff potential when wet / water transmission through the soil is unimpeded, C – moderately high runoff potential when wet / water transmission is somewhat restricted, and D – high runoff potential when wet / water movement through the soil is restricted or very restricted. If certain wet soils can be drained, they are assigned to dual HSGs (e.g., A/D, B/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter refers to the drained condition and the second to an undrained condition (Table 3.5-1).

Hydrologic Soil Group	*Definition/Characteristics*	*Area (acres)*	*Percent of Planning Area*
A	Soils have a low runoff potential when thoroughly wet. Water is transmitted freely through the soil	441.5	0.9
A/D	The first letter applied to the drained condition and the second to the undrained condition	6.9	0.01
B	Soils have a moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.	31,629.7	67.4
B/D	The first letter applied to the drained condition and the second to the undrained condition	13,067.6	27.9
C	Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.	650.0	1.4
C/D	The first letter applied to the drained condition and the second to the undrained condition	123.1	0.3
D	Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.	928.3	2.0
unclassified		41.9	0.09
	Totals	***46,889.0***	***100.0***

Table 3.5-1 Characteristics and Extent of Hydrologic Soil Groups in the Copperas Creek Planning Area

The majority of the Copperas Creek Planning Area features Group B soils (nearly 68 percent) (Figure 3.5-1). The dual group B/D is the next most common at 27.9 percent, respectively. The unclassified soils are those underlying waterbodies and gravel pits or highly urbanized areas where the ground has been previously disturbed and current, accurate data is not available. Figure 3.5-1 illustrates a general

pattern of HSGs distribution, revealing that A/D and B/D soils are found primarily along stream and river corridors where under saturated condition, infiltration is limited and runoff potential is high.

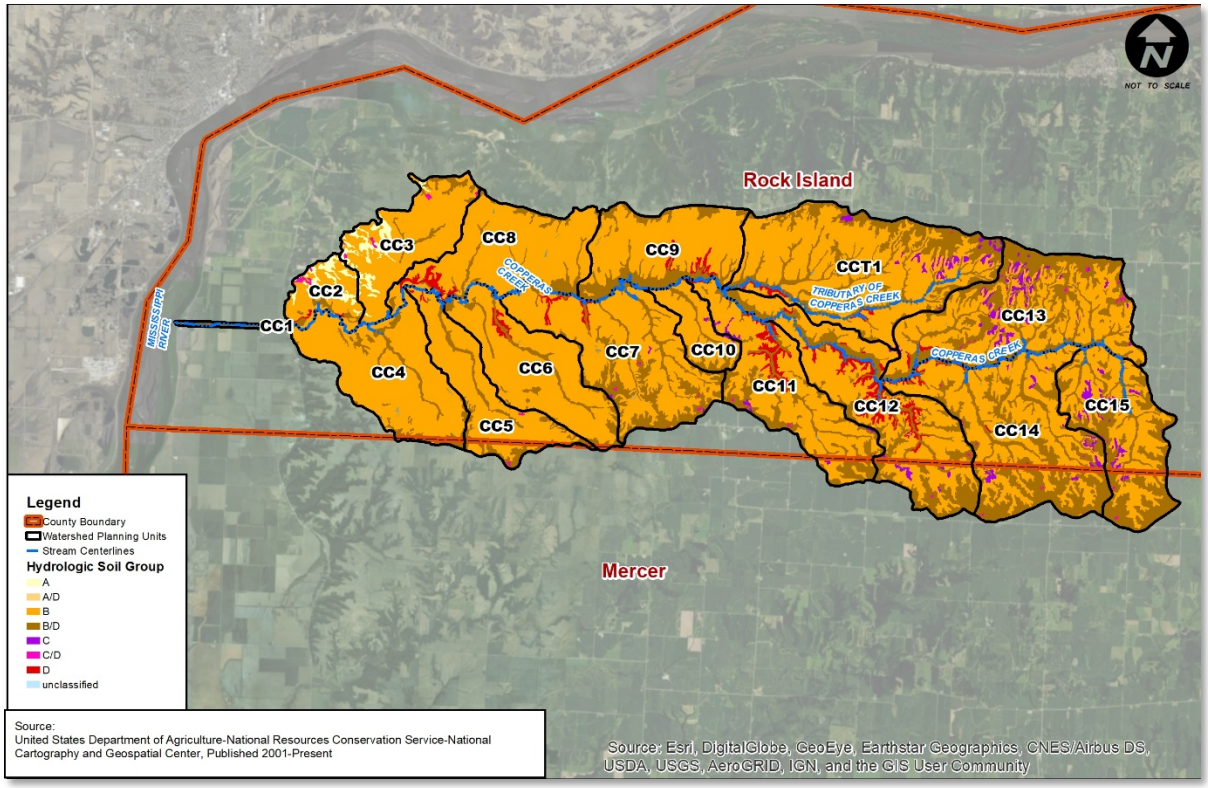


Figure 3.5-1 Hydrologic Soil Groups in the Copperas Creek Planning Area

3.5.2 Hydric Soils

Hydric soils are those soils that developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation and are sufficiently wet in the upper part of the soil profile to develop anaerobic conditions during the growing season. The presence of hydric soils is used as one of three key criteria for identifying the historic existence of wetlands. Knowledge about hydric soils has both agricultural and nonagricultural applications including land-use planning, conservation-area planning, and potential wildlife habitat. Much like an understanding of hydrologic soils groups, knowledge of the location and pattern of hydric soils can inform planners, builders, and engineers and influence their project design and location decisions. For example, areas with hydric soils and drained hydric soils that do not presently contain wetlands may be candidates for wetland restoration.

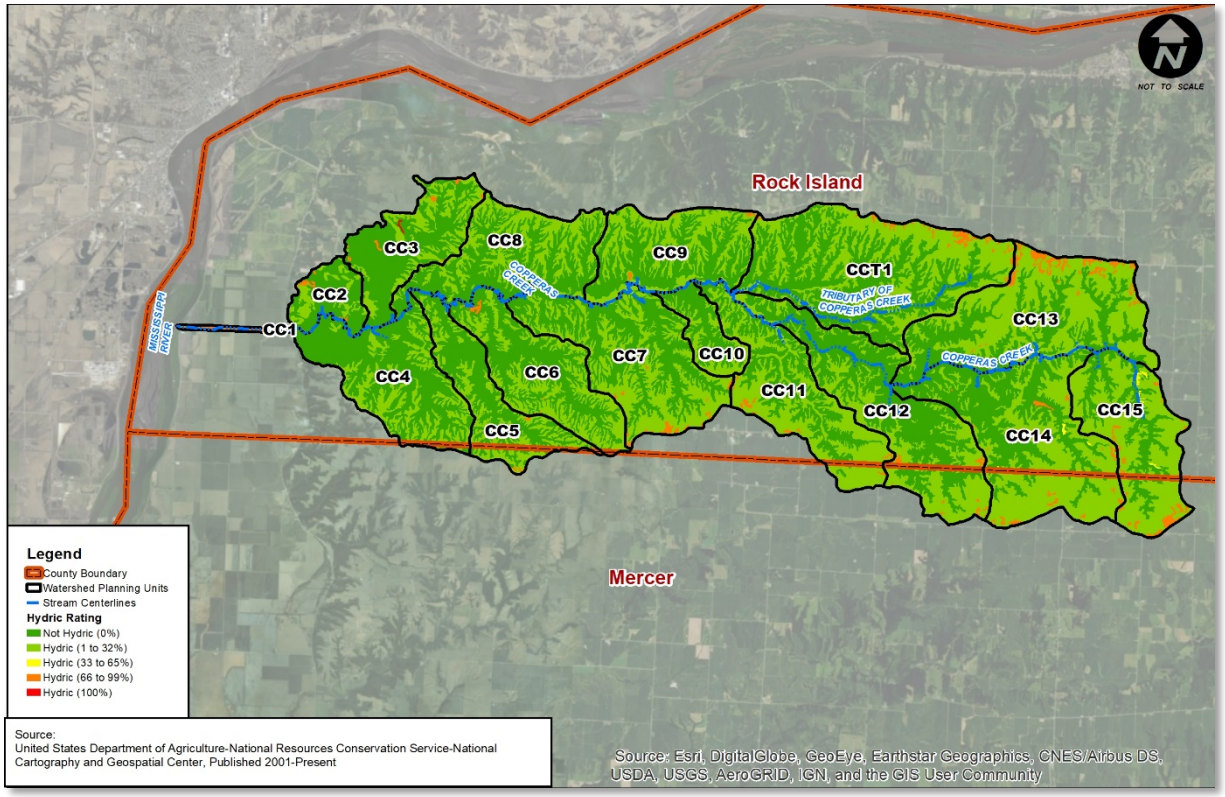


Figure 3.5-2 Hydric Soils in the Copperas Creek Planning Area

The extent of hydric soils within the Copperas Creek Planning Area is shown in Figure 3.5-2 and summarized in Table 3.5-2. Approximately 98% of the Copperas Creek Planning Area features "not hydric" soils (rows 1 and 2 in the Table). "All hydric" soils are distributed throughout the planning area, most commonly in the upper portions of the watershed, and represent less than 2 percent of the planning area. Muck soils are a category of hydric soils.

Hydric Soil Class	*Area (acres)*	*Percent of Planning Area*
Not Hydric (0%)	24,093.2	51.4
Hydric (1 to 32%)	21,838.6	46.6
Hydric (33 to 65%)	43.6	0.09
Hydric (66 to 99%)	906.5	1.9
Hydric (100%)	7.1	0.01
Totals	***46,889.0***	***100.0***

Table 3.5-2 Hydric Soil extent in the Copperas Creek Planning Area

3.5.3 Soil Drainage Class

Soils are categorized in drainage classes based on their natural drainage condition in reference to the frequency and duration of wet periods. The classes are Excessively Drained, Somewhat Excessively Drained, Well Drained, Moderately Well Drained, Somewhat Poorly Drained, Poorly Drained, and Very Poorly Drained. The extent of soils in these drainage classes within the Copperas Creek Planning Area is shown in Figure 3.5-3 and enumerated in Table 3.5-3.

Knowledge of soil drainage class has both agricultural and nonagricultural applications. For example, Well Drained drainage classes (which cover approximately 69% of the planning area) indicate areas where stormwater infiltration BMPs may best be utilized. On the other hand, Somewhat Excessively Drained soils (about 1.0% of the planning area) may not be good locations for siting infiltration.

The Poorly Drained drainage classes indicate soils which limit or exclude crop growth unless artificially drained. Soils in the Somewhat Poorly Drained, Poorly Drained, or Very Poorly Drained drainage class occur on 28.1% of the planning area. These areas that are farmed can be taken as an approximation of the likely extent of artificial drainage given that crop growth on these lands would be severely impacted or even impossible without artificial drainage. BMPs such as bioreactors may need to be constructed with controlled outlets in areas with these soils.

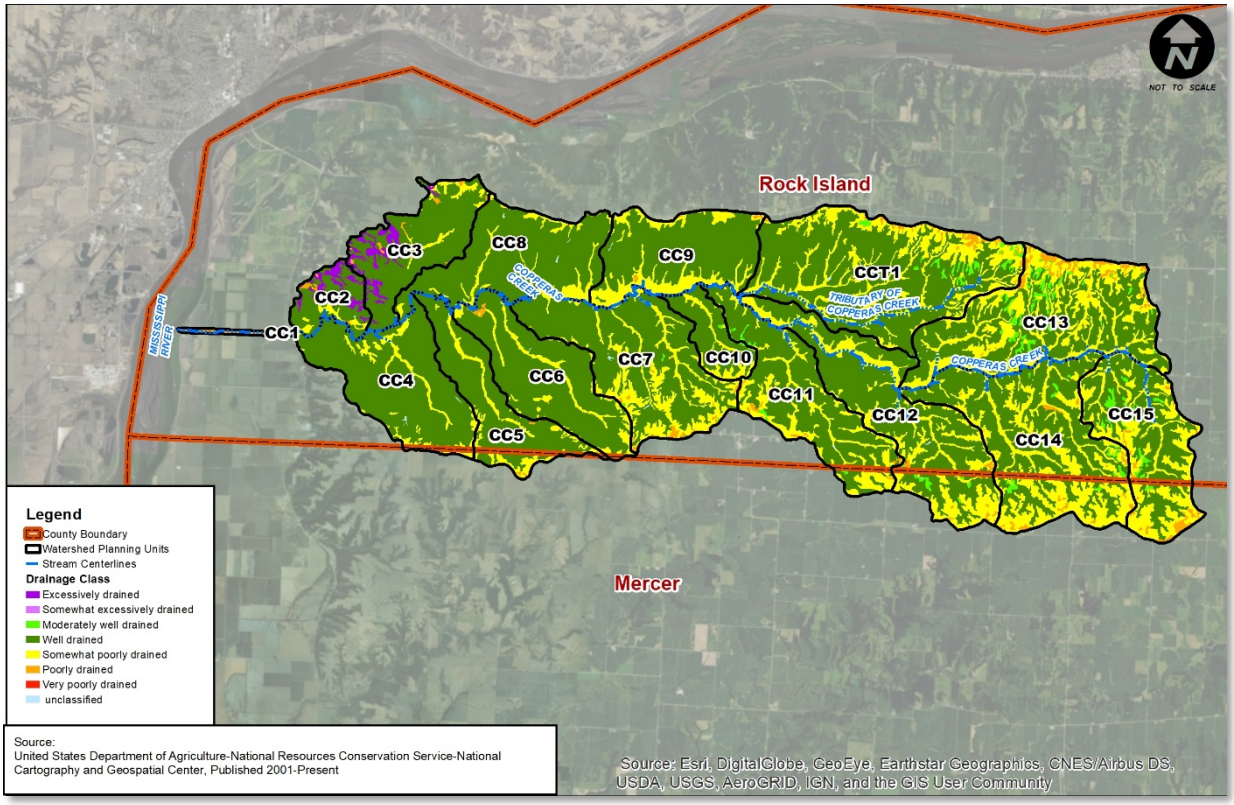


Figure 3.5-3 Soil Drainage Classes in the Copperas Creek Planning Area

Soil Drainage Class	*Area (acres)*	*Percent of Planning Area*
Excessively Drained	0.0	0.0
Somewhat Excessively Drained	441.6	1.0
Moderately Well Drained	643.5	1.4
Well Drained	32,560.6	69.4
Somewhat Poorly Drained	12,287.7	26.2
Poorly Drained	913.7	1.9
Very Poorly Drained	0.0	0.0
unclassified	41.9	0.1
Totals	***46,889.0***	***100.0***

Table 3.5-3 Extent of Soil Drainage Classes in the Copperas Creek Planning Area

3.5.4 Farmland Classification

Copperas Creek Bank Erosion along Corn Field
Photo Courtesy of RISWCD

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. Prime farmland has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding. Users of the lists of prime farmland map units should recognize that soil properties are only one of several criteria that are necessary. Other considerations include land use, frequency of flooding, irrigation, water table, and

wind erodibility. As shown in Figure 3.5-4 and Table 3.5-4, approximately 43 percent of the watershed planning area is prime farmland with an additional 15 percent considered prime farmland if it is drained or protected from flooding. As described above, Illinois is the 2nd largest producer of corn and soybeans in the U.S., thus providing further evidence of the watershed's vitality.

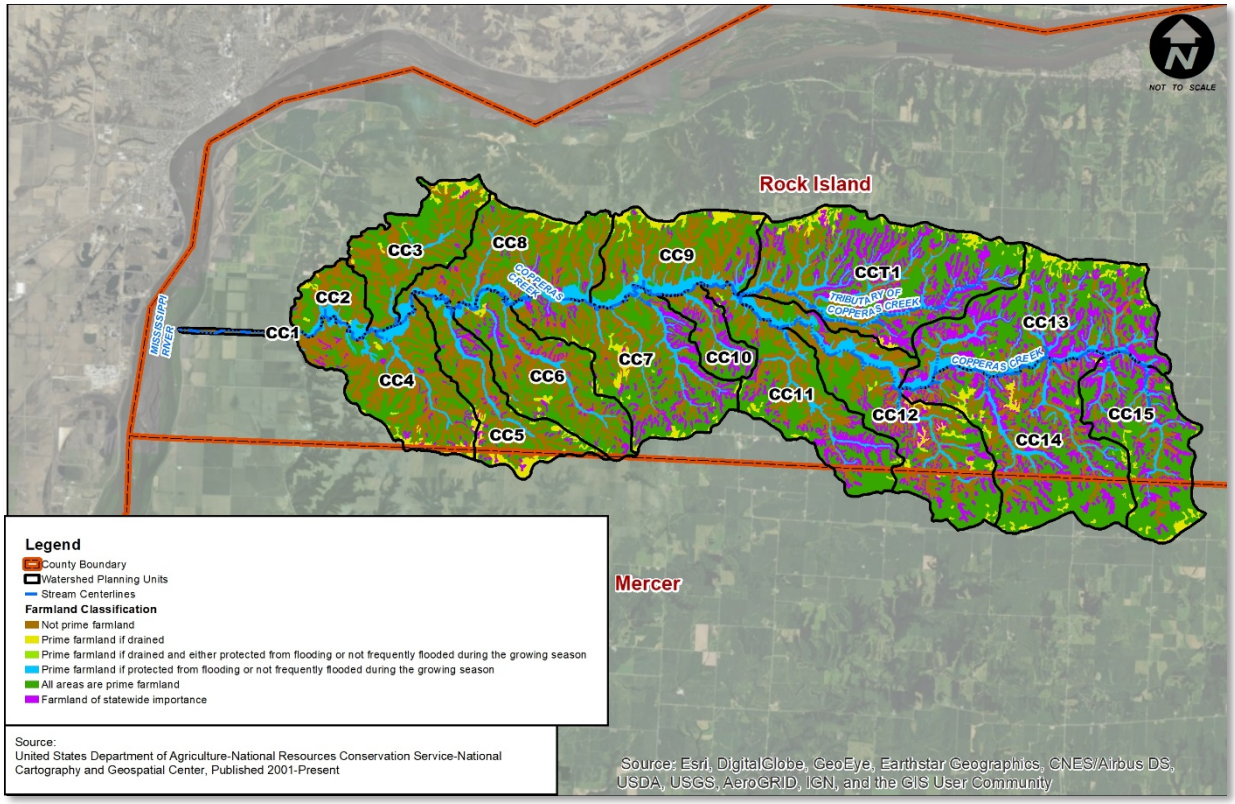


Figure 3.5-4 Farmland Classes in the Copperas Creek Planning Area

Farmland Classification	*Area (acres)*	*Percent of Planning Area*
Not Prime Farmland	13,217.3	28.2
Prime Farmland if Drained	2,151.8	4.6
Prime Farmland if Drained and Either Protected from Flooding or Not Frequently Flooded During Growing Season	26.5	0.1
Prime Farmland if Protected from Flooding or Not Frequently Flooded During Growing Season	4,842.3	10.3

All Areas Prime Farmland	20,086.9	42.8
Farmland of Statewide Importance	6,564.2	14.0
Totals	***46,889.0***	***100.0***

Table 3.5-4 Extent of Farmland Classes in the Copperas Creek Planning Area

3.5.5 Highly Erodible Soils

Soil erodibility can be defined by the tendency of soil particles to become detached and mobilized by water and the ground slope. Erodible soils are susceptible to erosion from runoff during storm events due to a combination of slope, particle size, and cohesion. The USDA – NRCS defines a highly erodible soil or soil map unit as one that has a maximum potential for erosion that equals or exceeds eight times the tolerable soil erosion rate (T). The NRCS uses the Universal Soil Loss Equation (USLE) to determine a soil's erosion rate by analyzing rainfall effects, characteristics of the soil, slope length and steepness, and cropping and management practices. The "T factor" is the soil loss tolerance (in tons per acre) that can be used for conservation planning. It is defined as the maximum amount of erosion at which the quality of a soil as a medium for plant growth can be maintained. The T factors are integer values of from 1 through 5 tons per acre per year. The factor of 1 ton per acre per year is for shallow or otherwise fragile soils (shown as red in Table 3.5-5) and 5 tons per acre per year is for deep soils that are least subject to damage by erosion (shown as green in Figure 3.5-5).

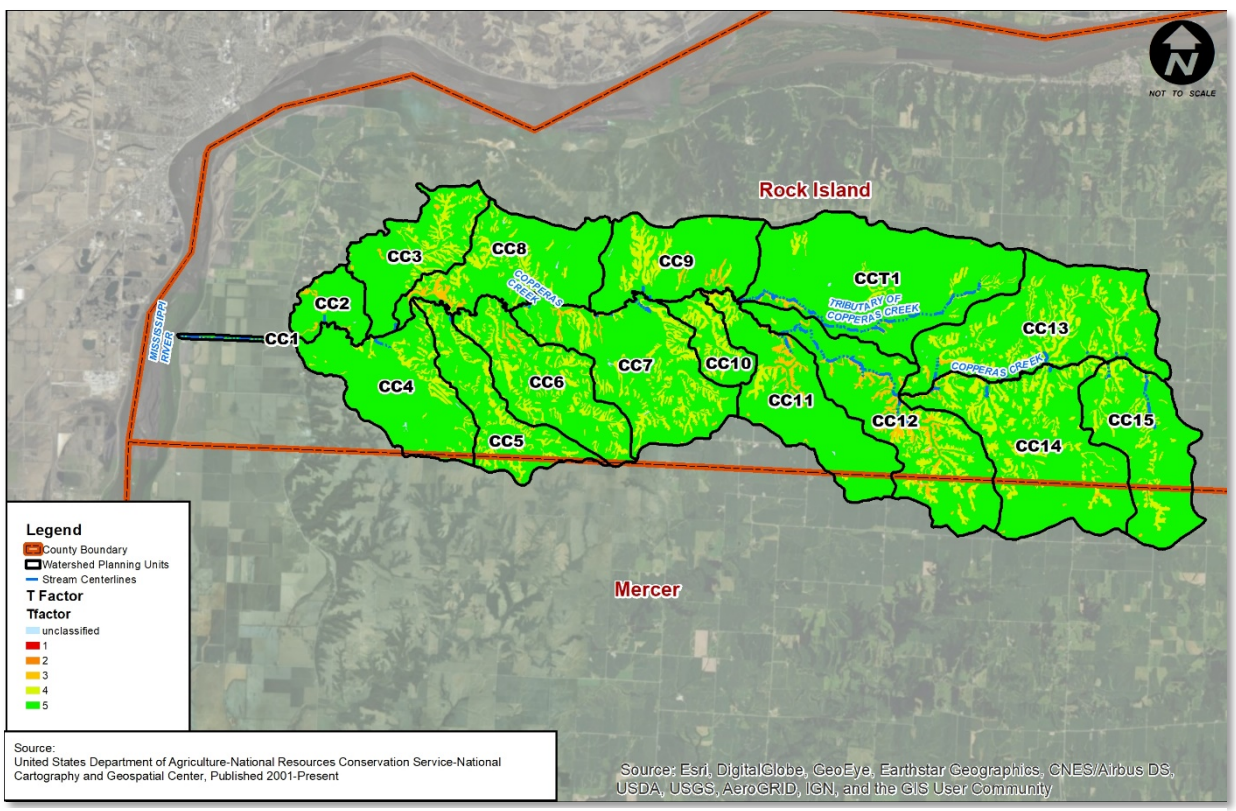


Figure 3.5-5 Highly Erodible Soils in the Copperas Creek Watershed

While the T factor is typically used for conservation planning on farms, it is appropriate to use soil tolerance for the objective of identifying the degree of soil loss potential. Highly erodible soils are considered in the watershed plan because erosion from these soils can potentially end up in surface waters, contributing to high amounts of total suspended solids and sediment accumulation in streams and lakes. This results in degradation of water quality due to silt and sediment deposition within the water body. Erodible soils along lakeshores and stream channels, and on disturbed land surfaces (e.g. active croplands and construction sites) are most susceptible to erosion. Therefore, stabilization practices near shorelines and stream channels could reduce erosion. All soils can severely erode when excavated and stockpiled; erosion control practices should be planned for any human disturbance of an area. Land developers are required to follow the National Pollutant Discharge Elimination System (NPDES) regulations regarding soil erosion and sediment control measures during construction.

T Factor (tons/acre/year)	*Area (acres)*	*Percent of Planning Area*
0/unclassified	41.9	0.1
1	0.0	0.0
2	0.0	0.0
3	1,097.7	2.3
4	5,996.4	12.8
5	39,753.0	84.8
Totals	***46,889.0***	***100.0***

Table 3.5-5 Extent of Erodibility in the Copperas Creek Planning Area

3.6 FLOODPLAINS

A floodplain is defined as any land area susceptible to being inundated by floodwaters from any source. The 100-year floodplain or base flood encompasses an area of land that has a 1% chance of being flooded or exceeded within any given year; the 500-year floodplain has a 0.2% chance of being flooded or exceeded within any given year. Floodways are defined by the National Flood Insurance Program (NFIP) as the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (0.1 foot in Illinois). Floodways are a subset of the 100-year floodplain and carry the deeper, faster moving water during a flood event.

When a natural floodplain is developed for other uses, such uses become susceptible to flooding which can result in property and crop damage as well as degraded water quality. Development in the floodplain can even affect areas that aren't directly adjacent to a waterbody, such that those areas can become flooded in heavy storms. Thus, it is important that floodplains and their relationship to land use be considered in watershed plans as well as any other type of land use planning.

According to floodplain data derived from the Federal Emergency Management Authority (FEMA) Flood Insurance Rate Maps (FIRMs), about 3.4 percent (1,614 acres) lies within the 100-year floodplain limits. The 1,614 acres includes studied and unstudied (Zone A) floodplains. About 0.1 percent (43.7 acres) of the planning area lies between the studied 100-year and 500-year floodplain (Table 3.6-1, Figure 3.6-1). The total area of the 500-year floodplain is all the Zone A, 100-year and 500-year floodplain which is roughly 1,657 acres or 3.5% of the planning area. Encroachments in the floodplain should be monitored by county since they can lead to increased upstream and downstream flood elevation.

Floodplain	*Rock Island County Area (acres)*	*Percent of Planning Area*
Zone A (unstudied)	1,502.5	3.2%
Only 100-year Floodplain	111.0	0.2%
Only 500-year Floodplain	43.7	0.1%
Totals	***1,657.2***	***3.5%***

Table 3.6-1 Floodplains in the Copperas Creek Planning Area

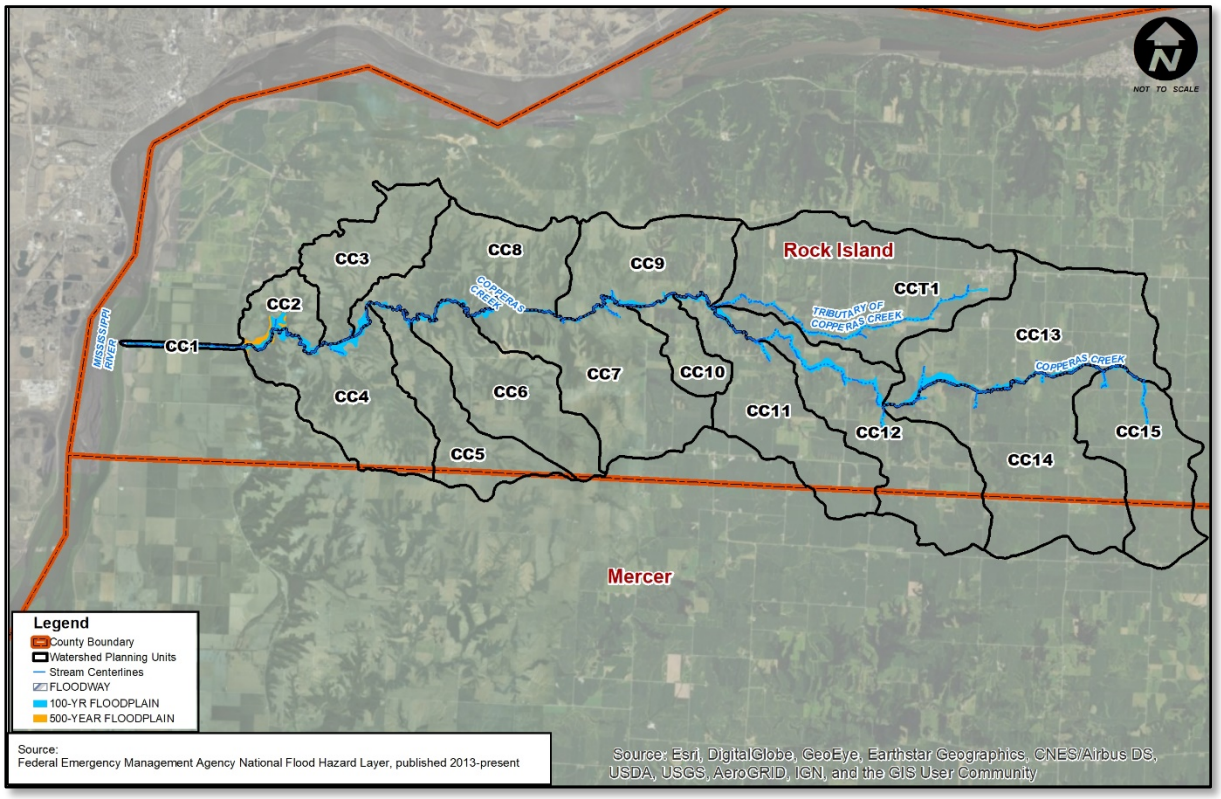


Figure 3.6-1 Floodplains in the Copperas Creek Planning Area

3.7 WETLANDS

Wetlands provide a variety of functions including social, economic, and ecological benefits to communities by providing valuable habitat, protecting natural hydrology and recharging groundwater. They also filter sediments and nutrients in runoff, provide wildlife habitat, reduce flooding, and help maintain water levels in streams. These functions improve water quality and the biological health of waterbodies, making wetlands an integral part of the watershed.

As the area was being developed, settlers altered presettlement wetlands by draining wet areas, channelizing streams, and clearing forests to farm the rich Midwestern soil. There are many wetland functions that generate ecosystem services that are valued by society. Wetlands are an integral part of the movement to conserve green infrastructure and thereby employ nature to help manage hydrology in the built environment. Despite this, the extent of America's wetlands continues to decline.

Based on the National Wetlands Inventory (NWI), there are an estimated 623 acres of wetlands, about 1.3% percent of the land area, within the Copperas Creek Watershed. Of this area, 446.7 acres is associated with riverine areas, 89.6 acres is associated with other open water areas and 86.7 acres is associated with freshwater forested/shrub or emergent wetlands. Each wetland is categorized by its type (identification code), size and location. The specific function and quality is unknown on a regional scale because a county specific function inventory (e.g. quality, water-quality, habitat, flood reduction) is unavailable.

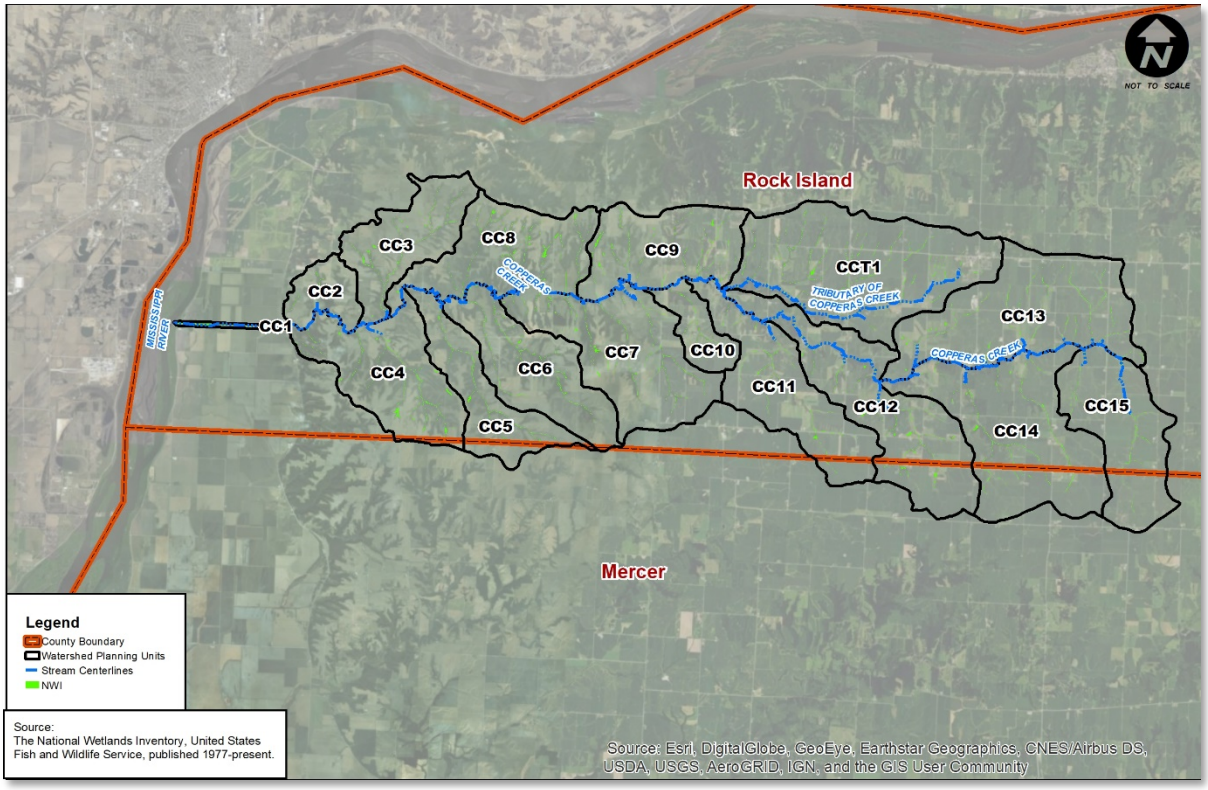


Figure 3.7-1 Wetlands in the Copperas Creek Planning Area

3.8 IMPERVIOUS SURFACE

The National Land Cover Database 2011 (NLCD 2011) for the watershed planning area is shown on Figure 3.9-1. The NLCD 2011 is the most recent Landsat-based, 30-meter resolution land cover database for the Nation and corresponds well with the USDA's land use database. Each data point or pixel represents a 30-meter square remotely-sensed image of the Earth's surface with a value of imperviousness assigned that ranges from 0 to 100%. Most of the planning area is at less than 5% impervious (Figure 3.8-1). The relationship between impervious surface and water quality is best examined at smaller units of geography. More localized land areas have direct impacts on the water quality of nearby lakes and streams. It may be appropriate to plan BMPs at priority locations to manage runoff from impervious areas.

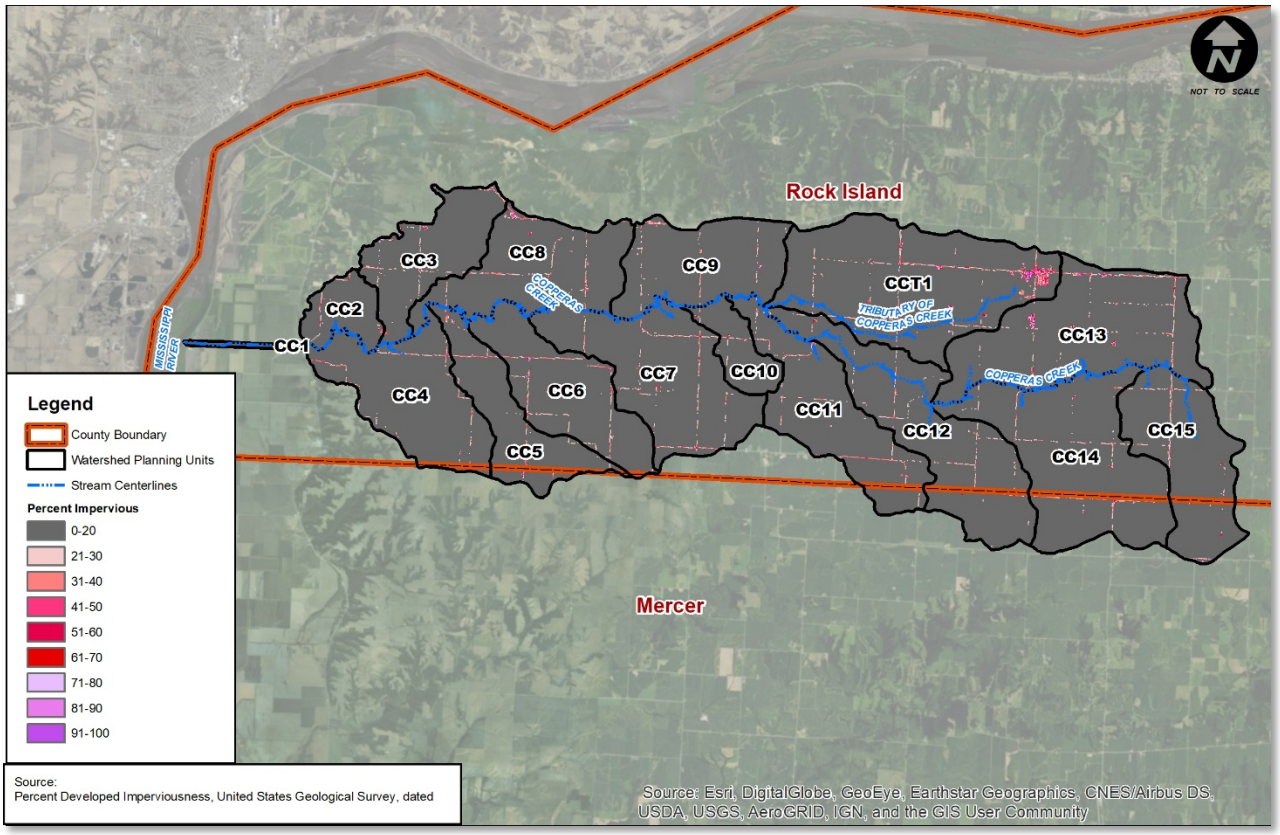


Figure 3.8-1 Percent Impervious in the Copperas Creek Planning Area

The watershed planning unit at the very downstream end (CC1) of the watershed warrants special consideration prior due to its proximity to the Mississippi River because it contains sandy soils and is the exit point of Copperas Creek into the Mississippi River Basin. Conservation development and green infrastructure will need to be implemented as development occurs in this area.

3.9 LAND USE AND LAND COVER

Land use has a significant effect on basin hydrology, affecting the volume and characteristics of runoff produced by a given area. Land use is classified using the NLCD 2011 for the watershed planning area.

For purposes of this watershed inventory, land use within the planning area is organized among ten categories (Figure 3.9-1 and Table 3.9-1). Cultivated Crops (66.7%) and Deciduous Forest (14.7%) are the most predominant land uses within the planning area. Hay/Pasture is the third most common of the area (13.2%). High density development is the least common type of land use (0.05%), followed by open water (0.07%). Wetlands (both emergent and woody) make up 1.2% of the land area, which is important to note since these areas may present opportunities for rehabilitation. Overall the watershed planning area is less than 6% developed with great opportunity to implement BMPs.

Land use within each of the watershed planning unit is shown in and is tabulated by the 10 major categories in Table 3.9-1. It is extremely important to strongly consider land use in the watershed planning process as land use relates the type and amounts of pollutant runoff that will occur and the types of watershed projects that will be most appropriate and most effective.

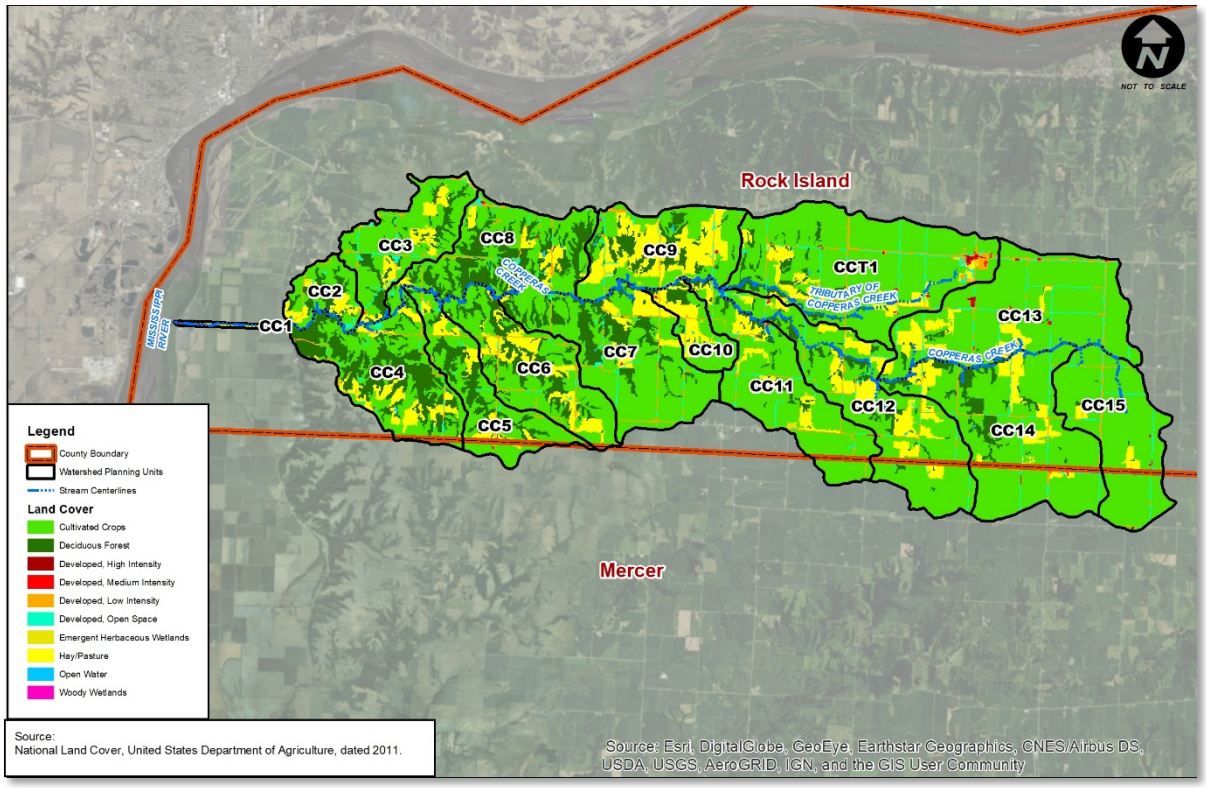


Figure 3.9-1 Land Use in the Copperas Creek Planning Area

Land-Use Category	*Area (acres)*	*Percent of Planning Area*
Cultivated Crops	31,280.2	66.7
Deciduous Forest	6,885.1	14.7
Developed, High Density	21.6	0.05
Developed, Medium Density	72.1	0.16
Developed, Low Density	1,292.1	2.7
Developed, Open Space	1,073.0	2.3
Emergent Herbaceous Wetlands	28.9	0.06
Hay/Pasture	6,177.5	13.2
Open Water	32.5	0.07
Woody Wetlands	26.0	0.06
Total	***46,889.0***	***100.0%***

Table 3.9-1 Land-Use Categories and Extent within the Copperas Creek Planning Area

As shown on Figure 3.9-2, a majority of the watershed is agricultural. While corn and soybeans dominate the cropland area watershed-wide, they are primarily in the upper portion of the watershed; pasture and forest areas are more prominent in the western portion of the watershed. Figure 3.9-2 shows all agricultural practices that occur within the watershed and Table 3.9-2 tabulates the crop production in the watershed.

Copperas Creek Bank Erosion along Hay Field
Photo Courtesy of RISWCD

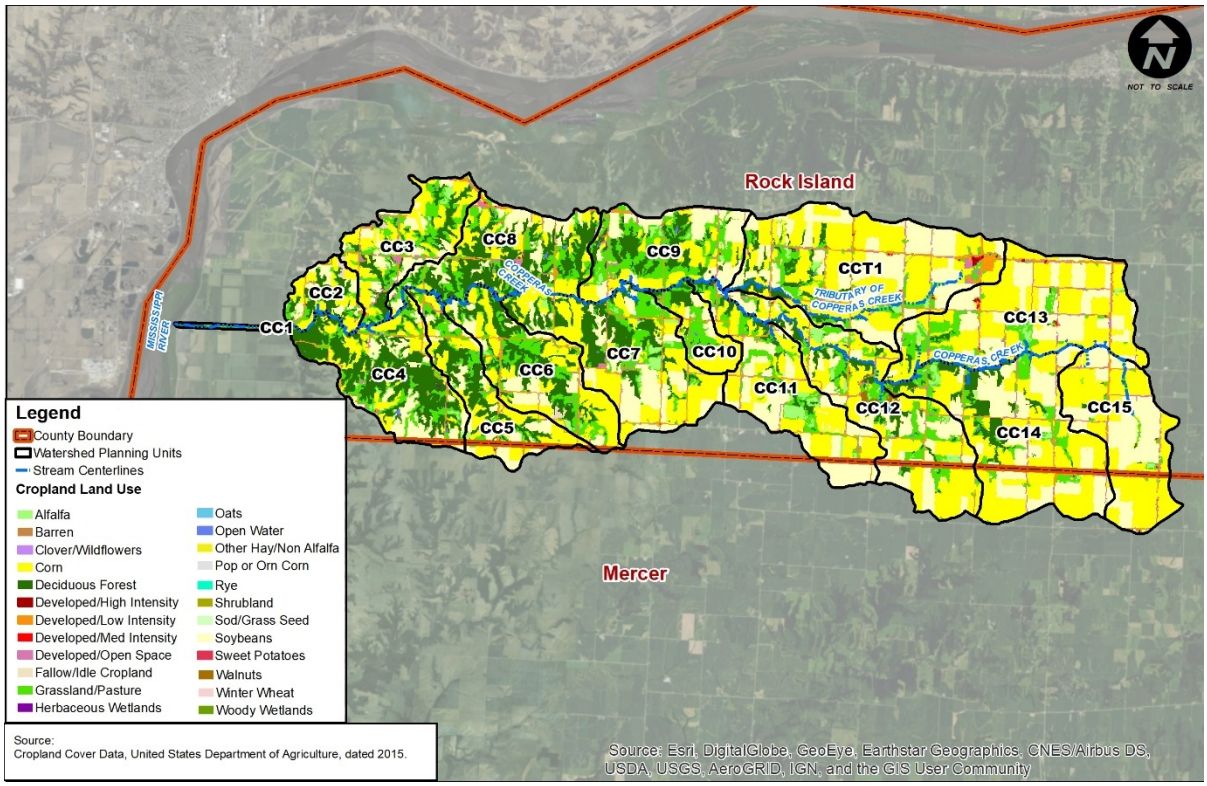


Figure 3.9-2 Cropland Land Use within the Copperas Creek Planning Area

Land-Use Category	*Area (acres)*	*Percent of Planning Area*
Alfalfa	736.3	1.6
Barren	2.4	0.005
Clover/Wildflowers	1.1	0.002
Corn	17,094.6	36.5
Deciduous Forest	7,289.0	15.5
Developed, High Density	15.8	0.03
Developed, Medium Density	93.9	0.2
Developed, Low Density	1,182.7	2.5
Developed, Open Space	1,072.8	2.3
Fallow/Idle Cropland	1.11	0.002
Grassland Pasture	6,789.9	14.5
Herbaceous Wetlands	85.8	0.18
Oats	7.3	0.016
Open Water	32.9	0.07
Other Hay/Non Alfalfa	1.8	0.004

Pop or Orn Corn	3.8	0.008
Rye	0.9	0.002
Shrubland	8.2	0.017
Sod/Grass Seed	2.2	0.005
Soybeans	12,293.3	26.2
Sweet Potatoes	0.2	0.001
Walnuts	67.8	0.14
Winter Wheat	70.1	0.15
Woody Wetlands	35.1	0.07
Total	***46,889.0***	***100.0%***

Table 3.9-2 Cropland Land Use in the Copperas Creek Planning Area

3.10 TILLAGE PRACTICES

The Illinois Department of Agriculture's Transect Surveys are depicted in the tables below. Table 3.10-1 and Table 3.10-2 show the corn and soybean tillage taken from the years of 2001-2017, bi-annually, for the counties of Rock Island and Mercer. Table 3.10-3 provides information about the percentages of Rock Island and Mercer counties' soil loss relative to the "T" (erodibility) factor. Ephemeral erosion is depicted in Table 3.10-4, which determines the amount of erosion, by percentage, for Rock Island and Mercer County.

Corn Tillage				
Rock Island				
	Averages for 2001-2013	**2015**	**2017**	**Difference (2015-2017)**
Average Soil Loss (%)	24.98	25.03	25.00	0.03
No Till (%)	37.7	26.8	23.7	3.1
Mulch Till (%)	9.7	45.1	18.3	26.8
Reduced Till (%)	24.5	14.1	31.5	17.4
Conventional Till (%)	28	14.1	26.5	12.4
Mercer County				
	Averages for 2001-2013	**2015**	**2017**	**Difference (2015-2017)**
Average Soil Loss (%)	25.02	25.0	25.0	0.0
No Till (%)	43	31	35.8	4.8
Mulch Till (%)	10.9	11.7	12.6	0.9
Reduced Till (%)	45.3	55.6	50.4	5.2
Conventional Till (%)	0.86	1.7	1.2	0.5

Table 3.10-1 Percentages of Corn Tillage Styles in Rock Island and Mercer County from 2001-2017

Soybean Tillage				
Rock Island				
	Averages for 2001-2013	**2015**	**2017**	**Difference (2015-2017)**
Average Soil Loss (%)	25.05	25.00	24.98	0.02
No Till (%)	68.4	48.8	58.3	9.5
Mulch Till (%)	16.4	48.2	25	23.2
Reduced Till (%)	8.7	2.4	9.5	7.1
Conventional Till (%)	6.7	0.6	7.1	6.5
Mercer County				
	Averages for 2001-2013	**2015**	**2017**	**Difference (2015-2017)**
Average Soil Loss (%)	24.99	25.0	25.0	0.0
No Till (%)	71.5	70.4	77.2	6.8
Mulch Till (%)	19.6	22.8	20	2.8
Reduced Till (%)	8	6.3	2.2	4.1
Conventional Till (%)	0.86	0.5	0.6	0.1

Table 3.10-2: Percentages of Soybean Tillage Styles in Rock Island and Mercer County from 2001-2017

The corn and soybean tillage have a high percentage of no tillage operations, according to the tables above. This shows that both counties practice no tillage operations over mulch, reduced, and conventional tillage. From 2001-2017, corn tillage showed a slight decrease in no till, while providing a slight increase for mulch, reduced, and conventional till for the counties of Rock Island and Mercer. Soybean tillage presented the exact opposite trend in these counties, where the mulch, reduced, and conventional till slightly decreased, while the no till slightly increased during the years of 2001-2017. As of 2017, the transect survey for Rock Island and Mercer counties, overall, show that the practices of mulch, reduced, and conventional tillage are more predominant than no till in corn tillage, while in soybean tillage, no till is predominantly practiced more than the other forms of tillage.

Soil Loss Relative to T			
Rock Island			
	Averages for 2001-2013	**2015**	**2017**
< = 1"T" (%)	76.1	83	70.7
1-2"T" (%)	15.4	12.3	14.9
> 2"T" (%)	8.4	4.7	13.9
Mercer County			
	Averages for 2001-2013	**2015**	**2017**
< = 1"T" (%)	87.3	82.2	84.8
1-2"T" (%)	9.4	11.7	10.7
> 2"T" (%)	3.3	6.1	4.4

Table 3.10-3: Percentage of Soil Loss in Rock Island and Mercer Country from 2001-2017

Copperas Creek Watershed Soybean Field with Conventional Tillage
Photo Courtesy of RISWCD

According to Table 3.10-3, between 2001-2017, over 70 percent of the soils in both counties exceed the soil loss tolerance. Conventional tillage practices are known to increase soil erosion, thus soil loss. Approximately 71 percent of the surveyed transects in Rock Island County exceed the soil loss tolerance, while approximately 85 percent of the surveyed transects are exceeded in Mercer County. This depicts that there is more fragile soil than deep soil presented in both counties. Mercer County has more fragile soil than Rock Island, and both show a decrease in the fragile soil compared to the surveys from 2001-2013. Between 2015 and 2017, Rock Island County the percentage of transects surveyed doubled for conventional tilling practices for corn and while no-till practices increased for soybean production, conventional tilling increased as well. Because a majority of the watershed is located in Rock Island County, it also indicates that conservation tillage practices should be implemented in the watershed for both corn and soybean production.

Table 3.10-4 shows the percentage of fields surveyed that show signs of ephemeral erosion within these two counties. The erosion correlates with the soil loss tolerance found in the table above. In Mercer county, there are greater amounts of fragile soil found, which shows that there is more erosion present. The corn and soybean tillage surveys for both counties indicate that while tillage practices have varied, the average soil loss is still the same and the relation of soil loss to "T" has decreased between 2001 and 2017, which is consistent with the ephemeral erosion shown in Table 3.10-4.

Ephemeral Erosion			
	Averages for 2001-2013	**2015**	**2017**
Rock Island	36.4%	18%	14%
Mercer County	50%	40%	40%

Table 3.10-4: Ephemeral Erosion Percentages in Rock Island and Mercer County from 2001-2017

3.11 AQUIFER SENSITIVITY

Aquifers are defined as geologic materials that are saturated and sufficiently permeable to yield economic quantities of water to wells or springs. Wells are drilled into aquifers and water can be pumped out; however, weather cycles, precipitation patterns, streamflow and geologic changes, and human-induced changes, such as increased imperviousness can cause the water table to change.

3.11.1 Pesticides

Pesticide usage has grown considerably due to crop production for food for local use and exports. The United States is the largest food producer in the world, partly due to the use of modern chemicals (pesticides and herbicides). Water is one of the main ways that pesticides are transported from one area to another. Ways that pesticides reach aquifers below ground include crop application, seepage, spills, and improper disposal. Groundwater contamination as a result of pesticide usage is of significant importance because 50% of the nation's population depends on groundwater for drinking water and approximately 95% of the population in rural areas. While the upstream areas within the watershed

are somewhat limited to pesticide sensitivity, the downstream areas area moderately to excessively sensitive to pesticide sensitivity (Figure 3.10-1 and Table 3.10-1).

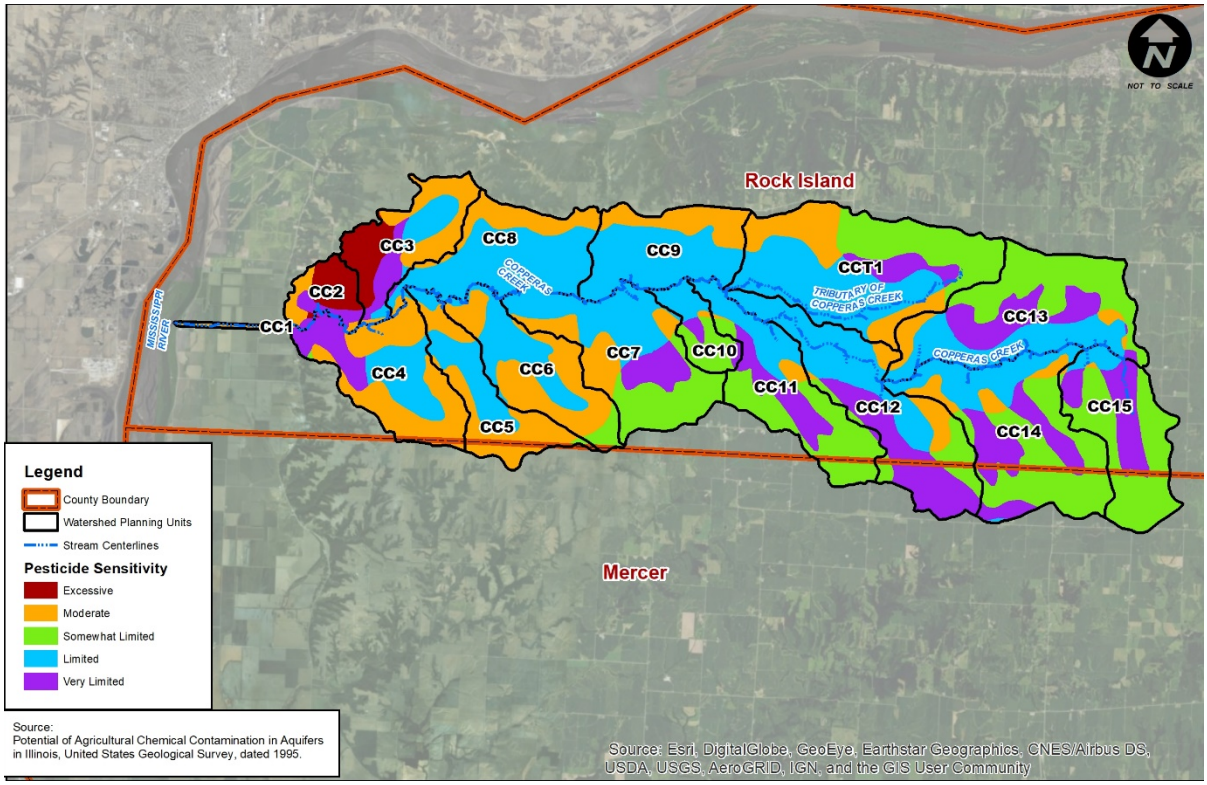


Figure 3.11-1 Pesticide Sensitivity in the Copperas Creek Planning Area

Pesticide Sensitivity	*Area (acres)*	*Percent of Planning Area*
Excessive	1,101.3	2.3
Moderate	10,352.3	22.1
Somewhat Limited	11,717.5	25.0
Limited	16,770.7	35.8
Very Limited	6,957.2	14.8
Total	***46,889.0***	***100.0%***

Table 3.11-1 Pesticide Sensitivity

3.11.2 Nitrogen

Nitrogen is an essential element for plant growth and reproduction. Crops that cannot convert nitrogen gas naturally rely on nitrogen from the soil or nitrogen applied through either manure or commercial fertilizer for optimal growth and production. Adequate nitrogen supply is critical to achieve high yield and economic profitability. In addition to fertilizer, nitrogen occurs naturally in the soil in

organic forms. The nitrogen that is not used by the plants in nitrate form is highly leachable and readily moves through the soil profile.

Contamination with nitrogen fertilizers (potassium nitrate, ammonium nitrate) raises the concentration of nitrate in the groundwater with excessive rain or irrigation. When nitrogen is applied to the soil, bacteria converts various forms of nitrogen to nitrate. Nitrate is the compound predominantly found in groundwater and drinking water. The EPA established a drinking water limit of 10 mg/L (www.water-research.net) Between 1970 and 1992, the USGS found that 9% of private wells that were tested exceed the recommended limit of 10 mg/L nitrate-nitrogen concentration. Excessive concentrations of nitrate-nitrogen in drinking water can be hazardous to health. Higher nitrogen rates needed when crop rotation practices are not implemented result in a higher nitrate concentration in tile flow. Using optimal nitrogen rates are important components on minimizing impacts of nitrogen application to corn on water quality. Management practices to reduce the risk of contamination from applied fertilizers and manure help keep the water supply safe.

Nitrate sensitivity is shown in Figure 3.10-2 and is summarized in Figure 3.10-1.

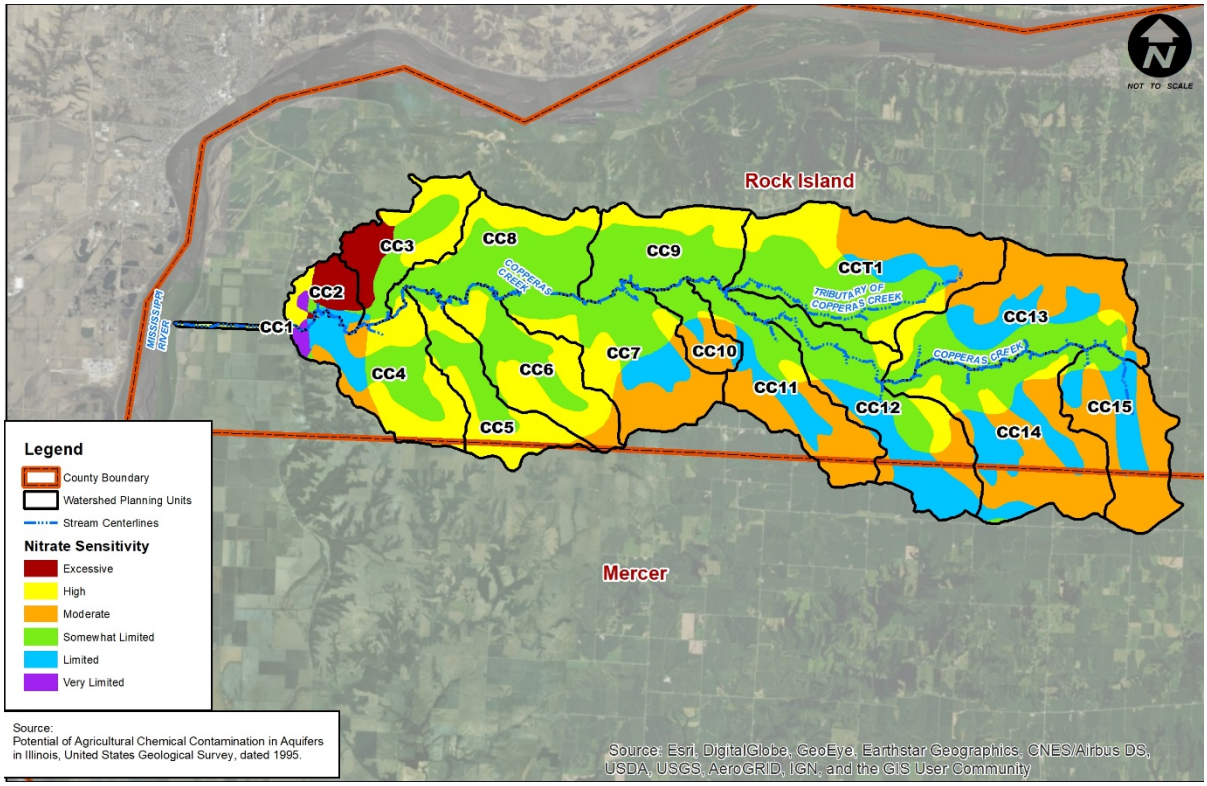


Figure 3.11-2 Nitrate Sensitivity in the Copperas Creek Planning Area

Nitrate Sensitivity	*Area (acres)*	*Percent of Planning Area*
Excessive	1,101.3	2.4
High	9,961.9	21.2
Moderate	12,101.3	25.8
Somewhat Limited	17,141.8	36.6
Limited	6,443.1	13.7
Very Limited	149.6	0.3
Total	***46,889.0***	***100.0%***

Table 3.11-2 Nitrate Sensitivity

3.12 GROUNDWATER

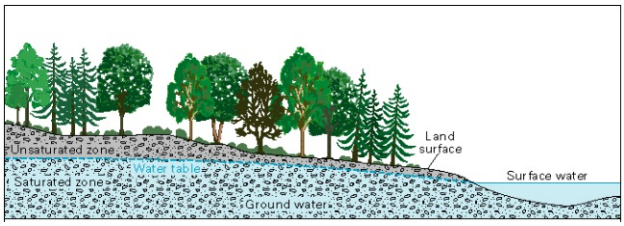


Figure 3.12-1 Groundwater

Some part of the precipitation that lands on the ground surface infiltrates into the subsurface, and accumulates as groundwater (Figure 3.11-2). Groundwater occurs in the saturated soil and rock below the water table. It is not always accessible, or fresh enough for use without treatment. This water may occur close to the land surface or it may lie many hundreds of feet below the surface. The water that continues downward through the soil until it reaches rock material that is saturated is groundwater recharge. Water in the saturated groundwater system moves slowly and may eventually discharge into streams, lakes, and oceans.

Groundwater supplies drinking water for 51% of the total U.S. population and 99% of the rural population. Approximately 64% of groundwater is used for irrigation to grow crops and is an important component in many industrial processes.

Figure 3.11-2 shows that over 97% of the watershed planning area has a major bedrock aquifer within 300 feet of the ground surface. These areas are overlain by thin layers of less permeable silts and clays. Many are directly overlain by shallow or major sand and gravel aquifers allowing direct hydrologic communication with the shallower aquifer systems, which cover approximately 55% of the Copperas Creek planning area. The major sand and gravel aquifers within the planning area cover approximately 4% of the planning area. These are usually separated from the shallower aquifers by layers of less permeable till or fine-grained lacustrine deposits. These aquifers, which generally lie between 300 and 500 feet in depth are generally found within pre-glacial bedrock valleys or along modern streams and rivers. The deep aquifers within the planning area are exclusively located downstream towards the Mississippi River. Knowledge of the depth to groundwater within the Copperas Creek Planning Area is important in the planning process for BMP selection as groundwater depths can influence infiltration capacity and affect the suitability of infiltration BMPs.

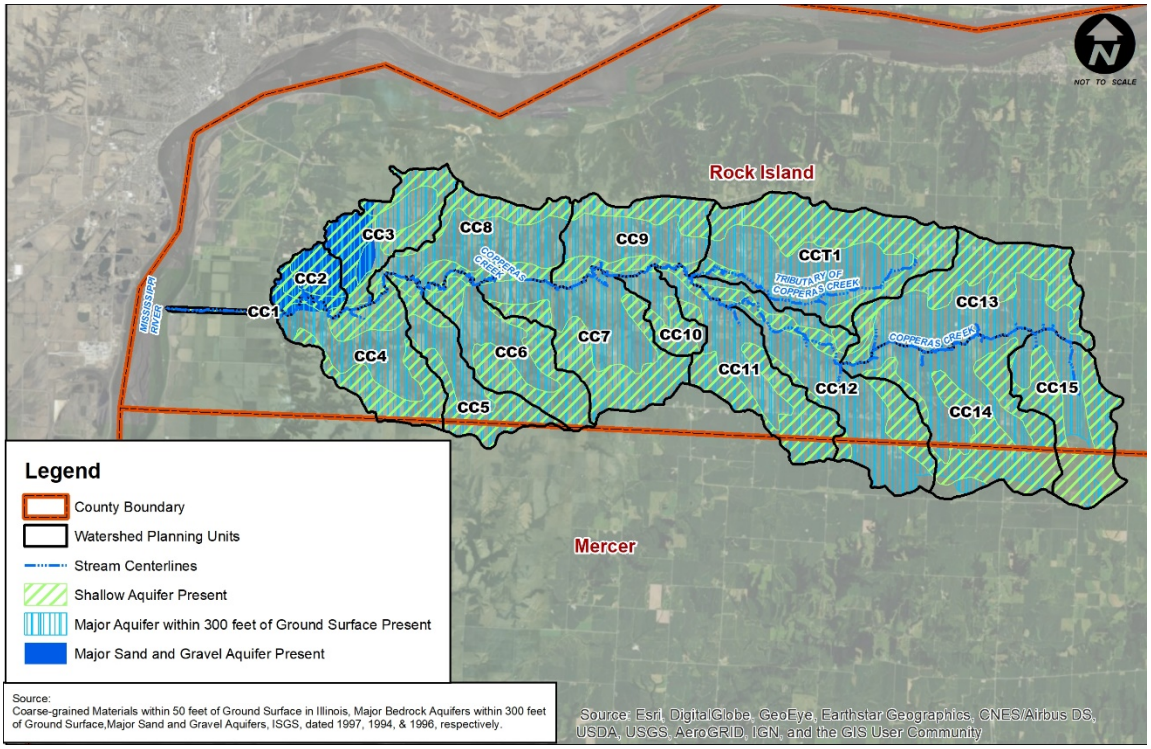


Figure 3.12-2 Groundwater in the Copperas Creek Planning Area

3.13 OPEN SPACE RESERVE

Open space reserve is an area of land and/or water that is protected or conserved such that development will not occur on this land at any time in the future. Lands adjacent to the Mississippi River have been categorized as either public land ownership, management and conservation lands, including voluntarily provided privately protected areas; however, there is no public owned land within the planning area.

3.14 PRESETTLEMENT LAND COVER

For a qualitative sense of historical land use change, Figure 3.13-1 shows the presettlement land cover (primarily vegetation) in and around the Copperas Creek planning area as surveyed in the early stages of Euro-American settlement in the early 1800s. At that time, the land cover was comprised primarily of forest and prairie along with wetlands (categorized as swamp), barren areas and open water. Following European settlement, most of this land was converted to agricultural practices. This historic land cover can be informative for current land use planning and future ecological restoration projects.

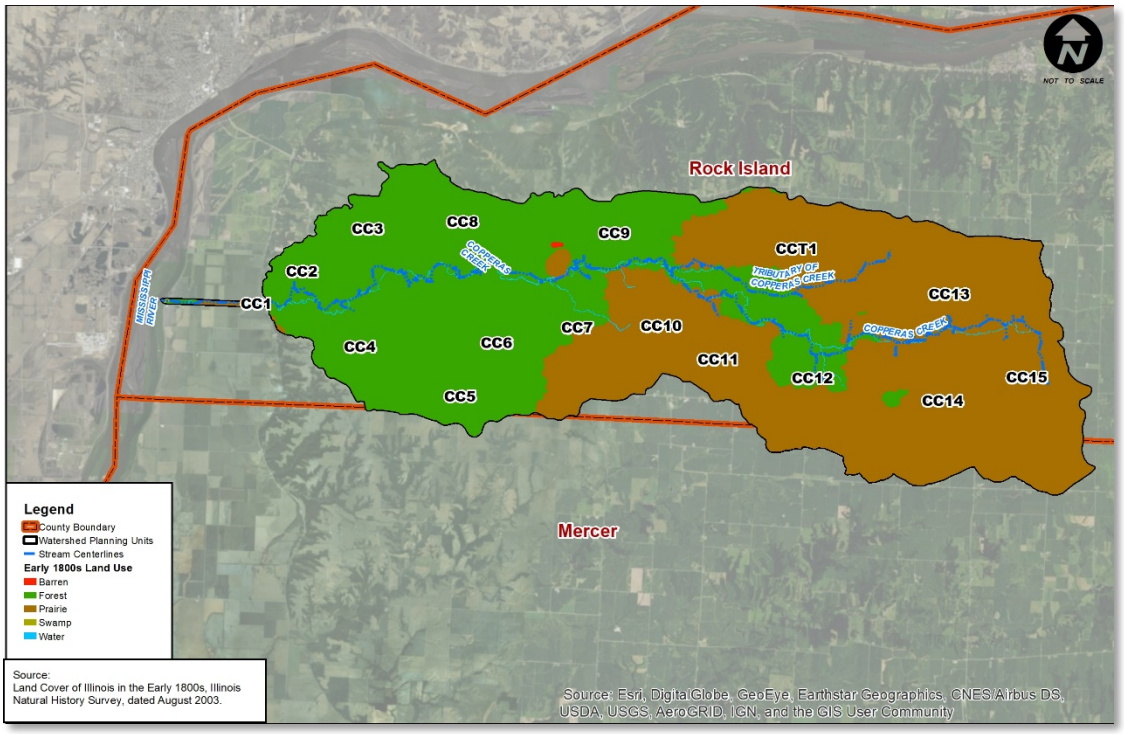


Figure 3.14-1 Presettlement Land Cover in the Copperas Creek Watershed

Vegetation Type	*Area (acres)*	*Percent of Planning Area*
Barren	16.4	0.03
Forest	20,988.2	44.8
Prairie	25,594.3	54.6
Swamp	7.5	0.02
Water	282.6	0.6
Totals	***46,889.0***	***100.0***

Table 3.14-1 Presettlement Land Cover in the Copperas Creek Planning Area.

3.15 WATERSHED DRAINAGE SYSTEM

Water in the approximately 73 square mile Copperas Creek watershed generally flows from east to west toward the Mississippi River. Copperas Creek originates west of 91st Street SW and north of 190th

Avenue West and continues west toward the Mississippi River. There are several smaller gullies in the watershed planning area both north and south of the mainstem Copperas Creek. The gullies north of the mainstem Copperas Creek generally flow south and the watercourses south of the mainstem Copperas Creek flow north. The Copperas Creek Planning Area consists of the mainstem and the main tributaries, as described below and shown on Figure 3.14-1.

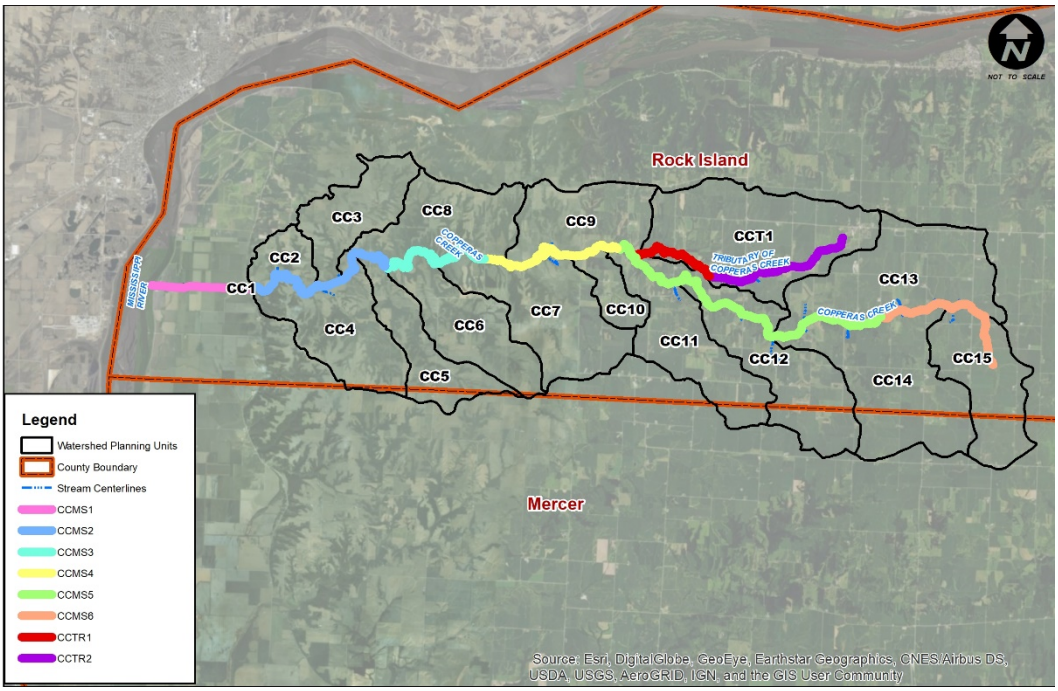


Figure 3.15-1 Watershed Drainage in the Copperas Creek Planning Area

3.15.1 Copperas Creek

Figure 3.15-2 Copperas Creek

The Copperas Creek watershed includes the main stem of Copperas Creek with one major named tributary (Tributary of Copperas Creek) and several unnamed tributaries and gullies. Copperas Creek is approximately 27.7 miles long and serves as the main conveyance channel for the entire watershed. Copperas Creek and its tributaries measure approximately 40.2 miles long.

There are no lakes along Copperas Creek and therefore a shoreline assessment is not part of this plan.

3.15.2 Tributary of Copperas Creek

The Tributary of Copperas Creek watershed planning unit drains approximately 8.62 square miles from the headwaters near the unincorporated community of Edgington to its confluence with Copperas Creek near the intersection of 210th St West and 148th Avenue West. This area contains primarily cropland with corn and soybeans being the dominant crop farmed.

Figure 3.15-3 Tributary of Copperas Creek

3.15.3 Watercourse Assessment Methodology

A desktop analysis was combined with field investigations to create an inventory of streams and tributaries with respect to streambed and bank conditions. The assessment focused on erosion, degree of channelization, condition of riparian areas and areas of debris blockages. The desktop analysis is based on review of high resolution aerial photography from 2013 through 2016. Aerial photography was used to identify large scale issues including stream alterations, land uses that could contribute to nonpoint source pollution impairments, presence or absence of stream buffers, evidence of streambank erosion, in-channel impoundments, or other features of interest.

The review of aerial photography was conducted in conjunction with drainage class and soil erodibility mapping ("T" factor) previously created for each watershed planning unit. As previously discussed, T factors are integer values of from 1 through 5 tons per acre per year. The factor of 1 ton per acre per year is for shallow or otherwise fragile soils (shown as red on Figure 3.14-3) and 5 tons per acre per year is for deep soils that are least subject to damage by erosion (shown as green on Figure 3.14-3). While the T factor is typically used for conservation planning on farms, it is appropriate to use soil tolerance for the objective of identifying the degree of soil loss potential and in this case quantification of erosion. For the case of the Copperas Creek Planning Area, the T factor is used in conjunction with aerial photography review to identify areas of low, moderate or high erosion.

Copperas Creek Streambank Undercutting and Soil Deposition
Photo Courtesy of RISWCD

Channels with high erodibility factors were identified as a channel susceptible to erosion. The combination of aerial reviews, identification of soil erodibility factors, and field assessments allowed for the assessment of overall erosion conditions, including streambed erosion. The field assessments generally included observations at bridges or other structures crossing a watercourse to both bolster and verify assessments made during the desktop analysis. Stream depth and widths used in the assessment area based on observation and topography.

Google earth and street views were assessed as these street views provided detail in areas where watercourses have been highly channelized or stabilized via rip rap. Data collected included a visual assessment of stream condition, adjacent land use, and environmental factors that could be attributed to altered flows and nonpoint source pollution. The findings of the desktop analysis, field notes, and photographs of conditions at each location visited were compiled as a part of the evaluation. This comprehensive analysis was used to identify vulnerable locations within the streams and streambeds where bank and streambed erosion control measures can be implemented.

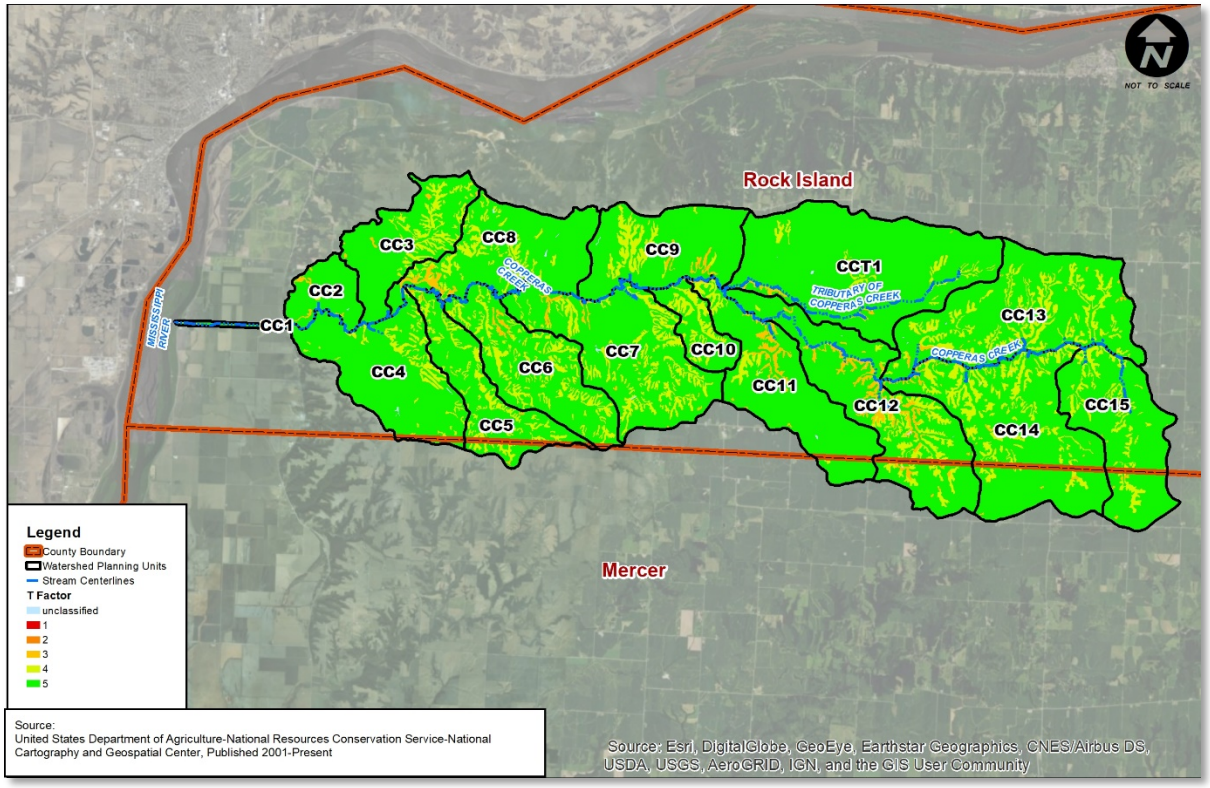


Figure 3.15-4 Highly Erodible Soils in the Copperas Creek Watershed

3.15.4 Channel Assessment Methodology

Channelization refers to the straightening of natural, meandering stream channels or the construction of channels for drainage (Figure 3.14-4). In natural meandering streams, channelization has the effect of reducing the overall length of the stream and increasing the gradient of the channel and therefore velocity. Channelization destroys in-stream and riparian habitat while disconnecting the stream from its floodplain. Channelization can also cause channel instability by reducing sinuosity while increasing streambank erosion. To restore and protect habitat and water quality, opportunities for re-meandering and reconnecting the stream with its floodplain should be pursued wherever possible. Figure 3.14-5 and Table 3.14-1 show the degree of

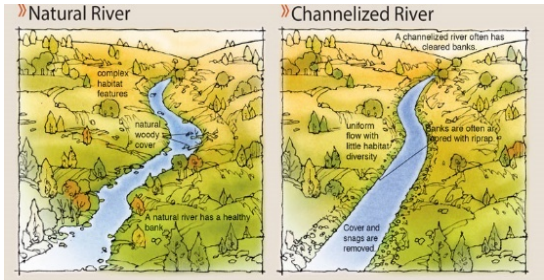


Figure 3.15-5 Channelization (Natural vs Channelized)

channelization through the Copperas Creek Planning Area. Channelization is described as low, moderate or high degree.

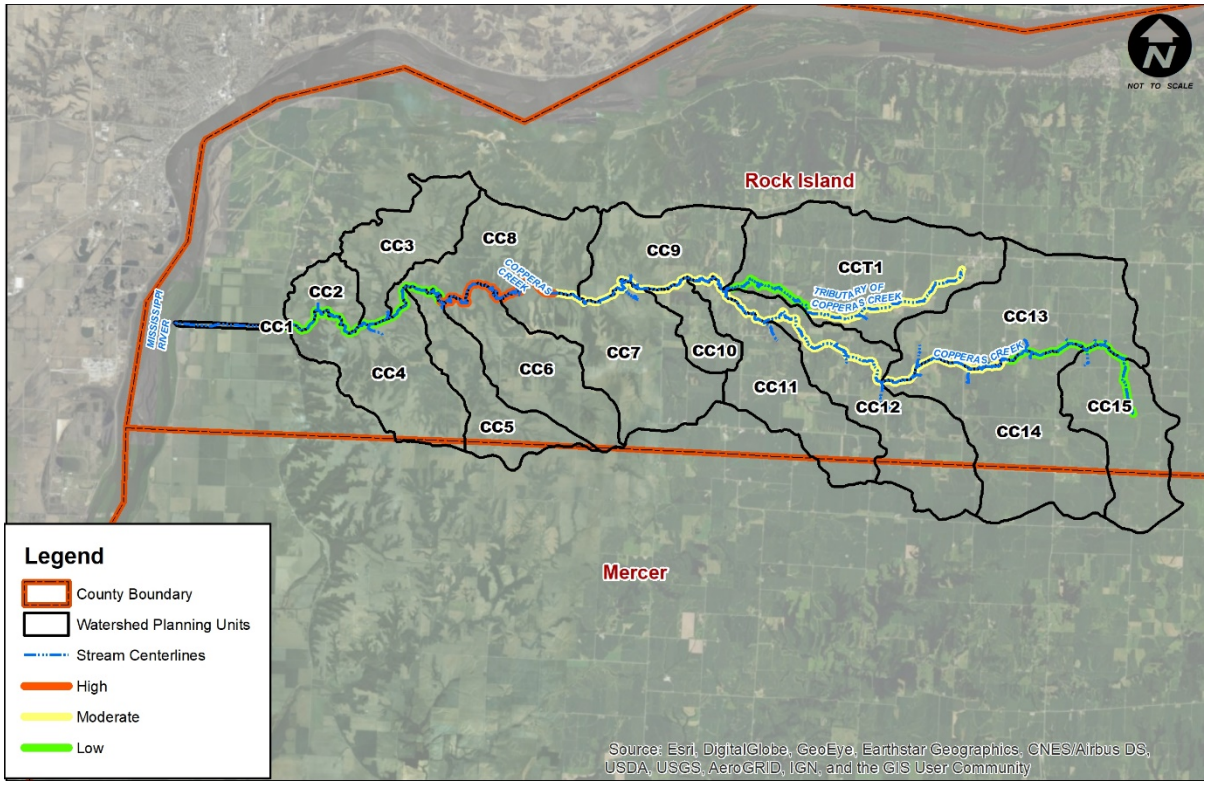


Figure 3.15-6 Summary of Channelization in the Copperas Creek Planning Area

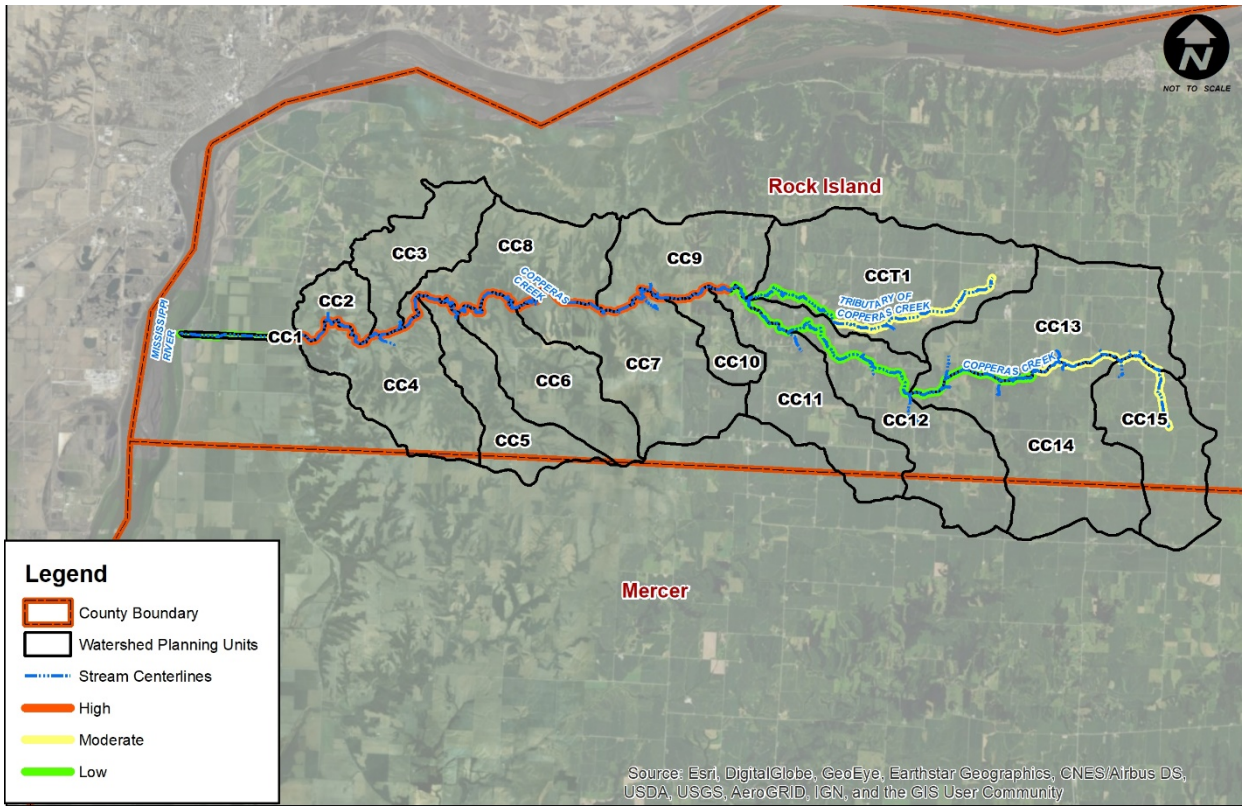


Figure 3.15-7 Summary of Stream Channel Erosion in the Copperas Creek Planning Area

3.15.5 Riparian Area Assessment Methodology

A riparian zone or riparian area is the interface between land and a river or stream. A riparian area is comprised of vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial, intermittent, or ephemeral surface or subsurface water drainage. An overall exhibit of the riparian area in the watershed planning area is shown on Figure 3.14-7. High resolution aerial imagery was used to assess riparian buffer conditions within 50-100 feet to each side of the watercourses throughout the watershed planning area. "Good" riparian condition was typically characterized by woodland, prairie, and/or wetland vegetation dominant on both sides of the stream. A "poor" condition was defined by turf grass and developed areas. A "fair" condition was noted as having at least some vegetative buffer along the stream. Reaches with a "good" riparian condition was assessed based solely on aerial interpretation.

Meandering Copperas Creek with Bank Erosion and Sandbars
Photo Courtesy of RISWCD

It should be noted that these areas may be dominated by invasive species, such as buckthorn, honeysuckle, reed canary grass, and phragmites, among others, and compromised in their pollutant filtering and settling capacities. The morphological changes produced in the alluvial terraces, including

the channel reduction due to channelization and armoring activities lower the assessment. The elimination of meanders is also considered. Several figures and summary tables follow in the discussion below. Figure 3.14-7 shows the riparian areas within the watershed planning area and Figure 3.14-8 shows the condition of the riparian areas. Table 3.14-1 quantifies the stream lengths associated with the characterized riparian areas. Protecting and enhancing riparian areas will be helpful for protecting water quality in the Copperas Creek Planning Area and its tributaries.

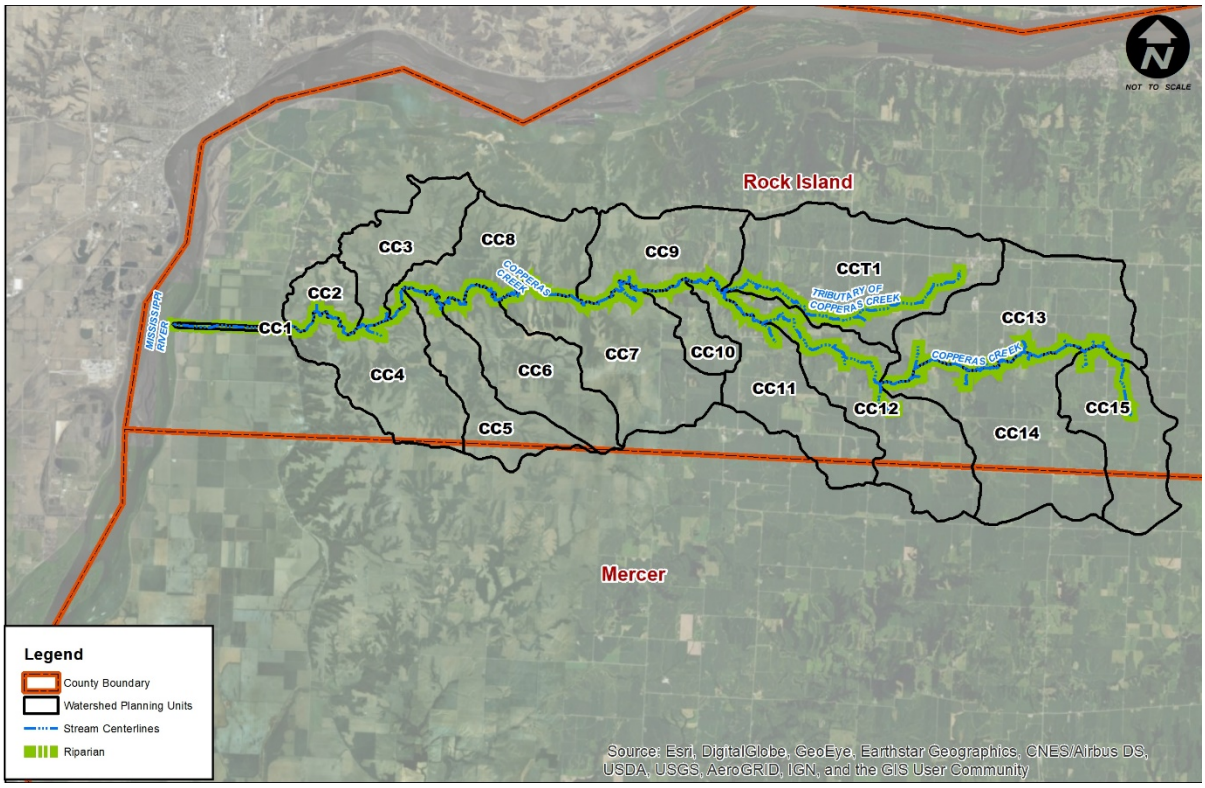


Figure 3.15-8 Riparian Corridors in the Copperas Creek Planning Area

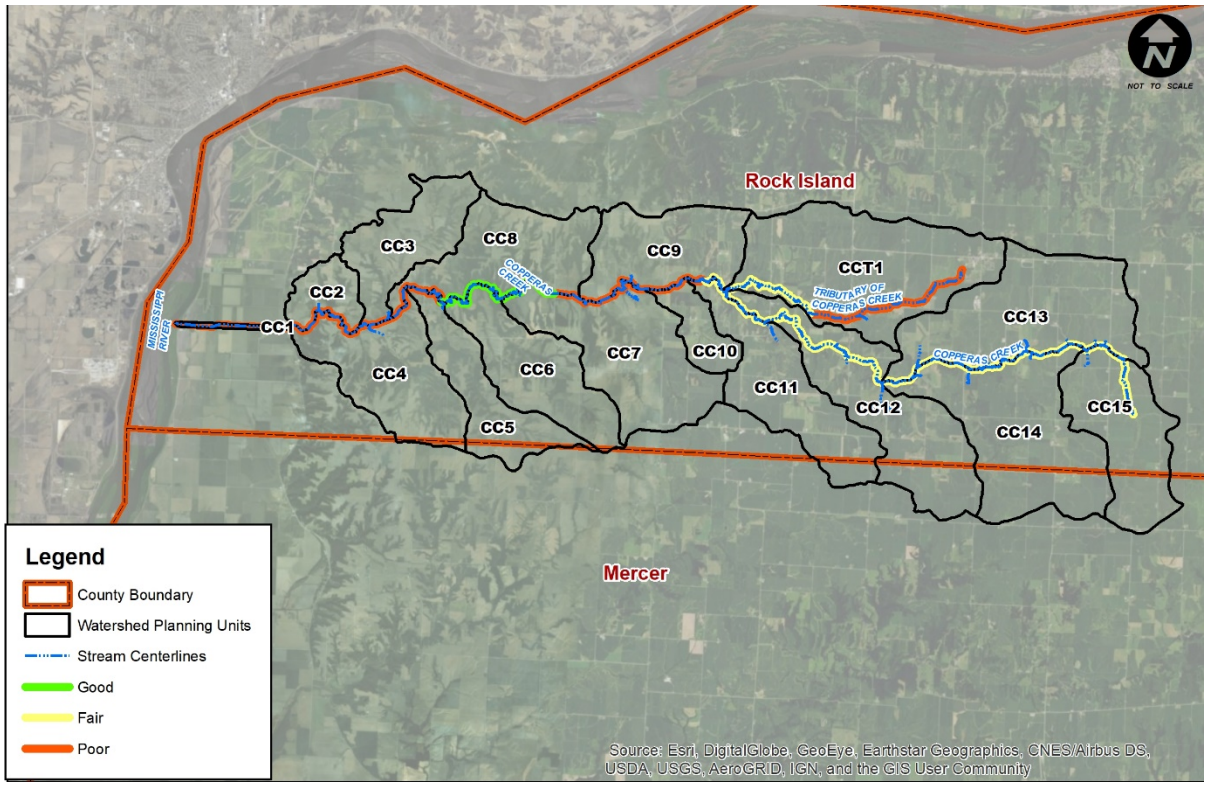


Figure 3.15-9 Summary of Riparian Areas in the Copperas Creek Planning Area

Watercourse Name	Reach Code	Stream Length Assessed (feet)	Total Length (feet)	% of Total	Degree of Channelization	Riparian Area Condition	Degree of Erosion
COPPERAS CREEK	CCMS1	11,024	145,349	7.6	High	Poor	Low
	CCMS2	26,686		18.4	Low	Poor	High
	CCMS3	21,283		14.6	High	Good	High
	CCMS4	20,705		14.2	Moderate	Poor	High
	CCMS5	44,561		30.7	Moderate	Fair	Low
	CCMS6	21,090		14.5	Low	Fair	Moderate
TRIBUTARY OF COPPERAS CREEK	CCTR1	12,928	30,787	42.0	Low	Fair	Low
	CCTR2	17,859		58.0	Moderate	Poor	Moderate

Table 3.15-1 Summary of Channelization, Riparian Corridor and Erosion in the Copperas Creek Planning Area

The results of the watercourse assessment indicate that channelization is low throughout the majority of the planning area, but the erosion of these same areas is generally high. These areas of high erosion and low channelization are areas associated with agriculture fields that abut the riparian area. Erosion is low to high depending on the proximity of the farm field to the watercourse. The loss of the riparian corridor and high erosion rates negate the natural removal process of constituents found in stormwater runoff. This condition highlights the need for BMPs to restore and protect any remaining open space or conversion of problematic land uses to open space within the riparian corridors. BMPs selected to restore the natural process may also include strategically planned and implemented streambank

stabilization projects. Areas where there is low erosion may have more erodible soils, but are located in areas with a better than poor riparian buffer. However, this also suggests the need for BMPs in areas noted with fair riparian condition.

3.16 GULLY FORMATIONS

Gullies are defined as a landform that is created by running water eroding sharply into the soil. Eroded soil is easily carried in the gully and can produce sediment that can clog downstream waterways. According to the NRCS, permanent gullies are formed when the channel has progressed to the point where the gully is too wide or deep to be tilled across. They carry large volumes of water and disfigure the landscape making it unfit for growing crops. These usually begin as ephemeral gullies, which are small erosion channels formed on crop fields as a result of concentrated flow of runoff water.

The typical gullies analyzed as part of the streambank assessment in Copperas Creek planning area can be considered permanent gullies, that have the potential to grow year to year by head cutting and lateral enlargement. Review of historic aerials indicates the gullies began to appear between 25 and 50 years. Although they have potential to grow, these gullies are considered stable. Gullies are of concern especially on highly erodible land. The infiltration rate increases with more clay soils, but resistance to erosion decreases. Gully erosion can be significant causing soil loss within the adjacent landscape. There are several other non-permanent, ephemeral gullies, that can that can be reshaped and farmed across. However, discing these gullies leaves topsoil vulnerable to erosion. Several natural resources conservation practices and management options are available to help farmers protecting productivity and water quality. Sheet and rill erosion can be addressed with: crop rotation, contour buffer strips, contour farming, strip cropping, and critical area planning. Ephemeral erosion can be combated with grassed waterways, dry dams, and water and sediment control basins. Figure 3.15-1 shows the locations of the gullies that were considered in the nutrient loading calculations.

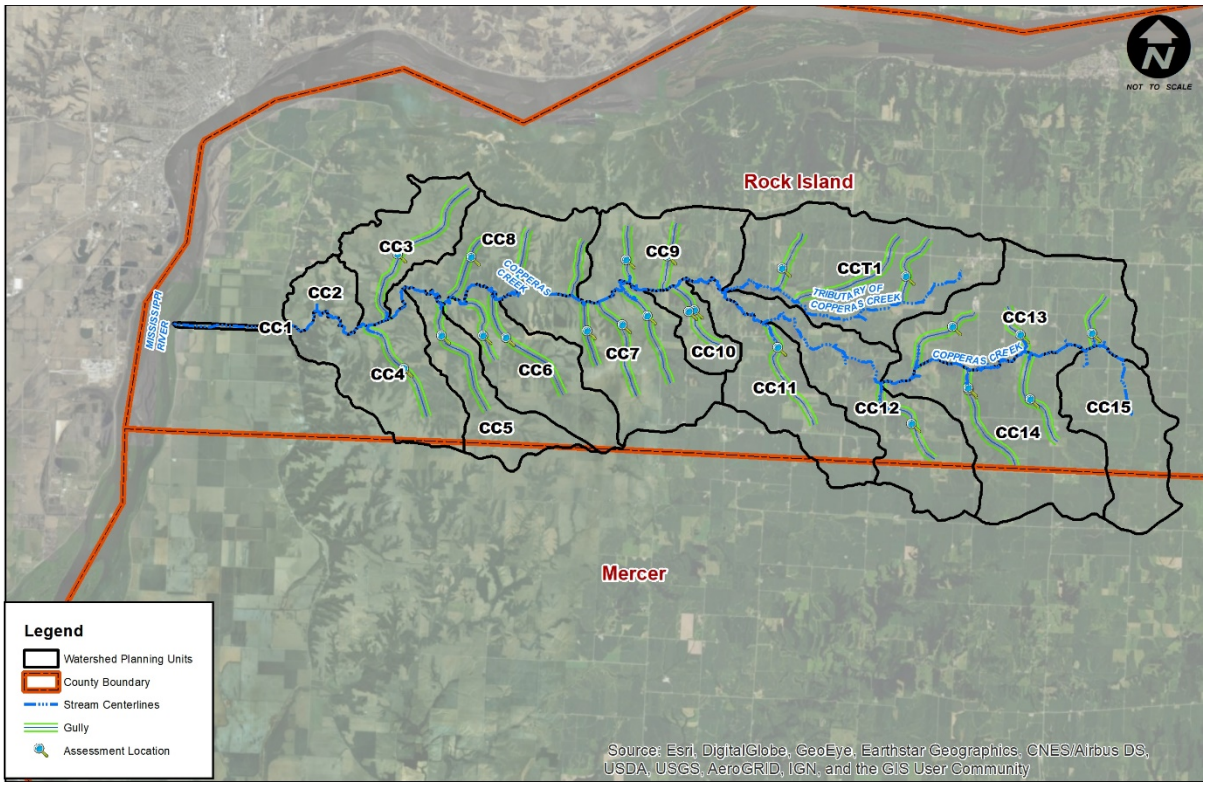


Figure 3.16-1 Gullies in the Copperas Creek Watershed Planning Area

3.17 DETENTION BASIN INVENTORY

Detention basins are man-made features that are used to temporarily store stormwater runoff during and after a storm. Detention basins can either be dry (during dry weather periods) or contain a permanent pool of water. The primary role of a detention basin is to store stormwater to reduce the risk of flooding, and basins can (but frequently do not) include design features to help protect local waterways. Detention basins are constructed to capture stormwater from storm events and snow melt, and then slowly release this water to a receiving watercourse. Problems such as streambank erosion and water pollution are just a few of the consequences of poorly managed stormwater. Degraded watercourses can be restored by employing BMPs, including retrofitting detention basins to incorporate features to restore and protect water quality. No detention basins were identified in the Copperas Creek planning area.

3.18 WATER QUALITY ASSESSMENT

3.18.1 Surface Water Quality Assessment (Illinois EPA)

Only the main stem of Copperas Creek was evaluated in the Copperas Creek Planning Area Watercourse Assessment with respect to designated uses and water quality standards. Neither the main stem of Copperas Creek nor the Tributary of Copperas Creek was included in the IEPA Integrated Water Quality Report and Section 303(d) List (2016) showing that the watercourse is fully supporting, as shown in Figure 3.17-1.

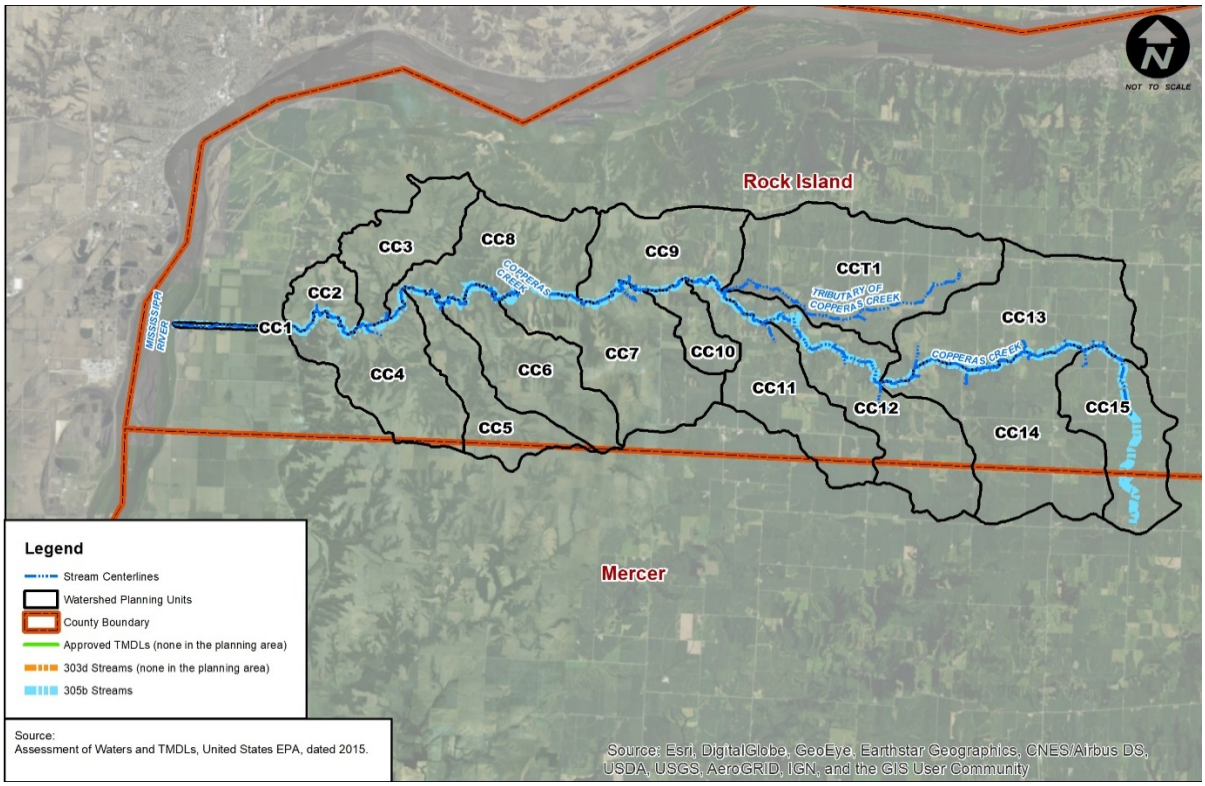


Figure 3.18-1 Summary of Assessed Watercourses in the Copperas Creek Watershed

Water pollution control programs are designed to protect the beneficial uses of the water resources of the state. Each State has the responsibility to set water quality standards that protect these beneficial uses, also called "designated uses." Illinois waters are designated for various uses including aquatic life, wildlife, agricultural use, primary contact (e.g., swimming, water skiing), secondary contact (e.g., boating, fishing), industrial use, public and food-processing water supply, and aesthetic quality. Illinois' water quality standards and water quality criteria provide the basis for assessing whether the beneficial uses of the state's waters are being attained. The Illinois Pollution Control Board is responsible for setting water quality standards to protect designated uses. The IEPA is responsible for developing scientifically-based water quality standards and proposing them to the Illinois Pollution Control Board for adoption into state rules and regulations. The federal Clean Water Act requires States to review and update water quality standards every three years. IEPA, in conjunction with USEPA, identifies and prioritizes those standards to be developed or revised during this three-year period.

The Illinois Pollution Control Board has established four primary sets (or categories) of narrative and numeric water quality standards for surface waters:

- General Use Standards, which are intended to protect aquatic life, wildlife, agricultural, primary contact, secondary contact, and most industrial uses;
- Public and Food Processing Water Supply Standards for waters associated with human consumption;

- Secondary Contact and Indigenous Aquatic Life Standards are intended to protect limited uses of those waters not suited for general use activities but are nonetheless suited for secondary contact uses and capable of supporting indigenous aquatic life limited only by the physical configuration of the body of water, characteristics, and origin of the water and the presence of contaminants in amounts that do not exceed these water quality standards. Secondary Contact and Indigenous Aquatic Life standards apply only to waters in which the General Use standards and the Public and Food Processing Water Supply standards do not apply including the Copperas Creek and Tributary of Copperas Creek; and
- Lake Michigan Basin Water Quality Standards.

3.18.2 IDNR Biological Stream Ratings

The Illinois Department of Natural Resources (IDNR) has biological stream ratings for Illinois streams. These ratings can be used to identify aquatic resource quality, including biologically diverse streams and those with a high degree of biological integrity. The diversity and integrity scores fall within one of five ratings ranging from A to E, with A representing the highest biological integrity or diversity of evaluated stream segments. A portion of Copperas Creek was rated by IDNR as B (diversity) and C (integrity). Neither the Tributary of Copperas Creek nor any other streams/gullies had IDNR stream ratings for diversity or integrity within the study area. No streams in the planning area were identified as Biologically Significant Streams. The portion of the Copperas Creek that was rated is shown Figure 3.17-2

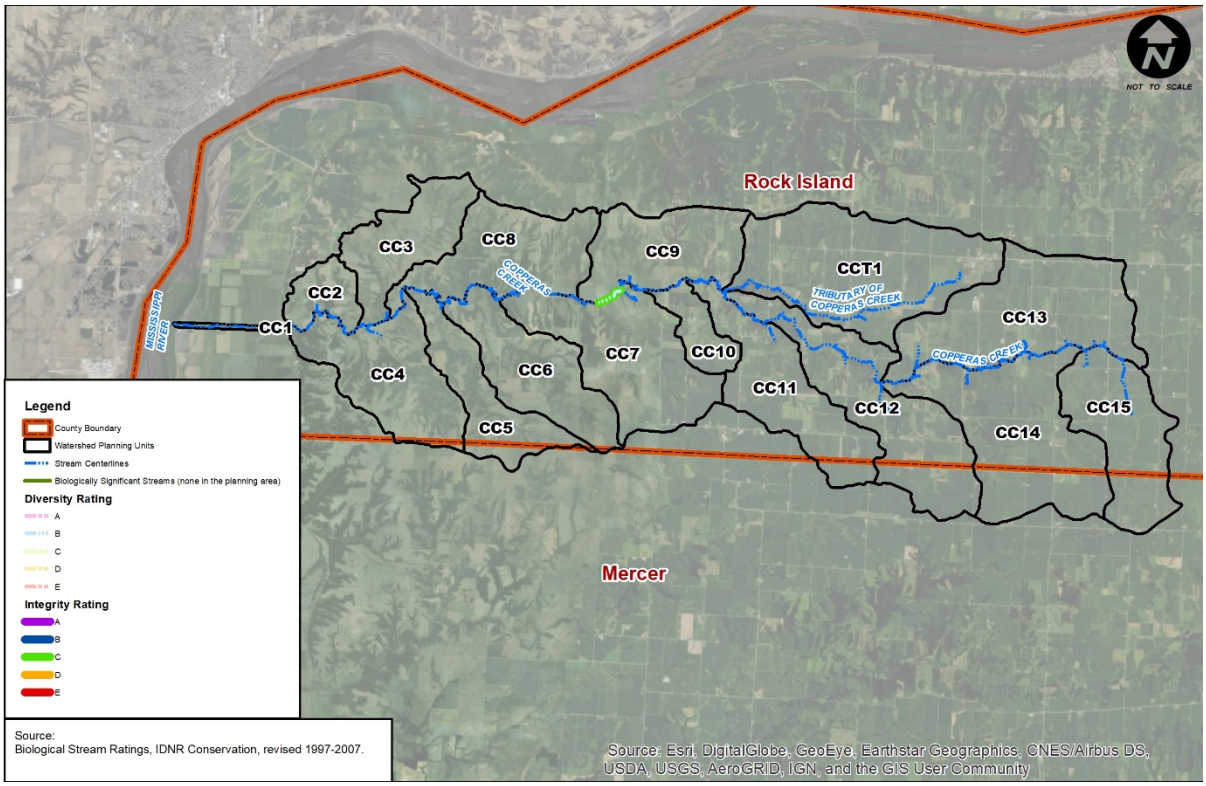


Figure 3.18-2 IDNR Biological Stream Ratings in the Copperas Creek Planning Area

3.18.3 Water Quality Sampling

Water quality sampling is currently not in practice within the watershed. However, if future water quality sampling and monitoring does take place criteria has been established by various agencies for the four major pollutants. This comparison criteria for evaluating water quality data are shown below in Table 3.17 3. The comparison criteria include enacted water quality standards for some parameters and other practical comparison values for other substances.

Water Quality Parameter	Reference	Comparison Criterion
Phosphorus	Wisconsin State Legislature, Administrative Code, Department of Natural Resources; Chapter NR 102.06 (3.a): Water quality Standards for Wisconsin Surface Waters *WQS for P adopted by Wisconsin*	0.1 mg/L
Total Suspended Solids	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; *Part 304 Effluent Standards* *Note these are Effluent Standards not WQS*	15.0 – 30.0 mg/L
Dissolved Oxygen	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; *Part 302 Water Quality Standards Section 302.206*	Summer: Minimum 5.0 mg/L Winter: Minimum 3.5 mg/L
Biochemical Oxygen Demand (BOD)	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; *Part 304 Effluent Standards for discharges to the Lake Michigan basin* *Note these are Effluent Standards not WQS*	< 4.0 mg/L

Table 3.18-1 Water Quality Comparison Criteria

3.18.4 Nonpoint Sources Pollutant Load Modeling

A nonpoint source of pollution can be defined as a source of pollution that releases from widely distributed or pervasive elements. Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. Nonpoint source (NPS) pollution comes from many diffuse sources, and is distinguished from point sources, where pollutants are released to a water body via a constructed ditch or pipe. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers wetlands and ground waters. To provide recommendations within the watershed plan supplement, it is critical to

identify pollutants of concern and sources within the watershed planning area. The relative magnitude of pollutant loads from each land use can then be quantified on a watershed based scale.

The analysis completed for the Copperas Creek watershed quantified NPS loadings of total nitrogen, total phosphorus, and total suspended solids (sediment) as pollutant loads based on land use type. The analysis also included biological oxygen demand (BOD) as a function of land use for each watershed planning unit. An analysis of chloride is provided in the ensuing section.

The Spreadsheet Tool for Estimating Pollutant Loads (STEPL), created by the US EPA, was used to quantify pollutant loadings through the watershed planning area. The tool uses simple algorithms to calculate nutrient and sediment loads from various land uses. The tool can then calculate load reductions that would result from implementing various BMPs. For each watershed planning unit, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as land use distribution and land management practices. Annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio.

Pollutant load estimates were developed using the previously delineated watershed boundaries and the 16 watershed planning units. Calculations for total nitrogen, total phosphorus, total suspended solids and BOD were performed using STEPL. STEPL is a simple planning tool with certain limitations, it is not an in-stream response model and is an un-calibrated tool which estimates only watershed pollutant loading based on coarse data, such as event mean concentrations. Specific limitations and considerations of the spreadsheet model include:

- annual nutrient loading is based on runoff volume
- runoff pollutant concentrations are based on land use
- a single event mean concentration represents pollutant concentration for all storm events
- pollutant loads are estimated only for storm events based on average rainfall amount
- stream channel erosion is not accounted for as a pollutant source
- drain tiles and constructions sites are not included as a pollutant source.

Inputs for this loadings analysis included land use data from the NLCD 2011 and an annual rainfall of 35.01 inches per year (weather station: IL Moline WSO AP). The NLCD land use data consists of a geodatabase depicting land use in 20 categories. For STEPL, land use category input includes: urban, cropland, pastureland, forest, user defined, and feedlots. Within STEPL, the urban category was further broken down by commercial, industrial, institutional, transportation, multi-family, single-family, urban-cultivated, vacant (developed), and open space. Forest areas were separated from the open space category and entered into STEPL as Forest to differentiate between the different land uses and to specifically capture the notable forest areas in the watershed planning area. Emergent herbaceous wetlands and woody wetlands have been included in the forest areas due to their similar soil and pollutant characteristics.

Table 3.17-2 shows the calculated loadings of total nitrogen, total phosphorus, total suspended solids and BOD for each watershed planning unit. These results highlight that based on existing watershed conditions, cropland is the largest nonpoint source contributor of total nitrogen (63.7%), total phosphorus (64.3%), and sediment (46.6%). BMPs will need to be strategically planned and

implemented in the developed areas to protect and restore water quality in the Copperas Creek Planning Area.

Watershed Planning Unit	Total Nitrogen Load Estimate (lb/ac/yr)	Total Phosphorus Load Estimate (lb/ac/yr)	Sediment Load Estimate (t/ac/yr)	BOD Load Estimate (lb/ac/yr)
CC1	8.6	2.1	2.23	22.0
CC2	7.8	2.2	1.66	17.5
CC3	9.3	2.8	2.51	20.3
CC4	5.7	1.6	1.24	12.8
CC5	8.0	2.3	1.81	17.8
CC6	8.4	2.4	2.17	18.7
CC7	9.6	3.0	2.97	20.4
CC8	7.5	2.3	2.13	16.2
CC9	11.8	3.6	4.28	26.5
CC10	9.2	2.6	2.22	21.0
CC11	10.1	3.0	2.72	21.5
CC12	8.2	2.3	1.72	18.1
CC13	8.9	2.6	1.99	19.3
CC14	8.3	2.4	1.87	17.9
CC15	8.7	2.5	1.62	18.4
CCT1	11.6	3.6	3.73	24.7
TOTAL	8.6	2.1	2.23	22.0

Table 3.18-2 Summary of Pollutant Loading per Watershed Planning Unit in the Copperas Creek Planning Area

In nature, wetlands are often described as filtering out pollutants from water or serving as sinks for total suspended solid as well nutrients and often function as closed systems with respect to nonpoint source pollution. Constructed wetlands are increasingly being used as an effective BMP for nutrient removal. For this plan, it is assumed that lakes and wetland complexes are not land uses contributing to annual pollutant loads and therefore loadings from lake shorelines, open water and wetlands has not been quantified. Pollutant loadings per land use categories relevant to annual pollutant loadings from non-point sources have been analyzed using the STEPL spreadsheets and are summarized in Table 3.18-3.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	24,454	3,936	75,497	607
Cropland	269,083	80,321	548,954	52,060
Forest	1,762	814	4,115	181
Pastureland	36,432	4,892	109,697	2,177
Streambank	18,915	7,282	37,830	11,822
Gully	71,859	27,666	143,718	44,912
Total	422,505	124,911	919,811	111,759

Table 3.18-3 Summary of Pollutant Loadings per Land Use in the Copperas Creek Planning Area

3.18.5 Livestock

It is known that livestock is present within the watershed and BMP measures to mitigate the adverse effects are addressed in Chapter 4. It should be noted that the dataset does not break down horse, dairy, livestock and mixed, including dairy and other livestock agricultural processing; however, information was obtained from the US Department of Agriculture summarizing the livestock present per county.

Figure 3.18-3 Livestock within the Copperas Creek Watershed

The United States Department of Agriculture provided the average and total numbers of livestock for the counties of Rock Island and Mercer, as seen in Table 3.18-4 below. Hogs, cattle, sheep, and chickens were considered as livestock. There are a greater number of hogs and cattle than sheep and chickens. Overall, Rock Island and Mercer County both have a greater number of hogs than any other livestock listed below. Mercer County compared to Rock Island has a copious number of hogs, while Rock Island has more cattle. The amount of livestock can affect the deposits and nutrients placed into the watershed and greater amounts of larger animals can provide a larger amount of livestock deposits, which will adversely affect the watershed.

Inventory of Livestock in 2012		
	Rock Island County	Mercer County
Number of Farms with 200 or More Cattle (as Percent of Farms with Cattle)	4.44	4.66
Average Number of Cattle and Calves per 100 Acres of All Land in Farms	6.64	3.75
Average Number of Sheep and Lambs per 100 Acres of All Land in Farms	0.6	0.24
Number of Farms with 200 or More Hogs (as Percent of Farms with Hogs)	69.23	80.77
Average Number of Hogs per 100 Acres of All Land in Farms	7.73	39.1
Average Number of Horses per 100 Acres of All Land in Farms	0.57	0.22
Total Cattle and Calves	9,901	9,461
Total Sheep and Lambs	896	617
Total Hogs	11,525	98,528
Total Chickens (Broilers, Layers) and Turkeys	1,055	591

Table 3.18-4: Inventory of Livestock in 2012 for Rock Island and Mercer Counties

3.18.6 Quantification of Chloride Loadings

Chlorides are typically used in urbanized areas in addition to the conventional methods of snow plowing; elevated chloride concentrations have been shown to be directly correlated with the percent of impervious surface area (Kaushal et. al., 2005). Following application to a roadway surface, chloride (road salt) will run off into receiving waterbodies where the concentration in the waterbody will increase, particularly throughout the winter months when chloride concentrations spike. Chloride levels in soils and waterbodies can also continue to be elevated several months after winter has ended. In a study conducted by the USGS, chloride concentrations have increased substantially over time with average concentrations approximately doubling from 1990 to 2011. The USGS study suggests that the rapid rate of chloride concentration increase is likely due to a combination of possible increased road salt application rates, increased baseline concentrations, and greater snowfall in the Midwestern U.S. during the study period (Corsi, et. al., 2014).

The Copperas Creek Planning Area consists primarily of rural roadways with approximately 40 miles of other state/county 2-lane highways. Because snow plowing is the typical snow removal method used in the Copperas Creek planning area with minimal rock salt application, chloride loadings to water bodies in the Copperas Creek Planning Area have not been quantified. Private property owners may apply deicers to privately-owned lots, thus contributing to chlorine loadings. If chlorides are used for deicing, BMPs to reduce chloride loadings may need to be implemented in the Copperas Creek Planning Area to protect the downstream areas.

This section of the resource inventory is intended to characterize and identify the existing watershed pollutant loads in each watershed planning unit. A detailed discussion and identification of annual pollutant load reduction targets for the Copperas Creek watershed are provided in ensuing sections of this plan. The targets are based on the information characterized in this chapter and the loading reductions that are expected to occur with a planned level of BMP implementation.

CHAPTER 4 WATERSHED PROBLEM ASSESSMENT

A watershed assessment is one of the most important aspects of watershed management as the assessment attempts to transform scientific data into policy-relevant information that can support decision-making and action. The following chapter of this plan focuses on the problems and watershed stressors identified in the watershed resource inventory for the Copperas Creek Planning Area (Chapter 3).

The Copperas Creek Planning Area is a typical agricultural watershed in the Midwest where water quality suffers from watershed stressors stemming from agricultural practices, including nutrient application which impairs riparian area. The problems identified throughout this chapter include several current and potential future problems.

4.1 IEPA NUTRIENT LOSS REDUCTION STRATEGY

The Illinois Nutrient Loss Reduction Strategy is an effort to improve water quality at home and downstream by reducing nitrogen and phosphorus levels in our lakes, streams, and rivers. Increased levels of phosphorus and nitrogen in our waterways is due to runoff from farm fields, decreasing the oxygen levels needed by plants and aquatic life. A “dead zone” exists where the Mississippi River flows into the Gulf of Mexico. The reduction in nutrient loads within the watershed will reduce the nutrient loads in the Mississippi River Basin. The plan includes eight key strategy components to facilitate the plan. One of the key goals is to reduce phosphorus loads by 25 percent nitrate-nitrogen loads by 15 percent by 2025, with an eventual target loss of nutrients in the Mississippi River watersheds of 45 percent. The intent of this watershed-based plan is to help facilitate the goals and strategy components of the NLRS.

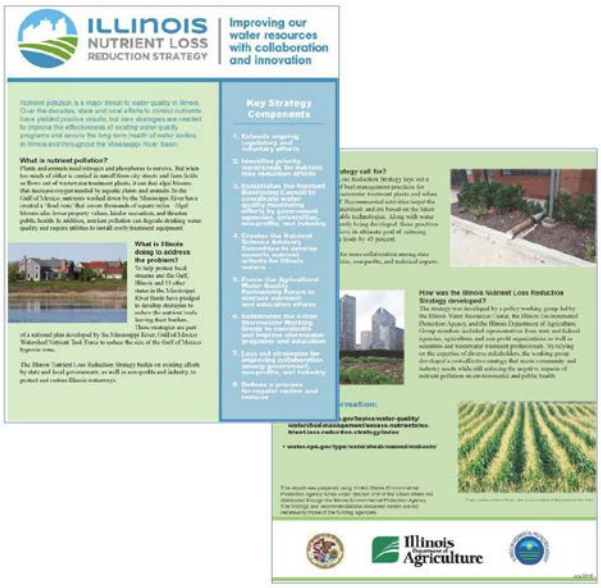


Figure 4.1-1 Illinois Nutrient Loss Reduction Strategy

Water quality stressors are specific to regions throughout the country and that no one specific component alone leads to overall ecosystem degradation. A combination of factors including physical effects and pollutant loadings, impact water quality and biological communities. Streams in different regions of the country respond differently to urban and rural development. Most of the planning units assessed have little to no riparian area and moderate to high erosion. The only instance in the watershed where riparian areas are good to moderate are those located near the headwaters of both Copperas Creek and the Tributary of Copperas Creek and those that separate the channel and the agricultural lands by forest. The habitat destruction and fragmentation has led to the degradation of riparian areas through portions of the planning area.

The conversion of a historically wet prairie combined with wetland networks and forested watershed (as seen in the presettlement vegetation cover) to agricultural areas has significantly degraded water quality and the aquatic ecosystem in the planning area. The removal of these ecosystems has altered the hydraulic process of interception and infiltration while increasing stormwater quantities and the mobility of potential harmful constituents. The priority areas for the planning area are further discussed in Chapter 4.2 and in Chapter 6.

4.2 STORMWATER QUALITY – CAUSES OF IMPAIRMENTS

The land use changes from presettlement to present that have occurred in the Copperas Creek Planning Area have altered stormwater runoff and water quality. According to the existing condition land use data, the areas of the watershed not dedicated to forest areas are primarily used for agricultural purposes, whether cropland or pasture.

According to the Census of Agriculture, approximately 940 million acres of farmland existed in 2002 (USDA, 2004). While this industry provides the backbone of the economy and food consumption, it is also a major source of nonpoint source pollution. Plowing the land disturbs and exposes the soil, making it vulnerable to erosion, thus carrying fertilizers into nearby waters. Although subsurface drainage allows for large gains in agricultural productivity, they are also recognized as potential pollution sources. These drainage systems have the potential to decrease runoff and associated pesticides, phosphorus and sediment loss, it also can increase the nitrogen loading.

To quantify nonpoint source constituents from within the watershed, a characterization of typical constituents found in stormwater runoff was performed as seen in Chapter 3. As previously discussed, the nonpoint source pollutant loadings were calculated using the EPAs developed and widely accepted STEPL spreadsheet tool.

The nonpoint source constituents or watershed stressors characterized in the Copperas Creek Planning Area are typical water quality stressors in rural areas and include:

- Sediment (Total Suspended Solids)
- Nutrients (Nitrogen and Phosphorus)
- Biological Oxygen Demand (BOD) – Indication of oxygen demanding substances

Following the pollutant loading characterization, an analysis was conducted combining the pollutant loading results, field and desk-top assessments of watercourses, channelization, riparian areas and overall erodibility assessments to identify priority areas within the planning area. The characterization results for each constituent or stress factor were ranked using 4 quartiles (1 = low; 4= high) and sorted based on rank and land use to determine watershed priority areas.

4.2.1 Sediment (Total Suspended Solids)

The EPA identifies sediment as the most common pollutant in rivers, stream and lakes. Sediment in stream beds disrupts the natural food chain by destroying the habitat where the smallest stream organisms live and causing massive declines in fish populations (EPA). Sediment also acts as a vehicle for other stormwater pollutants providing a mechanism to transport nutrients, hydrocarbons, metals and pesticides. Sediment loading in runoff can come from many sources including streets, lawns, driveways, roads, construction activities, and channel erosion (EPA).

The change in watershed hydrology associated with cropland within the Copperas Creek Planning Area has caused channel erosion, widening and scouring which has compounded poor stream ecology. Visible impacts to watercourses throughout the Copperas Creek Planning Area include eroded and exposed stream banks, fallen trees, sedimentation, and recognizably poor riparian areas. The physical impacts have led to the degradation of water quality and habitat due to sediment loadings and is seen throughout the Copperas Creek Planning Area. Increases in sediment within the water column throughout the Copperas Creek Planning Area has reduced the penetration of light at depths within the water column and limits the growth of aquatic plants. Sediment loadings to stream beds destroy the stream bed habitat where the smallest stream organisms live causing a disrupted food chain condition, which leads to overall decline in biodiversity at all levels.

The indication of higher levels of sediment loading due to increased impervious area suggests increased levels of hydrocarbons, organic and inorganic compounds and heavy metals as sediment particles act as vehicles for these constituents (Hwang and Foster 2006,). Hydrocarbon pollutant loads resulting from stormwater runoff to a receiving stream are associated with high concentrations of suspended sediments. This is explained by the sorption properties of dust, suspended solids and streambeds (Herrmann 1981).

As noted above, hydrocarbon pollutant loads are associated with loadings of suspended sediments, which primarily are associated in this watershed with stormwater runoff. This plan includes BMPs and other measures to reduce sediment loads. Loading of metals and hydrocarbons will be reduced through the control of sediment loadings.

4.2.2 Sediment Loading

The characterization results as determined from STEPL for total suspended solids were ranked by watershed planning unit using 4 quartiles (Table 4.2-1). A spatial reference of the sediment loading ranking results is shown in Figure 4.2-1. The watershed planning areas with a quartile ranking of 4 (shown in red) are priority areas for implementing BMPs and other measures to reduce sediment loadings. Areas where the riparian condition is identified as *Poor* are priority areas for buffers and restoration of riparian areas.

PU ID	COM	TRANS	SFH	OS	CROP	PAST	FOR	(t/yr)	(t/ac)	Channel	Riparian	Erosion	Sed Rank
CC1	0.0%	0.7%	0.0%	0.1%	0.1%	78.6%	20.4%	246	2.2	High	Poor	Low	2
CC2	0.0%	3.4%	0.0%	2.6%	50.1%	19.0%	24.9%	1,521	1.7	Low	Poor	High	1
CC3	0.0%	3.1%	0.1%	4.0%	64.9%	12.8%	15.2%	5,548	2.5	Low	Poor	High	2
CC4	0.0%	2.6%	0.0%	1.7%	40.6%	13.1%	41.9%	3,903	1.2	Low	Poor	High	1
CC5	0.0%	3.7%	0.1%	1.3%	60.1%	13.2%	21.6%	3,817	1.8	Low	Poor	High	1
CC6	0.0%	3.6%	0.0%	0.7%	53.9%	18.1%	23.6%	5,987	2.2	High	Good	High	2
CC7	0.0%	2.4%	0.0%	1.8%	66.9%	8.4%	20.5%	11,613	3.0	Moderate	Poor	High	3
CC8	0.1%	3.2%	0.1%	2.5%	49.9%	7.2%	37.1%	6,400	2.1	High	Good	High	2
CC9	0.0%	2.8%	0.1%	2.6%	39.9%	36.5%	18.2%	11,508	4.3	Moderate	Poor	High	4
CC10	0.0%	2.1%	0.2%	1.4%	51.8%	31.7%	12.8%	1,963	2.2	Moderate	Poor	High	2
CC11	0.0%	2.4%	0.1%	1.9%	77.9%	11.1%	6.7%	8,473	2.7	Low	Fair	Low	2
CC12	0.0%	2.3%	0.1%	2.1%	68.6%	18.3%	8.6%	7,083	1.7	Moderate	Fair	Low	1
CC13	0.2%	2.2%	0.3%	3.3%	82.4%	10.1%	1.4%	9,112	2.0	Low	Fair	Moderate	1
CC14	0.0%	2.1%	0.1%	2.3%	75.2%	10.5%	9.7%	8,966	1.9	Moderate	Fair	Low	1
CC15	0.1%	2.3%	0.1%	3.0%	91.1%	2.9%	0.5%	4,855	1.6	Low	Fair	Moderate	1
CCT1	0.1%	3.6%	0.5%	3.0%	78.5%	8.8%	5.5%	20,764	3.7	Moderate	Poor	Moderate	4

Table 4.2-1 Summary of STEPL results for Sediment Loading by Watershed Planning Unit

Notes: Com – Commercial; Trans – Transportation (ROW, Rail, Roadways); SFH – Residential Single-Family Homes; OS – Open Space; Crop – Agriculture; Past – Hay/Pasture; For – Forest (Deciduous Forest, Wetlands).

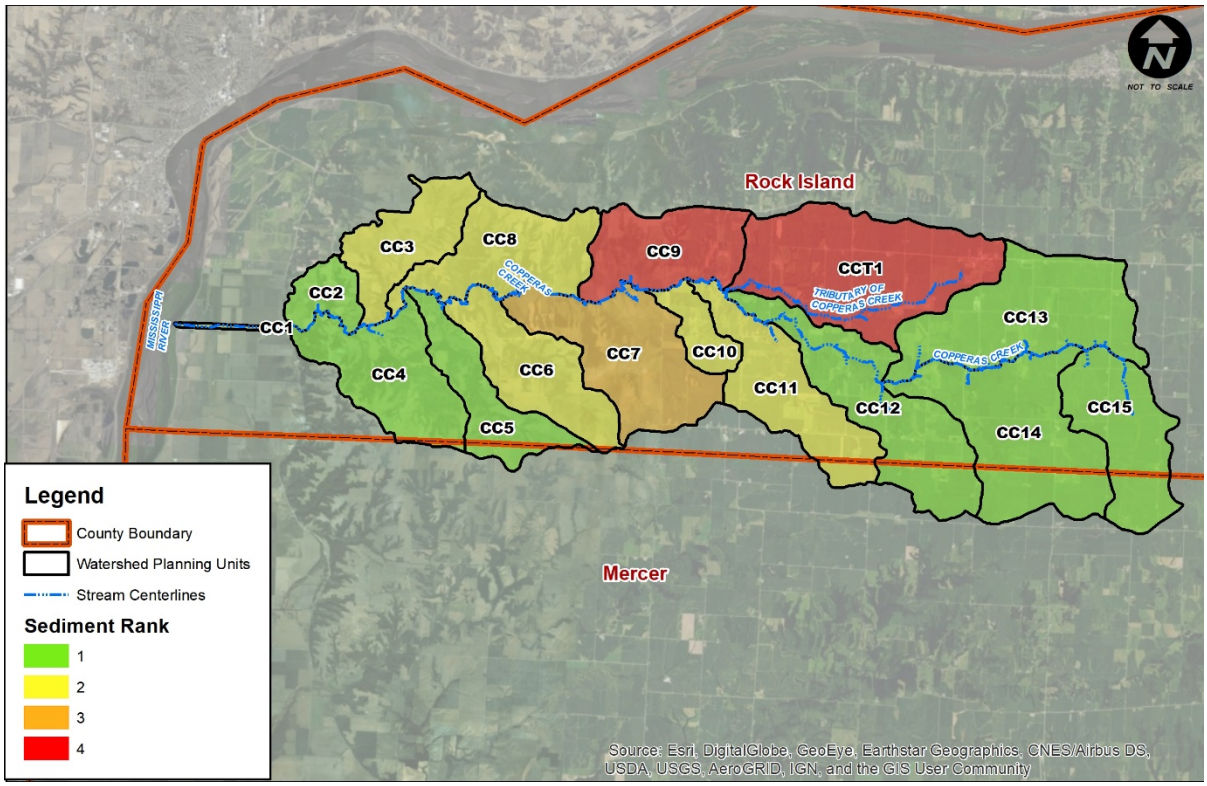


Figure 4.2-1 Sediment Load Ranking by Watershed Planning Unit

4.2.3 Nutrients (Nitrogen and Phosphorus)

Nutrient pollution is one of America's most widespread, costly and challenging environmental problems. Nutrient pollution is the process where too many nutrients (nitrogen and phosphorus) are introduced into receiving streams and act like fertilizer in the water, leading to massive overgrowth of algae. Algae creates nuisance conditions limiting recreational uses, and certain types of algae emit toxins creating serious health risks.

With respect to water quality and aquatic habitat, excessive amounts of nutrients can lead to low levels of dissolved oxygen. Severe algal growth blocks light in the water column that is needed for plants to grow. In addition, when algae die and decay, this process uses the oxygen in the water leading to low levels of dissolved oxygen in the water. The lack of growth and use of remaining oxygen in the water greatly reduces water quality for aquatic ecosystems. Copperas Creek is a regulated stream segment with enhanced dissolved oxygen protection meaning that the concentration of dissolved oxygen has higher minimum levels than other general water uses.

The primary sources of nutrient pollution are from human activities and include runoff of fertilizers, animal manure, sewage treatment plant discharges, stormwater runoff, car and power plant emissions, and failing septic tanks. While nutrients are a necessary part of the natural ecosystem, too much can be harmful to water quality. Both phosphorus and nitrogen levels are elevated in the Copperas Creek Planning Area.

To quantify nutrient loading from nonpoint sources or land use types, the water quality characterization results as determined from STEPL for nitrogen and phosphorus, were ranked per

watershed planning unit using 4 quartiles (Table 4.2-2). A spatial reference of the phosphorus and nitrogen load is shown on Figure 4.2-2 and Figure 4.2-3 respectively. Watershed planning areas with rows highlighted in red are priority areas for BMPs and other measures to reduce nutrient loadings. Practices to reduce sediment loads and nutrient loads are discussed in ensuing sections of this plan.

PU ID	COM	TRANS	SFH	OS	CROP	PAST	FOR	N Load (lb/yr)	N Load (lb/ac)	N Rank	P Load (lb/yr)	P Load (lb/ac)	P Rank
CC1	0.0%	0.7%	0.0%	0.1%	0.1%	78.6%	20.4%	947	9	2	234	2.1	2
CC2	0.0%	3.4%	0.0%	2.6%	50.1%	19.0%	24.9%	7,107	8	2	2,015	2.2	2
CC3	0.0%	3.1%	0.1%	4.0%	64.9%	12.8%	15.2%	20,675	9	4	6,179	2.8	3
CC4	0.0%	2.6%	0.0%	1.7%	40.6%	13.1%	41.9%	17,825	6	1	4,997	1.6	1
CC5	0.0%	3.7%	0.1%	1.3%	60.1%	13.2%	21.6%	16,954	8	2	4,876	2.3	2
CC6	0.0%	3.6%	0.0%	0.7%	53.9%	18.1%	23.6%	23,101	8	2	6,679	2.4	2
CC7	0.0%	2.4%	0.0%	1.8%	66.9%	8.4%	20.5%	37,530	10	4	11,646	3.0	3
CC8	0.1%	3.2%	0.1%	2.5%	49.9%	7.2%	37.1%	22,404	7	2	6,808	2.3	2
CC9	0.0%	2.8%	0.1%	2.6%	39.9%	36.5%	18.2%	31,670	12	4	9,633	3.6	4
CC10	0.0%	2.1%	0.2%	1.4%	51.8%	31.7%	12.8%	8,159	9	3	2,312	2.6	3
CC11	0.0%	2.4%	0.1%	1.9%	77.9%	11.1%	6.7%	31,380	10	4	9,457	3.0	3
CC12	0.0%	2.3%	0.1%	2.1%	68.6%	18.3%	8.6%	33,636	8	2	9,340	2.3	2
CC13	0.2%	2.2%	0.3%	3.3%	82.4%	10.1%	1.4%	40,952	9	3	11,787	2.6	3
CC14	0.0%	2.1%	0.1%	2.3%	75.2%	10.5%	9.7%	39,738	8	2	11,443	2.4	2
CC15	0.1%	2.3%	0.1%	3.0%	91.1%	2.9%	0.5%	25,998	9	2	7,543	2.5	2
CCT1	0.1%	3.6%	0.5%	3.0%	78.5%	8.8%	5.5%	64,429	12	4	19,963	3.6	4

Table 4.2-2 Summary of STEPL results for Phosphorus and Nitrogen Loading by Watershed Planning Unit

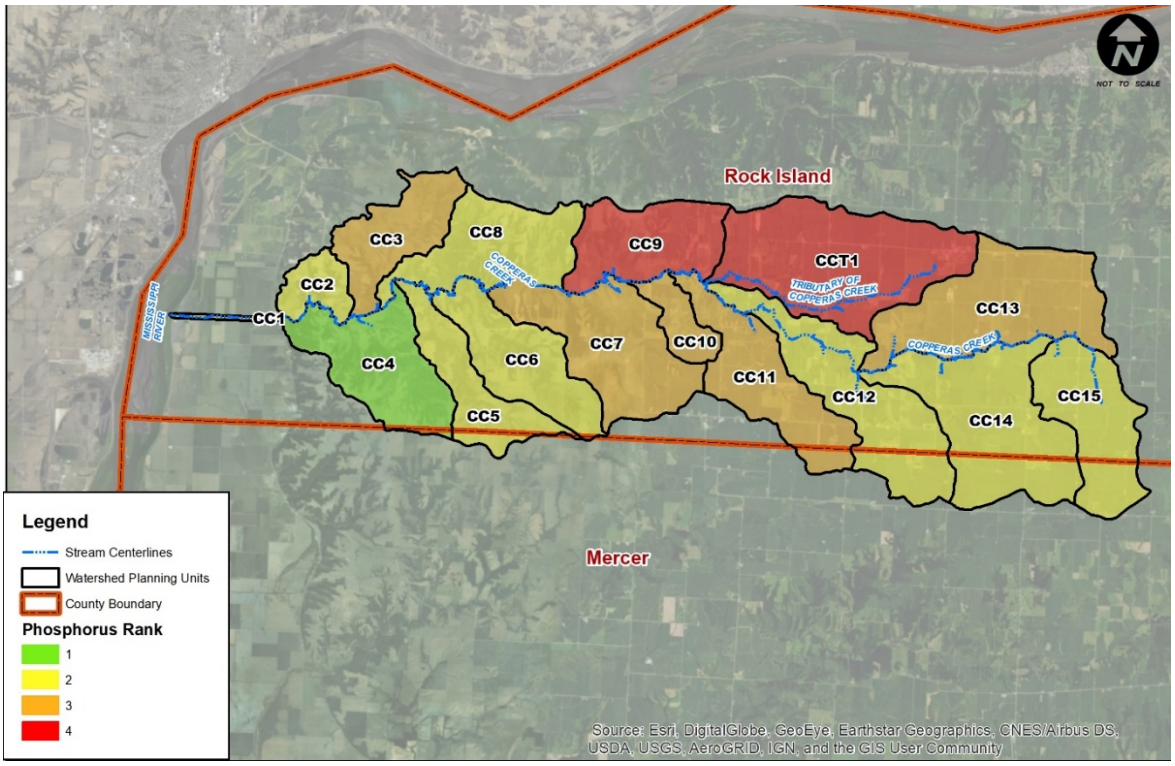


Figure 4.2-2 Phosphorus Load Ranking by Watershed Planning Unit

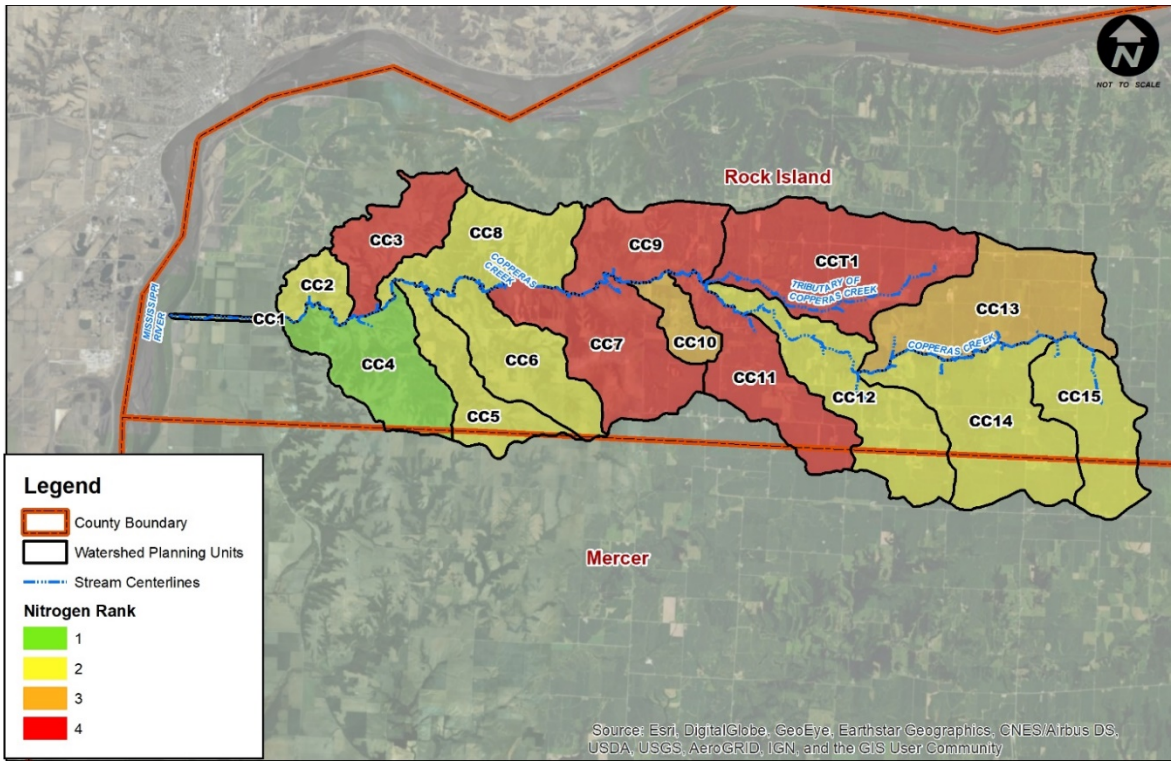


Figure 4.2-3 Nitrogen Load Ranking by Watershed Planning Unit

Notes: Com – Commercial; Trans – Transportation (ROW, Rail, Roadways); SFH – Residential Single-Family Homes; OS – Open Space; Crop – Agriculture; Past – Hay/Pasture; For – Forest (Deciduous Forest, Wetlands).

4.2.4 Biological Oxygen Demand (BOD)

Dissolved oxygen (DO) in waterbodies is essential for aquatic life. The amount of DO in waterbodies is dependent on water temperature, the amount of oxygen taken out of the system by respiring and decaying organisms, and the amount of oxygen put back into the system by photosynthesizing plants, stream flow, and aeration. The temperature of a waterbody affects the amount of dissolved oxygen present because less oxygen dissolves in warm water than cold water.

Polluted runoff can act as a food source for water-borne bacteria as discussed in the previous nutrient section. Bacteria in the waterbody uses DO to decompose organic matter thereby reducing DO present for aquatic ecosystems. The degradation of organic matter often occurs to the point where DO is reduced enough that aquatic life is impaired. Biochemical oxygen demand (BOD) is the measure of the amount of oxygen that bacteria will consume while decomposing organic matter under aerobic conditions (presence of oxygen). High BOD loadings will result in low DO levels. Reduced DO concentrations in waterbodies often occurs just after storm events because of oxygen demanding substances in receiving waters due to stormwater runoff (Erickson et. al., 2013).

DO concentrations can also be a surrogate for overall water quality as a low concentration of DO suggest the presence of oxygen demanding pollutants. These pollutants may include nutrients, metals, hydrocarbons, synthetic organic and inorganic compounds as discussed above.

To quantify BOD loadings from nonpoint sources or land use types, the water quality characterization results as determined from STEPL for BOD loadings were ranked per watershed planning unit using 4 quartiles (Table 4.2-3). A spatial reference of the BOD load is shown on Figure 4.2-4. Watershed planning areas with a quartile ranking of 4 (highlighted in red) are priority areas for BMPs and other measures to reduce BOD loads.

PU ID	COM	TRANS	SFH	OS	CROP	PAST	FOR	BOD Load (lb/yr)	BOD Load (lb/ac)	BOD Rank
CC1	0.0%	0.7%	0.0%	0.1%	0.1%	78.6%	20.4%	2,428	22.0	3
CC2	0.0%	3.4%	0.0%	2.6%	50.1%	19.0%	24.9%	16,040	17.5	2
CC3	0.0%	3.1%	0.1%	4.0%	64.9%	12.8%	15.2%	44,962	20.3	3
CC4	0.0%	2.6%	0.0%	1.7%	40.6%	13.1%	41.9%	40,261	12.8	1
CC5	0.0%	3.7%	0.1%	1.3%	60.1%	13.2%	21.6%	37,552	17.8	2
CC6	0.0%	3.6%	0.0%	0.7%	53.9%	18.1%	23.6%	51,663	18.7	2
CC7	0.0%	2.4%	0.0%	1.8%	66.9%	8.4%	20.5%	79,852	20.4	3
CC8	0.1%	3.2%	0.1%	2.5%	49.9%	7.2%	37.1%	48,689	16.2	2
CC9	0.0%	2.8%	0.1%	2.6%	39.9%	36.5%	18.2%	71,127	26.5	4
CC10	0.0%	2.1%	0.2%	1.4%	51.8%	31.7%	12.8%	18,531	21.0	3
CC11	0.0%	2.4%	0.1%	1.9%	77.9%	11.1%	6.7%	67,172	21.5	3
CC12	0.0%	2.3%	0.1%	2.1%	68.6%	18.3%	8.6%	74,695	18.1	2
CC13	0.2%	2.2%	0.3%	3.3%	82.4%	10.1%	1.4%	88,360	19.3	2
CC14	0.0%	2.1%	0.1%	2.3%	75.2%	10.5%	9.7%	85,874	17.9	2
CC15	0.1%	2.3%	0.1%	3.0%	91.1%	2.9%	0.5%	54,936	18.4	2
CCT1	0.1%	3.6%	0.5%	3.0%	78.5%	8.8%	5.5%	137,671	24.7	4

Table 4.2-3 Summary of STEPL results for BOD Loading by Watershed Planning Unit

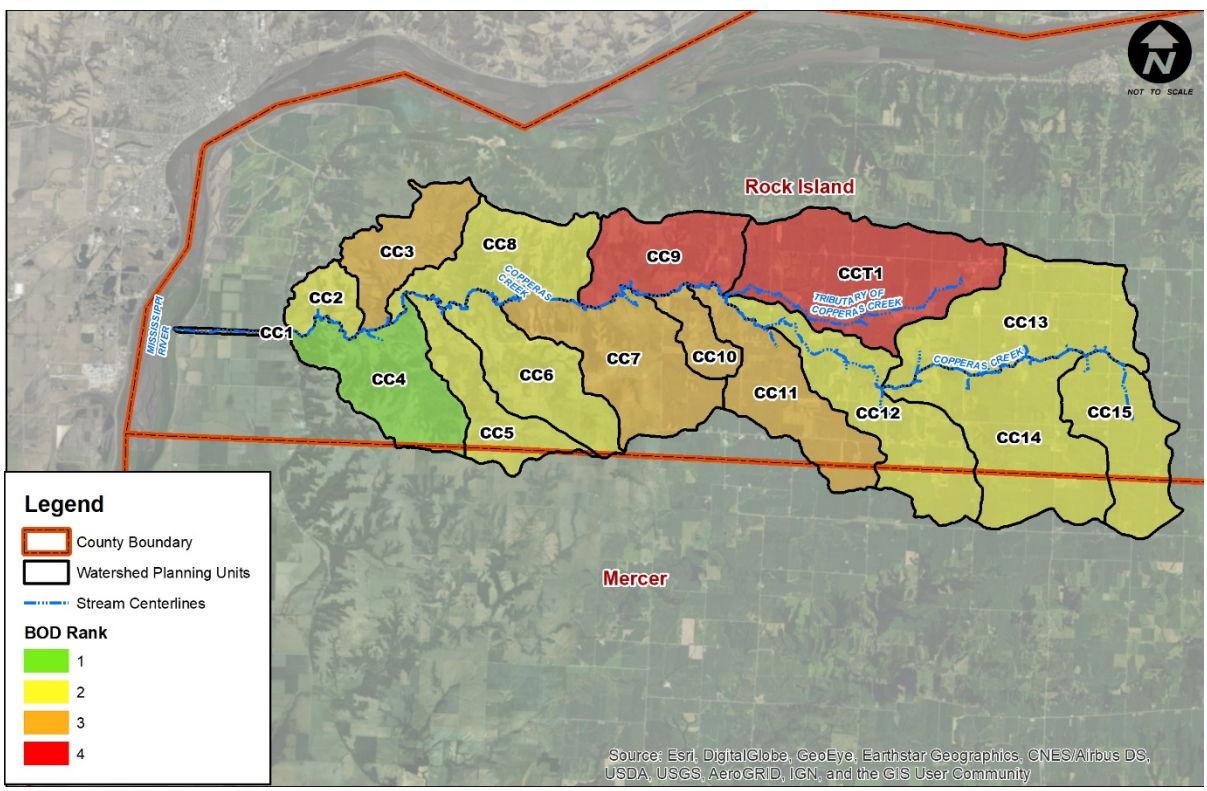


Figure 4.2-4 BOD Load Ranking by Watershed Planning Unit

Notes: Com – Commercial; Trans – Transportation (ROW, Rail, Roadways); SFH – Residential Single-Family Homes; OS – Open Space; Crop – Agriculture; Past – Hay/Pasture; For – Forest (Deciduous Forest, Wetlands).

4.2.5 Stream, Shoreline, and Riparian Impairments

Portions of the main stem of Copperas Creek and the Tributary of Copperas Creek have been channelized to some extent for agricultural purposes. Erosion through these watercourses is moderate to high as the watercourses have been armored and channelized using various methods to promote conveyance. There is little to no riparian area associated with these watercourses and cropland use does not allow for a riparian habitat. Streambank erosion contributes to sediment loads and degraded habitat. Natural characteristics that would help reduce that loadings of sediment and other pollutants are lacking. The deposition of excess sediment and organic matter has greatly degraded streambed habitat. However, increased use of cover crops reduces runoff rates, sediment loads, debris and eliminated natural riparian habitat as seen throughout the planning area.

4.2.6 Livestock Management

As shown in Chapter 3, livestock is present within the watershed, with a majority of all livestock being larger animals that provide a larger amount of livestock deposits, which will adversely affect the watershed. Manure is rich in phosphorus and nitrogen and can be significant sources of ammonia, which is harmful to surface waters, and nitrous oxide, which is a potent greenhouse gas. Keeping animals and their waste out of streams and rivers keeps nitrogen and phosphorus out of the water and restores the streambanks.

Manure management consists of either stored or composting manure. Store manure is creating composting bunkers, manure bunkers, windrow systems, and manure hauling. These can consist of cinder block, wood, concrete, recycled poly lumber, etc. Manure should be stored on a non-permeable surface with a cover for the best storage possible. Buffer strips of vegetation should be maintained between the storage areas and waterways to filter sediments and absorb nutrients in runoff. When composting manure, the piles should be kept moist and aerated to improve the quality of the compost and speed decomposition. Composting should be covered to prevent rain water from picking up contaminants and bringing them to surface or groundwater.

Manure Management
Photo Courtesy of Rutgers Equine Science Center

Paddock Management
Photo Courtesy of Livestock and Land

Paddock management consists of manure being collected from uncovered paddocks to be stored and sheltered in stockpile areas. This prevents excess chemicals from draining directly into waterways and maintains proper grading in paddock areas to prevent pooling water and mud. An aspect of paddock management are **filter strips**, which are composed of grass and installed behind the paddock filters and filter out sediments and nutrients before the water reaches the drain inlet.

Pasture management deals with protecting the pasture's soil and vegetative cover. The pasture is maintained through controlling the number of horses and amount of time they're allowed to spend on the pasture. This allows grass time for re-growth, prevents bare areas from forming, reduces soil compaction, and improves the porosity of soil. Pasture management deals with protecting sensitive areas, which helps erosion reduction. Maintaining buffer vegetation near bodies of water will filter out contaminants and reduce erosion. Some examples of pasture management are:

- **Cross fencing**, which divides a pasture area in half to provide rotational grazing.
- **Exclusionary fencing**, which is constructed along drainage ways to exclude animals from waterways and limit compaction.

Cross Fencing
Photo Courtesy of Livestock and Land

Exclusionary Fencing
Photo Courtesy of Everysite

- **Surface areas**, which is when a small portion of land is concentrated by animals, with no plant growth expected.
- To **re-stabilize, vegetate, and exclude**, which consists of jute or erosion control netting with an exclusion of animals to re-vegetate problematic areas of farmland.

Surface Area
Photo Courtesy of Fairfax County

Re-Stabilize, Vegetate, and Exclude
Photo Courtesy of Livestock and Land

- **Stream crossing**, where livestock can cross a stream without damage to the waterways.
- **Farm ponds**, where storm runoff is collected from a pasture before it enters a body of water to provide alternative watering and capture sediments.
- **Alternative watering**, which provides water for livestock that are excluded from streams and ponds.

Stream Crossing
Photo Courtesy of Source Water PA

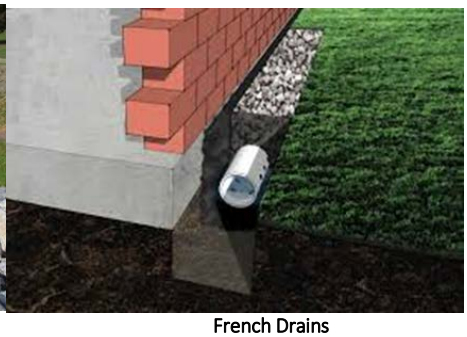
Farm Ponds
Photo Courtesy of Hobby Farms

Alternative Watering
Photo Courtesy of Blount Public Library

Drainage and erosion control is designing new facilities that will address water quality concerns and minimize erosion. This helps filter out water to reduce erosion, control runoff, remove sediments, and minimize water intake. Some examples of drainage and erosion control are:

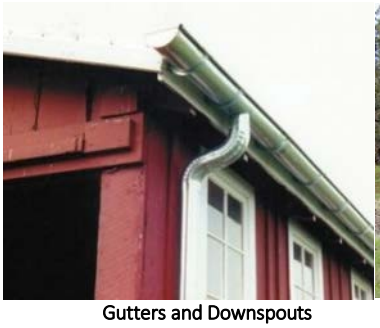
- Sediment basins, where a diverted drainage is entered into a basin, sediments are settled out, and the remaining clean water is emptied into a vertical outlet pipe.
- French drains, which is a trench filled with gravel that contains a pipe that will redirect surface or groundwater away from an area.

Sediment Basins
Photo Courtesy of TN Erosion Prevention



French Drains
Photo Courtesy of Innovative Water Solutions

- Gutters and downspouts, which are built to maintain roof control runoff systems.
- Rainwater catchment, which helps decrease erosion from storm water runoff and maintain vegetation through conserving rainwater.



Gutters and Downspouts
Photo Courtesy of Hood River Soil and Water Conservation District

Rainwater Catchment
Photo Courtesy of Jackson Soil and Water Conservation District

- Rock dissipaters, which are placed at a pipe outlet to slow down water and minimize erosion.
- Landscape walls, which are built to allow vegetation to stabilize and re-establish through slowing down water flowing down a hillside.

Rock Dissipaters
Photo Courtesy of Minnesota Stormwater Manual

Landscape Walls
Photo Courtesy of Greenwich Land Trust

- **Stream bank stabilization**, which is process that prevents more erosion to an already eroding stream bank.
- **Riparian Buffers**, which are areas of trees and shrubs next to streams, that is used to reduce nutrient and sediment loss.

Stream bank Stabilization
Photo Courtesy of City of Golden Valley

Riparian Buffers
Photo Courtesy of the Minnesota Department of Agriculture

4.3 OVERALL WATERSHED ASSESSMENT

Water quality in Copperas Creek can be attributed to the conditions of and runoff from the watershed areas draining to the mainstem. As such, water quality in Copperas Creek reflects the surrounding watershed and upland land use practices and changes. As more land is farmed, stormwater discharge volumes and pollutant loadings have increased, and overall water quality in Copperas Creek have become more degraded. This is shown in the watershed assessment completed as part of this plan. The data compiled and analyzed here suggest that fertilizer and discing associated with agricultural practices are associated stormwater discharges are the primary sources of pollutant loadings in the Copperas Creek planning area. Chemical and fertilizer runoffs are problems that are simultaneously addressed by the BMPs selected to treat erosion, which is the largest concern within the watershed.

4.4 ASSESSMENT OF PREDICTED FUTURE LAND USE CHANGE AND STORMWATER QUALITY

Understanding future development patterns and impacts and building in appropriate controls as development and/or agricultural practices occur is an important proactive strategy to address water quality issues as growth occurs within the planning area. The population forecast presented in Chapter 3 indicates that the population density is expected to decrease in the next 15 years. Understanding that the Copperas Creek watershed is primarily agricultural and hay/pasture, and the fact that population is predicated to decrease, land use changes are not anticipated in the near future. Any new

residential and associated commercial development will be a slight increase in impervious area, but the areas where major stormwater quality improvements can be made will likely remain pervious in the near future. Overall the future projected priority areas identified in the previous section will remain unchanged because of the predicated negative growth rate and anticipated low predicted lack in land change.

A factor that will help improve water quality conditions are agricultural practices implemented by the landowners, which include, but are not limited to cover crops. A primary conclusion from this plan is that existing priority areas for implementing BMPs to control stormwater will continue to be priority areas in the future. Measures can be planned and implemented in the priority areas with confidence that they will help improve and protect water quality now and in the future. Likewise, the goals established for nonpoint source water quality improvements will remain useful and valid based on future land use projections.

Cover Crops
Photo Courtesy of RISWCD taken from Planning Area

CHAPTER 5 WATERSHED PROTECTION MEASURES

As shown in the previous chapters, the Copperas Creek Planning Area is 95% pervious and is primarily used for agricultural purposes. Runoff from disturbed and fertilized area primarily rural Copperas Creek Planning Area is a major cause for degraded water quality in the waterbodies.

Green infrastructure is a stormwater management tool that can be used to reduce pollutant loads in runoff resulting from urbanization and land use change. Green infrastructure practices also reduce the volume of stormwater discharged to waterbodies by infiltrating into the ground or evaporating into the air.

According to the EPA, green infrastructure, or nature-based solutions, is a term that describes a number of best management practices designed to reduce and treat stormwater runoff at its source while delivering environmental, social and economic benefits. Green infrastructure is an approach to stormwater management that mimics the natural hydrologic cycle by allowing and promoting infiltration and creating habitat.

The purpose of this chapter is to provide nonpoint source best management practices specific to the Copperas Creek Planning Area. The target or goal of these implemented practices is to reduce pollutant loads. While achieving water quality goals is affected by many factors, the following measures including both policy and on-the-ground improvements, have been identified as the most significant for making progress toward watershed goals.

5.1 GREEN INFRASTRUCTURE AND NONPOINT SOURCE MANAGENMENT MEASURES

BMPs are effective for the treatment of runoff from smaller storm events and for the initial volumes of runoff from large storm events. The initial stormwater runoff at the beginning of a rain event will be more polluted than the stormwater runoff later in the event. The stormwater containing this high

initial pollutant load is called the "first flush". To be effective and efficient, consideration to the proper placement of a BMP should be considered such that the design involves the capture of the first flush from frequent, small storm events. Intercepting the first 40% of runoff volume can remove 55% of TSS load, 53% of COD load, 58% of total nitrogen load, and 61% of total phosphorus load (Dongya et. al., 2015). Treating the first flush is most effective on small catchments or individual properties, particularly if a high proportion of the catchment is impervious. On an individual property the first flush collection system can form an integral part of the stormwater pollution control system.

The following sections describe potential BMPs to treat stormwater throughout the planning area. It should be noted that wetland restoration was not included as a BMP in this planning area. As shown on Figure 3.7-1, the wetland areas are located in existing gullies and those outside of the gullies are generally farmed wetlands.

5.1.1 Woodchip Bioreactors

Woodchip Bioreactor
Photo Courtesy of Engineers Journal

A **woodchip bioreactor** is a buried trench filled with woodchips. Existing drain tiles are routed into the bioreactor and an outflow control structure retains the water so bacteria have time to remove nitrates from water before discharging into the receiving stream. Woodchips ¼ inch to 1 inch in size, that are untreated, provide a sustainable carbon source. The typical bioreactor has a life between 15 and 20 years before woodchips need replacement. They are optimal for drainage areas of 30 to 80 acres, with removal rates between 10 and 90 percent.

5.1.2 Vegetated Swales

A **vegetated swale** consists of an earthen channel vegetated with either native plants or conventional turf grasses. The vegetation slows down the movement of the water, which promotes the filtering of pollutants and sediments. Stormwater volumes are reduced through the process of infiltration during the conveyance of runoff. Native plantings provide the potential for greater pollutant removal vs. turf grasses as they are taller and provide more retardance, thus slowing down the runoff through the channel and trapping more pollutants. Side slopes no greater than 3:1 are recommended, with side slopes of 4:1 or less being ideal. The removal efficiency for a vegetated swale is approximately 83% TSS removal, 29% total phosphorous removal, and 25% total nitrogen removal (DuPage County, 2008).

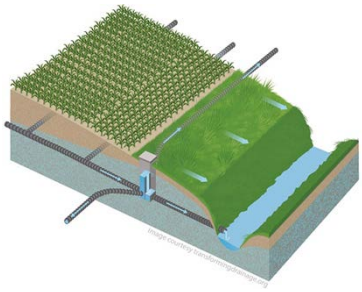
5.1.3 Vegetated Filter Strips, Grassed Waterways, and Saturated Buffers

A **vegetated filter strip** is a vegetated section flat land or low slope that accepts runoff from impervious areas as sheet flow across the strip. Pollutants are reduced through vegetative filtering while encouraging runoff to infiltrate the underlying soil. Filter strips used as a BMP can act as a landscaping feature or buffer between buildings and immediately upstream of a constructed basin/wetland. The removal efficiency for a vegetated filter strip is depended on length and removal rates increase as length is increased. The removal efficiency for a vegetated filter strip 20 feet long is approximately 50% TSS removal, 25% total phosphorous removal, and 25% total nitrogen removal (DuPage County, 2008).

Grassed Waterways
Photo Courtesy of NRCS-USDA

Grassed waterways are graded constructed channels that are seeded to grass and other forms of vegetation. Vegetation will slow the water while the grassed waterway transports the water at a non-erosive velocity to a stable outlet. They benefit the land through protecting the soil from concentrated flows, trapping sediments and increasing filtration, and significantly reducing gully erosion (NRCS). Grassed waterways have a nutrient removal rate based on the total phosphorus concentration reduced. The total phosphorus concentration is reduced by 58%, while the total nitrogen concentration reduced is 0% (Squaw Creek Watershed Implementation Strategies).

Saturated buffers are a subsurface, perforated distribution pipe that increases soil saturation and diverts and spreads the drainage system discharge to a vegetated area. Their benefits are to enhance saturated soil conditions different types of landscape classes and to reduce nitrate loading from subsurface drain outlets (NRCS). Saturated buffers are found to have a nutrient removal of 50% total nitrogen concentrations and 0% total phosphorus concentrations (Squaw Creek Watershed Implementation Strategies).



Saturated Buffer
Photo Courtesy of Transforming Drainage

Saturated Buffer
Photos Courtesy of RISWCD taken from Planning Area

5.1.4 Stream or Channel Restoration, Grade Stabilization Structure, and Diversion

Streambank Stabilization and Shoreline Protections
Photos Courtesy of RISWCD taken from Planning Area

Stream or channel restoration consists of returning a degraded corridor and aquatic ecosystem to a stable and healthy condition. This BMP involves both channel restoration and bank stabilization. Channel restoration involves constructed structures to address channel erosion and fish migration depending on the stream flow characteristics. Examples include rock vanes, w-weirs, current deflectors, mid-channel deflectors, channel constrictors, cross-channel logs and revetments. It should be noted that before any channel modifications to address erosion or deposition are implemented, upland watershed problems and processes (e.g., land use change sub-division development) must first be assessed. Correcting upstream problems should be the priority before channel modifications are implemented; otherwise the benefits of the restoration will be short-lived (NOAA Restoration Center).

Stream bank stabilization involves using native deep-rooted vegetation, tree stumps and logs; synthetic geo-fabrics/textiles such as coir fiber logs and mats; stone and other materials to minimize erosion potential on regraded banks. A wide variety of geo-fabrics and textiles can be used by providing a temporary organic material cover material until a natural vegetation cover is established (NOAA Restoration Center).

Stream or channel restoration projects employ the Natural Channel Design Methodology as well as other methodologies that result in the creation of a stable dimension, pattern, and profile for a stream type and channel morphology appropriate to its landform and valley. The channel is designed such that over time, is self-maintaining, meaning its ability to transport the flow and sediment of its watershed without aggrading or degrading. These design methods promote the use of instream structures, bio-engineering, functional riparian corridors and floodplain connectivity (U.S. Fish & Wildlife Service, 2013)

Grade Stabilization Structure
Photo Courtesy of Wayne Soil and Water Conservation District

A grade stabilization structure is an embankment built across a waterway to control the stormflow passage through a drop in elevation from one stable grade to the next. Its benefits are that they can stabilize the waterway outlet to prevent gully erosion, give better water quality through collecting and storing runoff, provide a water source and habitat for wildlife, and reduce the amount of sediments entering from nearby streams (NRCS). Their nutrient removal rates are based on the total phosphorus and nitrogen reduced. The total phosphorus concentration is reduced by 62%, while the total nitrogen concentration is reduced by 51% (Herron, Callie).

A **diversion** is a channel that is constructed across a slope with a supporting ridge on the lower side. Diversions are beneficial because they can easily break up concentrations of water, divert water from any type of agriculture, collect water for storage, protect terrace systems by diverting water, intercept surface and subsurface flow, and reduce runoff and erosion (NCRS). According to the example of a freshwater diversion created in Caernarvon, Louisiana, the average nutrient removal rate found is determined to be 32-57% total nitrogen concentrations and 0-46% total phosphorus concentrations (Lane, Robert).

Diversion
Photo Courtesy of MASCD

5.1.5 Riparian Corridor and Riparian Buffer Strip Restoration

Riparian corridor restoration can often be the most cost-effective means for restoring water quality in streams impacted by nonpoint source pollution (U.S. EPA, 1996), and should always be considered when evaluating restoration options. A critical step for any riparian restoration is the establishment of a riparian reserve or buffer strip (Kauffman et al. 1997).

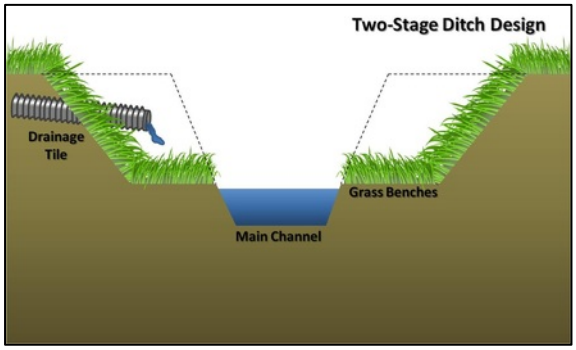
A **riparian buffer strip** is a linear band of permanent vegetation adjacent to an aquatic ecosystem intended to maintain or improve water quality by trapping and removing various nonpoint source pollutants (e.g., contaminants from herbicides and pesticides; nutrients from fertilizers; and sediment from upland soils) from both overland and shallow subsurface flow. **Buffer strips** occur in a variety of forms, including herbaceous or grassy buffers, grassed waterways, or forested riparian buffer strips (Fischer and Fischenich, 2000). A **riparian corridor** is a strip of vegetation that connects two or more larger patches of vegetation or habitat through which an organism will likely move over time. These landscape features are often referred to as conservation corridors, wildlife corridors, and dispersal corridors. Some scientists have suggested that corridors are a critical tool for reconnecting fragmented habitat (Fischer and Fischenich, 2000). Methods for restoring fragmented riparian corridors may include buy-outs of properties adjacent to watercourses where land use is unproductive. These buy-outs may also include properties that are inundated by flooding during frequent smaller storm events.

When used in concert with bank stabilization projects, the **riparian buffer strip and corridor restoration** will consist of re-grading streambanks to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate vegetative species. Healthy riparian areas are able to chemically and biologically bind or detoxify many contaminants contained in this water and natural riparian areas can denitrify and release 25 to 35 pound of nitrogen per acre per year. Farmers may be concerned about the loss of land as well as costs associated within these reduction strategies; however, for farmers to be willing to participate in riparian restoration practices, the environmental benefits need to be balanced with economic benefits from changing land management practices.

5.1.6 Two Stage Ditch (Reconnected Floodplain)

To restore and protect habitat and water quality, opportunities for re-meandering and reconnecting the stream with its floodplain should be pursued wherever possible. Riverine floodplains are dynamic

systems that play an important role in the function and ecology of rivers. Floodplains are inundated periodically where the intermittent interaction between base flow in a rivers channel combines with the riparian or terrestrial overbank areas where some of the most fertile and bio-diverse conditions exist. Floodplains also disperse high flow energy while mitigating erosive potential and allow sediment deposition.



Two Stage Ditch
Photo Courtesy of the Indiana Watershed Initiative

Constructed Two Stage Ditch
Photo Courtesy of Corn and Soybean Digest

In the watershed, floodplains and riparian corridors have been developed and compromised to accommodate land use. In this case, land use and site constraints prohibit the reconnection of floodplains due to challenges that largely include land ownership. Two stage ditches mimic natural floodplains and offer a unique solution to floodplain and riparian corridor reconnection by creating a channel and floodplain/riparian interaction within a smaller footprint. A two-stage ditch design incorporates benches on either side of the main channel by removing the ditch banks roughly 2-3 feet above the channel invert for a width of about 10 feet on each side. The laid-back banks at an elevation 2-3 feet above the channel invert allows the water to expand while decreasing velocity (energy). The benched areas become vital habitat allowing sedimentation and nutrient load reduction from the mainstem channel while improving ditch stability and reducing erosion.

5.1.7 Water and Sediment Control Basin (WASCOB) and Ponds

A **water and sediment control** basin is a combination ridge or earth embankment and channel built across the slope of a minor drainageway. Its benefits are that they trap sediments, reduce gully erosion, and reduce and manage runoff (NRCS). WASCOBs mainly consider the total phosphorus concentration reduced, which is 85% for its nutrient removal rate. The total nitrogen concentration reduced is determined to be 0% (Squaw Creek Watershed Implementation Strategies).

Water and Sediment Control Basin
Photo Courtesy of The Resource Conservation District of Monterey County

Pond
Photo Courtesy of College of ACES, University of Illinois

A **pond** is a water impoundment constructed by an embankment or excavation within a pit or dugout. Ponds are beneficial through providing water for wildlife and humanity while maintaining and improving water quality (NRCS). The nutrient removal rates found within a high rate pond are 94% total nitrogen concentrations and 71% total phosphorus concentrations reduced (Picot, B.).

5.1.8 Constructed Wetland

Wetlands have been shown to be an efficient way to remove nutrients and pesticides from cropland runoff, while restoring habitat and reducing flooding. The appropriate location for constructed wetlands, is in low lying edges of fields near a drain tile outlet and adjacent to an existing waterway/drainage way. Aside from periodic inspections, constructed wetlands require little to no management and do not require cropping system changes. They are generally three feet below the invert of the intercepted tile to create a shallow marsh system with emergent vegetation. Designs can incorporate the landowner and tenants' interests and concerns; however, with gentle side slopes, a wide berm, and emergent vegetation, the wetland will not look like a control basin or a farm pond. A wetland area that is about 5% of the tile drained area being intercepted will remove about 50% of the nitrate-N.

Constructed Wetland in Bureau County, Illinois
Photo Courtesy of The Wetlands Initiative

5.1.9 Terraces, Cover Crops, and Conservation Tillage

Terrace
Photo Courtesy of Minnesota Department of Agriculture

A **terrace** is a combination ridge or earth embankment and channel constructed across the slope of a field. Terraces can be beneficial through reducing erosion through the decrease in slope length and through retaining runoff for conservation of water (NRCS). Terraces have shown to have a nutrient removal rate of 76% for total nitrogen removal rate and 24% for total phosphorus removal rate (Czapar, George).

Cover crops are plants from seeds that are sown to provide seasonal soil cover on cropland when the soil would otherwise be bare. In the Midwest, there can be up to 7 months between the fall harvest and the spring crop emergence. They are primarily used to slow erosion and prevent nitrogen from leaching into the water table. Cover crops used in conjunction with no-till farming to help control weeds and increase water infiltration.

Conservation Tillage is any method of soil cultivation that leaves between 30 and 70% of the previous year's crop residue on field before and after planting the next crop. Conservation tillage includes no till, strip till, ridge till and mulch till. Conservation tillage can reduce soil loss by as much as 60%-90% (Minnesota Department of Agriculture).

Conservation Tillage (No Till Soybeans)
Photo Courtesy of USDA-ARS via Minnesota Department of Agriculture

5.1.10 Nutrient Management, Livestock Waste Management, and Exclusion Fencing

A **nutrient management plan** describes how nitrogen, phosphorus, sulfur, and potassium will be regulated within crops. Nutrient management plans are beneficial because it minimizes the risk of environmental damage, reduces the cost of supplying nutrients, ensures legal and industry requirements, and achieves beneficial changes in nutrient levels and production (Nutrient Management Plan). Nutrient management practices found at Squaw Creek found that the total nutrient removal rates of their nutrient management plan consist of removal of total nitrogen and phosphorus concentrations. The reduction of the total nitrogen concentration is 32%, while the reduction of total phosphorus concentration is 41% (Squaw Creek Watershed Implementation Strategies).

Livestock waste management plans consist of many ways to treat livestock deposits. The two ways that are predominant to treat livestock waste are a discharging system and a containment system. Discharging systems collect runoff using a basin, then release it into a grass treatment area. Containment systems collect and store waste and runoff by livestock. They are beneficial because they can reduce pollutants and reuse the waste for crops (NRCS). Livestock waste management has a nutrient removal rate of 72% total nitrogen concentration, 66% total phosphorus concentration, and 89% of total suspended solids (Land Pollution).

Exclusion fencing is used as a constructed barrier for livestock. This is beneficial by controlling access of animals to hazardous areas, protecting new areas from damage, implementing a grazing plan, preventing access to the areas by predators, and by maintaining the quality and quantity of natural resources (NRCS). When given the estimates of calculating the nutrient removal rate for exclusion fencing, the amount of total nitrogen concentration reduced to 92%, while the total phosphorus concentration reduced to 7.6% (Quantifying Benefits to Water Quality from Livestock Exclusion).

Exclusion Fencing
Photo Courtesy of NRCS-USDA

5.2 PROPOSED PROJECTS

The NRCS conducted a survey showing that, as of 2013, there were 123,512 feet of existing filter strips within the watershed. The RISWCD and the NRCS have continued to work with landowners to construct additional filter strips at locations previously identified by the RISWCD. Between 2007 and 2014 the following BMPs were implemented: 3 streambank and restoration projects were constructed through the SSRP, 3 wells were decommissioned through the WDP and 7 projects were implemented through the CPP. In 2016, RISWCD submitted a grant application for 319 grant funding for various projects, including site specific and general watershed projects. Twenty site-specific projects are being implemented as part of Grant Agreement 3191601. Table 5.2-1 provides a list of the projects approved by the IEPA and Table 5.2-2 includes a list of all watershed-wide, non site-specific projects that were proposed as part of the 2016 Grant Application. Table 5.2-1 shows all previous projects that were constructed have been listed above in relation to their job number, name, implementation completion date, and photographs, where available. The site-specific BMPs that were proposed as part of the 2016 Grant Application are included in Appendix 2.

Project ID Number	*Project Name*	*Implementation Date*	*Photos*
3191601001	*435' Streambank Stabilization and Shoreline Protection*	*08/11/2017*	
3191601002	*400' Water and Sediment Control Basin*	*06/01/2017*	*No Photo Available*
3191601005	*1.6 acre Grassed Waterway*	*10/01/2017*	*No Photo Available*
3191601007	*500' Streambank Stabilization and Shoreline Protection*	*03/28/2018*	*No Photo Available*
3191601008	*125' Water and Sediment Control Basin*	*10/01/2017*	
3191601009	*0.2 acre Grassed Waterway*	*Anticipated Fall 2018*	
3191601010	*1 Grade Stabilization Structure*	*Anticipated Fall 2018*	
3191601011	*0.5 acre Grassed Waterway*	*Anticipated Fall 2018*	
3191601012	*180' Streambank Stabilization and Shoreline Protection*	*Anticipated Fall 2018*	

3191601013	*70' Water and Sediment Control Basin*	*10/01/2017*	*No Photo Available*
3191601014	*375' Streambank Stabilization and Shoreline Protection*	*11/01/2017*	*No Photo Available*
3191601015	*200' Water and Sediment Control Basin*	*Anticipated Summer 2018*	*N/A*
3191601016	*125' Water and Sediment Control Basin*	*Anticipated Summer 2018*	*N/A*
3191601017	*1 Grade Stabilization Structure*	*Anticipated Summer 2018*	*N/A*
3191601018	*200' Water and Sediment Control Basin*	*Anticipated Summer 2018*	*N/A*
3191601019	*250' Water and Sediment Control Basin*	*05/25/2018*	*No Photo Available*
3191601020	*0.7 acre Grassed Waterway*	*05/25/2018*	*No Photo Available*
3191601003	*0.4 acre Grassed Waterway*	*09/01/2017*	*No Photo Available*
3191601004	*1 Grade Stabilization Structure*	*09/01/2017*	*No Photo Available*
3191601006	*270' Streambank Stabilization and Shoreline Protection*	*11/03/2017*	

Table 5.2-1 Grant Agreement 3191601 BMP Implementation

Project ID Number	*Project Name*
Landowner 1	*2000' Streambank Stabilization and Shoreline Protection*
Landowner 2	*6 Grade Stabilization Structures*
Landowner 3	*4600' Water and Sediment Control Basin*
Landowner 4	*5-acre Filter Strip*
Landowner 5	*3.5 acre Grassed Waterway*

Table 5.2-2: 2016 319 Grant Application Proposed Watershed BMPs

This plan is intended include projects identified in the grant application and recommend additional BMPs to incorporate within the planning area to meet the sediment and nutrient load reduction goals identified in Chapter 2. Grant funds that are still available are being used to pursue an additional six projects within the watershed, listed in Table 5.2-3. RISWCD has identified thirteen further projects that did not receive funding as part of the 2016 Grant Agreement, but the landowners have expressed interest in constructing a BMP on their property. These projects are identified in Table 5.2-4. The constructed BMPs and proposed BMPs, referenced in this section, are shown on the BMP implementation exhibit (Figure 5.2-1). If a project previously proposed has not yet been constructed, it is recommended that it be incorporated into this watershed plan.

Project Type	*Priority Level*	*IEPA Approval (if approved, list date)*
Streambank Stabilization	*Medium*	*05/28/2018*
Streambank Stabilization	*High*	*05/28/2018*
Streambank Stabilization	*Not Ranked*	*05/28/2018*
Streambank Stabilization	*Medium*	*05/28/2018*
Streambank Stabilization	*Not Ranked*	*Not approved*
Dry Dam	*Medium*	*Not approved*

Table 5.2-3 Projects to be Constructed using Remaining 2016 Grant Funds

Landowner ID	*Project Type*	*Priority Level*
Landowner TP	*Streambank Stabilization*	*High*
Landowner LZ	*Grade Stabilization Structure and Waterway*	*Medium*
Landowner SP	*Streambank Stabilization*	*Low*
Landowner GP	*Dry Dam*	*Medium*
Landowner BB	*Grade Stabilization Structure and Waterway*	*High*
Landowner PM	*Streambank Stabilization*	*Medium*
Landowner DR	*Streambank Stabilization*	*Medium*
Landowner DR	*Grade Stabilization Structure and Waterway*	*Medium*
Landowner RC	*Dry Dam*	*Low*
Landowner GM	*Streambank Stabilization*	*Unranked*
Landowner SB	*Design Options Being Considered*	*N/A*
Landowner BB	*Streambank Stabilization*	*Unranked*
Landowner BM	*Streambank Stabilization*	*Unranked*

Table 5.2-4 Identified Future Projects

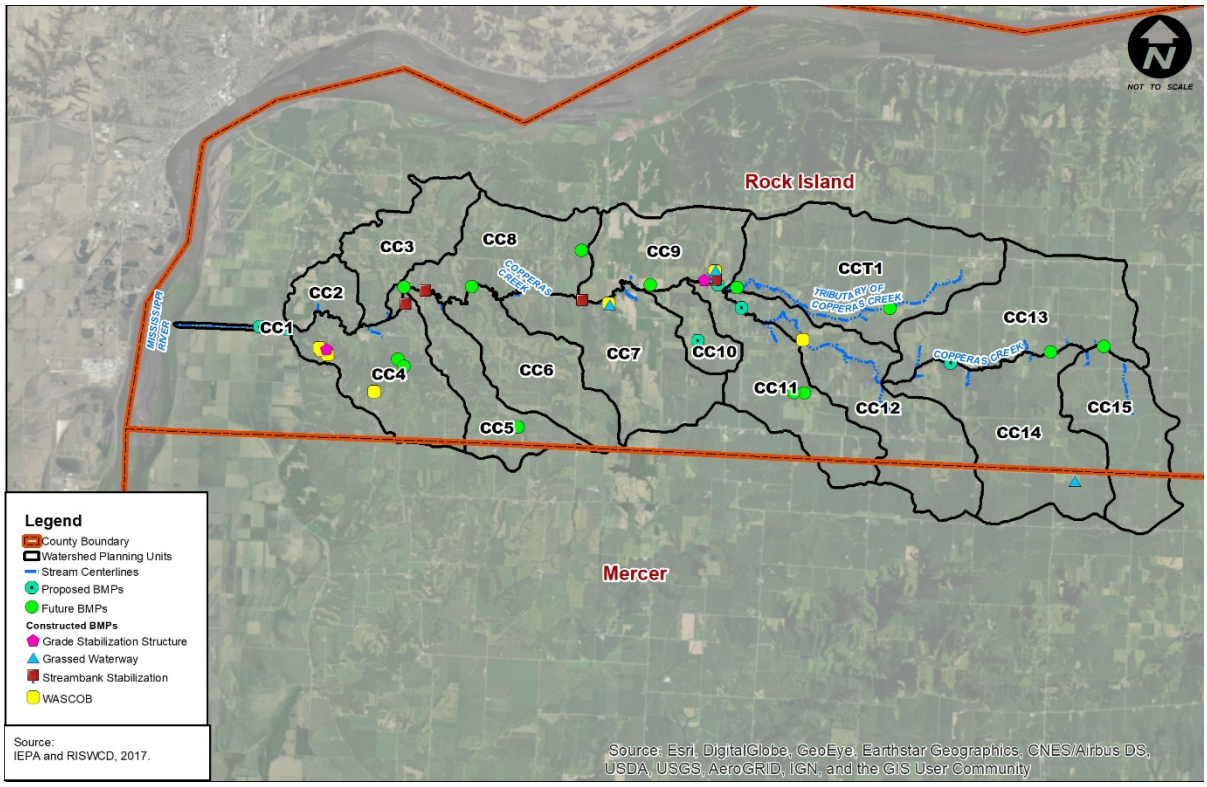


Figure 5.2-1 Watershed BMP Implementation

CHAPTER 6 PLAN IMPLEMENTATION

Various water quality projects and BMP scenarios were reviewed and plan elements are identified per watershed planning unit, based on a review of the information collected in the watershed assessment as well as the potential pool of BMPs. BMP selection was based largely on site-specific land use, soil infiltration capacity, constructability and available space or site constraints. The following sections outline how the potential BMPs will be applied as a function of land use, where BMPs should be implemented, cost of implementation and overall reduction as a result of implementation.

6.1 BMP SYNTHETIC SCENARIO SELECTION

The Copperas Creek Planning Area includes 16 watershed planning units which consist mainly of agricultural land use, making up approximately 67% of the watershed. While forest is the second largest land use in the overall watershed, most of this area only is present within 17 watershed planning units and is not likely to be developed in the relative future. BMPs have not been applied to any roadways within the planning area because they are typically a rural cross-section, which does not have both a curb and gutter or associated storm conveyance system. In addition, there are less than 40 miles of state/county highways within the planning area making this a very small contributor to nonpoint source pollution. These roads are traveled on by heavy machinery during the planting and harvesting seasons. This makes the use of BMPs such as porous pavement impracticable and water quality inlets impossible.

The following BMP scenarios were developed based on: 1) land use; 2) BMP effectiveness; 3) infiltration capacities; and 4) quantifying load reductions using STEPL. All BMPs were determined for each planning unit considering its current land use and farmland classification. Constructed wetlands and larger BMPs were selected in planning units that were historically forested according to the presettlement land cover. This BMP is more efficient at removing nitrates from larger drainage areas and is more efficient at the downstream end of the watershed. The downstream watershed planning units have a higher potential for nitrate and pesticide contamination due to sandy soils and groundwater contamination. Smaller BMPs (i.e. Woodchip Bioreactors) were selected for farmland of statewide importance and prime farmland areas due to the historical prairie land cover. A sensitivity analysis was completed to determine how a particular BMP selected from STEPL's suite of BMP choices performs and to determine which BMP is appropriate for a particular land use type. The following is an example of how BMP choices available in STEPL have been applied to the Copperas Creek Planning Area. It should be noted that these BMP scenarios have not been optimized and could vary based on site constraints. The quantification of load reduction should not be limited to the scenario chosen in this plan, however is shown as such to meet reduction goals.

6.1.1 Open spaces, Hay/Pasture and Forest Areas (BMP Scenario)

1. *Agricultural filter strips* 5 feet wide along downstream side of property.
2. *Constructed wetlands/Ponds* at a ratio of 1 acre of wetland per 800 acres of tillable land

6.1.2 Cropland – applied throughout where opportunities exist (BMP Scenario)

1. *Agricultural filter strips* (Nitrate bioreactors) 1 bioreactor (100'x20') per 80 acres of tillable land (assume all cropland has subsurface drainage).
2. *Grassed waterways* implemented along farmed gullies (not quantified in STEPL).
3. *Saturated Buffer Strips* 1,000 feet long and 20 feet wide per 80 acres of tillable land.
4. *Conservation Tillage* including but not limited no-till, strip till, ridge till and mulch till.
5. *WASCOB/Ponds* at a ratio of 1 acre of basin per 800 acres of tillable land (used in conjunction with conservation tillage)

6.1.3 Streambank and Riparian Corridor Restoration (BMP Scenario)

1. Watercourse specific *streambank restoration/stabilization* and enhancements including but not limited to channel regrading/re-meandering (pools, riffles, vanes), sediment removal, 2-stage ditches, bank regrading, slope stabilization (naturalized armoring, root wads, vegetated mechanically stabilized earth bank) and bio-engineering.
    a. Applications based on watercourse assessment and should not be limited to only areas identified in this plan as there are areas in the plan that are unassessed.
2. Riparian area restoration and stream corridor or habitat restoration. Replacement of rip-rap, and grass banks and adjacent areas with deep-rooted native vegetation.
    a. Applications based on watercourse assessment and should not be limited to only areas identified in this plan as there are areas in the plan that are unassessed.

It should be noted that the BMP scenarios presented above are one of many that could be selected as reduction loadings are readily quantifiable using STEPL. However, these scenarios are well-suited for the land cover in the Copperas Creek watershed, and represent an ambitious but practicable level of implementation.

BMP combinations are identified above that would be suitable and effective for reducing loadings associated with the various land covers within a watershed planning unit. STEPL can and has been used to quantify the loading reductions that would be achieved with these particular combinations of BMPs. The italicized and underlined BMPs in the sections above represent the corresponding identifier in STEPL.

It is anticipated there will be variations to the BMP combinations presented above in the watershed planning units. As summarized above, this watershed-based plan does not list or *prescribe* specific BMPs to be implemented in specific places, except as identified in the 2016 Grant application. The sizes and designs of BMPs and the optimal places for BMPs will need to be determined by communities and other stakeholders considering where benefits will be the greatest as well as other factors including land ownership, budgets, community buy-in, and how maintenance will be assured. In some watershed planning units, certain BMP types may prove to be relatively more (or less) implementable, considering these factors. Thus, actual BMP combinations within a watershed planning unit can and likely will vary from these templates. The pollutant load reduction goals for the watershed planning units can remain steady, while there can be flexibility in selecting and siting the BMPs to meet the reduction goals.

Other BMP combinations are readily quantifiable using STEPL. However, the template scenarios presented above are representative of a typical and appropriate combination of BMPs within a watershed planning unit and are used within this plan to develop cost-estimates and quantify loading reductions that can be achieved.

6.2 BMP COST ESTIMATING

The following cost estimates for BMPs to be applied in the Copperas Creek Planning Area have been generated from a combination of project specific experience from both design and construction phases as well as a succinct review of previous watershed based plans. The cost estimates presented reflect an expected economy of scale for potential BMP projects and should be validated for site-specific projects based on actual site constraints as cost estimates may range significantly. Conservation tillage is recommended as a part of this plan, but has not been cost out as part of this project as the relative cost of adopting conservation tillage depends on the system from which the farmer switched. Where costs are shown on a per acre basis, the costs reflect implementing many de-centralized practices that cumulatively amount to one-acre green infrastructure area. This amount of retrofitting would have the capacity to manage runoff from a significantly larger acreage. Cost estimates have not been provided for policy change or education and outreach programs as these practices, while important, are not readily quantifiable.

Best Management Practice	**Unit**	**Unit Cost**
Vegetated Filter Strips @ ~ *$3/ft^2*	Ac	$131,000
Constructed Wetland/Pond	Ac	$50,000
Woodchip Bioreactors @ *~$5/ft^2*	Each	$10,000
Saturated Buffer Strip	Ac	$18,000
WASCOB	ft^2	$8
Streambank Stabilization	LF	$130
BMPs not assessed using STEPL		

Best Management Practice	Unit	Unit Cost
Streambank Enhancement – Replacement of hardscape with native	LF	$100
Riparian Corridor Enhancement – Habitat Enhancement and Creation	Ac	$9,000
Grassed Waterway	Ac	$3,000
Floating Wetlands (quantified as unit(s) per acre of open water)	Ac	$10,000

6.3 COPPERAS CREEK WATERSHED PRIORITY IMPLEMENTATION AREAS

A ranking system was used to determine which watershed planning units are severely impaired and are critical to BMP implementation to provide a watershed planning unit and overall watershed benefit. Each pollutant load, as described in Chapter 4, was given a score from 1-4, with 1 being the least polluted to 4 being severely polluted, within each watershed planning unit. In addition, the riparian area of each watershed planning unit was given a score of 1 to 3, with 1 meaning the riparian area is in good condition to 3 with the riparian being in poor condition. The pollutant and riparian scores were then added to determine an overall score. The prioritization of each watershed planning unit was determined based on the overall score, with the most severely impaired watershed planning units having the highest score. Table 6.3-1 is a summary of the ranking system for each watershed planning unit. Priority should be given to the watershed planning units in the top 25% of the overall scoring.

PU ID	N Load (lb/ac)	N Rank	P Load (lb/ac)	P Rank	BOD Load (lb/ac)	BOD Rank	Sed Load (t/ac)	SED Rank	Channel	Riparian	Erosion	Rip Rank	Total
CC9	11.8	4	3.6	4	26.5	4	4.28	4	Moderate	Poor	High	3	24
CCT1	11.6	4	3.6	4	24.7	4	3.73	4	Moderate	Poor	Moderate	3	23
CC7	9.6	4	3.0	3	20.4	3	2.97	3	Moderate	Poor	High	3	21
CC3	9.3	4	2.8	3	20.3	3	2.51	2	Low	Poor	High	3	19
CC10	9.2	3	2.6	3	21.0	3	2.22	2	Moderate	Poor	High	3	19
CC1	8.6	2	2.1	2	22.0	3	2.23	2	High	Poor	Low	3	16
CC11	10.1	4	3.0	3	21.5	3	2.72	2	Low	Fair	Low	2	16
CC6	8.4	2	2.4	2	18.7	2	2.17	2	High	Good	High	1	15
CC8	7.5	2	2.3	2	16.2	2	2.13	2	High	Good	High	1	15
CC2	7.8	2	2.2	2	17.5	2	1.66	1	Low	Poor	High	3	14
CC5	8.0	2	2.3	2	17.8	2	1.81	1	Low	Poor	High	3	14
CC13	8.9	3	2.6	3	19.3	2	1.99	1	Low	Fair	Moderate	2	14
CC12	8.2	2	2.3	2	18.1	2	1.72	1	Moderate	Fair	Low	2	12
CC14	8.3	2	2.4	2	17.9	2	1.87	1	Moderate	Fair	Low	2	12
CC15	8.7	2	2.5	2	18.4	2	1.62	1	Low	Fair	Moderate	2	12
CC4	5.7	1	1.6	1	12.8	1	1.24	1	Low	Poor	High	3	11

Table 6.3-1 Copperas Creek Planning Area Pollutant Priority Ranking by Watershed Planning Unit

Watershed planning units with the lowest overall pollutant loadings are generally in the upper portions of the watershed and dominated by cropland. It should be noted that although some of the watershed planning units have a low prioritization score, BMPs can nevertheless be implemented in these areas

to help improve the quality of the Copperas Creek watershed, especially in the upper portions of the watershed where the erosion process has potential to damage downstream areas.

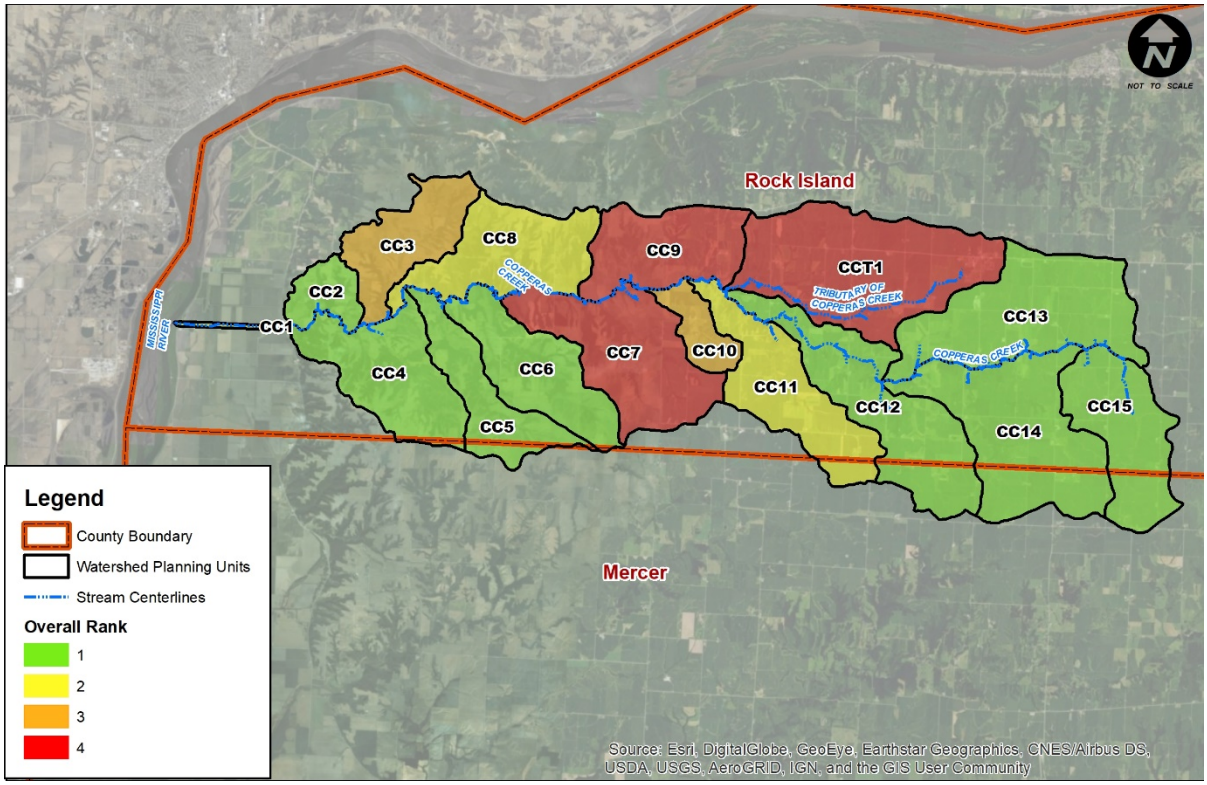


Figure 6.3-1 Copperas Creek Watershed Priority Area Ranking by Watershed Planning Unit

6.4 BMP IMPLEMENTATION, LOAD REDUCTIONS AND COST

Following the priority area analysis, special care was considered in how to apply BMPs pragmatically to land use types as described in Section 6.1 which is largely controlled by site constraints. Using both design and construction experience, various BMPs were selected for each watershed planning unit to generate the highest pollutant load removal and BMP efficiency per land use.

Overall reductions for a system of BMPs for each land use, in each watershed planning unit, were determined using the BMP Calculator in the STEPL suite combined with removal efficiencies per BMP as described in Section 5.1. An average BMP reduction value was derived for planning areas where multiple BMPs will be installed. Following implementation, cost estimates of the implemented BMPs by watershed planning unit were determined using the information collected in Section 6.2. Cost estimates are valued in current 2018 pricing, and do not have a multiplier to reflect inflation over time. This decision was made so that the costs provided by this plan can be interpreted accurately in the future without having to calculate from inaccurate inflation rate projections.

Based on short- and long-term goals, stakeholder engagement, and funding considerations, the loading reductions and costs were determined for a target level of BMP implementation was developed for load reductions and cost. The following sections describe the methodology used to determine the load reductions (using STEPL) and cost estimates associated with the target implementation level.

In addition to the developed areas, there are existing lakes, wetlands and detention basins that can be enhanced. These improvement opportunities have been identified and incorporated into the BMP scenarios selected for each land use type.

As discussed in Section 4.4, the predicted population increase in the Copperas Creek Planning Area is expected to decrease. Understanding that the Copperas Creek Planning Area is undeveloped as discussed above it is anticipated that existing and future priority area rankings are essentially the same due to little predicted land use change. Therefore, although the following analyses has been prepared for existing land uses and they also reflected projected future land use.

6.4.1 30% Implementation

The target level of BMP implementation is 30%. What this means is that runoff from 30% of the various land use areas within the watershed planning units will have runoff/stormwater controls as outlined above in Section 6.1. The target or objective of implementing BMPs to capture/treat runoff from 30% of the source areas is based on practicability and feasibility. The majority of the land in the watershed is privately owned. Our analysis concluded that the goal of implementing BMPs to manage/treat runoff from 30% of the source areas is the maximum amount of implementation that is practicable and realistic.

Through education and outreach watershed stakeholders can encourage implementation of BMPs on private property. This would result in a higher percentage of areas being treated, and further reductions to pollutant loadings. However, the quantification of effects presented in this watershed-based plan focuses on implementation of BMPs that can be designed to meet appropriate technical standards and will be reliably maintained, which corresponds to runoff from 30% of the land areas is treated with a BMP(s).

The numbers/scale of BMPs applied within each watershed planning unit (reflecting the Section 6.1 scenarios) are shown in Appendix 1. Appendix 1 displays BMP projects per watershed planning unit based on a detailed assessment of land cover/land use within the watershed planning unit. Information from this table was an input into the BMP Calculator in STEPL.

Table 6.4-1 below shows the compiled pollutant loading reductions and costs per watershed planning unit, reflecting the land cover in that planning area and the Section 6.1 scenarios. The loading reductions were calculated from the BMP Calculator in the STEPL Suite to determine the "Combined BMP efficiency" as if numerous BMPs are applied in the watershed planning unit. Based on land use and the total BMPs applied, the Table shows the estimated loading reductions as computed from STEPL's Combined BMP selection within the Urban BMP Tool. Load reductions are shown for a suite of BMPs applied to a particular watershed planning unit as the overall BMP efficiency to depict a realistic application rate of multiple BMPs throughout a watershed planning unit.

Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	BOD (lbs/yr)	Sediment (tons/yr)	Costs to Implement BMP
CC1 (110 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.00	Each	$10,000					$ -
	Vegetated Filter Strips @ ~ $3/ft²	0.09	Ac	$131,000					$ 12,380
	Constructed Wetland	0.04	Ac	$50,000					$ 2,051
	Saturated Buffer Strips	0.00	Ac	$18,000					$ -
	WASCOB	0.00	ft²	$8					$ -
	Streambank Stabilization	6,653	LF	$130					$ 864,911
Planning Unit Total					223	63	545	69	$ 879,342
CC2 (916 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.43	Each	$10,000					$ 4,302
	Vegetated Filter Strips @ ~ $3/ft²	0.22	Ac	$131,000					$ 28,533
	Constructed Wetland	0.16	Ac	$50,000					$ 7,993
	Saturated Buffer Strips	0.20	Ac	$18,000					$ 3,556
	WASCOB	387	ft²	$8					$ 3,098
	Streambank Stabilization	2,227	LF	$130					$ 289,523
Planning Unit Total					1,329	398	2,385	325	$ 337,004
CC3 (2,213 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.35	Each	$10,000					$ 13,460
	Vegetated Filter Strips @ ~ $3/ft²	0.29	Ac	$131,000					$ 38,298
	Constructed Wetland	0.27	Ac	$50,000					$ 13,271
	Saturated Buffer Strips	0.62	Ac	$18,000					$ 11,124
	WASCOB	1,211	ft²	$8					$ 9,691
	Streambank Stabilization	6,261	LF	$130					$ 813,870
Planning Unit Total					3,890	1,204	6,625	1,139	$ 899,714
CC4 (3,145 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.20	Each	$10,000					$ 11,981
	Vegetated Filter Strips @ ~ $3/ft²	0.42	Ac	$131,000					$ 55,001
	Constructed Wetland	0.67	Ac	$50,000					$ 33,469
	Saturated Buffer Strips	0.55	Ac	$18,000					$ 9,902
	WASCOB	1,078	ft²	$8					$ 8,627

Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	BOD (lbs/yr)	Sediment (tons/yr)	Costs to Implement BMP
	Streambank Stabilization	9,475	LF	$130					$ 1,231,758
Planning Unit Total					3,281	970	5,725	806	$ 1,350,737
CC5 (2,108 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.19	Each	$10,000					$ 11,881
	Vegetated Filter Strips @ ~ $3/ft²	0.28	Ac	$131,000					$ 37,223
	Constructed Wetland	0.29	Ac	$50,000					$ 14,275
	Saturated Buffer Strips	0.55	Ac	$18,000					$ 9,819
	WASCOB	1,069	ft²	$8					$ 8,554
	Streambank Stabilization	5,918	LF	$130					$ 769,368
Planning Unit Total					3,074	923	5,151	763	$ 851,121
CC6 (2,755 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.39	Each	$10,000					$ 13,917
	Vegetated Filter Strips @ ~ $3/ft²	0.34	Ac	$131,000					$ 44,958
	Constructed Wetland	0.44	Ac	$50,000					$ 21,932
	Saturated Buffer Strips	0.64	Ac	$18,000					$ 11,502
	WASCOB	1,253	ft²	$8					$ 10,021
	Streambank Stabilization	9,445	LF	$130					$ 1,227,798
Planning Unit Total					4,297	1,306	7,623	1,244	$ 1,330,128
CC7 (3,908 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.45	Each	$10,000					$ 24,500
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	$131,000					$ 47,147
	Constructed Wetland	0.45	Ac	$50,000					$ 22,492
	Saturated Buffer Strips	1.12	Ac	$18,000					$ 20,248
	WASCOB	2,205	ft²	$8					$ 17,640
	Streambank Stabilization	15,578	LF	$130					$ 2,025,149
Planning Unit Total					7,288	2,330	12,241	2,445	$ 2,157,177
CC8 (3,002 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.40	Each	$10,000					$ 14,031
	Vegetated Filter Strips @ ~ $3/ft²	0.37	Ac	$131,000					$ 48,694

Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	BOD (lbs/yr)	Sediment (tons/yr)	Costs to Implement BMP
	Constructed Wetland	0.53	Ac	$50,000					$ 26,303
	Saturated Buffer Strips	0.64	Ac	$18,000					$ 11,596
	WASCOB	1,263	ft^2	$8					$ 10,102
	Streambank Stabilization	16,051	LF	$130					$ 2,086,613
Planning Unit Total					4,204	1,341	7,121	1,348	$ 2,197,339
CC9 (2,689 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.01	Each	$10,000					$ 10,052
	Vegetated Filter Strips @ ~ $3/ft²	0.41	Ac	$131,000					$ 53,065
	Constructed Wetland	0.58	Ac	$50,000					$ 28,865
	Saturated Buffer Strips	0.46	Ac	$18,000					$ 8,308
	WASCOB	905	ft^2	$8					$ 7,238
	Streambank Stabilization	10,182	LF	$130					$ 1,323,705
Planning Unit Total					6,396	2,044	12,810	2,534	$ 1,421,181
CC10 (884 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.43	Each	$10,000					$ 4,294
	Vegetated Filter Strips @ ~ $3/ft²	0.20	Ac	$131,000					$ 26,593
	Constructed Wetland	0.15	Ac	$50,000					$ 7,615
	Saturated Buffer Strips	0.20	Ac	$18,000					$ 3,549
	WASCOB	386	ft^2	$8					$ 3,092
	Streambank Stabilization	3,875	LF	$130					$ 503,695
Planning Unit Total					1,568	462	2,979	407	$ 548,838
CC11 (3,118 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.28	Each	$10,000					$ 22,772
	Vegetated Filter Strips @ ~ $3/ft²	0.27	Ac	$131,000					$ 34,932
	Constructed Wetland	0.23	Ac	$50,000					$ 11,465
	Saturated Buffer Strips	1.05	Ac	$18,000					$ 18,819
	WASCOB	2,049	ft2	$8					$ 16,396
	Streambank Stabilization	7,298	LF	$130					$ 948,714

Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	BOD (lbs/yr)	Sediment (tons/yr)	Costs to Implement BMP
Planning Unit Total					5,999	1,853	9,863	1,739	$ 1,053,098
CC12 (4,116 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.65	Each	$10,000					$ 26,461
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	$131,000					$ 47,804
	Constructed Wetland	0.45	Ac	$50,000					$ 22,407
	Saturated Buffer Strips	1.21	Ac	$18,000					$ 21,869
	WASCOB	2,382	ft2	$8					$ 19,052
	Streambank Stabilization	18,392	LF	$130					$ 2,390,940
Planning Unit Total					6,338	1,817	10,602	1,444	$ 2,528,532
CC13 (4,583 acres)	*Woodchip Bioreactors @ ~$5/ft²*	3.54	Each	$10,000					$ 35,395
	Vegetated Filter Strips @ ~ $3/ft²	0.28	Ac	$131,000					$ 36,078
	Constructed Wetland	0.26	Ac	$50,000					$ 12,756
	Saturated Buffer Strips	1.63	Ac	$18,000					$ 29,252
	WASCOB	3,186	ft2	$8					$ 25,485
	Streambank Stabilization	15,327	LF	$130					$ 1,992,541
Planning Unit Total					7,674	2,258	11,953	1,816	$ 2,131,507
CC14 (4,786 acres)	*Woodchip Bioreactors @ ~$5/ft²*	3.37	Each	$10,000					$ 33,733
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	$131,000					$ 46,838
	Constructed Wetland	0.40	Ac	$50,000					$ 20,232
	Saturated Buffer Strips	1.55	Ac	$18,000					$ 27,878
	WASCOB	3,036	ft2	$8					$ 24,288
	Streambank Stabilization	14,395	LF	$130					$ 1,871,390
Planning Unit Total					7,472	2,202	11,779	1,795	$ 2,024,359
CC15 (2,988 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.55	Each	$10,000					$ 25,513
	Vegetated Filter Strips @ ~ $3/ft²	0.15	Ac	$131,000					$ 19,548
	Constructed Wetland	0.07	Ac	$50,000					$ 3,598

Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	BOD (lbs/yr)	Sediment (tons/yr)	Costs to Implement BMP
	Saturated Buffer Strips	1.17	Ac	$18,000					$ 21,085
	WASCOB	2,296	ft2	$8					$ 18,369
	Streambank Stabilization	5,362	LF	$130					$ 697,063
Planning Unit Total					4,730	1,384	6,729	894	$ 785,177
CC16 (5,566 acres)	*Woodchip Bioreactors @ ~$5/ft²*	4.10	Each	$10,000					$ 40,957
	Vegetated Filter Strips @ ~ $3/ft²	0.34	Ac	$131,000					$ 45,112
	Constructed Wetland	0.36	Ac	$50,000					$ 18,002
	Saturated Buffer Strips	1.88	Ac	$18,000					$ 33,848
	WASCOB	3,686	ft2	$8					$ 29,489
	Streambank Stabilization	26,425	LF	$130					$ 3,435,287
Planning Unit Total					13,201	4,291	22,425	4,883	$ 3,602,695
WATERSHED TOTAL					80,964	24,846	136,556	23,651	**$ 24,097,948**

Table 6.4-1 30% BMP Implementation, Load Reductions and Cost –Copperas Creek Planning Area

Targeting an implementation rate of 30% watershed wide results in a substantial reduction in sediment loading -- 33% -- with an overall cost of $24.1 million, of which $22.5 million is streambank stabilization. The sediment load reduction is significant for water quality improvement, and also, as discussed above, reductions in sediment loading suggests reductions in other pollutants through reduction in transport of phosphorus, heavy metals and hydrocarbons. In addition, the existing high sediment accumulation in the watercourses (as assessed in Chapters 3 and 4) is one of the main stressors for habitat degradation leading to the creation of anaerobic conditions in streambeds and causing aquatic life impacts.

Because nutrients are of concern, the 23% reduction in nitrogen indicates that BMPs proposed as part of this plan have been appropriately placed. Phosphorus and BOD reductions are consistent with nitrogen load reductions. Also, policy change effects (nonstructural BMPs) are not reflected in the STEPL results. For example, a county can implement ordinance provisions to require non-phosphorus fertilizers, which would have the effect of reducing nutrient loadings in stormwater. Overall, the predicted effects and the assessment of the watershed conditions and needs highlight the need for nitrogen load reductions to improve water quality.

This target level of BMP implementation will significantly reduce loadings and contribute to water quality improvement. It is difficult to precisely quantify and characterize the water quality rebound that will result from implementation of watershed wide nonpoint source pollution control measures. A key to understanding BMP implementation response within the watercourses is lag time. Even when management changes are well-designed and fully implemented, water quality monitoring efforts may not show definitive results if the monitoring period, program design, and sampling frequency are not sufficient to address the lag between treatment and response. The main components of lag time include the time required for an installed practice to produce an effect, the time required for the effect to be delivered to the water resource, the time required for the water body to respond to the effect, and the effectiveness of the monitoring program to measure the response (Meals, et al. 2009). Water quality characteristics are also affected by a variety of other factors, for example climate effects and activities in upstream watersheds.

Recognizing the difficulty in quantifying and characterizing the water quality rebound that will result and the timing of effects, this watershed plan is nevertheless establishing a target BMP implementation level. When considering a practical and reasonable implementation rate, the target for this plan is the 30% implementation rate. This will be an average across the planning units, with priority areas targeted. While this target implementation level will involve very significant expenditures, implementation can occur over a 25-year period, spreading out the costs and allowing vehicles for funding, implementation, outreach and response to take effect.

As discussed further below, this plan envisions that watershed monitoring will continue and the effects of plan implementation can be assessed. Through cooperative efforts with the RISWCD and landowners, nitrate testing will be offered monthly free of charge and the RISWCD will continue work with Augustana College for water quality sampling and testing. The plan will be reviewed and updated at 10-year increments. In between plan updates adaptive management techniques can be used to fine-tune BMP implementation plans, for example placing greater focus on BMPs shown to be practicable and effective.

6.4.2 Plan Implementation Responsibility

Jurisdiction for stormwater management and water quality lies primarily with Rock Island County and Mercer County and the townships within the watershed planning area.

As discussed above, it is anticipated RISWC will play a lead role on regional-scale stormwater projects, (see Section 6.6). It is anticipated that both counties will also continue to implement, and periodically update their respective ordinances.

It is anticipated landowners will play major roles in planning and implementing on-the-ground BMPs, such as implementing grassed waterways and saturated buffer strips. In most cases landowners will also be responsible for maintenance of BMPs. RISWCD may provide technical or financial assistance to landowners for certain projects.

Some BMP projects may also be implemented by other watershed stakeholders, such as school districts, not-for-profit organizations, or churches. Stakeholders should continue to discuss the proposed projects and collaborate with other agencies. As discussed further below, the Planning Committee meetings will be an important component of tracking plan implementation progress.

6.5 TECHNICAL AND FINANCIAL ASSISTANCE

Implementation of the plan will require substantial resources and partnerships with local, state, and federal organizations to fund planning, design, and implementation. There are many sources of funding programs available. Below is a list of various programs available. Most of the programs require a local match of funds or in-kind services.

Illinois EPA Section 319

- Under Section 319, states, territories, and Indian tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of projects that have been implemented. Grant provides up to 60% cost-share for eligible projects/activities that reduce nonpoint source pollution.

EPA Clean Water State Revolving Fund (CWSRF)

- The CWSRF program is a federal-state partnership that provides communities a permanent, independent source of low-cost financing for a wide range of water quality infrastructure projects. The program funds water quality protection projects for stormwater management, nonpoint source pollution control and estuary management.

National Fish and Wildlife Foundation – Five Star and Urban Waters Restoration Program

- The Five Star and Urban Waters Restoration Program seeks to develop nation-wide-community stewardship of local natural resources, preserving these resources for future generations and enhancing habitat for local wildlife. Projects seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development.

National Fish and Wildlife Foundation – Environmental Solutions for Communities

- In 2012, Wells Fargo and NFWF launched the Environmental Solutions for Communities initiative, designed to support projects that link economic development and community well-being to the stewardship and health of the environment. This five-year initiative is supported through a $15 million contribution from Wells Fargo that will be used to leverage other public and private investments with an expected total impact of over $37.5 million. Funding priorities for this program include:
    - Supporting sustainable agricultural practices and private lands stewardship
    - Conserving critical land and water resources and improving local water quality
    - Restoring and managing natural habitat, species and ecosystems that are important to community livelihoods
    - Facilitating investments in green infrastructure, renewable energy and energy efficiency
    - Encouraging broad-based citizen participation in project implementation.

USDA Conservation Reserve Program (CP-39)

- The Farmable Wetland Program seeks to construct wetlands to treat runoff from crop agricultural drainage systems, which reduces nutrient and sediment loading, improve water quality, prevent excessive erosion, reduce flood flows and provide wildlife habitat. Landowners receive incentives that include:
    - 10-15 years CRP rental payments plus a 20% incentive
    - $100/acre upfront SIP payment
    - 50% cost share
    - 40% practice incentive payment

Mississippi River Basin Healthy Watersheds Initiative (MRBI)

- Launched in 2009, the MRBI uses several Farm Bill programs to help agricultural producers to implement practices that conserve natural resources and improve agricultural operations. Overall goals are to improve water quality, wetland restoration, wildlife habitat enhancement, while ensuring economic viability of agricultural lands. In 2017, the MRBI provided over $920,000 to treat 5,246 acres.

Regional Conservation Partnership Program

- The RCPP efforts are focused on the increase in restoration and sustainable use of soil, water wildlife and related natural resources on both a regional and watershed scale. The purpose is to connect partners and private landowners to design and implement voluntary conservation by entering into conservation program contracts under the framework of a partnership agreement. Projects located in a single state receive 25 percent of national funding provided through the 2014 Farm Bill.

Conservation Innovation Grants (CIG)

- Authorized by the 2002 Farm Bill, CIG uses Environmental Quality Incentives Program (EQIP) funds to award grants to non-Federal governmental or non-governmental organizations. A CIG funding notice is announced each year. Funds are awarded through a nationwide competitive grant process. Projects may be watershed-based, region, multi-station or nationwide in scope. Grantees contributing an equal match have more leverage.

Partners for Conservation Program (PFC) (formerly known as Conservation Practices Program (CPP))

- The goal of the PFC is to assist land users experiencing gully erosion to use conservation practices that help preserve water and soil quality and reduce flooding. Within the Rock Island County Soil and Water Conservation District, these practices are applicable for the PFC to use: grassed waterways, water and sediment control structures, grade stabilization structures, terraces, cover crops, strip-till, pasture plantings, and rain gardens. The PFC aims to work with the Illinois Department of Agriculture and SWCD to fund the projects for this program. Projects are cost-shared, when met at cost guidelines, using 60% of the cost project.

Well Decommissioning Program (WDP) (or Abandoned Well Sealing)

- The purpose of WDP is to provide financial and technical help for owners to seal their abandoned wells to protect groundwater from possible contamination. They aim to keep good relationships between local health departments, participating SWCDs, and agencies that provide financial and technical assistance for well abandonment. They prioritize the wells that show the greatest risk to groundwater resources and are sure to coordinate educational activities with Illinois and the University of Illinois Extension's water resource protection programs. Cost-share on irrigation wells cannot exceed the lesser value of $750 or 60% of actual cost. The cost-share total cannot exceed the lesser value of $400 or 60% of the actual cost.

Streambank Stabilization and Restoration Program (SSRP)

- The objective of SSRP is to provide effective, low-cost vegetative bio-engineering techniques that can be used to stabilize streambanks. They aim to provide a cost-share financial assistance between Illinois landowners to help stabilize their severely eroding streambanks. The program works with the local Soil and Water Conservation District to aid with the eroding streambanks. Funding is provided by cost-sharing to not exceed 75% of all approved construction expenses, and the remaining 25% is the obligation of the land owner.

Nutrient Management Program (NMP)

- The purpose of NMP is to provide incentives to land users for projects on nutrient management which will minimize nutrients and pollutants being transported to surface and groundwater. The program can reduce nutrients leaving the farm into waters, give a better use of nutrients, and reduce input costs. They aim to work with SWCD to prioritize plans based on geographic location, watershed, and soils.

Vegetative Strip Assessment Law

- A "vegetative filter strip" is considered to be a piece of land that is located in between a farm field and an area to be protected (surface water, stream, river or sinkhole). Vegetative filter strips must meet the requirements of subsection and shall contain vegetation that has a heavy fibrous root system, a dense top growth, forms a uniform ground cover, and tolerates pesticides used in the farm. This law aims to meet all the needs of the taxpayer through completing a uniform certified document given by the Department of Revenue and Association of Illinois Soil and Water Conservation Districts. The funding for this law depends on the population per county. In counties with a population of less than 3,000,000, the vegetation strip is valued at 1/6th of its productivity index equalized assessed value as cropland. For counties with a population of more than 3,000,000, the

vegetation strip is valued at the lesser of 16% of the fair cash value of farmland, or 90% of the 1983 average equalized assessed value per acre.

Agricultural Conservation Easement Program (ACEP)

- The purpose of ACEP is to financially and technically help conserve, restore, protect, and enhance agricultural lands and wetlands. With the help of the National Resources Conservation Service (NCRS), they aim to help landowners, Native American tribes, state and local governments, and other organizations protect and limit the uses of the land. Within the Agricultural Land component, the NRCS can provide up to 50% of fair market value for the agricultural land easement. If NCRS determines that the land is of special environmental significance, they will contribute up to 75%.

6.6 SCHEDULE FOR IMPLEMENTATION

The following schedule is based on an implementation plan executed over the course of the next 25 years to make progress toward the established BMP implementation goals and the associated pollutant loading reduction targets:

2018-2019

- Outreach to townships, counties and stakeholder groups regarding the components of the plan and Section 319 funding.
- Townships, counties and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop Section 319 grant applications for submittal to Illinois EPA.
- Townships, counties and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop SRF loan application materials for NPS or capital projects that will significantly contribute to watershed improvement.
- Outreach to teachers and schools.
- Track/inventory watershed projects.
- Establish watershed monitoring efforts to the extent funding is available.

2020 - 2026

- Landowners and stakeholder groups implement project plans where funding has been provided or local governments have appropriated funds.
- On-going outreach to landowners and stakeholder groups regarding the components of the plan and Section 319 funding.
- Landowners and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop Section 319 grant applications for submittal to Illinois EPA.
- Landowners and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop SRF loan application materials for NPS or capital projects that will significantly contribute to watershed improvement.
- On-going outreach to teachers and schools. Develop and carry out events for in-service learning.
- Track/inventory watershed projects.
- Continue watershed monitoring efforts.

2027

- Continue activities as above.
- Evaluate Plan implementation. What has worked well? What barriers have been encountered? How have pollutant sources changed? How have water quality conditions changed?
- Update Watershed Plan and submit to Illinois EPA for approval.

2028 - 2037

- Continue implementation activities as laid out in the updated Watershed Plan.
- Track/inventory watershed projects.
- Continue watershed monitoring efforts.

2038

- Continue implementation activities.
- Evaluate Plan implementation. What has worked well? What barriers have been encountered? How have pollutant sources changed? How have water quality conditions changed?
- Update Watershed Plan and Submit to Illinois EPA for approval.

2039 - 2042

- Continue implementation activities as laid out in the updated Watershed Plan.
- Track/inventory watershed projects.
- Continue watershed monitoring efforts.

2043

- Evaluate Plan implementation. Have the 25-year goals for BMP implementation efforts and estimated loading reductions been achieved? How have water quality conditions changed?
- Plan next steps.

6.7 EDUCATION AND OUTREACH

The education and outreach component of the plan will be implemented to enhance public understanding and encourage positive behaviors and beneficial budgetary and policy decisions. The education and outreach strategy will encourage continued public participation in selecting, designing, implementing and maintaining the nonpoint source pollution management measures which will be implemented.

Issues within watersheds are often the outcome of many small actions which to an individual or small group may not be understood as a source of degradation to local waterways. Remedies to watershed scale issues are often voluntary and need effective public support and willing participation to yield results. For this to be successful, stakeholders must become engaged in watershed stewardship activities and alter behaviors which adversely affect the watershed. Having a basic understanding of current issues and how both individual and collective actions can contribute toward improving and protecting natural resources helps in both motivating and providing a basis for changing behaviors and addressing watershed issues. Pollutant reduction campaigns across the watershed can be developed by working with watershed groups, community groups, or individuals, and appropriate methods of education and outreach will vary based audience.

6.7.1 Education and Outreach Goals and Objectives

The USEPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (Handbook) was used in the development of the Copperas Creek Watershed education and outreach strategy. The Handbook outlines a 6-step approach for developing and implementing an education and outreach program:

1. Define the driving forces, goals and objectives;
2. Identify and analyze the target audience;
3. Create the message;
4. Package the message;
5. Distribute the message; and
6. Evaluate the outreach campaign.

Implementing these 6 steps will allow the watershed stakeholders to achieve their education and outreach goals and objectives, and contribute toward watershed restoration and protection goals. The *Handbook* informed and provided a template for the education and outreach components of this plan.

6.7.2 Target Audiences

There are specific audiences to target and partner with for education and outreach activities. These audiences include but are not limited to residents, landowners, businesses and organizations located or that work within the watershed. Levels of understanding of watershed issues varies across these audiences, so education needs to be tailored accordingly. Likewise, education and outreach should not be a one-time effort, but rather an ongoing occurrence that is mutually beneficial and allows for 2-way communication -- feedback and ideas should be collected from target audiences. The goal is to be receptive to current partners and to attract future partners who have not yet engaged in watershed improvement activities.

Education and outreach partners are expected to include the following entities:

- Local Government Officials and Agencies
  - Continued support from local governments and public landowners will be required to engage in projects on public lands and communicate with residents to encourage participation in watershed improvement. Communities in the watershed will be asked to adopt the watershed plan and participate as part of this education and outreach process.
- Farmers
  - It is necessary to inform, educate, and motivate farmers and partner with government programs across the watershed to achieve its goals.
- Schools and Youth Groups
  - Education programs specifically created for schools and youth groups are necessary to accomplish watershed improvements in the future. School and youth group participation in outdoor activities, such as river cleanups or invasive species control, are excellent ways to engage youth in learning about watershed conditions.

6.7.3 Partner Organizations

Several education and outreach programs are currently being implemented by other organizations in the Copperas Creek Planning Area that stakeholders can take advantage of. These organizations include the following:

- Rock Island Soil and Water Conservation District
  - In conjunction with NRCS, the RISWCD regulates and provides information for compliance with soil erosion and sediment control measures related natural resources.
- Copperas Creek Planning Committee
  - In conjunction with RISWCD, the Planning committee discusses and plans water quality projects within the planning area.
- Illinois Environmental Protection Agency
  - As a sponsor, IEPA has provided valuable support in the form of grant funds for watershed planning and detailed review for the Copperas Creek watershed resource inventory and watershed-based plan.
- Augustana College
  - RISWCD has worked with the Ag Program to collect water quality samples and perform water quality testing using the EPA standards and EPA approved equipment.
- Corn Growers Association
  - The Corn Growers Association has provided the RISWCD with equipment for performing nitrate testing. This service is offered on the third Tuesday of every month, free of charge.

6.7.4 General Message Guidance

Regional and local decision-makers today are bombarded with information and messages. As a result, audiences are selective about what information they take in and even more selective about what information is acted upon. For this reason, the education and outreach program needs to be strategic about how messages are formulated and communicated, so that they achieve positive results.

Target audiences will need specifically tailored messages through a variety of delivery methods for the education and outreach program to be effective. To encourage audiences to understand and act upon a key point, single issue messages are often simple and effective and simple. However, water quality improvement has many dimensions and many effects, so messages may sometimes be created to address multiple issues such as linking hydrology and stream health. General guidelines for education and outreach efforts in the Copperas Creek watershed include the following:

- Use terms which the public can readily understand and which speak to their values and priorities.
- Keep messages simple and straightforward with only a few key take-home messages. Use graphics and photos to illustrate the message.
- Repeat messages frequently and consistently, sometimes using different media to communicate the message.
- Use community events as an opportunity to communicate messages.
- Highlight connections between messages such as: storms, streams, land management, flooding and the urban landscape and streets.
- When with a target group, focus specifically on the elements of a project which are most applicable to their town, neighborhood, or property.

- Create several messages for topic areas, such as a broad message for the general public and additional targeted messages for specific audiences within the watershed such as landowners, business owners, and landowners.
- Organize materials and education strategies with partner organizations to combine efforts, share costs, access new networks and create a consistent message.
- Materials and messages should all promote local watershed groups with contact information as well as a brief note on how to get involved.
- Provide background information on watersheds when needed. Certain audiences may benefit from a briefing on biology, the water cycle, and basics of watersheds.
- Share information on websites and in popular public and private locations such as parks, forest preserves, libraries, cafes, grocery shops and municipal administration buildings.

6.7.5 Media and Marketing Campaign

The Copperas Creek Planning Area does not have funding sources at present to deploy a professional media and/or marketing campaign. However, such a campaign would be an appropriate strategy for several of the listed target audiences. In addition, the following methods have been utilized by other watershed groups and could be considered and used when applicable:

- Package together a media kit and identify potential media outlets (radio, TV, newspaper, websites, etc.). Seek to take advantage of public service announcements on local TV or radio.
- Install road signs at stream crossings and at watershed boundaries clearly stating that one is entering the watershed and urging citizens to protect the watershed and/or stream.
- Implement a public relations and marketing campaign to include advertisements and outreach through newspapers and committee meetings.
- Post and distribute watershed maps, posters and brochures which include pollution control strategies, current projects, future projects, and fun facts about the watershed.

6.7.6 Public Involvement, Stewardship and Community Event Strategies

The following strategies have been used by other groups to increase the influence of education and outreach messages. Different groups within the watershed may choose to engage in one of more of these activities.

- Create an “Adopt-a-River” program with an individual or group accepting responsibility for managing a specific reach.
- Create and publish a self-led tour of the watershed which notes scenic spots, natural areas, wetlands, and areas of concern such as streambank erosion sites.
- Directory of outstanding watershed management projects and hold an annual award ceremony for exemplary projects.
- Establish a form of recognition for watershed improvement efforts of citizens, elected officials, and environmental groups which implement watershed improvement projects.
- Arrange tours to visit BMP sites and install interpretive signs at BMP installation sites.

Efforts should be made to reach out to local officials and partner organizations to plan events and initiatives and to advertise and communicate about watershed events. Information should also be shared widely through partner organizations about projects underway or completed and other watershed success stories.

6.7.7 Primary and Secondary Education

Stewardship activities targeted for schools and youth programs may include education and outreach activities such as the following:

- Build a hands-on watershed curriculum which includes watershed ecology and nonpoint source pollution training for teachers, home-based educators, field trips, chemical test kits, nets, sampling equipment, and wildlife identification books. There are potential partnership opportunities with the Soil and Water Conservation Districts for sponsorship.
- Facilitate seminars and workshops for teachers, home-based educators, and/or an annual student congress.
- Maintain a group of trained student and teacher volunteers and create annual service learning opportunities such as clean ups and monitoring for students.

Outreach to school officials and teachers can be planned to prompt these types of initiatives.

6.7.8 Demonstration Projects with Educational Signage

Watershed groups have installed demonstration projects (bioswales, rain gardens, etc.) coupled with interpretive signage to promote education and outreach. These types of on-the-ground projects can provide watershed improvements as well as provide public outreach and education. Events like ribbon-cutting ceremonies can be used to highlight the beneficial practices. Volunteers can sometimes be enlisted to carry out projects, such as to build a rain garden at a school or park.

6.7.9 Evaluating the Outreach Plan

Measured improvements in water quality in the watershed is the ultimate indicator of the effects of education and outreach and other plan implementation activities. While connecting improvements in water quality to specific programs or activities is quantitatively difficult, it is expected that increased public understanding of improved water quality will support beneficial policy actions and motivate future involvement watershed improvement efforts. For events and activities planned measures of participation and effect will be used to the extent possible, for example tracking numbers of participants at events, volunteer clean-ups, etc. Follow-up surveys can be used selectively to try to ascertain if messages received or events participated in resulted in beneficial watershed actions.

6.7.10 Watershed Information and Education Resources

In addition to this plan, there are numerous resources which provide targeted outreach messages, effective delivery methods, watershed management planning, media relations, and strategies to help in developing a successful outreach campaign. These resources include:

- USEPA Watershed Academy
- USEPA NPS Outreach Toolbox
- The Center for Watershed Protection
- The Illinois River Watershed Partnership

These organizations and resources can be downloaded and customized for the Copperas Creek Watershed. Some of the education and outreach methods discussed in this section can be

incorporated into established work, projects, and education programs in the watershed, within existing budgets. Some activities (workshops, demonstration projects, and other large-scale actions) may require financial cost-share from public, private, or grant funding sources to support implementation.

CHAPTER 7 PLAN EVALUATION

Monitored water quality within the Copperas Creek watershed is the fundamental indicator of success in implementing measures to restore and protect water quality -- the effects of measures implemented throughout the watershed will ultimately be reflected in changes to water quality. However, the changes will occur slowly over time, and water quality data will be affected by a number of other factors, including water quality in waters flowing into Copperas Creek from upstream areas, weather, and infrastructure projects. Thus, to gauge plan implementation over shorter time horizons and identify plan implementation successes, indicators can be used to track progress. Indicators can include the number and scale of BMP projects planned and implemented, as well as the estimated pollutant loading reductions achieved. Recommended measures and milestones are presented in this section, along with recommendations regarding tracking and monitoring systems.

7.1 MEASUREABLE MILESTONES

The watershed assessment for the Copperas Creek watershed has indicated that the most significant source of pollutant loadings is primarily agricultural land which creates gullies and erosion in addition to degraded water quality due to stormwater runoff carrying nutrients to nearby streams. The plan has identified BMP types and target levels of BMP implementation to reduce stormwater volumes and pollutant loadings. The measurable milestones being established to gauge plan implementation reflect the plan's emphasis on BMP implementation.

The table below sets out measurable milestones by BMP type for each watershed planning unit. The 5-, 10-, and 25-year implementation targets are cumulative numbers. The associated estimated nitrogen and sediment reductions associated with the 25-year goals are also shown for each watershed planning unit.

In addition to establishing milestones for BMP implementation, nitrogen reduction is used here as the metric for plan implementation tracking purposes. This is valid, as nutrient levels in the watercourses are elevated, which contributes to use impairment. In addition, reductions in nutrient loadings suggest reductions of loadings of other pollutants present in agricultural areas. Reducing nitrogen loads results in reductions of loadings of other key pollutants. It should also be noted the methodology used to estimate nitrogen load reductions can also be used to estimate loading reductions for total phosphorus and BOD. The reduction in nutrient loading will also result in sediment reduction to the watercourses.

Planning Unit ID	BMP	Target Amount	Unit	2-year Goal	5-year Goal	10-year Goal	25-year Goal	Nitrogen Reduction Achieved by Year 25 (lbs/yr)	Sediment Reduction Achieved by Year 25 (t/yr)
CC1 (110 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.00	Ac	---	---	---	---		
	Vegetated Filter Strips @ ~ $3/ft²	0.09	Ac	0.008	0.019	0.038	0.09		
	Constructed Wetland	0.04	Ac	0.003	0.008	0.016	0.04		
	Saturated Buffer Strips	0.00	Ac	0.000	0.000	0.000	0.00		
	WASCOB	0.00	ft²	0.000	0.000	0.000	0.000		
	Streambank Stabilization	6,653	LF	532	1,331	2,661	6,653		
Planning Unit Total								223	69
CC2 (916 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.43	Ac	0.034	0.086	0.172	0.43		
	Vegetated Filter Strips @ ~ $3/ft²	0.22	Ac	0.017	0.044	0.087	0.22		
	Constructed Wetland	0.16	Ac	0.013	0.032	0.064	0.16		
	Saturated Buffer Strips	0.20	Ac	0.016	0.040	0.079	0.20		
	WASCOB	387	ft²	31	77	155	387		
	Streambank Stabilization	2,227	LF	178	445	891	2,227		
Planning Unit Total								1,329	325
CC3 (2,213 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.35	Ac	0.108	0.269	0.538	1.35		
	Vegetated Filter Strips @ ~ $3/ft²	0.29	Ac	0.023	0.058	0.117	0.29		
	Constructed Wetland	0.27	Ac	0.021	0.053	0.106	0.27		
	Saturated Buffer Strips	0.62	Ac	0.049	0.124	0.247	0.62		
	WASCOB	1,211	ft²	97	242	485	1,211		
	Streambank Stabilization	1,027	LF	82	205	411	1,027		
Planning Unit Total								3,890	1,139
CC4 (3,145 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.20	Ac	0.096	0.240	0.479	1.20		
	Vegetated Filter Strips @ ~ $3/ft²	0.42	Ac	0.034	0.084	0.168	0.42		
	Constructed Wetland	0.67	Ac	0.054	0.134	0.268	0.67		
	Saturated Buffer Strips	0.55	Ac	0.044	0.110	0.220	0.55		
	WASCOB	1,078	ft²	86	216	431	1,078		
	Streambank Stabilization	6,061	LF	485	1,212	2,425	6,061		
Planning Unit Total								3,281	806
CC5 (2,108 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.19	Ac	0.095	0.238	0.475	1.19		
	Vegetated Filter Strips @ ~ $3/ft²	0.28	Ac	0.023	0.057	0.114	0.28		
	Constructed Wetland	0.29	Ac	0.023	0.057	0.114	0.29		
	Saturated Buffer Strips	0.55	Ac	0.044	0.109	0.218	0.55		
	WASCOB	1,069	ft²	86	214	428	1,069		
	Streambank Stabilization	2,071	LF	166	414	828	2,071		

Planning Unit Total								3,074	763
CC6 (2,755 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.39	Ac	0.111	0.278	0.557	1.39		
	Vegetated Filter Strips @ ~ $3/ft²	0.34	Ac	0.027	0.069	0.137	0.34		
	Constructed Wetland	0.44	Ac	0.035	0.088	0.175	0.44		
	Saturated Buffer Strips	0.64	Ac	0.051	0.128	0.256	0.64		
	WASCOB	1,253	ft²	100	251	501	1,253		
	Streambank Stabilization	3,386	LF	271	677	1,354	3,386		
Planning Unit Total								4,297	1,244
CC7 (3,908 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.45	Ac	0.196	0.490	0.980	2.45		
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	0.029	0.072	0.144	0.36		
	Constructed Wetland	0.45	Ac	0.036	0.090	0.180	0.45		
	Saturated Buffer Strips	1.12	Ac	0.090	0.225	0.450	1.12		
	WASCOB	2,205	ft²	176	441	882	2,205		
	Streambank Stabilization	7,171	LF	574	1,434	2,869	7,171		
Planning Unit Total								7,288	2,445
CC8 (3,002 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.40	Ac	0.112	0.281	0.561	1.40		
	Vegetated Filter Strips @ ~ $3/ft²	0.37	Ac	0.030	0.074	0.149	0.37		
	Constructed Wetland	0.53	Ac	0.042	0.105	0.210	0.53		
	Saturated Buffer Strips	0.64	Ac	0.052	0.129	0.258	0.64		
	WASCOB	1,263	ft²	101	253	505	1,263		
	Streambank Stabilization	10,443	LF	835	2,089	4,177	10,443		
Planning Unit Total								4,204	1,348
CC9 (2,689 acres)	*Woodchip Bioreactors @ ~$5/ft²*	1.01	Ac	0.080	0.201	0.402	1.01		
	Vegetated Filter Strips @ ~ $3/ft²	0.41	Ac	0.032	0.081	0.162	0.41		
	Constructed Wetland	0.58	Ac	0.046	0.115	0.231	0.58		
	Saturated Buffer Strips	0.46	Ac	0.037	0.092	0.185	0.46		
	WASCOB	905	ft²	72	181	362	905		
	Streambank Stabilization	6,369	LF	510	1,274	2,548	6,369		
Planning Unit Total								6,396	2,534
CC10 (884 acres)	*Woodchip Bioreactors @ ~$5/ft²*	0.43	Ac	0.034	0.086	0.172	0.43		
	Vegetated Filter Strips @ ~ $3/ft²	0.20	Ac	0.016	0.041	0.081	0.20		
	Constructed Wetland	0.15	Ac	0.012	0.030	0.061	0.15		
	Saturated Buffer Strips	0.20	Ac	0.016	0.039	0.079	0.20		
	WASCOB	386	ft²	31	77	155	386		
	Streambank Stabilization	1,532	LF	123	306	613	1,532		
Planning Unit Total								1,566	407
	Woodchip Bioreactors @ ~$5/ft²	2.28	Ac	0.182	0.455	0.911	2.28		

CC11 (3,118 acres)	*Vegetated Filter Strips @ ~ $3/ft²*	0.27	Ac	0.021	0.053	0.107	0.27		
	Constructed Wetland	0.23	Ac	0.018	0.046	0.092	0.23		
	Saturated Buffer Strips	1.05	Ac	0.084	0.209	0.418	1.05		
	WASCOB	2,049	ft²	164	410	820	2,049		
	Streambank Stabilization	3,676	LF	294	735	1,470	3,676		
Planning Unit Total								5,999	1,739
CC12 (4,116 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.65	Ac	0.212	0.529	1.058	2.65		
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	0.029	0.073	0.146	0.36		
	Constructed Wetland	0.45	Ac	0.036	0.090	0.179	0.45		
	Saturated Buffer Strips	1.21	Ac	0.097	0.243	0.486	1.21		
	WASCOB	2,382	ft²	191	476	953	2,382		
	Streambank Stabilization	15,269	LF	1,222	3,054	6,108	15,269		
Planning Unit Total								6,338	1,444
CC13 (4,583 acres)	*Woodchip Bioreactors @ ~$5/ft²*	3.54	Ac	0.283	0.708	1.416	3.54		
	Vegetated Filter Strips @ ~ $3/ft²	0.28	Ac	0.022	0.055	0.110	0.28		
	Constructed Wetland	0.26	Ac	0.020	0.051	0.102	0.26		
	Saturated Buffer Strips	1.63	Ac	0.130	0.325	0.650	1.63		
	WASCOB	3,186	ft²	255	637	1,274	3,186		
	Streambank Stabilization	9,280	LF	742	1,856	3,712	9,280		
Planning Unit Total								7,674	1,816
CC14 (4,786 acres)	*Woodchip Bioreactors @ ~$5/ft²*	3.37	Ac	0.270	0.675	1.349	3.37		
	Vegetated Filter Strips @ ~ $3/ft²	0.36	Ac	0.029	0.072	0.143	0.36		
	Constructed Wetland	0.40	Ac	0.032	0.081	0.162	0.40		
	Saturated Buffer Strips	1.55	Ac	0.124	0.310	0.620	1.55		
	WASCOB	3,036	ft²	243	607	1,214	3,036		
	Streambank Stabilization	7,729	LF	618	1,546	3,091	7,729		
Planning Unit Total								7,472	1,795
CC15 (2,988 acres)	*Woodchip Bioreactors @ ~$5/ft²*	2.55	Ac	0.204	0.510	1.021	2.55		
	Vegetated Filter Strips @ ~ $3/ft²	0.15	Ac	0.012	0.030	0.060	0.15		
	Constructed Wetland	0.07	Ac	0.006	0.014	0.029	0.07		
	Saturated Buffer Strips	1.17	Ac	0.094	0.234	0.469	1.17		
	WASCOB	2,296	ft²	184	459	918	2,296		
	Streambank Stabilization	5,362	LF	429	1,072	2,145	5,362		
Planning Unit Total								4,730	894
CC16 (5,566 acres)	*Woodchip Bioreactors @ ~$5/ft²*	4.10	Ac	0.328	0.819	1.638	4.10		
	Vegetated Filter Strips @ ~ $3/ft²	0.34	Ac	0.028	0.069	0.138	0.34		
	Constructed Wetland	0.36	Ac	0.029	0.072	0.144	0.36		
	Saturated Buffer Strips	1.88	Ac	0.150	0.376	0.752	1.88		

	WASCOB	3,686	ft^2	295	737	1,474	3,686		
	Streambank Stabilization	18,406	LF	1,472	3,681	7,362	18,406		
Planning Unit Total								13,201	4,883
WATERSHED TOTAL								80,962	23,651

Table 7.1-1 Measurable Milestones for 2-, 5-, 10-, and 25-year Goals – Copperas Creek Planning Area

7.2 MEASURING PROGRESS AND MONITORING EFFECTIVNESS

7.2.1 Tracking Plan Implementation

Reflecting discussions stakeholders, this plan identifies three primary mechanisms to track plan implementation over time:

(1) RISWCD will include an agenda item in each Watershed Planning Committee meeting to discuss project ideas and capture projects in process or completed. Watershed landowners and other stakeholders can report on their projects. This will allow for projects to be tracked.
(2) A database of any future water quality project is implemented. The database will include BMP type and size and location as a function. Tracking these projects will capture the majority of stormwater BMP projects and allow for a check to see to what extent the milestones in Table 7.1-1 are being met.
(3) A database of nitrate levels within the watershed from water quality testing performed by both the RISWCD (through Augustana College) and individual landowners/farmers who submit water quality samples.

The cumulative expanse of projects completed can be compared to the table of milestones to determine if implementation is proceeding generally on schedule.

Participation in watershed protection events, trainings, workshops, and other outreach activities can be measured by event organizers. The effects of outreach activities will be selectively evaluated through surveys or other means. This includes encouragement of landowners to allocate funding toward improving water quality.

7.3 CURRENT WATER QUALITY MONITORING EFFORTS AND FUTURE EFFORTS

The ultimate indicator of the effects of plan implementation will be changes in water quality. Recognizing that changes will occur slowly over time, and water quality data will be affected by a number of other factors, monitoring is nevertheless critical to understand conditions and identify changes. State-conducted monitoring has been very important to characterizing water quality in the Copperas Creek watershed, including monitoring that has been carried out in the development of the 303(d) list of impaired waters. It will be valuable for the State to carry out monitoring in the watershed on a periodic basis, to the extent resources allow, to keep 303(d) listings up-to-date. If a segment(s) is listed that will be a direct indicator that water quality has degraded.

Biological monitoring would be a valuable complement to monitoring of chemical water quality. The Illinois DNR conducts monitoring at strategic locations to check for the presence of invasive species. It may be possible to draw out information about biological abundance and diversity from this sampling, if full biological surveys or the mainstem or tributaries are not practicable.

CHAPTER 8 CONCLUSION

This watershed-based plan for the Copperas Creek planning area is a comprehensive overview of the water quality conditions in the watershed and measures that need to be implemented to restore and protect water quality.

The analysis of water quality conditions and pollutant loadings revealed that stormwater discharges are the primary source of loadings of key pollutants. This is not surprising -- the planning area is approximately 90%-95% farmland, with high nutrient loadings and disturbed soils.

Reflecting the identified sources of pollutant loadings, the plan recommends BMPs to better manage stormwater. Many of the recommended BMPs will have the function of intercepting and treating runoff, including green infrastructure practices. Green infrastructure practices including vegetated filter strips, saturated buffer strips, and constructed wetlands, resulting in reduced stormwater volumes and reduced pollutant loads.

An aggressive level of BMP implementation will be needed to achieve substantial pollutant load reductions. The plan proposes a target degree of BMP implementation. Specifically, the plan recommends that 30% of the land areas with the different land uses/land covers in the watershed will have BMPs applied. This is the maximum degree of implementation expected to be practicable, given private land ownership, budgets, community-buy-in, and other factors. The watershed planning units contributing the greatest loadings are identified in the plan; these should be areas of focus for BMP implementation.

The plan identifies recommended BMPs to address the different land covers and sources of pollution from runoff within the watershed. It should be noted that the plan identifies *types* of BMPs that would address the sources of loadings, but does not list or *prescribe* specific BMPs in specific places. The sizes and designs of BMPs and the optimal places for BMPs will need to be determined by communities and other stakeholders taking into account where benefits will be the greatest but also numerous factors including land ownership, budgets, community buy-in, and how maintenance will be assured. Also, new concepts or designs for BMPs may be developed during the plan implementation period. The plan intends there be flexibility to incorporate new BMP concepts if they cost-effectively reduce pollutant loadings from urban runoff and stormwater discharges.

The plan models and quantifies the effects (i.e., the loading reductions) that would be achieved with a typical and suitable mix of BMPs within the watershed planning units, and the associated costs. Because of the size of the watershed and the amount of area that will need BMPs, the 30% target implementation level represents a fairly immense scale of BMP implementation. Creative thinking and strong resolve on the part of watershed decision-makers, landowners, and residents, significant progress can be made toward a healthy watershed that can be appreciated and enjoyed by all.

CHAPTER 9 REFERENCES

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APPENDIX 1 BMPS APPLIED WITHIN EACH WATERSHED PLANNING UNIT

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (*Reduced Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (*Dry Detention*)
Subarea CC1	**110.30**	33.09						
Cropland	0.16	0.05	0.00			0.00	0.02	0.14
Hay/Pasture	86.75	26.03		0.06	0.03			
Forest	22.51	6.75		0.03	0.01			
Open Space	0.12	0.04		0.00	0.00			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	0.00	0.00						
Streambank Length	22,177.20	6,653.16						
Subarea CC2	**916.20**	274.86						
Cropland	458.90	137.67	0.43			0.20	68.84	387.20
Hay/Pasture	174.05	52.22		0.09	0.07			
Forest	228.26	68.48		0.10	0.09			
Open Space	23.98	7.19		0.03	0.01			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	0.00	0.00						
Streambank Length	7,423.68	2,227.10						
Subarea CC3	**2,213.20**	663.96						
Cropland	1,435.71	430.71	1.35			0.62	215.36	1,211.38
Hay/Pasture	283.81	85.14		0.11	0.11			
Forest	335.88	100.76		0.12	0.13			
Open Space	88.10	26.43		0.06	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (*Reduced Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (*Dry Detention*)
Wetland - Open Space								
Gully Length	17,446.00	5,233.80						
Streambank Length	3,422.47	1,026.74						
Subarea CC4	**3,145.27**	943.58						
Cropland	1,278.00	383.40	1.20			0.55	191.70	1,078.31
Hay/Pasture	411.54	123.46		0.13	0.15			
Forest	1,318.80	395.64		0.24	0.49			
Open Space	54.65	16.40		0.05	0.02			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	11,379.00	3,413.70						
Streambank Length	20,204.55	6,061.36						
Subarea CC5	**2,107.89**	632.37						
Cropland	1,267.32	380.20	1.19			0.55	190.10	1,069.30
Hay/Pasture	277.64	83.29		0.11	0.10			
Forest	455.55	136.67		0.14	0.17			
Open Space	28.13	8.44		0.03	0.01			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	12,825.00	3,847.50						
Streambank Length	6,902.40	2,070.72						
Subarea CC6	**2,755.40**	826.62						
Cropland	1,484.53	445.36	1.39			0.64	222.68	1,252.57
Hay/Pasture	498.93	149.68		0.15	0.19			
Forest	650.85	195.26		0.17	0.24			
Open Space	19.90	5.97		0.03	0.01			

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (*Reduced Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (*Dry Detention*)
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	20,195.00	6,058.50						
Streambank Length	11,287.00	3,386.10						
Subarea CC7	**3,908.32**	1,172.50						
Cropland	2,613.38	784.01	2.45			1.12	392.01	2,205.04
Hay/Pasture	327.81	98.34		0.12	0.12			
Forest	800.10	240.03		0.19	0.30			
Open Space	71.66	21.50		0.06	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	28,022.00	8,406.60						
Streambank Length	23,904.89	7,171.47						
Subarea CC8	**3,001.70**	900.51						
Cropland	1,496.64	448.99	1.40			0.64	224.50	1,262.79
Hay/Pasture	216.30	64.89		0.10	0.08			
Forest	1,112.67	333.80		0.22	0.42			
Open Space	73.83	22.15		0.06	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	18,693.00	5,607.90						
Streambank Length	34,809.90	10,442.97						
Subarea CC9	**2,689.10**	806.73						
Cropland	1,072.26	321.68	1.01			0.46	160.84	904.72

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (*Reduced Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (*Dry Detention*)
Hay/Pasture	982.07	294.62		0.21	0.37			
Forest	488.43	146.53		0.14	0.18			
Open Space	68.96	20.69		0.05	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	12,710.00	3,813.00						
Streambank Length	21,231.15	6,369.34						
Subarea CC10	**884.06**	265.22						
Cropland	458.05	137.42	0.43			0.20	68.71	386.48
Hay/Pasture	280.34	84.10		0.11	0.11			
Forest	113.09	33.93		0.07	0.04			
Open Space	12.70	3.81		0.02	0.00			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	7,809.00	2,342.70						
Streambank Length	5,106.25	1,531.88						
Subarea CC11	**3,118.20**	935.46						
Cropland	2,428.97	728.69	2.28			1.05	364.35	2,049.44
Hay/Pasture	345.27	103.58		0.12	0.13			
Forest	207.65	62.30		0.09	0.08			
Open Space	58.56	17.57		0.05	0.02			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	12,074.00	3,622.20						
Streambank Length	12,252.00	3,675.60						

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (*Reduced Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (*Dry Detention*)
Subarea CC12	**4,116.48**	1,234.94						
Cropland	2,822.53	846.76	2.65			1.21	423.38	2,381.51
Hay/Pasture	753.50	226.05		0.18	0.28			
Forest	354.01	106.20		0.12	0.13			
Open Space	87.52	26.26		0.06	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	10,409.00	3,122.70						
Streambank Length	50,897.14	15,269.14						
Subarea CC13	**4,582.80**	1,374.84						
Cropland	3,775.50	1,132.65	3.54			1.63	566.33	3,185.58
Hay/Pasture	461.18	138.35		0.14	0.17			
Forest	66.17	19.85		0.05	0.02			
Open Space	152.96	45.89		0.08	0.06			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	20,156.00	6,046.80						
Streambank Length	30,934.79	9,280.44						
Subarea CC14	**4,785.67**	1,435.70						
Cropland	3,598.17	1,079.45	3.37			1.55	539.73	3,035.96
Hay/Pasture	502.96	150.89		0.15	0.19			
Forest	466.37	139.91		0.14	0.17			
Open Space	109.71	32.91		0.07	0.04			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								

	Planning Unit Area	Implementation Area (30% of PU Area Area)	*Woodchip Bioreactors (Agricultural Filter Strips)* - (100'x20') per 80 acres	*Vegetated Filter Strips* (5' around perimeter - 25% of Area)	Constructed Wetland @ 1 acre of wetland per 800 acres *(Wetland Detention)*	Saturated Buffer Strips (*Filter Strips*) (1000'x 20') per 80 acres	Conservation Tillage (R*educed Tillage Systems)*	WASCOB @ 1 acre (150' x 3') per 80 acres of Tillable Land (D*ry Detention*)
Wetland - Open Space								
Gully Length	22,222.00	6,666.60						
Streambank Length	25,762.36	7,728.71						
Subarea CC15	**2,988.30**	896.49						
Cropland	2,721.38	816.41	2.55			1.17	408.21	2,296.16
Hay/Pasture	86.96	26.09		0.06	0.03			
Forest	15.84	4.75		0.03	0.01			
Open Space	89.10	26.73		0.06	0.03			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	0.00	0.00						
Streambank Length	17,873.42	5,362.02						
Subarea CCT1	**5,566.14**	1,669.84						
Cropland	4,368.70	1,310.61	4.10			1.88	655.31	3,686.09
Hay/Pasture	488.39	146.52		0.14	0.18			
Forest	303.82	91.15		0.11	0.11			
Open Space	167.91	50.37		0.09	0.06			
Wetland - Cropland								
Wetland - Hay/Pasture								
Wetland - Forest								
Wetland - Open Space								
Gully Length	26,731.00	8,019.30						
Streambank Length	61,353.29	18,405.99						

APPENDIX 2 2016 SITE-SPECIFIC BMPS

Petreikis, Rock Island County, Illinois
Stream Assessment Trip Report
SSRP Application-May 17, 2014

The trip report includes a stream assessment with draft design and cost estimate. The sites are located on Copperas Creek in Rock Island County, Illinois, Section 15 (T16N, R5W). The closest municipality to the site is Andalusia, Illinois.

The sites were visited on December 2, 2013. Rich Stewart (RC-Rock Island County SWCD) was present to complete the field surveying. Copperas Creek is 56.6 square miles at this point in the watershed. The USGS StreamStats program shows the 2 year flow at 2140 cfs. The typical range for bankfull discharge (bkfl Q) is 1140 to 2300 cfs. The field survey determined that the rough bkfl Q is approximately 1250 cfs.

The entrenchment ratio of 2.41 is approaching what is considered in a normal range of stability at greater than 2.5. Typically an incised stream will continue to erode laterally and build a floodplain to a ratio of 2.5 or greater. For this stretch of the stream it appears that the stream is close to building the new floodplain within the new stream corridor.

To stabilize the stream banks Longitudinal Peaked Stone Toe Protection (LPSTP) can be used to stabilize the sites. There are good tie in points for the LPSTP at both upstream and downstream end points at each site. There are two sites total.

Site 1 (upstream site) is 300 ft and Site 2 400 ft for a grand total of 700 ft. The cost of implementing the project is based on the total length of LPSTP being 700 ft. and using ~ 631 ton of RR-5. Using an average cost of $40/ton for placement the total estimated project cost is $25,240. The SSRP program provides cost-sharing and the total amount available will need to be determined by the Rock Island County SWCD. In the past the cost-share has been 75% state and 25% landowner cost but there have been recent changes to the program.

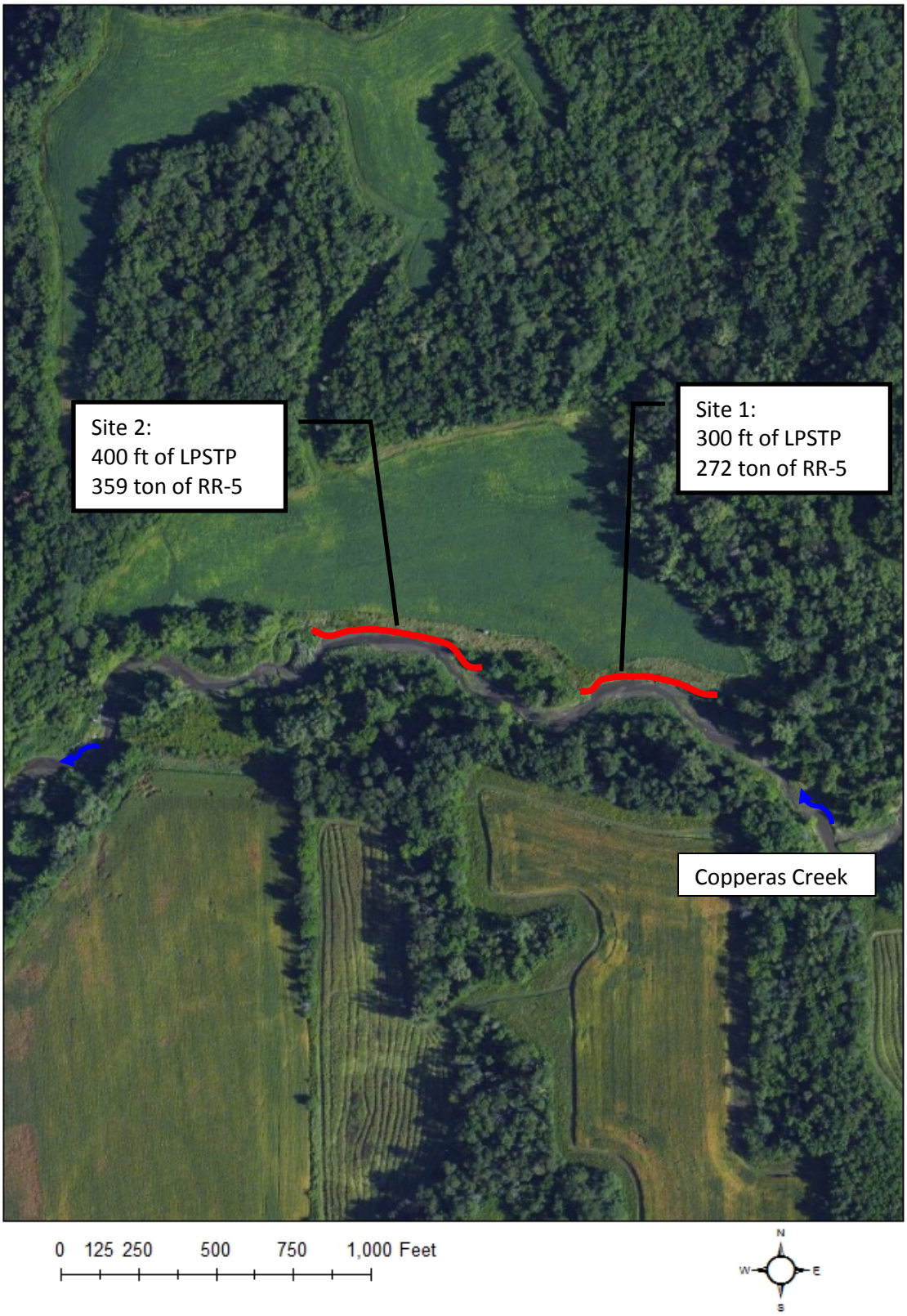
Please let me know if you have any questions.

Thanks,

Chris Haring

Chris Haring
IDOA Stream Restoration Specialist

Petreikis-Copperas Creek SSRP Site Map, Rock Island County, Illinois



Petreikis-Copperas Creek SSRP Watershed Map, Rock Island County, Illinois

0 2,625 5,250 10,500 15,750 21,000 Feet

N
W
E
S

Illinois StreamStats

Streamstats Ungaged Site Report

Date: Mon May 19 2014 15:17:03 Mountain Daylight Time
Site Location: Illinois
NAD27 Latitude: 41.3750 (41 22 30)
NAD27 Longitude: -90.9483 (-90 56 54)
NAD83 Latitude: 41.3751 (41 22 30)
NAD83 Longitude: -90.9484 (-90 56 54)
Drainage Area: 56.59 mi2

Peak Flow Basin Characteristics			
100% Region 4 AMS (56.6 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	56.6	0.03	9554
Stream Slope 10 and 85 Method (feet per mi)	9.326	0.81	317
Basin Length ArcHydro Method (miles)	14.84	0.3	190

Peak Flow Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	2140	41	2.5	1110	4140
PK5	3680	42	3	1890	7140
PK10	4800	43	3.7	2420	9540
PK25	6310	46	4.5	3060	13000
PK50	7440	48	5	3500	15800
PK100	8630	50	5.4	3930	19000
PK500	11500	56	6.1	4830	27400

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 3.2- modified 4/2008 R.Book

County Rock Island T. 16N. R. 5W. Sec. 15

Date 5/18/14 By C.Haring

Stream Name Copperas Creek UTM Coord.

Landowner Name Petreikis

Drainage Area 56.6 sq. mi.

Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	72 ft.	Cross Sectional Area	347 sq. ft.
	Depth	4.8 ft.		

Reference Stream Gage:

Mill Creek at Milan	Station No.	05448000	Gage Q_2 2780 cfs
	Drainage Area	62 sq.mi	Regression 2180 cfs
Rock Island County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	9.3	*ft./mi. (user-entered)*				Regression Q_2 2254 cfs
		ft/mi (from worksheet)	Rainfall	3.20 in	*(2 yr, 24 hr)*	Adjusted Q_2 2874 cfs
	0.0018	*ft./ft.*	Regional Factor	1.057		Typical Range for Bankfull Discharge:
						1140 to 2300 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

			Stream Length	3520	*ft.*
Basic Field Data:			Valley Length	2843	*ft.*
Bankfull Width	83	*ft.*	Contour Interval		
Mean Bankfull Depth	3.91	*ft.*	Estimated Sinuosity	1.24	
Width/Depth Ratio	21.23				
			Channel Slope:		
Max. Bankfull Depth	6.7	*ft.*	Surveyed:	0.0018	*ft./ft.*
Width at twice max. depth	200	*ft.*	Estimated:	#VALUE!	*ft./ft.*
(13.4 ft.)					
Entrenchment Ratio	2.41		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Q from:

Cross-Section	1241	*cfs*
Basic field data	1274	*cfs*
Selected Q	1250	*cfs*

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	3 *in.*	Velocity required to move D_{90}:	3.6	*ft./sec.*
	D_{50}	1 *in.*	Velocity from Cross-Section data:	3.82	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.92	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.9	*ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen) C3

Notes

Natural Open Channel Flow

back to I&E form

Project:	Petreikis	
Assisted by:	C.Haring	
Date:	5/18/2014	
Channel Slope (***S***):	0.001800	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.7	*ft*

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

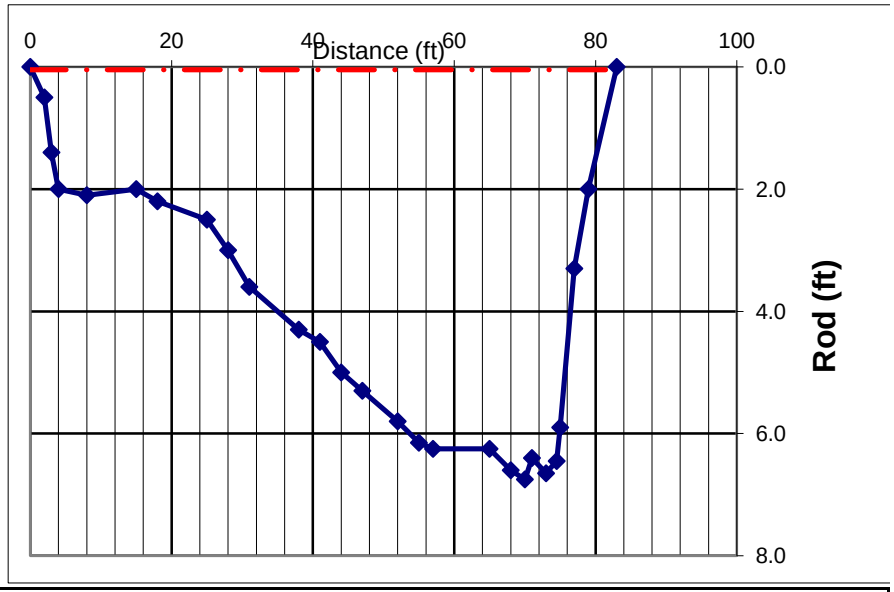
assuming uniform, steady flow

☑ Use this Cross-Section for Bankfull Determination

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.7 *ft*	5.0	2.0
Channel Flow (***Q***):	1,241.1 *cfs*	543.5	76.0
Channel Velocity:	3.8 *ft/sec*	2.9	1.8
Cross-Sectional Area (***A***):	324.7 *sq.ft.*	190.6	42.1
Hydraulic Radius (***R***):	3.8 *ft*	2.4	1.2

Survey Data:

Grade Rod *(ft)*	Distance *(ft)*
0.0	0
0.5	2
1.4	3
2.0	4
2.1	8
2.0	15
2.2	18
2.5	25
3.0	28
3.6	31
4.3	38
4.5	41
5.0	44
5.3	47
5.8	52
6.2	55
6.3	57
6.3	65
6.6	68
6.8	70
6.4	71
6.7	73
6.5	75
5.9	75
3.3	77
2.0	79
0.0	83



COMMENTS:

Longitudinal Peaked Stone Toe (STP) Design Drawing Preparation

Landuser: Petreikis
Stream: Copperas Creek
Rock Island County, Illinois
Location:
Sec.: 15 Twp.: 16N Range: 5 W.

Date: 5/18/2014
By: C.Haring

Selected rock gradation: 5

Typical Riprap Section STP Sideslope: 1.5 : 1

Key Depth: 8 *ft*

REFERENCE TABLE		
IDOT Class	Largest Rock(D_{100})	D_{50}
4	1.3 *ft*	7.4 *in*
5	1.7 *ft*	9.8 *in*
6	2.0 *ft*	12.1 *in*
7	2.5 *ft*	14.6 *in*

NOTE: Gradation 5 is the same as former RR-5.

STP Reach 1

Bank: Left or Right Side Looking Downstream: Right
Beginning (Upstream) Station: 0+00
Beginning Station Description:
Will be flagged prior to construction

Benchmark EL: 100.00 *ft.*
Description:
Downstream riffle crest

NOTE: Site 1

Approx. Key Spacing: 100 *ft.*
Downstream Riffle Elevation: 100.0 *ft.*
Peaked Stone Level Crest EL: 102.5 *ft.*
Average STP height: 2.5 *ft.*
Total Length of STP: 300 ft. *USE*
Average Tons/Ft. for STP: 0.63 0.75 *Tons/ft.*

For definitions of dimensions, refer to IL-ENG-152

Key	STA	h_1 *(ft.)*	W_1 *(ft.)*	Est. Rock *(Tons)* Calculated	USE
1	0+00	4.0	2.0	12	
2	1+00	4.0	2.0	12	
3	2+00	4.0	2.0	12	
4	3+00	4.0	2.0	12	

Average Tons Per Key: 12 *Tons*
Total Rock Amount (Estimate): 272 *Tons*

STP Reach 2

Bank: Left or Right Side Looking Downstream: Right
Beginning (Upstream) Station: 0+00
Beginning Station Description:
Will be flagged prior to construction

Benchmark EL: 100.00 *ft.*
Description:
Downstream riffle crest

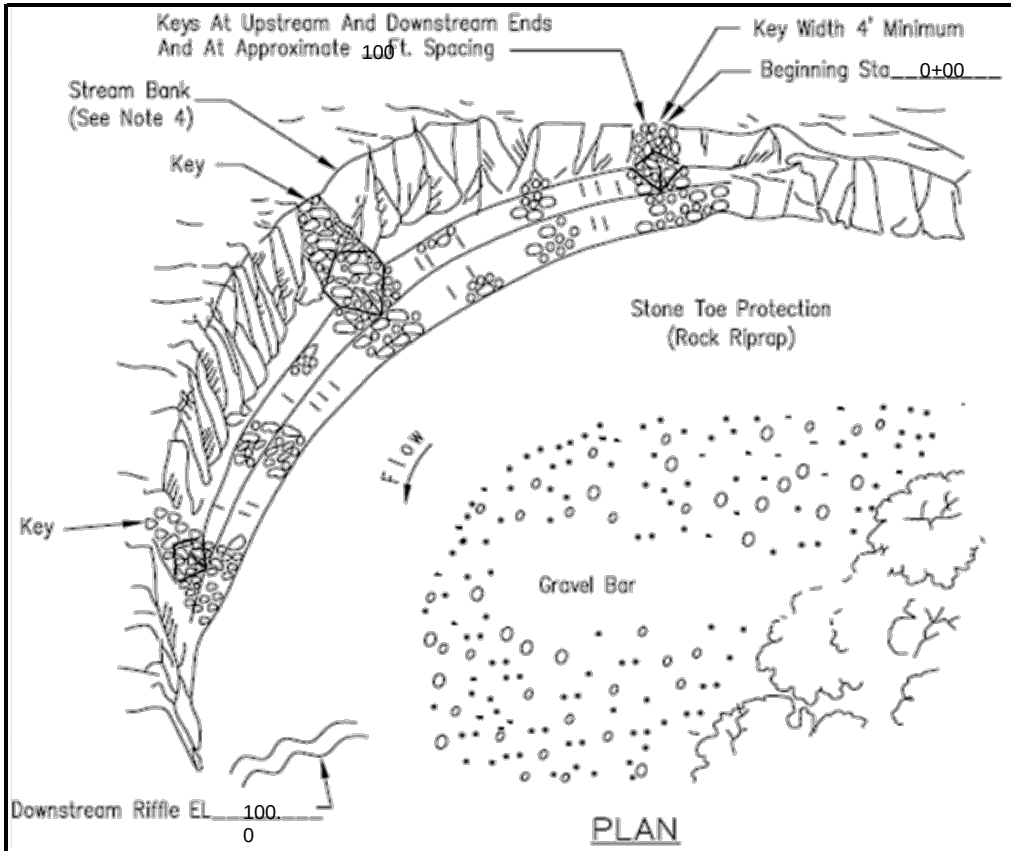
NOTE: Site 2

Approx. Key Spacing: 100 *ft.*
Downstream Riffle Elevation: 100.0 *ft.*
Peaked Stone Level Crest EL: 102.5 *ft.*
Average STP height: 2.5 *ft.*
Total Length of STP: 400 ft. *USE*
Average Tons/Ft. for STP: 0.63 0.75 *Tons/ft.*

For definitions of dimensions, refer to IL-ENG-152

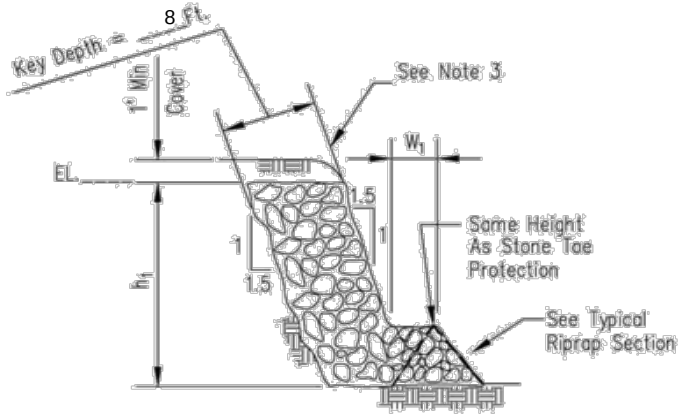
Key	STA	h_1 *(ft.)*	W_1 *(ft.)*	Est. Rock *(Tons)* Calculated	USE
1	0+00	4.0	2.0	12	
2	1+00	4.0	2.0	12	
3	2+00	4.0	2.0	12	
4	3+00	4.0	2.0	12	
5	4+00	4.0	2.0	12	

Average Tons Per Key: 12 *Tons*
Total Rock Amount (Estimate): 359 *Tons*

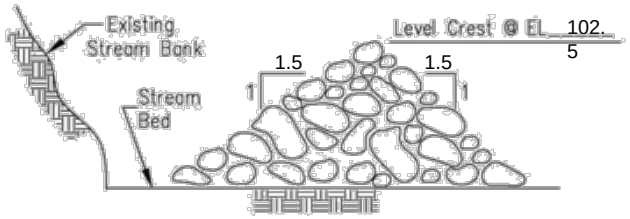


PLAN

Notes:
1. Rock gradation shall meet IDOT requirements for GRAD. NO. 5 riprpap, quality designation "A", or as designated by engineer.
2. Stone Toe 300 ft. @ 0.75 Tons / Ft. average
Keys 4 @ 12 Tons Each
Total Rock Amount (Estimate): 272 Tons
3. Key shall be constructed so that the vertical section remains embedded in the existing stream bank.
4. Location Right side of streambank looking downstream.



KEY DETAIL



TYPICAL RIPRAP SECTION

NOT TO SCALE

Key	Sta.	h_1	W_1	Level Crest El.
1	0+00	4.0	2.0	102.5
2	1+00	4.0	2.0	102.5
3	2+00	4.0	2.0	102.5
4	3+00	4.0	2.0	102.5

NOTE: Site 1

Benchmark EL. 100.00
Description
Downstream riffle crest

Beginning Sta. Description
Will be flagged prior to construction

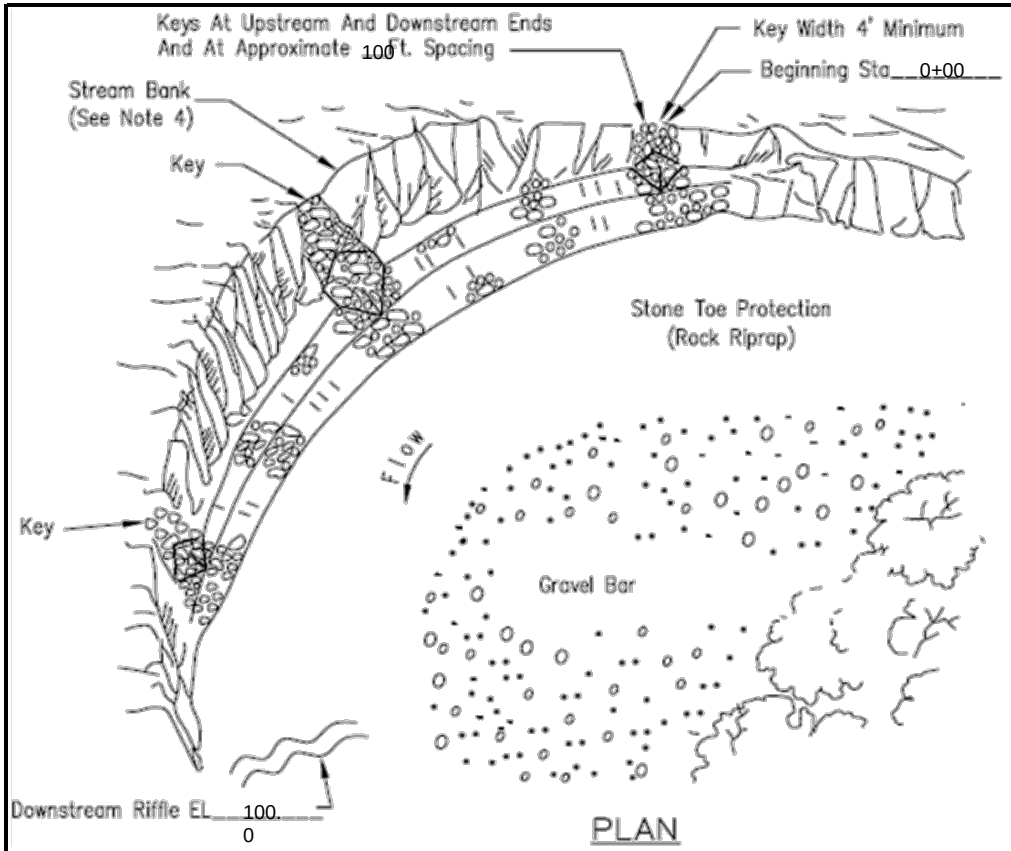
Date 5/16/2008
Designed
Drawn M. QUINONES
Checked
Approved

STREAM BANK STABILIZATION
STONE TOE PROTECTION

USDA NRCS Natural Resources Conservation Service

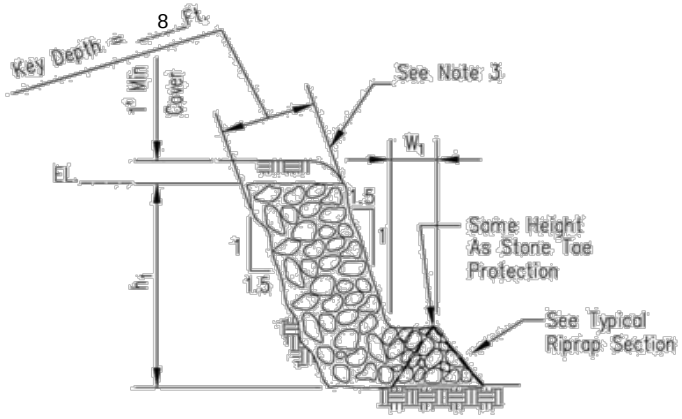
File No. IL-ENG-152
Drawing No.
Sheet 1 of 1

Landowner	Petreikis	Stream	Copperas Creek	Location	Sec. 15 T16N. R5W. Rock Island County, IL

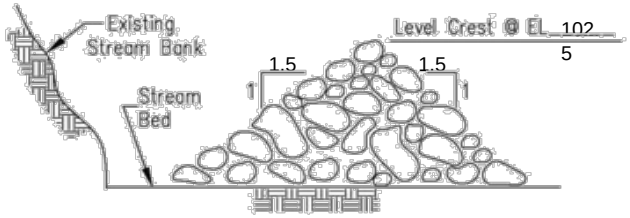


PLAN

Notes:
1. Rock gradation shall meet IDOT requirements for GRAD. NO. 5 riprpap, quality designation "A", or as designated by engineer.
2. Stone Toe 400 ft. @ 0.75 Tons / Ft. average
Keys 5 @ 12 Tons Each
Total Rock Amount (Estimate): 359 Tons
3. Key shall be constructed so that the vertical section remains embedded in the existing stream bank.
4. Location Right side of streambank looking downstream.



KEY DETAIL



TYPICAL RIPRAP SECTION

NOT TO SCALE

Key	Sta.	h_1	W_1	Level Crest El.
1	0+00	4.0	2.0	102.5
2	1+00	4.0	2.0	102.5
3	2+00	4.0	2.0	102.5
4	3+00	4.0	2.0	102.5
5	4+00	4.0	2.0	102.5

NOTE: Site 2

Benchmark EL. 100.00
Description
Downstream riffle crest

Beginning Sta. Description
Will be flagged prior to construction

Date 5 / 16 / 2008
Designed
Drawn M. QUINONES
Checked
Approved

STREAM BANK STABILIZATION
STONE TOE PROTECTION

USDA NRCS Natural Resources Conservation Service

File No. IL-ENG-152
Drawing No.
Sheet 1 of 1

Landowner	Petreikis	Stream	Copperas Creek	Location	Sec. 15 T16N. R5W. Rock Island County, IL

John Feldman, Rock Island County, Illinois
Stream Assessment Trip Report
SSRP Application-May 24, 2014

The trip report includes a stream assessment with draft design and cost estimate. The site is located on Copperas Creek in Rock Island County, Illinois, Section 21 (T16N, R5W). The closest municipality to the site is Andalusia, Illinois.

The sites were visited on December 2, 2013. Rich Stewart (RC-Rock Island County SWCD) was present to complete the field surveying. Copperas Creek is 62.7 square miles at this point in the watershed. The USGS StreamStats program shows the 2 year flow at 2270 cfs. The typical range for bankfull discharge (bkfl Q) is 1210 to 2440 cfs. The field survey determined that the rough bkfl Q is approximately 1400 cfs.

The bend immediately upstream of this site is stable. Upstream of the stable bend the stream is eroding alternating banks and the landowner may want to look at completing work upstream as funding permits. The history of Copperas Creek appears to be one of straightening and leveeing on the farthest downstream reaches in the Mississippi River floodplain. The area upstream of the Mississippi floodplain has been channelized as well and timber and prairie soils converted to agriculture. Tiling the agricultural lands has potentially led to quicker run off volumes in the feeder smaller watersheds increasing stream power and erosive ability of the water throughout the system. The Rock Island County SWCD and NRCS have submitted Copperas Creek as an EPA Watershed Plan and are continuing to complete and enhance the watershed through the funding of the program. Priority funding should be placed on projects like this as it will provide protection to public infrastructure.

The eroding site's entrenchment ratio of 2.41 is approaching what is considered in a normal range of stability at greater than 2.5. Typically an incised stream will continue to erode laterally and build a floodplain to a ratio of 2.5 or greater. For this stretch of the stream it appears that the stream is close to building the new floodplain within the new stream corridor but due to the low Radius of Curvature to Bankfull Width (Rc/Bkf ~1.28) ratio the thalweg (main channel) has formed a torturous curve in this stream segment. The stream segment needs to be realigned to move the thalweg to a more natural stable Rc/Bkf ratio (>1.8).

To bring the Rc/Bkf ratio to > 1.8 the stream segment needs 6 Bank Barbs and ~ 430 ft. of Longitudinal Peaked Stone Toe Protection (LPSTP) to stabilize the site. There are good tie in points for the LPSTP at both upstream and downstream end points. The downstream end will tie into the existing bridge riprap protection and the upstream site will tie into a stable bank upstream of an existing riffle.

Site 1 is 435 ft of LPSTP and has 6 bank barbs. The cost of implementing the project is based on the total length of LPSTP being 435 ft. and ~ 363 ton of RR-5 for 6 bank barbs at ~ 864 ton of RR-5. The total tonnage of RR-5 is 1227 ton. Using an average cost of $40/ton for placement the total estimated project cost is $49,080. The SSRP program provides cost-sharing and the total amount available will need to be determined by the Rock Island County SWCD. In the past the cost-share has been 75% state and 25% landowner cost but there have been recent changes to the program.

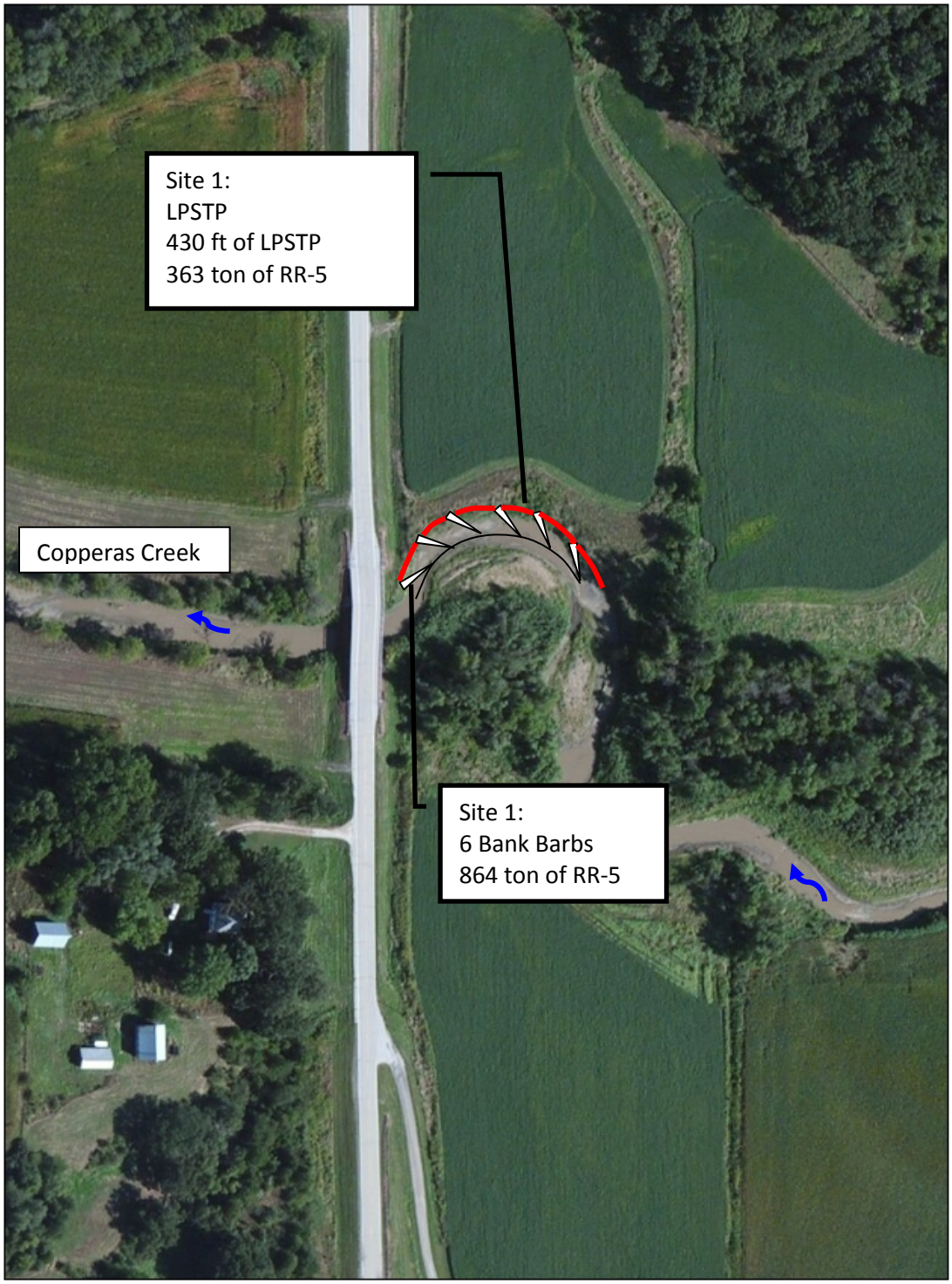
Please let me know if you have any questions.

Thanks,

Chris Haring

Chris Haring
IDOA Stream Restoration Specialist

Feldman-Copperas Creek SSRP Site Map, Rock Island County, Illinois



0 65 130 260 390 520 Feet

N
W
E
S

Feldman-Copperas Creek SSRP Watershed Map, Rock Island County, Illinois

0 2,625 5,250 10,500 15,750 21,000 Feet

N
W
E
S

Illinois StreamStats

Streamstats Ungaged Site Report

Date: Mon May 19 2014 15:08:10 Mountain Daylight Time
Site Location: Illinois
NAD27 Latitude: 41.3733 (41 22 24)
NAD27 Longitude: -90.9660 (-90 57 58)
NAD83 Latitude: 41.3733 (41 22 24)
NAD83 Longitude: -90.9662 (-90 57 58)
Drainage Area: 62.72 mi2

Peak Flow Basin Characteristics			
100% Region 4 AMS (62.7 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	62.7	0.03	9554
Stream Slope 10 and 85 Method (feet per mi)	8.924	0.81	317
Basin Length ArcHydro Method (miles)	15.81	0.3	190

Peak Flow Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	2270	41	2.5	1180	4400
PK5	3890	42	3	2000	7570
PK10	5070	43	3.7	2550	10100
PK25	6640	46	4.5	3220	13700
PK50	7830	48	5	3670	16700
PK100	9080	50	5.4	4120	20000
PK500	12100	56	6.1	5060	28800

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 3.2- modified 4/2008 R.Book

County Rock Island T. 16N. R. 5W. Sec. 21

Date 5/24/14 By C.Haring

Stream Name Copperas Creek UTM Coord.

Landowner Name John Feldman

Drainage Area 62.7 sq. mi.

Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	75 ft.	Cross Sectional Area	372 sq. ft.
	Depth	5.0 ft.		

Reference Stream Gage:

Mill Creek at Milan	Station No.	05448000	Gage Q_2 2780 cfs
	Drainage Area	62 sq.mi	Regression 2180 cfs
Rock Island County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	8.9	*ft./mi. (user-entered)*			Regression Q_2	2389 cfs
		ft/mi (from worksheet)	Rainfall	3.20 in *(2 yr, 24 hr)*	Adjusted Q_2	3046 cfs
	0.0017	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					1210	to 2440 cfs

Local Stream Morphology:

Channel Description: (b) Same as (a), but more stones and weeds

Manning's "n" 0.035

			Stream Length	3520	*ft.*		
Basic Field Data:			Valley Length	2843	*ft.*		
Bankfull Width	83	*ft.*	Contour Interval	6			
Mean Bankfull Depth	3.91	*ft.*	Estimated Sinuosity	1.24			
Width/Depth Ratio	21.23						
			Channel Slope:			Bankfull Q from:	
Max. Bankfull Depth	6.7	*ft.*	Surveyed:	0.0017	*ft./ft.*	Cross-Section	1378 *cfs*
Width at twice max. depth	200	*ft.*	Estimated:	0.00170	*ft./ft.*	Basic field data	1414 *cfs*
(13.4 ft.)						Selected Q	1400 *cfs*
Entrenchment Ratio	2.41		Radius of Curvature (Rc)	106	ft.		
			Rc/Bankfull width:	1.28			

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	4 *in.*	Velocity required to move D_{90}:	4.2	*ft./sec.*
	D_{50}	1 *in.*	Velocity from Cross-Section data:	4.24	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	4.36	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	4.3	*ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen) C3

Notes

Natural Open Channel Flow

back to I&E form

Project:	John Feldman	
Assisted by:	C.Haring	
Date:	5/24/2014	
Channel Slope (***S***):	0.001700	*ft/ft*
Manning's ***n***:	0.035	
Flow Depth:	6.7	*ft*

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

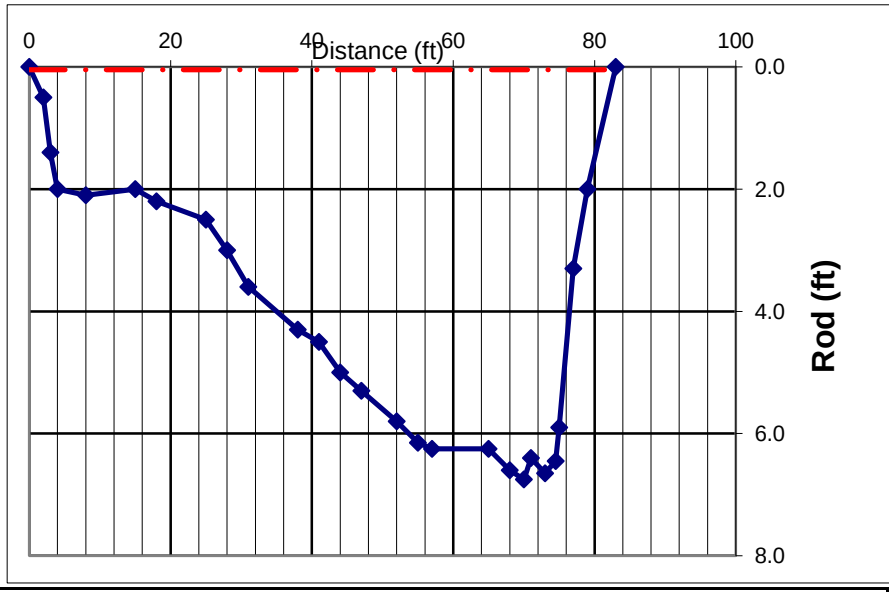
assuming uniform, steady flow

☑ Use this Cross-Section for Bankfull Determination

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.7 *ft*	5.0	2.0
Channel Flow (***Q***):	1,378.4 *cfs*	603.6	84.4
Channel Velocity:	4.2 *ft/sec*	3.2	2.0
Cross-Sectional Area (***A***):	324.7 *sq.ft.*	190.6	42.1
Hydraulic Radius (***R***):	3.8 *ft*	2.4	1.2

Survey Data:

Grade Rod *(ft)*	Distance *(ft)*
0.0	0
0.5	2
1.4	3
2.0	4
2.1	8
2.0	15
2.2	18
2.5	25
3.0	28
3.6	31
4.3	38
4.5	41
5.0	44
5.3	47
5.8	52
6.2	55
6.3	57
6.3	65
6.6	68
6.8	70
6.4	71
6.7	73
6.5	75
5.9	75
3.3	77
2.0	79
0.0	83



COMMENTS:

Longitudinal Peaked Stone Toe (STP) Design Drawing Preparation

Landuser: John Feldman
Stream: Copperas Creek
Rock Island County, Illinois
Location:
Sec.: 21 Twp.: 16N Range: 5 W.

Date: 5/24/2014
By: C.Haring

Selected rock gradation: 5

Typical Riprap Section STP Sideslope: 1.5 : 1

Key Depth: 5 *ft*

REFERENCE TABLE		
IDOT Class	Largest Rock(D_{100})	D_{50}
4	1.3 *ft*	7.4 *in*
5	1.7 *ft*	9.8 *in*
6	2.0 *ft*	12.1 *in*
7	2.5 *ft*	14.6 *in*

NOTE: Gradation 5 is the same as former RR-5.

STP Reach 1

Bank: Left or Right Side Looking Downstream: Right

Beginning (Upstream) Station: 0+00
Beginning Station Description:
Will be flagged prior to construction

Benchmark EL: 100.00 *ft.*
Description: NW Corner of concrete
Pier Wall (top if lip-marked with pink paint)

NOTE: Site 1

Approx. Key Spacing: 65 *ft.*
Downstream Riffle Elevation: 82.2 *ft.*
Peaked Stone Level Crest EL: 84.9 *ft.*
Average STP height: 2.7 *ft.*
Total Length of STP: 430 ft. *USE*
Average Tons/Ft. for STP: 0.73 0.75 *Tons/ft.*

For definitions of dimensions, refer to IL-ENG-152

Key	STA	h_1 *(ft.)*	W_1 *(ft.)*	Est. Rock *(Tons)* Calculated	Est. Rock *(Tons)* USE
1	0+00	4.0	2.0	7	5
2	0+65	4.0	2.0	7	5
3	1+30	4.0	2.0	7	5
4	1+95	4.0	2.0	7	5
5	2+60	4.0	2.0	7	5
6	3+35	4.0	2.0	7	5
7	3+85	4.0	2.0	7	5
8	4+30	4.0	2.0	7	5

Average Tons Per Key: 5 *Tons*
Total Rock Amount (Estimate): 363 *Tons*

STP Reach 2

Bank: Left or Right Side Looking Downstream: Right

Beginning (Upstream) Station:
Beginning Station Description:

Benchmark EL: *ft.*
Description:

NOTE:

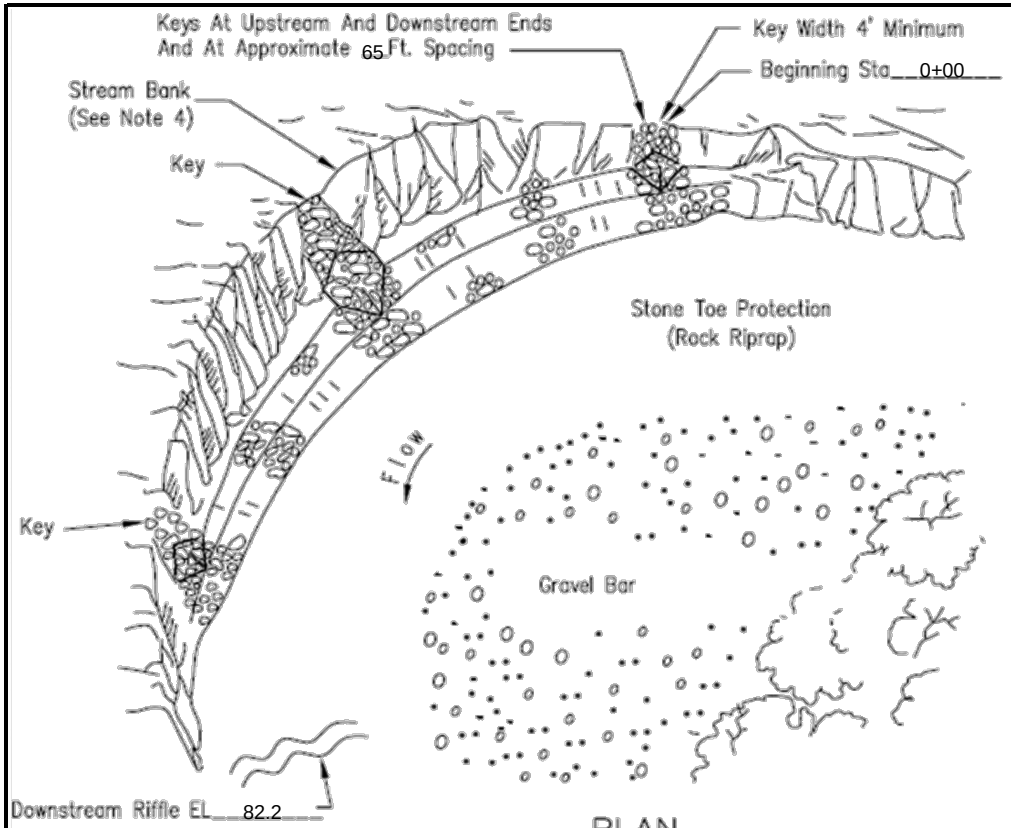
Approx. Key Spacing: *ft.*
Downstream Riffle Elevation: *ft.*
Peaked Stone Level Crest EL: *ft.*
Average STP height: *ft.*
Total Length of STP: 0 ft. *USE*
Average Tons/Ft. for STP: *Tons/ft.*

For definitions of dimensions, refer to IL-ENG-152

#VALUE!

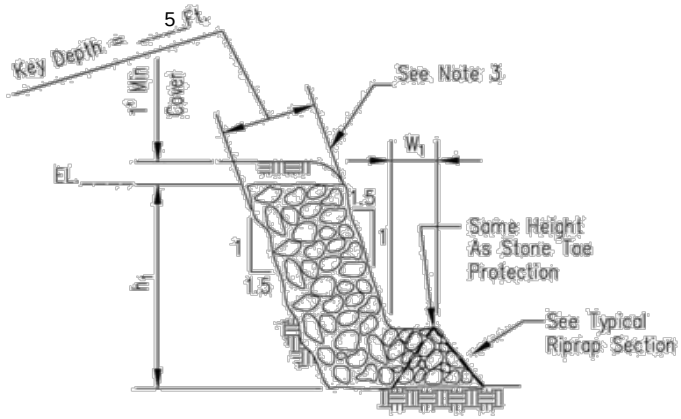
Key	STA	h_1 *(ft.)*	W_1 *(ft.)*	Est. Rock *(Tons)* Calculated	Est. Rock *(Tons)* USE

Average Tons Per Key: *Tons*
Total Rock Amount (Estimate): *Tons*

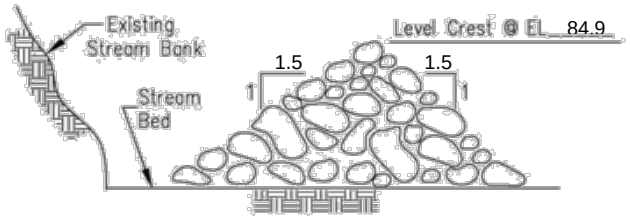


PLAN

Notes:
1. Rock gradation shall meet IDOT requirements for GRAD. NO. 5 riprpap, quality designation "A", or as designated by engineer.
2. Stone Toe 430 ft. @ 0.75 Tons / Ft. average
Keys 8 @ 5 Tons Each
Total Rock Amount (Estimate): 363 Tons
3. Key shall be constructed so that the vertical section remains embedded in the existing stream bank.
4. Location Right side of streambank looking downstream.



KEY DETAIL



TYPICAL RIPRAP SECTION

NOT TO SCALE

Key	Sta.	h_1	W_1	Level Crest El.
1	0+00	4.0	2.0	84.9
2	0+65	4.0	2.0	84.9
3	1+30	4.0	2.0	84.9
4	1+95	4.0	2.0	84.9
5	2+60	4.0	2.0	84.9
6	3+35	4.0	2.0	84.9
7	3+85	4.0	2.0	84.9
8	4+30	4.0	2.0	84.9

NOTE: Site 1

Benchmark EL. 100.00
Description NW Corner of concrete
Pier Wall (top if lip-marked with pink paint)

Beginning Sta. Description
Will be flagged prior to construction

Date 5 / 2 / 2008
Designed
Drawn M. QUINONES
Checked
Approved

STREAM BANK STABILIZATION
STONE TOE PROTECTION

USDA NRCS Natural Resources Conservation Service

File No. IL-ENG-152
Drawing No.
Sheet 1 of 1

Landowner	John Feldman	Stream	Copperas Creek	Location	Sec. 21 T16N. R5W. Rock Island County, IL

Stream Barb Design Drawing Preparation

Landuser: Feldman
Stream: Copperas Creek
Rock Island County, Illinois
Location:
Sec.: 21 Twp.: 16 N. Range: 5 W

Date: 5/24/2012
By: Chris Haring

Beginning (Upstream) Station: 4+30
Beginning Station Description:
upstream riffle above Bank Barb #1

Benchmark EL: 100.00 *ft.*
Description: NW Corner of Concrete
Pier Wall(Top of Lip-marked with Pink Paint)

Key Depth: 8.0 *ft.*
Key Width: 4.0 *ft.*
Base Flow Width: 60.0 *ft.*
Downstream Riffle Elevation: 82.2 *ft.*
Typical Bank Slope at Barb: 0.0 *:1*

☐ Bedrock or Shale Streambed (no bedkey needed)

REFERENCE TABLE		
IDOT Gradation	h_2 (D_{100})	D_{50}
4	1.3 *ft*	7.4 *in*
5	1.7 *ft*	9.8 *in*
6	2.0 *ft*	12.1 *in*
7	2.5 *ft*	14.6 *in*

Selected rock gradation: 5

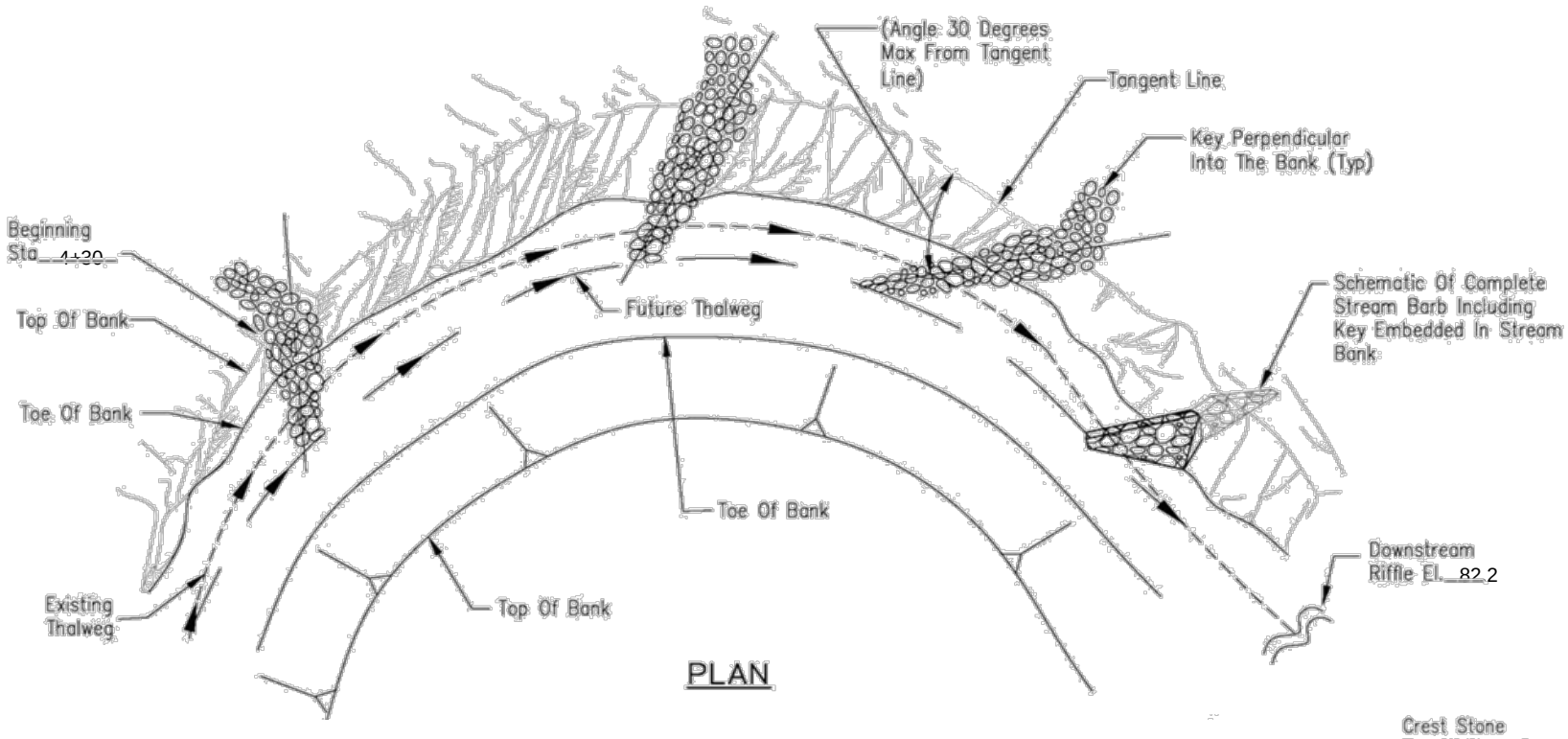
NOTE: Gradation 5 is the same as former RR-5.

For definitions of dimensions, refer to IL-ENG-167 and IL-ENG-168

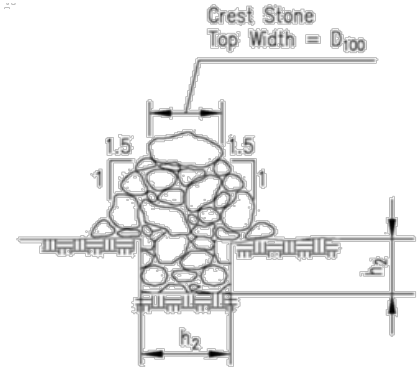
Barb	*Bank	STA	Total Barb Length *(ft)*	Effective Length *(ft)*	Control EL *(ft)*	Barb ht. h_1 *(ft.)*	Bedkey h_2 *(ft.)*	Bank key h_3 *(ft.)*	Slope *z:1*	Angle *(deg.)*	Azim *(deg.)*	Est. Rock *(Tons)* *Calculated*	*USE*
1	R	0+00	55	28	88.7	6.5	1.7	8.5	11.5 : 1	30	50	154	
2	R	0+65	50	21	88.7	6.5	1.7	8.5	10.4 : 1	25	78	142	
3	R	1+30	50	21	88.7	6.5	1.7	8.5	10.4 : 1	25	103	142	
4	R	1+95	50	21	88.7	6.5	1.7	8.5	10.4 : 1	25	141	142	
5	R	2+60	50	21	88.7	6.5	1.7	8.5	10.4 : 1	25	164	142	
6	R	3+35	50	21	88.7	6.5	1.7	8.5	10.4 : 1	25	167	142	
7													
8													
9													
10													
11													
12													
13													
14													
15													

Total Stone *(Tons)*: 864

Notes:



PLAN



TYPICAL BARB SECTION

NOT TO SCALE

Benchmark EL. 100.00

Description NW Corner of Concrete Pier Wall(Top of Lip-marked with Pink Paint)

Beginning Sta. Description upstream riffle above Bank Barb #1

Landowner	Feldman	Stream	Copperas Creek	Location	Sec. 21 T16N. R5W.	Rock Island County, IL

Date 5/24/2011

Designed

Drawn M. QUINONES 2/08

Checked

Approved

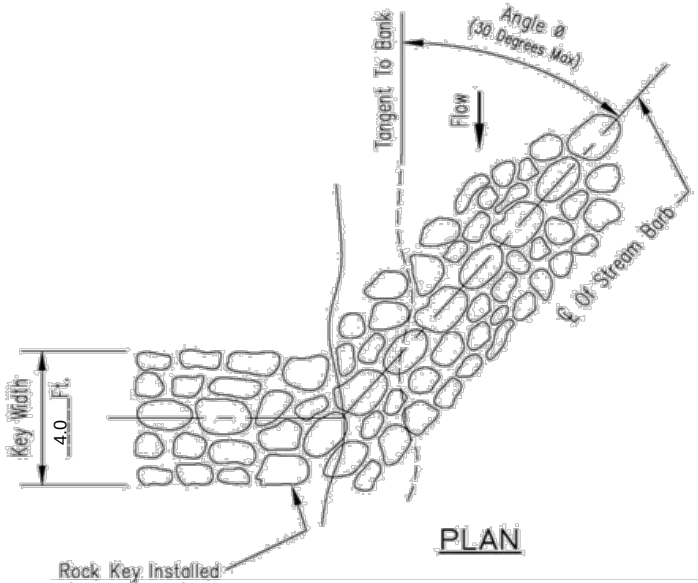
STREAM BANK STABILIZATION
STREAM BARB

USDA NRCS Natural Resources Conservation Service

File No. IL-ENG-167

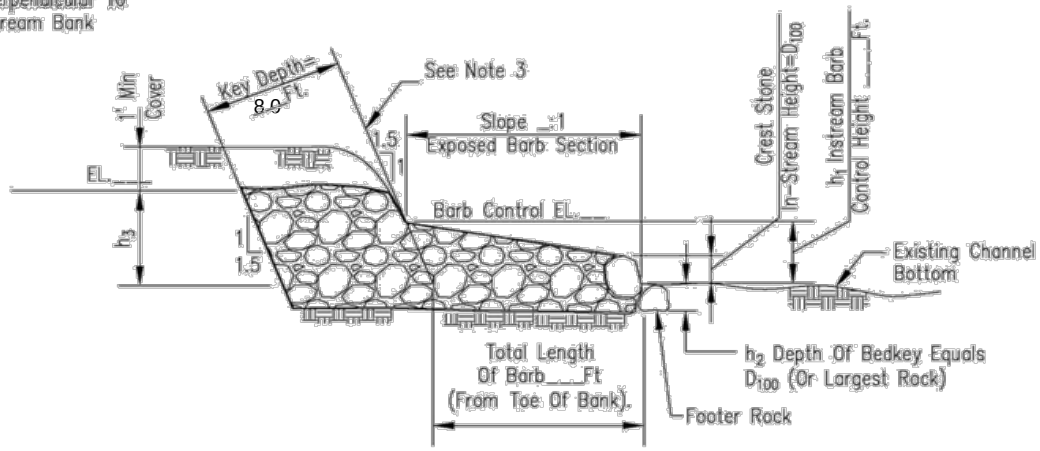
Drawing No.

Sheet 1 of 2



PLAN

Barb	*Bank	Station	Total Length Of Barb	Barb Control Elevation	h_1	h_2	h_3	Slope	Angle	** Azimuth	Tons
1	R	0+00	55	88.7	6.5	1.7	8.5	11 : 1	30	50	154
2	R	0+65	50	88.7	6.5	1.7	8.5	10 : 1	25	78	142
3	R	1+30	50	88.7	6.5	1.7	8.5	10 : 1	25	103	142
4	R	1+95	50	88.7	6.5	1.7	8.5	10 : 1	25	141	142
5	R	2+60	50	88.7	6.5	1.7	8.5	10 : 1	25	164	142
6	R	3+35	50	88.7	6.5	1.7	8.5	10 : 1	25	167	142
7											
8											
9											
10											
11											
12											
13											
14											
15											
									Total Stone		864



TYPICAL PROFILE,CENTERLINE OF STREAM BARB

Notes:
1. ** Azimuth is the compass reading from magnetic north along the centerline of weir.
2. *Bank - left side or right side looking downstream.
3. Key shall be constructed so that the vertical section remains embedded in the existing stream bank.
4. Rock gradation shall meet IDOT requirements for GRAD. NO. __5__ riprap, quality designation "A", or as designated by engineer.

NOT TO SCALE

REFERENCE TABLE		
GRAD. NO.	h_4 (D_{100})	D_{50}
A-4	1.3 *ft*	7.4 *in*
A-5	1.7 *ft*	9.8 *in*
A-6	2.0 *ft*	12.1 *in*
A-7	2.5 *ft*	14.6 *in*

Date 5/24/2012
Designed
Drawn M. QUINONES 2/08
Checked
Approved

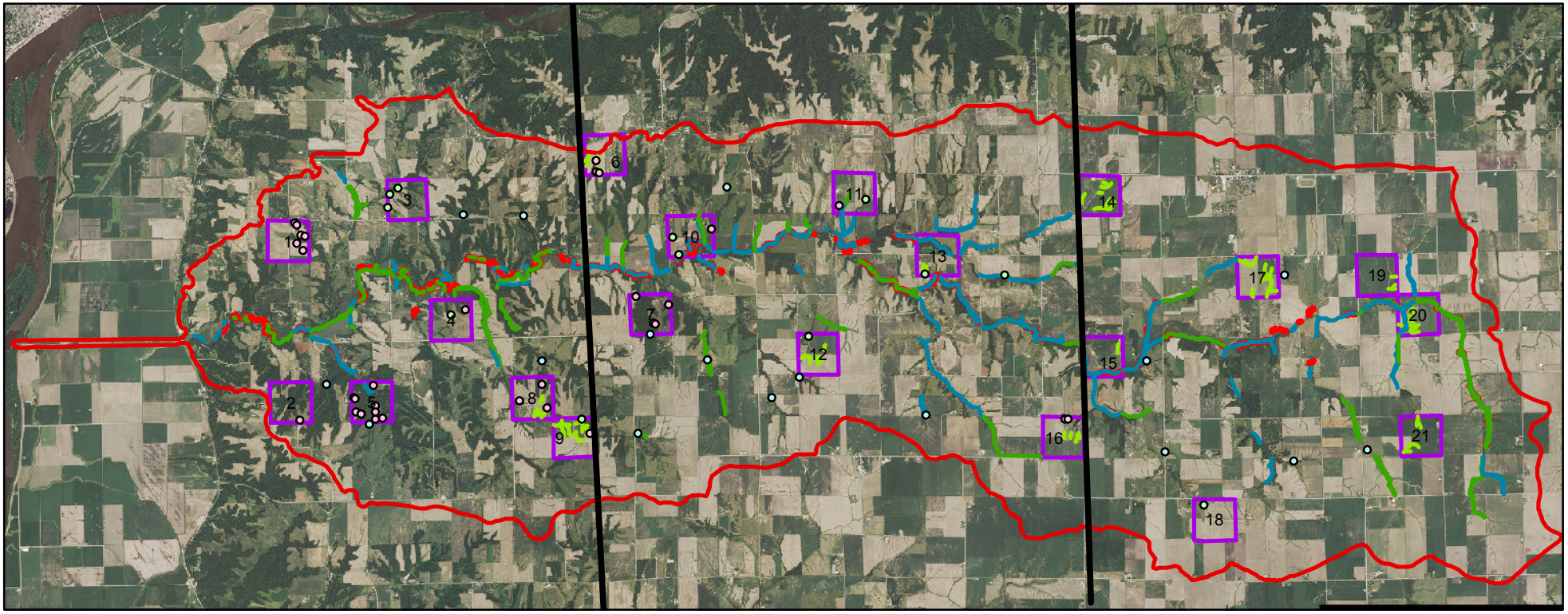
STREAM BANK STABILIZATION
STREAM BARB

USDA NRCS Natural Resources Conservation Service

File No. IL-ENG-168
Drawing No.

Landowner	Feldman	Stream	Copperas Creek	Location	Sec. 21 T16N. R5W.	Rock Island County, IL	Sheet 2 of 2

COPPERAS CREEK WATERSHED EROSION INVENTORY



Legend

Suggested Structures

- <all other values>

LABEL

- Grade Stabalization Structure
- Pond / Sediment Basin
- WASCOB

Copperas Creek Erosion Inventory

- <all other values>

LABEL

- Filter Strip Existing
- Filter Strip Nonexisting
- Stabalization Structure
- Grassed Waterway
- Copperas Creek Watershed_poly
- Copperas Creek RAPM polygon

ortho_1-1_1n_s_il161_2012_1.sid

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

10,000 0 10,000 Feet

N

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: July 2014	**Site Name: Copperas Creek**
Photo By: Doug Hessman **County**: Rock Island **Comments**: Soybean field that need grassed waterway and grade stabilization structure at outlet to control rills and classic gully erosion **Photo #**: 01	

Date: July 2014	
Photo By: Doug Hessman **County**: Rock Island **Comments**: Extreme bank erosion cutting into cropland **Photo #**: 02	

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: July 2014	
Photo By: Doug Hessman **County**: Rock Island	
Comments: Bank slumping caused by undercutting action of water on Copperas Creek	
Photo #: 03	

Date: July 2014	
Photo By: Doug Hessman **County**: Rock Island	
Comments: Streambank erosion with undercutting and soil being deposited into Copperas Creek causing water quality problems to it and into the Mississippi River which Copperas Creek discharges into.	
Photo #: 04	

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: June 2014	
Photo By: Doug Hessman **County**: Rock Island	
Comments: Filter strips used by landowners to reduce runoff and sediment delivery into Copperas Creek. More filterstrips and riparian areas are planned	
Photo #: 05	

Date: July 2014	
Photo By: Doug Hessman	
County: Rock Island	
Comments: Sediment in Copperas Creek after a recent rain showing the effects of poor water quality to this and the Mississippi River below.	
Photo #: 06	

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: April 2014	
Photo By: Rich Stewart	
County: Rock Island	
Comments: Recent bank erosion on Copperas Creek in spring of 2014	
Photo #: 07	

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: April 2014	
Photo By: Rich Stewart	
County: Rock Island	
Comments: Chris Haring under contract with IDOA completed a survey of the section of copperas Creek on the Feldman proerty	
Photo #: 08	

Date: April 2014	
Photo By: Rich Stewart	
County: Rock Island	
Comments: Meandering stream with severe bank erosion and sandbars	
Photo #: 09	

ROCK ISLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT – COPPERAS CREEK PHOTOS

Date: April 2014	
Photo By: Rich Stewart	
County: Rock Island	
Comments: Chris Haring documenting erosion and sedmentation on Copperas Creek above a County Bridge on the Feldmen property. An 18 inch tile lays exposed after the bank is washed away. The bridge is exposed to bank erosion and potential damage.	
Photo #: 10	

Date:	
Photo By: Alyssa Clarida	
County: Rock Island	
Comments: Severe streambank erosion July 2015	
Photo #: 11	