Metropolitan Planning Council

December 20, 2017

CALUMET-SAGANASHKEE CHANNEL WATERSHED-BASED PLAN

A WATER QUALITY-FOCUSED SUPPLEMENT TO MWRD'S DETAILED WATERSHED PLAN

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Illinois Environmental Protection Agency

Metropolitan Water Reclamation District of Greater Chicago

ACKNOWLEDGEMENTS

The Metropolitan Planning Council is grateful to the Illinois Environmental Protection Agency for providing funding to support watershed planning work for four watersheds in Cook County. MPC and Christopher B. Burke Engineering (CBBEL) also appreciate the guidance and reviews provided by Illinois EPA staff. This plan was prepared in part using United States Environmental Protection Agency funds under Section 319 (h) of the Clean Water Act distributed through the Illinois Environmental Protection Agency.

MPC and CBBEL would also like to acknowledge contributions, ideas, and information drawn from watershed planning work led by the Chicago Metropolitan Agency for Planning (CMAP). CMAP has managed watershed planning projects for numerous areas in Northeastern Illinois, including the Thorn Creek and Boone-Dutch Creek watersheds. CMAP maintains a webpage with information about watershed plans and watershed planning work in the region. The approved plans developed by CMAP and partner engineering firms, notably Geosyntec Consultants, were valuable resources from which structural ideas and content were drawn for this watershed planning document. Sections of the Resource Inventory in this plan mirror material from CMAP-led plans where the information is relevant across the region. This was an important efficiency for plan development and provides for some consistency in plans across the region. We would particularly like to thank Holly Hudson, Kelsey Pudlock, Nora Beck, and Jason Navota for being valuable collaborating partners in watershed planning and stormwater work.

This watershed planning document is a supplement to the Cal-Sag Channel Detailed Watershed Plan (DWP) prepared by the Metropolitan Water Reclamation District of Greater Chicago (MWRD) in 2014. The DWP thoroughly addresses flooding issues in the watershed. This complementary document focuses on water quality. MWRD has provided numerous datasets, mapping tools and information to support the 2017 watershed planning work.

Two additional references of great benefit in the watershed planning work were the “Guidance for Developing Watershed Action Plans in Illinois,” developed by CMAP and Illinois EPA, and USEPA’s “Handbook for Developing Watershed Plans to Restore and Protect Our Waters.”

Finally, MPC and CBBEL would like to thank the members of the Peer Review Committee that lent their experience and expertise to the WBP development process:

Matt Bardol: Geosyntec Consultants
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Joe Exl: Northwestern Indiana Regional Planning Commission (NIRPC)
Holly Hudson: CMAP
Eric Otto: Forest Preserve District of Cook County
John Quail: Friends of the Chicago River
Dom Tocci: Cook County
Nancy Williamson: Illinois Department of Natural Resources
Greg Wolterstorff: V3 Companies

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CHAPTER 1 INTRODUCTION

1.1 WATERSHED-BASED PLAN SCOPE AND PURPOSE

This watershed-based plan for the Cal-Sag Channel 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. This document assesses current conditions, predicts future conditions, and makes recommendations to improve future 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, 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 Cal-Sag Channel name is the shortened form of Calumet-Saganashkee Channel. The location of the Cal-Sag Channel Planning Area is shown in Figure 1.1-1 as it relates to northeastern Illinois and northwest Indiana.

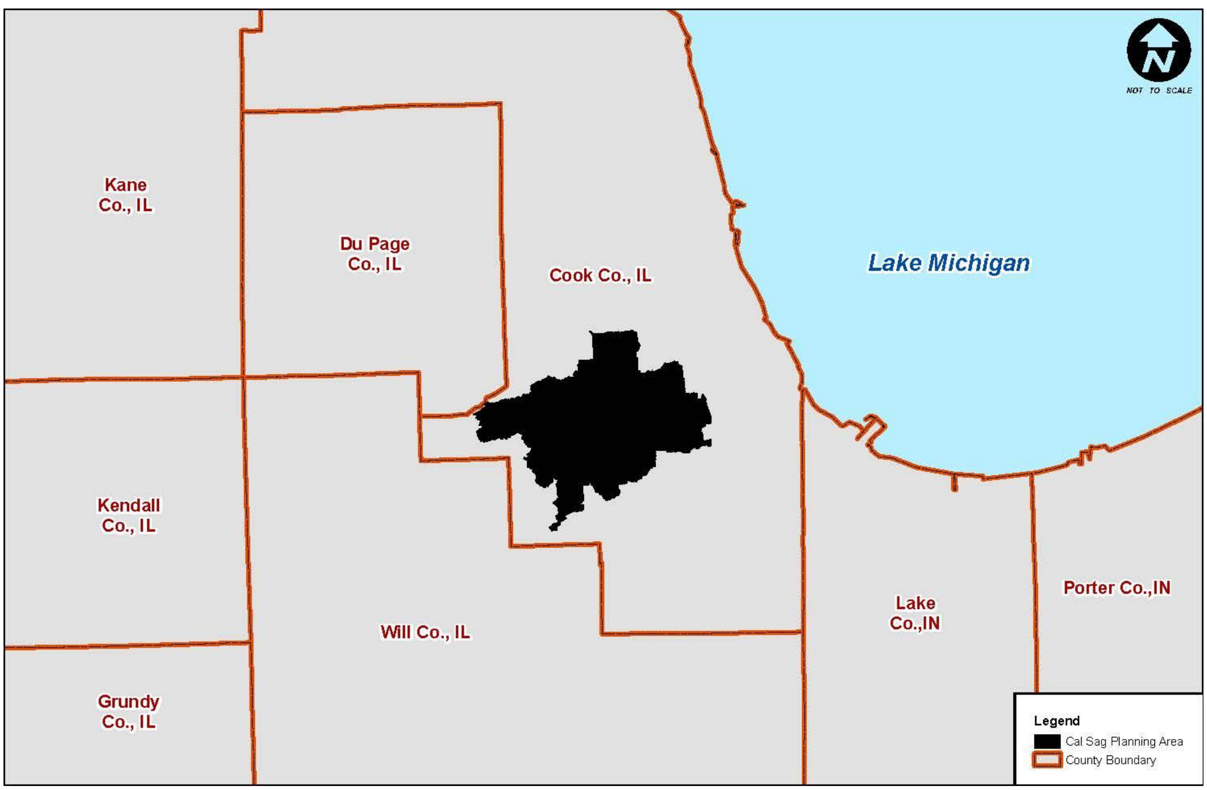


Figure 1.1-1 Cal-Sag Channel Planning Area in Relation to NE IL and NW IN

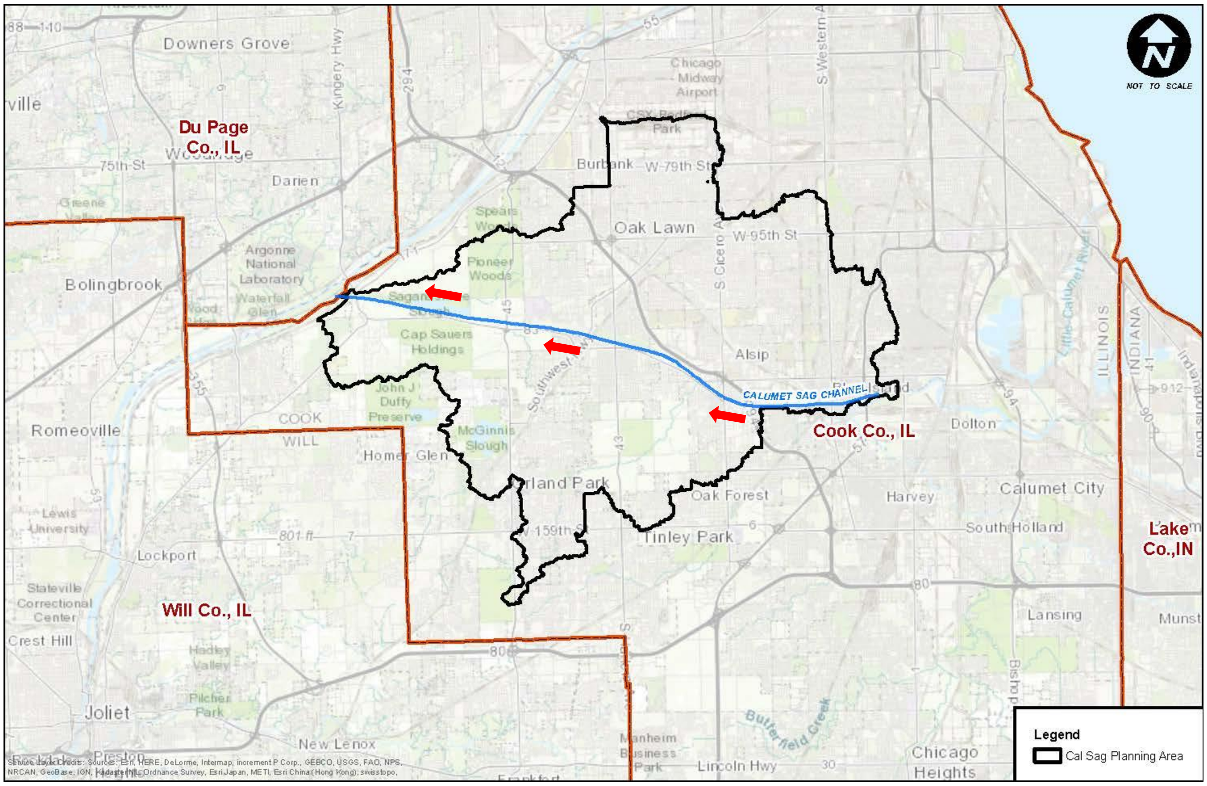


Figure 1.1-2 Cal-Sag Channel Planning Area in Cook County (flow direction in red)

Runoff from the approximately 103 square mile Cal-Sag Channel watershed drains to the Channel which generally flows from east to west toward the Illinois and Michigan (I&M Canal). The Cal-Sag Channel originates near the confluence of the Little Calumet River with the Calumet River at Calumet Park and continues west toward the I&M Canal, as shown in Figure 1.1-2. There are three large tributaries to the Cal-Sag Channel and 8 smaller tributaries to either the mainstem or one of the large tributaries both north and south of the mainstem Channel. The watercourses north of the mainstem Cal-Sag Channel generally flow south and the watercourses south of the mainstem Cal-Sag Channel flow north. The one significant variation to this is the Tinley Creek tributary that flows in a northeast direction to the mainstem. The mainstem and the major tributaries are shown in Figure 1.1-3. Details of the various tributaries and the approximately 103 square mile drainage area is provided in Sections 3.1 and 3.13. Physical Stream Conditions is covered in Section 3.14. The Water Quality Assessment is discussed in Section 3.17. Point sources of water pollution are covered in Section 3.18. 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.

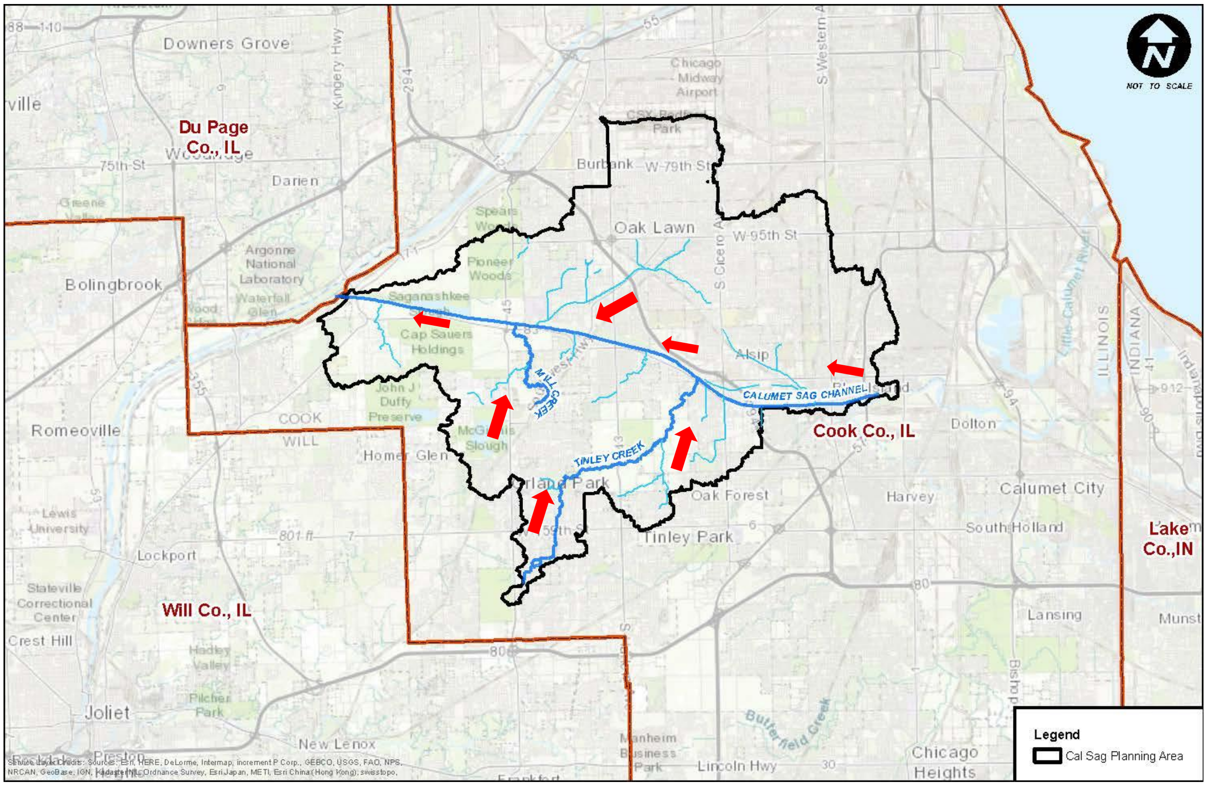
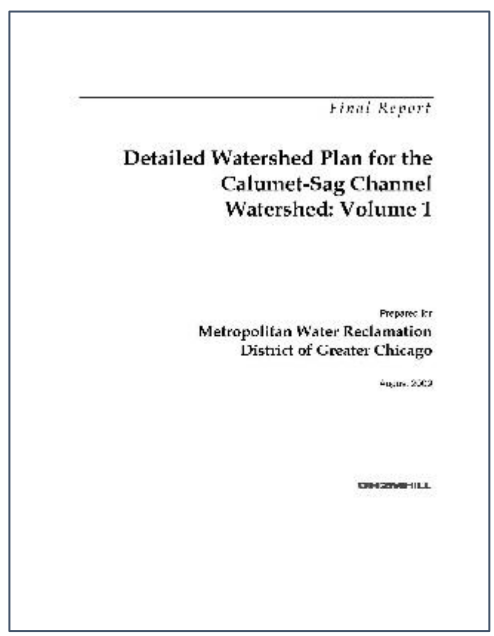


Figure 1.1-3 Cal-Sag Channel Planning Area and Major Tributaries (flow direction in red)

1.2 ADDENDUM TO DETAILED WATERSHED PLAN

This plan addresses water quality as a supplement to the Metropolitan Water Reclamation District of Greater Chicago (MWRD) Detailed Watershed Plan (DWP) for the Cal-Sag Channel watershed. The DWP addresses flooding concerns in the watershed. This watershed-based plan (Plan) examines water quality conditions and needs in the tributary drainage areas for the Cal-Sag Channel, and recommends measures to reduce pollutant loadings and improve water quality. The BMPs recommended for the watershed as a result of this plan have been identified in concert with the intent of the MWRD Watershed Management Ordinance (WMO) and the Technical Guidance Manual (TGM). Nothing in this plan sets new ordinance requirements with respect to the WMO or water quality. The BMPs identified within the plan are not required to meet the requirements of the WMO, but should work in concert with the WMO to better manage stormwater and restore and protect water quality. Some stormwater retrofit projects that are carried out pursuant to this plan will be beyond WMO requirements, but are warranted to help restore water quality.


Final Report

Detailed Watershed Plan for the Calumet-Sag Channel Watershed: Volume 1

Prepared for

Metropolitan Water Reclamation District of Greater Chicago

Figure 1.2-1 The DWP for Cal-Sag Channel

The WMO is a living document that will periodically be updated/amended to address current conditions and stormwater management needs. This plan is intended to be complementary with the WMO including management strategies for detention and volume control.

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 Illinois Environmental Protection Agency (Illinois EPA) 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 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, USDA'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 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 municipalities, 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 Forest Preserve District of Cook County (FPDCC), homeowner associations, local 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 best management practices (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 Cal-Sag Channel and its tributaries is greatly influenced by the various land uses in the watershed. While urban development dominates much of the watershed, there are large areas of open space, many of which are owned and managed by the FPDCC. Understanding the impacts of urban development on water quality and the use of BMPs to offset those impacts is critical to address the sources of pollutant loadings in this watershed.

Chapter 5 discusses ways to counteract the impacts of urban development 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 Illinois Environmental Protection Agency's (Illinois EPA) 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 Metropolitan Planning Council (MPC) to the Illinois EPA for the Section 319 grant. The Cal-Sag Channel Watershed is one of 4 watersheds being studied through the grant funding from Illinois EPA. MPC provided additional funds and resources to complete the Watershed Plans.

Figure 1.6-1 Hogwash Slough

Figure 1.6-2 Bullfrog Lake

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 Cal-Sag Channel 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 Cal-Sag 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 taking into account stakeholder input. MPC and CBBEL have met with the Cal-Sag Watershed Council and the Calumet Stormwater Collaborative to discuss the watershed planning work. Dialogue with these groups and South Suburban Mayors and Managers 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. As discussed further in the body of this plan, use impairments have been identified by Illinois EPA in the Cal-Sag watershed, and additional monitoring and assessment work has shown substandard water quality conditions and poor aquatic habitat. Many of the problems identified in the watershed are associated with land use and land cover. The wide expanses of impervious surfaces in most of the subwatersheds produce large quantities of stormwater containing 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 municipalities, landowners and other watershed stakeholders.

The water quality vision for the Cal-Sag watershed is to implement strategically planned and located best management practices 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 Cal-Sag Channel 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)
4%	5%	2%	17%

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 permeable pavement and bioretention will result in water being absorbed into the ground, vs. running off and draining into storm sewers. Reducing stormwater volumes will provide significant water quality benefits. Currently, many of the stream sections are *flashy*, that is the volume of water in the stream channel increases dramatically reflecting the amount of water running off surfaces when it rains. The stormwater volumes and energy cause stream channel/ streambank erosion, which results in increased loadings of sediment and other pollutants. The stormwater BMPs will reduce this effect.
- It is anticipated that the water quality of flows coming into the Cal-Sag Channel from the Little Calumet River will improve over time. MWRD has initiated operation of disinfection facilities at the Calumet wastewater treatment plant, and placed the Thornton Reservoir into operation. Monitoring data is already showing reduced levels of bacteria in the Little Calumet River as a result of the improved treatment and CSO control. Also, a watershed-based plan has been developed for the Little Calumet River watershed. As that plan is implemented the quality of river water flowing into Cal-Sag Channel will improve.

The combination of these factors and the measures set out in this plan is expected to result in significant progress toward attainment of designated uses.

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 Cal-Sag mainstem and major tributaries such that aquatic habitat and recreational uses are supported. There are large populations, including some in disadvantaged community areas that live close to the Cal-Sag Channel. There are significant opportunities for these people to enjoy fishing and boating/canoeing activities on the channel and some of the larger tributaries. However, presently many people perceive the water quality as being polluted and shy away from these recreational activities. 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 forest preserve areas and open space/greenspace. However, some of the open space is in deteriorated condition. For example, vacant lots may be strewn with rubble and may not provide significant open space benefits. 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 vacant parcels will help improve stormwater management and reduce pollutant loadings, and also provide habitat for some species. Efforts to protect and restore open space 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 neighborhood scale, green infrastructure practices remove pollutants and reduce the volume of stormwater discharges through infiltration, evapotranspiration, or harvesting and reusing stormwater. Examples of green infrastructure practices include rain gardens and bioswales, green roofs, permeable pavements, and cisterns. Where green infrastructure is well-designed and properly-maintained, the practices can provide significant co-benefits. For example, green infrastructure may provide habitat for pollinators or other species, and/or may be a park-like amenity for a community area.

2.8 RESPONSIBLE DEVELOPMENT

Population projections for the watershed predict noticeable population growth over the next 25 years. Population growth is accompanied by commercial development. Much of the expected residential and commercial development will actually be redevelopment — land developed previously which is vacant or underutilized will be redeveloped to increase density and accommodate the expected growth. As the redevelopment occurs, there will be significant opportunities to provide environmental safeguards and implement water quality-related controls. For example, communities can use zoning and comprehensive plans to steer development projects away from sensitive areas and promote infill and transit-oriented development. In addition, stormwater controls will be built in as sites are redeveloped. The Metropolitan Water Reclamation District Watershed Management Ordinance and local ordinances will require stormwater detention and volume control (green infrastructure) at development sites. Responsible development and redevelopment will be key aspects of improving quality of life in the watershed and helping to restore and protect water quality.

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. Integrating consideration of stormwater and water quality into local comprehensive plans, zoning decisions, and budgets will be important to achieving progress toward water quality goals. Additionally, outreach and education to civic groups, neighborhood organizations, businesses, 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 out 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 partnerships and expertise to enhance intergovernmental coordination for achieving progress toward water quality goals.

Figure 2.9-1 Bergman Slough

CHAPTER 3 CALUMET-SAGANASHKEE WATERSHED RESOURCE INVENTORY

3.1 WATERSHED BOUNDARIES

The Cal-Sag Channel (short for "Cal-Saganashkee Channel") is a man-made channel extending approximately 16 miles between the Little Calumet River and the Chicago Sanitary and Ship Canal. The channel was constructed over an 11-year period, from 1911 until 1922 and was created to divert flow from the Little Calumet River to drain sewage and industrial waste away from Lake Michigan. The western 4.5 miles of the channel flows through Forest Preserve District of Cook County (FPDCC) Property and the drainage area includes numerous forest preserves and open space. Flow in the channel is from east to west where the Cal-Sag Channel follows from approximately the confluence with the Little Calumet River west to the Illinois and Michigan (I&M) Canal.

The watershed area north of the Cal-Sag Channel is heavily developed and characterized by low relief. It is drained principally by the East and West branches of Stony Creek, which both discharge into the Cal-Sag Channel. The watershed area south of the Cal-Sag Channel is less intensely developed and characterized by greater topographic relief.

Previous studies completed for the Cal-Sag Channel watershed include the Metropolitan Water Reclamation District of Greater Chicago's (MWRD) Detailed Watershed Plan (DWP) for the Cal-Sag Channel dated 2009. The scope of the Cal-Sag Channel DWP included the development of stormwater improvement projects to address regional problem areas along open waterways, with a focus on flooding. As part of the DWP, the entire Cal-Sag Channel watershed was delineated into roughly 100 acre subbasins. The DWP delineation was based on Cook County 1-foot aerial topography to reflect topographic features and topographic drainage patterns caused by stormwater management infrastructure (storm sewer systems, culverts, etc.). Subbasin boundaries were also intended to encompass areas with similar development patterns.

The tributary areas delineated for the DWP included areas north and south of the Cal-Sag Channel (several smaller streams) that discharge westward into the I&M Canal (i.e., these areas are not in the Cal-Sag Channel watershed). As such, these areas are not included in this current watershed based plan. The area addressed in this watershed based planning supplement for the Cal-Sag Channel (IL_H-01) is defined by the following USGS 12-digit hydrologic unit codes (HUCs) and are shown in Figure 3.1-1:

- 071200040702
- 071200030401
- 071200030402
- 071200030403

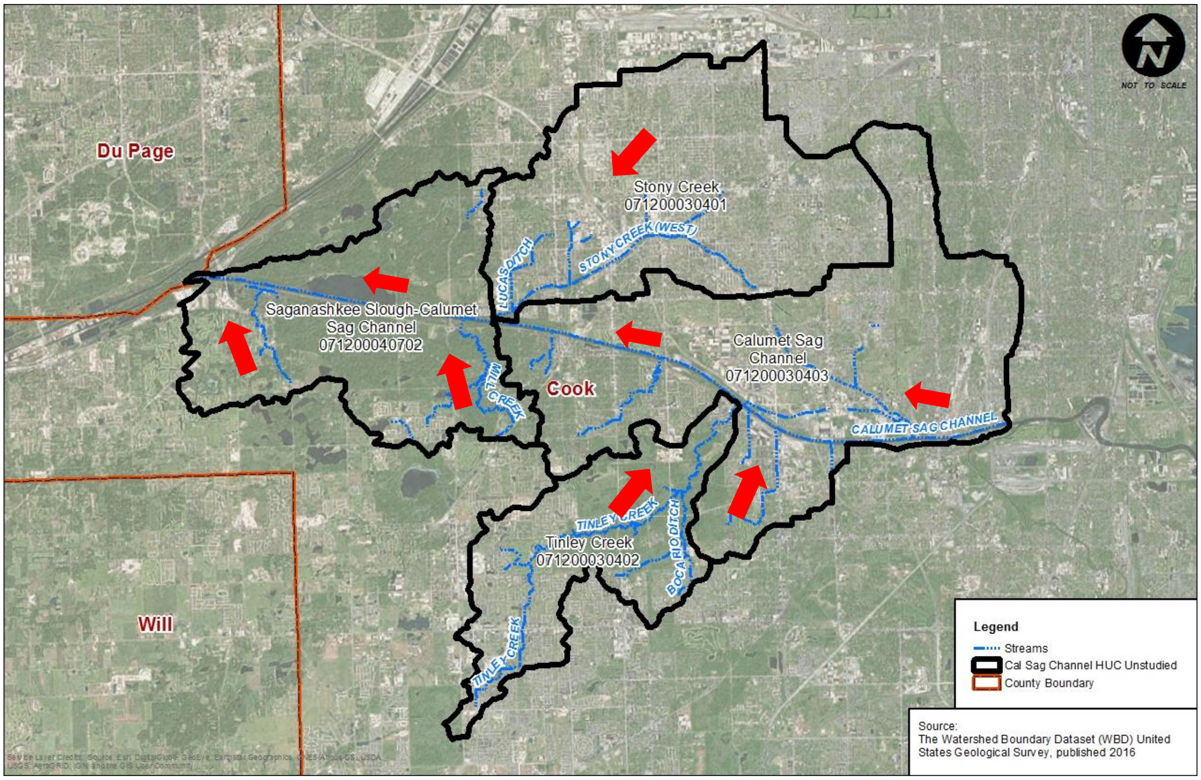


Figure 3.1-1 Cal-Sag Channel Planning Area by HUCs (flow direction in red)

As a water quality supplement to the MWRD's Cal-Sag Channel DWP, the subbasin and subwatershed delineations developed for the DWP were used as the starting point for delineation of watershed planning units for this watershed-based plan. The DWP subbasins and subwatersheds were overlaid with the USGS delineations for the HUCs. The DWP subbasin and subwatershed delineations matched closely with only minor discrepancies with the USGS HUCs. For cases where modifications were necessary, the subbasins and subwatersheds created for the DWP have been used in this plan supplement as the MWRD subbasin divides were created using the best available topography data on a 1 foot scale.

For this watershed-based plan, the HUCs have been subdivided into 22 *watershed planning units* based on sewersheds, stream confluences, similar land uses as well as overall watercourse topography. The watershed planning units are shown in Table 3.1-1 and Figure 3.1-2. The boundaries of the watershed planning units reflect delineated subbasin boundaries in the DWP, but DWP subbasins have been consolidated where the land use and pollutant sources were found to be similar. The term *watershed planning unit* is used in this plan supplement, to distinguish from *subwatershed* as that term is used in the DWP and the WMO.

Some land areas within the Cal-Sag Channel overall watershed boundaries, per the DWP, actually drain out of the watershed. These areas are shown in Figure 3.1-2. The blue arrows show the drainage direction and the Figure identifies the watersheds where the drainage ends up. The land areas that drain away from the Cal-Sag Channel watershed are not included within the scope of this plan, but are addressed in watershed planning work for the adjacent watersheds.

	ID	Area (acres)	Area (square miles)	Watercourse
1	ME	5,417	8.5	Melvina Ditch
2	NV	4,718	7.4	Navajo Creek
3	MP	2,699	4.2	Merrionette Park Ditch
4	TI1	4,310	6.7	Tinley Creek
5	TI2	3,953	6.2	
6	LD	2,188	3.4	Lucas Ditch
7	LDC	1,731	2.7	Lucas Diversion Ditch
8	STE	4,434	6.9	Stoney Creek East
9	STW1	4,327	6.8	Stoney Creek West
10	STW2	2,807	4.4	
11	OL	2,345	3.7	Oak Lawn Ditch
12	CS1	799	1.2	Cal-Sag 1
13	CS2	6,526	10.2	Cal-Sag 2
14	CS3	812	1.3	Cal-Sag 3
15	CS4	2,392	3.7	Cal-Sag 4
16	CS5	3,550	5.5	Cal-Sag 5
17	MI1	4,999	7.8	Mill Creek
18	MI2	2,327	3.6	
19	CSA	1,894	3.0	Cal-Sag Trib A
20	CSC	2,622	4.1	Cal-Sag Trib C
21	CSD	810	1.3	Cal-Sag Trib D
22	IMBC	606	0.9	I&M Trib B&C
	Total	**66,266**	**103.5**	

Table 3.1-1 Cal-Sag Channel Watershed Planning Unit Identification and Area.

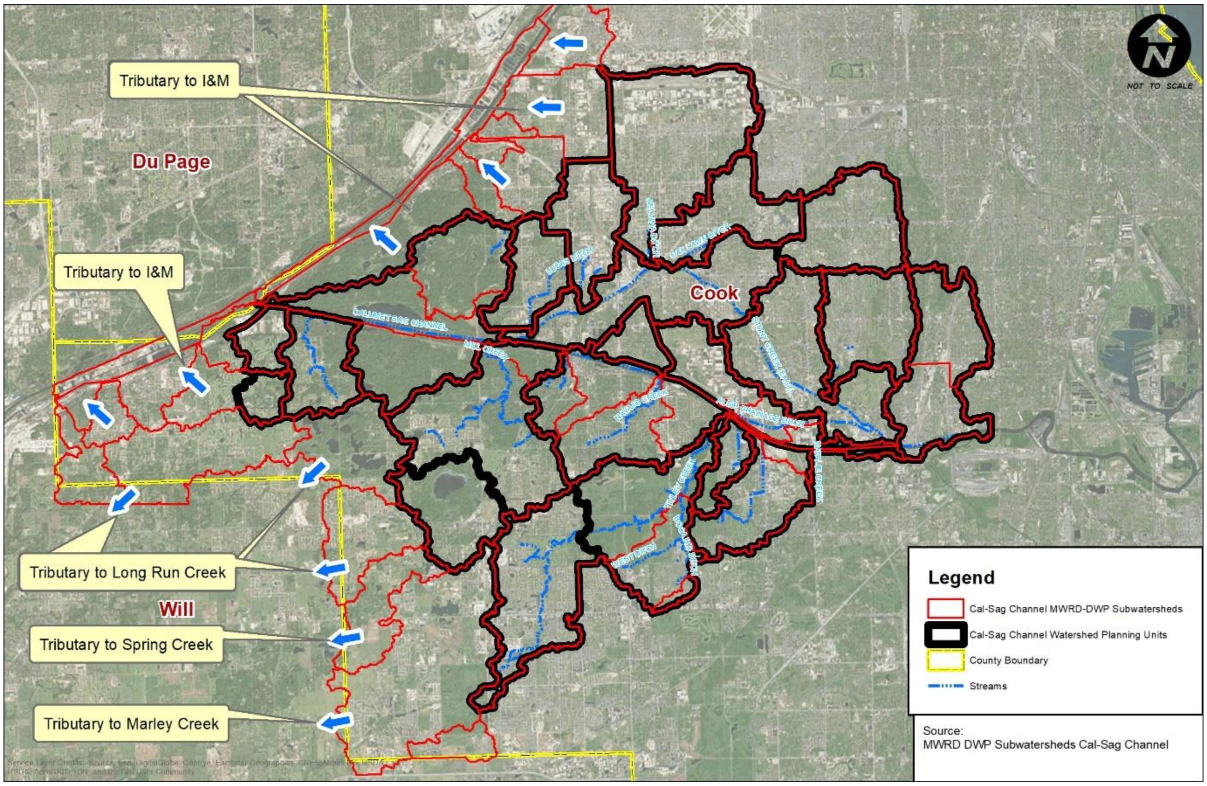


Figure 3.1-2 Cal-Sag Channel Watershed Planning Area, Showing Drainage to Other Watersheds

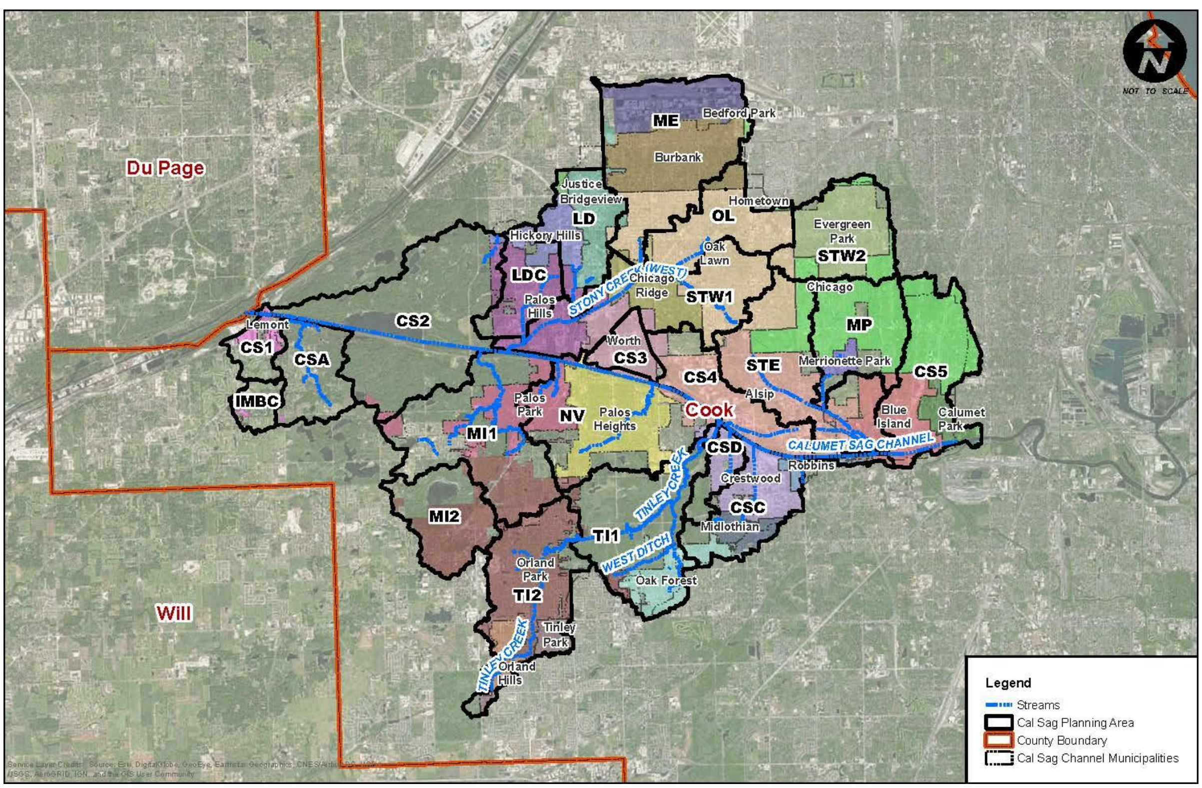


Figure 3.1-3 Cal-Sag Channel Watershed Planning Unit Identification and Area.

The Cal-Sag Channel major tributaries flow north and south to the Cal-Sag Channel mainstem. Topographically, the elevation difference between the headwaters of each northern watershed planning unit and the confluence with the Cal-Sag Channel is approximately 65 feet in elevation. The elevation difference between the headwaters of each southern watershed planning unit and the confluence with the Cal-Sag Channel is approximately 150 feet in elevation. Flow in the mainstem Cal-Sag Channel is from east to west with approximately 60 feet of elevation change between the confluence with the Little Calumet River on the east end at Calumet Park and the I&M Canal on the west end (Figure 3.1-3). Further discussion of each tributary of the Cal-Sag Channel watercourse connectivity is provided in the watershed drainage portion of this inventory.

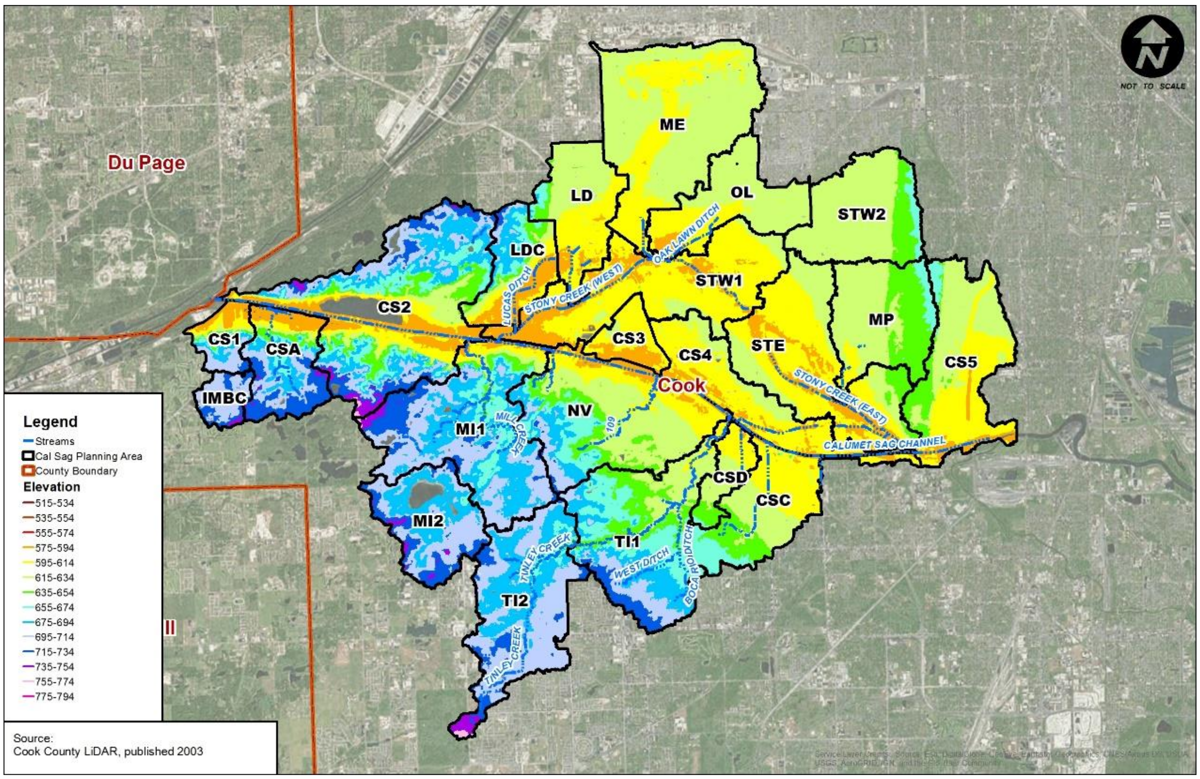


Figure 3.1-4 Cal-Sag Channel Planning Area Topography.

3.2 POPULATION AND DEMOGRAPHICS

Based on the 2010 decennial census, the population (2010) in the planning area is estimated to be 422,477. Chicago Metropolitan Agency for Planning's (CMAP) GO TO 2040 comprehensive regional plan (updated version, October 2014) forecasts a population of 478,157 or 13 percent growth. The difference in population over the intervening 30 years translates into a (linear) growth rate of approximately 4.3 percent per decade. This rate of estimated population growth is less than half of the 28.6 percent rate of growth forecast (Population in Households in 2040) for the entire seven-county region, and is slightly lower than the 17 percent growth forecast for Cook County. The following statistics were collected from City Data for the watershed planning area:

- Average Home Value = $192,018
- Average Income = $58,969
- Average Age = 40 years old

Employment forecasts are similarly relevant in that growth will impact land use change, water use, water quality, and other factors. The revised GO TO 2040 forecast totals for the region estimate employment growth to be 15 percent for the planning area, 18 percent in Cook County, and 31.2 percent for the region. The 2010 employment was 159,078 and the projected 2040 employment is 183,708.

3.2.1 Future Land Use Projections

The watershed planning area outside of the forest preserves is currently highly developed and densely populated. There are some vacant land parcels where businesses have closed or people have moved away, but these areas have compacted soils and some impervious cover and generally function from a hydrological point of view like impervious surfaces. The growth that is expected will primarily occur in one of two ways: (1) Parcels currently vacant or underutilized with be redeveloped for residential, commercial, or industrial uses; or (2) Areas currently developed will become more densely developed. For example, townhouses and multi-unit development projects will be planned at infill sites, as will the associated commercial areas. The expected result is there will be greater population and greater business activity but minimal increase in impervious area (i.e., the land area will continue to be approximately 95% developed).

The watershed planning units that are currently priority areas for BMP implementation are discussed in ensuing sections of this watershed plan supplement. 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.

One additional factor that will be important looking to the future: The stormwater detention and volume control requirements in the Cook County Watershed Management Ordinance (WMO) apply to new developments and redevelopment projects. What that means is as areas in the watershed undergo redevelopment to accommodate population growth and new businesses, controls to reduce pollutant loadings from urban runoff will be integrated into these areas. In this way the expected growth in the watershed will be beneficial for water quality.

3.3 JURISDICTIONS, LOCAL GOVERNMENTS AND DISTRICTS

In northeastern Illinois, over 1,200 units of government collect revenues and provide services to the seven-county region's residents, businesses, and visitors. Portions of 26 municipalities and 9 townships, are included in the Cal-Sag Channel Planning Area (Table 3.3-1 and Figure 3.3-1). Municipal jurisdictions cover approximately 71% (46,925 acres) of the planning area and townships cover approximately 29% (19,341 acres) of the planning area. Among the larger municipalities in the watershed are Chicago, Alsip, Oak Lawn and Orland Park, each with over 6% of the land area. The largest township in the watershed is Palos Township containing nearly 15% of the area of the watershed.

Jurisdiction for stormwater management and water quality in the watershed primarily lies with MWRD and the municipalities. In Cook County, the MWRD oversees the implementation of the Watershed Management Ordinance that encompasses stormwater management and floodplain protection.

MWRD is also responsible for treating most of the wastewater in Cook County. MWRD's Calumet Plant is located in the upstream Little Calumet River watershed.

The WMO forms the baseline for stormwater requirements in the watershed; development and redevelopment projects must at a minimum meet the requirements of the WMO for detention and volume control (green infrastructure). However, and municipalities can work with MWRD on the enforcement of the ordinances, and municipalities can enact more stringent rules. Townships generally do not have the same ordinance authorities as municipalities and the WMO requirements govern activities in the Townships.

The State and the Soil and Waters Conservation Districts help residents conserve, develop, manage, and wisely use land, water, and related resources.

Watershed planning in the watershed is typically done through the MWRD and six watershed councils. Municipalities participate in the watershed councils.

The MWRD WMO became effective in January 2014. There are stormwater detention and volume control (green infrastructure) requirements that apply to developments and redevelopments throughout the County, except for the City of Chicago. The volume control requirements are intended to capture runoff from first flush storm events or runoff from the directly connected impervious areas of a development from the first inch of rainfall. Volume control practices as stated in the Ordinance shall provide treatment of the volume control storage through practices including infiltration trenches, infiltration basins and other retention practices. The required practices reduce the volume of stormwater being discharged, and also reduce pollutant loadings. The volume control itself greatly reduces loadings, and volumes not retained generally have lower pollutant concentrations because of the green infrastructure measures. The WMO also addresses soil erosion and sediment control during and after construction of all developments within Cook County. The enforcement of these provisions greatly reduces loadings of sediment and other pollutants.

As noted above, municipalities can work with MWRD 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.

MWRD is responsible for planning for, constructing, operating, and maintaining the larger or regional components of the sewer systems. The larger-scale projects described in the DWP will typically be carried out by MWRD. As discussed further below, with some design modifications many of the flood-oriented projects can also provide significant water quality benefits. MWRD can also provide assistance to municipalities, either financial assistance or technical assistance, on local stormwater projects.

Municipalities and townships typically are responsible for local stormwater systems. This includes not only planning for, constructing, operating, and maintaining local sewers and municipal detention facilities, but also non-structural BMPs such as street sweeping. Maintenance activities such as cleaning out catch basins and non-structural BMPs are very important for reducing nonpoint source pollutant loadings from urban runoff. Municipalities that are regulated Municipal Separate Storm Sewer System (MS4) communities must implement six minimum measures aimed at reducing pollutant loadings in stormwater discharges.

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

In addition to municipalities and townships, the Cal-Sag Watershed governmental bodies include:

- Forest Preserve District of Cook County
- Illinois State Representative Districts (21st District, 22nd District, 23rd District, 27th District, 28th District, 30th District, 31st District, 32nd District, 35th District, 36th District, 37th District, 38th District, 82nd District)
- Illinois State Senatorial Districts (11th District, 12th District, 14th District, 15th District, 16th District, 18th District, 19th District, 41st District)
- US Congressional Districts (1st District, 2nd District, 3rd District)
- Park Districts (Alsip, Blue Island, Bridgeview, Burbank, Chicago Ridge, Chicago, Hickory Hills, Lemont, Midlothian, Oak Forest, Oak Lawn, Tinley Park, Worth)

The governmental units in the watershed are shown in Table 3.3-1.

Jurisdictional Body	Acres	% of Watershed	% of County
Cook County	66,266	100	100
Municipalities			
Alsip	4,248	6.4	6.4
Bedford Park	1,643	2.5	2.5
Blue Island	1,916	2.9	2.9
Bridgeview	1,357	2.0	2.0
Burbank	2,632	4.0	4.0
Calumet Park	514	0.8	0.8
Chicago	5,103	7.7	7.7
Chicago Ridge	1,452	2.2	2.2
Crestwood	1,814	2.7	2.7
Evergreen Park	1,997	3.0	3.0
Hickory Hills	985	1.5	1.5
Hometown	29	0.0	0.0
Lemont	270	0.4	0.4
Merrionette Park	248	0.4	0.4
Midlothian	543	0.8	0.8
Oak Forest	1,176	1.8	1.8
Oak Lawn	5,486	8.3	8.3
Orland Hills	559	0.8	0.8
Orland Park	5,553	8.4	8.4
Palos Heights	2,481	3.7	3.7
Palos Hills	2,740	4.1	4.1
Palos Park	2,051	3.1	3.1
Riverdale	23	0.0	0.0

Jurisdictional Body	Acres	% of Watershed	% of County
Robbins	181	0.3	0.3
Tinley Park	404	0.6	0.6
Worth	1,524	2.3	2.3
Unincorporated	19,341	29.2	29.2
Total	66,266	100.0	100.0
Townships			
Bremen	5,263	7.9	7.9
Calumet	1,450	2.2	2.2
Lake	5,120	7.7	7.7
Lemont	3,160	4.8	4.8
Lyons	348	0.5	0.5
Orland	8,050	12.1	12.1
Palos	18,452	27.8	27.8
Sitckney	4,458	6.7	6.7
Thornton	2	0.0	0.0
Worth	19,964	30.1	30.1
Total	66,266	100.0	100.0
U.S. Congressional Districts			
1st Congressional District	26,758	40.4	40.4
2nd Congressional District	28	0.0	0.0
3rd Congressional District	39,480	59.6	59.6
Total	66,266	100.0	100.0
State Representative Districts			
State Representative District - 21st	11	0.0	0.0
State Representative District - 22nd	1,014	1.5	1.5
State Representative District - 23rd	2,348	3.5	3.5
State Representative District - 27th	13,184	19.9	19.9
State Representative District - 28th	6,895	10.4	10.4
State Representative District - 30th	50	0.1	0.1
State Representative District - 31st	3,903	5.9	5.9
State Representative District - 32nd	2,796	4.2	4.2
State Representative District - 35th	13,059	19.7	19.7
State Representative District - 36th	19,693	29.7	29.7
State Representative District - 37th	149	0.2	0.2
State Representative District - 38th	6	0.0	0.0
State Representative District - 82nd	3,156	4.8	4.8
Total	66,263	100.0	100.0

State Senate Districts			
State Senate District - 11th	1,025	1.5	1.5
State Senate District - 12th	2,348	3.5	3.5
State Senate District - 14th	20,080	30.3	30.3
State Senate District - 15th	50	0.1	0.1
State Senate District - 16th	6,698	10.1	10.1
State Senate District - 18th	32,752	49.4	49.4
State Senate District - 19th	155	0.2	0.2
State Senate District - 41st	3,156	4.8	4.8
Total	66,263	100.0	100.0
Park Districts			
Alsip	62.2	0.1	0.1
Blue Island	49.5	0.1	0.1
Bridgeview	4.1	0.0	0.0
Burbank	87.2	0.1	0.1
Chicago Ridge	18.6	0.0	0.0
Chicago	194.8	0.3	0.3
Evergreen Park	8.1	0.0	0.0
Hickory Hills	26.3	0.0	0.0
Lemont	0.5	0.0	0.0
Midlothian	8.4	0.0	0.0
Oak Forest	18.9	0.0	0.0
Oak Lawn	273.8	0.4	0.4
Palos Hills	2.5	0.0	0.0
Tinley Park	0.1	0.0	0.0
Worth	17.5	0.0	0.0
Total	772.5	1.2	1.2

Table 3.3-1 Cal-Sag Channel Planning Area Jurisdictions

The municipalities in the watershed are shown below in Figure 3.3-1.

The Cal-Sag watershed is fortunate in that through the MWRD efforts there is an active Watershed Council. Quarterly watershed meetings are convened during which the municipalities and townships and other watershed stakeholders are invited to discuss stormwater issues. MPC and CBBEL have presented information to and solicited information from the Cal-Sag Channel Watershed Council as part of the watershed planning process.

One of the challenges with stormwater management is that a project or change in one location can affect another location in a separate municipality, especially a downstream jurisdiction. 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 municipalities and agencies can benefit the watershed when working together.

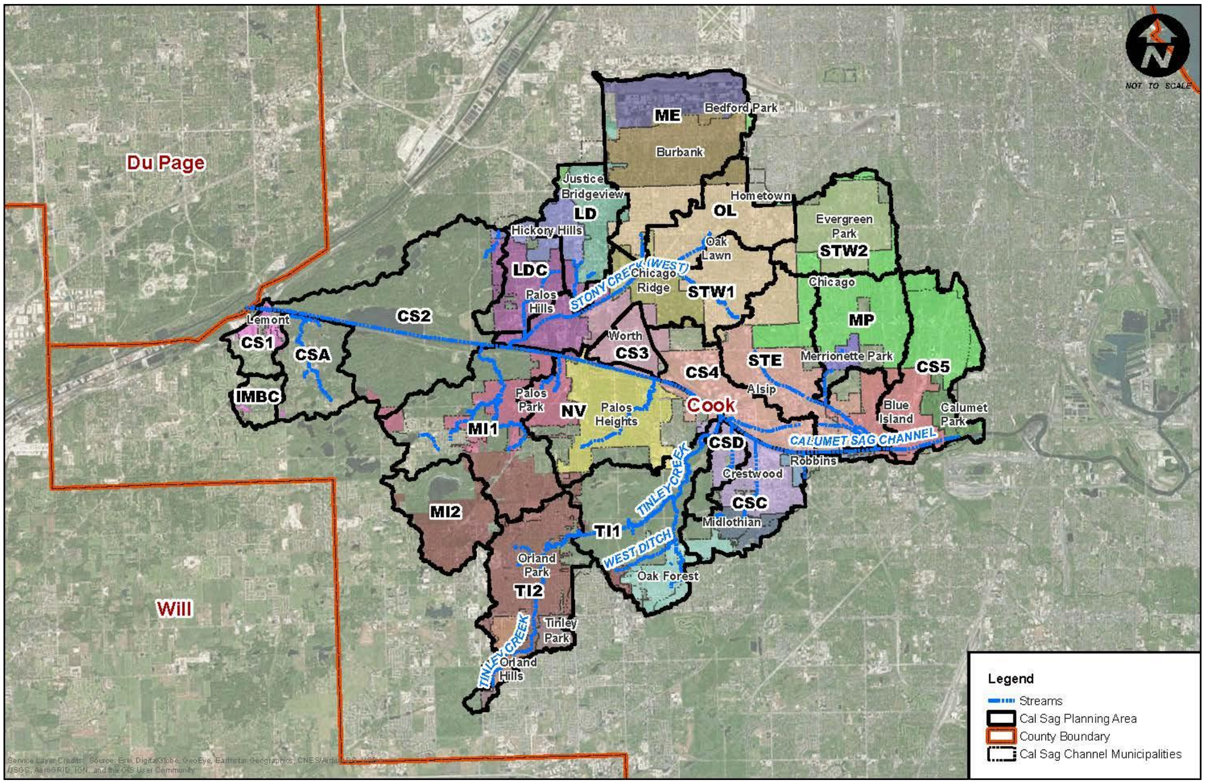


Figure 3.3-1 Municipalities within the Cal-Sag Channel Planning Area

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, the proximity of Lake Michigan, and urban areas.

The planning area has a continental climate with hot, wet summers and cold, snowy winters. The seasons' average temperatures are 22˚F in the winter and 70˚F in the summer. Annual rainfall averages 36 inches and snowfall of 37 inches. Consistent with a continental climate, there is no pronounced wet or dry season (according to City Data).

The winter season features the four driest months (December 2.57 in., January 1.92 in., and February 1.80 in., and March 2.38 in.) while summer features the wettest rainfall months (July 4.37 in., and August 4.23 in.). Spring (April through June) and fall (September through November) are similar for their average seasonal precipitation totals, 10.11 in. (3.37 in./mo.) and 9.2 in. (3.07 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 an extensive road network results in large amounts of applied road salts whose fate has a negative impact on both local surface waters and shallow groundwater.

3.5 CLIMATE CHANGE

While we have discussed the averages for the Illinois climate in the previous section, and the corresponding rainfall amounts, we are aware that the Cook County has experienced significant departures from the "average" rainfall storms many times over the past 20-plus years. Where we would often see rainfall of modest intensity over many hours or days, the Cook County area has been experiencing much more intense rainfall events that have led to significant flooding and degradation of water quality. The rainfall data used in the County and local ordinances typically references Bulletin 70 rainfall data prepared by Angel and Huff for a period 1901 to 1980. Another common source for rainfall data for the watershed is NOAA Atlas 14. Christopher B. Burke Engineering, Ltd. performed a detailed statistical analysis of the Cook County Precipitation Network rainfall dataset. This dataset is a quality controlled and hourly rainfall data for 25 stations throughout Cook County for the period of 1989-2013. The analysis utilized an L-moments approach which ensured that the dataset was homogeneous and used several different regressions to estimate the best fit for the dataset. The results of the analysis were then compared to previous rainfall studies in the region using older rainfall data including Bulletin 70 and NOAA Atlas 14.

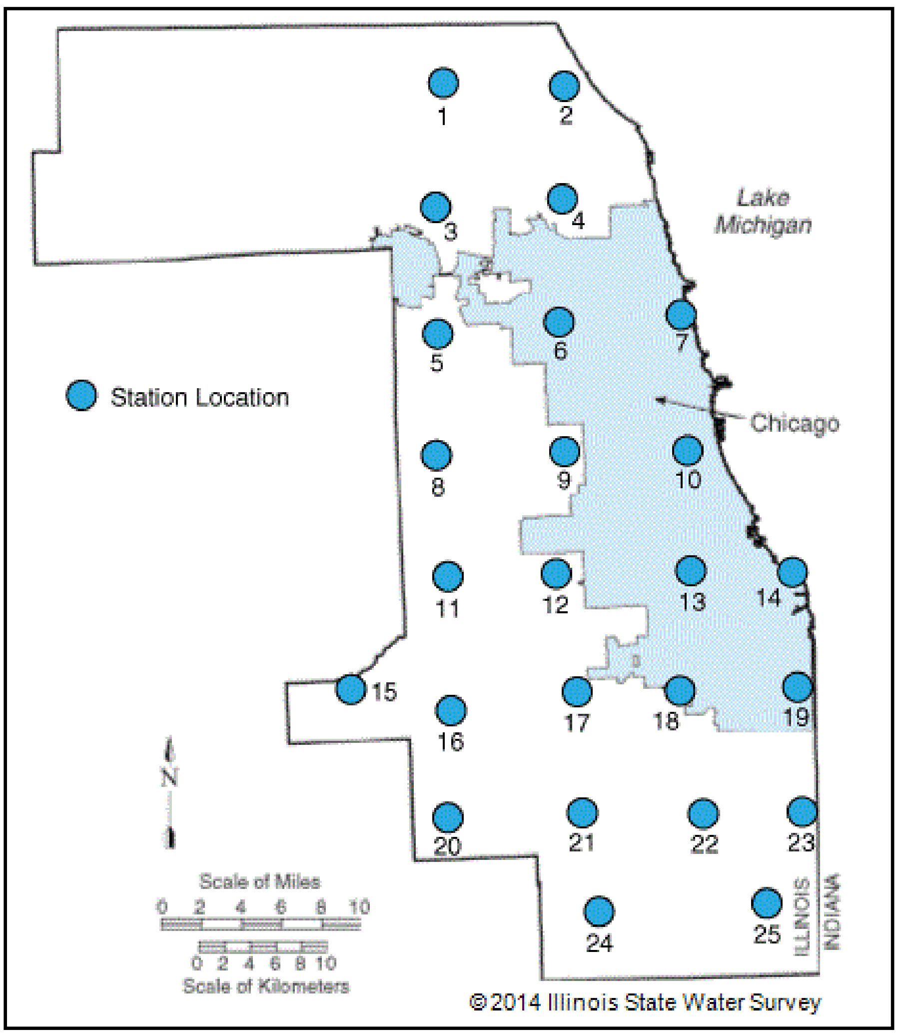


Figure 3.5-1 Cook County Precipitation Network Rain Gauge Location Map

As shown in Figure 3.5-1, the Cook County Precipitation Network contains 25 rain gauge locations throughout the County. Stations 21, 22 and 23 are located near or within the Cal-Sag Channel Planning Area. The results derived in the rainfall study were compared to historical rainfall estimates obtained from Bulletin 70 and NOAA Atlas 14. The estimated intensity which resulted from this study was found to be higher than Bulletin 70 at longer rainfall durations (greater than 3-hour) while in shorter durations (less than 3-hour) the estimated intensities are less than the ones in Bulletin 70. Furthermore, the rainfall estimates from this study was found to be higher than NOAA Atlas 14 study in all durations except for 1-hour duration where lower rainfall depths were estimated. These discrepancies can be explained by differences in the data and methodology used and the studied region. For Bulletin 70, Cook County has been considered as part of a larger section, identified as Northeast Illinois. The NOAA Atlas 14, volume 2, studied the Midwest region including Illinois with 11 stations in Cook County. The results presented herein were derived from actual rainfall data for all durations while in Bulletin 70, the estimates for durations shorter than 24 hours was obtained by applying duration-specific conversions to the 24-hour estimates.

NOAA 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. Using the data for our study, the mean number of days annually with the daily precipitation of larger than 0.01-inches, 0.1-inches, 0.5-inches and 1-inch was calculated for all 25 stations in Cook County and the results for stations within the Cal-Sag Channel Planning Area are presented in Table 3.5-1.

Station #	Mean Number of Days Annually			
	Daily Precipitation			
	>=0.01	>=0.10	>=0.50	>=1.00
21	111.8	71.0	24.2	8.3
22	109.6	67.6	23.8	8.0
23	107.0	69.3	23.7	8.4

Table 3.5-1 Mean Number of Days Annually in Which Variable Precipitation Occurred

The results for station #23, a station within the Cal-Sag Channel watershed, were compared to the results obtained from NOAA's studies on the O'Hare International Airport station (Table 3.5-2).
Data presented in Table 3.5-2, show a higher mean number of days were obtained from this study versus NOAA's study for the more intense rainfalls (greater than 0.5-inch and greater than 1-inch) while for the less intense rainfalls (greater than 0.01-inch and greater than 0.1-inch) a lower number of days were noted from this study versus the NOAA's studies within 1971-2000 and 1981-2010.

Source	Mean Number of Days Annually with Daily Precipitation Greater Than			
	0.01"	0.10"	0.50"	1.00"
NOAA NCDC Chicago O'Hare Intl Airport, IL COOP ID 111549, 1971-2000	127.0	69.9	22.5	8.1
NOAA NCDC Chicago O'Hare Intl Airport, IL COOP ID 111549, 1981-2010	124.1	69.1	22.7	8.3
CBBEL Study, Station #23 (station within the Little Calumet Watershed), 1989-2013	107.0	69.3	23.7	8.4

Table 3.5-2 Study Results versus NOAA Published Study

Urban runoff and stormwater discharges are the most significant source of pollutant loadings in the Cal-Sag Channel Watershed. Changing rainfall patterns are expected to increase runoff volumes and pollutant loadings. 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 lakes. The precipitation analyses discussed here suggests properly-sized BMPs to capture rainfall runoff will be increasingly important for the control of nonpoint source pollution.

3.6 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 manner in which 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 U.S. Department of Agriculture – Natural Resources Conservation Service (NRCS).[1]

3.6.1 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 hydrologic soil groups 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 3.6-1).

[1] The NRCS Soil Survey of Cook County is posted on-line here: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/illinois/cookIL2012/Cook_IL.pdf

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	955.4	1.4
A/D	The first letter applied to the drained condition and the second to the undrained condition	1369.8	2.1
B	Soils have a moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.	1678.9	2.5
B/D	The first letter applied to the drained condition and the second to the undrained condition	3967.0	6.0
C	Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.	19827.0	29.9
C/D	The first letter applied to the drained condition and the second to the undrained condition	12141.3	18.3
D	Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.	10833.3	16.3
Unclassified	n/a	15493.6	23.4
	Totals	***66266.3***	***100.0***

Table 3.6-1 Characteristics and extent of hydrologic soil groups in the Cal-Sag Channel Planning Area

The majority of the Cal-Sag Planning Area features Group C soils (nearly 30 percent) (Figure 3.6-1). The dual group C/D and Group D soils are the next most common at 18.3 and 16.3 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 3.6-1 (next page) illustrates a general pattern of HSG 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.

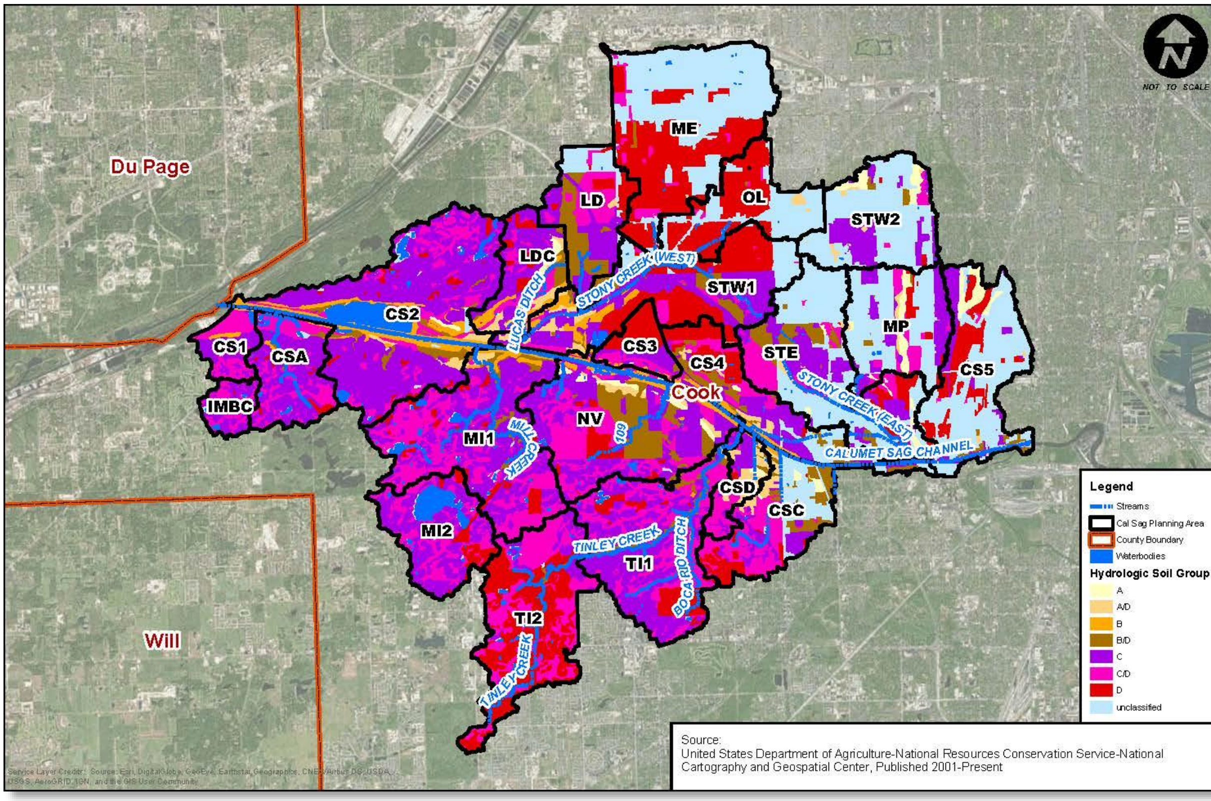


Figure 3.6-1 Hydrologic Soil Groups in the Cal-Sag Channel Planning Area

3.6.2 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.

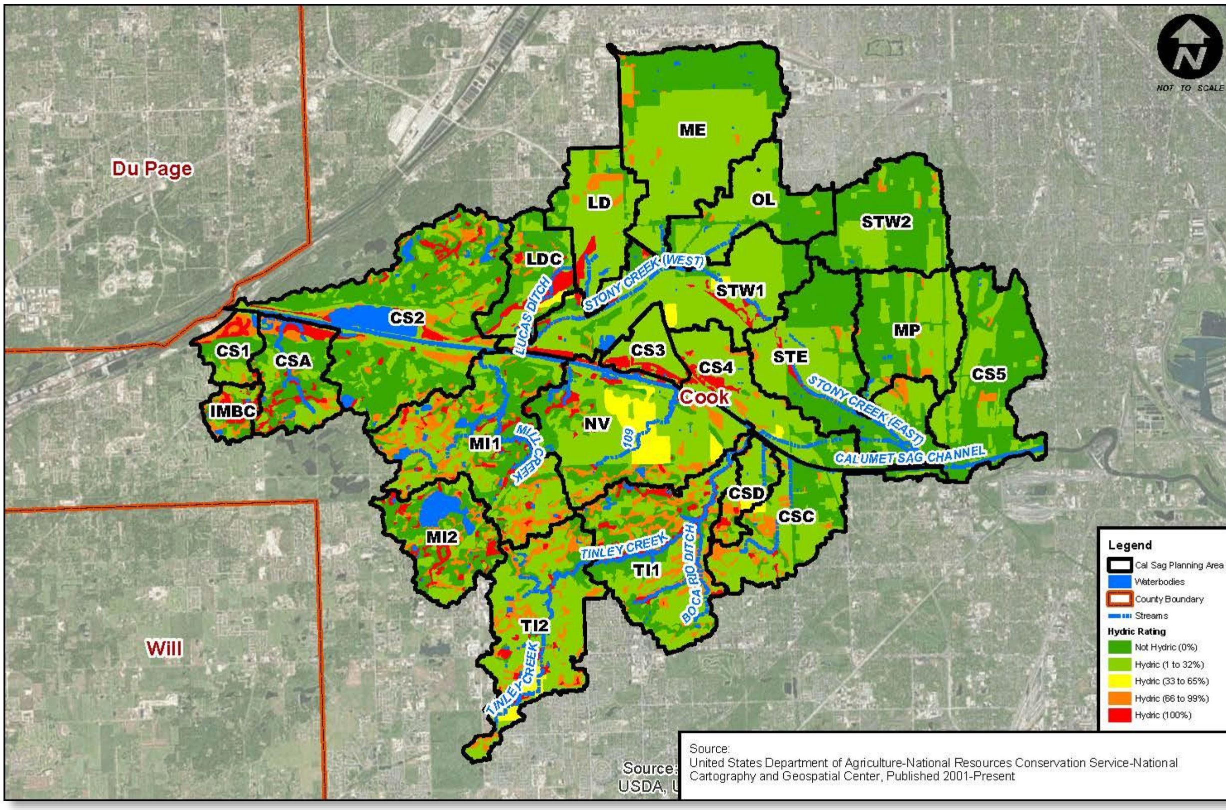


Figure 3.6-2 Hydric Soils in the Cal-Sag Channel Planning Area

The extent of hydric soils within the Cal-Sag Channel Planning Area is shown in Figure 3.6-2 and summarized in Table 3.6-2. Approximately 85% of the Cal-Sag Channel Planning Area features "not hydric" soils (rows 1 and 2 in the Table). "All hydric" soils are distributed throughout the planning area, most commonly along stream and river corridors, and represent about 13 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%)	24,609.2	37.1
Hydric (1 to 32%)	31,824.4	48.0
Hydric (33 to 65%)	1,184.2	1.8
Hydric (66 to 99%)	5,282.4	8.0
Hydric (100%)	3,365.9	5.1
Totals	***66,266.3***	***100.0***

Table 3.6-2 Hydric Soil extent in the Cal-Sag Channel Planning Area

3.6.3 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 Cal-Sag Channel Planning Area is shown in Figure 3.6-3 and enumerated in Table 3.6-3.

Knowledge of soil drainage class has both agricultural and nonagricultural applications. For example, Well Drained drainage classes (which cover approximately 12% of the planning area) indicate areas where stormwater infiltration BMPs may best be utilized. On the other hand, the Excessively Drained or Somewhat Excessively Drained soils (about 1.4% and 0.05% of the planning area, respectively) 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 28.8% 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 rain gardens may need to be constructed with under-drains in areas with these soils.

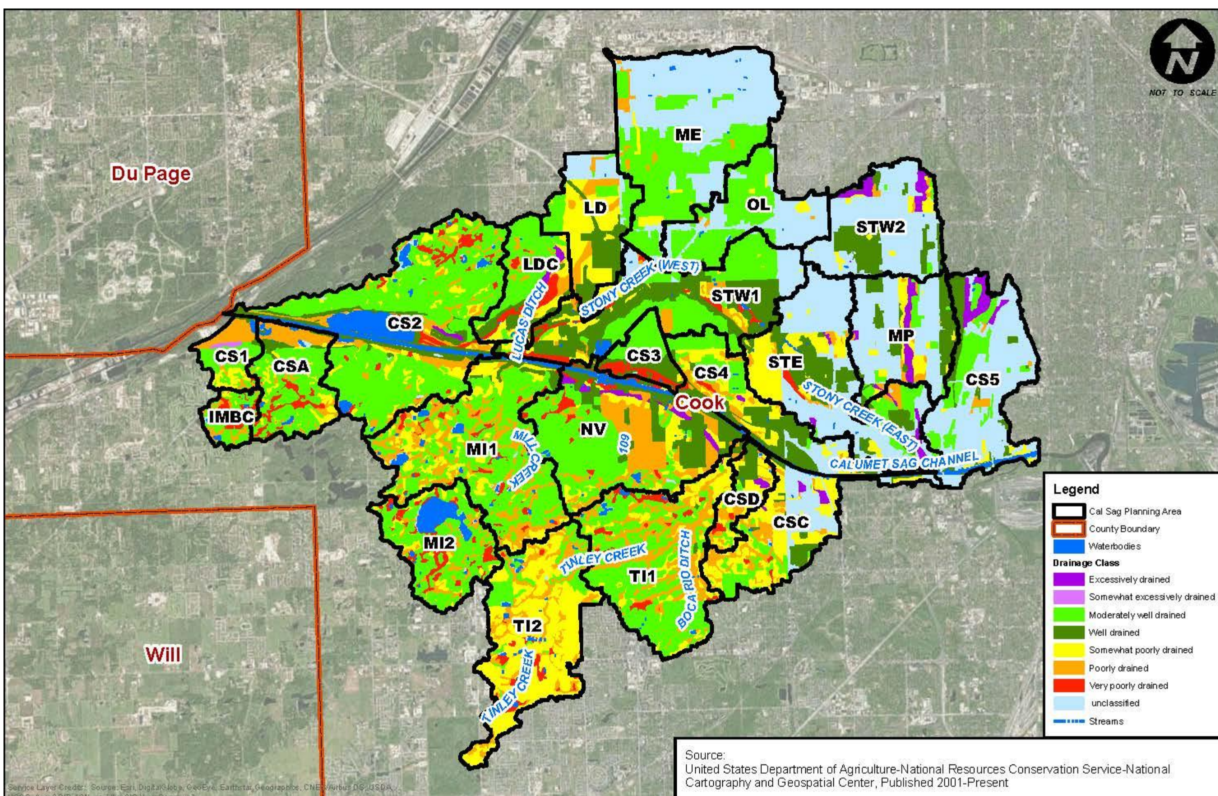


Figure 3.6-3 Soil Drainage Classes in the Cal-Sag Channel Planning Area

Soil Drainage Class	*Area (acres)*	*Percent of Planning Area*
Excessively Drained	960.7	1.4
Somewhat Excessively Drained	30.4	0.0
Moderately Well Drained	22,806.6	34.4
Well Drained	7,964.5	12.0
Somewhat Poorly Drained	9,589.1	14.5
Poorly Drained	7,107.8	10.7
Very Poorly Drained	2,355.4	3.6
unclassified	15,451.7	23.3
Totals	***66,266.3***	***100.0***

Table 3.6-3 Extent of Soil Drainage Classes in the Cal-Sag Channel Planning Area

3.6.4 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 Figure 3.6-4) and 5 tons per acre per year is for deep soils that are least subject to damage by erosion (shown as green in Figure 3.6-4).

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.

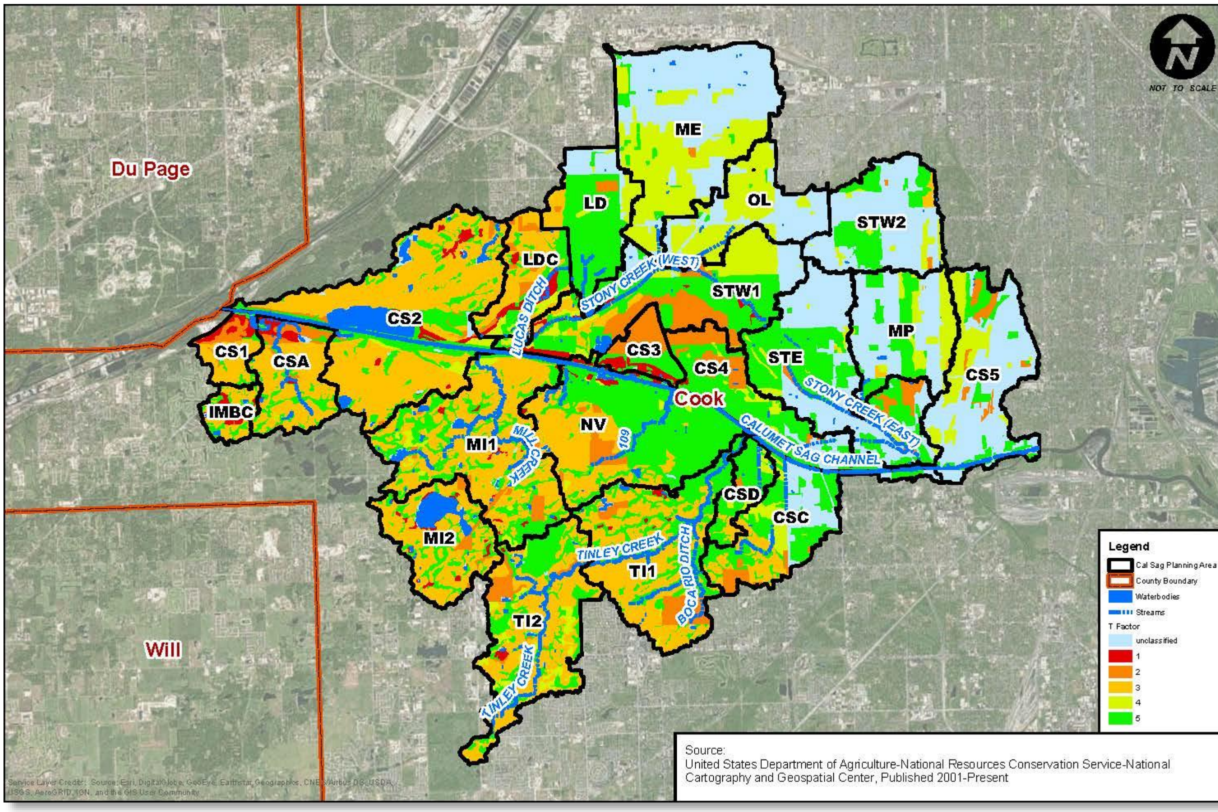


Figure 3.6-4 Highly Erodible Soils in the Cal-Sag Channel Planning Area

T Factor (tons/acre/year)	Area (acres)	Percent of Planning Area
0/unclassified	15,493.6	23.4
1	1,395.5	2.1
2	4,144.5	6.3
3	18,331.8	27.7
4	7,569.0	11.4
5	19,331.9	29.2
Totals	***66,266.3***	***100.0***

Table 3.6-4 Extent of Erodibility in the Cal-Sag Channel Planning Area

3.7 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 in order 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 5.6 percent (3,702 acres) lies within the 100-year floodplain limits. The 3,702 acres includes studied and unstudied (Zone A) floodplains. About 0.7 percent (493.4 acres) of the planning area lies between the studied 100-year and 500-year floodplain (Table 3.7-1, Figure 3.7-1). The total area of the 500-year floodplain is all the Zone A, 100-year and 500-year floodplain which is roughly 4,200 acres or 6.3% of the planning area. Encroachments in the floodplain should be monitored by communities since they can lead to increased upstream and downstream flood elevation.

Floodplain	*Cook County Area (acres)*	*Percent of Planning Area*
Zone A (unstudied)	2,358.6	3.6%
Only 100-year Floodplain	1,343.4	2.0%
Only 500-year Floodplain	493.4	0.7%
Totals	***4,195.4***	***6.3%***

Table 3.7-1 Floodplains in the Cal-Sag Channel Planning Area

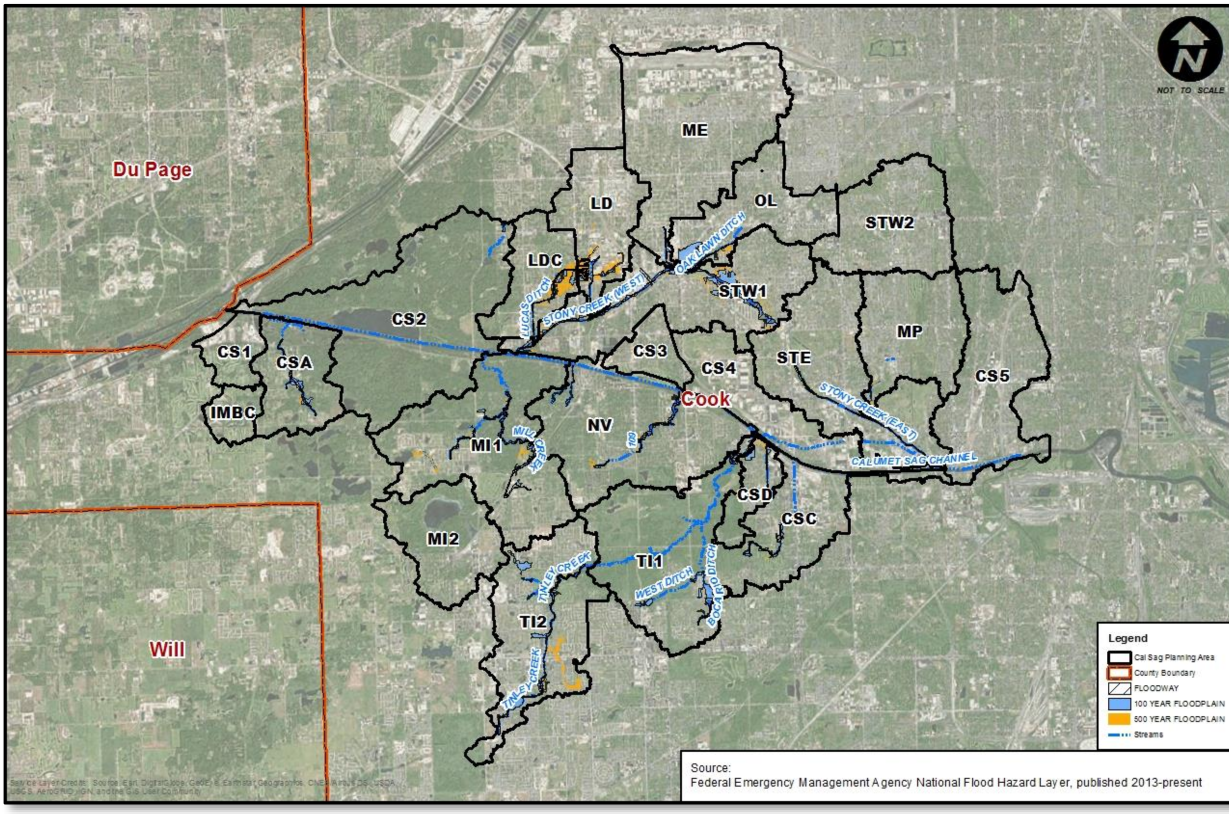


Figure 3.7-1 Floodplains in the Cal-Sag Channel Planning Area

3.8 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 3,425 acres of wetlands, about 5% percent of the land area, within the Cal-Sag Channel Planning Area. 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. The watershed does have a high concentration of wetlands associated with the FPDCC properties in the west and southwest portions of watershed planning area.

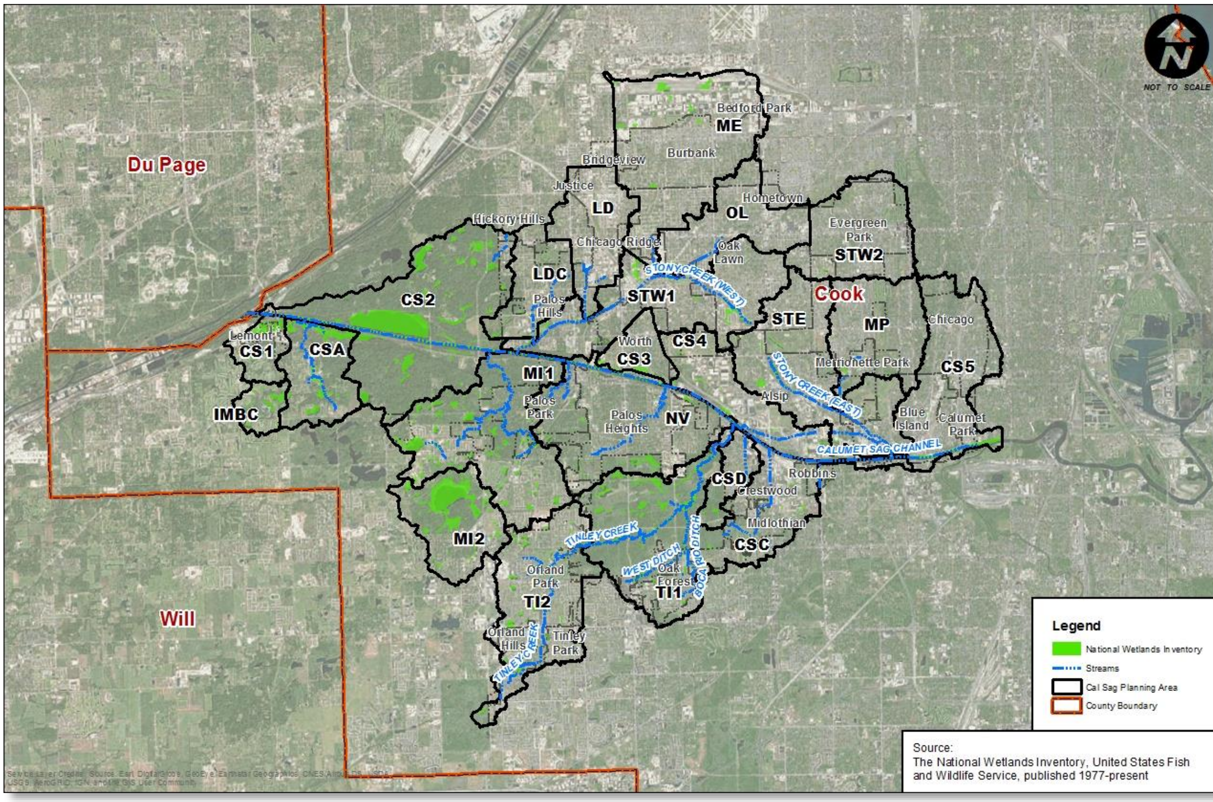


Figure 3.8-1 Wetlands in the Cal-Sag Channel Planning Area

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 CMAP's 2013 Land Use Inventory Classification Scheme and data inventory. The land-use scheme employs a new methodology and results in 57 categories of land use that are aggregated under five general categories: Urbanized, Agriculture, Open Space, Vacant or Under Construction, and Water. CMAP's land-use data is parcel based.

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). Open space (26.2%) and Residential (33.7%) are the most predominant land uses within the planning area. This is due in large part to the FPDCC land which is included within the open space category. Vacant land is the third least common of the area (2.8%). Agricultural land is the least common type of land use (0.6%). Right-of-way is 15.1% of the land area, which is important to note since these areas may present opportunities for publicly-owned and maintained BMPs. Overall the watershed planning area is highly developed north of the Cal-Sag Channel mainstem with little remaining open space. There is a large forest preserve complex both south of the Cal-Sag Channel and in the western portion of the planning area. Forest Preserve constitutes nearly 25% of the land use within the Cal-Sag Channel Planning Area.

Land use within each of the watershed planning unit is shown in Figure 3.9-1 and is tabulated by the 10 major categories in Table 3.9-1. It is extremely important to consider land use in the watershed planning process as land use relates to the types of pollutant runoff that will occur and proposed watershed protection projects.

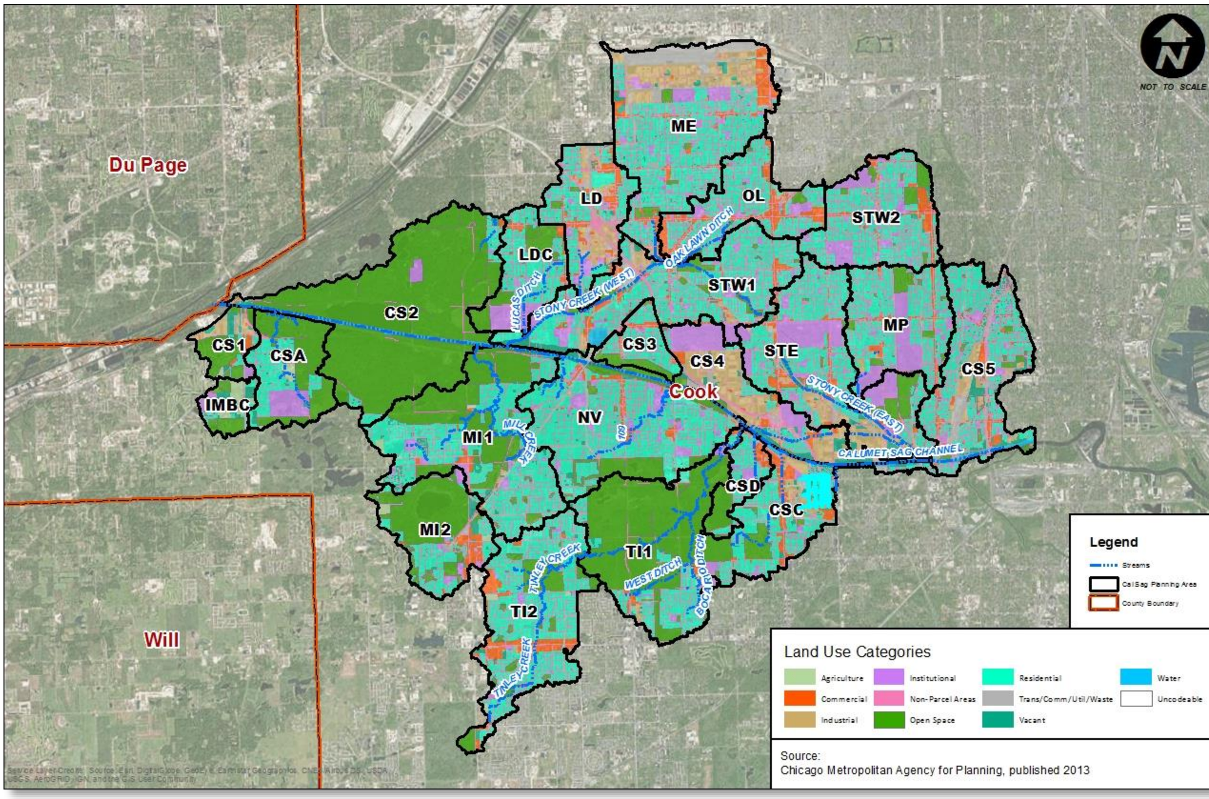


Figure 3.9-1 Land Use in the Cal-Sag Channel Planning Area

Land-Use Category	*Area (acres)*	*Percent of Planning Area*
Agriculture	371.4	0.6%
Residential	22,346.4	33.7%
Commercial	3,231.5	4.9%
Institutional	4,704.0	7.1%
Industrial	3,126.0	4.7%
T/C/U/W	2,688.2	4.1%
Open Space	17,329.4	26.2%
Right of Way	10,007.3	15.1%
Vacant/Under Construction	1,878.1	2.8%
Water	583.9	0.9%
Total	***66,266.3***	***100.0%***

Table 3.9-1 Land-Use Categories and extent within Cal-Sag Channel Planning Area

Notes: T/C/U/W = transportation, communications, utilities, and wastewater

It is extremely important to strongly consider land use in the watershed planning process as land use relates the types and amounts of pollutant runoff that will occur and the types of watershed projects that will be most appropriate and most effective.

3.10 IMPERVIOUS SURFACE

Impervious surface is a land cover use that is paved or otherwise overlain with nonporous material (e.g., concrete, asphalt, roofs, etc.) that prevents infiltration of rain and snowmelt and is responsible for generating runoff and nonpoint source pollution. Impervious areas produce significant amounts of runoff, which is often delivered to receiving system rapidly through storm sewer networks. Impervious surface changes local hydrology which often leads to downcutting and widening of stream channels. The resultant erosion of the streambanks and streambeds further aggravates water quality and can negatively impact land resources and infrastructure. Impervious surfaces and the resultant runoff may also contribute to erosion of lakeshore areas. In addition, runoff from impervious areas often picks up pollutants, for example as water runs across a road or parking lot, and these pollutants are delivered to nearby surface waters. Given the impacts of impervious surface on local hydrology, water quality, and other resources, this man-made feature of the landscape warrants special attention in any effort to protect or restore water quality.

The National Land Cover Database 2011 (NLCD 2011) for the watershed planning area is shown in Figure 3.10-2. The NLCD 2011 is the most recent Landsat-based, 30-meter resolution land cover database for the Nation and corresponds well with the CMAP 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%.

The potential change in impervious surface area due to population increases discussed in the previous section may contribute to higher flow rates and higher volumes of stormwater runoff produced within the watershed. Wide expanses of impervious surfaces without stormwater control result in high amounts of runoff, which in turn causes stream sections to be flashy, which in turn degrades channels and produces erosion and sediment releases. For purposes of this plan, the extent of impervious surface is best understood in the context of its impact on water quality (Figure 3.10-1). As the percentage of land cover imperviousness increases, general watercourse health degrades. This water quality can be understood as a function of impervious area coverage within the tributary area.

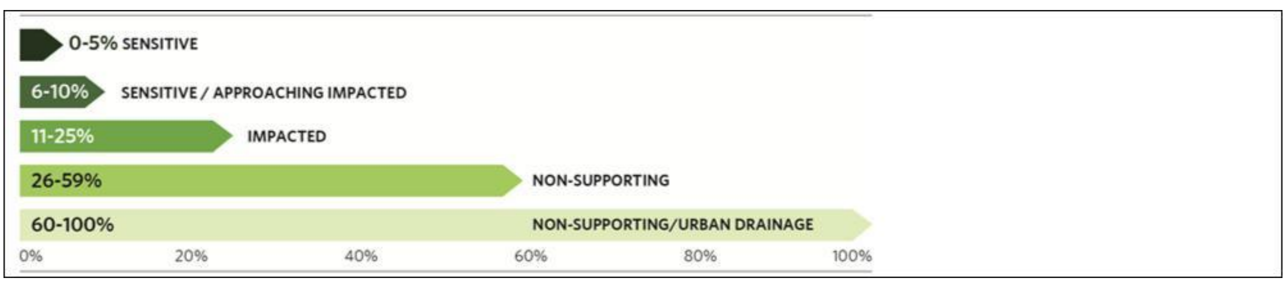


Figure 3.10-1 Stream Health Categories Relative to Extent of Impervious Surface

Figure 3.10-2 displays the pattern and extent of impervious surface within the Cal-Sag Channel planning area. Most of the planning area is at least 40% impervious, with the exception of the Saganashkee Slough in the Palos Preserves, which contains four miles of shoreline and approximately 377 acres (FPDCC). 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.

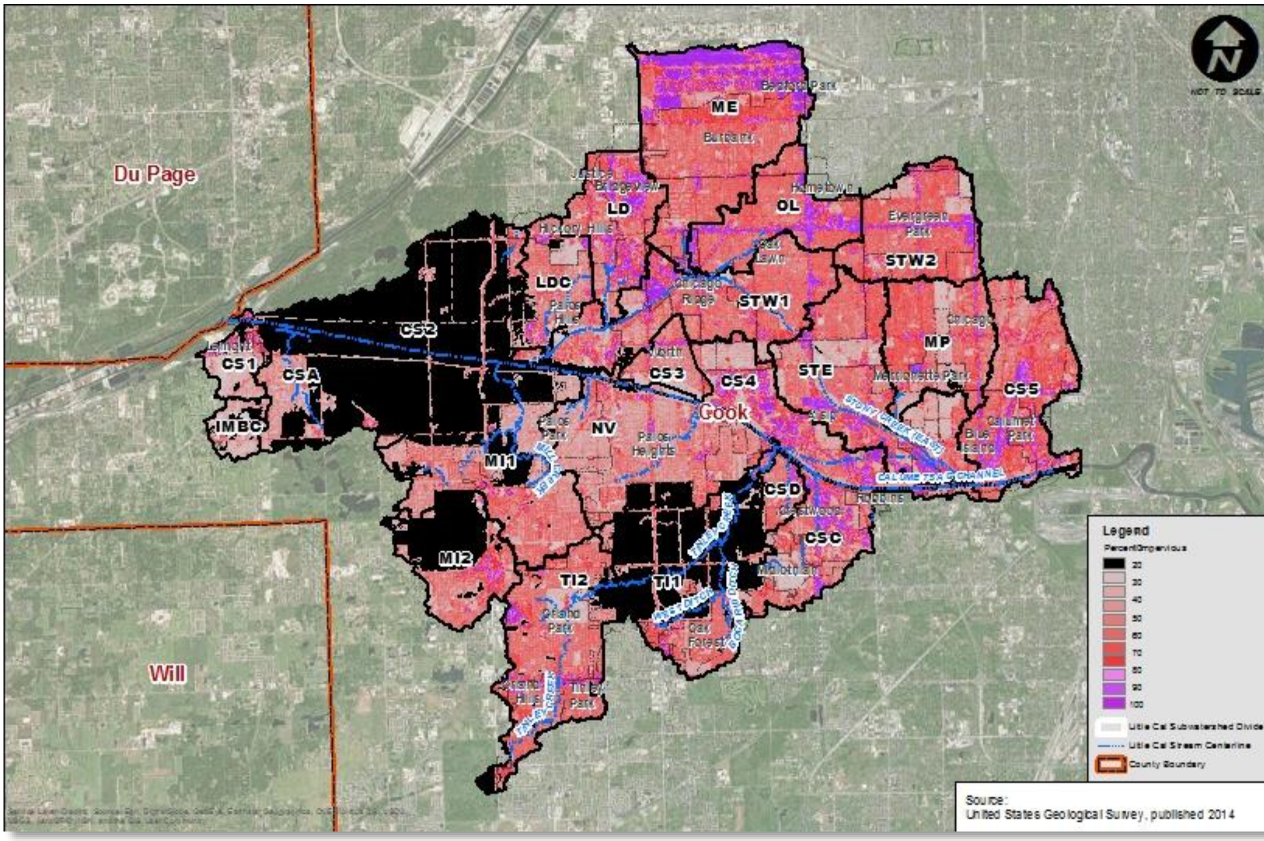


Figure 3.10-2 Impervious Surface (0-100%) in the Cal-Sag Channel Planning Area

The watershed planning units adjacent to the I&M Canal (CS2, which contains the Palos Preserves) warrants special consideration as development proceeds to maintain relatively good water quality for both this planning area and the downstream watersheds. Conservation development and green infrastructure will need to be implemented as development occurs in this area. For the existing highly impervious areas, low impact development and site-level green infrastructure should be retrofitted into these areas at the highest levels possible to not worsen the water quality of the entire area. Population and employment growth forecasts for the planning area and County as discussed above suggest that without ordinances and subdivision codes that seek to protect water quality, the likelihood of water resource degradation is great.

3.10.1 Coal Tar-Based Sealants

Impervious surfaces including roads and parking lots are of concern from a water quality perspective because water runs off these surfaces, drains into sewers, and is released in large quantities to receiving waters. There are physical effects from the stormwater discharges, in particular erosion from the volumes and energy in the discharges, but there are also chemical effects. The water picks up pollutants as it runs across surfaces and these substances are carried to the water bodies in the watershed. Pollution prevention practices can be employed to help reduce the amount of pollutants in the stormwater.

One practice that has specific and important water quality and public health implications is the sealing of pavements. Pavement sealants are applied to the asphalt pavement of many parking lots, driveways, and even playgrounds in the U.S. When first applied, the sealants cover the pavement with a glossy black and to a degree make the pavement look like new. Sealant products used commercially in the central, eastern, and northern U.S. very often are coal-tar-based (whereas those used in the western U.S. typically are asphalt-based). Although the products look similar, they are chemically different. Coal-tar-based pavement sealants typically are 25-35 percent (by weight) coal tar or coal-tar pitch. Coal tar is a thick black liquid that's a byproduct of coke production. Coal tar contains high concentrations of a family of chemicals known as polycyclic aromatic hydrocarbons or PAHs. Sixteen PAHs have been classified by the U.S. Environmental Protection Agency as "Priority Pollutants." Six are classified as probable human carcinogens, and one (benzo[*a*]pyrene) is classified as a known human carcinogen. These are chemical substance we want to keep out of our air and water.

Coal tar-based pavement sealant products contain, on average, about 70,000 mg/kg of PAHs, on the order of 1,000 times higher than asphalt-based sealant products.[2] The fact that there is sealant on a driveway or parking lot or playground is not a water quality concern in and of itself. However, what happens is the sealant wears off the pavement over time, due to weather and vehicle traffic and snow plowing. The sealant is worn a fine powdery texture that is picked up by stormwater and transported to streams or lakes. PAHs can also accumulate in stormwater detention ponds. Also important, some PAHs can dissolve into stormwater, especially if it rains soon after the sealant is applied. Having PAHs out in the environment is detrimental to the health of water bodies and the health of people.

A good pollution prevention practice to limit the release of PAHs in a watershed is to use a sealant product other than a coal tar-based sealant. Another option is to not seal pavement at all. In particular, converting a parking lot or driveway or playground to permeable pavement will allow water to soak into the ground and reduce stormwater discharge volumes and pollutant releases.

3.11 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. Land that is owned by the FPDCC is a core component of the open space reserve within the planning area. Public parks are included along with private land on which a conservation easement is placed (Figure 3.11-1). Also shown on the figure are golf courses and other land that is privately held and could be sold and converted to a type of land use that is neither protected nor considered to be in a conservation status; thus, these lands are not necessarily a permanent part of the open space reserve.

[2] USGS https://tx.usgs.gov/sealcoat.html

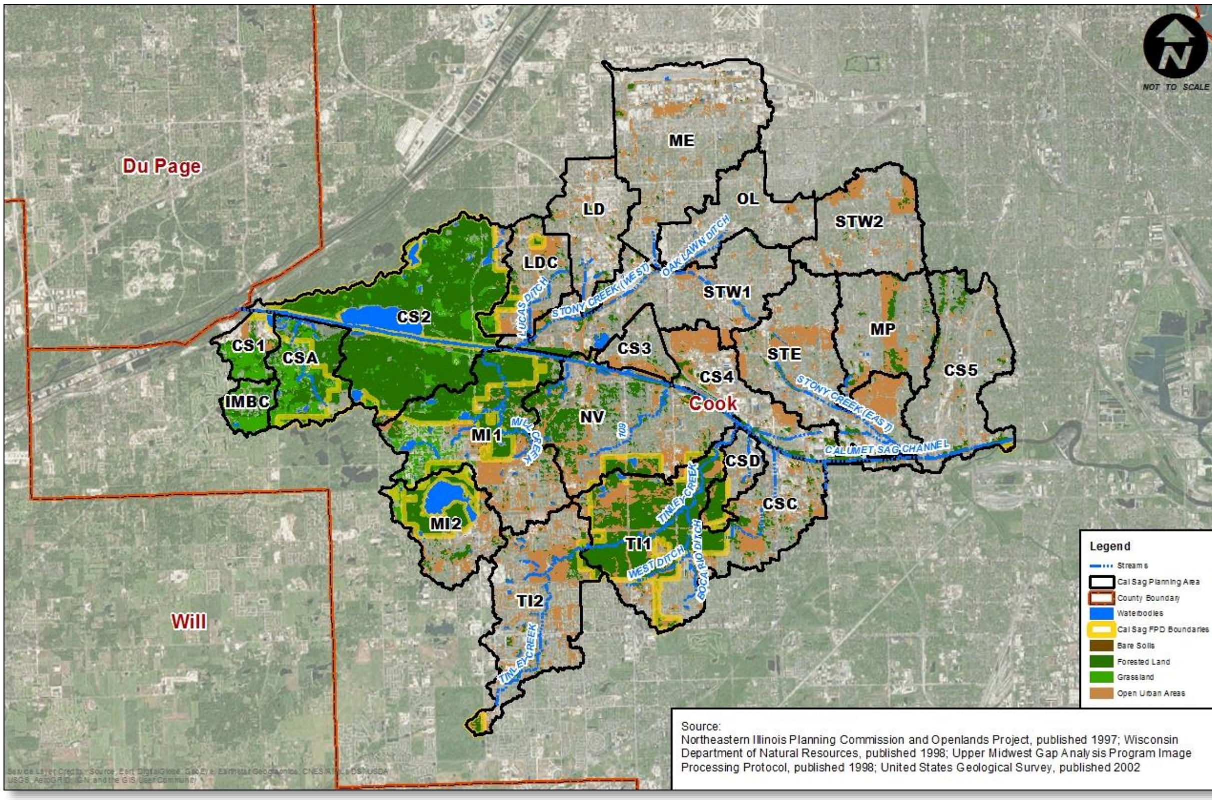


Figure 3.11-1 Greenways and Open Urban Areas in the Cal-Sag Channel Planning Area

Vegetation Type	*Area (acres)*	*Percent of Planning Area*
Bare Soils	11.6	0.0
Forested Land	13,491.5	20.4
Grassland	2,685.4	4.1
Open Urban Areas	10,410.7	15.7
Totals	***26,599.1***	***40.1***

Table 3.11-1 Greenways and Open Urban Areas in the Sal-Sag Channel Planning Area

3.12 PRESETTLEMENT LAND COVER

For a qualitative sense of historical land use change, Figure 3.12-1 shows the presettlement land cover (primarily vegetation) in and around the Cal-Sag Channel 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 bottomland, slough, swamp, or other wetland types) and open water. Following European settlement, most of this land was converted to agricultural practices, followed by residential and commercial land uses. This historic land cover can be informative for current land use planning and future ecological restoration projects.

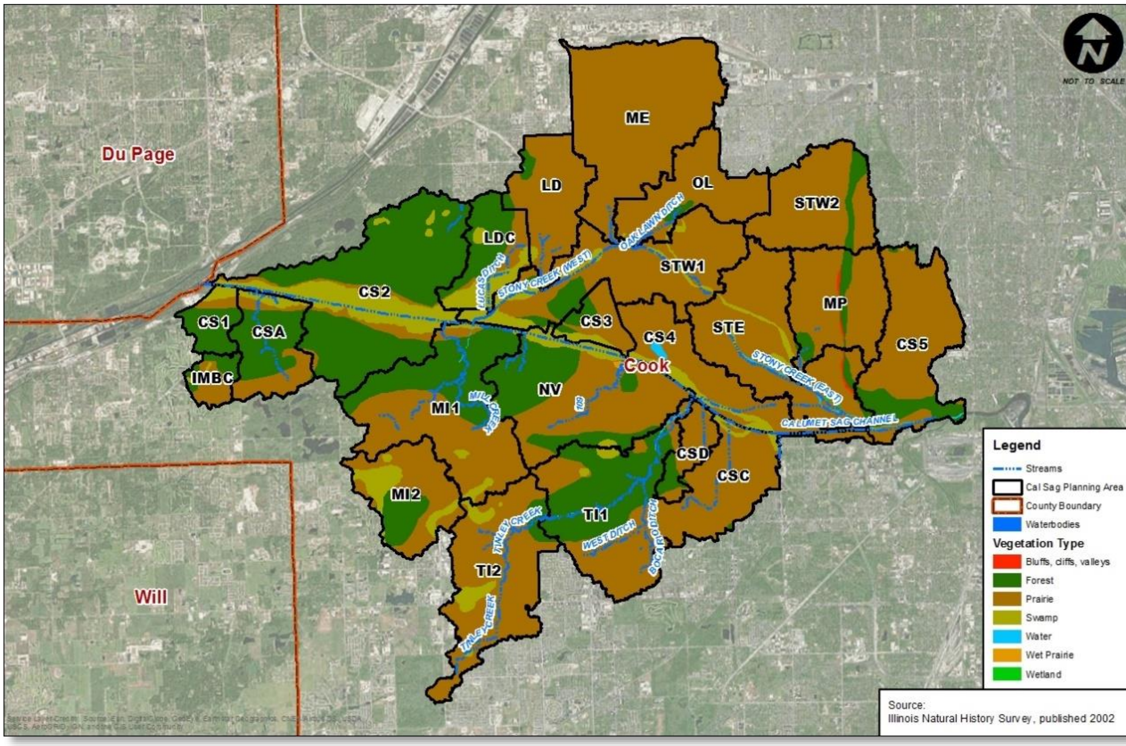


Figure 3.12-1 Presettlement Land Cover in the Cal-Sag Channel Planning Area

Vegetation Type	*Area (acres)*	*Percent of Planning Area*
Bluffs, cliffs, valleys	57.5	0.1
Forest	16,413.2	24.8
Prairie	44,390.4	67.0
Swamp	5,188.8	7.8
Water	168.5	0.3

Vegetation Type	*Area (acres)*	*Percent of Planning Area*
Wet Prairie	31.2	0.0
Wetland	16.6	0.0
Totals	***66,266.3***	***100.0***

Table 3.12-1 Presettlement Land Cover in the Cal-Sag Channel Planning Area.

3.13 WATERSHED DRAINAGE SYSTEM

Water in the approximately 103 square mile Cal-Sag Channel watershed generally flows from east to west toward the I&M Canal. The Cal-Sag Channel originates near the confluence of the Little Calumet River at Calumet Park and continues west toward the I&M Canal. There are several smaller watercourses in the watershed planning area both north and south of the mainstem Cal-Sag Channel. The watercourses north of the mainstem Cal-Sag Channel generally flow south and the watercourses south of the mainstem Cal-Sag Channel flow north. The Cal-Sag Channel Planning Area consists of the mainstem and the main tributaries, as described below and shown in Figure 3.13-1.

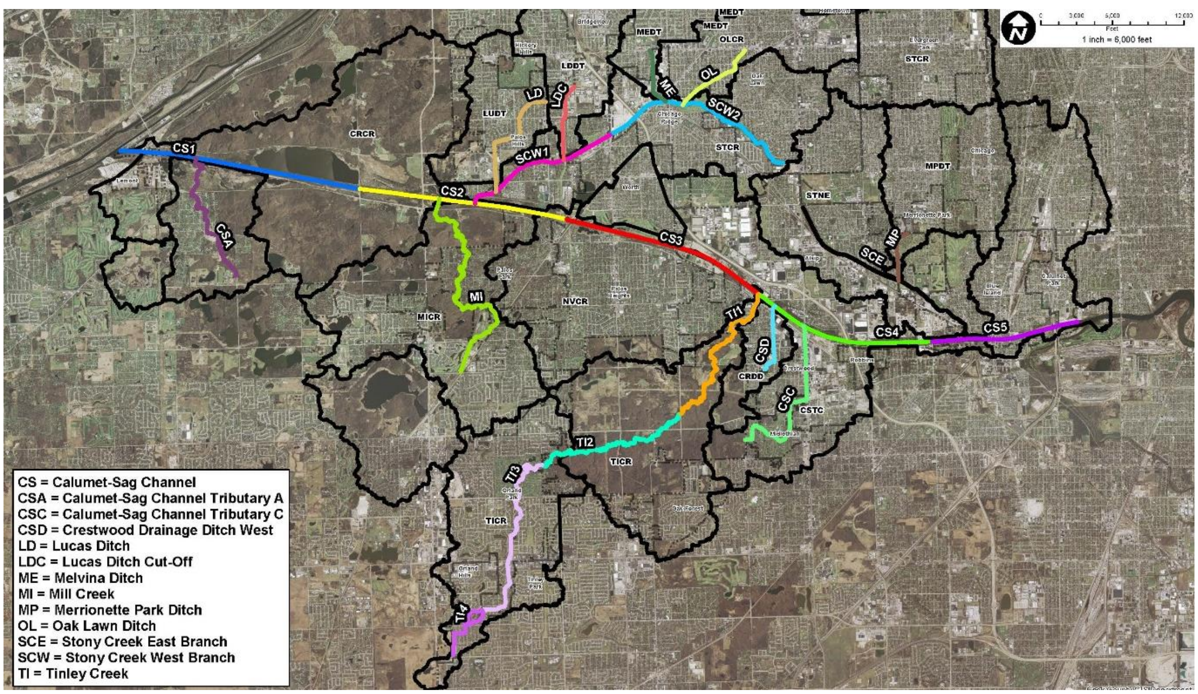


Figure 3.13-1 Watershed Drainage in the Cal-Sag Channel Planning Area

3.13.1 Cal-Sag Channel

The Calumet Sag Channel watershed planning unit includes the mainstem of the Cal-Sag Channel with major tributaries including Tinley Creek, Mill Creek, Stoney Creek West Branch and Tributary A. The Cal-Sag Channel is approximately 15.8 miles long and serves as a channel between the Little Calumet

River and the Chicago Sanitary and Ship Canal. The Cal-Sag Channel and its tributaries measure approximately 88.4 miles long. There are many lakes along the west end of the Cal-Sag Channel, most of which are associated with forest preserve property. Another large waterbody located in the Cal-Sag Channel watershed planning unit is Long John Slough, which is southwest of the intersection of 95th Street and Flavin Road in Willow Springs. Long John Slough is one of several waterbodies in the Palos Preserves and drains south into Saganashkee Slough. Saganashkee Slough is located immediately north of the Cal-Sag Channel, southwest of the intersection of 107th Street and South Willow Springs Road in Willow Springs. The 377-acre slough drains directly into the Cal-Sag Channel. Lake Arrowhead is also located within this watershed planning unit. The Lake drains into Navajo Creek, which one of the Cal-Sag Channel's smaller tributaries. Lake Arrowhead is located southeast of the intersection of Harlem Avenue and 131st Street in Worth Township, and is approximately 12 acres in size. More information regarding the aforementioned waterbodies is provided in Section 3.16. Lake Katherine is one of the large lakes that feeds into the Cal-Sag Channel. It is located northwest of the intersection of Harlem Avenue and 119th Street in Palos Heights. Lake Katherine is approximately 10.0 acres in size.

3.13.2 Cal-Sag Channel Tributary A

The Cal-Sag Channel Tributary A watershed planning unit drains approximately 2.96 square miles from the headwaters near the intersection of South Will Cook Road and McCarthy Road in unincorporated Cook County. It drains to the northwest to where it drains into the Cal-Sag Channel. This area contains a mix of suburban development and open land that is predominantly owned by the Forest Preserve District of Cook County.

3.13.3 Cal-Sag Channel Tributary C

The Cal-Sag Channel Tributary C watershed planning unit drains approximately 3.35 square miles from the headwaters on the west side of Central Avenue, between the Midlothian Turnpike and 147th Street, in Midlothian. It drains to the northeast toward Midlothian Turnpike where it collected in a storm sewer and drains north into the Cal-Sag Channel. The watershed planning unit drains area from 4 different communities as well as open land/Forest Preserve District property.

3.13.4 Crestwood Drainage Ditch West

The Crestwood Drainage Ditch watershed planning unit drains approximately 1.3 square miles from the headwaters south of 135th Street, between Central Avenue and Cicero Avenue, in Crestwood. On the north side of 135th Street it drains north into the Cal-Sag Channel, south of 127th Street. The ditch is approximately 0.9 mile long. The watershed planning unit drains area from Crestwood and open land/Forest Preserve District property.

3.13.5 Lucas Ditch

The Lucas Ditch watershed planning unit drains approximately 2.7 square miles from the headwaters at S Roberts Road and 101st Street in Palos Hills. The ditch drains in a southwesterly direction until just north of 107th Street and east of S 88th Avenue where it turns to the south and flows in a straight line until it discharges into Stony Creek West Branch. The Lucas Ditch is approximately 2 miles long. The watershed planning unit drains area mostly from Palos Hills with some contribution from Hickory Hills and open land/Forest Preserve District property.

3.13.6 Lucas Ditch cut-off

The Lucas Diversion Ditch watershed planning unit drains approximately 3.4 square miles from the headwaters on the west side of S 76th Avenue, north of W 100th Place, in Crestwood. The ditch conveys runoff from highly developed areas. It drains into Stony Creek West Branch east of S Roberts Road and south of 107th Street. The watershed planning unit drains mostly areas from Bridgeview and Hickory Hills along with 4 other communities contributing less significant drainage areas.

3.13.7 Melvina Ditch

The Melvina Ditch watershed planning unit drains approximately 8.5 square miles and is enclosed in sewers in the majority of the watershed with the open ditch roughly 1 mile in length. The open ditch starts on the south side of 95th Street, immediately east of Chicago Ridge Mall. It continues south until West 99th Street where it turns southeast following railroad tracks until it reaches discharges into Stony Creek West Branch. The watershed planning unit drains mostly areas from Bedford Park, Burbank and Oak Lawn with 4 other communities with less significant drainage areas.

3.13.8 Mill Creek

The Mill Creek watershed planning unit drains approximately 10.6 square miles which includes 3.1 square miles of tributary area from Mill Creek West Branch. The headwaters of the creek are located at the southeast corner of the Palos Country Club, north of 135th Street and west of Southwest Highway in Orland Park. Mill Creek discharges into the Cal-Sag Channel. The watershed planning unit drains areas from Orland Park and Palos Park as well as large area of open land/Forest Preserve District property. McGinnis Slough is located in the Mill Creek watershed planning unit to the northwest of the intersection of Southwest Highway and 96th Avenue just north of Orland Park. The 300-acre slough drains east into Mill Creek. More information pertaining to McGinnis Slough is provided in Section 3.16.

3.13.9 Merrionette Park Ditch

The Merrionette Park Ditch watershed planning unit drains approximately 4.2 square miles. The headwaters of the creek are located on the south side of West 119th Street, just south of Merrionette Park and on the west side of Beverly Memorial Park Cemetery. Merrionette Park Ditch discharges into the Stony Creek East Branch on the east side of Alsip. The majority of the drainage from the watershed planning unit is from Chicago, with 4 other communities contributing drainage area as well as some open land/Forest Preserve District property.

3.13.10 Oak Lawn Ditch

The Oak Lawn Creek watershed planning unit drains approximately 3.7 square miles. The headwaters of the creek are located on the south side of 95th Avenue, just west of South 54th Avenue which is the start of Lake Oak Lawn. Lake Oak Lawn is located online with Oak Lawn Ditch at 96th Street and is a multiuse waterbody that is approximately 2.0 acres in size. It is discussed further in Section 3.16. Oak Lawn Creek discharges into Stony Creek East Branch. The watershed planning unit drains areas mostly from Oak Lawn as well as smaller amounts from 3 other communities.

3.13.11 Stony Creek East and West Branch

Stony Creek watershed is comprised of the East and West Branches. The Branches are connected at their upstream end by the Cicero Avenue storm sewer where stormwater can flow into both the east and west Branches. The area is near 111th Street and Cicero Avenue in Alsip. Five tributaries flow into Stony Creek with flow coming from 40.5 square miles of area. Oak Lawn Creek, Melvina Ditch, Lucas Diversion Ditch and Lucas Ditch flow into the West Branch. Merrionette Park Ditch flows into the East Branch. The watershed planning units drains areas from 15 communities as well as area of open land/Forest Preserve District property.

3.13.12 Tinley Creek

The Tinley Creek watershed planning unit drains approximately 12.9 square miles. The headwaters of the creek are located at W 171st Street and South 94th Avenue in Orland Hills. Tinley Creek drains in a northeasterly direction and discharges into the Cal-Sag Channel in Crestwood near the intersection of Route 83 and West 127th Street. The majority of the contributing area in the watershed planning unit is from open land/Forest Preserve District property and the Village of Orland Park as well as smaller amounts from 7 other communities.

3.14 PHYSICAL STREAM CONDITIONS

3.14.1 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 in Figure 3.14-2) and 5 tons per acre per year is for deep soils that are least subject to damage by erosion (shown as green in Figure 3.14-2). 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 Cal-Sag Channel Planning Area, the T factor is used in conjunction with aerial photography review to identify areas of low, moderate or high erosion.

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. The field assessment focused on the collection of data including bank heights, degree of bank erosion, degree of streambed erosion, streambed material, streambed sediment depth, streambed width, overall streambed description and water column description.

Figure 3.14-1 Crestwood Drainage Ditch

Google earth and street views were assessed as these street views provided detail in areas where watercourses have been highly channelized and hard armored as in the case through the Crestwood Drainage Ditch watershed planning unit (Figure 3.14-1). 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.

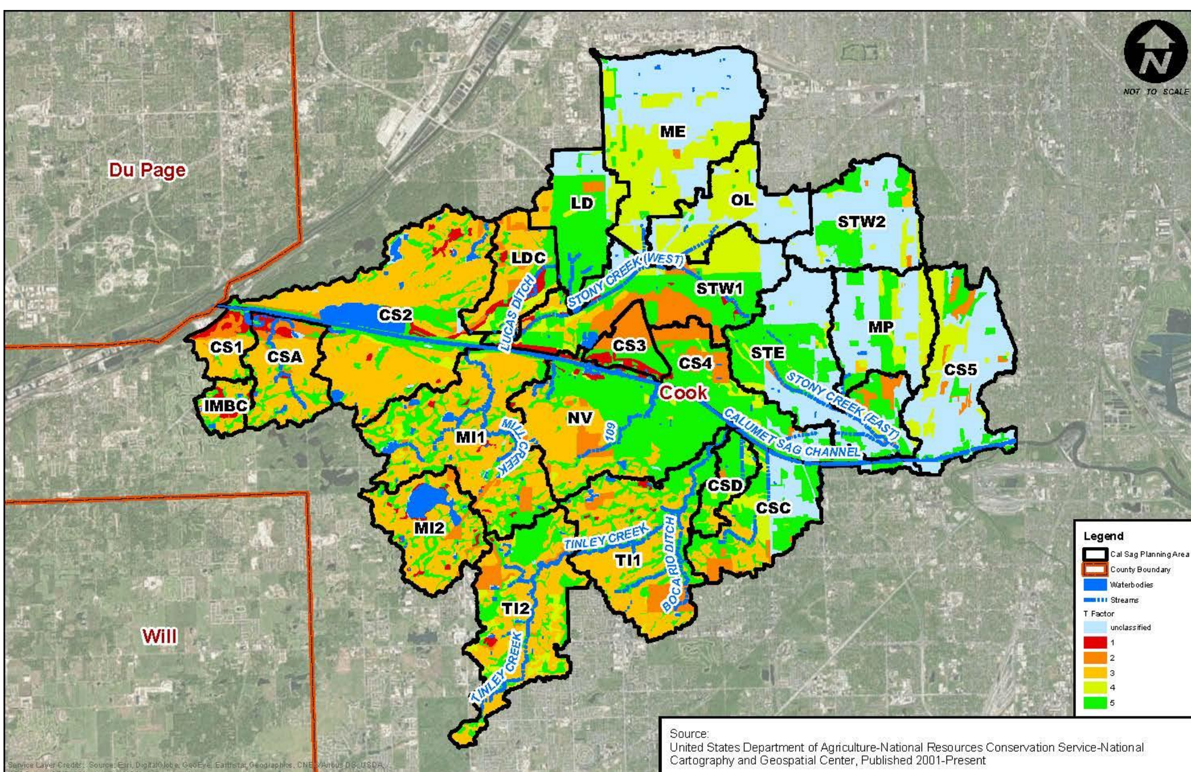


Figure 3.14-2 Highly Erodible Soils in the Cal-Sag Channel Planning Area

3.14.2 Channel Assessment Methodology

Channelization refers to the straightening of natural, meandering stream channels or the construction of channels for drainage (Figure 3.14-3). 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 3.14-4 and Table 3.14-2 (Page 39) show the degree of channelization through the Cal-Sag Channel Planning Area. Channelization is described as low, moderate or high degree.

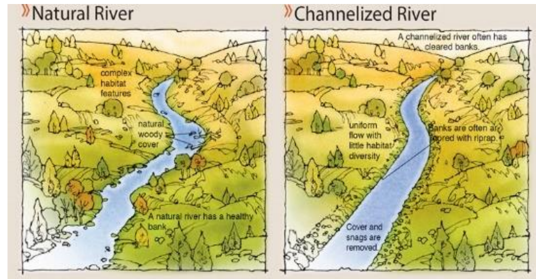


Figure 3.14-3 Channelization (Natural vs Channelized)

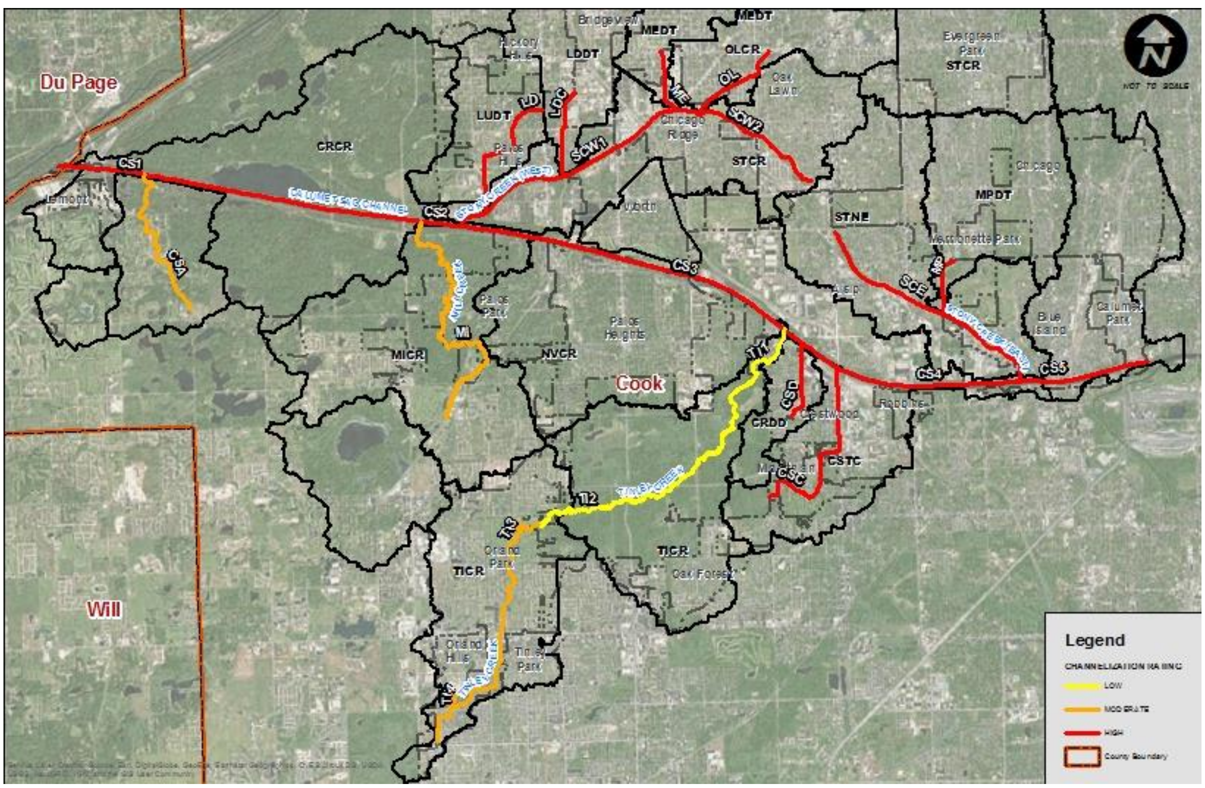


Figure 3.14-4 Summary of Channelization in the Cal-Sag Channel Planning Area

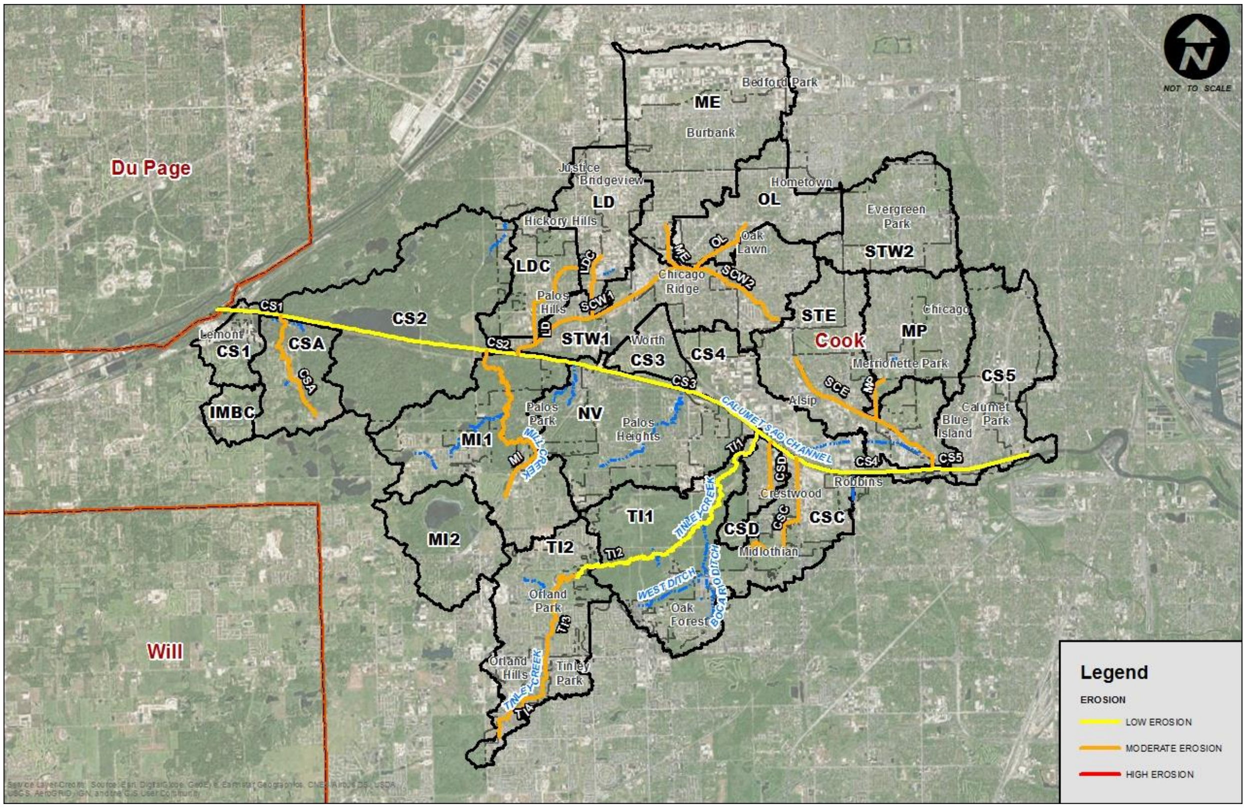


Figure 3.14-5 Summary of Stream Channel Erosion in the Cal-Sag Channel Planning Area

The locations of the field assessment verification are shown in Figure 3.14-6. A summary of the data collected is shown below in Table 3.14-1.

Segment	Bank Height		Sediment Depth		Channel Width		Channel Description	Streambed Description	Water Column Description
	Min	Max	Min	Max	(top of bank)	(normal water level)			
	(ft)	(ft)	(ft)	(ft)	ft	ft			
SCW 1A	18	23	0.05	0.15	112	48	Channelized	Large rocks on bottom	Sediment laden water
SCW 1B	3	4	0.2	0.3	50	39	Sediment Point Bar	Silty bottom, tires in stream	Transparent water
SCW 1C	3	8	0.2	0.25	66	39	Channelized	Silty bottom, shopping carts in stream	Transparent water
SCW 2A	5	10	0.1	0.2	82	42	Sediment Point Bar	Silty bottom, in stream vegetation	Sediment laden water
SCW 2B	7	8	0.5	0.6	54	30	Channelized	Very silty bottom, dark algae	Sediment laden water
SCE A	8	9	0.4	0.5	64	26	Channelized	In stream vegetation, silty bottom	Sediment laden water
SCE B	8	11	0.1	0.2	58	21	Channelized	Silty bottom, in stream vegetation	Sediment laden water
SCE C	5	11	0.1	0.2	86	33	Channelized	Small rocks on bottom, foul smell	Sediment laden water, dark algae
TI 1A	3	6	0.2	0.3	38	26	Channelized	Rip rap along bank, rocky bottom	Sediment laden water
TI 1B	3	7	0.2	0.25	54	40	Sediment Point Bar	Rocky bottom, narrow section	Sediment laden water
TI 2A	3	4	0.4	0.6	40	27	Channelized	4-6-foot debris blockage under bridge	Sediment laden water
TI 2B	2	3	0.4	0.4	33	22.5	Channelized	Rocky bottom, debris blockage	Shallow, sediment laden water
TI 2C	2	3	0.1	0.3	28	17	Channelized	Debris blockage, silty bottom	Sediment laden water
TI 3A	7	10	0.1	0.1	44	18	Channelized	Narrow section, bank erosion	Sediment laden water

Segment	Bank Height		Sediment Depth		Channel Width		Channel Description	Streambed Description	Water Column Description
	Min	Max	Min	Max	(top of bank)	(normal water level)			
TI 3B	5	6	0.1	0.2	42	15	Channelized	Small rocks on bottom	Sediment laden bottom
TI 4A	3	4	0.2	0.8	50	18	Sediment Point Bar	In stream vegetation	Shallow sediment laden water

Table 3.14-1 Summary of Stream Channel Field Data

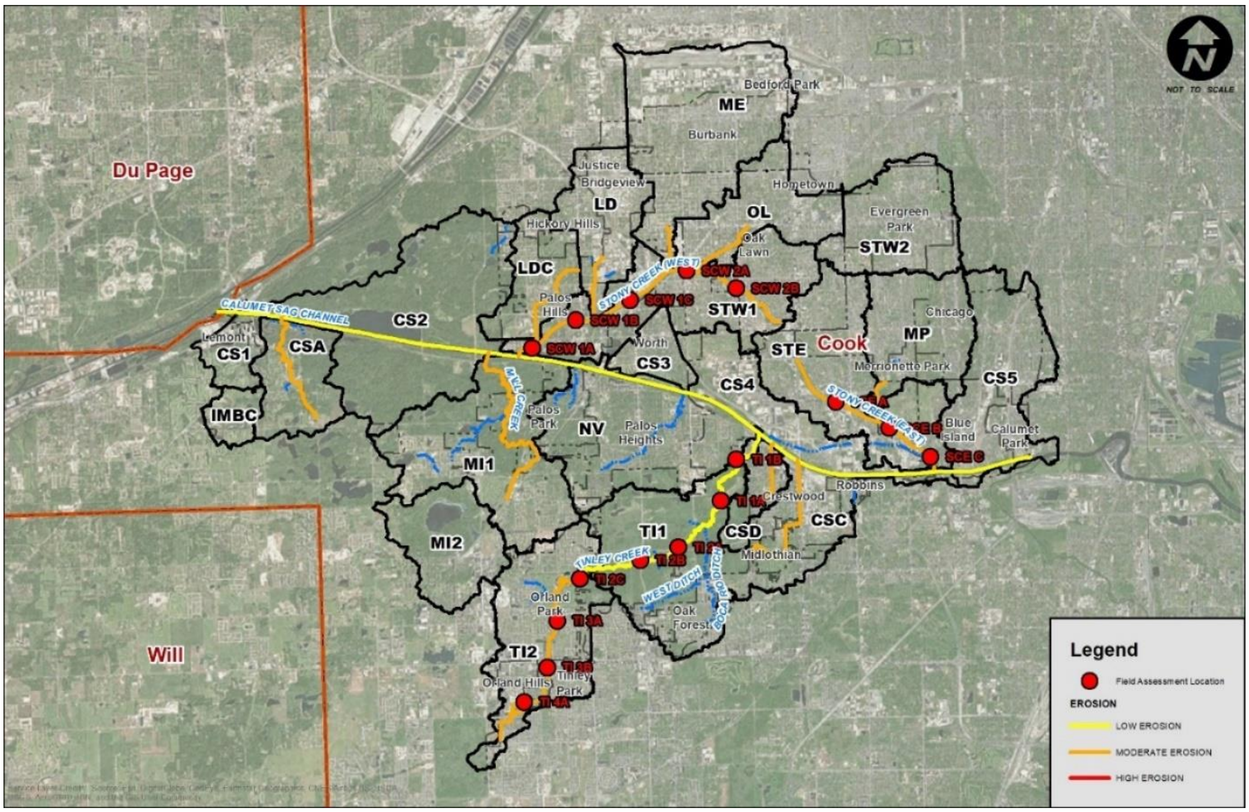


Figure 3.14-6 Streambed Field Data Collection Locations

3.14.3 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 in 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 to filter runoff from upland developed areas. Reaches with a "good" riparian condition were assessed based solely on aerial interpretation.

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 and construction of large closed conduit conveyance systems 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 3.14-2 (Page 37) quantifies the stream lengths associated with the characterized riparian areas. Protecting and enhancing riparian areas will be helpful for protecting water quality in the Cal-Sag Channel and its tributaries.

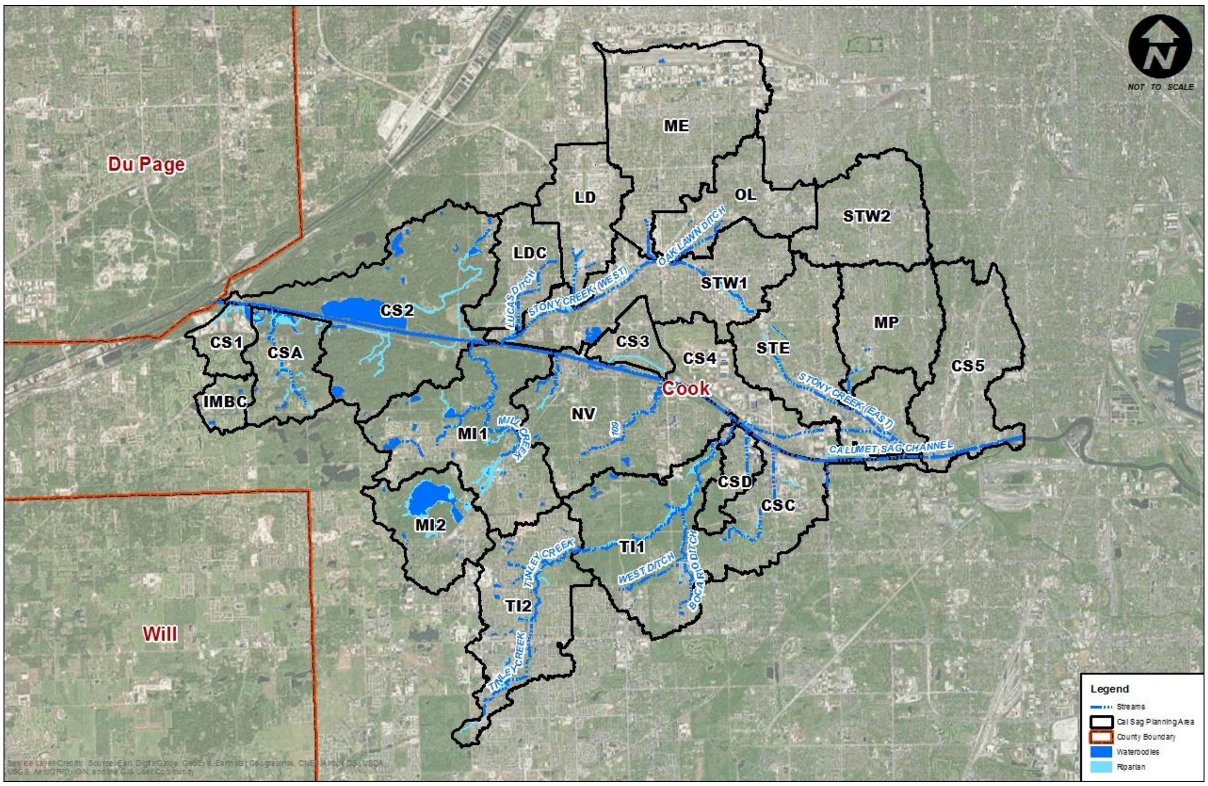


Figure 3.14-7 Riparian Corridors in the Cal-Sag Channel Planning Area

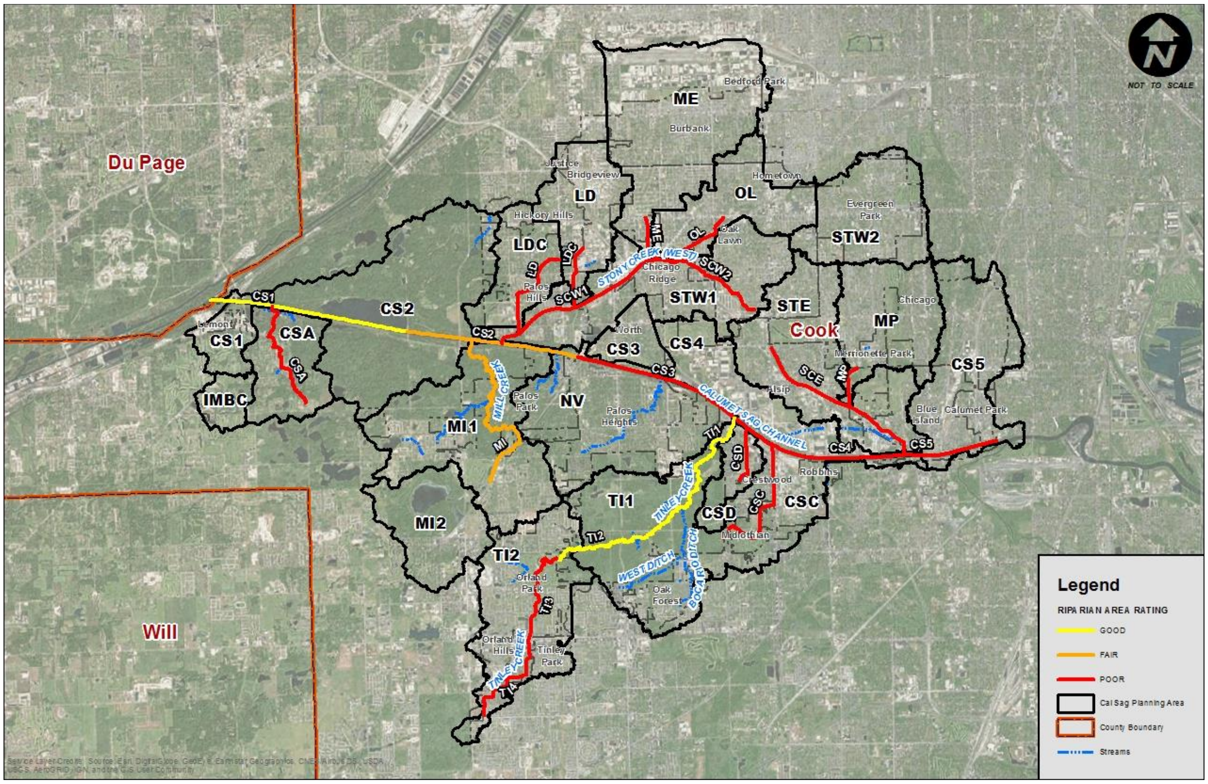


Figure 3.14-8 Summary of Riparian Areas in the Cal-Sag Channel Planning Area

All of the tributary watercourses assessed north of the of the Cal-Sag Channel including Lucas Ditch, Lucas Ditch Cut-off, Stoney Creek East and West, Oak Lawn Ditch, Merrionette Park Ditch and Melvina Ditch flow through densely developed areas and are channelized. Erosion through these watercourses is minimal as the watercourses have been armored using various methods. The riparian area associated with these watercourses is that of an urban setting and does not promote a riparian habitat due to land constraints. A portion of Stoney Creek East contains the Wolfe Wildlife Refuge where the riparian zone that is protected and land constraints ease to allow for natural wetland areas. The Cal-Sag Channel is, as the name implies a channel with low erosion as it is a manmade channel with hard armoring. The riparian zone is rarely accessible during storm events as the bank heights along the channel greatly exceed the normal water level in the channel.

The upper portion of Tinley Creek flows through largely residential areas and is channelized with some erosion and limited riparian areas due to land constraints and residential landscaping practices. The lower portion of Tinley Creek flows through Rubio Woods where the watercourse is less channelized and erosion is low to moderate (Figure 3.14-9). The riparian area consists of forest preserve and is good condition.

Figure 3.14-9 Tinley Creek

Like Tinley Creek, the north portion of Mill Creek flows through residential and light commercial areas while the lower portion flows through Palos Park Woods where erosion and channelization is moderate. The riparian areas through this section is somewhat good to moderate as there are pockets of residential development prior to entering forest preserve property.

Watercourse Name	Reach Code	Stream Length Assessed (feet)	Total Length (feet)	% of Total	Degree of Channelization	Riparian Area Condition	Degree of Erosion
CAL-SAG CHANNEL	CS1	20,376	83,568	24%	HIGH	GOOD	LOW
	CS2	17,564		21%	HIGH	FAIR	LOW
	CS3	17,517		21%	HIGH	POOR	LOW
	CS4	15,709		19%	HIGH	POOR	LOW
	CS5	12,403		15%	HIGH	POOR	LOW
CAL-SAG CHANNEL TRIBUTARY A	CSA	14,245	14,245	100%	MODERATE	POOR	MODERATE
CAL-SAG CHANNEL TRIBUTARY C	CSC	15,835	15,835	100%	HIGH	POOR	MODERATE
CRESTWOOD DRAINAGE DITCH WEST	CSD	6,019	6,019	100%	HIGH	POOR	MODERATE
LUCAS DITCH	LD	10,725	10,725	100%	HIGH	POOR	MODERATE
LUCAS DITCH CUT-OFF	LDC	6,592	6,592	100%	HIGH	POOR	MODERATE
MELVINA CREEK	ME	4,880	4,880	100%	HIGH	POOR	MODERATE
MILL CREEK	MI	26,775	26,775	100%	MODERATE	FAIR	MODERATE
MERRIONETTE PARK DITCH	MP	4,466	4,466	100%	HIGH	POOR	MODERATE
OAK LAWN DITCH	OL	7,393	7,393	100%	HIGH	POOR	MODERATE
STONY CREEK (EAST)	SCE	18,856	50,139	38%	HIGH	POOR	MODERATE
	SCW1	13,342		27%	HIGH	POOR	MODERATE
	SCW2	17,941		36%	HIGH	POOR	MODERATE
TINLEY CREEK	TI1	18,713	63,647	29%	LOW	GOOD	LOW
	TI2	18,917		30%	LOW	GOOD	LOW
	TI3	18,072		28%	MODERATE	POOR	MODERATE
	TI4	7,946		12%	MODERATE	POOR	MODERATE

Table 3.14-2 Summary of Channelization, Riparian Corridor and Erosion in the Cal-Sag Channel Planning Area

The results of the watercourse assessment indicate that channelization is high with riparian areas in poor condition throughout the planning area. These areas of high channelization and poor riparian buffers are associated with densely urbanized areas. Erosion is low to moderate as many of the watercourses have some type of hard armoring to prevent future erosion. The combination of channelization and hard armoring has assisted with conveyance through the watercourse, however the loss of the riparian corridor and natural meandering negates 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. The results of this watercourse assessment also correspond well with the erodible soils map; areas north of the Cal-Sag mainstem are less erodible and exhibit less erosion (mainly due to armoring) and areas south of the Cal-Sag mainstem are more susceptible to erosion and exhibit moderate erosion. This also suggests the need for BMPs in areas noted with moderate erosion.

3.15 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.

Initial identification of detention basins within the Cal-Sag Channel planning area was accomplished using Google Earth. Additional information from the MWRD permitting database was analyzed and inventory information was expanded to include all applicable MWRD detention basins receiving a permit after 2012. Figure 3.15-1 displays the inventory of detention basins. The condition of the basin is identified, pointing to opportunities for basin retrofits. Inventory data is shown by municipality, watershed planning unit, tributary land use and type (dry or wet bottom). Detention basins often show signs of erosion where the fluctuation of water surface elevations from incoming stormwater can cause a ring of bare soil susceptible to erosion around shorelines. BMPs can be employed to retrofit eroding or unstable detention basins e.g., to flatten and naturalize the shorelines. A detailed summary of retrofit types and locations is provided in Section 6.4.1 of this watershed-based plan.

Detention Basin ID	*Municipality*	*Watershed Planning Unit*	*Tributary Land Use*	*Type*	*Stable/Needs Improvement*
CS-1	Lemont	CS	IND	Wet	Needs Improvement
CS-2	Palos Park	CSTA	INST	Wet	Stable
CS-3	Palos Park	CSTA	SF	Wet	Stable
CS-4	Palos Park	MC	SF	Wet	Stable
CS-5	Palos Park	MC	SF	Wet	Needs Improvement
CS-6	Palos Park	MC	SF	Wet	Needs Improvement
CS-7	Palos Park	MC	SF	Wet	Stable
CS-8	Palos Park	MC	MF	Wet	Needs Improvement
CS-9	Palos Park	MC	MF	Wet	Stable
CS-10	Palos Park	MC	MF	Wet	Stable

Detention Basin ID	*Municipality*	*Watershed Planning Unit*	*Tributary Land Use*	*Type*	*Stable/Needs Improvement*
CS-11	Palos Park	MC	SF	Wet	Needs Improvement
CS-12	Palos Park	MC	C	Wet	Needs Improvement
CS-13	Orland Park	MC	MF	Wet	Stable
CS-14	Orland Park	MC	MF	Wet	Stable
CS-15	Orland Park	MC	OS	Wet	Needs Improvement
CS-16	Orland Park	MC	OS	Wet	Needs Improvement
CS-17	Orland Park	MC	MF	Wet	Needs Improvement
CS-18	Orland Park	MC	OS	Wet	Stable
CS-19	Orland Park	MC	OS	Wet	Needs Improvement
CS-20	Orland Park	MC	OS	Wet	Needs Improvement
CS-21.1	Orland Park	MC	OS	Wet	Needs Improvement
CS-21.2	Orland Park	MC	OS	Wet	Needs Improvement
CS-22	Orland Park	MC	SF	Wet	Stable
CS-23	Orland Park	MC	SF	Wet	Needs Improvement
CS-24	Orland Park	MC	SF	Wet	Needs Improvement
CS-25	Orland Park	MC	OS	Wet	Needs Improvement
CS-26	Orland Park	MC	OS	Wet	Needs Improvement
CS-27	Orland Park	MC	SF	Wet	Needs Improvement
CS-28	Orland Park	MC	MF	Wet	Needs Improvement
CS-29	Orland Park	TC	SF/MF	Wet	Needs Improvement
CS-30	Orland Park	MC	SF	Wet	Needs Improvement
CS-31	Orland Park	NC	SF	Wet	Needs Improvement
CS-32	Orland Park	MC	SF	Wet	Needs Improvement
CS-33	Orland Park	MC	OS	Wet	Needs Improvement
CS-34	Orland Park	MC	OS	Wet	Needs Improvement
CS-35	Orland Park	MC	T	Wet	Needs Improvement
CS-36	Orland Park	MC	C	Wet	Stable
CS-37	Orland Park	MC	INST	Wet	Stable
CS-38	Orland Park	MC	OS	Wet	Stable
CS-39	Orland Hills	TC	OS	Wet	Needs Improvement
CS-40	Orland Hills	TC	OS	Wet	Needs Improvement
CS-41	Orland Hills	TC	SF	Wet	Needs Improvement
CS-43	Orland Park	TC	MF	Wet	Stable
CS-44	Orland Park	TC	MF	Wet	Stable

Detention Basin ID	*Municipality*	*Watershed Planning Unit*	*Tributary Land Use*	*Type*	*Stable/Needs Improvement*
CS-45	Orland Park	TC	OS	Wet	Needs Improvement
CS-46	Orland Park	TC	C & SF	Wet	Needs Improvement
CS-47	Orland Park	TC	SF & MF	Wet	Needs Improvement
CS-48	Orland Park	TC	MF	Wet	Needs Improvement
CS-49	Orland Park	TC	OS	Wet	Needs Improvement
CS-50	Orland Park	TC	SF	Wet	Needs Improvement
CS-51	Orland Park	TC	MF	Wet	Needs Improvement
CS-52	Orland Park	TC	MF	Wet	Stable
CS-53	Oak Forest	TC	SF	Wet	Needs Improvement
CS-54	Crestwood	CS	T	Wet	Stable
CS-55	Crestwood	CS	T	Wet	Needs Improvement
CS-56	Palos Heights	NC	SF	Wet	Stable
CS-57	Palos Heights	NC	SF	Wet	Stable
CS-58	Palos Park	NC	SF	Wet	Stable
CS-59	Palos Park	NC	SF	Wet	Stable
CS-60	Palos Park	NC	C	Wet	Needs Improvement
CS-61	Palos Park	NC	MF	Wet	Stable
CS-62	Palos Park	NC	SF	Wet	Stable
CS-63	Evergreen Park	MPD	C	Wet	Stable
CS-64	Evergreen Park	MPD	T	Wet	Stable
CS-65	Alsip	SCE	OS	Wet	Needs Improvement
CS-66	Alsip	CS	IND	Wet	Needs Improvement
CS-67	Chicago	SCE	INST	Wet	Stable
CS-68	Alsip	CS	IND	Dry	Needs Improvement
CS-69	Alsip	CS	IND	Wet	Stable
CS-70	Alsip	CS	IND	Dry	Needs Improvement
CS-71	Alsip	CS	IND	Wet	Needs Improvement
CS-72	Alsip	CS	IND	Wet	Stable
CS-73	Alsip	CS	IND	Wet	Stable
CS-74	Alsip	CS	IND	Wet	Needs Improvement
CS-75	Alsip	CS	IND	Wet	Stable
CS-76	Chicago Ridge	MD	T	Wetland	Needs Improvement
CS-77	Bridgeview	MD	C	Wet	Needs Improvement
CS-78	Bridgeview	MD	T	Dry	Needs Improvement

Detention Basin ID	*Municipality*	*Watershed Planning Unit*	*Tributary Land Use*	*Type*	*Stable/Needs Improvement*
CS-79	Bridgeview	MD	IND	Wet	Needs Improvement
CS-80	Bridgeview	MD	IND	Wetland	Needs Improvement
CS-81	Palos Park	LD	INST	Wet	Stable
CS-82	Palos Park	SCW	MF	Wet	Stable
CS-83	Palos Park	CS	T	Wet	Needs Improvement
CS-84	Palos Park	CS	MF	Wet	Needs Improvement
CS-12012	Orland Park	MC	C	Wet	Needs Improvement
CS-12016	Orland Park	TC	MF	Dry	Needs Improvement
CS-12052	Crestwood	CS	C	Dry	Needs Improvement
CS-12074	Calumet Park	CS	INST	Underground	Not Applicable
CS-12092	Unincorporated	MI	INST	Dry	Needs Improvement
CS-12201	Lemont	CS	IND	Dry	Needs Improvement
CS-12215	Alsip	CS	IND	Wet	Needs Improvement
CS-12219	Evergreen Park	SCW	SF	Dry	Needs Improvement
CS-12237	Burbank	MD	C	Dry	Needs Improvement
CS-12240	Burbank	MD	OS	Dry	Needs Improvement
CS-12242	Evergreen Park	SCW	INST	Underground/Pipe	Not Applicable
CS-12262	Tinley Park	TI	C	Underground	Not Applicable
CS-13020	Tinley Park	TI	C	Dry/Pipe	Needs Improvement
CS-13041	Evergreen Park	SCW	C	Surface	Not Applicable
CS-13089	Oak Lawn	OC	INST	Underground	Not Applicable
CS-13116	Bridgeview	LD	C	Wet	Needs Improvement
CS-13130	Oak Lawn	SCW	OS	Dry/Underground	Needs Improvement
CS-13270	Evergreen Park	SCW	C	Dry	Needs Improvement
CS-14116	Burbank	MD	INST	Surface	Not Applicable
CS-14129	Oak Lawn	OC	INST	Underground	Not Applicable
CS-15015	Burbank	MD	INST	Dry/Underground	Needs Improvement
CS-15038	Unincorporated	MC	AG	Dry	Needs Improvement
CS-15069	Oak Lawn	OC	INST	Dry	Needs Improvement
CS-15071	Tinley Park	TC	C	Wet	Needs Improvement
CS-15089	Alsip	SCE	C	Dry/Wet	Needs Improvement
CS-15105	Bridgeview	MD	V	Dry	Needs Improvement
CS-15121	Bridgeview	LD	IND	Dry	Needs Improvement
CS-15175	Oak Lawn	OC	INST	Underground	Not Applicable

Detention Basin ID	Municipality	Watershed Planning Unit	Tributary Land Use	Type	Stable/Needs Improvement
CS-15405	Orland Park	MC	C	Wet	Needs Improvement
CS-16082	Crestwood	CS	IND	Wet	Needs Improvement
CS-16092	Crestwood	CS	C	Wet	Stable
CS-16207	Unincorporated	CS	SF	Dry	Needs Improvement
CS-16220	Crestwood	CS	SF	Wet	Needs Improvement
CS-16263	Alsip	CS	IND	Dry	Needs Improvement

Table 3.15-1 Inventory of Detention Basins in the Cal-Sag Channel Planning Area

Notes:
CSTA – Cal-Sag Channel Tributary A; LD – Lucas Ditch; MD – Melvina Ditch; MPD – Merrionette Park Ditch; MC – Mill Creek; TC – Tinley Creek; NC – Navajo Creek; SCE – Stony Creek East; SCW – Stony Creek West; CS – Cal-Sag Channel;

SF – Single Family Residential, MF – Multifamily, C – Commercial, IND – Industrial, INST – Institutional

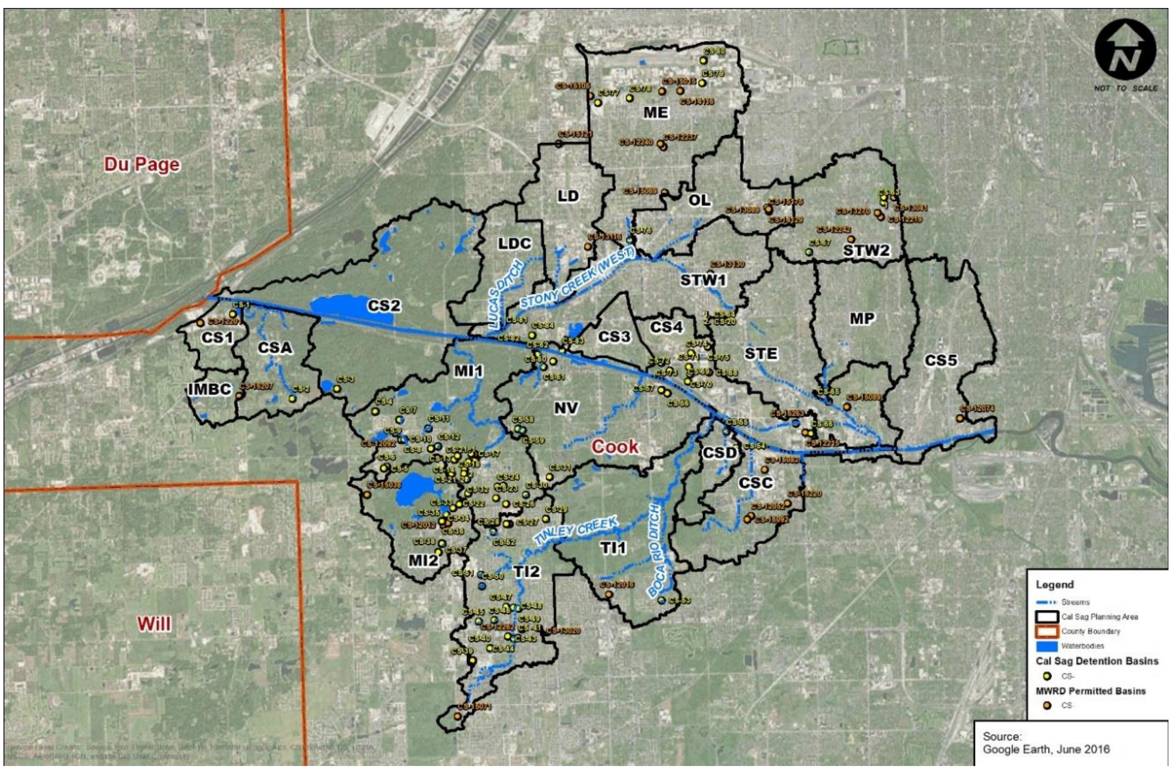


Figure 3.15-1 Cal-Sag Planning Area Detention Basin Inventory

3.16 COOK COUNTY FOREST PRESERVE DISTRICT AND CAL-SAG CHANNEL PLANNING AREA LAKES

Figure 3.16-1 Lake Oak Lawn

Much of the Cal-Sag Channel Planning Area is densely developed (75%) with very few open bodies of water, with the exception of the portion of the planning area that is under the jurisdiction of the FPDCC. Notable lakes within the developed area include Lake Oak Lawn (approximately 2.0 acres with 2,200 feet of shoreline) and Lake Katherine (approximately 10.0 acres with 4,800 feet of shoreline). Lake Oak Lawn (Figure 3.16-1) is typical of a multi-use lake in that the lake serves as a stormwater management facility while providing a natural feature in a dense urban setting. Erosion around the lake is protected by various hard armoring applications that are beginning to fail. The lake is surrounded by residential land use with very poor riparian area condition. Lake Oak Lawn is an on-line storage basin along Oak Lawn Creek, east of Central Avenue at 96th Street (Figure 3.16-6). Lake Oak Lawn flows south discharging into Stony Creek East Branch.

Lake Katherine is located in the Lake Katherine Nature Center and Botanic Gardens on an 85-acre non-profit park that includes woodlands, prairie, wetlands, gardens and Lake Katherine itself. The area is a manicured and well-maintained park setting surrounded by largely commercial land use located northwest of Harlem Avenue and College Drive. There are multiple storm sewer discharge points to the lake from the surrounding land use as the lake is adjacent to the south bank of the Cal-Sag Channel. Erosion around the shoreline is very low and the riparian area is in good condition. Lake Katherine collects drainage from the southern adjacent areas and outlets north to the Cal-Sag Channel.

The majority of the open bodies of water in the Cal-Sag Channel Planning Area are located in the FPDCC. See Figure 3.16-6. Very few of these lakes and sloughs historically had standing water, most of them were artificially created. Many sloughs and lakes, including Long John Slough were created decades ago by damming slow, deep-water swamps or small stream systems. Sloughs have characteristics of swamps or marshy, wetland areas and are found throughout FPDCC, notably in the Palos Preserves. As noted, some are natural, but many have been created by modern hydrological changes.

The FPDCC Department of Resources Management – Fisheries has conducted filed surveys of many of the lakes within the Cal-Sag Planning Area throughout forest reserve property. The field data collected at the lakes include water chemistry of the lake at depth intervals. The water quality parameters include DO, Chloride, color, turbidity, nitrate, phosphate, ammonia and pH. These constituents were measured in approximately 6 lakes within the planning area in 2014 and 2015. A discussion of the water quality parameters collected is below based on available data.

Figure 3.16-2 Saganashkee Slough

The largest open water body in the watershed is Saganashkee Slough consisting of approximately 377 acres of open water with approximately 4.0 miles of shoreline in the Saganashkee Slough Woods (Figure 3.16-2). Erosion around the slough is low and the riparian area consists of forest preserve. Saganashkee Slough is located southwest of the intersection of 107th Street and 104th Avenue where it drains south, discharging directly into the Cal-Sag Channel from forest preserve property (Figure 3.16-6). According to the field data collected by FPDCC – Fisheries on 8/12/14, Dissolved Oxygen (DO) levels throughout the water column are 4.5 mg/L and do not meet the Illinois EPA's standard for DO (> 5 mg/L). The measured values for nitrate, phosphate and ammonia are elevated (0.9 mg/L, 0.55 mg/L and 0.76 mg/L) respectively at the surface.

The second largest open water body in the watershed planning area is McGinnis Slough consisting of approximately 300 acres of open water with approximately 4 miles of shoreline located in the Mill Creek watershed planning unit (Figure 3.16-3) west of Rte. 45 between 143rd Street and 131st Street (Figure 3.16-6). McGinnis Slough drains north into Mill Creek. The slough has more of a lake characteristic in the winter months and is drained in the summer to create more of a slough habitat for birds and waterfowl. The slough is man-made, with surrounding forest preserve and the shoreline consisting of marsh and wetland complexes as well as shrubby edges. Shoreline erosion is non-existent and the riparian area is in good condition. Migratory ducks and shorebirds as well as some breeding wetland species including herons use the slough. The slough receives stormwater from surrounding adjacent. It should be noted that while the riparian area and shoreline are in good condition, long wind fetches over shallow sloughs can create a condition where sediment can be to re-suspended within the water column due to wave action.

Figure 3.16-3 McGinnis Slough

Figure 3.16-4 Lake Arrowhead

Lake Arrowhead is located within the Navajo Creek watershed planning unit consisting of approximately 12 acres of open water with approximately 3,300 feet of shoreline (Figure 3.16-4). Lake Arrowhead is located on forest preserve property northeast of the intersection of 135st Street and Harlem Avenue (Figure 3.16-6). It is an upstream lake that is tributary to Navajo Creek. Lake Arrowhead drains north to Navajo Creek. Erosion around the lake is low however approximately half of the perimeter riparian area consists of managed turf grass for recreation and lake accessibility. According to the field data collected by FPDCC – Fisheries on 8/20/15, the first 6 feet of the lake meets the Illinois EPA's standard for dissolved oxygen (> 5 mg/L). At nine and twelve feet deep, DO levels decrease to 3 mg/L. The measured values for nitrate, phosphate and ammonia are elevated (0.5 mg/L, 0.59 mg/L and 1.24 mg/L) respectively at a depth of three feet.

Many of the other lakes and sloughs throughout the FPDCC have similar characteristics with one another. Shoreline erosion is limited and relatively low while riparian areas are in good condition as the areas are maintained by the FPDCC. Saganashkee and McGinnis Sloughs are part of the 14,000-acre Palos Preserves complex of woods, sloughs and lakes. A list of some of the larger sloughs and lakes in the Cal-Sag Channel Planning Area is shown below. These lakes are all located on forest preserve property in the western areas of watershed. A few of the lakes have been assessed by the FPDCC Department of Resources Management – Fisheries as discussed above. Where available, a summary of the available water quality field measurements is included in the descriptions below. These preserves are interspersed with highways and residential and business subdivisions. It should be noted that DO levels in slough areas often do not meet the water quality criterion for DO (5.0 mg/l). This is due to the marshy conditions of the waterbody, where there is little water movement and aeration and there is often shallow water and dense plant growth.

- Bergman Slough

Bergman Slough is located northwest of the intersection of McCarthy Road and Wolf Road, south of the Cal-Sag Channel (Figure 3.16-6). Bergman Slough drains northeast through an unnamed tributary directly to the Cal-Sag Chanel.

- Hogwash Slough

Hogwash Slough is located northwest of the intersection of Rte. 45 and 95th Street, north of the Cal-Sag Channel (Figure 3.16-6). Hogwash Slough drains south to Crooked Creek and south into Saganashkee Slough before discharging to the Cal-Sag Channel.

- Longjohn Slough

Hogwash Slough is located southwest of the intersection of Willow Springs Road and 95th Street, north of the Cal-Sag Channel (Figure 3.16-6). Longjohn Slough drains south to Crooked Creek and south into Saganashkee Slough before discharging to the Cal-Sag Channel.

- Suttonbush Slough

Suttonbush Slough is located southwest of the intersection of Rte. 45 south of 95th Street and is surrounded by forest preserve except for the north and east banks which are adjacent to Rte. 45 and 95th Street (Figure 3.16-6). Suttonbush Slough drains southwest to Crooked Creek and south into Saganashkee Slough before discharging to the Cal-Sag Channel.

- Belly Deep Slough

Belly Deep Slough is located east of Rte. 45 south of 95th Street and is surrounded by forest preserve with the exception of the western bank which is adjacent to Rte. 45 (Figure 3.16-6). According to the field data collected by FPDCC – Fisheries on 7/2/14, there is no portion of the slough that meets the Illinois EPA's standard for dissolved oxygen. Measured at 3 depths, the average value for DO is 2.6 mg/L. At its peak, the surface, DO levels reach 4.76 mg/L (<5.0 mg/L) making it a difficult habitat for any aquatic life to with stand. The average values for nitrate and phosphate are 1.25 mg/L and .39 mg/L respectively. High nutrient levels have caused shoreline vegetation to thrive providing a strong shoreline that is not prone to eroding however this had led to a poor aquatic environment. Belly Deep slough drains southwest into Saganashkee Slough via Crooked Creek.

- Joes Pond

Joes Pond is located west of Willow Springs Road just north of 107th Street and is surrounded by forest preserve with the exception of the east bank which is adjacent to Willow Springs Road (Figure 3.16-6). According to the field data collected by FPDCC – Fisheries on 7/30/15, DO levels are above the Illinois EPA's standard (> 5 mg/L) at 4.5 feet deep (5.7 mg/L). At depths below 4.5 feet, DO levels decrease to 0.64 mg/L. The values for nitrate and phosphate are 3.7 mg/L and 0.32 mg/L respectively at 7.5 feet deep. Joes Pond drains southeast into Saganashkee Slough via Crooked Creek.

- Papoose Lake

Papoose Lake is located southwest of the intersection of McCarthy Road and Rte. 45 and is surrounded by forest preserve with the exception of the north bank which is adjacent to McCarthy Road (Figure 3.16-6). Papoose Lake is south of the Cal-Sag Channel and drains east into Mill Creek before outletting into the Cal-Sag Channel. According to the field data collected by FPDCC – Fisheries on 6/24/15, DO levels are above the Illinois EPA's standard (> 5 mg/L) at 3 feet deep (5.07 mg/L). At depths below 3 feet, DO levels decrease to 0.04 mg/L. The values for nitrate and phosphate are 3.6 mg/L and 0.62 mg/L respectively at the surface.

- Turtlehead Lake

Turtlehead Lake is located northeast of the intersection of 104th Avenue and McCarthy Road and is surrounded by forest preserve (Figure 3.16-6). Turtlehead Lake is south of the Cal-Sag Channel and drains north into Tinley Creek before outletting into the Cal-Sag Channel. According to the field data collected by FPDCC – Fisheries on 6/24/15, DO levels are above the Illinois EPA's standard (> 5 mg/L) at three feet deep (9.0 mg/L). At depths below 3 feet, DO levels decrease to 1.0 mg/L. The values for nitrate and phosphate are 1.4 mg/L and 0.54 mg/L respectively at approximately six feet deep.

- Horsetail Lake

Horsetail Lake is located northwest of the intersection of 104th Avenue and McCarthy Road and is surrounded by forest preserve with the exception of the west bank (adjacent to 104th Avenue). Horsetail Lake drains east overtopping the east embankment and flowing overland into Papoose Lake before outletting to Mill Creek to the east (Figure 3.16-6). According to the field data collected by FPDCC – Fisheries on 6/24/14, DO levels are above the Illinois EPA's standard (> 5 mg/L) at seven feet deep (5.64 mg/L). At depths below seven feet, DO levels decrease to 1.3 mg/L. The values for nitrate and phosphate are 6.7 and 0.27 mg/L respectively at elevated at the surface.

Figure 3.16-5 Horsetail Lake

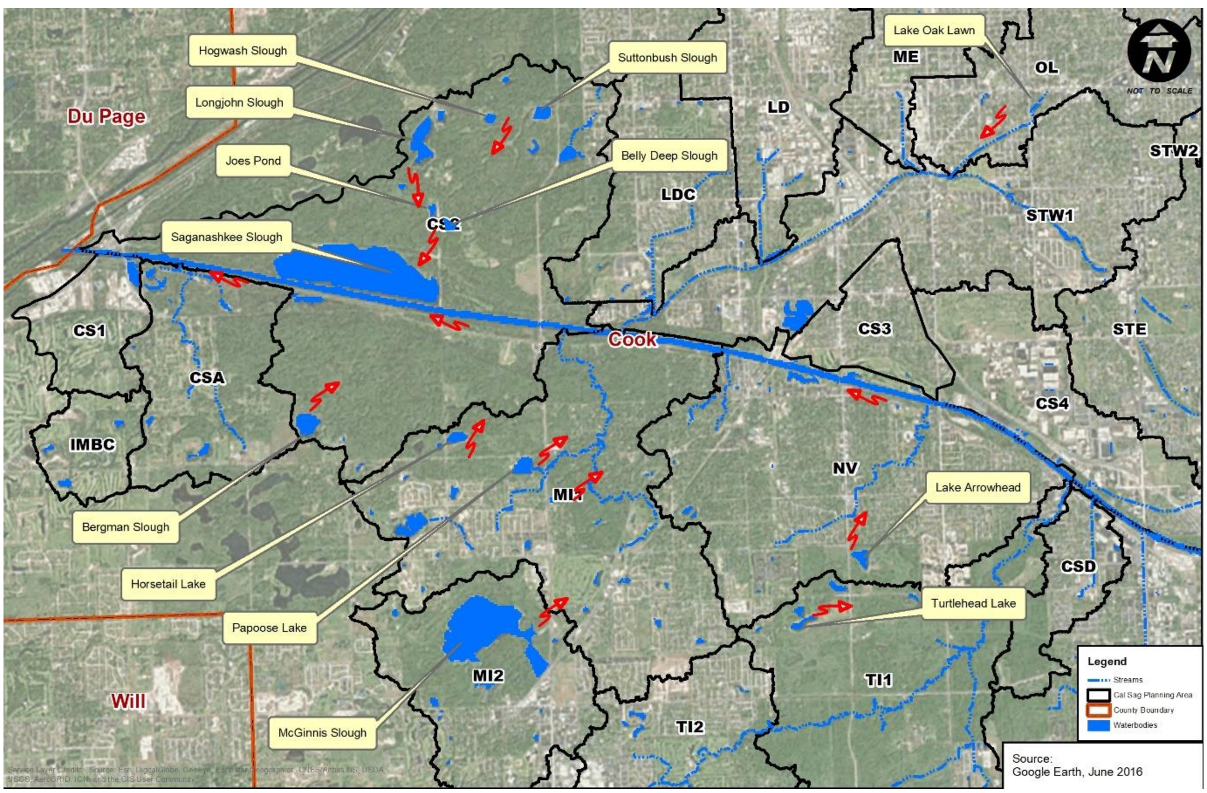


Figure 3.16-6 Cook County Forest Preserve District and Cal-Sag Channel Planning Area Lakes

In addition to the water quality information collected by the FPDCC, a field assessment was conducted to enhance the desktop assessment completed for several of the lakes above as well as others. Table 3.16-1 and Table 3.16-2 show the condition of shoreline buffer and degree of erosion for the lakes assessed.

Lake Name	Reach Code	Shoreline Length Assessed (ft)	Good Condition (ft/%)		Fair Condition (ft/%)		Poor Condition (ft/%)	
Arrowhead Lake	BFL	3,419	3,077	90%	342	10%	0	0%
Oak Lawn Lake	OLL	2165	0	0%	0	0%	2,165	100%
Saganashkee Slough	SAG	20,192	12,947	64%	3,911	19%	3,334	17%
McGinnis Slough	MGS	25,987	25,987	100%	0	0%	0	0%
Joes Pond	JSP	2,235	1,777	80%	0	0%	458	20%
Horsetail Lake	HTL	3,014	1,287	43%	1,458	48%	269	9%
Bergman Slough	BGS	5,202	4,924	95%	278	5%	0	0%
Suttonbush Slough	SBS	4,433	2,660	60%	443	10%	1,330	30%
Hogwash Slough	HWS	1,744	1,744	100%	0	0%	0	0%
Longjohn Slough	LJS	8,707	7,140	82%	522	6%	1,045	12%
Papoose Lake	PPL	3,519	1,768	50%	908	26%	843	24%
Turtlehead Lake	TTL	3,664	2,978	81%	399	11%	287	8%
Belly Deep Slough	BDS	4,857	3,199	66%	904	19%	754	16%
Total		**89,138**	**69,488**	**78%**	**9,165**	**10%**	**10,485**	**12%**

Table 3.16-1 Field Data in Support of Shoreline Condition for Lakes in the Cal-Sag Planning Area

Lake Name	Reach Code	Shoreline Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
Arrowhead Lake	BFL	3,419	1,234	36%	2,185	64%	0	0%
Oak Lawn Lake	OLL	2165	0	0%	0	0%	2,165	100%
Saganashkee Slough	SAG	20,192	15,161	75%	5,031	25%	0	0%
McGinnis Slough	MGS	25,987	25,987	100%	0	0%	0	0%
Joes Pond	JSP	2,235	978	44%	1,257	0%	0	0%
Horsetail Lake	HTL	3,014	1,279	42%	1,014	48%	721	9%
Bergman Slough	BGS	5,202	5,202	100%	0	0%	0	0%
Suttonbush Slough	SBS	4,433	3,312	75%	0	0%	0	0%
Hogwash Slough	HWS	1,744	1,744	100%	0	0%	0	0%
Longjohn Slough	LJS	8,707	8,707	100%	0	0%	0	0%
Papoose Lake	PPL	3,519	1,585	45%	800	23%	1,134	32%
Turtlehead Lake	TTL	3,664	2,198	60%	916	15%	550	15%
Belly Deep Slough	BDS	4,857	4,479	92%	295	6%	83	2%
Total		**89,138**	**71,866**	**81%**	**11,498**	**13%**	**4,653**	**5%**

Table 3.16-2 Field Data in Support of Shoreline Erosion for Lakes in the Cal-Sag Planning Area

3.17 WATER QUALITY ASSESSMENT

3.17.1 Surface Water Quality Assessment (Illinois EPA)

Thirteen creeks were evaluated in the Cal-Sag Channel Planning Area Watercourse Assessment with respect to designated uses and water quality standards. Six of the thirteen watercourses within the Cal-Sag Planning Area were included in the Illinois EPA Integrated Water Quality Report and Section 303(d) List (2016). Two of the watercourses failed to meet at least one of their designated uses and were considered impaired (i.e., included on the 303(d) List): the Cal-Sag Channel and Tinley Creek. The causes and sources for the impairments are included in Table 3.17-1 and shown in Figure 3.17-2. Most the designated uses for the other creeks were not assessed. Even though the Cal-Sag Channel and Tinley Creek are impaired, portions of the water bodies support the aesthetic quality designated use.

Stream Name	*Illinois EPA AUID*	*Impairment*	*Use Attainment*			*Source*
			Not Supporting	*Fully Supporting*	*Not Assessed*	
Calumet Sag Channel (CS 1-5)	IL_H-01	Mercury, Polychlorinated Biphenyls, Iron, Dissolved Oxygen, Total Suspended Solids (TSS), Phosphorus (Total)	Fish Consumption, Indigenous Aquatic Life	Aesthetic Quality	Secondary Contact	Atmosheric Deposition - Toxics, Source Unknown, Combined Sewer Overflows, Sediment Resuspension (Contaminated Sediment), Urban Runoff/Storm Sewers, Impacts from Hydrostructure Flow Regulation/Modification
	IL_H-02	Mercury, Polychlorinated Biphenyls, Iron, Dissolved Oxygen, Total Dissolved Solids	Fish Consumption, Indigenous Aquatic Life	---	Secondary Contact, Aesthetic Quality	Atmospheric Deposition – Toxics, Source Unknown, Sediment Resuspension (Contaminated Sediment), Combined Sewer Overflows, Urban Runoff/Storm Sewers
Lucas Ditch (LD)	IL_HGA	---	---	---	Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality	No source identified

Stream Name	Illinois EPA AUID	Impairment	*Use Attainment* Not Supporting	Fully Supporting	Not Assessed	Source
Mill Creek (MI)	IL_HE	---	---	---	Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality	No source identified
Stony Creek East Branch (SCE)	IL_HJ	---	---	---	Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality	No source identified
Stony Creek West Branch (SCW1-2)	IL_HG	---	---	---	Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality	No source identified
Tinley Creek	IL_HF-01	Fish-Passage Barrier, Other Flow Regime Alterations, Cause Unknown	Aquatic Life	Aesthetic Quality	Fish Consumption, Primary Contact, Secondary Contact	Impacts from Hydrostructure Flow Regulation/Modification, Urban Runoff/Storm Sewers, Source Unknown

Table 3.17-1 Summary of Impaired Watercourses in the Cal-Sag Channel Planning Area

Notes:

(1) Only stream segments with Assessment Unit Identification (AUID) numbers from the Illinois EPA 2016 Integrated Water Quality Report and Section 303(d) List are included in the table above.

(2) The study area includes Tampier Lake/Saganashkee Slough TMDL (approved May 2010) to address Total Phosphorus and Low Dissolved Oxygen.

Source: Resource Management Mapping Service (2017); Illinois Integrated Water Quality Report and Section 303(d) List (2016).

The Table shows that aquatic life uses were not met in the Cal-Sag Channel and Tinley Creek. Recreation uses were not extensively assessed. Recreational uses are affected by bacteria in the water body, which can make the water unsafe for wading or swimming or kayaking (see discussion below on water quality standards). Historical monitoring in the upstream Little Calumet River at times showed elevated levels of bacteria. Much of the data collected was prior to 2015. Since that time MWRD has made significant strides to address Calumet-area water quality through better stormwater management and wastewater treatment: (1) The Thornton Reservoir, part of the regional Tunnel and Reservoir Plan, came on line. This has greatly reduced combined sewer overflows (CSOs) to the Chicago Area Waterways System. CSOs release large amounts of bacteria when events occur. (2) MWRD initiated operation of a new disinfection facility at the Calumet Water Reclamation Plant. This plant serves more than one million people in a 300-square-mile area covering the south side of Chicago and surrounding south suburbs. The improved treatment system at the plant and the CSO control provided by the Reservoir have greatly reduced bacteria loadings to the Little Calumet River, which drains to the Cal-Sag Channel. Based on MWRD data collected its Halsted Street monitoring location on the Little Calumet River, where data was collected pre- and post-disinfection between March 2015 and November 2016, the amount of monthly fecal coliform had been reduced between 82% and 99%. It is expected that future monitoring data will show the Little Calumet River and the Cal-Sag Channel are achieving recreation-based designated uses. Stormwater BMPs, structural and non-structural, can also help reduce bacteria pollutant loadings. These BMPs are discussed in ensuing sections of this watershed plan.

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 Tinley Creek was rated by IDNR (2008) as C (diversity) and D (integrity). The other streams did not have IDNR (2008) stream ratings for diversity or integrity within the study area. No streams in the planning area were identified as Biologically Significant Streams.

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 Illinois EPA 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. Illinois EPA, 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 Cal-Sag Channel and the Little Calumet River from its junction with the Grand Calumet River to the Cal-Sag Channel; and

- Lake Michigan Basin Water Quality Standards.

Inland Lakes have a total pond acreage of 318,477 in the State. More than 91,400 inland lakes and ponds exist in Illinois, 3,256 of which have a surface area of six acres or more (IDNR 1999). The term inland lake is used for any Illinois lake other than Lake Michigan and its bays/harbors. About three-fourths of Illinois' inland lakes are man-made, including dammed stream and side-channel impoundments, strip-mine lakes, borrow pits, and other excavated lakes. Natural lakes include glacial lakes in the northeastern counties, sinkhole ponds in the southwest, and oxbow and backwater lakes along major rivers. As with streams, lakes are assessed as Fully Supporting (good), Not Supporting (fair), or Not Supporting (poor), for each applicable designated use. Five lakes that have been assessed are located within the planning area: Arrowhead Lake, Horsetail Lake, Papoose Lake, Saganashkee Slough, and Turtlehead Lake Table 3.17-2.

Lake Name	*Illinois EPA AUID*	*Impairment*	*Use Attainment*			*Source*
			Not Supporting	*Fully Supporting*	*Not Assessed*	
Arrowhead Lake	IL_RHZE	Mercury, Cause Unknown	Fish Consumption, Aesthetic Quality	Aquatic Life	Primary Contact, Secondary Contact	Atmospheric Deposition, Source Unknown
Horsetail Lake	IL_RHZB	---	---	Aquatic Life, Aesthetic Quality	Fish Consumption, Primary Contact, Secondary Contact	No source identified
Papoose Lake	IL_RHZC	---	---	---	Aquatic Life, Fish Consumption, Primary Contact, Secondary Contact, Aesthetic Quality	No source identified

Lake Name	Illinois EPA AUID	Impairment	Use Attainment			Source
			Not Supporting	Fully Supporting	Not Assessed	
Saganashkee Slough	IL_RHH	Nickel, Sedimentation/Siltation, Silver, Total Suspended Solids (TSS), Phosphorus (Total), Aquatic Algae, Polychlorinated biphenyls	Aquatic Life, Fish Consumption, Aesthetic Quality	---	Primary Contact, Secondary Contact	Contaminated Sediments, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland, Source Unknown
Turtlehead Lake	IL_RHS	Phosphorus (Total), Aquatic Plants (Macrophytes), Aquatic Algae	Aesthetic Quality	Aquatic Life	Fish Consumption, Primary Contact, Secondary Contact	Internal Nutrient Recycling, Waterfowl, Urban Runoff/Storm Sewers, Runoff from Forest/Grassland/Parkland

Table 3.17-2 Summary of Impaired Lakes in the Cal-Sag Channel Planning Area

Figure 3.17-1 Hogwash Slough

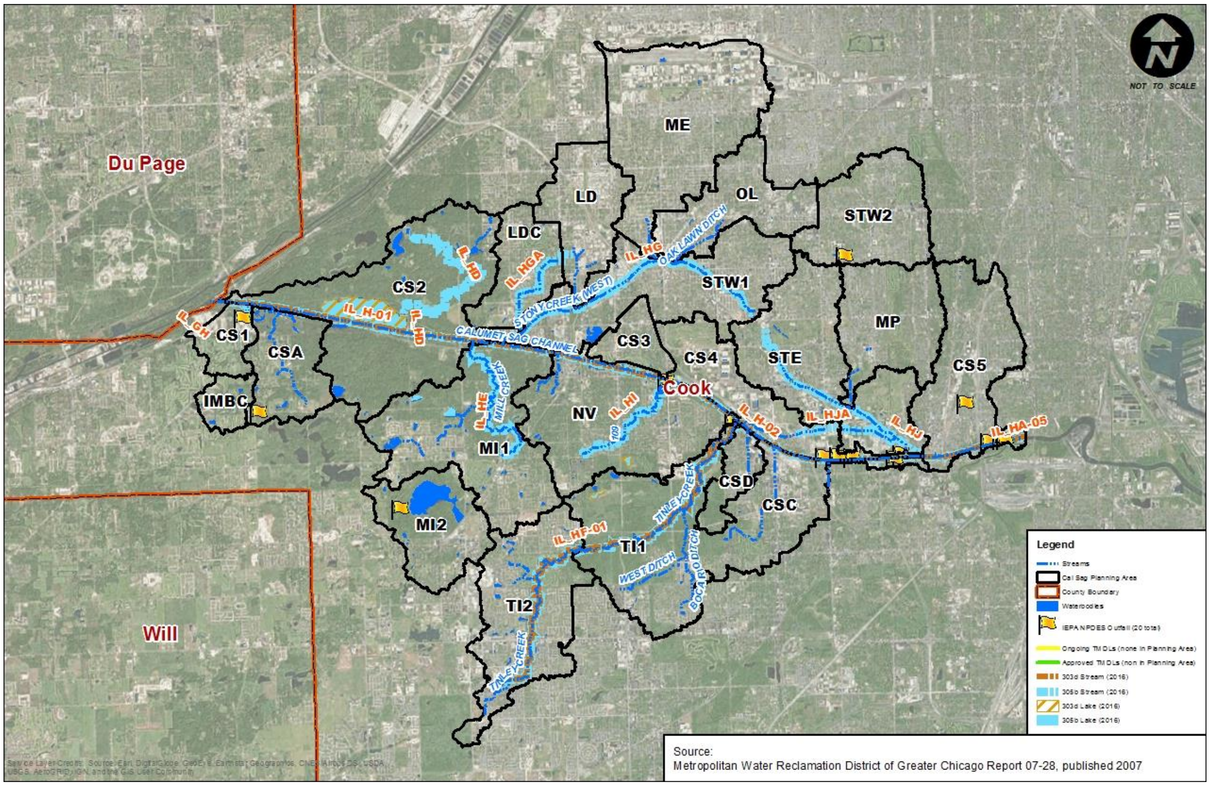


Figure 3.17-2 Summary of Illinois EPA Impaired Watercourses in the Cal-Sag Channel Planning Area

3.17.2 MWRD Water Quality Sampling

MWRD has been monitoring water quality constituents as part of its Ambient Water Quality Monitoring in the Cal-Sag Channel Planning Area since 2001. The list of constituents for which data is available is widespread and data is somewhat sporadic as sampling programs may have been stopped or started for various reasons. Thus is must be understood that the data is not sufficiently systematic or robust such that conclusions can be drawn regarding if water quality standards are being met. Nevertheless it is illuminative to review the MWRD water quality information.

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
Chloride	Illinois Administrative Code. Title 35: Environmental Protection; Subtitle C: Water Pollution; Chapter I: Pollution Control Board; *Part 302 Water Quality Standards Section 302.304*	500 mg/L
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 3.17-3 Water Quality Comparison Criteria

The MWRD sampling locations in the watershed planning area are shown on Figure 3.17-2.

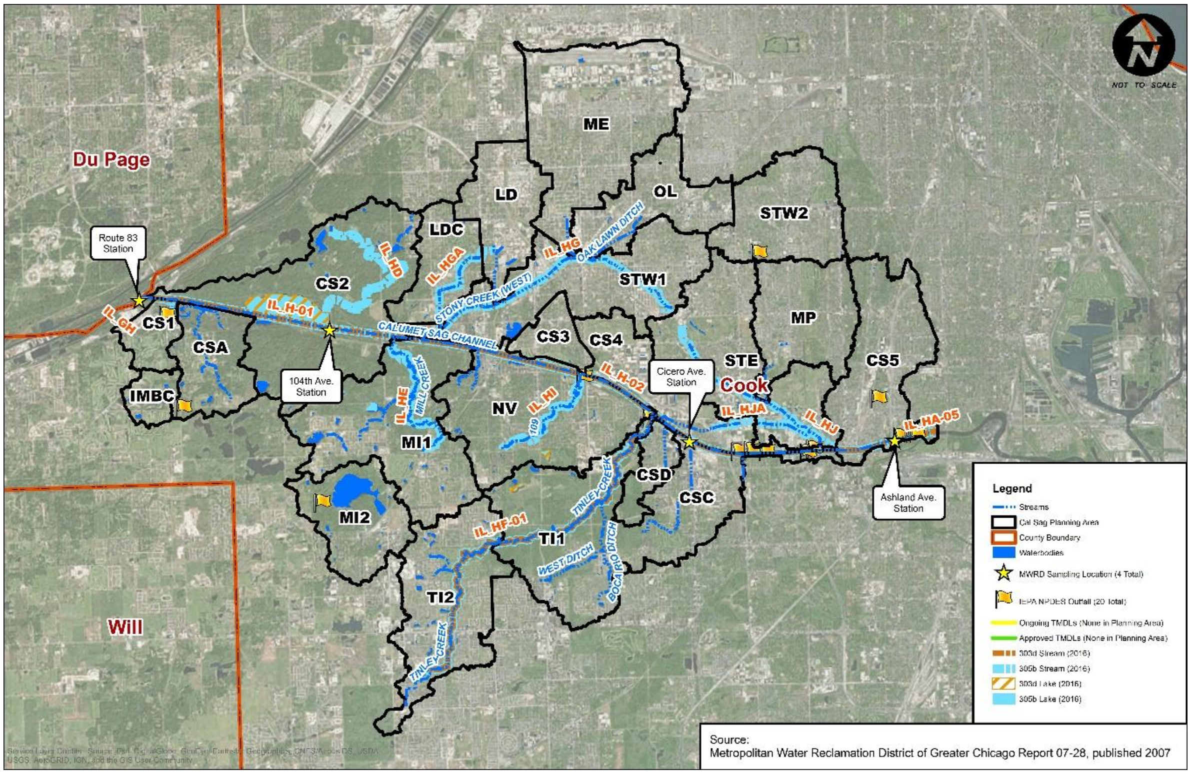


Figure 3.17-3 MWRD Sampling Locations – Cal-Sag Channel Planning Area

Average concentrations of DO, total phosphorus, total kjeldahl nitrogen and BOD based on MWRD data are shown in the following figures for the monitoring locations within the watershed planning area. In some cases comparison criteria values are shown on the charts.

Figure 3.17-4 Laughing Squaw Slough

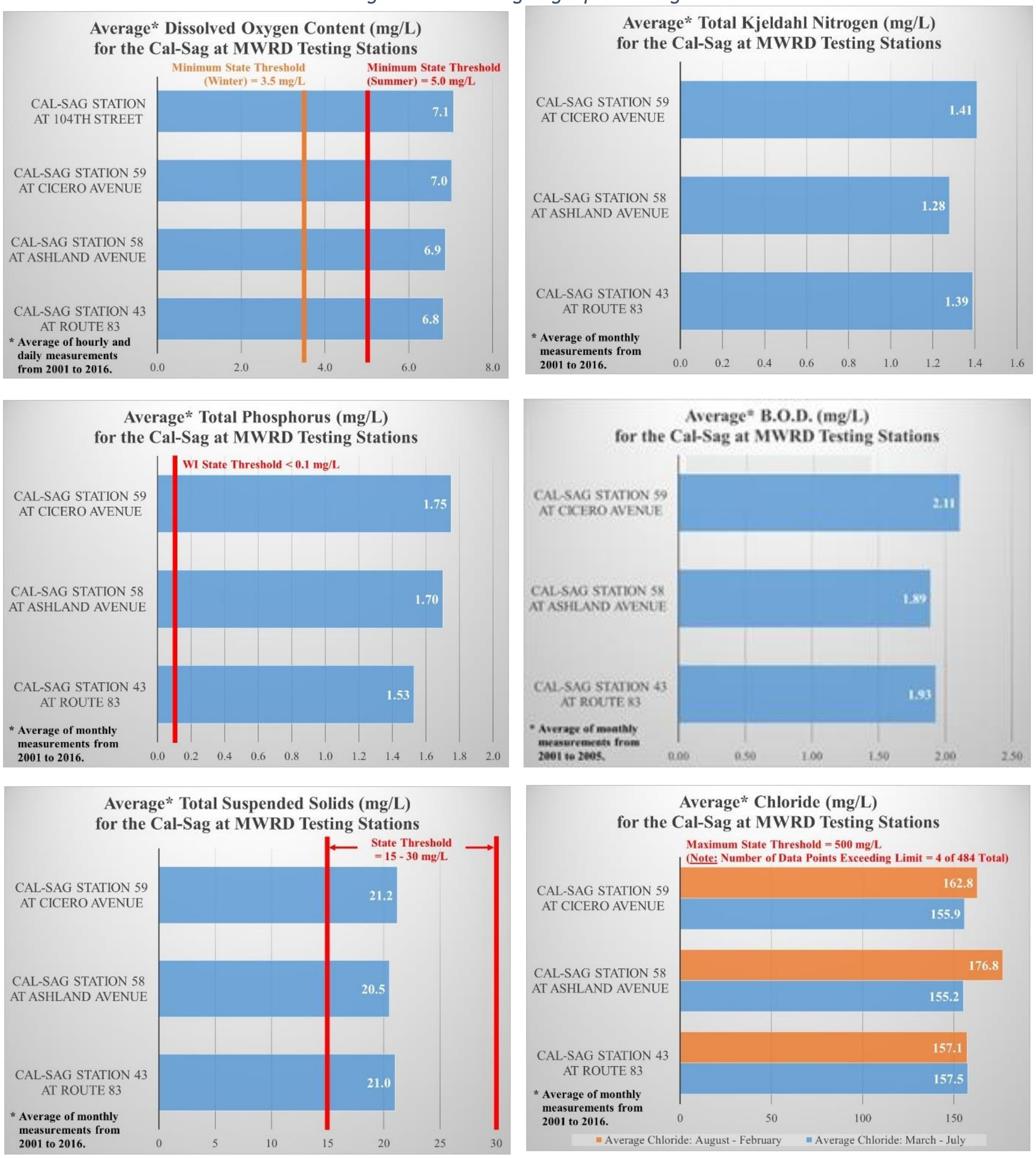


Figure 3.17-5 Cal-Sag Channel Planning Area Water Quality Sampling Data – MWRD Sampling Program

The summaries of the MWRD data shown in Figure 3.17-5 depict averages from sampling once a month from 2001 to 2016 with the exception of DO, which is reported as an average of daily measurements. Chloride is reported as a monthly average for winter and summer months and includes the number of times the water quality criterion was exceeded. It should be noted that the data displayed in Figure 3.17-5 is a summary of the sampling data. For most of the parameters the data represent a "snap shot" of constituent level for one day in a single month. For some parameters, e.g., BOD, the monitoring data is only available for a relatively short time period. Thus, the data presented above should not be interpreted as a strong indicator as to if water quality goals are being met. Nevertheless, the data are useful for confirming priority pollutants and pointing toward priority pollutant sources. For example, the relatively elevated levels of Total Suspended Solids are likely associated with runoff from urbanized areas and erosion of stream channels. Continued and possibly more focused monitoring will be needed to more definitively assess the extent to which water quality criteria are being met.

3.17.3 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 Cal-Sag Channel 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 U.S. 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 22 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 CMAP's 2013 Land Use Inventory for Northeast Illinois and an annual rainfall of 35.01 inches per year (weather station: IL CHICAGO MIDWAY AP 3). The CMAP land use data consists of a geodatabase and supporting documentation depicting land use in northeast Illinois divided into 60 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 preserves and forested area were separated from the open space category and entered into STEPL as Forest to specifically capture the notable forest preserves in the watershed planning area. CMAP previously characterized open space into 5 categories including residential recreation areas and forested areas. Therefore, we quantified the open space subset 'forest' to capture forested areas and forest preserves.

Table 3.17-4 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, urban land is the largest nonpoint source contributor of total nitrogen (98.7%), total phosphorus (96.9%), and sediment (94.8%). BMPs will need to be strategically planned and implemented in the developed areas to protect and restore water quality in the Cal-Sag Channel 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)
ME	7.8	1.3	0.2	26.8
NV	5.2	0.9	0.1	18.5
MP	6.1	1.0	0.1	22.0
TI2	5.2	0.8	0.1	18.8
TI1	0.9	0.2	0.0	2.9
CSD	4.1	0.6	0.1	14.7
CSC	5.3	0.8	0.1	18.7
LD	7.8	1.3	0.2	26.9
LDC	4.3	0.7	0.1	15.4
STW2	6.6	1.1	0.2	23.6
CS2	0.3	0.1	0.0	0.7
STE	6.2	1.0	0.1	22.1
MI1	2.8	0.5	0.1	9.5
STW1	6.1	1.0	0.1	21.6
OL	6.9	1.1	0.2	24.9
CS5	7.5	1.2	0.2	25.4
CS3	5.9	1.0	0.1	20.5
CS4	6.7	1.1	0.2	23.6
MI2	2.0	0.3	0.1	6.6
CSA	2.5	0.4	0.1	8.5
CS1	4.5	0.7	0.1	14.7

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)
IMBC	4.1	0.8	0.3	11.9
TOTAL	108.9	17.8	2.8	378.3

Table 3.17-4 Summary of Pollutant Loading per Watershed Planning Unit in the Cal-Sag Channel 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 3.17-5.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	375,383	60,902	1,355,337	8,834
Cropland	2,376	583	4,906	286
Forest & Grassland	3,460	1,686	8,460	118
Streambank	26,266	10,112	52,532	16,416
Total	407,485	73,284	1,421,235	25,655

Table 3.17-5 Summary of Pollutant Loadings per Land Use in the Cal-Sag Planning Area

Cropland in the land use table includes all agricultural land use. The land use dataset provided by CMAP is the best available land use dataset and does not break cropland into row crops and pasturelands. Per the CMAP classification of land use database; agricultural land classed by the county assessor as agricultural, is noted as parcel dominated by: row crops, field crops & fallow field farms & pasture, horse, dairy, livestock, and mixed, including dairy and other livestock agricultural processing. Given that the Cal-Sag Planning Area is 95% developed, there is minimal agricultural land use associated with the planning area.

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 Cal-Sag Channel 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.

3.17.4 Quantification of Chloride Loadings

Within the primarily urbanized Cal-Sag Channel Planning Area, the primary source of chloride loading is from roadway, parking lot and sidewalk deicing activities. Chloride loads have been estimated for each municipality in the watershed planning area, as municipalities are responsible for purchasing and applying on public streets and parking areas the majority of chloride deicers. It is necessary to estimate the loadings based on an established methodology because currently there is no data readily available for the rates of use of chloride deicing materials being used throughout the watershed planning area.

Chloride loads were analyzed using methodology drawn from the 2014 Thorn Creek Watershed Based Plan Addendum, prepared by Geosyntec Consultants, Inc. and CMAP. This method was used in large part to be consistent with other communities in the region. The Thorn Creek Watershed Based Plan estimated the application of chloride-based deicers using de-icing survey information collected by the DuPage River Salt Creek Workgroup for several local municipalities.

According to the Thorn Creek Watershed Based Plan, usable survey responses were received from the following Illinois units of local government: Addison, Bloomingdale, Bolingbrook, DuPage County, Hanover Park, Naperville, West Chicago, and Woodridge. These areas represent a typical jurisdiction within the Cal-Sag Channel planning area. For the winter for 2011-2012, jurisdictions reported using between 230 and 1,071 pounds of salt per lane-mile per salt application event. The reported mean, standard deviation and median were 490, 313, and 327 pounds of salt per lane-mile per salt application event, respectively. With this data, the Thorn Creek methodology included chloride loading assuming applications of 300, 400, 500, and 800 pounds per lane-mile per salt application event.

To be consistent with the application rates used in the Thorn Creek Plan, it was determined that the chloride deicing methods were applied approximately 18 times per year between 2011 and 2012. This method used in the Thorn Creek Addendum was selected due to the proximity of the Cal-Sag Channel Planning Area and the Thorn Creek Watershed, and both watersheds draining to the same receiving water body, the I&M Canal. The estimated chloride loadings per jurisdiction and per watershed planning unit are shown in Table 3.17-6 and Table 3.17-7 respectively.

	Lane Miles	**300 lb per lane-mile**	**400 lb per lane-mile**	**500 lb per lane-mile**	**800 lb per lane-mile**
		(tons/year)	(tons/year)	(tons/year)	(tons/year)
Unincorporated	236	645	859	1074	1719
Alsip	187	511	682	852	1363
Bedford Park	24	66	88	109	175
Blue Island	119	325	433	541	865
Bridgeview	96	262	350	437	700
Burbank	170	463	617	772	1235
Calumet Park	48	131	174	218	349
Chicago	355	968	1291	1614	2583
Chicago Ridge	84	230	306	383	613
Crestwood	93	253	338	422	675
Evergreen Park	140	383	511	639	1022
Hickory Hills	63	173	231	289	462
Hometown	8	21	28	35	56
Justice	10	28	37	47	75

	Lane Miles	300 lb per lane-mile	400 lb per lane-mile	500 lb per lane-mile	800 lb per lane-mile
Lemont	2	5	6	8	12
Merrionette Park	14	37	49	62	99
Midlothian	27	73	97	121	194
Oak Forest	72	197	263	328	525
Oak Lawn	385	1052	1402	1753	2804
Orland Hills	34	93	124	155	247
Orland Park	293	799	1066	1332	2132
Palos Heights	145	396	527	659	1055
Palos Hills	137	375	499	624	999
Palos Park	102	278	370	463	740
Riverdale	1	1	2	2	4
Robbins	18	50	67	84	134
Tinley Park	32	87	116	145	232
Worth	91	248	331	413	662
TOTAL	2,985	**8,149**	**10,865**	**13,582**	**21,731**

Table 3.17-6 Summary of Chloride Loadings per Jurisdiction in the Cal-Sag Channel Planning Area

	Lane Miles	300 lb per lane-mile	400 lb per lane-mile	500 lb per lane-mile	800 lb per lane-mile
Watershed Planning Unit		(tons/year)	(tons/year)	(tons/year)	(tons/year)
ME	279	763	1017	1272	2035
NV	226	617	822	1028	1645
MP	152	416	555	694	1110
TI2	187	511	681	852	1363
TI1	99	270	361	451	721
CSD	31	84	112	139	223
CSC	119	325	433	542	867
LD	137	375	500	625	999
LDC	79	215	287	358	573
STW2	182	496	662	827	1324
CS2	68	185	247	309	494
STE	218	594	793	991	1585
MI1	159	434	579	724	1158
STW1	255	695	927	1158	1853
OL	182	496	662	827	1323
CS5	243	662	883	1104	1766

	Lane Miles	300 lb per lane-mile	400 lb per lane-mile	500 lb per lane-mile	800 lb per lane-mile
CS3	54	147	195	244	391
CS4	79	215	286	358	572
MI2	56	153	203	254	407
CSA	29	78	104	130	209
CS1	10	26	35	43	69
IMBC	4	11	15	19	31
TOTAL	2846	7769	10359	12949	20718

Table 3.17-7 Summary of Chloride Loadings per Watershed Planning Unit in the Cal-Sag Channel Planning Area

It should be noted these estimates are based on the use of deicers by municipalities mostly for deicing roads and public parking lots. Private contractors also apply deicers to privately-owned parking lots. Thus, actual loadings to water bodies in the Cal-Sag Channel Planning Area are likely higher than these estimated values. To protect designated uses, BMPs to reduce chloride loadings will need to be implemented in the Cal-Sag Channel Planning Area.

3.18 POINT SOURCES

3.18.1 National Pollutant Discharge Elimination System (NPDES)

Municipalities discharging stormwater to the watercourses in the Cal-Sag Channel watershed planning area are regulated by Illinois EPA's National Pollutant Discharge Elimination System (NPDES) Stormwater Permit Program. This program was created to improve the water quality of stormwater runoff from urban and suburban areas, and requires that municipalities obtain permit coverage for discharges of stormwater. Most units of government within the planning area are operators of small municipal separate storm sewer systems (MS4s). MS4s are intended to collect urban stormwater runoff, an important contributor to nonpoint source pollution, and, consequently, are regulated under the program.

In Illinois, discharges from small MS4s are regulated under Illinois EPA's General NPDES Permit No. ILR40. This permit requires that MS4 operators develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants. A permittee's stormwater management program must include at least the following six minimum control measures:

1. Public education and outreach on storm water impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control
5. Post construction storm water management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

In addition to the regulated stormwater discharges, there are other "point source" discharges of pollutants in the Cal-Sag Channel watershed. The Clean Water Act prohibits the discharge of "pollutants" through a "point source" into a "water of the United States" unless the discharge is covered by an NPDES permit. The permit will contain effluent, monitoring and reporting requirements, and other provisions to ensure that the discharge does not harm water quality or public health.

As part of the Illinois EPA's NPDES program, point sources and outfall locations to receiving waters are monitored for discharge quality. Figure 3.17-3 (page 77) shows the location of the 20 Illinois EPA NPDES permitted outfalls located within the Cal-Sag Channel Planning Area. Eight (8) of these outfalls discharge combined sewer overflows, four (4) discharge cooling water, two (2) of the outfalls are for intake screen backwash, two (2) discharge effluent from sewage treatment plants, two (2) outfalls are for pump priming water, one (1) outfall is for a water reclamation plant emergency high level bypass, and one (1) discharges treated contaminated groundwater.

3.19 GROUNDWATER

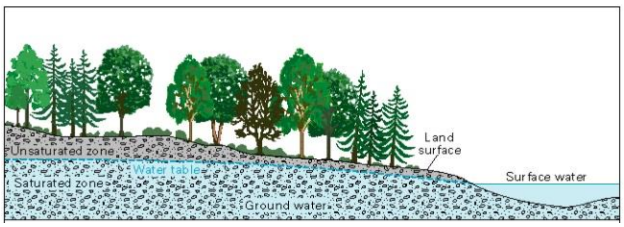


Figure 3.19-1 Groundwater

Some part of the precipitation that lands on the ground surface infiltrates into the subsurface, and accumulates as groundwater (Figure 3.19-1). 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.

The groundwater elevations within the Cal-Sag Channel Planning Area are between elevations 550 and 660 feet (NAVD88 Datum). Review of the monitoring wells in the area in and around the watershed indicate that the average groundwater depth is approximately 50-60 feet below the surface. However, in certain areas the groundwater table may be much closer to the surface. Knowledge of the depth to groundwater within the Cal-Sag Channel 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.

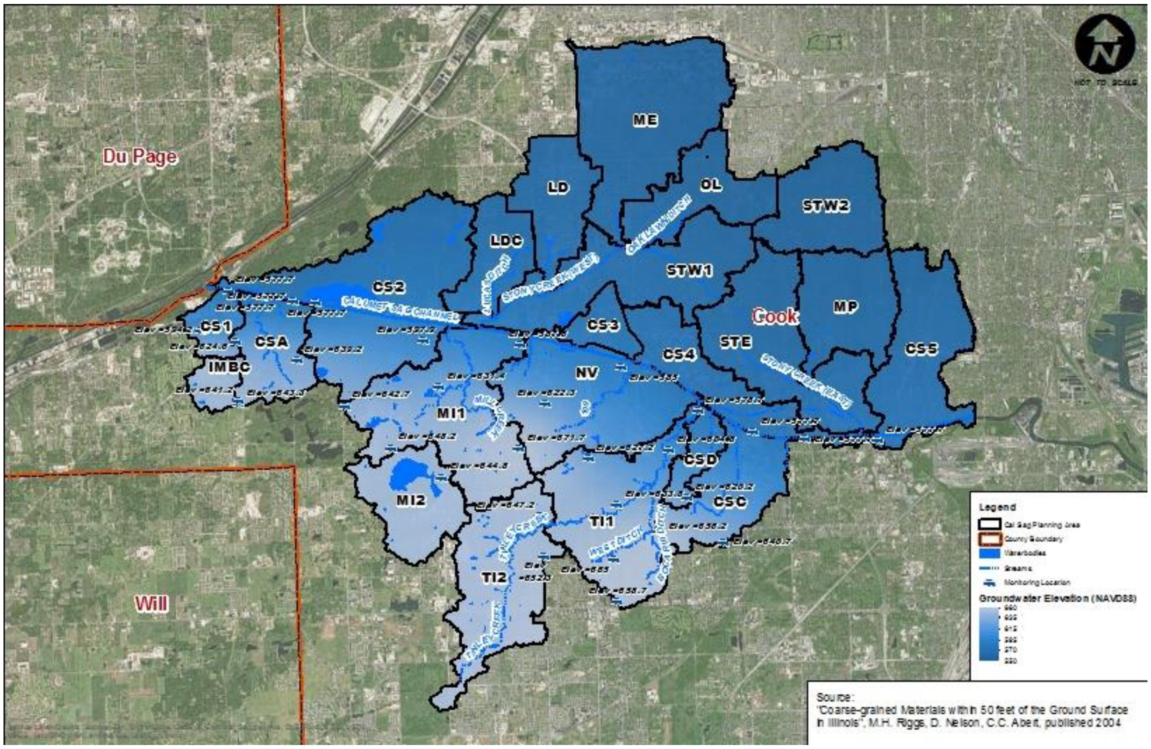


Figure 3.19-2 Groundwater Elevations in the Cal-Sag Channel Planning Area

Figure 3.19-3 Laughing Squaw Slough

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 Cal-Sag Channel Planning Area (Chapter 3).

The Cal-Sag Planning Area is a typical densely urbanized watershed within the Chicagoland area where water quality suffers from watershed stressors stemming from land use conditions and the impact of land use change on aquatic and natural resources. This includes the creation of extensive areas of impervious surfaces, elimination of naturalized and/or riparian areas, and changes to overall stream corridors. The problems identified throughout this chapter include several current and potential future problems.

4.1 LAND USE CHANGE

Land use change has widely been noted as the cause for water quality and watershed degradation. As part of the National Water Quality Assessment (NAWQA) Program, the USGS conducted a study of Effects of Urbanization on Stream Ecosystems (EUSE). The study was performed for nine metropolitan areas from 2003 through 2012 where biological, physical (hydrology and habitat) and chemical components were measured along reaches. The USGS study looks at a watercourses biological community, hydrology, habitat and chemistry and how these elements change as related to urban development across the country. The results of the USGS efforts indicate that the cause of degradation and sources of pollutant loadings are multi-faceted and interrelated. No single environmental factor was identified that can be used in explaining why the health of streams decline as levels of urban development increase. Overall, the study showed that urban development can alter hydrology, habitat and stream chemistry which in turn cause multiple stressors that can degrade aquatic ecosystems. In addition, urban development leads to increased storm flow variability, often creating a "flash" of stormwater in receiving systems because of engineered drainage. This in turn leads to temperature fluctuation, erosion, increased velocities and channelization (Beaulieu et al., 2012). The USGS study is consistent with findings regarding conditions in the Cal-Sag watershed and helps inform plans to reduce nonpoint pollution sources.

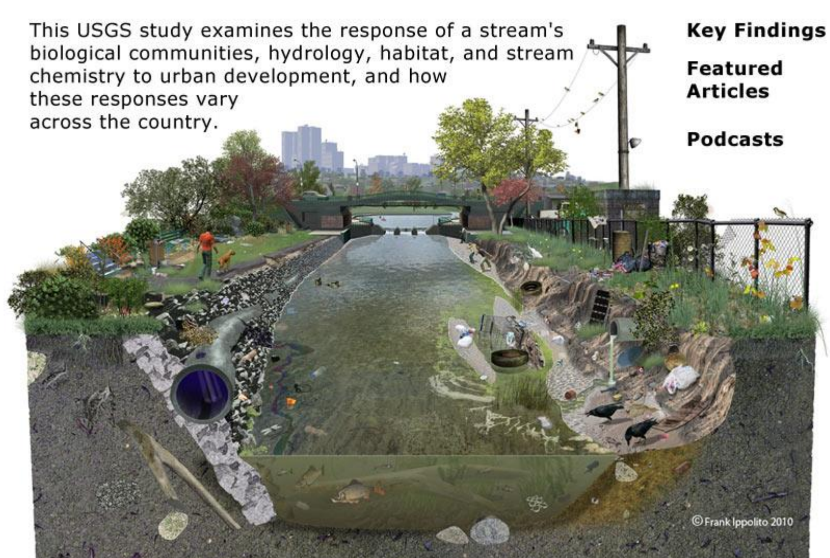


Figure 4.1-1 Effects of Urbanization on Stream Ecosystems (USGS, 2012)

The main takeaway from the USGS study is that 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 development. In this region and specific to the Cal-Sag Channel Planning Area, the resource inventory for which data is available and complied, indicates a very dense highly urbanized watershed. The physical changes to all watercourses throughout the Cal-Sag Channel Planning Area are most notable as the resource inventory indicates that majority of the watercourses assessed have little to no riparian area and are highly channelized with high erosion. The only instance in the watershed where riparian areas are good to moderate are those located on Forest Preserve District property. The habitat destruction and habitat fragmentation has led to the complete elimination of riparian areas through the urbanized 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 urbanized areas has significantly degraded water quality and the aquatic ecosystem in the planning area. The removal of these ecosystems, the creation of impervious surfaces, and the alteration of stream networks have altered the hydraulic process of interception and infiltration while increasing stormwater quantities and the mobility of potential harmful constituents.

Much of the Cal-Sag Planning Area was developed prior to the adoption of modern stormwater management practices. The changes to land use combined with lack of appropriate stormwater management measures implemented as development progressed has contributed to the degradation of water quality. This can be seen throughout much of the planning area north of the Cal-Sag Channel where municipality incorporation dates as far back as the 1900s. Development in these municipalities occurred sporadically. The period from which the most notable increases in population occurred during the 1950s through the 1970s. For example, the Village of Oak Lawn's population grew from approximately 9,000 in the 1950s to 60,000 in the 1970s (Encyclopedia of Chicago). The timing of new development in the watershed is important with respect to stormwater management. Many stormwater systems did not include detention basins or other controls in the 1950's and 60's. The MWRD did not begin to regulate stormwater until 1972 with the adoption of the Sewer Permit Ordinance. In addition, it was not until recently (May, 2014) the MWRD adopted the Watershed Management Ordinance which directly addresses water quality. Likewise, the EPA's National Pollution Discharge Elimination System (NPDES) was created in 1972, following much of the development of the planning area. Thus, these areas release large volumes of stormwater which surge into the waterways delivering pollutants and contributing to erosion.

The overall land use change and impervious surface creation combined with minimal stormwater management controls has led to increased runoff volumes, creating altered hydrologic conditions for receiving streams. This is most notable in the channelization and erosion characterization shown in Chapter 3.

4.2 LAND USE CHANGE AND STORMWATER QUALITY – CAUSES OF IMPAIRMENTS

A strong correlation exists between impervious area cover and degradation of aquatic ecosystems in receiving waters. This correlation has been validated in many scientific studies across the country. As stormwater runoff increases in volume and velocity, there is increased potential for erosion and the types and concentration of pollutants entering receiving waters increases. The lack of infiltration resulting from land use change eliminates the natural breakdown and filtering processes of the soil profile that normally cleanses and filters water as part of the natural water cycle (Miller, 2002). Many studies have shown a strong link between increased impervious area coverage and increased pollutant/constituent levels in receiving waters (Brabec et al., 2002).

The land use changes that have occurred in the Cal-Sag 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 preserve areas are densely developed with high percentages of impervious areas regardless of residential, transportation or commercial land use.

Stormwater runoff from urbanized areas is known to contain a wide range of pollutants coming from various point and nonpoint sources. Urban nonpoint source pollution is a significant contributor to water quality degradation (Brezonik and Stadelmann, 2002). MWRD has been monitoring water quality constituents as part of its Ambient Water Quality Monitoring in the Cal-Sag Channel since 2001. The list of constituents for which data is available is widespread and somewhat limited to the Cal-Sag Channel sampling locations. These locations are near point sources or inflow location from smaller tributaries. 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 Cal-Sag Planning Area are typical water quality stressors in urbanized areas and include:

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

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.

Overall the ratio of impervious area to the entire watershed planning area greatly exceeds open space. The exceptions are the areas of forest preserve, which constitute approximately 25% of the Cal-Sag Planning Area. The remaining open space is very limited with small to no riparian corridors or open space throughout most of the residential and commercial land use areas. The Cal-Sag Planning Area is dominated by impervious area suggesting that the watershed is susceptible to elevated pollutant levels associated with stormwater runoff from impervious area. The following is a discussion of the impairments and summary of the priority areas analysis completed for the Cal-Sag Planning Area.

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 urban development in the Cal-Sag Planning Area has caused channel erosion, widening and scouring which has compounded poor urban stream ecology. Visible impacts to watercourses throughout the Cal-Sag Planning Area include eroded and exposed stream banks, fallen trees, sedimentation, and recognizably turbid conditions. The physical impacts have led to the degradation of water quality and habitat due to sediment loadings and is seen throughout the Cal-Sag Planning Area. The increase in sediment within the water column throughout the Cal-Sag 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 have destroyed stream bed habitat where the smallest stream organisms live causing a disrupted food chain condition. This has led to the 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 street dust, suspended solids and streambeds (Herrmann 1981). Water quality sampling conducted by MWRD at 4 sampling locations along the Cal-Sag Channel Mainstem generally confirms these findings from the literature; the monitoring conducted indicates the presence of many constitutes, including the following:

Selenium	Zinc
Mercury	Manganese
Nickel	Lead
Iron	Cadmium
Hexavalent Chromium	Copper
Boron	Barium
Sulfate	Arsenic
Silver	Magnesium
Fluoride	
Xylene	Toluene
Ethylbenzene	Phenols
Fats, Oils and Greases	

The presence of these constituents has been identified at each of the four MWRD sampling locations during single monthly measurements from 2001 – 2016. The list includes metals, hydrocarbons and synthetic organic compounds. The somewhat limited sampling data confirms these pollutants exist in the watershed and can be found in runoff from the highly impervious, urbanized areas. As noted above, hydrocarbon pollutant loads are associated with loadings of suspended sediments, which primarily are associated in this watershed with stormwater runoff. Consequently, this plan places a strong focus on 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 pollutant priority area ranking shows sediment loadings are greatest from the residential areas and transportation-related corridors when the ranking dataset is sorted by the residential land use category. Likewise, the riparian areas and channelized reaches within each watershed planning unit are grouped together when sorted by the residential land use category. Thus, 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.

SUB	COM	IND	INS	TRA	RES	VAC	OPEN	WAT	FOR	AGR	t/year	t/ac	Rank	Channel	Riparian	Erosion
TI2	9%	0%	2%	19%	52%	1%	14%	0%	1%	1%	6468	1.64	4	LOW	GOOD	LOW
NV	3%	1%	6%	21%	52%	2%	14%	1%	2%	0%	1696	0.36	3	NA	NA	NA
STW1	5%	3%	8%	25%	48%	4%	4%	2%	2%	0%	2385	0.56	4	HIGH	POOR	MOD
CS3	5%	0%	1%	25%	47%	1%	20%	0%	0%	0%	131	0.16	1	HIGH	POOR	LOW
OL	14%	0%	7%	28%	47%	1%	4%	0%	0%	0%	700	0.30	3	HIGH	POOR	MOD
MP	4%	1%	18%	23%	45%	0%	7%	0%	0%	0%	622	0.23	2	HIGH	POOR	MOD
STW2	8%	0%	13%	27%	45%	1%	6%	0%	0%	0%	488	0.17	1	NA	NA	NA
LDC	4%	0%	16%	15%	42%	1%	16%	0%	5%	0%	1116	0.64	4	HIGH	POOR	MOD
MI1	1%	0%	3%	15%	41%	4%	0%	1%	35%	1%	2310	0.47	4	MOD	FAIR	MOD
CS5	5%	6%	4%	35%	40%	7%	4%	2%	0%	0%	706	0.20	2	HIGH	POOR	LOW
ME	7%	14%	5%	33%	37%	2%	2%	0%	0%	0%	1566	0.29	3	HIGH	POOR	MOD
CSD	8%	0%	7%	15%	37%	1%	19%	1%	12%	0%	858	1.07	4	HIGH	POOR	MOD
LD	9%	13%	4%	32%	36%	2%	2%	0%	0%	0%	597	0.27	3	HIGH	POOR	MOD
CSC	10%	8%	4%	22%	36%	5%	8%	4%	7%	0%	651	0.26	2	HIGH	POOR	MOD
STE	5%	10%	18%	22%	34%	4%	6%	0%	1%	0%	1121	0.25	2	HIGH	POOR	MOD
CSA	0%	0%	13%	6%	26%	3%	28%	0%	22%	2%	490	0.26	2	MOD	POOR	MOD
MI2	6%	0%	5%	12%	21%	3%	0%	0%	52%	2%	228	0.10	1	NA	NA	NA
TI1	2%	1%	2%	6%	16%	1%	0%	0%	72%	0%	2673	0.62	4	LOW	GOOD	LOW
IMBC	1%	0%	13%	7%	13%	14%	21%	0%	7%	25%	184	0.30	3	NA	NA	NA
CS4	5%	36%	19%	18%	9%	9%	4%	2%	0%	0%	425	0.18	1	HIGH	POOR	LOW
CS1	5%	13%	3%	15%	6%	10%	39%	0%	7%	2%	117	0.15	1	HIGH	GOOD	LOW
CS2	0%	0%	1%	2%	3%	1%	0%	3%	91%	0%	122	0.02	1	HIGH	FAIR	LOW

Table 4.2-1 Summary of STEPL results for Sediment Loading by Watershed Planning Unit, Ranked and Sorted by Residential Land Use

Notes: Res – Residential; Com – Commercial; Ins – Institutional (hospitals, schools, churches, cemeteries); Ind – Industrial; Tra – Transportation (ROW, Rail, Roadways); Agr – Agriculture; Open – Open Space (e.g., Golf Courses); Vac – Vacant, Wat – Water; For – Forest Preserve.

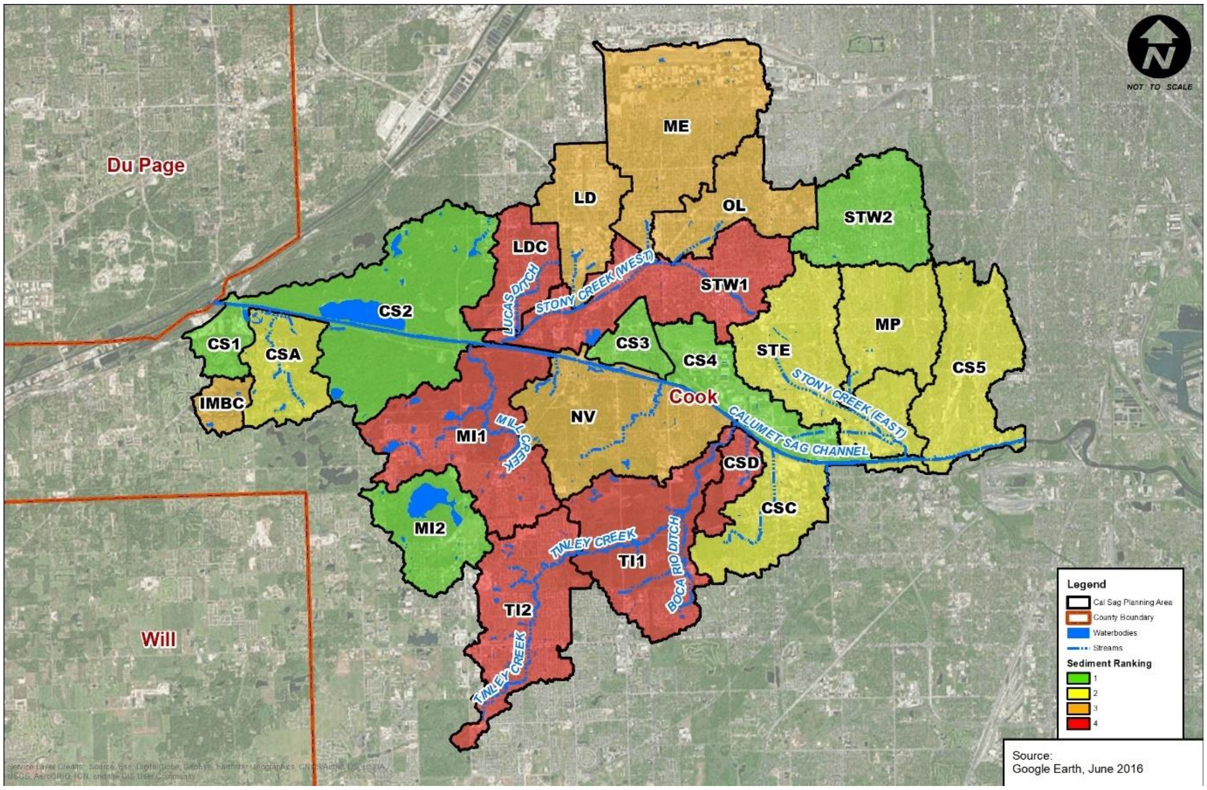


Figure 4.2-1 Sediment Load Ranking by Watershed Planning Unit

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.

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 phosphors and nitrogen levels are elevated in the Cal-Sag Planning Area as seen by the MWRD water quality sampling data. Increased nutrient levels are abundant throughout the Cal-Sag Planning Area where excess growth in receiving streams, lakes and ponds was visible in majority of the locations inspected during the watershed resource inventory (Chapter 3).

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 in Figure 4.2-2 and Figure 4.2-3 respectively. The priority area rankings show phosphorus and nitrogen loadings are greatest for watershed planning units with the most intensive residential and transportation land use, as seen when the ranking dataset is sorted by the residential land use category. 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.

SUB	COM	IND	INS	TRA	RES	VAC	OPEN	WAT	FOR	AGR	lb/year	lb/ac	rank	lb/year	lb/ac	rank
											Nitrogen			Phosphorus		
TI2	9%	0%	2%	19%	52%	1%	14%	0%	1%	1%	33755	8.5	4	7545	1.91	4
NV	3%	1%	6%	21%	52%	2%	14%	1%	2%	0%	30670	6.6	2	5410	1.159	2
STW1	5%	3%	8%	25%	48%	4%	4%	2%	2%	0%	33110	7.8	4	6024	1.42	4
CS3	5%	0%	1%	25%	47%	1%	20%	0%	0%	0%	5468	6.7	2	887	1.1	2
OL	14%	0%	7%	28%	47%	1%	4%	0%	0%	0%	18595	7.9	4	3076	1.31	3
MP	4%	1%	18%	23%	45%	0%	7%	0%	0%	0%	19093	7.1	3	3226	1.195	2
STW2	8%	0%	13%	27%	45%	1%	6%	0%	0%	0%	20905	7.4	3	3409	1.215	3
LDC	4%	0%	16%	15%	42%	1%	16%	0%	5%	0%	11153	6.4	2	2133	1.232	3
MI1	1%	0%	3%	15%	41%	4%	0%	1%	35%	1%	24728	5.0	1	4938	1.0	2
CS5	5%	6%	4%	35%	40%	7%	4%	2%	0%	0%	29359	8.4	4	4795	1.38	4
CSD	8%	0%	7%	15%	37%	1%	19%	1%	12%	0%	5486	6.9	3	1146	1.43	4
ME	7%	14%	5%	33%	37%	2%	2%	0%	0%	0%	47109	8.7	4	7862	1.45	4
CSC	10%	8%	4%	22%	36%	5%	8%	4%	7%	0%	17376	6.9	3	2854	1.1	2
LD	9%	13%	4%	32%	36%	2%	2%	0%	0%	0%	18994	8.7	4	3127	1.43	4
STE	5%	10%	18%	22%	34%	4%	6%	0%	1%	0%	32140	7.3	3	5357	1.212	3
CSA	0%	0%	13%	6%	26%	3%	28%	0%	22%	2%	7281	3.8	1	1312	0.7	1
MI2	6%	0%	5%	12%	21%	3%	0%	0%	52%	2%	8618	3.7	1	1497	0.6	1
TI1	2%	1%	2%	6%	16%	1%	0%	0%	72%	0%	13257	3.1	1	3316	0.8	1
IMBC	1%	0%	13%	7%	13%	14%	21%	0%	7%	25%	3091	5.1	1	568	0.9	1
CS4	5%	36%	19%	18%	9%	9%	4%	2%	0%	0%	18228	7.8	4	2885	1.231	3
CS1	5%	13%	3%	15%	6%	10%	39%	0%	7%	2%	4418	5.5	2	660	0.8	1
CS2	0%	0%	1%	2%	3%	1%	0%	3%	91%	0%	4650	0.7	1	1258	0.2	1

Table 4.2-2 Summary of STEPL results for Phosphorus and Nitrogen Loading by Watershed Planning Unit, Ranked and Sorted by Residential Land Use

Notes:

Res – Residential; Com – Commercial; Ins – Institutional (hospitals, schools, churches, cemeteries); Ind – Industrial; Tra – Transportation (ROW, Rail, Roadways); Agr – Agriculture; Open – Open Space (Golf Courses); Vac – Vacant, Wat – Water; For – Forest Preserve.

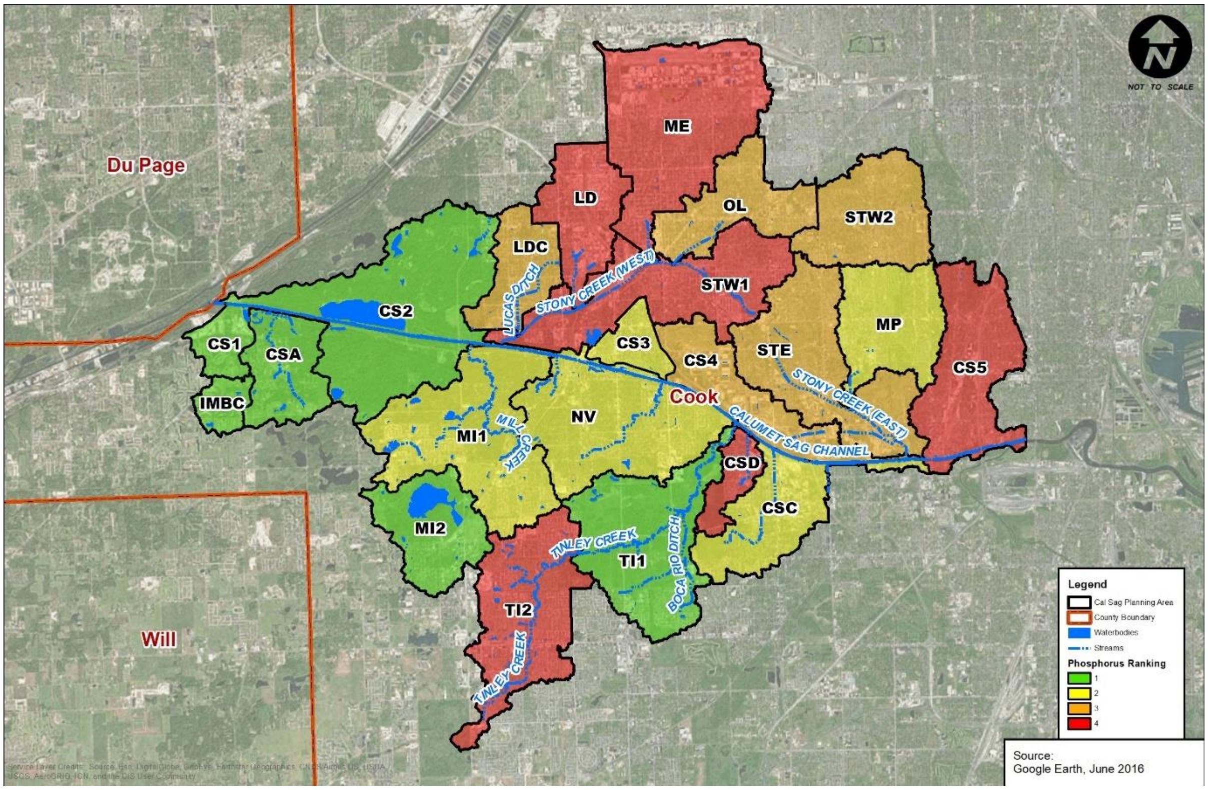


Figure 4.2-2 Phosphorus Load Ranking by Watershed Planning Unit

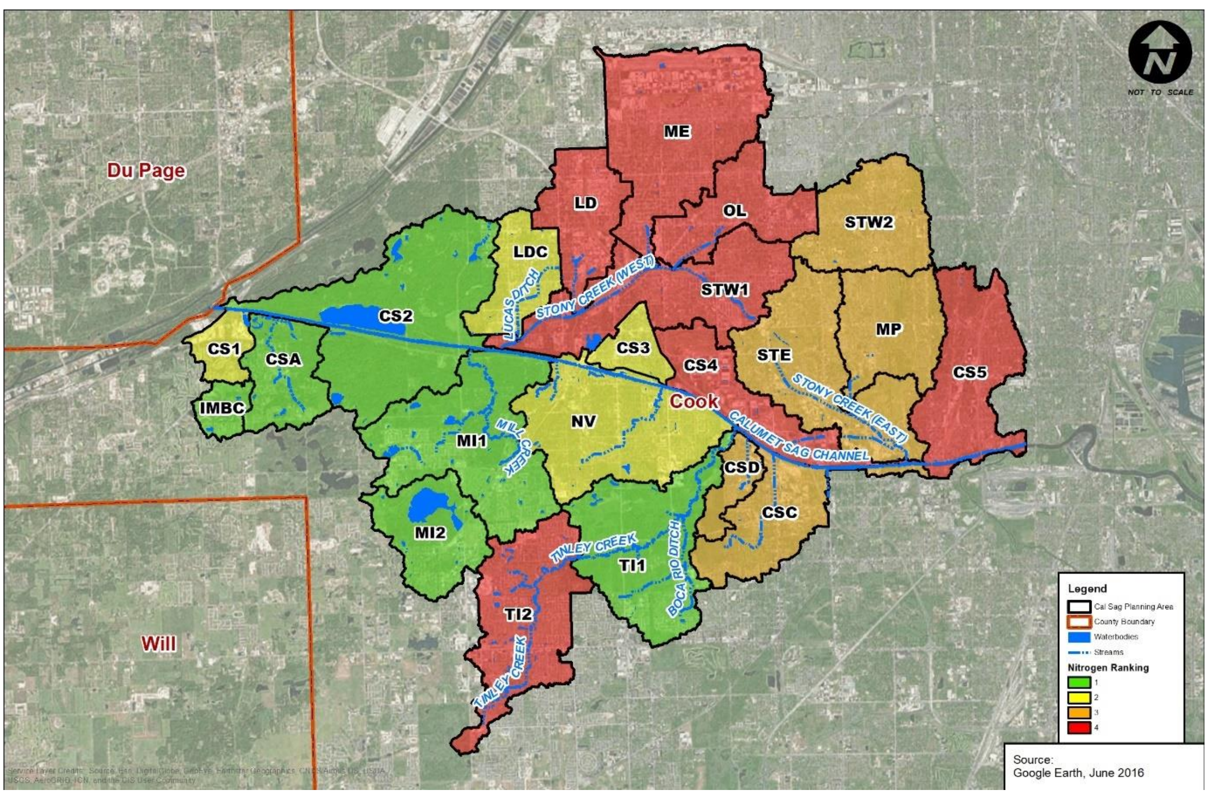


Figure 4.2-3 Nitrogen Load Ranking by Watershed Planning Unit

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.

Urban 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 in urbanized areas often occurs just after storm events because of oxygen demanding substances in receiving waters due to stormwater runoff (Erickson et. al., 2013).

BOD loadings can also come from wastewater treatment plants. The primary wastewater treatment plant upstream of the Cal-Sag watershed is the MWRD Calumet WWTP. This plant provides very good treatment of wastewater to limit BOD loads. Thus stormwater sources are a primary source of BOD loadings within the Cal-Sag watershed.

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.

The sampling of BOD conducted by the MWRD at four sampling locations provides a snapshot of the Cal-Sag Channel mainstem and is limited to single monthly measurements. 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 in Figure 4.2-4. The priority area ranking shows BOD loadings are greatest for watershed planning units with the most transportation land use. Watershed planning areas with a quartile ranking of 4 (highlighted in red) are priority areas for BMPs and other measures to reduce BOD loads.

SUB	COM	IND	INS	TRA	RES	VAC	OPEN	WAT	FOR	AGR	lb/year	lb/ac	rank
CS5	5%	6%	4%	35%	40%	7%	4%	2%	0%	0%	101505	29.2	4
ME	7%	14%	5%	33%	37%	2%	2%	0%	0%	0%	164702	30.4	4
LD	9%	13%	4%	32%	36%	2%	2%	0%	0%	0%	66820	30.5	4
OL	14%	0%	7%	28%	47%	1%	4%	0%	0%	0%	67805	28.9	4
STW2	8%	0%	13%	27%	45%	1%	6%	0%	0%	0%	76290	27.2	3
STW1	5%	3%	8%	25%	48%	4%	4%	2%	2%	0%	115328	27.2	3
CS3	5%	0%	1%	25%	47%	1%	20%	0%	0%	0%	19343	23.8	2
MP	4%	1%	18%	23%	45%	0%	7%	0%	0%	0%	69895	25.9	3
CSC	10%	8%	4%	22%	36%	5%	8%	4%	7%	0%	61903	24.5	3
STE	5%	10%	18%	22%	34%	4%	6%	0%	1%	0%	116042	26.3	3

SUB	COM	IND	INS	TRA	RES	VAC	OPEN	WAT	FOR	AGR	lb/year	lb/ac	rank
NV	3%	1%	6%	21%	52%	2%	14%	1%	2%	0%	109112	23.4	2
TI2	9%	0%	2%	19%	52%	1%	14%	0%	1%	1%	109061	27.6	4
CS4	5%	36%	19%	18%	9%	9%	4%	2%	0%	0%	64625	27.6	4
CS1	5%	13%	3%	15%	6%	10%	39%	0%	7%	2%	14408	18.0	2
MI1	1%	0%	3%	15%	41%	4%	0%	1%	35%	1%	85101	17.1	1
CSD	8%	0%	7%	15%	37%	1%	19%	1%	12%	0%	18189	22.7	2
LDC	4%	0%	16%	15%	42%	1%	16%	0%	5%	0%	39214	22.7	2
MI2	6%	0%	5%	12%	21%	3%	0%	0%	52%	2%	31066	13.3	1
IMBC	1%	0%	13%	7%	13%	14%	21%	0%	7%	25%	9196	15.2	1
CSA	0%	0%	13%	6%	26%	3%	28%	0%	22%	2%	25227	13.3	1
TI1	2%	1%	2%	6%	16%	1%	0%	0%	72%	0%	41409	9.6	1
CS2	0%	0%	1%	2%	3%	1%	0%	3%	91%	0%	14993	2.4	1

Table 4.2-3 Summary of STEPL results for BOD Loading by Watershed Planning Unit, Ranked and Sorted by Transportation

Notes:
Res – Residential; Com – Commercial; Ins – Institutional (hospitals, schools, churches, cemeteries); Ind – Industrial; Tra – Transportation (ROW, Rail, Roadways); Agr – Agriculture; Open – Open Space (Golf Courses); Vac – Vacant, Wat – Water; For – Forest Preserve.

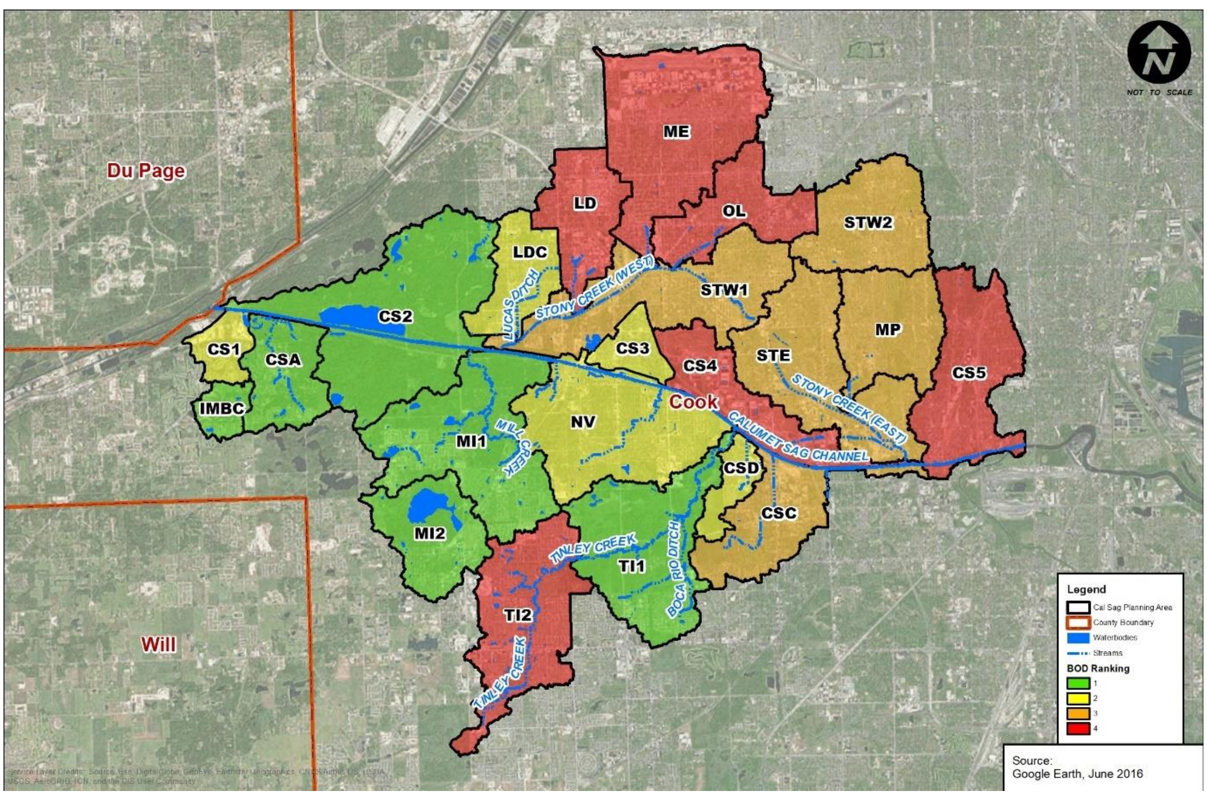


Figure 4.2-4 BOD Load Ranking by Watershed Planning Unit

4.2.5 Chlorides

Chlorides are an emerging pollutant of concern. Chlorides can impair uses and in high concentrations are toxic to aquatic ecosystems. The primary source of chloride loadings within the Cal-Sag Planning Area is deicing activities; 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 highly-urbanized Cal-Sag Planning Area consists of significant roadway and ROW land uses; ROW makes up nearly 20-30% of the more dense watershed planning units. To quantify chloride loading from nonpoint sources or land use types, the water quality characterization results as determined for chloride using application rates and lane miles within a watershed planning unit were ranked using 4 quartiles (Table 4.2-4). The priority area ranking shows chloride loadings are greatest for watershed planning units with the highest residential land use as seen when ranking the dataset according to residential land use. This is due to the street networks in the residential areas and current deicing practices implemented on streets, driveways, and parking lots. Measures to reduce chloride loads are important in all areas, but are especially critical in watershed planning areas with a quartile ranking of 4 (shown in red).

Sub	RES	COM	INS	IND	TRA	AGR	OPEN	VAC	WAT	FOR	Ln Mi	500 lb/ln mi	rank
TI2	52%	9%	2%	0%	19%	1%	14%	1%	0%	1%	187	852	4
NV	51%	3%	6%	1%	20%	0%	13%	2%	1%	2%	226	1028	4
OL	47%	14%	7%	0%	28%	0%	4%	1%	0%	0%	182	827	3
CS3	47%	5%	1%	0%	25%	0%	20%	1%	0%	0%	54	244	1
STW1	47%	5%	8%	3%	25%	0%	4%	4%	2%	2%	255	1158	4
STW2	45%	8%	13%	0%	27%	0%	6%	1%	0%	0%	182	827	3
MP	45%	4%	18%	1%	23%	0%	7%	0%	0%	0%	152	694	3
LDC	42%	4%	16%	0%	15%	0%	16%	1%	0%	5%	79	358	2
MI1	41%	1%	3%	0%	15%	1%	0%	4%	1%	35%	159	724	3
CS5	39%	5%	4%	6%	34%	0%	4%	6%	2%	0%	243	1104	4
ME	37%	7%	5%	14%	33%	0%	2%	2%	0%	0%	279	1272	4
CSD	37%	8%	7%	0%	15%	0%	19%	1%	1%	12%	31	139	1
LD	36%	9%	4%	13%	32%	0%	2%	2%	0%	0%	137	625	3
STE	34%	5%	18%	10%	22%	0%	6%	4%	0%	1%	218	991	4
CSC	34%	9%	4%	8%	21%	0%	8%	5%	4%	7%	119	542	2
CSA	26%	0%	13%	0%	6%	2%	28%	3%	0%	22%	29	130	1
MI2	21%	6%	5%	0%	12%	2%	0%	3%	0%	52%	56	254	1
TI1	16%	2%	2%	1%	6%	0%	0%	1%	0%	72%	99	451	2

Sub	RES	COM	INS	IND	TRA	AGR	OPEN	VAC	WAT	FOR	Ln Mi	500 lb/ln mi	rank
IMBC	13%	1%	13%	0%	7%	25%	21%	14%	0%	7%	4	19	1
CS4	9%	5%	19%	35%	18%	0%	4%	8%	2%	0%	79	358	2
CS1	6%	5%	3%	13%	15%	2%	39%	10%	0%	7%	10	43	1
CS2	3%	0%	1%	0%	2%	0%	0%	1%	3%	91%	68	309	2

Table 4.2-4 Summary of Chloride Loading by Watershed Planning Unit, Ranked and Sorted by Residential

Notes:

Res – Residential; Com – Commercial; Ins – Institutional (hospitals, schools, churches, cemeteries); Ind – Industrial; Tra – Transportation (ROW, Rail, Roadways); Agr – Agriculture; Open – Open Space (Golf Courses); Vac – Vacant, Wat – Water; For – Forest Preserve.

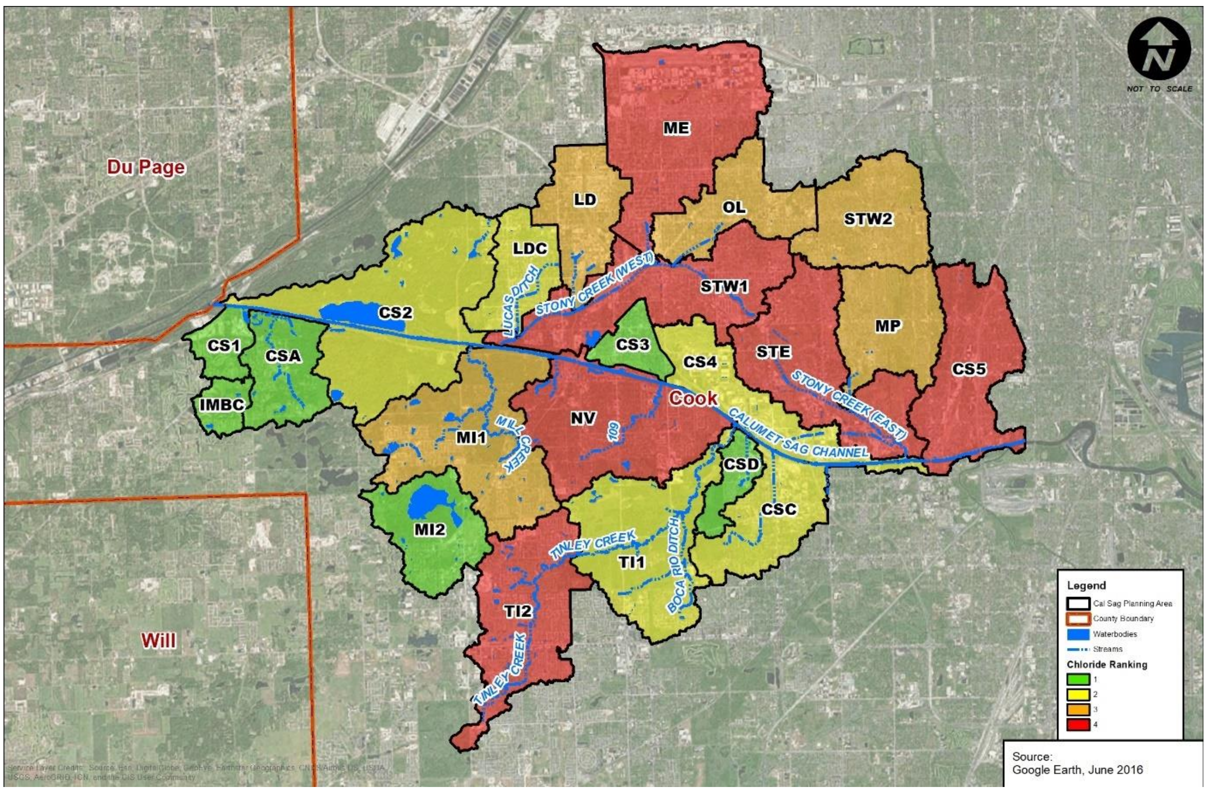


Figure 4.2-5 Chloride Load Ranking by Watershed Planning Unit

4.2.6 Stream, Shoreline, and Riparian Impairments

Most watercourses in the Cal-Sag Planning Area have been channelized to some extent except for those reaches through forest preserve property. All the tributary watercourses assessed north of the Cal-Sag Channel including Lucas Ditch, Lucas Ditch Cut-off, Stoney Creek East and West, Oak Lawn Ditch, Merrionette Park Ditch and Melvina Ditch flow through densely developed areas and are highly channelized. Many reaches along these watercourses flow through large diameter pipes underground. Erosion through these watercourses is moderate to minimal 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 the dense land use does not allow for a riparian habitat due to land constraints. Land use change has increased runoff rates, sediment loads, debris and eliminated natural riparian habitat as seen throughout the planning area. In areas where the waterbody is not piped or armored, streambank erosion contributes to sediment loads and degraded habitat. In areas that are piped or armored, 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. Excessive sediment loadings from runoff has led to areas of deep silt creating anaerobic conditions, non-supporting of fish habitat, low DO levels and often foul smelling conditions (Chapter 3).

Tinley Creek and Mill Creek (as well as the minor unnamed tributaries to these watercourses including for example, Boca Rio and Arroyo Ditches) south of the Cal-Sag Channel flow through residential areas prior to flowing through forest preserve property. While the lower sections of these watercourses exhibit minor channelization, the upper portions through the residential areas are highly channelized with very limited riparian areas. Loadings to the upper portions of the Tinley and Mill Creeks are relatively greater as these areas receive runoff from residential and roadway ROW land uses. The loss of habitat and riparian areas due to land use change and sediment loading has degraded water quality and reduced aquatic biodiversity.

4.3 OVERALL WATERSHED ASSESSMENT

When compared to other recently approved watershed based plans of similar land uses (Long Run Creek, Mill Creek, Buffalo Creek and Boone Dutch Creek), nonpoint source loadings are on average greater in the Cal-Sag Planning Area for all constituents. One reason for this is that the Cal-Sag Planning Area is approximately 90-95% developed excluding forest preserves while the other watersheds are approximately 50-75% developed. The data summarized in Chapter 3 and sections above indicate impaired water quality, which is caused by urbanization which creates expanses of impervious area which greatly increases runoff volumes and pollutant loadings.

The Illinois EPA Integrated Water Quality Report indicates that the mainstem of the Cal-Sag Channel is impaired (Table 3.17-1). The Illinois EPA lists the Cal-Sag Channel as impaired for mercury, polychlorinated biphenyls (PCBs), iron, DO (low), total suspended solids (TSS), and total phosphorus. The use attainment for which the Cal-Sag Channel does not support is fish consumption and indigenous aquatic life. This is confirmed in the 303d list where the Illinois EPA identified the causes for these impairments as: channelization, contaminated sediments, urban runoff, storm sewer discharges, combined sewer overflows, and sediment resuspension of contaminated sediments. The other tributary watercourse assessed by the Illinois EPA in the Cal-Sag Planning Area is Tinley Creek. Per the Illinois EPA 303d list, Tinley Creek is impaired due to fish-passage barriers and flow regime alterations. The cause of this impairment is identified as impacts from hydrostructure flow regulation or modification, urban runoff and storm sewers. These pollutants associated with the use impairments are typical constituents found in stormwater runoff and the impairments are largely a result of upstream water quality influences and stormwater discharges. The correlation between stressors included on the Illinois EPA 303d list and the stressors identified in the watershed assessment has been established linking increased impervious area with increased runoff and increased pollutant loadings, resulting in diminished water quality. The 303d list and the watershed assessment both point to stormwater runoff as the primary source of pollutant loadings.

Water quality in the Cal-Sag Channel can be attributed to conditions of the water flowing in from the Little Calumet River and the conditions of and runoff from the watershed areas draining to the Cal-Sag Channel. As such, water quality in the Cal-Sag Channel reflects the surrounding watershed and upland land use practices and changes. As land use has changed and impervious areas increased, stormwater discharge volumes and pollutant loadings have increased, and overall water quality in the Cal-Sag Channel became more degraded. This is shown in concert from both the Illinois EPA Integrated Water Quality Report assessment for the Cal-Sag Channel and the watershed assessment completed as part of this plan. The data compiled and analyzed here suggest that urbanization and increases in impervious area and the associated stormwater discharges are the primary sources of pollutant loadings in the Cal-Sag Channel planning area.

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 occurs 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 increase from 6.4 people per acre to 7.2 people per acre. Understanding that the Cal-Sag Planning Area outside of the forest preserve areas is 90-95% developed, land use changes in the future will consist mainly of modifications to already impervious areas to accommodate a moderate population increase. It is expected that most of the population increase will be accommodated in more dense (multi-unit development) residential and associated commercial areas. There will be a slight increase in impervious area, but much of the growth will be fit into areas that are already largely impervious. Overall the future projected priority areas identified in the previous section will remain unchanged because of population increase.

A factor that will help improve water quality conditions as redevelopment occurs is the MWRD WMO. The WMO establishes requirements for stormwater detention and volume control (green infrastructure) for many redevelopment projects. Thus, as redevelopment occurs, measures which will help reduce loadings will be built into the watershed, helping to reduce loadings even as growth occurs.

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.

Figure 4.4-1 Long John Slough

CHAPTER 5 WATERSHED PROTECTION MEASURES

As shown in the previous chapters, the Cal-Sag Planning Area is 90-95% developed. Runoff from impervious area and land use change in the highly-urbanized Cal-Sag Planning Area is a major cause for degraded water quality in the waterbodies. Past stormwater management practices in the planning area have primarily focused on conventional stormwater management designed to convey and drain stormwater runoff from developed areas as efficiently as possible to prevent localized flooding. While development in large portions of the planning area occurred prior to the adoption of conventional stormwater management, detention basins and flow reduction strategies have been implemented on developments since the early 1970s. However, little focus has been given to water quality and current stormwater management practices lack water quality components.

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. Using engineered systems and methodology, green infrastructure can provide a beneficial connection between natural environmental processes and gray stormwater management (conventional piped drainage) practices.

The purpose of this chapter is to provide nonpoint source best management practices specific to the Cal-Sag 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. This is because the initial runoff washes off pavements and "cleanses" the catchment. 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 (as is the case in the Cal-Sag Planning Area). On an individual property or in a neighborhood, 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.

5.1.1 Urban Stormwater Infrastructure Retrofits

Older developments in an urban setting were constructed prior to stormwater management requirements and before modern design criteria had been established. While current stormwater management regulations intend to limit increases in pollution associated with new development, they do not specifically address the hydrologic modification associated with runoff from existing development (Bitting, et. al., 2008). **Retrofits** include new installations or upgrades to existing BMPs in developed areas where there is a lack of adequate stormwater treatment. Stormwater retrofit goals may include the correction of prior design or performance deficiencies, flood mitigation, disconnecting impervious areas, improving recharge and infiltration performance, addressing pollutants of concern, demonstrating new technologies, and supporting stream restoration activities (EPA, 2011). Examples of a stormwater retrofit is to install rain gardens or bioswales to take runoff from streets or parking lots, or to convert driveway or parking areas to permeable pavements. In some situations, improvements can be made to catch-basins. Retrofitting BMPs or other measures into areas with existing development can significantly reduce pollutant loadings from stormwater discharges.

5.1.2 Detention Basin Retrofits

Potential **detention basin retrofits** include repurposing an existing basin to act as extended detention, wet pond, or constructed wetlands. These types of retrofits will provide for improved removal of pollutants while still allowing detention basins to provide flood control benefits. Extended detention utilizes an under-sized restrictor, which causes water to back up and be stored temporarily within the pond or wetland allowing particulate pollutants to settle out. Extended detention is often utilized with other treatment options such as wet ponds and constructed wetlands to improve performance and aesthetics. **Dry extended detention ponds** have efficiencies of 70% TSS removal, 20% total phosphorous removal, and 25% total nitrogen removal. Wet ponds promote pollutant removal through settling in a permanent pool of standing water, with a residence time that can range from days to several weeks. Wet ponds are an ideal retrofit based on their consistent and high pollutant removal. **Wet ponds** have removal efficiencies of 80% TSS, 50% total phosphorous, and 30% total nitrogen. **Constructed wetlands** are shallow depressions (typically less than one foot deep except at forebays and micropools) with long residence times that promote gravitational settling, biological uptake, and microbial activity. Constructed wetlands replicate a natural wetland ecosystem that enables consistent pollutant removal. Constructed wetlands have removal efficiencies of 70% TSS removal, 50% total phosphorous removal, and 25% total nitrogen removal (Center for Watershed Protection, 2007).

5.1.3 Building Rooftop Retrofits

Rooftop retrofits to a building consisting of either a green or blue roof, which detain stormwater runoff and reduce the peak rate of discharge, resulting in less runoff compared to a conventional rooftop. A **green roof** is comprised of a layer of vegetation and soil on top of a rooftop that stores and treats rooftop runoff. Green roofs can be either extensive or intensive systems, by being either a thin layer of soil and cover of grass or moss, or a thick layer of soil which contains vegetation such as trees, shrubs, or plants, respectively (Center for Watershed Protection, 2007). Green roofs provide runoff reduction but don't provide active removal of suspended solids, while increasing the total phosphorous and total nitrogen (Massachusetts Stormwater Handbook, 2008). **Blue roofs** detain water on top of the rooftop temporarily using check dams or slotted flow restriction devices around roof drains. Blue roofs provide minimal pollutant removal as its function is mainly detention. (Philadelphia Water, 2015).

5.1.4 Bioretention Basins and Swales

Bioretention basins and swales consist of landscaping features adapted to increase infiltration and provide on-site removal of pollutants from stormwater runoff. Surface runoff is directed into shallow, landscape depressions, which are designed to incorporate many of the pollutant removal mechanisms that operate in forested or other natural (prairies, wetlands, etc.) ecosystems. Bioretention elements include rain gardens, sidewalk planters, curb extensions and other plant or soil systems designed to infiltrate and/or evapotranspirate stormwater (EPA, 2010). The removal efficiency for a bioretention basin is approximately 75% TSS removal and 16% total nitrogen removal. The total phosphorous removal efficiency is typically less significant (International Stormwater BMP Database, 2017). The reason for this is bioretention practices can commonly capture particulate phosphorus by settling or filtration, but leave dissolved phosphorus (typically phosphates) untreated. This untreated phosphorus accounts on average for 45%of total phosphorus in stormwater runoff and can be up to 95%of the total phosphorus, depending on the storm event (Erickson et al., 2012). Dissolved phosphorus is bioavailable and represents a significant concern for surface water quality.

Soil components and amendments that have been shown to be effective in increasing chemical sorption of dissolved phosphorus. Media that can be used to enhance the removal of dissolved phosphorus by green infrastructure practices include iron filings (Erickson et al., 2012) and steel wool (Erickson et al., 2007).

It should be noted that bioretention practices will infiltrate more rainwater more quickly in areas with A or B soils, as compared to C or D soils. If a bioretention practice will not hold/infiltrate all the water that will flow into it during a rain event, the practice can be designed with an underdrain. The underdrain will release excess water to the storm sewer system and thus prevent the practice from overtopping. Bioretention practices provide volume control and pollutant reduction benefits even if there is an underdrain, as some water is held in the soil, some is released back in the air through evapotranspiration, and some pollutants are filtered out as the rainfall runoff drains through the soil.

5.1.5 Vegetated Swales

A v**egetated 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).

5.1.6 Vegetated Filter Strips

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 other developments. 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).

5.1.7 Permeable Pavement

Permeable pavement consists of permeable pavement material, which allows distributed infiltration of rainfall runoff into the underlying soil. There may typically be an underlying stone reservoir that temporarily stores the surface runoff before it infiltrates into the underlying soil. Examples include; porous asphalt, permeable concrete, permeable block pavers (EPA, 2010). Permeable pavements have removal efficiencies of approximately 72% TSS removal, and 42% total phosphorous removal. Limited data is available on expected total nitrogen removal (International Stormwater BMP Database, 2017). Besides filtering pollutants, permeable pavements can significantly reduce the volume of runoff discharged to waterbodies. This helps reduce the erosive effects of stormwater. Permeable pavements can be an important component of measures to restore and protect water quality as land areas can be used as they were before -- driveways, parking lots, etc. The paved surfaces are still used, they are just converted from impervious to pervious.

5.1.8 Manufactured BMP Structures

Many **manufactured BMPs** and control devices exist on the market ranging from oil and grit (debris) separators to sand or biomass filters. They are capable of trapping debris, oil, grease, sediment, and other floatables that would otherwise be discharged to water resources (DuPage County, 2008). Manufactured BMPs are typically installed at outfall locations or at key junctures within a storm sewer network. Sizing and flow-through requirements are site-specific and typically dictated by the manufacturer specifications. Likewise, removal rates are specified by the manufacturer depending on site-specific applications. Typically, removal rates are 80% for TSS, 80% for free floatable hydrocarbons (DuPage County, 2008). Maintenance of manufactured devices is critical to ensure continued effective performance.

Manufactured control devices may be considered as point source controls, particularly if they are installed at outfall locations, and thus may not be eligible for Section 319 grant funding. However, installation of such devices by a municipality may be eligible for low interest loan financing from the State Revolving Fund (SRF).

5.1.9 Stream or Channel Restoration

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).

In a few limited situations in the Cal-Sag watershed, where land is available and the project area is suitable, it may be possible to convert armored streambanks to naturalized streambanks with flatter slopes and vegetation. This would help slow down flows, thus reducing erosion potential, and help trap pollutants. Stream daylighting can similarly be beneficial where tributary sections are currently piped. However the dense development patterns in much of the watershed will preclude these types of stream restoration projects.

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)

5.1.10 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.

5.1.11 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.

In the watershed, floodplains and riparian corridors have been developed and compromised to accommodate urbanized 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.

5.1.12 Forebay Retrofits - Treatment at Existing Storm Sewer Outfalls and Hydraulic Structure Retrofits

A **forebay** is a pool or settling basin constructed at the incoming point of a BMP. The purpose of a forebay is to provide retention for a portion of the first flush stormwater runoff and allow sediment to settle out from the incoming stormwater before it reaches the larger BMP. The forebay traps pollutants and litter, and protects the practice from being clogged. Forebays facilitate maintenance as they are easier and less expensive to clean out as compared to repairing or replacing the full BMP.

While typically used as a component of a larger BMP (for example, wetland bottom and wet bottom detention basins), forebay retrofits at existing storm sewer outfalls allow treatment of the first flush from existing storm sewer networks outletting to a watercourse. Storm sewer outfalls are typically constructed to discharge at a watercourse often bypassing the infiltration benefits of a riparian corridor or buffer strip. The introduction of a forebay with the existing outfall "set back" from the watercourse mainstem will promote infiltration. Storm sewer outfalls at receiving waters are often in easements; further enhancing the forebay potential at an existing outfall.

5.1.13 Floating Wetlands

Floating wetlands are man-made islands that float in the water and are planted with wetland vegetation. The vegetation roots grow into the water and are used to filter the water by providing water-cleansing microorganisms. The islands typically take several years to establish. As the plant roots grow beneath the island, they absorb excess nutrients from fertilizer runoff, animal waste and other sources. Thus an important benefit of the floating wetlands is that they reduce nitrogen, phosphorus, TSS, pathogens and heavy metals. They also improve dissolved oxygen by reducing biological oxygen demand from organic muck build up. Floating wetlands may also provide habitat benefits for certain species.

The islands are typically located at the inlet of a pond so that runoff entering a basin passes by the floating wetlands. To keep them at a desired location, they are usually anchored with weights that allow the island to rise and fall with the change in elevation. Floating wetlands are not limited to a specific shape or area.

5.1.14 Chloride Reduction Strategies

Studies show that chlorides in urban streams have increased substantially over the last 50 years, especially in northern metropolitan areas like Chicago. While some structural BMPs can reduce chloride loadings to receiving waters (e.g. permeable pavement), significant chloride reduction needs to come from chloride reduction (pollution prevention) measures. This can be achieved through the adoption of standards and improved practices for winter salt use to help reduce the increasing trend in background salt levels.

In 2015, the Illinois Pollution Control Board adopted a new water quality standard for chloride in the Chicago Area Waterway System (CAWS) which includes the Cal-Sag Channel and its tributaries. Nonpoint source and point source controls will be needed to reduce chloride levels in the CAWS and ensure that the new standards are met. MWRD has convened and is coordinating a stakeholder group to address chloride concerns. The CAWS Chloride Initiative Workgroup is developing a technical report, which will address best management practices to reduce salt usage and also the social, environmental, and economic impacts of salt use reduction. The CAWS Chloride Initiative Workgroup is assessing current water conditions, documenting current road deicing activities, identifying opportunities to reduce road salt runoff while maintaining public safety, and developing pollutant minimization strategies. The report will be released in 2018. It is expected that the report will recommend best practices which can be implemented by municipalities and other stakeholders.

This watershed-based plan recommends *a low-salt diet* when it comes to de-icing pavements in the winter. Following are generally accepted best practices for reducing chloride loadings:

- Plow, shovel, and blow accumulated snow. Do not use salt or other de-icing chemicals to “burn-off” snow.
- Calibrate de-icing equipment. Knowing equipment is calibrated and the application rate is accurate will save chemical costs and will reduce environmental impacts. Calibrate annually and keep a record in the vehicle for spreader settings.
- Choose the right material and apply the correct amount. Know the limits of deicing chemicals. For example, rock salt is not effective at temperatures below 15°F no matter how much is applied. Check application rates given the current weather conditions.
- Use ground speed controls on spreaders. Application rates should correspond with vehicles speed.
- Pre-wet the salt. Adding brine to salt before it is applied will jump start the melting process and help keep the salt in place by reducing bounce and scatter. Pre-wetting salt can reduce application rates by 20 percent.
- Use anti-icing. Be proactive by applying de-icing chemical prior to snow and ice accumulation. It can reduce the amount of chemical needed by 30 percent.
- Don’t mix salt and sand. Salt is for melting and sand is for traction on top of the ice, they work against each other.
- Consider possible alternative to salt. For example beet juice is a de-icer.
- Be familiar with sensitive areas (such as wetlands or a small lake) to which stormwater may drain. Consider designating reduced salt areas or identifying safe alternatives to road salt in these areas.
- Department of Public Works supervisors and staff should attend training workshops and stay up to date with new technologies and practices.

This watershed-based plan recommends these generally accepted practices, and other good ideas that may be recommended in the CAWS Chloride Initiative Workgroup report. Watershed stakeholders are encouraged to participate in the Workgroup; in fact, many of the communities in the planning area already participate. The ultimate goal is to improve deicing practices so that less salt is used (and that the salt which is applied is used most effectively) with the result that chloride loadings to the watershed are reduced.

5.1.15 Tree Boxes

Tree box filters mimic miniature bioretention areas installed beneath trees and can be very effective at treating runoff when distributed throughout a site. Runoff is directed to the tree box, where vegetation and soil media have an opportunity to filter the runoff before it can enter a catch basin. The runoff collected by the tree box helps irrigate the tree. Tree box filters are based on bioretention processes with improvements that enhance constituent removal, increased performance, ease of construction and improved aesthetics (http://lowimpactdevelopment.org/).

5.1.16 MS4 Compliance

As previously discussed in Section 3.18.1, most units of government within the Cal-Sag Channel planning area are operators of small municipal separate storm sewer systems (MS4s). MS4s collect urban stormwater runoff, and discharge stormwater to local water bodies and, consequently are regulated under the State MS4 permitting program.

In Illinois, discharges from small MS4s are covered under Illinois EPA's General NPDES Permit No. ILR40. This permit requires that MS4 operators develop, implement, and enforce a stormwater management program to reduce the discharge of pollutants through the municipality's sewer system. The permittee's stormwater management program must include six minimum control measures:

1. Public education and outreach on storm water impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control
5. Post construction storm water management in new development and redevelopment
6. Pollution prevention / good housekeeping for municipal operations

Effective local MS4 programs are an important component of the overall strategy for improving water quality in the Cal-Sag Channel watershed. For example, the non-structural BMPs that will be carried out by MS4 communities, such as street sweeping and good housekeeping for municipal operations, will reduce loadings of pollutants and complement the structural BMPs described above, such as rain gardens and bioswales and permeable pavement.

Many of the structural BMPs reduce pollutant loadings through methods such as sediment trapping and runoff reduction. Generally speaking, these BMPs do not target bacteria reduction. As noted in Chapter 3, bacteria is included on the 303d list as a stressor. As also summarized, until approximately 2015 the majority of bacteria loadings were coming from the MWRD Calumet Plant and from CSOs upstream of the watershed. With the improvements that have been made by MWRD (disinfection at the plant and completion of the Thornton reservoir) these point source loadings have been significantly reduced and water quality is rebounding. Nevertheless, measures to further reduce bacteria loadings will be beneficial. Stormwater can be a source of bacteria loadings. Two examples how bacteria can get into stormwater are: (1) Pet waste is not picked up, and fecal matter is washed off urban surfaces by stormwater; and (2) There can be cross-connections between sanitary and storm sewers, allowing sewage to be mixed the stormwater.

Effective implementation of the MS4 six minimum measures is a primary way of reducing bacteria loadings from stormwater. For example, minimum measure 3. is intended to find and eliminate inappropriate connections to the storm sewer system, including cross connections with the sanitary sewers. This program element can also help address other stressors, including visible oil. Street sweeping helps reduce loadings of bacteria as well as sediment and other pollutants. Public education programs can highlight the need for residents to pick up pet wastes as a way to help protect the watershed. Compliance with municipalities' MS4 permit requirements is a critical aspect of efforts to reduce and prevent loadings of bacteria and other pollutants affecting the Cal-Sag Channel watershed.

5.1.17 Selecting and Implementing BMPs

This section of the watershed-based 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. For example, bioretention basins and swales can be located and designed to capture runoff from parking lots and other impervious surfaces to reduce stormwater discharge volumes and pollutant loads. However, this plan does not list or *prescribe* specific BMPs to be implemented 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 as well as numerous other 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.

Figure 5.1-1 Maple Lake

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 Cal-Sag Planning Area includes 17 watershed planning units which consist mainly of residential and roadway right-of-way areas (identified as transportation / communications / utilities / wastewater areas). These two land uses make-up approximately 53% of overall watershed. While open space is the second largest land use in the overall watershed, most of this area only is present within 5 watershed planning units and is typically forest preserve area that is not likely to be developed.

The following BMP scenarios were developed based on: 1) land use; 2) BMP effectiveness; 3) infiltration capacities; and 4) quantifying load reductions using STEPL. 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 Cal-Sag 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 Residential Land Use (BMP Scenario)

1. Rain gardens or *bioretention* area at a rate of 0.06 acre/acre (50 feet x 50 feet per acre) of residential area.
2. Detention pond retrofits:
    a. Conversion of dry bottom ponds to a naturalized bottom for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    b. Enhancement of wet bottom ponds for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    c. Enhancement of wetland ponds to create *wetland detention* for the area of pond. Invasion species maintenance and management, increase bio-diversity.

6.1.2 Industrial / Commercial / Institutional Land Use (BMP Scenario)

1. Planter boxes or *bioretention* as landscaped median and parking islands 5 feet wide x 3 feet long; 1 per 200 feet of 3 sides of site perimeter. Assumed to be applied to 50% of total area.
2. *Infiltration trench* as 5 feet wide along 3 sides of perimeter of site to be applied downstream of planter boxes.

3. *Oil and grit separators* or mechanical BMPs to be applied 1 per 10 acre.
4. Detention pond retrofits:
    a. Conversion of dry bottom ponds to a naturalized bottom for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    b. Enhancement of wet bottom ponds for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    c. Enhancement of wetland ponds to create *wetland detention* for the area of pond.
5. *Bioretention* as green roofs assuming 15% of rooftop for all buildings.
6. *Dry detention* as blue roofs assuming 15% of rooftop for all buildings.
7. *Porous pavement* to be applied to 10% of impervious areas.

6.1.3 Roadway ROWs and Transportation Hubs (BMP Scenario)

1. *Porous pavement* to be applied to 10% of impervious areas.
2. *Weekly street sweeping* total area of roadways only.
3. *Water quality inlets* = 1 per 500 feet of roadway based on perimeter of roadway.

6.1.4 Open spaces and Forest Areas (BMP Scenario)

1. *Vegetated filter strips* around perimeter of property at 5 feet wide.
2. *Water quality inlets* = 1 per 500 feet of roadway based on perimeter of roadway.

6.1.5 Urban Cultivated and Vacant Land Use (BMP Scenario)

1. *Agricultural filter strips* around perimeter of property at 5 feet wide.

6.1.6 Various Land Use – applied throughout where opportunities exist (BMP Scenario)

1. Rain gardens or *bioretention* area at a rate of 0.06 acre/acre (50 feet x 50 feet per acre) of residential area.
2. Detention pond retrofits:
    a. Conversion of dry bottom ponds to a naturalized bottom for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    b. Enhancement of wet bottom ponds for area of pond to create *extended wet detention*.
        i. Addition of forebays or *settling basins* at a rate of 0.03 acre / acre of pond (25 feet x 50 feet per acre of pond) x 2.
    c. Enhancement of wetland ponds to create *wetland detention* for the area of pond. Invasion species maintenance and management.

6.1.7 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, concrete and turf 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 Cal-Sag Channel 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. 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 Cal-Sag 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. Where costs are shown on a per acre basis, the costs reflect implementing a number of 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
Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft^2$	Ac	$172,500
Bioretention as Green Roof (assuming structurally sound) @ ~ $30/ft^2$	Ac	$1,307,000
Dry Detention as Blue Roof (assuming structurally sound) @ ~ $20/ft^2$	Ac	$871,200
Extended Wet Detention (Detention Basin Retrofit - native planting in dry bottom pond)	Ac	$12,500
Extended Wet Detention (Detention Basin Retrofit - wet bottom pond restoration and bank enhancement)	Ac	$8,000
Settling Basins (To be included in all detention basin retrofits 4 ft deep) @ ~445 CY / AC @ $30 / CY	Ac	$13,500
Porous Pavement @ ~ $8/ft^2$	Ac	$348,500
Vegetated Filter Strips @ ~ $3/ft^2$	Ac	$131,000
Infiltration Trench @ ~ $6/ft^2$	Ac	$261,500
Mechanical BMPs (assuming 1 per 10 acres of tributary area)	Ea	$10,000
Weekly Street Sweeping	Ac	$1,000
Water Quality Inlets (does not include maintenance)	Ea	$350
Wetland Restoration	Ac	$15,000
Streambank Stabilization	LF	$130
BMPs not assessed using STEPL		
Streambank Enhancement – Replacement of hardscape with native	LF	$100
Riparian Corridor Enhancement – Habitat Enhancement and Creation	Ac	$9,000
Hydraulic Outfall Structure Retrofits with Forebay Retrofits	Ea	$75,000
Floating Wetlands (quantified as unit(s) per acre of open water)	Ac	$10,000

6.3 CAL-SAG 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 0 to 3, with 0 being not applicable (i.e., creek is enclosed in a pipe) 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 was given to the watershed planning units in the top 20% of the overall scoring.

Sub	N Load (lb/ac)		P Load (lb/ac)		BOD Load (lb/ac)		Sed Load (t/ac)		Chloride Load (t/ac)		Channel	Riparian	Erosion	Rip Score	Sub	Priority Score
STW1	7.8	4	1.42	4	27.2	3	0.56	4	0.27	4	HIGH	POOR	MOD	3	STW1	22
LD	8.7	4	1.43	4	30.5	4	0.27	3	0.29	4	HIGH	POOR	MOD	3	LD	22
ME	8.7	4	1.45	4	30.4	4	0.29	3	0.23	3	HIGH	POOR	MOD	3	ME	21
CS5	8.4	4	1.38	4	29.2	4	0.20	2	0.32	4	HIGH	POOR	LOW	3	CS5	21
OL	7.9	4	1.31	3	28.9	4	0.30	3	0.35	4	HIGH	POOR	MOD	3	OL	21
TI2	8.5	4	1.91	4	27.6	4	1.64	4	0.22	3	LOW	GOOD	LOW	1	TI2	20
CSD	6.9	3	1.43	4	22.7	2	1.07	4	0.17	2	HIGH	POOR	MOD	3	CSD	18
CS4	7.8	4	1.231	3	27.6	4	0.18	1	0.15	2	HIGH	POOR	LOW	3	CS4	17
STE	7.3	3	1.212	3	26.3	3	0.25	2	0.22	3	HIGH	POOR	MOD	3	STE	17
LDC	6.4	2	1.232	3	22.7	2	0.64	4	0.21	2	HIGH	POOR	MOD	3	LDC	16
MP	7.1	3	1.195	2	25.9	3	0.23	2	0.26	3	HIGH	POOR	MOD	3	MP	16
CSC	6.9	3	1.1	2	24.5	3	0.26	2	0.21	2	HIGH	POOR	MOD	3	CSC	15
STW2	7.4	3	1.215	3	27.2	3	0.17	1	0.29	4	NA	NA	NA	0	STW2	14
CS3	6.7	2	1.1	2	23.8	2	0.16	1	0.30	4	HIGH	POOR	LOW	3	CS3	14
MI1	5.0	1	1.0	2	17.1	1	0.47	4	0.15	2	MOD	FAIR	MOD	2	MI1	12
NV	6.6	2	1.159	2	23.4	2	0.36	3	0.22	3	NA	NA	NA	0	NV	12
CSA	3.8	1	0.7	1	13.3	1	0.26	2	0.07	1	MOD	POOR	MOD	3	CSA	9
TI1	3.1	1	0.8	1	9.6	1	0.62	4	0.10	1	LOW	GOOD	LOW	1	TI1	9
CS1	5.5	2	0.8	1	18.0	2	0.15	1	0.05	1	HIGH	GOOD	LOW	1	CS1	8
IMBC	5.1	1	0.9	1	15.2	1	0.30	3	0.03	1	NA	NA	NA	0	IMBC	7
CS2	0.7	1	0.2	1	2.4	1	0.02	1	0.05	1	HIGH	FAIR	LOW	2	CS2	7
MI2	3.7	1	0.6	1	13.3	1	0.10	1	0.11	1	NA	NA	NA	0	MI2	5

Table 6.3-1 Cal-Sag Planning Area Pollutant Priority Ranking by Watershed Planning Unit

The watershed planning units that are the highest priority based on loadings are dominated by impervious area. Watershed planning units with the lowest overall pollutant loadings are generally in the upper portions of the watershed and dominated by forest preserves, with less than 50% residential land use. 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 Cal-Sag Channel and its tributaries.

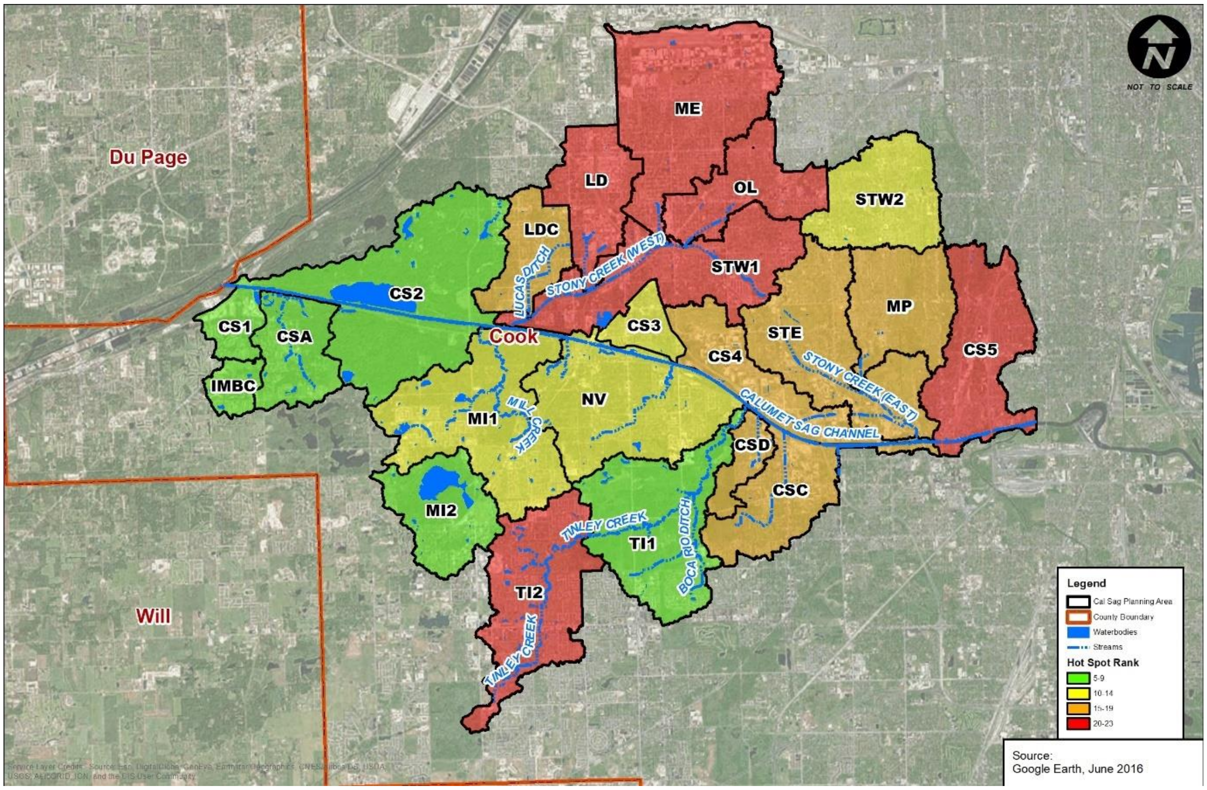


Figure 6.3-1 Cal-Sag Watershed Priority Area Ranking by Watershed Planning Unit

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 from BMPs for urban areas, commercial and roadway / transportation areas. 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 2017 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. The MWRD detention basin database includes 27 detention basins within the watershed that received a Sewerage Permit for development. An additional 149 open water areas were identified within the watershed. These open water areas and detention basin retrofits have been incorporated into the following analyses.

As discussed in Section 4.4, the predicted population increase in the Cal-Sag Planning Area is from 6.4 people per acre to 7.2 people per acre. Understanding that the Cal-Sag Planning Area outside of the forest preserve areas is 90-95% developed, 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 25% Implementation

The target level of BMP implementation is 25%. What this means is that runoff from 25% 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 25% of the source areas is based on practicability and feasibility. It will be most feasible to implement BMPs in public areas, such as municipal parking lots, public parks, and road right-of-ways. BMPs can also be implemented on private property, but this presents certain challenges such as ensuring the practices will be preserved and maintained over time. 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 25% 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 25% 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.

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
STW1 (2,028 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	30.5	Ac	$172,500					$ 5,261,250
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	$12,500					$ 2,344
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.8	Ac	$8,000					$ 6,020
	Settling Basins	0.1	*Ac*	*$13,500*					$ 776
	Porous Pavement @ ~ $8/ft²	22.3	Ac	$348,500					$ 7,754,125
	Weekly Street Sweeping	221.5	Ac	$1,000					$ 221,500
	Water Quality Inlets (does not include maintenance)	714.7	Ea	$350					$ 250,147
	Wetland Restoration	14.6	Ac	$15,000					$ 218,888
	Streambank Stabilization	6671.0	LF	$130					$ 867,230
Watershed Planning Unit Total					1,306	334	2,766	410	**$ 14,582,280**
LD (2,188 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	12.0	Ac	$172,500					$ 2,070,000
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.2	Ac	$8,000					$ 1,920
	Settling Basins	0.02	*Ac*	*$13,500*					$ 203
	Porous Pavement @ ~ $8/ft²	12.8	Ac	$348,500					$ 4,443,375
	Weekly Street Sweeping	127.5	Ac	$1,000					$ 127,500
	Water Quality Inlets (does not include maintenance)	411.4	Ea	$350					$ 143,990
	Wetland Restoration	2.3	Ac	$15,000					$ 34,613
	Streambank Stabilization	4476.5	LF	$130					$ 581,945
Watershed Planning Unit Total					498	82	1,074	57	**$ 7,403,545**
ME	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	30.5	Ac	$172,500					$ 5,261,250
	Detention Basin Retrofit - native planting in dry bottom pond	0.8	Ac	$12,500					$ 9,375
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	6.3	Ac	$8,000					$ 50,000
	Settling Basins	0.4	*Ac*	*$13,500*					$ 5,704
	Porous Pavement @ ~ $8/ft²	25.5	Ac	$348,500					$ 8,886,750
	Weekly Street Sweeping	253.8	Ac	$1,000					$ 253,750

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
	Water Quality Inlets (does not include maintenance)	818.8	Ea	$350					$ 286,568
	Wetland Restoration	6.8	Ac	$15,000					$ 101,250
	Streambank Stabilization	2417.5	LF	$130					$ 314,275
Watershed Planning Unit Total					1,107	201	2,501	151	**$ 15,168,922**
CS5	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	20.8	Ac	$172,500					$ 3,579,375
	Porous Pavement @ ~ $8/ft²	22.5	Ac	$348,500					$ 7,841,250
	Weekly Street Sweeping	224.3	Ac	$1,000					$ 224,250
	Water Quality Inlets (does not include maintenance)	723.6	Ea	$350					$ 253,253
	Wetland Restoration	0.2	Ac	$15,000					$ 2,513
Watershed Planning Unit Total					749	102	1,575	38	**$ 11,900,641**
OL (2,345 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	16.5	Ac	$172,500					$ 2,846,250
	Detention Basin Retrofit - native planting in dry bottom pond	0.1	Ac	$12,500					$ 969
	Settling Basins	0.01	*Ac*	*$13,500*					$ 68
	Porous Pavement @ ~ $8/ft²	15.3	Ac	$348,500					$ 5,314,625
	Weekly Street Sweeping	152.8	Ac	$1,000					$ 152,750
	Water Quality Inlets (does not include maintenance)	492.9	Ea	$350					$ 172,506
	Wetland Restoration	0.4	Ac	$15,000					$ 6,113
	Streambank Stabilization	2422.5	LF	$130					$ 314,925
Watershed Planning Unit Total					572	104	1,190	86	**$ 8,808,204**
TI2 (3,953 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	31.0	Ac	$172,500					$ 5,347,500
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	$12,500					$ 2,063
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	17.9	Ac	$8,000					$ 143,200
	Settling Basins	0.3	*Ac*	*$13,500*					$ 3,915
	Porous Pavement @ ~ $8/ft²	17.3	Ac	$348,500					$ 6,011,625

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
	Weekly Street Sweeping	171.3	Ac	$1,000					$ 171,250
	Water Quality Inlets (does not include maintenance)	552.6	Ea	$350					$ 193,398
	Wetland Restoration	18.9	Ac	$15,000					$ 284,138
	Streambank Stabilization	13118.5	LF	$130					$ 1,705,405
Watershed Planning Unit Total					2,841	922	5,891	1,359	**$ 13,862,493**
CSD (810 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	4.5	Ac	$172,500					$ 776,250
	Vegetated Filter Strips @ ~ $3/ft²	41.7	*Ac*	$131,000					$ 5,459,425
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.3	Ac	$8,000					$ 10,320
	Settling Basins	0.1	*Ac*	*$13,500*					$ 1,046
	Porous Pavement @ ~ $8/ft²	2.8	Ac	$348,500					$ 958,375
	Weekly Street Sweeping	28.5	Ac	$1,000					$ 28,500
	Water Quality Inlets (does not include maintenance)	92.0	Ea	$350					$ 32,186
	Wetland Restoration	0.1	Ac	$15,000					$ 750
	Streambank Stabilization	2370.0	LF	$130					$ 308,100
Watershed Planning Unit Total					402	123	881	177	**$ 7,574,952**
CS4 (2,392 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	1.0	Ac	$172,500					$ 172,500
	Detention Basin Retrofit - native planting in dry bottom pond	1.0	Ac	$12,500					$ 12,313
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.7	Ac	$8,000					$ 13,920
	Settling Basins	0.2	*Ac*	*$13,500*					$ 2,194
	Porous Pavement @ ~ $8/ft²	8.0	Ac	$348,500					$ 2,788,000
	Weekly Street Sweeping	79.5	Ac	$1,000					$ 79,500
	Water Quality Inlets (does not include maintenance)	256.5	Ea	$350					$ 89,782
	Wetland Restoration	5.8	Ac	$15,000					$ 87,038
Watershed Planning Unit Total					854	144	2,309	34	**$ 3,245,246**

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
STE (4,434 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	22.8	Ac	$172,500					$ 3,924,375
	Detention Basin Retrofit - native planting in dry bottom pond	0.3	Ac	$12,500					$ 4,344
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.4	Ac	$8,000					$ 3,580
	Settling Basins	0.05	*Ac*	*$13,500*					$ 641
	Porous Pavement @ ~ $8/ft²	19.3	Ac	$348,500					$ 6,708,625
	Weekly Street Sweeping	192.0	Ac	$1,000					$ 192,000
	Water Quality Inlets (does not include maintenance)	619.5	Ea	$350					$ 216,832
	Wetland Restoration	10.5	Ac	$15,000					$ 157,988
	Streambank Stabilization	9556.0	LF	$130					$ 1,242,280
Watershed Planning Unit Total					836	152	1,802	124	**$ 12,450,665**
LDC (1,731 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	55.2	Ac	$172,500					$ 9,522,000
	Infiltration Trench @ ~ $6/ft²	44.5	*Ac*	$261,500					$ 11,623,675
	Bioretention as Green Roof (assuming structurally sound) @ ~ $30/ft²	5.3	*Ac*	$1,307,000					$ 6,887,890
	Dry Detention as Blue Roof (assuming structurally sound) @ ~ $20/ft²	5.3	*Ac*	$871,200					$ 4,591,224
	Mechanical BMPs (assuming 1 per 10 acres of tributary area)	7.0	*Ea*	$10,000					$ 70,250
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.8	Ac	$8,000					$ 6,760
	Settling Basins	0.1	*Ac*	*$13,500*					$ 675
	Porous Pavement @ ~ $8/ft²	6.5	Ac	$348,500					$ 2,265,250
	Weekly Street Sweeping	65.8	Ac	$1,000					$ 65,750
	Water Quality Inlets (does not include maintenance)	212.2	Ea	$350					$ 74,254
	Wetland Restoration	4.4	Ac	$15,000					$ 65,925
	Streambank Stabilization	5362.5	LF	$130					$ 697,125
Watershed Planning Unit Total					805	210	1,833	214	**$ 35,173,653**
MP (2,699 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	18.3	Ac	$172,500					$ 3,148,125
	Settling Basins	0.05	*Ac*	*$13,500*					$ 641

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
	Porous Pavement @ ~ $8/ft²	14.5	Ac	$348,500					$ 5,053,250
	Weekly Street Sweeping	145.5	Ac	$1,000					$ 145,500
	Water Quality Inlets (does not include maintenance)	469.5	Ea	$350					$ 164,318
	Wetland Restoration	1.5	Ac	$15,000					$ 23,063
	Streambank Stabilization	2233.0	LF	$130					$ 290,290
Watershed Planning Unit Total					532	92	1,114	65	**$ 8,825,187**
CSC (2,622 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	13.5	Ac	$172,500					$ 2,328,750
	Detention Basin Retrofit - native planting in dry bottom pond	0.05	Ac	$12,500					$ 563
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.9	Ac	$8,000					$ 6,880
	Settling Basins	0.1	*Ac*	*$13,500*					$ 743
	Porous Pavement @ ~ $8/ft²	10.0	Ac	$348,500					$ 3,485,000
	Weekly Street Sweeping	98.8	Ac	$1,000					$ 98,750
	Water Quality Inlets (does not include maintenance)	318.6	Ea	$350					$ 111,522
	Wetland Restoration	3.7	Ac	$15,000					$ 54,900
	Streambank Stabilization	3947.0	LF	$130					$ 513,110
Watershed Planning Unit Total					448	85	938	74	**$ 6,600,217**
STW2 (2,807 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	18.8	Ac	$172,500					$ 3,234,375
	Detention Basin Retrofit - native planting in dry bottom pond	0.4	Ac	$12,500					$ 4,563
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.5	Ac	$8,000					$ 11,820
	Settling Basins	0.1	*Ac*	*$13,500*					$ 1,485
	Porous Pavement @ ~ $8/ft²	17.8	Ac	$348,500					$ 6,185,875
	Weekly Street Sweeping	176.5	Ac	$1,000					$ 176,500
	Water Quality Inlets (does not include maintenance)	569.5	Ea	$350					$ 199,327
	Wetland Restoration	1.4	Ac	$15,000					$ 20,400

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
Watershed Planning Unit Total					563	79	1,228	29	**$ 9,834,345**
CS3 (812 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	5.8	Ac	$172,500					$ 991,875
	Porous Pavement @ ~ $8/ft²	4.8	Ac	$348,500					$ 1,655,375
	Weekly Street Sweeping	46.3	Ac	$1,000					$ 46,250
	Water Quality Inlets (does not include maintenance)	149.2	Ea	$350					$ 52,232
	Wetland Restoration	7.7	Ac	$15,000					$ 114,975
Watershed Planning Unit Total					147	21	328	8	**$ 2,860,707**
MI1 (4,999 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	30.8	Ac	$172,500					$ 5,304,375
	Vegetated Filter Strips @ ~ $3/ft²	9.7	*Ac*	$131,000					$ 1,265,133
	Porous Pavement @ ~ $8/ft²	15.0	Ac	$348,500					$ 5,227,500
	Detention Basin Retrofit - native planting in dry bottom pond	0.04	Ac	$12,500					$ 469
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	16.9	Ac	$8,000					$ 135,520
	Settling Basins	0.1	*Ac*	*$13,500*					$ 1,485
	Weekly Street Sweeping	149.0	Ac	$1,000					$ 149,000
	Water Quality Inlets (does not include maintenance)	480.8	Ea	$350					$ 168,271
	Wetland Restoration	21.5	Ac	$15,000					$ 322,838
	Streambank Stabilization	14139.0	LF	$130					$ 1,838,070
Watershed Planning Unit Total					1,199	332	2,633	425	**$ 14,412,659**
NV (4,718 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	36.3	Ac	$172,500					$ 6,253,125
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.9	Ac	$8,000					$ 14,980
	Settling Basins	0.3	*Ac*	*$13,500*					$ 3,669
	Porous Pavement @ ~ $8/ft²	19.3	Ac	$348,500					$ 6,708,625
	Weekly Street Sweeping	193.5	Ac	$1,000					$ 193,500
	Water Quality Inlets (does not include maintenance)	624.4	Ea	$350					$ 218,526

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
	Wetland Restoration	7.4	Ac	$15,000					$ 111,675
	Streambank Stabilization	12089.5	LF	$130					$ 1,571,635
Watershed Planning Unit Total					802	195	1,662	250	**$ 15,075,735**
CSA (1,894 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	7.3	Ac	$172,500					$ 1,250,625
	Vegetated Filter Strips @ ~ $3/ft^2	10.6	*Ac*	$131,000					$ 1,394,823
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.3	Ac	$8,000					$ 2,780
	Settling Basins	0.02	*Ac*	*$13,500*					$ 270
	Porous Pavement @ ~ $8/ft^2	3.0	Ac	$348,500					$ 1,045,500
	Weekly Street Sweeping	28.8	Ac	$1,000					$ 28,750
	Water Quality Inlets (does not include maintenance)	92.8	Ea	$350					$ 32,468
	Wetland Restoration	28.1	Ac	$15,000					$ 421,238
	Streambank Stabilization	4925.0	LF	$130					$ 640,250
Watershed Planning Unit Total					341	90	1,025	86	**$ 4,816,703**
TI1 (4,310 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	10.5	Ac	$172,500					$ 1,811,250
	Vegetated Filter Strips @ ~ $3/ft^2	16.7	*Ac*	$131,000					$ 2,184,425
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	$12,500					$ 2,188
	Settling Basins	0.01	*Ac*	*$13,500*					$ 135
	Porous Pavement @ ~ $8/ft^2	6.3	Ac	$348,500					$ 2,178,125
	Weekly Street Sweeping	62.5	Ac	$1,000					$ 62,500
	Water Quality Inlets (does not include maintenance)	201.7	Ea	$350					$ 70,583
	Wetland Restoration	6.7	Ac	$15,000					$ 99,938
	Streambank Stabilization	18042.5	LF	$130					$ 2,345,525
Watershed Planning Unit Total					1,184	382	2,411	565	**$ 8,754,668**
	Vegetated Filter Strips @ ~ $3/ft^2	50.8	*Ac*	$131,000					$ 6,654,473

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
CS1 (799 acres)	*Detention Basin Retrofit - wet bottom pond restoration and bank enhancement*	0.3	Ac	$8,000					$ 2,480
	Settling Basins	0.02	*Ac*	*$13,500*					$ 236
	Porous Pavement @ ~ $8/ft²	1.0	Ac	$348,500					$ 348,500
	Weekly Street Sweeping	9.5	Ac	$1,000					$ 9,500
	Water Quality Inlets (does not include maintenance)	30.7	Ea	$350					$ 10,729
	Wetland Restoration	12.0	Ac	$15,000					$ 179,925
Watershed Planning Unit Total					85	11	294	4	**$ 7,205,842**
IMBC (606 acres)	*Vegetated Filter Strips @ ~ $3/ft²*	66.9	*Ac*	$131,000					$ 8,769,140
	Porous Pavement @ ~ $8/ft²	0.3	Ac	$348,500					$ 113,263
	Weekly Street Sweeping	3.3	Ac	$1,000					$ 3,250
	Water Quality Inlets (does not include maintenance)	10.5	Ea	$350					$ 3,670
	Wetland Restoration	14.4	Ac	$15,000					$ 216,075
Watershed Planning Unit Total					198	54	536	32	**$ 9,105,398**
CS2 (6,526 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	2.8	Ac	$172,500					$ 474,375
	Vegetated Filter Strips @ ~ $3/ft²	8.7	*Ac*	$131,000					$ 1,140,028
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.1	Ac	$8,000					$ 940
	Settling Basins	0.01	*Ac*	*$13,500*					$ 101
	Porous Pavement @ ~ $8/ft²	4.6	Ac	$348,500					$ 1,611,813
	Weekly Street Sweeping	46.3	Ac	$1,000					$ 46,250
	Water Quality Inlets (does not include maintenance)	149.2	Ea	$350					$ 52,232
	Wetland Restoration	1.5	Ac	$15,000					$ 22,125
Watershed Planning Unit Total					112	16	242	6	**$ 3,347,863**
MI2 (2,327 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians) @ ~ $4/ft2*	7.3	Ac	$172,500					$ 1,250,625
	Vegetated Filter Strips @ ~ $3/ft²	13.0	*Ac*	$131,000					$ 1,696,778

Watershed Planning Unit ID	BMP	Amount	Unit	Cost	Nitrogen Reduced (lbs/yr)	Phosphorus Reduced (lbs/yr)	BOD Reduced (lbs/yr)	Sediment Reduced (tons/yr)	Costs to Implement BMP
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.2	Ac	$8,000					$ 9,560
	Settling Basins	0.02	*Ac*	*$13,500*					$ 270
	Porous Pavement @ ~ $8/ft²	6.7	Ac	$348,500					$ 2,343,663
	Weekly Street Sweeping	67.3	Ac	$1,000					$ 67,250
	Water Quality Inlets (does not include maintenance)	217.0	Ea	$350					$ 75,948
	Wetland Restoration	8.3	Ac	$15,000					$ 125,138
Watershed Planning Unit Total					287	41	663	15	**$ 5,569,230**
Watershed Total					15,869	3,770	34,896	4,206	***$ 226,579,154***

Table 6.4-1 25% BMP Implementation, Load Reductions and Cost – Cal-Sag Planning Area

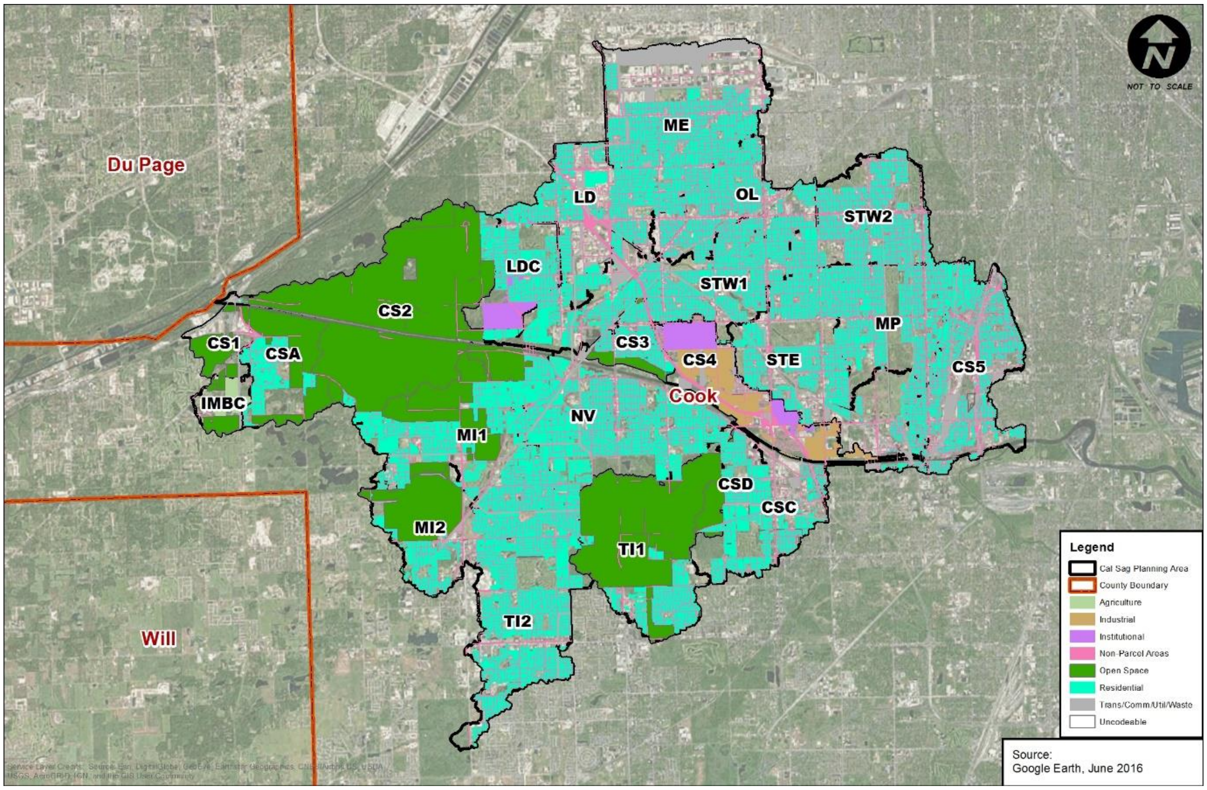


Figure 6.4-1 BMP Applications Per Land Use – Cal-Sag Planning Area

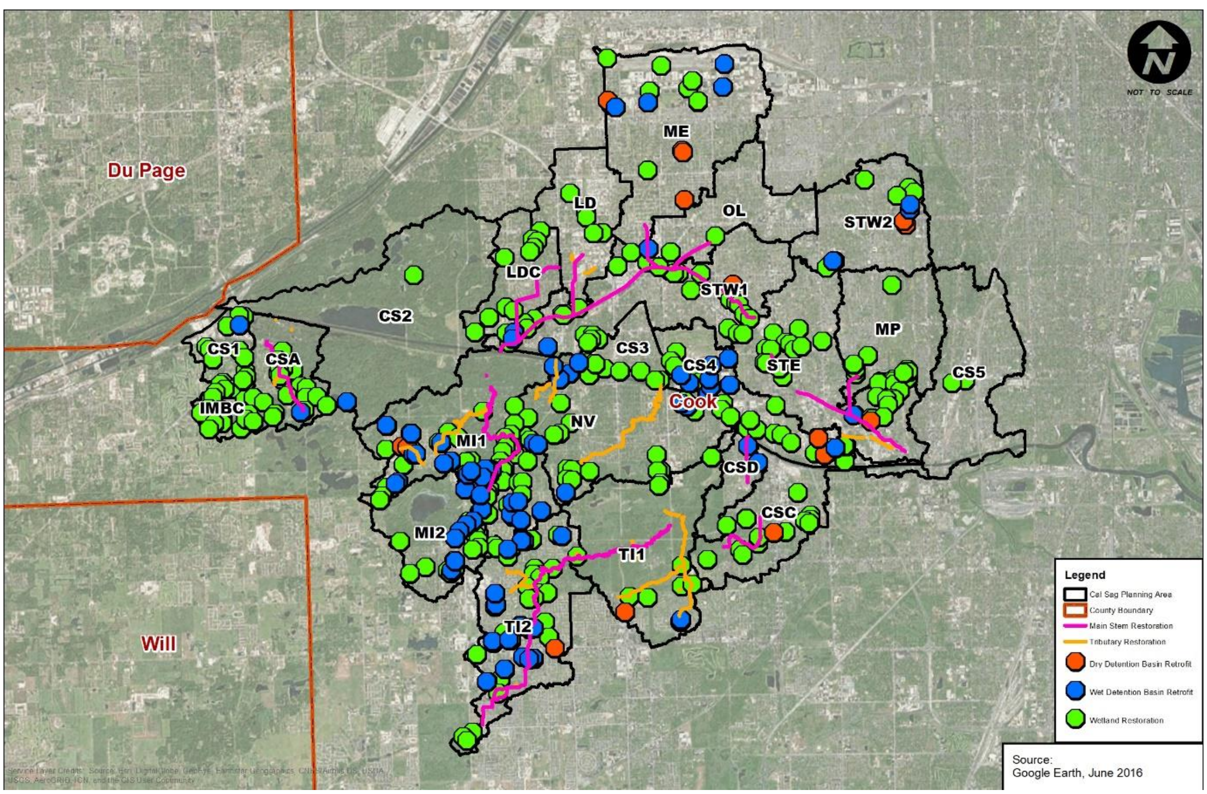


Figure 6.4-2 Detention Basin Retrofits and Restoration – Cal-Sag Planning Area

Targeting an implementation rate of 25% watershed wide results in a substantial reduction in sediment loading -- 17% -- with an overall cost of $227 million. 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.

Nitrogen, phosphorus and BOD reductions vary on a percentage basis as compared to sediment. The relatively low percentage reductions of nutrients and BOD loadings reflect that some of the loadings are from point sources, vs. nonpoint. Media can be designed in to some practices to enhance the removal of dissolved phosphorus where nutrients are a particular concern, e.g., upstream of lakes. Also, policy change effects (nonstructural BMPs) are not reflected in the STEPL results. For example, a community 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 sediment load reductions to improve water quality and support uses.

As indicated in previous sections, chloride reductions will need to be addressed through policy recommendations due to the high solubility and residence time of chloride. Costs and effects associated with policy recommendations and changes are not included in Table 6.4-3.

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 25% implementation rate. This will be an average across the watersheds, with priority areas targeted for a higher percentage of land area being addressed. 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. 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 the MWRD and the municipalities within the watershed planning area.

As discussed above, it is anticipated MWRD will play a lead role on regional-scale stormwater projects, such as retrofitting possible flood control projects to provide water quality benefits (see Section 6.6). MWRD will also continue to implement, and periodically update, the WMO.

It is anticipated municipalities will play major roles in planning and implementing on-the-ground BMPs, such as implementing bioretention or permeable pavement in road right-of-ways or city parking lots. In most cases municipalities will also be responsible for maintenance of BMPs. MWRD may provide technical or financial assistance to municipalities for certain projects. MS4 communities will continue to implement their MS4 programs, including the six minimum measures.

Some BMP projects may also be implemented by other watershed stakeholders, such as school districts, not-for-profit organizations, or churches.

MWRD hosts quarterly Watershed Planning Council (WPC) meetings during which municipal stakeholders within the Cal-Sag Channel planning area are informed of information including on-going capital improvement projects, completed projects, maintenance practices, chloride reduction strategies, and upcoming funding opportunities.

The local stakeholders who regularly attend the Cal-Sag Channel WPC meetings are from the communities in the watershed. Many of the civic leaders are members of the South Suburban Mayors and Managers Association or the Southwest Council of Mayors. The WPC meetings provide an opportunity for mayors and managers within the planning area to discuss capital improvement projects as well as water quality. Local officials can describe their needs and proposed projects, and look for opportunities to collaborate with neighboring communities. As discussed further below, the quarterly WPC meetings will be an important component of tracking plan implementation progress.

6.5 ADDITIONAL BMP IMPLEMENTATION

There are 5 lakes located within the Cal-Sag Channel Watershed that are included in the Illinois EPA's list of impaired lakes. There are numerous other lakes within the watershed that are currently unassessed by the Illinois EPA, which are included in Chapter 3 of this plan. Lake water quality in the watershed is predominantly affected by pollutant loads coming into the lakes from upstream areas. Water quality improvements in the lakes will occur as BMPs are implemented in the upstream developed and undeveloped areas whose runoff contributes to the degradation of the waterbody. Implementation of BMPs in upstream areas that reduce nutrient loads will have significant beneficial effects on the lakes. Aquatic habitat in lakes and recreational activities on the lakes are significantly affected by algae growth which, as explained above, is dramatically affected by nutrient loadings. Implementation of BMPs as described above is expected to help restore and protect the lakes in the watershed. Additional improvements for lakes may include site-specific improvements, for example Oak Lawn Lake where water quality components have been explored through stakeholder engagement for inclusion in a potential project. These improvements could be carried out in conjunction with the BMP plan implementation for the watershed planning unit.

Overall the focus of this plan is treatment of stormwater runoff and the impact that impervious surfaces have on water quality. The projects in this plan are identified with the goal of re-establishing or mimicking the watershed's historical drainage characteristics while reducing pollutant loadings in runoff as a function of volume reduction. 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.

6.6 MWRD DETAILED WATERSHED PLAN AND PROJECT RETROFITS

This plan addresses water quality as a supplement to the MWRD Detailed Watershed Plan for the Cal-Sag Channel. A promising and cost-effective approach for implementing pollutant reduction projects is to integrate pollutant control features into projects being designed for flood control. As such, many projects already identified in the DWP to address flooding concerns can be slightly modified or enhanced to provide a water quality component (Figure 6.6-1).

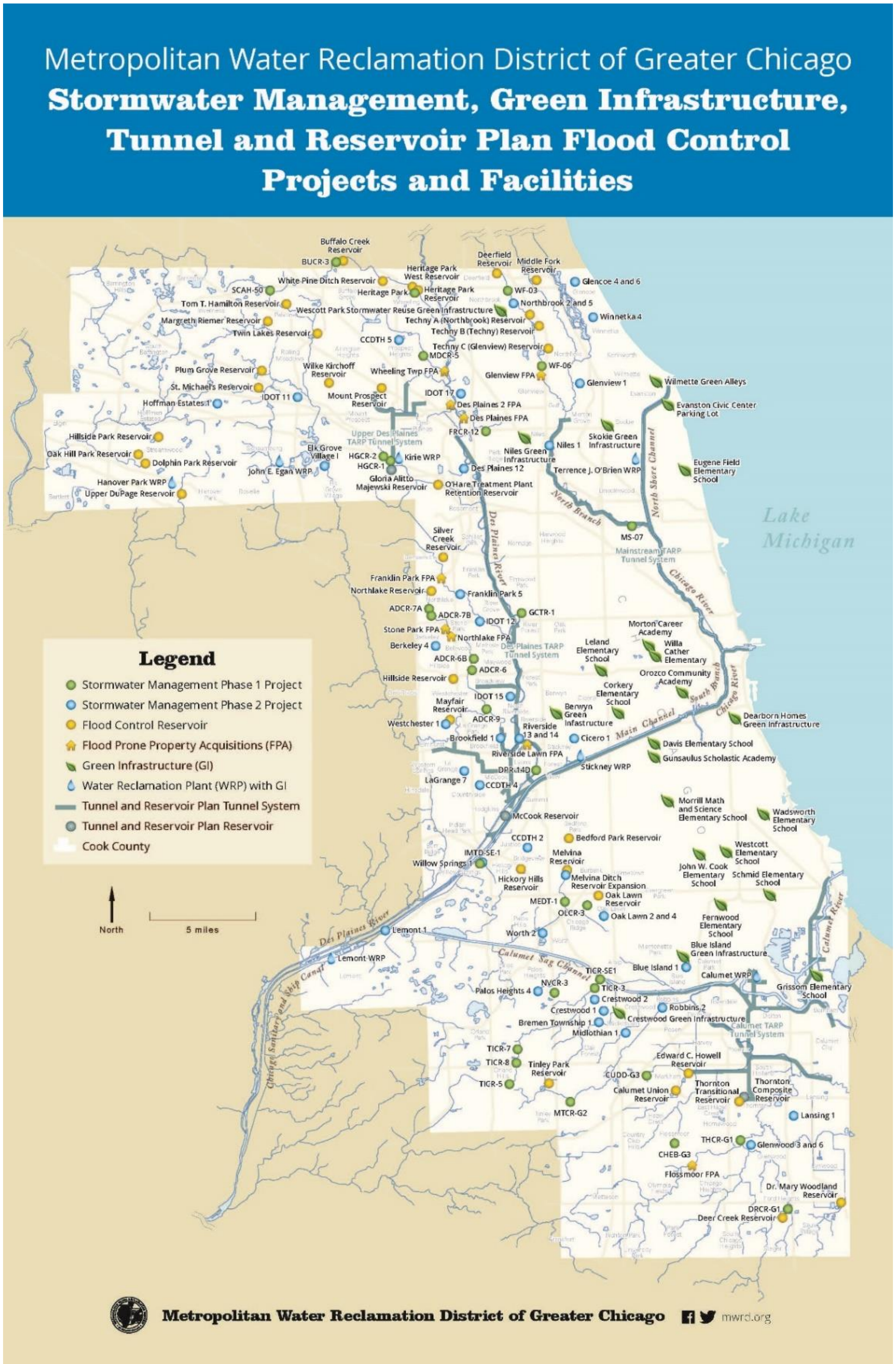


Figure 6.6-1 MWRD Facilities and Projects

As part of the MWRD DWP for the Cal-Sag Channel, a total of 48 projects were analyzed, with the main goal of reducing overbank flooding within the watershed. Of these 48 projects, which range in cost from $1.5 to $8 million dollars (2009 dollars), 20 projects were recommended as part of the DWP. For this plan, all projects, whether recommended or not, were reviewed to determine if water quality projects could be implemented/incorporated into the potential projects at these same locations. Twenty-one (21) of the projects in the DWP could potentially have a water quality benefit, 12 of which were ultimately recommended in the DWP. To meet the goal of improvements in water quality, the project alternative identified in the DWP was reassessed to determine if a viable water quality component could be added to the flood control project. A list of the site-specific projects identified in the DWP for the purposes of water quality improvements to be implemented as part of this plan is shown in Table 6.6-1.

Subwatershed Plan ID	MWRD Subbasin ID	Cost	BC Ratio	Project Description	Plan Reco	DWP Reco
CSC	CSTC-1	$4,355,700	0.05	Construct detention basin just upstream of Central Ave	Y	N
LD	LDDT-3	$6,765,000	0.13	Construct three detention basins and clear channel	Y	Y
LD	LDDT-5	$3,959,300	0.13	Construction of three detention basins and channel clearing	Y	N
LD	LDDT-4	$11,648,400	0.1	Construct four detention basins	Y	N
LD	LDDT-1	$1,883,400	0.09	Construct detention basin on Commonwealth Edison right-of-way	Y	N
LDC	LUDT-2	$4,282,700	0.06	Construct detention basin on Hickory Hills Golf Course	Y	N
ME	MEDT-1	$2,854,500	0.58	Stabilize Melvina Ditch with hard-armoring of eroding streambanks	Y	Y
MI1	MICR-2	$2,003,400	0.2	Construct levee and compensatory storage	Y	Y
MP	MPDT-1	$0	-1	Construct detention basin on Oak Hill Cemetery property	Y	N
NV	CSTB-1	$649,100	0.03	Construct detention basin	Y	N
NV	NVCR-1	$0	-1	Construct detention basin at Harlem Avenue near Navajo Creek outfall	Y	N
OL	OLCR-1	$6,306,100	0.07	Expand Lake Oak Lawn detention capacity	Y	Y
OL	OLCR-3	$7,299,200	0.42	Stabilize Oak Lawn Creek with hard-armoring of eroding streambanks	Y	Y
STE	STCR-2	$48,496,800	0.25	Construct detention basin on undeveloped St Casimir Cemetery property	Y	Y
STE	STCR-4	$4,327,300	0.05	Construct detention basin on a portion of K-Mart parking lot site	Y	Y
STW1	STCR-3	$7,691,000	0.1	Expand Wolfe Wildlife Refuge detention capacity	Y	Y
STW1	STCR-10	$2,754,800	0	Stabilize the Oak Lawn Creek / Stony Creek confluence with hard-armoring of eroding streambanks	Y	Y
STW1	STCR-8	$6,286,400	0.18	Construct channel diversion to the Calumet-Sag Channel beneath Commonwealth Edison right-of-way	Y	Y
TI1	TICR-2	$3,104,200	0.54	Impound Tinley Creek upstream of Oak Park avenue (with low-flow bypass)	Y	N
TI2	TICR-5	$112,800	1.26	Improve / dredge Tinley Creek between 88th Avenue and Lake Lorin	Y	Y

Subwatershed Plan ID	MWRD Subbasin ID	Cost	BC Ratio	Project Description	Plan Reco	DWP Reco
TI2	TICR-8	$4,627,200	1.55	Stabilize Tinley Creek to prevent erosion	Y	Y

Table 6.6-1 Potential MWRD Projects Identified in the Cal-Sag DWP Recommended for Water Quality Enhancements in this WBP

The projects listed in Table 6.6-1 have been either identified or recommended in the DWP for flood control. They are identified in this plan as projects that have a potential to contain a viable water quality component. The projects envisioned in the DWP will require modification to include a water quality component as they do not as currently recommended in the DWP. The cost to modify the projects identified in the DWP with water quality components has not been included in this plan. The cost in Table 6.6-1 reflects the cost estimate from the DWP only. It is expected that the incremental cost change to incorporate a water quality component(s) would be relatively low as compared to the overall project costs. The projects highlighted in Table 6.6-1 have been included in the total reach lengths to be restored as described in the synthetic BMP application and have been assessed in the pollutant load reduction discussion for implementation. These reach lengths are part of the overall stream length that is assessed in the STEPL calculations.

6.7 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 program 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.

MWRD Green Infrastructure Assistance Program

- MWRD is committed to providing administrative and technical assistance to communities to facilitate the implementation of green infrastructure projects. MWRD funds projects based on the likelihood of flooding and/or basement backup reduction, number of structures benefitting, project cost, project location with respect to maintenance and outreach opportunities and socio-economic considerations.

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 – Chi-Cal Rivers Fund

- The Chi-Cal Rivers Fund is a public-private partnership working to restore the health, vitality and accessibility of the waterways in the Chicago and Calumet region by supporting green stormwater infrastructure, habitat enhancement, and public-use improvements.

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.

Illinois EPA's - Illinois Green Infrastructure Grant Program (IGIG)

- Since FY 2011, forty IGIG grants, totaling nearly $20 million, have been made available to local units of government and other organizations to demonstrate green infrastructure best management practices to control stormwater runoff for water quality protection in Illinois. Projects are located within a Municipal Separate Storm Sewer System (MS4) or combined sewer area. Areas with permeable pavement and rain gardens and other techniques are now in place to help restore, mimic, or enhance natural hydrology to protect and improve local water quality.

Two projects within the Cal-Sag Watershed, with components and effects similar to what is proposed in this plan, have been funded through the Illinois EPA IGIG program:

→ *The* ***Blue Island, Blue Water*** *project received approximately $1.1 million dollars in funding under Illinois EPA's IGIG program for purposes of reducing both stormwater volume and non-point source pollution associated with urban runoff from Blue Island. The project will reduce pollutant loadings into the Cal-Sag Channel. Over 22,000 square feet of permeable pavement will be constructed over an open-graded stone that will provide temporary storage prior to either infiltrating or draining to the existing storm sewer system. Additionally, twelve bio-retention basins, totaling 13,000 square feet is being constructed at street intersections and approximately 20,000 square feet of deep-rooted native vegetation will be planted. This project began in 2015 and is scheduled for completion in January 2019.*

→ *The* ***Beverly Area Planning Association Green Parking Lot and Rain Garden*** *project, constructed between 2011 and 2013, received over $72,000 to reduce stormwater volume and nonpoint source pollution to the Cal-Sag Channel by constructing a variety of BMPs. The BMPs included replacing the existing asphalt parking lot with approximately 3,700 square feet of permeable pavement along with over 650 square feet of natural landscaping. The project also included the construction of 300 square feet of landscaped bioretention rain garden. The BMPs implemented with this funding (and matching amount from the grantee) will reduce TSS loadings by over 180 lbs/yr.*

Local Program Initiatives

- Communities will have a leadership role in implementing many BMP projects under this plan. Communities can and will seek out grant opportunities to help fund project implementation. In most cases the costs for maintaining BMPs will need to be covered by the project owner/sponsor. And certain high priority projects will need to be implemented even if grant funding cannot be obtained. To have a reliable, steady source of revenue for stormwater projects and maintenance, it is recommended that the communities in the watershed consider establishment of a stormwater utility and fee system. MPC's Steady Streams report provides information on establishment of a stormwater fee system.

6.8 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

- Outreach to municipalities and stakeholder groups regarding the components of the plan and Section 319 funding.
- Municipalities and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop Section 319 grant applications for submittal to Illinois EPA.
- Municipalities 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.
- Chicago River Day 2018 and other events to encourage public awareness and participation.
- Work with MWRD to build water quality components into plans/designs for identified flood control projects.
- Track/inventory watershed projects.
- Continue watershed monitoring efforts and expand to the extent funding is available.

2019 - 2026

- Municipalities and stakeholder groups implement project plans where funding has been provided or local governments have appropriated funds.
- On-going outreach to municipalities and stakeholder groups regarding the components of the plan and Section 319 funding.

- Municipalities and stakeholder groups prepare project plans for beneficial projects, particularly in priority areas, and develop Section 319 grant applications for submittal to Illinois EPA.
- Municipalities 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.
- Continue participation in Chicago River Day and other events to encourage public awareness and participation
- MWRD, working with local partners, implements flood control projects which include water quality components.
- 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.

2027 - 2036

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

2037

- 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.

2038 - 2041

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

2042

- 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.

6.9 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.

6.9.1 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 Cal-Sag Channel 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 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.

6.9.2 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, municipalities, 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.

- Residents
  - It is necessary to inform, educate, and motivate residents and partner with municipal 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.
- Developers, Contractors and Consultants
  - This group has the potential to negatively or positively affect the watershed through design and development processes.
  - Already regulated by local ordinances, compliance with a variety of best development standards, regulations, codes and ordinances to protect the watershed will demonstrate a culture for concern of the health for waterways, which will eventually benefit their clients and their product.
  - Consultants and contractors will play a key role in bringing education and outreach messages to their clients through influence for BMPs and watershed improvements.
- Landscapers/Lawn Care and Snow Removal Contractors
  - Contractors tasked with landscape and lawn care, as well as winter snow and ice removal have the potential to make a large impact on improving water quality within the watershed by implementing best management practices. By implementing best practices these enterprises can contribute toward significant reductions in nutrient and chloride loadings to the watershed and positive water quality changes.
  - Communities in the watershed can support education by maintaining registries for landscape, lawn care and winter maintenance providers with pollution reduction programs.
- Non-governmental Organizations
  - Our region has a wealth of non-governmental organizations committed to improved stormwater management, water quality and reduced flooding. Partnering with these agencies will help align goals, projects, resources and overall beneficial impacts for improved watershed conditions.

6.9.3 Partner Organizations

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

- MWRD
  - With this watershed-based plan being supplemental to the Cal-Sag Watershed DWP, MWRD has been a partner with the development of this watershed plan from the start. The MWRD has provided numerous data sets, mapping tools and information throughout the watershed. In addition, MWRD is responsible for spearheading many improvement projects in the watershed as well as performing on-going stream maintenance and restoration projects while hosting community events. MWRD will continue to convene quarterly WPC meetings to discuss water quality-related topics.

- Cal-Sag Channel Watershed Planning Peer Review Committee
    - This group formed as a function of creating this plan, consists of private consultants, nonprofit groups and governmental organizations to provide technical guidance and input on the watershed plan. Members of the review committee include:
        - Christopher B. Burke Engineering, Ltd.
        - Metropolitan Planning Council
        - Geosyntec Consultants
        - V3 Companies
        - Conservation Foundation
        - Illinois Environmental Protection Agency
        - Cook County Forest Preserve
        - Cook County Planning and Development
        - Illinois Department of Natural Resources

      The varied backgrounds and experience of these members brings valuable insight to the watershed planning process.

- Cal-Sag Channel Watershed Planning Council (Council)
    - The Council has been useful in the development of this plan by allowing presentations and soliciting information and feedback at their quarterly meetings. It has been a helpful way to reach out to stakeholders in the watershed. In Cook County watershed planning councils represent communities located within major watersheds, and communicate the needs and interests of the members of the public and local governments to the MWRD.

- Illinois Environmental Protection Agency (Illinois EPA)
    - As a sponsor, Illinois EPA has provided valuable support in the form of grant funds for watershed planning and detailed review for the Cal-Sag Channel watershed resource inventory and watershed-based plan.

- Chicago Metropolitan Agency for Planning (CMAP)
    - CMAP is the land use planning organization for northeastern Illinois. CMAP has provided detailed reviews of watershed documents, providing data, maps, exhibits, and statistics about the watershed. CMAP will play a valuable role improving stormwater management in the coming years through its release of the On-to-2050 regional plan and its Local Technical Assistance (LTA) program.

- Will – South Cook Soil and Water Conservation District (District)
    - In conjunction with Natural Resources Conservation Service (NRCS), the District regulates and provides information for compliance with soil erosion and sediment control measures related natural resources.

- o Friends of the Chicago River
    - Annually, Friends of the Chicago River hold a river cleanup across the region, *Chicago River Day*. This cleanup effort stretches from the Des Plaines River to the Cal-Sag Channel and along the Chicago River. Volunteers remove tons of debris, restore river-side trails, remove invasive species, and plant native species. The continued efforts from Friends of the Chicago River and their annual volunteers contribute toward the cleanup and restoration of rivers and streams in the watershed.

Figure 6.9-1 Chicago River Day volunteers in Blue Island, cleaning up the Cal-Sag Channel. May 13, 2017

6.9.4 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 Cal-Sag watershed include the following:

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

6.9.5 Media and Marketing Campaign

The Cal-Sag 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. The Cal-Sag trail which runs along the Channel is an appropriate place for some messages or signage.
- Implement a public relations and marketing campaign to include advertisements and outreach through newspapers, village newsletters, homeowner association circulars, and community meetings.
- Post and distribute watershed maps, posters and brochures which include pollution control strategies, current projects, future projects, and fun facts about the watershed.

6.9.6 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.

- Encourage participation in Chicago River Day, with riverside clean-up events or boating activities. Look for other event opportunities such as river clean-ups, watershed tours, stream walks, rain garden tours, restoration projects, and other participatory learning events.
- 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, trails, and areas of concern such as streambank erosion sites, stormwater outfalls, and urban runoff sites.
- Publish a 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 industry, business, schools, citizens, elected officials, and environmental groups which implement watershed improvement projects.
- Start a storm drain stenciling or button campaign, noting when storm drains lead directly to local water bodies. Distribute door hangers to educate residents on storm drain stenciling efforts.
- 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.

6.9.7 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.

6.9.8 Demonstration Projects with Educational Signage

Other 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.

6.9.9 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.

6.9.10 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 Cal-Sag Channel 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.

Figure 6.9-2 Centennial Park Lake

CHAPTER 7 PLAN EVALUATION

Monitored water quality within the Cal-Sag Channel 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 Channel from upstream areas, weather, and infrastructure projects (e.g., possible measures to control migration of Asian Carp). 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 Cal-Sag Channel watershed has indicated that the most significant source of pollutant loadings is urban runoff and stormwater. 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 sediment reductions associated with the 25-year goals are also shown for each watershed planning unit.

In addition to establishing milestones for BMP implementation, sediment loading reduction is used here as the metric for plan implementation tracking purposes. This is valid, as sediment/TSS levels in the water bodies are elevated, which contributes to use impairment. In addition, reductions in sediment loadings suggest reductions of loadings of other pollutants present in urban stormwater. As previously noted, sediment loadings also bring with them increased levels of hydrocarbons, organic and inorganic compounds and heavy metals, as sediment particles act as vehicles for these constituents. Reducing sediment loads results in reductions of loadings of other key pollutants. It should also be noted the methodology used to estimate sediment load reductions can also be used to estimate loading reductions for total phosphorus, nitrogen and BOD. This table focuses on sediment as the most useful surrogate or indicator pollutant.

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
STW1 (2,028 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	30.5	Ac	1.22	4.88	12.2	30.5	
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	0.008	0.032	0.08	0.2	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.8	Ac	0.032	0.128	0.32	0.8	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
	Porous Pavement	22.3	Ac	0.892	3.568	8.92	22.3	
	Weekly Street Sweeping	221.5	Ac	8.86	35.44	88.6	221.5	
	Water Quality Inlets (does not include maintenance)	714.7	Ea	28.588	114.352	285.88	714.7	
	Wetland Restoration	14.6	Ac	0.584	2.336	5.84	14.6	
	Streambank Stabilization	6671	LF	266.84	1067.36	2668.4	6671	
Watershed Planning Unit Total								410
LD (2,188 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	12	Ac	0.48	1.92	4.8	12	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.2	Ac	0.008	0.032	0.08	0.2	
	Settling Basins	0.02	*Ac*	0.0008	0.0032	0.008	0.02	
	Porous Pavement	12.8	Ac	0.512	2.048	5.12	12.8	
	Weekly Street Sweeping	127.5	Ac	5.1	20.4	51	127.5	
	Water Quality Inlets (does not include maintenance)	411.4	Ea	16.456	65.824	164.56	411.4	
	Wetland Restoration	2.3	Ac	0.092	0.368	0.92	2.3	
	Streambank Stabilization	4476.5	LF	179.06	716.24	1790.6	4476.5	
Watershed Planning Unit Total								57
ME	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	30.5	Ac	1.22	4.88	12.2	30.5	
	Detention Basin Retrofit - native planting in dry bottom pond	0.8	Ac	0.032	0.128	0.32	0.8	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	6.3	Ac	0.252	1.008	2.52	6.3	
	Settling Basins	0.4	*Ac*	0.016	0.064	0.16	0.4	
	Porous Pavement	25.5	Ac	1.02	4.08	10.2	25.5	
	Weekly Street Sweeping	253.8	Ac	10.152	40.608	101.52	253.8	
	Water Quality Inlets (does not include maintenance)	818.8	Ea	32.752	131.008	327.52	818.8	
	Wetland Restoration	6.8	Ac	0.272	1.088	2.72	6.8	
	Streambank Stabilization	2417.5	LF	96.7	386.8	967	2417.5	
Watershed Planning Unit Total								151
CS5	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	20.8	Ac	0.832	3.328	8.32	20.8	
	Porous Pavement	22.5	Ac	0.9	3.6	9	22.5	
	Weekly Street Sweeping	224.3	Ac	8.972	35.888	89.72	224.3	
	Water Quality Inlets (does not include maintenance)	723.6	Ea	28.944	115.776	289.44	723.6	
	Wetland Restoration	0.2	Ac	0.008	0.032	0.08	0.2	
Watershed Planning Unit Total								38

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
OL (2,345 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	16.5	Ac	0.66	2.64	6.6	16.5	
	Detention Basin Retrofit - native planting in dry bottom pond	0.1	Ac	0.004	0.016	0.04	0.1	
	Settling Basins	0.01	*Ac*	0.0004	0.0016	0.004	0.01	
	Porous Pavement	15.3	Ac	0.612	2.448	6.12	15.3	
	Weekly Street Sweeping	152.8	Ac	6.112	24.448	61.12	152.8	
	Water Quality Inlets (does not include maintenance)	492.9	Ea	19.716	78.864	197.16	492.9	
	Wetland Restoration	0.4	Ac	0.016	0.064	0.16	0.4	
	Streambank Stabilization	2422.5	LF	96.9	387.6	969	2422.5	
Watershed Planning Unit Total								86
TI2 (3,953 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	31	Ac	1.24	4.96	12.4	31	
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	0.008	0.032	0.08	0.2	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	17.9	Ac	0.716	2.864	7.16	17.9	
	Settling Basins	0.3	*Ac*	0.012	0.048	0.12	0.3	
	Porous Pavement	17.3	Ac	0.692	2.768	6.92	17.3	
	Weekly Street Sweeping	171.3	Ac	6.852	27.408	68.52	171.3	
	Water Quality Inlets (does not include maintenance)	552.6	Ea	22.104	88.416	221.04	552.6	
	Wetland Restoration	18.9	Ac	0.756	3.024	7.56	18.9	
	Streambank Stabilization	13118.5	LF	524.74	2098.96	5247.4	13118.5	
Watershed Planning Unit Total								1,359
CSD (810 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	4.5	Ac	0.18	0.72	1.8	4.5	
	Vegetated Filter Strips	41.7	*Ac*	1.668	6.672	16.68	41.7	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.3	Ac	0.052	0.208	0.52	1.3	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	
	Porous Pavement	2.8	Ac	0.112	0.448	1.12	2.8	
	Weekly Street Sweeping	28.5	Ac	1.14	4.56	11.4	28.5	
	Water Quality Inlets (does not include maintenance)	92	Ea	3.68	14.72	36.8	92	
	Wetland Restoration	0.1	Ac	0.004	0.016	0.04	0.1	
	Streambank Stabilization	2370	LF	94.8	379.2	948	2370	
Watershed Planning Unit Total								177
CS4 (2,392 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	1	Ac	0.04	0.16	0.4	1	
	Detention Basin Retrofit - native planting in dry bottom pond	1	Ac	0.04	0.16	0.4	1	

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.7	Ac	0.068	0.272	0.68	1.7	
	Settling Basins	0.2	*Ac*	0.008	0.032	0.08	0.2	
	Porous Pavement	8	Ac	0.32	1.28	3.2	8	
	Weekly Street Sweeping	79.5	Ac	3.18	12.72	31.8	79.5	
	Water Quality Inlets (does not include maintenance)	256.5	Ea	10.26	41.04	102.6	256.5	
	Wetland Restoration	5.8	Ac	0.232	0.928	2.32	5.8	
Watershed Planning Unit Total								34
STE (4,434 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	22.8	Ac	0.912	3.648	9.12	22.8	
	Detention Basin Retrofit - native planting in dry bottom pond	0.3	Ac	0.012	0.048	0.12	0.3	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.4	Ac	0.016	0.064	0.16	0.4	
	Settling Basins	0.05	*Ac*	0.002	0.008	0.02	0.05	
	Porous Pavement	19.3	Ac	0.772	3.088	7.72	19.3	
	Weekly Street Sweeping	192	Ac	7.68	30.72	76.8	192	
	Water Quality Inlets (does not include maintenance)	619.5	Ea	24.78	99.12	247.8	619.5	
	Wetland Restoration	10.5	Ac	0.42	1.68	4.2	10.5	
	Streambank Stabilization	9556	LF	382.24	1528.96	3822.4	9556	
Watershed Planning Unit Total								124
LDC (1,731 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	55.2	Ac	2.208	8.832	22.08	55.2	
	Infiltration Trench	44.5	*Ac*	1.78	7.12	17.8	44.5	
	Bioretention as Green Roof (assuming structurally sound)	5.3	*Ac*	0.212	0.848	2.12	5.3	
	Dry Detention as Blue Roof (assuming structurally sound)	5.3	*Ac*	0.212	0.848	2.12	5.3	
	Mechanical BMPs (assuming 1 per 10 acres of tributary area)	7	*Ea*	0.28	1.12	2.8	7	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.8	Ac	0.032	0.128	0.32	0.8	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	
	Porous Pavement	6.5	Ac	0.26	1.04	2.6	6.5	
	Weekly Street Sweeping	65.8	Ac	2.632	10.528	26.32	65.8	
	Water Quality Inlets (does not include maintenance)	212.2	Ea	8.488	33.952	84.88	212.2	
	Wetland Restoration	4.4	Ac	0.176	0.704	1.76	4.4	
	Streambank Stabilization	5362.5	LF	214.5	858	2145	5362.5	
Watershed Planning Unit Total								214
MP (2,699 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	18.3	Ac	0.732	2.928	7.32	18.3	

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
	Settling Basins	0.05	*Ac*	0.002	0.008	0.02	0.05	
	Porous Pavement	14.5	Ac	0.58	2.32	5.8	14.5	
	Weekly Street Sweeping	145.5	Ac	5.82	23.28	58.2	145.5	
	Water Quality Inlets (does not include maintenance)	469.5	Ea	18.78	75.12	187.8	469.5	
	Wetland Restoration	1.5	Ac	0.06	0.24	0.6	1.5	
	Streambank Stabilization	2233	LF	89.32	357.28	893.2	2233	
Watershed Planning Unit Total								65
CSC (2,622 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	13.5	Ac	0.54	2.16	5.4	13.5	
	Detention Basin Retrofit - native planting in dry bottom pond	0.05	Ac	0.002	0.008	0.02	0.05	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.9	Ac	0.036	0.144	0.36	0.9	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	
	Porous Pavement	10	Ac	0.4	1.6	4	10	
	Weekly Street Sweeping	98.8	Ac	3.952	15.808	39.52	98.8	
	Water Quality Inlets (does not include maintenance)	318.6	Ea	12.744	50.976	127.44	318.6	
	Wetland Restoration	3.7	Ac	0.148	0.592	1.48	3.7	
	Streambank Stabilization	3947	LF	157.88	631.52	1578.8	3947	
Watershed Planning Unit Total								74
STW2 (2,807 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	18.8	Ac	0.752	3.008	7.52	18.8	
	Detention Basin Retrofit - native planting in dry bottom pond	0.4	Ac	0.016	0.064	0.16	0.4	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.5	Ac	0.06	0.24	0.6	1.5	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	
	Porous Pavement	17.8	Ac	0.712	2.848	7.12	17.8	
	Weekly Street Sweeping	176.5	Ac	7.06	28.24	70.6	176.5	
	Water Quality Inlets (does not include maintenance)	569.5	Ea	22.78	91.12	227.8	569.5	
	Wetland Restoration	1.4	Ac	0.056	0.224	0.56	1.4	
Watershed Planning Unit Total								29
CS3 (812 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	5.8	Ac	0.232	0.928	2.32	5.8	
	Porous Pavement	4.8	Ac	0.192	0.768	1.92	4.8	
	Weekly Street Sweeping	46.3	Ac	1.852	7.408	18.52	46.3	
	Water Quality Inlets (does not include maintenance)	149.2	Ea	5.968	23.872	59.68	149.2	
	Wetland Restoration	7.7	Ac	0.308	1.232	3.08	7.7	

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
Watershed Planning Unit Total								8
MI1 (4,999 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	30.8	Ac	1.232	4.928	12.32	30.8	
	Vegetated Filter Strips	9.7	*Ac*	0.388	1.552	3.88	9.7	
	Porous Pavement	15	Ac	0.6	2.4	6	15	
	Detention Basin Retrofit - native planting in dry bottom pond	0.04	Ac	0.0016	0.0064	0.016	0.04	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	16.9	Ac	0.676	2.704	6.76	16.9	
	Settling Basins	0.1	*Ac*	0.004	0.016	0.04	0.1	
	Weekly Street Sweeping	149	Ac	5.96	23.84	59.6	149	
	Water Quality Inlets (does not include maintenance)	480.8	Ea	19.232	76.928	192.32	480.8	
	Wetland Restoration	21.5	Ac	0.86	3.44	8.6	21.5	
	Streambank Stabilization	14139	LF	565.56	2262.24	5655.6	14139	
Watershed Planning Unit Total								425
NV (4,718 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	36.3	Ac	1.452	5.808	14.52	36.3	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.9	Ac	0.076	0.304	0.76	1.9	
	Settling Basins	0.3	*Ac*	0.012	0.048	0.12	0.3	
	Porous Pavement	19.3	Ac	0.772	3.088	7.72	19.3	
	Weekly Street Sweeping	193.5	Ac	7.74	30.96	77.4	193.5	
	Water Quality Inlets (does not include maintenance)	624.4	Ea	24.976	99.904	249.76	624.4	
	Wetland Restoration	7.4	Ac	0.296	1.184	2.96	7.4	
	Streambank Stabilization	12089.5	LF	483.58	1934.32	4835.8	12089.5	
Watershed Planning Unit Total								250
CSA (1,894 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	7.3	Ac	0.292	1.168	2.92	7.3	
	Vegetated Filter Strips	10.6	*Ac*	0.424	1.696	4.24	10.6	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.3	Ac	0.012	0.048	0.12	0.3	
	Settling Basins	0.02	*Ac*	0.0008	0.0032	0.008	0.02	
	Porous Pavement	3	Ac	0.12	0.48	1.2	3	
	Weekly Street Sweeping	28.8	Ac	1.152	4.608	11.52	28.8	
	Water Quality Inlets (does not include maintenance)	92.8	Ea	3.712	14.848	37.12	92.8	
	Wetland Restoration	28.1	Ac	1.124	4.496	11.24	28.1	
	Streambank Stabilization	4925	LF	197	788	1970	4925	
Watershed Planning Unit Total								86

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
TI1 (4,310 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	10.5	Ac	0.42	1.68	4.2	10.5	
	Vegetated Filter Strips	16.7	*Ac*	0.668	2.672	6.68	16.7	
	Detention Basin Retrofit - native planting in dry bottom pond	0.2	Ac	0.008	0.032	0.08	0.2	
	Settling Basins	0.01	*Ac*	0.0004	0.0016	0.004	0.01	
	Porous Pavement	6.3	Ac	0.252	1.008	2.52	6.3	
	Weekly Street Sweeping	62.5	Ac	2.5	10	25	62.5	
	Water Quality Inlets (does not include maintenance)	201.7	Ea	8.068	32.272	80.68	201.7	
	Wetland Restoration	6.7	Ac	0.268	1.072	2.68	6.7	
	Streambank Stabilization	18042.5	LF	721.7	2886.8	7217	18042.5	
Watershed Planning Unit Total								565
CS1 (799 acres)	*Vegetated Filter Strips*	50.8	*Ac*	2.032	8.128	20.32	50.8	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.3	Ac	0.012	0.048	0.12	0.3	
	Settling Basins	0.02	*Ac*	0.0008	0.0032	0.008	0.02	
	Porous Pavement	1	Ac	0.04	0.16	0.4	1	
	Weekly Street Sweeping	9.5	Ac	0.38	1.52	3.8	9.5	
	Water Quality Inlets (does not include maintenance)	30.7	Ea	1.228	4.912	12.28	30.7	
	Wetland Restoration	12	Ac	0.48	1.92	4.8	12	
Watershed Planning Unit Total								4
IMBC (606 acres)	*Vegetated Filter Strips*	66.9	*Ac*	2.676	10.704	26.76	66.9	
	Porous Pavement	0.3	Ac	0.012	0.048	0.12	0.3	
	Weekly Street Sweeping	3.3	Ac	0.132	0.528	1.32	3.3	
	Water Quality Inlets (does not include maintenance)	10.5	Ea	0.42	1.68	4.2	10.5	
	Wetland Restoration	14.4	Ac	0.576	2.304	5.76	14.4	
Watershed Planning Unit Total								32
CS2 (6,526 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	2.8	Ac	0.112	0.448	1.12	2.8	
	Vegetated Filter Strips	8.7	*Ac*	0.348	1.392	3.48	8.7	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	0.1	Ac	0.004	0.016	0.04	0.1	
	Settling Basins	0.01	*Ac*	0.0004	0.0016	0.004	0.01	
	Porous Pavement	4.6	Ac	0.184	0.736	1.84	4.6	
	Weekly Street Sweeping	46.3	Ac	1.852	7.408	18.52	46.3	
	Water Quality Inlets (does not include maintenance)	149.2	Ea	5.968	23.872	59.68	149.2	
	Wetland Restoration	1.5	Ac	0.06	0.24	0.6	1.5	

Watershed Planning Unit ID	BMP	Target Amount	Unit	2-Year Goal	5-Year Goal	10-Year Goal	25-Year Goal	Sediment Reduction Achieved (tons/yr) by Year 25
Watershed Planning Unit Total								6
MI2 (2,327 acres)	*Bioretention (Rain Gardens / Planter Boxes / Landscaped Medians)*	7.3	Ac	0.292	1.168	2.92	7.3	
	Vegetated Filter Strips	13	*Ac*	0.52	2.08	5.2	13	
	Detention Basin Retrofit - wet bottom pond restoration and bank enhancement	1.2	Ac	0.048	0.192	0.48	1.2	
	Settling Basins	0.02	*Ac*	0.0008	0.0032	0.008	0.02	
	Porous Pavement	6.7	Ac	0.268	1.072	2.68	6.7	
	Weekly Street Sweeping	67.3	Ac	2.692	10.768	26.92	67.3	
	Water Quality Inlets (does not include maintenance)	217	Ea	8.68	34.72	86.8	217	
	Wetland Restoration	8.3	Ac	0.332	1.328	3.32	8.3	
Watershed Planning Unit Total								15
Watershed Total								4,206

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

7.2 MEASURING PROGRESS AND MONITORING EFFECTIVNESS

7.2.1 Tracking Plan Implementation

Reflecting discussions with MWRD and other watershed stakeholders, this plan identifies two primary mechanisms to track plan implementation over time:

(1) Many of the capital/BMP projects envisioned in this plan will need to be permitted under the MWRD WMO. MWRD has a database of permit actions. The database includes information such as BMP type and size and location as a function of the WMO requirements with respect to volume control and detention for new and redevelopment. A principal means of tracking plan implementation will be to periodically pull reports for permitted projects in the Cal-Sag Channel watershed. This 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. In this way MWRD can be aware of all the projects in the watershed.

(2) MWRD will include an agenda item in each quarterly Watershed Planning Council meeting to discuss project ideas and capture projects in process or completed. Watershed communities and other stakeholders can report on their projects, some of which may be small or otherwise be of a nature that a WMO permit was not required. This will allow for projects to be tracked even if the project is not in the WMO permit database.

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

Communities that are MS4 communities and are subject to the State-wide MS4 general permit will also be tracking implementation of stormwater-related projects. This will include structural/on-the-ground projects as well as non-structural practices such as street sweeping. This is also a requirement of the State-wide MS4 general permit where an annual report outlining milestones for BMP implementation is required.

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 municipalities 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 Cal-Sag Channel 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) can be de-listed that will be a direct indicator that water quality has improved.

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.

As noted in Chapter 3, MWRD has been monitoring water quality constituents as part of its Ambient Water Quality Monitoring in the planning area since 2001. It will be valuable for the District to continue these monitoring efforts at as many stations as is feasible. The data on TSS, nutrients, DO, bacteria, and chlorides will be indicative of overall water quality and may reveal material results from BMP implementation.

There is a good amount data generated nationally on the effectiveness of BMPs. However, few studies have been done in the Cal-Sag Channel watershed. Studies of the performance of typical individual BMPs will be useful to determine locally the extent to which BMPs are performing as expected. Monitoring and observation of BMPs will also be valuable to assess if maintenance is occurring and if BMP performance is continuing over time.

CHAPTER 8 CONCLUSION

This watershed-based plan for the Cal-Sag Channel 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% developed excluding the forest preserves. As would be expected in an urbanized watershed, much of the land area is covered with impervious surfaces. Much of the development in the watershed occurred prior to 1970's and stormwater control measures were not integrated into the areas. The overall land use characteristics and impervious surfaces and the fairly minimal stormwater controls result in high volumes of stormwater runoff and significant pollutant loadings.

Reflecting the identified sources of pollutant loadings, the plan recommends BMPs to better manage urban runoff and stormwater. Many of the recommended BMPs will have the function of intercepting and treating runoff, including green infrastructure practices. Green infrastructure practices including rain gardens, bioswales, permeable pavements and green roofs, capture and treat runoff, resulting in reduced stormwater volumes and reduced pollutant loads. The plan also notes the importance of non-structural controls, including but not limited to measures that communities will carry out in conformance with MS4 permit provisions.

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 25% 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 public vs. 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 developed area, the 25% target implementation level represents a fairly immense scale of BMP implementation. The costs will be significant. This can be considered a *stretch goal*, that is an ambitious goal that will need to be pursued incrementally. However, with creative thinking and strong resolve on the part of watershed decision-makers, businesses, and residents, significant progress can be made toward a healthy watershed that can be appreciated and enjoyed by all.

Figure 7.3-1 Turtlehead Lake

CHAPTER 9 REFERENCES

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