RAMSEY COUNTY
Parks & Recreation

Pigs Eye Lake Master Plan Amendment

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EXECUTIVE SUMMARY

OVERVIEW

Ramsey County is requesting an amendment to the 1981 Battle Creek Regional Park Master Plan to address natural resource improvements to Ramsey County section Pigs Eye Lake. This master plan request does not address recreational improvements but will address sequencing of natural resource improvements for the Pigs Eye Lake Island building project, other natural resource activities, and public protection for the Ramsey County section of Pigs Eye Lake. Recreation improvements for the Pigs Eye Lake section will be addressed in conjunction with long-term improvements for the overall Battle Creek Regional Park master plan process.

Sequencing of Natural Resource Improvements:

- Pigs Eye Island Lake Project (first step of improvements)
- Other Natural Resource Restoration activities and projects
- Pigs Eye Lake Public Protection (may include components as a future amendment or agency-wide planning study for long-term clean-up and public safety measures)

BATTLE CREEK REGIONAL PARK – PIGS EYE SECTION BACKGROUND

Battle Creek Regional Park is located in the southeast corner of Ramsey County in the cities of Saint Paul and Maplewood. The park is comprised of four regional segments: Indian Mounds (97 acres); Fish Hatchery (105 acres); Pigs Eye (610 acres); and Battle Creek (846 acres). In accordance with the 1981 joint master plan, the city of Saint Paul owns and operates the Indian Mounds and Fish Hatchery segments of the park. Ramsey County owns and operates the Battle Creek and Pigs Eye segments, consisting of 1,456 acres.

The Pig's Eye section of Battle Creek Regional Park consists of a 629-acre lake, which is a back water of the Mississippi river, surrounded by 378 acres of land to the west and 125 acres of wetlands to the east and northwest of the lake, which is in the floodplain.

PIGS EYE LAKE ISLAND BUILDING BACKGROUND

The Corps, in close collaboration with Parks & Recreation, completed a Feasibility Study for constructing habitat enhancements in Pigs Eye Lake. The project will enhance and restore backwater habitat by creating island and wetland features. Project features include six islands, sand benches, marsh habitat and land plantings. These enhancements will improve aquatic and land habitat as well as maintaining the shoreline of Pigs Eye Lake. This project will also allow us to utilize dredged material from the Mississippi in an environmentally beneficial way. Dredged material was tested by MPCA standards and was approved to be utilized for placement within public water.

See Page 2 for U.S. Army Corps of Engineers Island Building Graphic

Feasibility Study

In 2015, funding became available for a feasibility study and work began to identify the project scope, objectives, coordination, stakeholders and process for developing the feasibility study with an integrated Environmental Assessment. The Feasibility Study Report with Integrated Environmental Assessment investigated the feasibility of alternative measures to address problems and opportunities associated with the Pigs Eye Lake Continuing Authorities Program Section 204 beneficial use of dredged material project. This report was prepared to comply with the National Environmental Policy Act (NEPA) of 1969.

Pigs Eye Lake - Island Building Graphic
U.S Army Corps of Engineers

The project scope included habitat within and immediately around Pigs Eye Lake. Implementation of a restoration plan in this area will directly benefit the entire Pigs Eye Lake ecosystem; restoration efforts are essential restoring aquatic habitat in the lake. The study team identified a variety of measures that could be taken to achieve project objectives, including full and split island designs, sand benches, and creation of wetland (marsh) habitat. The measures were combined in various logical combinations to form alternative project plans. The habitat concerns within the project area primarily include high levels of turbidity, wind-induced shoreline erosion, lack of depth diversity, and lack of shoreline habitat for birds and aquatic plants.

Project Plan

The selected plan includes six islands with sand benches. Three of the islands would utilize a "split" design that would establish sheltered areas in the centers of the islands, allowing for the creation of approximately 17.6 acres of protected wetland habitat.

The Corps has constructed many habitat islands on the Upper Mississippi over the past few decades. Many of the features and recommendation been denoted in the Corps of Engineers Upper Mississippi River Restoration Program - Environmental Design Handbook, December 2012. Several features of the proposed island layout have varied from more typical sections. This has been done in part to provide a better design for construction on very soft sediments. Changes have also been proposed to improve the island/lake habitat value.

One of the main features that differ from the more traditional island design is the 'submerged berm'. The submerged berm would function as a significant step toward creation of a beach zone around the islands. The beach zone helps dissipate wave energy as waves approach and break on the islands. This reduces the wave's erosive action on the higher island portions. Over time the beach material is regularly rearranged by the waves and the bank material becomes more stable.

Three of the project's islands would be constructed as 'split' islands. Conceptually these islands evolved from the full section island. The thought was that if one of the berms was split off of the island and separated from it by a short distance, the island should still have little risk of erosion along the split since the fetch would be very small. This gap between the two sides could be enlarged further as long as the interior remains very sheltered. These islands are generally constructed in pairs where a portion of one section that has the higher island elevation and another island that is similar to an independent split off berm.

The alternative plans incorporate three cross section designs. These are the 'Full' section which is the most similar to traditional HREP islands with the addition of a perpetually submerged berm. The other two sections reflect the design for the 'Split' island concept where the island pairs provide heavily sheltered interior embayment's.

Island Construction Material and Placement

A variety of fill material including rock, sand, and topsoil will be utilized for the habitat island construction in Pigs Eye Lake. Materials utilized for construction will include a sand, rock and topsoil. The rock would be clean and sourced from a quarry, however the sand and topsoil material will consist primarily of material generated from dredging in the southern portion of Pool 2. Material dredged in lower Pool 2 is placed on one of three temporary placement islands (Pine Bend, Upper Boulanger, and Lower Boulanger) to be later moved to a permanent location. The material utilized for the Pigs Eye Islands project will come from one of these temporary placement islands.

Approximately 413,329 CY of sand and topsoil material is anticipated for island construction. All dredged material to be utilized on this project was previously tested by MPCA standards and was approved to be used for placement within public water. The USACE has had great success with using dredge material from the Mississippi River on past island construction projects. Reuse of this material can provide substantial cost savings and is an environmentally beneficial way for island construction.

After offloading material from a temporary placement island, material will be transported via barge approximately 12 river miles up the main channel of the Mississippi River through the access channel of the Red Rock Terminal to a staging location at the southern end of Pigs Eye Lake. Analysis has concluded that the southern end of the lake can be reached through the access channel for the Red Rock Barge Terminal (8-9+ ft draft). Additional coordination will continue with businesses utilizing the Red Rock Terminal prior to project construction.

The typical construction process of habitat island building on the Mississippi River starts with the placement of a sand base via the use of either hydraulic or mechanical dredging equipment. Following the sand base construction, rock vanes will be placed at locations along the outer edges of the islands to prevent erosion. After rock vanes are in place topsoil material will be spread on top of the sand bases, followed lastly by seeding and planting of natural vegetations.

Island Construction Steps

Sand Placement

Stabilize with Rock

Topsoil Placement

Planting and Seeding

Project Schedule – Next Steps

1. Final Design - September 2019 – Summer/Fall 2020
2. 45-Day Online Public Review of Draft Plan– Summer/Fall 2020
3. Anticipated Project Construction – Spring 2021- Fall 2024
4. Complete Construction –Fall 2024

OTHER NATURAL RESOURCE ACTIVITIES AND PROJECTS BACKGROUND

The Pigs Eye section of Battle Creek is within natural resource management Unit 10 as defined within 2018 Park and Recreation System Plan – Battle Creek Regional Park section (see appendix Figures 1.1-1.47). Management of Pig's Eye natural resources will be coordinated by Ramsey County Parks & Recreation department and will include, ongoing protection in coordination with partnering agencies, site inventories, and restoration of the land and lake resources.

Current State

The entire Pigs Eye section is within the Mississippi River Corridor Critical Area (MRCCA), which shares the boundary with the Mississippi National River and Recreation Area. This section of park is subject to MRCCA regulations (State statute under Minnesota Rule 6106) which is in place to protect the unique natural and cultural resources and values within this corridor. Much of the existing landcover for the Pigs Eye section of the park consist of mixed forest and wetland habitats. In order to provide and increase healthy aquatic, land and wildlife habitats it is critical that these environments are maintained, protected and restored. The habitat concerns for the Pigs Eye section of the park primarily include high levels of turbidity, wind-induced shoreline erosion, lack of depth diversity, and lack of shoreline habitat for birds and aquatic plants.

Need and Long-term Outcome

Pigs Eye natural resources will be coordinated by Ramsey County Parks & Recreation department and will include, ongoing protection in coordination with partnering agencies, site inventories, and restoration of the land and lake resources.

Surveys of the Pigs Eye area will need to be completed prior to any restoration work to gather more information about the current state of the area. Inventory info will include wildlife, plant and shoreline surveys and will focus on determining restoration needs for shoreline erosion, invasive plant species removal, and reforestation of floodplain tree species, such as cottonwood. Habitat restoration for upland and flood zone areas includes transition of the mixed forest to floodplain forest, through mainly removal of invasive species.

The Pigs Eye island building project will provide much needed wildlife habitat within the lake itself, prevent further erosion to the lakeshore, compliment the surrounding natural resources, and will directly benefit the entire Pigs Eye Lake ecosystem. These restoration efforts are essential to restoring aquatic habitat within Pigs Eye lake and for providing greater diversity of other vegetation and wildlife habitats.

PIGS EYE LAKE PUBLIC PROTECTION BACKGROUND

This is meant to provide a high-level summary of environmental conditions for Pigs Eye Lake and surrounding areas within the regional park boundary. Long-term contamination cleanup activities will likely be covered within a future master plan amendment.

The north end of the lake and adjacent riparian land is owned by the City of St. Paul. The majority of Pigs Eye lake and riparian area is owned by Ramsey County. The land area northwest of the lake contains inactive waste water treatment ponds and is owned by the Metropolitan Council Environmental Service (MCES) at the Metropolitan

Wastewater Treatment Plant. The Port Authority owns portions of the lake and riparian land on the southern tip of the lake around the outlet of Pigs Eye Lake into the Mississippi River. The Canadian Pacific Railway, or CP Rail System, is near highway 61 and the east edge of Pigs Eye Lake. Saint Paul Port Authorities maintains Red Rock on the south end of Pigs Eye Lake.

Pigs Eye Landfill

To the north is the 300-acre site of the former Pigs Eye Landfill on City of St. Paul property, which was used for the disposal of mixed municipal, commercial, and industrial waste beginning in the mid-1950s until 1972, and for disposal of incinerated sludge ash from 1977 to 1985. According to the Minnesota Department of Health, "although commonly referred to as a landfill, the site did not operate according to Minnesota Pollution Control Agency's (MPCA) landfill rules, which were not yet in place when the site was in operation. Therefore, the site is more accurately described as a dump where refuse of various types was disposed of with minimal control" (Minnesota Department of Health, 2000).

As a result of the various types of waste dumped at the site over the years, it is currently listed on U.S. Environmental Protection Agency's (EPA) Comprehensive Response, Compensation, and Liability Information System (CERCLIS) and is a Minnesota Superfund site addressed by the MPCA Superfund Program.

Currently, the MPCA is coordinating cleanup activities at the dump site, as required by the Minnesota Superfund program.

Hazardous, Toxic, Radioactive Waste

Environmental studies by several agencies, including the Corps, have been conducted in the project vicinity of Pigs Eye Lake. Because there are known sources of hazardous, toxic, and radioactive wastes (HTRW) in the project area, a Phase I HTRW analysis was conducted in June 2016, in accordance with ER-1165-2-132, Water Resource Policies and Authorities HTRW Guidance for Civil Works Projects. The Phase I analysis identified the primary sites with the highest potential for soil and water contamination, which are the Pigs Eye Landfill, a 350-acre site immediately north of the lake, and the Pigs Eye Wastewater Treatment Plant, 1-mile northwest of the lake. As a result of the Phase I report, a Phase II investigation with additional sampling at the proposed project locations was conducted in order to better quantify any potential chemical or environmental contamination that may exist and thereby impact the proposed Project. The results of the tests conducted are summarized in Section 2.3.4 of the Island Building Feasibility Report, while full results are included in Appendix E - Sediment Report (see appendix page 151). Section 7.1.6 presents a discussion and conclusion about the results in regard to the proposed alternative.

Pigs Eye Lake Sediment Contaminant Testing Summary

The Corps collected sediment samples throughout Pigs Eye Lake and analyzed them for a suite of routinely-tested physical and chemical parameters as part of the Feasibility Study that was completed in 2018. The Corps also collected and incorporated results of tests previously conducted by other entities in Pigs Eye Lake. Contaminant levels found in the tests were compared with several sets of reference values developed by the Minnesota Pollution Control Agency (MPCA) to evaluate the acceptability of constructing potential project measures within the lake. The results were coordinated and discussed with local and regional resource agencies. The analysis and coordination led to the conclusions that: (1) The northernmost portion of the lake near the former Pigs Eye Landfill should be avoided as part of this project (incorporated as a planning constraint, see Section 4.2 and Figure 15), and (2) of the Island Building Feasibility Study). Construction of habitat features in the remainder of the lake are not expected to pose an unacceptable risk to wildlife and therefore, overall project planning should continue.

Targets used to interpret the degree of contamination are divided into SQTs and SRVs. The Sediment Quality Targets (SQTs) consist of level I guidance for a high level of protection for benthic invertebrates and level II

guidance for the moderate level of protection for benthic invertebrates. The MPCA's Residential Soil Reference Values (SRVs) were also compared to the results to determine if the material is suitable for upland placement.

The MPCA oversaw and/or conducted sediment sampling in the northernmost portion of Pigs Eye Lake between 1992 and 2007. Results of the various investigations conducted in the lake indicate that cadmium, copper, lead, zinc, and polychlorinated biphenyls (PCBs) are present in the Pigs Eye Lake sediments at concentrations that exceed respective level I and level II sediment quality targets (SQTs). Additionally, perfluorinated chemicals (PFCs), including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have been detected in lake sediments. However, PFCs are ubiquitous throughout Mississippi River Pool 2, and with the exception of the area directly around the landfill, PFC levels within Pigs Eye Lake do not appear to be significantly elevated compared to the general region.

The Corps conducted two sediment surveys; 3 boreholes were tested in 2015 and 10 boreholes were tested in 2016. The samples were analyzed for grain size, metals, PCBs, pesticides, PAHs, cyanide, total organic carbon, percent moisture, percent solids and percent total volatile solids. In addition, PFCs were analyzed for 6 of the 10 2016 boreholes. Under MPCA's current SQT and SRV levels, the only exceedances detected in the 2015 sampling were for SQTs and only for the borehole closest to the former landfill (15-1M), except for cadmium which exceeded the SQT I in all three boreholes. Under the proposed changes to the SRVs, cadmium levels from boreholes 15-1M and 15-2M and benzo(a)pyrene from 15-1M exceeded the Residential/Recreational limit but were below the Commercial/Industrial SRVs.

The 2016 results showed similar results as the 2015 survey, with a large number of SQT exceedances, but again there were no SRV exceedances under the current MPCA guidance. Similar to the 2015 results, however, several boreholes showed recreational/residential use exceedances for cadmium and benzo(a)pyrene under the proposed MPCA SRV values.

As an outcome of the USACE surveys, it is believed that the highest levels of contamination are limited to the area adjacent to the landfill. The rest of the lake shows contamination of PFCs, widespread low level (SQT I) exceedances for heavy metals and PAHs, limited locations with higher exceedances for cadmium and PAHS (SQT II and proposed Recreational/Residential SRVs) and no recent detection of PCBs. A detailed discussion of the sediment analysis conducted for the project is identified in the Feasibility Study Appendix E section.

Canadian Pacific Railway

The Canadian Pacific Railway, or CP Rail System, is near highway 61 and the east edge of Pigs Eye Lake. The rail yard was built in 1950s, and currently more than 110 trains pass through this area per day.

Metropolitan Wastewater Treatment Plant

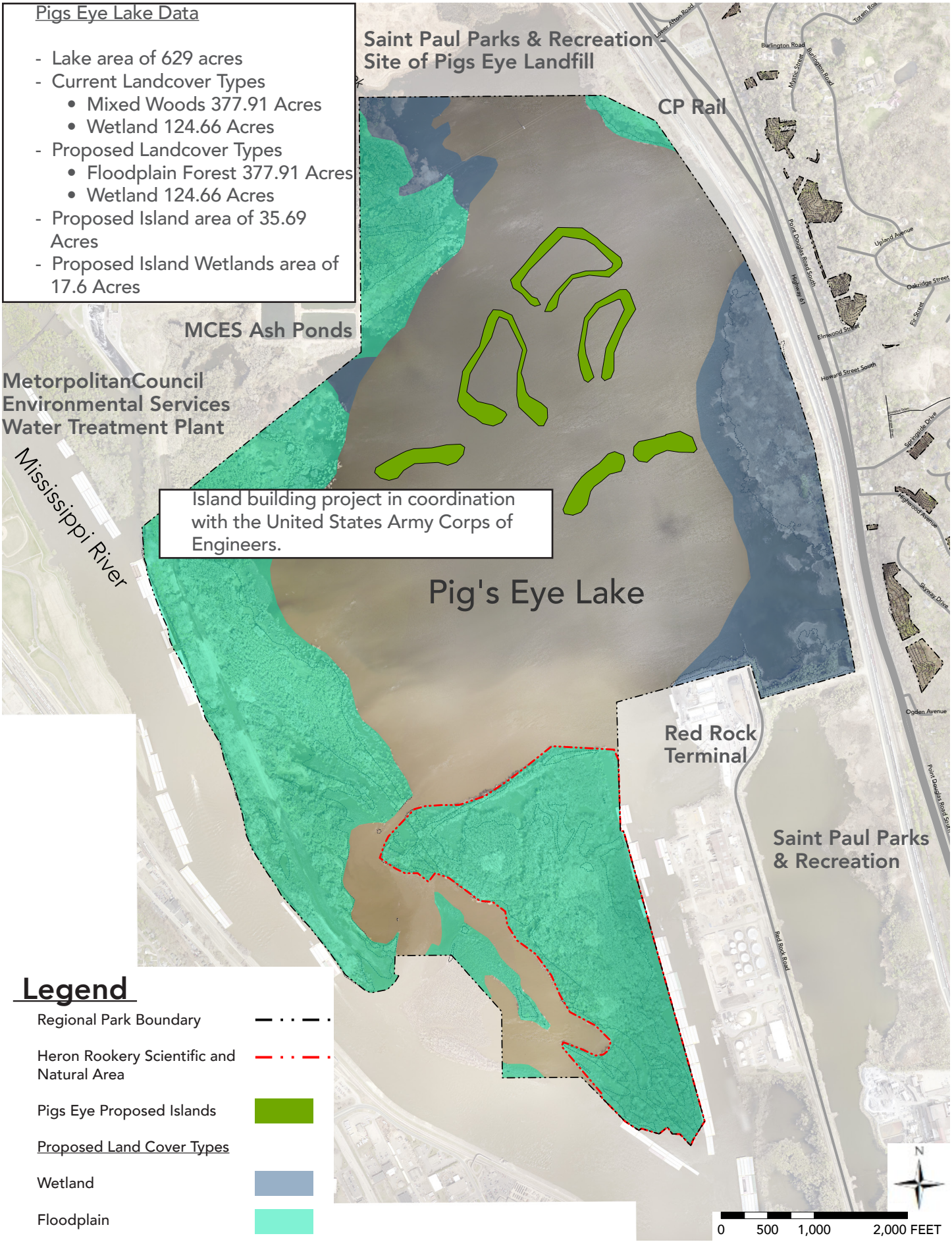
To the west of Pigs Eye Lake is an upland area with a moderate degree of development, including the Metropolitan Wastewater Treatment Plant. Two inactive ash ponds are located on this site.

Saint Paul Port Authorities

Red Rock Terminal is located on the south end of Pigs Eye Lake which encompasses a variety of industrial business for land and barge access.

MASTER PLANNING CONSIDERATIONS

The following information responds to 6 of the 11-master plan requirements identified in the 2040 Regional Parks Policy Plan with a focus on the Pigs Eye Lake Island building project, and other natural resource activities.


Pigs Eye Lake Data
- Lake area of 629 acres
- Current Landcover Types
  - Mixed Woods 377.91 Acres
  - Wetland 124.66 Acres
- Proposed Landcover Types
  - Floodplain Forest 377.91 Acres
  - Wetland 124.66 Acres
- Proposed Island area of 35.69 Acres
- Proposed Island Wetlands area of 17.6 Acres
Saint Paul Parks & Recreation - Site of Pigs Eye Landfill
CP Rail
MCES Ash Ponds
MetorpolitanCouncil Environmental Services Water Treatment Plant
Mississippi River
Island building project in coordination with the United States Army Corps of Engineers.
Pig's Eye Lake
Red Rock Terminal
Saint Paul Parks & Recreation
Legend
Regional Park Boundary
Heron Rookery Scientific and Natural Area
Pigs Eye Proposed Islands
Proposed Land Cover Types
Wetland
Floodplain
N
0 500 1,000 2,000 FEET

ACQUISITION COSTS

No Acquisition is proposed in this focused master plan amendment. Potential future access easements may be required by other governmental agency partners related to long-term natural resource improvements for the Pigs Eye islands, other natural resource project, and environmental cleanup activities.

STEWARDSHIP PLANS

The natural resources within the Pigs Eye section of the regional park will be restored and managed according to the 2018 system plan. Restoration and maintenance of restored areas will be a priority throughout the Pigs Eye Lake area to carry out the mission of providing adequate sustainable habitats to support populations of native wildlife species. Future restoration projects are listed in the appendix. This list shows the current land cover and proposed land cover changes with associated restoration efforts, ongoing maintenance practices, and costs. Some examples of projects listed include the conversion of mixed woodland to floodplain forest, through mainly removal of invasive species.

The Pigs Eye island building project will provide much needed wildlife habitat within the lake itself, prevent further erosion to the lake shore, compliment the surrounding natural resources, and will directly benefit the entire Pigs Eye Lake ecosystem.

DEVELOPMENT CONCEPT

This focused master plan amendment addresses natural resource improvements to the Ramsey County Pigs Eye section of Battle Creek Regional Park. This master plan request does not address recreational improvements but will address sequencing of natural resource improvements for the Pigs Eye Lake Island building project, other natural resource activities, and public protection for the Ramsey County section of Pigs Eye Lake and surrounding land area. Recreation improvements for the Pigs Eye Lake section will be addressed in conjunction with long-term improvements for the overall Battle Creek Regional Park master plan process.

Sequencing of Natural Resource Improvements

- Pigs Eye Island Lake Project (first step of improvements)
- Other Natural Resource Restoration activities and projects
- Pigs Eye Lake Public Protection (may include as a future amendment)

See page 8 for the Pigs Eye Lake Development Graphic

Pigs Eye Lake Island Building

The development design features include seven islands with sand benches with the objective of improving aquatic habitat, terrestrial habitat, and reduction of shoreline erosion from reducing lake wind fetch and water turbulence. Three of the islands would utilize a "split" design that would establish sheltered areas in the centers of the islands, allowing for the creation of approximately 17.6 acres of protected wetland habitat. The other four islands will be constructed as full islands with the addition of a perpetually submerged berm for improved wind fetch and water turbulence control. The recommended plan was developed to address the following objectives in Pigs Eye Lake:

1. Improve aquatic habitat – Create depth and habitat diversity in Pigs Eye Lake. Increase acreage of aquatic vegetation. Incorporate structural habitat features to promote fisheries.
2. Improve the quantity and quality of habitat for migratory bird species – Create suitable habitat for migratory birds such as dabbling ducks within Pigs Eye Lake.

3. Maintain or enhance the quantity of shoreline habitat – Protect existing floodplain forest and marsh habitat along the shoreline of Pigs Eye Lake from wind and wave erosion.

The total estimated cost for constructing the project is $15.6 million. The ACOE Operation and Maintenance budget would provide $3.2 million toward the project. The remaining $12.4 million would be cost-shared by the Section 204 program ($8.1 million) and the local sponsor, Ramsey County ($4.3 million). In efforts to off-set the local share cost, Ramsey County submitted a Lessard Sams Outdoor Heritage Council (LSOHC) application for the Pigs Eye Lake Island Building project. In September 2018, Ramsey County received preliminary LSOHC grant approval in the amount of $4,377,200 million and in the 2019 Minnesota Legislative session, Ramsey County received final approval.

Other Natural Resource Projects

The Pigs Eye section of Battle Creek is within natural resource management Unit 10 as defined within 2018 Park and Recreation System Plan – Battle Creek Regional Park section (see appendix figure 1.37). Surveys of the Pigs Eye area will need to be completed prior to any restoration work to gather more information about the current state of the area. Inventory info will include wildlife, plant and shoreline surveys and will focus on determining restoration needs for shoreline erosion, invasive plant species removal, and reforestation of floodplain tree species, such as cottonwood. Habitat restoration for upland and flood zone areas includes transition of the mixed forest to floodplain forest, through mainly removal of invasive species with an estimated cost of $380,000.

OPERATIONS

Management of Pig's Eye natural resources will be coordinated by Ramsey County Parks & Recreation department and will include, ongoing protection in coordination with partnering agencies, site inventories, and restoration of the land and lake resources.

Pigs Eye Islands

The Army Corps of Engineers (ACOE) is responsible for determining ecological success for the ecosystem restoration projects it constructs for up to 10 years following project completion. Monitoring tasks and project evaluation reports will be ACOE responsibilities. Close-out of monitoring task would occur when the level of success of the project is determined adequate or when the maximum 10-year monitoring period has been reached. The level of success would be based on the extent to which the project objectives have been or will be met based upon the trends for the site conditions and processes. After the 10-year monitoring period, Ramsey County would assume maintenance and operation activities for the islands.

The ACOE will be providing monitoring for the islands for a period of up to 10 years. Monitoring activities will consist of water quality sampling, bird counts, vegetation surveys, elevation surveys, and GIS analysis of the lake's shoreline. ACOE plans to utilize other federal agencies such as the Nation Park Service if possible, for some monitoring activities such as bird counts.

Active adaptive management actions by the ACOE for the project may include tree, wet prairie, or marsh replanting and herbivory and weed control may be required in the event vegetation establishment fails and replanting is required. Specific adaptive management replanting strategies have not been developed but would be based on the landscape plan and vegetation monitoring activities. In extreme events, adaptive management for vegetation replanting are estimated to be as much as $120,000 dependent on the amount of vegetation failure, however actual vegetation adaptive management costs are likely to be much lower than that.

Other Natural Resource Maintenance and Operation

Management of Pig's Eye natural resources will be coordinated by Ramsey County Parks & Recreation department and will include, ongoing protection in coordination with partnering agencies, site inventories, and restoration of the land and lake resources (see appendix figures 1.1 - 1.47).

Within the parks system plan, habitat restoration of Pig's Eye includes information on the transition of the mixed forest to floodplain forest, through mainly removal of invasive species, with an estimated cost of $380,000 and ongoing maintenance cost of $90,000 every three years.

PUBLIC ENGAGEMENT

Public engagement for this master plan amendment was completed through past planning activities from 2015-2020 for the Pigs Eye section of Battle Creek Regional Park consisting of the Pigs Eye Lake Island feasibility study, 2018 Park and Recreation System Plan, overall Battle Creek Regional Park master plan amendment/update, and online public review for the focused Battle Creek Regional Park - Pigs Eye Lake amendment.

Pigs Eye Lake Island Building Feasibility Study

The Parks department reached out to the Army Corps of Engineers (ACOE) Saint Paul District in October 2012 to identify a need for developing a feasibility study within Pigs Eye Lake. Late 2014, the Parks department was made aware that funding for the study would be made available in 2015. The study was initiated in January 2015 and the Federal Interest Determination was approved by the ACOE Mississippi Valley Division on May 14, 2015. The Feasibility phase began immediately to identify the project scope, objectives, coordination, stakeholders and process for developing the feasibility study with integrated Environmental Assessment.

The feasibility Study was prepared in accordance to local, Minnesota Environmental Protection Agency (MEPA) and the National Environmental Policy Act (NEPA) as part of the Environmental Quality Board Environmental Assessment Worksheet (EQB EAW) Process and was finalized in 2018.

To ensure there was successful project coordination, regular inter-agency coordination and sub work group meetings were established to review and discuss all project components identified within the Feasibility Study. Ramsey County, RWMWD, and the City of Saint Paul Parks department attended regular inter-agency coordination and sub work group meetings to review and discuss all project components. Additional groups such as Tribal groups, Friends of Pool 2, Friends of the Mississippi River and the Friends of Parks and Trails were included within the development of the feasibility study process.

If efforts to comply with local, State EQB-EAW process, and NEPA process there was a concurrent State and Federal public comment period for the Feasibility Study with integrated EAW. 30-day public notices for both the State and Federal review were listed on the EQB website in accordance to requirements for both State and Federal process to ensure the public had an opportunity to review and comment on all material identified within the Feasibility Study with EAW. All comments received from both 30-day public comment periods were reviewed and responses were prepared for development of an EAW Record of Decision.

Public comment involvement regarding the development of the project plan and feasibility study ended as an outcome of the Feasibility Study EAW Record of Decision in April 2018. (see Appendix for the attached Feasibility Study EAW Appendix A; EAW Record of Decision).

2018 Park and Recreation System Plan

Significant public participation was completed to gage additional amenity improvements in addition to future planning considerations. In preparing this System Plan update, Parks & Recreation recognized a need to engage the community. The System Plan community engagement process was conducted using two methods:

- Electronic Online Survey
- Pop-Up Table Meetings

Electronic media such as social media, website, and email blasts were used to inform residents of upcoming engagement opportunities. An online was launched in July 2017 and remained active until February 2, 2018.

Almost 1,000 responses were received. In addition, a series of nine informal or "pop-up" table meetings were conducted at various libraries, community centers, and ice arenas located across the county.

Overall Battle Creek Regional Park Master Plan Amendment/Update

A robust two-phase public participation process was launched to include Pop-up workshops, community meetings and collaborative design sessions to gather community feedback on what is and is not currently working. Phase 1 public engagement started spring 2019 which included an online survey, several pop-up events with the public, multiple stakeholder discussions, (3) community forums, and (1) design work shops. Phase 2 public engagement is planned to be completed in 2020 to gather additional feedback for proposed master plan amendment changes. A similar process for phase 2 engagement will be utilized during phase 1 engagement activities.

- Phase 1 started spring 2019 (online survey, several pop-up events with the public, multiple stakeholder discussions, (3) community forums, and (1) design work shops)
- Phase 2 public engagement is planned to be completed in 2020 for completion of the overall master plan amendment/update in spring 2021.

Battle Creek Regional Park Master – Pigs Eye section focused master plan amendment

If efforts to provide additional public engagement for the Battle Creek Regional Park - Pigs Eye focused master plan amendment, a 45-day online public review was provided for comment and feedback. (Additional summary information will be provided after the 45-day public review is completed)

NATURAL RESOURCES

The Pig's Eye section of Battle Creek Regional Park consists of a 629-acre lake, which is a back water of the Mississippi river, surrounded by 378 acres of land to the west and 125 acres of wetlands to the east and northwest of the lake, which is in the floodplain. Pig's eye lake water levels fluctuate with the river and the land within the park boundary is often inundated by water for varying lengths of time. The Pig's Eye section is within the Mississippi River Corridor Critical Area (MRCCA), which shares the boundary with the Mississippi National River and Recreation Area. This section of park is subject to MRCCA regulations (State statute under Minnesota Rule 6106) which is in place to protect the unique natural and cultural resources and values within this corridor. The Pig's Eye section of Battle Creek Regional Park also contains one of the largest heron rookeries in the State of Minnesota and is designated as a State Scientific and Natural Area by the Minnesota Department of Natural Resources. The Pig's Eye section is included in the "National Great River Park" and is also defined as an Environmental Natural Area, within the Ramsey County Parks & Recreation department system plan, which warrants additional protection and preservation.

The majority of Pig's Eye area land cover consists of mixed woods located on a peninsula of land that separates the lake from the main channel of the Mississippi River. This peninsula of land is historically a floodplain forest, but is presently defined as a mixed woods, within the Ramsey County Parks & Recreation department system plan, due to a number of invasive and tree species that have encroached into the area, such as buckthorn and boxelder, however, the woods consists of typical floodplain trees such as cottonwood, silver maple, green ash, willows, American elm, and some swamp white oak. The constant flooding of the area creates an open understory with few shrubs or saplings. Ground cover can consist of forest pools, mucky depressions, bare silt or sand, and dense patches of wood nettle (Laportea canadensis) or impatiens (Impatiens capensis or I. pallida), which can all constantly shift due to movement of water. The wetlands within the park consist of native vegetation, such as prairie cord grass, and various rushes and sedges. Invasive cattails and reed canary grass also dominate a lot of the wetland edges.

The wildlife diversity of the park is very high and includes a variety of nesting songbirds, waterfowl, raptors, and wild turkeys. Larger mammals include white-tailed deer, coyotes, red fox, raccoons, and river otters. The Pig's Eye section of the park is especially unique and contains the heron rookery, nesting area for bald eagles,

and habitat for countless amphibian, reptiles, migratory waterfowl, and shorebirds. Fish species within the lake consist of common native river fish, such as, black bullheads, crappie, bluegill, catfish, sunfish, freshwater drum. Invasive fauna species within the lake include zebra mussels and carp.

Management of Pig's Eye natural resources will be coordinated by Ramsey County Parks & Recreation department and will include, ongoing protection in coordination with partnering agencies, site inventories, and restoration of the land and lake resources (see appendix figures 1.1 - 1.47). The park will remain a natural area to benefit wildlife foremost and being in the floodplain/Mississippi river corridor, the land is protected by and subject to MRCCA, Parks department, Federal, State and watershed district regulations for any development. Natural phenomena, such as hydric soils, areas prone to flooding, water features, and wetlands, make up the majority of the park and will dictate which recreational amenities should be planned for the area. The south portion of the peninsula will remain a scientific natural area for the protection of the heron rookery. Wetlands will remain protected under the State and Federal wetland conservation act.

Surveys of the Pigs Eye area will need to be completed prior to any restoration work to gather more information about the current state of the area. Inventory info will include wildlife, plant and shoreline surveys and will focus on determining restoration needs for shoreline erosion, invasive plant species removal, and reforestation of floodplain tree species, such as cottonwood. Past natural resource management within the park has included controlled deer hunts, wildlife surveys and planting of native vegetation in conjunction with a sanitary sewer pipe project on the west side of the park.

The Pigs Eye island building project will provide much needed wildlife habitat within the lake itself, prevent further erosion to the lake shore, compliment the surrounding natural resources, and will directly benefit the entire Pigs Eye Lake ecosystem. These restoration efforts are essential to restoring aquatic habitat within Pigs Eye lake and for providing greater diversity of other vegetation and wildlife habitats.

Appendix

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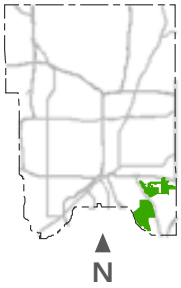
2018

BATTLE CREEK REGIONAL PARK



EXISTING SITE CONDITIONS

MASTER PLAN DATE: 1981
LOCATION AND SIZE

Battle Creek Regional Park is located in the southeast corner of Ramsey County in the cities of Saint Paul and Maplewood. The park is comprised of four segments: Indian Mounds (97 acres) ; Fish Hatchery (105 acres); Pigs Eye (610 acres); and Battle Creek (846 acres). In accordance with the 1981 joint master plan, the city of Saint Paul owns and operates the Indian Mounds and Fish Hatchery segments of the park. Ramsey County owns and operates the Battle Creek and Pigs Eye segments, consisting of 1,456 acres.

SITE CHARACTERISTICS

The park derives its name from Battle Creek, which flows from east to west through the length of the park on its way to the Mississippi River. Although the creek has been degraded and altered to accommodate extraordinary storm water run-off from surrounding development, it remains a positive asset to the park. Improvements to the creek and upstream watershed area by the Ramsey-Washington Metro Watershed District have corrected erosion problems and restored the creek within the park.

The most prominent visual characteristic of the park are the steep wooded slopes paralleling the Mississippi River and Battle Creek. The park includes approximately two miles of bluff land along the east side of the Mississippi River Corridor. Battle Creek flows through a steep wooded valley, which varies in depth from 25 feet to over 150 feet. The bluffs are significant in the development of the park as they provide a corridor and barriers, as well as panoramic views of the river valley. The entire Pigs Eye Lake segment of the park lies within the floodplain of the Mississippi River. The lake is approximately 500 acres in size and very shallow (less than 10 feet). The segment includes 610 acres surrounding the lake, which is entirely floodplain. The Pigs Eye Lake segment includes a 40-acre former landfill area at the north end of Pigs Eye Lake, which is an environmental concern that has been addressed by the city of Saint Paul and the Minnesota Pollution Control Agency. Pigs Eye Lake is also a scientific and natural area for a Heron Rookery. Ramsey County and the Army Corps Of Engineers have collaborated for potential island building within Pigs Eye Lake and have developed a feasibility study for the development of islands within the lake. Most of the remaining areas of the park consist of oak woods, prairie, and scattered ponds. At the lower end of Battle Creek, sandstone bluffs are exposed on both sides of the valley.

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

RECREATION DEVELOPMENT

Picnic Area/Family Aquatic Center

The 80-acre site, located in the northeast quadrant of McKnight Road and Upper Afton Road, is the primary recreation area within the park. The area includes a large group picnic pavilion, medium-sized picnic shelter, general picnic area, 275-car parking lot, destination play area, open game field, and a 1.2-mile bituminous biking/hiking trail. Battle Creek Waterworks, a family aquatics center, is located in the area and includes an interactive water play area, leisure pool, water slide, and sand play area. In addition to picnicking and water park activity, the area is used as a venue for special events and cross-country running meets.

Eastern Trails Area

The area of the park southeast of McKnight Road and Upper Afton Road includes 2.5 miles of bituminous multi-use trails, and an additional 3 miles of unpaved hiking and cross-country ski trails. The bituminous trail corridors are also groomed for cross-country skiing, providing approximately 5 miles of cross-country ski trails in this area. The trails are connected to the trail system located in the picnic area to the north. A 110-car parking lot is located south of Upper Afton Road to serve this area, as well as provide overflow parking for the picnic area/family aquatics center. An additional 30-car parking lot is located on Lower Afton Road. A 35-acre fully fenced in off-leash dog area is located in the southwest portion of this area. Trail access to the off-leash dog area is provided from both parking lots.

Battle Creek Corridor

The park encompasses land on both sides of Battle Creek between McKnight Road and State Highway 61. A 1.7-mile bituminous multi-use trail follows the creek throughout the area. A 36-car parking lot, located at the lower end of Battle Creek near State Highway 61, provides parking for trail users, as well as a small general picnic area located at the lower reaches of the corridor. An underpass of State Highway 61 provides trail access to the Fish Hatchery Lake and Indian Mounds Park areas and Sam Morgan Regional Trail.

Lower Afton Trail

A 12ft wide multi-use trail exists along Lower Afton Road from Century Avenue to Point Douglas Road. The eastern section of this trail is located on county-owned land (Community Corrections department) outside the boundary of Battle Creek Regional Park. At the intersection of Point Douglas Road, the trail extends north and south on the existing road shoulder. This trail serves to connect Battle Creek from the Western portion of the park all the way to the east, as well as connecting it to other pedestrian and bike facilities along Century Ave.

Battle Creek West/Winthrop Street Areas

These areas of the park have been developed principally for trail use. The area includes 4 miles of mountain biking trail, 4 miles of cross-country ski trail (including 2.4 miles of lighted ski trail), and 4 miles of hiking trail. The area includes a lighted sledding hill. The primary access to the site is provided from a 180-car parking lot located off Winthrop Street. The parking lot and adjacent recreation center were developed by the city of Saint Paul under a joint powers agreement. Pursuant to this agreement, the parking lot is available for all trail users and the recreation center serves as a visitors' center for trail and sledding area users. Ramsey County has priority rights to use the recreation center for interpretive programming.

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

MAINTENANCE

- Plow selected internal trails and parking lots.
- Groom cross country ski trails at Battle Creek East and West locations.
- Plow parking lots and maintain access to the Battle Creek off leash dog area.
- Battle Creek OLDA is heavily used and the turf areas are worn and difficult to reestablish. There are significant wetlands located inside the dog park and the shoreline is being degraded by overuse.
- There is an off-road cycling trail system that will occasionally need to be cleared of downed trees, grass and brush need to be cut back.
- Waterworks Water Park takes additional maintenance personnel to maintain and operate
- Due to many isolated areas in the park there are homeless camps that need to be removed frequently.
- The park is frequently used for cross country running and skiing meets which requires up keep of the turf trails.
- The pavilion is heavily used and requires cleaning and preparation daily.

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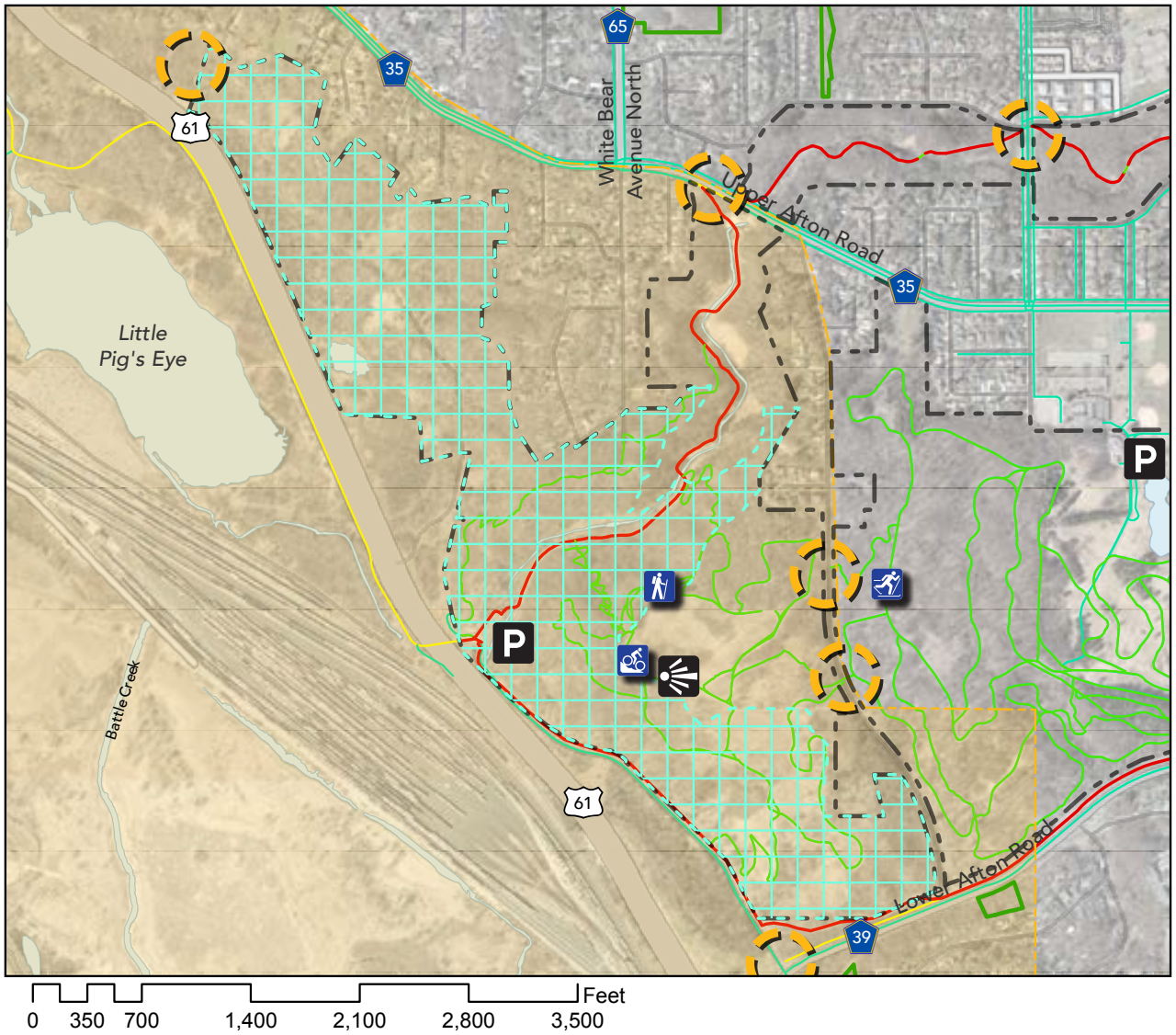
BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK CORRIDOR



Legend

- Park Border
- Park Entrance
- Metro Tranist Stop
- Mississippi River Corridor Critical Area
- Environmental Natural Area
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Scenic Viewpoint
- Mountain Biking
- Hiking
- XC Ski
- Parking Lot

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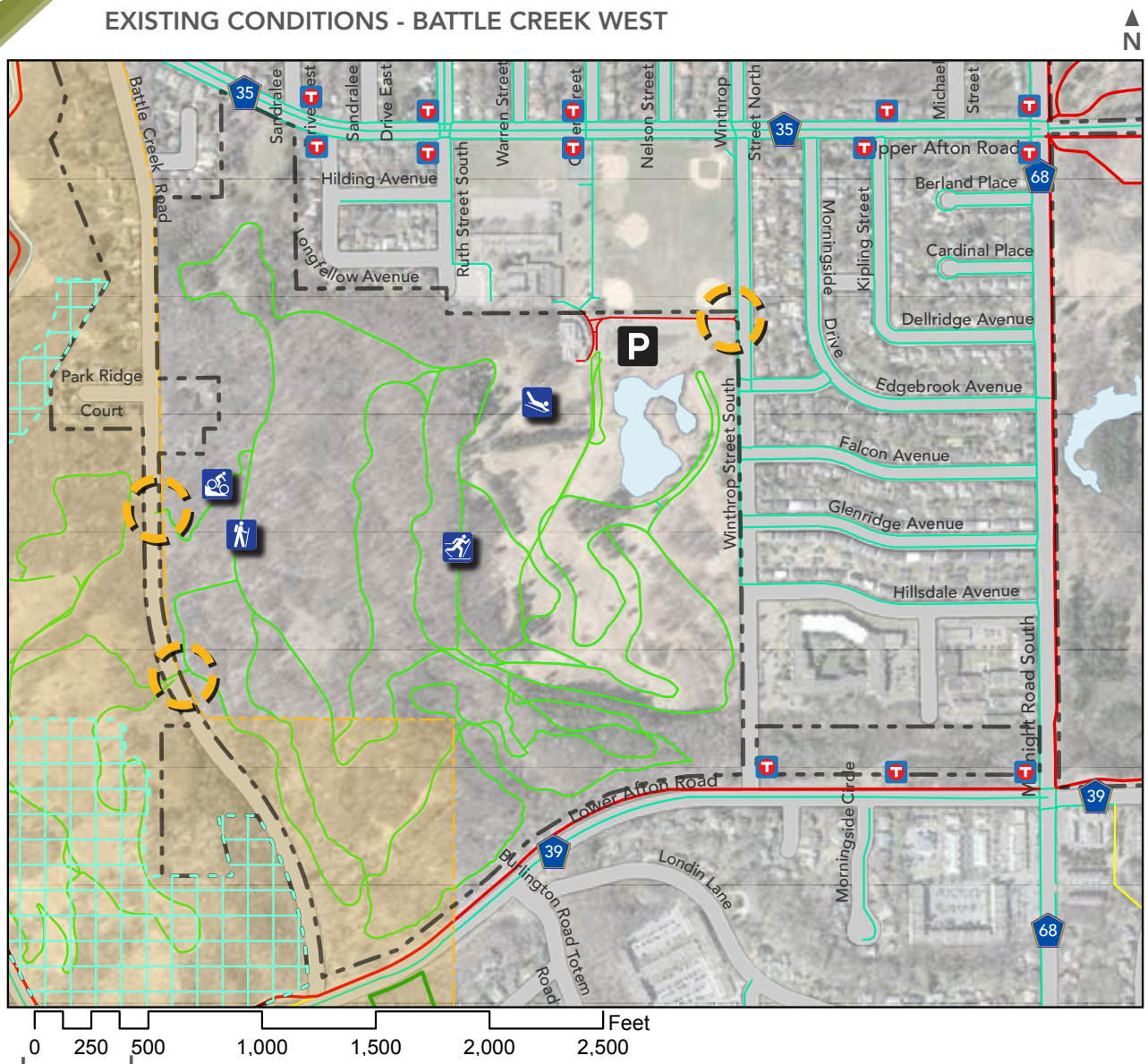
BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK WEST



Legend

- Park Border
- Park Entrance
- Metro Tranist Stop
- Mississippi River Corridor Critical Area
- Environmental Natural Area
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Sledding Hill
- Mountain Biking
- Hiking
- XC Ski
- Parking Lot

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK CONNECTION

Legend

- Park Border
- Park Entrance
- Metro Tranist Stop
- Regional Trail
- Environmental Natural Area
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Mountain Biking
- Hiking
- Mississippi River Corridor Critical Area

Appendix : Battle Creek Regional Park System Plan Section

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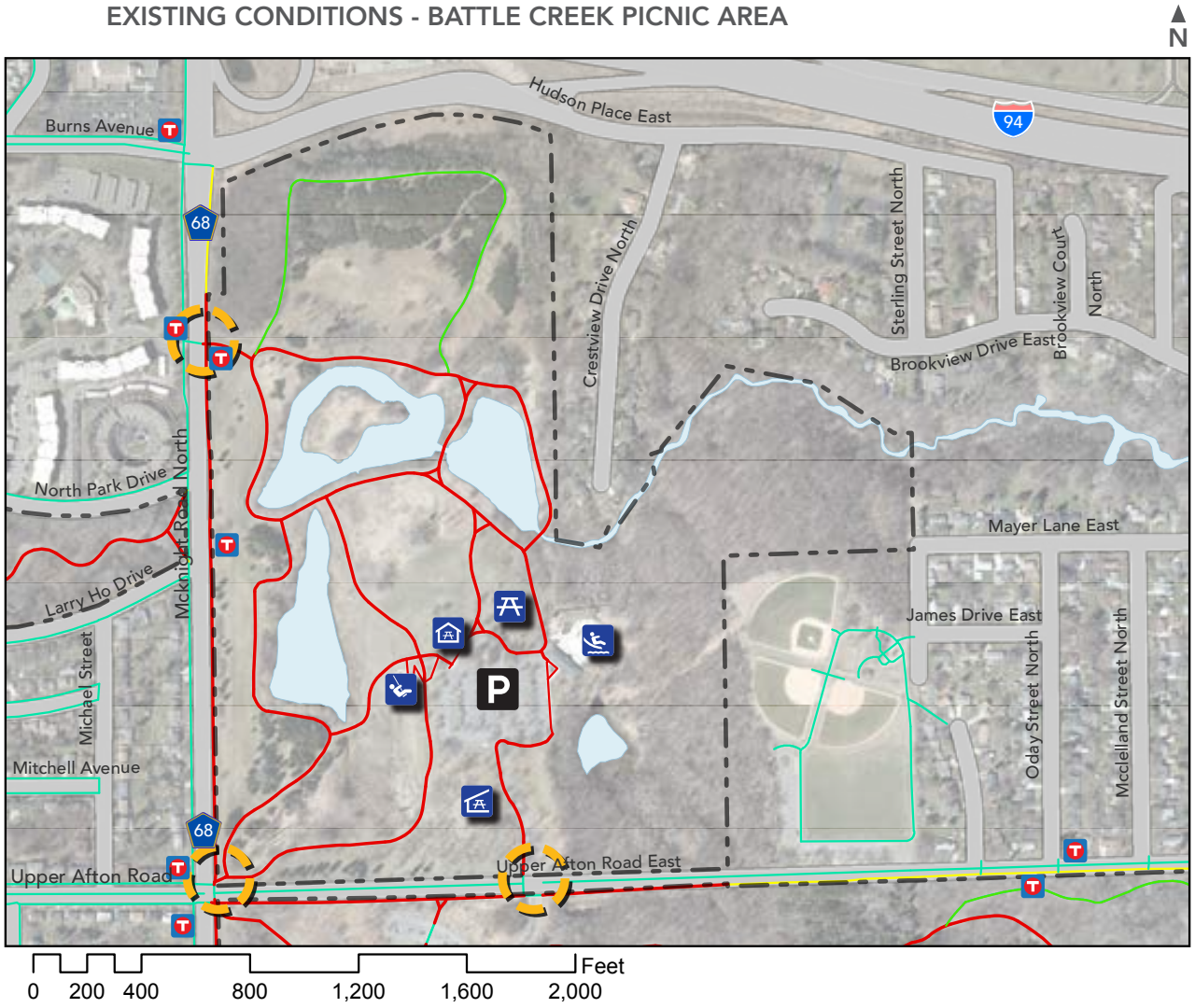
BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK PICNIC AREA



Legend

- Park Border
- Park Entrance
- Metro Tranist Stop
- Regional Trail
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Picnic Shelter
- Water Park
- Picnic Area
- Pavilion
- Playground
- Parking Lot

Appendix : Battle Creek Regional Park System Plan Section

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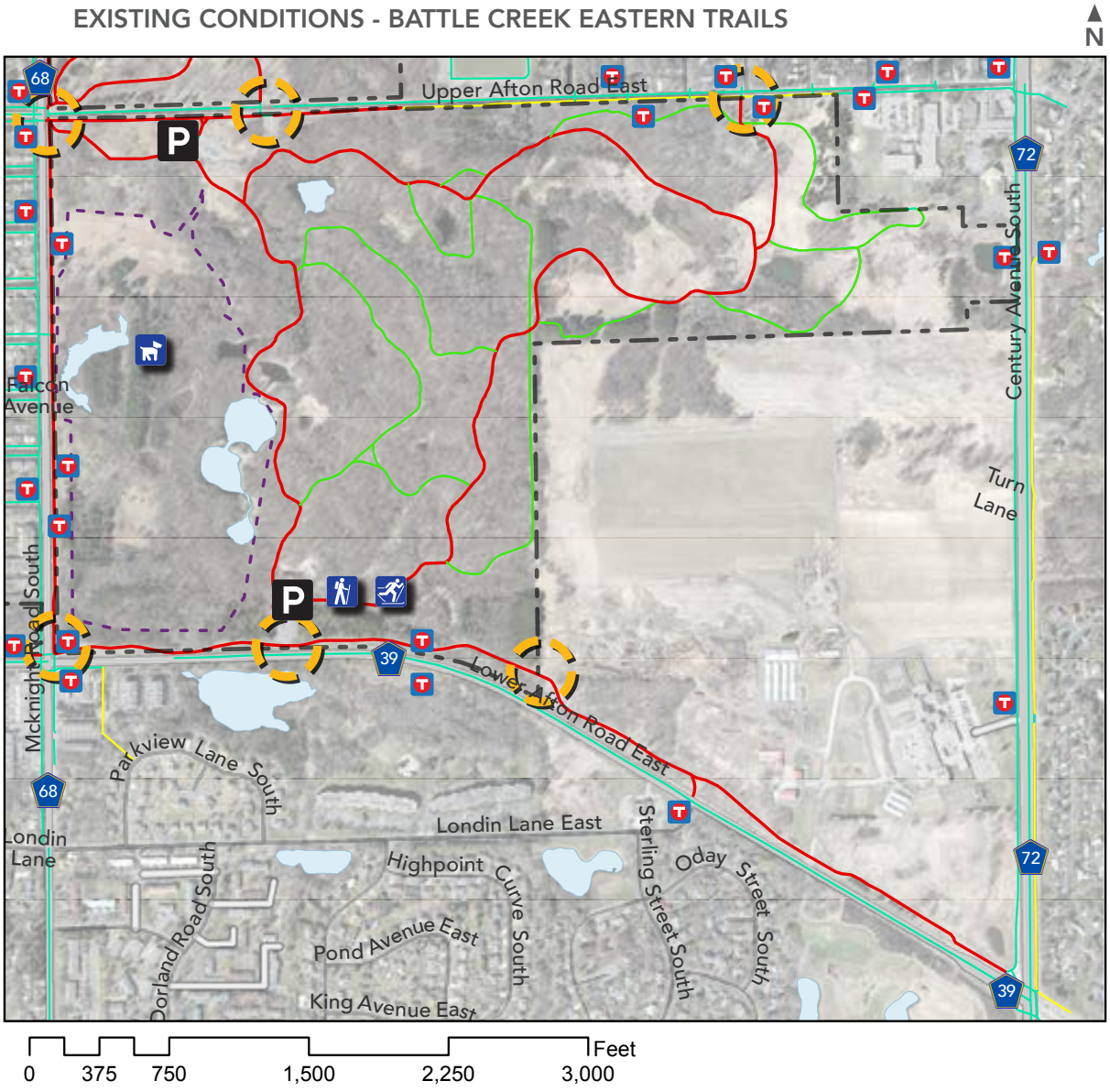
BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK EASTERN TRAILS



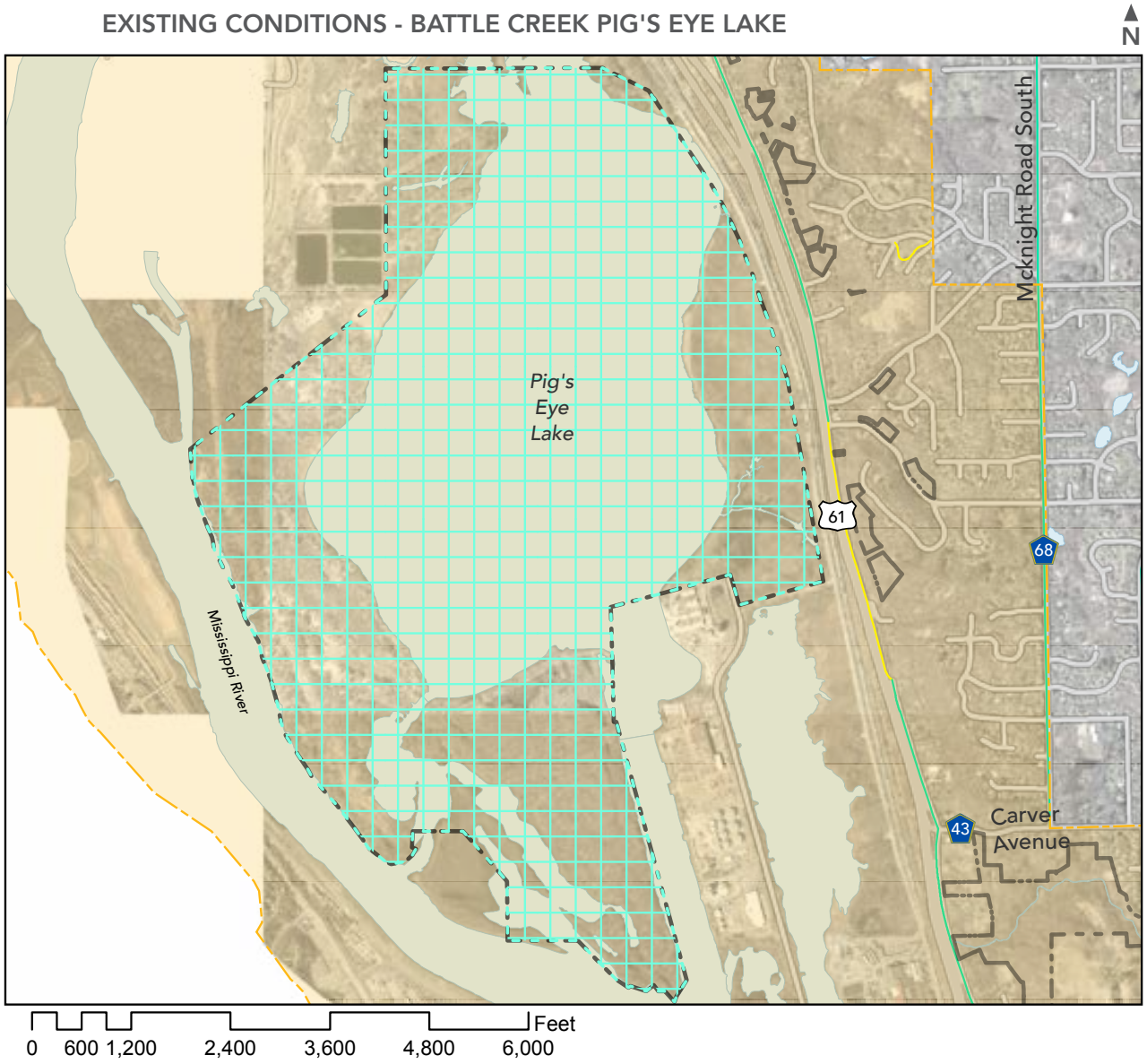
Legend

Park Border	Park Paved Trail	OLDA
Park Entrance	Park Turf Trail	XC Ski
Metro Tranist Stop	Municipal Trail	Hiking
Regional Trail	Municipal Ped/Bike Facility	Parking Lot

2018

BATTLE CREEK REGIONAL PARK

EXISTING CONDITIONS - BATTLE CREEK PIG'S EYE LAKE



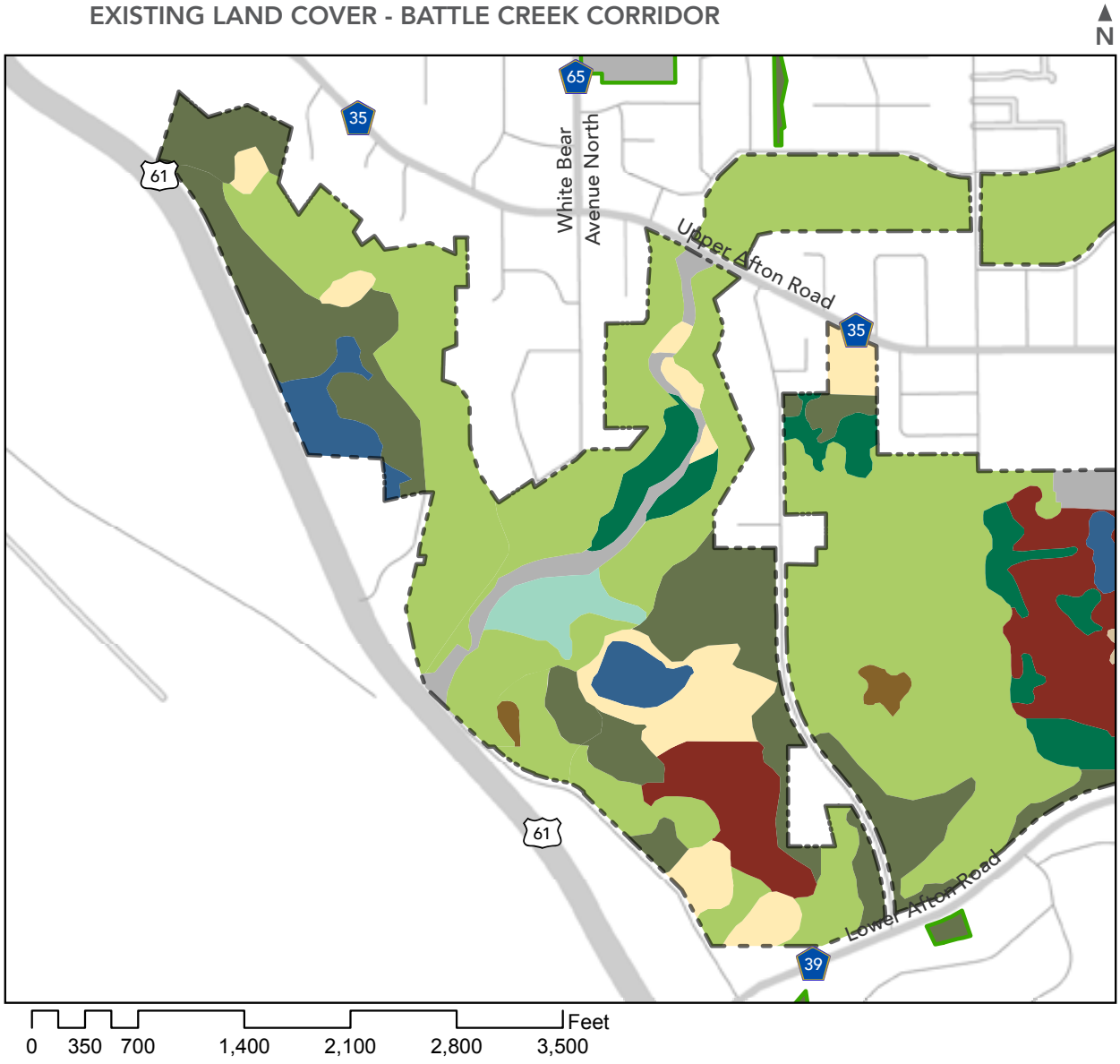
Legend

- Park Border
- Park Entrance
- Metro Tranist Stop
- Regional Trail
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Mississippi River Corridor Critical Area
- Environmental Natural Area

2018

BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK CORRIDOR



Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK WEST

Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK CONNECTION

Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

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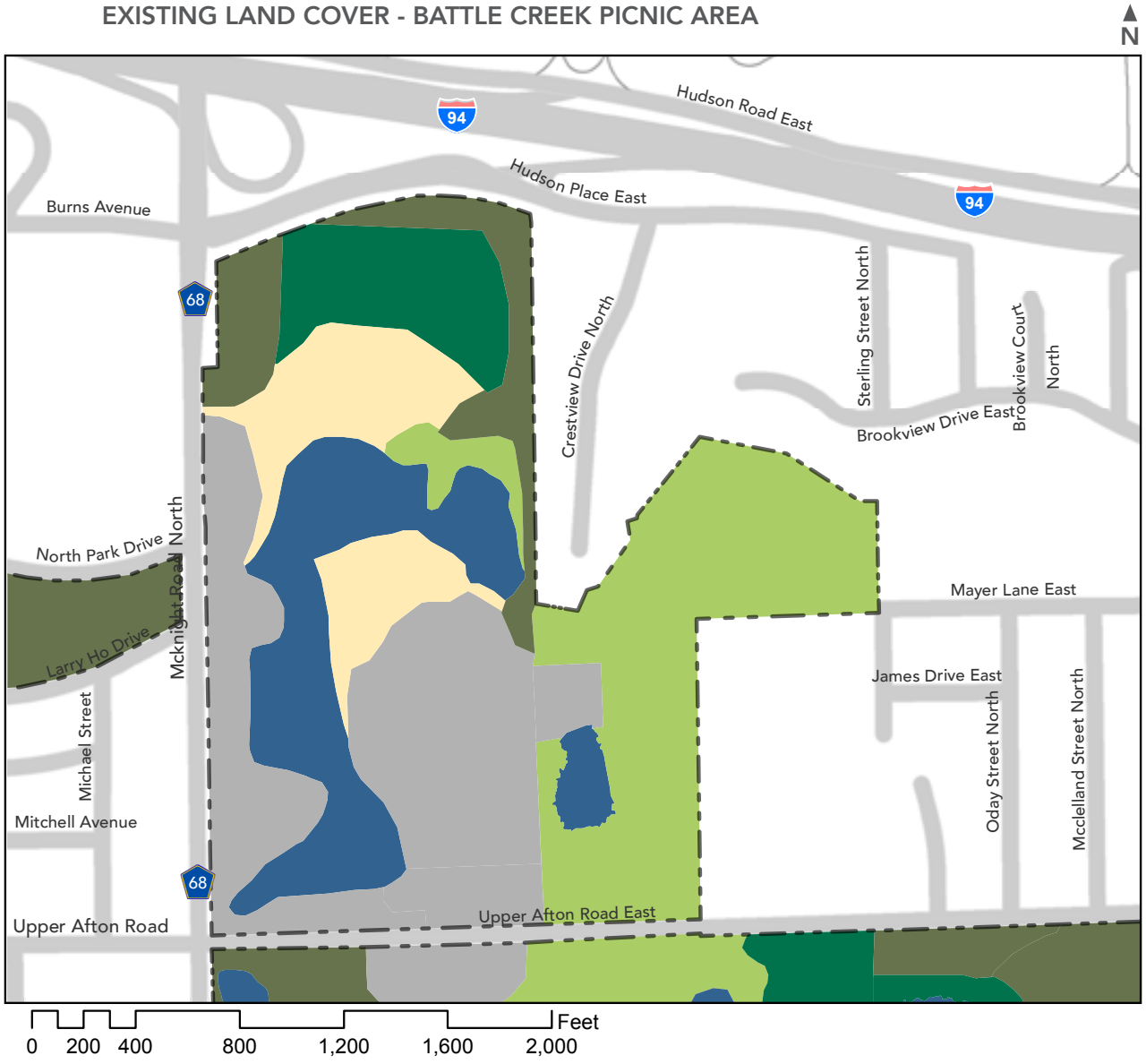
BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK PICNIC AREA



Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section

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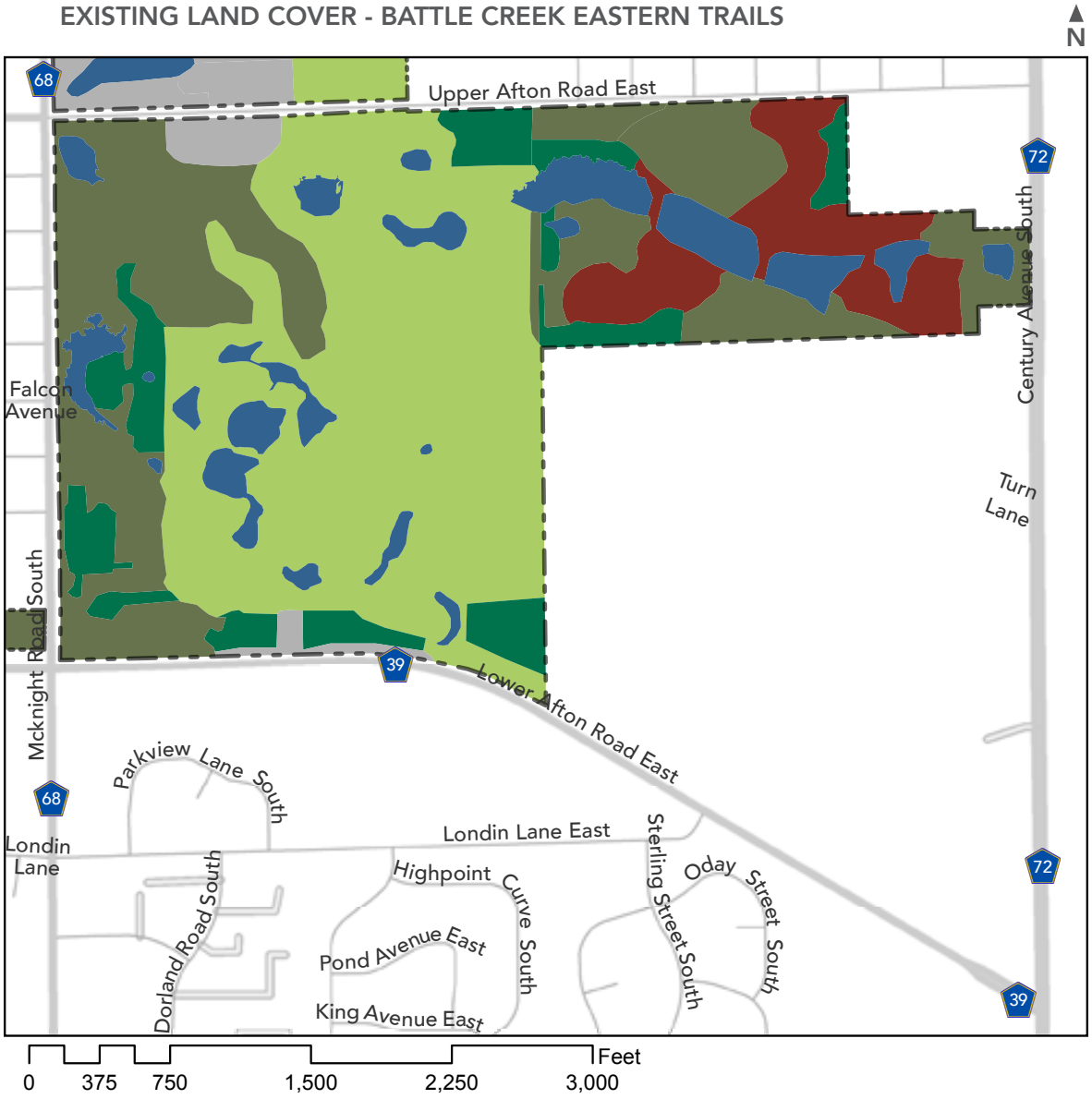
BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK EASTERN TRAILS



Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section

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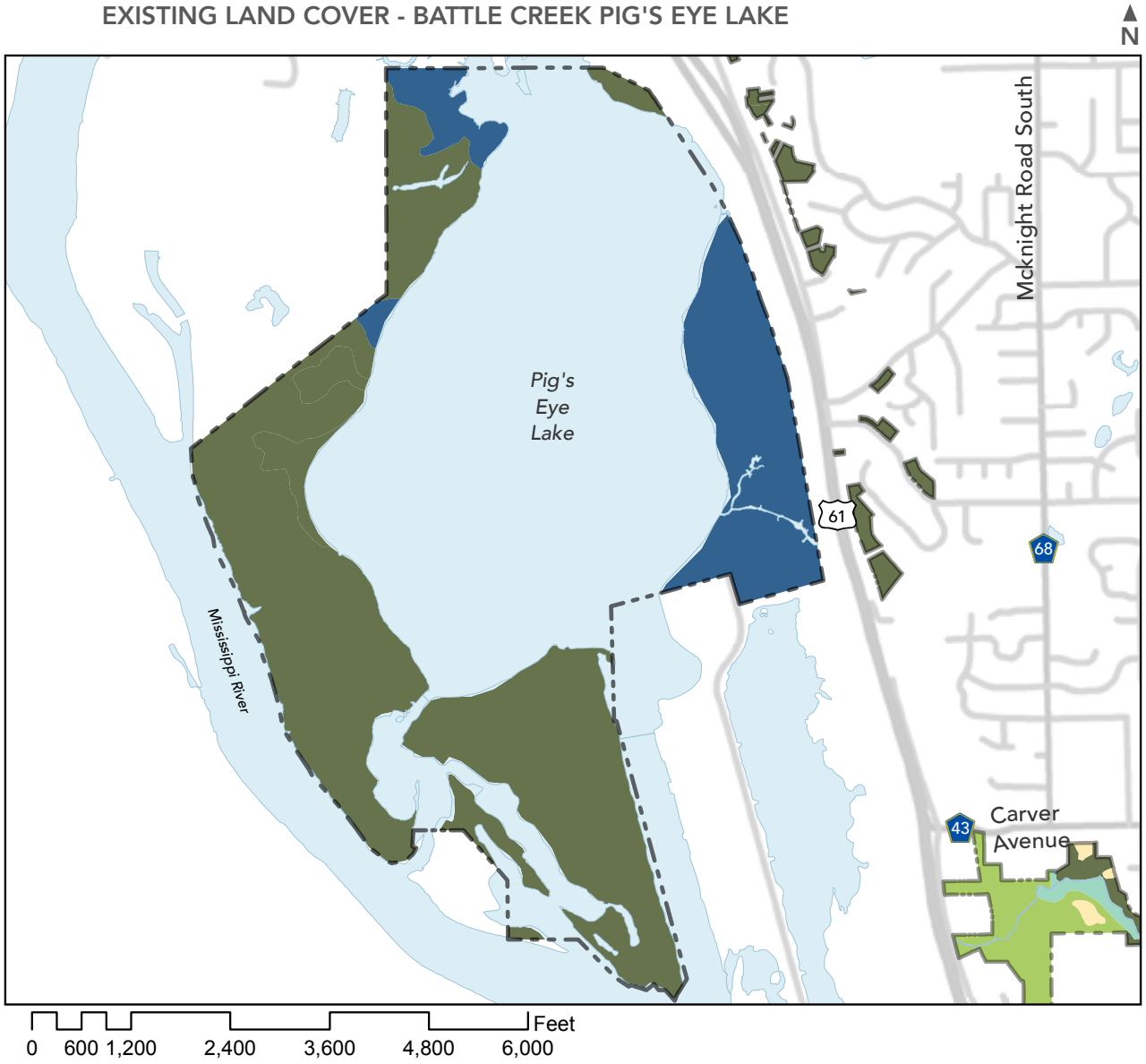
BATTLE CREEK REGIONAL PARK

EXISTING LAND COVER - BATTLE CREEK PIG'S EYE LAKE



Existing Land Cover

Active Use	Floodplain Forest	Oak Woods	Remnant Prairie
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

LAND COVER AND HABITAT

Battle Creek Regional Park is the ninth largest regional park in the twin cities metro area and contains the largest tract of undeveloped natural parkland within the twin cities I-694-494 ring, making it the closest and largest natural park to the cities of Saint Paul and Minneapolis. The western portion of Battle Creek Regional Park, including the entire Pig's Eye section, is within the Mississippi River Corridor Critical Area (MRCCA), which shares the boundary with the Mississippi National River and Recreation Area. This section of park is subject to MRCCA regulations (State statute under Minnesota Rule 6106) which is in place to protect the unique natural and cultural resources and values within this corridor. The Pig's Eye section of Battle Creek Regional Park also contains one of the largest heron rookeries in the State of Minnesota and is designated as a State Scientific and Natural Area by the Minnesota Department of Natural Resources. Battle Creek Regional Park provides wildlife habitat and urban users a "natural" experience in a major urban environment and all preservation of natural, undeveloped parkland should take priority over any future park development.

The native vegetation of Battle Creek Regional Park was a mixture of prairies, oak savanna, oak woods, and wetlands. Current habitat and land cover includes native habitat, including established prairies, some of the highest quality oak, floodplain, and mesic woods in the area, plus old field, cultivated conifers, and mixed woods. There are also several smaller unique remnant habitats, including wetland seep swamps with skunk cabbage and marsh marigolds, mesic hardwoods with yellow birch and white pine, and native bluff land prairies and savannas, which include a variety of rare plants, particularly the state listed Kittentails (Besseya bulli). Invasive species have become widespread in most habitats. The most troublesome species include buckthorn, black locust, garlic mustard, and purple loosestrife. More recent invasive species include Japanese knotweed, Japanese hedge parsley, and narrowleaf bittercress.

WILDLIFE

The wildlife diversity of the park is very high and includes a variety of nesting songbirds, waterfowl, raptors, and wild turkeys. Larger mammals include white-tailed deer, coyotes, red fox, and raccoons. The Pig's Eye section of the park is especially unique and contains a heron rookery, nesting area for bald eagles, and habitat for countless amphibian, reptiles, migratory waterfowl, and shorebirds

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

WILDLIFE MANAGEMENT

Deer populations in the area are surveyed annually to determine the need and location for deer management. Deer management has been occurring in the park since 2000, through special archery hunts under the Ramsey County Cooperative Deer Management Plan in partnership with the cities of Saint Paul and Maplewood. Nest boxes are provided for wood ducks and eastern bluebirds.

SURFACE WATER RESOURCES

The surface waters in Battle Creek Regional Park include numerous wetland complexes, most of Pig's Eye Lake, and Battle Creek. Battle Creek is a perennial, urban stream that originates at the outlet from Battle Creek Lake and flows west, mostly through Battle Creek Regional Park, and discharging into Pig's Eye Lake and the Mississippi River. Ramsey-Washington Metro Watershed District (RWMWD), in cooperation with the Metropolitan Council, monitors the flow and water quality of Battle Creek. Historically, Battle Creek frequently flooded and in the early 1980s the Ramsey-Washington Metro Watershed District implemented an erosion and flood control project to capture flash flood overflows. This project included the installation of storm sewer piping under the above ground stream located in the lower section of the creek corridor within the park. In addition, storm ponds and an overflow structure were created for flood control within the creek corridor located in the park, north of Upper Afton road. Pigs' Eye Lake is an open water shallow lake with a sediment laden bottom. The lake is prime habitat for waterfowl, shoreline birds, raptors, amphibians, and reptiles. The lake has the longest section of natural shoreline in the park system, which warrants additional preservation.

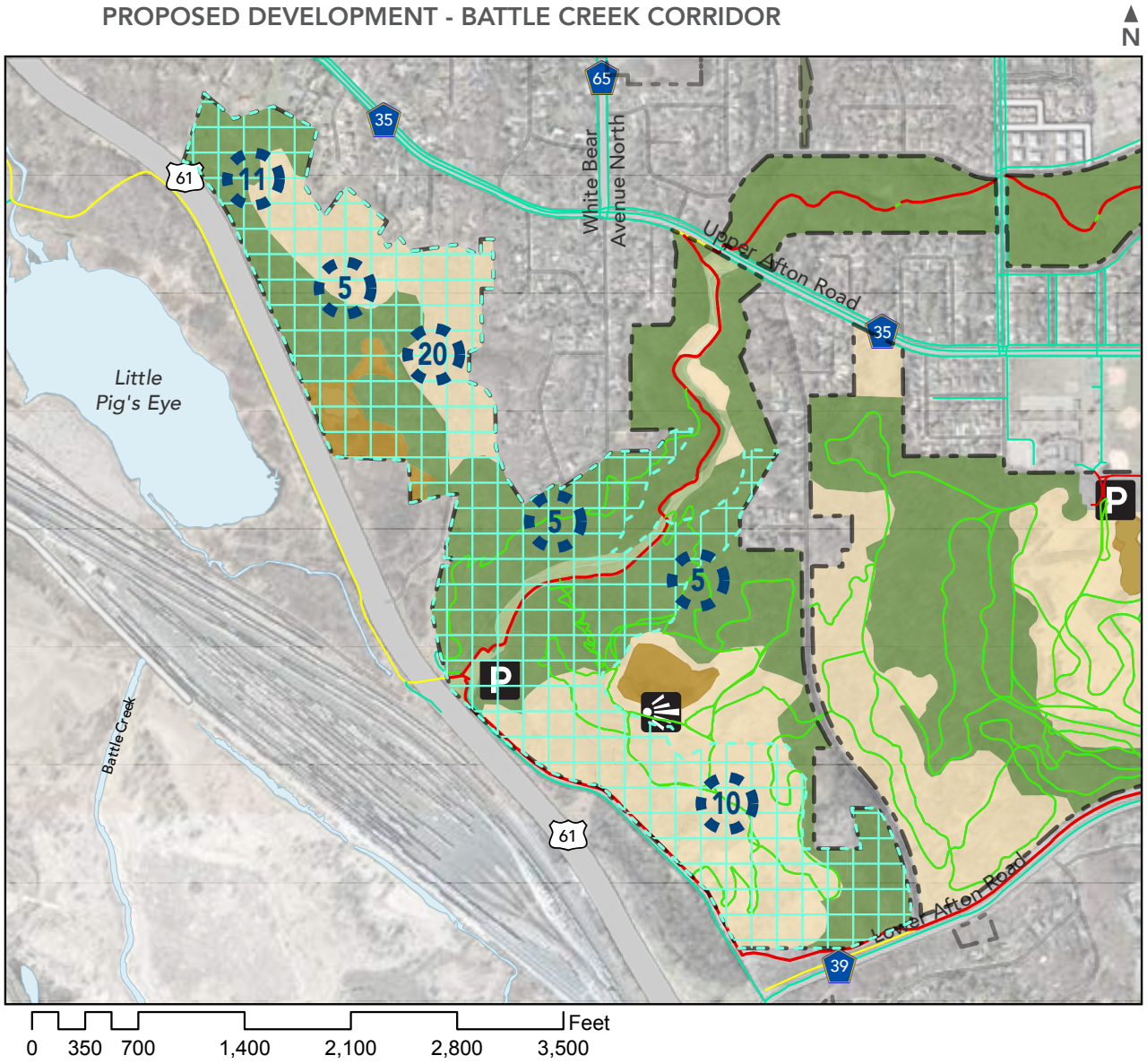
ENVIRONMENTAL NATURAL AREAS

Battle Creek Regional Park's designated Environmental Natural Areas (ENA) include the entire Pig's Eye Lake section and the bluff area along the western portion of the main park, south of Upper Afton Road and west of Battle Creek Road. The Pig's Eye lake ENA consists of extensive flood plain forest and a peninsula that contains a large heron colony and important eagle nesting and roosting habitat. The heron rookery is designated as a State Scientific and Natural Area by the Minnesota Department of Natural Resources. The bluff lands are a unique ecosystem that contain remnants of bluff prairies and savannas which include a variety of rare plants, including the State listed Kittentails (Besseya bulli).

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK CORRIDOR



Legend

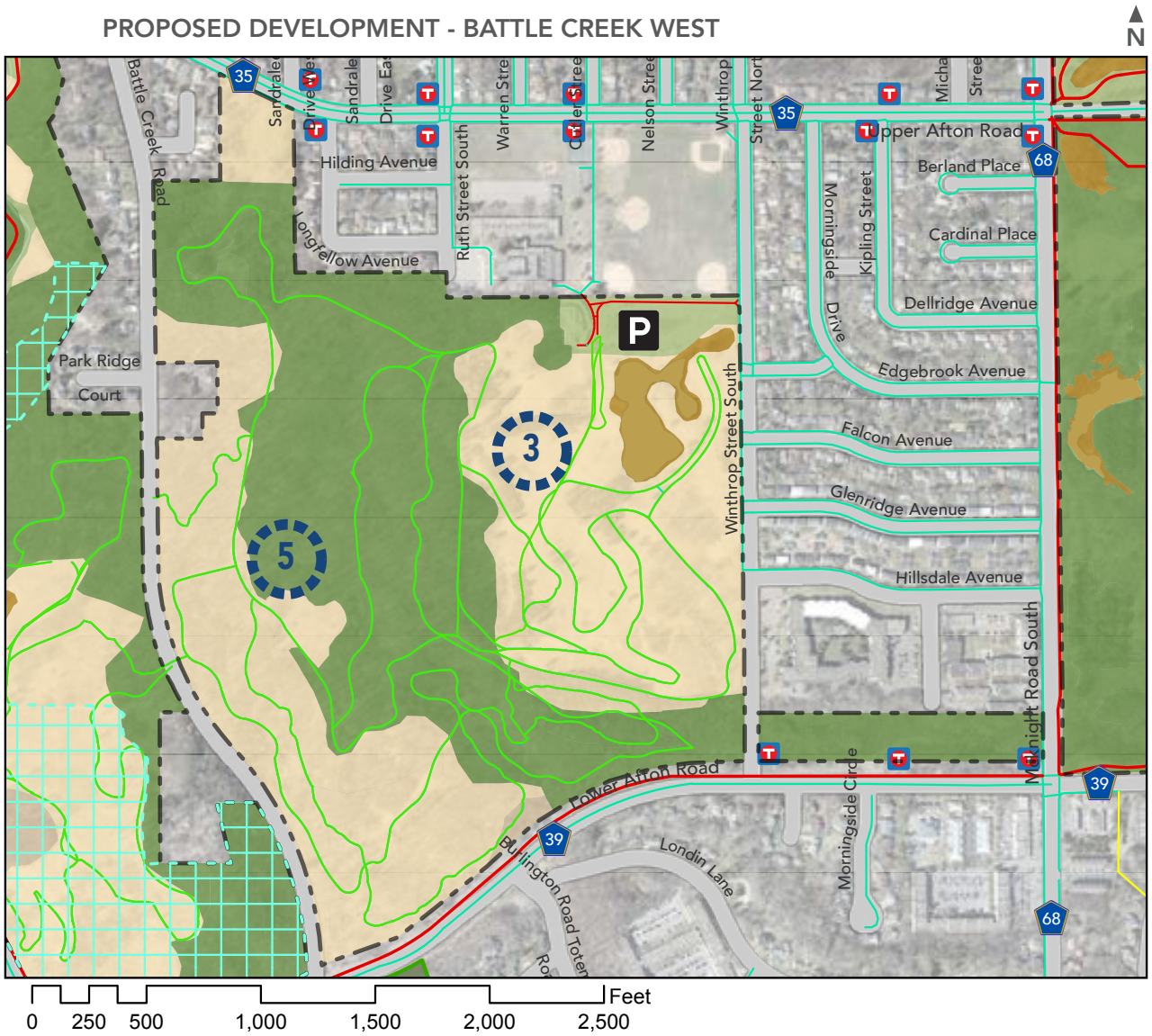
- Park Border
- Proposed Development (3)
- Proposed Development Node (1)
- Metro Tranist Stop
- Parking Lot
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Proposed Regional Trail
- Environmental Natural Area
- Significant Views

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK WEST



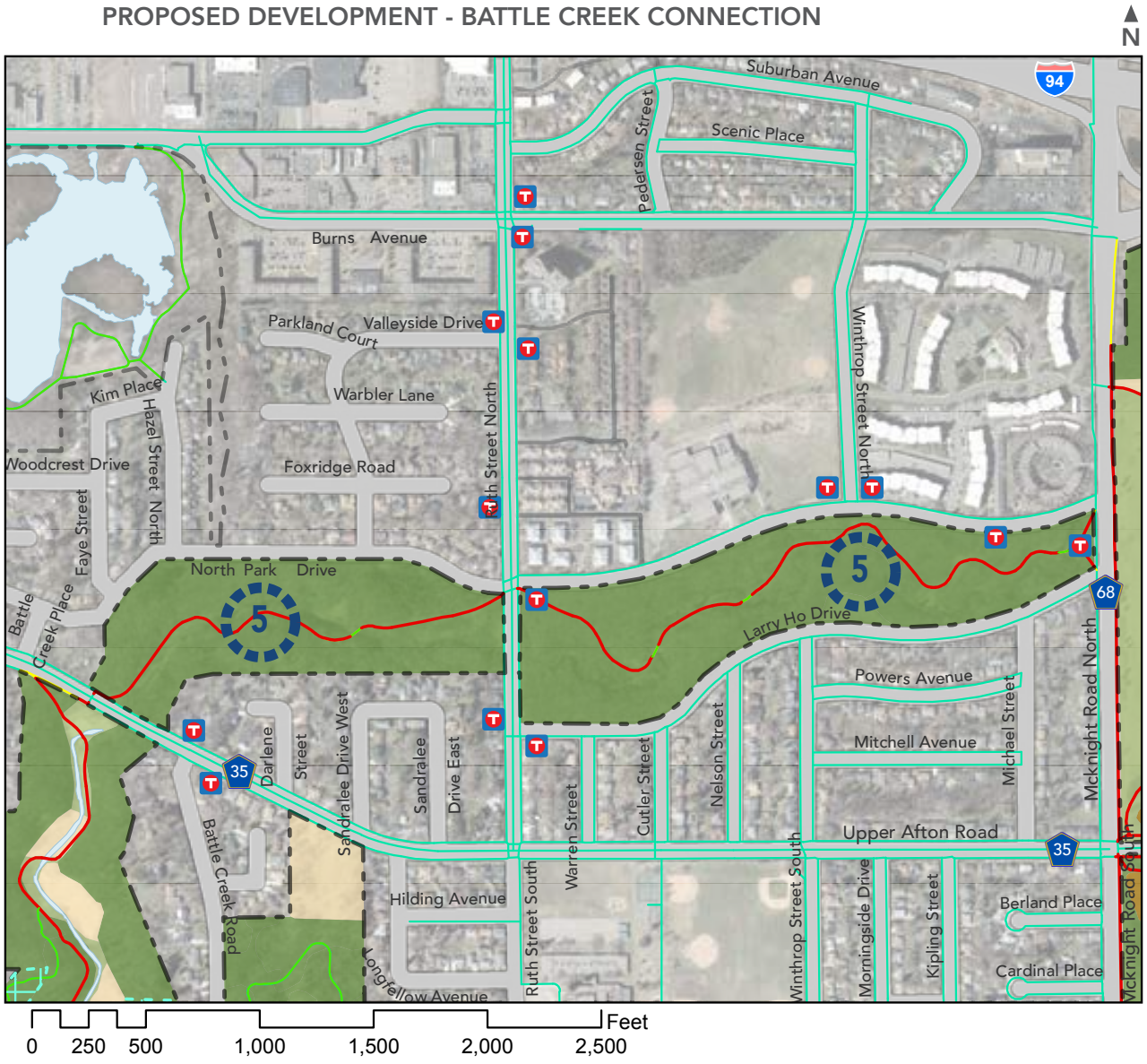
Legend

Park Border		Park Paved Trail		Regional Trail	
Proposed Development	3	Park Turf Trail		Proposed Regional Trail	
Proposed Development Node	1	Municipal Trail		Environmental Natural Area	
Metro Tranist Stop		Municipal Ped/Bike Facility			
Parking Lot	P				

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK CONNECTION



Legend

- Park Border
- Proposed Development
- Proposed Development Node
- Metro Tranist Stop
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Proposed Regional Trail
- Environmental Natural Area

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BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK PICNIC AREA

Legend

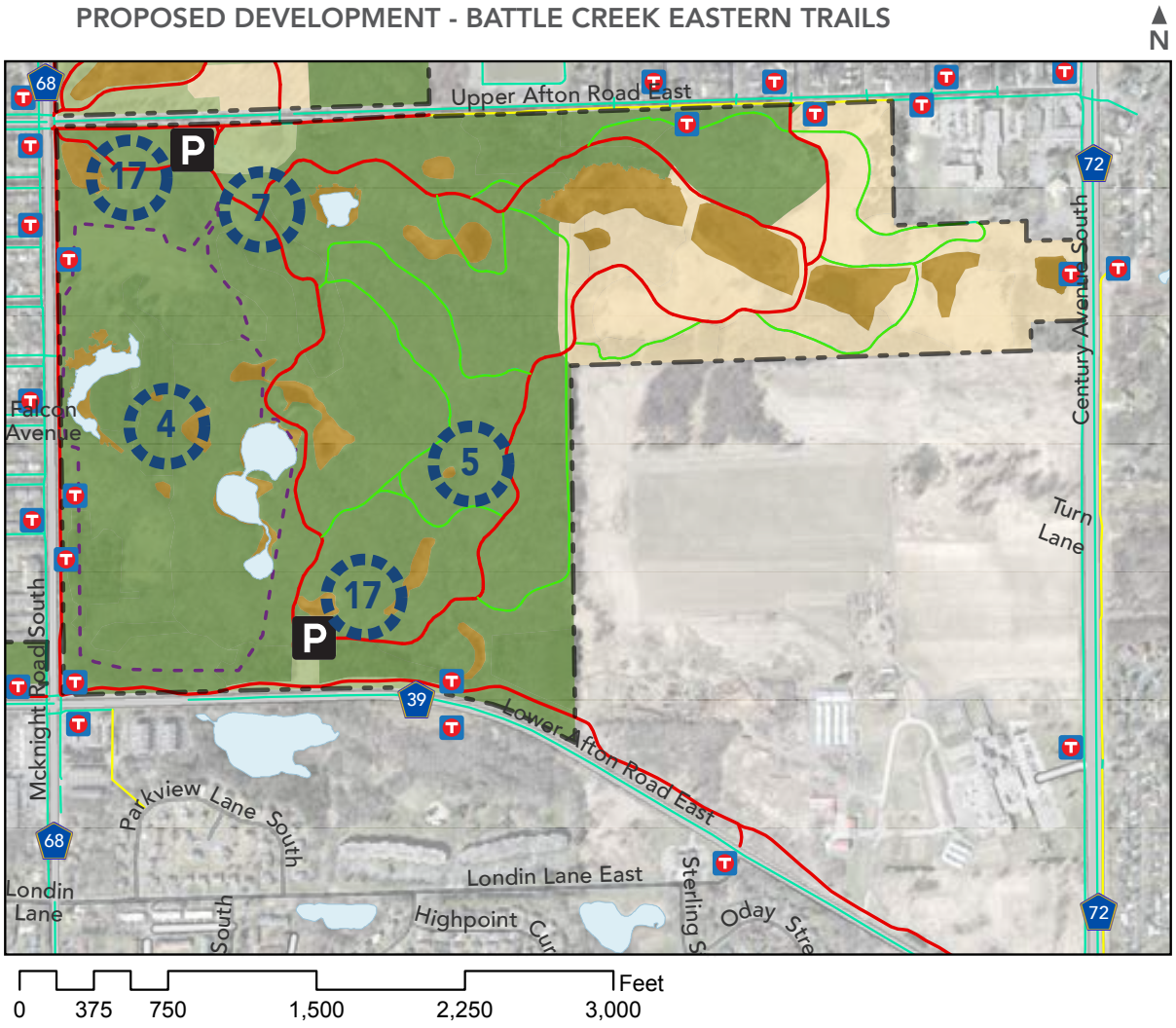
Park Border		Park Paved Trail		Regional Trail	
Proposed Development	3	Park Turf Trail		Proposed Regional Trail	
Proposed Development Node	1	Municipal Trail		Parking	P
Metro Tranist Stop		Municipal Ped/Bike Facility			

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK EASTERN TRAILS



Legend

- Park Border
- Proposed Development
- Proposed Development Node
- Metro Tranist Stop
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Proposed Regional Trail
- Parking

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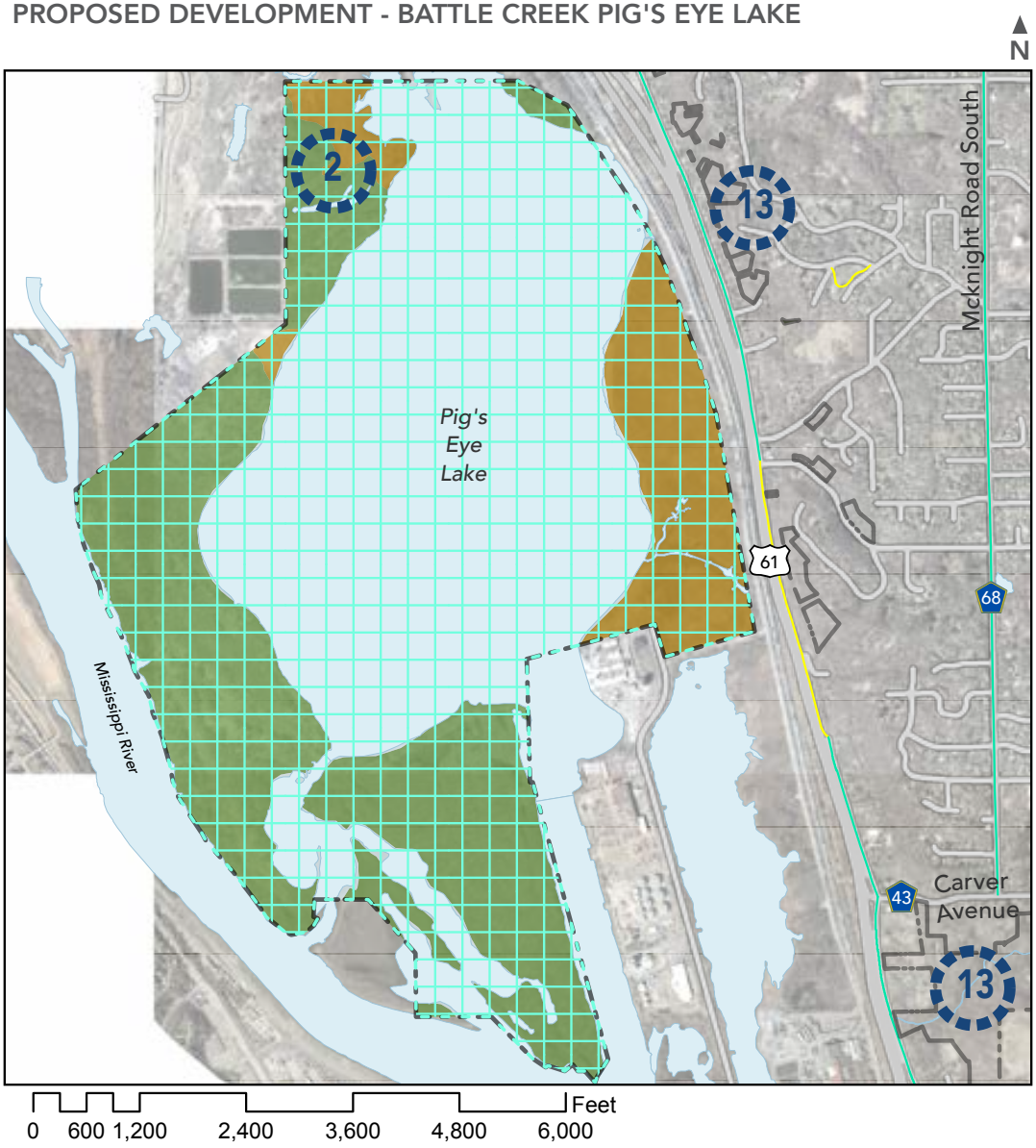
BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT - BATTLE CREEK PIG'S EYE LAKE



Legend

- Park Border
- Proposed Development
- Proposed Development Node
- Metro Tranist Stop
- Park Paved Trail
- Park Turf Trail
- Municipal Trail
- Municipal Ped/Bike Facility
- Regional Trail
- Proposed Regional Trail
- Environmental Natural Area

Appendix : Battle Creek Regional Park System Plan Section Figure

2018

BATTLE CREEK REGIONAL PARK

PLANNING CONSIDERATIONS

The Battle Creek Regional Park Master Plan is over 35 years old. The plan will be updated during 2018-2019.

Portions of Battle Creek Regional Park are within the boundary of the Mississippi National River and Recreation Area (MNRRA). Plans for MNRRA may provide opportunities for coordinated development. In accordance with the Battle Creek Regional Park Master Plan, Saint Paul and Ramsey County will continue to coordinate development and operations of the park. Portions of the Battle Creek segment and Pig's Eye Lake segment of the park are included in the "National Great River Park" and as such future plans for development will be coordinated with the Saint Paul Riverfront Corporation and the city of Saint Paul. A logical relationship exists for adjacent schools to use the park for environmental education. Three schools (Carver Elementary, Battle Creek Elementary and Battle Creek Middle) all have easy access to the park and positive use of the park should be encouraged. In accordance with the joint powers agreement between Ramsey County and the city of Saint Paul, the Battle Creek Recreation Center and parking lot are located within Battle Creek Regional Park. These shared facilities provide opportunities for trail access and joint programming. The master plan for Battle Creek Regional Park identifies the adjacent land area as a winter sports area. The current cross-country ski trails and sledding hill provide these services, however, in order to provide predictable snow conditions consideration will be given to installation of snowmaking equipment to maintain a portion of the cross-country ski trail and the snowboarding and tubing hill. The golf facility known as the Ponds at Battle Creek provides a 9-hole regulation golf course and driving range on the Ramsey County Community Corrections property located south of Lower Afton Road.

PROPOSED DEVELOPMENT

1. Master Planning

A joint master plan between the city of Saint Paul and Ramsey County for Battle Creek Regional Park was completed in June 1981. The master plan was approved by the city of Saint Paul, the Ramsey County Board of Commissioners, and the Metropolitan Council. Portions of Battle Creek Regional Park are within the Mississippi National River and Recreation Area (MNRRA). Plans for MNRRA may provide opportunities for coordinated development. Due to changing trends of park and recreation facilities, demographics, and the need to provide improved recreational facilities a master plan update is proposed for the regional park.

- Develop partnerships with the Cities of Saint Paul, Maplewood, the National Park Service, the Army Corps of Engineers (ACOE), Ramsey Washington Metro Watershed District (RWMWD), local schools, local agencies, and private parties for increased recreational opportunities and funding strategies for improvements throughout the park.
- Master planning activities for a master plan update are anticipated to begin in 2018 and will assess the entire regional park for recreational uses, redevelopment of existing facilities, new recreation development opportunities, improvements to existing recreational facilities, storm water management best practices, funding strategies, and partnerships.

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

2. Pig's Eye Lake

Potential improvements to the Pigs Eye Lake area will be compatible with the Great River Passage Plan created by the city of Saint Paul and may consist of a parking facility, nature interpretation and educational programing components, a restroom facility, paved trails, natural surface trails, a boardwalk, and observation areas. Master planning activities will be required for improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

3. Winter Recreation Area

The 1981 master plan for Battle Creek Regional Park identified a portion of park between Battle Creek Road and Winthrop as a winter sports area. A long-term plan exists to make the winter recreation area in Battle Creek Regional Park a destination for the east metro area. Planning activities have started for the implementation of snowmaking equipment and supporting infrastructure including a parking expansion, expansion of the cross-country ski trail system, cross-country ski trail lighting improvements, an improved crossing over Battle Creek Road for connection to trails located on either side of the road, and additional building infrastructure such as a winter chalet and maintenance storage. Further master planning activities will be required for proposed winter recreation development.

4. Battle Creek Off Leash Dog Area

Master planning for the system-wide Off-Leash Dog Area Master Plan began in 2017 and was completed in 2018. This master plan addresses improvements to the Battle Creek Off-Leash Dog Area.

5. Battle Creek Mountain Bike Trails

Master planning for the Battle Creek mountain bike trails began in 2016 and was completed in 2018. This master plan addresses improvements to the Battle Creek Mountain Bike system.

6. Picnic Area

Redevelopment activities are proposed within the large group picnic area consisting of pavilion improvements, parking lot redevelopment or expansion, use of the turf area, playground development, improved trail connections, mountain bike trails, interpretive education programming areas, and site amenities. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

7. Eastern Trails

Redevelopment activities are proposed consisting of parking lot redevelopment and expansion, trail redevelopment, improved trail connections, interpretive education programming areas, potential restroom facilities, mountain bike trails, improved site amenities, and potential recreation improvements such as a disc golf course. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

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BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

8. Battle Creek Corridor

Redevelopment activities are proposed consisting of parking lot redevelopment and expansion, trail redevelopment, improved trail connections, interpretive education programming areas, potential restroom facilities, improved site amenities, mountain bike trails, and recreation improvements. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

9. Battle Creek West, Winthrop Street Area

Redevelopment activities are proposed consisting of parking lot redevelopment and expansion, winter recreation development, mountain bike and hiking trail improvements, cross-country ski trail improvements, and interpretive education programming areas. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

10. Battle Creek Road to Park Entrance Road

Redevelopment activities are proposed consisting of parking lot development, mountain bike and hiking trail improvements, cross-country ski trail improvements, and interpretive education programming areas. A bluff top visitor center facility overlooking the Mississippi River Valley is proposed to provide interpretive, educational, and recreational programming with adjacent parking opportunities, site amenities, and scenic overlooks. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

11. Northwest Bluff Area

Redevelopment activities are proposed consisting of mountain bike and hiking trail improvements, bituminous trail development for connections to the Burns Avenue Overlook in coordination with the city of Saint Paul and MNDOT, overlooks, and interpretive education programming areas. Master planning activities will be required for potential improvements and will be addressed in the Battle Creek Regional Park Master Plan update.

12. Regional Park Expansion Opportunities

Investigate opportunities for expansion of Battle Creek Regional Park to include Suburban Pond, Mississippi River Bluff Protection Open Space, Fish Creek Open Space (Maplewood and Ramsey County sections), and possibly the land owned by the city of Maplewood located on the north side of Carver Road. Another possibility for expansion is including Carver Lake Park in the city of Woodbury into the regional park system. Future planning activities will require a comprehensive study with the Metropolitan Council, city of Maplewood, city of Saint Paul, and city of Woodbury for viability as a Regional Park component.

13. Recreation Events

There is a need for improvements to accommodate recreation events such as cross-country running, mountain biking, and cross-country skiing. Possible improvements may consist of improved vehicular and pedestrian access, event areas, and improved recreational amenities that would be conducive for these types of events.

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

14. Expand Recreational Opportunities

Explore alternative types of recreation opportunities that are not currently provided at Battle Creek Regional Park due to changing trends of park and recreation facilities, and the need to provide improved recreational facilities. Additional master planning activities will be required to identify new recreation opportunities as part of the Battle Creek Regional Park Master Plan update.

15. Access Points

- **Upper Afton Picnic Area:** Ramsey County proposes additional access points from McKnight Road, Upper Afton Road, adjacent neighborhoods, and Afton Heights Park for connections to the existing trail system. Explore additional access points from the overflow parking lot located on the south side of Upper Afton Road for improved access and safe crossing at Upper Afton Road.
- **Eastern Trails Area:** Ramsey County proposes additional trail access points from Upper Afton Road, Lower Afton Road, and adjacent neighborhoods for connection to the existing trail system.
- **Battle Creek Corridor:** Ramsey County proposes additional access points from Battle Creek Road, Lower Afton Road, Winthrop Street, and adjacent neighborhoods for connection to the existing trail system. Explore additional access points and crossings at Battle Creek Road for improved connection to cross-country ski and mountain bike trails located on both sides of Battle Creek Road.
- **Northwest Bluff:** Ramsey County proposes additional trail access points to the existing trails within Battle Creek Corridor on the north side of the bluff area for connection to the Burns Avenue Scenic Overlook.
- **Pigs Eye Lake:** Explore additional access points for pedestrians and vehicles from Childs Road and city of Saint Paul park land on the north side of Pigs Eye Lake. An additional access may be developed to connect the Lower Afton Trail to the Pigs Eye Lake area such as a pedestrian bridge over Highway 61. Additional master planning activities will be required as part of the Battle Creek Regional Park master plan update for improved connection.

16. Trail Development

- Redevelop existing internal park trails for more direct and user-friendly trail connections to park amenities. Improvements shall consist of trail repaving, re-aligning of trail sections for improved connections, the reduction of sharp corners and steep slopes adjacent to trail sections, and trail rebuilding through wet areas.
- **Eastern Trails Area:** Ramsey County proposes additional paved trails between Upper and Lower Afton Road, and natural surface trails such as mountain biking, hiking, and cross-country ski trails for improved use and connections to recreation amenities. Proposed mountain bike and hiking trails are identified in the Battle Creek Off Road Cycling Master Plan.
- **Battle Creek Corridor:** Ramsey County proposes additional paved trails to provide connection between Winthrop and Battle Creek Road, and Battle Creek Road to Park Entrance Road adjacent to Highway 61. Develop additional natural surface trails such as mountain biking, hiking, and cross-country ski trails for improved use and connection to recreation amenities. Proposed mountain bike and hiking trails are identified in the Battle Creek Off Road Cycling Master Plan.
- **Northwest Bluff:** Ramsey County proposes additional paved trails to connect the trail system within the Battle Creek corridor to the Burns Avenue Scenic Overlook, and additional natural surface trails such as mountain biking and hiking trails for improved use and connection to recreation amenities. Proposed mountain bike and hiking trails are identified in the Battle Creek Off Road Cycling Master Plan.

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

- **Pigs Eye:** Explore trail development within the Pigs Eye Lake area for paved trails, natural surface trails, boardwalks with interpretive and educational programing, and observation viewing areas.

17. Vehicular Access

- Upper Afton Picnic Area
  - -Pavilion Parking Lot: A mill and overlay was completed in 2014 and will require future pavement maintenance. Parking expansion is proposed due to an increase in demand. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management best practices, and site amenities.
  - -Waterworks Parking Lot: Pavement maintenance was last completed in 2008. A mill and overlay will be required for this parking lot. Parking expansion is also proposed due to an increase in demand. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management best practices, and site amenities.
  - -Entrance Road: A mill and overlay was completed in 2014 and will require future pavement maintenance.
- Eastern Trails Area
  - -Upper Afton Parking Lot: Pavement maintenance was last completed in 2010. A mill and overlay will be required for this parking lot. Additional parking expansion is proposed due to an increase in demand for recreation use. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management practices, and site amenities.
  - -Lower Afton Parking Lot: Pavement maintenance was last completed in 2010. A mill and overlay will be required for this parking lot. Additional parking expansion is proposed due to an increase in demand for recreation use. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management practices, and site amenities.
- Battle Creek Corridor
  - -Winthrop Parking Lot: Pavement maintenance was last completed in 2009. A mill and overlay will be required for this parking lot. Parking expansion is proposed due to an increase in demand for recreation use. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management best practices, and site amenities.
  - -Lower Afton Parking Lot: Pavement maintenance was last completed in 2009. A mill and overlay will be required for this parking lot. Parking expansion is proposed due to an increase in demand for recreation use. During any parking lot redevelopment additional parking should be considered along with improved pedestrian connections, signage, storm water management best practices, and site amenities.

18. Wayfinding

- Pedestrian signage was implemented in 2015 for improved wayfinding to trail accesses and other amenities. Provide interpretive signage in natural areas for increased wayfinding to nature education opportunities. Additional pedestrian signage will be required along with any new trail development.

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

- Improve vehicular entrance signage at parking lot entrances and key high traffic areas for better wayfinding to and within the park. Redevelop existing wood vehicle park ID signs and replace with appropriate main entrance or tertiary signage according to the Ramsey County Parks & Recreations department's Wayfinding Master Plan

19. Recreation Opportunities

- **Shelter/Pavilion/Restrooms/Water Works:** Development of the existing picnic pavilion, shelters, restrooms, and Water Works in the picnic area occurred from 1984 (large pavilion and restroom) to 1999 (Water Works), and most recently in 2011 for the new picnic shelter. Due to aging infrastructure and changing recreation trends redevelopment of these facilities will likely be required to provide enhanced recreation amenities for picnic reservations, water recreation, and improved use with adjacent recreational amenities. Improvements to these facilities should comply with the Americans with Disabilities Act (ADA) and Universal Design standards.
- **Playground:** Due to the existing age of the playground equipment and location, redevelopment is required for improved use and play. Master planning and community engagement activities started in 2017 for the relocation and redevelopment of the playground in the open area to the north of the parking lot. An outcome from the community engagement and master planning process was a need to plan for a destination playground consisting of multiple components including traditional playground equipment, nature playground components, water play with education and interpretive programming, a challenge or high ropes course, and a childrens bike park. Additional partnerships are encouraged for funding strategies and increased use. Development will likely occur in multiple phases and is planned to start in 2019. Additional playground development within the regional park may be proposed as part of the Battle Creek Master Plan update and as development occurs in the park.
- **Multi-Use Turf:** Improve turf areas for increased recreation and community event opportunities.
- **Court Games:** Explore the development of court games to correspond with changing trends, demographics and park uses.
- **Public Art:** Provide the opportunity and appropriate infrastructure to accommodate public art, this will strengthen the bond between the department and its public user base.
- **Culturally Significant Areas:** Provide access and interpretive education for culturally significant areas within the regional park. Proposed improvements would consist of observation areas, interpretive educational signage, and pedestrian connections.
- **Wildlife Areas:** Provide visual and interpretive educational signage, and pedestrian connections to wildlife areas. If federally or state listed protected plants or animals are discovered statutes and guidelines will be followed.
- **Fishing:** Fishing in Pigs Eye Lake is minimal. Most fishing activity occurs in backwaters of the Mississippi River and Pigs Eye Lake. Additional master planning activities are required to determine appropriate locations for proposed access points and fishing opportunities in Pigs Eye Lake.
- **Programming:** Increase recreation and nature programming activities.
- **Water Access:** Provide access for small water craft within Pigs Eye Lake. This would likely be developed along with access improvements to the northwest corner of the lake. Along with park development there may be enough demand to provide rental amenities for small watercraft in Pig's Eye Lake.

Appendix : Battle Creek Regional Park System Plan Section Figure

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BATTLE CREEK REGIONAL PARK

PROPOSED DEVELOPMENT

20. Habitat Restoration & Management

- In the past 20 years, restoration efforts to combat invasive species and improve habitat within Battle Creek Regional Park have been extensive. Restored and maintained habitat includes restoration through sections of old growth oak woods, maintenance of around 57 acres of established native prairie, around 70 acres of oak and mixed woods, and conversion of old field to prairie within the northwest section of the park.
- Land cover changes and ongoing future restoration across other sections of the park will include woodland restoration, prioritizing established old growth oak forest and bluff savannas, conversion of old field to oak woods or prairie, and removal of cultivated conifers to natural habitat.
- Continued restoration and ongoing maintenance of established savanna and woodlands will include removal of buckthorn and other woody invasives, foliar spraying of buckthorn and other invasives, prescribed burns through select areas, and casting of native herbaceous seed as needed.
- Prairie conversion and maintenance of established prairies across the park will include herbicide weed treatment, prescribed burns, removal of noxious weeds and drill seeding or inter-seeding of forbs as needed.

21. Acquisitions

Future land acquisition is proposed when properties or easements become available. Future acquisition would allow additional park and recreation opportunities, trail development, and long-term expansion of the regional park. Acquisition of properties along Battle Creek Road would provide an opportunity to close a portion of the road within the park, causing the removal of a barrier between park areas located on either side of the road for improved trail connections, additional recreation opportunities, and habitat restoration.

Appendix : Battle Creek Regional Park System Plan Section Figure

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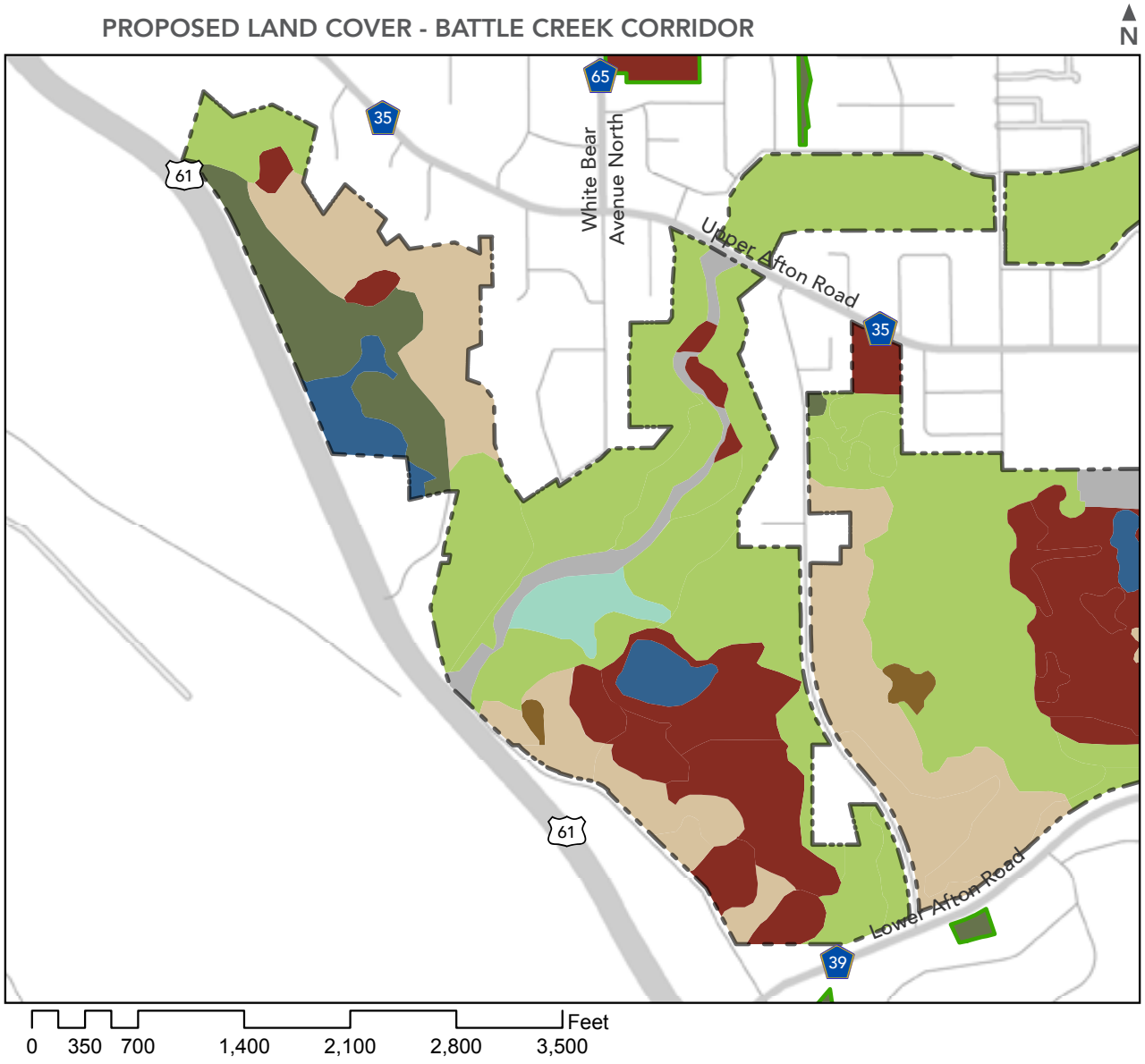
BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK CORRIDOR



Proposed Land Cover

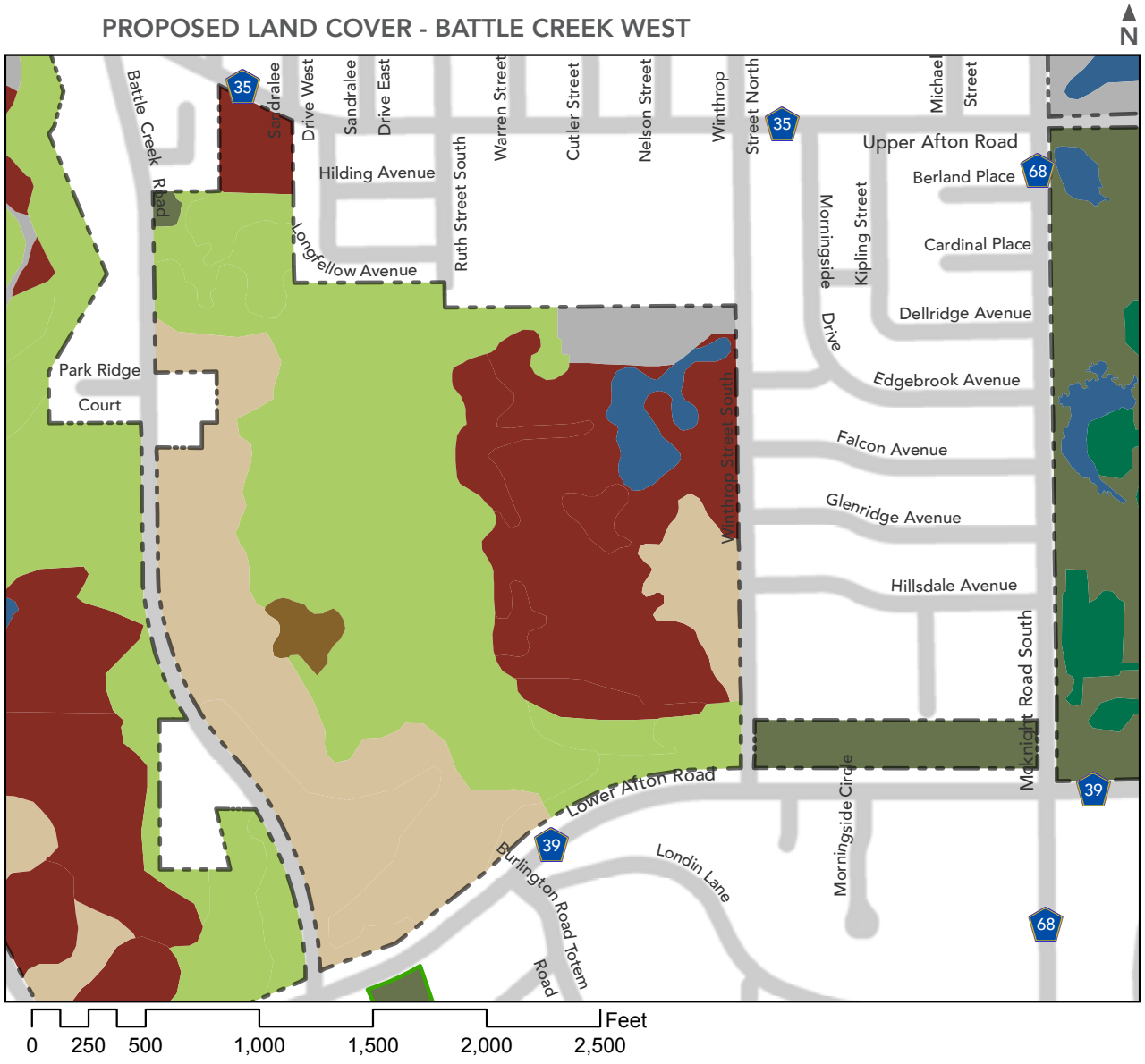
- Active Use
- Impervious
- Cultivated Conifers
- Tamarack Swamp
- Floodplain Forest
- Mesic Forest
- Mixed Woods
- Wetland
- Oak Woods
- Old Field
- Prairie
- Open Water
- Prairie (remnant)
- Savanna
- Shrub Swamp

Appendix : Battle Creek Regional Park System Plan Section Figure

2018

BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK WEST



Proposed Land Cover

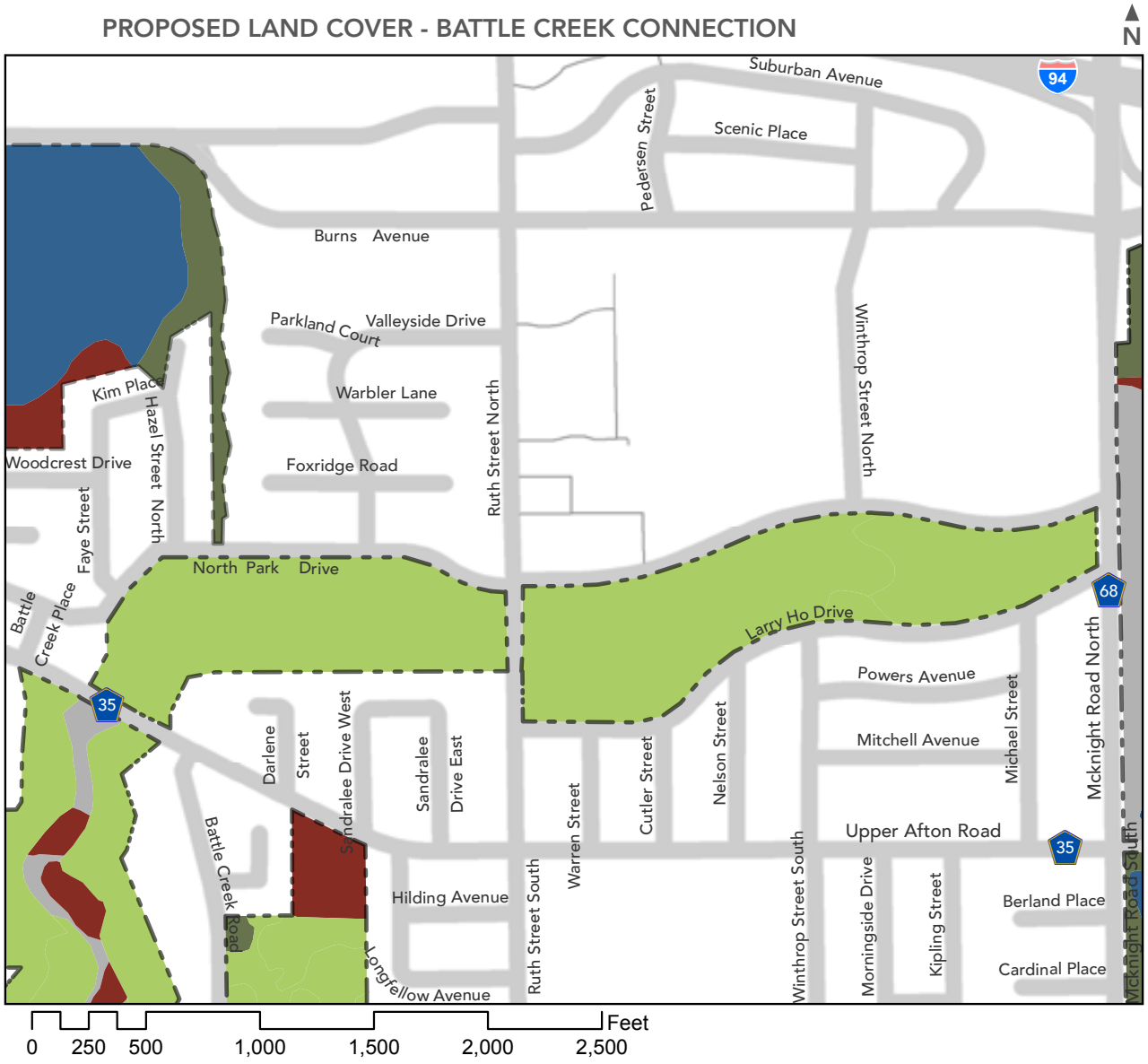
Active Use	Floodplain Forest	Oak Woods	Prairie (remnant)
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section Figure

2018

BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK CONNECTION



Proposed Land Cover

Active Use	Floodplain Forest	Oak Woods	Prairie (remnant)
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section Figure

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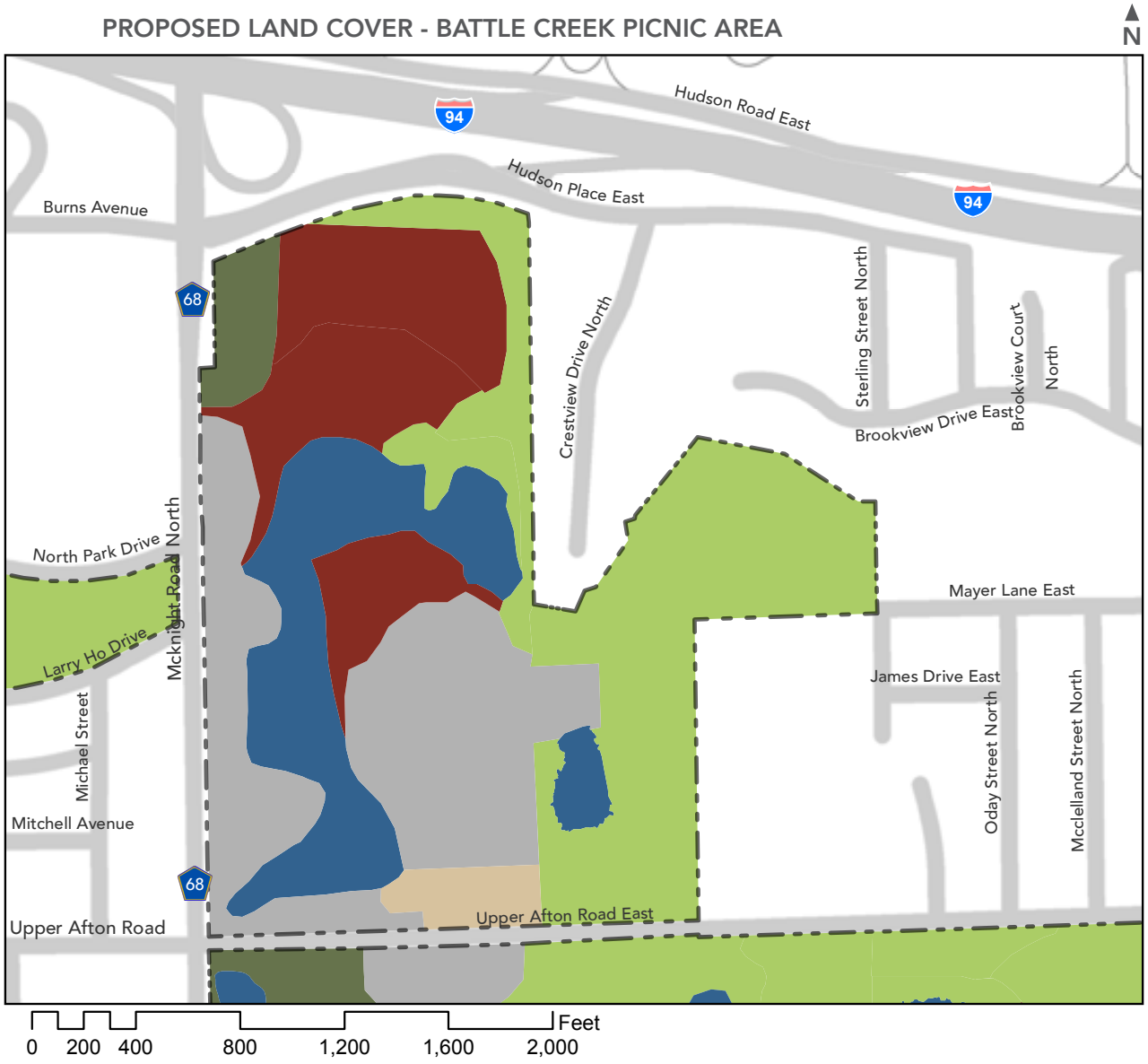
BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK PICNIC AREA



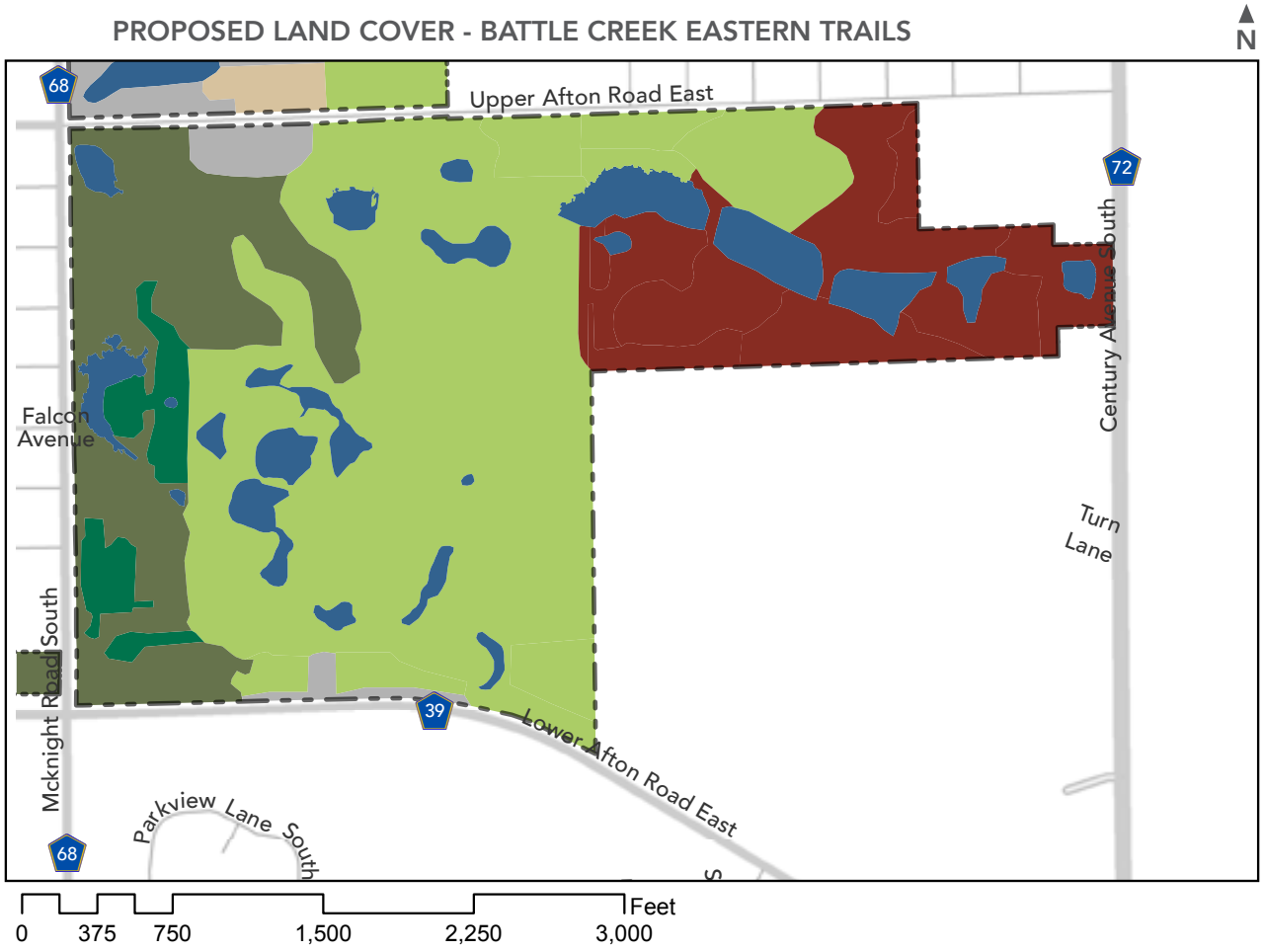
Proposed Land Cover

Active Use	Floodplain Forest	Oak Woods	Prairie (remnant)
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

2018

BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK EASTERN TRAILS



Proposed Land Cover

Active Use	Floodplain Forest	Oak Woods	Prairie (remnant)
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section Figure

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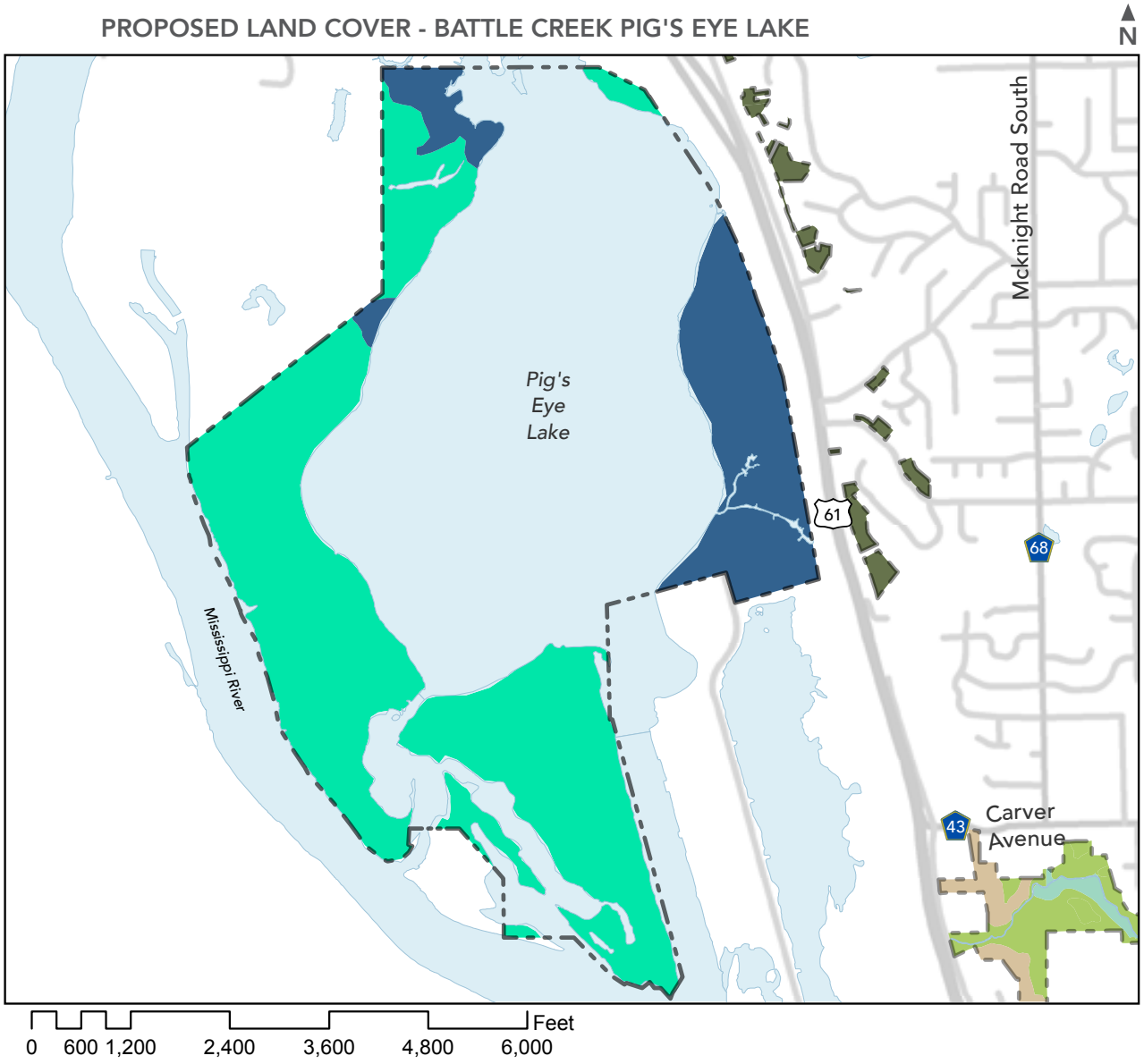
BATTLE CREEK REGIONAL PARK

PROPOSED LAND COVER - BATTLE CREEK PIG'S EYE LAKE



Proposed Land Cover

Active Use	Floodplain Forest	Oak Woods	Prairie (remnant)
Impervious	Mesic Forest	Old Field	Savanna
Cultivated Conifers	Mixed Woods	Prairie	Shrub Swamp
Tamarack Swamp	Wetland	Open Water	

Appendix : Battle Creek Regional Park System Plan Section Figure

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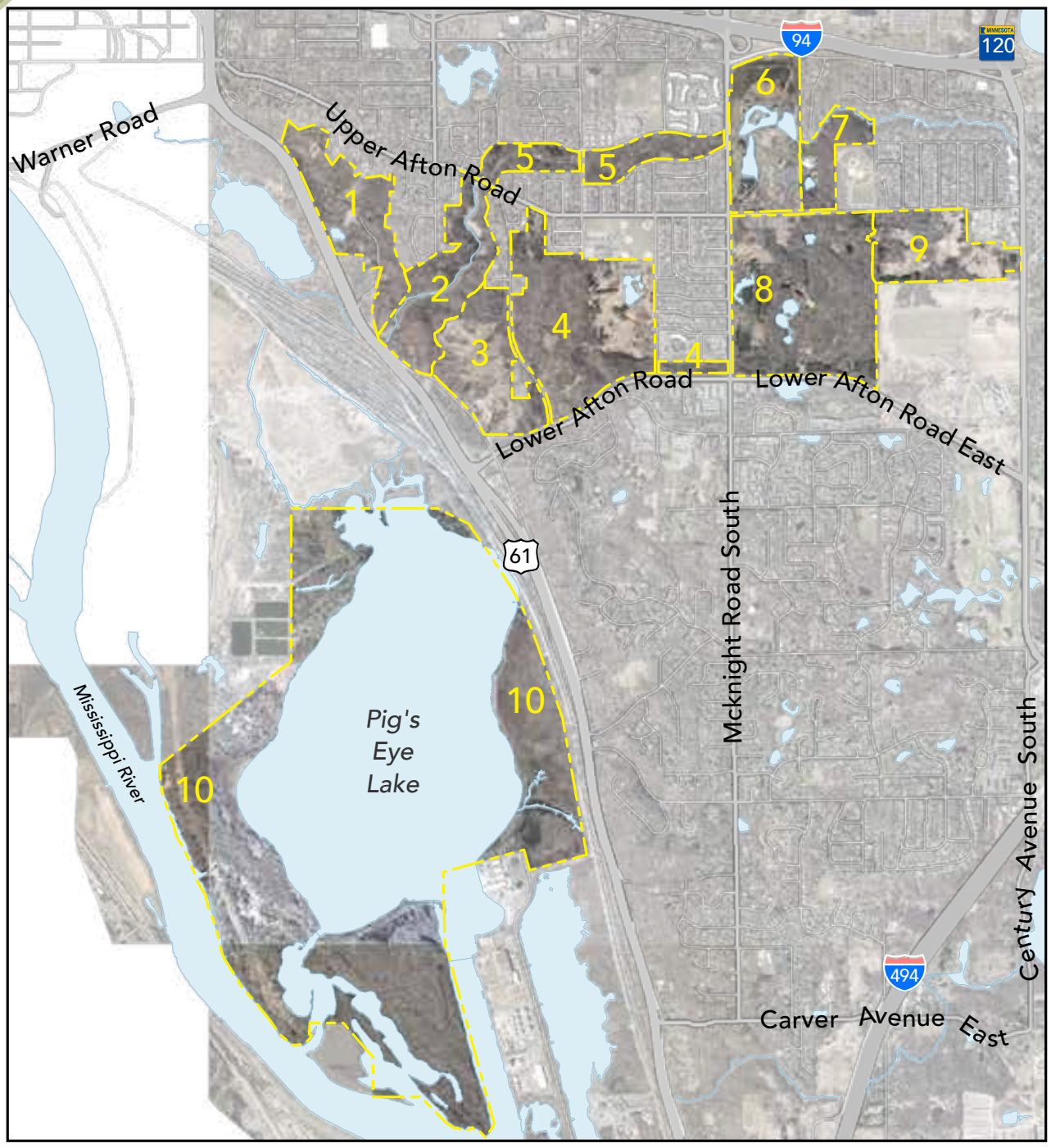
BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNITS



Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 1 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
2.42	OLD FIELD	PRAIRIE	MOW, HERBI-CIDE, RX BURN, CAST SEED	$8,470.00	2	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$2,541.00
6.40	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
27.15	MIXED WOODS	MIXED WOODS 20.35 ACRES	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, STACK & BURN	$50,875.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$15,262.50
		OAK WOODS 6.8 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$23,800.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$5,100.00
37.07	OAK WOODS	OAK WOODS 12.94 ACRES, SAVANNA 24.136 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$129,745.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$27,802.50
MANAGEMENT UNIT 1 TOTAL							
73.04				$212,890.00			$50,706.00

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 2 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
0.72	PRAIRIE (REMNANT)	PRAIRIE (REMNANT)	MONITOR	N/A	1	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$755.22
2.27	OLD FIELD	PRAIRIE	MOW, HERBI-CIDE, RX BURN, DRILL SEED	$4,530.47	2	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$2,378.50
2.85	MIXED WOODS	PRAIRIE	REMOVE TREES, HERBICIDE, RX BURN, DRILL SEED	$9,960.36	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$2,134.36
6.68	MESIC FOREST	MESIC FOREST	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, STACK & BURN	$13,353.89	1	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$3,004.63
6.84	CULTIVATED CONIFERS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$23,932.76	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$6,496.03
7.40	ACTIVE USE	ACTIVE USE	N/A	N/A	N/A	N/A	N/A
46.94	OAK WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$164,274.29	1	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$44,588.74
MANAGEMENT UNIT 2 TOTAL							
73.68				$216,051.77			$59,357.47

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 3 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
4.37	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
12.21	PRAIRIE	PRAIRIE	MONITOR	N/A	1	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$12,815.40
13.78	OAK WOODS	OAK WOODS 5.65 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$19,775.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$5,367.50
		SAVANNA 8.13 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$28,455.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$7,723.50

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 3 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
16.97	OLD FIELD	PRAIRIE	MOW, HERBI-CIDE, RX BURN, DRILL SEED	$33,943.71	2	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$10,183.11
24.46	MIXED WOODS	SAVANNA 1.61 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$5,635.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$1,529.50
		PRAIRIE 3.56 ACRES	REMOVE TREES, HERBICIDE, RX BURN, DRILL SEED	$12,460.00	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$2,136.00
		OAK WOODS 19.25 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$85,593.69	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$18,287.50
MANAGEMENT UNIT 3 TOTAL							
71.78				$185,862.41			$58,042.51

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 4 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
1.59	PRAIRIE (REMNANT)	PRAIRIE (REMNANT)	MONITOR	N/A	1	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$1,671.41
2.93	OLD FIELD	PRAIRIE	MOW, HERBI-CIDE, RX BURN, DRILL SEED	$5,862.80	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$3,077.97
3.28	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
3.96	ACTIVE USE	ACTIVE USE	N/A	N/A	N/A	N/A	N/A
5.09	SAVANNA	SAVANNA	N/A	N/A	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN, RESEED-ING OF FORBS	$10,172.44
12.90	CULTIVATED CONIFERS	OAK WOODS 3.43 ACRES	REMOVE TREES, HERBICIDE, RX BURN, PLANT OAKS	$6,860.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$3,258.50
		PRAIRIE 9.47 ACRES	REMOVE TREES, HERBICIDE, RX BURN, DRILL SEED	$18,940.00	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$9,943.50

Appendix : Battle Creek Regional Park System Plan Section

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BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 4 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
20.57	MIXED WOODS	OAK WOODS 5.31	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$18,585.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$5,044.50
		MIXED WOODS 6.45 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$22,575.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$6,127.50
		SAVANNA 8.81 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$30,835.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$8,369.50
27.72	PRAIRIE	PRAIRIE	N/A	N/A	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$30,047.95
75.12	OAK WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$262,919.56	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$30,047.95
MANAGEMENT UNIT 4 TOTAL							
150.17				$366,577.36			$127,156.94

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 5 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
0.70	OLD FIELD	OAK WOODS	HERBICIDE, RX BURN, PLANT OAKS	$1,400	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$665.00
1.36	CULTIVATED CONIFERS	OAK WOODS	REMOVE TREES, HERBICIDE, RX BURN, PLANT OAKS	$2,720.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$1,292.00
8.31	MIXED WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$29,085.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$7,894.50
38.78	OAK WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$135,730	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$15,512.00
MANAGEMENT UNIT 5 TOTAL							
49.15				$168,935.00			$25,363.50

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 6 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
2.10	OAK WOODS	OAK WOODS	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, HAUL OFF SITE	$4,203.76	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$1,996.78
8.87	CULTIVATED CONIFERS	PRAIRIE	REMOVE TREES, MOW, HERBI-CIDE, RX BURN, DRILL SEED	$17,749.60	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$4,437.40
9.26	MIXED WOODS	MIXED WOODS 3.36 ACRES	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, STACK & BURN	$6,720.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$3,192.00
		OAK WOODS 5.9 ACRES	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED, PLANT OAKS	$20,031.09	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$5,605.00
12.52	OLD FIELD	PRAIRIE	MOW, HERBI-CIDE, RX BURN, DRILL SEED	$25,031.09	2	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$6,257.77
17.12	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
29.28	ACTIVE USE	ACTIVE USE	N/A	N/A	N/A	N/A	N/A
MANAGEMENT UNIT 6 TOTAL							
79.15				$74,354.45			$21,488.96

Appendix : Battle Creek Regional Park System Plan Section

2018

BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 7 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
1.54	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
1.59	ACTIVE USE	ACTIVE USE	N/A	N/A	N/A	N/A	N/A
26.90	OAK WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$94,150.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$25,555.00
MANAGEMENT UNIT 7 TOTAL							
30.03				$94,150.00			$25,555.00

MANAGEMENT UNIT 8 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
5.08	ACTIVE USE	ACTIVE USE	N/A	N/A	N/A	N/A	N/A
12.27	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
17.69	CULTIVATED CONIFERS	CULTIVATED CONIFERS 6.77 ACRES	MONITOR	N/A	N/A	N/A	N/A
		OAK WOODS 10.92 ACRES	REMOVE TREES, HERBICIDE, RX BURN, PLANT OAKS	$21,840.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$4,914.00
40.00	MIXED WOODS	MIXED WOODS	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, STACK & BURN	$80,220.00	4	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$18,049.50
95.94	OAK WOODS	OAK WOODS	INVASIVE WOODY REMOV-AL, CUT, STUMP TREAT, STACK & BURN, RX BURN, NATIVE SEED	$287,820.00	2	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$43,173.00
MANAGEMENT UNIT 8 TOTAL							
171.09				$389,880.00			$66,136.50

Appendix : Battle Creek Regional Park System Plan Section Figure

2018

BATTLE CREEK REGIONAL PARK

NATURAL RESOURCE MANAGEMENT UNIT TABLE

MANAGEMENT UNIT 9 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
6.06	CULTIVATED CONIFERS	OAK WOODS 1.44 ACRES	REMOVE TREES REMOVE TREES, HERBICIDE, RX BURN, PLANT OAKS	$2,880.00	3	RX BURN, FOLIAR SPRAY OF BUCK-THORN	$648.00
		PRAIRIE 4.61 ACRES	REMOVE TREES, HERBICIDE, RX BURN, DRILL SEED	$13,830.00	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$4,840.50
10.94	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
20.30	PRAIRIE	PRAIRIE	N/A	N/A	2	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$10,150.11
25.49	MIXED WOODS	PRAIRIE	REMOVE TREES, HERBICIDE, RX BURN, DRILL SEED	$76,455.27	3	RX BURN, FOLIAR SPRAY OF HERBA-CEOUS	$12,742.54
MANAGEMENT UNIT 9 TOTAL							
62.79				$93,165.27			$28,381.15

MANAGEMENT UNIT 10 - BATTLE CREEK REGIONAL PARK							
ACRES	**CURRENT** LAND COVER	**FUTURE** LAND COVER	RESTORATION ACTIVITY	ACTIVITY COST	PRIOR-ITY	MAINTE-NANCE	MAINTE-NANCE COST/ 3 YEARS
124.65	WETLAND	WETLAND	MONITOR	N/A	N/A	N/A	N/A
377.92	MIXED WOODS	FLOOD-PLAIN FOREST	INVASIVE WOODY RE-MOVAL, CUT, STUMP TREAT, STACK & BURN	$377,916.41	N/A	N/A	$94,479.10
629.12	OPEN WATER	OPEN WATER	MONITOR	N/A	N/A	N/A	N/A
MANAGEMENT UNIT 10 TOTAL							
1,161.69				$377,916.41			$94,479.10
BATTLE CREEK REGIONAL PARK TOTAL							
1,829.57				$2,179,782.67			$556,667.14

EXECUTIVE SUMMARY

This Feasibility Study Report with Integrated Environmental Assessment investigates the feasibility of alternative measures to address problems and opportunities associated with the Pigs Eye Lake Continuing Authorities Program Section 204 beneficial use of dredged material project. Pigs Eye Lake is a 628-acre, shallow backwater lake, situated southeast of St. Paul, Minnesota, within Pool 2 of the Mississippi River.

The project lies within the Mississippi National River and Recreation Area, established by Congress to protect, preserve, and enhance the nationally significant resources of this reach of the Mississippi River. The project area is directly adjacent to one of the largest nesting sites for colonial water birds within the state. Several species of herons, egrets, and cormorants nest in the rookery. In addition, the project area is located within the Pigs Eye Lake section of Battle Creek Regional Park, and Battle Creek flows into the north end of Pigs Eye Lake.

The habitat concerns within the project area primarily include high levels of turbidity, wind-induced shoreline erosion, lack of depth diversity, and lack of shoreline habitat for birds and aquatic plants.

The objectives of the project are to:

1. *Improve aquatic habitat* – Create depth and habitat diversity in Pigs Eye Lake. Increase acreage of aquatic vegetation. Incorporate structural habitat features to promote fisheries.
2. *Improve the quantity and quality of habitat for migratory bird species* – Create suitable habitat for migratory birds such as dabbling ducks within Pigs Eye Lake.
3. *Maintain or enhance the quantity of shoreline habitat* – Protect existing floodplain forest and marsh habitat along the shoreline of Pigs Eye Lake from wind and wave erosion.

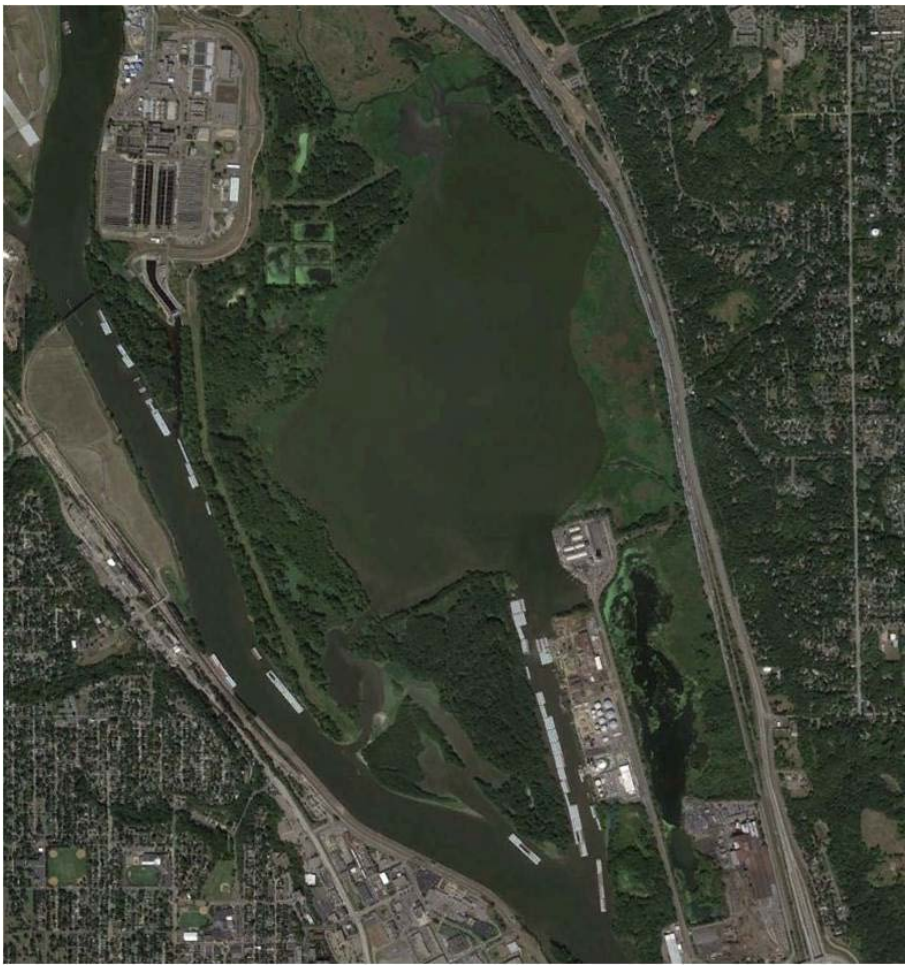
The study team identified a variety of measures that could be taken to achieve project objectives, including full and split island designs, sand benches, and creation of wetland (marsh) habitat. The measures were combined in various logical combinations to form alternative project plans.

The Tentatively Selected Plan, shown in Executive Figure 1, would restore backwater habitat by creating seven islands with sand benches. Three of the islands would utilize a “split” design that would establish a sheltered area in the center, allowing for the inclusion of approximately 17.6 acres of marsh plantings. The recommended plan addresses all project objectives. The plan would cost approximately $12.4 million and result in a net gain of 171.1 average annual habitat units at a cost of $2,700 per average annual habitat unit.

US Army Corps of Engineers®
St. Paul District

Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



U.S. Army Corps of Engineers, St. Paul District
Ramsey County, Local Sponsor
May 2018

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Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and
Environmental Assessment May 2018

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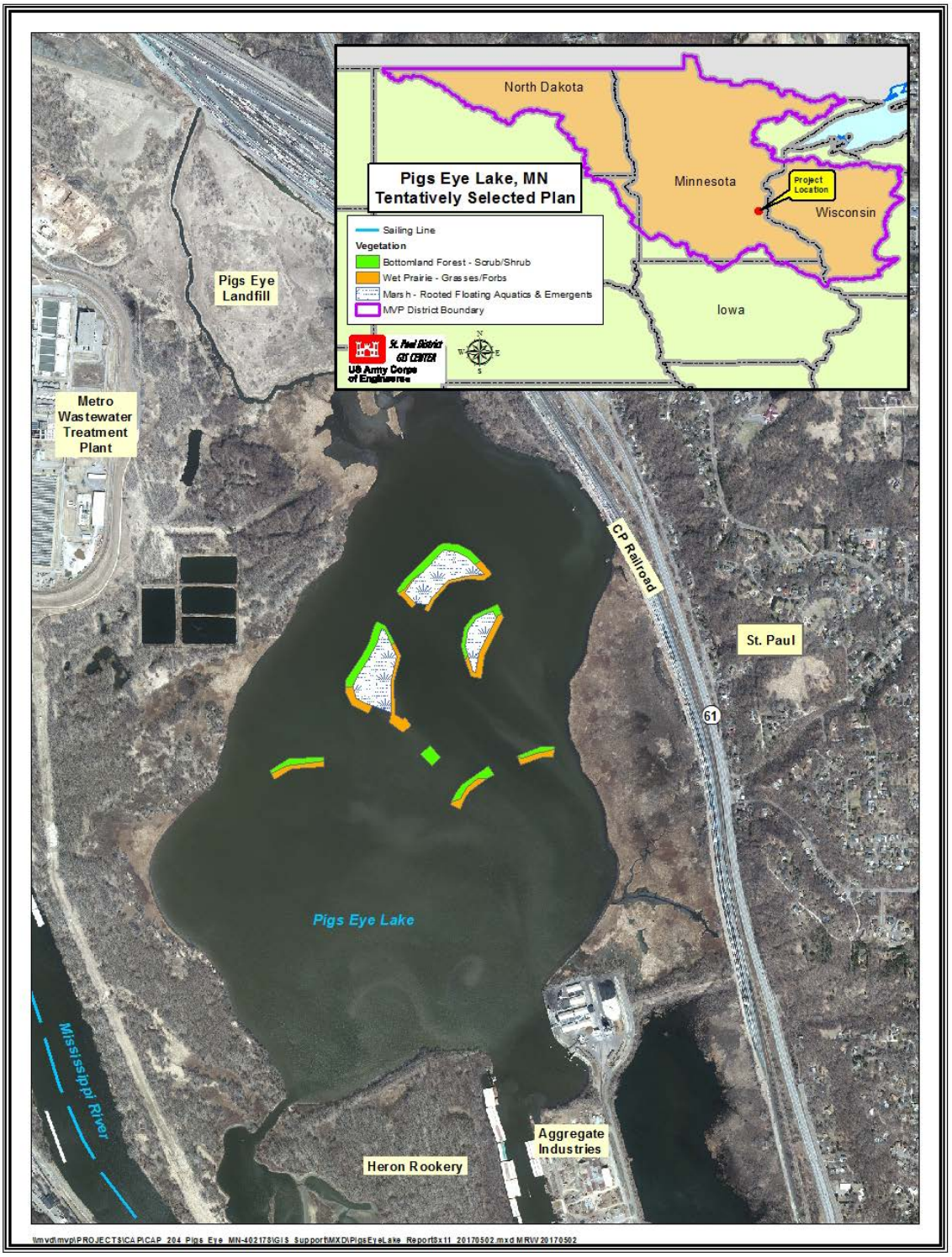

Executive Figure 1: Pigs Eye Lake Tentatively Selected Plan

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Appendix N Plan Formulation

Appendix : Pigs Eye Lake Feasibility Study Report with Integrated Environmental Assessment

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1 Study Background

1.1 Purpose and Scope of the Investigation

The U.S. Army Corps of Engineers (Corps, USACE), St. Paul District (District) is proposing to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized project under Continuing Authorities Program (CAP) Section 204 at Pigs Eye Lake, Ramsey County, MN.

This Feasibility Study Report with integrated Environmental Assessment (EA) provides a concise study overview of the plan formulation process that has been followed to create viable alternatives and ultimately identify the recommended plan for the Pigs Eye Lake Section 204 Feasibility Study. This report was prepared to comply with the National Environmental Policy Act (NEPA) of 1969. Upon completion, this report will provide planning, engineering, and construction details of the recommended restoration plan to allow final design and construction to proceed subsequent to the approval of the plan.

The project scope includes habitat within and immediately around Pigs Eye Lake. Implementation of a restoration plan in this area will directly benefit the entire Pigs Eye Lake ecosystem; restoration efforts are essential to restoring aquatic habitat in the lake.

On October 17, 2012 the Corps received a letter of interest from Ramsey County Parks & Recreation expressing interest in acting as a sponsor and requesting that the Corps perform a study to determine the feasibility of restoring aquatic habitat through the creation of islands in Pigs Eye Lake. Funding for the study under the authority of the Beneficial Use of Dredged Material Program (Section 204 of the Water Resources Development Act [WRDA] of 1992, as amended) was made available in 2015. The study was initiated in January 2015 and the Federal Interest Determination was approved by the Mississippi Valley Division on May 14, 2015. The Feasibility phase of the effort began immediately.

1.2 Authority

This study is authorized under Section 204 of the WRDA of 1992, as amended. Section 204 provides authority for the Corps to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized federal navigation project. Section 204 is one of a number of existing authorities in the CAP, which gives USACE authority to plan, design, and construct a project without specific project authorization by Congress. The federal cost for individual Section 204 projects is limited by statute to $10 million.

The general purpose of this program is for:

"(1) Sediment Use – For sediment obtained through the construction, operation, or maintenance of an authorized federal water resources project, the Secretary shall develop, at federal expense, regional sediment management plans and carry out projects at locations identified in plans developed under this section, or identified jointly by the non-federal interest and the Secretary, for use in the construction, repair, modification, or rehabilitation of projects associated with federal water resources projects for

purposes …(A) to reduce storm damage to property; (B) to protect, restore, and create aquatic and ecologically related habitats, including wetlands; and (C) to transport and place suitable sediment."

In accordance with the 2007 WRDA authority, the Planning Phase of the project is developed at 100 percent federal expense. The Design and Implementation Phase of the project is cost-shared 65 percent federal and 35 percent non-federal. The Sponsor must provide all lands required for the project and is responsible for 100 percent of the operation and maintenance, repairs, replacements, and rehabilitations (OMRR&R) of the completed project. If needed, the non-federal sponsor is 100 percent responsible for any costs associated with testing, handling, and treatment of HTRW. The non-federal sponsor must meet requirements of Section 221 of Flood Control Act of 1970 as amended.

1.3 Project Area

Pigs Eye Lake is a 628-acre, shallow backwater lake, situated southeast of St. Paul, Minnesota, within Pool 2 of the Mississippi River (Figure 1). Pigs Eye is the largest lake in St. Paul and is located in Pool 2, which extends approximately 33 miles upstream from Lock and Dam 2 at Hastings, Minnesota (river mile 815.2) to Lock and Dam 1 (Ford Dam) at Minneapolis, Minnesota (river mile 847.9). The Minnesota River joins the Mississippi River at the upper end of Pool 2. The project lies within the Mississippi National River and Recreation Area, established by Congress to protect, preserve, and enhance the nationally significant resources of this reach of the Mississippi River. The project area is directly adjacent to one of the largest nesting sites for colonial water birds within the state. Several species of herons, egrets, and cormorants nest in the rookery. In addition, the project area is located within the Pigs Eye Lake section of Battle Creek Regional Park, and Battle Creek flows into the north end of Pigs Eye Lake.

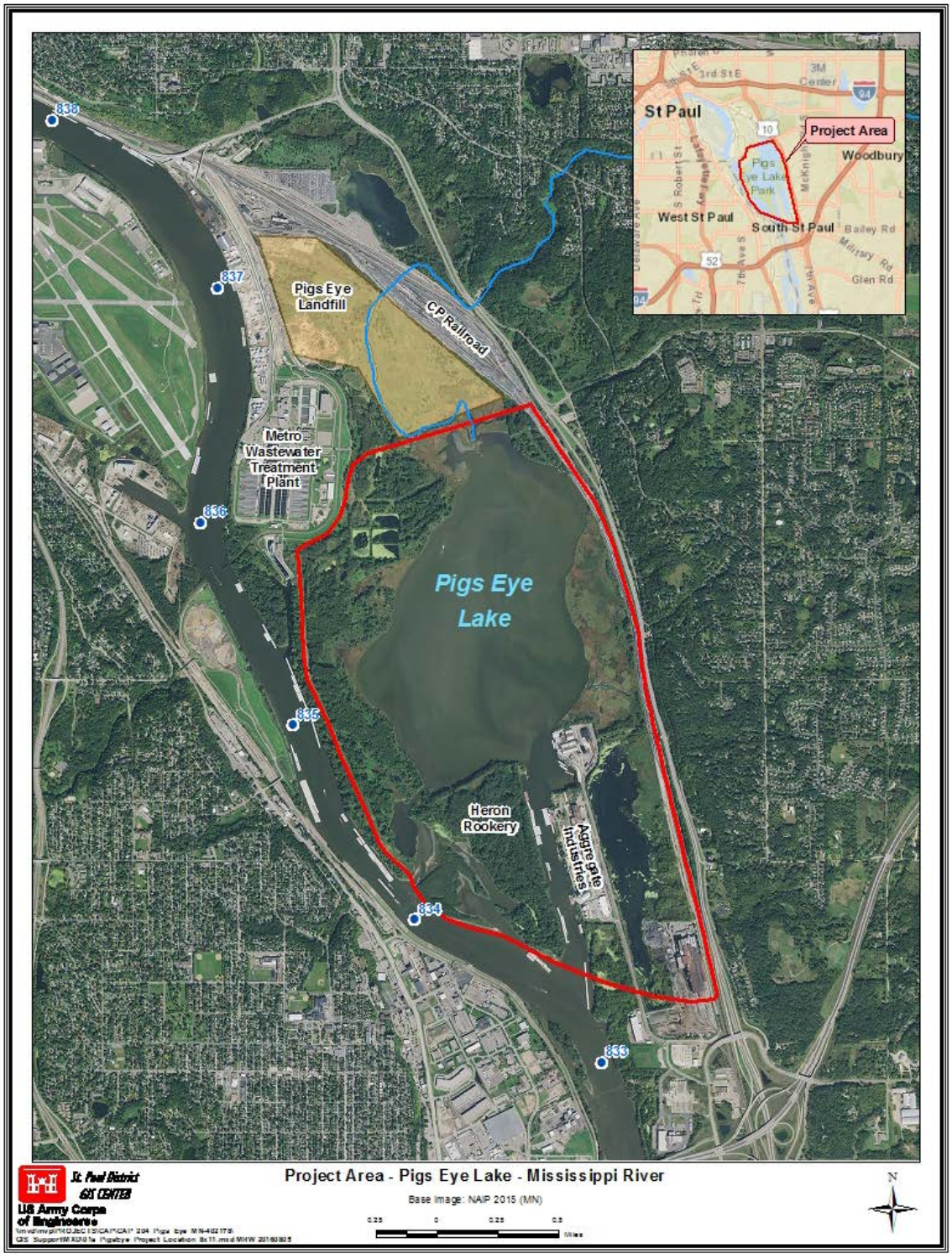

Figure 1: Project Area

1.4 Prior Studies, Reports, and Existing Water Resources Projects

This section contains a summary of relevant past and current projects

Upper Mississippi River Environmental Design Handbook, August 2006. This document provides design guidance for habitat projects involving items such as water level management, floodplain restoration and other features. It is a documentation of lessons learned and innovations in the Environmental Management Program (EMP).

Identifying, Planning and Financing Beneficial Use Projects using Dredged Material is a guidance document that was published jointly by the Corps and the U.S. Environmental Protection Agency (USEPA) in October 2007. In this document Habitat Development is identified as one of the most common and most important beneficial uses of dredged material.

Pool 2 Dredged Material Management Plan. This draft report is under development in 2018. Long term planning for dredged material placement has been ongoing since the mid-1970's to maximize opportunities for beneficial use, starting with the Great River Environmental Action Team (GREAT) study from 1974 -1980. As a result of the GREAT recommendations, seventeen reconnaissance reports were developed in the mid-1980's assessing specific dredging locations and subsequent management of the material. These documents have reached the end of their planning period and are being updated on a pool-by-pool basis. Issues to be addressed in the Pool 2 Dredged Material Management Plan (DMMP) include increased sedimentation throughout Pool 2 and the lack of long-term upland dredged material placement sites available for use.

Lock and Dam 2 Embankment Repair. This effort is in plan formulation and the project design will be initiated and completed in 2018, with construction award scheduled for 2019. Lock and Dam 2 is located at approximately river mile 815, near Hastings, Minnesota, between Dakota and Washington Counties. This site consists of the main lock, and one auxiliary lock on the Washington County side, and the embankment on the Dakota County side. The Lock and Dam 2 embankment will undergo an embankment repair and improvement project to ensure it is protected from potential erosion due to high waters, ice action, and wind fetch.

Lower Pool 2 Channel Management Study. The Boulanger Bend to Lock & Dam 2 study is located on the Mississippi River in Lower Pool 2 between river miles 815.2 and 821.0. This segment of the nine foot navigation channel has experienced changing sedimentation patterns that have exceeded the Corps' ability to maintain the channel. The degraded channel has adversely affected commercial navigation and strained the U.S. Coast Guard's ability to delineate safe conditions for all users. The Lower Pool 2 Channel Management Study recommended plan is to excavate/maintain a wider channel that is still within authorized dimensions and place two new training structures (rock sills) one on the right descending bank and one on the left descending bank. These minor changes would improve navigability and safety.

2 Affected Environment and Future without Project conditions

The following paragraphs describe the current conditions and the anticipated future without project conditions within and around the project area.

2.1 Physical Setting

Pigs Eye Lake is located in Ramsey County, MN; the shallow backwater is 628 acres in size, with depths averaging only 3-4 feet deep in the deepest areas (Figure 2). Pigs Eye is located southeast of St. Paul, Minnesota, within Pool 2 of the Mississippi River. Pigs Eye is one of the three largest lakes in St. Paul, MN. Although Pigs Eye is called a lake, it is actually a large riverine open-water floodplain. The area is managed as part of the Ramsey-Washington Metro Watershed District. Pigs Eye Lake was named after an early European settler named Pierre "Pigs Eye" Parrant, who was blind in one eye.

The north end of the lake and adjacent riparian land is owned by the City of St. Paul (Figure 3). The majority of the lake and riparian area is owned by Ramsey County. The land area northwest of the lake contains inactive waste water treatment ponds and is owned by the Metropolitan Waste Control. The Port Authority owns portions of the lake and riparian land on the southern tip of the lake around the outlet of Pigs Eye Lake into the Mississippi River. The Port Authority land is currently being utilized for barge loading/off loading, and this area is dredged to maintain suitable depths for barge traffic.

The existing land use in and around the project area is predominantly floodplain forest and shallow marsh (Figure 4).

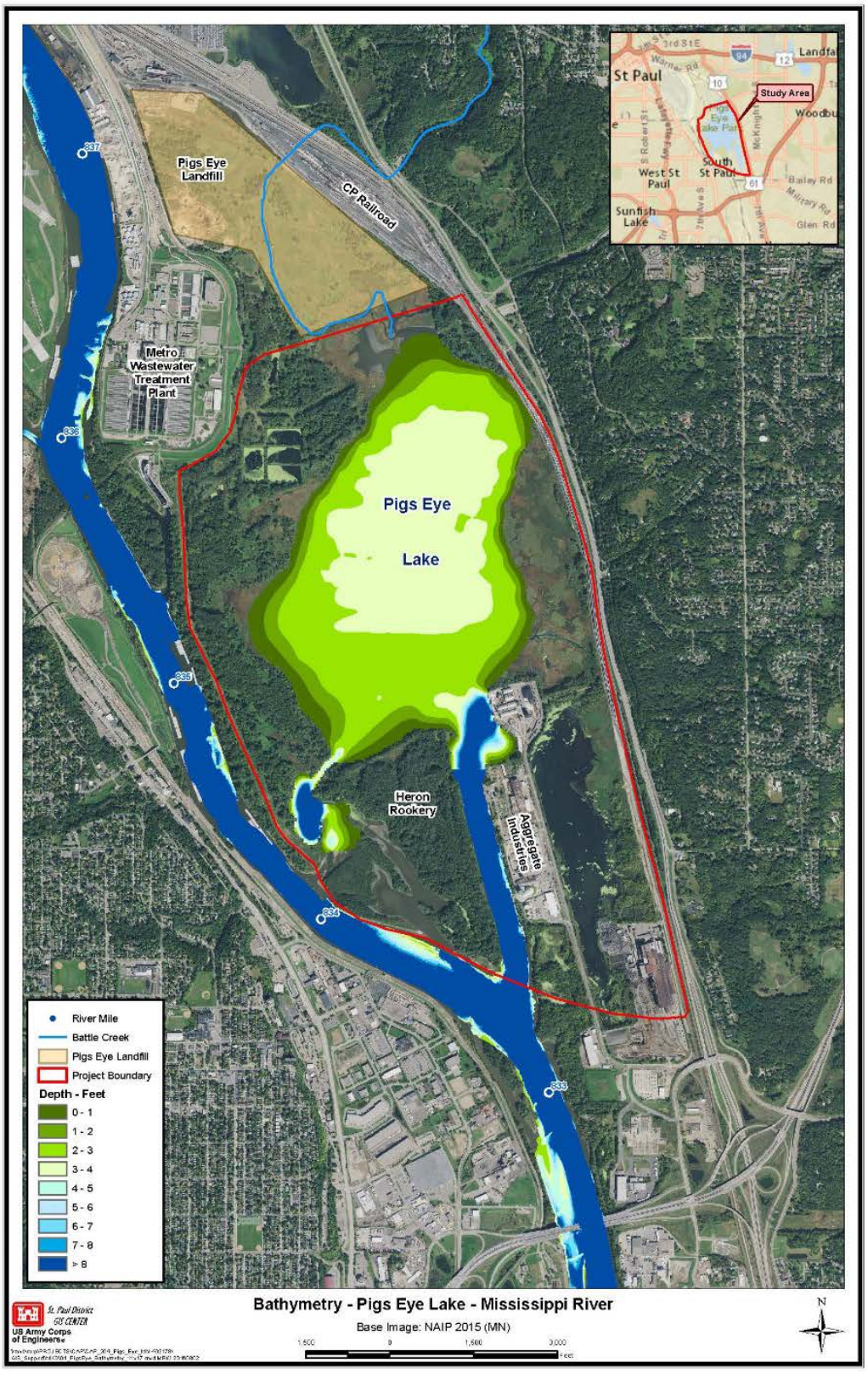

Figure 2: Pigs Eye Lake Bathymetry

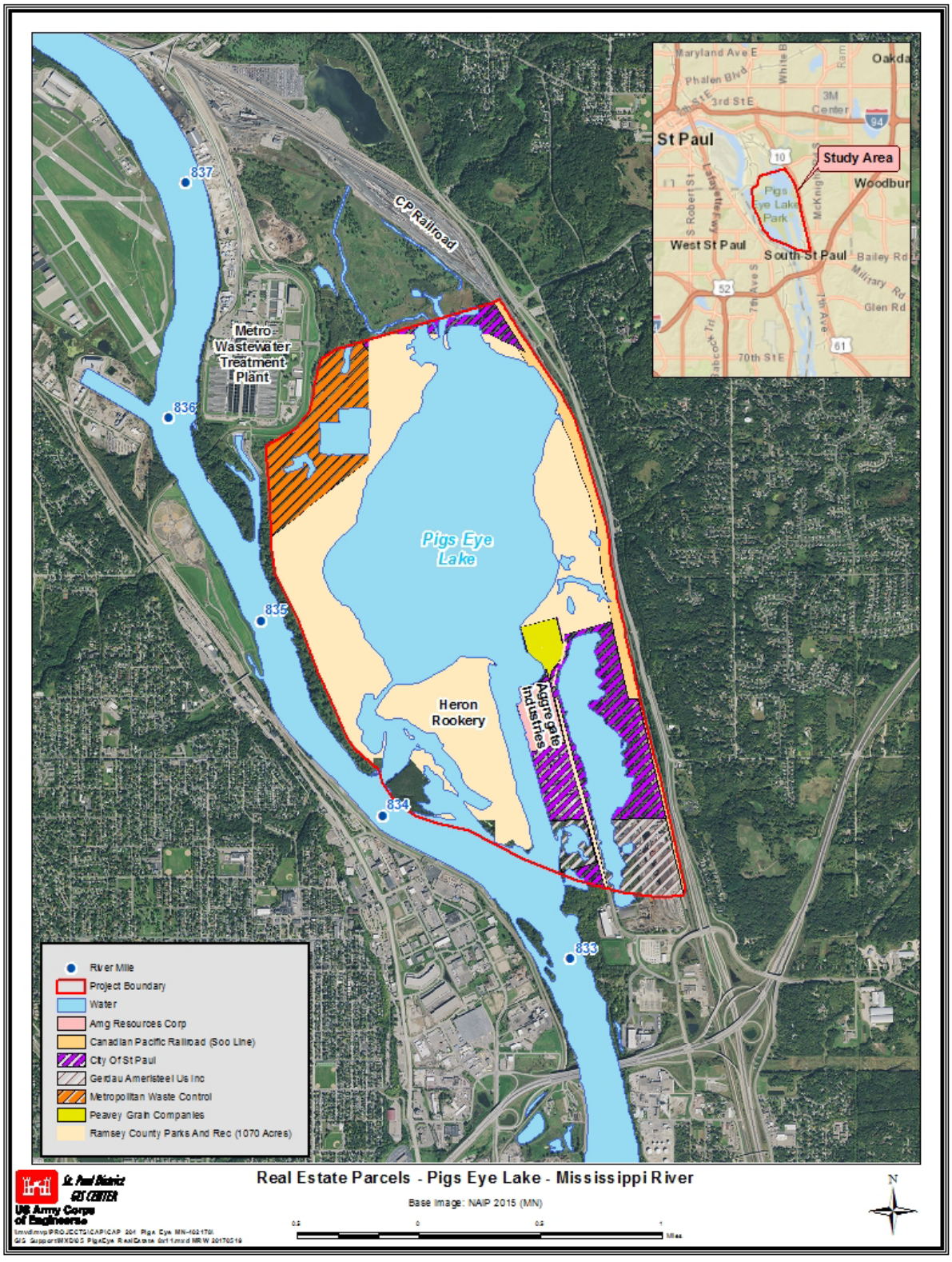

Figure 3: Pigs Eye Lake Real Estate

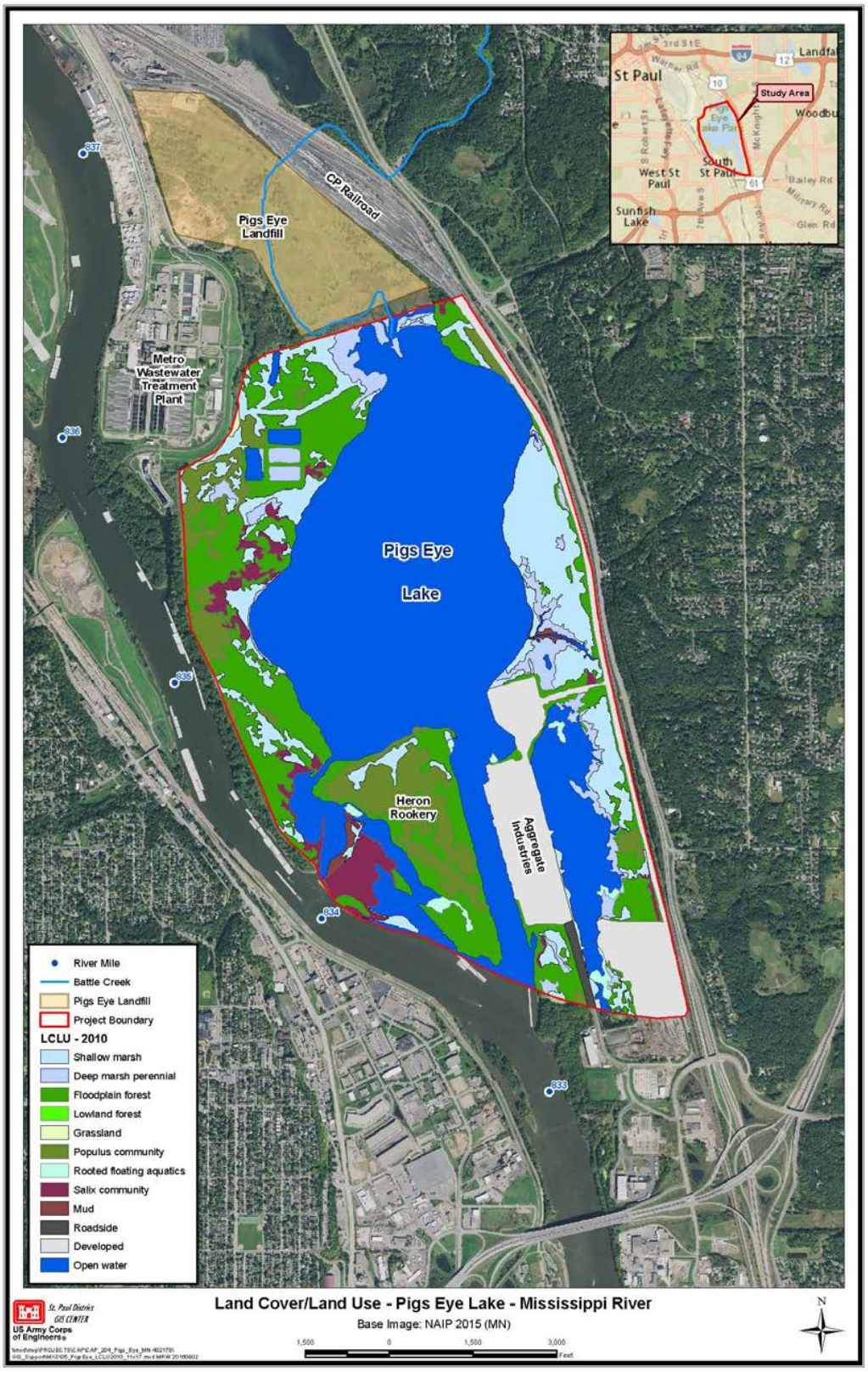

Figure 4: Land Use and Land Cover

2.1.1 Pigs Eye Lake Heron Rookery

To the south of Pigs Eye Lake, on Pigs Eye Island, is the Pigs Eye Heron Rookery Scientific and Natural Area. This floodplain forest supports nesting colonies of a number of colonial waterbirds, including the great blue heron, great egret, black-crowned night-heron, double-crested cormorant and yellow-crowned night-heron. This is one of only four locations within Minnesota where yellow-crowned night-herons are known to nest. Many other birds also utilize the site, and a total of 89 bird species have been documented on the island.

2.1.2 Pigs Eye Landfill

To the north is the 300 acre site of the former Pigs Eye Landfill, which was used for the disposal of mixed municipal, commercial, and industrial waste beginning in the mid-1950s until 1972, and for disposal of incinerated sludge ash from 1977 to 1985. According to the Minnesota Department of Health, "although commonly referred to as a landfill, the site did not operate according to Minnesota Pollution Control Agency's (MPCA) landfill rules, which were not yet in place when the site was in operation. Therefore, the site is more accurately described as a dump where refuse of various types were disposed of with minimal control" (Minnesota Department of Health, 2000).

As a result of the various types of waste dumped at the site over the years, it is currently listed on U.S. Environmental Protection Agency's (EPA) Comprehensive Response, Compensation, and Liability Information System (CERCLIS) and is a Minnesota Superfund site addressed by the MPCA Superfund Program.

Currently, the MPCA is coordinating cleanup activities at the dump site, as required by the Minnesota Superfund program.

2.1.3 Canadian Pacific Railway

The Canadian Pacific Railway, or CP Rail System, is near highway 61 and the east edge of Pigs Eye Lake. The rail yard was built in 1950s, and currently more than 110 trains pass through this area per day.

2.1.4 Metropolitan Wastewater Treatment Plant

To the west of Pigs Eye Lake is an upland area with a moderate degree of development, including the Metropolitan Wastewater Treatment Plant.

2.1.5 Aggregate Industries

The main access to Pigs Eye Lake is through a slip maintained by Aggregate Industries, a manufacturer and supplier of asphalt, concrete, and other aggregates. Barges from the main channel of the Mississippi River travel through the slip to access Aggregate Industries, and can load and unload on the northern most end of the property at the Red Rock Terminal.

2.2 Climate

The project area has a continental climate typical of the upper Midwestern United States. Winters are cold and snowy while summers are hot and humid. The average annual temperature of the area is

47.05° F (56.6° F/37.5° F) with an average annual precipitation of 32.04 inches. As a result of the continental climate, the area experiences a great range of temperatures and the full range of precipitation and related weather events including snow, sleet, rain, ice, thunderstorms, tornadoes, and fog. Further climate change analysis for the region and potential effects on flow has been conducted and is available in Appendix G.

2.3 Geology and Soil Substrate

2.3.1 Geology

Pigs Eye Lake is located within a historic river channel cut into Paleozoic sedimentary rock formations during the Pleistocene glacial period 40,000 to 10,000 years ago. The valley was subsequently filled with glacial sediment. The current Mississippi River channel adjacent to Pigs Eye Lake was cut during the draining of Glacial Lake Agassiz via Glacial River Warren 11,700 and 9,400 years ago. During glacial waning periods large amounts of sediments deposited by Mississippi tributaries acted as natural dams, creating a series of lakes upstream and likely leading to the deposition of glacio-lacustrine clays on the western portion of Pigs Eye Lake. Since glacial time the Mississippi River has been a braided stream affecting Pigs Eye Lake only in times of flood.

The construction of the locks and dams upstream and downstream along the Mississippi is not believed to have had a significant effect on the sedimentation patterns of Pigs Eye Lake, which was already a backwater area. On the other hand, development to the north and west of the lake likely did have an impact on sedimentation. Development immediately upstream of the lake, including the adjacent waste water treatment plant, resulted in the abandonment of an upstream channel connecting the lake to the main channel. Additionally, as a result of the rail yard development north of Pigs Eye Lake, Battle Creek channel was re-routed and its flow conditions were likely altered. By further isolating the lake from the main channel, these changes likely resulted in an increased rate of fine particle sedimentation within the lake.

2.3.2 Subsurface Conditions

Four soil borings were performed during late October 2015 by USACE personnel. The boring locations were selected in order to characterize conditions throughout the lake, and generally corresponded with the locations of conceptual project features. Results on the borings are further detailed in Appendix E, Section 5.1.

Borings generally indicated very soft soils for a depth between 10 ft and 22 ft. The bottom of Pigs Eye Lake is primarily composed of unconsolidated silts and clays (with 90 percent of material passing through a #200 sieve) and a high concentration of organic carbon. The soils were dominated by silty clay with organics (CH) but also included clayey organic silt (OH), clayey peat (Pt), clayey sand (SC), and wood fragments mixed with clay (Pt).

The very soft soils are underlain by either bedrock, indicated by the trace levels of the St. Peter sandstone in boring 15-3M, or dense sandy and/or gravelly alluvium.

2.3.3 Hazardous, Toxic, and Radioactive Waste (HTRW)

Environmental studies by several agencies, including the Corps, have been conducted in the project vicinity of Pigs Eye Lake. Because there are known sources of hazardous, toxic, and radioactive wastes (HTRW) in the project area, a Phase I HTRW analysis was conducted in June 2016, in accordance with ER-1165-2-132, Water Resource Policies and Authorities HTRW Guidance for Civil Works Projects. The Phase I analysis identified the primary sites with the highest potential for soil and water contamination, which are the Pigs Eye Landfill, a 350 acre site immediately north of the lake, and the Pigs Eye Wastewater Treatment Plant, 1 mile northwest of the lake (see Appendix K – HTRW, for the full report).

As a result of the Phase I report, a Phase II investigation with additional sampling at the proposed project locations was conducted in order to better quantify any potential chemical or environmental contamination that may exist and thereby impact the proposed Project. The results of the tests conducted are summarized below in Section 2.3.4, while full results are included in Appendix E - Sediment Report. Section 7.1.6 presents a discussion and conclusion about the results in regards to the proposed alternative.

2.3.4 Sediment Contaminant Testing Summary

The Corps collected sediment samples throughout Pigs Eye Lake and analyzed them for a suite of routinely-tested physical and chemical parameters. The Corps also collected and incorporated results of tests previously conducted by other entities in Pigs Eye Lake. Contaminant levels found in the tests were compared with several sets of reference values developed by the Minnesota Pollution Control Agency (MPCA) to evaluate the acceptability of constructing potential project measures within the lake. The results were coordinated and discussed with local and regional resource agencies. The analysis and coordination led to the conclusions that: (1) The northernmost portion of the lake near the former Pigs Eye Landfill should be avoided as part of this project (incorporated as a planning constraint, see Section 4.2 and Figure 15), and (2) Construction of habitat features in the remainder of the lake are not expected to pose an unacceptable risk to wildlife and therefore, overall project planning should continue.

Targets used to interpret the degree of contamination are divided into SQTs and SRVs. The Sediment Quality Targets (SQTs) consist of level I guidance for a high level of protection for benthic invertebrates and level II guidance for the moderate level of protection for benthic invertebrates. The MPCA's Residential Soil Reference Values (SRVs) were also compared to the results to determine if the material is suitable for upland placement.

The MPCA oversaw and/or conducted sediment sampling in the northernmost portion of Pigs Eye Lake between 1992 and 2007. Results of the various investigations conducted in the lake indicate that cadmium, copper, lead, zinc, and polychlorinated biphenyls (PCBs) are present in the Pigs Eye Lake sediments at concentrations that exceed respective level I and level II sediment quality targets (SQTs). Additionally, perfluorinated chemicals (PFCs), including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have been detected in lake sediments. However, PFCs are ubiquitous throughout Mississippi River Pool 2, and with the exception of the area directly around the landfill, PFC

levels within Pigs Eye Lake do not appear to be significantly elevated compared to the general region (see Appendix E – Sediment Report, Attachment 1, PFC Summary).

The Corps conducted two sediment surveys; 3 boreholes were tested in 2015 and 10 boreholes were tested in 2016. The samples were analyzed for grain size, metals, PCBs, pesticides, PAHs, cyanide, total organic carbon, percent moisture, percent solids and percent total volatile solids. In addition, PFCs were analyzed for 6 of the 10 2016 boreholes. Under MPCA's current SQT and SRV levels, the only exceedances detected in the 2015 sampling were for SQTs and only for the borehole closest to the former landfill (15-1M), except for cadmium which exceeded the SQT I in all three boreholes. Under the proposed changes to the SRVs, cadmium levels from boreholes 15-1M and 15-2M and benzo(a)pyrene from 15-1M exceeded the Residential/Recreational limit, but were below the Commercial/Industrial SRVs.

The 2016 results showed similar results as the 2015 survey, with a large number of SQT exceedances, but again there were no SRV exceedances under the current MPCA guidance. Similar to the 2015 results, however, several boreholes showed recreational/residential use exceedances for cadmium and benzo(a)pyrene under the proposed MPCA SRV values.

As an outcome of the USACE surveys, it is believed that the highest levels of contamination are limited to the area adjacent to the landfill. The rest of the lake shows contamination of PFCs, widespread low level (SQT I) exceedances for heavy metals and PAHs, limited locations with higher exceedances for cadmium and PAHS (SQT II and proposed Recreational/Residential SRVs) and no recent detection of PCBs. A detailed discussion of the sediment analysis conducted for the project is presented in Appendix E – Sediment Report.

2.4 Hydrologic and Hydraulic Conditions

2.4.1 River Discharge and Stages

Mississippi River annual chance exceedance of discharge is shown in Appendix G - Hydrology and Hydraulics; the tables in the appendix can be used to relate discharge with frequency. Annual Chance Exceedance (ACE) discharges that could be useful in this study are:

50% ACE (2-year)	38,500 cfs
20% ACE (5-year)	63,400 cfs
10% ACE (10-year)	81,800 cfs
5% ACE (20-year)	101,000 cfs
2% ACE (50-year)	127,000 cfs
1% ACE (100-year)	148,000 cfs
0.5% ACE (200-year)	169,000 cfs
0.2% ACE (500-year)	200,000 cfs

This data is taken from a discharge frequency analysis of the Saint Paul Gage (USGS) on the Mississippi River. These discharges are used in the most recent Flood Insurance Study models (HEC-RAS). A more detailed figure which includes additional technical information can be seen as Figure 1 in Appendix G.

2.4.1.1 Dam Operation

Pool 2 is regulated in a manner typical for navigation pools in the St. Paul District. Figure 5 shows the operating curves for Lock and Dam 2 on the Mississippi River. All elevations stated are NAVD 1988. The curve for the South Saint Paul Control Point (CP) can be used to estimate water elevations in Pigs Eye Lake. When river discharges are greater than 62,500 cfs, the gates are removed from the water at Lock and Dam 2 and the pool is unregulated. When discharges are between 12,500 and 62,500 cfs the pool is in "secondary control," i.e., a pool elevation of 686.1 ft is maintained at the dam. The water surface elevation upstream of the dam rises and falls with river discharge. Due to the slope on the pool, the range of fluctuation under secondary control is greater the farther upstream from the dam one progresses.

Figure 5: Operating Curves for Dam 2 (Note Elevations are in NAVD88 Datum)

When river discharges decline to 12,500 cfs, regulation of the pool shifts to "primary control," whereby a water surface elevation of 686.8 is maintained at the primary control point at the South Saint Paul Gage (which happens to be adjacent to the Pigs Eye Lake area). As discharges decline below 12,500 cfs, the water surface elevation at Lock and Dam 2 is increased from 686.1 to 686.8. If river discharges were to decline to zero, the pool water surface would (in theory) be flat at elevation 686.1. The mapped floodway and ineffective flow areas were also identified in order to avoid inducing flood stage impacts (see Figure 15).

2.5 Water Quality

Historical water quality data for Pigs Eye Lake is limited, as the lake is not monitored by the local watershed district or Ramsey County Parks & Recreation. However, the lake does have a long

documented history of high turbidity. As just one example, an account in a local newspaper from September of 1973 describes a canoe tour of Pigs Eye Lake: "The muddy bottom is so close to the surface during these waning summer days that large carp barely have room to jump over canoe paddles. But the water is so murky you can't see them."

According to the MPCA website, the mean concentration for total phosphorus in Pigs Eye Lake is 0.365 mg/L and the mean Secchi disk transparency for Pigs Eye Lake is 1.3 feet, giving the lake a hypereutrophic classification. These average conditions are based on a summary of lake water quality data available on the MPCA website (www.pca.state.mn.us), which indicates that the data is old (collected between 1970 and 1988), but does not indicate the origin of the data. Satellite imagery acquired between 1999 and 2000 indicated that the lake's transparency depth is less than 1.5 feet (Minnesota Lake Finder, www.dnr.state.mn.us). In general, these data are indicators of poor water quality and suggest that the lake is very nutrient-rich and has low visibility and light penetration.

2.6 Air Quality

The EPA is required by the Clean Air Act to establish air quality standards that primarily protect human health. These National Ambient Air Quality Standards (NAAQS) regulate six major air contaminants across the United States. When an area meets criteria for each of the six contaminants, it is called an 'attainment area' for that contaminant; those areas that do not meet the criteria are called 'nonattainment areas.' Ramsey County is classified as an attainment area for each of the six contaminants and is therefore not a region of impaired ambient air quality (EPA 2017). This designation means that the project area has relatively few air pollution sources of concern.

2.7 Habitat

2.7.1 Aquatic Habitat

Pigs Eye Lake is a contiguous backwater floodplain lake, situated in the middle portion of Navigation Pool 2 of the Mississippi River. The upper and middle portions of Pool 2 are constricted by tall bluffs, and consist predominantly of main channel and main channel border habitats. The main channel is the part of the river that conveys the majority of river discharge. The main channel in Pool 2 is managed for commercial navigation (i.e., barge) traffic and is maintained at a depth of at least nine-feet-deep by dredging in areas where sediment accumulates. Main channel border habitat includes the areas between the deep channel and the riverbank. Pigs Eye Lake is somewhat unique as one of the few backwater areas in this upper portion of the Pool. No comparable backwater areas exist upstream of Pigs Eye Lake in Pool 2, and the next nearest backwater lake is more than six miles downstream. Unfortunately, Pigs Eye Lake's loose, mucky bottom, wind-swept surface, and shallow depths limit the biological productivity of the lake. Re-suspension of sediments from wind and rough-fish activity limit light penetration and rooting capability of submersed vegetation. The lack of stable substrate and high nutrient levels limit the establishment of macroinvertebrate communities.

2.7.2 Wetlands

The Corps' definition of wetlands are, "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a

prevalence of vegetation typically adapted for life in saturated soil conditions." While a full, detailed wetland delineation has not been conducted for the project area, it is apparent from aerial imagery dating as far back as 1951 that the majority of the lake does not support aquatic vegetation. Wetland vegetation is prevalent around the outside edge of the lake and the surrounding floodplain habitat, and includes species such as bulrush, bur-reed, arrowhead, and cutgrass. However, the extent of the wetland vegetation has slowly been receding due to de-stabilization and erosion of the shoreline. It is estimated that 111 acres of wetland have been lost in this manner since 1951. Approximately 131 acres of shallow marsh wetland and 18.6 acres of bottomland scrub/shrub forest are estimated to remain in the shoreline area surrounding Pigs Eye Lake.

2.7.3 Terrestrial Habitat

The riparian area surrounding Pigs Eye Lake is low-lying marsh. Areas of emergent aquatic vegetation, represented by sedges, rushes, cutgrass, smartweeds, arrowhead, and water plantains are interspersed with woody terrestrial communities represented by species such as silver maple, green ash, American elm, cottonwood, box elder, and sandbar willow. Most of the immediate shoreline is undeveloped, but is bordered by a network of railroad tracks to the northeast, a wastewater treatment facility to the west, and a former dump site to the north. The island on the south side of the lake is a valuable Heron Rookery, and is more densely forested than the areas on the north and west sides of the lake

2.8 Fish and Wildlife

2.8.1 Fish

In comparison to other Upper Mississippi River pools, Pool 2 supports a moderate fishery. Upper Pool 2 provides mostly main channel and main channel border habitat because the floodplain is restricted by bluffs throughout the upper portion. Water quality also influences the fish community in Pool 2 – high turbidity and high nutrient levels downstream of where the Minnesota River enters Pool 2 decrease the suitability of this habitat for some fish. Trapnet surveys of Pigs Eye Lake were conducted five times between 1972 and 1999. The most recent survey in 1999 found gizzard shad to be the most abundant (319 of 605 fish sampled), while common carp made up the majority of biomass (164 of 334 pounds of fish sampled). Other species found include black crappie, bluegill, bowfin, channel catfish, freshwater drum, quillback, and white bass. Twenty species were sampled in total.

The UMR on a whole supports a diverse assemblage of freshwater fish. Approximately 100 species of fish representing as many as 25 families have been recently sampled from the UMR between Minneapolis and Lock and Dam 10 (Schmidt & Proulx, 2009). Most of the fish present are native warmwater species. Common game species include walleye, sauger, northern pike, channel catfish, largemouth bass, bluegill, and white and black crappie. Common non-game fish include freshwater drum, carp, redhorses, buffaloes, and a wide variety of minnows. Exotic species currently residing in the UMR include common carp, grass carp, bighead carp, goldfish, and rainbow and brown trout.

2.8.2 Wildlife

The Mississippi River is a part of a major bird migration route, termed the Mississippi Flyway. At least 300 species of birds, about 60 percent of the total number of species in the conterminous United States,

are known to nest along the Upper Mississippi River and within the river valley. Waterfowl are considered particularly important due to their large numbers and visibility. Approximately 30 species of waterfowl use the UMR. Waterbird surveys were conducted by the National Park Service during the fall migration, from October-December of 2015. Surveyors observed 17 species of waterbirds on Pigs Eye Lake. Species included mallard, gadwall, widgeon, common merganser, ring-billed gull, and ruddy duck. Between 4 and 8 bald eagles were observed during each of the five site visits as well (Holdhusen, 2016).

A variety of mammals and birds inhabit the floodplain forests and wetlands adjacent to Pigs Eye Lake. River otters and beavers were observed during National Park Service waterbird surveys (Holdhusen, 2016), and an active beaver lodge and several otter dens have been documented. White-tailed deer, red fox, raccoon, woodchuck, striped skunk, Eastern cottontail, and a variety of squirrels all inhabit the floodplain, and also likely make use of the shoreline habitat surrounding Pigs Eye Lake.

2.8.3 Aquatic Invertebrates

The unconsolidated, flocculent, and organically-enriched substrate present throughout Pigs Eye Lake is not well suited to a diverse macroinvertebrate community. A 2007 report describing the results of a survey of the benthic community in Pigs Eye Lake characterized the area as having extremely low diversity and noted that the lake was “dominated by two groups – Chironomidae (midges) and Oligochaeta (aquatic worms) – that are normally considered tolerant of pollution and organic enrichment” (Montz 2007).

2.8.4 Threatened and Endangered Species

2.8.4.1 Federally-Listed Species

A review of the FWS Information for Planning and Conservation (IPaC) website (https://ecos.fws.gov/ipac/), was conducted on February 20, 2018 to determine whether any federally-listed threatened and endangered species may occur within or near the project area. The search area used for the IPaC report is shown in Figure 6 below.

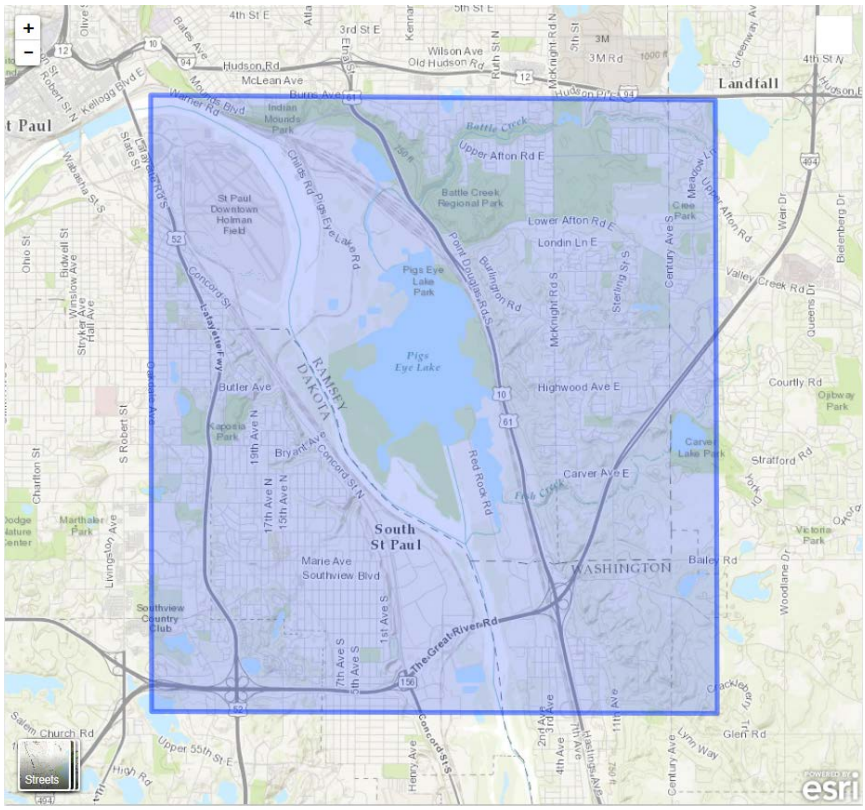

Figure 6: Search Area for IPaC Trust Report, February 20, 2018

The IPaC database search indicated the potential occurrence of four federally-listed species: one endangered mussel - the Higgins eye (*Lampsilis higginsii*); one endangered insect – the rusty patched bumble bee (*Bombus affinis*); one threatened prairie plant – the prairie bush clover (*Lespedeza leptostachya*); and one threatened mammal – the Northern long-eared bat (*Myopis septentrionalis*). These species are listed in Table 1.

Table 1: Federally-Listed Threatened and Endangered Species That May Occur In the Project Area

Scientific Name	Common Name	Federal Status
Mussels		
Lampsilis higginsii	Higgins eye	E
Insects		
Bombus affinis	Rusty patched bumble bee	E
Mammals		
Myotis septentrionalis	Northern long-eared bat	T
Plants		
Lespedeza leptostachya	Prairie bush-clover	T

Status: E = endangered, T= threatened

Suitable habitat for the Higgins eye consists of areas of various stable substrates in large streams and rivers (U.S. Fish and Wildlife Service [USFWS] 2004, Ohio River Valley Ecosystem Team 2002). The Higgins eye has been reintroduced to Pool 2 on a larger scale since 2000, and the population is now naturally reproducing.

The rusty patched bumble bee occupies grasslands and tallgrass prairies of the Upper Midwest and Northeast. This bumble bee needs areas that provide food (nectar and pollen from flowers), nesting sites (underground and abandoned rodent cavities or clumps of grasses above ground), and overwintering sites for hibernating queens (undisturbed soil) (USFWS 2016).

The northern long-eared bat's spring and summer habitat includes live and dead standing trees and the bat feeds on insects while flying through the understory of forested hillsides and ridges. The bat hibernates in caves and mines during the winter, and swarms in surrounding wooded areas in autumn.

The prairie bush-clover is an upland prairie plant, and a member of the pea family. The species only occurs within high-quality, dry to mesic, native tallgrass prairie habitats in the upper Mississippi River Valley.

2.8.4.2 State-Listed Species

A number of species that are listed by the State of Minnesota as endangered, threatened, or special concern have been historically documented in the vicinity of the project area. A review of the Minnesota DNR's State Natural Heritage Information System (NHIS) database was conducted on February 20, 2018. Natural Heritage Database information was obtained from the Division of Ecological and Water Resources, Minnesota Department of Natural Resources (DNR) through an inter-agency cooperative licensing agreement and includes the most recent July 14, 2017 update. The search included a one-mile buffer around the project area to ensure that any listed species, sensitive communities, or critical habitats adjacent to the proposed project area would be included. There are a total of nine species listed by the state of Minnesota as endangered, threatened, or of special concern that may occur within or near the project area: six freshwater mussels, two fishes, and one plant. These species are listed in Table 2.

Table 2: State-Listed Threatened and Endangered Species With Historic Records Near the Project Area

Scientific Name	Common Name	Minnesota Status
Mussels		
Fusconaia ebena	Ebonyshell	E
Arcidens confragosus	Rock pocketbook	E
Truncilla donaciformis	Fawnsfoot	T
Quadrula metanevra	Monkeyface	T
Quadrula nodulata	Wartyback	T
Pleurobema sintoxia	Round pigtoe	SC
Fish		
Ictiobus niger	Black Buffalo	T
Cycleptus elongates	Blue Sucker	SC
Plants		
Besseya bullii	Kitten-tails	T
Crocanthemum canadense	Canada frostweed	SC

Status: E = endangered, T= threatened, SC = special concern

All accounts of the nine state-listed species occur outside of Pigs Eye Lake. The six species of freshwater mussels listed in Minnesota occur in nearby main channel locations with more consistent flow. There are no known recent collections of freshwater mussels from within Pigs Eye Lake. It is unlikely that freshwater mussels would exist in the substrate conditions present within the lake. The accounts of the fish are also outside of the project area, but due to the highly mobile nature of fish, it is assumed that individuals of these species may use the project area. Accounts of the plant, kitten-tails, are from upland areas surrounding the project area. The proposed project does not include any activities expected to take place within the vicinity of these occurrences.

2.9 Historic and Cultural Resources

The Pool 2 locality contains numerous historic properties indicating continual human occupation over approximately the last 12,000 years. Historic properties include a variety of precontact and historic archaeological sites. Precontact sites include lithic and artifact scatters, village sites, petroglyphs, and burial mounds. Historic sites include Dakota villages, trading posts and forts, early town sites, standing structures, shipwrecks, transportation corridors, bridges and river training structures. Several historic properties within this locality are listed on the National Register of Historic Places (NRHP) or are eligible for listing on the NRHP. In addition, the pool contains several historic districts.

Previous investigations proximal to the Project Area include exploration of burial mounds, identification of military roads, transportation features and standing structures and studies associated with the Metropolitan Council Environmental Services sewerage plant. Twenty-six recorded historic properties exist within two and half miles of the Project Area. Several of these sites are listed on or are eligible for listing on the NRHP.

None of the historic properties are situated along the lake's shoreline (most of the shoreline is wetlands or udorthents). Only higher landforms, such as a natural levee running along the peninsula west of the lake and a terrace along the east side of the lake, contain or afford a high probability to harbor intact historic properties.

The nearest historic properties include two burial mounds, a historic road and railroad corridor situated northeast of the lake and a historic road and two historic artifact scatters on the peninsula west of the lake. In addition, possible precontact components were recovered in geologic cores located along the natural levee/peninsula west of the lake. Charred fish bone fragments were identified from two deeply buried soil horizons residing five and eight meters below the modern ground surface. It is not certain if these materials represent human activities or are the product of natural processes, such as a marsh fire. Consequently, these finds have not been assigned a site number.

Pigs Eye Lake proper appears to be a relatively recent body of water. Historical accounts and maps depict the area as marsh, wetland or hay meadow with several streams running through it. The French called the area the Grand Marais. The lake may have formed after the construction of river training structures in the late 19th century and subsequently Lock and Dam 2.

Historic Dakota villages were located along the peninsula west of the lake during the 18th and 19th centuries. Europeans began to occupy the Pigs Eye peninsula in the 1830s and continued through the 1950s. A variety of structures, including a tavern, sawmill, rest house, residences, agricultural fields and a railroad bridge and corridor are depicted on a series of maps and aerial photographs. The community was known by several names, most recently denoted as Pigs Eye. By the 1920s the wastewater treatment plant along the peninsula was installed and the mid-20th century witnessed the construction of barge terminals for elevators and other facilities along the lakes southern outlet. Beginning in the 1950s the area immediately north of the lake was utilized as a dump.

A total of 18 river training structures (e.g., wing dams) are situated along the main channel along the peninsula west of the lake. In the larger context of Upper Mississippi River constriction works, wing dams appear to be eligible for listing on the NRHP (Pearson 2003). As navigation features, they have been periodically modified as dictated by river conditions and navigation needs, especially after the 9-foot channel project began operation in the 1930s. In some cases, they were reduced or extended in length and height or removed. Under the current operations, the wing dams are submerged, although portions of some of the wing dams may be visible during low water events. No historic shipwrecks or river training structures are recorded along the main channel or within Pigs Eye Lake.

Aside from geomorphological investigations along the peninsula and sub-surface investigations in areas within the sewerage plant, no comprehensive cultural resources surveys have been conducted in the Project Area. Because most of the lake's shoreline is wetlands or udorthents (urban or disturbed soil), only the higher ground formed by natural levees, point bars and crevasse splays afford a high probability to harbor intact cultural resources.

2.10 Socioeconomic Resources

Ramsey County is located in the State of Minnesota. The county is named for Alexander Ramsey, the first governor of the Minnesota Territory.

As of 2014, the population of Ramsey County was 532,655. Ramsey County is the 2nd most populated county in the state of Minnesota out of 87 counties and it is one of the most densely populated counties in the United States. The largest Ramsey County racial/ethnic groups are White (64.0 percent) followed by Asian (13.7 percent) and Black (11.1 percent). In 2014, the median household income of Ramsey County residents was $55,101, however, 16.3 percent of Ramsey County residents live in poverty.

St. Paul, the county seat of Ramsey County, is the capital and second-most populous city in Minnesota. The city hosts the Capitol building and the House and Senate office buildings, numerous state departments, federal buildings, and other services are also headquartered in St. Paul. Several major corporations are also headquartered in St. Paul. The city lies mostly on the east bank of the Mississippi River in the area surrounding its point of confluence with the Minnesota River. St. Paul adjoins Minneapolis, and together the "Twin Cities" form the Minneapolis-St. Paul Metropolitan area, with a population of about 3.5 million residents.

2.10.1 Recreation/Aesthetic Resources

The Ramsey County Parks & Recreation system is a natural resource base park system which, encompasses over 6,500 acres consisting of 6 regional parks including a family aquatic center and nature center, 6 regional trail corridors, 9 county parks, 9 protection open space sites, 11 indoor ice arenas and 5 golf courses. The park system is comprised of a variety of land types ranging from urbanized lake fronts, natural lake fronts, and low-land and upland natural areas. Due to the wide range of differing land types a variety of recreational activities consist mainly of boating, fishing, picnicking, play areas, swimming, biking, walking, running, mountain biking, cross country skiing, archery, bird watching, hiking, off-leash dog areas, golf, hockey, and many more.

The project area lies within Pigs Eye Lake section of Battle Creek Regional Park. Battle Creek Regional Park is jointly owned and maintained by Ramsey County and the City of St. Paul and is a is comprised of four segments, Fish Hatchery, Indian Mounds, Pigs Eye Lake, and Battle Creek. The Battle Creek and Pigs Eye Lake segment is owned and maintained by Ramsey County.

2.10.2 Commercial Navigation

Pool 2 serves as a link between the upstream ports of Minneapolis, St. Paul, the Minnesota River, and the remaining Mississippi River navigation system downstream. Between 2006 and 2015 barge freight through Lock and Dam 2 ranged from 4.7 to 7.4 million tons (average of 6.8 million tons). The most important commodities hauled are farm products moving from local terminals in St. Paul and on the Minnesota River to the Gulf for export. Other important commodities include fertilizer, crude materials (sand/gravel/stone, road salt, scrap metal, etc.), cement, and petroleum products.

2.10.3 Airport Wildlife Hazards

The St. Paul Downtown Airport (Holman Field) is located approximately 5,500 feet west/northwest of Pigs Eye Lake. The airport has three runways and services more than 64,000 takeoffs and landings

annually. Aircraft collisions with birds and other wildlife can pose a threat to aircraft safety. Because the proposed project is relatively close to the St. Paul Downtown Airport, the project's potential effects to airport operations were evaluated and coordinated with relevant agencies including the Federal Aviation Administration (FAA), U.S. Department of Agriculture-Wildlife Services (USDA-WS), and Minneapolis Saint Paul Metropolitan Airports Commission.

2.10.4 Environmental Justice

The U.S. Environmental Protection Agency (USEPA) on-line EJScreen mapping tool (Version 2017) was used to characterize existing conditions for minority and low-income groups. A 2-mile buffer around the center of Pigs Eye Lake was created as the study area (a 1-mile buffer was initially selected, but included mostly the lake itself). The EJScreen tool estimated an approximate population of 21,063 in the area. The EJScreen tool identified several Demographic Indicators that had relatively high percentile values compared to the state and regional percentiles, but were not as high when compared to the national averages. For example, the minority population living in the area surrounding the project area is 39%, compared to a state average of 18%, and an EPA regional value of 25%, but a national average of 38%.

2.11 Resource Significance

The criteria for determining the significance of resources are provided in the *Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Water Resources Council 1983)* (P&G) and USACE planning guidance ER 1105-2-100. Protecting and restoring significant resources is in the national interest. The significance and the relative scarcity of the resources helps determine the federal interest in the project. Significant resources in the project area include natural and cultural resources that are recognized as significant by institutions and the public. For ecosystem restoration projects, the significance of resources is based on both monetary and non-monetary values. Monetary value is based on the contribution of the resources to the Nation's economy. Non-monetary value is based on technical, institutional or public recognition of the ecological, cultural, and aesthetic attributes of resources in the project area. The scientific community and natural resources management agencies recognize the technical significance of resources.

2.11.1 Institutional Recognition

Tangible support for the restoration of the lake ecosystem has been demonstrated at the federal, state, and local level. Backwater habitats on the Upper Mississippi River are a significant resource. In 1986, U.S. Congress designated the Upper Mississippi River System as both a "…nationally significant ecosystem and a nationally significant navigation system…" in Section 1103 of the WRDA 1986. The National Research Council's Committee on Restoration of Aquatic Ecosystems targeted the Upper Mississippi River for restoration as one of only three large river-floodplain ecosystems so designated. The Upper Mississippi River Basin Association is an advocate for restoration on habitat on the Upper Mississippi River. In addition, the Upper Mississippi River Conservation Committee recognized the importance of the floodplain forest to the fish and wildlife of the river.

Specific recognition of Pigs Eye Lake's value to wildlife and goals to preserve the area have been ongoing for well over 40 years. For example, an environmental impact report published by the Corps in 1973 noted that, "64 species of birds, including 2,500 herons nest there," and related correspondence from

the USFWS in 1974 reiterated that, "The Pigs Eye Lake area has diverse environmental characteristics which make it imperative that it should be preserved as a natural area."

2.11.2 Public Recognition

Ramsey County is proud of the history of their lake and watershed as a fully-functioning ecosystem and wish to see the habitat restored such that the wildlife there will again be abundant and diverse. The public recognizes the Upper Mississippi River, including Pool 2, as a nationally, regionally, and locally significant resource. Some of the public services the Mississippi River provides include aesthetics, recreation, science, education, raw materials, and flood regulation. In general, these services identified show the wide range of uses from the river, which extend beyond the ecological health of the Upper Mississippi River, and directly relate to public welfare and long-term ecological health of the region.

2.11.3 Technical Recognition

Numerous scientific analyses and long-term evaluations of the Upper Mississippi River have documented its significant ecological resources. Since the early 20th century, researchers, government agencies, and private groups have studied the large river floodplain system. The UMR ecosystem consists of hundreds of thousands of acres of bottomland forest, islands, backwaters, side channels, and wetlands, all of which support more than 300 species of birds; 57 species of mammals; 45 species of amphibians and reptiles; 150 species of fish; and nearly 50 species of mussels. More than 40 percent of North America's migratory waterfowl and shorebirds depend on the food resources and other life requisites (shelter, nesting habitats, etc.) that the ecosystem provides.

3 Problem Identification

Based on the information discussed in Chapter 2, the existing conditions for a variety of fish and wildlife species expected to occur in the type of habitat in Pigs Eye Lake would be considered poor. High turbidity, a lack of habitat diversity, and poor sediment quality are some of the problems that have been identified within the lake that influence the value of the existing habitat. This chapter documents what is known about the problems such as when they may have arisen, stressors that currently contribute to the problems, and how they interact with one another to create the conditions observed in Pigs Eye Lake today. This understanding of the problems is used to predict the future conditions in the project area in the absence of a project.

3.1 Historically Documented Landscape Changes

Historic maps and aerial imagery reveal substantial changes in the landscape and around Pigs Eye Lake. The 1890 Mississippi River Commission map portrays conditions prior to impoundment of the river, and reveals that the majority of Pigs Eye Lake prior was a large, shallow marsh, connected to the main channel of the Mississippi River by small side channels on both the upstream and downstream ends (Figure 7). As mentioned in the Cultural Resources section, French explorers called the area the Grand Marais, meaning "great marsh".

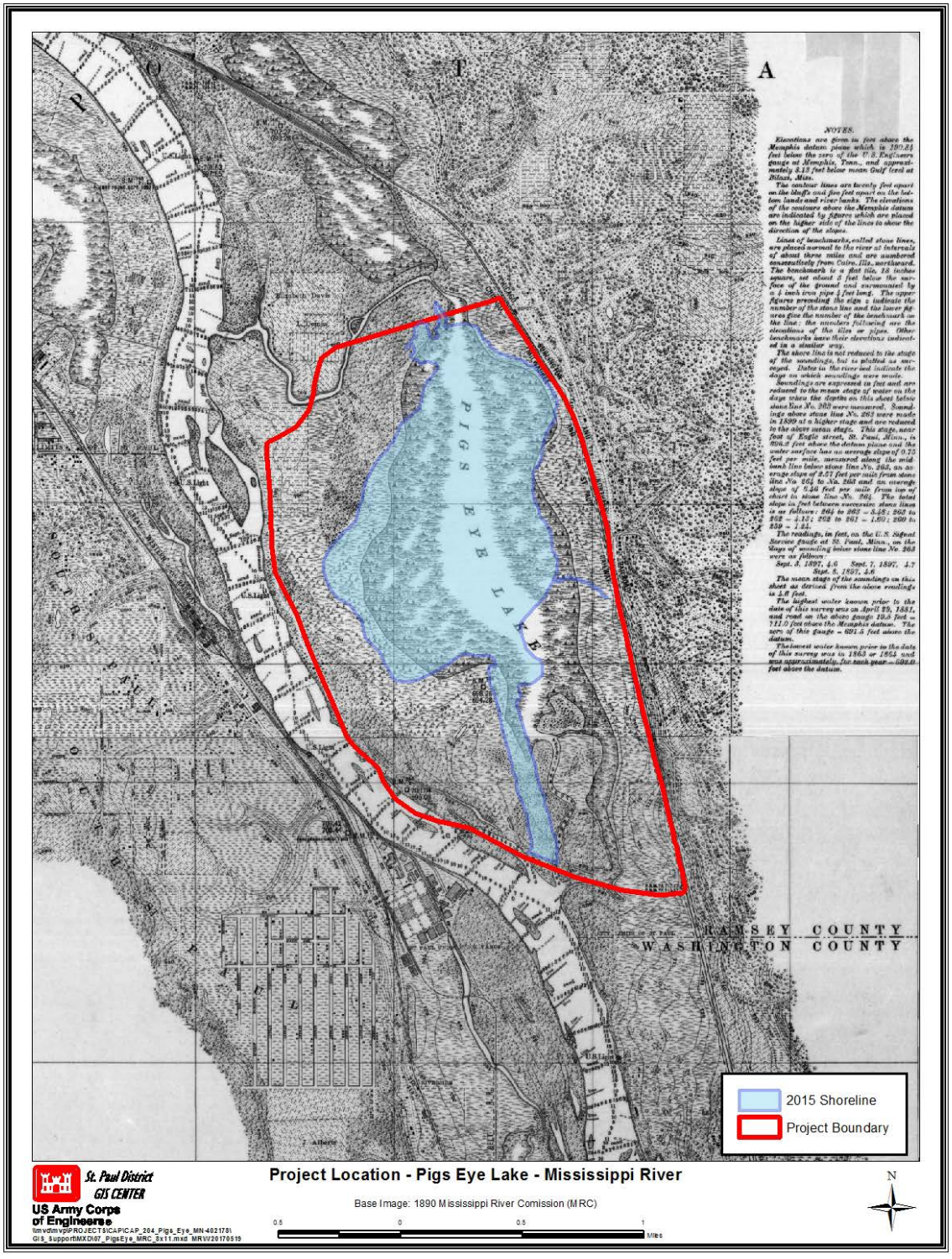

Figure 7: 1890 Mississippi River Commission Map

An aerial photo taken in July of 1951 (Figure 8) shows the impacts of construction of Lock and Dam 2 in inundating much of the marsh area within Pigs Eye Lake. The image also shows the beginning of significant development around the perimeter of the lake. To the northwest, a wastewater treatment plant has been constructed. Railroads, roads, and residential developments are prevalent along the east side of the lake. Compared to modern-day images, the southern end of the lake is significantly less developed and a mosaic of channels and islands is present. The lake itself has more shoreline variability, as well as marsh, wetland, and wooded habitat. The presence of aquatic vegetation can be seen within the lake, as well as shallow areas around the modern-day Heron Rookery.

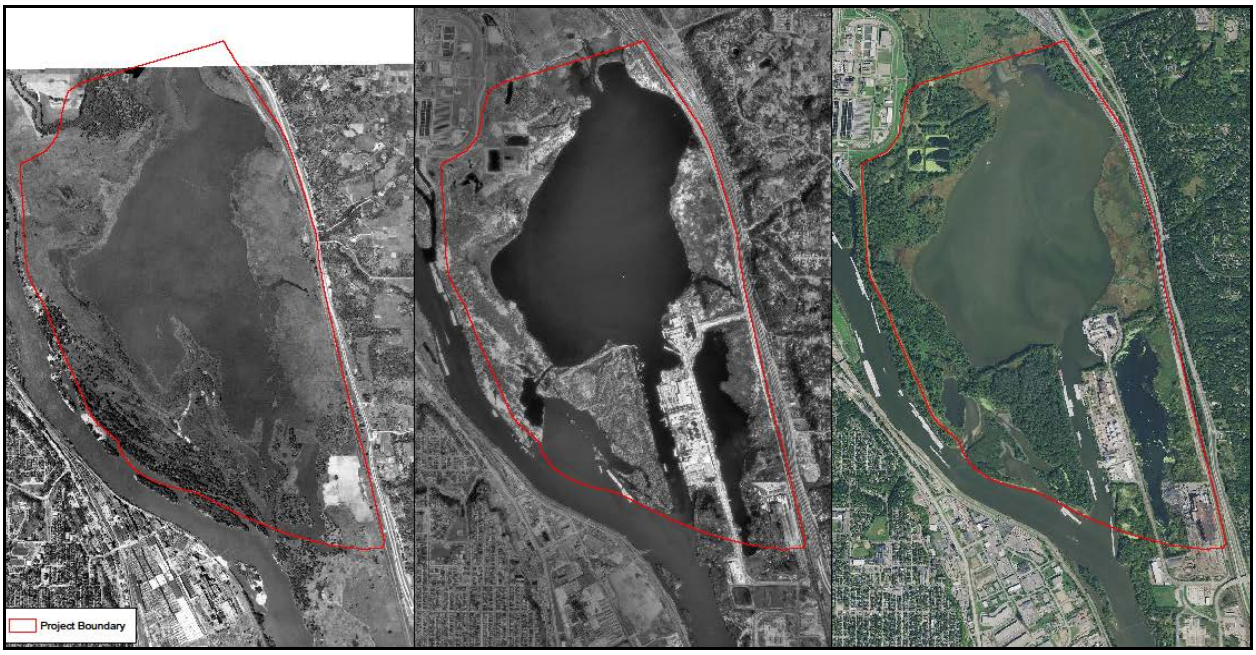

Figure 8: Aerial Photographs From Left to Right: 1951, 1991, and 2015

The 1991 aerial photograph, taken in April, shows much more industrial development around the lake. The Metropolitan Wastewater Treatment Plant has expanded and the associated ash ponds are now visible. Although it is not clear on the map, it should be noted that the Pigs Eye Landfill that was located a little north of the lake was opened and closed in this time period between these two photos. The Red Rock Terminal to the southeast of the lake was constructed, with a prominent dredged channel leading north from the main channel into the lake. The peninsula at the southern end of the lake has disappeared, and the shoreline has eroded, widening the lake. The Canadian Pacific Railroad has expanded into former open water habitat on the northeast side. A channel is apparent at the southeast corner of the lake that leads into the modern-day Hog Lake and the area that connects Hog Lake to the main navigation channel also appears to have been dredged. The dredged area was used as a barge fleeting area, though no barges are visible at the time of the photo.

By 2015, the size of the lake does not appear to have increased dramatically, but a comparison using GIS software suggest that shoreline has indeed continued to erode (see Figure 12). Development has continued in more localized areas to the north, east, and south. The barge fleeting area that had been

dredged to the southwest of the heron rookery has received significant sedimentation and began to revegetate. The 2015 photo was taken in September.

3.2 Factors Influencing Habitat Change

3.2.1 Lock and Dam 2 and Pool Regulation

Prior to river modification projects, this stretch of the UMR contained numerous islands, natural levees, point bars, and secondary channels. At that time, Pigs Eye Lake contained a significant amount of marsh, especially on its east and west sides (Figure 7). When Lock and Dam No. 2 was completed and began operating in 1930, many areas of the floodplain were permanently inundated, including Pigs Eye Lake. The consistent increase in water elevations within the marsh that is now Pigs Eye Lake likely caused the vegetation to slowly die off and become unsuitable for the growth of marsh vegetation.

3.2.2 Wind and Wave Action

Wind blowing across Pigs Eye Lake generates waves that cause shoreline erosion and greatly increase the suspension of the very fine lake bottom sediments. Typical wind direction and magnitude for the area are shown in Figure 9. The wind data that is nearest to Pigs Eye Lake is at the Holman Field Airport which is about two to three miles northwest of Pigs Eye Lake. Figure 10 shows the dominant wind directions overlaid on an image of Pigs Eye Lake, illustrating the most affected shorelines. The primary wind direction is indicated by yellow arrows, whereas the secondary wind direction is shown by black arrows.

Water depths and wind data from Pigs Eye Lake were used to model the 'wind fetch' of the existing conditions for comparison with proposed project. Wind fetch is a measure of the distance wind can travel in a constant direction across water without encountering an obstacle (e.g., shoreline, an island, reef, etc.). Wind data is incorporated into the model to account for the likelihood of wind blowing in any particular direction. The wind fetch of the existing conditions is greater than 900 meters in most parts of Pigs Eye Lake. The strongest wind fetch is in the open water of the lake (Figure 11). Areas with longer wind fetch produce larger wind-generated waves, which can subsequently increase turbidity and erode shorelines. The shallow nature of Pigs Eye Lake makes this particularly problematic because waves have a greater effect on mobilizing sediment when they occur in shallower areas.

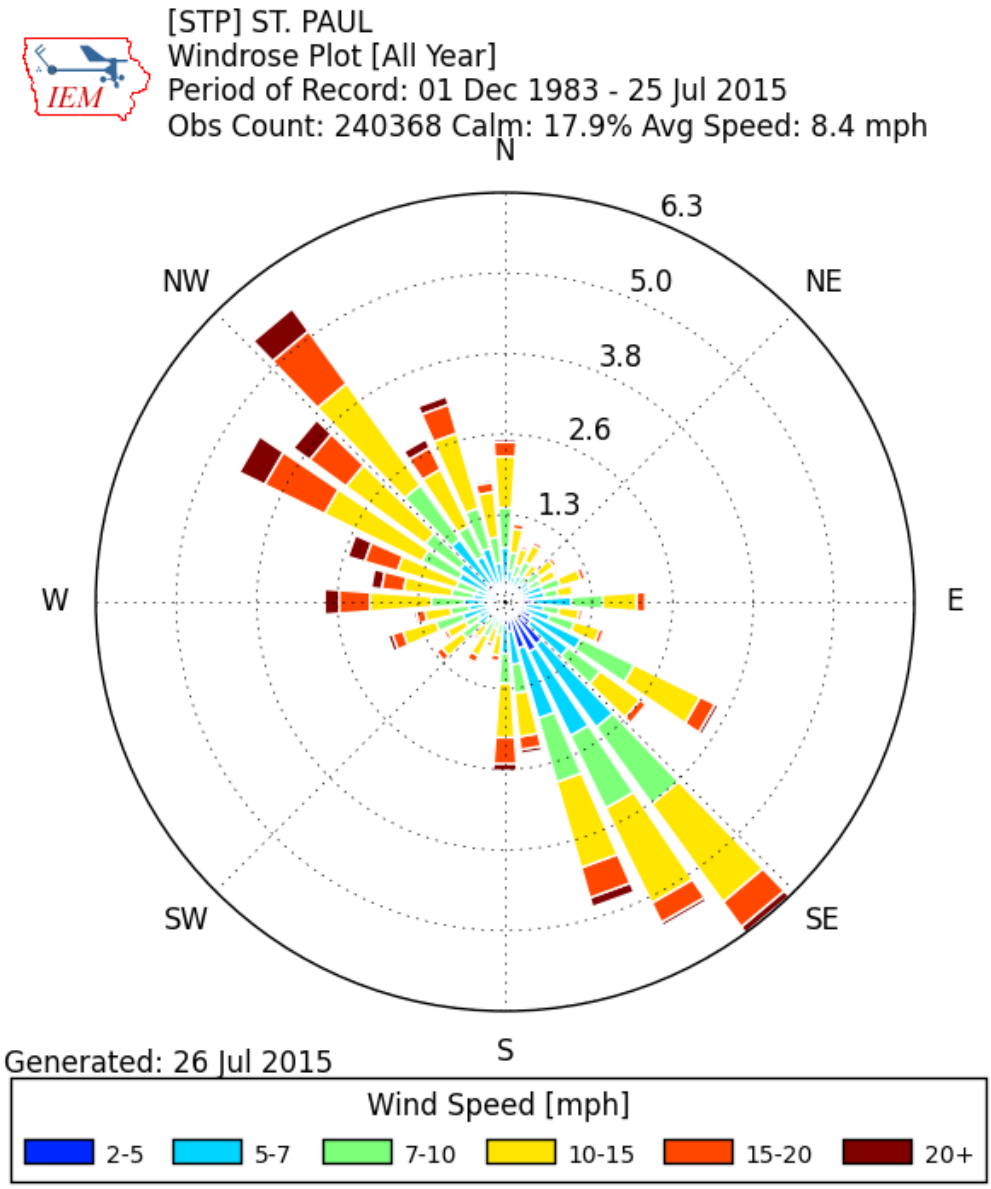

Figure 9: Wind Rose at Holman Field Saint Paul MN (Graphics from IEM/Iowa State University)

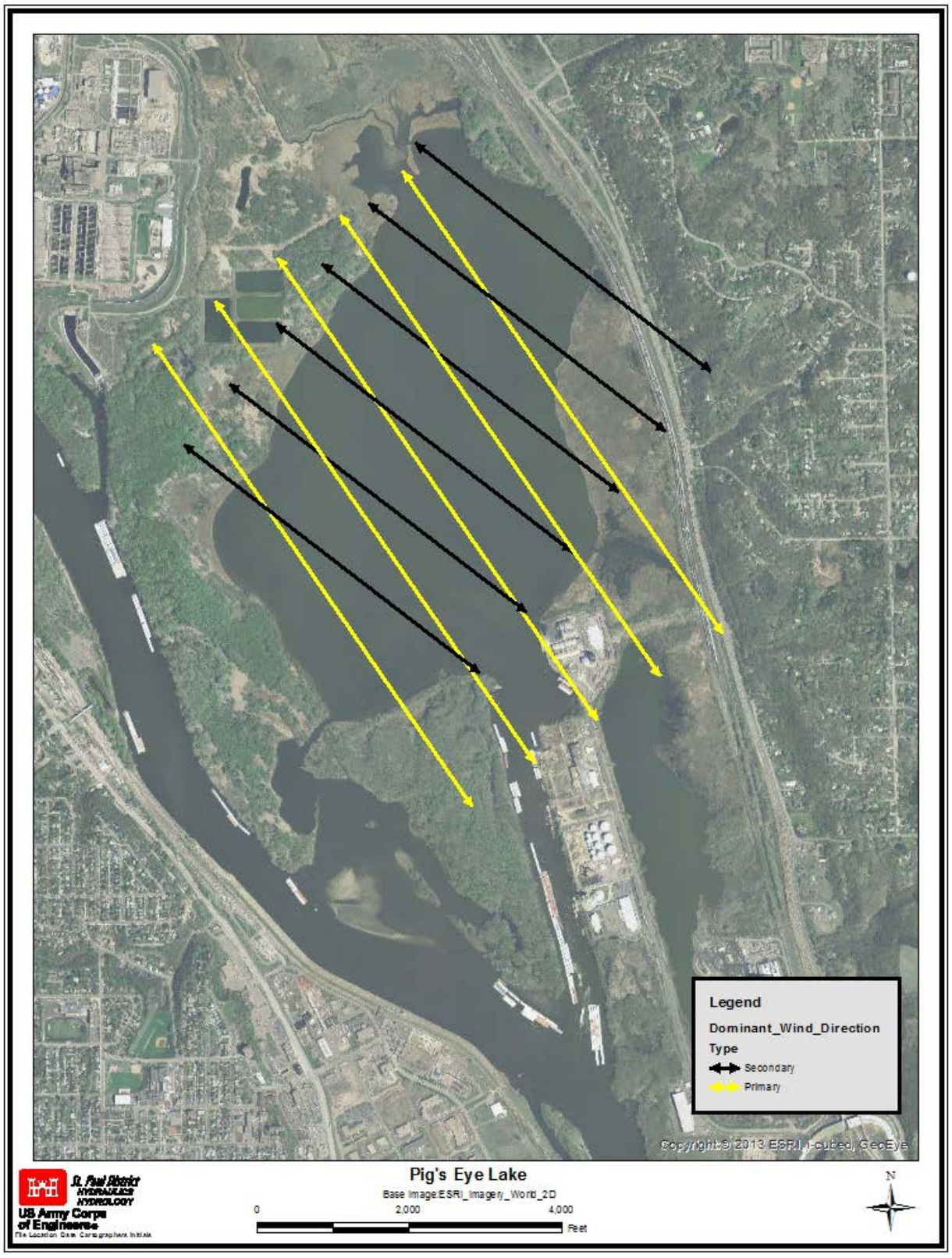

Figure 10: Map Showing Primary and Secondary Wind Direction Over Pigs Eye Lake

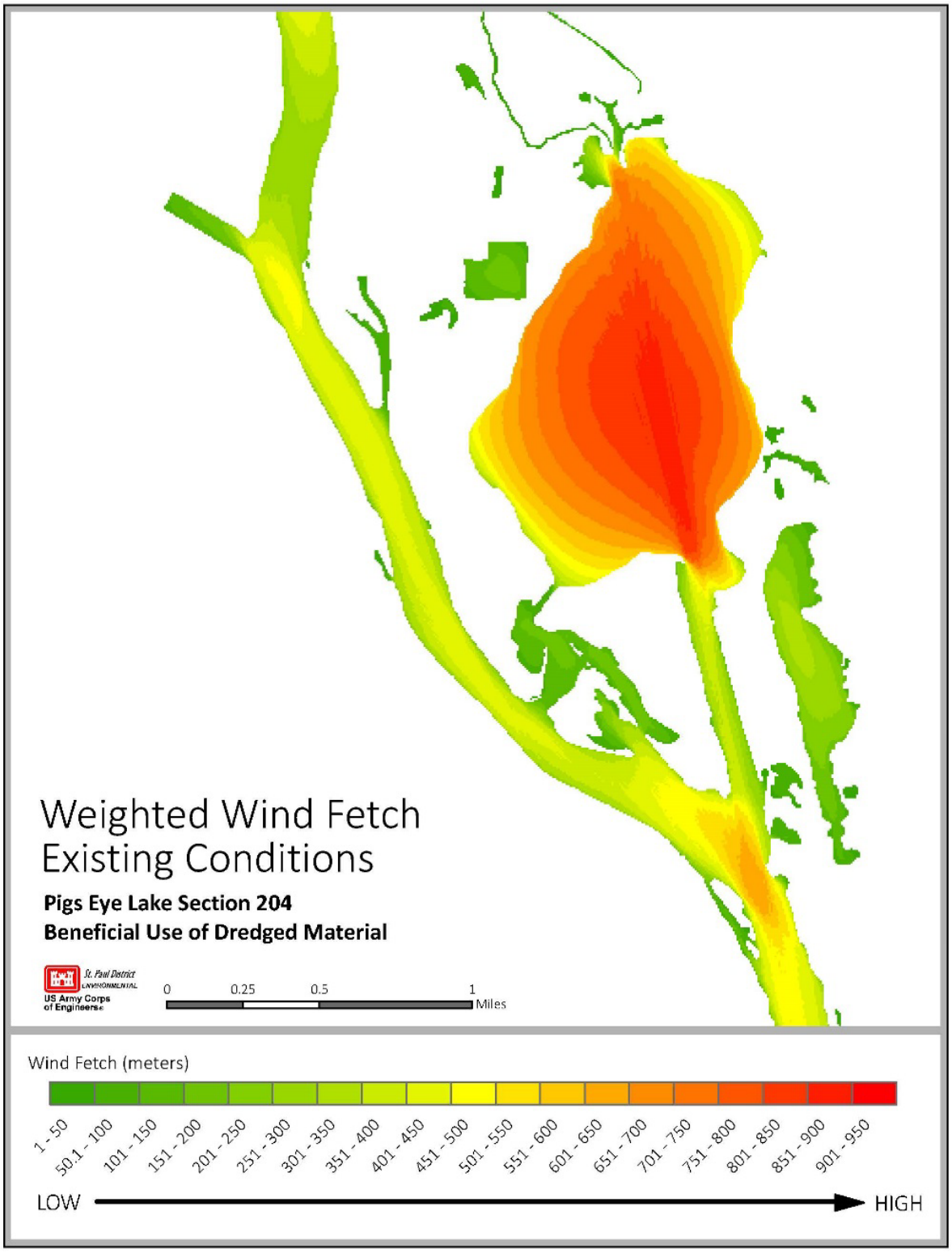

Figure 11: Existing Wind Fetch Conditions in Pigs Eye Lake

3.2.3 Shoreline Erosion

One of the most significant changes in Pigs Eye Lake is the progression of receding vegetation around the shoreline of the lake, giving way to open water. An examination of aerial imagery in Figure 12 highlights the areas that have eroded. In the forty years between 1951 and 1991, approximately 93 acres of vegetated shoreline area was converted to open water. Between 1991 and 2015, an additional 18 acres was lost, particularly along the northwest and eastern shorelines. It is likely that the exposure of the vegetation to wave energy weakened the vegetation over time, destabilizing the substrate, and allowing the shoreline substrate to erode. As the amount of open water in the lake increased, wind fetch also increased, allowing larger, unbroken waves to further erode the vegetation and substrate of the shorelines. The areas where erosion is worst correspond with the predominant wind directions, further suggesting that wind-generated waves are likely causing the ongoing erosion.

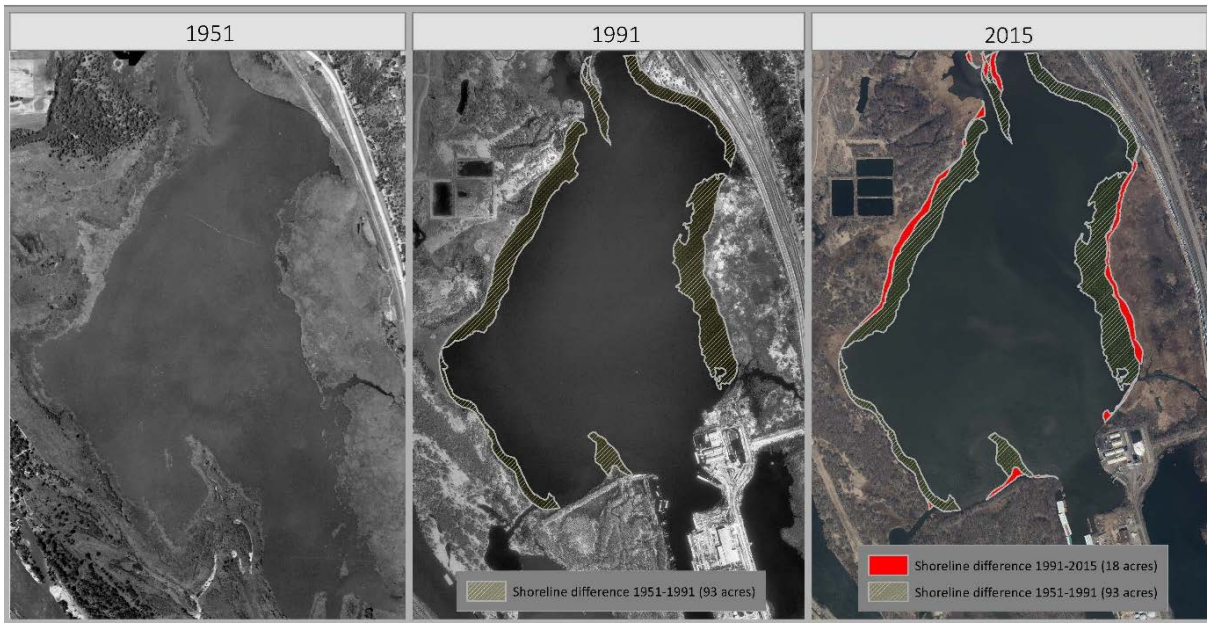

Figure 12: Shoreline Erosion in Pigs Eye Lake From 1951–2015

3.3 Problem Summary and Interactions

Each of the historic changes and problems identified above have influenced the resulting habitat conditions present today in Pigs Eye Lake. The problems were combined and summarized in a conceptual model to show how they are believed to be interacting with one another (Figure 13).

Altered Hydrology - The construction and operation of Lock and Dam No. 2, and the subsequent development around the lake, including the wastewater treatment plant, landfill, Red Rock Terminal, Hog Lake, and railroads have contributed to the alteration of the hydrology of Pigs Eye Lake.

Problems – The altered hydrology of the lake has led to the problem of increased wind fetch within the lake, which has subsequently led to shoreline erosion and loss of aquatic vegetation. As the shoreline erodes further, more vegetation is lost, and the wind fetch is further increased.

Poor Existing Habitat Conditions – The problems have led to the poor habitat conditions present in Pigs Eye Lake today. The high wind fetch results in constant re-suspension of the sediments within the lake, which causes high turbidity. The constant shifting of sediment and unstable substrate reduces the ability of vegetation to stay rooted. As vegetation decreases and open water increases, even more sediment is disturbed. The problems and resulting poor conditions create a negative feedback loop with no foreseeable improvements without intervention.

Risk to Infrastructure and Human Health – As the shoreline erosion continues to progress, it will soon threaten adjacent infrastructure. Of particular concern are the 4 ash ponds belonging to the Metropolitan Wastewater Treatment Plant to the northwest of the lake.

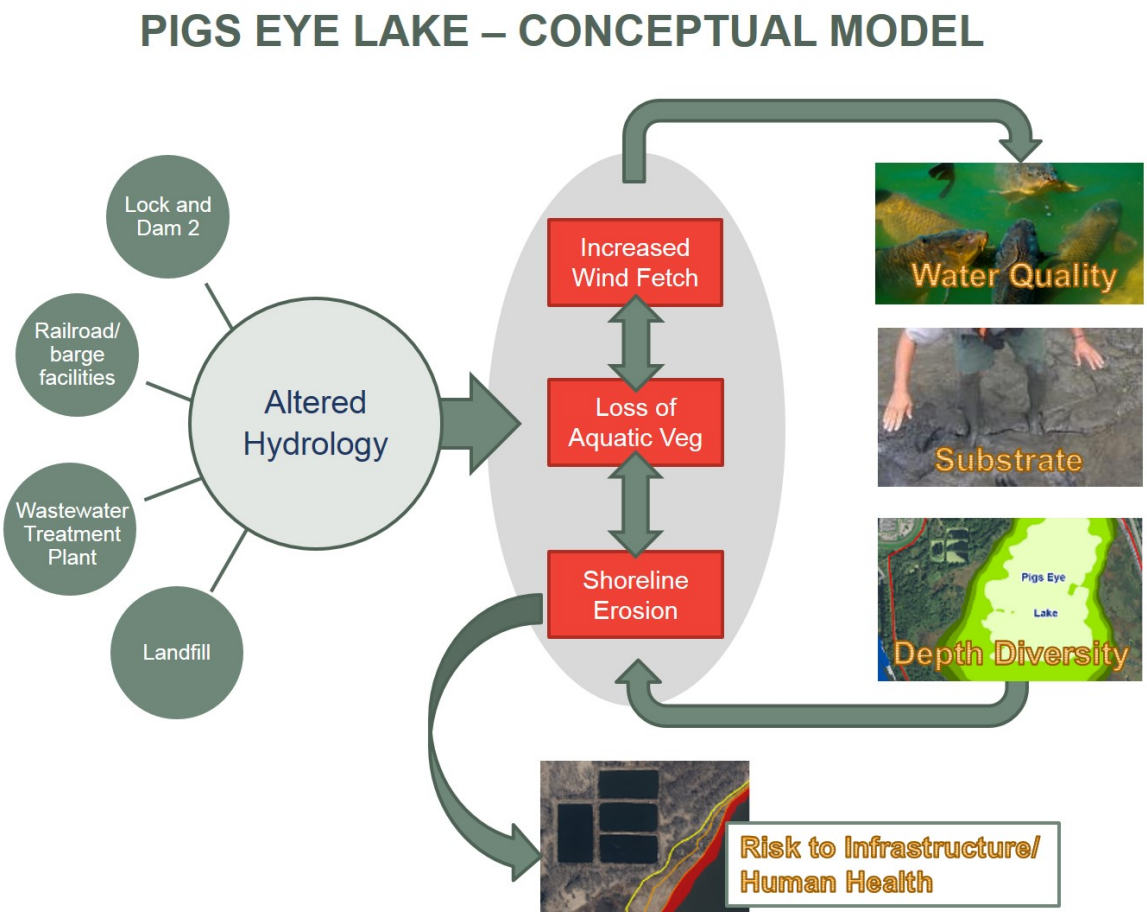

Figure 13: Conceptual Model of Pigs Eye Lake Problems

3.4 Estimated Future Without Project Conditions

The Future Without Project (FWOP) condition is the forecasted condition of the project area for the next 50 years, assuming that no significant action is taken to address the resource problems identified.

Based on the information discussed above, baseline conditions for a variety of fish and wildlife species expected to occur in the type of habitat in Pigs Eye Lake would generally be considered marginal at best,

and poor in many areas. The lake's lack of depth diversity and overall shallow average depth combined with wind and wave activity subject the environment to continual re-suspension of fine sediments and result in very limited aquatic plant growth.

Without construction of a project within Pigs Eye Lake, little change in the lake geomorphology is anticipated during the next 50 years. Continued deposition of fine-grained materials will occur along with occasional flooding that washes some sediments downstream.

In the absence of a project, the current rate of erosion is expected to continue. The 18 acres of erosion over the last 24 years equates to a loss of 0.75 acres per year. This rate of erosion was used to estimate the additional erosion expected over the period of evaluation of 50 years (years 2019-2069). This amounts to 18.75 acres within the next 25 years, and 37.5 acres over the 50-year evaluation period. A visual representation of the predicted area where erosion and loss of vegetation would be expected to occur is presented on the FWOP 25-Year and FWOP 50-Year (Figure 14).

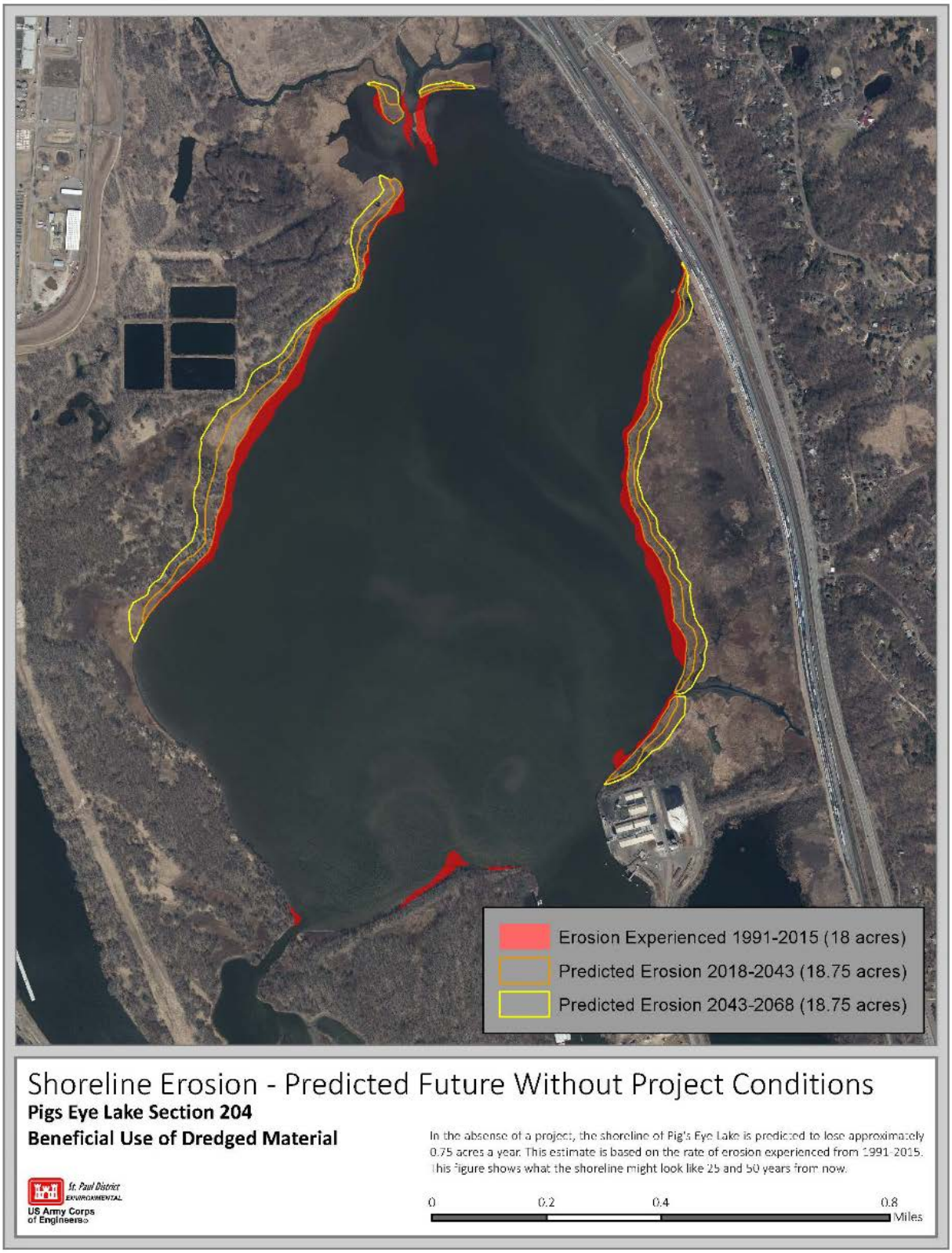

Figure 14: Predicted Shoreline Erosion in Pigs Eye Lake 2018–2068

Over the 50 year period, the erosion predicted in Pigs Eye Lake threatens several pieces of infrastructure including the Wastewater Treatment Facility's ash ponds that hold toxic material on the western shoreline, as well as the Canadian Pacific Railway on the northeast shoreline.

3.4.1 Climate Change

ECB No. 2016-25 (USACE 2016) provides guidance for incorporating climate change information in hydrologic analyses in accordance with the Corps overarching climate change adaption policy. It calls for a qualitative analysis and provides links to online tools that can be used in this qualitative analysis. The goal of a qualitative analysis of potential climate threats and impacts to Corps hydrology-related projects and operations is to describe the observed present and possible future climate threats, vulnerabilities, and impacts specific to the study goals or engineering designs. This includes consideration of both past (observed) changes as well as potential future (projected) changes to relevant climatic and hydrologic variables.

The U.S. Global Research Program's Third National Climate Assessment was completed in 2014. It states that:

> "in the Upper Midwest extreme heat, heavy downpours, and flooding will affect infrastructure, health, agriculture, forestry, transportation, air and water quality, and more. Climate change will tend to amplify existing risks climate poses to people, ecosystems, and infrastructure. Climate change also alters pests and disease prevalence, competition from non-native or opportunistic native species, ecosystem disturbances, land-use change, landscape fragmentation, atmospheric and watershed pollutants, and economic shocks such as crop failures, reduced yields, or toxic blooms of algae due to extreme weather events."

Important driving climate variables include seasonal precipitation and air temperature and both variables are expected to increase in the future. In the Pigs Eye Lake project area this could alter hydrologic characteristics such as the magnitude, duration, and timing of river flows; water quality variables such as temperature, dissolved oxygen, and turbidity; and geomorphic processes like sediment deposition and secondary channel erosion.

While climate change modeling and assessment at the project scale relies on qualitative information at this point in time, the existing hydrologic record can provide some insight on recent changes. An analysis of the Mississippi River discharge record at the nearby USGS gage at Prescott, Wisconsin indicates that the average annual discharge and the number of days of overbank flows per year have increased over the last 3 or 4 decades. Most of the increase is occurring during the spring and early summer months with smaller increases in the fall. During the winter months of December, January, and February overbank flooding has not occurred. Given that climate modeling indicates a wetter climate in the future, the increased flows indicated in the recent hydrologic record are likely to persist and potentially get worse. These changes will be considered during project planning and design. Additional information can be found in Appendix G – Hydrology and Hydraulics.

In addition, a study was done looking at climate change and trends to river flows on the Mississippi and Minnesota Rivers (see the Climate Change Effects on Pool 2 Attachment in Appendix G).

4 Plan Formulation

Plan formulation for Pigs Eye Lake Section 204 has been conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983) and the *Planning Guidance Notebook* (ER 1105-2-100, dated April 2000). The six steps in the iterative plan formulation process are:

1. Specify the water and related land resources problems and opportunities of the project area;
2. Inventory and forecast existing conditions;
3. Formulate alternative plans;
4. Evaluate alternative plans;
5. Compare alternative plans; and
6. Select the recommended plan.

The basis for selection of the recommended plan is fully documented below, including the logic used in the plan formulation and selection process (Appendix N – Plan Formulation).

4.1 Problems and Opportunities

One of the critical steps in the initial planning process is the identification of problems and opportunities associated within the geographic scope of the project area. Problem statements are concise characterizations of the broad issue that will be addressed with the project. Opportunity statements follow each problem and consist of an array of opportunities presented by the virtue of planning and construction activities occurring at the site of the problem. Opportunities can be directly related to solving the problem at hand, but can also be ancillary to the identified problem. From the list of problems and opportunities, objectives for the project are drafted. The success of the project planning is determined by the fulfillment of the objectives through identified measures.

Problem Statements

- Loss of emergent aquatic vegetation
- Loss of submergent aquatic vegetation
- Lack of habitat diversity in Pigs Eye Lake and within Pool 2
- Degradation & loss of shoreline habitat
- Lack of depth diversity
- Exotic fish (common carp) present in lake and throughout Mississippi River

Opportunities

- Increase beneficial use of dredged material
- Increase fish spawning habitat

- Increase bird feeding and nesting habitat
- Increase recreational opportunities where compatible with overall project goals and objectives

4.2 Objectives and Constraints

Based on the project's problems and opportunities, specific objectives were established and are listed below. The guidance for developing objectives is provided in USACE planning guidance ER 1105-2-100 and specifies that objectives must be clearly defined, must provide information on the effect desired, the subject of the objective, the location where the effect will occur and the timing and duration of the effect. For the purpose of this report, the timing or duration of the objectives is assumed to be the 50 year period of analysis (years 2019-2069).

Objectives:

1. *Improve aquatic habitat* – Create depth and habitat diversity in Pigs Eye Lake. Increase acreage of aquatic vegetation. Incorporate structural habitat features to promote fisheries.

2. *Improve the quantity and quality of habitat for migratory bird species* – Create suitable habitat for migratory birds such as dabbling ducks within Pigs Eye Lake.

3. *Maintain or enhance the quantity of shoreline habitat* – Protect existing floodplain forest and marsh habitat along the shoreline of Pigs Eye Lake from wind and wave erosion.

Planning constraints are temporary or permanent limits imposed on the scope of the planning process and the choice of solutions. These limits can be related to the ecological, economic, engineering, legal, and administrative aspects of a project. Some constraints are states of nature, whereas others are based on the design of built structures and other engineering considerations. Legislation and decision makers can impose other constraints; such human-imposed constraints are possible to change. The following planning constraints were established to guide and set boundaries on the formulation and evaluation of alternatives.

The following constraints were considered in plan formulation:

- Institutional constraints: Avoid or minimize impacts to flood stages and navigation.
    - Ensure measures do not negatively impact the 9-foot navigation channel.
    - Restoration measures should not increase flood heights or adversely affect private property or infrastructure.
    - Avoid or minimize impacts on aviation (i.e., aircraft wildlife strikes).
- Engineering constraints: Construction access must be feasible. Material quantities for the project must be available from the navigation dredge cuts or temporary dredged material placement sites in Pool 2.
- Environmental constraints: Construct measures consistent with federal, state, and local laws. Compliance and coordination under NEPA emphasizes the importance of environmental impacts to be minimized and avoided, as much as possible. Therefore, the following constraints are considered when analyzing alternatives:

- Avoid disturbance of contaminated area adjacent to the Pigs Eye Landfill
- Minimize disturbance of sediments within the lake
- Avoid adverse impacts to endangered species
- Minimize waterbird and migratory bird impacts (e.g., Heron Rookery SNA)
- Avoid adverse impacts to cultural resources

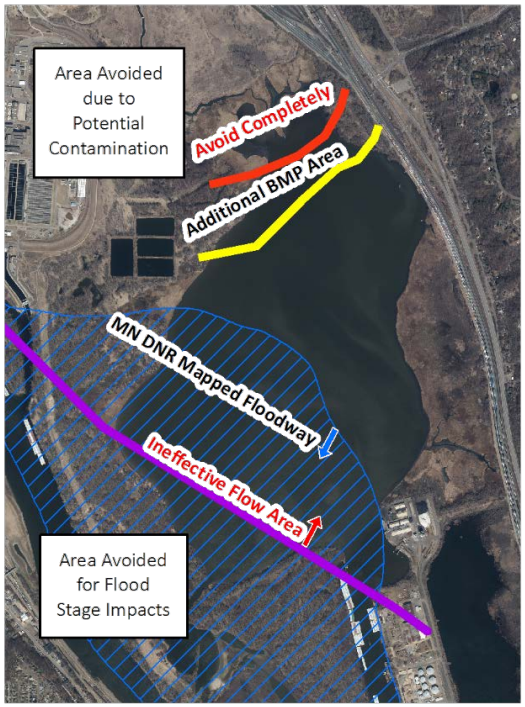

Figure 15: Contamination and Flood Stage Constraints

4.3 Identification and Evaluation of Available Measures

A management measure is a feature (a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can be combined with other management measures to form alternative plans. Management measures were developed to address project area problems and to capitalize upon project area opportunities. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, interagency project delivery team.

Before alternative plans were formulated, the first step taken was to identify general locations and categories of potential improvements that would satisfy the objectives established previously. The process began with several discussions concerning the management goals and objectives discussed in the previous section. This generated an array of *general measures* from which *alternative plans* were developed. The formulation of these alternative plans involved an assessment of the measures as to whether they met the goals and objectives of the study and how likely they were to produce measurable habitat benefits. This is a subjective process requiring further trade-off analysis and habitat evaluation

procedures of alternative plans; however, the depth of professional experience and first-hand management knowledge by many members of the team was invaluable in defining specific measures.

Finally, during this process, several measures were screened for a variety of reasons and are described in the screening section below, along with the necessary justification for their elimination from consideration. Alternative plans were developed through combinations of the measures carried forward.

4.3.1 No Action

The no action measure is defined as no implementation of a project to modify habitat conditions in the project area. This measure is carried forward for further consideration.

4.3.2 Sand Blanket

A sand blanket could be implemented in Pigs Eye Lake by placing coarse sand material over the entire existing lake substrate. The current substrate is very soft flocculent material, and a sand blanket may provide a more stable substrate and reduce sediment resuspension. There are several disadvantages of this measure. First, is the relatively high cost; a rough estimate to lay a sand blanket 6–12 inches deep would cost $10 million to $20 million. Second, a sand blanket would require a large amount of material (more sand may be required for an effective sand blanket than is available from maintenance dredging in Pool 2 or even from temporary dredged material placement sites in Pool 2). Finally, the team determined that this measure would have a low likelihood of addressing the project objective of reducing shoreline erosion. The high cost and relatively low habitat benefits would result in a poor cost-benefit ratio. Therefore a sand blanket would not be effective or efficient and this measure was screened from further consideration.

4.3.3 Islands

Island creation could serve a variety of habitat purposes in Pigs Eye Lake. Islands protect shallow areas from wind and wave action and erosion, which in turn protects existing aquatic vegetation and improves conditions for the growth of aquatic vegetation in other shallow areas. Islands provide floodplain habitat, and their creation increases habitat diversity and provides habitat niches that have been lost in Pool 2. This measure was carried forward for further consideration in alternative plans.

4.3.4 Sand Benches

Sand benches are in essence a smaller-scale version of a sand blanket that would be constructed adjacent to islands to extend the shallower, limnetic habitat surrounding islands. Sand benches would be established by extending sand placement below the water surface adjacent to project island features. Sand benches could be constructed at varying elevations, but would be submerged at normal pool elevation. Sand benches would provide seasonal sandbar habitat under low water level conditions; sand benches would also improve substrate conditions through stabilization, and reduce turbidity in Pigs Eye Lake by reducing sediment resuspension. Like the sand blankets, the potential disadvantages are cost and availability of sand material for construction. Sand benches may be more effective and efficient than sand blankets, especially when combined with other measures such as islands. Sand benches were carried forward for further consideration.

4.3.5 Marsh Creation/ Enhancement

Wetlands could be created in Pigs Eye Lake. This would be accomplished by a combination of creating areas protected from wind, stabilizing substrate, and planting wetland vegetation. Wetlands would be constructed to an elevation near normal lake elevation. This would increase the amount of emergent vegetation or wetland habitat in the project area; establishment of emergent marsh and isolated wetlands is important for fish and wildlife. This measure was carried forward for further consideration in alternative plan development.

4.3.6 Shoreline Stabilization

Shoreline stabilization could be accomplished by several types of features: Placement of coarse sand material on top of existing shoreline areas; Constructing groins, vanes, or berms; Bio-stabilization measures; or combinations of these features. The progression of erosion despite current vegetation makes it unlikely that bio-stabilization measures would be effective on their own. Rock groins, vanes, and berms would be feasible, but are not preferable as they would reduce the aesthetic value of the area. Placing sand along the shorelines would be expected to provide only a short-term solution. None of these features would contribute to the project objective of protecting shoreline habitat from wind and waves. Therefore, this measure was screened from further consideration.

4.3.7 Water Level Management

Management of the water elevation within Pigs Eye Lake – either on a one-time or recurring basis – could enhance aquatic habitat. A full-lake or partial drawdown would consolidate the flocculent substrate, and could allow construction of island or other features in the dry, de-watered conditions.

A full-lake or smaller-scale growing season drawdown could enhance aquatic vegetation and consolidate sediment in the dewatered areas. Exposure of the substrate within the lake may allow sediments to consolidate, reducing turbidity within the lake. If seeds are present within the sediments, drying and exposure to light could cause plants to germinate and increase vegetation. A drawdown could be conducted during the growing season (approximately June through September) to best promote aquatic plant growth. Additional drawdowns could be done in the following growing seasons to enhance growth of perennial vegetation established with the initial drawdown.

A temporary drawdown of water levels performed during the winter season may be effective as a rough fish management tool. Lowered lake levels reduce oxygen and increase the likelihood of a winter fish kill; this tool can be implemented to reduce the population of nuisance fish such as carp.

A temporary reduction of water levels within Pigs Eye Lake was considered for portions of the lake and the complete lake. There are numerous issues and disadvantages associated with this measure. The measure is not efficient in terms of cost; constructing structures for water exclosure and pumping water out of lake would be very expensive. Additionally, the hydraulic conditions in the lake are not favorable for a drawdown because Battle Creek flows into the lake, and these flows would also need to be redirected. Finally, the conditions in the lake substrate may not be suitable for an effective drawdown because the thick layer of soft and mucky substrate may not consolidate as expected during a drawdown. This measure was screened from further consideration.

4.3.8 Hydraulic Modifications

Hydraulic modifications considered consisted of manipulating water quality characteristics by designing project features specifically to influence flow direction, rate, timing, and other hydraulic conditions in Pigs Eye Lake. Upon evaluation of existing hydraulic conditions in the area, the study team determined it would not be effective in terms of meeting project objectives. Water movement in Pigs Eye Lake is highly variable and dependent on Pool 2 dynamics. No opportunities for improving water quality were identified that could be influenced by hydraulic manipulations. This measure was screened from further consideration.

4.3.9 Carp Exclosures

Nuisance fish contribute to the resource problems in Pigs Eye Lake. Nuisance fish, including carp, contribute to sediment re-suspension and turbidity and their rooting behavior disturbs beneficial aquatic plants. The study team evaluated carp exclosures or structures to keep common carp out of the lake. If carp could be excluded from the lake, this would likely decrease turbidity within the lake and could increase water clarity and overall conditions for aquatic vegetation.

It is unlikely this measure could be effectively implemented at Pigs Eye Lake. The lake itself is large, and part of a larger system connected hydraulically to Battle Creek and the Mississippi River. In a lake the size of Pigs Eye, with the extensive connectivity to the larger Pool 2 river system, it would be very difficult to remove all existing carp. Additionally, from a feasibility standpoint, it would be quite difficult to construct and maintain a rough fish exclosure. This measure could not be effectively implemented to meet study objectives and was screened from further consideration.

4.3.10 Habitat Dredging

The lack of depth diversity and aquatic structure in Pigs Eye Lake limits the value of the lake for some types of fish. Pothole dredging would involve dredging various sized “pothole” areas in Pigs Eye Lake to a depth consistent with healthy aquatic ecosystem function at this location. Pothole dredging could be implemented at critical locations for restored and expanded depth diversity, aquatic structure, deepwater habitat and improved water quality. Increased availability of deeper water would improve habitat conditions. However, it was determined that there would be a very high risk that a dredge cut in the lake would not be sustainable. This is because the deep layer of unconsolidated substrate throughout Pigs Eye Lake would likely lead to sloughing, causing the sides of the dredge cut to fall into the cut and fail. Therefore, this measure was screened from further consideration.

Table 3 outlines the resource problems; the objectives; the chemical, physical, and biological stressors that need to be addressed to reach the objectives; and the potential management measures to address these stressors.

Table 3: Summary of the Problems, Opportunities, Objectives and Measures

Resource Problems	Stressors	Objectives	Restoration Measures
Loss of emergent aquatic vegetation	Wind fetch, wave action, erosion, rough fish, turbidity, sediment resuspension, plant breakage.	Objectives 1 & 3	Sand blanket, high & low islands, wetland creation, water level management, hydraulic modification, carp exclosures.
Loss of submersed aquatic vegetation	Wind fetch, wave action, erosion, rough fish, turbidity, sediment resuspension, plant breakage.	Objectives 1 & 3	Sand blanket, sand bench, high & low islands, wetland creation, water level management, hydraulic modification, carp exclosures.
Lack of habitat diversity in Pigs Eye Lake and within Pool 2	Wind fetch, erosion, lack of habitat diversity.	Objectives 1, 2, & 3	High & low islands, sand bench.
Degradation & loss of of shoreline habitat	Wind fetch, wave action, erosion, rough fish, turbidity, sediment resuspension, invasive species, altered hydrologic regime, poor water quality.	Objectives 1, 2, & 3	Sand blanket, sand bench, high & low islands, wetland creation, shoreline stabilization, water level management, hydraulic modification, carp exclosures, habitat dredging.
Lack of water bird habitat	Lack of habitat diversity, lack of aquatic vegetation, sediment resuspension, invasive species, poor water quality.	Objectives 1 & 3	Sand benches, high & low islands, wetland creation, shoreline stabilization.

4.4 Screening of Measures

Screening of measures (Table 4) is a process whereby various criteria are evaluated to better characterize a specific measure and the likelihood that it can achieve cost effective restoration. The evaluation criteria identified in the P&G were used to identify the alternative management measures retained for further consideration. The purpose of this preliminary screening is to narrow down the number of alternatives to be subjected to detailed further analysis; however, it will not preclude resurrecting a measure at a future date if it becomes apparent that a measure was screened out based on incomplete data or an invalid assumption. The measures that are retained for further consideration must derive from the planning objectives for the project, must be feasible within the project constraints, and must be considered to best meet the screening criteria within the range of alternatives considered. Alternative plans are developed from the measures carried forward; if a measure is not justified and not carried forward, the measure would not be further developed into an alternative plan. Alternative plans are different combinations of various sizes and scales of measures that would contribute to attaining the planning objectives. A measure may stand alone as an alternative plan that can be implemented independently of other measures, resulting in some achievement of the planning objectives. Measures are screened against selected criteria in the first iteration of the planning process and alternative plans are developed and screened against the same criteria in a later iteration of the planning process. Review of the four formulation criteria suggested by the P&G (completeness, effectiveness, efficiency,

and acceptability, defined below) and resource significance (institutional, public, and technical) were used to aide in the selection of the TSP.

- **Completeness -** Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planned effects.
- **Effectiveness -** Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified objectives.
- **Efficiency -** Efficiency refers to cost-effectiveness and the most efficient allocation of other resources. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and achieving the specified objectives.
- **Acceptability -** Acceptability refers to the workability and viability of the alternative with respect to acceptance by state and local entities and the public compatibility with existing laws.
- **Institutional Recognition** - The importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups.
- **Public Recognition -** Some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource.
- **Technical Recognition** - The resource qualifies as significant based on its "technical" merits, which are based on scientific knowledge or judgment of critical resource characteristics. Technical significance should be described in terms of one or more of the following criteria or concepts: scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity.

Table 4: Screening of Measures (Shaded Measures Are Screened From Further Analysis)

Measure	Complete	Effective	Efficient	Acceptable	Justification for Elimination from Further Consideration
No Action					No action will be carried forward. All alternative plans must be compared against the No Action alternative.
Sand Blanket	Yes	No	No	Yes	The sand blanket is not effective in meeting all project objectives; it is also a high cost measure and may exceed available quantities of dredged material for project use. This measure is not cost efficient if the entire lake bottom is capped. This measure is screened from further consideration.
Sand Benches	Yes	Yes	No	Yes	Sand benches may be effective when combined with islands, and could be scaled to be cost effective. This measure is retained.
Islands	Yes	Yes	No	Yes	Islands would improve habitat quality in a variety of ways and would benefit aquatic vegetation, provide floodplain habitat, and reduce the impacts of wind fetch and wave action. In these site conditions, islands may not be efficient on their own however when combined with sand benches and marsh creation the efficiency would be gained. In addition, this measure could be more cost effective based on island design and island size. This measure is retained.
Marsh Creation/ Enhancement	Yes	Yes	No	No	Marsh creation and/or enhancement may be complete and effective, however the cost and acceptability are of concern. Wetland enhancement near Battle Creek is directly adjacent to the Pigs Eye Landfill and superfund site. Disturbing or re-suspending HTRW is not in line with Corps policy. However, marsh wetlands could be created in combination with islands, or split island designs, and could be scaled to be cost effective. This measure is retained.
Shoreline Stabilization	Yes	No	No	Yes	Shoreline stabilization would be accomplished by placement of dredged material over existing shoreline. The coarse sand material would reduce erosion and stabilize the shoreline. This measure may be partially effective at meeting objectives, but it would not be efficient in terms of cost. This measure was screened from further consideration.

Measure	Complete	Effective	Efficient	Acceptable	Justification for Elimination from Further Consideration
Water Level Management	No	No	No	Yes	A partial or complete drawdown of Pigs Eye Lake would be very costly and only partially meet study objectives. The measures is not effective or efficient and it is screened from further consideration.
Hydraulic Modifications	Yes	No	No	Yes	Hydraulic modification is intended to improve flow direction, rates, and more for the purpose of improved water quality or ecosystem function. However, no opportunities to use this measure to improve water quality were identified and it was determined that this measure would not be effective or efficient and is screened from further consideration
Carp Exclosures	No	No	No	Yes	Due to the size of Pigs Eye Lake and the hydraulic connectivity with Battle Creek and the Mississippi River, carp exclosures would not be feasible. This measure is not effective or efficient, and it is not complete as it would require additional actions outside the project area. This measure is screened from further consideration.
Habitat Dredging	No	Yes	Yes	No	Habitat dredging would be effective in meeting some project objectives. This measure is not complete as it would require additional actions outside the project area, such as land acquisition for upland disposal of fine material from Pigs Eye Lake. It is also questionable whether the increased depths would be maintainable due to the instability of the substrate. This measure is screened from further consideration.

The measures retained for further consideration (islands, sand benches, and marsh creation/enhancement) were derived from the planning objectives for the project, and are considered to be the most complete, effective, efficient, and acceptable within the range of measures considered. Increments and scales of the retained measures were developed and combinations of the different scales and increments of the measures will be used to formulate alternative plans.

4.5 Formulation of Alternative Plans

Alternative plans are combinations of measures that would contribute to attaining the planning objectives. A measure may stand alone as an alternative plan that can be implemented independently of other measures, resulting in some achievement of the planning objectives. Measures can also be combined to form an alternative plan. Measures identified and described in Section 4.4 that were deemed feasible were carried forward for consideration in the development of alternatives. The measures carried forward were: islands, sand benches, and marsh creation/enhancement.

Some of the important factors that led to the development of the final array of alternatives for this project are described below. Alternative development is a complex, iterative process with many inputs. Several of the constraints and objectives can be identified as the most influential in producing the alternatives that were considered, and are therefore the focus of the discussion.

Constraints – Two of the project constraints highly limited the acceptable geographical placement of measures. First was avoiding disturbance to the contamination in the northern part of the lake, adjacent to the former landfill. Available contaminant testing data was collected, reviewed, and assessed, and additional sampling needs were identified and collected (as described in Section 2.3.4 and Appendix E – Sediment Report). The data and analysis were coordinated with internal and external stakeholders through a specially-formed group of members of the interagency project team, formed to analyze contaminant concerns related to the project. The consensus of the group was to avoid disturbance to the area in the northernmost part of the lake (shown in Figure 15). Appendix A – Correspondence & Coordination presents documentation related to the discussions and conclusions of the Pigs Eye Lake Contaminants Sub-Group. The final array of alternative plans also avoided the area that would have required additional BMPs.

A second factor that limited the geographical placement of measures is the constraint to avoid impacting flood stages. Hydraulic modeling was used to identify the effective flow limit boundary within the lake, as shown in Figure 15. By keeping project features to the north of this boundary, they are kept within the ineffective flow area and do not have an effect on flood stages. The Minnesota DNR's regulatory floodway boundary (also shown in Figure 15) extends further into the lake, so islands within this zone were aligned roughly parallel to the expected flowlines in order to ensure that stage impacts would be negligible if flood waters were to move through this region.

Project Objectives – Meeting objective number 3 - *Maintain or enhance the quantity of shoreline habitat* - had a significant influence on alternative design. The future of the shoreline habitat around the lake was determined to be heavily affected by wind fetch and related wave action. Therefore, in order to meet this objective, measures needed to be used in a way that would maximize the reduction of wind

fetch across Pigs Eye Lake. Islands are the primary measure carried forward that would reduce wind fetch, and initial island concepts did not meet this objective well. The hydraulic engineer working on the project designed a group of islands specifically aimed at reducing wind fetch.

Preliminary dredged material quantity estimates for constructing the initial alternative plans exceeded the amount of available sand material on placement sites. In addition, the cost estimate for initial iterations of alternatives significantly exceeded the non-federal cost share threshold and some alternatives exceeded the federal cost limit for a Section 204 study of $10 million. (More information on the initial formulation of alternatives that included Alternatives 1-3m can be found in Appendix N – Plan Formulation.) These alternatives were then screened from further consideration, and the PDT reformulated to design smaller alternatives aimed to reduce the quantity of dredged material needed for construction, while attempting to maintain wind fetch reduction benefits. This resulted in retaining the overall shape of the 9-island concept but reducing the overall sand quantity required (Alternative 4). Islands in this concept were spaced far enough apart that the shoreline habitat around the islands wouldn't necessarily be sheltered. The 'split island' design better addresses Objectives 1 and 2 to *improve aquatic habitat* and *Improve the quantity and quality of habitat for migratory bird species* (Alternative 5). Split islands would create pockets of very sheltered aquatic habitat, while minimizing the additional sand needed for construction. The concept was that if one of the berms was split off of the island and separated from it by a short distance, the island should still have little risk of erosion along the split since the fetch would be very small. This gap between the two sides would create a very sheltered pocket that would provide protection for birds and animals and increased stability for aquatic vegetation.

The sheltered areas within the split island interiors in Alternative 5 provides areas where aquatic vegetation may be able to grow, but it was felt that the existing substrate may still be too loose for aquatic plants to take root. To improve the likelihood of these areas to support aquatic vegetation, the team designed a marsh component which would include a layer of sand placed over the existing substrate in these split island centers. The addition of sand would be expected to consolidate the existing sediments and incorporating some wetland plantings in these areas would increase the habitat value immediately (Alternative 5m).

The final iteration of alternatives were designed to further reduce the quantity of material for construction to reduce project costs while also maximizing habitat benefits. The final iterations of design reduced the number of islands to 7 (Alternative 6m) and to 4 (Alternative 7m). Both Alternative 6m and Alternative 7m maintained 3 split islands, and retained the marsh feature. More information on determination of the island size and layout can be found in Appendix C - Habitat Evaluation and Quantification and Appendix G - Hydrology and Hydraulics.

4.6 Final Array of Alternative Plans

4.6.1 No Action Alternative

The No Action Alternative is the plan in which none of the measures or combinations thereof would be constructed. There would be no cost to the No Action Alternative.

Under future without-project conditions, habitat conditions in the project area would generally stay about the same or decline at a slow rate. Pigs Eye Lake would continue to provide marginal habitat for birds, fish, and other aquatic biota, and in general it is expected that conditions there will not change markedly over the project life. Pigs Eye Lake will continue to be affected by wind and wave action and turbidity, and aquatic vegetation will continue to be limited. Wind-induced waves would continue to erode the shoreline and further widen the lake. The HEP analysis for Pigs Eye Lake (Appendix C - Habitat Evaluation and Quantification) resulted in an estimated 231.7 Average Annual Habitat Units (AAHUs) for the project area over the next 50 years.

4.6.2 Alternatives 4-7m

The alternative plans all contain the retained measures of islands and sand benches. The difference across alternatives is primarily the island size (quantity of dredged material required) and inclusion of marsh creation. Three plans contain modified islands which allow for marsh habitat to be placed within areas further sheltered from wind and wave action, and are referred to as “split islands” as compared to the other “full” islands. Only the split island designs provide areas that are protected enough to allow for marsh habitat to be established (Alternatives 5m, 6m, and 7m). A summary of each alternative can be found in Table 5 and Figure 16 (No Action Alternative and Alternative 4), Figure 17 (Alternative 5 and 5m), and Figure 18 (Alternative 6m and 7m).

Table 5: Summary of Pigs Eye Lake Alternatives

Alternative	Island Design	Marsh	Total Fill (cy)
No Action	-	-	-
4	Full	No	419,748
5	Split	No	470,859
5m	Split	Yes	502,121
6m	Split	Yes	413,329
7m	Split	Yes	345,959

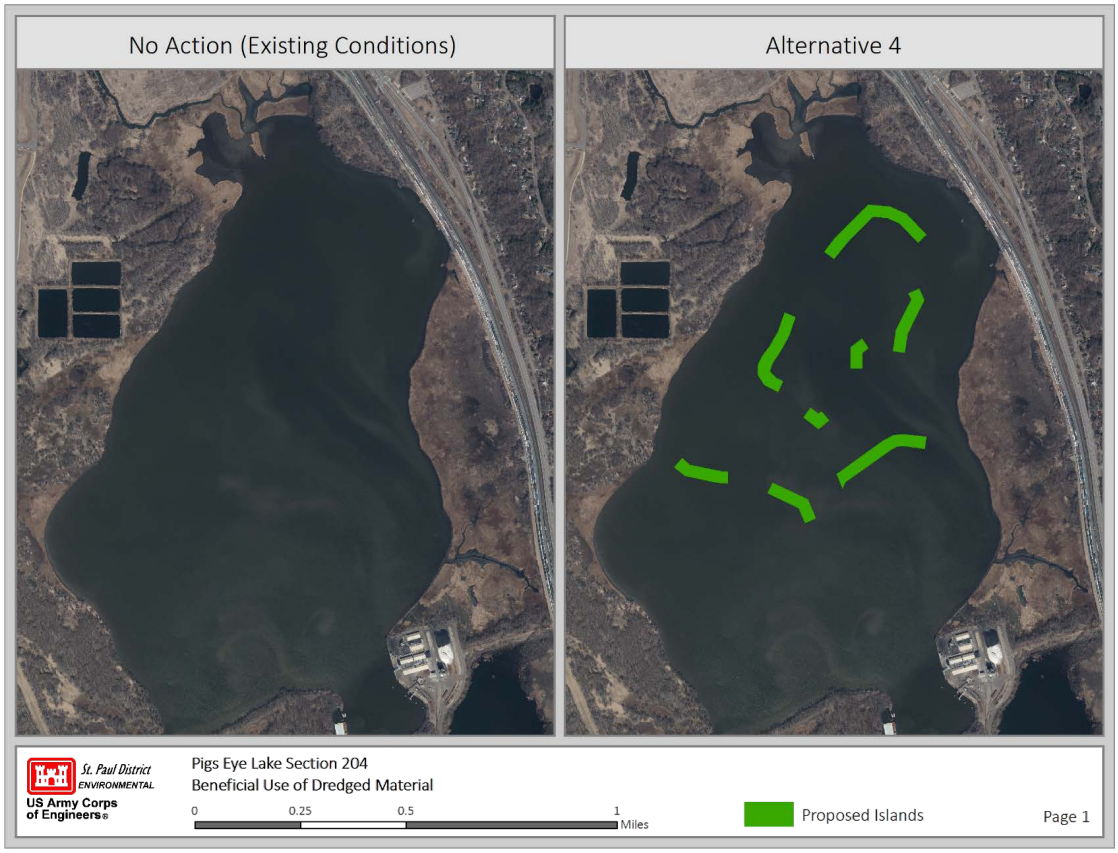

Figure 16: No Action Alternative and Alternative 4

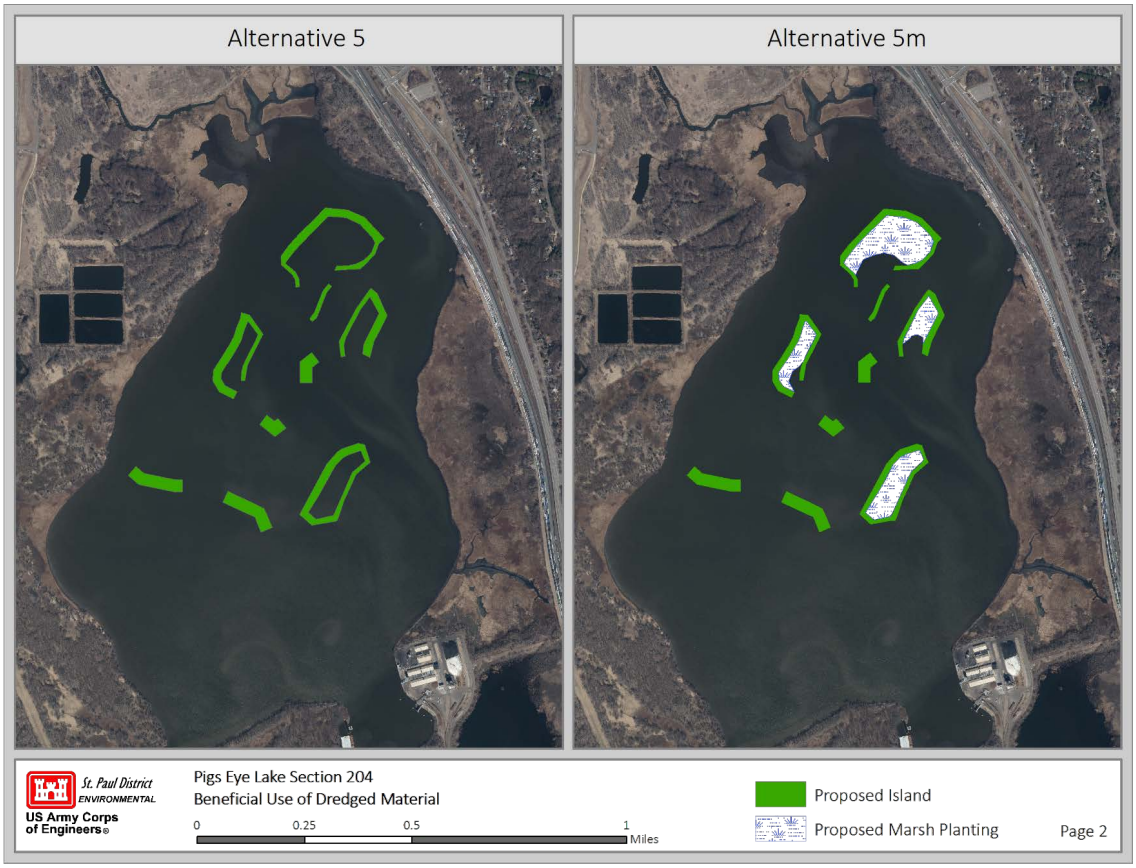

Figure 17: Alternative 5 and 5m

Figure 18: Alternative 6m and 7m

5 Evaluation and Comparison of Alternatives

This section describes the final array of feature groups and alternatives that were evaluated. It also documents the process used to determine the potential costs and habitat benefits of each alternative.

5.1 Environmental Benefits

The USFWS's 1980 version of Habitat Evaluation Procedures (HEP) was used to quantify and evaluate the potential project effects and benefits. The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing the projected HU's available without a proposed action to projected HU's with a proposed action or alternative, the benefits of different alternatives can be quantified. HSIs and HUs were calculated for the baseline conditions and for Future Without-Project and Future With-Project conditions.

The Migratory Habitat Model for Dabbling Ducks (Devendorf 2001) HSI was selected to evaluate potential benefits of the proposed project based on the existing habitat and habitat enhancement strategies proposed for this project. The objectives developed for the project are to (1) Improve aquatic habitat, (2) Improve the quantity and quality of habitat for migratory bird species, and (3) Maintain or enhance the quantity of shoreline habitat. Meeting these objectives would result in an increase of nesting and resting areas, improved visual and wind barriers, and increased aquatic vegetation, all of which would result in greater suitability of the area for waterbirds such as ducks, geese, and swans. The Migratory Habitat Model for Dabbling Ducks reflects success of meeting objectives (1) and (2) well.

A 37.5 acre subset of the project area is being evaluated using the marsh wren HSI model to reflect success in meeting Objective (3). In the absence of a project, this subset of the project area is predicted to be entirely converted from marsh to open water over the course of the 50-year planning period due to the effects of wind-generated waves. The dabbling duck migration model is not sensitive enough to capture the total loss of this area in the context of the much larger 741 acre project area. The use of the marsh wren model for this subset emphasizes the importance of this predicted habitat loss, and incorporates a quantitative measure of benefits obtained by reducing wind fetch. The resulting Average Annual Habitat Units (AAHUs) for each alternative are included in Table 8. For a more detailed description of the habitat analysis as well as the detailed net AAHUs generated for feasible feature combinations see Appendix C – Habitat Evaluation and Quantification.

5.2 Base Plan Costs

The Federal Standard, or "Base Plan" for the disposal of dredged material associated with construction or maintenance dredging of navigation projects is the least costly, environmentally acceptable plan. The Base Plan costs for this project assume normal excavation and transportation costs based on the current practices in Lower Pool 2. The Base Plan costs were estimated based on excavation of dredged material from the nearest temporary placement sites in Pool 2 (Upper Boulanger, Lower Boulanger, and Pine Bend), transportation to the nearest prospective permanent placement site, and the cost to acquire real estate for permanent placement. Real estate costs were estimated based on obtaining a one-time

dredged material placement easement at the closest identified potential placement location. The total Base Plan costs associated with the amount of dredged material needed for each alternative is presented in Table 6.

If a beneficial use is selected for a project and the costs exceed those of the Base Plan, the costs borne by the Section 204 project are those incremental costs above the Base Plan cost (Appendix E of ER 1105-2-100). The incremental costs above the Base Plan include transportation the additional distance up river to Pigs Eye Lake, unloading and placement of the dredged material, stabilizing with rock, capping the islands with fines, and seeding with willows. The incremental portion (Section 204 Costs) are the costs that are used to compare the alternatives in the Cost Effectiveness and Incremental Cost Analyses. For funding purposes, these incremental costs are then split between the Section 204 funding (65 percent) and the non-federal sponsor (35 percent).

Table 6: Base Plan Costs for Each Alternative

Alternative	Total Fill (cy)	Base Plan Costs
4	419,748	$ 3,243,000
5	470,859	$ 3,636,000
5m	502,121	$ 3,886,000
6m	413,329	$ 3,178,000
7m	345,959	$ 2,706,000

5.3 Cost Effectiveness and Incremental Cost Analysis

Corps guidance requires a cost effectiveness analysis and an incremental cost analysis (CE/ICA) for determining what project features and design alternatives should be built based on comparison of quantified habitat benefits (outputs) and estimated costs of alternative features designs. This process identifies alternative features or combinations of features that fully or partially meet the objectives of the project and at the same time are the most cost effective. A cost effectiveness analysis is conducted to ensure that the least cost alternatives have been established, subsequent incremental cost analysis is conducted to reveal and evaluate changes in cost for increasing levels of environmental output.

CE/ICA is a three step procedure: (1) calculate the environmental outputs of each feature; (2) determine a cost estimate for each feature; and (3) combine the features to evaluate the best overall project alternative based on habitat benefits and cost.

Costs were annualized by applying the interest and amortization factor of 0.03795 (50 year period of analysis at 2.875 percent interest rate) to the construction cost (Table 7) over a period of 50 years. The incremental analysis of alternatives was accomplished following guidance by Corps' Institute of Water Resources and using methodology described in Robinson *et al*. (1995). Refer to Appendix D – Incremental Cost Analysis, for the detailed results of the analysis.

Section 204 construction costs for features and subsequently for project alternatives were computed (Table 8), assuming a 50-year project period of analysis and a FY2017 project discount rate of 2.875 percent. All plans assume 1 year of construction and reflect October 2017 price levels. Operation,

Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) and Interest During Construction (IDC) costs were quantified and considered in the analysis but not applied; both were found to be minimal and inclusion would not change the outcome of the CE/ICA analysis. OMRR&R is estimated to be $2,000 annually (see Section 6.4) and IDC is estimated to be $4,000-6,000 annually.

Table 7: Section 204 Project Costs and Annualized Costs

Alternative	Total Fill (cy)	Total Project Cost	Base Plan Cost	Section 204 Cost	Annualized Cost (Section 204)
Alt4	419,748	$ 15,710,000	$ 3,243,000	$ 12,467,000	$ 473,000
Alt5	470,859	$ 17,664,000	$ 3,636,000	$ 14,028,000	$ 532,000
Alt5m	502,121	$ 18,781,000	$ 3,886,000	$ 14,895,000	$ 565,000
Alt6m	413,329	$ 15,569,000	$ 3,178,000	$ 12,392,000	$ 470,000
Alt7m	345,959	$ 13,102,000	$ 2,706,000	$ 10,396,000	$ 395,000

*The annualized cost was determined using the FY17 discount rate of 2.875 percent

Primary assumptions and constraints used in conducting CE/ICA are as follows:

1) AAHUs for all analyzed fish and wildlife species were assumed to have equal value in comparing alternative plans.
2) Alternatives analysis was limited to combinations that at least partially met the project's objectives listed in section 4.2.

From the process, 6 plans were generated. The CE/ICA process resulted in 1 cost effective plan and 3 "Best Buy" plans (including the No Action plan). The full array of alternatives and results of the CE/ICA analysis is displayed in Figure 19 and Table 8. The Best Buy alternatives are displayed in Figure 20.

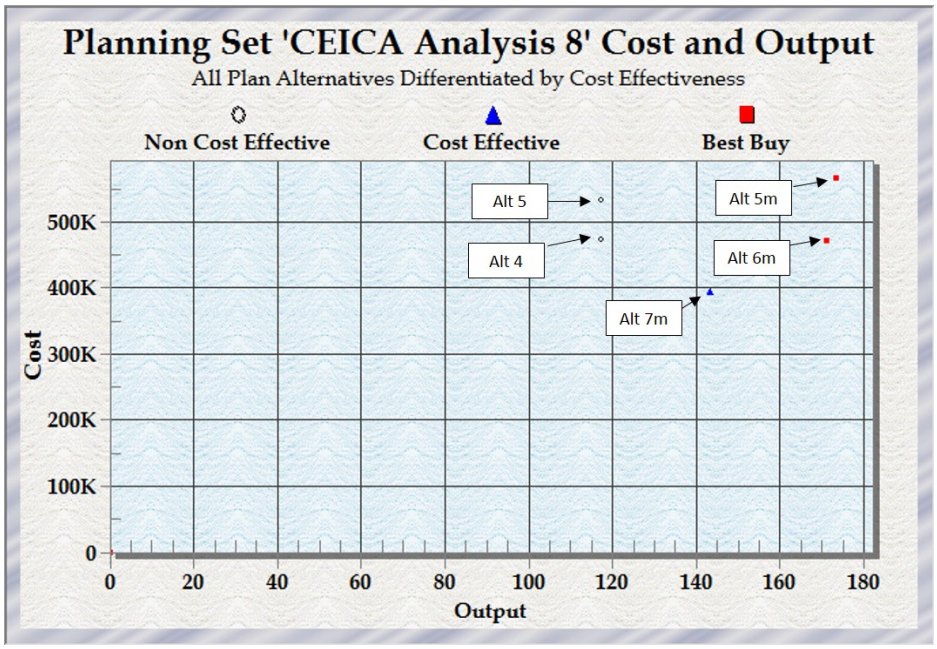

Figure 19: CE/ICA Results – Full Array of Alternatives

Table 8: Results of CE/ICA for Alternative Plans

Alternative	Total Fill (cy)	Section 204 Cost	Annualized Cost (2.875% Discount Rate)	AAHU Gain	AACost/ AAHU	Cost Effectiveness
No Action	-	$ -	$ -	0	$ -	Best Buy
Alt4	419,748	$ 12,467,000	$ 473,100	117.2	$ 4,000	No
Alt5	470,859	$ 14,028,000	$ 532,300	117.2	$ 4,500	No
Alt5m	502,121	$ 14,895,000	$ 565,200	173.4	$ 3,300	Best Buy
Alt6m	413,329	$ 12,392,000	$ 470,200	171.1	$ 2,700	Best Buy
Alt7m	345,959	$ 10,396,000	$ 395,500	143.4	$ 2,800	Yes

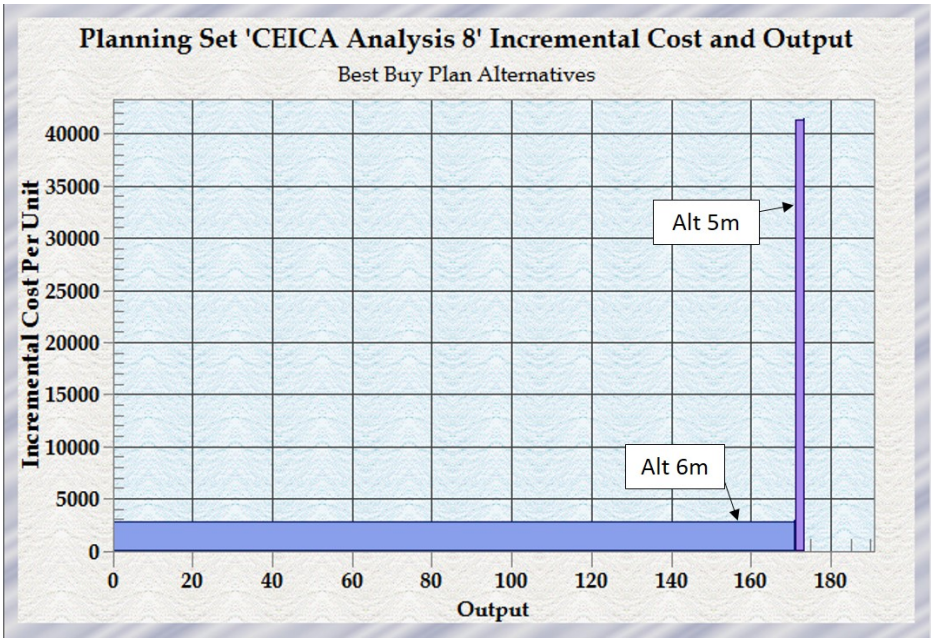

Figure 20: CE/ICA Results – Incremental Cost Per Unit of Best Buy Plans

The Best Buy plans presented provide the information necessary to make well-informed decisions regarding desired project scale and features. Progressing through the increasing levels of output for the alternatives in Table 9 helps determine whether the increase in output is worth the additional cost. As long as decision makers consider a level of output to be "worth it", subsequent levels of output are considered. When a level of output is determined to be "not worth it", then subsequent levels of output will also likely be "not worth it", and the final decision regarding desired project scale and features for environmental restoration will be reached.

Table 9: Incremental Cost Per Output (Net AAHUs) for Pigs Eye Lake Best Buy Plans

Alternative	Net AAHUs	Annualized Cost	AACost/ AAHU	Incremental AACost	Incremental Output (HUs)	Incremental AACost/AAHU
No Action	0	$ -	$ -	$ -	0	$ -
Alt6m	171.1	$ 470,200	$ 2,700	$ 470,200	171.1	$ 2,700
Alt5m	173.4	$ 565,200	$ 3,300	$ 95,000	2.3	$ 41,300

Typically in the evaluation of Best Buy plans, "break points" are identified in either the last column in Table 9, or in the stair-step progression from left to right in Figure 20. Break points are defined as significant increases or jumps in incremental cost per output, such that subsequent levels of output may not be considered "worth it". Identification of such break points can be subjective. For Pigs Eye Lake, break points were identified between each of the three Best Buy plans (No Action, Alternative 5m, and Alternative 6m). The Cost Effective Plan, Alternative 7m, was also evaluated.

No Action (Best Buy) - This alternative was not chosen because it does not improve or maintain the ecosystem resources within the project area. This alternative would cost $0. The continued shoreline erosion due to wind and wave activity would reduce the habitat value provided in the project area. The existing project area provides 217.9 AAHUs. Although conditions in the project area would decline under the FWOP, no model variables would be expected to change because existing conditions already reflect the lowest possible score for a majority of the variables. This alternative does not meet any of the project objectives.

Alternative 7m (Cost Effective) – This is the smallest alternative formulated, which would only create 4 islands, and significantly less acreage of floodplain forest and marsh habitat compared to Alternatives 5m and 6m. This results in lower habitat benefits (143 habitat units compared to over 170 in the subsequent Best Buy 5m and 6m plans). This alternative also does not meet the project objective of reducing shoreline erosion, as 3-5 fewer islands respectively, exposes more shoreline to wind and wave erosion. This alternative would not even reduce the current rate of erosion (almost 1 acre per year) by 50%. The Best Buy plans both would reduce rate of erosion by over 70%. For these reasons, Alternative 7m was deemed as not worth it and this alternative was eliminated.

Alternative 5m (Best Buy) –This alternative improves the aquatic ecosystem in Pigs Eye Lake by creating new floodplain forest habitat, reducing wind-wave action, and creating new wetland habitat. This alternative has all the same features as Alternative 6m, with the main difference being 3 additional islands (100,000 additional cy). This alternative would cost approximately $14.9 million and net 173.4 AAHUs, at an average annual cost per average annual habitat unit of $3,300. This larger alternative meets the project objectives and provides slightly more AAHUs, however, the incremental average annual cost per average annual habitat unit is $41,300 and only generates an incremental output of 2.3 additional habitat units. This small increase in habitat units, without providing additional features, and at a much larger cost, was deemed not worth it, and this alternative was eliminated.

Alternative 6m (Best Buy) - This alternative improves the aquatic ecosystem in Pigs Eye Lake by creating new floodplain forest habitat, reducing wind-wave action, and creating new wetland habitat. This

alternative would cost approximately $12.4 million and would result in a net gain of 171.1 AAHUs, at an average annual cost per average annual habitat unit of $2,748. The incremental output is 171.1 habitat units and the incremental average annual cost per average annual habitat unit is $2,700. Alternative 6m was considered worth the investment as it met all project objectives and maximizes habitat benefits at a reasonable cost.

5.4 Plan Selection

Selecting the National Ecosystem Restoration (NER) plan requires careful consideration of the plan that meets planning objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, completeness, effectiveness, efficiency, and acceptability.

5.4.1 National Ecosystem Restoration Plan

The alternative plan that reasonably maximizes the benefits in relation to cost and meets the overall planning objectives is Alternative 6m, tentatively selected as the National Ecosystem Restoration Plan (NER Plan). This is the first CAP Section 204 study in the District, but in comparison to similar island building projects in the District's Habitat Rehabilitation and Enhancement Project (HREP) program, the $2,700 per AAHU created by Alternative 6m is efficient in achieving the ecosystem restoration objectives and has been considered reasonable. For reference, HREPs yielding an average annual cost per AAHU of $2,000 have generally been accepted as justified, with $3,000 per AAHU accepted in some circumstances. These numbers have not been adjusted for inflation since they were developed in the early 1990s. These criteria have been used to justify construction of over $59 million in habitat projects within the St. Paul District since the program began. The Tentatively Selected Plan – Alternative 6m is consistent with regional and State planning for the area.

The federal objective for water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other federal planning requirements. Achievement of the federal objective is measured in terms of contribution to federal accounts intended to track the overall benefits of a given project.

5.4.2 Risk and Uncertainty

Areas of risk and uncertainty have been analyzed and were defined so that decisions could be made with some knowledge of the degree of reliability of the estimated benefits and costs of alternative plans. Risk is a measure of the probability and consequence of uncertain future events. Uncertainty refers to a lack of knowledge about critical elements or processes contributing to risk or natural variability in the same elements or processes.

The team worked to manage risk in developing measures. The team used experience from past projects to identify potential risks and reduce uncertainty during plan formulation. The team developed measures by expanding on and referencing successful similar island building work in the Upper Mississippi River (UMRR HREPs), referencing the *UMRR Design Handbook* (USACE, 2012), and best professional judgment.

The primary risks identified for Pigs Eye Lake included risk of disturbing contaminants, constructability risks, and risks associated with climate change impacts to flow discharges. The risk of disturbing contaminants was significantly minimized following extensive HTRW and sediment sampling. The outcome of these surveys was that contamination was not a project risk as construction would avoid the former landfill and sediment samples were within acceptable limits, as described in Appendix E – Sediment Report and Appendix K - HTRW. The potential consequence identified from construction risks was largely the risk of island settlement. The team discussed the MPCA's work in the St. Louis River Interlake Duluth Tar Site, which has similar unconsolidated substrate characteristics to Pigs Eye Lake and was successfully implemented. The team also held numerous constructability meetings aimed at proper island design that incorporated additional material for settlement and lateral spread. Risks associated with increases in flow discharges as a result of climate change are also present. The primary effect of generally increasing discharges will be the increased duration of inundation on the constructed project features which would affect the success of the project. As outlined in great detail in Appendix G, rising stages would increase the potential for erosion to the islands. Higher stages could increase erosion on the lower island areas in particular. Vegetation is an important component of erosion protection and increased flooding could impact vegetative quality and species.

Furthermore, the team had several meetings to conduct an Abbreviated Risk Analysis during which project risks were factored into project costs (Attachment 2 of Appendix I – Cost Engineering). The adjacent Mississippi river is a dynamic system, and post-construction monitoring and adaptive management would be used to address any unplanned outcomes of the Tentatively Selected Plan. Therefore, none of the project measures (islands, sand benches, marsh habitat) are believed to be burdened by significant risk or uncertainty regarding the eventual success of the proposed habitat.

5.4.3 Consistency with Corps Campaign Plan

The Corps has developed a Campaign Plan with a mission to "provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risk from disasters." This study is consistent with the Corps Campaign Plan by producing lasting benefits for the nation, by optimizing agency coordination, and by using innovative solutions in pursuit of a sustainable, environmentally beneficial, and cost-effective ecosystem restoration design.

5.4.4 Consistency with Corps Environmental Operating Principles

The Corps has reaffirmed its commitment to the environment by formalizing a set of Environmental Operating Principles (EOP) applicable to all of its decision-making and programs. The EOPs are: foster sustainability as a way of life throughout the organization; proactively consider environmental consequences of all USACE activities and act accordingly; create mutually supporting economic and environmentally sustainable solutions; continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments; consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs; leverage scientific, economic and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner; and employ an open, transparent process that respects views of individuals and groups interested in USACE activities. The EOPs were considered during the plan formulation, and the TSP is consistent with the EOPs. The TSP

promotes sustainability and economically sound measures by incorporating the most natural and least cost methods for restoring Pigs Eye Lake, floodplain forest, and wetland habitat for fish and wildlife species.

6 Recommended Plan

The results of the NEPA analysis, incremental cost analysis, P&G criteria evaluation, and habitat evaluation in this chapter were considered in the decision-making process along with other factors, including physical features on the site, management objectives, critical needs of the region, and ecosystem needs. The Pigs Eye Lake team concluded that the alternative plan that best meets the goals and objectives is Alternative 6m. This alternative is cost-effective and justified as a "Best Buy" plan.

Alternative 6m was identified by the PDT as the NER Plan and is the recommended or Tentatively Selected Plan (TSP), and is currently being coordinated for concurrence with the Project Sponsor, Ramsey County (Appendix A – Correspondence & Coordination). The plan would create a complex of 7 islands with approximately 16.3 acres of floodplain forest and wet prairie habitat and 17.6 acres of marsh habitat in Pigs Eye Lake (Figure 21).

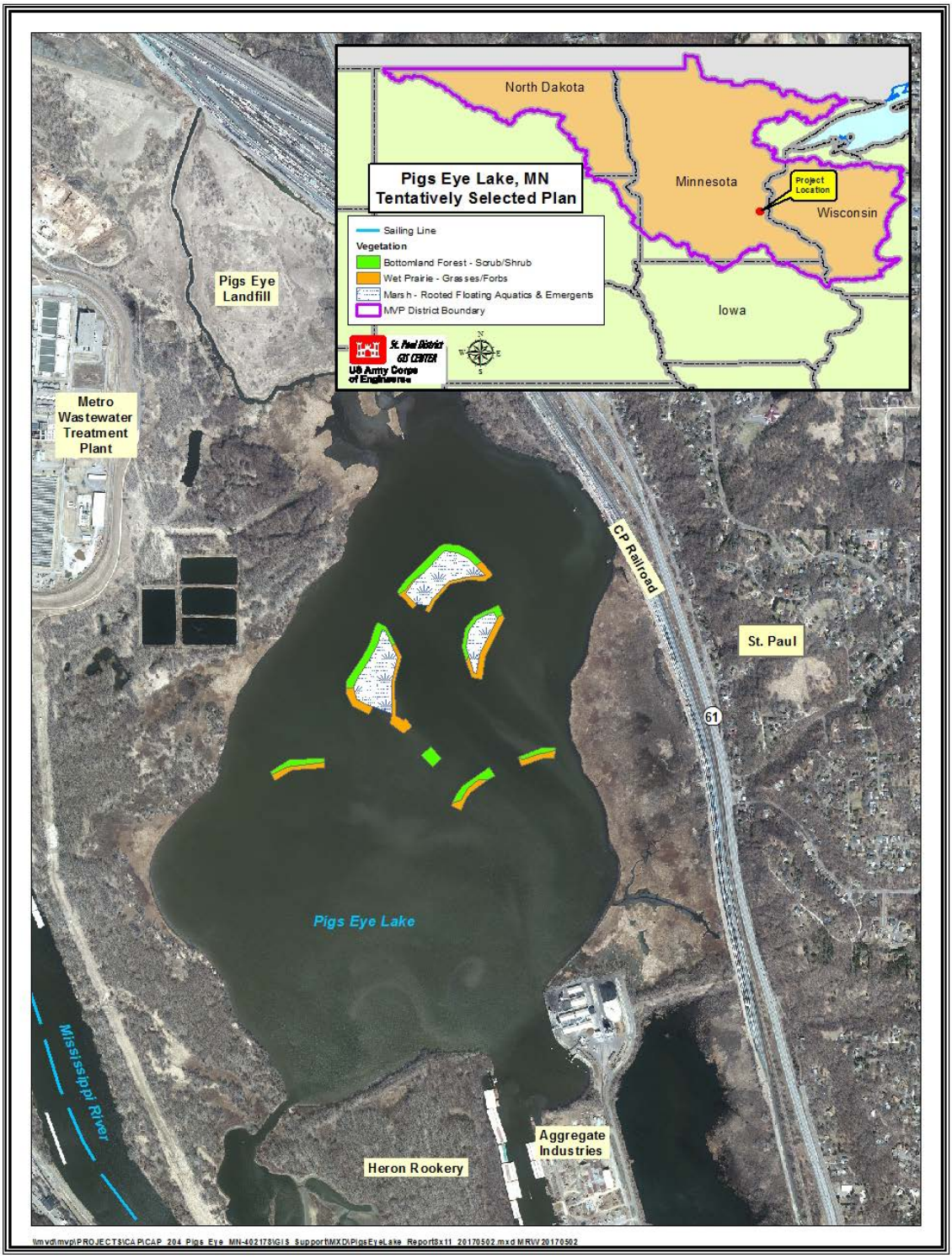

Figure 21: Map of the Tentatively Selected Plan (Alternative 6m)

6.1 Plan Features

The recommended plan for beneficial use of dredged material in Pigs Eye Lake (Alternative 6m) includes construction of 7 islands (3 of which are split island designs), 17.6 acres of marsh habitat (associated with the 3 split islands), and 16.3 acres of island habitat for floodplain forest or wet prairie plantings. The features of the recommended plan are designed to address study objectives (Table 10). Some features of the recommended plan address multiple objectives.

Table 10: Plan Features and Project Objectives

Features	Objectives	Description
Islands	Improve aquatic habitat Improve the quantity and quality of habitat for migratory bird species Maintain or enhance the quantity of shoreline habitat	The islands improve habitat conditions by increasing habitat diversity, increasing the amount of protected areas, and protect the existing shoreline vegetation by reducing wind and wave action.
Marsh Habitat	Improve aquatic habitat Improve the quantity and quality of habitat for migratory bird species	The marsh feature would provide the added benefit of promoting emergent and floating leaf aquatic vegetation.
Floodplain Forest/ Wet Prairie Habitat	Improve the quantity and quality of habitat for migratory bird species Maintain or enhance the quantity of shoreline habitat	Floodplain forest plantings would provide habitat for shoreline species while also acting as an obstacle to wind blowing across the lake.

The Corps has constructed many islands to improve habitat on the Upper Mississippi over the past few decades. Many of the features and recommendations have been denoted in the Corps' *Upper Mississippi River Restoration Program - Environmental Design Handbook, December 2012*. This document was used to insure island dimensions and design criteria were in general agreement with currently accepted design characteristics. Figure 22 is an aerial image taken in Pool 8 that shows some islands constructed by the Corps as part of a habitat improvement project. Islands constructed in different years are shown and identified to demonstrate the progression and growth of island vegetation.

The proposed islands for Pigs Eye Lake would vary somewhat from these typical sections. This has been done in part to provide a better design for construction on very soft sediments. Changes have also been proposed to improve the habitat value. However, the proposed island designs retain the general linear form of the islands shown in Figure 22. See Appendix L – Civil Drawings, for details.

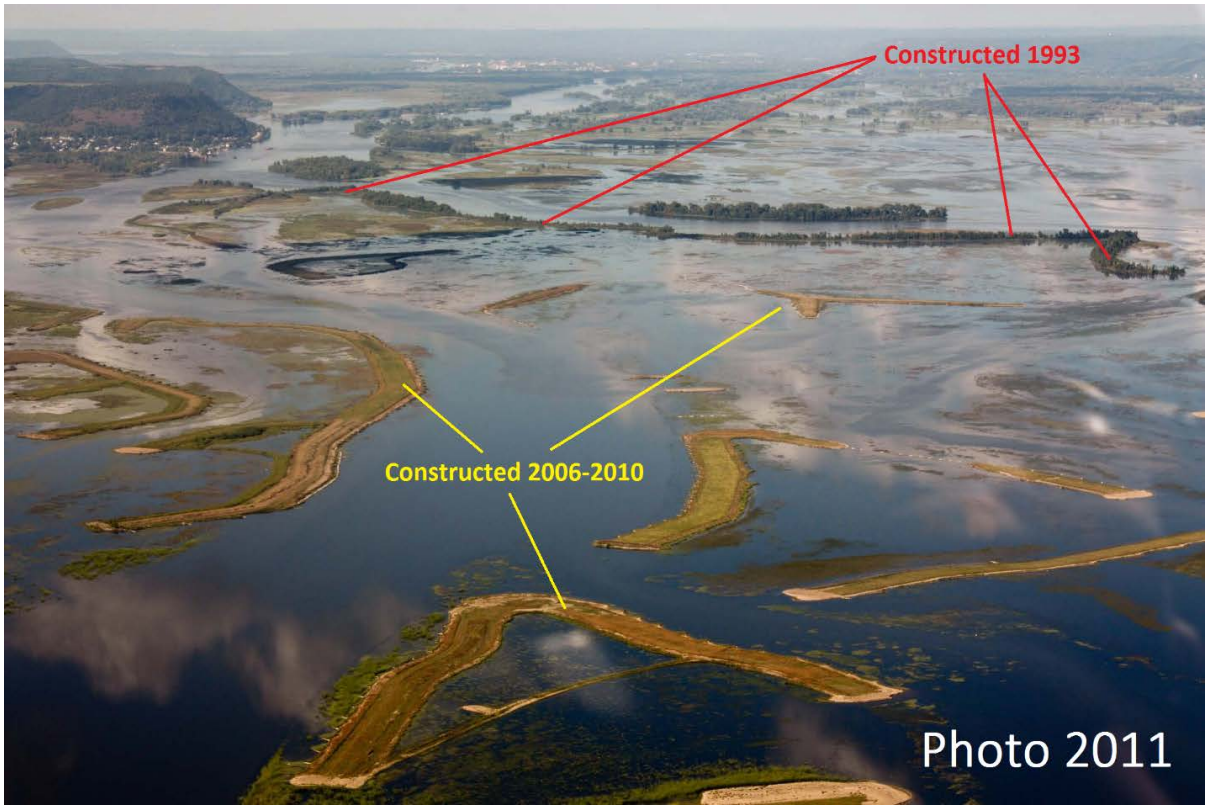

Figure 22: Example of Islands constructed by Corps for Habitat in Pool 8

6.2 Design Considerations

The Project has been developed to a feasibility level of design (Table 11). Design details are included in Appendix L – Civil Drawings. As with all feasibility level studies, these details will be refined in the Plans and Specifications (P&S) Stage.

Assumptions:

Settlement: Assumptions for settlement were 2.5 ft where design grade was 1 ft above low control pool (LCP, 686.8), or 687.8. Conversely, 1.5 ft of settlement was assumed where design grade was lower than 1 ft above LCP, or 687.8.

Lateral Displacement: A 10 percent increase in sand fill material was assumed to account for lateral displacement of the foundation.

Observation of test fill sections prior to construction of the project can be utilized to inform settlement and lateral displacement specifics.

Design quantities: Design quantities are based on a bathymetry survey performed by the Corps, dated October, 22, 2015. The survey was performed for River Miles 834.4-836.3 and adjusted to Low Control Pool (L.C.P.) elevation 687.2. The water surface elevation at the time of the survey was elevation 687.4. The Vertical Control is NAVD 88 and Horizontal Control DGPS NAD 83-State plane MN-South.

Table 11: Design Quantities for the Tentatively Selected Plan

Topsoil (Fine Material)	Volume	Settlement	Lateral Spread	Rock Groins	Marsh Plantings	Willows
Topsoil total volume [cu.yd.]	Total sand + settlement + lateral fill volume [cu.yd.]	Total Settlement [cu.yd.]	10% in sand fill quantity [cu.yd.]	Rock total volume [cu.yd.]	Marsh Volume [cu.yd.]	2 rows spaced at 2' apart [ln.ft.]
14,579	369,867	115,735	23,103	2,100	28,883	17,294

6.3 Construction Implementation

The sand and topsoil needed to construct the islands would be sourced from material dredged for maintenance of the 9 foot navigation channel project on the Upper Mississippi River. Most likely, sand would be obtained by mechanically offloading temporary placement sites in Lower Pool 2 (Pine Bend, Upper Boulanger, and Lower Boulanger). To transport dredged material from temporary placements sites, barges could travel from the main channel through the access channel for the Red Rock Terminal to a staging location at the southern end of Pigs Eye Lake. Preliminary analysis has concluded that the southern end of the lake can be reached through the access channel for the Red Rock Barge Terminal (8-9+ ft draft). Coordination will continue with businesses utilizing the Red Rock Terminal with regard to project construction.

How islands are constructed is generally left to the discretion of the contractor. The contractor is responsible for providing the finished product (the islands as designed) in a manner best suited to their operation, and without causing environmental damage. Experience with construction of other island projects within the St. Paul District (28 islands in 6 different locations) has shown that there is a general pattern to cost effective construction of islands.

The sand base for an island is placed using hydraulic or mechanical dredging equipment. Because of the large quantities involved, it is usually much more cost effective to use hydraulic dredging equipment than mechanical dredging equipment.

Fine material is placed on islands by a variety of methods. Placement of fine material using mechanical equipment is slower and more costly in terms of actual placement. By comparison, placement of fine material using hydraulic dredging equipment is faster.

The contractor would be allowed to use available technologies, so long as they are able to meet all the other conditions, including any necessary State permits and/or water quality certifications.

Rock, utilized for groin construction along island shorelines, can be barged to the islands and placed using mechanical equipment (hydraulic excavators) from either the new island base or from barges.

Front end loaders can be used for unloading rock form material barges for direct placement, or for loading on to haul trucks. Soft conditions expected on the islands, however, may reduce the amount of work performed with tire mounted equipment on this project. A primary factor limiting production for rock placement is usually water depths for the rock barges and push boats. To reduce the amount of access dredging or double handling of rock along the islands, contractors may elect to place rock protection during periods of high water.

Generally, a balance must be struck to provide reasonable access for the construction while minimizing the environmental disturbances associated with the dredging and construction. Contractors are allowed to request alternate access routes. These requests would be evaluated on a case-by-case basis for approval and may require additional environmental review.

6.3.1 Construction Restrictions

Construction restrictions could be applied for any number of reasons. Restrictions are generally applied in the construction of habitat projects to minimize the adverse effects of construction and to protect valuable habitats. The following are the basic construction restrictions that would likely be applied in the construction of the island measures.

Access Dredging – Preliminary analysis has indicated that the southern part of the lake can be reached without access dredging.

Bald Eagles – In general, project activities will not be allowed within 660 feet of a bald eagle nest during the nesting season. If construction activities would involve loud noises, a ½ mile buffer zone would be required during this period.

Pigs Eye Island Heron Rookery SNA – Disturbance to the SNA due to construction activities would need to be minimized. Staging on or directly adjacent to the Pigs Eye Island Heron Rookery SNA would not be allowed without special precautions to avoid disturbance. Additional restrictions may be necessary during the sensitive nesting period of April 1 – July 15 depending on the proposed method of construction.

Mud Waves – Due to the soft substrate conditions in the project area, lateral displacement of substrate (i.e., “mud waves”) could be caused by construction. Construction techniques to reduce this risk should be used. For example, lateral displacement could be reduced by construction methods such as placing the material in staggered “lifts.”

6.3.2 Construction Schedule

Because of the location and nature of the construction, nearly all the work would require use of marine equipment. Construction of this type is limited to the open water season on the Upper Mississippi River. Construction in certain years can begin in April, but May is a more typical for beginning construction due to the constraints associated with spring high water. At the other end of the spectrum, late November is the end of the construction season due to winter freeze-up. The construction schedule for the project would depend on the funds available for construction and other factors such as the potential for combining construction with District operation and maintenance activities or the need to accommodate

other habitat measures such as pool drawdown. Based on current and expected CAP and O&M budgets and project priorities within the St. Paul District, it is estimated that construction of the project would begin in 2019 and be completed in 2020. The optimum approach would be to construct the project under one construction contract.

6.3.3 Permits

This document will be distributed for public review and comment in compliance with NEPA. Ramsey County – the state-designated Responsible Governmental Unit (RGU) – will concurrently ensure compliance with the Minnesota Environmental Protection Act. This will be accomplished by distributing the report for review as an Environmental Assessment Worksheet. An application for a Public Waters Work Permit from the state of Minnesota will be submitted. Clean Water Act Section 401 water quality certification from the State of Minnesota will be requested by the Environmental Compliance Branch of the Corps, based upon the Finding of Compliance of the 404(b)(1) evaluation in Appendix B – Clean Water Act. The proposed fill activity would comply with State water quality standards and it is not anticipated that the proposed project would violate Minnesota water quality standards for toxicity. Water quality certification would be obtained from Minnesota prior to project construction. The St. Paul District has determined that the proposed activity is in compliance with all environmental laws and regulations, including the Endangered Species Act, Clean Water Act, NEPA, and Bald and Golden Eagle Protection Act.

6.4 Operation and Maintenance Considerations

The purpose of assigning Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs is to ensure commitment and accountability by the project partner. The project features are dynamic and intended to emulate natural backwater processes, therefore, operation and maintenance will be minimal. Dynamic features are those where river and lake forces will be allowed to shape the measures with no future maintenance anticipated. The present value and estimated average annual OMRR&R costs for Ramsey County are estimated to be minimal ($2,000 annually). Ramsey County Parks & Recreation, if a project partnership agreement is executed, would be responsible for 100 percent of the operation and maintenance of the project features.

Operation and maintenance would be similar to that undertaken by the project partner for day-to-day management of wildlife areas and other public use areas. The only potential maintenance actions anticipated would be wildlife management activities such as inspections and monitoring and management of nuisance or invasive species. The project sponsor may need to coordinate proposed maintenance activities with nearby stakeholders such as the St. Paul Downtown Airport, Metropolitan Council, and MPCA.

6.5 Real Estate Considerations

The majority of the lake and riparian area is owned by the non-federal sponsor, Ramsey County (see Figure 3). The north end of the lake and adjacent riparian land is owned by the City of St. Paul. The land area northwest of the lake contains inactive waste water treatment ponds and is owned by the Metropolitan Waste Control. The Port Authority owns portions of the lake and riparian land on the

southern tip of the lake around the outlet of Pigs Eye Lake into the Mississippi River. The Port Authority land is currently being utilized for barge loading/offloading.

No additional land interest is required for the project. The project will be constructed in waters owned and managed by the non-federal sponsor, with the underlying land owned by the sponsor as well. The exact staging area for construction will be determined during development of plans and specifications. No additional real estate or relocations are deemed necessary.

6.6 Project Cost Summary

After a recommended plan was identified using preliminary costs, a more detailed cost estimate was completed for the recommended plan. Table 12 shows the estimated cost by account. Total project costs are separated by base plan costs and the CAP Section 204 costs (as described in Section 5). The costs are expressed as Project First Costs and include construction, contingencies, engineering, planning, design, and construction management. The Project First Costs are the project costs at the effective price level of October 2017. The more refined cost estimate also involved updated quantities, an updated Abbreviated Risk Analysis to determine contingencies, Micro-Computer Aided Cost Estimating System (MCACES), and Total Project Cost System (TPCS) to determine Present Value costs. The detailed estimate of the project design and construction costs are provided in Appendix I – Cost Estimate; however due to the sensitivity of providing this detailed cost information which could bias construction contract bidding, this material has been omitted in the public document. Quantities and costs may vary during final design.

Table 12: Tentatively Selected Plan Preliminary Cost

Account	Feature	Cost Plus Contingency
01	LANDS AND DAMAGES	$100,000
06	WILDLIFE FACILITIES AND SANCTUARIES	$13,371,000
31	ADAPTIVE MANAGEMENT AND MONITORING	$281,000
30	PLANNING, ENGINEERING, AND DESIGN	$932,000
31	CONSTRUCTION MANAGEMENT	$885,000
TOTALS	BASE PLAN	$3,178,000
	SECTION 204	**$12,392,000**

6.7 Project Performance (Monitoring and Adaptive Management)

The project performance assessment will allow measurement of differences from baseline conditions for key physical and biological factors. This should allow a quantitative determination of improvement and assessment of whether features are functioning as intended (see Table 13). Additional information can be found in Appendix J – Monitoring and Adaptive Management.

Table 13 Monitoring and Adaptive Management Summary

Performance Indicator	Activity	Monitoring Target
Migratory Bird Use Rates	Fall Waterbird Counts	10% increase in total bird numbers or increase in species richness by year 5 following construction
Vegetation Monitoring	1-yr planted seedling survival & growth	75% planted seedling survival & positive production & survivorship
	Long-term planted seedling survival & growth	Year 3: >75% survival Year 6: >60% survival Year 10: >50% survival
	Marsh and wet prairie establishment success	Density, Species Richness, and Quality targets detailed in Appx. J.
Island Settlement	Island Elevation Surveys	Islands at or very close to design elevation
Water Quality	Pre- and post- project Turbidity and TSS monitoring	Consistent and measurable reduction from baseline
Shoreline Protection	Shoreline Erosion Analysis	Retreat of overall shoreline less than predicted 0.75 acres per year

7 Environmental Effects

An environmental evaluation in accordance with NEPA (42 U.S.S 4331) has been conducted for the recommended action, and a discussion of the impacts follows. This discussion also examines the no action alternative.

The important natural resources of the project area and its surroundings are described in Chapter 2 (Existing Resources) of this Feasibility Study Report with Integrated EA. Table 14 shows the comparison of benefits (i.e. habitat value increase) among all alternatives to floodplain forest habitat and aquatic resources. The types of effects to Alternatives 4, 5, 5m and 7m are similar to the TSP, but the degree of increase in habitat value varied by alternative. Additional descriptions of the ecological effects and benefits associated with the no action, recommended plan, and alternative plans can be found in Chapters 3, 4, and Appendix C - Habitat Evaluation and Quantification.

Table 14: Comparison of Environmental Benefits and Habitat Acreages

Alternative	AAHU Gain	Marsh Habitat (acres)	Floodplain Forest & Wet Prairie (acres)
No Action	0	0	0
Alt4	117.2	0	23.3
Alt5	117.2	0	21.4
Alt5m	173.4	20.0	21.4
Alt6m	171.1	17.6	16.3
Alt7m	143.4	17.6	14.9

In addition, Alternatives 4, 5, 5m and 7m involve the same restoration measures, and the type and degree of adverse impacts, if any, to noise, aesthetics, recreation, commercial navigation, HTRW, environmental justice, air quality, water quality and threatened and endangered species, and cumulative effects would not be appreciably different from those associated with the TSP. Therefore, only the effects of the TSP and the No-Action Alternative are discussed in detail below. To maintain brevity, the discussion does not include those parameters where there are “no effects,” but this information is included in the Table 15.

Table 15: Environmental Assessment Matrix

	No Action Alternative							Proposed Alternative						
	BENEFICIAL				ADVERSE			BENEFICIAL				ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. Social Effects														
1. Noise Levels				X								T		
2. Aesthetic Values					X					X		T		
3. Recreational Opportunities					X					X		T		
4. Transportation				X							X			
5. Public Health and Safety				X							X			
6. Community Cohesion (Sense of Unity)				X							X			
7. Community Growth and Development				X							X			
8. Business and Home Relocations				X							X			
9. Existing/Potential Land Use				X							X			
10. Controversy				X							X			
B. Economic Effects														
1. Property Values				X							X			
2. Tax Revenue				X							X			
3. Public Facilities and Services				X							X			
4. Regional Growth				X							X			
5. Employment				X						T				
6. Business Activity				X							X			
7. Farmland/Food Supply				X							X			
8. Commercial Navigation				X						X				
9. Flooding Effects				X							X			
10. Energy Needs and Resources				X							X			
C. Natural Resource Effects														
1. Air Quality				X								T		
2. Terrestrial Habitat					X				X			T		
3. Wetlands						X			X					
4. Aquatic Habitat					X				X			T		
5. Habitat Diversity and Interspersion					X				X					
6. Biological Productivity					X					X		T		
7. Surface Water Quality					X					X		T		
8. Water Supply				X							X			
9. Groundwater				X							X			
10. Soils				X							X			
11. Threatened or Endangered Species				X							X			
D. Cultural Resource Effects														
1. Historic Architectural Values				X							X			
2. Prehistoric & Historic Archeological Values				X							X			

T= Temporary Effect

7.1 Socioeconomic Effects

7.1.1 Noise

The no-action alternative would have no impact on noise in the project area.

The proposed project would cause temporary, minor, adverse impacts on local noise levels during construction. The project area is relatively isolated, and any nearby noise receptors already experience noise generated by the adjacent railroad tracks, Highway 10/61, a barge shipping facility, and wastewater treatment plant. The increased noise levels would be temporary and would disappear upon project completion.

7.1.2 Aesthetics

The no-action alternative would have minor, adverse effects on aesthetics in the project area. Without intervention, the shoreline would be expected to continue to erode and lead to additional loss of shoreline vegetation and further decline in the area's aesthetic value.

The proposed project would cause temporary, minor, adverse impacts on aesthetics during construction. The aesthetic value of the areas would be reduced as a result of the activity and disturbance associated with construction and the presence of construction equipment.

The proposed project would also have long-term minor beneficial impacts. Impacted entities would be residences on the bluffs to the east of Pigs Eye Lake that currently overlook the project area and recreationists. Construction of the proposed project would change some views of the area from vast expanse of open water to interspersed, vegetated islands. Although aesthetic values are somewhat subjective, the islands would likely be considered aesthetically pleasing to most.

7.1.3 Recreation

The no-action alternative would have minor adverse effects on recreation. The project area would continue to degrade due to further loss of shoreline and the turbidity exacerbated throughout the lake by wind-generated waves.

The proposed project would result in a short-term adverse impact to recreation and a long-term beneficial effect on recreation. During construction, project activities would preclude recreational access and use of some of the lake. These adverse effects would be temporary and would disappear upon project completion. In the long-term, the improvement to the habitat in Pigs Eye Lake as a result of project construction would lead to more and enhanced recreational opportunities, including fishing, paddling, and bird-watching.

7.1.4 Commercial Navigation

The no-action alternative would have no effect on commercial navigation.

The proposed project would have a minor beneficial impact on commercial navigation. The project would provide a location to place sediments dredged in the maintenance of the 9-Foot Navigation Channel, which would otherwise occupy space in designated placement sites.

7.1.5 Airport Wildlife Hazards

The proposed project is located approximately 6,000 feet southeast of the St. Paul Downtown Airport. Because certain types of wildlife may interact with airport operations, the proposed project was evaluated for potential impacts.

The no-action alternative would have no impact on aviation in the project area.

The proposed alternative is not expected to adversely impact local aviation operations or cause an increase in wildlife strikes. This conclusion is based on (1) Comparison of existing and proposed habitat conditions and wildlife use, (2) Analysis of reported airport strikes at St. Paul Downtown Airport, and (3) Results of coordination with representatives from the local airport authorities, USDA Wildlife Services, and wildlife management experts from local resource agencies. The evaluation and coordination resulted in the Minneapolis Saint Paul Metropolitan Airports Commission stating that they were "Not Opposed" to the project. These factors are discussed in the following sections.

7.1.5.1 Existing and Proposed Project Conditions

The proposed project would improve habitat and increase wildlife use of the area. However, there is already significant wildlife use in and around the Pigs Eye Lake area such that the change would not lead to significantly different overall hazards for the airport.

Although habitat conditions in Pigs Eye Lake are degraded, it remains a high-use area for many types of birds. Surveys conducted in 2015 by the National Park Service recorded 17 waterbird species using Pigs Eye Lake, with 2,384 total birds counted in only five days over the course of the fall migration season. The most commonly identified bird was the mallard, followed closely by Canada geese. Eighty-five percent of mallards counted were seen on a single observation day on November 24, while the Canada geese were observed in similar numbers throughout the survey with an average of 144 individual geese counted per day. At least four eagle nests have been identified around the perimeter of the lake, and surveyors noted between four and eight eagles present each day. The Pigs Eye Lake Heron Rookery – a Minnesota-recognized Scientific Natural Area – supports populations of herons, egrets, cormorants; in total, 89 species of birds have been documented at the rookery. The heavy use of Pigs Eye Lake by birds, despite the degraded conditions, is likely due in part to the fact that the area represents one of the larger tracts of undeveloped land along the Mississippi River within the Twin Cities area, and the River is the central feature of the largest migration route in North America. This would suggest that birds would also likely be expected to continue using the site into the future, regardless of project construction.

One of the primary objectives of the proposed project is to improve the habitat in Pigs Eye Lake for migratory birds. The proposed islands would improve the existing habitat by reducing wind-induced waves, protecting existing shoreline habitats, and increasing habitat diversity. As discussed previously, the lake already receives significant use by birds. In addition to the lake itself, there are thousands of acres of valuable bird habitat adjacent to Pigs Eye Lake (i.e., Pigs Eye Lake Heron Rookery, Red Rock Lake, Hog Lake, Little Pigs Eye Lake, etc.). Of the nearly 3,000 acres of water and undeveloped floodplain area including and surrounding Pigs Eye Lake, the project would directly affect only 60 acres. Specifically, the project would convert approximately 20 acres of open water to islands and 20 acres of open water

to marsh. The project would reduce wind-driven waves on approximately 681 acres of open water and the direct surrounding shoreline. However, the project would not change the total acreage of wildlife habitat near the St. Paul Downtown Airport – it would improve and protect a portion of it.

Large-scale population fluctuations could further influence the numbers of birds using the area at a greater rate and regardless of project completion. For example, the most recent FAA National Wildlife Strike Database Serial Report (Number 22) cites a study by Dolbeer and Begier (2013) that concluded, "Of the 21 species of birds in North America with mean body masses >4 lbs and with at least 10 reported air strikes with civil aircraft from 1990-2012, 17 species' populations increased with a net gain of 17 million birds" (Dolbeer et al. 2016).

7.1.5.2 Wildlife-Aircraft Strikes at Downtown St. Paul Airport

Despite the significant wildlife use presently occurring in Pigs Eye Lake and the surrounding area, the Downtown St. Paul Airport has experienced a lower incidence of wildlife-aircraft strikes than the U.S. average.

The FAA maintains and publishes strike data online. Strike reporting by airports and pilots is voluntary, but research suggests that over 90 percent of strikes with commercial aircraft are now reported (Dolbeer 2015). Between 1990 and 2015, the total number of reported Bird Strikes by U.S. Aircraft (including strikes by U.S. planes occurring in other countries) was 164,444. The total number of commercial and general aviation aircraft movements during this time period was 2.7 billion. This equates to approximately 6.1 strikes per 100,000 flights. Approximately eight percent of all strikes (13,558 strikes) were reported as causing some level of damage to the plane. During the same 26-year period, 365 human injuries were attributed to bird strikes (205 strikes) and eleven of these bird strikes caused a total of 25 human fatalities.

Wildlife strikes have occurred in the airspace near the St. Paul Downtown Airport, and data about the strikes has been collected since 1990. The Wildlife Strike Database was searched on February 10, 2017 for records from the St. Paul Downtown Airport. The data ranges from January 1990 to present, and includes reports of a total of 68 bird strikes in this 27-year period, averaging 2.5 strikes per year. Based on a reported 64,000 flights annually from the airport, this equates to approximately 3.9 strikes per 100,000 flights. The number of strikes per year has increased since 1990, but it is difficult to interpret this without corresponding data for the number of flights each year in order to standardize the measure. Increased reporting may also play a role.

The type of birds most frequently struck at St. Paul Downtown Airport were hawks, eagles, and falcons, which accounted for 19 of the 68 total strikes (~28 percent). The species struck most was the Bald Eagle (8 strikes). Geese, ducks, and swans accounted for 12 strikes total. The data is summarized in Table 15. Nearly 60 percent of all strikes occurred during the months of July through October, likely coinciding with the period when young birds fledge from nests (Figure 23). Of note, this appears to be prior to the main migratory season as represented by bird count data collected in Pigs Eye Lake by the National Park Service, which reported the highest bird counts at the end of November and early December.

The strike database also allows those reporting incidents to enter a qualitative assessment of the level of damage, if any, which was sustained by the aircraft from each strike. Categories of damage include “None,” “Minor,” Substantial,” “Destroyed,” and “Uncertain.” Table 16 provides a summary of the damage levels reported for the 68 bird strikes from St. Paul Downtown Airport. Of those reported, most strikes caused No damage or Minor damage (n=42). Approximately nine percent of strikes were reported as causing Substantial damage (n=6). None were categorized as Destroyed.

Table 16: Bird Species Struck at St. Paul Downtown Airport, 1990–2016

Species	Number
Hawks/Eagles/Falcons	**19**
American kestrel	4
Bald eagle	8
Hawks	3
Peregrine falcon	3
Red-tailed hawk	1
Geese, ducks, swans	**12**
Canada goose	7
Ducks	2
Unidentified Geese	1
Mallard	1
Snow goose	1
Gulls	**7**
Gulls	7
"Songbirds" (*Passeriformes*)	**5**
American crow	1
Eastern meadowlark	1
European starling	1
Red-winged blackbird	1
Western meadowlark	1
Other	**4**
Common loon	1
Hairy woodpecker	1
Rock pigeon	2
Unknown Birds	**21**
Unknown bird	2
Unknown bird - large	2
Unknown bird - medium	6
Unknown bird - small	11
Mammals	**2**
Striped skunk	1
White-tailed deer	1
Total	**70**

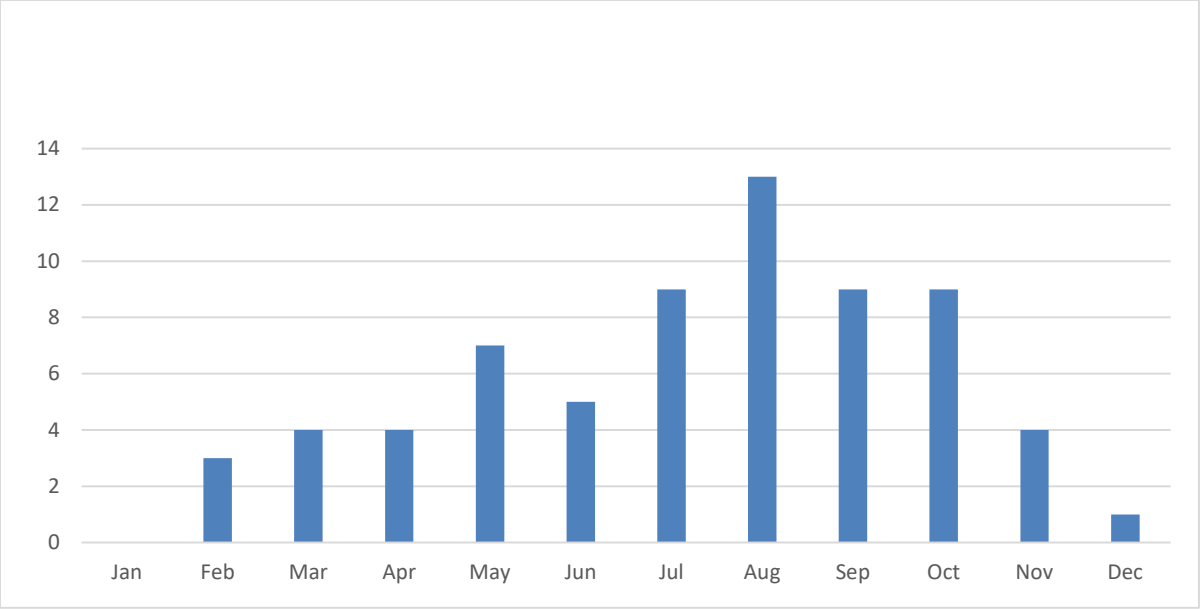

Figure 23: Number of Reported Bird Strikes by Month

7.1.5.3 Aircraft-Wildlife Hazard Coordination

Coordination in regards to airport safety has been ongoing with the FAA, USDA-WS, and Minneapolis Saint Paul Metropolitan Airports Commission (see Appendix A - Correspondence & Coordination). Together with the FAA, the USDA-WS provided four recommendations that might reduce the chance for the project to attract wildlife hazards based on their review of the project. The recommendations have been taken into consideration during project planning and incorporated to the extent practicable, as discussed below.

Table 17: Reported Damage from Bird Strikes Occurring at St. Paul Downtown Airport, 1990–2016

Damage	Number
None	29
Minor	13
Substantial	6
Destroyed	0
Uncertain/Unreported	20
Total	68

First, the USDA-WS recommended planting thick, woody, scrub-brush vegetation species, especially near the water's edge, in order to minimize open areas where waterfowl nesting occurs. Two rows of willows are incorporated in most of the island perimeters in order to stabilize the island edges, and should serve well in partially fulfilling this suggestion. However, some open sandy areas are desirable as a project feature to allow for turtle nesting and are therefore being incorporated into the project design. Additionally, there are concerns that planting entirely woody and shrubby species would have a high potential for being foraged by resident beavers, whereas it is believed that planting a more diverse cover would likely have greater success. The Corps believes this would meet the intended goal of this suggestion. Detailed planting plans will be developed following the feasibility stage, which will be coordinated for additional comments.

Second, the USDA-WS recommended minimizing shallow-water emergent vegetation (i.e., cattails) to prevent muskrats from building huts, which could provide nesting platforms for Canada geese. A focus

of the wetland plantings will be rooted floating aquatic vegetation such as lotus, but some emergent vegetation would also be incorporated into the project. Softstem and hardstem bulrush are already prevalent along much of the Pigs Eye Lake shoreline. These species provide important fish habitat for cover and spawning. Emergent vegetation like bulrush can actually discourage birds like geese from accessing the land. Muskrats, beavers, and mink already make use of Pigs Eye Lake and the bulrush, with a number of huts observable along the shoreline. However, resource managers that frequent the lake have not noted use of these huts by nesting geese. Therefore, the Corps will partially implement this recommendation, and will remain cognizant of the concern as detailed planting plans are developed.

The third recommendation by the USDA-WS is to avoid incorporating sand benches above or below the water's surface, due to concerns that fluctuating water levels could lead to exposing the sand and creating nesting areas. Although sand benches (i.e., sandbars, sand flats, etc.) were considered during planning, none were incorporated into the TSP. The water levels in Pigs Eye Lake are highly connected to the navigation channel. During dry periods, minimum water levels are maintained by manipulating the Lock and Dam system in order to facilitate navigation in the main channel. The Corps used this minimum low water level elevation in order to design the islands such that there would be minimal areas of frequently exposed, barren sand. The only areas expected to be shallow and sandy would be the transitional areas between the water and the shoreline, and any areas set aside for turtle nesting habitat.

Finally, the fourth USDA-WS recommendation is to reduce the overall number of islands and steepening the slopes of the island banks to decrease the shoreline available to nesting waterfowl. Unfortunately, because of the unconsolidated nature of the substrate in Pigs Eye Lake, the islands require relatively gentle slopes to increase stability. Even still, the slopes were designed to be as steep as possible in order to minimize the quantity of sand needed to construct them. The number of islands in the TSP was reduced from 9 islands to 7 islands during planning following this suggestion. Concerning shoreline length, the TSP would have among the shortest total length of shoreline of all the island configurations considered during planning. Although reducing wildlife hazards was not the main reason for doing so, shoreline length in the TSP was in fact reduced by 32 percent (~17,000 feet) since this recommendation was made.

7.1.6 Hazardous, Toxic, and Radioactive Waste

Under the no-action alternative, continued wind-wave action could mobilize contaminated sediments near the Pigs Eye Landfill and move them throughout the lake. Waste from the Pigs Eye Landfill has contributed to known contaminated land on the former landfill site as well as heavy metals found in borings taken from the far northern portions of the lake, as discussed in Section 2.3.

The proposed alternative would have a short-term risk of disturbing sediments during construction, but would have a long-term positive effect on the project area by capping existing flocculent sediments and reducing the likelihood of redistributing contaminated sediment due to wind-generated waves. The existing lake substrate conditions and the proposed fill material were considered in this determination, as discussed in the following sections.

This project would not involve Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) related activities or costs. The project would not involve clean-up or management of materials regulated by the CERCLA, and would not interfere with any ongoing or future cleanup actions associated with the nearby Pigs Eye dump site. Analysis and coordination of HTRW testing results indicate that: (1) CERCLA materials in the project area are at acceptable levels for construction of the proposed project features, and (2) Constructing the proposed ecosystem restoration features within the lake would have positive incidental benefits to the lake and surrounding areas.

7.1.6.1 Existing Sediment and Substrate

Sediment sampling and testing of the substrate throughout the lake has indicated that contaminants are not a major concern in the proposed project location. The test results revealed the highest levels of contamination are limited to the area adjacent to the landfill, which is outside of the footprint of the proposed islands. For the rest of the lake that would be affected by the island construction, sediment testing showed that the lake has ubiquitous contamination of PFCs, widespread low level (SQT I) exceedances for heavy metals and PAHs, limited locations with higher exceedances for cadmium and PAHS (SQT II and proposed Recreational/Residential SRVs) and no recent detection of PCBs. The relatively low levels of contamination (SQT I exceedances) present in the existing substrate would not pose a large risk of bioavailability or uptake of contaminants, and placing clean sand on top of the existing sediments to construct the proposed islands would probably benefit the aquatic and benthic environment by capping serving as an additional barrier to contaminant mobility. Local and regional resource agencies have been coordinated with and are supportive of this determination, and coordination will continue into the next project phase to develop strategies for further minimizing risks.

Construction activities may cause short-term disturbance and redistribution of the sediment adjacent to the islands during construction. The contractor would be required to utilize BMPs during construction to minimize these effects.

7.1.6.2 Proposed Fill Material

The proposed fill material would include rock, sand, and topsoil. The rock would be clean and sourced from a quarry. The sand and topsoil fill would consist primarily of material generated from dredging in the lower portion of Pool 2. Historically, sediment testing in Pool 2 has shown that some of the siltier dredge cuts in Lower Pool 2 have had issues with contamination. The levels of Pool 2 contamination appear to increase downstream, likely due to decreased granular size seen downstream where the pool becomes more lake-like. However, all of the dredged material currently available on the temporary placement islands where sand would be sourced for the project was dredged after 1999-2000. Sediment testing since 2000 has revealed fewer types and decreased levels of contamination. The only hits noted have been exceedances of SQT Level 1 limits for several PAHs (e.g., acenaphthylene and pyrene), and two pesticides (DDD and DDT). These contaminants were found at relatively low levels that would not have negative impacts if used to construct wildlife habitat (based on MN SQT guidelines), or if used as topsoil (based on MN SRV Guidelines). If preparation of project plans and specifications leads to a proposal to utilize material from Pigs Eye Lake for topsoil, existing contaminant data would be examined and additional testing may be required to ensure the material is acceptable for this use. Data and

conclusions would be coordinated with the Contaminants Sub-Group and any other relevant agencies for concurrence.

7.1.7 Environmental Justice

Environmental Justice is a national goal and is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Project goals and objectives were established to provide environmental restoration and enhance the quality of the environment for all people. Public involvement, via public meetings and distribution of information concerning the proposed project, has and will continue to be an integral part of planning for this project to ensure that concerns of all people will be fully considered in the decision-making process. Minority groups were identified in communities surrounding the project area; however, the project itself would not have any adverse effects on surrounding communities. Therefore, neither the no action alternative nor the proposed action would cause a disproportionate impact on any population.

7.2 Natural Resource Effects

7.2.1 Air Quality and Climate Change

The proposed project has been assessed for air quality effects on several levels: compliance with the rules provided by the Federal Clean Air Act, analysis of greenhouse gas emissions and potential effects on climate change, and impacts to sensitive local receptors (e.g., schools, parks, residences, hospitals, etc.).

The 1990 Federal Clean Air Act Amendments directed the Environmental Protection Agency (EPA) to develop federal conformity rules. Those rules (promulgated as 40 CFR parts 51 and 93) are designed to ensure that federal actions do not cause, or contribute to, air quality violations in areas that do not meet the National Ambient Air Quality Standards (NAAQS). The EPA has developed NAAQS for six principal air quality pollutants: carbon monoxide, nitrogen dioxide, ozone, lead, particulate matter, and sulfur dioxide. The final rule dictates that a conformity review be performed when a federal action generates air pollutants in a region that has been designated a non-attainment area for one or more of the six NAAQS criteria pollutants. Ramsey County is in “attainment” of the NAAQS for each of the criteria pollutants, so no conformity analysis is required for the proposed project.

Greenhouse gas (GHG) emissions and their effect on climate change are global issues resulting from numerous and varied sources, with each source making a relatively small addition to global atmospheric GHG concentrations, but which collectively have a large impact on a global scale. Although climate changes in the past have been caused by natural factors, human activities are now the dominant agents of change. Human activities are affecting climate through increasing atmospheric levels of heat-trapping gasses, including those emitted by the combustion of fossil fuels (e.g., Mellilo et al. 2014).

The proposed project would have both short-term adverse impacts from GHG emissions and long-term beneficial impacts from providing carbon sequestration. The proposed project would be expected to produce greenhouse gasses during construction in the form of exhaust from various types of machinery used for material transport and material placement. This particular project involves an alternative end

use of material that is already dredged in order to maintain another federally-authorized project. Therefore, the impact of this project would be the difference in emissions that would result from the proposed use of dredged material to construct islands in Pigs Eye Lake, rather than the typical placement of this material at a nearby upland placement site. In particular, the main difference would be transporting the previously-dredged material, by barge, approximately 13 miles upstream to Pigs Eye Lake. On the other hand, the proposed project would also provide carbon sequestration benefits by increasing carbon storage potential in standing riparian biomass and eventually by cycling the carbon through the floodplain river system and into the sediment. Quantifying these benefits would be difficult and outside of the scope of this analysis, but are well-documented throughout scientific literature (e.g., Sutfin, Wohl, and Dwire 2015). These benefits would be long-term and would continue for the life of the project.

At a local scale, the nearest sensitive receptor is a residential community of St. Paul, which is located on top of the bluff, approximately 2,000 feet east of the proposed project. During project construction, the project would have a temporary, minor, and localized adverse effect on air quality due to emissions produced by construction equipment. Air quality impacts generated by the project would be indistinguishable from the adjacent railroad tracks, Highway 10/61, a barge shipping facility, and wastewater treatment plant, and would not be expected to individually or cumulatively significantly change air quality in the area. This would be short-lived and would disappear upon project completion. Construction activities are expected to produce very little dust because the materials to be handled would be either wet (dredged material) or larger materials than are generally mobilized by wind (large rocks for training structure construction).

7.2.2 Terrestrial Habitat

The no action alternative would have minor adverse effects on terrestrial habitat. Under the no action alternative, the shoreline surrounding Pigs Eye Lake would be expected to continue eroding, reducing both the quantity and quality of terrestrial habitat.

The proposed project would have substantial beneficial effects to terrestrial habitat by preserving existing terrestrial habitat along shoreline of Pigs Eye Lake from erosion.

An estimated 111 acres of habitat around the perimeter of Pigs Eye Lake has eroded over the last 64 years, including low-elevation terrestrial habitat. Erosion that would be expected to continue in the absence of a project threatens an estimated 37.5 acres of additional shoreline habitat over the next 50 years. The proposed project would provide protection for some of this terrestrial habitat by reducing wind-generated waves within the lake.

7.2.3 Wetlands

The no action alternative would have substantial adverse effects on wetlands. Several areas along the shallow shoreline of Pigs Eye Lake currently support stands of aquatic vegetation. Under the no action alternative, many of these areas would be degraded due to the continued wind-generated waves and consequent shoreline erosion.

The proposed project would have substantial beneficial effects to wetlands both by preserving existing wetlands and by creating additional wetlands.

An estimated 111 acres of habitat around the perimeter of Pigs Eye Lake has eroded over the last 64 years, most of which was wetland. Erosion that would be expected to continue in the absence of a project threatens an estimated 37.5 acres of additional shoreline habitat over the next 50 years. The proposed project would provide protection for some of this terrestrial habitat by reducing wind-generated waves within the lake.

The proposed project would also create an estimated 33.9 acres of additional wetland habitat. This would include approximately 16.3 acres of bottomland forest and/or wet prairie and approximately 17.6 acres of marsh. Other areas within the island complex or newly-protected shoreline areas may re-vegetate over time as well.

7.2.4 Aquatic Habitat

The no action alternative would have a minor adverse effect on aquatic habitat. The stressors reducing the quality of aquatic habitat in Pigs Eye Lake would continue to act on the habitat and further declines in quantity and quality of aquatic habitat would occur if no action is taken to protect or improve the area.

The proposed project would have substantial beneficial effects on the aquatic habitat within the lake. Reducing wind-generated waves throughout the lake would lead to reduced turbidity and would help preserve the existing vulnerable wetlands around the perimeter of the lake. In inundated areas where sand would be placed - such as the bases of the islands and in some of the island interiors - the substrate would be significantly more stable than existing, allowing macroinvertebrates and plants to colonize. The increased habitat diversity (substrate elevation, near-shore shallow areas, substrate type) and increased vegetation would provide additional habitat for fish and aquatic organisms.

7.2.5 Habitat Diversity & Interspersion

The no action alternative would have a minor adverse effect on habitat diversity and interspersion, as the Pigs Eye ecosystem will continue to degrade over time.

The proposed project would have a substantial beneficial effect on habitat diversity and interspersion by creating more varied and higher-quality habitat within the lake. The existing habitat within the lake is very uniform, consisting of a vast expanse of shallow water (2-4 feet deep) with a soft and silty substrate. The proposed project would introduce additional habitat types within the area including shallow sandy areas, shallow marsh, low and frequently inundated floodplain forest. The proposed project would increase the availability of littoral habitat near each of the new islands.

7.2.6 Biological Productivity

The no action alternative would have a minor adverse effect on biological productivity. The continued degradation of the area that would occur in the absence of a project would further reduce the quantity and quality of habitat available within Pigs Eye Lake.

The proposed project would have temporary, minor adverse effects on biological productivity resulting from disturbance caused by construction activities. Birds, fish, and other mobile animals that might normally utilize the immediate project area would likely avoid the area during construction. The construction disturbance would be expected to be localized, and areas of the lake would remain relatively undisturbed during construction.

The project is in close proximity to the Pigs Eye Island Heron Rookery Scientific and Natural Area (SNA), shown in Figure 24. This was taken into account during project planning in order to avoid and minimize impacts to biological productivity within the SNA. No project work, including staging, is currently proposed on or directly connected to the SNA. However, the main location for accessing Pigs Eye Lake – especially by barge – is the channel maintained for use by the Red Rock Terminal which runs directly adjacent to the eastern shore of the SNA. Pigs Eye Lake itself borders the north part of the SNA. It is likely that barges would use the channel for project construction in order to transport construction materials into the area, such as sand, rock, topsoil, or plantings. The project would therefore likely cause an increase in barge traffic frequency. However, because of how common barge traffic is through the channel already, no additional impacts to the rookery would be expected from the use of the channel. Additionally, special attention will be given to the time period from April 1 through July 15 to ensure project activities are compatible. This time has been designated as a sensitive nesting period for the Pigs Eye Heron Rookery SNA, and the area is closed during that time. Contractor-proposed activities would be evaluated to ensure they would have no or negligible impacts to the SNA.

The proposed project would also have a long-term minor positive effect by improving and maintaining existing habitat and by creating additional habitat that would provide forage and spawning opportunities for a variety of fish and wildlife.

Figure 24: Pigs Eye Island Heron Rookery SNA and surrounding project areas

7.2.7 Surface Water Quality

The no-action alternative would have no effect on surface water quality.

There would be a temporary, minor adverse effect on water quality in the project area during construction. Localized increases in suspended sediment and turbidity are likely. However, a number of best management practices would be incorporated into the project construction in order to minimize these effects, such as spreading thin layers of material and allowing settlement and utilizing silt curtains to reduce the movement of suspended sediments out of the project area.

In the long term, the project would have a minor beneficial effect to local water quality in Pigs Eye Lake due to reduction in wind-generated waves and establishment of additional aquatic vegetation.

7.2.8 Aquatic and Terrestrial Organisms

The no-action alternative would have no effect on aquatic and terrestrial organisms.

Under the proposed alternative, there would be a temporary, minor adverse effect to fish and wildlife during project construction that may have otherwise used the project area. These would most likely include fish, ducks and other waterbirds, muskrat, mink, and beavers. These mobile organisms would be displaced due to avoidance of the area during construction. The few invertebrates inhabiting the proposed island footprints would be covered and killed.

There would be a long-term, substantial positive effect on fish and wildlife utilizing the area in the future, as the project area would provide significantly improved habitat conditions. The Habitat Evaluation Appendix C discusses some of these benefits in greater detail.

7.2.9 Threatened and Endangered Species

7.2.9.1 Federally-listed Species

The Higgins eye (*Lampsilis higginsii*), rusty patched bumble bee (*Bombus affinis*), prairie bush-clover (*Lespedeza leptostachya*) and the northern long-eared bat (*Myotis septentrionalis*) are the only federally-listed species known to possibly exist in the project area (FWS IPaC website, accessed on 20 February 2018). No critical habitat is found in the project area.

No past surveys have reported freshwater mussels living in Pigs Eye Lake, and the habitat in the lake is not conducive to supporting these species or any other mussel species in high abundance.

No trees are planned to be cut at a result of any of the project features and no bat roosting or maternity trees are known in the project area.

The prairie bush-clover has not been found in the project area and is typically not found in any of the types of habitats affected by the proposed project.

The USFWS has compiled recent survey data and conducted habitat modeling to identify the potential for occurrence of the rusty patched bumble bee (USFWS 2017). The area surrounding the proposed project has been identified as having a high potential for supporting the rusty patched bumble bee. However, the proposed project construction activities would be limited to permanently inundated and open water areas, where the rusty patched bumble bee is unlikely to be present. If project construction activities are identified that would potentially impact upland areas, they would require further review.

For these reasons, the St. Paul District has determined that both the No Action and the Tentatively Selected Plan would have no effect on federally-listed threatened and endangered species.

7.2.9.2 State-listed Species

Fish – There is a potential to impact fish during project construction. Any listed fish using the project area would likely be temporarily displaced during project construction, but would benefit from the improvement in habitat following construction.

Mussels – No past surveys have reported freshwater mussels living in Pigs Eye Lake, and habitat in the lake is not conducive to supporting these species or any other mussel species in high abundance.

Plants – Kitten-tails have been documented in the upland areas near the proposed project site. Although no construction activities would occur directly in these areas, a survey of any upland areas that would be disturbed would be conducted to ensure that resources of concern, such as listed plants, are not disturbed by project construction.

7.2.9.3 Bald Eagles

Bald eagles exist throughout Pool 2 and have been documented using Pigs Eye Lake during numerous studies (i.e. Holdhusen 2016). A large part of their life cycle (breeding, fledging, and feeding) is dependent upon use of the Mississippi River and surrounding shallow water areas.

It is possible the proposed project could have some adverse effects to eagles, though such effects would likely be limited to disturbance during construction. The primary concern would be the disturbance of eagles during the nesting season, which generally occurs from mid-January to mid-June. Eagles generally return to the same nest or group of nests each year, but often build new nests in different locations. Because of this, existing nest data can help in the assessment of potential effects, though a nest survey conducted in the nesting season just prior to construction would be needed to ensure impacts to eagles are avoided or minimized. In cases where some impacts to eagles are possible, a permit may be requested from the FWS to ensure compliance with the Bald and Golden Eagle Protection Act. While it is unlikely that such a permit would be needed for this project after the application of minimization and avoidance measures, the Corps would coordinate with the FWS in seeking a permit if needed for any given project component.

7.3 Cultural Resource Effects

Pigs Eye Lake has historically been an extensive wetland (Grand Marias of the Mississippi) that has become more lacustrine during the 20th century. Creating isolated islands in this normally saturated setting would not affect significant cultural resources. As the construction will take place entirely from river-borne barges, no landward access roads or storage yards will be used. The Corps has determined that the Project has no potential to effect historic properties.

7.4 Cumulative Effects

7.4.1 Scope of Cumulative Effects Analysis

Cumulative effects are defined by the Council on Environmental Quality as, "[T]he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The time frame considered for the scoping of potential future cumulative impacts was bounded by the project life considered during other analyses, which was 50 years, which is the time frame used for project planning and analysis of the project benefits. Although this life-span is somewhat arbitrary, no reasonably foreseeable future actions were identified beyond this time scale.

The geographic scale analyzed for cumulative impacts was limited to potential actions that have or would have effects in the immediate and adjacent project area. However, this does not mean that only activities with footprints overlapping the proposed project were considered - this is because the proposed project is a part of a large river system, which necessitates considering if actions upstream or downstream could also impact this particular reach of the river.

7.4.2 Actions Identified within the Project Area

The following past, present, and reasonably foreseeable future actions were identified as having the potential to interact with or have impacts related to those of the proposed project.

7.4.2.1 Past actions

7.4.2.1.1 Modifications to UMR for Navigation

The floodplain geomorphology, stream hydraulics, and water levels of the Upper Mississippi River have been modified by impoundment and other navigation features since the 1820s. The most relevant navigation improvement actions within the project impact area are likely the construction of hundreds of channel training structures placed between 1866 and 1907 as part of the 4-foot, 4.5-foot, and 6-foot navigation channel projects. Following the construction of these structures was the construction of Lock and Dam Number 2 in 1930, which raised water levels by several feet in the immediate project area and allowed for a 9-foot-deep navigation channel adjacent to Pigs Eye Lake. The cumulative effect of these actions has played a large role in the development of the habitat that currently exists in the project area.

7.4.2.1.2 Pigs Eye Landfill

Directly to the north of the lake is the site of Pigs Eye Landfill, operated from the mid-1950s until 1972 for the disposal of mixed municipal and commercial waste. Some remediation has been completed at the dump site, but monitoring and further remediation is ongoing.

7.4.2.2 Concurrent and Ongoing Actions

7.4.2.2.1 Navigation on the UMR

The operation, maintenance, and navigation use of the main channel of the UMR at its current authorized level is expected to continue into the future.

7.4.2.2.2 Wastewater Treatment Plant

The St. Paul Metropolitan Council's Metro Wastewater Treatment Plant is located directly northwest of Pigs Eye Lake. It is the largest wastewater treatment plant in Minnesota and has a capacity of 251 million gallons per day. The plant serves 1.8 million residents. The plant utilizes advanced secondary treatment with chlorination/dechlorination and discharges directly to the Mississippi River approximately one mile upstream of where Pigs Eye Lake is connected to the main stem of the river. A series of excavated ponds exist to the direct northwest of Pigs Eye Lake shoreline. Previously the ponds were filled with incinerator ash. However, due to contaminant concerns by the MPCA the contents of the ponds were removed to an offsite locations. The remnant level of contamination in the ponds is unknown.

7.4.2.2.3 Industrial, Commercial, and Transportation Facility Development

A number of industrial, commercial, and transportation developments surround Pigs Eye Lake. A railroad and major highway (MN 10/61) border Pigs Eye to the northeast. The railroad facilities include a recently-expanded 8 track rail system with an adjacent railyard that covers approximately 40 acres. The Red Rock Barge Terminal is a barge loading facility that has been constructed at the southern end of Pigs Eye Lake, and includes a maintained, 9-foot channel from the main channel of the UMR into the lake.

The terminal encompasses 272 acres. Eight lessees utilize the site for both inbound and outbound shipping of steel scrap, asphalt, grain, fertilizer, and coal.

7.4.2.2.4 Residential Development

The area on top of the bluff to the east of Pigs Eye Lake is generally developed residential land.

7.4.2.2.5 Lake Pepin Eutrophication Total Maximum Daily Load (TMDL) Study and South Metro Mississippi River Total Suspended Solids TMDL Study

The Minnesota Pollution Control Agency has identified the Mississippi River from Lock and Dam 1 to the head of Lake Pepin to be impaired for phosphorus and total suspended solids (TSS). Ongoing TMDL studies are being undertaken to identify the maximum quantities of these pollutants that can be allowed to enter the water body without exceeding water quality standards. The proposed project would have an effect on TSS and turbidity levels. Turbidity in this reach of the river began increasing in the early 1920s as the Twin Cities metropolitan area grew and agricultural use of the Minnesota River Basin increased. Sediment cores from Lake Pepin have shown that the sediment load to Lake Pepin doubled between the 1930s and the 1960s and has stabilized at that level, although the source of the sediment has shifted from farm fields to increased erosion of stream banks and bluffs.

7.4.2.2.6 Minnesota River Watershed Study

The Corps is currently working on an integrated watershed study of the Minnesota River, with the intent to produce a watershed management plan. The results of the study will enable examination of existing conditions, forecasting of future conditions, and simulation of alternatives to identify management actions that are ecologically sustainable, economically sound, and socially desirable.

7.4.2.3 Reasonably Foreseeable Actions

7.4.2.3.1 Additional Remediation to Pigs Eye Landfill

Studies of the Pigs Eye Landfill site are ongoing. It is anticipated that these studies could lead to additional remediation of the site, if necessary.

7.4.2.3.2 Expansion of Barge Fleeting

Proposals have been made to expand or construct additional barge fleeting or unloading in and near Pigs Eye Lake. No official steps have been taken to begin evaluating or permitting these actions to the knowledge of the Corps.

7.4.2.3.3 Battle Creek Regional Park Master Plan

Ramsey County proposes to begin the process of updating the 1981 Master Plan for Battle Creek Regional Park in 2018. This parkland generally includes the area owned by Ramsey County in and around Pigs Eye Lake. Ramsey County plans to consider potential actions for developing the Pigs Eye Lake area as parkland during this process.

7.4.2.3.4 Mississippi River Paddle Share

The Mississippi Park Connection and the Mississippi National River and Recreation Area coordinated to create a first-of-its-kind recreational opportunity wherein users can rent a kayak and necessary paddling equipment at an unmanned station. Several stations are provided so that users can drop the kayak off at

a downstream location and ride a rented bike to the point of origin. In 2016, the first four stations were installed in Minneapolis. There are plans to continue developing these stations downstream in St. Paul, including one near Pigs Eye Lake itself.

7.4.3 Environmental Consequences of Cumulative Effects

The environmental consequences outlined below are organized by resource categories, in the same order as resources are discussed for the project in Chapter 7. For brevity, only those resources where cumulative effects are expected are discussed.

7.4.3.1 Recreation

The proposed project would be expected to have a long-term, minor beneficial impact on recreation. Many of the past, present, and reasonably foreseeable actions identified above have effects on recreation. The project is located in an urban setting with a relatively high population density. The water quality improvements that have followed the implementation of the Federal Clean Water Act of 1972 have increased the public's interest in recreating on this stretch of the river. Water quality impairments still exist, but the success of programs such as the Mississippi River Paddle Share described above highlight the fact that the public has a desire to experience the river in a recreational capacity. The ongoing Lake Pepin TMDL and Minnesota River Watershed Study demonstrate that the public is interested in further improving water quality in this reach. The reasonably foreseeable actions of further developing the area for recreation in connection with the upcoming Battle Creek Regional Park Master Planning effort further emphasizes the desire to create additional recreational opportunities along the Mississippi River near the Twin Cities Metro area. The expected improvements to water quality, reduction in wind and waves, and improvement of the area for wildlife use would all lead to an improvement in the recreational experience of future users of the lake. If other reasonably foreseeable actions are taken to improve recreation as predicted, the overall effect of these actions would likely provide substantial benefits to recreation.

7.4.3.2 Terrestrial Habitat, Aquatic Habitat, and Habitat Diversity/Interspersion

The proposed project would be expected to have a long-term, substantial beneficial impact on terrestrial habitat, aquatic habitat, and habitat diversity and interspersion. The proposed project was designed to improve the habitat in and around the lake, and to protect the existing resources. The modification of the river for navigation purposes and the development around Pigs Eye Lake has undoubtedly had an impact on the terrestrial and aquatic habitat resources surrounding the project area. Many of these actions have contributed to the problems identified as a part of this project. Further expansion of these developments could have additional adverse impacts on the habitat quantity and quality present within Pigs Eye Lake, and on the UMR as a whole.

7.4.3.3 Bird Populations and Aircraft-wildlife Interactions

As described in the previous section, the proposed project would improve the habitat in the project area for wildlife, including migratory birds. Many of the past, present, and reasonably foreseeable actions identified above would also likely have some level of effect on migratory birds in the Upper Mississippi River. Further, since migratory birds spend portions of their lives across extremely vast areas, many additional actions throughout the United States and beyond our national borders would also affect

habitat that these birds use. All of these actions, combined with the uncertainty of other drivers of bird populations make any real analysis of the issue unrealistic. However, from the standpoint of a cumulative effects analysis, the magnitude of the proposed project and its impacts to bird populations would not contribute to any identifiable threshold of cumulative significant impact to either bird populations or subsequently, aircraft-wildlife interactions.

7.4.3.4 Surface Water Quality

The proposed project would be expected to have a minor beneficial effect on surface water quality due to the reduction in suspended sediments. Several of the other ongoing efforts are attempting to address water quality issues in the watershed – the Lake Pepin TMDL and the Minnesota River Watershed Study. These actions, considered together, would be expected to further benefit water quality. Due to the massive scale of actions that may impact water quality, other unknown factors such as the effects of climate change on future watershed hydrology or due to unknown developments throughout the watershed have potential to impact water quality in both positive and negative ways. Overall, the identified ongoing efforts would be expected to have a net positive effect on water quality.

8 Plan Implementation

The schedule for the feasibility study is documented in Table 18. After the feasibility report is approved, and a Project Partnership Agreement is executed with the non-Federal Sponsor, the PDT will initiate Plans & Specifications. The Preconstruction Engineering and Design phase is pending funding and will include refinements to the design of the Recommended Plan. This schedule assumes that availability of funds to prepare plans and specifications and undertake construction will not be limiting.

The project has been broken out into two construction phases. The first phase of construction could begin Fall 2019 with the unloading and transport of sand to Pigs Eye Lake and be complete in Fall 2020. The first phase includes dewatering of fines needed to cap the islands.

The second phase of construction focuses placement of fines to cap the islands and plantings for marsh species and floodplain forest seedlings. This phase includes planting and weed control to ensure quality tree establishment. Capping and seeding islands could begin around Spring 2021, and be complete in Fall 2021.

Table 18: Estimated Project Schedule

Requirement	Scheduled Date
Submit final Feasibility Report and Environmental Assessment to Mississippi Valley Division, U.S. Army Corps of Engineers	November 2017
Execute Project Partnership Agreement with Ramsey County Parks & Recreation	May 2018
Obtain construction approval by Mississippi Valley Division U.S. Army Corps of Engineers	July 2018
Begin Plans and Specifications	August 2018
Complete Plans and Specifications	January 2019
Advertise for Bids	May 2019
Award Contract (FY19)	July 2019
Complete island construction	November 2020
Complete capping islands and floodplain forest plantings	November 2021

9 Summary of Environmental Compliance and Public Involvement

The planning for Pigs Eye Lake Project has been an interagency effort involving the St. Paul District, Ramsey County, the USFWS, the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, National Park Service, local airport authorities, and others. Interagency meetings and site visits were held on a periodic basis throughout the study. In addition to the meetings, information coordination took place on an as-needed basis to address specific problems, issues, and ideas.

The draft Feasibility Report and Environmental Assessment was sent to congressional interests, federal, state, and local agencies; Native American groups; special interest groups; interested citizens; and others listed in Appendix A– Correspondence & Coordination.

9.1 Environmental Laws and Regulations

This Feasibility Study Report with Integrated EA was prepared and the proposed work designed to comply with all applicable environmental laws and regulations. A highlight of compliance with the major environmental laws and regulations follows and is summarized in Table 19.

Discussions with permitting agencies have not indicated any major obstacles with the issuance of permits that would be critical for construction of the project at this time.

9.1.1 Clean Water Act

The proposed project would involve discharges of fill into waters of the United States. A Clean Water Act Section 404(b)(1) Evaluation has been prepared for the project and is included as Appendix B. Section 401 water quality certification from the State of Minnesota will be requested by the Environmental Compliance Branch of the Corps.

9.1.2 Fish and Wildlife Coordination Act

In compliance with the FWCA, project plans have been coordinated with the USFWS and the Minnesota DNR. Correspondence is documented in Appendix A: Correspondence & Coordination.

9.1.3 Cultural Resources and Tribal Coordination

In accordance with 36 CFR 800.3(a)(1), the Corps has determined the proposed project to have no potential to cause effects and has no further obligations under Section 106. Tribal letters were sent out in accordance with Executive Orders 13007 and 13175.

9.1.4 State Permits

The Corps will submit an application to the Minnesota DNR for a Public Waters Work Permit, out of comity. Some additional permits and environmental planning may fall under the responsibility of the contractor conducting the proposed work. The contractor would be responsible for obtaining construction permits as necessary, such as a National Pollutant Discharge Elimination System permit. These responsibilities would be detailed in the Specifications provided to the Contractor.

Table 19: Compliance Review with Applicable Environmental Regulations and Guidelines

Environmental Requirement	Compliance[1]
Federal Statutes	
Archaeological and Historic Preservation Act	Full
Bald and Golden Eagle Protection Act of 1940, as amended	Partial
Clean Air Act, as amended	Full
Clean Water Act, as amended	Partial[2]
Endangered Species Act of 1973, as amended	Full
Federal Water Project Recreation Act, as amended	Full
Fish and Wildlife Coordination Act, as amended	Full
Land and Water Conservation Fund Act of 1965, as amended	Full
Migratory Bird Treaty Act of 1918, as amended	Full
National Environmental Policy Act of 1969, as amended	Partial[3]
National Historic Preservation Act of 1966, as amended	Full
National Wildlife Refuge Administration Act of 1966	Full
Noise Pollution and Abatement Act of 1972	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic Rivers Act of 1968, as amended	N/A
Farmland Protection Policy Act of 1981	N/A
Executive Orders, Memoranda	
Floodplain Management (EO.. 11988)	Full
Protection and Enhancement of Environmental Quality (E.O. 11514)	Full
Protection and Enhancement of the Cultural Environment (E.O. 11593)	Full
Protection of Wetlands (E.O. 11990)	Full
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 30 August 1976)	Full

[1] The compliance categories used in this table were assigned according to the following definitions:
a. Full - All requirements of the statute, E.O., or other policy and related regulations have been met for the current stage of planning.
b. Partial - Some requirements of the statute, E.O., or other policy and related regulations remain to be met for the current stage of planning.
c. Noncompliance (NC) - Violation of a requirement of the statute, E.O., or other policy and related regulations.
d. Not Applicable (N/A) - Statute, E.O., or other policy and related regulations not applicable for the current stage of planning.

[2] Full compliance to be achieved with the District Commander's signing of the 404(b)(1) Evaluation and receipt or waiver of Section 401 Water Quality Certification from the State of Minnesota.

[3] Full compliance to be achieved with the District Commander's signing of the Finding of No Significant Impact.

9.2 Summary of Coordination, Public Views, and Comments

Interagency meetings were held on a periodic basis throughout the study phase. Two subgroups were also formed to evaluate contaminants and discuss habitat impacts during the planning phase. In addition to the meetings, coordination took place on an as-needed basis to address specific problems, issues, and ideas. Documentation of these interactions can be found in Appendix A – Correspondence & Coordination.

A public notice of availability of the draft Report was published on March 12, 2018 on the Corps website. The draft Feasibility Report and Environmental Assessment was sent to congressional interests, federal, state, and local agencies; special interest groups; interested citizens; and others.

A summary of comments received and responses to the comments is presented in Appendix A, along with copies of each of the comment letters. All comments received were considered. No comments led to substantive report revisions; several minor typographical corrections were made to the report based on comments received.

The majority of commenters expressed general support for the project. Comments were received from the MnDNR and MPCA reiterating that construction activities should adhere to local noise regulations, minimize impacts to nearby natural resources (e.g., heron rookery and sensitive nesting periods), and that additional permitting may be required if dredging is incorporated into the project. One entity – the Metropolitan Council – indicated concerns about project assumptions related to project objectives, construction and long-term project performance uncertainties, and contaminated sediments assumed to be located within the project footprint. Responses were provided for each of these comments, but did not lead to any changes in the report or in the recommended plan because the topics of concerns raised (e.g., contaminants, water quality, wildlife, airport bird strikes) were coordinated with the appropriate regulatory or implementing agencies throughout the planning process (e.g., MPCA, MnDNR, MAC/FAA). The data, technical opinions, and correspondence received from each of the agency experts were used in planning the project and contradict the concerns presented in the comments. Data collected by the Corps along with data provided by other resource agencies indicated that sediment contamination levels in the project area were below thresholds for CERCLA requirements as well as more stringent state requirements. The risks and uncertainties associated with the project constructability and success were considered and incorporated into project quantities, construction considerations, and monitoring and adaptive management strategies.

10 Recommendation

The recommended plan is Alternative 6m, which includes 7 Islands, floodplain forest (16.3 acres) and marsh habitat (17.6 acres).

The estimated cost of the project at current price levels is $12.4 million (including sunk general design costs). Upon completion, Ramsey County would be responsible for Operation, Maintenance, Repair, Rehabilitation, and Replacement at an estimated average annual cost at current price levels of $2,000. The recommended plan also includes a monitoring program at an estimated total cost at current price levels of $139,000.

The project area covers over 1700 acres. The expected outputs include the enhancement and creation of 7 islands, 16.3 acres of floodplain forest, and 17.6 acres of marsh. This plan would reduce wind and wave action and create conditions more suitable for floodplain forest and shoreline species, while preserving the existing shoreline from further erosion. The recommended plan will contribute 171.1 average annual habitat units over the 50-year period of analysis to the National Environmental Quality Account at an average annual cost of $2,700 per average annual habitat unit.

I have weighed the accomplishments to be obtained from the Pigs Eye Lake project against the cost and have considered the alternatives, impacts, and scope of the proposed project. Therefore, I recommend that the Pigs Eye Lake project for the beneficial use of dredged material in Pool 2 of the Upper Mississippi River be approved for construction.

The recommendations contained herein reflect the information available at this time and current department policies governing formulation of individual projects under the continuing authorities Environmental Management Program. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works continuing authorities program nor the perspective of higher review levels within the Executive Branch.

Samuel L. Calkins
Colonel, Corps of Engineers
District Commander

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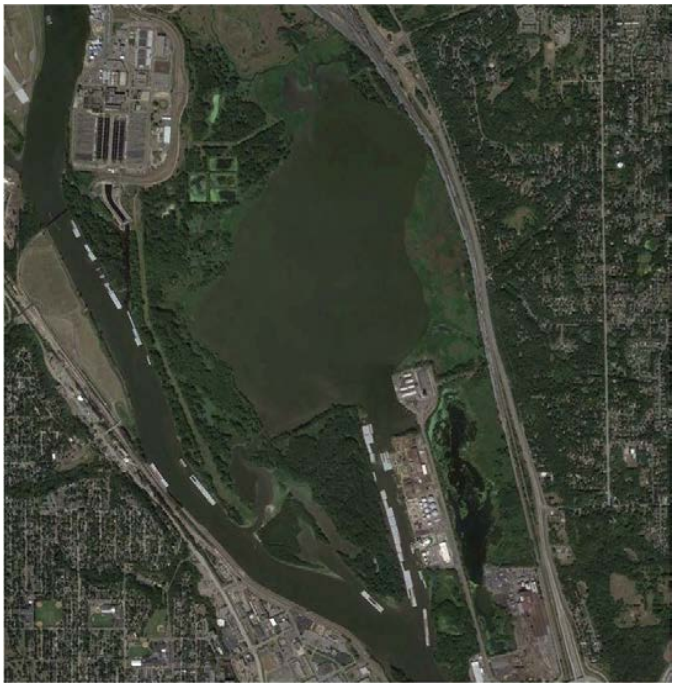
Appendix A Correspondence and Coordination Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers

May 2018

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

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Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

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1 Summary of Comments Received During Public Review

During the 30-day public review and comment period, correspondence was received from the individuals and agencies listed below. Copies of the comment letters received are also included following this summary. Comments are summarized below, along with responses.

1. Telephone call from Mr. Daniel Richardson, Newport; *14 March 2018*
2. Telephone call from BioCleaner company, Monterey Park, CA; *21 March 2018*
3. Email from Minnesota Pollution Control Agency Remediation Division; *2 Apr 2018*
4. Minnesota Pollution Control Agency; *5 April 2018*
5. Friends of the Mississippi River; *5 April 2018*
6. Minnesota Department of Transportation, Metro District; *5 April 2018*
7. Minnesota Department of Natural Resources; *12 April 2018*
8. National Park Service; *12 April 2018*
9. Metropolitan Council; *12 April 2018*
10. City of St. Paul, Minnesota; *12 April 2018*

Comment 1: The commenter indicated that a side channel near Newport, MN may contain sediments suitable for project construction. (*Mr. Daniel Richardson*)

Response: As discussed on the phone with the commenter, this opportunity is acknowledged and would be considered for potential future needs. The purpose of the current project is to utilize material dredged in support of the congressionally-authorized navigation channel for ecosystem restoration and because dredging the identified area near Newport would not support the authorized navigation channel, it cannot not be pursued as part of the proposed project.

Comment 2: The commenter solicited the sale of products and services to clean up organic wastes. (*BioCleaner*)

Response: No comments regarding the project were offered, and therefore, no response is provided.

Comment 3: The commenter indicates support for the project. Commenter notes that there is an area of contamination outside of the project footprint in the northern part of Pig's Eye Lake that will need to be addressed by other entities. (*MPCA Remediation Division*)

Response: Comment acknowledged.

Comment 4: The commenter provided several editorial comments. (*MPCA Remediation Division*)

Response: Comment acknowledged and typographical errors have been fixed in the final document.

Comment 5: In regards to EAW Item 17, commenter encourages project contractors to appropriately manage project construction noise and recommends limiting construction activities to the hours of 7 a.m. to 10 p.m. (*MPCA)*

Response: Comment acknowledged. Contractors will be obligated to comply with local noise regulations.

Comment 6: Commenter suggests partnering with local organizations to develop planting plans for the islands that would allow experimentation or study of responses to climate change and environmental stressors. (*Friends of the Mississippi River*)

Response: Comment acknowledged. Planting plans will be completed during the Design and Implementation phase of the project, and input will be sought at that time.

Comment 7: The Minnesota Department of Transportation has reviewed the project and provides no comments. (*MNDoT*)

Response: Noted.

Comment 8: Commenter requests additional explanation why direct shoreline stabilization was not carried forward in planning analyses and how benefits of creating habitat along the shoreline would compare to the proposed habitat creation. (*MNDNR*)

Response: Direct shoreline stabilization was considered but did not appear to provide as much benefit as the proposed plan. Using rock groins similar to what is proposed for the islands appeared to be technically feasible. However, this measure remained uncompetitive with the currently proposed alternative because it would only provide benefits in the form of protecting existing habitat, rather than enhancing and restoring additional habitat as the proposed project would. Placing a blanket of sand around the perimeter of the lake instead of rock groins was also considered. This would likely have more habitat value than the rock groins, but the cost to benefit ratio would again be higher than the selected alternative which both restores a substantial quantity of habitat and provides some protection for the shoreline. These measures could be considered in the future as additional projects.

Comment 9: Commenter questions how the setting of the proposed project compares with other island building projects completed in the past, and whether additional risks and uncertainties were identified for the proposed project. (*MNDNR*)

Response: The Corps has constructed islands for habitat restoration and enhancement purposes throughout the Upper Mississippi River, under widely varied conditions. Often they are areas of the floodplain that were likely once ephemeral marshes that were permanently inundated following hydrologic alterations. Many of these areas have faced similar problems to Pigs Eye Lake with large expanses of open water and loose, silty sediments. The largest uncertainty identified is the extent of settlement, and these risks have been incorporated into project design through adding contingencies.

Comment 10: Commenter requests quantification of the excavation that may be required to gain access to the lake for island construction, what the disposition of any dredged material would be, and asserts that additional environmental review may be necessary. (*MNDNR*)

Response: The necessity of or amount of dredging for access into Pigs Eye Lake are both uncertainties at this time. The goal of this stage in planning is to verify that the construction would be feasible, with the intent to continue coordination as project designs progress. A variety of construction methods were considered during planning to broadly assess whether they were generally feasible, including methods that would not require access dredging. Preliminary testing of the lake sediments revealed a number of areas that could provide suitable topsoil and would potentially benefit the lake by creating bathymetric

variability. If construction methods are selected which require additional environmental review, reviews would be conducted as needed.

Comment 11: Commenter requests clarification of if and how the project construction schedule may overlap with the sensitive nesting period of April 1 – July 15. (*MNDNR*)

Response: The project schedule is dependent on many unknown factors at this time, including funding. The Corps and Ramsey County will continue coordination on the topic of construction timing and best practices or restrictions to limit disturbance to sensitive wildlife as project design advances.

Comment 12: The commenter has provided editorial comments and supplemental information that is suggested for inclusion within the report related to species present in the project area, project coordination needs, and fish movement studies. (*MNDNR*)

Response: Supplemental information has been incorporated into the report as appropriate.

Comment 13: The commenter states they have no objections to the project and support the proposed work. (*National Park Service – Mississippi National River and Recreation Area*)

Response: Noted.

Comment 14: The commenter would like Pigs Eye Lake to be referenced a wetland throughout the document as they believe the area functions as a wetland and is classified as a wetland on Minnesota state wetland mapping. (*Metropolitan Council*)

Response: The open water area of Pigs Eye Lake does not meet the definition of a wetland. Although the area is inundated at sufficient frequency by surface water to create the hydrologic and soil conditions to meet the legal definition of a wetland, the area does not support "a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR §328.3(b)). As such, the area is referred to as a contiguous, shallow, backwater floodplain lake. The reference in Chapter 6.5 of the report is a typographical error and will be changed to reflect this fact.

Comment 15: The commenter believes that the Corps should collect water quality samples prior to progressing on the project as a means of certifying that improved habitat conditions could be realized following a project. (*Metropolitan Council*)

Response: The Corps goal within the feasibility planning process is to collect the data necessary to make decisions of how to design or whether to proceed with a project. Improving water quality is not an objective of the project, and is not an objective of the CAP authority under which the project is being planned. Therefore, the only reason additional water quality data would be needed is if water quality was identified as a constraining factor. Considering the ability for wetland plants to grow around the edge of the lake and the documented use of the lake by fish, birds, and mammals, there is no apparent reason to collect additional water quality data. The approximate residence time of water in the lake is a little less than 5 days. This relatively short residence time suggests that there is probably not enough time for sediment contaminants diffusing into the water column to concentrate up to levels far exceeding what is seen in Pool 2 of the Mississippi River. No further action or change to the plan is required as a result of this comment.

Comment 16: The commenter expresses concern that the eroding shoreline may be a result of water fluctuation and plants dying due to toxic water quality and thus the project would not improve the habitat conditions of Pigs Eye Lake. (*Metropolitan Council*)

Response: The comment is acknowledged. The Corps and Ramsey County are not aware of any evidence that would suggest contaminants are a cause of vegetation loss in Pigs Eye Lake. Contamination concerns have been closely coordinated with the Minnesota Pollution Control Agency - the state experts and regulatory authority. The plan has been designed to avoid impacting areas where higher levels of contamination are present. Historic sediment studies were collected and substantial additional sediment testing within the lake was conducted with input from the MPCA and Metropolitan Council, as presented in the main feasibility report and Appendix E. Healthy plant communities exist behind the eroding shoreline at similar elevations, suggesting that upon reduction of wind fetch a healthy plant community will reestablish. No further action or change to the plan is required as a result of this comment.

Comment 17: The commenter expresses concerns about the suitability of establishing woody plants on the islands and requests additional study be completed on what species may be more adept at establishing in the project setting. (*Metropolitan Council*)

Response: A detailed planting plan will be developed during the design and implementation phase, which will more closely consider the appropriate species for the site conditions. This will be developed in consultation with applicable resource agencies and the monitoring and adaptive management will provide the ability to adjust as necessary.

Comment 18: The commenter is concerned about the settlement of the islands during construction and wants to know what would occur if settlement in excess of what is expected takes place during and post construction. (*Metropolitan Council*)

Response: The settlement estimate was developed utilizing knowledge obtained from experience constructing islands on the river. The amount of material estimated to be required for construction was developed with large contingencies to account for the uncertainties regarding settlement. The successful completion of the project will hinge on meeting standards outlined in the Plans and Specifications developed in the design phase of the project. The roles and responsibilities of the operation and maintenance of the project post construction will be outline in the Project Partnership Agreement as well as in the operation and maintenance manual that is developed prior to completion of the project. No further action or change to the plan is required as a result of this comment.

Comment 19: The commenter is questioning who will have monitoring and maintenance responsibility following the construction of the project. They also request additional details regarding the monitoring and adaptive management plan, specifically when the project Sponsor would obtain sole responsibility and what that means from a funding perspective. (*Metropolitan Council*)

Response: The monitoring and adaptive management responsibilities will be further detailed during the Project Partnership Agreement development and the design and implementation phase of the project. Additional details are not typical at the feasibility phase of the project. Ultimately the Corps will ensure that the project is completed to design specifications before closing out the project and moving the project to Sponsor responsibility.

Comment 20: The commenter claims that it is unlikely that neither hardstem nor softstem bulrush will spread sufficiently to prevent shoreline erosion due to the "frequency and extent of bounce in the basin". (*Metropolitan Council*)

Response: The comment is acknowledged, and will be considered during planting plan development. Bulrush is present around the perimeter of the lake, growing at similar elevations to what is proposed. No further action or change to the plan is required at this time as a result of this comment.

Comment 21: The commenter is concerned with the use of benthic material from the basin for the purposes of topsoil on the constructed islands. (*Metropolitan Council*)

Response: It is not anticipated at this time that the project would utilize benthic muds for topsoil. If preparation of project plans and specifications leads to a proposal to utilize material from Pigs Eye Lake for topsoil, existing contaminant data would be examined and additional testing may be required to ensure the material is acceptable for this use. MPCA, the regulatory authority and regional experts on contamination have been closely consulted with during the development of the feasibility study. No further action or change to the plan is required as a result of this comment.

Comment 22: The commenter is concerned about the project "promoting unrestricted public access for recreation." Specifically, the commenter is worried about drawing the public into the dump site as well as the lack of a safe public access to the area. (*Metropolitan Council*)

Response: The authority in which this project is proposed is specifically to restore, protect, and create aquatic and wetland habitats. The promotion of recreation is not a project objective. The project area is presently under public ownership; the project would not alter access or land ownership. It is noted that the Regional Park and five-year Capital Improvement Plan will need to be updated by the project Sponsor. No further action or change to the plan is required as a result of this comment.

Comment 23: The commenter is concerned about the likelihood of significant quantities of benthic material discharging into the Mississippi River during construction. The commenter requests the Corps clarify their position on the likelihood of this situation occurring and how it expects the potential mud wave to dissipate without mixing into the water column. (*Metropolitan Council*)

Response: As stated in the feasibility report (pg. 63), construction techniques to reduce the risk of mud waves would be used. Several potential specific measures were discussed during project planning meetings, but were not discussed in detail within the report because: (1) The appropriateness of these measures would be dependent on the construction methods selected by the contractor, and (2) The necessary measures may change as more detailed plans and specifications are developed. Contractors would be required to meet all permit conditions including those identified in the Clean Water Act Section 401 Water Quality Certification provided by the MPCA as well as the Public Waters Work Permit provided by the DNR. Contractors' plans for environmental protection would be reviewed for acceptability by the Corps as part of the contracting process and quality control would be performed by the Corps during construction. This allows for potential innovative construction techniques, while at the same time requiring that unacceptable impacts are avoided.

Comment 24: The commenter questions the presence of reptiles and amphibians in the project area and is concerned about creating habitat that could attract reptiles and amphibians to an area with contaminated benthic material. (*Metropolitan Council*)

Response: The study teams collaborated closely with local wildlife experts from key state and federal agencies. The plan has been designed to avoid impacting areas where high levels of contamination are present. Historical sediment studies were reviewed and substantial additional sediment testing within the lake was conducted with input from the MPCA and Metropolitan Council, as presented in the main feasibility report (Sec. 7.1.6) and Appendix E. No further action or change to the plan is required as a result of this comment.

Comment 25: The commenter suggests that Battle Creek flows be entirely isolated from the rest of the basin with a floating silt curtain during construction to ensure that disturbed contaminated benthic material isn't carried into the Mississippi River. For the same reason the commenter requests that all barge movement also occurs behind a silt curtain. (*Metropolitan Council*)

Response: This comment suggests that benthic material in the construction area is contaminated to a level that would require special precautions take place. It is important to note that Corps projects are required to avoid being constructed on Hazardous, Toxic and Radioactive Waste (HTRW). Therefore, substantial investigation and coordination went into determining if the benthic material did or did not reach the levels of HTRW or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) level material. Analysis and coordination of HTRW testing results indicated that: (1) CERCLA materials in the project area are at acceptable levels for construction of the proposed project features, and (2) Constructing the proposed ecosystem restoration features within the lake would have positive incidental benefits to the lake and surrounding areas. As a result of these facts, no further action or change to the plan is required as a result of this comment. Construction of the project will be required to meet the conditions of the Clean Water Act Section 401 Water Quality certification provided by the MPCA as well as the Public Waters Works permit provided by the DNR. Compliance with these conditions would assure that water quality downstream is not significantly adversely impacted by project construction.

Comment 26: The commenter is concerned about utilizing data obtained from the New Orleans area to estimate consolidation values and suggested that we obtain a local sample to estimate the consolidation value. (*Metropolitan Council*)

Response: In the feasibility phase of the project the estimation utilizing available data was sufficient to determine that the project will be feasible. Additional testing, if required, will occur during the design and implementation phase of the project. No further action or change to the plan is required as a result of this comment.

Comment 27: The commenter recommends that the Monitoring and Adaptive Management plan annually review the number of reported bird strike by month following the construction of the project and prepare a mitigation plan if an observed change occurs. (*Metropolitan Council*)

Response: The project was closely coordinated with the Metropolitan Airport Commission (MAC) and the Federal Aviation Administration (FAA). The results of that coordination were changes to the project plans as outlined in the report that appeased the concerns of the MAC and FAA. The monitoring of bird strikes will not be a responsibility of the Corps or Sponsor.

Comment 28: The commenter has concerns regarding the long-term stability the project. Specifically the commenter is concerned about the success of vegetation establishment as it is a critical aspect of habitat creation and island stability. *(City of St. Paul)*

Response: The concerns of the commenter are noted; however, there is no evidence to suggest that vegetation will not establish. There are strong plant communities throughout the basin and with the reduction of wind-generated wave erosion, vegetation is expected to establish. If problems are discovered during the 10-year monitoring and adaptive management period, measures will be taken to correct the problem. No further action or change to the plan is required as a result of this comment.

Comment 29: The commenter asserts that the proposed maintenance budget is "woefully inadequate" and that there is not enough detail on adaptive management practices that could be utilized to address the problems. *(City of St. Paul)*

Response: The monitoring and adaptive management plan presented as Appendix J in the feasibility study was developed to address the largest uncertainties of project performance identified during project planning. Monitoring commences upon construction completion and is continued up to 10 years, or until ecological restoration success is documented. The budget for monitoring and adaptive management presented in the report was developed based on cost estimates from those who have completed the proposed tasks in the past, and is consistent with congressional authorizations for monitoring and adaptive management. Similar ecosystem restoration projects planned and constructed by the Corps have required very minimal adaptive management to meet similar success criteria. The detail put forth in the study is adequate for feasibility phase purposes; further detail on adaptive management will be developed in the design and implementation phase of the project. No further action or change to the plan is required as a result of this comment.

2 Public Release Documents

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL, MN 55101-1678

RAMSEY COUNTY
PARKS AND RECREATION DEPARTMENT
2015 VAN DYKE STREET
MAPLEWOOD, MN 55109-3796

March 12, 2018

Dear Interested Parties:

The U.S. Army Corps of Engineers, St. Paul District – in close collaboration with the non-federal project sponsor, Ramsey County, Minnesota – has completed a draft feasibility study for the Pigs Eye Islands Continuing Authorities Program Section 204 project. The project documentation is being released for concurrent public review and comment under applicable Federal and State laws:

Federal:	National Environmental Policy Act (NEPA) Section 404 of the Clean Water Act
State (MN):	Minnesota Environmental Policy Act (MEPA)

Enclosed for your information, review, and comment is the draft Environmental Assessment, Clean Water Act Section 404(b)(1) evaluation, Public Notice, and Minnesota Environmental Assessment Worksheet (EAW) supplement appendix. These documents and all additional appendices are posted at: http://www.mvp.usace.army.mil/Home/PublicNotices.aspx. A 30-day public review and comment period will begin on March 12, 2018

National Environmental Policy Act (NEPA) and Section 404 of the Clean Water Act:
A draft Environmental Assessment has been prepared for the proposed action in accordance with the NEPA. If public review identifies any significant concerns or results in project modifications, a revised NEPA document may be prepared. A Section 404(b)(1) evaluation has been prepared to evaluate the proposed placement of fill in waters of the United States, in accordance with the Clean Water Act of 1977.

Minnesota Environmental Policy Act:
The proposed project exceeds the threshold requiring a Mandatory EAW (*Minnesota Rules, part 4410.4300, subpart 27A, Wetlands and Public Waters*). The Federal Environmental Assessment that was prepared for the project is being circulated in place of the Environmental Assessment Worksheet (EAW) form (*as allowed by Minnesota Rules, part 4410.1300*). For your convenience, a supplemental document has been prepared and is presented as **Appendix H** that identifies where each of the EAW items can be found within the project report. The publication of the notice of availability will be posted in the EQB Monitor on March 12, 2018. This signed cover letter serves as the certification found in the EAW form by the responsible governmental unit (RGU), assuring the document's completeness and accuracy.

Comment Submission:
Comments should be submitted no later than **April 12, 2018 at 4:30 pm**. All comments will become an official part of the administrative record and will be available for public examination.

Comments will be addressed jointly as applicable, unless the commenter specifies that the comment should be directed to a particular environmental review process or agency. In efforts for efficiency, if your agency is reviewing and providing comments for both the Federal NEPA review and the non-federal review, please submit one set of responses to avoid duplication of comments

Questions or comments can be submitted electronically to Aaron McFarlane, project Biologist at (651) 290-5660 or at aaron.m.mcfarlane@usacre.army.mil. If submitting comments electronically, please include your name and U.S. mailing address.

Written comments must be received by Thursday, April 12, 2018, at 4:30 pm, and sent to:

District Commander
St. Paul District, Corps of Engineers
Attention: Regional Planning and Environment Division North
180 Fifth Street East, Suite 700
St. Paul, Minnesota 55101-1678

Sincerely,

Terry J. Birkenstock
Deputy Chief, Regional Planning and Environment Division North

Jon Oyanagi
Director, Ramsey County Parks and Recreation

2

US Army Corps
of Engineers®
St. Paul District

Public Notice

Project: Pigs Eye Lake – CAP Section 204
Ramsey County, Minnesota

Date: 12 March 2018
Expires: 12 April 2018

In Reply Refer to:
Regional Planning and
Environment Division North

1. **Project Proponent.** St. Paul District, Corps of Engineers, 180 Fifth Street East, Suite 700, St. Paul, Minnesota 55101-1678, in conjunction with the local sponsor: Ramsey County Parks and Recreation.

2. **Project Authority.** The proposed actions were authorized under Section 204 of the Water Resources Development Act of 1992, as amended.

3. **Project Location.** The proposed actions would be located in Pool 2 of the Mississippi River in Ramsey County, Minnesota, in the Saint Paul metro area.

4. **Summary of the Proposed Project.**

a. The proposed project would enhance and restore backwater habitat by creating island and wetland features within Pigs Eye Lake. Construction of project features would primarily use material dredged from the Mississippi River by the Corps of Engineers during routine maintenance of the navigation channel. A complex of seven islands would be constructed; three of these would incorporate wetland creation and plantings in the centers of the islands. Islands would be planted with a mix of native plants that would be appropriate for floodplain soils. The project would benefit the area by: (1) Serving as wind barriers within the lake to reduce sediment resuspension and shoreline erosion; (2) Improving habitat for migratory birds; (3) Stabilizing the lake bottom; and (4) Providing a positive and productive use of dredged material.

b. The proposed fill action would involve placing clean sand, topsoil, and rock into Pigs Eye Lake with a total footprint of approximately 40 acres. The total estimated fill quantity is estimated to be 413,300 cubic yards.

5. **Construction Schedule.** Construction of the proposed actions is scheduled to be carried out beginning in 2019.

6. **Permits/Coordination.**

a. General. The proposed action has been coordinated with Ramsey County, the U.S. Fish and Wildlife Service, the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, National Park Service, local airport authorities, and others.

b. State. The filling for the proposed project is subject to regulation by the State of Minnesota in accordance with Section 401 of the Clean Water Act. A request for Water Quality Certification will be made to the Minnesota Pollution Control Agency (MPCA). Any comments relative to the MPCA's Section 401 Certification for the activity proposed in the public notice may be sent to the following address:

Minnesota Pollution Control Agency,
Resource Management and Assistance Division.
Attention 401 Certification
520 Lafayette road North
St. Paul, MN 55155-4194

c. Federal. A Draft Environmental Assessment and Finding of No Significant Impact was prepared and coordinated in accordance with the National Environmental Policy Act. Coordination with the U.S. Fish and Wildlife Service occurred during the planning process. A Section 404(b)(1) evaluation was prepared in accordance with the Clean Water Act of 1977.

7. **Summary of Environmental Impacts.** The project would have temporary minor adverse impacts on noise levels, aesthetic values, recreational opportunities, air quality, terrestrial habitat, aquatic habitat, biological productivity, and surface water quality; the project would have substantial beneficial effects on terrestrial habitat, wetlands, aquatic habitat, and habitat diversity and interspersion; the project would have additional minor beneficial effects on aesthetic values, recreational opportunities, commercial navigation, biological productivity, and surface water quality; and the project would have temporary, minor beneficial effects on employment.

8. **Report.** A Draft Environmental Assessment that describes the project and the environmental impacts in detail is available to the public and can be viewed at http://www.mvp.usace.army.mil/Home/Public-Notices/. The report includes project drawings, a Draft Finding of No Significant Impact, and letters of coordination from regulatory agencies.

9. **Public Hearing Requests.** The Section 404(b)(1) evaluation is being distributed as part of this environmental assessment. Anyone may request a public hearing on this project. The request must be submitted in writing to the District Engineer within 15 working days of the date of this Public Notice. Interested parties are also invited to submit to this office written facts, arguments, or objections to this project prior to the expiration date of this Public Notice. These statements should clearly state the interest the project would affect and how the project would affect that interest. A request for public hearing may be denied if substantive reasons for holding a hearing are not provided or there is otherwise no valid interest to be served. All statements will become an official part of the project file and will be available for public examination.

10. **Review and Comment.** If you have any comments on the environmental assessment they should be provided before the expiration date of this notice. Persons submitting comments are advised that all comments received will be available for public review, to

include the possibility of posting on a public website. Questions on the project or comments on the Environmental Assessment can be directed to Aaron McFarlane, project biologist at (651) 290-5660 or at aaron.m.mcfarlane@usace.army.mil. Please address all formal written correspondence on this project to District Commander, St. Paul District, Corps of Engineers, ATTN: Regional Planning and Environment Division North, 180 Fifth Street East, Suite 700, St. Paul, Minnesota 55101-1600.

Terry J. Birkenstock
Deputy Chief, Regional Planning and
Environment Division North

3 Copies of Comments Received

Comment letters received during the public review period (March 12 – April 12, 2018) are provided in this section.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

MINNESOTA POLLUTION CONTROL AGENCY

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300
800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

April 5, 2018

District Commander
St. Paul District, Corps of Engineers
ATTN: Regional Planning and Environment Division North
180 Fifth Street East, Suite 700
St. Paul, MN 55101-1600

Re: Pigs Eye Lake Section 204 Environmental Assessment

Dear District Commander:

Thank you for the opportunity to review and comment on the Environmental Assessment (EA) for the Pigs Eye Lake Section 204 project (Project) in Ramsey County, Minnesota. The Project consists of restoration of Pigs Eye Lake via the creation of aquatic and wetland habitats in connection with maintenance dredging. Regarding matters for which the Minnesota Pollution Control Agency (MPCA) has regulatory responsibility or other interests, the MPCA staff has the following comments for your consideration.

Noise (Item 17)
The MPCA agrees with the Army Corps of Engineers, and does not expect that there will be any noise impacts to the area after completion of the Project. The MPCA encourages the contractors to ensure that all construction equipment is fitted with the appropriate mufflers during Project activities, as feasible, and that construction activities take place between 7 a.m. and 10 p.m., during which time the state noise standards are slightly higher.

We appreciate the opportunity to review this Project. Please provide your specific responses to our comments and notice of decision on the need for an Environmental Impact Statement. Please be aware that this letter does not constitute approval by the MPCA of any or all elements of the Project for the purpose of pending or future permit action(s) by the MPCA. Ultimately, it is the responsibility of the Project proposer to secure any required permits and to comply with any requisite permit conditions. If you have any questions concerning our review of this EA, please contact me by email at Karen.kromar@state.mn.us or by telephone at 651-757-2508.

Sincerely,

Karen Kromar

Karen Kromar
Project Manager
Environmental Review Unit
Resource Management and Assistance Division

KK:bt

cc: Dan Card, MPCA, St. Paul
Christine Steinwand, MPCA, St. Paul
Teresa McDill, MPCA, St. Paul

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

FRIENDS OF THE MISSISSIPPI RIVER

Working to protect the Mississippi River and its watershed in the Twin Cities area.

101 East Fifth Street
Suite 2000
Saint Paul, MN 55101

651-222-2193
www.fmr.org
info@fmr.org

April 12, 2018

District Commander
St. Paul District, U.S. Army Corps of Engineers
ATTN: Regional Planning and Environment Division North
180 Fifth Street East, Suite 700
St. Paul, MN 55101

RE: Environmental assessment of the ACOE Pigs Eye Lake habitat restoration project.

District Commander:

Friends of the Mississippi River (FMR) is a local non-profit community-based organization that works to protect and enhance the natural and cultural assets of the Mississippi River and its watershed in the Twin Cities. We have 2,400 active members, more than 3,000 volunteers and 1,600 advocates who care deeply about the river's unique resources. FMR has long been an active and ongoing participant in environmental review processes occurring in and along the Mississippi River in the Twin Cities.

We are writing today with brief comments on the draft environmental assessment for the proposed Pigs Eye Lake restoration project.

FMR is generally in support of the draft environmental assessment and proposed creation of seven islands in Pig's Eye Lake. The stated project objectives are in line with FMR's mission to protect, restore, and enhance habitat along the Mississippi River. However, we also believe that this project presents an important opportunity to build in experimentation around climate resilience, which is not currently presented in the plan.

Creation of new habitat in any given area must take into account historical, current, and potential future conditions of that area. Facing an uncertain climate future, one in which the state of Minnesota is expected to experience increases in temperature and subsequent range shifts of both plant and animal species, any project creating new habitat would be wise to consider the implications of these changes.

The proposed seven islands in Pig's Eye Lake present an opportunity for a living laboratory of sorts, in which different combinations of plant communities or plant ecotypes on each island could provide important insights into how shoreline and wetland communities will respond to a changing climate. This idea also builds resilience into the overall project itself, preventing a large loss of investment if a particular island or plant community were to fail due to pests, disease, climate change, or other related stressors.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

FMR proposes that the Corps consider using this Pig's Eye habitat project as a study site, in partnership with organizations like FMR and the University of Minnesota, to experiment with plant community assembly questions in the face of a changing climate. By monitoring these changes in the long-term, we could gain important insights that could influence how non-profit, local, state, and federal agencies approach the field of habitat restoration.

Thank you for your consideration of these comments. I would be happy to discuss these further – please do not hesitate to contact me at 651-222-2193 x 33, or aroth@fmr.org.

Sincerely,

Alex Roth, PhD
FMR Ecologist

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Yonke, Scott
To: Mcfarlane, Aaron M CIV USARMY CEMVP (US)
Subject: FW: EAW18-007 Pigs Eye Lake Islands
Date: Thursday, April 05, 2018 10:16:45 AM
Attachments: Undeliverable EAW18-007 Pigs Eye Lake Islands.msg

FYI

Scott Yonke, PLA | Director of Planning and Development

Ramsey County Parks and Recreation Department
2015 Van Dyke Street

Maplewood, MN 55109-3796

DD: 651-363-3786

Blockedwww.co.ramsey.mn.us <BlockedHttp://www.co.ramsey.mn.us/>

From: Pansch, Joshua (DOT) [mailto:josh.pansch@state.mn.us]
Sent: Thursday, April 05, 2018 8:02 AM
To: Yonke, Scott <scott.yonke@co.ramsey.mn.us>
Subject: FW: EAW18-007 Pigs Eye Lake Islands

Hello Scott,

I attempted to send the following email to Aaron Mcfarlane regarding the Pigs Eye Lake Islands EAW and it was undeliverable (attached). Can you please have this sent on to the appropriate people?

Thank you,

Josh

Josh Pansch, Senior Planner

MnDOT Metro District

1500 W. County Road B-2

Roseville, MN 55113

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

(651) 234-7795

josh.pansch@state.mn.us <mailto:josh.pansch@state.mn.us>

From: Pansch, Joshua (DOT)
Sent: Thursday, April 5, 2018 7:57 AM
To: Aaron.m.mcfarlane@usacre.army.mil <mailto:Aaron.m.mcfarlane@usacre.army.mil>
Cc: Olson, Nicholas (DOT) <nicholas.olson@state.mn.us <mailto:nicholas.olson@state.mn.us> >; Craig, E (DOT) <buck.craig@state.mn.us <mailto:buck.craig@state.mn.us> >; Coddington, Ryan (DOT) <ryan.coddington@state.mn.us <mailto:ryan.coddington@state.mn.us> >; Straumanis, Sarma (DOT) <sarma.straumanis@state.mn.us <mailto:sarma.straumanis@state.mn.us> >; Tiedeken, Nicklas (DOT) <nick.tiedeken@state.mn.us <mailto:nick.tiedeken@state.mn.us> >; Sherman, Tod (DOT) <tod.sherman@state.mn.us <mailto:tod.sherman@state.mn.us> >; Scheffing, Karen (DOT) <karen.scheffing@state.mn.us <mailto:karen.scheffing@state.mn.us> >; Wiltgen, Jennifer (DOT) <jennifer.wiltgen@state.mn.us <mailto:jennifer.wiltgen@state.mn.us> >; Pansch, Joshua (DOT) <josh.pansch@state.mn.us <mailto:josh.pansch@state.mn.us> >
Subject: EAW18-007 Pigs Eye Lake Islands

Good Morning,

The Minnesota Department of Transportation (MnDOT) has reviewed the above-referenced EAW and has no comments, as the proposed project should have little or no impact on MnDOT's highway system.

If you have any questions please let me know.

Thanks

Josh

Josh Pansch, Senior Planner

MnDOT Metro District

1500 W. County Road B-2

Roseville, MN 55113

(651) 234-7795

josh.pansch@state.mn.us <mailto:josh.pansch@state.mn.us>

DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources
Ecological and Water Resource
1200 Warner Road
St. Paul, MN 55106

April 12, 2018 Transmitted Electronically

Scott Yonke
Director of Planning and Development
2015 Van Dyke St
Maplewood, MN 55109

Re: Pigs Eye Lake Islands EA/EAW

Dear Scott Yonke,

The Minnesota Department of Natural Resources (DNR) has reviewed the Environmental Assessment Worksheet (EAW)/Environmental Assessment for the Pigs Eye Lake Islands project. While staff from the DNR have been involved with project discussions over the course of the last couple of years we have some questions regarding the project, in many cases, our comments below are aimed at better understanding the Project and how it would be carried through. Other comments include areas where DNR has information that could have been included in the EAW as additional information/background. We offer the following comments for your consideration.

Clarification requested:
Section 4.3.6 Shoreline Stabilization (p 39):

- Explain in more detail why stabilization of the existing shoreline was not given greater consideration as a construction design alternative. The narrative describes the use of rock groins and other structures along the shoreline as feasible but not preferable for shoreline stabilization because they would reduce the aesthetic value of the area. However, rock groins are included in the island design to provide shoreline stabilization. How is the impact on the aesthetic value of the area from the rock groins associated with island building different than if groins were constructed on the shoreline of the lake?
- How do the benefits of habitat creation in the middle of the lake compare to habitat creation along the shoreline of the lake, where habitat is currently being lost from erosion? Table 4 (p 43) states that shoreline stabilization would not be efficient in terms of cost. What factor did cost play in removing this management measure from further consideration?

Section 5.4.2 Risk and Uncertainty (p 56):

- Describe in greater detail how the setting of this project (a large riverine wetland) compares with the river settings where island building projects have been constructed in the past. What potential risks and uncertainties were identified for this particular setting, in comparison to other island building locations on the Upper Mississippi River?

Section 6.3.1 Construction Restrictions (p 63):

- In the plan formulation, the feasibility of construction access was mentioned as an engineering constraint for this project, but this issue was not discussed in any detail. From the north end of the Red Rock Barge Terminal to the north end of the area of construction, the depth of Pigs Eye Lake varies from 2 – 4 feet. Provide more detail on how access to the interior of the lake would be obtained for the type of construction that is proposed. For example, if barge access into the lake is required for construction, explain and quantify what excavation would be required to gain access and to build islands. Would

material excavated for construction be incorporated into the islands or disposed of offsite? Additional Environmental Review may be needed, depending on the design and degree/need for dredging.

- Please describe what is meant by "staggered lifts" and the amount of time required for staggering.

Section 6.3.2 Construction Schedule:

- Much of the construction schedule described lies within the sensitive nesting period of April 1 – July 15. It's not clear how long construction of the project is expected to take. It's stated that it is optimum to construct the project under one contract, but, it's not clear the length of time that might be needed (e.g. one month or eight months). Provide information on the expected duration of the project.

Supplemental information from DNR:

- Section 2.1.1 Pigs Eye Lake Heron Rookery. In addition to the information provided within this Section, please note that the SNA is also designated as a Sanctuary during the peak breeding and brooding period for the many birds using the colony. Sanctuaries are sites within Natural Areas that are closed year-round or during specific seasons and help protect rare and sensitive natural features, such as nesting sites. Pigs Eye Island Heron Rookery Scientific and Natural Area Sanctuary is closed April 1 – July 15. Entering a closed sanctuary is in violation of state law. While the closure dates are noted within the EAW, we feel the designation as a "sanctuary" should be noted, and proposers should be aware of this status.
- Section 2.8.1 Fish. Invasive silver carp are also present.
- Section 2.8.4.2 State-listed Species. Paddlefish, a state threatened species, were thought to inhabit Pig's Eye Lake at various times of the year, though they had not actually been documented in the lake. However, in 2017 one paddlefish implanted with a transmitter in the Minnesota River was detected on a passive acoustic receiver in the middle of Pig's Eye Lake on three separate occasions (in June, September, and October). The importance of Pig's Eye Lake to paddlefish is not currently known; islands are not believed to be detrimental to paddlefish in Pig's Eye Lake. This information was not entered into the NHIS database and therefore would not have been discovered in an NHIS inquiry, ~~but should be~~ included within this section.
- 6.7 Project Performance
- Section 7.2.6 Biological Productivity. DNR should be contacted and be involved in evaluating impacts from contractor proposed activities to ensure impacts to nesting birds utilizing the Pigs Eye Island Heron Rookery Scientific and Natural Area Sanctuary do not occur.
- Appendix E: Pages 40-42 of Appendix E Sediment Report highlights fish and PFC concentrations in Pool 2. It states "Ye et al. examined common carp in particular, and noted that because common carp are known to generally stay within a smaller home range, the 27 km distance between Pig's Eye Lake and Lower Pool 2 is likely to limit the movement of carp between these areas, and therefore, the differences in PFC concentrations between the two areas may be a good indicator of significantly different levels of PFC inputs to the system." A fish telemetry study initiated in 2013 (and still ongoing) in the Mississippi and St. Croix rivers has implanted acoustic transmitters in over 230 fish representing 12 species. Specific to common carp, the mean river mile range for 10 common carp implanted with transmitters in Pool 2 was 18.46 miles (29.71 km) in the Mississippi River (one of which routinely travels to Pool 1). All 10 of these common carp were also detected in the Minnesota River ranging from 2.21 miles (3.56 km) to 209.4 miles (337 km) up the Minnesota River. Five of these common carp were detected in Pig's Eye Lake, of which three had over 58% of their detections within the lake. Three of the common carp traveled downstream at least as far as Spring Lake. Transmitters implanted in common carp have a 10 year life expectancy so data collection continues on the travels of these fish, however half have either died, been harvested, expelled their transmitter, or are in a location not within range of a passive

acoustic receiver and their whereabouts are unknown. DNR fisheries staff believe that the movement assumptions by Ye et al. are underestimates and not relevant as they were based on a common carp movement study in Australia (Stuart IG, Jones MJ. Movement of common carp *Cyprinus carpio*, in a regulated lowland Australian river: implications for management. Fish Manag Ecol 2006; 13: 213-9). Stuart and Jones stated less than 20% of tagged common carp moved more than five km from their original capture site over a five year period (based on recaptures of externally tagged fish, not transmitters). However over 7% moved over 100 km. In our current ongoing study, including the missing common carp and travels into the Minnesota River, all 10 have traveled over 3.1 miles (5 km) in a four year period. Based on our preliminary data, there is no reason to conclude that the distance between Pig's Eye Lake and Lower Pool 2 is great enough to limit interchange of common carp. Additional fish contaminant testing was conducted on Pool 2 in 2016 and included fish specifically from Pig's Eye Lake. It does not appear that the Pig's Eye Lake fish were tested for PFC's, but were tested for other contaminants like PCB's and Dioxins (Bruce Monson at MPCA can be contacted regarding this data). It is not believed fish movement data currently being collected by the MNDNR should preclude island construction.

On behalf of the DNR, thank you for consideration of these comments.

Sincerely,

/s/ Rebecca Horton
Region Environmental Assessment Ecologist

CC: Jen Sorenson, Joel Stiras

Minnesota Department of Natural Resources • Ecological and Water Resources
1200 Warner Road, St. Paul, MN 55106

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

United States Department of the Interior

NATIONAL PARK SERVICE
Mississippi National River and Recreation Area
111 E. Kellogg Blvd., Ste 105
St. Paul, Minnesota 55101-1256

IN REPLY REFER TO
L3033

April 12, 2018

Col. Sam Calkins
District Commander
Corps of Engineers, St. Paul District
Attention: Regional Planning and Environment Division North
180 East Fifth Street, Suite 700
Saint Paul, MN 55101

RE: Comments – Pigs Eye Lake Ramsey County, MN Secton 204 Draft Feasibility Study Report with Integrated Environmental Assessment

Dear Col. Calkins:

This letter is in regards to the draft "Pigs Eye Lake Ramsey County, MN Secton 204 Draft Feasibility Study Report with Integrated Environmental Assessment" recently sent out for comment. The entirety of Pool 2, which includes Pigs Eye Lake, is within the boundaries of the Mississippi National River and Recreation Area (NRRA). In 1988, Congress established the NRRA to protect and enhance the nationally significant historical, recreational, scenic, cultural, natural, economic and scientific resources of the 72-mile Mississippi River corridor through the Twin Cities metropolitan area.

After reviewing this document and the attached appendices, we find the project supports the enabling legislation of the NRRA, as well as the goals and objectives found in our Foundation Document. We, therefore, have no objections to this project and support work done to enhance the Pigs Eye Lake area for the benefit of the river system and its inhabitants.

Thank you for the opportunity to comment on this draft, and we are interested in being part of continuing work on this endeavor. If you have any questions, please contact me at 651-293-8432, or email john_anfinson@nps.gov.

Sincerely,

John O. Anfinson
Superintendent

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

April 12, 2018

Mr. Aaron McFarlane
Saint Paul District, Corps of Engineers
ATTN: Regional Planning and Environment Division North
180 Fifth Street East, Suite 700
Saint Paul, MN 55101-1678

RE: Pigs Eye Lake Project
CAP Sections 204 – Clean Water Act - Public Notice
City of Saint Paul, Ramsey County, Minnesota
Metropolitan Council District 13, Richard Kramer
Review File No. 21896-1

Dear Mr. McFarlane:

Metropolitan Council (Council) staff have reviewed the Public Notice for this proposed project (Project) to determine its adequacy and accuracy in addressing regional concerns and its potential for significant environmental impacts. The project proposes to construct seven island structures within Pigs Eye Lake primarily out of reclaimed Mississippi River navigation channel dredge material under Section 204 of the Corps' Continuing Authorities Program (Program). This Program provides authority for the Corps of Engineers to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized Federal navigation project (in this case, the Mississippi River). The islands would be constructed to meet the Project objectives of improving aquatic habitat, increase available nesting and resting bird habitat, and maintain or enhance the quantity of shoreline habitat within Pigs Eye Lake.

While Council staff has not made a specific determination that an Environmental Impact Statement needs to be prepared for the Project, we have identified a number of concerns that we believe should receive additional review prior to proceeding with the Project as currently designed. We also have concerns with this project proceeding without a more comprehensive approach or plan to addressing the contamination issues in the area.

The following comments are offered concerning the Public Noticed Project Draft Feasibility Study Report, EA/EAW, and Appendices.

Draft Feasibility Study Report

Section 1.3 – Project Area

The text here and throughout the document identifies the Pigs Eye Lake basin (basin) as a shallow backwater lake. Text in Section 6.5 however, specifically classifies the basin as a "large riverine wetland", which seems more accurate since Section 2.1 and Figure 2 indicate water depths to benthic muds average only 3-4 feet deep in the deepest areas of the 628-acre open-water basin which is surrounded by 131 acres of shallow marsh wetland. We would expect that the basin currently exhibits predominately wetland functions over those of a lake. While the basin may at some point in its life have met the definition and exhibited the functions of a lake – after the creation of Mississippi River Pool 2 in approximately 1930 and before disposal of waste

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began in the upstream dump area in the mid-50s and before the Red Rock (barge) Terminal was dredged from the basin to the main channel of the River, Council staff proposes it should be referred to only as a wetland throughout the Feasibility Study Report (Report) and Appendices, and as a lake in its mapped name only.

Section 2.5 – Water Quality
The text indicates that no water quality samples were taken from within the basin in preparation of the Report, and that the most recent samples of record available were obtained between 1970 and 1988. The only water quality values presented were one mean concentration for total phosphorus of 0.365 mg/l and a mean Secchi disk transparency of 1.3 feet – both of unknown time or location. Council staff believes that this level of water quality information for the 628-acre basin is inadequate to base a $15M+ Project's objective assumptions that the construction of sand bench islands as proposed will lower basin turbidity and result in improved aquatic plant diversity, fishery, and migratory bird habitat in the basin.

Water column turbidity would likely persist after construction of the project as proposed solely due to the anticipated continued dominance of Chironomidae and Oligochaeta in the poor quality benthic muds and their ability to continue to attract a persistent overabundance of rough-fish into the basin. We recommend that water quality and toxicity testing be carried out on water column samples within the basin before progressing with the project to determine if the quality of water in the basin will support a more diverse fishery; enhanced populations of phytoplankton and zooplankton (should turbidity drop); and propagation of the palate of wetland plant species proposed to be planted on the islands. With no DO, BOD/COD, ammonia/nitrogen, phosphorus, pH, heavy metals, or chronic/acute aquatic toxicity test data available on the basin water column to support the Project's many assumptions, we believe it is premature to move the Project forward.

Section 3.2.3 – Shoreline Erosion
The text and Figure 12 document shoreline erosion, observed to have occurred from 1951 to 2015, with an intermediate observation point in 1991. There is no doubt that the basin boundaries have not stabilized, but Council staff is not convinced that they are primarily due to wind fetch, or that the proposed Project will be effective in stabilizing the shorelines if constructed as proposed.

The 1951 aerial depicts a point in time shortly before the upstream dump began its operation and significant level of disturbance in the upstream area. It is possible that the direct runoff containing peat and woody (construction waste) debris during dump excavation and operation and continual seepage of fine silt and clay particles, organics, and toxic materials disposed of in that 300-acre site from the mid-1950s until 1972 are likely responsible for the observed succession of sediment that has accumulated into the 10 to 22 feet thick layer of very soft, highly organic benthic muds in the bottom of the basin. We believe that the degraded quality of the water and accumulated sediment may have contributed to the gradual die-off of more sensitive vegetation species over the observed period of time. And, since neither the extensive accumulation of benthic muds in the basin, nor the upstream 300-acre dump are proposed to be further encapsulated or removed, their negative influence on the basin's health can be expected to continue.

We would expect that wind fetch should have had a similar effect from 1930 to 1951 if it is a current primary cause of the erosion, but aerial photo evaluation of that period of time has not been evaluated in the document. Aerial photos from 1937 and 1947 are included in an unlabeled section between Appendices J and L, but do not show the entire basin so that perimeter landmarks can be compared with later aerials. If toxicity in the water column and basin substrate has, since the mid-1950s been one of the primary reasons for limited aquatic plant germination and diversity, construction of the Project as proposed may have little change in the erosional progression of the basin's shoreline in the future as predicted in Figure 14.

Council staff believes that a primary contributor to erosion of the basin shoreline is water level fluctuation in the basin and extended periods of root crown inundation during periods of high water elevation. The River's stated 'normal summer elevation' is 687.1 feet at the South Saint Paul Gage (Gage) at River Mile 833.7 just downstream from the barge channel outlet of the basin (as shown on Figure 5 in Appendix G). We would expect that the water level within the basin should closely mirror that of the River at the nearby Gage based upon the proximity and size of the interconnecting barge channel. In examining historic daily water level readings at the Gage for 2016 and 2017, obtained from http://rivergages.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=SSPM5&fid=SSPM5&dt=S, the water level exceeded 690 feet (also the approximate maximum elevation of Project constructed sand islands) for approximately 50 days in 2016 and 65 days in 2017, almost exclusively during the growing season. There were five time periods during those two years when there were two to three weeks of continuous water level above elevation 690 – two in 2016 and three in 2017. Few plant species are able to withstand that extent of water level rise and period of inundation. Any degree of wind fetch could be expected to exacerbate shoreland erosion. The study does not provide any shoreline cross-sections or elevations at any locations around its perimeter to adequately determine the full potential negative effects of water surface level fluctuations of this magnitude and frequency.

Section 6 – Recommended Plan
Study Alternative 6m has been recommended based upon aquatic ecosystem enhancements anticipated from 16.3 acres of newly created floodplain forest habitat, reduced wind-wave action and 17.6 acres of new wetland marsh habitat. Council staff is concerned with the assumption that deciduous hardwoods will be able to become established on the sand islands constructed over unconsolidated benthic muds as well as they have historically on the adjacent floodplain soils. Young deciduous trees are more vulnerable to extended periods of inundation than mature trees. It is also unknown if there will be sufficient oxygen available to the tree roots for the trees to thrive. As deciduous trees grow taller in this setting, their root systems may struggle to become established and attain sufficient stability to resist overturning in windy conditions. The only woody species mentioned in the study as planned for planting on the islands at present is 'willow' – presumably sandbar willow, a medium sized shrub and not a hardwood tree.

Additional study of specifically what hardwoods might survive in the shallow contaminated substrate and repeated extended periods of crown inundation without sinking or toppling in periods of sustained winds should be carried out during the planning phase and not following construction. Without some indication of what species of trees are going to be viable on the proposed 16.3 acres of bottomland forest, we are unable to provide an adequate review of the

proposal. The maximum planned depth of the coarse sand islands of approximately five feet will be over poorly consolidated organic muds which exhibit no soil structure for tree roots to gain stable footing. While we are aware of several areas where the Corps has successfully constructed vegetated islands to improve habitat within the River corridor, we are not aware of any which have been undertaken on sediment with exhibits the extent of chemical and physical limitations the basin's benthic muds present.

Section 6.2 – Design Considerations
Settlement of sand islands into the benthic mud is assumed to be 2.5 feet where the sand islands will be 4 to 5 feet thick, and an average of 1.5 feet where shallower. Notes from a meeting held on January 20, 2016 contained in Section 2 of Appendix A indicate it was estimated that sediment consolidation of soft soils over time under the weight of the constructed islands was estimated at 1.5 to 3 feet. Should that estimate fall short of actual settlement by one half foot, and the islands continue to settle to a maximum depth of 3.5 feet during the first few years after construction, they will all be submerged during all but low River flow periods. Would this situation be considered a maintenance issue, and the responsibility of Ramsey County, or might alternatives be considered to either abandon the effort or add further material to the constructed islands and replant all vegetation?

Section 6.4 – Operation and Maintenance Considerations
Critical issues that will have significant implications on the long-term cost for Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) will be how quickly the islands reach their stable settlement point, and how long it takes for vegetation to become established on the islands. Annual OMRR&R will only be minimal as anticipated (currently estimated at $2000/year) if full stability is achieved by the Project before its responsibility is turned over to Ramsey County, the identified Project Sponsor. It is unclear from the Study how long monitoring and joint (Corps and County) responsibility for monitoring and replanting will extend and when the County will assume full responsibility for future expenses.

Section 11 in Appendix I states that cost-shared Monitoring and Adaptive Management (MAM) will continue for 10 years following implementation. Does that mean that Ramsey County will not assume sole maintenance responsibilities for the Project until after this 10-year MAM period is completed?

Section 7.1.5.3
The text indicates that softstem and hardstem bulrush are prevalent along much of the basin shoreline. Typically, softstem varieties tend to grow in softer sediment and hardstem varieties in firmer sediment, and both expand rhizomatously. It is unlikely that either plant type have or will spread sufficiently to prevent shoreline recession due to the frequency and extent of bounce in the basin.

Section 7.1.6.2 – Proposed Fill Material
The text indicates the potential for use of benthic muds from the basin for proposed Project island topsoil. Council staff strongly discourages any use of benthic muds sourced from the basin as topsoil for the Project. Heavy metals including copper, cadmium, lead, and zinc; in addition to PAHs, PCBs, and PFCs in particular are reportedly found to be abundantly adsorbed

to benthic sediments throughout the basin. Copper and cadmium in particular have both been reported to inhibit plant growth (including willow), exert negative effects upon both shoot and root growth, and tend to accumulate preferentially in plant roots.

The indicated high organic content (9 to 17%) in benthic muds in the basin would also be expected to increase their heavy metal adsorption capacity over typical clay or silica sediment particles. Copper is specifically reported to interfere with the metabolism of many plant species, inhibiting photosynthesis, nitrogen fixation, and phosphorus uptake in algae, if present in sufficient concentrations. Additionally, continual wetting and drying of the benthic material can be expected to result in the chemical release of heavy metals and other bound pollutants. Choice of plants to be grown on the proposed islands should be made carefully, as some species have a high ability to absorb and accumulate elevated levels of metals in various plant areas (root, crown, stem, seeds, etc.), which if/when consumed by fauna, can become magnified through the food chain. Additionally, acidic water is reported to enhance the uptake of heavy metals by plants, and the pH of water within the basin is presently unknown.

Section 7.4.3.1 – Recreation
At this time the document has provided limited information from which to determine the appropriateness of proposed expanded recreational opportunities for Pigs Eye Lake. The basin is located within the boundaries of Battle Creek – Indian Mounds Regional Park which is jointly operated by Ramsey County and the City of Saint Paul. There are four units within the park master plan – Battle Creek, Fish Hatchery Lake, Indian Mounds Park/Municipal Forest, and Pigs Eye Lake. Saint Paul independently oversees the Indian Mounds and Fish Hatchery Lake portion of the park, and Ramsey County the Battle Creek and Pigs Eye Lake portion. Battle Creek – Indian Mounds Regional Park is a component of the regional parks system and is governed and afforded additional protection by the Metropolitan Council's *2040 Regional Parks Policy Plan*.

While there have been more recent master plan (Plan) amendments to the park boundaries, the Plan for the Battle Creek portion which contains Pigs Eye Lake dates to June 1981. At that time, the Plan indicated that the Pigs Eye Lake unit was not yet in a development stage, so plans and information were extremely limited.

There are several regional trails and a trail search corridor in vicinity of the proposed Project. The Mississippi River Regional Trail is located directly adjacent to the Project site area, on the western bank of the River. The Samuel Morgan Regional Trail, and State and Ramsey County components of the trail pass through the adjacent Indian Mounds Park and Battle Creek Regional Park units across the rail yard and adjacent to CSAH 61 to the east of the Project site. Additionally, the Point Douglas (Bruce Vento-Washington County) Regional Trail Search Corridor, a wide potential siting corridor in which a future trail is planned, passes through the Project site, trending along the River and CSAH 61 in the immediate vicinity of the area. These facilities should be acknowledged in the Report and EA/EAW as current and future regional trail facilities that may be affected by the Project.

As noted in the document text, the Plan for the Battle Creek portion of the Regional Park and five-year Capital Improvement Program (CIP) will need to be updated or amended by Ramsey

County Parks and Recreation to include the proposed project. The Metropolitan Council will need to review the plan amendment for conformance with the Council's *2040 Regional Parks Policy Plan* (Policy Plan). The Policy Plan requires that any regional park that involves more than one implementing agency submit only one master plan for that park. Additionally, that master plan shall be approved by each of the implementing agencies and shall identify the nature of each agency's responsibilities for carrying out compatible development and operation of the park. Funds for regional recreational facilities, made available through the Council, are only available after a master plan and CIP covering those facilities has been reviewed by the Council and found to be in conformance with the Policy Plan.

At this point in time, however, the Council's primary concerns regarding promotion of recreation within the proposed Project site area are two-fold. First, Council staff are concerned that shallow marsh-ringed perimeter of Pigs Eye Lake is already exhibiting significant shoreline erosion, and the construction of islands as currently proposed has the potential for significant environmental effect through long-term displacement and disturbance of toxic benthic muds into the water column over an extended period of time, both during island construction and a subsequent unknown time period of settling and benthic mud disturbance.

The second is the absence of safe access to and within the site which is surrounded by busy CSAH 61, the active BNSR Railway and CP Railway and hump yard; active Aggregate Industries barge terminal within a narrow dredged Lake outlet channel; a Minnesota DNR heron rookery Scientific and Natural Area; the Council's Metropolitan Wastewater Treatment Facility and adjacent retired ash pond area; the 300-acre CERCLIS/MPCA Superfund dump area; and over 130 acres of surrounding shallow marsh wetlands.

Additionally, the sediment in the northern-most portion of the basin adjacent to the mouth of Battle Creek was determined to be too contaminated to subject to disturbance or alteration by this Project. The cumulative effect of these factors, as well as the uniform coverage of the bottom of the 628-acre basin with 10 to 22 feet of unconsolidated organic sediment rich in heavy metals and pollutants that have overflowed or leached out of the dump do not lead Council staff to conclude that Pigs Eye Lake is currently an appropriate site to promote unrestricted public access for recreation.

Appendix A
Section 2 – Initial Interagency Coordination Meeting Notes
During the January 20, 2016 meeting, it was stated that due to the unconsolidated nature of the benthic muds in the basin that it was "likely that mud will displace above the water surface" in response to (sand) material placement. This finding is also discussed in some detail in Section F.1.5 of Appendix F. We have grave concerns relative to the potential for the Project to discharge significant quantities of benthic material into the Mississippi River during its construction if this is still the position of the Corps, as placement is anticipated to be occurring in water that is 3 to 4 feet deep. Council staff requests the Corps clarify their position on the likelihood of this situation occurring and how it expects this mud wave to dissipate without mixing into the water column and being discharged into the River.

Section 7 – Habitat Sub-Group
The sub-group expressed consideration for promoting habitat for reptiles and amphibians. Did existing area habitat surveys give indications that the basin is currently inhabited by observed populations? Council staff question their presence in the basin based upon its limited food supply sources and their general sensitivity to pollutants. Based upon the extent of benthic mud contamination in the basin which will remain following Project construction as proposed, we do not believe the basin to be a healthy or preferred location to attract them to in greater numbers either with a food source or place to overwinter.

Great variation is reported among amphibian species in their sensitivity to heavy metal and organic contaminants, but they generally tend to be more sensitive to pollutants than fish, and water quality criteria established for fish may not be protective of amphibians

Appendix B

Section II. C. – Suspended Particulate/Turbidity Determination – Actions Taken to Minimize Impacts
Council staff suggests that a channel for Battle Creek flows be entirely isolated from the rest of the basin from its entrance into the basin to the barge channel exit with a floating silt curtain during any activities that might disturb the benthic substrate within the basin, to prevent those pollutants from being swept into the River. Additionally, all barge movement during any construction phase in the basin should also take place behind a separate silt curtain to prevent disturbed sediment from being swept out of the basin through either of the interconnecting passages between the basin and River.

Appendix F

Section F.2.5. – Settlement
Text in the Appendix states that it was impossible to obtain an undisturbed sample of the benthic muds in the basin due to the loose, liquid nature of the soft soils. Acquisition of a disturbed sample should be adequate however, if it is to be utilized to calculate the density of the benthic material (and not perform a laboratory consolidation test).

Table 2 in the Appendix indicates that a value of 90 pounds per cubic foot (pcf) for 'very soft silty clay' and 115pcf for 'dredge sand' were utilized to estimate settlement of the constructed islands – data obtained from the New Orleans area. Council staff is concerned that the assumed value of 90pcf assigned to the benthic mud significantly overestimates its actual density by not taking into consideration its indicated 9 to 17 percent (high) organic component, likely resulting in an underestimated degree of settlement. The 115pcf value associated with the New Orleans dredge sand may be close to the actual value for the locally dredged navigation channel material that would be utilized for the Project, but we recommend an actual local sample value be obtained and utilized in the calculations, since it is so readily available. Densities for the additional topsoil and quarry rock material quantities planned for use, while relatively small, should also be factored into the calculations.

We strongly suggest that the Corps take and average a number of actual site samples to obtain more accurate benthic material density values with which to calculate settlement assumptions that would result in a greater degree of confidence in the estimated settlement assumption

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

range than what is currently provided in the Appendix. We request that this Appendix be updated and expanded to present the revised assumptions, data, and revised settlement estimate calculations.

Appendix I.11 – Monitoring and Adaptive Management
Council staff recommends that the Project MAM plan also annually review the 'number of reported bird strikes by month' data following construction of the Project, as is historically presented in Figure 23 and Section 7.1.5.2 of the text of the Report, in addition to fall waterbird counts, and to prepare a mitigation plan, should there be an observed seasonal change or overall increase in the number of bird strikes with aircraft.

Given the issues described in this letter, Council staff are concerned about this project proceeding at this time. Because of the extent of environmental contamination and the number of stakeholders, including the Metropolitan Council, that might be affected by this project, we strongly encourage the project proposer and project sponsor to convene all stakeholders to develop a shared vision for this area and a comprehensive approach to addressing the environmental issues and reaching those goals. Without that comprehensive approach, we have concerns that individual projects might have unintended impacts or might not be as effective in addressing the environmental concerns.

In addition, Council staff requests that the Corps of Engineers address and respond to the above issues prior to drafting the final Feasibility Report and Environmental Assessment document or making a final determination on the need for preparation of an environmental impact statement for the proposed Project. If you have questions about these comments, please contact Jim Larsen PE, Principal Reviewer, at 651-602-1159.

Sincerely,

LisaBeth Barajas, Manager
Local Planning Assistance

CC: Richard Kramer, Metropolitan Council District 13
Scott Yonke, Ramsey County Parks and Recreation
Emmett Mullin, Council Parks and Natural Resources Manager
Patrick Boylan, Council Sector Representative
Judy Sventek, Water Resources Manager
Raya Esmaeili, Reviews Coordinator

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Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

DEPARTMENT OF PARKS AND RECREATION

CITY OF SAINT PAUL
Mayor Melvin Carter

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District Commander

St. Paul District, U.S. Army Corps of Engineers

ATTN: Regional Planning and Environment Division North

180 Fifth Street East, Suite 700
St. Paul, MN 55101

Comments on DRAFT Environmental Assessment and Finding of No Significant Impact developed pursuant to the National Environmental Policy Act
Project:
Pigs Eye lake restoration project

Project proponent and authority:
St. Paul District, U.S. Army Corps of Engineers (USACOE), in conjunction with the local sponsor, Ramsey County Parks and Recreation. The proposed actions were authorized under Section 204 of the Water Resources Development Act of 1992, as amended.

Summary of the proposed project:
The proposed project would create island and wetland features within Pigs Eye Lake. Construction of project features would primarily use material dredged from the Mississippi River by the Corps of Engineers during routine maintenance of the navigation channel. A complex of seven islands would be constructed; three of these would incorporate wetland creation and plantings in the centers of the islands. Islands would be planted with a mix of native plants that would be appropriate for floodplain soils.

Comments:
The proposed project is intended to address ongoing problems in Pigs Eye Lake, primarily ongoing shoreline erosion and sediment resuspension due to long-term hydrological changes and wind fetch.

Title 32 of the Code of Federal Regulations, Volume 4, Sec. 651.29 describes criteria used by the USACOE in determining whether or not an Environmental Assessment (EA) for a proposed action is sufficient and if the preparation of an Environmental Impact Statement (EIS) is required. This section states that an EIS is required if the proposed action has the potential to "significantly affect… public parks and recreation areas, wildlife refuge or wilderness areas". Pigs Eye Lake is part of a regional park, located within the Mississippi National River Recreation Area (MNRRA, a unit of the National Park System), and is located in close proximity to a Minnesota Scientific and Natural Area and important heron rookery.

The proposed action is to use dredge spoils consisting of sand and silt to create islands in Pigs Eye Lake, and to seed the islands with appropriate vegetation. The EA contends that the islands will create water depth variation, stabilize the lake bottom, and act as windbreaks. The EA contends that the result will be to provide new terrestrial habitat, increase terrestrial and aquatic habitat quality, and reduce shoreline erosion.

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The City of Saint Paul has concerns regarding the long-term stability of the islands. Success in establishing vegetation on the islands is critical to both creation of habitat and to the stabilization of the dredge materials used to create the islands. However, the EA does little to address how establishment of vegetation will be ensured. While a monitoring plan is proposed, the first monitoring would not occur until 1 year after construction, by which time storms, flooding, and wind may have already severely compromised both the integrity of the islands and the growth prospects of the vegetation. Moreover, the proposed maintenance budget is woefully inadequate, and the EA does not describe any significant adaptive management practices to address these problems, much less evaluate the potential feasibility nor cost of such approaches.

In short, the EA does not adequately evaluate the feasibility of the project, nor the potential impacts should any number of the assumptions used in project design prove to be unreliable.

Sincerely,

Alice J Messer

Alice Messer
Manager Design and Construction

Cc

Mike Hahm, Director Parks and Recreation
Russ Stark, Mayors Office
Mary deLaittre, Manager Great River Passage
Josh Williams, Planning and Economic Development

4 Initial Interagency Coordination Meeting Notes

The following are the meeting notes from the initial feasibility interagency coordination meeting.

Pigs Eye Lake Section 204
Interagency Planning & Coordination Meeting
January 20, 2016
9:00 – 11:00

NOTES

Background: The Corps initiated the feasibility study stage of the CAP 204 Pigs Eye Lake project in summer 2015. The Corps and the local sponsor of the project, Ramsey County Parks and Rec Department, gathered local, state and federal stakeholders together for discussion and coordination during the feasibility study phase of the effort.

Agencies in attendance included US Army Corps of Engineers – St. Paul District (Corps), Ramsey County Parks, Ramsey Washing Metro Watershed District (RWMWD), Minnesota Pollution Control Agency (MPCA), National Parks Service Mississippi National River and Recreation Area (NPS), Minnesota Department of Natural Resources (MNDNR), Metropolitan Council (Met Council) and the City of St. Paul.

Purpose: Interagency team collaboration meeting is to progress through the planning process in the feasibility study phase for Pigs Eye Lake Section 204.

Attendees:

USACE - Nate Campbell (PM), Sierra Keenan & Angela Deen (Planning), Scott Goodfellow (H&H), Jim Noren (H&H), Zach Kimmel (Operations), Susan Taylor (Cost), Greg Wachman (Geotech), Jack Westman (GIS), Brad Perkl (Cultural), Rod Peterson (Real Estate), Nate Wallerstedt (CAP Program Manager)

Ramsey County Parks – Mike Goodnature

MPCA - Hans Neve, Emily Schnick

NPS – Nancy Duncan, Allie Holdhusen

MN DNR – Joel Stiras, Jen Sorensen

Met Council – Jim Larsen, Mary Gail Scott

City of St. Paul – Don Varney

Ramsey-Washington Metro Watershed District – Bill Bartodziej

Discussion Notes

1. Progress since the July kickoff meeting
    a. Measures Considered
        i. Sand Blanket or Sand Benches -
            - Expensive – may require more sand than available.
        ii. High Islands

- Modified to more natural appearance

iii. Low Islands
- Modified to more natural appearance
- Limited low/seasonally wet island benches to reduce material needs

iv. Shoreline material placement
- Limited areas with severe erosion that would benefit from this

v. Drawdown
- Team looked at full and partial drawdown, use of inflatable or temporary dams. Challenge to work with Battle Creek flows.
- Costs would exceed federal cost limit for a Section 204 - Although a drawdown and consolidation of substrate material would benefit the area and improve conditions for construction, it is not feasible within the scope of the Section 204.

vi. Hydraulic Modifications
- Water movement in Pigs Eye highly variable and dependent on Pool dynamic

vii. Carp Exclosures
- Very large system; difficult to remove carp, challenge to maintain exclosures

b. Development of "Base Plan"
   i. CAP Section 204 Authority is for beneficial use of dredged material for ecosystem restoration. Funding covers construction costs that are in excess of the Base Plan (normal dredging costs without the project).
   ii. Sources of sand to build islands:
   - St. Paul Barge Terminal upper Pool 2 dredge cuts - closest source of material, but quantities vary significantly (30,000 yds is an average).
   - Pine Bend and Boulange temporary placement sites - greater certainty on quantities, but added costs to transport material 14 miles.

c. Bathymetry
   i. Shallow lake, only 3' average depth (max depth of 4.5').

d. Soil Borings
   i. Goal of exploration was to characterize the subsurface material and identify depth to 'hard bottom,' or the thickness of the compressible sediment.
   ii. Borings collected at four locations with samples for geotechnical and environmental sampling.
   iii. Very soft soils. 10-22' thick. Soils made of clay, silt, sand, and peat.
   iv. Lateral displacement of soft soils in response to material placement ("mud wave"). Likely to occur, but difficult to quantify the extent. Likely that mud will displace above water surface.
   v. Consolidation settlement of soft soils over time – also difficult to quantify but estimated 1.5-3'

- Soils sampled are too soft to perform full consolidation testing.
- This is an issue because it impacts accuracy of quantities estimate.

vi. Potential environmental issues related to soils
- Construction of access channels within contaminated sediments
- Increased suspension of contaminated soils due to mud wave formation
  a. Contaminated material refers to lake bottom material, not to Mississippi River navigation channel dredged material
- Any construction activities are likely to lead to increased suspension of lake soils.

e. Environmental Samples

i. Existing survey data:
- 1998-2001 survey of 3 sites in Pigs Eye Lake for 2006 MCES report
- The 2007-2008 MPCA sediment chemistry survey of Pigs Eye Lake included 11 locations at multiple depth increments. The sediment samples were tested for metals, PCBs, PAHs and pesticides.
- If there is other ongoing testing or data available, the study team could use it.

ii. 2015 USACE Sediment sampling
- Collected a total of six environmental samples for chemical and physical analyses from three of the four boreholes. For each borehole tested, two composite samples were analyzed. The composite samples were collected at roughly two foot intervals starting a couple feet below the sediment surface.
- Similar to what was seen in previous surveys, the most contaminated site was the northern most borehole, likely as a result of its proximity to the Pigs Eye Landfill.
- Only samples from one borehole showed any SQT or SRV exceedances for organic pollutants. The only exceedances for metals were for cadmium, lead and mercury. Cadmium, however was above the proposed 2015 recreational SRV limit for two boreholes.
- In contrast to the surveys done 9-17 years ago, we did not detect any PCBs or have any SQT exceedances for nickel and zinc.
  a. Discussion:
  b. Cadmium – not a large exceedance. The MPCA is continuing to review the SRV limit, likely to be finalized by fall 2016.
  c. Until SRV limit is finalized, unclear if/to what extent Cadmium will be in exceedance.
  d. The MPCA would like to see the project happen; from the superfund program perspective the project is beneficial.
  e. The contaminated materials may be problematic not only during dredging for access, also with displacement during

construction. Access dredging could be limited if hydraulic dredging is utilized for material placement.

f. Mud wave could expose sediments that are contaminated. Would have to be managed and contained during construction.
g. As materials are disturbed, materials from Pigs Eye Lake would not be allowed to enter the Mississippi River.
h. Mud wave – would it be ongoing/repeat? Or a onetime occurrence? This would depend on construction schedule, if it was built all at once, or constructed in phases.

2. Alternative Plans
    a. Draft Design
        i. Study team presented the latest iteration of the island concept. Last year, the team developed an initial conceptual layout for the Fact Sheet; that has been revised several times through the planning process. At kickoff meeting July, study team got feedback to look for a more natural layout. In September team developed initial crab claw concept and shared with agencies and sponsors. This crab claw concept is based on naturally occurring islands in the upper Mississippi river.
            - Initial crab claw with wide benches would require more material than what is available. Islands were revised to narrow benches and reduced the overall estimate of sand quantities.
            - Alternative planning is an iterative process and will continue to undergo revisions.
    b. Habitat Benefits
        i. Terrestrial Habitat
        ii. Sandbar/Littoral Zone Habitat
        iii. Wind Fetch Reduction
        iv. Substrate Stabilization
            - Comments: River otters also benefit from hardwood, have a den near island C1; 3 bald eagle nests in the area should be considered.
            - How long will the islands last with the soft substrate? The Corps has experience building islands in both backwater and main channel of the Mississippi River. Islands will be built out of sand, and stabilized. Design team has confidence the islands will last.
3. Construction options – it is feasible to build islands.
    a. Hydraulic dredging – the most likely approach
        i. Can be done for large or small jobs, ideal in shallow locations (3-4'), less expensive for large quantities
        ii. Mechanical dredging would require 7' access channel, can be costly, and may be difficult to maintain in soft soil conditions like Pigs Eye Lake.

4. Discussion:
    a. Section 204 authority is not a remediation or water quality authority. It would not be possible to dredge sediments for removal under this authority. Any in-lake dredging would be site prep and construction only.
        i. For dredging and removal of contaminated sediments, another agency would have to take the lead and provide funding, as it is outside authority of Section 204.
    b. Contaminated material issues
        i. Concern that carp are the main source of turbulence in the lake, not wind fetch. This project would not be addressing carp problem.
    c. What is the cost of not doing anything? Is measurable or how is it factored in to the feasibility study?
        i. This would be addressed as part of the "no action" alternative, the consequences of doing nothing.
    d. What are the ecosystem benefits of the project – what species are being targeted (invertebrates, turtles, birds)? Is there any information on benthic invertebrates? How diverse is the assemblage compared to what we would expect in a backwater lake habitat?
        i. Ecosystem enhancement & restoration is the primary objective of this project.
        ii. Not just a dredge material placement effort. The costs of the project must be justified by habitat benefits, this will be quantified in report.
        iii. The Section 204 project will be incorporated to regional park plans as appropriate.
5. Met Council/MPCA – Pigs Eye Dump Study Update
    a. Minnesota's largest unpermitted dump.
    b. Met Council currently sampling 24-28 locations. Data available in 6-8 weeks.
    c. Purpose of MPCA study: to identify where contaminants are located, how much, and what needs to be done.
        i. Interested in partnership and coordination to benefit the area.
        ii. Once MPCA has a proposed action, the Corps can determine if/where within the Section 204 collaboration might be possible.
    d. Could the Section 204 benefit the superfund site?
        i. Depends on final design. Northern islands might slow spread of pollutants?
        ii. Corps/Met Council/MPCA will need to continue close coordination
    e. Joel Stiras: Any fish sampling data concerning bioaccumulation of contaminates? Common carp and buffalo in the lake are currently exported for food.
6. Sponsor input Ramsey County Parks & Recreation
    a. Potential phasing of construction and interest in looking at "test islands" to determine settlement. This is just in discussion at this point.
    b. Possibility for additional testing in footprint of final design.
    c. Floodplain boundary and contaminated areas narrow the scope of what we can consider in Pigs Eye.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

7. Path Forward
    a. Schedule
    b. USACE will document meeting notes
    c. Draft notes will be distributed for team review and input
    d. Feasibility Study efforts continue. Draft report available for review fall 2016.
8. Next meetings
    a. Periodic agency planning meetings
    b. Public meeting
9. Adjourn

5 Tribal Coordination – Sample Letter

The following is a letter sent to the Shakopee Mdewakanton Sioux tribe. A similar letter was sent to all tribes with ties to the project area.

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL, MN 55101-1678

MAR 2 8 2016

Regional Planning and Environment Division North

Honorable Charles Vig, Chairman
Shakopee Mdewakanton Sioux Community of Minnesota
2330 Sioux Trail NW
Prior Lake, Minnesota 55372

Dear Chairman Vig:

The U.S. Army Corps of Engineers, St. Paul District (Corps) is proposing an ecosystem improvement project on Pig's Eye Lake (project). Pig's Eye Lake is located in the Upper Mississippi River Navigation Pool 2 (River Miles 834-836) southeast of Downtown St. Paul in Ramsey County, Minnesota (Figure 1). Habitat and water quality in the lake are poor due to sedimentation, high turbidity, nutrient loading, wind fetch, and rough fish populations.

The potential plan for the project would be to use dredge material from Pool 2 to create a series of islands of various sizes and locations. The islands would reduce wind and wave action while providing a variety of habitat for fish and wildlife. Dredge material would be obtained from active dredge cuts within the main channel or transported from temporary placement sites. The methods of constructing the islands are still being explored and may include a combination of mechanical and hydraulic placement. Staging areas and access routes have not been identified.

The Corps is aware of a variety of cultural resources situated in the area around Pig's Eye Lake, including the village of Kaposia. Several cultural resource investigations have occurred within the area, principally along the natural levee running between the river's main channel and the lake's western shore. The Corps does not anticipate the project will affect historic properties.

If your band has information regarding properties of cultural significance to the band that may be affected by the project, the Corps would appreciate your assistance in identifying those properties. Should you have such information, please notify us within

30 days of your receipt of this letter. Our point of contact on this matter is Dr. Bradley Perkl. Please address correspondence to his attention at 180 5th Street East, St. Paul, MN 55101-1678, or he may be reached by telephone at (651) 290-5370.

Sincerely,

Daniel C. Koprowski
Colonel, Corps of Engineers
District Commander

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

-3-

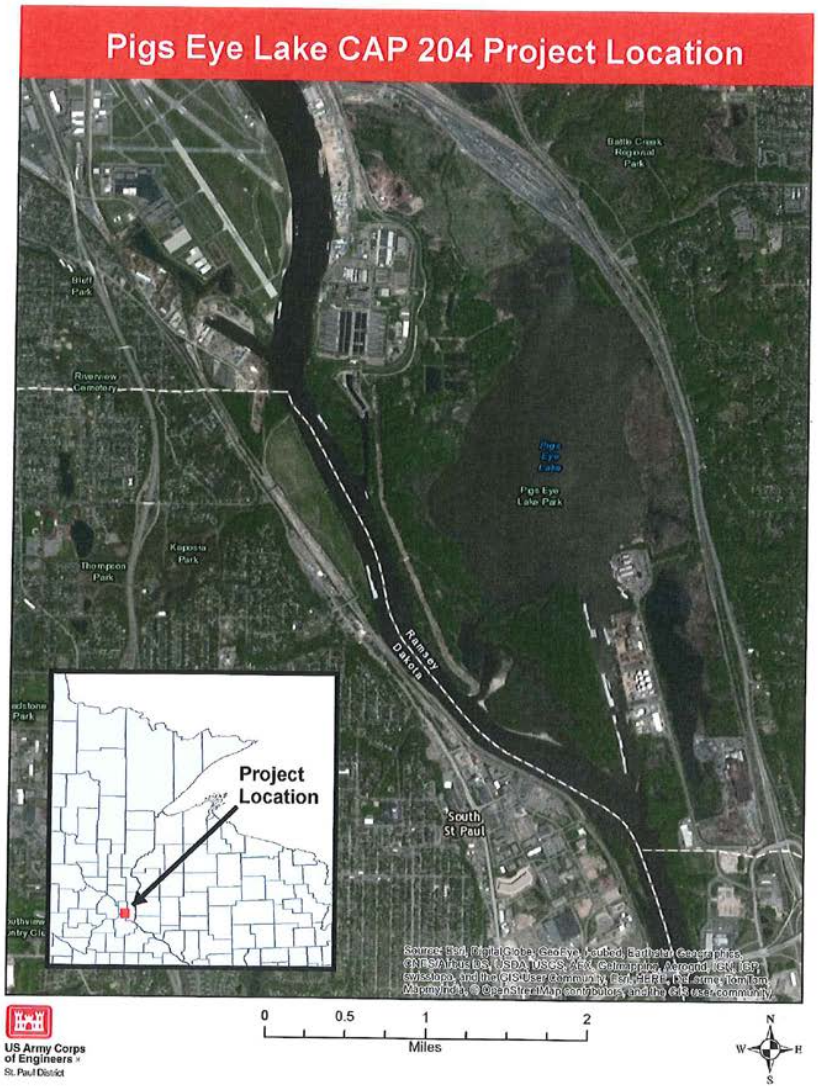

Figure 1. Project Location, Pool 2 Upper Mississippi River.

6 Airport Correspondence Letter Chain

The following is the correspondence between the Corps and applicable Airport Agencies.

USDA

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

St. Paul Downtown Airport
644 Bayfield Street, Suite 215
Saint Paul, MN 55107
Ph: 651-224-6027
Fax: 651-224-4271

October 11, 2016

Nathan Campbell
St. Paul District USACE
Civil Works Project Manager
PAS and IIS Program Manager
Office: 651-290-5544
Cell: 651-219-2963

Subject: Proposed Pigs Eye Lake Habitat Enhancement Project

Mr. Campbell-
Based on a brief review of the single page project proposal you provided, USDA-Wildlife Services offers the following response.

The Federal Aviation Administration addresses the general separation criteria for hazardous wildlife attractants on or near airports in Section 1 of Advisory Circular (AC) 150/5200-33B. This AC recommends a separation distance of 5,000 feet between the Air Operations Area (AOA) and hazardous wildlife attractants for airports serving piston-powered aircraft, and 10,000 feet for airports serving turbine-powered aircraft. The nearby St. Paul Downtown Airport, Holman Field (STP) serves both of these classes of aircraft. The FAA also strongly discourages the creation of any new hazardous wildlife attractants within these separation distances. The center of Pigs Eye Lake (location of the proposed Pigs Eye Lake Habitat Enhancement Project area) is situated approximately 7,300 feet from runways 14/32 and 13/31 of the Downtown St. Paul Airport. As a result, the increased presence of avian species that could result from the Pigs Eye project could pose a significant potential threat to aircraft during the approach and departure phases of flights to and from STP which averages approximately 180 aircraft operations per day.

A review of the FAA Strike Database indicates that there have been 70 reported wildlife strikes by aircraft at STP since 1990 which includes 9 bald eagles, 10+ waterfowl, 5 gulls and a variety of other primarily avian species. Large flocking birds, like American white pelicans, Canada geese, swans, gulls, cormorants, and other waterfowl, generally pose a higher risk to aviation due to their size and flocking tendencies. The Pigs Eye project is likely to increase the presence of a number of avian species which would most likely increase the hazardous wildlife strike threat to air operations at STP.

From a wildlife habitat enhancement and protection perspective this project appears to be a good idea. From an airport hazardous wildlife strike perspective, this project does not appear to be in the best interest of air operations at the nearby downtown St. Paul airport due to the potential of increasing the presence of hazardous wildlife species that are likely to be present in the approach and departure paths of daily aircraft operations at STP.

Based on our review of the limited information provided and the reasons stated above, the USDA WS MN program does not support the proposed Pigs Eye Lake project. We also recommend that the project's approving authorities include the FAA and Metropolitan Airports Commission in any ongoing discussions related to this project. If you have questions, please call me at 651-224-6027.

Sincerely,

Alan K. Schumacher
Wildlife Biologist

cc:
G. Nohrenberg, USDA-WS, St. Paul, MN
J. Fitzpatrick, FAA- Dakota-Minnesota/ADO
A. Fenedick, FAA- Great Lakes Regional Office
J. Harris, MAC- STP Airport
J. Ostrom, MAC-MSP Airport
N. Ralston, MAC-MSP Airport
P. Mosites, MAC-MSP Airport

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Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

St. Paul Downtown Airport
644 Bayfield Street, Suite 215
Saint Paul, MN 55107
Ph: 651-224-6027
Fax: 651-224-4271

November 10, 2016

Nathan Campbell
St. Paul District USACE
Civil Works Project Manager
PAS and IIS Program Manager
Office: 651-290-5544
Cell: 651-219-2963

Subject: Proposed Pigs Eye Lake Habitat Enhancement Project- Design/Vegetation Recommendations

Mr. Campbell-

Following our recent meeting regarding the proposed improvements to Pigs Eye Lake, USDA Wildlife Services (WS) was asked to provide a design/vegetation preference to help discourage nesting and loafing of large waterfowl on the proposed islands.

WS recommends the proposed islands be covered with thick, woody scrub brush species. The goal would be to minimize open areas, especially near the water's edge, where large waterfowl nesting generally occurs. Some suggested species would include, but are not limited to, willow, dogwood, and alder.

WS also recommends minimizing the amount of shallow water emergent vegetation (i.e. cattails) associated with the project to help prevent muskrats from building huts, simultaneously creating nesting platforms for Canada geese.

WS does not recommend the use of sand benches above or below the water's surface. Due to fluctuating water levels of the lake and river system, the proposed benches may become exposed, creating loafing habitat for large water birds such as Canada geese and American white pelicans.

WS recommends the overall number of proposed islands be reduced to decrease the amount shoreline available to nesting waterfowl. The overall size of islands may be increased to obtain the goals of the project, while limiting shoreline. If possible, islands should be linear and have steep banks.

Implementing the aforementioned recommendations may help reduce the amount of nesting and loafing of large waterfowl that could be hazardous to safe flying operations at nearby STP Downtown Airport.

Sincerely,

Alan K. Schumacher
Wildlife Biologist

cc:
G. Nohrenberg, USDA-WS, St. Paul, MN
J. Fitzpatrick, FAA- Dakota-Minnesota/ADO
N. Nistler, FAA- Dakota-Minnesota/ADO
J. Harris, MAC- STP Airport
J. Ostrom, MAC-MSP Airport
N. Ralston, MAC-MSP Airport
P. Mosites, MAC-MSP Airport

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Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

U.S. Department
of Transportation
Federal Aviation Administration

Dakota-Minnesota Airports District Office
Bismarck Office
2301 University Drive, Building 23B
Bismarck, ND 58504

Dakota-Minnesota Airports District Office
Minneapolis Office
6020 28th Avenue South, Suite 102
Minneapolis, MN 55450

December 12, 2016

Nathan Campbell
Civil Works Project Manager
PAS and IIS Program Manager
St. Paul District
U.S. Army Corps of Engineers
180 5th Street East
St. Paul, Minnesota 55101

Re: Proposed U.S. Army Corps of Engineers (USACE) Pigs Eye Lake Habitat Enhancement Project

Dear Mr. Campbell:

The Federal Aviation Administration (FAA) has reviewed the USACE "Project Summary" for the proposed Pigs Eye Lake Habitat Enhancement project located near the St. Paul Downtown Airport (Airport). The goal of the proposal is to increase bird and nesting habitat, increase recreational opportunities, and improve aquatic habitat.

Wildlife hazards to aviation, particularly bird strikes, have been a long-term high priority for the FAA. The FAA is committed to addressing hazardous wildlife issues and is focused on preventing the creation of new hazards while promoting ways to reduce and/or mitigate the potential for wildlife strikes. Each airport setting is unique, as is the potential for wildlife hazards. In addition, there are areas more susceptible to wildlife strikes including the arrival/departure surfaces and the aircraft operating area (AOA). For these reasons the FAA must review each airport individually to identify hazardous wildlife conditions and develop ways to reduce and prevent wildlife strikes.

The FAA's Advisory Circular (AC) 150/5200-33B, Hazardous Wildlife Attractants On or Near Airports (Wildlife AC), provides separation criteria for the placement of potentially hazardous wildlife attractants near airports (Section 1) and includes a description of land uses with the potential to attract hazardous wildlife (Section 2). Airports that receive Federal grant-in-aid assistance are required to follow the recommendations in the AC. For other government agencies, private property owners and businesses, the AC provides guidance to ensure adequate safety for airports.

Based on our review and utilizing the criteria in AC 150/5200-33B, the FAA is concerned with the initial proposed project given the location, and potential to create a wildlife hazard attractant near the Airport. The proposed project is within approximately 5,000 feet of the Airport approach and departure pathways. This location, in conjunction with the type of habitat enhancement being proposed, has a very high probability to become a hazardous

wildlife attractant. Our agency recognizes and understands the value of the ecological benefits that may occur with these types of habitat enhancement opportunities. Nonetheless, we cannot ignore the potential adverse effect this could have on airport safety.

The FAA often defers judgment for hazardous wildlife issues to the U.S. Department of Agriculture Wildlife Services (USDA WS) since their agency is considered a subject matter expert. The FAA supports the design recommendations provided to your office by the USDA WS in a letter dated November 10, 2016. These design recommendations include:

- Planting thick, woody scrub brush species on the proposed islands.
- Minimizing the amount of emergent vegetation in shallow water.
- Eliminating the use of sand benches for the project.
- Reducing the overall number of proposed islands.

Our agency recommends these design considerations be included in the full design of the project and for your agency to continue coordinating with the Airport, USDA WS and the FAA as project planning and design further progresses. We will continue to thoughtfully and carefully review any additional information submitted to us for review by the USACE.

Thank you for the opportunity to review and provide comments and concerns with the initial proposed project. We trust that you will fully utilize our input while making a final decision regarding the proposed project. If you have any questions or comments, please feel free to contact me at (612) 253-4639 or by E-mail at joshua.fitzpatrick@faa.gov.

Sincerely,

Josh Fitzpatrick
Environmental Protection Specialist
FAA Dakota-Minnesota Airport District Office

Cc: Alan Schumacher, USDA Wildlife Services
John Ostrom, Metropolitan Airports Commission
Nancy Nistler, FAA

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL, MN 55101-1678

REPLY TO
ATTENTION OF

Project Management January 18, 2017

SUBJECT: Pigs Eye Lake CAP 204 Wildlife Hazard Recommendations

SENT VIA E-MAIL TO:

Alan Schumacher
USDA Wildlife Services
St. Paul Downtown Airport
644 Bayfield Street, Suite 215
Saint Paul, MN 55107

Josh Fitzpatrick
FAA Dakota-Minnesota Airport District Office
Minneapolis Office
6020 28th Avenue South, Suite 102
Minneapolis, MN 55450

Dear Mr. Schumacher and Mr. Fitzpatrick:

Thank you for providing your recommendations in your recent letters to the Corps to help reduce the amount of nesting and loafing of large waterfowl on Pigs Eye Lake as a result of Ramsey County Parks Department and the Army Corps of Engineers potential aquatic restoration project. We understand your concerns regarding wildlife hazards near the airport and appreciate the recommendations to improve our potential project to satisfy your concerns.

Below we have provided responses to your recommendations that include plan changes that can be included to meet your recommendations as well as additional detail on the current plan that we believe would satisfy your recommendation.

1. WS/FAA Recommendation: Recommended that the islands be vegetated in thick, woody scrub brush species to minimize open areas, especially near the water's edge, where large waterfowl nesting generally occurs.

   Corps Response: Plans currently involve willow plantings along the water's edge to stabilize the islands and prevent erosion. Normally, willows would be planted in two rows, with a spacing of between 3-5 feet, and would be planted along the outer edges of the islands that would be exposed to wind and waves. Based on this comment, the Corps will plan to incorporate willows around the perimeters of all islands near the water's edge. Photos are attached of the willows at some islands the Corps has constructed for habitat restoration purposes.

2. WS/FAA Recommendation: Recommended that the Corps minimize the amount of shallow water emergent vegetation (i.e. cattails) associated with the project to help prevent muskrats from building huts, which create nesting platforms for geese.

Corps Response: The focus of the proposed aquatic vegetation plantings within the island centers would be rooted floating-leaf species rather than emergent species. Based on this recommendation, the Corps will avoid incorporating emergents into the project that would lend themselves to muskrat huts. (Although it should be noted that muskrats, beavers, and mink are currently prevalent in Pig's Eye Lake and a number of their huts are observable on the existing shores of Pig's Eye Lake).

3. WS/FAA Recommendation: Recommended against using sand benches above or below the water's surface, due to concerns that fluctuating water levels could lead to exposing the sand and creating nesting areas.

   Corps Response: As it is currently designed, the proposed project does not include any sand benches that would be subject to becoming exposed by changes in water levels. Water levels in Pig's Eye Lake are highly connected with the main stem of the Mississippi River. The Corps of Engineers manages the water surface elevation in the river in this area to stay at or above 686.8 feet above mean sea level (NAVD 88). The project on a whole was designed with consideration to these 'minimum' water levels. The proposed project does include some "sand blankets" for substrate stabilization, but these areas would remain at greater than 18 inches deep, even at the lowest regulated water levels. The only areas expected to be shallower are the transitional areas between the water and the shoreline.

4. WS/FAA Recommendation: Recommended that the overall number of islands be reduced to decrease the amount of shoreline available to nesting waterfowl. Suggest linear islands with steep banks.

   Corps Response: Unfortunately, due to the unconsolidated nature of the substrate in Pig's Eye Lake, the slope of the shoreline from the islands into the water cannot be made significantly steeper without compromising the stability of the islands. Hopefully the willows described in Comment 1 will alleviate this issue.

   We analyzed the shoreline length for each of the island alternatives that we considered (below).

   Analysis of shoreline length
   Alt 4: 15,895 ft
   Alt 2: 19,409 ft
   Alt 5: 24,982 ft ← Tentatively Selected Plan
   Alt 1: 29,768 ft
   Alt 3: 30,912 ft

   The results show that we selected an intermediate alternative. We will consider attempting to reduce this further, but any major changes would be likely to greatly reduce the habitat benefits of the overall project. The alternatives that have less shoreline area are those without the "split" island alternatives, which would not allow for marsh

creation, would not provide heavily sheltered areas from wind and waves, and would greatly reduce the amount of littoral zone habitat created. We would instead propose to incorporate as much dense, brushy vegetation on the islands as possible to deter large waterfowl from nesting there.

We will continue to coordinate with you as project planning progresses. Should you have any immediate questions regarding this letter, or if you would like to discuss the project features further, please contact Nathan Campbell at 651-290-5544 or by email at Nathan.j.campbell@usace.army.mil.

Sincerely,

Nathan Campbell
Project Manager

Enclosures:
1. USDA-WS Letter to the Corps, dated 10 November 2016
2. FAA Letter to the Corps, dated 12 December 2016

Metropolitan Airports Commission
6040 - 28th Avenue South, Minneapolis, MN 55450 • 612-726-8100 • metroairports.org

March 20, 2017

Mr. Nathan Campbell, Project Manager
Department of the Army
St. Paul District, Corps of Engineers
180 Fifth Street East, Suite 700
St. Paul, MN 55101-1678

Mr. Nathan Campbell-

Following the letter dated January 18, 2017 and addressed to the FAA and USDA-Wildlife Services, The Metropolitan Airports Commission (MAC) would like to formally acknowledge our stance as "Not Opposed" to the Pigs Eye Lake Habitat Enhancement Project. The Corps response's to FAA and USDA project construction/design recommendations reasonably address, while still maintaining project goals, the potential wildlife hazards to aviation near the St. Paul Downtown Airport created during and following the project.

Furthermore the MAC requests that stakeholders of the project, work to establish protocols and identify the responsible parties to develop and carryout the following;

1. Post monitoring of the project area for nesting and loafing of large waterfowl
2. A Management Plan to mitigate identified wildlife hazards. Part of the management plan may include but are not limited to;
    a. Habitat modification
    b. Exclusion
    c. Harassment
    d. Nest and egg destruction/addling
    e. Lethal control
3. Identify Action Levels when those wildlife management activities are deployed.

If you have any further questions we would be happy to assist, 651-224-4306.

Thank you,

Joe Harris
Manager St. Paul Downtown Airport

Minneapolis-St. Paul International • Airlake • Anoka County-Blaine • Crystal • Flying Cloud • Lake Elmo • St. Paul Downtown

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL, MN 55101-1678

JULY 27, 2017

Project Management

SUBJECT: Pigs Eye Lake CAP 204 Wildlife Hazard Recommendations

SENT VIA E-MAIL TO:

Alan Schumacher
USDA Wildlife Services
St. Paul Downtown Airport
644 Bayfield Street, Suite 215
St.t Paul, MN 55107

Joe Harris
Manager St. Paul Downtown Airport
St. Paul Downtown Airport
644 Bayfield Street, Suite 215
St. Paul, MN 55107

Dear Mr. Schumacher and Mr. Harris:

This is in regard to the Pigs Eye Lake aquatic habitat restoration project. We wanted to inform you of several changes we have made to the Pigs Eye Lake project design. These include a reduced-size set of islands and revised general vegetation planting plans. We have concluded that these changes would not increase the wildlife hazard risk of the proposed project, for the reasons described under the "Proposed Project Changes" heading below. Further, we would like to offer a response regarding a request made in the Metropolitan Airports Commission (MAC) letter to the U.S. Army Corps of Engineers dated March 20, 2017 (enclosed). This is discussed in the section below titled, "Monitoring and Management Considerations."

Proposed Project Changes

First, we have reformulated alternatives since our last correspondence. The new tentatively selected plan has been reduced in size, with 32 percent less shoreline than the previous plan (approximately 17,000 feet compared to the previous 25,000 feet). This change will further reduce the risk for the project to contribute to wildlife hazards.

Since our last correspondence, the Corps met with members of the U.S. Fish and Wildlife Service, Minnesota Department of Natural Resources, National Park Service and Ramsey County (project sponsor) to discuss project planting goals. It was recognized that one of the potential benefits of the project is providing turtle nesting locations, which are relatively rare in this portion of the river. It was suggested that a desirable project feature would be incorporation of some open, sandy areas for this purpose. Since the willows also serve as a stabilization feature, this would only be

possible in select areas. The vast majority of the shoreline would still be planted with willows as previously described, and we don't anticipate this to significantly increase the potential for waterfowl nesting.

The group also discussed the U.S. Department of Agriculture–Wildlife Services recommendation to discourage the growth of emergent vegetation. It was acknowledged that shallow-water emergent vegetation may indeed lead to muskrat huts and thereby nesting platforms for Canada geese. However, softstem and hardstem bulrush are already prevalent along much of the Pigs Eye Lake shoreline. These species provide important fish habitat for cover and spawning. Those at the meeting discussed how dense emergent vegetation like bulrush would likely discourage birds, like geese, from accessing the land, thereby decreasing the risk of nesting geese. Muskrats, beavers and mink already make use of Pigs Eye Lake and the bulrush, with a number of huts observable along the shoreline, and resource managers that frequent the lake have not observed use of these huts by nesting geese. Therefore, we have incorporated bulrush plantings into areas of the planting plan, but we feel that this change will likely decrease the risk of wildlife hazards.

Monitoring and Management Considerations

In the enclosed letter, the MAC also requested incorporating monitoring and management strategies into the project planning. The Corps concurs that monitoring bird use is important, and the proposed project would incorporate 10 years of post-project bird monitoring, which may be useful in determining if there are significant increases in bird populations utilizing Pigs Eye Lake. Monitoring data would be shared with MAC and other agencies as desired. If a potential issue is identified within the interagency team, the Corps will consider modifications or management actions that might be appropriate.

We will continue to coordinate with you as project planning progresses. Should you have any immediate questions regarding this letter, or if you would like to discuss the project features further, please contact Nathan Campbell at 651-290-5544 or by email at nathan.j.campbell@usace.army.mil.

Sincerely,
CAMPBELL.NATHAN.J.13856139
18
2017.07.28 08:11:19 -05'00'
Nathan Campbell
Project Manager

Enclosures

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Harris, Joe
To: Campbell, Nathan J CIV (US)
Cc: Schumacher, Alan
Subject: [EXTERNAL] Project
Date: Tuesday, September 12, 2017 4:20:41 PM

Hi Nathan,
Sorry for the delayed response. I am okay with the proposed project. I appreciate your willingness to meet with us to listen to our concerns related to aircraft operations.

Regards,
Joe Harris

7 Joint Pool 2 Meeting

As a result of numerous USACE projects occurring in Pool 2. The Corps called a meeting that included all applicable agencies to discuss the projects and address questions and concerns. The following document is the meeting notes from that meeting.

Joint Pool 2 Meeting
October 5, 2016
9:00 – 11:00

NOTES

Background: The Corps is currently leading 4 concurrent projects in Pool 2 of the Upper Mississippi River: the Pool 2 Dredge Material Management Plan, the Lower Pool 2 Channel Management Study, the L/D 2 Embankment study, and the Pigs Eye Lake CAP 204 study. There is an opportunity for the Corps, agencies, and stakeholders to coordinate the upcoming document reviews and team leads to most efficiently complete project report documents.

Purpose: The Joint Pool 2 meeting will review each effort, discuss relationships across studies, and enhance coordination efforts going forward with Pool 2 projects.

Attendees:
USACE – Tom Novak & Nate Campbell (PM), Sierra Keenan & Angela Deen (Planning), Aaron McFarlane & Steve Clark (Environmental), Scott Goodfellow (H&H), Zach Kimmel & Paul Machajewski (Operations),
Ramsey County Parks – Scott Yonke
MPCA – Kurt Schroeder, Emily Schnick
MN DNR – Joel Stiras, Jen Sorensen
Met Council – Mary Gail Scott
Ramsey-Washington Metro Watershed District – Bill Bartodziej
Friends of Pool 2 – John Senglaub
Watershed – Barbara Haake
Dakota County – Kurt Chatfield
Upper Mississippi Watershed Association (UMWA) – Greg Genz

Due 31 October:
- Confirm points of contacts for each effort (see below)
- Submit any additional placement site ideas for the DMMP
- Submit any other comments on Pigs Eye tentatively selected plan

Discussion Notes

1. DMMP – Updating 1995 plan
    a. Identify placement sites for approximately 6.76 million cy of sand over a 40 year period. The Pigs Eye Lake project identifies one location that could take some of the dredged material. Currently working to identify sites in the Upper and Lower parts of the pool that would be the least cost, environmentally acceptable alternative for permanent dredged material placement.
    b. Compared to other pools, Pool 2 limited by flood stage impacts (Limited opportunities to build islands)
    c. Discussion:
        i. Can FEMA re-evaluate flood impacts? (So that islands can be built in Pool 2) Pool 2 has not had island construction or water level drawdowns due to flood

stage impacts. Conditions are not likely to improve – sedimentation has significantly increased, along with higher flows, increased development (bridges/piers being added), etc. Additionally, options to mitigate (e.g., raising a house) are cost prohibitive.

ii. The ash ponds were excavated and used as cover on the dump in the 1970s.

iii. PFCs: Prior to construction of this project, Corps will be testing sand for PFCs for placement in Pigs Eye Lake. 3M and MPCA have tested for PFCs in the sediment, and are found in fish pool-wide. The MPCA has tested Pigs Eye Lake sediments in 2007 and the Corps has tested Pigs Eye Lake sediments in 2016; details are included in the Pigs Eye PFC appendix. Lower Pool 2 high concentrations of PFCs due to plant (also high densities of zebra mussels and sheephead). The Pigs Eye Feasibility Report will include an attachment to the sediment appendix on PFCs.

iv. MPCA's status update on PFC standards:

- Updated levels just published on MPCA's website.
- PFC levels last published in June 2016. Final in Feb/March 2017.
- New numbers have gone down slightly.

2. Lower Pool 2 Channel Management Study
   a. Channel widening with Control Structures – improved dredging and safe navigation
      i. $8M plan Channel Widening & River Training Structures (versus $15M realign channel with Boulanger cut)
      ii. Control structures: 6" above pool with 10' top width. Wider, island-like structures were looked at, however caused flood stage impacts. It is not expected that sediment accretion (islands) will form behind structures. Structures not marked, but may have higher boulders that would be visible when rock line is submerged.
      iii. Navigation aids: The navigation channel will continue to be buoyed. Wing dams and other rock structures are numerous, and if one structure is marked then all structures must be marked for liability purposes. It is cost prohibitive to mark all rock structures on the Upper Mississippi River. The U.S. Coast Guard marks the navigation channel, and incidentally some of the buoys are set at the point of wing dams adjacent the main channel.

3. L/D 2 Embankments – Recon study.
   a. Embankment protection berm.
   b. Approximately 100,000 cy of sand.
   c. L/D 4 example.

4. Pigs Eye Lake – CAP 204 Study

a. Fishery: Good fishing spots on south end of Pigs Eye Lake. Native Americans used wood traps along southwestern shoreline to catch Buffalo. Current commercial fishery exports approximately 10,000 lbs of Buffalo and Carp annually from Pigs Eye Lake.
b. Shoreline Erosion: The stage of the river was considered under the 3 scenarios. Although water surface elevations were not available, other imagery years were examined to ensure the comparison was appropriate. One important indicator is the consistent recession of vegetation, which is unable to re-establish as the consolidated shoreline sediments are eroded and deepened. Comments: Eastern bank is river bulrush, steep, a lot of wave action scouring the bank.
c. Source of material for islands: Some could come from dredge operations in Upper Pool 2, however since close to 1/2M cy would be required in a short period of time for construction, the majority would come from Lower Pool 2 temporary placement sites where there is more sand available. Currently, there is over 600,000 cy on the temporary placement sites of Pine Bend, Upper Boulanger, and Lower Boulanger.
d. Floodway area discussion (below the red line): Currently operating in a constrained environment, as previous projects, development, "used up" flood area.
e. Shallow Depths: Comment: barges once floated up to north side of lake during high water, and then got stuck up there when water went down.
f. RGU (Responsible Governmental Unit) –Project impacts can trigger a state EAW (Environmental Assessment Worksheet). More than 1 acre of fill in river = EAW process. Scott Y, Nate C., and Aaron M. will meet to discuss details. For Pigs Eye, it makes sense for Ramsey County to serve as RGU. Corps' Feasibility report and combined Environmental Assessment will be formatted to include all necessary documentation for the EAW. As the RGU, Ramsey County would determine (based on EAW) if/that an Environmental Impact Statement is not required.
g. O&M of islands: The project sponsor is responsible for operation and maintenance of islands post-construction. Typically, islands do not require maintenance. The Pigs Eye Lake islands would be within Battle Creek Regional Park, and O&M, if any, would primarily entail vegetation monitoring/maintenance.

5. Verify stakeholder team members:

DMMP
MN DNR: Jen Sorenson
MPCA: Kurt Schroeder, Hans Neve, Emily Schnick
Met Council: Mary Gail Scott

Pool 2 CMS
RGU: MNDNR – Ronald Wieland
MN DNR: Ronald Wieland, Richard Baker, Randall Doneen
NPS: Nancy Duncan
Dakota County: Kurt Chatfield, Laura Jester, Jane Vanderpoel
Washington County: Wayne Sandberg

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

MPCA: Jim Brist, Emily Schnick
USFWS: Phil Delphey
Upper Mississippi Waterway Association

L/D 2 Embankments

Pigs Eye Lake
RGU: Ramsey County – Scott Yonke
MN DNR: Jen Sorenson, Joel Stiras
MPCA: Kurt Schroeder, Hans Neve, Emily Schnick
Met Council: Mary Gail Scott
USFWS: Nick Utrup
NPS: Allie Holdhusen

8 Contaminants Sub-Group

The St. Paul District Pigs Eye Islands CAP 204 PDT (Corps), Minnesota Pollution Control Agency (MPCA) and the Metropolitan Council (Met Council) formed a sub-group to discuss contamination from the Pigs Eye Land Fill, the plan for remediation of that site by the Met Council and MPCA, and the effect the remediation efforts may or may not have on the Pigs Eye Lake CAP 204 project and vice-versa. The following documents the correspondences and shared information meeting notes from that sub-group.

From: Campbell, Nathan J MVP
To: McFarlane, Aaron M MVP; Noren, James B MVP; Wachman, Gregory S MVP
Subject: FW: Pig"s Eye Lake Sediment Contamination Subgroup
Date: Wednesday, February 24, 2016 3:49:07 PM

-----Original Message-----
From: Schroeder, Kurt (MPCA) [mailto:kurt.schroeder@state.mn.us]
Sent: Wednesday, February 24, 2016 3:02 PM
To: Campbell, Nathan J MVP <Nathan.J.Campbell@usace.army.mil>
Cc: Foster, Pamela (MPCA) <Pamela.Foster@state.mn.us>
Subject: [EXTERNAL] FW: Pig's Eye Lake Sediment Contamination Subgroup

HI Nathan,

The MPCA sediment guidance for Managing In-Water Placement of Dredge Material for Habitat Restoration Sites in the St Louis R AOC and Bio-Chemical Physical Approach to habitat restoration is in the appendices in the link below.

Thanks

Kurt Schroeder

MPCA

From: Bares, Mike (MPCA)
Sent: Wednesday, February 17, 2016 8:57 AM
To: Schroeder, Kurt (MPCA)
Subject: RE: Pig's Eye Lake Sediment Contamination Subgroup

The MPCA guidance in Appendix 1 & 2 of this QAAP is what I provided you. I will leave it up to you to determine if you want to pass them along to the USACE or others. I only have an MPCA web link for the entire QAPP that includes the two appendices.

Blockedhttps://www.pca.state.mn.us/sites/default/files/p-eao2-20.pdf

Mike Bares P.G.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Campbell, Nathan J MVP
To: Deen, Angela MVP; Keenan, Sierra MVP; Goodfellow, Scott M MVP; Baker, Scott L MVP; Kimmel, Zachary MVP; Moss, Christine MVP; Perkl, Bradley E MVP; Westman, Jack MVP; Peterson, Rodney MVR @ MVP
Cc: McFarlane, Aaron M MVP; Noren, James B MVP; Wachman, Gregory S MVP; Wallerstedt, Nathan MVP
Subject: RE: Contaminants Sub Group Update
Date: Thursday, February 25, 2016 9:43:31 AM

Sorry I should clarify # 6. It was the initial gut reaction from the group that that contaminant levels won't be an issue for construction but further result analysis will be needed on MPCA's end to confirm that. Additionally, once we have a plan in place it's possible that intensive testing on the construction footprint may be required.

Thanks

Nate

-----Original Message-----
From: Campbell, Nathan J MVP
Sent: Thursday, February 25, 2016 9:20 AM
To: Deen, Angela MVP <Angela.M.Deen@usace.army.mil>; Keenan, Sierra MVP <Sierra.L.Keenan@usace.army.mil>; Goodfellow, Scott M MVP <Scott.M.Goodfellow@usace.army.mil>; Baker, Scott L MVP <Scott.L.Baker@usace.army.mil>; Kimmel, Zachary MVP <Zachary.R.Kimmel@usace.army.mil>; Moss, Christine MVP <Christine.R.Moss@usace.army.mil>; Perkl, Bradley E MVP <Bradley.E.Perkl@usace.army.mil>; Westman, Jack MVP <Jack.F.Westman@usace.army.mil>; Peterson, Rodney MVR @ MVP <Rodney.R.Peterson@usace.army.mil>
Cc: McFarlane, Aaron M MVP <Aaron.M.McFarlane@usace.army.mil>; Noren, James B MVP <James.B.Noren@usace.army.mil>; Wachman, Gregory S MVP <Gregory.S.Wachman@usace.army.mil>; Wallerstedt, Nathan MVP <Nathan.H.Wallerstedt@usace.army.mil>
Subject: Contaminants Sub Group Update

Pigs Eye PDT,

As you know Aaron, Jim, Greg and myself went over to the PCA yesterday and met with a few members of the PCA and Met Council to discuss contaminant issues and testing of contaminants on Pigs Eye Lake. The meeting was very beneficial. I wanted to provide you all with a few key outcomes from the meeting:

1. We decided that PCA would be the clearing house for all available and future data. The PCA will collect and distribute a spreadsheet containing all testing results on that have been done on the lake and the dump perimeter.

2. Mike Bares, a hydrogeologist in the remediation division with the PCA, shared information on projects in the St. Louis River Watershed (Detroit District) that will likely be very beneficial to the Pigs Eye project. For that region they have developed a Quality Assurance Program Plan with the MnDNR and Detroit District that sets testing and data management for numerous actions occurring in the St. Louis River watershed. That document has been shared with us and I have saved it to the pigs eye network folder (X:\PROJECTS\CAP\CAP_204_Pigs_Eye_MN-402178\01FeasibilityFEA\02FeasilityReport_EA\Reports and Documents). Of interest to us is Appendix 1, Managing In-Water Placement of Dredge Material for Habitat Restoration Sites in the St. Louis River Area of Concern and Appendix 2, A Biological, Chemical and Physical Approach to Aquatic Habitat Restoration Decisions in the St. Louis River Area of Concern. I have attached the decision trees from Appendix 1 and 2. I believe that these can be applied pretty readily to the Pigs Eye project. At the very least to provide assurance that our chosen alternative and construction methods are acceptable.

3. Mike Bares also shared construction method info on specific projects where habitat building occurred very soft substrate. We weren't able to get into great detail on this topic but it sounds like they have tackled the mud wave reduction and stabilization to reduce settling issues. We will need to follow up with him. He mentioned the Styrker Bay project as a specific example.

4. Met Council made it clear that PFCs were a concern to them, particularly the level of PFCs in our dredged

material that would be placed in the lake. Currently MPCA does not require us to test our material for PFCs however we may want to consider it to satisfy the agencies.

5. I mentioned our potential measure of emergent wetland creation in the northern portion of the lake (near the battle creek inflow). MPCA was particularly interested in this alternative and asked if we would be willing and able to add a carbon filter soil layer our placed material if we were to go with that measure. The additional cost associated with this would be covered by MPCA and could potentially be added as a betterment (I discussed this with Mr. Wallerstedt and he thought that it could be possible).

6. The overall consensus from the technical folks in the room was that the level of contamination in the areas we have expressed interest in building in was not at a level that would preclude us from constructing.

Let me know if you have questions and if interested please review the QAPP.

Aaron, Jim or Greg do you guys have anything to add?

Thanks

Nate

Nathan Campbell
St. Paul District USACE
Civil Works Project Manager
PAS and IIS Program Manager
Office: 651-290-5544
Cell: 651-219-2963

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Campbell, Nathan J MVP
To: Noren, James B MVP; Deen, Angela MVP; Wachman, Gregory S MVP; McFarlane, Aaron M MVP
Subject: FW: Emailing - PigsEye_PAHs1.pdf
Date: Tuesday, May 31, 2016 9:08:48 AM
Attachments: PigsEye_PAHs1.pdf

-----Original Message-----
From: Schroeder, Kurt (MPCA) [mailto:kurt.schroeder@state.mn.us]
Sent: Friday, May 27, 2016 4:43 PM
To: Campbell, Nathan J MVP <Nathan.J.Campbell@usace.army.mil>
Cc: Foster, Pamela (MPCA) <Pamela.Foster@state.mn.us>; Monson, Phil (MPCA) <phil.monson@state.mn.us>; Schnick, Emily (MPCA) <Emily.Schnick@state.mn.us>; Bares, Mike (MPCA) <mike.bares@state.mn.us>
Subject: [EXTERNAL] Emailing - PigsEye_PAHs1.pdf

Nathan,

Attached is a map of PAH sampling results in Pig's Eye Lake sediment. Besides the elevated cadmium and PCBs (at PEL Mid, PE-8-2, PE10-2) in the mid-lake area, there is one sampling point toward the western shore (15-2M) that had a total PAHs concentration of 25.12 mg/kg. This exceeds the level II sediment quality target of 23 mg/kg. This sampling location and parameter group should be considered when additional sampling is done in the mid-lake area. Based on current data, we would probably include this point in a best management practices (BMP) area.

I should also note that we likely would redraw the upper lake BMP area boundary another 200 feet south of the line drawn on the maps we provided you on May 25, 2016, at our meeting. The redrawing would account for elevated PAHs in PE-3 and 15-1M.

Let me know if you have questions.

Thanks

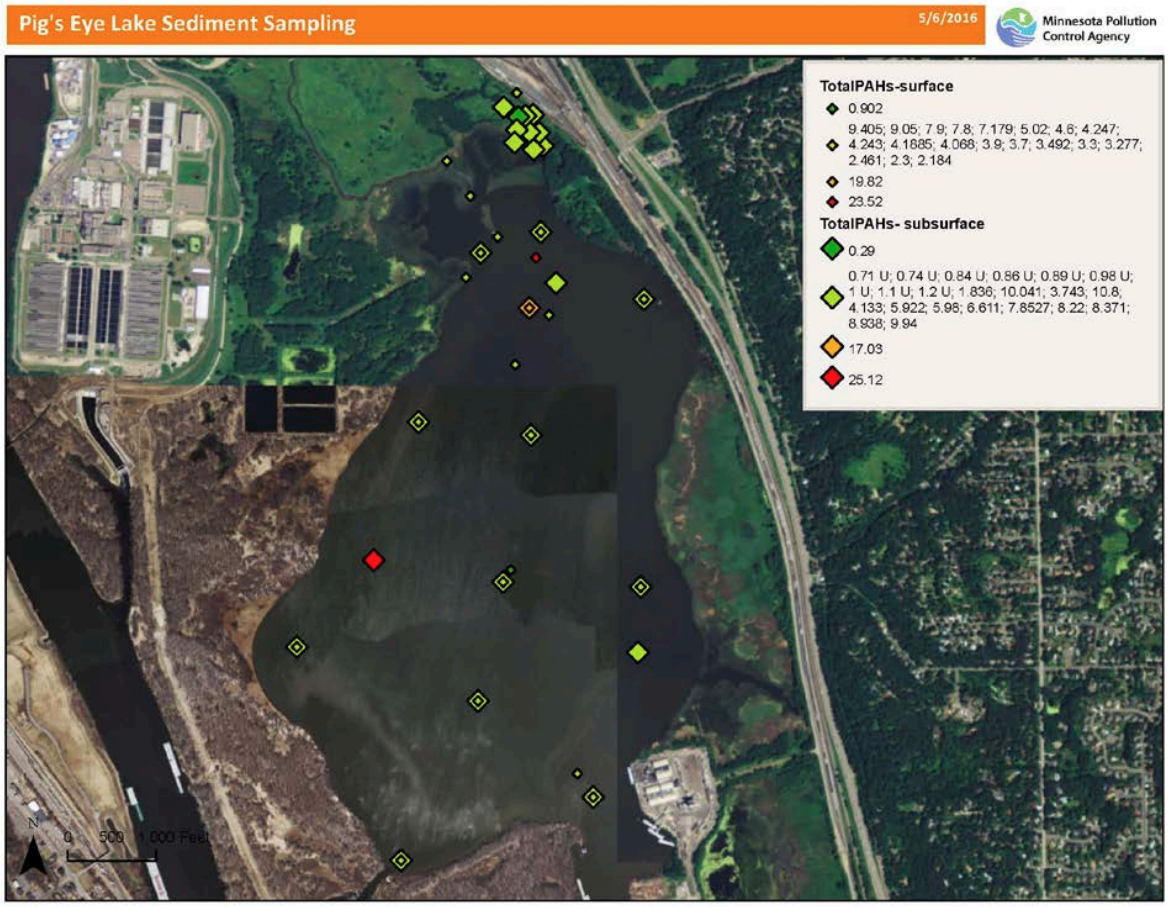
Kurt Schroeder

MPCA

Remediation Div.

651 757 2703

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County



Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

-----Original Message-----
From: Schroeder, Kurt (MPCA) [mailto:kurt.schroeder@state.mn.us]
Sent: Tuesday, June 21, 2016 8:20 AM
To: Campbell, Nathan J MVP <Nathan.J.Campbell@usace.army.mil>
Cc: Neve, Hans (MPCA) <hans.neve@state.mn.us>; Foster, Pamela (MPCA) <Pamela.Foster@state.mn.us>; Scott, Mary Gail (MaryGail.Scott@metc.state.mn.us) <MaryGail.Scott@metc.state.mn.us>
Subject: [EXTERNAL] PigsEye_BMPmaplake.pdf

Nathan,

Here is our revised map of Pig's Eye Lake Sediment Management Areas. We have not delineated the area that needs more sampling but it encompasses the three points where PAHs, PCBs and metals were elevated, i.e. PE7, PE8 and PE10.

We can discuss more at today's meeting if you like.

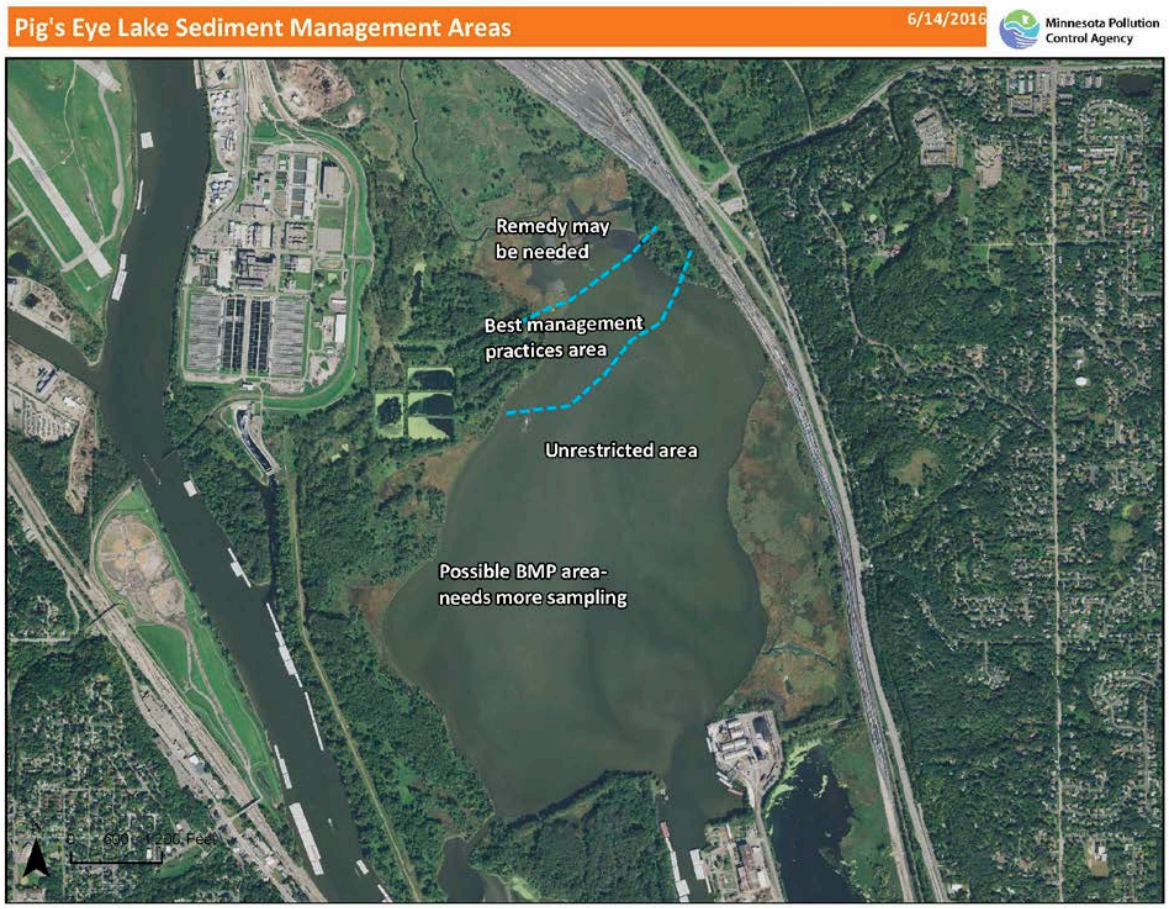
Thanks

Kurt Schroeder

MPCA

Remediation Div.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County



Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Schroeder, Kurt (MPCA)
To: Campbell, Nathan J MVP; Schnick, Emily (MPCA); Neve, Hans (MPCA); Scott, Mary Gail (MaryGail.Scott@metc.state.mn.us)
Cc: Deen, Angela MVP; Noren, James B MVP; McFarlane, Aaron M MVP
Subject: [EXTERNAL] RE: Proposed contaminant sampling points
Date: Monday, July 25, 2016 2:34:31 PM

Nathan,

The proposed distribution of sediment sampling locations for PFC analysis looks satisfactory.

Kurt Schroeder
MPCA
Remediation Div.

-----Original Message-----
From: Campbell, Nathan J MVP [mailto:Nathan.J.Campbell@usace.army.mil]
Sent: Thursday, July 21, 2016 8:33 AM
To: Schnick, Emily (MPCA); Neve, Hans (MPCA); Schroeder, Kurt (MPCA); Scott, Mary Gail (MaryGail.Scott@metc.state.mn.us)
Cc: Deen, Angela MVP; Noren, James B MVP; McFarlane, Aaron M MVP
Subject: RE: Proposed contaminant sampling points

Emily, Hans, Kurt, and Mary Gail,

The lab we go through does not do PFC analysis. We found a lab that can do it however we need to take separate samples. Also we have only budgeted for 6 PFC samples. I've attached the same map I sent before but with the proposed locations for PFC testing. Can you take a quick look and let me know if you recommend moving them at all. Please get back to me by Friday if possible.

Thanks

Nate

Nathan Campbell
St. Paul District USACE
Civil Works Project Manager
PAS and IIS Program Manager
Office: 651-290-5544
Cell: 651-219-2963

-----Original Message-----
From: Campbell, Nathan J MVP
Sent: Wednesday, July 06, 2016 3:19 PM
To: Schnick, Emily (MPCA) <Emily.Schnick@state.mn.us>; Hans Neve <hans.neve@state.mn.us>; 'Schroeder, Kurt (MPCA)' <kurt.schroeder@state.mn.us>; Foster, Pamela (MPCA) <Pamela.Foster@state.mn.us>; 'Bares, Mike (MPCA)' <mike.bares@state.mn.us>; Scott, Mary Gail (MaryGail.Scott@metc.state.mn.us) <MaryGail.Scott@metc.state.mn.us>
Cc: Deen, Angela MVP <Angela.M.Deen@usace.army.mil>; Noren, James B MVP <James.B.Noren@usace.army.mil>; McFarlane, Aaron M MVP <Aaron.M.McFarlane@usace.army.mil>
Subject: Proposed contaminant sampling points

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

MPCA and Mary Gail,

I've attached a map with our proposed sampling locations for Pigs Eye Lake. There are 8 locations that exist in the common locations of the various island footprints that we are considering at this time. The proposal is to take composite samples of 3 foot cores at each location. We will be testing for PCBs, PEST, PAHs, metals, grain size and PFCs.

We will plan on testing the temporary placement piles that we propose to obtain our material from at a later date.

Please provide any comments or concerns with this plan by the end of the week (July 8).

Thanks

Nate

Nathan Campbell
St. Paul District USACE
Civil Works Project Manager
PAS and IIS Program Manager
Office: 651-290-5544
Cell: 651-219-2963

-----Original Message-----
From: McFarlane, Aaron M MVP
Sent: Tuesday, June 21, 2016 11:13 AM
To: Deen, Angela MVP <Angela.M.Deen@usace.army.mil>; Campbell, Nathan J MVP <Nathan.J.Campbell@usace.army.mil>
Subject: Proposed contaminant sampling points

As promised, here's my proposed sampling points. The proposed island outlines are shown in differing colors, and the areas where they all intersect are shown in yellow. Not all islands had good intersects, so I took my best shot at them.

Also shown are the past sampling points, in case that influences decisions.

Aaron

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

From: Foster, Pamela (MPCA)
To: Campbell, Nathan J CIV (US)
Cc: Neve, Hans (MPCA); Campbell, Fred (MPCA)
Subject: [EXTERNAL] BMP map
Date: Tuesday, September 26, 2017 10:30:22 AM

Hi Nate,

Glad to hear the Pig's Eye Islands FS moving into the final phase! The MPCA Pig's Eye team has reviewed the draft feasibility report you provided and the Appendix E Sediment Report. There will not be any changes to the MPCA's BMP area map (figure 14, pg. 30 of pdf). We are looking forward to seeing the final report.

Please let me know if you have any further questions.

Have a great day!

Pam

Pamela **Foster**
Remediation Division
Minnesota Pollution Control Agency
520 Lafayette Road | Saint Paul, MN | 55155
Office: 651-757-2778| Fax: 651-296-9707 | Email: pamela.foster@state.mn.us

Minnesota Pollution Control Agency

9 Habitat Sub-Group

To improve efficiency of correspondence amongst agencies with an expertise in habitat development and habitats of the Pigs Eye Lake area the Pigs Eye Islands CAP 204 PDT developed an interagency habitat sub-group. The sub-group consisted of staff from the Minnesota DNR, National Park Service, Fish and Wildlife Service and the Corps. The following are the meeting minutes from the Habitat Sub-Group meetings.

PIGS EYE LAKE SECTION 204 28 Mar 2016

Meeting Notes: Habitat Sub Group Meeting #1

Prepared by: Aaron McFarlane

Attendees:
MNDNR – Joel Stiras
NPS – Allison Holdhusen
USFWS – Nick Utrup
USACE – Nate Campbell, Aaron McFarlane

On preferred habitat types and target species...

-Incorporation of structure – log cribs, downed trees, etc. to promote fisheries
-Additional shoreline and interstitial space will add some level of fisheries benefits
-Shad Production (rock habitat?)
-Protection of existing resources a priority. Otter dens, eagle nests, hardwoods on west shore...
-Incorporation of an overwintering area could be helpful with carp problem
-It would be good to consider mussels. Any way to construct habitat for backwater species?
-Crayfish, cricket frogs, or mudpuppies?

On target vegetation types

-River bulrush – possible spread by rhizomes and flood-tolerant
-Arrowhead and lotus likely plantable
-pickerelweed, blueflag iris could be desirable
-prairie cordgrass and willows on lower islands desirable
-Trick will be ensuring substrate will be consolidated enough for plants to hold.
-NPS may be able to provide some assistance with planting – volunteers or funding.
-Willows likely to be targeted by beavers, so recommend ensuring diversity
-Cottonwoods

On surrogate species and habitat benefit calculation

-Dabbling duck and black-capped chickadee most promising at present.
-It was also suggested to consider models of species present nearby, such as herons.
-Turtles could be considered. Currently only snapping turtle model available.

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

On existing resources

-Several river otter populations
-Beavers prolific in some areas
-Fishery consists primarily of carp and buffalo, but carp have been decreasing to some degree
-Several active bald eagle nests
-Heavy waterfowl/waterbird use on Pigs Eye and Red Rock Lakes.
-Waterfowl composition weighted toward dabblers in Red Rock and divers in Pigs Eye.

On contaminants

-Universal concern for construction techniques and ensuring that construction does not suspend contaminants.
-Corps planning to date has focused on how to construct on thick layer of flocculent sediment while minimizing mud waves, re-suspension, and sinking. Currently developing construction methods based on those used successfully in other areas with similar sediments and contamination present.
-In regards to attracting wildlife to the area with contaminants present, several points were made:
    -Remediation would be preferable and should occur (although it cannot be a goal of this project based on the Corps authority the project is being funded under).
    -Lots of wildlife currently
    -In the absence of remediation, habitat may still be preferable
    -Not likely to attract enough wildlife to have population impacts on species
    -Because the islands would reduce wind fetch, sediment and contaminant re-suspension would hopefully be reduced, perhaps reducing contaminant exposure.
    -Sand features would reduce the exposed area of existing (contaminated) substrate
-Additional Eagle contaminant data to be reviewed by Corps

Ideas for potential related management options

-Closing off upper Battle Creek inlet area with rock or sand structure to keep contaminants out.
-Drawdown still desirable. Potential for coordination with Lassard Sams or Clean Water Legacy Council?

Appendix : Correspondence and Coordination Pigs Eye Lake Ramsey County

PIGS EYE LAKE SECTION 204

Habitat Sub Group Meeting #2 AGENDA

Date & Time:	Monday, July 11; 1:00-3:00 p.m.
Location:	1200 Warner Road St. Paul, MN 55106-6793
Room:	Willow Brook Room, Downstairs

(1) Array of Alternatives *(Maps Included in read-ahead)*

- 5 Island alternatives to address problems:

- Loss of emergent aquatic vegetation
- Loss of submergent aquatic vegetation
- Lack of island habitat in Pigs Eye Lake and within Pool 2
- Degradation & loss of shoreline habitat
- Lack of depth diversity
- Others?

1. *Improve aquatic habitat.*
2. *Increase terrestrial habitat diversity.*
3. *Maintain or enhance the quantity of shoreline habitat.*

- Additional Formulation Considerations – smaller details, benches, sand blankets, etc.
- Requesting input on alternative designs and finishing touches:
  - Plantings -
  - Structure incorporation -
  - Target species -

(2) Dabbling Duck Model

- Discuss Early Results
- Wind Fetch Model Results

(3) Vegetation Survey Results

- Water was high – performed limited ground survey
- Used to develop very coarse idea of communities present
- Still need survey from water to assess near-shore plants

(4) Contaminants Update

- MPCA discussions summary
- USACE Draft PFC Data/Literature Review *(Draft Report included in read-ahead)*
- Path Forward – proposed sampling etc.

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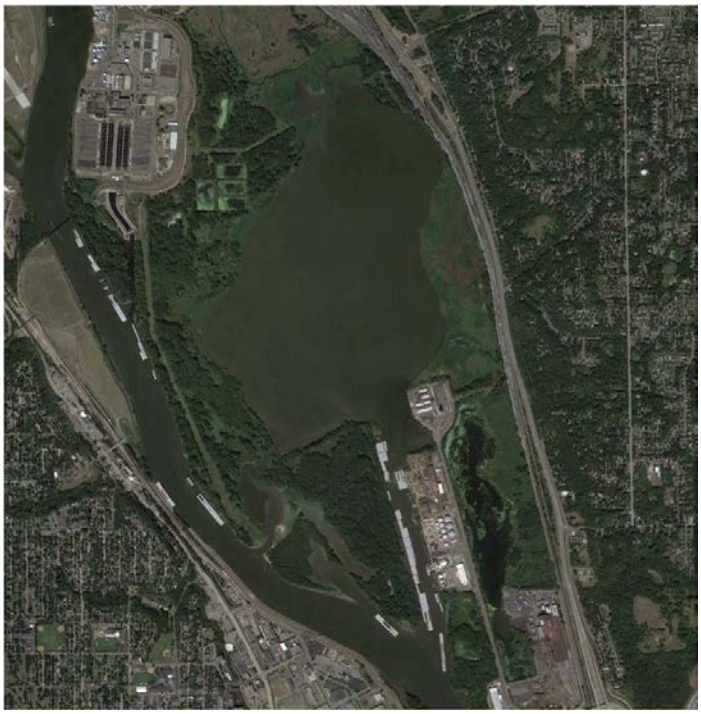
Appendix D Incremental Cost Analysis Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers
May 2018

Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix D Incremental Cost Analysis

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Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix D Incremental Cost Analysis

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1.1.2 HEP Analysis 2
1.1.3 Cost Effective Incremental Cost Analysis 2
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Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix D Incremental Cost Analysis

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Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix D Incremental Cost Analysis

1 Purpose

Corps of Engineers guidance requires a cost effectiveness analysis and an incremental cost analysis (CE/CIA) for recommending environmental restoration plans. A cost effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. An incremental cost analysis of the solutions is conducted to reveal changes in costs of increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the nonmonetary benefits with the monetary costs of environmental plans, cost effectiveness and incremental cost analysis are valuable tools to assist in decision making. This appendix presents the results of the cost effectiveness and incremental cost analysis of the Pigs Eye Lake Section 204 Feasibility Study.

1.1 Methods

The project was evaluated using guidance documents and software prepared by the Corps of Engineers' Institute of Water Resources (IWR). IWR – Planning Suite Software (Version 2.0) was used to automate steps in the cost effectiveness and incremental cost analysis. CE/ICA is a three step procedure: (1) calculate the environmental outputs of each feature; (2) determine a cost estimate for each feature; and (3) combine the features to evaluate the best overall project alternative based on habitat benefits and cost.

1.1.1 Costs

Section 204 construction costs and relevant Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs for features and subsequently for project alternatives were computed by calculating total project costs less the Base Plan cost. The Base Plan is the Federal Standard for the disposal of dredged material associated with construction or maintenance dredging of navigation projects is the least costly, environmentally acceptable plan. The Base Plan costs for this project assume normal excavation and transportation costs based on the current practices in Lower Pool 2. Section 204 costs are incremental costs above the Base Plan (per ER 1105-2-100).

Section 204 costs were annualized by applying the interest and amortization factor of 0.03795 (50 year period of anlaysis at 2.875% interest rate) to the construction cost (Table 1). The 50 year-period of analysis was selected based on the expected time required to reach maximum environmental outputs from project features and the subsequent accrual of benefits leveling off past 50 years. All plans assume 1 year of construction and reflect October 2017 price levels. Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) and Interest During Construction (IDC) costs were quantified and considered in the analysis but not applied; both were found to be minimal and inclusion would not change the outcome of the CE/ICA analysis. OMRR&R is estimated to be $2,000 annually (see Main Report – Section 6.4) and IDC is estimated to be $4,000-6,000 annually.

The incremental analysis of alternatives was accomplished following guidance by Corps' Institute of Water Resources.

Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental Assessment May 2018
Appendix D Incremental Cost Analysis

Table 1 Section 204 Project Costs and Annualized Costs

Alternative	Total Fill (cy)	Total Project Cost	Base Plan Cost	Section 204 Cost	Annualized Cost (Section 204)
Alt4	419,748	$ 15,710,000	$ 3,243,000	$ 12,467,000	$ 473,000
Alt5	470,859	$ 17,664,000	$ 3,636,000	$ 14,028,000	$ 532,000
Alt5m	502,121	$ 18,781,000	$ 3,886,000	$ 14,895,000	$ 565,000
Alt6m	413,329	$ 15,569,000	$ 3,178,000	$ 12,392,000	$ 470,000
Alt7m	345,959	$ 13,102,000	$ 2,706,000	$ 10,396,000	$ 395,000

1.1.2 HEP Analysis

An intensive HEP analysis was conducted on the alternative solutions. Details of the HEP analysis are provided in Appendix C. A summary of outputs from this analysis for each alternative are shown in Table 2. Average annual habitat units (AAHUs) are a quantitative result of annualizing habitat unit (HU) gains or losses across all years in the period of analysis. The net gain is the difference between AAHUs of an alternative in comparison to the no action alternative.

Table 2 Summary of the net gain in AAHUs from HEP analysis

Alternative	Net Gain AAHUs
Alt4	117.2
Alt5	117.2
Alt5m	173.4
Alt6m	171.1
Alt7m	143.4

1.1.3 Cost Effective Incremental Cost Analysis

An analysis of preliminary costs versus quantifiable habitat benefits was conducted to identify the most cost-effective alternative. The net gain in AAHUs was compared to the preliminary average annual cost for each alternative (Table 3). The CE/ICA process resulted in 1 cost effective plan and 3 “Best Buy” plans (including the No Action plan). The full array of alternatives and results of the CE/ICA analysis is displayed in Figure 1.

Table 3 Results of CE/ICA for Alternative Plans

Alternative	Total Fill (cy)	Section 204 Cost	Annualized Cost (2.875% Discount Rate)	AAHU Gain	AACost/ AAHU	Cost Effectiveness
No Action	**-**	**$ -**	**$ -**	**0**	**$ -**	**Best Buy**
Alt4	**419,748**	**$ 12,467,000**	**$ 473,100**	**117.2**	**$ 4,000**	**No**
Alt5	**470,859**	**$ 14,028,000**	**$ 532,300**	**117.2**	**$ 4,500**	**No**
Alt5m	**502,121**	**$ 14,895,000**	**$ 565,200**	**173.4**	**$ 3,300**	**Best Buy**
Alt6m	**413,329**	**$ 12,392,000**	**$ 470,200**	**171.1**	**$ 2,700**	**Best Buy**
Alt7m	**345,959**	**$ 10,396,000**	**$ 395,500**	**143.4**	**$ 2,800**	**Yes**

Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
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Assessment May 2018
Appendix D Incremental Cost Analysis

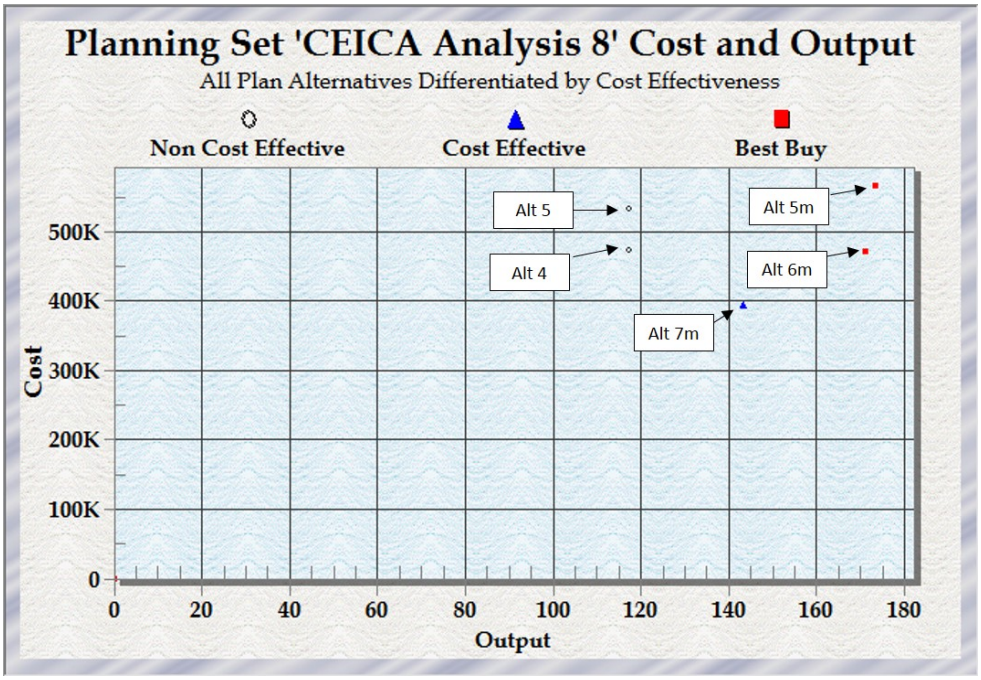

Figure 1 CE/ICA Results – Full Array of Alternatives

When combined with estimated costs of proposed actions, an analysis of both cost effectiveness and incremental costs associated with the identified alternatives can be completed. An evaluation of cost effectiveness and incremental cost analysis was completed using the Institute of Water Resources economic analysis program IWR-Planning Suite. This analysis identifies the cost effective plans that are superior financial investments, called "best buys," through incremental cost analysis. Best buys are the most efficient plans at producing the output variable. In this case, best buys provide the greatest increase in AAHUs for the least increase in cost. The incremental costs of best buy plans are displayed in Table 4. The first best buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first best buy, the second best buy is the most efficient plan for producing additional output, and so on. The Best Buy plans are compared in Figure 2 and Figure 3.

Table 4 Incremental cost of best buy plans

Alternative	Net AAHUs	Annualized Cost	AACost/ AAHU	Incremental AACost	Incremental Output (HUs)	Incremental AACost/AAHU
No Action	0	$ -	$ -	$ -	0	$ -
Alt6m	171.1	$ 470,200	$ 2,700	$ 470,200	171.1	$ 2,700
Alt5m	173.4	$ 565,200	$ 3,300	$ 95,000	2.3	$ 41,300

Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

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Appendix D Incremental Cost Analysis

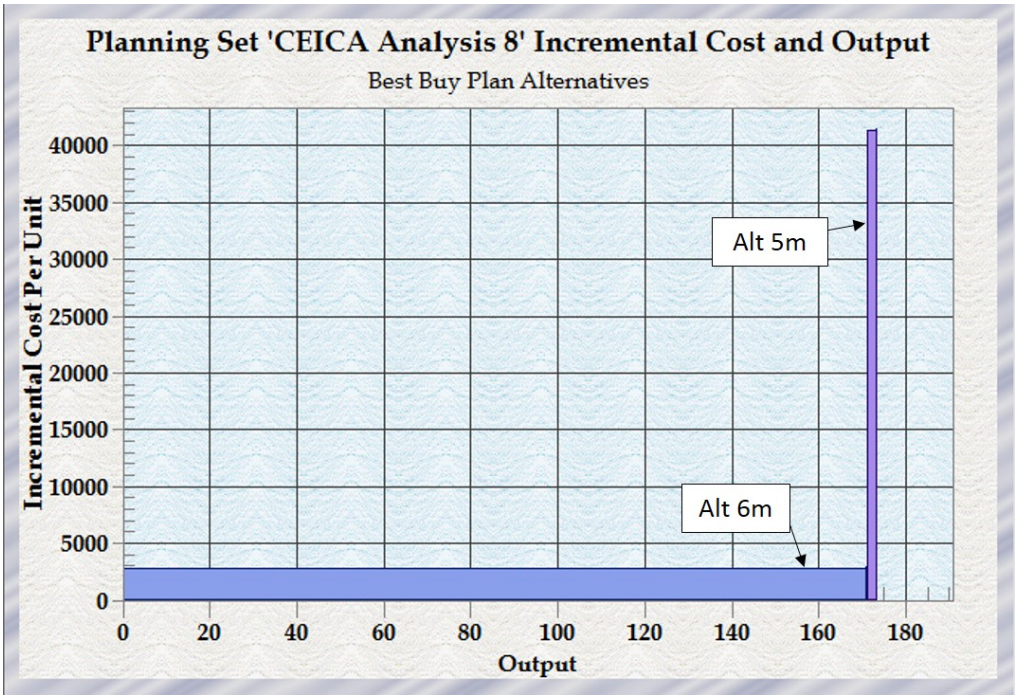

Figure 2 CE/ICA Results – Incremental Cost Per Unit of Best Buy Plans

Figure 3 Comparison of Best Buy Plans (Alternative 5m and 6m)

1.2 Discussion

Typically in the evaluation of Best Buy plans, “break points” are identified in either the last column in Table 4, or in the stair-step progression from left to right in Figure 2. Break points are defined as significant increases or jumps in incremental cost per output, such that subsequent levels of output may not be considered “worth it”. Identification of such break points can be subjective. For Pigs Eye Lake, break points were identified between each of the three Best Buy plans (No Action, Alternative 5m, and Alternative 6m). The Cost Effective Plan, Alternative 7m, was also evaluated.

No Action (Best Buy) - This alternative was not chosen because it does not improve or maintain the ecosystem resources within the project area. This alternative would cost $0. The continued shoreline erosion due to wind and wave activity would reduce the habitat value provided in the project area. The existing project area provides 217.9 AAHUs. Although conditions in the project area would decline under the FWOP, no model variables would be expected to change because existing conditions already reflect the lowest possible score for a majority of the variables. This alternative does not meet any of the

Appendix : Incremental Cost Analysis Pigs Eye Lake Ramsey County

Alternative 7m (Cost Effective) – This is the smallest alternative formulated, which would only create 4 islands, and significantly less acreage of floodplain forest and marsh habitat compared to Alternatives 5m and 6m. This results in lower habitat benefits (143 habitat units compared to over 170 in the subsequent Best Buy 5m and 6m plans). This alternative also does not meet the project objective of reducing shoreline erosion, as 3-5 fewer islands respectively, exposes more shoreline to wind and wave erosion. This alternative would not even reduce the current rate of erosion (almost 1 acre per year) by 50%. The Best Buy plans both would reduce rate of erosion by over 70%. For these reasons, Alternative 7m was deemed as not worth it and this alternative was eliminated.

Alternative 5m (Best Buy) –This alternative improves the aquatic ecosystem in Pigs Eye Lake by creating new floodplain forest habitat, reducing wind-wave action, and creating new wetland habitat. This alternative has all the same features as Alternative 6m, with the main difference being 3 additional islands (100,000 additional cy). This alternative would cost approximately $14.9 million and net 173.4 AAHUs, at an average annual cost per average annual habitat unit of $3,300. This larger alternative meets the project objectives and provides slightly more AAHUs, however, the incremental average annual cost per average annual habitat unit is $41,300 and only generates an incremental output of 2.3 additional habitat units. This small increase in habitat units, without providing additional features, and at a much larger cost, was deemed not worth it, and this alternative was eliminated.

Alternative 6m (Best Buy) - This alternative improves the aquatic ecosystem in Pigs Eye Lake by creating new floodplain forest habitat, reducing wind-wave action, and creating new wetland habitat. This alternative would cost approximately $12.4 million and would result in a net gain of 171.1 AAHUs, at an average annual cost per average annual habitat unit of $2,700. The incremental output is 171.1 habitat units and the incremental average annual cost per average annual habitat unit is $2,700. Alternative 6m was considered worth the investment as it met all project objectives and maximizes habitat benefits at a reasonable cost.

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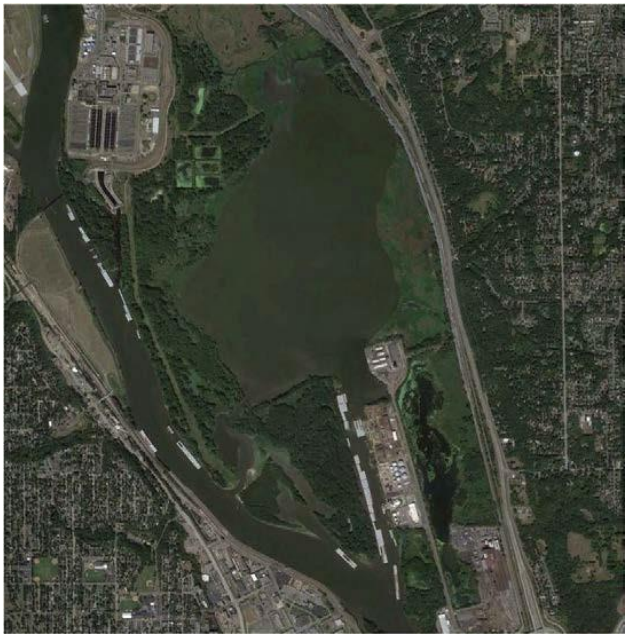
Appendix E Sediment Report Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers
May 2018

Appendix : Sediment Report Pigs Eye Lake Ramsey County

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Appendix E Sediment Report

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1 Pigs Eye Lake - Sediment Quality

1.1 Corps Involvement

Section 204 of the Water Resources Development Act of 1992 provides authority for the Corps of Engineers to plan, design and build projects to protect, restore and create aquatic and ecologically related habitats in connection with dredging of authorized Federal navigation projects. The proposed plan for Pigs Eye Lake Section 204 is to utilize dredged material from the Pool 2 navigational channel to build islands outside of the floodway in Pigs Eye Lake. As part of the planning process, three suitability determinations related to sediment/water quality need to be answered: 1) are the sources of sand and fines proposed for island construction within Pigs Eye Lake appropriate for aquatic and terrestrial habitats, 2) does the quality of the existing sediment under and around the proposed project islands a cause for concern for benthic organisms and possible bioaccumulation and 3) will the lake's water quality insure a safe environment for a project that promotes a goal to attract larger and more diverse populations of wildlife.

To address these issues, the discussion below utilizes historical and recent findings on the sediment quality found at potential borrow sites in Pool 2 and sediment and water quality information for Pigs Eye Lake, including a site description, pollution sources (Pigs Eye Landfill), and summary of results from previous reports.

1.2 Site Description

Pigs Eye Lake is a 628 acre Contiguous, Floodplain Depression Lake just downstream of downtown St. Paul along the left bank of the Mississippi River in Ramsey County, Minnesota (Figure 1). The lake has a maximum depth of around 4 feet and is fed by Battle Creek from the north and is subject to variable mixing with the Mississippi River (depending on river stage). The sediment found in Pigs Eye Lake is consistently soft for the majority of the boring depths to hard bottom. Composition varies between clay, silt, sand and peat. Depth to hard bottom also varies. In some cases there is stiffer clay underlying the soft materials. Hard bottom is what is considered either bedrock or sandy/gravelly alluvium. The very soft materials range in thickness from 10-22 ft. Based on borings collected by the Saint Paul District in 2015, it may be the case that the very soft deposits are thicker outside the floodway than within it. As detailed in the following sections, sediment surveys have shown considerable contamination within the lake sediment, which has been degraded over the last many decades due to the presence of the Pigs Eye Landfill and urbanization of the Battle Creek Watershed.

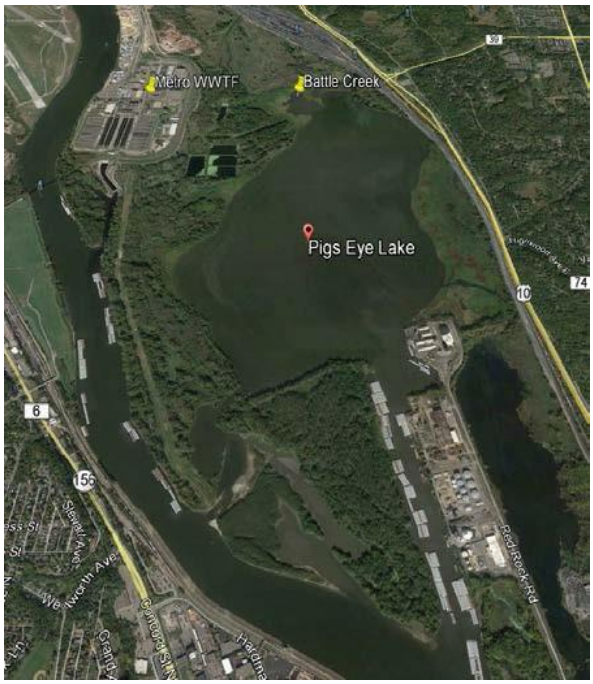

Figure 1. Aerial photo of Pigs Eye Lake (2014)

2 Pigs Eye landfill

2.1 Landfill Background

The Pigs Eye Landfill is listed on the Minnesota Pollution Control Agency's (MPCA) Superfund list. The site is located approximately three miles southeast of downtown St. Paul. It is bordered by the CP Railroad yard to the north and east, and by the Metro WWTP and Pigs Eye Lake to the south. The dump was operated by the City of St. Paul from the mid-1950s to 1972 for the disposal of mixed municipal, commercial and finally closed in 1972, after the Minnesota Pollution Control Agency refused to give Pigs Eye Landfill a permit.

2.2 Landfill contamination concerns

A 2000 Health Consultation report prepared by the Minnesota Department of Health (http://www.health.state.mn.us/divs/eh/hazardous/sites/ramsey/pigseyedumphc0900.pdf) states the following concerns based upon sampling of groundwater, surface water, sediments, soil, and landfill seeps conducted in 1998 and 1999:

1) Based on elevation data from the Mississippi River that the groundwater has come in contact with the waste material an average of 67 days per year since 1972.

2) Battle Creek surface samples detected low concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and heavy metals at levels below applicable MPCA surface water criteria. One pesticide (dicamba) was also detected in several samples. Two VOCs, ethylbenzene and styrene, were detected in all of the surface water samples collected. The levels of these contaminants did not vary greatly between the upstream (where Battle Creek enters the site) and downstream (near where it discharges into the lake) sampling locations.

3) Two sediment samples collected in Battle Creek showed elevated levels of heavy metals, namely copper, lead, mercury and zinc. Levels of these metals exceeded the MPCA's ecological sediment screening criteria in the downstream sample taken near where Battle Creek discharges into the lake, but not in a sample collected in the middle portion of the creek. A sediment sample collected in the wetland below the discharge area of the creek also showed elevated levels of heavy metals, above sediment screening criteria. Neither PCBs nor pesticides were detected in sediment samples collected from Battle Creek.

4) Soil samples from the battery disposal area located along the east side of the southeast pond is contaminated with lead and cadmium. Levels of lead in soil were as high as 62,000 milligrams per kilogram (mg/kg), while cadmium levels were as high as 80 mg/kg. Levels of lead and cadmium are well in excess of the MPCA recreational land use Soil Reference Values (SRVs) for these two elements of 400 mg/kg and 40 mg/kg respectively. Past sediment samples collected from the southeast pond showed elevated levels of lead, with concentrations of lead ranging from 33 mg/kg to 59,000 mg/kg, with a median value of 100 mg/kg. Further samples confirmed this result, and also showed elevated levels of cadmium, copper, mercury, and zinc. Concentrations of these heavy metals exceeded their respective MPCA ecological sediment screening criteria. Low levels of one PCB compound and one pesticide, 4,4-DDE, were also detected in a sediment sample from the southeast pond. A sediment sample taken south of where the southeast pond discharges into Pig's Eye Lake also showed elevated levels of copper, lead, mercury, and zinc, as well as one pesticide, 4,4-DDD.

5) In late 1999, the MPCA coordinated the removal of approximately 25 drums from an area adjacent to Battle Creek and Pigs Eye Lake. Testing of the contents of some of the removed drums revealed PCBs, heavy metals such as cadmium and lead, petroleum products, and VOCs such as benzene and xylene. Some of the drums removed were required to be managed as hazardous waste due primarily to the presence of high concentrations of PCBs in the drummed wastes.

6) Vertical flow likely reaches the deeper sand layer, and ultimately discharges to Pigs Eye Lake and/or the Mississippi River. Analysis of groundwater samples from three wells which presumably represent groundwater that discharges directly to Pigs Eye Lake through the lower sand unit showed detectable concentrations of PCBs (Aroclor 1242), polynuclear aromatic hydrocarbons (PAHs), mercury, and VOCs. Levels of PCBs, and some individual PAHs and VOCs, were in excess of MDH Health Risk Limits (HRLs) for groundwater and MPCA surface water criteria.

3 Historical Pigs Eye Sediment Data

Two historic sediment studies that include sampling locations in Pigs Eye Lake:

1) 2001 survey of 3 sites in Pigs Eye Lake for 2006 MCES report: Physical, Chemical, and Biological Characteristics of Mississippi, Minnesota, and St. Croix River Bed Sediments in the Twin Cities, MN Area during a 1998-2001 Survey.

2) 2007-2008 MPCA sediment chemistry survey of Pigs Eye Lake

The MCES survey found that "much of the variation observed in the concentrations and distributions of the contaminants measured in bulk and fine-grained sediments during the 1998-2001 MCES sediment survey is associated with sediment particle size and TOC concentration. With few exceptions, sites that were composed predominantly (greater than 50%) of fine particle sizes (silts and clays smaller than 53 um) and a TOC content of 1.5% or greater contained substantially higher levels of most contaminants, including trace metals, OC pesticides, and PAHs". These sites included Pigs Eye Lake (all three sites).

The MCES 1998-2001 survey used MPCA SQT values to evaluate the contaminant concentrations measured in both the bulk and fine-grained sediments. These two types of narrative SQTs were established by the MPCA and its collaborators for the St. Louis River AOC (Crane, et al., 2000); and these narrative objectives are also applicable to other water bodies within Minnesota (MPCA, 2007). Level I SQTs are intended to identify contaminant concentrations below which harmful effects on sediment dwelling organisms (i.e. benthic macroinvertebrates) are unlikely to be observed. Level II SQTs are intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are likely to be observed.

Level I and Level II SQTs have been established for 8 trace metals, 13 individual PAH compounds, total PAHs, total PCBs, and 10 OC pesticides (MPCA, 2007). Table 1 below summarizes the SQT exceedances found in the 1998-2001 survey for Pigs Eye Lake and results of the biological analysis.

Appendix : Sediment Report Pigs Eye Lake Ramsey County

Table 1. Summary of results from the MCES 1998-2001 sediment survey that included 3 sites at Pigs Eye Lake

Trace Metals Analysis	**PAH Analysis**	**Biological Analysis**
Bulk Sediment- Level I SQT exceedances: PEL North (Cd)	Level I SQT exceedances: PEL North	Benthic Macroinvertebrate Analysis Contaminant-related impacts PEL Mid (reduced taxa richness and density; dominated by midges)
Fine-grained Sediment- Level I SQT exceedances: PEL North (Cd) PEL Mid (Cd, Cr, Cu, Pb, Hg, Ni, Zn) PEL South (Cd) Level II SQT exceedances: PEL Mid (Cd)	Level II SQT exceedances: PEL North	Highest densities in the survey are found in: Lake Pepin, PEL North and South, and MI 3.5, Possibly due to the greater presence of fine-grained sediments.

The 2007-2008 MPCA sediment chemistry survey of Pigs Eye Lake included 11 locations at multiple depth increments. The sediment samples were tested for metals, PCBs, PAHs and pesticides. In general the results were in-line with the MCES survey. But due to the increased number of locations and depths of the samples a spatial distribution of the contamination was detected. For example, in Figure 2, SQT I exceedances of lead, mercury, nickel and zinc show the exceedances occur below the surficial sediment (yellow bar) and mainly located along the centerline between the creek outlet and the lake outlet. In contrast, PAHs and PCBs seem to be ubiquitous throughout the lake at multiple depths (Figure 3).

Figure 2. Spatial distribution of SQT I exceedances for mercury, lead, nickel and zinc. MPCA 2007-2008 survey (green = below SQT level I, yellow = between level I and level II SQT)

Figure 3. Spatial distribution of SQT I exceedances PAHs and PCBs. MPCA 2007-2008 survey (green = below SQT level I, yellow = between level I and level II SQT).

Two other historical studies include a Pigs Eye Lake Benthic Invertebrates study done by Gary Montz of the Minnesota Department of Natural Resources and a Minnesota DNR study of 7 fish tissues. The invertebrates study showed that Pigs Eye Lake has a benthic community of little diversity and the samples were nearly totally dominated by two groups – Chironomidae (midges) and Oligochaeta (aquatic worms). The fish tissue study showed very little mercury, but some PCB contamination was detected in fish tissue.

4 Recent Pigs Eye Sediment investigations

Two recent investigations that focused primarily on metals and PFCs inside the northern most portion of the lake include the Bay West LLC (Bay West) study in 2014 and Wenck and associates study in 2016. The Bay West samples were mostly collected on the east side of the northern bay and the Wenck study concentrated on the west side of the bay (Figures 4 and 5).

4.1 Bay West (2014)

The general findings of the Bay west study were:

Cadmium, copper, lead, and zinc are present at concentrations greater than applicable SQTs in sediment samples collected throughout the investigation area, and cadmium is present at concentrations greater than the applicable SSV in several locations (Sediment Screening Values- SSVs were developed by the Minnesota Department of Health for use in a St. Louis River study as a human health risk assessment tool).

- Level 2 SQT exceedances for analyzed metals appear to be concentrated in the areas adjacent to Battle Creek. Generally, A-horizon samples contained greater concentrations of metals than B-horizon samples.

- PCBs were not detected at concentrations greater than laboratory reporting limits in any of the samples collected during this investigation.

- PFOA and PFOS were detected at concentrations exceeding laboratory reporting limits in all of the samples analyzed.

- B-horizon samples were collected from 6 to 15 inches below the sediment surface, on average. Based on the analytical results of B-horizon samples for metal and PFCs, it appears that contamination in sediments may extend deeper than approximately 15 inches below the sediment surface.

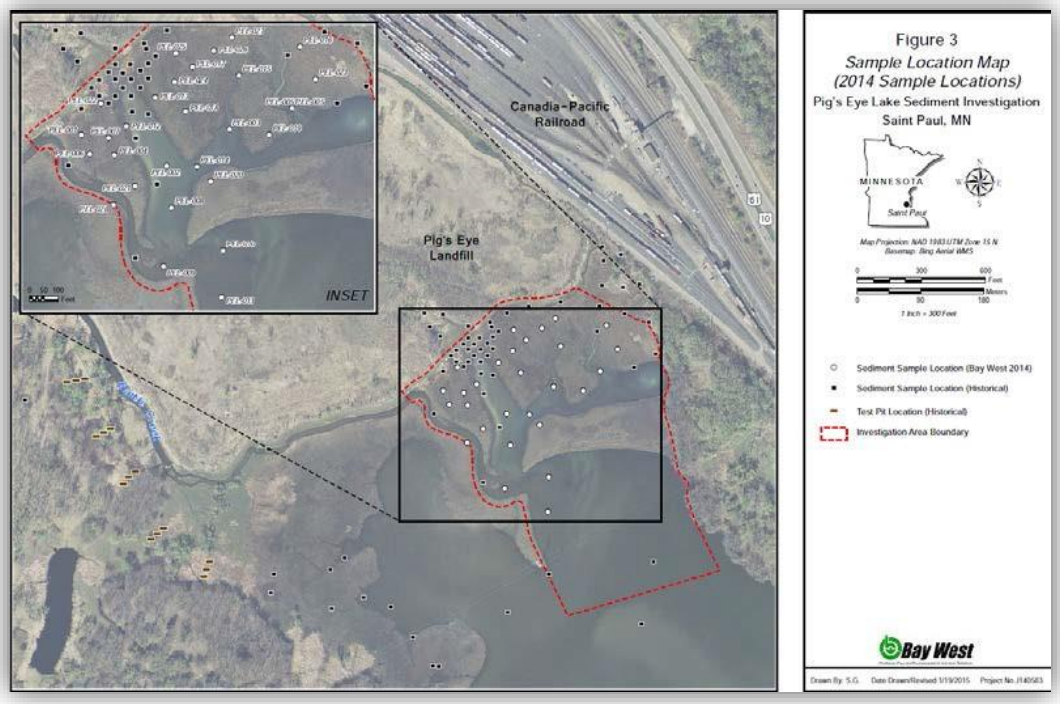

Figure 4. 2014 Bay West Sediment - sample locations.

4.2 Wenck (2016)

The general findings of the Wenck study were:

- With the exception of cadmium, no samples exceeded SSVs.
- With the exception of cadmium, exceedances of SQT 2 were very low: zinc 0%, lead 5% and copper 5%.
- All samples of sediments collected in the northwest bay during this investigation reported lower percentages exceeding the SQT and SSV values than were reported for the 2014 northeast bay investigation conducted by Bay West.
- PFCs highest sample results were lower than values reported for the 2014 northeast bay investigation conducted by Bay West.
- Man-made materials in the sediment indicate Pig's Eye Dump is likely the origin of the contamination.
- AVS-SEM metals data suggest that metal toxicity is low in Pigs Eye Lake since the metals are unavailable to biota.

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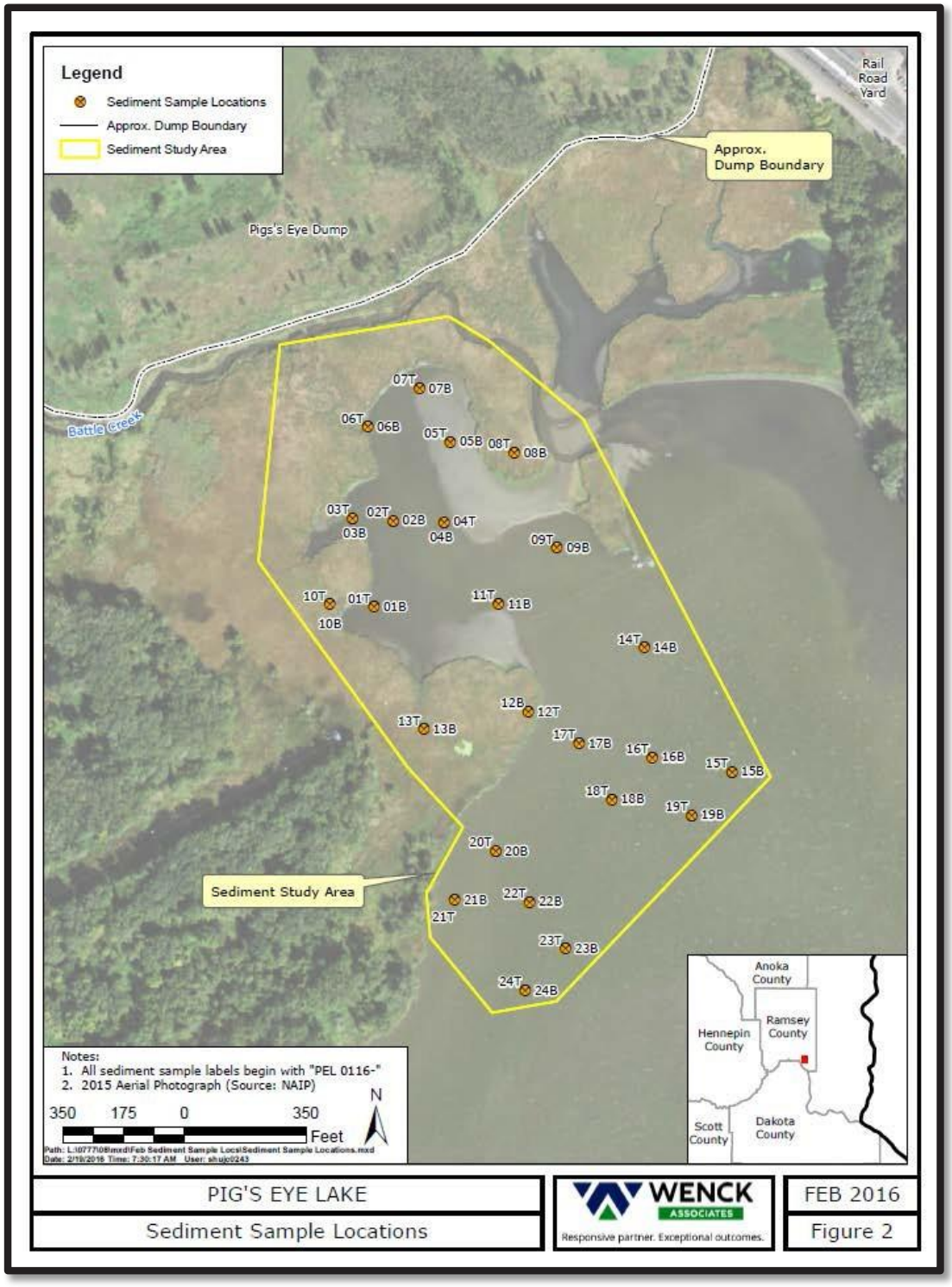

Figure 5. 2016 Wenck sediment survey - sample locations

5 USACE Sediment Surveys

5.1 2015 USACE Pigs Eye Lake Sediment Survey

Sampling:
On October 26th, 2015, district staff drilled four boreholes in Pigs Eye Lake (Figure 6) and collected a total of six environmental samples for chemical and physical analyses from three of the four boreholes (15-1M, 15-2M and 15-3M). For each borehole tested, two composite samples were analyzed. The composite samples were collected at roughly two foot intervals starting a couple feet below the sediment surface (Table 2).

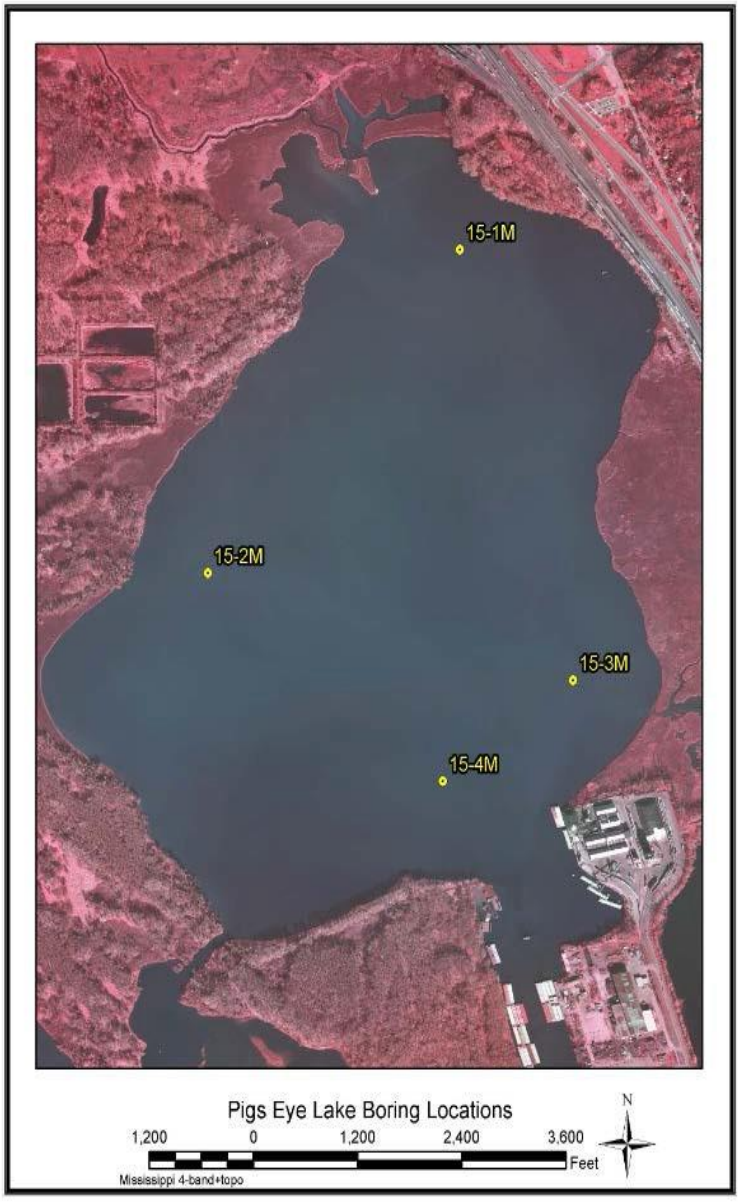

Table 2. Depth and Description of Sediment Samples

Boring	Sample	depth from lake bottom (ft)	Description
15-1M	1	2.3	Clayey Silt (OH) - Very soft, loose, saturated, green, 85% organic silt, 15% clay
		4.3	
	2	4.3	
		6.3	
15-2M	1	1.9	Organic-Rich Silty Clay (CH) - Soft, wet, green-gray, 80% clay, 20% silt, scattered roots, etc.
		3.9	
	2	3.9	Gradational transition from CH in sample #1 to Silty Clay (CH) - soft, wet, blue-gray, 80% clay, 20% silt, few organics
		5.9	
15-3M	1	1.6	Clayey Peat (Pt) - soft, spongy, wet, green, 70% wood fragments, 30% clay
		3.6	
	2	3.6	
		5.6	

The six sediment samples were immediately processed after collection and sent on ice to ARDL, Inc., Mt Vernon, IL for physical and chemical analyses to determine grain size and contamination.

Analyses:

Metals, PCBs, pesticides, PAHs, cyanide, total organic carbon, percent moisture, percent solids, percent total volatile solids, selected inorganics and grain-size analyses were performed by ARDL, Inc. for each of the composite samples.

Results and Discussion:

The analytical results (Table 3) showed that the sediment samples were mostly silt/clay, with around 90% of

wide range between 29,000 mg/kg seen in 15-2M #2 to a very high concentration of 120,000 mg/kg in 15-3M #2. The role of sediment in chemical pollution is tied both to the particle size of sediment, and to the amount of particulate organic carbon associated with the sediment. Silt content is important, because finer material has more surface area for binding with contaminants, but as TOC increases, the affinity between the sediment and the contaminants also increases. As a result, greater TOC concentrations reduces the biological availability of many of the persistent, bioaccumulating and toxic organic contaminants, especially chlorinated compounds.

To ascertain the possible toxicity of the samples to the benthic environment, the chemical results were compared to the Minnesota Pollution Control Agency's (MPCA) sediment quality targets (SQTs) for the protection of sediment-dwelling organisms in Minnesota and the MPCA's Soil Reference Values (SRVs) that are used for upland placement suitability.

Metals:

Similar to what was seen in previous surveys, the most contaminated site (15-1M) was the borehole closest to the Pigs Eye Landfill. Cadmium, lead and mercury were above SQT 1 levels in the upper sample in 15-1M and cadmium and mercury concentrations were exceeded in the lower sample. In both layers, however, cadmium was above the proposed Residential/Recreational SRV limit. In boreholes 15-2M and 15-3M, both located in the southern part of the lake, there were not any SQT exceedances for metals except for cadmium, which also equaled the proposed 2016 cadmium Residential/Recreational SRV in the upper sample of 15-2M.

Organics:

Only the samples from borehole 15-1M showed any SQT or SRV exceedances for organic pollutants. Of the two layers tested, the upper layer had more contamination with four contaminates exceeding SQT II guidelines (acenaphthylene, pyrene, benzo(a) anthracene and benzo(a)pyrene), another four exceeding SQT I guidelines (acenaphthene, anthracene, fluoranthene and dieldrin) and benzo(a)pyrene exceeding the proposed 2016 PAH recreational SRV by itself. The lower 15-1M sample had significantly less contamination with only SQT I exceedances for acenaphthylene, acenaphthene, anthracene, pyrene, benzo(a) anthracene and benzo(a)pyrene. PCBs and pesticides were all non-detect for all 6 samples, except for dieldrin in the upper sample of 15-1M.

The recommended action related to sediment quality for this study was to engage the MPCA to determine if the results of the 2015 surveys were acceptable to continue pursuing the construction of islands inside Pigs Eye Lake. It was decided that 10 more samples located within the preferred alternative plan's footprint of the islands would be collected for further analyses.

5.2 2016 USACE Pigs Eye Lake Sediment Survey

Sampling:
On August 8 and 9, 2016, district staff drilled ten boreholes inside the proposed construction area of Pigs Eye Lake (Figure 7) and collected one sample for chemical and physical analyses from each boreholes. Each

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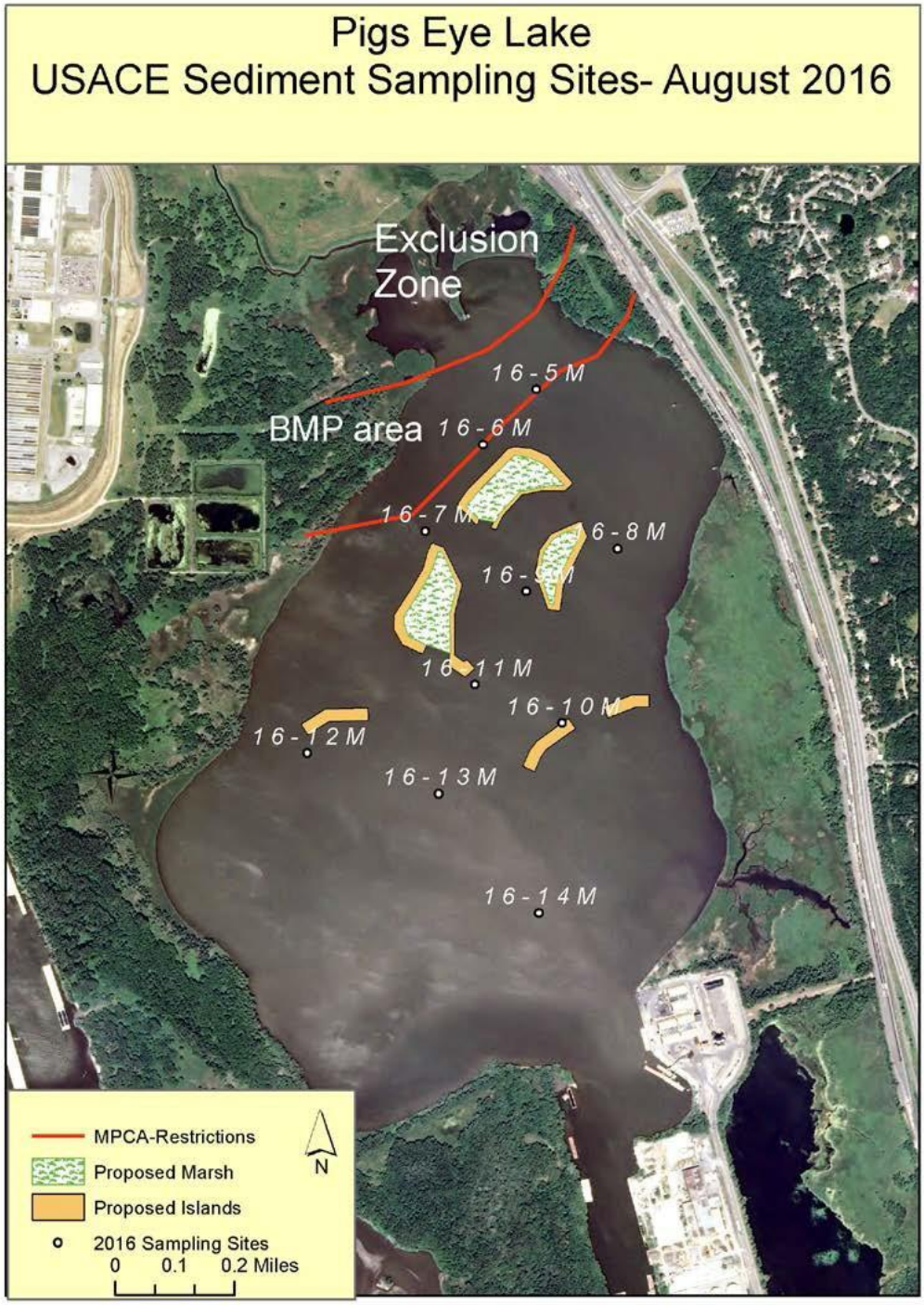
2015-2016 USACE Pigs Eye Sediment Data	Units		Parameter	MPCA SQT I	MPCA SQT II	Previous Residential	Previous Recreational	MPCA Res/Rec Soil Reference Value (SRV)	MPCA Comm/Ind Soil Reference Value (SRV)	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake	Pigs Eye Lake
Pool										2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Top of Sample Elev										2'	4'	2'	4'	2'	4'	1'	1'	1'	1'	1'	1'	1'	1'	2'	1'	1'
Bottom of Sample Elev										4'	6'	4'	6'	4'	6'	4'	4'	4'	4'	4'	4'	4'	4'	4'	4'	4'
Lab										ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC
Lab ID										008066-01	008066-02	008066-03	008066-04	008066-05	008066-06	008100-01	008100-02	008100-03	008100-04	008100-5	008100-6	008100-7	008100-8	008100-9	008100-10
Corps ID										15-1M	15-1M	15-2M	15-2M	15-3M	15-3M	16-10M	16-11M	16-12M	16-13M	16-14M	16-5M	16-6M	16-7M	16-8M	16-9M
Date Collected										10/26/2015	10/26/2015	10/26/2015	10/26/2015	10/26/2015	10/26/2015	8/9/2016	8/9/2016	8/9/2016	8/9/2016	8/9/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016	8/9/2016	8/9/2016
Organics	ug/kg		Acenaphthylene	5.9	130					202	37.7	1.78 J	ND	1.70 J	2.29 J	66.9	110	91.3	171	113	197	308	5.48 J	ND	112
	ug/kg		Acenaphthene	6.7	89	1200000	1860000	1300000	19000000	31.5	7.21 J	ND	ND	ND	2.26 J	11.5	18.4	15.9	24	17	33.7	97.1	1.25 J	ND	17.9
	ug/kg		Anthracene	57	850	7880000	10000000	6500000	97000000	347	59.2	ND	ND	1.87 J	2.49 J	53.2	144	65.7	187	113	376	963	6.07	ND	162
	ug/kg		Fluoranthene	420	2200	1080000	1260000	510000	6700000	1610	281	8.22	1.91 J	9.94	11.5	430	793	479	870	689	1480	3640	35.3	9.39	955
	ug/kg		Pyrene	200	1500	800000	1060000	44000		2190	358	8.73	1.91 J	8.29 J	8.34 J	483	1080	545	1340	944	2110	4790	46.7	9.6	1270
	ug/kg		Benzo(a) anthracene	110	1100					1580	259	4.93 J	ND	2.97 J	ND	248	617	284	784	485	1380	2660	25.6	3.67 J	710
	ug/kg		Benzo(b)fluoranthene							1810	315	8.17	2.23 J	5.82 J	3.59 J	412	840	477	1110	719	1640	3130	37.1	6.23 J	954
	ug/kg		Benzo(k)fluoranthene							480	93 J	2.63 J	ND	1.95 J	ND	161	331	173	411	274	610	1070	13.4	2.56 J	337
	ug/kg		Benzo(a)pyrene	150	1500	2000	2000	1000 ***	14000***	1690	285	6.15 J	ND	2.67 J	ND	381	843	413	1080	662	1590	3170	40.2	6.31 J	904
	ug/kg		Benzo(g,h,i)perylene							905	111	2.61 J	ND	ND	ND	134	247	148	424	288	581	1180	21.4	2.32 J	339
	ug/kg		Hexachlorobenzene							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		Chlordane trans isomer							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		Chlordane cis isomer	3.2*	18*	13000	16000	7000 *	75000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		P, P' -DDE	3.2	31	40000	52000	13000	70000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		O, P' -DDD							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		Dieldrin	1.9	62	800	1200	110	1500	9.63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		O, P'-DDE							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		O, P' -DDT							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		P, P' -DDD	4.9	28	56000	74000	19000	100000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		P, P' -DDT	4.2	63	15000	18000	7300	86000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		PCB 1016							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		PCB 1248							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		PCB 1254							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		PCB 1260							ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ug/kg		Total PCBs	60	680	1200	1400	620	8200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals	mg/kg		Arsenic	9.8	33	9	11	9	9	6.6	5	3.5	2.9	4	4	6.6	3.4	2.5	3.1	5.8	5.8	4.5	2.2	1.2	6.7
	mg/kg		Cadmium	0.99	5	25	35	1.6	23	2.3	1.8	1.6	1.5	1.2	1.2	5.4	2.1	2.8	3.3	2.5	3.3	0.84	0.46	0.57	5.6
	mg/kg		Chromium	43	110	44000	60000	23000	100000	30.1	22.3	24.7	25.9	26.6	30.9	54.3	36.8	39.8	41.5	37.5	41.2	25.4	27.1	27	52.4
	mg/kg		Copper	32	150	100	100	2200	33000	31.7	17.6	17.2	18.2	19.4	20	49.5	36.5	36.5	42.8	35.2	39.6	25.9	19.5	20.2	47.4
	mg/kg		Lead	36	130	300	300	300	700	48.9	12.5	6.6	6.7	7	7.6	52.6	51	38.3	54.4	39.2	45.8	43.3	12.9	14.4	54.1
	mg/kg		Manganese			3000	5000	2100	21000	815	1100	711	748	127	138	1140	1020	920	949	927	841	1220	967	245	985
	mg/kg		Mercury	0.18	1.1	0.5	1.2	3.1 **	3.1	0.63	0.26	ND	ND	ND	ND	0.59	0.59	0.4	0.6	0.44	0.47	0.63	ND	ND	0.41
	mg/kg		Nickel	23	49	560	800	170	2600	20.6	15.6	19.4	22.6	20.2	21. 0	31	26.5	26.9	27.5	25.8	26	21.2	25.8	23.1	29.1
	mg/kg		Zinc	120	460	8700	12000	4600	70000	116	60.4	60.4	71. 9	62.8	62.4	194	156	144	172	143	151	116	77.5	70	192
Inorganics	mg/kg		Ammonia Nitrogen							376	224	270	233	216	199										
	mg/kg		Chromium (VI)			87	120	11	57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	mg/kg		Cyanide, Total			60	60	13	190	ND	ND	ND	ND	ND	ND										
	%		Moisture							58.9	60.7	50.9	39.2	59.6	70	64.1	61.8	32.1	63.6	59.6	57.5	48.3	42.7	57.1	63.2
	mg/kg		Phenol							2.7	ND	ND	ND	6.5	8.2										
	mg/kg		Phosphorus							910	736	862	718	640	536										
	%		Solids, Percent							41. 2	39.3	49.1	60.8	40.4	30	35.9	38.3	37.9	36.4	40.4	42.5	51.8	57.3	42.9	36.8
	%		Solids,Total Volatile							7.6	8.1	10.1	5.4	18.5	28.2										
	mg/kg		Total Kjeldahl Nitrogen							3960	3000	4690	2380	7530	9620										
	mg/kg		Total Organic Carbon							51000	71000	50000	29000	83000	120000										
PARTICLE SIZE %	SAND	coarse	4							100	100	100	100	100	100	100	100	100	100	100	100	99.9	100	100	99.9
			10							100	100	100	100	100	100	99.9	100	100	100	100	100	99.5	99.8	100	99.8
		medium	20							99.9	99.9	99.8	99.9	99.9	99.9	99.7	99.9	99.9	100	99.9	99.9	99.3	99.2	98.5	99.8
			40							99.6	99.5	97.9	99.4	97.4	98.4	99.3	99.8	99.8	99.9	99.8	99.9	98.7	98.6	97.7	99.7
		fine	60							98.9	99	96.2	98.9	94.9	95.6	99	99.7	99.7	99.8	99.7	99.8	96.3	98.1	96.3	99.2
			140							97.5	92.1	93.7	98	90.4	88.9	97	99.1	98.1	99.3	97.1	97.6	79.6	96	92.1	96.2
	SILT	clay	200							96.4	86.1	91.7	97	88.7	87.2	96.1	97.4	96	98.8	96.1	96.3	75.9	94.6	90.1	94.9

Table 3. USACE Sediment Analytical and Physical Results from Pigs Eye Lake 2015-1016

Level I SQT –

Level II SQT –

2016 draft MPCA Res/Rec Soil Reference Value (SRV)


Pigs Eye Lake
USACE Sediment Sampling Sites- August 2016
Exclusion Zone
BMP area
16-5M
16-6M
16-7M
16-8M
16-9M
16-11M
16-10M
16-12M
16-13M
16-14M
MPCA-Restrictions
Proposed Marsh
Proposed Islands
2016 Sampling Sites
N
0 0.1 0.2 Miles

Appendix : Sediment Report Pigs Eye Lake Ramsey County

The 10 sediment samples were immediately processed after collection and sent on ice to ARDL, Inc., (Mt Vernon, IL) for physical and chemical analyses to determine grain size and contamination. In addition, samples from 6 boreholes were sent to AXYS Analytical Services Ltd. (Sydney, British Columbia) for PFC analysis (see PFC appendix).

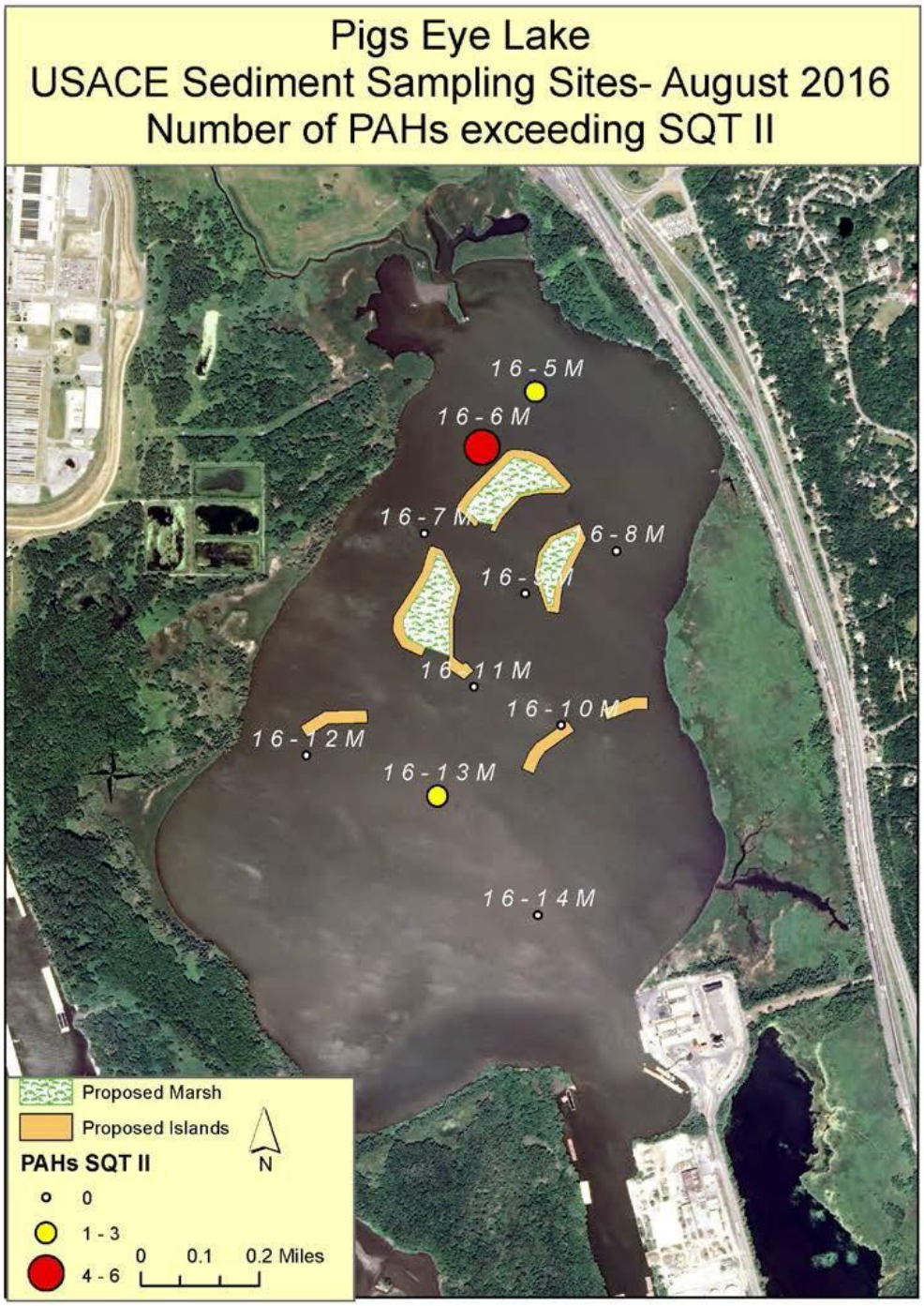
Results:

Figures 8-11 shows the number of different metals and PAHs tested that exceeded MPCA's SQTs II and 2016 Rec/Res SRVs. Three of the ten boreholes (16-5M, 16-6M and 16-13M) collected in 2016 showed elevated levels of contamination similar to what was seen in the 2015 borehole, 15-1M. Namely, these 3 boreholes had: numerous SQT I exceedances for many different metals and PAHs, several SQT II exceedances for cadmium and PAHs and a few cadmium and benzo(a)pyrene (using the BaP equivalents approach) results were above proposed SRV limits for Recreational/Residential use. Conversely, two boreholes, 16-7M and 16-8M, had only SQT I exceedances for nickel and were more akin to the relatively clean 2015 boreholes, 15-2M and 15-3M. Why some of the boreholes were more contaminated and others were relatively clean, is not obvious, but similar to the MPCA 2007-2008 survey, the less contaminated boreholes appear to be located along the edges of the lake.

Appendix : Sediment Report Pigs Eye Lake Ramsey County

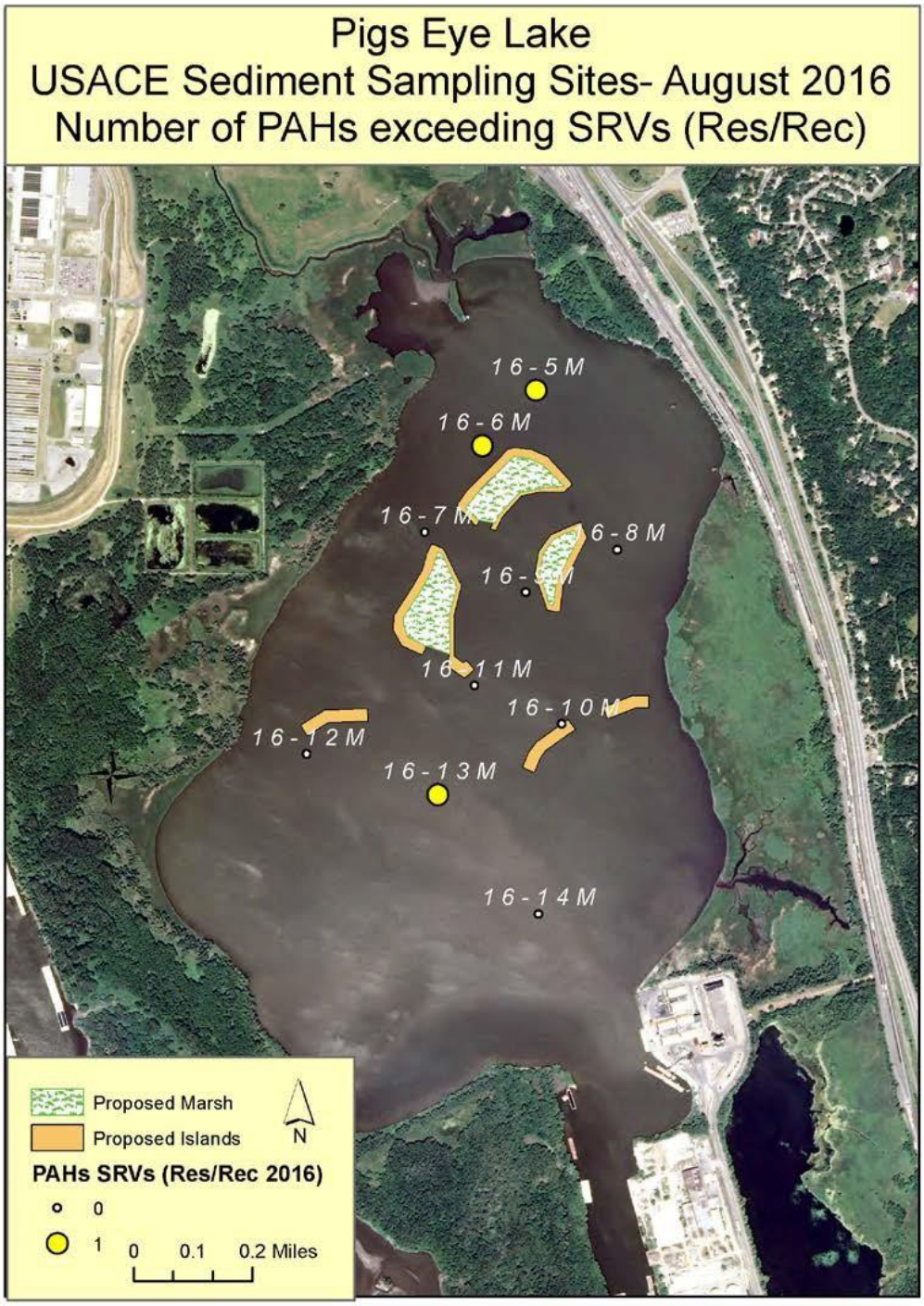
Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix E Sediment Report



Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix E Sediment Report



Appendix : Sediment Report Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
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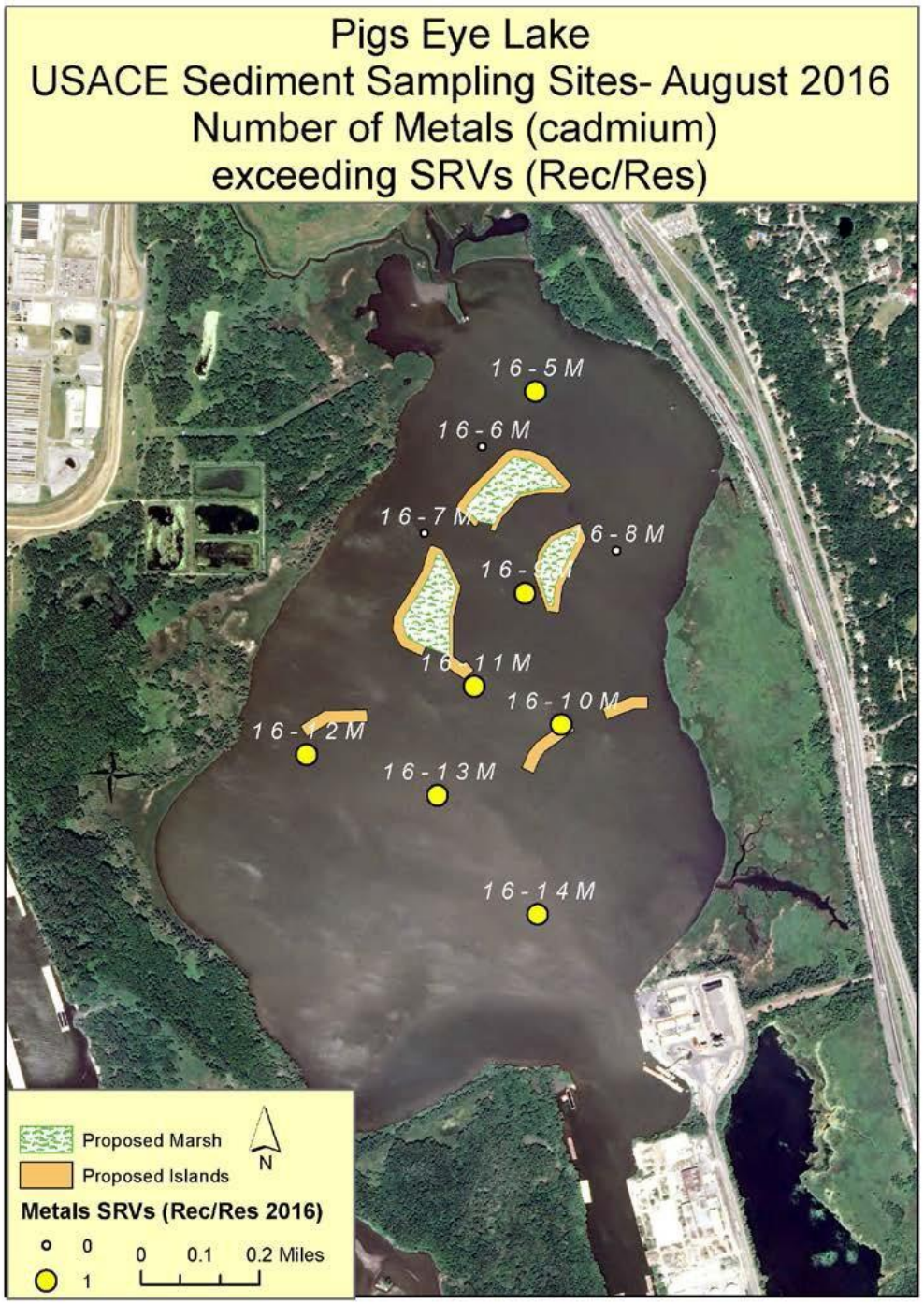

Appendix : Sediment Report Pigs Eye Lake Ramsey County

Compared to Wenck and the Bay West surveys, which focused their sampling to the area immediately downstream of the landfill, the USACE surveys demonstrate that the contamination in the lake is widespread, but at lower levels than what is found immediately adjacent to the landfill. Table 4 shows the percentage of heavy metal samples exceeding SQT and SSV sediment toxicity guidelines for USACE, Wenck and the Bay West surveys. The exceedance percentages are fairly similar for the lake-wide corps samples and the near-landfill, Wenck and the Bay West samples, at the lowest levels (SQT I), but the near-landfill samples had the majority of exceedances at the SQT II levels and all of the SSV exceedances. Similar comparisons cannot be done with PAHs, since the Wenck and the Bay West did not analyze their samples for PAHs, but levels of PFCs from the three surveys show the same heavy metal pattern of wide-spread contamination in the lake sediments, but with hot-spots located only near the landfill (PFC appendix).

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Table 4. Comparison of SQT I, SQT II and SSV heavy metal exceedances for the USACE 2015-2016 surveys and the Wenck and Bay West Surveys

Cadmium Comparison Criteria		Wenck NW Bay 0-0.5'	Wenck NW Bay >0.5'	Bay West NE Bay A-Horizon	Bay West NE Bay B-Horizon	USACE 2015 and 2016 Surveys
Level 1 SQT	**0.99 mg/kg**	59% (8)	26%(5)	89%	54%	81% (13)
Level 2 SQT	**5 mg/kg**	23% (3)	4% (1)	24%	29%	13% (2)
SSV	**10 mg/kg**	9% (2)	4% (1)	11%	11%	0%
Copper Comparison Criteria		**Wenck NW Bay 0-0.5'**	**Wenck NW Bay >0.5'**	**Bay West NE Bay A-Horizon**	**Bay West NE Bay B-Horizon**	**USACE 2015 and 2016 Surveys**
Level 1 SQT	**32 mg/kg**	68% (13)	26% (5)	93%	71%	44% (7)
Level 2 SQT	**150 mg/kg**	5% (1)	0% (0)	7%	4%	0%
SSV	**9000 mg/kg**	0% (0)	0% (0)	0%	0%	0%
Lead Comparison Criteria		**Wenck NW Bay 0-0.5'**	**Wenck NW Bay >0.5'**	**BayWest NE Bay A-Horizon**	**BayWest NE Bay B-Horizon**	**USACE 2015 and 2016 Surveys**
Level 1 SQT	**36 mg/kg**	73% (13)	52% (10)	93%	71%	50% (8)
Level 2 SQT	**130 mg/kg**	5% (1)	0% (0)	7%	4%	0%
SSV	**300 mg/kg**	0% (0)	0% (0)	0%	0%	0%
Zinc Comparison Criteria		**Wenck NW Bay 0-0.5'**	**Wenck NW Bay >0.5'**	**BayWest NE Bay A-Horizon**	**BayWest NE Bay B-Horizon**	**USACE 2015 and 2016 Surveys**
Level 1 SQT	**120 mg/kg**	50% (11)	17% (4)	93%	64%	44% (7)
Level 2 SQT	**460 mg/kg**	0% (0)	0% (0)	4%	7%	0%
SSV	**73,000 mg/kg**	0% (0)	0% (0)	0%	0%	0%

Sediment Screening Values- SSVs (developed by the Minnesota Department of Health for use in a St. Louis River study as a human health risk assessment tool).

6 Pool 2 Sediment – Proposed borrow material

Starting in the 1970s, the St. Paul District has completed 15 sediment surveys of the historic dredge cuts in Pool 2 (1974, 1975, 1978, 1981, 1982, 1983, 1984, 1985, 1989, 1992, 1994, 2002, 2008, 2013 and 2014). Sediment testing of historic dredge cuts in Pool 2 Pre-2008 (Addendum 1) have shown that some of the most contaminated sediments that the St Paul District dredges are in Lower Pool 2. The levels of Pool 2 contamination appear to increase downstream, with little or no SQT and SRV exceedances detected in the upper reaches to multiple exceedances detected around Boulanger Bend and the Upper Approach to Lock and Dam 2. The reason for the increased contamination in the lower pool is likely due to the increasing percentage of fines seen downstream where the pool becomes more lake-like. The increased affinity of smaller granular sizes to heavy metals and organic contaminates is probably the key factor influencing higher contamination, but point sources of urban, industrial and agricultural pollution between St. Paul and Lock and Dam 2 may also be significant.

Results from post-2008 testing in pool 2 (Addendum 2), however, shows that the contamination levels throughout the whole pool is much improved. This noticeable reduction in SQT and SRV exceedances over time suggest that the Pool 2 sand, and more importantly, fines from the navigational channel that are available for the construction of islands in Pigs Eye Lake are suitable for wildlife habitat.

7 Results and Discussion

Three suitability determinations:

1) Are the sources of sand and fines proposed for island construction within Pigs Eye Lake appropriate for aquatic and terrestrial habitats?

As an outcome of the markedly decreased levels of pollution seen in USACE Pool 2 sediment surveys over time, it is believed that the construction of the proposed islands in Pigs Eye Lake (Figure 7) with sand and fines from USACE placement sites in Pool 2 would not cause significant detrimental effects, in terms of habitat suitability.

2) Is the quality of the existing sediment under and around the proposed project islands a cause for concern for benthic organisms and possible bioaccumulation?

Unfortunately, recent sediment surveys of the lake's bottom shows there are varying level of contamination throughout the entire lake. The sediment testing shows that the lake has contamination of PFCs, widespread low level (SQT I) exceedances for heavy metals and PAHs, and limited locations with higher exceedances for cadmium and PAHS (SQT II and proposed Recreational/Residential SRVs). As a result, stakeholders that are part of the planning process formed a Contaminant Sub-Group that included several MPCA, MN DNR, Metropolitan Council, and Corps of Engineers staff members familiar with the contamination issues. One of the final products that came out of this group were maps extrapolating the likely contamination levels of many constituents throughout the lake (Mean Probable Effects Concentration Maps, Figures 12-16). These maps later led to the development of the Exclusion Zone, Best Management Practices (BMP) Zone, and Unrestricted Areas identified on Figure 7. As currently proposed, the island construction plan shown in Figure 7 delineates all of the Islands outside of the Exclusion Zone. Furthermore, it is thought that placing clean sand to construct the proposed islands outside

of the most contaminated areas would probably be a benefit for the lake by capping some of the lesser contaminated underlying sediments. Placement of the sand may cause short-term disturbance and redistribution of the sediment adjacent to the islands during construction, but as long as the possibility of mud waves are managed and the contaminated sediment is not discharged to the Mississippi River, there shouldn't be a long-term concern that the construction of the islands will further contaminate the lake.

3) Will the lake's water quality ensure a safe environment for a project that promotes a goal to attract larger and more diverse populations of wildlife?

The answer to this question is still an unknown and obtaining a scientifically defensible conclusion is probably not feasible within the scope and budget of this project. At this point, there is not enough water quality, biological and toxicity data available for the area to clearly demonstrate the risk. But, what is known is that the approximate residence time calculated for July 2015 was a little less than 5 days. This relatively short residence time for the lake suggests that there is probably not enough time for sediment contaminants diffusing into the water column to concentrate up to levels far exceeding what is seen in Pool 2 of the Mississippi River.

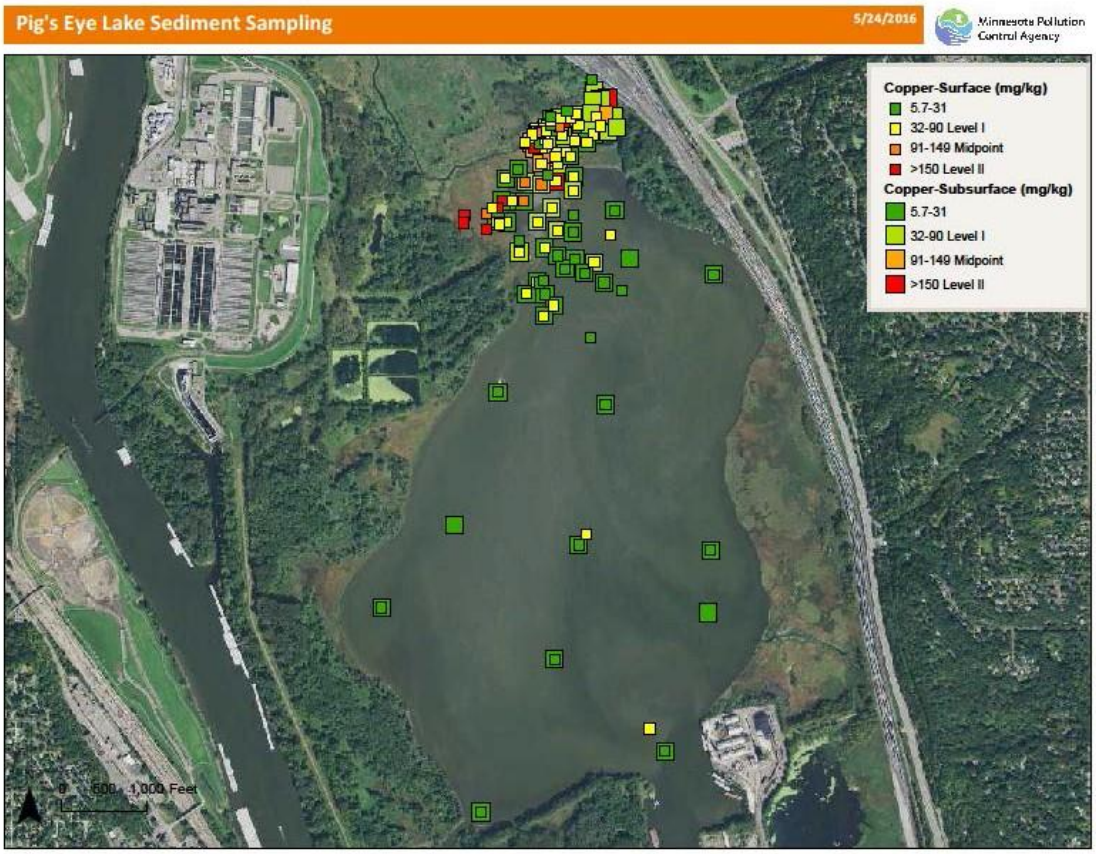

Figure 12. Pigs Eye Sediment - Copper Mean Probable Effects Concentration

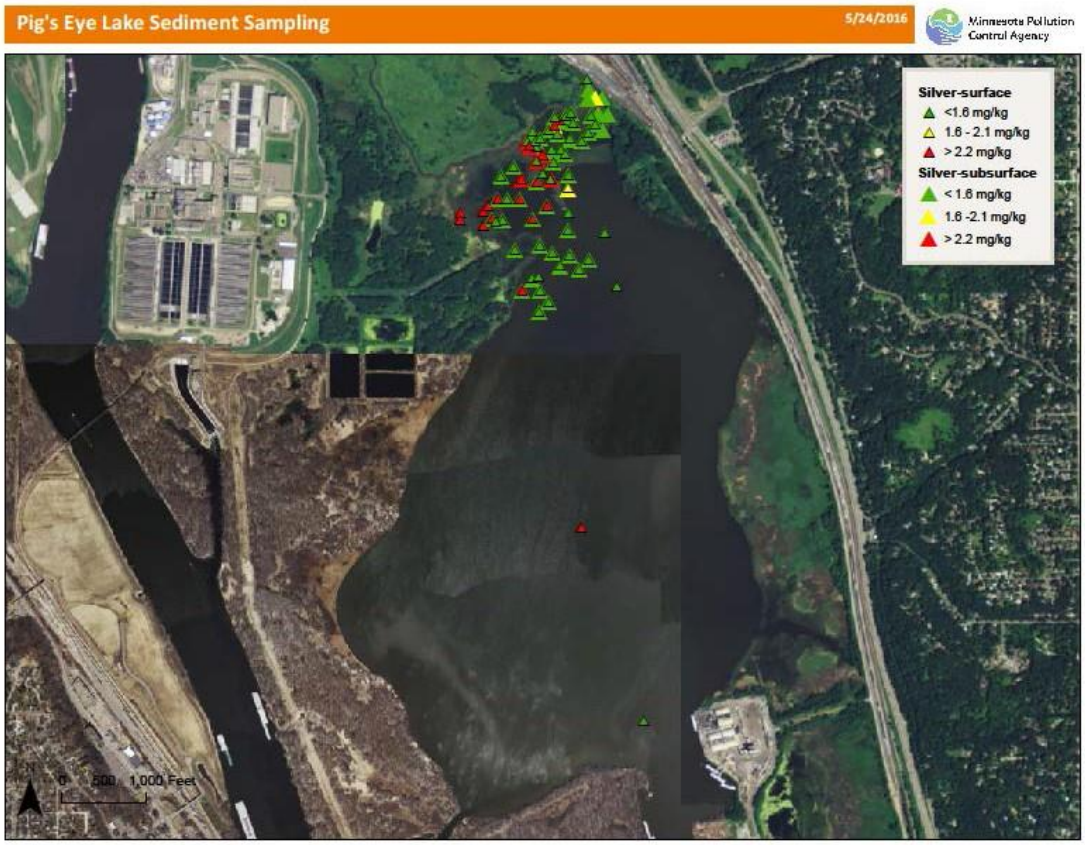

Figure 13. Pigs Eye Sediment - Silver Mean Probable Effects Concentration

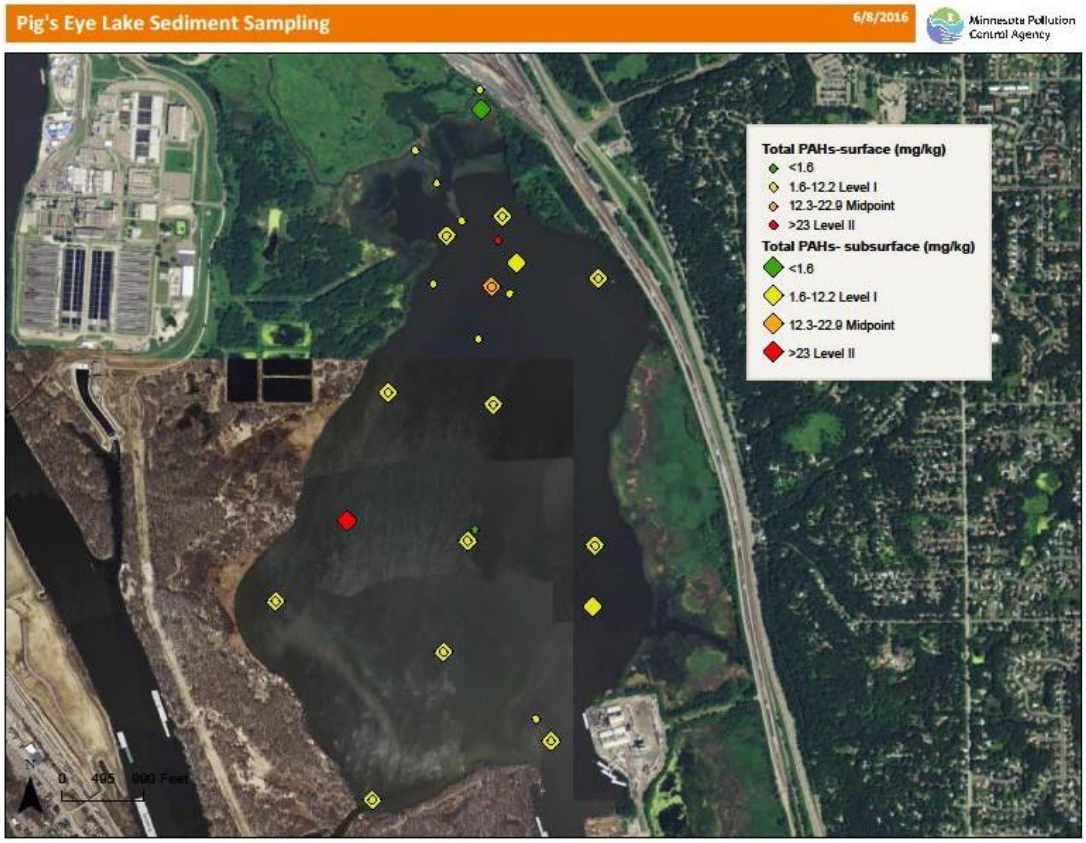

Figure 14. Pigs Eye Sediment – Total PAHs Mean Probable Effects Concentration

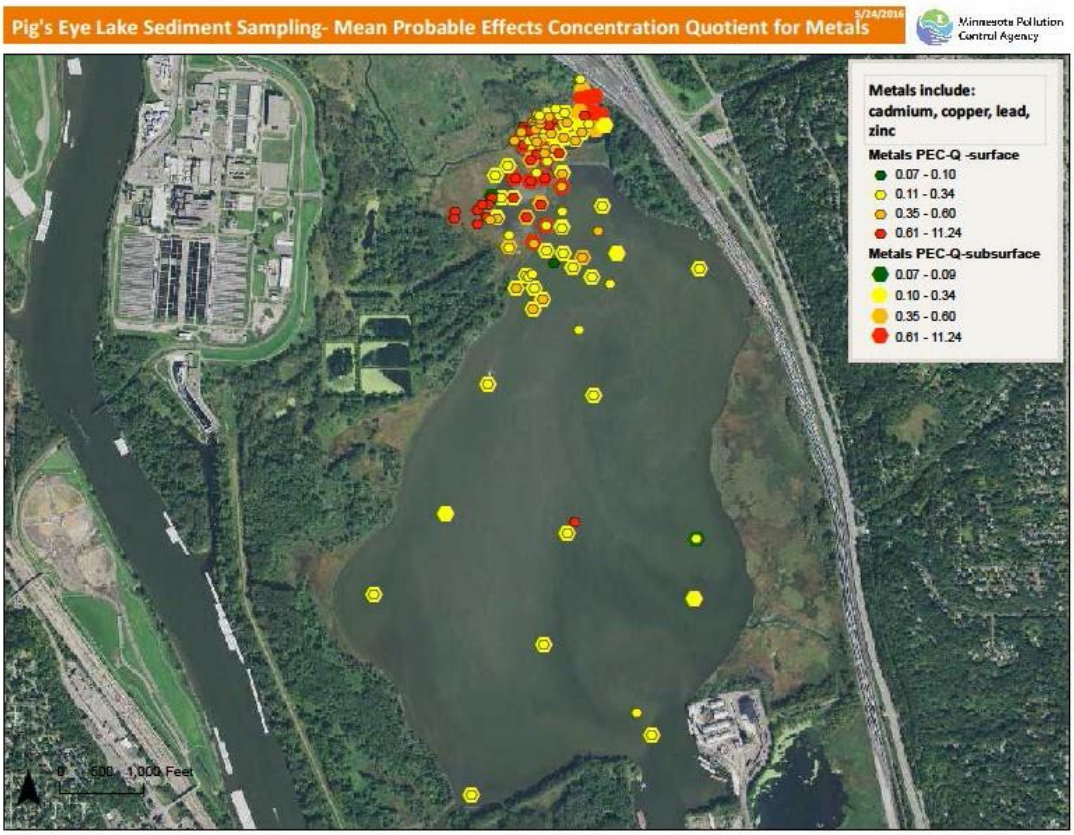

Figure 15. Pigs Eye Sediment - Metals Mean Probable Effects Concentration

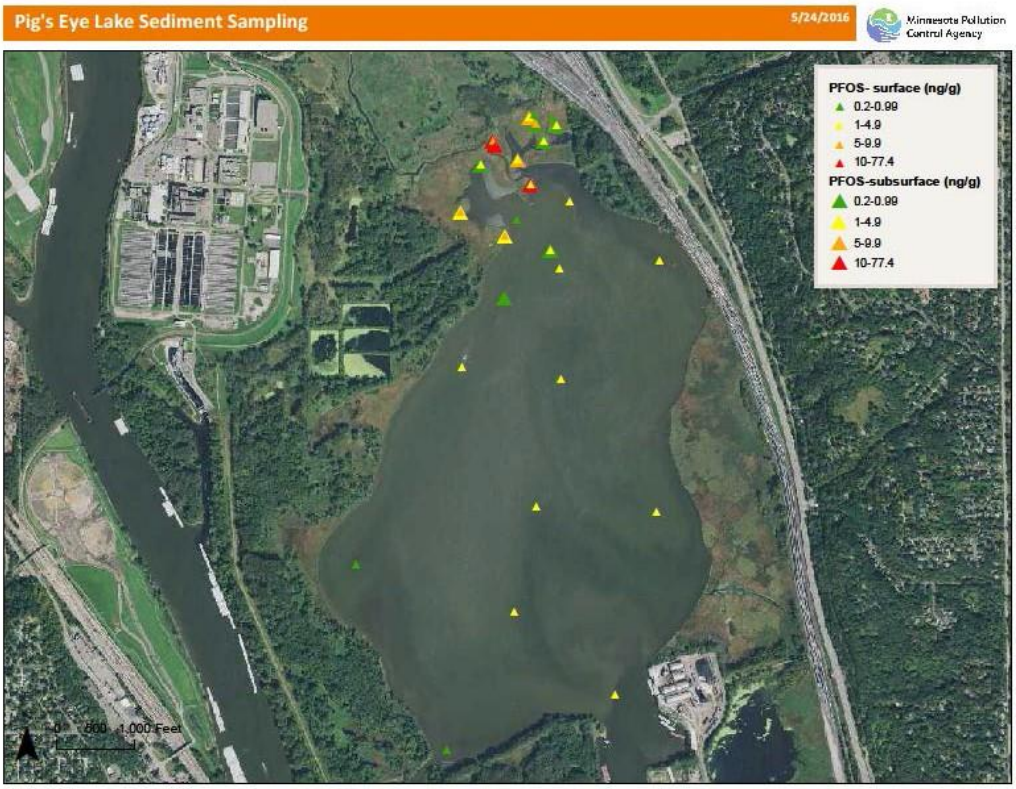

Figure 16. Pigs Eye Sediment - PFOS Mean Probable Effects Concentration

8 References

Sediment Investigation Report**,** Pig's Eye Lake, WENCK File #0777-08
Prepared for: Lockridge Grindal Nauen P.L.L.P, March 2016

Sediment Investigation Results, Pig's Eye Lake, Bay West LLC file BWJ140583
Prepared for: Minnesota Pollution Control Agency, January 30, 2015

Pigs Eye Landfill, St. Paul, Ramsey County Minnesota, Cerclis NO. MND980609085
U.S. Dept. of Health and Human Services, September, 29 2000
Public Health Service Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation, Atlanta, GA

PIG'S EYE LAKE SECTION 204
Perfluorochemicals (PFCs) in Pig's Eye Lake

Summary

The Corps is currently studying the feasibility of constructing habitat enhancement features in Pig's Eye Lake using material dredged during maintenance of the main channel of the Mississippi River navigation channel, under the authority of Section 204 of the Corps' Continuing Authorities Program. Due to the proximity of Pig's Eye Lake to a former landfill, potential contamination of the area is being considered during project planning. One group of contaminants known to exist near the proposed project location is Perfluorochemicals (PFCs). This paper summarizes the information available regarding PFCs in Pig's Eye Lake and nearby areas in order to (1) Compare the levels of PFCs in the sediment and water of the project area with local and regional levels, (2) Compare levels of PFCs found in local and regional wildlife, and (3) Use this information to make a determination of whether PFCs should be studied further or remediated prior to implementing a project in Pig's Eye Lake.

Data available included numerous peer-reviewed research articles and several studies published by the Minnesota Pollution Control Agency. All reports indicate that PFCs are widespread throughout Mississippi River Pool 2 and downstream of the Minneapolis-St. Paul metro area, and that they are elevated compared to reference sites upstream of the metro area and lakes throughout Minnesota. Several sites in Pool 2 have been identified as point-source contributors of PFCs, including the former Pig's Eye Landfill located north of the proposed project. PFC concentrations in sediments collected in Pig's Eye Lake are slightly elevated compared to the pool-wide concentrations, but significantly lower than the Pig's Eye Dump site, the area directly below the 3M Cottage Grove Plant, and Lower Pool 2 in general. Water, bird, and fish testing all show similar patterns, with the highest PFC levels in Lower Pool 2. Although PFCs are clearly present in Pig's Eye Lake, studies to date indicate that the contamination levels within the lake itself are much lower than sites where PFCs have been introduced

Based on the available data as summarized in this review, it is concluded that PFCs are not at levels that should preclude construction of habitat enhancement features within Pig's Eye Lake. Best Management Practices will be developed and implemented during project construction to minimize re-suspension and disturbance of sediments to further minimize risk of impacts. Coordination with local resource agencies will continue, and a monitoring plan may be developed to confirm the absence of effects.

Appendix : Sediment Report Pigs Eye Lake Ramsey County

Introduction

Perfluorochemicals (PFCs) are a group of chemical compounds that have been used since the 1950s in the production and manufacture of numerous consumer products, most notably fire-fighting foam, stain protection, and non-stick surfaces (MPCA 2013). PFCs were identified as a pollutant relatively recently in 2001, when scientists reported perfluorooctane sulfonate (PFOS) in wildlife throughout the world (Giesy & Kannan 2001). Since then, a number of studies have reported PFCs found in sediments, soils, surface water, groundwater, fish, birds, bird eggs, and humans. A number of sources have been identified for PFCs, including direct releases from manufacturing facilities, certain waste disposal areas, sites of certain firefighting efforts or training, and wastewater treatment plant effluent. The effects of PFCs on humans and wildlife are under investigation. Studies so far have indicated the potential for these compounds to disrupt endocrine system function and enhance cell membrane permeability for other pollutants. However, guidelines and criteria for assessing the potential impacts of PFC concentrations in the environment have not been fully developed.

Pig's Eye Lake is a 668-acre floodplain depression lake that is connected to the Mississippi River on the downstream side of the lake. Directly to the north of the lake is the site of Pig's Eye Landfill, operated from the mid-1950s until 1972 for the disposal of mixed municipal and commercial waste. Some remediation has been completed at the dump site, but monitoring and further remediation is ongoing. PFCs are one of the contaminants that has been found in soils tested at the dump site as recently as 2016. Additionally, PFCs have been found in sediments tested in Pig's Eye Lake.

The habitat in Pig's Eye Lake is currently of low quality. The lake is uniformly 3-4 feet deep with little bathymetric diversity (USACE 2015). Macroinvertebrate investigations of Pig's Eye Lake have reported low diversity and low abundance, and noted that the species present are groups that are considered to be tolerant to pollution and organic enrichment (Durland, Pattock, & Johnson 2006; Montz 2007). Sediments are easily and frequently re-suspended in the water column due to wind/wave action and rough fish leading to very turbid conditions. The high turbidity and unconsolidated sediments prevent growth of aquatic vegetation. The wind fetch across the lake has led to consistent and significant shoreline erosion on the northwest and southeast sides of the lake for at least the last 70 years (USACE 2016). Despite these challenges, there are some areas of high value to wildlife surrounding Pig's Eye Lake, leading to fairly frequent use of the lake by wildlife. This includes Pig's Eye Heron Rookery Scientific and Natural Area to the south of the lake, which is one of the largest nesting sites for colonial waterbirds within Minnesota and one of four places in the state where yellow-crowned night herons are known to nest. The natural high ground separating the main channel of the Mississippi River from Pig's Eye Lake is a tract of bottomland hardwood forest where eagles, otters, and beaver activity has been observed (Holdhusen 2016). There is a dense patch of aquatic vegetation on the southeast of the lake that consists mainly of river bulrush with a few instances of purple loosestrife (Stiras, *pers comm,* 2016).

The juxtaposition of the low-quality habitat available within Pig's Eye Lake with the relatively abundant wildlife documented nearby suggests that an improvement of habitat within the lake could be of significant value to the local ecosystem. The Corps of Engineers is not authorized to conduct site remediation under the Section 204 authority, and therefore is limited to working within the constraints of the area. Because of the lack of clear guidelines regarding PFC levels, this paper summarizes the data available regarding PFCs and discusses the risks related to habitat enhancement in Pig's Eye Lake.

PFC Levels in the Environment and Wildlife

PFCs have been detected in many locations throughout the world. While there are still many aspects of these contaminants that are unknown, data regarding PFC levels in the environment and in wildlife are available for many locations. At a local level, Minnesota is home to several facilities that have historically manufactured PFCs starting in the late 1950s, and some facilities that still do today. Because of the proximity of the proposed project site to these known PFC sources, some data is available in the immediate project area. Studies examining PFCs in the regional environment have been collected and summarized below to compare PFC levels reported in sediment, water, soil, fish, birds, and humans.

Sediment Data

Sediment sampling results for PFOS and PFOA from Pool 2 were summarized geographically on the map shown on Plate 1. PFC concentrations in sediments collected in Pig's Eye Lake are slightly elevated compared to the poolwide concentrations, but significantly lower than sub-areas that are known to be contaminated with PFCs such as the Pig's Eye Dump site, the area directly below the 3M Cottage Grove Plant, and Lower Pool 2 in general. Data was summarized from the following studies:

Sediment References:

MPCA May 2007 Sampling Data (Sites PE1-PE12, tested for various analytes, including PFOA/PFOS)
MPCA 2013. PFCs in Mississippi River Pool 2: 2012 Update
Bay West 2015. Sediment Investigation Results for Pig's Eye Lake, conducted Oct 2014
Wenck 2016. Sediment Investigation Report: Pig's Eye Lake, St. Paul, Minnesota
USACE 2016. Sediment Investigation of Pig's Eye Lake for Section 204 Project

Wildlife - Birds

Four studies were identified that reported PFC levels in birds in the region. Three of the studies analyzed PFCs in great blue heron eggs, and included samples collected from several locations: from the southern side of Lake Michigan in Indiana, Pig's Eye Lake, and from colonies both upstream and downstream of Pig's Eye Lake on the Mississippi River. Eggs from the Pig's Eye colony were tested multiple years, enabling both spatial and temporal comparisons. The archived eggs from the Pig's Eye Lake colony in 1993 had the highest mean total PFC concentrations, but eggs from the colony in 2010 and 2011 tested significantly lower. The upstream Mississippi River site had the lowest PFC levels. Relatively high variation within the sites was apparent, with exceptionally high PFC concentrations (in excess of 1,000 g/ng wet wt., up to 9,546 g/ng) for individual eggs collected from each of the sites except the Mississippi River upstream site.

The fourth study examined PFC concentrations in the blood-plasma of bald eagle nestlings over six years from locations along the Mississippi River in and around the Twin Cities Metro Area, throughout the St. Croix River watershed, and on Lake Superior. PFCs were detected at the highest concentrations in Navigation Pools 3 & 4, downstream of the 3M Cottage Grove facility located in Lower Pool 2. In general,

high PFC concentrations were widespread throughout the Twin Cities Metro area and downstream on the Mississippi River for approximately 60 miles to Wabasha, Minnesota, and approximately 50 miles upstream on the St. Croix River all the way to Taylor's Falls, Minnesota.

Overall, these studies appear to indicate that PFC concentrations are higher in birds in the Minneapolis-St. Paul metro area. Two studies presented evidence that total PFC levels, including PFOS, may be generally decreasing; however, one study found evidence that some congeners may be increasing. It is unknown at what level PFCs would cause effects to great blue heron eggs, but the authors noted that the PFC concentrations found were generally similar to those reported for other North American fish-eating birds. The majority of eagle nestlings tested, even those within the metro area, had blood-plasma PFC concentrations lower than the toxicity reference value. These findings suggest that birds nesting near Pig's' eye would be exposed to similar levels of contaminants compared to those nesting in the surrounding Mississippi or St. Croix Rivers.

Bird References:

Custer et al. 2009. PFCs and PBDE in Great Blue Heron Eggs from Indiana Dunes National Lakeshore, Indiana. *Journal of Great Lakes Research (35): 401-405*.

The authors tested archived great blue heron eggs that were collected at the Indiana Dunes National Lakeshore Park in 1993 for PFCs. The authors reported that PFCs were detected in all of the eggs analyzed. One exceptionally high PFOS concentration of 9,450 ng/g wet weight was reported, but the geometric mean for total PFCs was 279 ng/g wet weight (range 55.7 - 9,546). The authors note that the PFC concentrations reported are similar to those reported from other North American fish-eating birds. The authors also note that concentrations of PFOS were below toxicity thresholds estimated for bobwhite quail and mallards (Newsted et al. 2005), but within toxicity thresholds for white leghorn chickens (Molina et al. 2006), but that since no studies have been conducted to determine the sensitivity of great blue herons to PFOS, it is unknown how these levels may be impacting the birds.

Custer et al. 2010. PFCs and PBDEs in Great Blue Heron Eggs from Three Colonies on the Mississippi River, Minnesota. *Waterbirds 33(1): 86-95*.

The authors tested archived great blue heron eggs that were collected from three colonies on the Mississippi River in 1993 – one colony was located on Pig's Eye Island, one colony was located 140 km upstream from Pig's Eye Lake, and one colony located 114 km downstream. The authors reported that PFCs were detected in all of the eggs analyzed, but concentrations of PFCs in eggs from the Pig's Eye Lake colony were significantly higher than those from the other colonies. The Total PFC concentrations in the eggs from the Pig's Eye colony had a mean 1,015 ng/g wet weight (range 617 - 2,031), while the mean for the upstream colony was 68 ng/g wet wt. (range 43 - 161), and the mean total PFCs for the downstream colony was 153 ng/g wet wt. (range 47 - 1,279).

Custer et al. 2013. PFC Concentrations in Great Blue Heron Eggs Near St. Paul, MN, USA, in 1993 and 2010-2011. *Environmental Toxicology 32:5, pp 1077-1083*.

The authors measured PFC concentrations in great blue heron eggs from the Pig's Eye Lake colony in 2010 and 2011 and compared the results to those obtained from the archived eggs tested in 1993 (Custer et al. 2010). Concentrations of total PFCs and PFOS were significantly lower at Pig's Eye in 2010 and 2011 than 1993. However, several other PFCs that constituted a smaller percentage of the total PFCs increased significantly since 1993. Mean total PFCs were 1,015 (95%CI: 649-1,589) ng/g wet weight in 1993, 340 (95%CI: 204-566) in 2010, and 492 (95%CI: 270-896) in 2011. Two exceptionally high PFOS concentrations were noted: 1,878 ng/g in 1993 and 2,506 ng/g in 2011.

Route et al. 2014. Spatial and Temporal Patterns in Concentrations of PFC Compounds in Bald Eagle Nestlings in Upper Midwestern United States. *Environmental Science & Technology 48:6653-6660*.

The authors of this six-year study found evidence of relatively high PFC concentrations in eagle nestling blood plasma in the Twin Cities Metro Area, with the highest mean concentrations downstream of the 3M Cottage Grove facility in Pools 3 & 4. Similar to other studies, PFOS was the most abundant PFC. The authors note that the PFOS levels found in this study were mostly lower than the toxicity reference value (TRV) developed by Newsted et al. (2005) for level IV fish-eating birds (1700 ng PFOS/mL blood-plasma). However, several individual nestlings in Mississippi National River and Recreation Area (5 of 98 nestlings) and in the Lower St. Croix National Scenic Riverway (2 of 21 nestlings) were higher than the protective TRV.

Water

Two studies were identified that reported PFC levels in water in the region. One study tested levels of thirteen PFC congeners throughout the Upper Mississippi River Basin in 2008 including six sites near the study area, while the other study was focused entirely on Pool 2 and reported only PFOS levels for 2009 and 2012. Similar trends were seen in fewer detections and lesser concentrations of PFCs above Pig's Eye Lake, slightly elevated concentrations below Pig's Eye Lake, and significantly higher (doubled or more) concentrations in Lower Pool 2. Nakayama et al. even reported that one station in upper Pool 3 had the highest PFOA detection in the entire study.

Water References:

Nakayama et al. 2010. Determination of PFCs in Upper Mississippi River Basin. *Environmental Science & Technology 44: 4103-4109*.

This study was designed to improve analytical methods for determining PFC concentrations in surface water. In doing so, the authors organized the collection of 177 samples from 88 sites

throughout the Upper Mississippi River Basin and a portion of the Missouri River Basin by five state and federal agencies. Collection occurred in 2008. Six local sampling sites are of particular interest to the proposed Pig's Eye project and span the Mississippi River from above the confluence with the Minnesota River in Minneapolis to below the confluence of the St. Croix River near Red Wing, Minnesota. PFOS was reported below Pig's Eye Lake at 10.2 ng/L and rose to 29.0 ng/L below Lock and Dam Number 2. Similarly, PFBA was detected at 6.26 ng/L below Pig's Eye Lake and rose to 34.2 ng/L below Lock and Dam No. 2. Another sampling point downstream before the confluence of the St. Croix River reported PFOS and PFBA concentrations similar to those below Lock and Dam No. 2, but also was recorded as the site with the highest PFOA detection in the entire study.

The authors concluded that, "measurements in most samples were comparable to low-level 'background' concentrations reported in previous studies (<10 ng/L)," but also noted that, "samples occasionally had elevated levels," citing concentrations of C4 at 458 ng/L, PFOS at 245 ng/L, and C8 at 125 ng/L. To this end, the authors noted many sampling points with localized increases in PFC concentrations that dissipated shortly downstream, suggesting point-source inputs. The authors identified wastewater treatment plants, chemical manufacturing plants, and historical firefighting activity as known point sources, and speculated surface water runoff from cities and farm fields and groundwater input from agricultural areas as potential sources.

MPCA 2013. PFCs in Mississippi River Pool 2: 2012 Update

As part of a long-term plan for monitoring PFCs in Mississippi River Pool 2, the MPCA conducted water sampling and testing for PFOS in 2009 and 2012. (*Because the results from the two years are compared in this most recent report, the 2009 report is not separately summarized*.) Twelve sampling stations were spread throughout Pool 2. In both years, PFOS was below the detection limit of approximately 5 ng/L in all five stations upstream of Pig's Eye Lake. PFOS was at detectable levels in 2009 at the three stations downstream of Pig's Eye Lake at average concentrations of 7.7, 10.3, and 8.5 ng/L, but not detectable in 2012. Stations 11 and 12 are located downstream of the 3M Cottage Grove Center and the East Cove and showed significant increases from 90.1 ng/L to 149 ng/L at Station 11 and from 15.2 ng/L to 24.4 ng/L at Station 12.

Fish and Aquatic Biota

Three studies examining PFCs in fish were reviewed. All three studies sampled fish within Pool 2, and all three reported that fish in Lower Pool 2 had the highest PFC concentrations found. Ye et al. examined common carp in particular, and noted that because common carp are known to generally stay within a smaller home range, the 27km distance between Pig's Eye Lake and Lower Pool 2 is likely to limit the movement of carp between these areas, and therefore, the differences in PFC concentrations between the two areas may be a good indicator of significantly different levels of PFC inputs to the system. Delinsky et al. also reported PFC concentrations in fish from 59 lakes in Minnesota, most of which were significantly lower than those reported in fish from the Mississippi River. The MPCA report compared

PFC concentrations from 2004-2012 and noted that annual median PFOS concentrations in Lower Pool 2 have declined over time, especially in the most recent two years.

Fish and Aquatic Biota References:

Ye, X., H. L. Schoenfuss, N. D. Jahns, A. D. Delinsky, M. J. Strynar, J. V. Varns, S. F. Nakayama, L. Helfant, and A. B. Lindstrom. (2008). Perfluorinated compounds in Common Carp (*Cyprinus carpio*) fillets from the Upper Mississippi River. Environment International 34: 932-938.

The authors measured PFCs in 30 common carp fillets collected from three sites on the UMR including one reference site upstream of the Twin Cities Metro area in St. Cloud, Minnesota, one site in Pig's Eye Lake, and one site in Spring Lake in Lower Pool 2. Median PFOS concentrations increased from 8.1 ng/g wet wt. at the St. Cloud site to 26 ng/g wet wt. at the Pig's Eye Lake site, and to 40 ng/g wet wt. at the Lower Pool 2 site. PFDoA, PFUnA, and PFDA also all showed significant increases as compared to the St. Cloud site. The authors note that although the Lower Pool 2 site and the Pig's Eye Lake site are longitudinally connected by being within the same navigational pool, a 2006 study of carp movement reported that over an observation period of 5 years, less than 20% of tagged common carp moved more than 5 km from their original capture site (Stuart and Jones). Consequently, the 27 km distance between the Pig's Eye Lake site and the downstream Lower Pool 2 site may be enough distance to limit the majority of common carp interchange, and therefore, the differences in PFC concentrations between the two sites may be a good indicator of significantly different levels of PFC inputs to the system in each area.

Delinsky et al. 2010. Geographical Distribution of PFCs in Fish from Minnesota Lakes and Rivers. *Environmental Science & Technology. (44) 2549-2554*.

The authors tested fish collected from 59 lakes throughout Minnesota, and from several areas of the Mississippi River. Species tested were limited to bluegill, black crappie, and pumpkinseed. On the Mississippi River, fish collected from Lower Pool 2 had the highest PFOS concentrations in the study – 144 ng/g in pumpkinseed and 2,000 ng/g in bluegill. (The authors noted that another previous study had also reported higher PFC concentrations in bluegill than in pumpkinseed). All other samples on the Mississippi River were at least 110 miles upstream of Lower Pool 2, and contained significantly lower PFOS concentrations, ranging from 3.06 to 20 ng/g. The majority of lakes tested had significantly lower levels with PFOS concentrations less than 3 ng/g in 88% of lakes sampled. Only two lakes had PFOS concentrations above 40 ng/g.

MPCA 2013. PFCs in Mississippi River Pool 2: 2012 Update

As part of a long-term plan for monitoring PFCs in Mississippi River Pool 2, the MPCA collected and analyzed PFOS data from fish collected from 2004-2012 and from benthic invertebrates in 2012. For fish, bluegill sunfish, common carp, freshwater drum, smallmouth bass, and white bass were targeted. The median PFOS concentrations for each species throughout the pool ranged from 24 ng/g wet wt. in carp to 60 ng/g wet wt. in white bass. The highest PFOS concentration, 6,160 ng/g,

was detected in a carp collected in Lower Pool 2 in 2012. The annual median PFOS concentrations in Lower Pool 2 have declined over time, especially in the most recent two years. Sampling in 2009 and 2012 was conducted throughout Pool 2, and was therefore compared by section and species. There was a decline in PFOS concentrations in all areas of the pool. Fish collected in Lower Pool 2 had higher PFOS concentrations than fish collected in all other areas of the pool for all species in both years.

PFOS concentrations in benthic Invertebrates were positively correlated with PFOS concentrations in sediments. PFOS concentrations ranged from 1.7 ng/g wet wt. to 684 ng/g wet wt., with a median of 11.9 ng/g wet wt. Only two samples had PFOS concentrations greater than 50 ng/g wet wt., and these were both collected immediately downstream of the 3M Cottage Grove Center in Lower Pool 2.

Conclusions and Recommendations

PFCs are clearly ubiquitous within our environment today, and a number of studies have reported levels of PFCs in the Upper Mississippi River. Most studies show increased levels of PFCs in the Twin Cities Metro Area and directly downstream. However, the most significantly elevated levels of PFCs appear to be in Lower Pool 2, approximately 27km downstream of the project area. PFC levels also remain high in sediments at the Pig's Eye Landfill to the north of the project area; however, levels in the lake itself do not appear to be significantly elevated compared to the general region. Levels of most PFC congeners appear to be declining in water, fish, and birds, based on studies that have repeated samples over time.

Because data is limited and PFCs are a relatively new pollutant of concern, new studies should be reviewed as they become available and any conclusions drawn from them incorporated into project planning or adaptive management strategies as applicable. Based on a review of Route et al. (2014a) and personal communications with the corresponding author, it may be prudent to conduct monitoring of eagle nestling blood-plasma PFC levels as a method to see if project construction releases PFCs into the aquatic food web.

Based on the available data as summarized in this review, it is concluded that PFCs are not at levels that should preclude construction of habitat enhancement features within Pig's Eye Lake. Best Management Practices will be developed and implemented during project construction to minimize re-suspension and disturbance of sediments to further minimize risk of impacts. Coordination with local resource agencies will continue, and a monitoring plan may be developed to confirm the absence of effects.

Additional Sources Reviewed

The following sources were identified during the literature search as related to PFCs but were not summarized in this paper because of limited applicability (subject matter, location, etc.) or duplicative content.

Gebbink, W.A., C. E. Hebert, and R. J. Letcher. 2009. Perfluorinated Carboxylates and Sulfonates and Precursor Compounds in Herring Gull Eggs from Colonies Spanning the Laurentian Great Lakes of North America. Environmental Science & Technology 2009 43 (19), 7443-7449.

Houde et al. 2011. Monitoring of PFCs in Aquatic Biota: An Updated Review. Environmental Science & Technology (45)7962-7973.

Nakata et al. 2006. PFCs in Sediments and Aquatic Organisms Collected from Shallow Water and Tidal Flat Areas of the Ariake Sea, Japan: Environmental Fate of PFOS on Aquatic Ecosystems. Environmental Science & Technology (40): 4916-4921.

Pan et al. 2011. Pilot Investigation of PFCs in River Water, Sediment, Soil, and Fish in Tianjin, China. Bull. Environmental Contaminant Toxicology (87):152-157.

Route, et al. 2011. Spatial patterns of persistent contaminants in bald eagle nestlings at three national parks in the upper Midwest: 2006-2009. Natural Resource Technical Report NPS/GLKN/NRTR---2011/431/ National Park Service, Fort Collins, Colorado.

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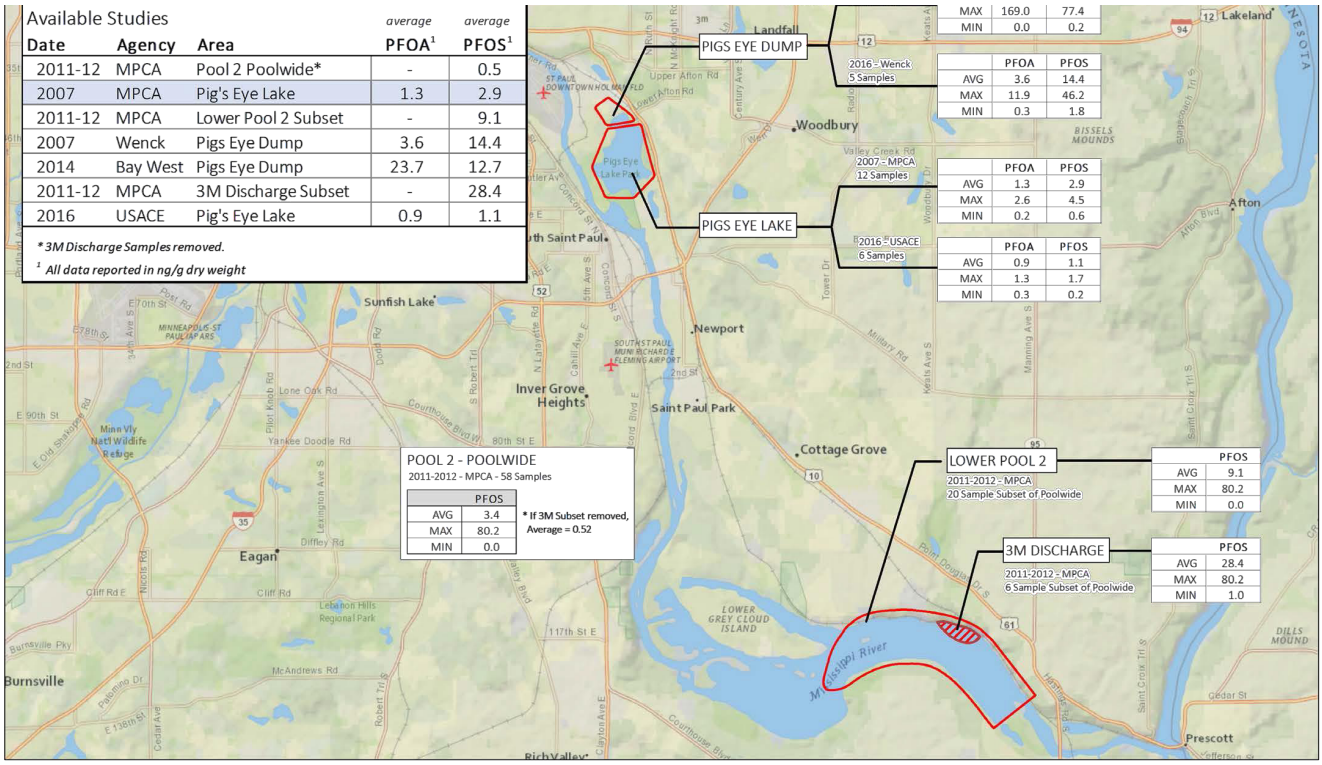

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		Lab																						
		Data Cit.					COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	Barr	Stat			COE	COE
CHCS	ug/kg	a-BHC			680	3500			< 0.1	< 0.24	< 0.22			< 0.08	< 0.08		< 0.09	< 0.12	<2.1	< 0.13			< 1.1	< 1
	ug/kg	b-BHC			2500	13000			< 0.2	1.7	< 0.22			< 0.16	< 0.15		< 0.19	< 0.12	<2.1	< 0.27			< 1.1	< 1
	ug/kg	BHC			1100	5900			< 0.29	< 0.24	< 0.22			< 0.24	< 0.23		< 0.28	< 0.12	<2.1	< 0.4			< 1.1	< 1
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000			< 0.13	< 0.24	< 0.22			< 0.11	< 0.1		< 0.13	< 0.12	<2.1	< 0.18			< 1.1	< 1
	ug/kg	Heptachlor			1600	7700			< 0.1	< 0.24	< 0.22			< 0.08	< 0.08		< 0.09	< 0.08	<2.1	< 0.13			< 1.1	< 1
	ug/kg	Aldrin			450	2400			< 0.13					< 0.11	< 0.1		< 0.13		<2.1	1.1				
	ug/kg	Heptachlorepoxid	2.5	16	280	4100			< 0.16					< 0.14	< 0.13		< 0.16	< 1.48	<2.1	< 0.22				
	ug/kg	Endosulfan I			13000	13000			< 0.16					< 0.14	< 0.13		< 0.16		<2.1	< 0.22				
	ug/kg	Dieldrin	1.9	62	110	1500	0	0	< 0.16	< 0.48	< 0.44		< 10	< 0.14	< 0.13	1.5	< 0.16	< 0.12	<2.1	< 0.22			< 1.1	< 1
	ug/kg	4,4'-DDE	3.2	31	22000	28000	0	0	< 0.13	< 0.48	< 0.44		< 10	< 0.11	< 0.1	< 0.1	< 0.13	0.55	<2.1	< 0.18			1.5	2.6
	ug/kg	Endrin	2.2	210	4000	54000	0	1	< 0.29	< 0.48	< 0.44		< 10	< 0.24	< 0.23	< 0.1	< 0.28	< 0.12	<2.1	< 0.4			< 1.1	< 1
	ug/kg	Endosulfan II							< 0.33					< 0.27	< 0.26		< 0.31		<2.1	< 0.45				
	ug/kg	4,4'-DDD	4.9	28	19000	100000	0.4	0	< 0.36	< 0.48	< 0.44		< 10	< 0.3	< 0.28	1.5	< 0.35	< 0.12	<2.1	< 0.49			< 1.1	< 1
	ug/kg	Endrinaldehyde							< 0.36					< 0.3	< 0.28		< 0.35		<2.1	< 0.49				
	ug/kg	Sulfan sulfate							< 0.36					< 0.3	< 0.28		< 0.35			< 0.49				
	ug/kg	4,4'-DDT	4.2	63	7300	86000	0	0	< 0.42	< 0.48	< 0.44		< 10	< 0.35	< 0.33	0.9	< 0.41	< 0.24	<2.1	< 0.58			< 1.1	< 1
	ug/kg	Methoxychlo							< 0.72					< 0.59	< 0.56		< 0.69		<2.1	< 0.98				
	ug/kg	Endrinketone							< 0.36					< 0.3	< 0.28		< 0.35		<2.1	< 0.49				
	ug/kg	Chlorodane	3.2	18	9500	11000	0	0	< 1.96	< 0.24	< 0.22		< 10	< 1.62	< 1.54	7	< 1.88	25.2	<44	< 2.68			< 1.1	< 1
	ug/kg	Oxychlordane																< 0.52						
	ug/kg	Toxaphene	0.1	32	4000	22000			< 1.54					< 1.88	< 1.38		< 1.46		<44	< 2.09				
METALS	mg/kg	Ag (silver)			77	1200																		
	mg/kg	Al(aluminum)																						
	mg/kg	As (arsenic)	9.8	33	9	9	0	0	2.7	0.72	0.68	0.36	< 0.8	2.7	< 1	29	2.5	3.27	2.5	4.5	1.56	1.5	5.9	3.2
	mg/kg	B (boron)			3100	46000																		
	mg/kg	Ba (barium)			3000	35000	20	20								100								
	mg/kg	Be (beryllium			31	380																		
	mg/kg	Cd (cadmium)	0.99	5	1.6	23	< 10	< 10	< 1.7	< 0.11	< 0.11	< 0.1	< 1	< 1.7	< 1.1	3	< 1.5	1.21	<0.61	< 2.2	0.9	1	0.41	0.36
	mg/kg	Cr (chromium) III	43	110	23000	100000	< 10	< 10	11.75	6.7	5.9	8.6	12	7.4	6.4	10	7.7	11.4	9.3	13.6	10.9	13.3	11	6.5
	mg/kg	Cu (copper)	32	150	2200	33000	< 10	< 10	19.8	2.6	5.3	3.5	3	10.9	8	18	10.4	11.4	8.7	11	9.7	10.4	19	6.5
	mg/kg	Fe (iron)			100000	100000	3500	3400								1200								
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1	0	0	0.64	< 0.04	< 0.04	0.079	0.6	0.034	< 0.01	< 0.01	0.037	< 0.008	<0.032	0.066	0.058	0.051	< 0.1	< 0.1
	mg/kg	Mg (magnesium																						
	mg/kg	Mn (manganese			2100	21000	210	210	777.5	197	632			427	81.1	1100	558	656	460	713			1100	390
	mg/kg	Mo (molybdenum																					<	
	mg/kg	Ni (nickel)	23	49	170	2600	< 10	< 10	11.15	6.2	8.4		12	< 8.4	< 5.7	20	8.6	20.9	11	< 11			12	8.2
	mg/kg	Pb (lead)			300	700	< 10	< 10	23.75	1.9	2.3	< 0.1	12	26.9	3.8	40	8.1	16.6	7.8	36.7	28.4	36.5	21	< 2.5
	mg/kg	Sb (antimony			6.2	93																		
	mg/kg	Se (selenium			77	1200			1.7					< 1.2	< 0.81		< 1.1			< 1.6				
	mg/kg	Sn (tin)			4600	70000																		
	mg/kg	Sr (strontium)			9300	100000																		
	mg/kg	Ti (titanium)			40000	28000																		
	mg/kg	Zn (zinc)			4600	70000	10	10	55.55	11.5	14.9	16.1	18	38	24.7	67	40.8	47	36	50.9	41.3	42.7	66	26
	mg/kg	V (vanadium																						
PCBS	ug/kg	Aroclor-1006							< 1.96	< 4.8	< 4.4			< 1.62	< 1.54		< 1.88		<110	< 2.68			< 11	< 10
	ug/kg	Aroclor-1221							< 1.96	< 4.8	< 4.4			< 1.62	< 1.54		< 1.88			< 2.68			< 11	< 10
	ug/kg	Aroclor-1232							< 1.96	< 4.8	< 4.4			< 1.62	< 1.54		< 1.88			< 2.68			< 11	< 10
	ug/kg	Aroclor-1242							< 1.96	< 4.8	< 4.4			< 1.62	< 1.54		< 1.88			< 2.68			< 11	< 10
	ug/kg	Aroclor-1248							< 1.96	< 4.8	< 4.4			< 1.62	< 1.54		< 1.88		<110	< 2.68			< 11	< 10
	ug/kg	Aroclor-1254							< 4.08	< 4.8	< 4.4			< 3.38	< 3.2		< 3.93		<110	< 5.58			< 11	< 10
	ug/kg	Aroclor-1260							< 4.08	< 4.8	< 4.4			< 3.38	< 3.2		< 3.93		<110	< 5.58			< 11	< 10
	ug/kg	Total PCB's	60	680	810	10000	5	0					0	0		8		314			0	0		
PARTICLE SIZE %FINER		3 in					100	100				100	100								100	100		
		1 1/2					100	100				100	100			100					100	100		
		3/4					100	100				100	100			100					100	100		
		3/8					100	79				89	100			100					100	100		
		4					99	60	100	99.3	58.3	79	98	100	96.9	100	100	100	99.5	99.2	99	99		
		8										57	90			100					99	99		
		10					95	34	99.7	96.3	42.6			96.6	86.1		100	200	98.6	94.6				
		16							96.1			43.0	23.0	91.5	68.7	100	99.7			93.7	96.0	96.0		
		18																100.0						
		20					75.0	15.0		75.4	30.7								95.8					
		30							84.1					87.6	35.0	100	98.8			76.0				
		40					38.0	7.0		23.9	12.9	7.0	12.0			100			91.3		53.0	53.0		
		50							84.1					87.6	35.0	100	98.8	95.5		76.0				
		60																	98.6					
		70														99.0		91.0						
		80					7.0	4.0	69.3					83.3	16.4		97.5			60.9				
		100							29.7	5.5	1.0	1.0	0.0	25.9	1.3	98.0	48.4	85.9		41.1	19.0	19.0		
		140							24.8	4.6	0.7			19.0	1.1		40.0	76.1	49.9	35.7				
		170																63.1						
		200					3.0	3.0	18.2	3.0	0.4	0.0	0.0	16.0	0.9	92.0	27.0	48.4	29.9	24.0	9.0	9.0	64.1	24.2
		230																44.9						
		270							13.6					9.7	0.7	85.0	17.5			16.5				
		0.20 mm					0.5	0.0	10.5			0.0	0.0	6.7	0.5	51.0	12.9			14.9				
		0.05 mm					0.0	0.0	7.0			0.0	0.0	6.0	0.4	22.0	10.4			8.5				
MISC	%	Total Organic Carb							2.43	0.061	0.069			4.37	2.61		3.39	1.1	26000	6.24			2.33	0.87
	mg/kg	Chem Oxy Demand					4400	2900				1850	< 487			62000					15755	16600		
	mg/kg	Kjedahl Nitrogen					330	330				--	447			6030			455		--	--		
	mg/kg	Total Phosph					160	470				--	216			--			26		--	--		
	mg/kg	Oil and Grease					0	0				47	773			0					1625	1712		
	mg/kg	Cyanide, Tota							< 0.91	< 0.06	< 0.06			< 0.91	< 0.62		< 0.83	< 0.10	<0.33	< 1.2			< 5	< 5
	mg/kg	Ammonia							87					94	5.3		90	52	35	110				
	mg/l	Ammonia Elutriate								< 0.06	< 0.06												28	2.1
	%	Moisture							44.6	16.3	15.7			45.1	18.9		39.5	39.8	25	59				
	%	Total Solids							55.4	83.7	84.3			54.9	81.1		60.5	60.2	75	41			57.5	72.1
	%	Volatile Solids							4.5	1.19	1.23			4.8	0.8		4.2	3.24	<0.01	6.5			6.5	2.7

Appendix : Sediment Report Pigs Eye Lake Ramsey County

			Data Cit.																					
CHCS	ug/kg	a-BHC			680	3500	< 1	< 0.31	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9			< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.23
	ug/kg	b-BHC			2500	13000	18	0.92	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9			< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	0.45
	ug/kg	BHC			1100	5900	< 1	< 0.31	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9			< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.23
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000	1.1	< 0.31	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9			< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.23
	ug/kg	Heptachlor			1600	7700	< 1	< 0.31	< 1	< 1	< 0.7	< 1.2	< 1	< 0.08	< 0.8	<1.9			< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.23
	ug/kg	Aldrin			450	2400										<1.9								
	ug/kg	Heptachlorepoxid	2.5	16	280	4100								< 1.48		<1.9								
	ug/kg	Endosulfan I			13000	13000										<1.9								
	ug/kg	Dieldrin	1.9	62	110	1500	1.2	< 0.62	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9	1.9	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.45
	ug/kg	4,4'-DDE	3.2	31	22000	28000	2.8	< 0.62	< 1	< 1	< 0.7	3.6	1.4	< 0.12	< 0.8	<1.9	0	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.45
	ug/kg	Endrin	2.2	210	4000	54000	< 1	< 0.62	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9	0	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.45
	ug/kg	Endosulfan II														<1.9								
	ug/kg	4,4'-DDD	4.9	28	19000	100000	< 1	< 0.62	< 1	< 1	< 0.7	< 1.2	< 1	< 0.12	< 0.8	<1.9	3.8	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.45
	ug/kg	Endrinaldehyde														<1.9								
	ug/kg	Sulfan sulfate																						
	ug/kg	4,4'-DDT	4.2	63	7300	86000	< 1	< 0.62	< 1	< 1	< 0.7	< 1.2	< 1	< 0.24	< 0.8	<1.9	0	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.45
	ug/kg	Methoxychlo														<1.9								
	ug/kg	Endrinketone														<1.9								
	ug/kg	Chlorodane	3.2	18	9500	11000	< 1	< 0.31	< 1	< 1	< 0.7	< 1.2	< 1	< 0.36	< 0.8	<40	9	< 10	< 0.79	< 0.79	< 0.9	< 0.9	< 0.86	< 0.23
	ug/kg	Oxychlordane												< 0.52										
	ug/kg	Toxaphene	0.1	32	4000	22000										<40								
METALS	mg/kg	Ag (silver)			77	1200																		
	mg/kg	Al (aluminum)																						
	mg/kg	As (arsenic)	9.8	33	9	9	6.1	3.5	4.5	5.1	2.2	6.9	3.6	1.4	1.9	1.4	2	< 0.8	1.3	2.3	5.4	3.9	3	1.9
	mg/kg	B (boron)			3100	46000																		
	mg/kg	Ba (barium)			3000	35000											100							
	mg/kg	Be (beryllium			31	380																		
	mg/kg	Cd (cadmium)	0.99	5	1.6	23	0.67	0.43	0.35	0.29	0.12	1	0.26	0.4	0.09	<0.56	< 10	0.9	0.06	0.17	0.29	0.23	0.16	0.41
	mg/kg	Cr (chromium) III	43	110	23000	100000	13	14	8.5	10	3.4	15	8.7	6.58	4.9	5.8	10	9	2.5	5.6	8.6	8.3	6.7	11.3
	mg/kg	Cu (copper)	32	150	2200	33000	25	9	16	16	4	42	13	4.04	4.3	<2.8	20	2	1.4	5.8	10	10	7	3.4
	mg/kg	Fe (iron)			100000	100000											12000							
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1	< 0.1	< 0.05	< 0.1	< 0.1	< 0.1	0.13	< 0.1	< 0.005	< 0.1	<0.029	0	1.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.04
	mg/kg	Mg (magnesium																						
	mg/kg	Mn (manganese			2100	21000	1500	563	926	940	260	1400	690	266	280	340	1300		140	300	620	600	400	345
	mg/kg	Mo (molybdenum																						
	mg/kg	Ni (nickel)	23	49	170	2600	15	11	11	14	4.7	13	11	10.9	6.2	6.1	30	5	2.9	7	11	10	7.5	11.1
	mg/kg	Pb (lead)			300	700	13	10	9.2	8.9	< 2.5	35	< 9.7	4.52	< 2.5	3.8	60	< 9	< 2.5	6.5	7	4.2	3.7	2.3
	mg/kg	Sb (antimony			6.2	93																	<	
	mg/kg	Se (selenium			77	1200																		
	mg/kg	Sn (tin)			4600	70000																		
	mg/kg	Sr (strontium)			9300	100000																		
	mg/kg	Ti (titanium)			40000	28000																		
	mg/kg	Zn (zinc)			4600	70000	70	40.7	48	49	15	100	45	14.6	21	17	70	12	9.4	27	40	38	27	17.6
	mg/kg	V (vanadium																						
PCBS	ug/kg	Aroclor-1006					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8	<96			< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1221					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8				< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1232					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8				< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1242					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8				< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1248					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8	<96			< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1254					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8	<96			< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Aroclor-1260					< 11	< 6.2	< 10	< 10	< 7	< 12	< 10		< 8	<96			< 7.9	< 7.9	< 9	< 9	< 8.6	< 4.5
	ug/kg	Total PCB's	60	680	810	10000								< 0.88			200	0						
PARTICLE SIZE %FINER	SILT CLAY	3 in															100	100						
		1 1/2															100	100						
		3/4															100	100						
		3/8															100	100						
	SAND coarse	4												99.7		99.7	100	100						71.6
		8																96						
		10						100						93.6		96	100							52.7
		16																90.0						
		18												78.6										
		20						99.8								77.7	100							35.0
		30																						
		40						99.5								39.6	100	20.0						16.0
		50												9.1										
		60														21.1								
		70												5										
		80															94.0							
		100						95.6						1.7				0.0						3.8
		140						86.3						0.5		3.8								3.6
		170												0.3										
		200					75.2	76.0	66.5	51.2	6.5	64.6	48.4	0.1	20.9	3.0	83.0	0.0	2.5	19.9	37.4	43.0	26.5	3.0
		230												0.1										
		270																						
		0.20 mm															45.0	0.0						
		0.05 mm															22.0	0.0						
MISC	%	Total Organic Carb					2.8	0.744	1.84	1.77	0.3	3.48	1.85	0.03	0.58	5900			0.28	0.7	1.21	1.7	0.76	0.075
	mg/kg	Chem Oxy Demand															73000	1874						
	mg/kg	Kjedahl Nitrogen														132	7300	134						
	mg/kg	Total Phosph														16	960	210						
	mg/kg	Oil and Grease															0	318						
	mg/kg	Cyanide, Tota					< 5	0.63	< 5	< 5	< 5	< 5	< 5	0.18	< 5	<0.3			< 5	< 5	< 5	< 5	< 5	< 0.06
	mg/kg	Ammonia												9		9.2								
	mg/l	Ammonia Elutriate					30	1.5	19	15	0.49	30	14		1.7				3.7	4.7	8.3	4.1	5.1	< 0.06
	%	Moisture						36.2						15.2		17.6								15.7
	%	Total Solids					55.8	63.8	60.1	63	78.3	47.8	57.6	84.8	68.1	82.3			76.3	72.8	67.2	63.6	70.3	84.3
	%	Volatile Solids					6.7	4.66	5.8	4.8	1.2	9.4	4.9	0.37	1.7	<0.01			1.2	2.7	4.5	5.1	3.5	1.21

Appendix : Sediment Report Pigs Eye Lake Ramsey County

			Data Cit.					COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	COE	MWCC	MWCC	MWCC
CHCS	ug/kg		a-BHC			680	3500			<0.12	<2.1	< 0.1	< 0.77				< 0.25			< 0.24		< 0.12	< 0.07			
	ug/kg		b-BHC			2500	13000			<0.12	<2.1	< 0.21	< 1.54				< 0.25			< 0.24		< 0.12	< 0.14			
	ug/kg		BHC			1100	5900			<0.12	<2.1	< 0.31	< 2.3				< 0.25			< 0.24		< 0.12	< 0.22			
	ug/kg		g-BHC (lindane)	2.4	5	4300	23000			<0.12	<2.1	< 0.14	< 1.02				< 0.25			< 0.24		< 0.12	< 0.1			
	ug/kg		Heptachlor			1600	7700			<0.08	<2.1	< 0.1	< 0.77				< 0.25			< 0.24		< 0.08	< 0.07			
	ug/kg		Aldrin			450	2400				<2.1	< 0.14	< 1.02										< 0.1			
	ug/kg		Heptachlorepoxid	2.5	16	280	4100			<1.48	<2.1	< 0.17	< 1.28									< 1.48	< 0.12			
	ug/kg		Endosulfan I			13000	13000				<2.1	< 0.17	< 1.28										< 0.12			
	ug/kg		Dieldrin	1.9	62	110	1500	0	0.66	<0.12	<2.1	< 0.17	< 1.28	< 0.2	0	0	< 0.49	< 10	< 10	< 0.48		< 0.12	< 0.12			
	ug/kg		4,4'-DDE	3.2	31	22000	28000	0	< 0.2	<0.12	<2.1	< 0.14	< 1.02	< 0.2	0	0	< 0.49	< 10	< 10	< 0.48		< 0.12	< 0.1			
	ug/kg		Endrin	2.2	210	4000	54000	0	0.2	<0.12	<2.1	< 0.31	< 2.3	< 0.2	0	0	< 0.49	< 10	< 10	< 0.48		< 0.12	< 0.22			
	ug/kg		Endosulfan II								<2.1	< 0.35	< 2.56										< 0.24			
	ug/kg		4,4'-DDD	4.9	28	19000	100000	0.3	1.43	<0.12	<2.1	< 0.38	< 2.82	0.2	0	0	< 0.49	< 10	< 10	< 0.48		< 0.12	< 0.26			
	ug/kg		Endrinaldehyde								<2.1	< 0.38	< 2.82										< 0.26			
	ug/kg		Sulfan sulfate									< 0.38	< 2.82										< 0.26			
	ug/kg		4,4'-DDT	4.2	63	7300	86000	0	1.68	<0.24	<2.1	< 0.45	< 3.33	< 0.4	0	0	< 0.49	< 10	< 10	< 0.48		< 0.24	< 0.84			
	ug/kg		Methoxychlo								<2.1	< 0.77	< 5.63										< 0.53			
	ug/kg		Endrinketone								<2.1	< 0.38	< 2.82										< 0.26			
	ug/kg		Chlorodane	3.2	18	9500	11000	1	3.05	<0.36	<41	< 2.09	< 15.36	< 0.4	0	0	< 0.25	< 10	< 10	< 0.24		< 0.36	< 1.44			
	ug/kg		Oxychlordane							<0.52												< 0.52				
	ug/kg		Toxaphene	0.1	32	4000	22000				<42	< 2.05	< 1.62										< 15.36			
METALS	mg/kg		Ag (silver)			77	1200																	0.094	0.588	0.175
	mg/kg		Al (aluminum)																							
	mg/kg		As (arsenic)	9.8	33	9	9	0		3.01	1.5	3.1	1.6		0	0	0.77	< 0.8	< 0.9	1.4	0.45	0.79	1	1.83	8.82	1.44
	mg/kg		B (boron)			3100	46000																			
	mg/kg		Ba (barium)			3000	35000	10							10	10										
	mg/kg		Be (beryllium			31	380																	0.174	0.588	0.218
	mg/kg		Cd (cadmium)	0.99	5	1.6	23	< 10	0.75	0.82	<0.57	< 1.6	< 1.2	0.96	< 10	< 10	0.38	< 1	< 1	0.39	< 0.1	0.36	< 1.1	0.085	1.024	0.346
	mg/kg		Cr (chromium) III	43	110	23000	100000	< 10	38.5	11.6	6.4	11.1	5.9	33.2	< 10	< 10	7.8	12	10	8.7	16.5	6.2	6.7	22.6	50.2	31.8
	mg/kg		Cu (copper)	32	150	2200	33000	< 10	8.8	9.81	4.1	10.8	< 1.5	6.64	< 10	< 10	2.4	5	2	2	7.9	2.3	7.7	5.3	24.8	8.4
	mg/kg		Fe (iron)			100000	100000	2600	14500					11100	3000	1700										
	mg/kg		Hg (mercury)	0.18	1.1	3.1	3.1	0	< 0.01	0.008	<0.032	0.048	< 0.01	< 0.01	0.06	0	< 0.04	0.7	0.4	< 0.04	0.097	< 0.006	< 0.01	0.02	0.1	0.22
	mg/kg		Mg (magnesium																							
	mg/kg		Mn (manganese			2100	21000	130		588	370	609	257		170	100	256			487		233	537			
	mg/kg		Mo (molybdenum																							
	mg/kg		Ni (nickel)	23	49	170	2600	< 10	22.4	17.4	7	9.2	< 5.8	28.7	< 10	< 10	6.8	10	7	8.2		8.77	5.6	15.4	25.5	18.9
	mg/kg		Pb (lead)			300	700	10	19.5	11.8	4.2	21.8	2.8	4.9	< 10	< 10	2.6	< 10	< 10	6.7	< 0.1	4.86	1.5	5.5	25.8	13.7
	mg/kg		Sb (antimony			6.2	93																			
	mg/kg		Se (selenium			77	1200					< 1.2	< 0.83										< 0.79	0.19	0.2	0.64
	mg/kg		Sn (tin)			4600	70000																			
	mg/kg		Sr (strontium)			9300	100000																			
	mg/kg		Ti (titanium)			40000	28000																			
	mg/kg		Zn (zinc)			4600	70000	10	202	41.8	21	55.6	13.4	66.4	20	8	14	19	20	15.3	29.7	14.7	15.6	30	102	40.3
	mg/kg		V (vanadium																							
PCBS	ug/kg		Aroclor-1006								<100	< 2.09	< 15.36				< 4.9			< 4.8			< 1.44			
	ug/kg		Aroclor-1221									< 2.09	< 15.36				< 4.9			< 4.8			< 1.44			
	ug/kg		Aroclor-1232									< 2.09	< 15.36				< 4.9			< 4.8			< 1.44			
	ug/kg		Aroclor-1242									< 2.09	< 15.36				< 4.9			< 4.8			< 1.44			
	ug/kg		Aroclor-1248								<100	< 2.09	< 15.36				< 4.9			< 4.8			< 1.44			
	ug/kg		Aroclor-1254								<100	< 4.35	< 32				< 4.9			< 4.8			< 3			
	ug/kg		Aroclor-1260								<100	< 4.35	< 32				< 4.9			< 4.8			< 3			
	ug/kg		Total PCB's	60	680	810	10000	11	15.9	< 0.88				1.2	0	0		0	0		0	< 0.88				
PARTICLE SIZE %FINER	SAND coarse		3 in					100	100					100		100		100	100		100					
			1 1/2					100	100					100		100		100	100		100					
			3/4					100	100					100		100		100	100		100					
			3/8					100	100					100		100		100			100					
			4					100	100	100	100	100	98.4	100		100	99.9	100	100	96.2	99	100	100			
			8						100					100				98	98		98					
			10					100		100	99.7	100	95.9			96	96.4			82		96.6	96.4			
			16						100			99.5	88.2	90.0				92.0	92.0		88.0		84.4			
			18							98.8												92.0				
			20					90.0			98.9					84.0	70.4			59.2						
			30									97.8	35.1										30.6			
			40					34.0	100		83.2			35.0		34.0	7.9	18.0	18.0	29.1	26.0					
			50							37.7		97.8	35.1									10.1	30.6			
			60								20.7															
			70							24.7												2.8				
			80					9.0				85.6	2.4			3.0							2.1			
			100						76.0	18.9		33.0	0.4	3.0			0.4	0.0	0.0	4.1	3.0	0.9	0.6			
			140							15.1	4.1	29.0	0.3				0.0			1.6		0.5	0.5			
			170																			0.4				
	SILT	fine	200					4.0	42.0	11.3	3.3	19.5		2.0		2.0	0.0	0.0	0.0	1.1	3.0	0.4	0.5			
			230							11												0.3				
	CLAY		270									13.3											0.4			
			0.20 mm					0.0				9.3				0.0		0.0	0.0				0.3			
			0.05 mm					0.0	19.0			8.8		2.0		0.0		0.0	0.0				0.2			
MISC	%		Total Organic Carb							0.98	11000	6.69	0.068				0.066			0.043		0.02	0.049			
	mg/kg		Chem Oxy Demand					3500	18400		<2.1			2760	1900	2800	11500	950	511	10600	4850					
	mg/kg		Kjedahl Nitrogen					230	--		389			--	350	302		236	138		--					
	mg/kg		Total Phosph					100	1770		4.5			853	85	97		177	250		--					
	mg/kg		Oil and Grease					0	560					7870	0	0	< 0.06	76	64	< 0.06	133					
	mg/kg		Cyanide, Tota							<0.10	<0.32	< 0.89	< 0.63				<0.06			0.09		< 0.10	< 0.6			
	mg/kg		Ammonia							68	27	77	1.2									7	< 0.24			
	mg/l		Ammonia Elutriate														<0.06			<0.06						
	%		Moisture							37.8	22.3	43.7	20.8				20.2			15.8		17.3	16.6			
	%		Total Solids							62.2	77.8	56.3	79.2				79.8			84.2		82.7	83.4			
	%		Volatile Solids							3.08	<0.01	4	0.5				1.15			1.06		0.41	0.7			

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CHC'S	ug/kg	a-BHC			680	3500	< 5				< 5	< 0.53	< 5	< 5	< 0.32	3.5	3	4.9	< 0.32	< 0.26	< 0.26	< 0.26	< 0.26									
	ug/kg	b-BHC			2500	13000	< 10				< 10	< 1.1	< 10	< 10	< 0.64	< 0.64	< 0.64	< 0.64	< 0.64	< 0.64	< 0.53	< 0.53	< 0.53									
	ug/kg	BHC			1100	5900																									
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000	8				< 7	< 0.53	< 7	< 7	< 0.32	< 0.32	< 0.32	1.2	< 0.32	< 0.26	< 0.26	< 0.26	< 0.26									
	ug/kg	Heptachlor			1600	7700	9				< 5	< 0.53	< 5	< 5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.26	< 0.26	0.33	< 0.26									
	ug/kg	Aldrin			450	2400																									
	ug/kg	Heptachlorepoxid	2.5	16	280	4100																									
	ug/kg	Endosulfan I			13000	13000																									
	ug/kg	Dieldrin	1.9	62	110	1500	< 20				< 20	< 1.6	< 20	< 20	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.79	< 0.79	< 0.79	< 0.79	< 0.1	< 0.1							
	ug/kg	4,4'-DDE	3.2	31	22000	28000	< 7				< 7	< 1.6	< 7	< 7	< 0.96	< 0.96	< 0.96	< 0.96	< 0.96	< 0.79	< 0.79	< 0.79	< 0.79	< 0.1	< 0.1							
	ug/kg	Endrin	2.2	210	4000	54000	< 10				< 10	< 2.1	< 10	< 10	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 1.1	< 1.1	< 1.1	< 1.1	< 0.1	< 0.1							
	ug/kg	Endosulfan II																													
	ug/kg	4,4'-DDD	4.9	28	19000	100000	< 14				< 14	< 3.2	< 14	< 14	< 1.9	< 1.9	< 1.9	< 1.9	< 1.9	< 1.6	< 1.6	< 1.6	< 1.6	< 0.1	< 0.1							
	ug/kg	Endrinaldehyde																													
	ug/kg	Sulfan sulfate																													
	ug/kg	4,4'-DDT	4.2	63	7300	86000	< 20				< 20	< 4.2	< 20	< 20	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	< 2.1	< 2.1	< 2.1	< 2.1	< 0.1	< 0.1							
	ug/kg	Methoxychlo																													
	ug/kg	Endrinketone																													
	ug/kg	Chlorodane	3.2	18	9500	11000	< 2				< 2	< 11	< 2	< 2	< 6.4	< 6.4	< 6.4	< 6.4	< 6.4	< 5.3	< 5.3	< 5.3	< 5.3	< 1	< 1							
	ug/kg	Oxychlordane																													
	ug/kg	Toxaphene	0.1	32	4000	22000																									
METALS	mg/kg	Ag (silver)			77	1200		0.28	0.06	0.124	0.144		0.041	0.042	0.136			0.024	0.026	0.011		1.139	0.02									
	mg/kg	Al (aluminum)																													
	mg/kg	As (arsenic)	9.8	33	9	9		3.3	1.71	2.13	2.09		1.15	2.16	1.65			2.9	1.48	1.66		6.34	3.25	1.5	1.3							
	mg/kg	B (boron)			3100	46000																									
	mg/kg	Ba (barium)			3000	35000																									
	mg/kg	Be (beryllium			31	380		0.36	0.119	0.233	0.137		0.107	0.149	0.158			0.159	0.102	0.091		0.235	0.167									
	mg/kg	Cd (cadmium)	0.99	5	1.6	23		0.341	0.123	0.38	0.202		0.309	0.47	0.355			0.141	0.126	0.052		4.5	0.112	< 0.2	< 0.2							
	mg/kg	Cr (chromium) III	43	110	23000	100000		19	14.8	18.8	33.5		17.3	38.7	10.8			13.1	7.4	7.5		41.8	14.5	6	6							
	mg/kg	Cu (copper)	32	150	2200	33000		10.4	4.3	7.4	6.2		6.2	12.3	5.4			4.3	2.8	1.9		23.4	4.9	3	3							
	mg/kg	Fe (iron)			100000	100000																		5600	4700						
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1		0.08	0.05	0.06	0.05		0.05	0.05	0.06			0.05	0.07	0.05		0.12	0.05	0.028	0.05							
	mg/kg	Mg (magnesium																													
	mg/kg	Mn (manganese			2100	21000		539	415.8	923.8					257.9			2090.7	275.8	196.8		478.2	2227.8									
	mg/kg	Mo (molybdenum																													
	mg/kg	Ni (nickel)	23	49	170	2600		11.5	9.8	13.2	15.8		11.7	16	6.6			9.7	6.7	5.7		13.7	9.5	8	7							
	mg/kg	Pb (lead)			300	700		10.6	2.2	4.2	4.2		3	11.9	4.8			2.7	2.5	2.2		25.2	3.2	4	4							
	mg/kg	Sb (antimony			6.2	93														4.7		7.9	14.1								
	mg/kg	Se (selenium			77	1200		0.08	0.05	0.07	0.05		0.05	0.16	0.12			0.12	0.12	0.12		0.12	0.13									
	mg/kg	Sn (tin)			4600	70000																									
	mg/kg	Sr (strontium)			9300	100000																									
	mg/kg	Ti (titanium)			40000	28000		0.7	0.6	0.6	0.6		0.6	0.7	0.6			0.6	0.6	1.9		3.3	5.4									
	mg/kg	Zn (zinc)			4600	70000		44.4	19	28.9	27.1		19.3	44.7	23.6			18.5	16.1	11.6		61.6	18.5	15	16							
	mg/kg	V (vanadium																													
PCB'S	ug/kg	Aroclor-1006					80				< 20	32	9.8	13	< 3.2	< 3.2	< 3.2	< 3.2	18	30.6	27.9	387	23.1									
	ug/kg	Aroclor-1221																													
	ug/kg	Aroclor-1232																													
	ug/kg	Aroclor-1242																													
	ug/kg	Aroclor-1248																													
	ug/kg	Aroclor-1254					1000				42	60	17	14	34	62	61	45	37	< 5.3	< 5.3	< 5.3	< 5.3									
	ug/kg	Aroclor-1260					< 20				9.8	8.5	< 20	< 20	12	19	18	12	11	< 5.3	< 5.3	9.3	< 5.3									
	ug/kg	Total PCB's	60	680	810	10000																		0	0						
PARTICLE SIZE %FINER		3 in																													
	SAND coarse	1 1/2																						100	100						
		3/4																						100	100						
		3/8																						99	100						
		4																						95	100						
		8																						88	99						
		10																													
		16																						76.0	96.0						
		18																													
		20																													
	SAND medium	30																						44.0	78.0						
		40																						17.0	49.0						
		50																						6.0	14.0						
		60																													
	SAND fine	70																						5.0	8.0						
		80																													
		100																						5.0	6.0						
		140																													
		170																													
	SILT	200																						4.0	5.0						
		230																													
	CLAY	270																						4.0	5.0						
		0.20 mm																						1.0	1.0						
		0.05 mm																						0.0	0.0						
MISC	%	Total Organic Carb																													
	mg/kg	Chem Oxy Demand																						2590	4400						
	mg/kg	Kjedahl Nitrogen																						130	190						
	mg/kg	Total Phosph																						190	170						
	mg/kg	Oil and Grease																						< 50	60						
	mg/kg	Cyanide, Tota																													
	mg/kg	Ammonia																													
	mg/l	Ammonia Elutriate																													
	%	Moisture																													
	%	Total Solids																													
	%	Volatile Solids																													

Appendix : Sediment Report Pigs Eye Lake Ramsey County

		Data Cit.																							
CHCS	ug/kg	a-BHC			680	3500		< 0.07	< 0.24	< 0.26								< 0.12	< 0.24			< 0.24	< 0.25	<2.2
	ug/kg	b-BHC			2500	13000		< 0.15	< 0.24	0.52								< 0.24	< 0.24			< 0.24	1.3	<2.2
	ug/kg	BHC			1100	5900		< 0.22	< 0.24	< 0.26								< 0.36	< 0.24			< 0.24	< 0.25	<2.2
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000		< 0.1	< 0.24	< 0.26								< 0.16	< 0.24			< 0.24	< 0.25	<2.2
	ug/kg	Heptachlor			1600	7700		< 0.07	< 0.24	< 0.26								< 0.12	< 0.24			< 0.24	< 0.25	<2.2
	ug/kg	Aldrin			450	2400		< 0.1										< 0.16						<2.2
	ug/kg	Heptachlorepoxid	2.5	16	280	4100		< 0.12										< 0.2						<2.2
	ug/kg	Endosulfan I			13000	13000		< 0.12										< 0.2						<2.2
	ug/kg	Dieldrin	1.9	62	110	1500	< 0.1	< 0.12	< 0.49	< 0.51	< 10	0	0	< 0.1				< 0.2	< 0.48	< 1	< 10	< 0.48	1.10	<2.2
	ug/kg	4,4'-DDE	3.2	31	22000	28000	< 0.1	< 0.1	< 0.49	< 0.51	< 10	0	0	< 0.1				< 0.16	< 0.48		< 10	0.74	< 0.48	<2.2
	ug/kg	Endrin	2.2	210	4000	54000	< 0.1	< 0.22	< 0.49	< 0.51	< 10	0	0	< 0.1				< 0.36	< 0.48	< 1	< 10	< 0.48	< 0.48	<2.2
	ug/kg	Endosulfan II						< 0.24										< 0.4						<2.2
	ug/kg	4,4'-DDD	4.9	28	19000	100000	< 0.1	< 0.27	< 0.49	< 0.51	< 10	0	0	< 0.1				< 0.44	< 0.48		< 10	< 0.48	< 0.48	<2.2
	ug/kg	Endrinaldehyde						< 0.27										< 0.44						<2.2
	ug/kg	Sulfan sulfate						< 0.27										< 0.44						
	ug/kg	4,4'-DDT	4.2	63	7300	86000	< 0.1	< 0.32	< 0.49	< 0.51	< 10	0	0	< 0.1				< 0.51	< 0.48	< 4	< 10	< 0.48	< 0.48	<2.2
	ug/kg	Methoxychlo						< 0.54										< 0.87						<2.2
	ug/kg	Endrinketone						< 0.27										< 0.44						<2.2
	ug/kg	Chlorodane	3.2	18	9500	11000	< 1	< 1.46	< 0.24	< 0.26	< 10	0	0	< 1				< 2.38	< 0.24		< 10	< 0.24	< 0.25	<44
	ug/kg	Oxychlordane																						
	ug/kg	Toxaphene	0.1	32	4000	22000		< 2.38										< 1.63						<44
METALS	mg/kg	Ag (silver)			77	1200																		
	mg/kg	Al (aluminum)																						
	mg/kg	As (arsenic)	9.8	33	9	9	1.1	< 1.11	0.97	1.2	< 1	0	0	1	0	0	0.67	0.94	2.6	0.91	2.3	< 0.8	0.9	1.2	3.1
	mg/kg	B (boron)			3100	46000																		
	mg/kg	Ba (barium)			3000	35000						10	10											
	mg/kg	Be (beryllium			31	380																		
	mg/kg	Cd (cadmium)	0.99	5	1.6	23	< 0.15	< 1.21	< 0.12	< 0.12	1	< 10	< 10	< 0.19	< 0.1	< 0.1	1.6	2.7	< 1.77	0.41	4.5	1	0.42	0.45	<0.6
	mg/kg	Cr (chromium) III	43	110	23000	100000	5.3	8.7	5.6	8.1	29	< 10	< 10	3.8	9.2	9.2	16.5	31.7	20	6.6	54.7	8	8	6.9	11
	mg/kg	Cu (copper)	32	150	2200	33000	2.3	4.5	1.9	3.4	5	< 10	< 10	1.9	4.9	5	9	13.9	18.3	1.8	25.3	2	3	2.4	7.4
	mg/kg	Fe (iron)			100000	100000	5400					3400	2600	4400							16000				
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1	0.018	< 0.01	< 0.05	< 0.05	0.8	0	0	0.031	0.093	0.069	0.048	0.07	< 0.02	< 0.04	0.118	1.8	< 0.05	< 0.05	<0.031
	mg/kg	Mg (magnesium																						
	mg/kg	Mn (manganese			2100	21000		264	180	289		130	120						1080	167	652		245	222	580
	mg/kg	Mo (molybdenum																						
	mg/kg	Ni (nickel)	23	49	170	2600	6	8.78	4.7	6.4	19	< 10	< 10	6					15.8	5.7	24	5	6.5	5.3	12
	mg/kg	Pb (lead)			300	700	5	5.4	3.4	4.2	< 11	< 10	< 10	4	< 0.1	< 0.1	9.7	10	10.9	9.1	104	< 10	5.7	3.8	8.2
	mg/kg	Sb (antimony			6.2	93																		
	mg/kg	Se (selenium			77	1200		< 0.92											< 1.34						
	mg/kg	Sn (tin)			4600	70000																		
	mg/kg	Sr (strontium)			9300	100000																		
	mg/kg	Ti (titanium)			40000	28000																		
	mg/kg	Zn (zinc)			4600	70000	13	23.6	12.8	20	14	20	20	13	20.5	21.3	30.7	55.3	74	12.9	93.4	19	18	17.2	40
	mg/kg	V (vanadium																						
PCBS	ug/kg	Aroclor-1006						< 1.46	< 4.9	< 5.1									< 2.38	< 4.8			< 4.8	< 5.1	<110
	ug/kg	Aroclor-1221						< 1.46	< 4.9	< 5.1									< 2.38	< 4.8			< 4.8	< 5.1	
	ug/kg	Aroclor-1232						< 1.46	< 4.9	< 5.1									< 2.38	< 4.8			< 4.8	< 5.1	
	ug/kg	Aroclor-1242						< 1.46	< 4.9	< 5.1									< 2.38	< 4.8			< 4.8	< 5.1	
	ug/kg	Aroclor-1248						< 1.46	< 4.9	< 5.1									< 2.38	< 4.8			< 4.8	< 5.1	<110
	ug/kg	Aroclor-1254						< 3.05	< 4.9	< 5.1									< 4.95	< 4.8			< 4.8	< 5.1	<110
	ug/kg	Aroclor-1260						< 3.05	< 4.9	< 5.1									< 4.95	< 4.8			< 4.8	< 5.1	<110
	ug/kg	Total PCB's	60	680	810	10000	0				0	0	8	0	0	0	0	0			90	0			
PARTICLE SIZE %FINER		3 in									100	100	100		100	100	100	100			100	100			
		1 1/2					100				100	100	100	100	100	100	100	100			100	100			
		3/4					100				100	100	100	100	100	100	100	100			100	100			
		3/8					100				100	100	100	100	100	100	100	100			100	100			
	SAND coarse	4					99	100	100	100	100	100	100	100	99	99	98	98	99.9	100	100	99	100		
		8					95				100			99	96	96	94	94				99			
		10						100	99.6	99.3		100	100						99.8	98.6			99.5	100	
		16					81.0	98.6			100.0			94.0	87.0	87.0	89.0	91.0	99.2			95.0			
		18																							
		20							92.2	96.7		99.0	100.0							91.1			90.1	99.2	
		30					47.0	82.9						77.0					97.5						
		40					24.0		31.4	68.1	94.0	85.0	91.0	66.0	41.0	41.0	54.0	76.0		56.6		48.0	58.9	95.3	
		50					9.0	82.9						41.0					97.5						
		60																							
		70					6.0							18.0											
		80						33.4				13.0	11.0						83.4						
		100					5.0	6.8	2.8	12.2	4.0			8.0	5.0	5.0	9.0	34.0	65.3	3.2		0.0	11.8	21.3	
		140						5.5	1.8	10.5									48.4	1.3			10.0	11.1	
		170																							
	SILT fine	200					4.0	4.1	1.3	10.2	0.0	6.0	3.0	4.0	2.0	2.0	8.0	31.0	28.4	1.0	45.0	0.0	9.7	10.4	
		230																							
	CLAY	270					3.0	3.2						4.0					19.0						
		0.20 mm					1.0	2.1			0.0	0.0	0.0	1.0					14.1			0.0			
		0.05 mm					0.0	1.5			0.0	0.0	0.0	0.0					9.1		30.0	0.0			
MISC	%	Total Organic Carb						0.58	0.062	0.101									5.73	0.375			0.132	0.125	24000
	mg/kg	Chem Oxy Demand					1630		11800	18800	4079	5600	4300	1630	1848	2386	7050	15600		10200	27000	2872	15800	19400	
	mg/kg	Kjedahl Nitrogen					64				99	520	450	94	--	--	--	--			1870	73			329
	mg/kg	Total Phosph					250				143	88	190	940	--	--	--	--			867	217			19
	mg/kg	Oil and Grease					< 50		0.2	0.48	285	0	0	< 50	204	284	374	483		< 0.06	230	204	< 0.06	0.57	
	mg/kg	Cyanide, Tota						< 0.65	0.09	0.11									< 1.06	0.11			<0.06	<0.07	<0.34
	mg/kg	Ammonia						14											175						35
	mg/l	Ammonia Elutriate							0.2	0.48										<0.06			<0.06	0.6	
	%	Moisture						22.6	20.7	23.5									52.7	16			21.1	24.9	26.8
	%	Total Solids						77.4	79.3	76.5									47.3	84			78.9	75.1	73.2
	%	Volatile Solids						1.2	1.18	1.88									4.4	1.02			1.58	1.9	<0.01

Appendix : Sediment Report Pigs Eye Lake Ramsey County

CHC'S	ug/kg	a-BHC			680	3500			<2.3	< 0.43	<2.4					< 5			2.4	2.000	9.70	12.000	13		1.600
	ug/kg	b-BHC			2500	13000			<2.3	1.6	<2.4					< 10			< 1.1	< 1.1	< 1.1	< 1.1	< 0.64		< 0.64
	ug/kg	BHC			1100	5900			<2.3	< 0.43	<2.4														
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000			<2.3	< 0.43	<2.4					11			< 0.53	< 0.53	< 0.53	< 0.53	4.1		< 0.32
	ug/kg	Heptachlor			1600	7700			<2.3	< 0.43	<2.4					5			< 0.53	< 0.53	< 0.53	< 0.53	< 0.32		< 0.32
	ug/kg	Aldrin			450	2400			<2.3		<2.4														
	ug/kg	Heptachlorepoxid	2.5	16	280	4100			<2.3		<2.4														
	ug/kg	Endosulfan I			13000	13000			<2.3		<2.4														
	ug/kg	Dieldrin	1.9	62	110	1500	1.6	2.9	<2.3	< 0.94	<2.4					< 20			< 1.6	< 1.6	< 1.6	< 1.6	< 0.96		< 0.96
	ug/kg	4,4'-DDE	3.2	31	22000	28000	< 0.1	2.4	<2.3	< 0.48	<2.4					< 7			< 1.6	< 1.6	< 1.6	< 1.6	< 0.96		< 0.96
	ug/kg	Endrin	2.2	210	4000	54000	< 0.1	< 0.1	<2.3	< 0.48	<2.4					< 10			< 2.1	< 2.1	< 2.1	< 2.1	< 1.3		< 1.3
	ug/kg	Endosulfan II							<2.3		<2.4														
	ug/kg	4,4'-DDD	4.9	28	19000	100000	7	6.30	<2.3	< 0.48	<2.4					< 14			< 3.2	< 3.2	< 3.2	< 3.2	< 1.9		< 1.9
	ug/kg	Endrinaldehyde							<2.3		<2.4														
	ug/kg	Sulfan sulfate																							
	ug/kg	4,4'-DDT	4.2	63	7300	86000	0.8	9.70	<2.3	< 0.48	<2.4					< 20			< 4.2	< 4.2	< 4.2	< 4.2	< 2.5		< 2.5
	ug/kg	Methoxychlo							<2.3		<2.4														
	ug/kg	Endrinketone							<2.3		<2.4														
	ug/kg	Chlorodane	3.2	18	9500	11000	11	7.00	<47	< 0.43	<49					< 2			< 11	< 11	< 11	< 11	< 6.4		< 6.4
	ug/kg	Oxychlordane																							
	ug/kg	Toxaphene	0.1	32	4000	22000			<47		<49														
METALS	mg/kg	Ag (silver)			77	1200						1.1	1.08	0.69	0.67		0.54	1.07	0.592	0.4885		0.1515		1.374	0.395
	mg/kg	Al (aluminum)																							
	mg/kg	As (arsenic)	9.8	33	9	9	29	21	3.1	4.7	3.7	6.3	6.14	5.68	5.2		7	15	6.2	7.6		7.4		5.06	2.99
	mg/kg	B (boron)			3100	46000																			
	mg/kg	Ba (barium)			3000	35000	100	80																	
	mg/kg	Be (beryllium			31	380						0.641	0.54	0.529	0.43		0.5	0.77	0.281	0.2755		0.298		0.642	0.36
	mg/kg	Cd (cadmium)	0.99	5	1.6	23	8	4	<0.66	0.93	<0.69	3.159	2.93	2.61	1.4		1	2.23	1.075	0.683		0.4895		3.101	0.875
	mg/kg	Cr (chromium) III	43	110	23000	100000		30	10	26.2	14	63.6	62.6	58.2	33.8		36.4	58.5	62.4	80.7		92.6		49.2	22.6
	mg/kg	Cu (copper)	32	150	2200	33000	38	18	8.5	21.5	11	33.8	31.5	28.3	17.2		18.8	31.3	17.7	16.5		13.15		26.1	13.4
	mg/kg	Fe (iron)			100000	100000	13000	7100																	
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1	< 0.01	< 0.01	<0.033	0.14	0.037	0.25	0.19	0.2	0.15		0.14	0.22	0.05	0.1		0.05		0.05	0.1
	mg/kg	Mg (magnesium																							
	mg/kg	Mn (manganese			2100	21000	1400	700	530	1210	740				698		906	1305						932.6	649.9
	mg/kg	Mo (molybdenum																							
	mg/kg	Ni (nickel)	23	49	170	2600	30	30	11	21.3	15	29.2	25.6	28.3	18.3		19.2	28.9	21.4	24.55		25.4		24.3	15.5
	mg/kg	Pb (lead)			300	700	30	30	7.6	16.5	11	40	37.7	33.5	19.4		18	32.7	18.2	16.85		10.2		32.3	14.2
	mg/kg	Sb (antimony			6.2	93																			
	mg/kg	Se (selenium			77	1200						0.22	0.21	0.2	0.06		0.07	0.1	0.05	0.06		0.07		0.12	0.12
	mg/kg	Sn (tin)			4600	70000																			
	mg/kg	Sr (strontium)			9300	100000																			
	mg/kg	Ti (titanium)			40000	28000									0.8		0.8	0.9	0.3	0.7		0.6		0.6	0.6
	mg/kg	Zn (zinc)			4600	70000	130	62	39	82.8	53	152.7	128	113.4	70.6		75.9	153.4	84	70.95		53.55		123.5	57.6
	mg/kg	V (vanadium																							
PCB'S	ug/kg	Aroclor-1006							<110	< 8.6	<120					60			24	40.00	146	195.00	214		25
	ug/kg	Aroclor-1221								< 8.6															
	ug/kg	Aroclor-1232								< 8.6															
	ug/kg	Aroclor-1242								< 8.6															
	ug/kg	Aroclor-1248							<110	< 8.6	<120														
	ug/kg	Aroclor-1254							<110	16	<120					1100			5.7	16	24	44	52		7.8
	ug/kg	Aroclor-1260							<110	< 8.6	<120					< 20			< 5.3	6.1	10	21	27		< 3.2
	ug/kg	Total PCB's	60	680	810	10000	68	170																	
PARTICLE SIZE %FINER		3 in																							
	SAND coarse	1 1/2					100	100																	
		3/4					100	100																	
		3/8					100	100																	
		4					100	100																	
		8					100	100																	
		10																							
		16					99.0	99.0																	
		18																							
	SAND medium	20								100.0															
		30					97.0	97.0																	
		40					95.0	95.0		99.7															
		50					92.0	92.0																	
		60																							
	SAND fine	70					90.0	90.0																	
		80																							
		100					88.0	88.0		98.9															
		140								96.7															
		170																							
	SILT	200					82.0	87.0		96.2															
		230																							
		270					78.0	85.0																	
	CLAY	0.20 mm					49.0	63.0																	
		0.05 mm					23.0	29.0																	
MISC	%	Total Organic Carb							35000	> 1.6	51000														
	mg/kg	Chem Oxy Demand					110000	51000		86900															
	mg/kg	Kjedahl Nitrogen					7680	4860	658		791														
	mg/kg	Total Phosph					--	--	2.3		29														
	mg/kg	Oil and Grease					0	0		1.7															
	mg/kg	Cyanide, Tota							<0.36	<0.11	<0.38														
	mg/kg	Ammonia							28		61														
	mg/l	Ammonia Elutriate								1.7															
	%	Moisture							30.7	54.9	34.9														
	%	Total Solids							69.3	45.1	65.1														
	%	Volatile Solids							<0.01	8.7	<0.01														

Appendix : Sediment Report Pigs Eye Lake Ramsey County

		Sam. Gear	MPCA SQT LEVEL I	MPCA SQT LEVEL II	Residential/Recreational mg/kg August 2016 Revised	Commercial/Industrial mg/kg August 2016 Revised	3	3	3	3	3	3	3		1	1	1	1	1
		Sam. Depth					10	10	10	10	10	10	10	10	10	10	10	10	10
		Lab												STAT					
		Data Cit.					MWCC	MWCC	MWCC	MWCC	MWCC	MWCC	MWCC	COE	COE	COE	COE	COE	COE
CHC'S	ug/kg	a-BHC			680	3500	1.2	12.000	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	<3.4	< 0.08				< 0.08
	ug/kg	b-BHC			2500	13000	< 0.64	< 0.64	< 0.53	< 0.53	< 0.53	< 0.53	< 0.53	<3.4	< 0.17				< 0.16
	ug/kg	BHC			1100	5900								<3.4	< 0.25				< 0.24
	ug/kg	g-BHC (lindane)	2.4	5	4300	23000	< 0.32	< 0.32	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	<3.4	< 0.11				< 0.11
	ug/kg	Heptachlor			1600	7700	< 0.32	< 0.32	< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	<3.4	< 0.08				< 0.08
	ug/kg	Aldrin			450	2400								<3.4	< 0.11				< 0.11
	ug/kg	Heptachlorepoxid	2.5	16	280	4100								<3.4	< 0.14				< 0.14
	ug/kg	Endosulfan I			13000	13000								<3.4	< 0.14				< 0.14
	ug/kg	Dieldrin	1.9	62	110	1500	< 0.96	< 0.96	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	<3.4	< 0.14	< 0.1	< 0.1	< 10	< 0.14
	ug/kg	4,4'-DDE	3.2	31	22000	28000	< 0.96	< 0.96	< 0.79	< 0.79	< 0.79	< 0.79	< 0.79	<3.4	< 0.11	< 0.1	< 0.1	< 10	< 0.11
	ug/kg	Endrin	2.2	210	4000	54000	< 1.3	< 1.3	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	<3.4	< 0.25	< 0.1	< 0.1	< 10	< 0.24
	ug/kg	Endosulfan II												<3.4	< 0.28				< 0.27
	ug/kg	4,4'-DDD	4.9	28	19000	100000	< 1.9	< 1.9	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	<3.4	< 0.31	< 0.1	< 0.1	< 10	< 0.3
	ug/kg	Endrinaldehyde												<3.4	< 0.31				< 0.3
	ug/kg	Sulfan sulfate													< 0.31				< 0.3
	ug/kg	4,4'-DDT	4.2	63	7300	86000	< 2.5	< 2.5	< 2.1	< 2.1	< 2.1	< 2.1	< 2.1	<3.4	< 0.36	< 0.1	< 0.1	< 10	< 0.35
	ug/kg	Methoxychlo												<3.4	< 0.62				< 0.6
	ug/kg	Endrinketone												<3.4	< 0.31				< 0.3
	ug/kg	Chlorodane	3.2	18	9500	11000	< 6.4	< 6.4	< 5.3	< 5.3	< 5.3	115.00	< 5.3	<71	< 1.68	< 1	< 1	< 10	< 1.63
	ug/kg	Oxychlordane																	
	ug/kg	Toxaphene	0.1	32	4000	22000								<71					< 1.68
METALS	mg/kg	Ag (silver)			77	1200	0.085				0.297	0.374	1.1						
	mg/kg	Al (aluminum)																	
	mg/kg	As (arsenic)	9.8	33	9	9	5				6.79	9.92	8.53	5.7	< 1.18	2.8	2.7	1	2.9
	mg/kg	B (boron)			3100	46000													
	mg/kg	Ba (barium)			3000	35000													
	mg/kg	Be (beryllium			31	380	0.538				0.48	0.444	0.432						
	mg/kg	Cd (cadmium)	0.99	5	1.6	23	0.252				1.244	1.242	1.618	<1.1	< 1.3	0.77	1.2	3	< 1.33
	mg/kg	Cr (chromium) III	43	110	23000	100000	31.4				27.3	27.2	27.2	21	12.1	10	12	39	14.6
	mg/kg	Cu (copper)	32	150	2200	33000	11.6				15	15.6	18.5	20	5.64	10	13	10	5.4
	mg/kg	Fe (iron)			100000	100000										6800	6300		
	mg/kg	Hg (mercury)	0.18	1.1	3.1	3.1	0.05				0.1	0.09	0.24	0.061	< 0.01	0.038	0.02	0.7	< 0.01
	mg/kg	Mg (magnesium																	
	mg/kg	Mn (manganese			2100	21000	1052.2				711.7	721.4	693.7	1300	1860				674
	mg/kg	Mo (molybdenum																	
	mg/kg	Ni (nickel)	23	49	170	2600	22.2				15.5	14.7	14	20	15	10	9	29	19.2
	mg/kg	Pb (lead)			300	700	8.7				14.8	14.9	23.6	16	4.73	13	18	< 13	5.3
	mg/kg	Sb (antimony			6.2	93					14	14.2	13.5						
	mg/kg	Se (selenium			77	1200	0.12				0.13	0.12	0.13		< 0.99				< 1.01
	mg/kg	Sn (tin)			4600	70000													
	mg/kg	Sr (strontium)			9300	100000													
	mg/kg	Ti (titanium)			40000	28000	0.6				5.4	5.4	5.2						
	mg/kg	Zn (zinc)			4600	70000	48.9				60.4	62.1	77.3	83	37	46	54	44	43.5
	mg/kg	V (vanadium																	
PCB'S	ug/kg	Aroclor-1006					41	176.00	424	387	171	95	485	<170	< 1.68				< 1.63
	ug/kg	Aroclor-1221													< 1.68				< 1.63
	ug/kg	Aroclor-1232													< 1.68				< 1.63
	ug/kg	Aroclor-1242													< 1.68				< 1.63
	ug/kg	Aroclor-1248												<170	< 1.68				< 1.63
	ug/kg	Aroclor-1254					20	26	< 5.3	< 5.3	< 5.3	< 5.3	< 5.3	<170	< 3.5				< 3.4
	ug/kg	Aroclor-1260					10	13	7.7	7.2	27.2	31	29.4	<170	< 3.5				< 3.4
	ug/kg	Total PCB's	60	680	810	10000										0	1460	0	
PARTICLE SIZE %FINER		3 in																	
		1 1/2														100	100		
		3/4														100	100		
		3/8														100	100		
	SAND coarse	4													100	100	100		100
		8														99	100		
		10													97.0				95.4
		16													88.0	99.0	99.0		84.6
		18																	
		20																	
	SAND medium	30													69.5	97.0	95.0		65.8
		40														96.0	89.0		
		50													69.5	95.0	77.0		65.8
		60																	
	SAND fine	70														94.0	65.0		
		80													53.9				50.8
		100													45.8	93.0	58.0		41.2
		140													35.7				34.6
		170																	
	SILT CLAY	200													25.8	91.0	56.0		24.2
		230																	
		270													17.8	90.0	55.0		17.7
		0.20 mm													12.6	69.0	39.0		12.4
		0.05 mm													9.4	33.0	17.0		8.5
MISC	%	Total Organic Carb												120000	1.32				1.23
	mg/kg	Chem Oxy Demand														19200	35600	14184	
	mg/kg	Kjedahl Nitrogen												1770		1100	1200	288	
	mg/kg	Total Phosph												85		1100	1400	980	
	mg/kg	Oil and Grease														175	370	163	
	mg/kg	Cyanide, Tota												<0.55	< 0.68				< 0.71
	mg/kg	Ammonia												85.0	12				9.8
	mg/l	Ammonia Elutriate																	
	%	Moisture												54.8	27				29.9
	%	Total Solids												45.2	73				70.1
	%	Volatile Solids												<0.01	2.8				3.9

Appendix : Sediment Report Pigs Eye Lake Ramsey County

Longitude								93° 6'18.50"W	93° 6'11.80"W	93° 5'34.40"W	93° 5'32.80"W	93° 3'2.90"W	93° 3'1.90"W	93° 1'10.00"W	93° 1'12.60"W	92°56'37.40"W	92°56'59.50"W	92°55'44.20"W	92°55'36.90"W	93°05'36.24"W
Lab								ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC
Lab ID								8967-10	8967-09	8967-08	8967-07	8967-06	8967-05	8967-11	8967-12	8967-15	8967-16	8967-13	8967-14	8006-05
Corps ID								15B	15A	14B	14A	13B	13A	16A	16B	18A	18B	17A	17B	Abv Wabasha Ave Br A
Date Collected								9/10/2013	9/10/2013	9/10/2013	9/10/2013	9/10/2013	9/10/2013	9/11/2013	9/11/2013	9/11/2013	9/11/2013	9/11/2013	9/11/2013	10/21/2014
	ug/kg		Acenaphthylene	5.9	130			ND	ND	1.45 J	ND	ND	3.96	-3.94	-4.01	12.2	17.3	10.3	9.32	1.05 J
	ug/kg		Acenaphthene	6.7	89	1300000	19000000	ND	2.77 J	ND	1.28 J	ND	1.51 J	-3.94	-4.01	5.24	5.71	2.82 J	4.98J	<0.887
	ug/kg		Anthracene	57	850	6500000	97000000	ND	1.21 J	1.55 J	3.33 J	1.4 J	4.95	-3.94	-4.01	16.4	39.1	10.7	12.4	1.64 J
	ug/kg		Fluoranthene	420	2200	510000	6700000	7.9	4.6	16.5	41.6	13.7	35.1	5.55	6.54	140	181	79.9	102	23
	ug/kg		Pyrene	200	1500	44000		7.15	4.81	13.7	38.6	12.4	31.8	6.56	6.39	137	218	77.7	94.6	31.1
	ug/kg		Benzo(a)anthracene	110	1100			4.26	2.72 J	7.86	17.2	8.18	18.6	4.71	3.95 J	65	102	38.2	41.9	10.3
	ug/kg		Benzo(b)fluoranthene					5.51	2.44 J	12.8	32.4	12.1	33.3	5.53	5.14	116	119	71.4	91.3	33
	ug/kg		Benzo(k)fluoranthene					1.4 J	ND	4.01 J	9.42	3.52J	9.21	1.59 J	1. 32 J	25.2	39.1	21.4	20.1	6.87
	ug/kg		Benzo(a)pyrene	150	1500	1000 ***	14000***	3.21 J	1.59 J	6.77	19.4	7.27	19.7	4.64	2.95 J	66.9	107	44.8	47.4	16.7
	ug/kg		Benzo(g,h,i)perylene					2.8 J	1.20 J	6.13	24.4	6.4	17.3	3.48 J	2.55 J	37.9	51. 2	33.5	33.5	20
	ug/kg		Hexachlorobenzene					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		Chlordane trans isomer					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		Chlordane cis isomer	3.2*	18*			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		P, P' -DDE	3.2	31	7000 *	75000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		O, P' -DDD			13000	70000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		Dieldrin	1.9	62			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		O, P'-DDE			110	1500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		O, P' -DDT					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		P, P' -DDD	4.9	28	19000	100000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		P, P' -DDT	4.2	63	7300	86000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 4.36
	ug/kg		PCB 1016					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 8.74
	ug/kg		PCB 1248					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 13.1
	ug/kg		PCB 1254					ND	ND	ND	ND	ND	ND	ND	ND	17.2 J	ND	ND	ND	< 13.1
	ug/kg		PCB 1260					ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 8.74
	ug/kg		Total PCBs	60	680	620	8200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<65.5
Metals	mg/kg		Arsenic	9.8	33	9	9	1. 8	1.5	1.4	1.1	1. 3	1.3	1. 0	1.3	2.2	1.3	3.1	4.6	1.7
	mg/kg		Cadmium	0.99	5	1.6	23	0.34	0.3	0.22	0.23	0.21	0.24	0.22	0. 21	0.44	0.26	0.54	0.68	<0.25
	mg/kg		Chromium	43	110	23000	100000	5.6	6.8	5	7.5	5.2	6	6	5.1	9.5	6.1	11. 3	12.6	19.8
	mg/kg		Copper	32	150	2200	33000	2.3	4	1.9	3.6	1.6	2.7	2.2	2.2	5.7	2.4	8.8	11.3	18.5
	mg/kg		Lead	36	130	300	700	2.1	1.9	2.2	2.6	1.9	2.4	1. 5	2	5.1	2.9	6	7.2	6.7
	mg/kg		Manganese			2100	21000	381	244	174	194	237	345	220	262	471	229	571	1230	587
	mg/kg		Mercury	0.18	1.1	3.1 **	3.1	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	0.12	< 0.10
	mg/kg		Nickel	23	49	170	2600	4.8	8.2	4.3	6.2	4.7	4.8	5.9	4.8	7.3	5	11.3	12.5	13
	mg/kg		Zinc	120	460	4600	70000	17.5	18.5	16	19.2	12.4	15.3	13.7	14	36.3	21	51. 0	58.1	58.5
	mg/kg		Chromium (VI)			11	57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	3.9	< 1.3
Inorganics	mg/kg		Ammonia Nitrogen					ND	5.4	15.5	5.8	ND	22.7	ND	7.1	39.5	12.8	68.5	445	14.8
	mg/kg		Cyanide, Total			13	190	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	< 0.31
	%		Moisture					9.2	10.3	20.9	15.1	16.8	19.9	15.6	17.8	31.9	20.2	38.2	55.5	22.9
	mg/kg		Phenol			3500	24000	ND	ND	ND	ND	0.31	ND	ND	ND	ND	ND	ND	ND	< 3.2
	mg/kg		Phosphorus					170	198	377	256	184	307	333	228	388	266	446	748	252
	%		Solids, Percent					90.8	89.7	79.1	84.9	83.2	80.1	84.4	82.2	68.1	79.8	61. 8	44.5	77.1
	%		Solids, Total Volatile					ND	ND	ND	ND	ND	ND	ND	ND	1. 6	ND	1. 8	2.8	2.3
	mg/kg		Total Kjeldahl Nitrogen					122	65.4	213	169	78.2	404	69.4	162	984	195	1220	2760	493
	mg/kg		Total Organic Carbon					1600	570	1900	2600	510	3200	570	1400	7800	1800	12000	26000	17000
PARTICLE SIZE % FINER	SAND	coarse	4					38.5	51.4	100	99.3	99.9	100	99.4	99.5	99.6	99.6	99.9	100	98.6
			10					24.7	32.8	100	94.7	98.9	99.9	99.4	97.6	98.6	97.9	99.8	100	90.3
		medium	20					16.9	20	100	80.5	88.1	98.1	82.6	86.3	97.9	95.4	99.6	99.9	45.9
			40					10.6	9.7	99.7	54	41.9	68.7	19.5	49.6	96.4	84.9	98.6	99.4	19.6
		fine	60					4.4	3.5	90	32.9	9.5	21.4	3.8	17.3	91.4	39.7	96	97.8	16.5
			140					1.2	0.6	63.6	9.9	3.8	11.9	1.5	3.7	46.2	7.7	68.6	68	12.5
	SILT	clay	200					1.1	0.6	59.7	8.6	3.7	11.5	1.4	3.6	40.5	7	64.8	66.5	10.8

Appendix : Sediment Report Pigs Eye Lake Ramsey County

Historical Dredge Cuts (top ~10 cm) after 2009				SQT I	SQT II	Value (SRV)	Value (SRV)	Wabasha Ave Br	Pine Bend Landing	Pine Bend Landing	Freeborn Light	Freeborn Light	Upper Appch L/D 2	Appch L/D 2
Pool								2	2	2	2.00	2.00	2	2
Latitude								44°56'32.89"N	44°46'39.15"N	44°46'34.09"N	44°46'43.22"N	44°46'46.31"N	44°46'31.01"N	44°46'11.87"N
Longitude								93°05'36.59"W	93°01'07.62"W	93°01'00.93"W	92°55'11.94"W	92°55'17.10"W	92°52'53.24"W	92°52'29.97"W
Lab								ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC
Lab ID								8006-06	8006-7	8006-08	8006-09	8006-10	8006-11	8006-12
Corps ID								Abv Wabasha Ave Br B	Pine Bend Landing A	Pine Bend Landing B	Freeborn Light A	Freeborn Light B	Upper Appch L/D 2 A	Upper Appch L/D 2 B
Date Collected								10/21/2014	10/21/2014	10/21/2014	10/22/2014	10/22/2014	10/22/2014	10/22/2014
	ug/kg		Acenaphthylene	5.9	130			<0.923	<0.824	<0.815	3.37 J	3.74 J	31	40.7
	ug/kg		Acenaphthene	6.7	89	1300000	19000000	<0.923	<0.824	<0.815	1.47 J	1.59 J	5.06	5.04 J
	ug/kg		Anthracene	57	850	6500000	97000000	1.57 J	<0.824	<0.815	5.99	6.95	36.8	38.5
	ug/kg		Fluoranthene	420	2200	510000	6700000	22.9	3.99 J	1.17 J	62.50	56.20	192	186
	ug/kg		Pyrene	200	1500	44000		24.7	8.57	1.58 J	55.10	57.10	221	212
	ug/kg		Benzo(a)anthracene	110	1100			12.7	2.40 J	1.06 J	30.60	32.80	136	132
	ug/kg		Benzo(b)fluoranthene					27.5	1.48 J	0.912 J	46.10	47.90	189	188
	ug/kg		Benzo(k)fluoranthene					8.28	<0.824	<0.815	13.80	11.90	57.1	59.9
	ug/kg		Benzo(a)pyrene	150	1500	1000 ***	14000***	12.9	0.849 J	<0.815	30.90	30.00	149	156
	ug/kg		Benzo(g,h,i)perylene					8.62	<0.824	<0.815	21.30	12.90	63.5	62.9
	ug/kg		Hexachlorobenzene					< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		Chlordane trans isomer					< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		Chlordane cis isomer	3.2*	18*			< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		P, P' -DDE	3.2	31	7000 *	75000	< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		O, P' -DDD			13000	70000	< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		Dieldrin	1.9	62			< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		O, P'-DDE			110	1500	< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		O, P' -DDT					< 4.49	< 3.91	< 4.06	< 4.15	< 4.22	< 4.80	< 5.02
	ug/kg		P, P' -DDD	4.9	28	19000	100000	< 4.49	< 3.91	< 4.06	13.10	< 4.22	< 4.80	< 5.02
	ug/kg		P, P' -DDT	4.2	63	7300	86000	< 4.49	< 3.91	< 4.06	120.00	< 4.22	< 4.80	< 5.02
	ug/kg		PCB 1016					< 9.0	< 7.83	< 8.14	< 8.32	< 8.46	< 9.61	< 10.1
	ug/kg		PCB 1248					< 13.5	< 11.7	< 12.2	< 12.5	< 12.7	< 14.4	< 15.1
	ug/kg		PCB 1254					< 13.5	< 11.7	< 12.2	< 12.5	< 12.7	< 14.4	< 15.1
	ug/kg		PCB 1260					< 9.0	< 7.83	< 8.14	< 8.32	< 8.46	< 9.61	< 10.1
	ug/kg		Total PCBs	60	680	620	8200	< 67.5	< 58.7	< 61.0	< 62.3	< 63.4	< 72.0	< 75.4
Metals	mg/kg		Arsenic	9.8	33	9	9	2.7	1.1	0.85	1.60	1.40	4.3	4.2
	mg/kg		Cadmium	0.99	5	1.6	23	< 0.26	< 0.24	< 0.24	< 0.25	< 0.25	0.33	0.36
	mg/kg		Chromium	43	110	23000	100000	12.9	5.9	9.3	6.90	6.90	14.1	12
	mg/kg		Copper	32	150	2200	33000	10.8	2.3	1.8	2.80	2.20	9.5	7.8
	mg/kg		Lead	36	130	300	700	5.4	2.4	1.4	3.40	5.50	7	7
	mg/kg		Manganese			2100	21000	521	226	177	235.00	215.00	653	710
	mg/kg		Mercury	0.18	1.1	3.1 **	3.1	< 0.10	< 0.094	< 0.093	< 0.096	< 0.097	< 0.11	< 0.12
	mg/kg		Nickel	23	49	170	2600	12	6.8	5	5.10	5.10	11.1	11
	mg/kg		Zinc	120	460	4600	70000	47.1	14.4	11.5	18.70	18.40	42	46.7
	mg/kg		Chromium (VI)			11	57	< 1.3	< 1.2	< 1.2	< 1.3	< 1.3	< 1.4	< 1.5
Inorganics	mg/kg		Ammonia Nitrogen					27.1	5.1	4.6	14.50	14.10	65.2	60.6
	mg/kg		Cyanide, Total			13	190	< 0.30	< 0.30	< 0.29	< 0.31	< 0.31	< 0.35	< 0.37
	%		Moisture					25.4	16.2	17.5	20.60	20.90	29.9	33.5
	mg/kg		Phenol			3500	24000	< 3.4	< 3.0	< 3.0	< 3.2	< 3.2	< 3.6	< 3.8
	mg/kg		Phosphorus					280	127	177	356.00	359.00	480	530
	%		Solids, Percent					74.6	83.8	82.5	79.40	79.10	70.1	66.5
	%		Solids,Total Volatile					2.1	< 1.2	< 1.2	< 1.3	< 1.3	2.7	2.8
	mg/kg		Total Kjeldahl Nitrogen					764	47.8	27.6	165.00	215.00	837	760
	mg/kg		Total Organic Carbon					3100	2500	1700	6300.00	6300.00	14000	14000
PARTICLE SIZE % FINER	SAND	coarse	4					99.8	95	94.5	100.00	100.00	99.5	99.8
			10					98.1	81.8	81	100.00	100.00	99.2	99.1
		medium	20					93.1	52.1	45.1	99.70	99.90	98.9	98.6
			40					86.5	10.1	6.3	99.40	99.80	98.1	97.7
		fine	60					70.1	1.9	0.8	97.80	99.40	95.6	95.2
			140					15.5	1.6	0.7	25.90	20.50	58.2	54.2
	SILT	clay	200					9.9	1.5	0.7	13.10	9.70	38.6	37.2

US Army Corps of Engineers®
St. Paul District

Appendix F: Geology & Geotechnical Engineering Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment

St. Paul District U.S. Army Corps of Engineers
May 2018

Appendix F: Geology and Geotechnical Engineering

F.1 Introduction

The Pigs Eye Lake Section 204 project proposes using dredge material in order to improve and create aquatic and terrestrial habitat within the lake. The project includes placement of dredge cut material in shaped bands within the lake in order to create islands with a maximum height of around 3 ft above normal pool (6 ft total height).

The geological and geotechnical evaluation of the site focused on characterizing the subsurface materials for susceptibility to lateral and vertical deformation. Recommendations were developed for island geometry (height, slope) as well as construction techniques that could help mitigate undesirable deformation.

F.2 Regional Geology

Pigs Eye Lake is located within a historic river channel cut into Paleozoic sedimentary rock formations during the Pleistocene glacial period 40,000 to 10,000 years ago. The valley was subsequently filled with glacial sediment. The current Mississippi River channel adjacent to Pigs Eye Lake was cut during the draining of Glacial Lake Agassiz via Glacial River Warren 11,700 and 9,400 years ago. During glacial waning periods large amounts of sediments deposited by Mississippi tributaries acted as natural dams, creating a series of lakes upstream and likely leading to the deposition of glacio-lacustrine clays on the western portion of Pigs Eye Lake. Since glacial time the Mississippi River has been a braided stream affecting Pigs Eye Lake only in times of flood.

The construction of the locks and dams upstream and downstream along the Mississippi is not believed to have had a significant effect on the sedimentation patterns of Pigs Eye Lake, which was already a backwater area. On the other hand, development to the north and west of the lake likely did have an impact on sedimentation. Development immediately upstream of the lake, including the adjacent waste water treatment plant, resulted in the abandonment of an upstream channel connecting the lake to the main channel. Additionally, as a result of the rail yard development north of Pigs Eye Lake, Battle Creek channel was re-routed and its flow conditions were likely altered. By further isolating the lake from the main channel, these changes likely resulted in an increased rate of fine particle sedimentation within the lake.

Without construction of a project within Pigs Eye Lake, little change in the lake geomorphology is anticipated during the next 50 years. Continued deposition of fine-grained materials will occur along with occasional flooding that washes some sediments downstream.

F.3 Subsurface Exploration

Four soil borings (15-1M, 15-2M, 15-3M, and 15-4M) were performed during late October 2015 by USACE personnel. The boring locations (Figure 1) were selected in order to characterize conditions throughout the lake, and generally corresponded with the locations of conceptual project features. Additional borings (16-5M through 16-14M) were performed in July 2016 for the purposes of obtaining environmental samples and some bag samples for index testing.

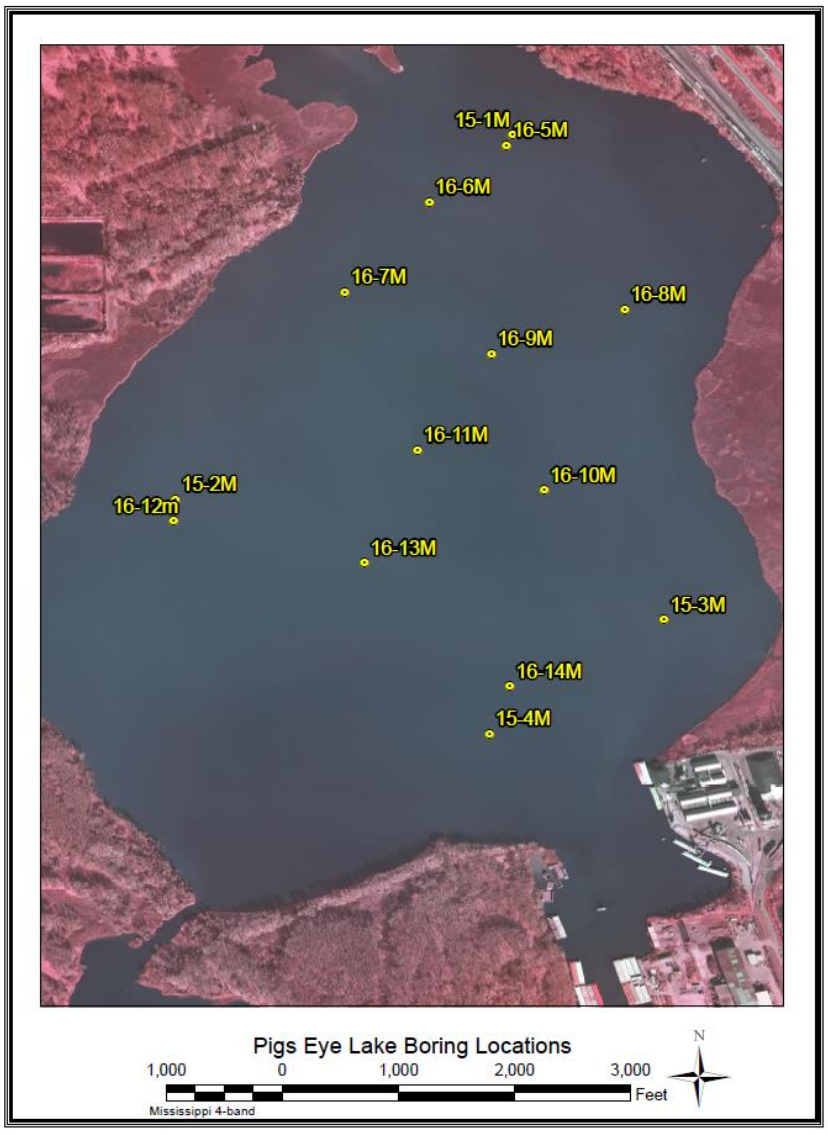


Figure 1 Boring Locations at Pigs Eye Lake (replace with updated map)

Soil borings (Figure 2 through Figure 5) generally indicated very soft soils for a depth between 10 ft and 22 ft below the lake bed. The very soft soils were dominated by silty clay with organics (CH) but also included clayey organic silt (OH) and clayey peat (Pt), and clayey sand (SC) in 15-1M, and wood fragments mixed with clay (Pt) in 15-3M. It is suspected that the 19 ft thick layer of wood fragments represents historical industrial waste from upriver.

Appendix : Geology & Geotechnical Engineering Pigs Eye Lake Ramsey County

The very soft soils were underlain by either bedrock – the St. Peter sandstone in boring 15-3M – or dense sandy and/or gravelly alluvium.

Soft soils were not sufficiently competent in order to collect undisturbed samples for laboratory testing. Field personnel reported that much of the clays was likely in a liquid state.

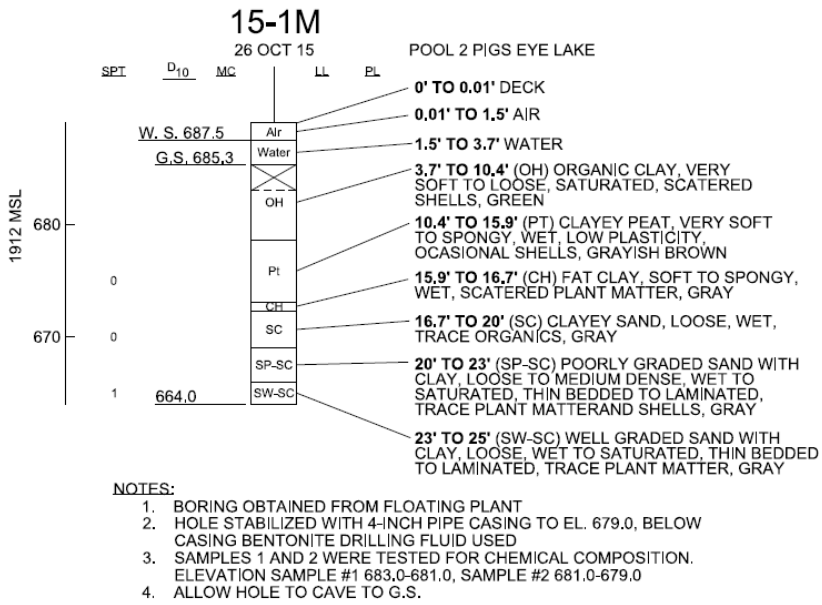


Figure 2 Boring 15-1M

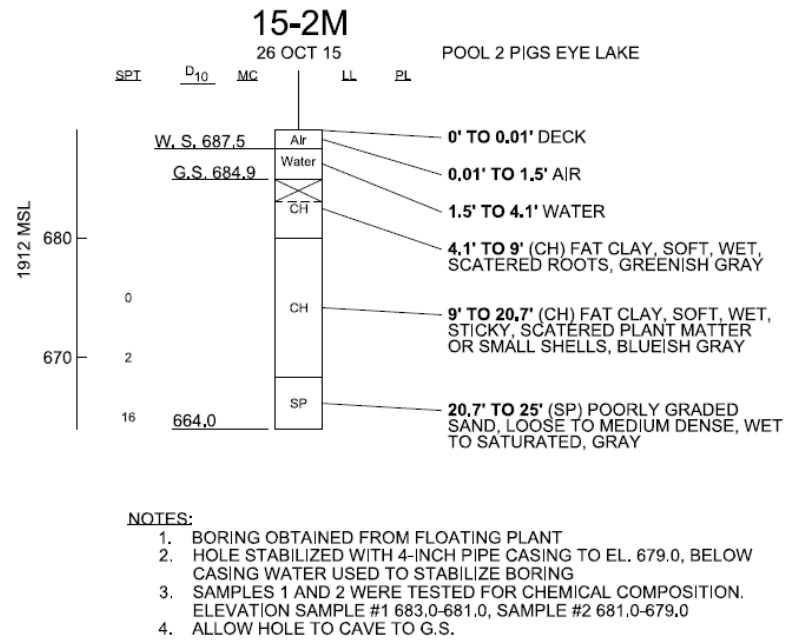


Figure 3 Boring 15-2M

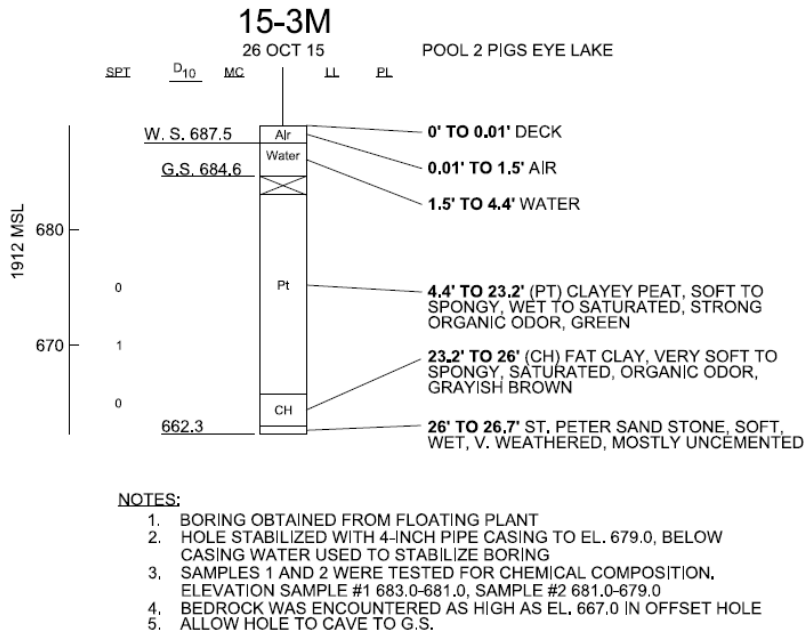


Figure 4 Boring 15-3M

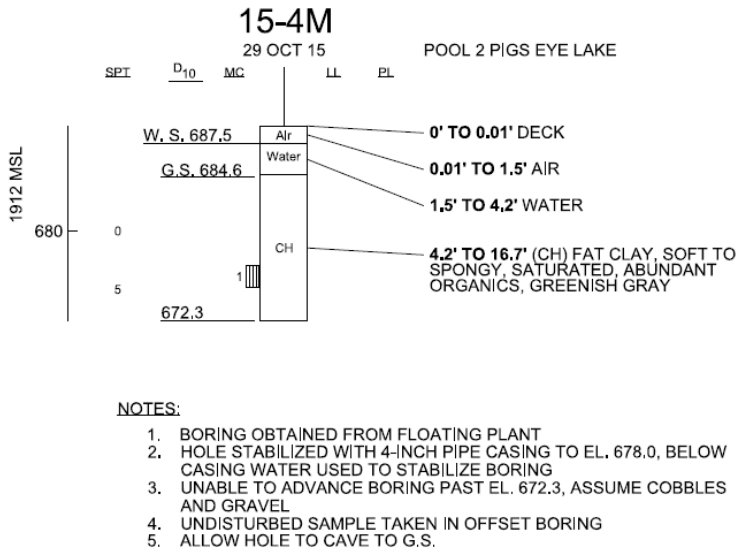


Figure 5 Boring 15-4M

F.4 Soils Testing

Atterberg Limits and Moisture contents were performed on three samples, and an organics content test was ordered on two samples. The samples were taken from the shallow subsurface locations throughout the lake. Testing results are summarized in Table 1.

Testing indicates that the samples have high plasticity with a moisture content above the liquid limit. The samples tested contained between 9-17% organics content.

The sample from boring 16-8M was visually and texturally distinct from the other bag samples obtained in August 2016, resembling a black and spongy topsoil rather than the grayish-black clay found elsewhere. This difference is reflected in the test results, as it shows lower plasticity and higher organic content. The organic clay material from 16-11M and 16-12M is more reflective of the typical shallow subsurface materials at Pigs Eye lake.

Table 1 – Summary of laboratory geotechnical testing

Boring	Sample	Depth (ft from deck)	LL	PL	PI	MC	Organic Content (% of mass)	USCS Classification
16-8M	1	5-8	118.6	63.8	54.8	133.2	16.6	Organic Silt (OH)
16-11M	1	5-8	123.9	37	86.9	144.2	9.1	Organic Clay (OH)
16-12M	1	4.8-7.8	125.5	39.7	85.8	137.7	N/A	Organic Clay (OH)

F.5 Geotechnical Evaluation

F.1.5 Lateral Displacement/Spreading ("mudwave")

Experience on previous projects has shown that shear stresses resulting from the placement of fill atop very soft clayey strata can result in lateral displacement of the foundation material. Lateral displacement can occur in a semi-liquid fashion, in which the material is simply "squeezed" outwards from beneath the fill like toothpaste, or in a plastic fashion, in which distinct shear zones or planes develop within the soil mass and wedges of material are displaced outwards along those shear zones. Either mechanism is likely to result in uplift of foundation material directly outside the vicinity of loading. This uplifted material is often referred to colloquially as a "mud wave", as it can protrude above the water surface giving the appearance of a wave. For the Pigs Eye Section 204 project, mud waves are of interest since they can result in increased turbidity as well as suspension of contaminants that might have previously been sequestered beneath the lake bottom. A large mud wave may also be a concern as the lateral loss of foundation material would require additional fill in order to meet the required grade. Based on environmental sampling and testing (see Appendix E – Sediment Report) it has been determined that the soils most likely to be exposed in a mud wave fall within acceptable limits with regards to contamination, however turbidity and fill quantities remain concerns that need to be considered.

Based on the subsurface investigation, it is very likely that rapid fill placement to the planned elevations would result in mud wave formation. Many of the soils encountered during drilling were reported as being in a liquid state, which is consistent with laboratory testing. The mechanics of mud wave formation are complex, and any prediction based on mechanics would require advanced geotechnical testing and modeling. Such an effort is not only considered outside the scope of the project, but is unlikely to provide accurate results without some sort of field calibration. What can be said safely is that

F.2.5 Settlement

The placement of fill atop soft, compressible, and relatively low permeability sediments results in excess pore water pressures that dissipate slowly over time as water drains out of the pore spaces. Primary consolidation settlement is the cumulative volume changes that results from the expulsion of water and compression of the soil structure.

Consolidation settlement is typically estimated by obtaining undisturbed samples and performing laboratory consolidation tests on specimens derived from those samples. The parameters obtained from the laboratory tests are used together with estimated changes in stress from fill placement in order to estimate settlement. Settlement estimates are often not very accurate due to variability of naturally occurring soils as well as non-uniform stress distributions that result from fill placement. In the case of Pigs Eye Lake, it was impossible to obtain undisturbed samples due to the loose, liquid nature of the soft soils.

Settlement was estimated using assumed soil parameters from the New Orleans area (Table 2), where shallow marsh conditions are prevalent and shallow soils are mostly normally consolidated. Looking at a range of properties and fill heights, it was judged that 2.5 ft settlement was a reasonable estimate for a 6 ft fill height. In addition to estimating settlement for 6 ft of fill, it was assumed that 3 ft of settlement had occurred for the 6 ft placement, and that 3 ft of additional fill placement would be necessary to reach design grade. In short, the 9 ft analysis is only accounting for the increased density of 3 ft of sand fill in comparison to the in-situ soft clays. It does not account for consolidation of the upper clays as a result of compression during construction.

There is a low degree of confidence associated with this estimate, and it does not account for any lateral displacement of liquid soils.

While a large portion of the consolidation settlement is likely to occur following construction, in very soft soils it is also likely that that significant deformations will occur during construction. These deformations can be due to lateral displacement and initial consolidation. For New Orleans levees over soft foundations the standard practice is to assume a 25% increase in fill material over the neat line quantity in order to account for settlement and lateral spreading that occur during construction. While some lateral spreading is expected for Pig's Eye, the profile of the island features is much flatter than a levee embankment and is expected to lead to a smaller amount of lateral displacement relative to the total fill volume. However the very soft soils will compress during construction and this should be accounted for in the material quantity estimate. For the purposes of the Feasibility Study cost estimate, a 10% increase in fill quantity is assumed. Experience with initial island building will help calibrate estimates for subsequent features.

Appendix : Geology & Geotechnical Engineering Pigs Eye Lake Ramsey County

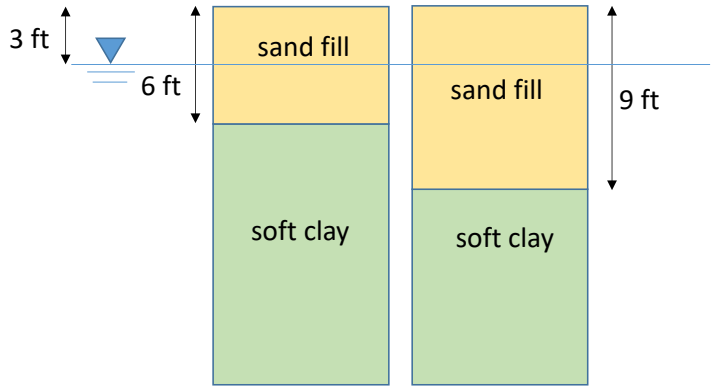


Figure 6 - Diagram illustrating settlement scenarios. On the left 6 ft of fill is placed above existing grade, 3 ft below the water line. On the right, it is assumed that 3 ft of settlement or displacement occurs during construction and additional fill is needed

Table 2 Material properties used to estimate settlement

Material	γ (pcf)	C_c	e_o
very soft silty clay	90	0.5	1.2
dredge sand	115		
water	62.4		

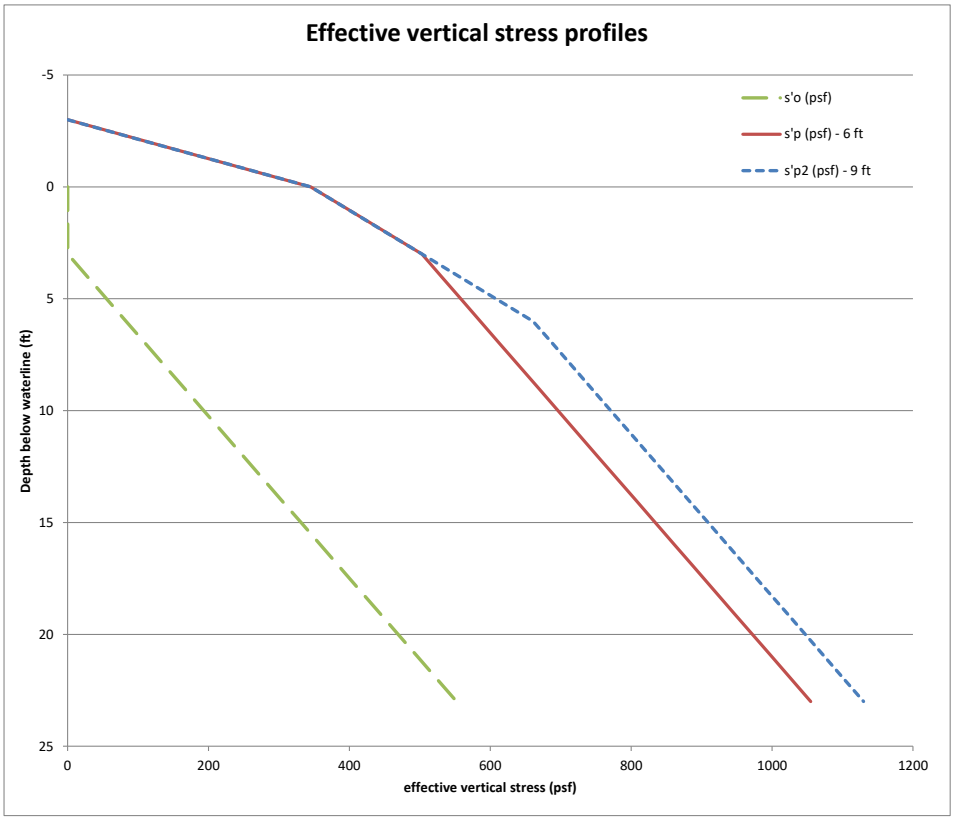


Figure 7 - initial effective vertical stress and profiles for 6 ft and 9 ft of fill

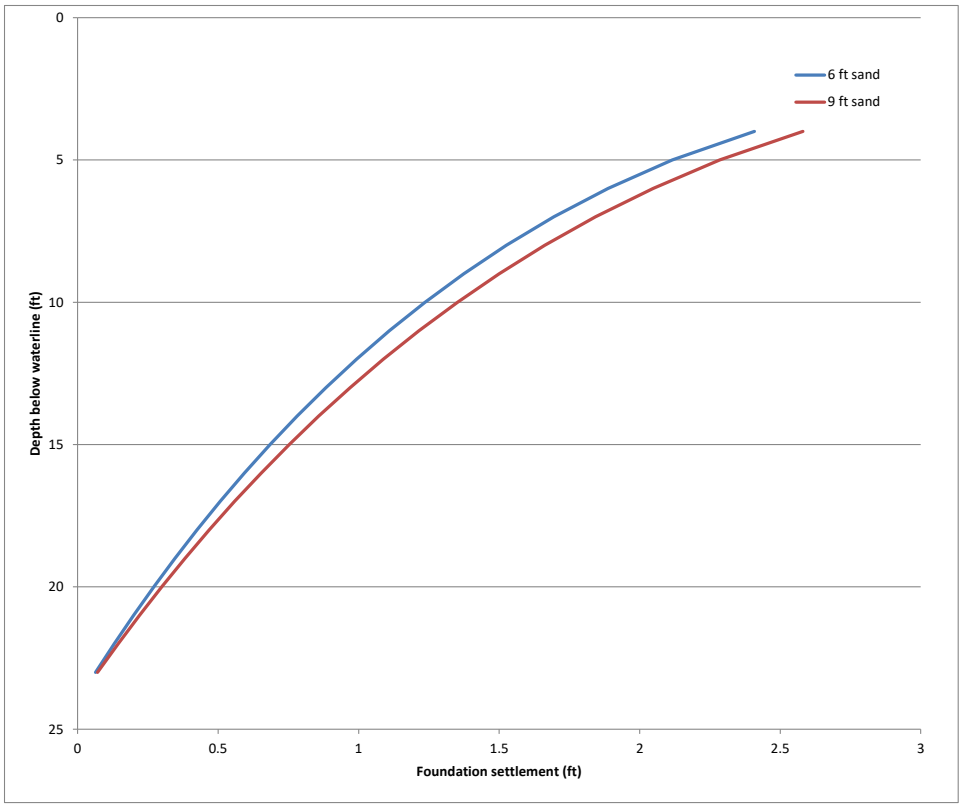


Figure 8 - Plot of predicted settlement for 6 ft and 9 ft of dredge sand fill

F.6 Conclusions and Recommendations.

The shallow soils within Pigs Eye Lake are both very soft and fairly thick, creating ideal conditions for soil displacement in response to fill placement. Field reports and laboratory testing confirm that the material in the upper few feet of the lake bed is in a liquid state.

Vertical displacement occurs over time and is a function of the amount of weight on the soil. Overbuild of the islands will help compensate for eventual settlement, but there is little that can be done to reduce the fill quantities required to bring the project features to the required grade. For estimation of quantities, it was recommended that 2.5 ft settlement be assumed for fill heights above the waterline, and 1.5 ft settlement for fill heights below the waterline.

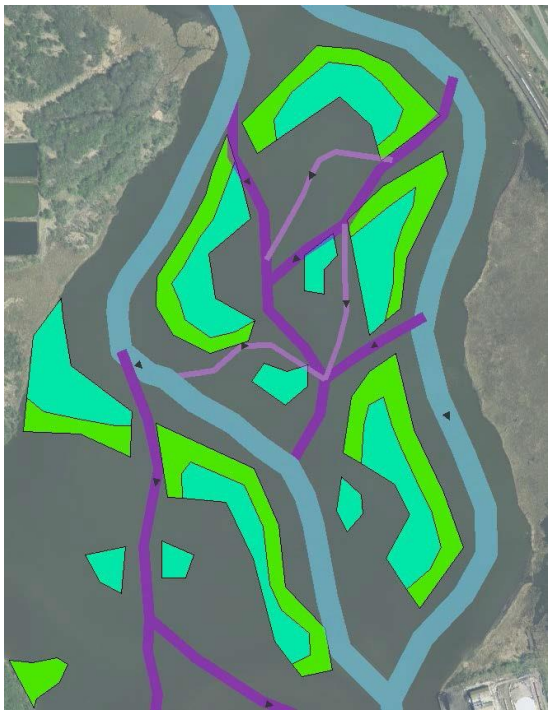
Lateral displacement of foundation material is more dependent on the slope, construction method, and rate of placement, and can be reduced by allowing for the dissipation of pore water pressures as fill material is placed. In effect this means placing the material in staggered “lifts”. This will reduce liquid behavior of the soil and increase shear strengths in order to resist the shear stresses induced by fill placement. Furthermore, shear stresses within the foundation can be reduced by constructing islands with relatively flat slopes (5H:1V to 10H:1V), which will also minimize the amount of lateral displacement.

The most reliable method for predicting the foundation response would be to complete a test fill section on-site using the planned construction methods. Meticulous documentation and monitoring would be required in order to make an appropriate interpretation of the results.

US Army Corps of Engineers®
St. Paul District

Appendix G
Hydrology and Hydraulics Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers
May 2018

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix G Hydrology and Hydraulics

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Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
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1 Introduction

This document describes some of the considerations that were used to produce alternatives for the Pigs Eye Lake study. The document includes information on existing conditions as well as floodplain regulation considerations. This document also describes some of the thought behind the development of the project alternatives.

1.1 Hydrology and Hydrologic Conditions

1.1.1 River Discharge and Stages

Mississippi River annual chance exceedance of discharge is shown in Figure 1. This discharges-frequency relation was developed by the St. Paul District of the Corps of Engineers. The relation is based on the discharge records at the USGS gage on the Mississippi River at St. Paul Minnesota (1898 to 1998). Recurrence Interval discharges that could be useful in this study are:

2 Year – 38,500 cfs

5 Year – 63,400 cfs

10 Year – 81,800 cfs

20 Year – 101,000 cfs

50 Year – 127,000 cfs

100 Year – 148,000 cfs

200 Year – 169,000 cfs

500 Year – 200,000 cfs

Figure 1 is a frequency curve for the Mississippi River at Saint Paul Minnesota. The chart can be used to relate discharge with frequency. Figure 2 and Figure 3 include stage-duration and flow-duration tables. These tables show the percentage of time a stage or discharge is above the indicated value.

Figure 4 includes the operating curves for Lock and Dam 2 on the Mississippi River. The curve for the South Saint Paul Control Point (CP) can be used to estimate water elevations in Pigs Eye Lake.

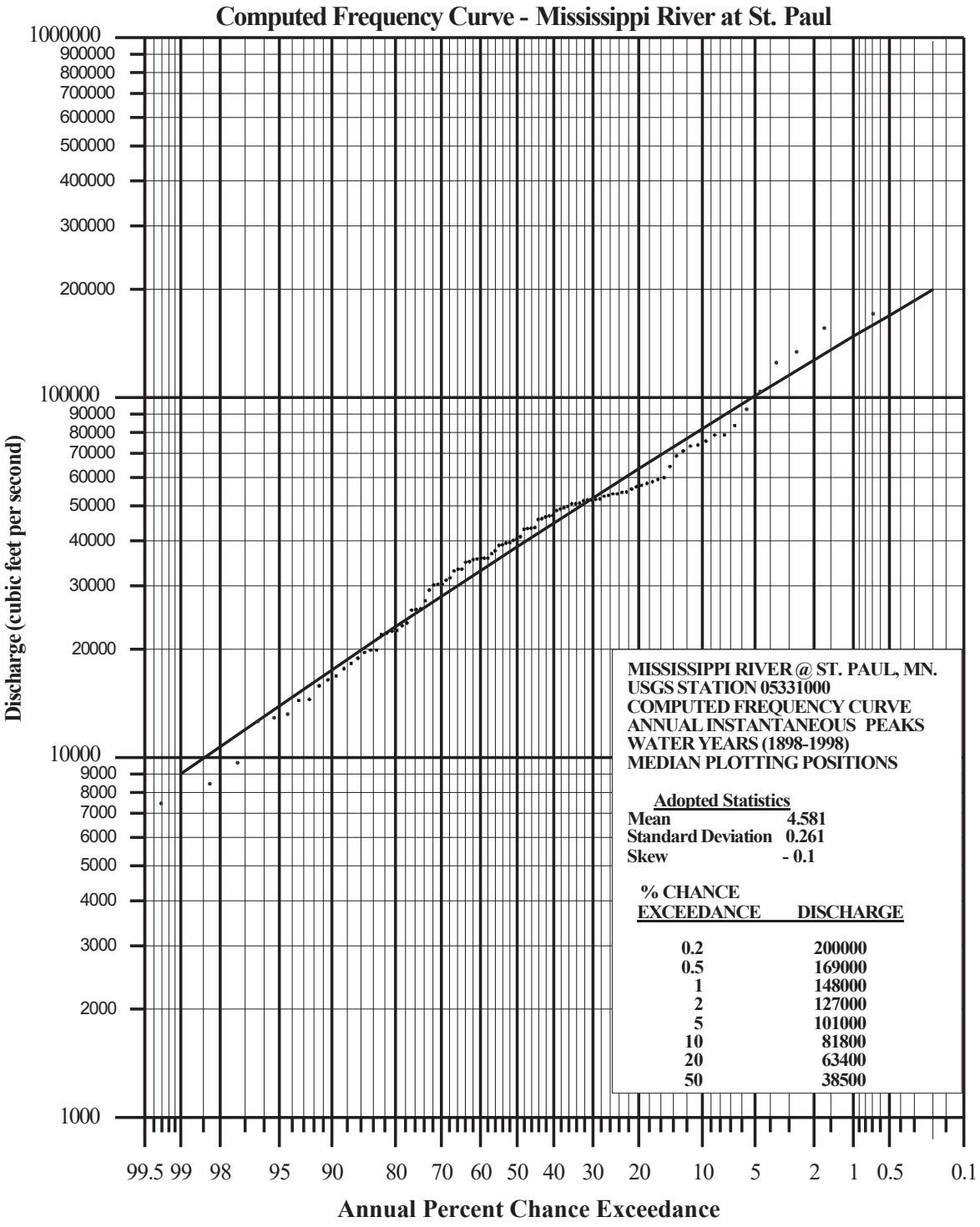


Figure 1 Discharge/ Annual Percent Exceedance Curve

Appendix : Hydrology and Hydraulics Pigs Eye Lake Ramsey County

South Saint Paul Gage — Based on South Saint Paul Gage 1981-2016 record (typical years of recent history)

Discharge in CFS

Percent	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.100	25800	37677	84000	140411	131149	99760	86253	51030	58389	72553	38343	38266
0.200	25800	37080	83260	139323	121873	98381	85221	50360	55417	71896	37587	36383
0.500	20400	34113	79194	135289	90806	96254	78125	47172	51419	65708	36397	35124
1.000	19406	24532	71272	124089	72512	91107	74981	42666	46094	53747	32357	26315
2.000	15512	19324	54412	112246	67800	62414	64090	39062	35680	46624	30500	24000
5.000	12300	15870	46300	75545	53500	53570	49100	32500	28595	36615	24495	17515
10.000	11300	10240	36600	55380	49520	45980	41590	23400	24370	29760	20900	14600
15.000	10000	9200	29000	50900	45980	41000	36045	19900	20185	24645	18400	13300
20.000	9260	8600	24840	47380	43500	37540	31360	17360	16060	20700	16500	12300
30.000	8000	7420	17960	41900	38460	32500	25100	13900	11770	14600	14400	10800
40.000	6820	6400	13600	35500	34300	28600	21300	11700	9300	11200	12700	9400
50.000	5800	5800	11100	30400	29500	24100	18150	9400	7400	8900	11100	7850
60.000	5300	5240	8900	25200	23500	20400	15600	7700	5707	7100	9100	6600
70.000	4700	4400	7400	19230	19040	16800	13210	6500	4800	5600	7300	5400
80.000	3900	3500	5700	14400	15200	13800	10400	5100	4000	4690	5700	4500
85.000	3500	3300	5200	10865	13400	11900	8000	4800	3500	4155	5000	4100
90.000	3200	3000	4700	9400	10780	9600	5700	4000	3000	3800	4400	3500
95.000	2800	2630	3600	8155	8000	7000	4200	2900	2600	3200	3700	3000
98.000	2300	2300	2900	7022	6996	3358	1500	2100	2200	2400	3281	2400
99.000	2100	1800	2096	6311	6500	2100	1400	1600	2000	1909	3000	2017
99.500	1737	1462	1759	5756	5974	1800	1300	888	1950	1450	2641	1400
99.800	1550	1200	1000	4789	5119	1619	947	500	1850	1162	2516	1200
99.900	1465	1000	800	4611	5000	1419	900	500	903	135	2500	1068

Figure 2 Discharge-Duration Relation (include period of record)

South Saint Paul Gage — Based on South Saint Paul Gage 1981-2016 record (typical years of recent history)

Top of Higher Island		690.1	
Top of main Berm		689.1 (navd88)	
Minimum Topsoil=	(689.1-0.5)	688.6	FEET NAVD88

Duration Percent Exceedance	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.100	688.28	688.58	698.57	702.63	702.20	700.83	698.26	692.87	695.13	696.76	689.90	689.03
0.200	688.22	688.52	698.46	702.58	701.49	700.66	698.06	692.78	694.01	696.67	689.86	688.82
0.500	688.16	688.38	698.01	702.46	698.56	700.33	697.79	692.44	693.48	695.58	689.73	688.11
1.000	687.84	688.18	697.06	702.15	696.73	699.59	697.23	691.93	691.76	693.74	689.29	688.00
2.000	687.63	687.73	693.71	701.07	695.31	695.04	695.63	690.73	690.39	691.69	688.98	687.93
5.000	687.31	687.34	691.66	696.55	693.23	693.33	692.20	688.73	688.76	689.74	688.29	687.73
10.000	687.17	687.15	689.84	693.67	692.29	691.60	690.74	687.93	688.08	688.84	687.77	687.49
15.000	687.12	687.08	688.66	692.65	691.67	690.79	690.00	687.63	687.64	688.19	687.46	687.35
20.000	687.08	687.05	688.15	691.90	691.12	690.22	689.33	687.37	687.31	687.71	687.36	687.26
30.000	687.01	686.98	687.44	690.82	690.22	689.43	688.45	687.17	687.10	687.23	687.19	687.15
40.000	686.96	686.93	687.21	689.85	689.57	688.83	687.92	687.06	687.03	687.10	687.11	687.07
50.000	686.91	686.87	687.09	688.96	688.82	688.10	687.50	687.00	686.97	687.04	687.04	687.01
60.000	686.84	686.81	687.01	688.22	688.09	687.63	687.24	686.95	686.94	686.99	686.99	686.96
70.000	686.78	686.76	686.93	687.53	687.60	687.31	687.07	686.89	686.88	686.93	686.93	686.89
80.000	686.71	686.69	686.86	687.09	687.24	687.10	686.96	686.83	686.83	686.88	686.88	686.82
85.000	686.67	686.64	686.81	686.97	687.13	687.03	686.91	686.80	686.80	686.85	686.84	686.75
90.000	686.61	686.60	686.75	686.89	686.96	686.96	686.86	686.76	686.77	686.81	686.80	686.69
95.000	686.54	686.52	686.65	686.80	686.84	686.85	686.79	686.70	686.71	686.76	686.72	686.60
98.000	686.46	686.46	686.55	686.71	686.73	686.73	686.72	686.63	686.64	686.68	686.62	686.48
99.000	686.41	686.41	686.50	686.67	686.65	686.68	686.69	686.58	686.58	686.65	686.57	686.39
99.500	686.38	686.36	686.41	686.64	686.59	686.65	686.65	686.54	686.54	686.60	686.49	686.27
99.800	686.33	686.28	686.36	686.54	686.53	686.57	686.60	686.41	686.46	686.57	686.35	686.18
99.900	686.28	686.23	686.35	686.48	686.51	686.53	686.59	686.36	686.43	686.51	686.26	686.14

Elevations in NAVD88

Figure 3 Elevation - Duration Relation (NAVD88) at South Saint Paul Gage (include period of record)

1.1.2 Mississippi River/Dam 2 Operation

The following figure shows the Operating Curve for Lock and Dam 2 on the Mississippi River. The green curve shows the Control Point in South Saint Paul. This control point is directly across the river from Pigs Eye Lake. The river stage at Pigs Eye Lake is held constant at 686.8 feet NAVD (687.2 (1912 datum) for discharges below 12,500 cfs. At a river discharge of 12,500 cfs, the river stages begin to rise with discharge.

Appendix : Hydrology and Hydraulics Pigs Eye Lake Ramsey County

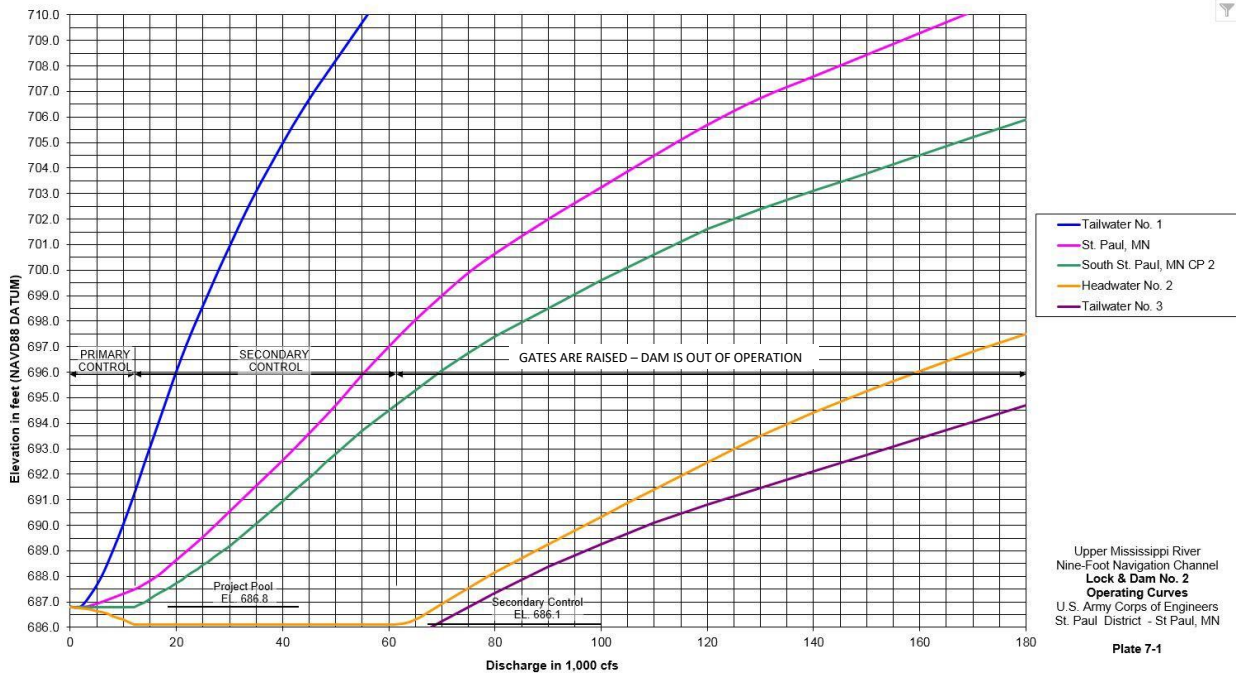


Figure 4 Pool 2 Operating Curve (NAVD88 Datum)

1.1.2.1 Stage Variability

The stage variability with discharge is greater in Pigs Eye Lake than in many the Corp's other Mississippi River project locations. This is because the site is located higher in the pool and that there is a fairly low discharge (12,500 cfs) above which the pool is allowed to rise.

1.1.3 Circulation within Pigs Eye Lake

Pigs Eye Lake has two primary sources of inflow. One source is Battle Creek which enters the lake at its northern end. The other is the Mississippi River. There is a small amount of flow that enters from a small channel entering the lake from the south west. Flow from this channel would pass across the southern end of the lake and exit to the south along the main fleeting channel. This pattern would occur during fairly constant discharge. Figure 5 illustrates some of circulation pattern features described in this section. The yellow lines show flow into the lake which cuts across the south end of the lake and exits thru the harbor channel. Inflow from Battle Creek in the north is also shown in yellow. The figure also shows the location of the South Saint Paul Gage.

When river stages rise rapidly at Pig's Eye Lake (and South Saint Paul Gage) for discharges above 12,000 cfs, water would flow into the lake from both inlets to allow lake stages to match river stages. This would reverse when river stages reverse. Flow would go out of each of the 'inlets' to provide a common water surface between the river and the lake. Gradual rise in stage would have more of a pattern similar to that shown in

This process provides a kind of 'bellows' effect on water exchange between the lake and the river. Aerial photography was used in an attempt to see a pattern of how this 'bellows' action affects circulation in the lake. No clear pattern was evident. In general is seemed like the incoming river water displaces the water in the southern part of the lake. Sometimes a horizontal boundary seemed to be present that demarcated a line between water zones. Other times there was little differentiation that was observable.

It appears that water entering from Battle Creek is a more dominant source of water in the upper lake than in the lower lake.

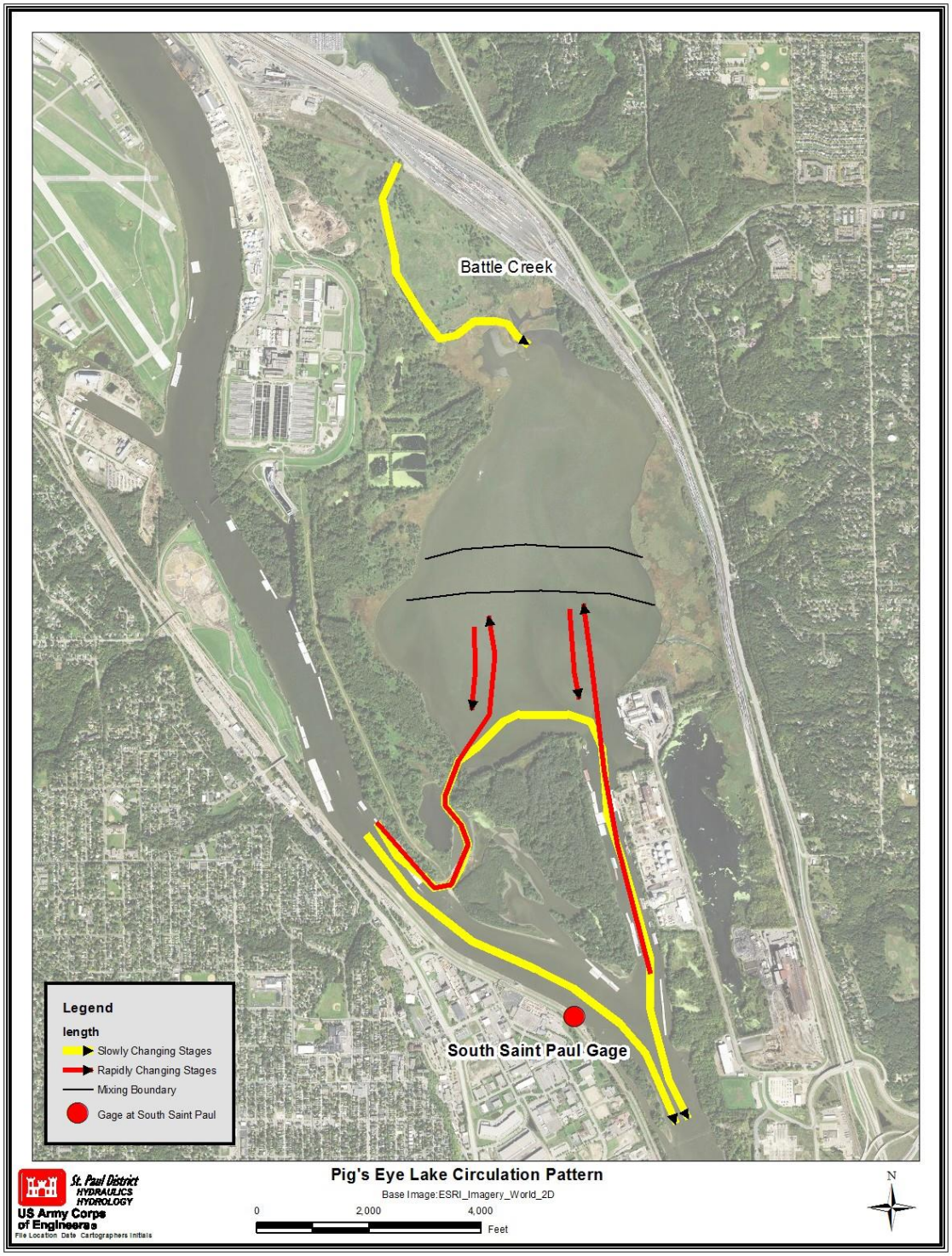


Figure 5 General Lake Circulation and the Relative Location of the South Saint Paul Gage

1.2 Wind and Waves

Wind blowing across Pigs Eye Lake generates waves that cause shoreline erosion and greatly increase the suspension of the very fine lake bottom sediments. Typical wind direction and magnitudes are shown in Figure 6 and Figure 7. The wind data that is nearest to Pigs Eye Lake is at the Holman Field Airport which is about two to three miles northwest of Pigs Eye Lake. The airport is located on a bend in the river valley. Winds typically align themselves with the valley walls of the Mississippi River. This also seems to be affecting the wind orientation at Holman Field Airport. The wind directions are significantly oriented from the northwest and southeast. At the location of Pigs Eye Lake, the orientation of the dominant winds would likely be shifted about 15 degrees (clockwise) to better align with the valley walls in the vicinity of the Pigs Eye Lake. Figure 8 contains a map showing the dominant and secondary wind directions that have been adopted for this project. The secondary wind direction is the most significant wind orientation at the Holman Field gages. The alignment can be used for wind directions in either directions along the arrows since the significant winds are generally along the same axis from both the northwest and southeast. The primary wind direction is generally the direction that best aligns with the eastern valley wall near Pigs Eye Lake.

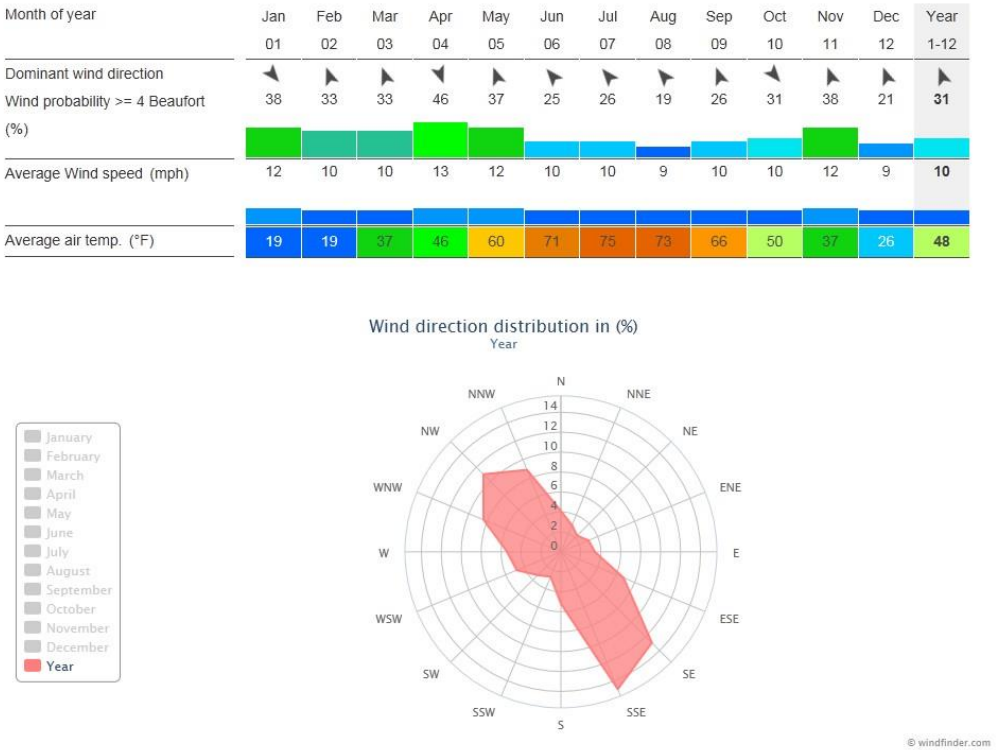


Figure 6 Wind Rose and Other Statistics at Holman Field (graphics from windfinder.com)

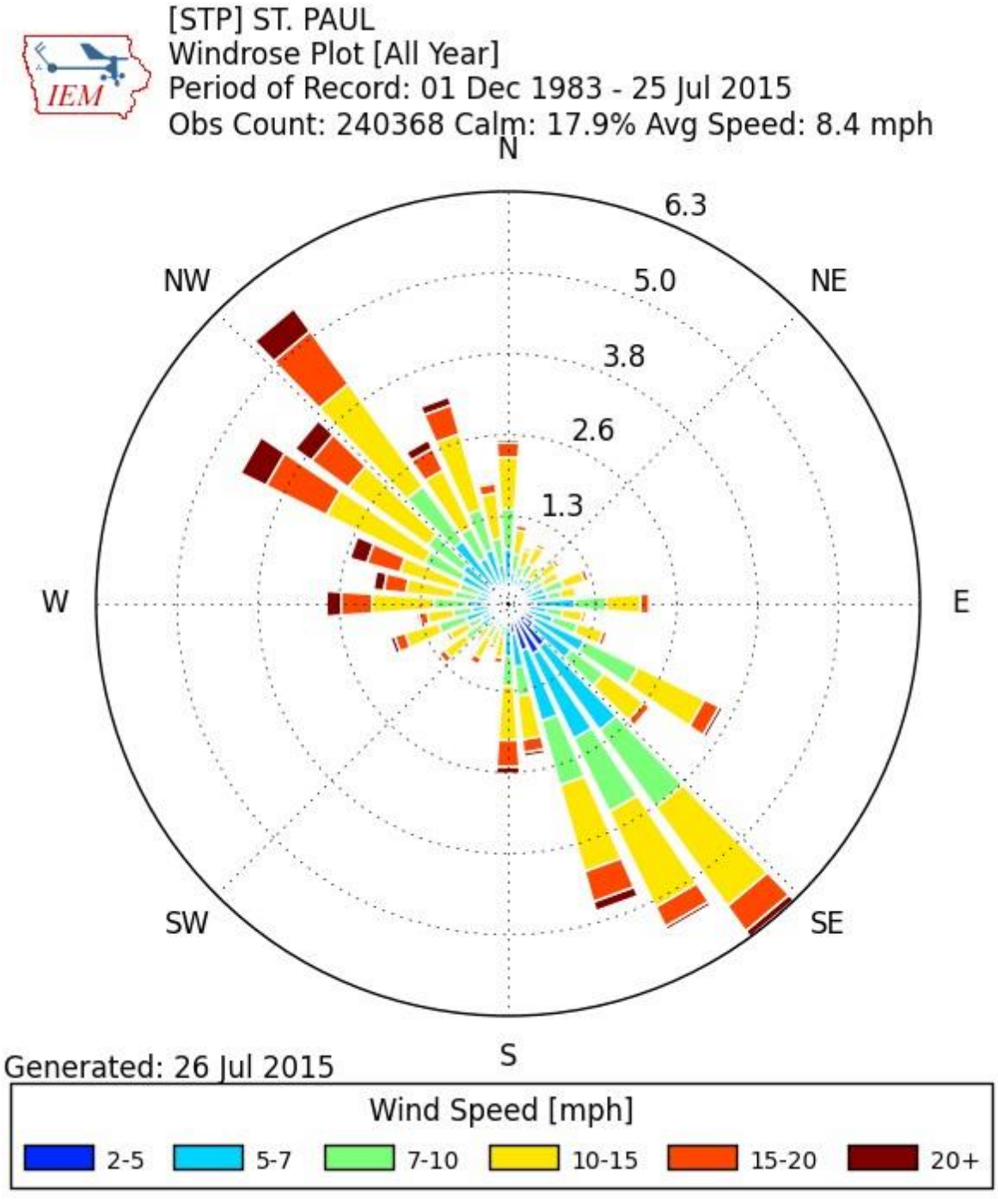


Figure 7 Wind Rose at Holman Field Saint Paul MN (graphics from IEM/Iowa State University)

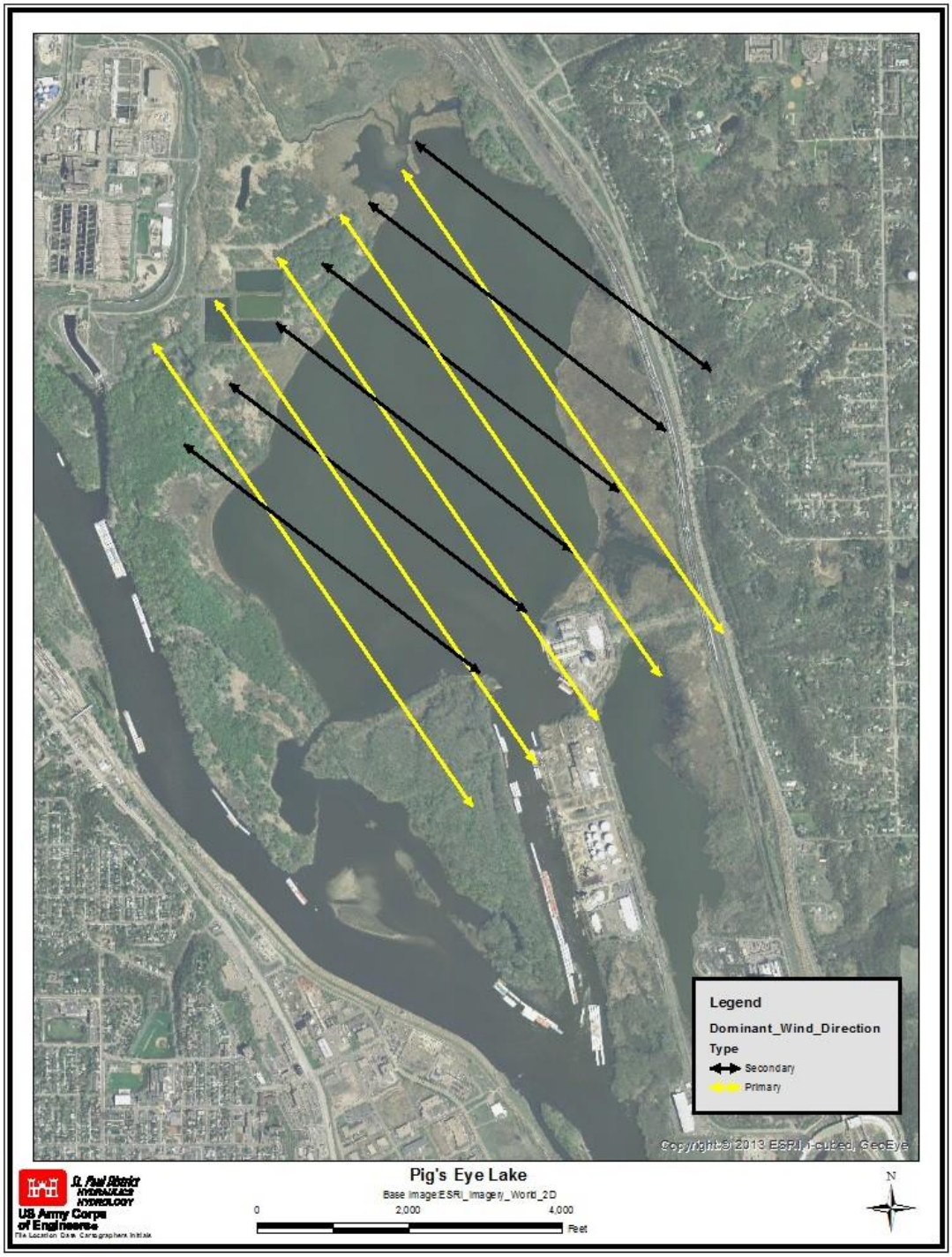


Figure 8 Map showing Primary and Secondary Wind Direction over Pigs Eye Lake

1.3 Shoreline Stability

The long periods where wind generated waves have expended their energy on the shoreline. There is evidence that the shoreline in certain regions of the lake have retreated approximately 80 feet since 1991. The following figures show the shoreline retreat over several time periods.

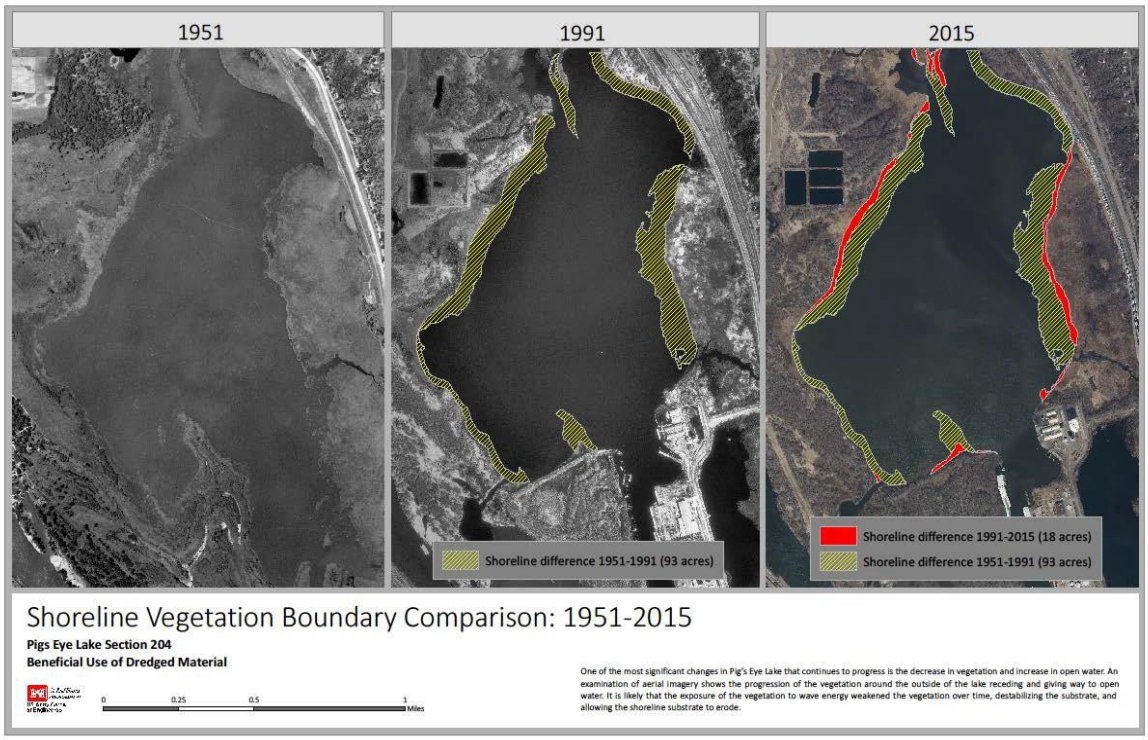


Figure 9 Shoreline Erosion in Pigs Eye Lake from 1951-2015

Shoreline erosion is not thought to be closely related to the impacts of flow from the main channel. The lake is significantly sheltered from direct inflow by the wastewater treatment plant and the high roadway that connects it with high ground. The lower west side of the lake would be exposed to overland flood flows from the main channel. The shoreline in this area is the most stable in the lake. Erosion from wind generated waves seems the most likely explanation for shoreline erosion.

1.4 Sedimentation

1.4.1 Sediment from the Mississippi River

Sediment enters the lake by flowing overland during flood events and also enters the lake through the inlets and outlets along its southern end. Changes in pool elevation cause water to back into Pigs Eye Lake from the main river channel. This sediment would be very fine since it would have to be suspended in the water column under fairly low velocity to enter the lake. During flood events,

overland flow the Mississippi (beginning at approximately 65,000 cfs and an elevation of 695 feet NAVD88) from could bring sediment into the lake from the main river channel. It would be expected that a good portion of this sediment would be channel sand. At present, there is not much evidence of sand within the lake so it is not thought that this is a significant source of sediment.

1.4.2 Sediment from Battle Creek

Battle Creek also carries sediment into Pigs Eye Lake but would tend to drop it near it's delta in the northern end of the lake. Battle Creek's source water is generally collected from urban storm sewered runoff. It is assumed sands and other road sediments constitute a majority of the sediment entering the lake from Battle Creek.

1.4.3 Sediment from Shoreline Erosion

Shoreline erosion over the years has removed sediment from the shorelines and deposited a significant portion of it on the lake bed as fine sediment.

1.4.4 Accumulation and/or Loss of Sediment from Pigs Eye Lake

It is difficult to say definitively how the overall balance of sediment input to the lake should be understood, but generalizations can be made. Some of the fine lakebed sediment could be suspended in the water column by wave action and removed from the lake with outflow. It seems unlikely that this would be significant in relation to the sediment entering the lake from its various sources. The very soft upper layers of the lake sediments would be consistent with the assumption that there is a net accumulation of very fine sediments within the lake. The coarser sediments entering the lake from Battle Creek would most likely fall out in the Battle Creek delta areas and would not move much further into the greater lake.

2 Regulatory Floodway

The following Figure 10 shows both the mapped floodway as well as the limits of effective flow limits currently used by the Minnesota Department of Natural Resources (MnDNR) to regulate floodplain impacts. The mapping was done using HEC-2 (an earlier direct ancestor of HEC-RAS). The current HEC-RAS modeling shows ineffective areas (below elevation 709.0 feet) east of the red line shown in the figure. The most extensive of the island alternative layouts is also shown for visual reference.

There should be no stage impact to the regulatory floodway or to the 1 percent annual chance exceedance flood stages (100 Year) because all of the proposed construction is outside of the effective flow limits shown in the latest modeling.

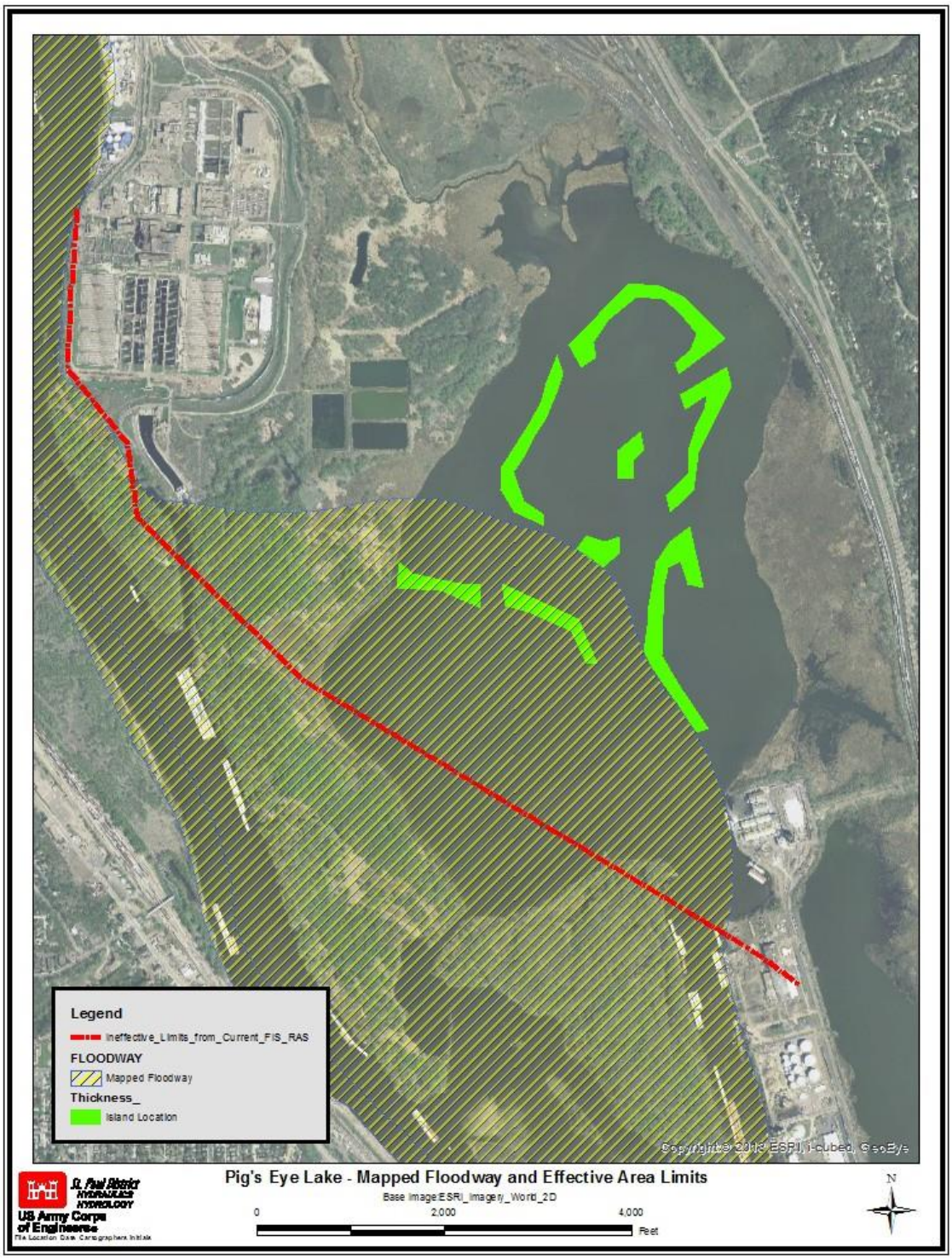


Figure 10 Mapped Floodway and Effective Flow Area Limits

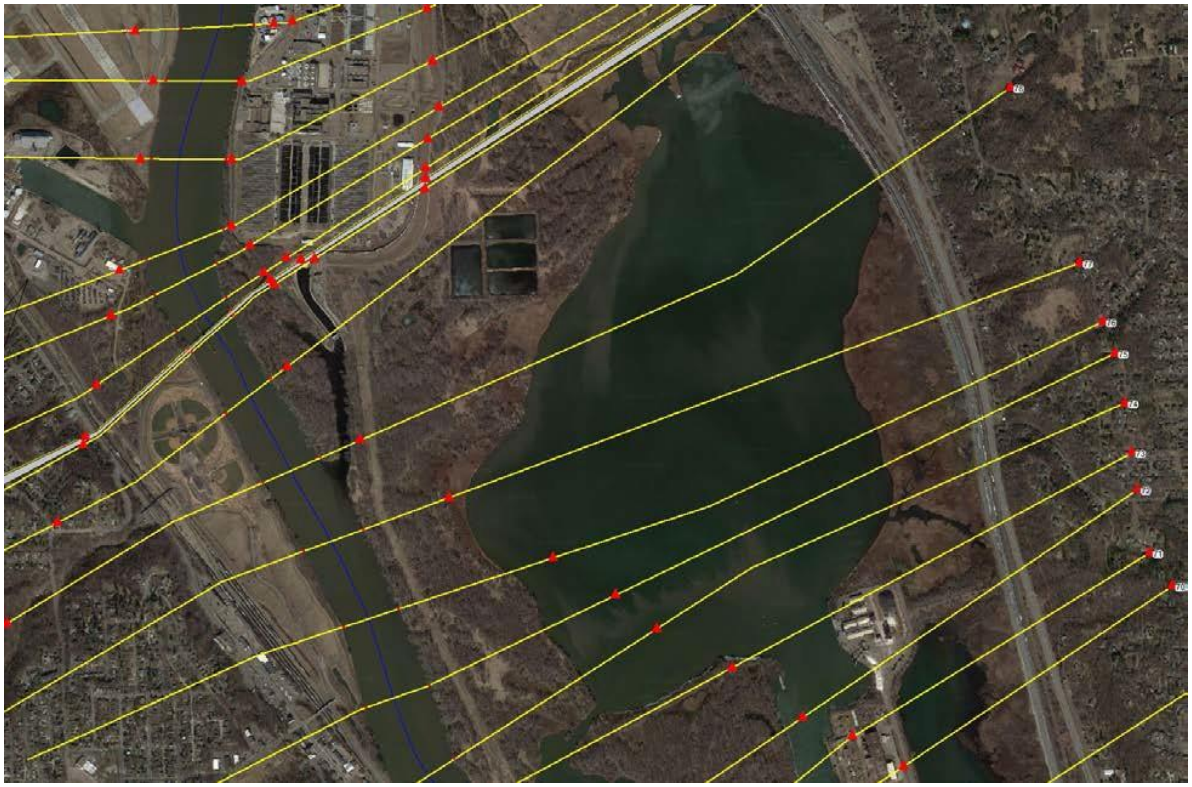


Figure 11 HEC-RAS Cross Sections (Ineffective Flow Boundary Shown in Red)

3 Island Alternative Design Considerations

3.1 Avoid Stage Impacts

The islands were laid out to avoid the effective flow limit boundary which is the MnDNR's primary focus for preventing stage impacts. The islands were also placed using deference to the mapped floodway which is also shown in the figure.

No islands encroach on the effective limits of the HEC-RAS model. Two islands fall within the mapped floodway boundary but are within the ineffective flow area. These islands (the south western islands in the figure) were aligned roughly parallel to the mapped floodway boundary. This was to make them parallel to any flowlines through this region. This will insure that that any stage impacts would be negligible if water were to move through this region.

3.2 Construction on Soft Substrate

Geotechnical concerns with the soft sediment substrate in the bottom of the lake required that some choices be made in the island design.

Generally the concept has been to build the islands in a few phases. First the base layer would be placed using hydraulic dredging. This would build the islands up to near the water surface. This layer would be allowed to consolidate the underlying sediments for a time before the above water parts of the islands would be constructed. This method allowed for the extension of a submerged berm around the perimeter of the islands. This bench would help function as a constructed beach zone as well as aid in minimizing the mud wave formation.

The height of the islands was also restrained to keep the weight of the islands down to keep settlement issues manageable. Ideally, certain portions of the islands would be given greater height to aid in habitat diversity. These areas would probably be a small percentage of the island acreage proposed in the alternatives. The highest portion of selected alternative has a crest elevation of 690.1 which is only 3 feet above the common water surface elevation. Localized higher features will have to be considered in more detail in the Plans and Specifications phase of this project.

4 Island Cross Section Design

4.1 Typical Section

The Corps has constructed many habitat islands on the Upper Mississippi over the past few decades. Many of the features and recommendation been denoted in the Corps of Engineers Upper Mississippi River Restoration Program - Environmental Design Handbook, December 2012. This document was used to insure island dimensions and design criteria were in general agreement with currently accepted design characteristics.

Several features of the new proposed island layout have varied from more typical sections. This has been done in part to provide a better design for construction on very soft sediments. Changes have also been proposed to improve the island/lake habitat value.

Typically sand islands consist of a sand terrace “berm”. A portion of this berm is sacrificial and in concert with groins or vanes will help establish a beach zone as the island partially erodes with time. The beach zone helps to dissipate wave energy and slow the erosion of higher portions of the islands. A higher central area is typically included that is covered more thickly with topsoil. Willows are often included to aid in reducing wave energy and as insurance if certain segments of the berm are eroded more quickly than anticipated.

4.2 Submerged Berm

One of the main features that differ from the more traditional island design is the 'submerged berm'. Normally this would be an additional expense. The soft lake bed sediment posed a significant risk of producing 'mud waves' associated with island construction. 'Mud waves' are essentially the displaced material from under the island footprint that pushes out and up from beneath the island. Geotechnical considerations indicated that a transitional layer that does not significantly rise above the typical water surface may help control the production of mud waves.

Construction of the islands was proposed to occur in two phases. The first would be to hydraulically place sand up to near the water line. This would be allowed to settle for a while before equipment is brought in for the above water parts. This submerged berm would basically be constructed as part of the first layer of island construction.

In essence the submerged berm would function as a significant step toward creation of a beach zone around the islands. The beach zone helps dissipate wave energy as waves approach and break on the islands. This reduces the wave's erosive action on the higher island portions. Over time the beach material is regularly rearranged by the waves and the bank material becomes more stable.

Groins placed on the berm should take much less rock since they are limited in thickness to about two feet. In deeper water, typical groins gain most of their volume as the base widens with depth.

Most of the elevations in these island design alternatives are based on an assumed water surface elevation of 687.1 (NAVD88). Low Control Pool is 686.8 (NAVD88) at this site. This is also the elevation that the Operating Curve shows the South Saint Paul gage held to until a discharge of 12500 cfs is exceeded (which is fairly common). The stage hydrographs for the South Saint Paul gage were examined and normal summer elevation was commonly at 687.1 (NAVD88).

The submerged berm goes from 687.1 to 686.5. This runs from the edge of the emergent island out to the outer edge of the submerged berm.

4.3 Split Island Alternatives – Sections

A couple of the alternatives have what are being called 'split' islands. Conceptually these islands evolved from the full section island. The thought was that if one of the berms was split off of the island and separated from it by a short distance, the island should still have little risk of erosion along the split since the fetch would be very small. This gap between the two sides could be enlarged further as long as the interior remains very sheltered. These islands are generally constructed in pairs where a portion of one section that has the higher island elevation and another island that is similar to an independent split off berm.

4.4 Three Adopted Sections

The alternative plans incorporate three cross section designs. These are the 'Full' section which is the most similar to traditional HREP islands with the addition of a perpetually submerged berm. The other two sections reflect the design for the 'Split' island concept where the island pairs provide heavily sheltered interior embayments.

4.4.1 Full Section

The first island cross section type is shown as Type "A" in Figure 12. It is very close in its dimensions to examples in the EMP Environmental Design Handbook. The addition of the submerged berms is the primary exception. The 40 foot long berm has an elevation of 689.1 which is 2 feet above the common water elevation. The interior rises another foot to 690.1.

Table 1 shows the duration of inundation as percentages of the non-winter months as well as full year and the April to October period. Although these islands will be subject to repeated inundation, they should have enough time out of the water to develop a healthy vegetative cover. Land at these elevations surrounding Pigs Eye Lake are supporting healthy vegetation.

South Saint Paul Gage (1988 NAVD)	Apr	May	Jun	Jul	Aug	Sep	Oct	All-Year	Apr-Oct
690.1 Top of High Island	39.9	29.7	10.5	9.9	3.9	1.5	1.5	8.9	15.8
689.1 Top of Main Berm	52.6	42.3	23.9	16.5	5.5	2.9	4.8	13.9	21.1
688.6 Bottom of Topsoil Elev.	56.8	49.8	30.8	22.4	6.1	4.6	8.7	16.9	25.5

Table 1 Percentage of Time Elevation in Overtopped (based on South Saint Paul Gage record 1972-2000)

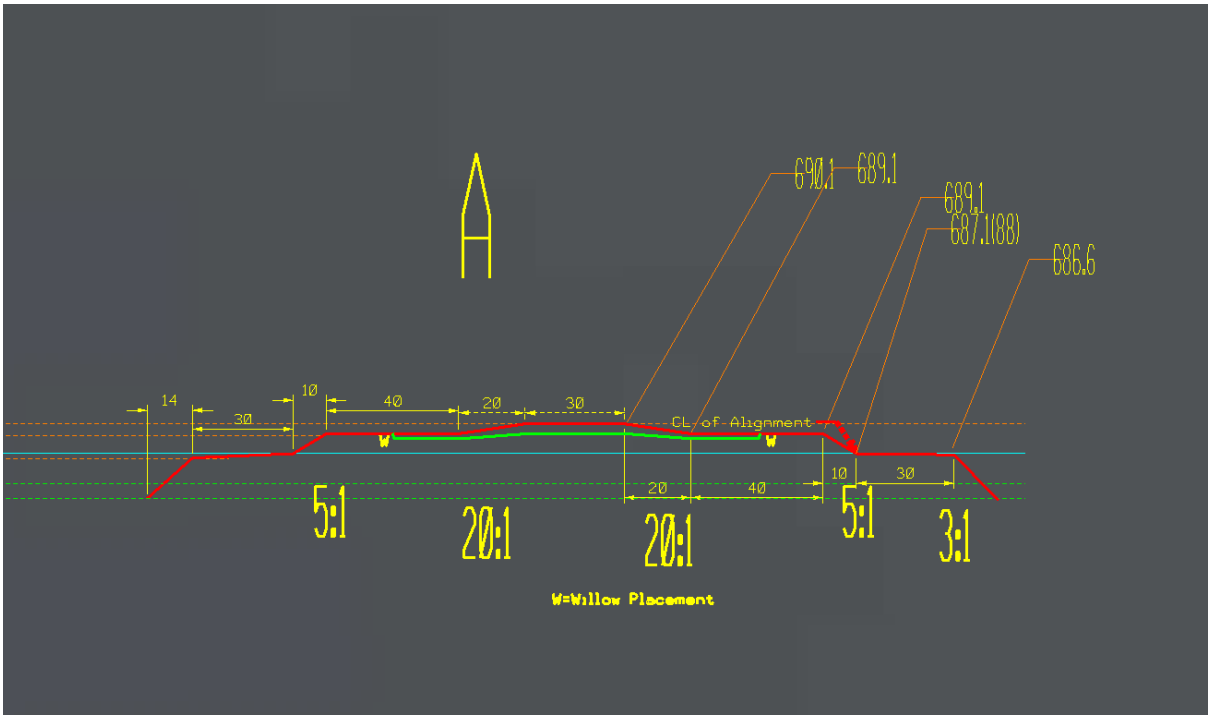


Figure 12 Full Island Section

4.4.2 Split Island Section

Figure 13 shows two sections that represent the 'split' island concept. Island "B" section shows the low, berm only side of the split. Island "C" section shows the section of the 'split' island concept that that retains the higher elevation interior.

These islands have an interior and exterior side. The interior side has only a small submerged berm and regular emergent berm. These minimal dimensions are acceptable because of the extremely sheltered nature of these shorelines. Island "C" has outer berms that have been shortened to 25 feet. These islands are located within a sheltered complex where wind fetch is much smaller than a half mile which is often a criteria for the need for erosion protection. The submerged berm is another factor in support of the smaller berm dimensions. Much of the sand is already in place for the beach zone. Little additional erosion of the berm would be necessary to produce a stable beach.

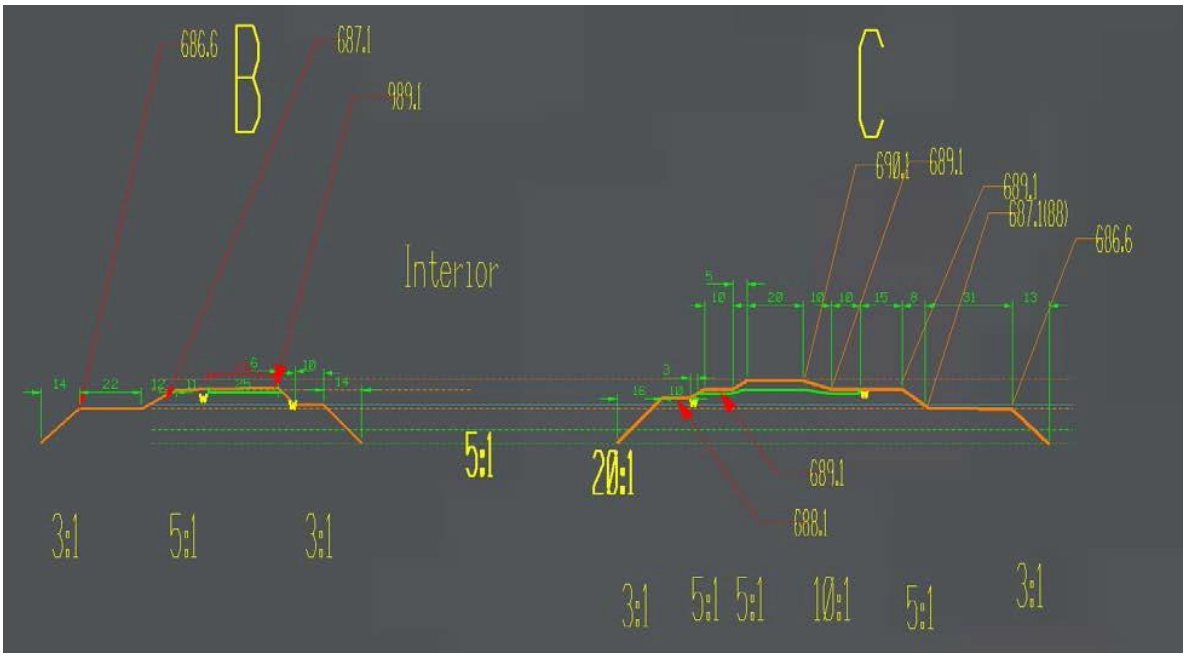


Figure 13 Split Island Cross Sections

4.5 Topsoil

Topsoil is needed on the islands to produce more diverse vegetation. A half foot of topsoil will be placed on the berms. On exposed sides of the islands half of the berm will receive topsoil. The remaining sand is considered sacrificial and will be allowed go into beach formation. The higher portions of the islands (sections A and C) will receive a thicker layer of one foot of topsoil to improve the prospects of vegetation and provide addition moisture retention in these areas that are further from the water table.

5 Erosion Protection

The EMP Environmental Design Handbook was used when considering if shoreline erosion protection was necessary on the proposed islands. Table 4-2 in the Handbook itemizes several factors and estimates a combined score that is then used to assess the need for bank stabilization methods. The following shows the results:

Appendix : Hydrology and Hydraulics Pigs Eye Lake Ramsey County

Table 2 Need for Bank Protection - Assessment

Factor		Value
River Currents	none	0
Wind Fetch	0.6 miles	0
Navigation Effects	none	0
Ice Action	minimal	3
Shoreline Geometry	skewed to wind axis	2
Nearshore Depths	<2 considering constructed submerged berm	0
Nearshore Vegetation	none	3
Bank Conditions	sand and silt	3
Local Sediment Source	none	1
	Total	12

The value of 12 indicates the boundary between “Bank Stabilization Not Needed” and “Further Analysis Needed”. It has been decided to use groins along all outer surfaces of the islands. Consideration may be made for the more protected areas at a future date when detailed plans are available.

The use of 25 foot long groins are recommended along the outer shorelines of the islands. This is more important for the islands facing the large basin in the south of the lake. If all of the islands are constructed in a single an action, it may be possible to reduce the number of groins on the more protected islands where wind fetches would be less than one half mile. The groin spacing of 100 feet is recommend (4 times groin length) since the groin length is shorter than usual. The 25 foot length is based on the 30 foot length of the submerged berms. The groins would be placed on top of the submerged berms need to be shorter to insure the outer slope falls on the berm. The elevation of the groins would be equal to (regular) berm at 689.1 (1988 NAVD). Side slopes of the groins will be 1.5 horizontal to 1 vertical. A 5 foot tie in will be added to the groin (1 foot thick).

Ice is not expected to be a significant issue affecting the long term functionality of the groins. The most southern of the proposed islands would have a fetch of about 1 mile. The south facing ends of some of the groins could be given a flatter slope to make expanding ice ramp over the groin ends. The thickness in rock in the groins is about 2-2.5 feet. The thin rock layer would make it more difficult to put a slope (e.g. 5H:1V) on the groin ends. It may make more sense to leave the groin crest elevation constant and let the ice re-work the groin. Over time the groins would become more stable.

Figure 14 shows the proposed end treatment for islands. The groin fields transition to a series of three 25 foot riprap segments with 25 foot tie back (1 foot thick and 3 foot wide). The sand berm is extended another 25 feet to allow for the placement of the riprap segments.

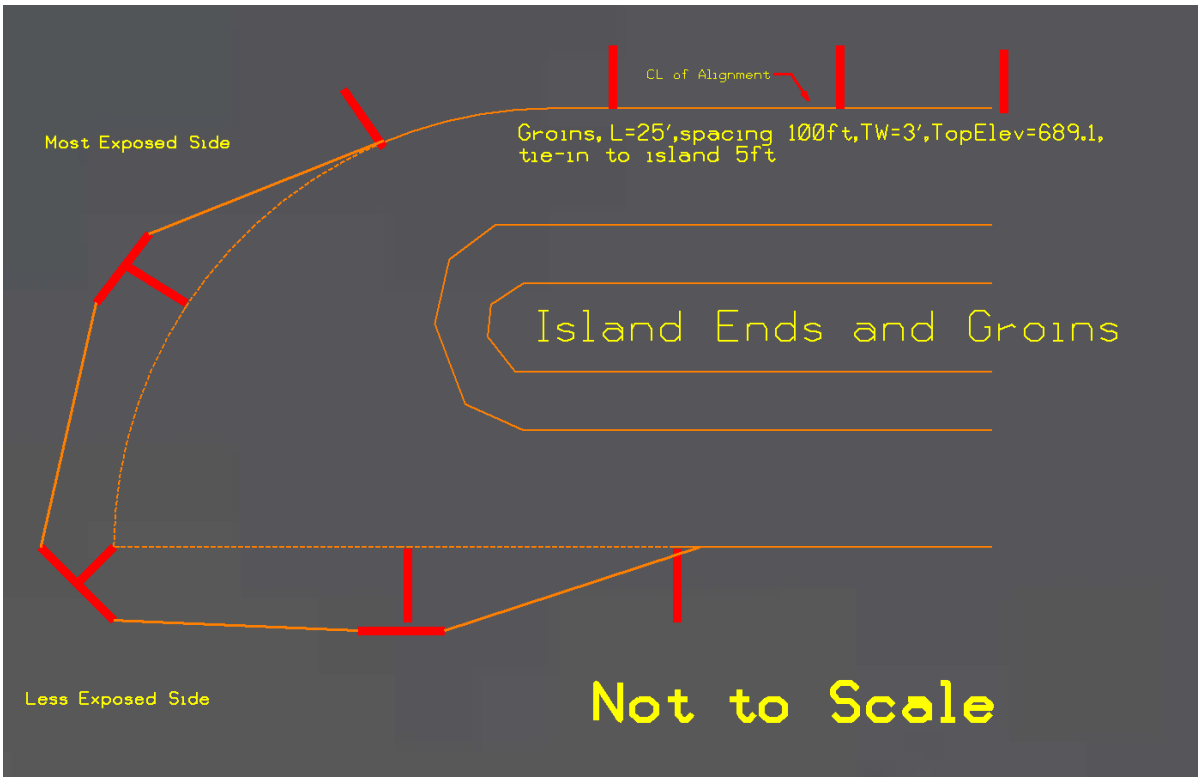


Figure 14 Typical Treatment of Island Tips

6 Island Alternatives

The production of island alternatives was structured around a basic pattern that would be 'naturalistic'. This can be very subjective but an understanding of basic geomorphic principals can help produce island archipelago geometry that would be similar to other areas on the Mississippi River that were created by the river. Pigs Eye Lake was never island studded body of water. As well as we know it has been a lake for many thousands of years.

The patterning of islands within Pigs Eye Lake was produced after making a few assumptions. The first assumption was that the old pre-historic river channels entering the lake from the north were still active. The question is asked. How would sediment from these channels be distributed if it entered Pigs Eye Lake?

Considerations include:

-Uses existing shoreline as shoreline for primary channels

-Consider the primary wind directions and try to provide a wave sheltering pattern that minimizes wind fetch along the dominant wind directions.

--Provide a naturalistic deltaic/anastomosing planform. Asymmetrical branching where deposition along a greater channel will extend further than along a lesser channel.

-Scale of island width and length is based on the curvature of the existing lake shoreline.

-Self similar patterning – Repeating patterns at decreasing scale (e.g. crab claw within crab claw etc.)

-Insure that assumed flow patterns are acceptable and would allow water circulation within the island complex.

- Island layout indicates the direction of the assumed flow pattern. Island segments terminate at the downstream end based on assumed flow paths.

- Provide multiple 'embayment' sizes for a varied habitat with different degrees of sheltering.

-Provide substrate for vegetation

A 'crab claw' type island complex typical of anastomosing river (where multiple channels divide and recombine) would be a reasonable island type for this region. Several of these types of island patterns can be seen on the Mississippi extending from Pool 2 for hundreds of miles.

Figure 15 and Figure 16 show an idealized form of an island complex for an anastomosing river system. At this point cost and other practicalities have not been included in the plan. The primary constraint in the plan is to keep cost acceptable to stakeholders and to keep the total sand volume in the same range as expected sand availability.

Several island alternatives have been devised that attempt to provide as much of the character and habitat value of a natural island complex but are more economically viable while continuing to maximize habitat value.

Constraints on sand volume and cost required thinner islands. This optimized the wave reduction in relation to island cost. The length of the islands was also reduced to try to bring costs and sand volumes into acceptable ranges. Reduction of the lengths of the islands does have an effect on the wave sheltering ability of the island complex. The larger gaps between islands and the greater size of inter-island corridors means that larger waves would be present but should still be significantly reduced from existing conditions. It is difficult to determine the significance in sediment re-suspension between the island alternatives. We can say that quieter water should provide better water quality. Figure 17 through Figure 20 show plan views of the island alternatives.

Alternatives 1, 2, and 4 have a wider 'Full' island cross section. Alternatives 3 and 5 are alternate versions of Alternative 2 and 4respectively. These two alternatives replace the single wider island section (Section "A") with the 'split' island cross sections ("B" and "C") for several of the primary islands. These two alternatives provide the very quiet sheltered bays.

Alternative 5m adds a sand layer (approximate 1 foot thickness) to the interior of the embayments of Alternative 5 (The "m" in the alternative name stands for "marsh"). Alternatives 6m and 7m are similar layouts that were reduced in size to lower project costs while retaining as much of the function of the larger alternatives as was possible. The selected alternative is Alternative 6m (Figure 21).

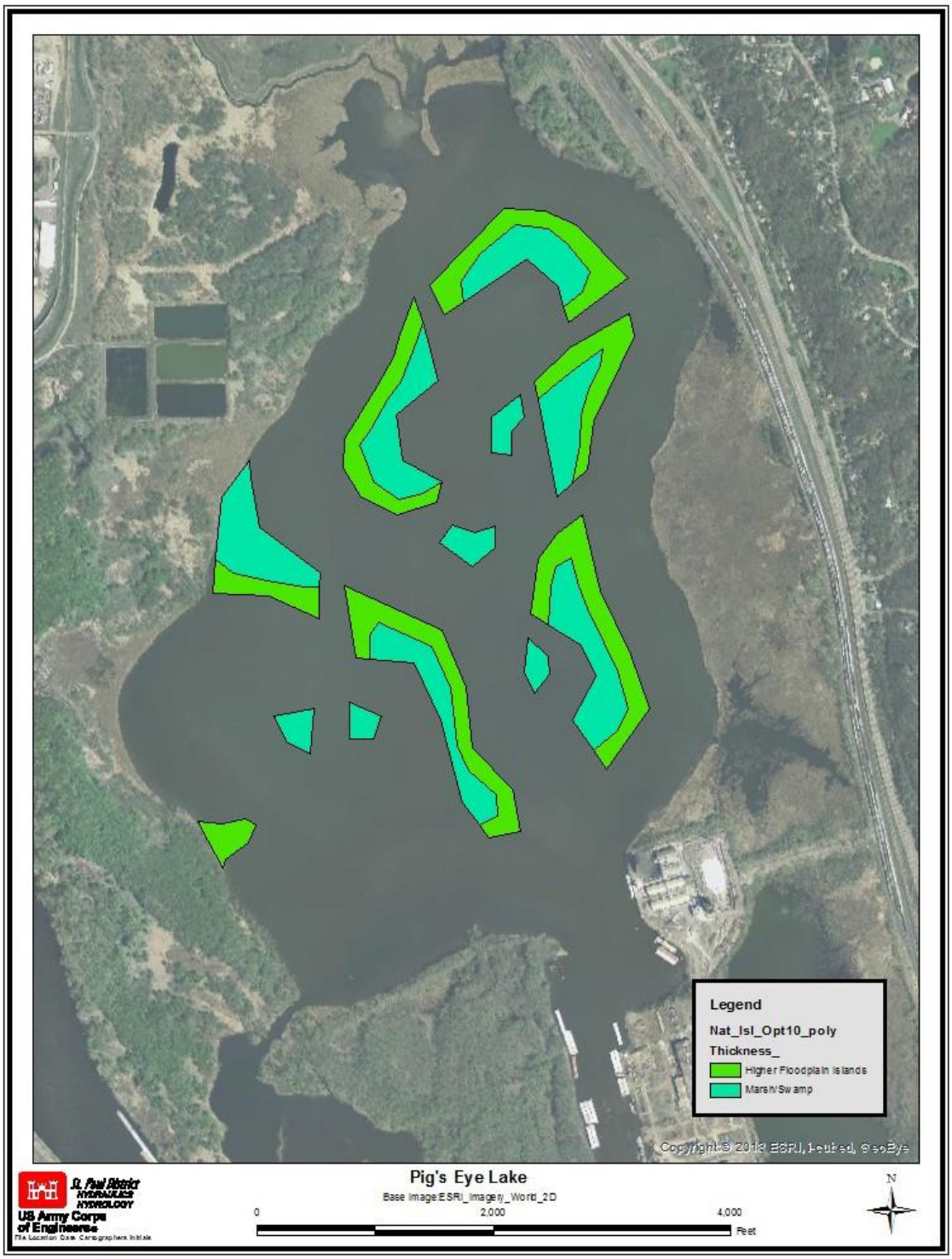


Figure 15 Idealized Island Layout

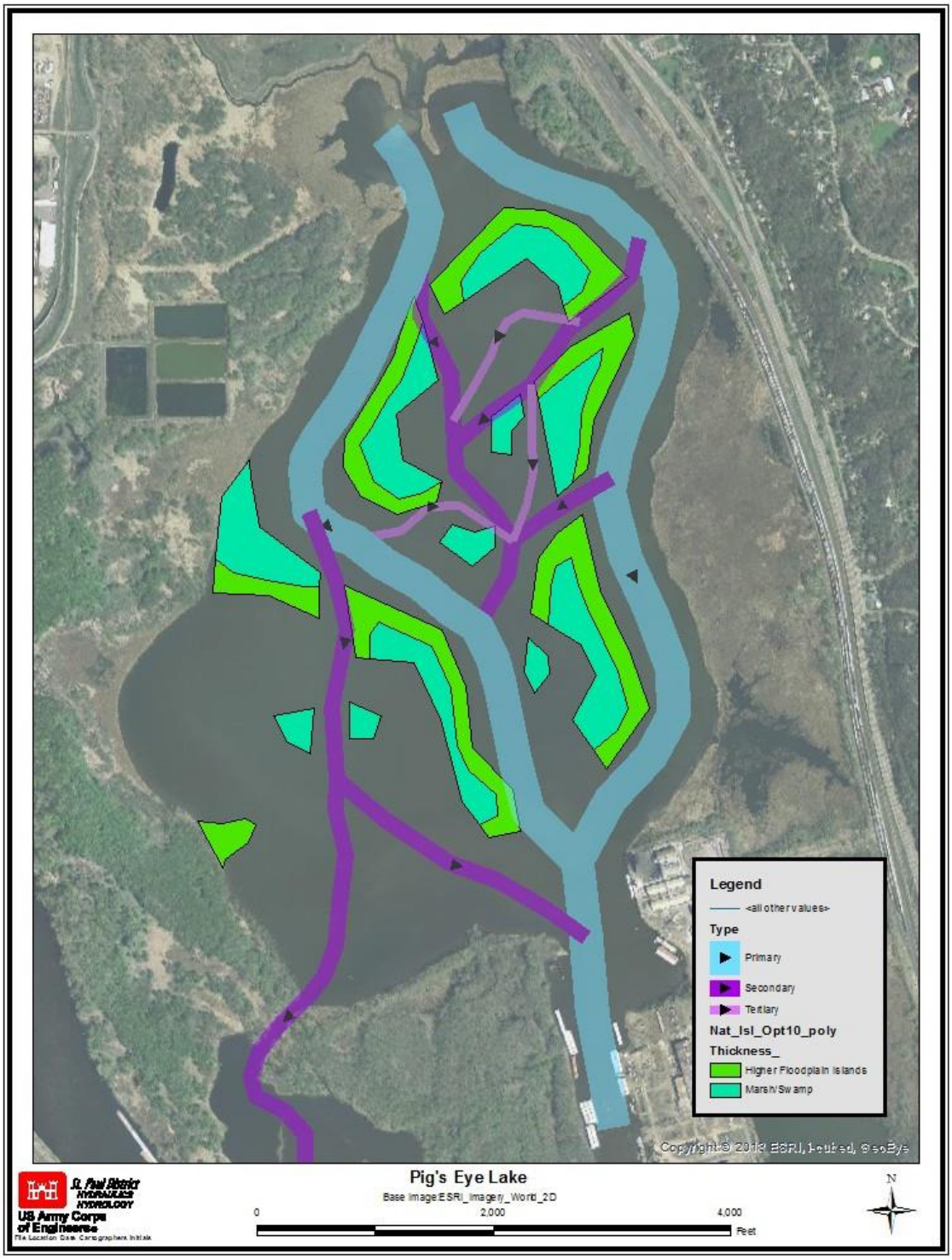


Figure 16 Idealized Island Layout showing Flow Paths

Appendix : Hydrology and Hydraulics Pigs Eye Lake Ramsey County

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix G Hydrology and Hydraulics

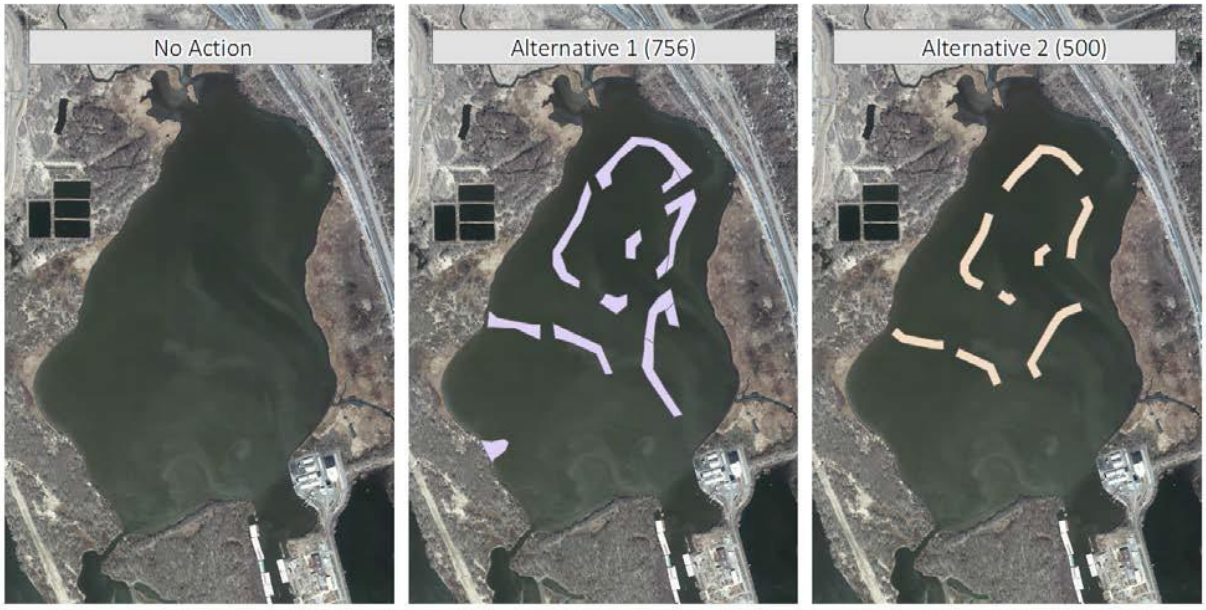


Figure 17 Island Alternatives (Part 1)

Figure 18 Island Alternatives (Part 2)

Figure 19 Island Alternatives (Part 3)

Figure 20 Island Alternatives (Part 4)

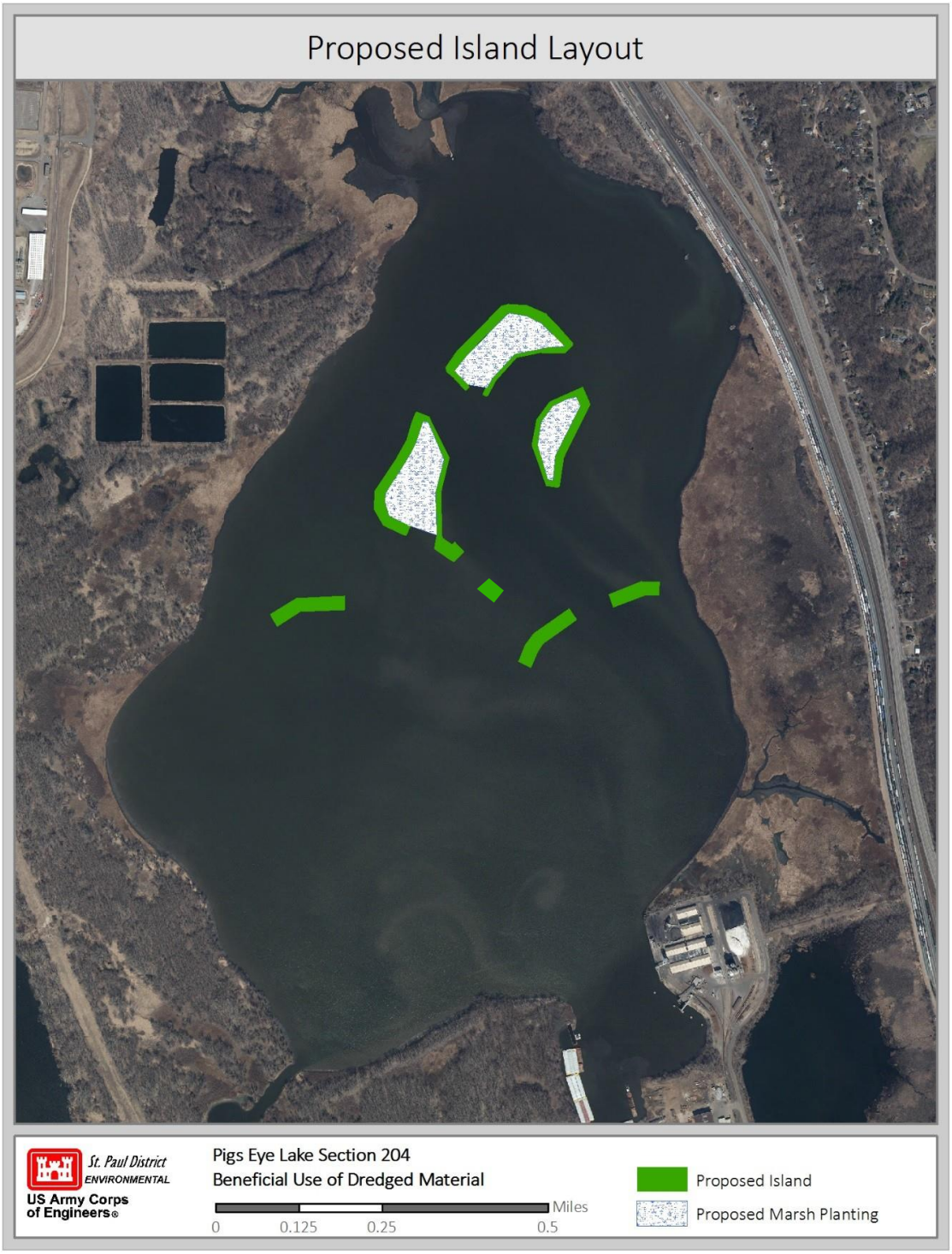


Figure 21 Selected Alternative (Alternative 6M)

7 Effects of Climate Change on the Project

A study was done looking at climate change and trends to river flows on the Mississippi and Minnesota Rivers. This document is attached (Appendix G - Attachment 1). The Mississippi River average annual discharge has risen about 40 percent at Saint Paul (comparing the periods 1948-1980 and 1981-2015).

Figure 4 shows the Operating Curves for Pool 2. Stages are controlled by dam operation. They are held constant (686.8 feet NAVD88) at the South Saint Paul gage (green line in the figure) for river discharges at or below 15,000 cfs. Figure 2 currently shows April-October inundation of about 50 percent (30 percent for the entire year). These stages at the South Saint Paul gage would be very similar for Pigs Eye Lake since it is directly across the channel from the gage. Water rises for higher discharges and will completely inundate the higher parts of the islands (elevation 689.1) at a discharge of around 30,000 cfs. This complete overtopping would occur about 20% of the time during the growing season (April-October) and 14% of the time over all twelve months.

The primary effect of generally increasing discharges will be the increased duration of island inundation. No changes are expected to project water elevations for discharges below 15,000 cfs. However higher discharges will become more common if typical discharges continue to increase. Rising stages would increase the potential for erosion to the islands. Higher stages could increase erosion on the lower island areas in particular. Vegetation is an important component of erosion protection and increased flooding could impact vegetative quality and species.

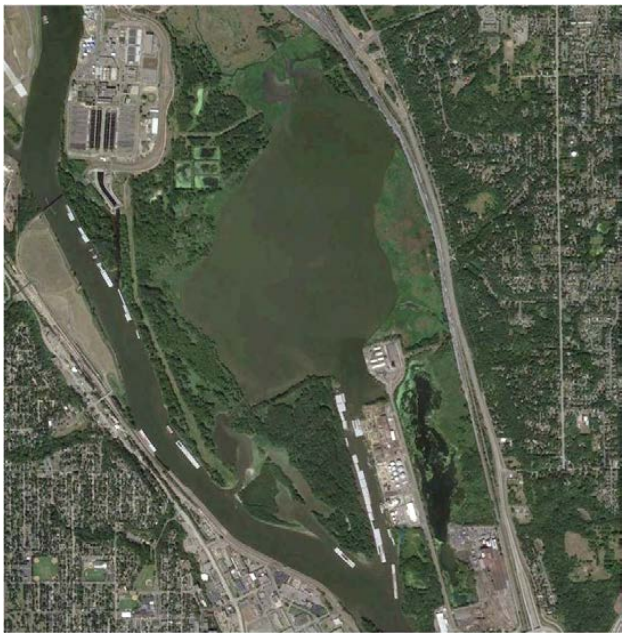
Existing condition shoreline erosion would also be greater due to more common higher stages.

No additional features have been changed in the project design as a result of anticipated climate change.

US Army Corps of Engineers®
St. Paul District

Appendix H: Minnesota EAW Supplement and ROD Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers
May 2018

Minnesota EAW Item Identification

A supplement prepared for Ramsey County to identify locations of EAW Items within the Feasibility Study Report and Integrated Environmental Assessment.

1. **Project Title:** Pig's Eye Lake Ramsey County, MN Section 204

2. **Proposer** – U.S. Army Corps of Engineers

   Contact Person: Aaron McFarlane
   Biologist
   St. Paul District, U.S. Army Corps of Engineers
   180 Fifth Street East, Suite 700
   Saint Paul, MN 55101-1678
   Telephone: 651-290-5660
   Email: aaron.m.mcfarlane@usace.army.mil

3. **RGU** – Ramsey County

   Contact Person: Scott Yonke, PLA
   Director of Planning and Development
   Ramsey County Parks and Recreation Department
   2015 Van Dyke Street
   Maplewood, MN 55109-3796
   Telephone: 651-363-3786
   Email: scott.yonke@co.ramsey.mn.us

4. **Reason for EAW Preparation** – Mandatory EAW

5. **Project Location**
   See Chapter 1.3, Figure 1, and attached Topo Map (Exhibit 1)

   County: Ramsey County, Minnesota
   City: St. Paul
   Watershed: HUC-8 = 07010206
   Approximate GPS Coordinates of project extent (NAD83, UTM Zone 15N, meters):

Northern-most island	498014E	4974535N
Western-most island	497220E	4973523N
Southern-most island	497746E	4973311N
Eastern-most island	498206E	4974125N

PLSS Sections within footprint: Ramsey Co. T28 R22W, Sections 10, 11, 14, and 15

6. **Project Description**
   a. **EQB Monitor Summary** – The US Army Corps of Engineers, St. Paul District and Ramsey County are proposing to restore, protect, and create aquatic and wetland habitats by constructing islands and marsh in Pigs Eye Lake. The project would be constructed using material dredged to maintain the Upper Mississippi River 9-Foot Navigation Channel Project.

   b. **Full summary** – Ch. 6
   c. **Project Magnitude –** Total Acreage Directly Impacted: 63 Acres
   d. **Project Purpose –** Chapter 1.3, with additional details in Chapter 3.2
   e. **Future Stages** – None planned.
   f. **Is this a subsequent stage –** No.

7. **Cover Types** – Type of existing habitat converted: 63 Acres of shallow, open water; loose, mucky, and silty substrate; void of vegetation

Types of habitat created:	
Islands -	23 acres
Marsh -	20 acres
Shallow littoral sandy-	20 acres

8. **Permits and Approvals Required** – Chapter 6.3.3

9. **Land Use**
   a. **Describe:**
      i. **Existing Land Use** – Ch. 2.1
      ii. **Planned Land use –** Ch. 6.1.5
      iii. **Zoning –** Ch. 6.1.5
   b. **Compatibility with nearby land uses** – Ch. 6.1.5
   c. **Identify land use compatibility mitigation** – Since no land use incompatibilities were identified, no mitigation is necessary or proposed.

10. **Geology, soils, and topography/landforms**
    a. **Geology** – 2.3.1, Appendix F – Geotechnical Considerations
    b. **Soil and topography** – Appendix F – Geotechnical Considerations

11. Water Resources

a. Features

i. Surface Water – The proposed project would take place in Pig's Eye Lake (Public Water Inventory: "Pigs Eye 62-4 P"), within Navigation Pool 2 of the Mississippi River (Exhibit 2). The lake is directly connected with the Mississippi River, and the river segment is listed by the MPCA as having an approved TMDL plan for: mercury in fish tissue and mercury in water column, and additional impairments of: PCB in fish tissue; perfluorooctane sulfonate (PFOS) in fish tissue; and turbidity. Battle Creek also flows into Pig's Eye Lake, which is listed by the MPCA as impaired for chloride. The area is part of the MNRRA. The project area is not a designated wild, scenic, or recreational river segment. There are no designated Wildlife Lakes in Ramsey County, no designated trout lakes or streams are in the project vicinity, and no calcareous fens identified in project vicinity.

Additional descriptions of the surface water features directly impacted by the proposed project can be found in the report, in Sections 2.4, 2.5, 2.6, and 7.2.7.

ii. Groundwater – No groundwater impacts are expected. The following considerations contributed to this determination:

1. Depth to groundwater at the proposed placement site would be 0-feet as material will be placed into open water.
2. The project and area is not within a WHPA (wellhead protection area) as of the most recent MN Department of Heath WHPA map update (October 3, 2017).

b. Effects from project activities

i. Wastewater – N/A – No wastewater is associated with the project.

ii. Stormwater – N/A – No stormwater impacts are expected with the project.

iii. Water Appropriation – N/A – The project will not involve water use.

iv. Surface Waters

a) Wetland alterations – No wetlands have been identified in the project footprint. Therefore, no mitigation is necessary or proposed.
See report sections: Existing: 2.8.2; Effects: 7.2.3

b) Other Surface Waters – This project would involve the placement of fill in public waters. Ch. 6 describes the proposed project features and some of the best management practices that would be implemented. Environmental effects of the proposed actions are discussed in Chapter 7, organized by resource. Effects on Aquatic Habitat are discussed in 7.2.4. Effects on Water quality are addressed in 7.2.7. These effects are also discussed in the Clean Water Act 404(b)(1) analysis in Appendix B.

12. Contamination/Hazardous Materials/Wastes

- **a. Pre-project conditions** – Ch. 2.3, 7.1.6, and Appendices E, F, and K
- **b. Project-related generation of solid wastes** – The only solid waste that would be potentially generated by the project would be sediments dredged from within Pig's Eye Lake to create an access channel for barges to transport construction materials and equipment to the island locations. Any material generated in this manner would be incorporated into the proposed project as topsoil. Sediment testing shows this material to be suitable for this use (Appendix E).
- **c. Project-related use/storage of hazardous materials**
  The only expected hazardous materials to be used during construction would be fuels and oils for construction equipment. As part of the Corps' contracting procedure, any contractor would be required to prepare and submit for approval a spill prevention and control plan for these materials prior to construction.
- **d. Project-related generation/storage of hazardous wastes** – No hazardous waste expected to be stored or generated during project construction or operation.

13. Fish, wildlife, plant communities, and rare features

- **a. Fish, wildlife, habitat, and vegetation** – Ch. 2.6, 2.8, 2.9, 7.2
- **b. Rare features** – Ch. 2.9.4, 7.2.9
  Heritage Database License Agreement Number: LA-768
  Information in the report regarding species listed by the State of Minnesota as endangered, threatened, or special concern was compiled using the Minnesota Natural Heritage Information System (NHIS) dataset. The following steps were conducted to locate potentially-affected rare species within the project area using the newest available NHIS layer (July 14, 2017 NHIS file update, accessed 20 February 2018) in ESRI ArcMAP:
  (1) A shapefile delineating a one-mile buffer around the proposed project area was created.
  (2) The "Select by Location" tool was used to select all polygons within the NHIS shapefile which intersected the buffered project area shapefile.
  (3) A list of unique species listed as endangered, threatened, or special concern with recorded Element Occurrences selected by this operation was recorded in Chapter 2.2.5 of the main report.
  (4) The metadata for records was examined and the results compared with the results of all available recent surveys of Lower Pool 2 to determine which species are likely to be extant within Lower Pool 2, and therefore potentially within the project footprint. Recent propagation efforts for freshwater mussels were also considered.

c. **Effects** – Ch. 7.2.9
d. **Avoidance, minimization, and mitigation of effects** – Negligible adverse impacts to fish, wildlife, habitat, or vegetation were identified. Construction disturbance would have the potential to temporarily disturb birds using the area. For the most part, construction would not occur in areas that would be expected to have high use during the construction season. Access is planned to occur through the heavily-used barge channel adjacent to the Red Rock Terminal. Avoidance and minimization practices would be applied to local bald eagles and birds if project activities are proposed by the contractor that could cause disturbance.

14. **Historic properties** – 2.10, 7.3

15. **Visual** – 7.1.2

16. **Air**
    a. **Stationary source emissions** - N/A
    b. **Vehicle emissions** – 2.7, 7.2.1
    c. **Dust and Odors** - 2.7, 7.2.1

17. **Noise** – 7.1.1

18. **Transportation** – No transportation impacts are expected during construction or operation of the proposed project.

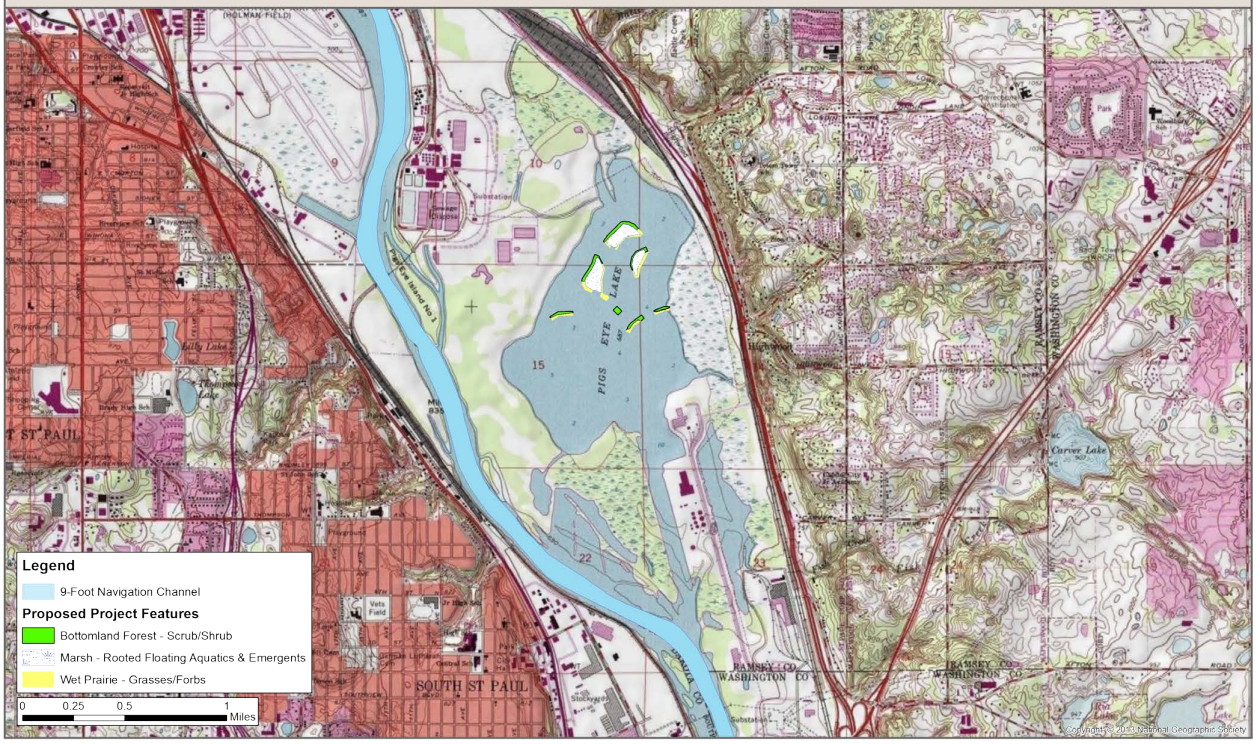
19. **Cumulative potential effects** – Ch. 7.4

20. **Other potential environmental effects** - N/A

Appendix : Minnesota EAW Supplement and ROD Pigs Eye Lake Ramsey County

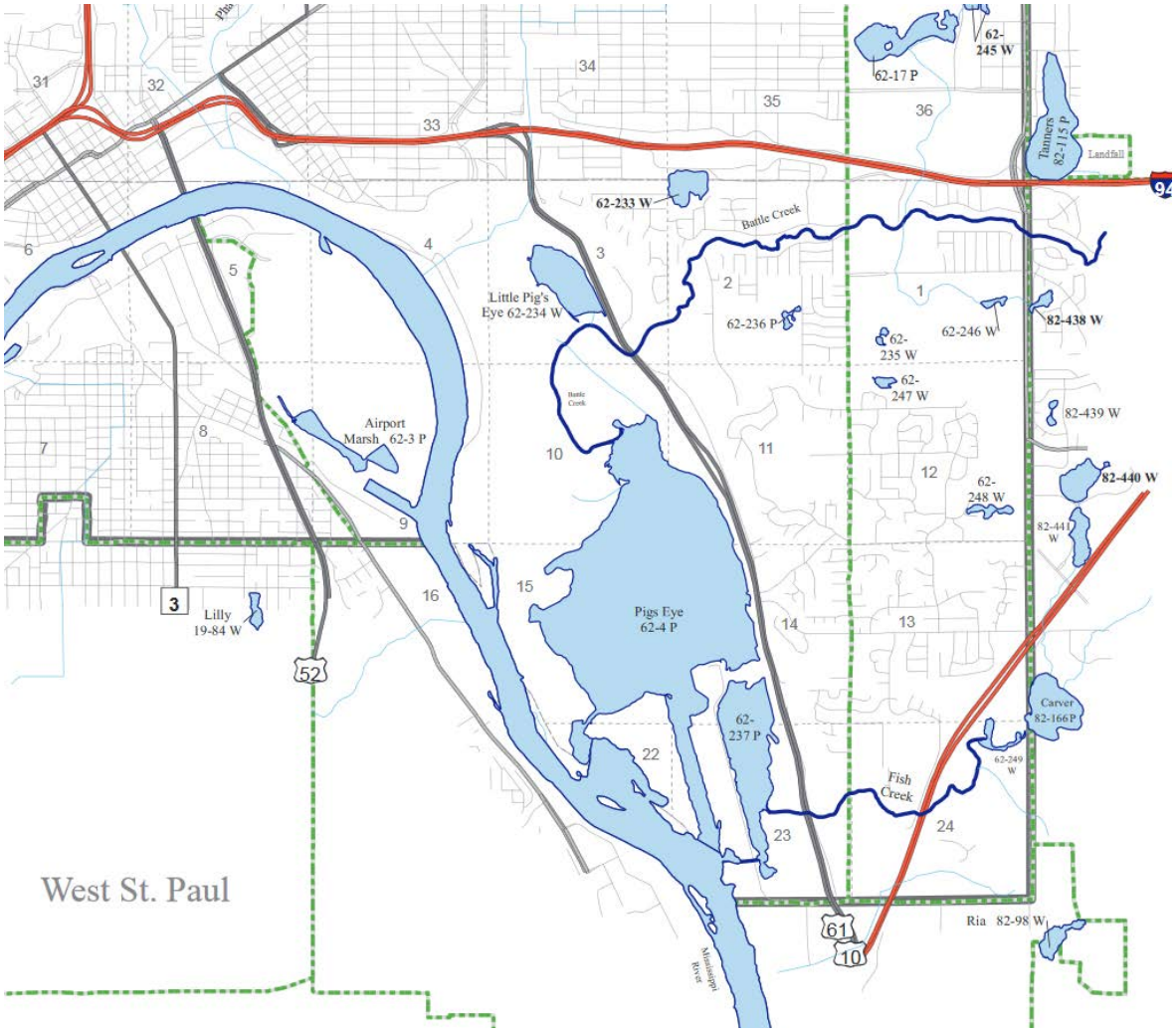
Exhibit 1

Project Area Overview - 1:24,000 scale Topographic Map



Appendix : Minnesota EAW Supplement and ROD Pigs Eye Lake Ramsey County

Exhibit 2 – Map of Nearby Minnesota State-Designated Public Waters



RAMSEY COUNTY
RECORD OF DECISION

In the Matter of the Determination of the Need for an Environmental Impact Statement for the Pigs Eye Islands Project in Ramsey County, Minnesota

FINDINGS OF FACT AND CONCLUSIONS

FINDINGS OF FACT

1. The U.S. Army Corps of Engineers, in partnership with Ramsey County Parks & Recreation Department (Ramsey County) proposes to enhance and restore backwater habitat by creating island and wetland features within Pigs Eye Lake in St. Paul, Minnesota. Construction of project features would primarily use material dredged from the Mississippi River by the Corps of Engineers during routine maintenance of the navigation channel. A complex of seven islands would be constructed; three of these would incorporate wetland creation and plantings in the centers of the islands. Islands would be planted with a mix of native plants that would be appropriate for floodplain soils. The project would benefit the area by: (1) Serving as wind barriers within the lake to reduce sediment resuspension and shoreline erosion; (2) Improving habitat for migratory birds; (3) Stabilizing the lake bottom; and (4) Providing a positive and productive use of dredged material.

2. The U.S. Army Corps of Engineers, in partnership with Ramsey County prepared an environmental assessment worksheet (EAW) for the proposed project according to Minnesota Administrative Rules (Minn. R.) 4410.1400 and 4410.1500. The document was prepared as a mandatory EAW pursuant to Minnesota Rules, part 4410.4300, subpart 27A, Wetlands and Public Waters. As allowed by Minn R. part 4410.1300, the Federal Environmental Assessment (EA) that was prepared for the project was circulated in place of the Environmental Assessment Worksheet (EAW) form. The EA was appended by a document, Appendix H, which identified how the EA addressed each of the environmental effects identified in the EAW form.

3. The EAW was filed with the Minnesota Environmental Quality Board (EQB) and a notice of its availability was published in the EQB monitor on March 12, 2018. A copy of the EAW was sent to all persons on the EQB Distribution List and to those persons known by the Corps or Ramsey County to be interested in the proposed project. The EAW was made available to the public via posting on the Corps' website.

4. Pursuant to Minn. R. 4410.1600, the 30-day EAW public review and comment period began March 12, 2018 and ended at 4:30 p.m. on April 12, 2018. The public was provided the opportunity to submit written comments by the U.S. Postal Service or email, as well as by telephone.

5. The EAW is incorporated by reference into this Record of Decision on the determination of need for an environmental impact statement (EIS).

6. During the 30-day public review and comment period, correspondence was received from the individuals and agencies listed below. The comment letters are included in the Coordination and Correspondence Appendix of the main report. Discussion on comments received and responses are provided in Finding of Fact Number 7.

1. Telephone call from Mr. Daniel Richardson, Newport; *14 March 2018*
2. Telephone call from BioCleaner company, Monterey Park, CA; *21 March 2018*
3. Email from Minnesota Pollution Control Agency Remediation Division; *2 Apr 2018*
4. Minnesota Pollution Control Agency; *5 April 2018*
5. Friends of the Mississippi River; *5 April 2018*
6. Minnesota Department of Transportation, Metro District; *5 April 2018*
7. Minnesota Department of Natural Resources; *12 April 2018*
8. National Park Service; *12 April 2018*
9. Metropolitan Council; *12 April 2018*
10. City of St. Paul, Minnesota; *12 April 2018*

7. Each comment is summarized below with Ramsey County's Response following each comment.

Comment 1: The commenter indicated that a side channel near Newport, MN may contain sediments suitable for project construction. (*Mr. Daniel Richardson*)

Response: As discussed on the phone with the commenter, this opportunity is acknowledged and would be considered for potential future needs. The purpose of the current project is to utilize material dredged in support of the congressionally-authorized navigation channel for ecosystem restoration and because dredging the identified area near Newport would not support the authorized navigation channel, it cannot not be pursued as part of the proposed project.

Comment 2: The commenter solicited the sale of products and services to clean up organic wastes. (*BioCleaner*)

Response: No comments regarding the project were offered, and therefore, no response is provided.

Comment 3: The commenter indicates support for the project. Commenter notes that there is an area of contamination outside of the project footprint in the northern part of Pig's Eye Lake that will need to be addressed by other entities. (*MPCA Remediation Division*)

Response: Comment acknowledged.

Comment 4: The commenter provided several editorial comments. (*MPCA Remediation Division*)

Response: Comment acknowledged and typographical errors have been fixed in the final document.

Comment 5: Regarding EAW Item 17, commenter encourages project contractors to appropriately manage project construction noise and recommends limiting construction activities to the hours of 7 a.m. to 10 p.m. (*MPCA)*

Response: Comment acknowledged. Contractors will be obligated to comply with local noise regulations.

Comment 6: Commenter suggests partnering with local organizations to develop planting plans for the islands that would allow experimentation or study of responses to climate change and environmental stressors. (*Friends of the Mississippi River*)

Response: Comment acknowledged. Planting plans will be completed during the Design and Implementation phase of the project, and input will be sought at that time.

Comment 7: The Minnesota Department of Transportation has reviewed the project and provides no comments. (*MNDoT*)

Response: Noted.

Comment 8: Commenter requests additional explanation why direct shoreline stabilization was not carried forward in planning analyses and how benefits of creating habitat along the shoreline would compare to the proposed habitat creation. (*MNDNR*)

Response: Direct shoreline stabilization was considered but did not appear to provide as much benefit as the proposed plan. Using rock groins similar to what is proposed for the islands appeared to be technically feasible. However, this measure remained uncompetitive with the currently proposed alternative because it would only provide benefits in the form of protecting existing habitat, rather than enhancing and restoring additional habitat as the proposed project would. Placing a blanket of sand around the perimeter of the lake instead of rock groins was also considered. This would likely have more habitat value than the rock groins, but the cost to benefit ratio would again be higher than the selected alternative which both restores a substantial quantity of habitat and provides some protection for the shoreline. These measures could be considered in the future as additional projects.

Comment 9: Commenter questions how the setting of the proposed project compares with other island building projects completed in the past, and whether additional risks and uncertainties were identified for the proposed project. (*MNDNR*)

Response: The Corps has constructed islands for habitat restoration and enhancement purposes throughout the Upper Mississippi River, under widely varied conditions. Often, they are areas of the floodplain that were likely once ephemeral marshes that were permanently inundated following hydrologic alterations. Many of these areas have faced similar problems to Pigs Eye Lake with large expanses of open water and loose, silty sediments. The largest uncertainty identified is the extent of settlement, and these risks have been incorporated into project design through adding contingencies.

Comment 10: Commenter requests quantification of the excavation that may be required to gain access to the lake for island construction, what the disposition of any dredged material would be, and asserts that additional environmental review may be necessary. (*MNDNR*)

Response: The necessity of or amount of dredging for access into Pigs Eye Lake are both uncertainties at this time. The goal of this stage in planning is to verify that the construction would be feasible, with the intent to continue coordination as project designs progress. A variety of construction methods were considered during planning to broadly assess whether they were generally feasible, including methods that would not require access dredging. Preliminary testing of the lake sediments revealed a number of areas that could provide suitable topsoil and would potentially benefit the lake by creating bathymetric variability. If construction methods are selected which require additional environmental review, reviews would be conducted as needed.

Comment 11: Commenter requests clarification of if and how the project construction schedule may overlap with the sensitive nesting period of April 1 – July 15. (*MNDNR*)

Response: The project schedule is dependent on many unknown factors at this time, including funding. The Corps and Ramsey County will continue coordination on the topic of construction timing and best practices or restrictions to limit disturbance to sensitive wildlife as project design advances.

Comment 12: The commenter has provided editorial comments and supplemental information that is suggested for inclusion within the report related to species present in the project area, project coordination needs, and fish movement studies. (*MNDNR*)

Response: Supplemental information has been incorporated into the report as appropriate.

Comment 13: The commenter states they have no objections to the project and support the proposed work. (*National Park Service – Mississippi National River and Recreation Area*)

Response: Noted.

Comment 14: The commenter would like Pigs Eye Lake to be referenced a wetland throughout the document as they believe the area functions as a wetland and is classified as a wetland on Minnesota state wetland mapping. (*Metropolitan Council*)

Response: The open water area of Pigs Eye Lake does not meet the definition of a wetland. Although the area is inundated at sufficient frequency by surface water to create the hydrologic and soil conditions to meet the legal definition of a wetland, the area does not support "a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR §328.3(b)). As such, the area is referred to as a contiguous, shallow, backwater floodplain lake. The reference in Chapter 6.5 of the report is a typographical error and will be changed to reflect this fact.

Comment 15: The commenter believes that the Corps should collect water quality samples prior to progressing on the project as a means of certifying that improved habitat conditions could be realized following a project. (*Metropolitan Council*)

Response: The Corps goal within the feasibility planning process is to collect the data necessary to make decisions of how to design or whether to proceed with a project. Improving water quality is not an objective of the project, and is not an objective of the CAP authority under which the project is being planned. Therefore, the only reason additional water quality data would be needed is if water quality was identified as a constraining factor. Considering the ability for wetland plants to grow around the edge of the lake and the documented use of the lake by fish, birds, and mammals, there is no apparent reason to collect additional water quality data. The approximate residence time of water in the lake is a little less than 5 days. This relatively short residence time suggests that there is probably not enough time for sediment contaminants diffusing into the water column to concentrate up to levels far exceeding what is seen in Pool 2 of the Mississippi River. No further action or change to the plan is required as a result of this comment.

Comment 16: The commenter expresses concern that the eroding shoreline may be a result of water fluctuation and plants dying due to toxic water quality and thus the project would not improve the habitat conditions of Pigs Eye Lake. (*Metropolitan Council*)

Response: The comment is acknowledged. The Corps and Ramsey County are not aware of any evidence that would suggest contaminants are a cause of vegetation loss in Pigs Eye Lake. Contamination concerns have been closely coordinated with the Minnesota Pollution Control Agency - the state experts and regulatory authority. The plan has been designed to avoid impacting areas where higher levels of contamination are present. Historic sediment studies were collected and substantial additional sediment testing within the lake was conducted with input from the MPCA and Metropolitan Council, as presented in the main feasibility report and Appendix E. Healthy plant communities exist behind the eroding shoreline at similar elevations, suggesting that upon reduction of wind fetch a healthy plant community will reestablish. No further action or change to the plan is required as a result of this comment.

Comment 17: The commenter expresses concerns about the suitability of establishing woody plants on the islands and requests additional study be completed on what species may be more adept at establishing in the project setting. (*Metropolitan Council*)

Response: A detailed planting plan will be developed during the design and implementation phase, which will more closely consider the appropriate species for the site conditions. This will be developed in consultation with applicable resource agencies and the monitoring and adaptive management will provide the ability to adjust as necessary.

Comment 18: The commenter is concerned about the settlement of the islands during construction and wants to know what would occur if settlement in excess of what is expected takes place during and post construction. (*Metropolitan Council*)

Response: The settlement estimate was developed utilizing knowledge obtained from experience constructing islands on the river. The amount of material estimated to be required for construction was developed with large contingencies to account for the uncertainties regarding settlement. The successful completion of the project will hinge on meeting standards outlined in the Plans and Specifications developed in the design phase of the project. The roles and responsibilities of the operation and maintenance of the project post construction will be outline in the Project Partnership Agreement as well as in the operation and maintenance manual that is developed prior to completion of the project. No further action or change to the plan is required as a result of this comment.

Comment 19: The commenter is questioning who will have monitoring and maintenance responsibility following the construction of the project. They also request additional details regarding the monitoring and adaptive management plan, specifically when the project Sponsor would obtain sole responsibility and what that means from a funding perspective. (*Metropolitan Council*)

Response: The monitoring and adaptive management responsibilities will be further detailed during the Project Partnership Agreement development and the design and implementation phase of the project. Additional details are not typical at the feasibility phase of the project. Ultimately the Corps will ensure that the project is completed to design specifications before closing out the project and moving the project to Sponsor responsibility.

Comment 20: The commenter claims that it is unlikely that neither hardstem nor softstem bulrush will spread sufficiently to prevent shoreline erosion due to the "frequency and extent of bounce in the basin". (*Metropolitan Council*)

Response: The comment is acknowledged, and will be considered during planting plan development. Bulrush is present around the perimeter of the lake, growing at similar elevations to what is proposed. No further action or change to the plan is required at this time as a result of this comment.

Comment 21: The commenter is concerned with the use of benthic material from the basin for the purposes of topsoil on the constructed islands. (*Metropolitan Council*)

Response: It is not anticipated at this time that the project would utilize benthic muds for topsoil. If preparation of project plans and specifications leads to a proposal to utilize material from Pigs Eye Lake for topsoil, existing contaminant data would be examined and additional testing may be required to ensure the material is acceptable for this use. MPCA, the regulatory authority and regional experts on contamination have been closely consulted with during the development of the feasibility study. No further action or change to the plan is required as a result of this comment.

Comment 22: The commenter is concerned about the project "promoting unrestricted public access for recreation." Specifically, the commenter is worried about drawing the public into the dump site as well as the lack of a safe public access to the area. (*Metropolitan Council*)

Response: The authority in which this project is proposed is specifically to restore, protect, and create aquatic and wetland habitats. The promotion of recreation is not a project objective. The project area is presently under public ownership; the project would not alter access or land ownership. It is noted that the Regional Park and five-year Capital Improvement Plan will need to be updated by the project Sponsor. No further action or change to the plan is required as a result of this comment.

Comment 23: The commenter is concerned about the likelihood of significant quantities of benthic material discharging into the Mississippi River during construction. The commenter requests the Corps clarify their position on the likelihood of this situation occurring and how it expects the potential mud wave to dissipate without mixing into the water column. (*Metropolitan Council*)

Response: As stated in the feasibility report (pg. 63), construction techniques to reduce the risk of mud waves would be used. Several potential specific measures were discussed during project planning meetings, but were not discussed in detail within the report because: (1) The appropriateness of these measures would be dependent on the construction methods selected by the contractor, and (2) The necessary measures may change as more detailed plans and specifications are developed. Contractors would be required to meet all permit conditions including those identified in the Clean Water Act Section 401 Water Quality Certification provided by the MPCA as well as the Public Waters Work Permit provided by the DNR. Contractors' plans for environmental protection would be reviewed for acceptability by the Corps as part of the contracting process and quality control would be performed by the Corps during construction. This allows for potential innovative construction techniques, while at the same time requiring that unacceptable impacts are avoided.

Comment 24: The commenter questions the presence of reptiles and amphibians in the project area and is concerned about creating habitat that could attract reptiles and amphibians to an area with contaminated benthic material. (*Metropolitan Council*)

Response: The study teams collaborated closely with local wildlife experts from key state and federal agencies. The plan has been designed to avoid impacting areas where high levels of contamination are present. Historical sediment studies were reviewed and substantial additional sediment testing within the lake was conducted with input from the MPCA and Metropolitan Council, as presented in the main feasibility report (Sec. 7.1.6) and Appendix E. No further action or change to the plan is required as a result of this comment.

Comment 25: The commenter suggests that Battle Creek flows be entirely isolated from the rest of the basin with a floating silt curtain during construction to ensure that disturbed contaminated benthic material isn't carried into the Mississippi River. For the same reason the commenter requests that all barge movement also occurs behind a silt curtain. (*Metropolitan Council*)

Response: This comment suggests that benthic material in the construction area is contaminated to a level that would require special precautions take place. It is important to note that Corps projects are required to avoid being constructed on Hazardous, Toxic and Radioactive Waste (HTRW). Therefore, substantial investigation and coordination went into determining if the benthic material did or did not reach the levels of HTRW or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) level material. Analysis and coordination of HTRW testing results indicated that: (1) CERCLA materials in the project area are at acceptable levels for construction of the proposed project

features, and (2) Constructing the proposed ecosystem restoration features within the lake would have positive incidental benefits to the lake and surrounding areas. As a result of these facts, no further action or change to the plan is required as a result of this comment. Construction of the project will be required to meet the conditions of the Clean Water Act Section 401 Water Quality certification provided by the MPCA as well as the Public Waters Works permit provided by the DNR. Compliance with these conditions would assure that water quality downstream is not significantly adversely impacted by project construction.

Comment 26: The commenter is concerned about utilizing data obtained from the New Orleans area to estimate consolidation values and suggested that we obtain a local sample to estimate the consolidation value. (*Metropolitan Council*)

Response: In the feasibility phase of the project the estimation utilizing available data was sufficient to determine that the project will be feasible. Additional testing, if required, will occur during the design and implementation phase of the project. No further action or change to the plan is required as a result of this comment.

Comment 27: The commenter recommends that the Monitoring and Adaptive Management plan annually review the number of reported bird strike by month following the construction of the project and prepare a mitigation plan if an observed change occurs. (*Metropolitan Council*)

Response: The project was closely coordinated with the Metropolitan Airport Commission (MAC) and the Federal Aviation Administration (FAA). The results of that coordination were changes to the project plans as outlined in the report that appeased the concerns of the MAC and FAA. The monitoring of bird strikes will not be a responsibility of the Corps or Sponsor.

Comment 28: The commenter has concerns regarding the long-term stability the project. Specifically, the commenter is concerned about the success of vegetation establishment as it is a critical aspect of habitat creation and island stability. *(City of St. Paul)*

Response: The concerns of the commenter are noted; however, there is no evidence to suggest that vegetation will not establish. There are strong plant communities throughout the basin and with the reduction of wind-generated wave erosion, vegetation is expected to establish. If problems are discovered during the 10-year monitoring and adaptive management period, measures will be taken to correct the problem. No further action or change to the plan is required as a result of this comment.

Comment 29: The commenter asserts that the proposed maintenance budget is "woefully inadequate" and that there is not enough detail on adaptive management practices that could be utilized to address the problems. *(City of St. Paul)*

Response: The monitoring and adaptive management plan presented as Appendix J in the feasibility study was developed to address the largest uncertainties of project performance identified during project planning. Monitoring commences upon construction completion and is continued up to 10 years, or until ecological restoration success is documented. The budget for monitoring and adaptive management presented in the report was developed based on cost estimates from those who have completed the proposed tasks in the past, and is consistent with congressional authorizations for monitoring and adaptive management. Similar ecosystem restoration projects planned and constructed by the Corps have required very minimal adaptive management to meet similar success criteria. The detail put forth in the study is adequate for feasibility phase purposes; further detail on adaptive management will be developed in the design and implementation phase of the project. No further action or change to the plan is required as a result of this comment.

8. Based upon the information contained in the EAW, Ramsey County has identified the following topics of potential environmental effects associated with the proposed project:

   a. Water Resources
   b. Wildlife and Habitat
   c. Visual Effects
   d. Air
   e. Noise
   f. Cumulative Potential Effects

   The environmental effects identified are briefly summarized below, with reference to further discussion on each topic in the project's feasibility report.

   a. Water Resources
      This topic was addressed in the EAW under item 11, and in the EA Chapters 2.4, 2.5, 2.6, and 7.2.7, and in the Clean Water Act Section 404(b)(1) analysis in Appendix B.

      The proposed project would take place in Pig's Eye Lake (Public Water Inventory: "Pigs Eye 62-4 P"), within Navigation Pool 2 of the Mississippi River (Exhibit 2). The lake is directly connected with the Mississippi River, and the river segment is listed by the MPCA as having an approved TMDL plan for: mercury in fish tissue and mercury in water column, and additional impairments of: PCB in fish tissue; perfluorooctane sulfonate (PFOS) in fish tissue; and turbidity. Battle Creek also flows into Pig's Eye Lake, which is listed by the MPCA as impaired for chloride. The area is part of the MNRRA. The project area is not a designated wild, scenic, or recreational river segment. There are no designated Wildlife Lakes in Ramsey County, no designated trout lakes or streams are in the project vicinity, and no calcareous fens identified in project vicinity.

      There would be a temporary, minor adverse effect on water quality in the project area during construction. Localized increases in suspended sediment and turbidity are likely. Sediment testing showed that the lake sediments within the proposed island footprints have some levels of contamination by PFCs, low level (SQT I) exceedances for heavy metals and PAHs, limited locations with higher exceedances for cadmium and PAHS (SQT II and proposed Recreational/Residential SRVs) and no recent detection of PCBs. The relatively low levels of contamination (SQT I exceedances) present in the existing substrate would not pose a large risk of bioavailability or uptake of contaminants, and placing clean sand on top of the existing sediments to construct the proposed islands would probably benefit the aquatic and benthic environment by capping serving as an additional barrier to contaminant mobility. Local and regional resource agencies have been coordinated with and are supportive of this determination, and coordination will continue into the next project phase to develop strategies for further minimizing risks. BMPs based on the construction techniques would be coordinated with the MPCA and incorporated into the project to minimize effects. In the long term, the project is expected to have a beneficial effect to local water quality in Pigs Eye Lake due to reduction in wind-generated waves and establishment of additional aquatic vegetation.

   b. Wildlife and Habitat
      This topic was addressed in the EAW under Item number 13, in the EA in chapters 2.6, 2.8, 2.9, and 7.2.

In summary, only negligible adverse impacts to fish, wildlife, habitat, or vegetation were identified. These would be temporary due to the disturbances from construction activities. Construction disturbance would have the potential to temporarily disturb birds using the area. For the most part, construction would not occur in areas that would be expected to have high wildlife use during the construction season. Access is planned to occur through the heavily-used barge channel adjacent to the Red Rock Terminal. Avoidance and minimization practices would be applied to local bald eagles and birds if project activities are proposed by the contractor that could cause disturbance. The localized and minor increases in turbidity would likely cause aquatic organisms to avoid the area during construction, but these organisms would return following project completion.

In the long-term, the proposed project would have substantial beneficial effects to terrestrial habitat, wetlands, aquatic habitat, and habitat diversity and interspersion by creating new areas of terrestrial and aquatic habitat and protecting existing areas.

c. Visual Effects
This topic was addressed in the EAW under Item number 15 and in the EA in chapter 7.1.2.

The proposed project would cause temporary, minor, adverse impacts on aesthetics during construction. The aesthetic value of the areas would be reduced as a result of the activity and disturbance associated with construction and the presence of construction equipment.
The proposed project would also have long-term beneficial impacts. Impacted entities would be residences on the bluffs to the east of Pigs Eye Lake that currently overlook the project area and recreationists. Construction of the proposed project would change some views of the area from vast expanse of open water to interspersed, vegetated islands. Although aesthetic values are somewhat subjective, the islands would likely be considered aesthetically pleasing to most.

d. Air
This topic was addressed in the EAW under Item 16, and in the EA in chapters 2.7 and 7.2.1.

During project construction, the project would have a temporary, minor, and localized adverse effect on air quality due to emissions produced by construction equipment. Air quality impacts generated by the project would be indistinguishable from the adjacent railroad tracks, Highway 10/61, a barge shipping facility, and wastewater treatment plant, and would not be expected to individually or cumulatively significantly change air quality in the area. This would be short-lived and would disappear upon project completion. Construction activities are expected to produce very little dust because the materials to be handled would be either wet (dredged material) or larger materials than are generally mobilized by wind (large rocks for training structure construction).

e. Noise
This topic was addressed in the EAW under Item 17 and in the EA in chapter 7.1.1.

The proposed project would cause temporary, minor, adverse impacts on local noise levels during construction. The project area is relatively isolated, and any nearby noise receptors already experience noise generated by the adjacent railroad tracks, Highway 10/61, a barge shipping

facility, and wastewater treatment plant. The increased noise levels would be temporary and would disappear upon project completion.

f. Cumulative Potential Effects
This topic was addressed in the EAW under item 19 and in the EA in chapter 7.4.

Anticipated environmental effects of the project include water resources effects, wildlife and habitat effects, and visual effects. Additionally, short-term air and noise effects would be anticipated during project construction. All environmental effects would be expected to be limited to an area immediately surrounding the project site. Construction-related air and noise effects would be expected to be short-term, and would conclude at the completion of construction.

Short-term air and noise effects associated with the construction of the project are expected to have limited potential for cumulative effects due to the minor incremental increases of these effects during the project activities. Potential cumulative effects to water resources, wildlife and habitat, and visual effects from the project in combination with the other reasonably foreseeable future projects are discussed in chapter 7.4 of the EA

9. Ramsey County requested and was granted by the Minnesota Environmental Quality Board (MEQB) a 15-day extension for making a decision on the need for an EIS for the proposed project, consistent with Minn. R. 4410.1700, subp. 2b.

10. The following permits and approvals are needed for the project, and will be applied for during the next phase of project planning – design and implementation:

Unit of Government	**Type of Application**
DNR	Public Waters Work Permit
MPCA	CWA 401 Water Quality Certification

CONCLUSIONS

1. The following standards and criteria are applied by the RGU to determine whether the proposed project has the potential for significant environmental effects and requires the preparation of an EIS:

In deciding whether a project has the potential for significant environmental effects, the following factors shall be considered:

a. type, extent, and reversibility of environmental effects;
b. cumulative potential effects;
c. extent to which the environmental effects are subject to mitigation by on-going regulatory authority; and
d. the extent to which environmental effects can be anticipated and controlled as a result of other environmental studies undertaken by agencies or the project proposer, including other EISs.

2. *Type, extent, and reversibility of environmental effects*

Based on the Findings of Fact above, Ramsey County concludes that the following potential environmental effects, as described in Finding of Fact No. 8, will be limited in extent, temporary, or reversible:

- Water Resources
- Wildlife and Habitat
- Air
- Noise
- Visual
- Cumulative Potential Effects

3. *Cumulative potential effects*

Based on the Finding of Fact above, Ramsey County concludes that the following potential effects do not have the potential to be significant environmental effects:

- Water Resources
- Wildlife and Habitat
- Air
- Noise
- Visual

The proposed project's contribution to cumulative potential effects to water resources, wildlife and habitat, air, noise, and visual are limited when viewed in connection with other contributions.

4. *Extent to which environmental effects are subject to mitigation by ongoing public regulatory authority*

The following environmental effects are subject to mitigation by DNR regulatory authority:

- Water Resources
- Wildlife and Habitat

The following environmental effects are subject to mitigation by MPCA regulatory authority:

- Water Resources
- Air
- Noise

5. *Extent to which environmental effects can be anticipated and controlled as a result of other environmental studies undertaken by agencies or the project proposer, including other EISs:*

The following environmental studies and documents assist in the anticipation and controlling of potential environmental effects:

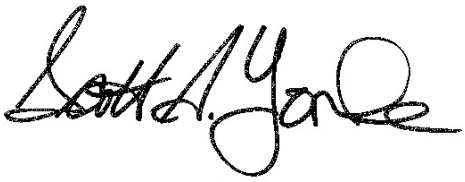
Upper Mississippi River Environmental Design Handbook, August 2006. This document provides design guidance for habitat projects involving items such as water level management, floodplain restoration and other features. It is a documentation of lessons learned and innovations in the Environmental Management Program (EMP).

Identifying, Planning and Financing Beneficial Use Projects using Dredged Material is a guidance document that was published jointly by the Corps and the U.S. Environmental Protection Agency (USEPA) in October 2007. In this document Habitat Development is identified as one of the most common and most important beneficial uses of dredged material.

Channel Maintenance Management Plan (CMMP) and Environmental Impact Statement (EIS)
The CMMP and accompanying Environmental Impact Statement (EIS) is the St. Paul District, U.S. Army Corps of Engineers' plan for channel maintenance and dredged material management for the UMR. The report was published in 1996. Much of the plan is devoted to the designation and design of dredged material placement sites. Included in this report is a discussion of the District's program for channel management.

6. Ramsey County has fulfilled all the procedural requirements of law and rule applicable to determining the need for an environmental impact statement on the proposed Pigs Eye Islands project.

7. Based on considerations of the criteria and factors specified in Minn R. 4410.170, subp. 6 and 7 to determine whether a project has the potential for significant environmental effects, and on the Findings and Record in this matter, Ramsey County determines that the proposed Pigs Eye Islands project does not have the potential for significant environmental effects.



Scott Yonke, Director of Planning and Development
Ramsey County Parks & Recreation

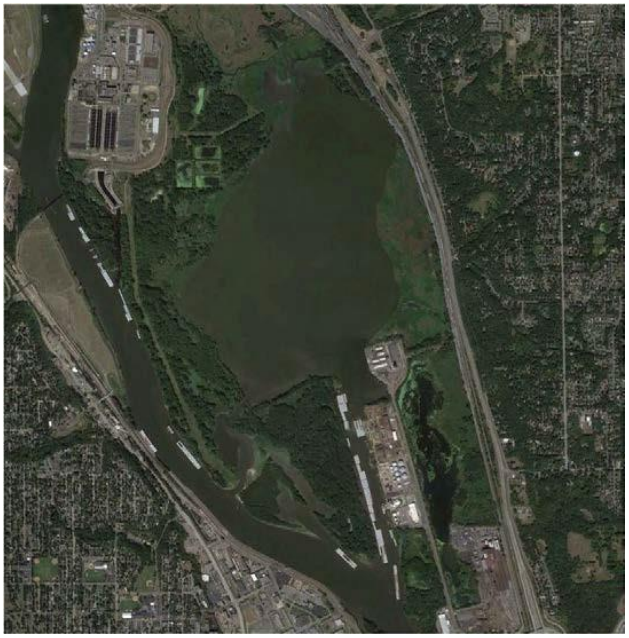
5/24/18

Date

US Army Corps of Engineers®
St. Paul District

Appendix J Monitoring and Adaptive Management Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers May 2018

Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
Appendix J Monitoring and Adaptive Management

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Pigs Eye Lake Section 204
Ramsey County, MN

Feasibility Report and Environmental
Assessment May 2018
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Pigs Eye Lake Section 204
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Appendix J Monitoring and Adaptive Management

1 Introduction

The St. Paul District, Army Corps of Engineers, in conjunction with Ramsey County, has prepared a plan for constructing islands in Pig's Eye Lake using dredged material from the Upper Mississippi River 9-foot Navigation Channel. The project is being studied under Section 204 of the Corps' Continuing Authorities Program, which provides authority for the Corps of Engineers to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized Federal navigation project. Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure, when conducting a Feasibility Study for ecosystem restoration, that the recommended project includes a plan for monitoring the success of the ecosystem restoration. The implementation guidance for Section 2039, in the form of a CECW-PB Memo dated 31 August 2009, also requires that an Adaptive Management Plan be developed for all ecosystem restoration projects.

At the programmatic level, knowledge gained from monitoring one project can be applied to other projects. Opportunities for this type of adaptive management are common within Corps restoration projects. Lessons learned in designing, constructing, and operating similar restoration projects within the UMRS have been incorporated into the planning and design of this project to ensure that the proposed plan represents the most effective design and operation to achieve the project goal and objectives.

The adaptive management plan for the Pig's Eye Lake Section 204 project describes and justifies whether adaptive management is needed in relation to the proposed project management alternatives identified in the project feasibility study. This appendix outlines how the results of the project specific monitoring plan would be used to adaptively manage the project, including monitoring targets which demonstrate project success in meeting objectives. The intent of the project delivery team (PDT) was to develop monitoring and adaptive management actions appropriate for the project's goal and objectives.

Adaptive management provides a process for making decisions in the face of uncertainty. The primary incentive for implementing an adaptive management plan is to increase the likelihood of achieving desired project outcomes given the identified uncertainties, which can include incomplete description and understanding of relevant ecosystem structure and function; imprecise relationships among project management actions and corresponding outcomes; engineering challenges in implementing project alternatives; and ambiguous management and decision-making processes. Additional uncertainties (i.e., scientific and technological) relating to the proposed project that were identified by the PDT included:

- Vegetation Planting Success
- Settlement Rates
- Migratory Bird Use Rates
- Presence and introduction of invasive species
- Water quality

Adaptive management may be achieved through either active or passive adaptive management techniques. Active adaptive management in the Pigs Eye Lake Section 204 project would involve iterative management decisions influenced by the results achieved by project features. Actions of active adaptive management for the project may include the physical modification of project features and documentation of the changing conditions.

Passive adaptive management uses the best available information to achieve management objectives, involves updating resource understanding through analysis of the monitoring data, and the incorporation of the updated understanding into future best management practices. For this project, passive adaptive management would include an assessment of feature functionality through observation and the documentation of lessons learned.

All monitoring and adaptive management plans discussed below will be reviewed following preparation of detailed project plans and specifications to ensure each performance indicator is adequately addressed. Modifications and adjustments will be made to the plan as necessary.

2 Project Objectives

The objectives of the project are to:

1. *Improve aquatic habitat* – Create depth and habitat diversity in Pigs Eye Lake. Increase acreage of aquatic vegetation. Incorporate structural habitat features to promote fisheries.
2. *Increase available nesting and resting habitat* – Create suitable nesting and resting habitat for birds and shoreline species within Pigs Eye Lake.
3. *Maintain or enhance the quantity of shoreline habitat* – Protect existing floodplain forest and marsh habitat along the shoreline of Pigs Eye Lake from wind and wave erosion.

3 Performance Indicators

Performance indicators for the above objectives were developed with the best available knowledge. They were developed to be specific, measureable, attainable, realistic, and timely. The conceptual monitoring schedule and estimated costs are discussed in the following sections.

Each project objective was assessed by at least one performance indicator. For each performance indicator, the rationale behind the indicator and the methodology used are discussed. In addition, the monitoring targets (the desired outcomes) and action criteria (the adaptive management triggers) are listed. The action criteria are used to determine if and when adaptive management actions should be implemented.

3.1 Objective 1 - Improve aquatic habitat

Performance Indicator 1A: Water Quality (Turbidity or TSS)

Rationale
A reduction in turbidity throughout Pig's Eye Lake should be realized immediately due to the effect of the islands on wind fetch lengths. Water quality in Pig's Eye Lake has several stressors, but it is thought that wind-generated waves are a large contributor to turbidity problems. Documenting the change in conditions through time will help managers to understand how much of an impact wind fetch reduction can have on water quality parameters in this type of setting.

Methodology:
Measure turbidity or total suspended solids (TSS) in at least one location towards the protected northern area of the lake within the island complex, and one location in the southern part of the lake, outside of the project area. Samples should be taken at multiple times over the open-water growing season, and may be best taken using remote sensing units.

Monitoring Targets (Desired Outcomes):
Water quality data records are not available for Pig's Eye Lake, but the turbidity problem is clearly apparent. Because the baseline is not known, the first goal of the monitoring would be to establish a pre-project baseline. The target condition would be a consistent and measurable reduction in turbidity or TSS following construction of the project, relative to the baseline. Because it is believed that waves generated by wind are influential in creating the turbidity, trends in both the existing conditions and post-project data should be compared to wind conditions at the time water quality is measured to verify if there is a correlation.

Adaptive Management:
Passive adaptive management would be applied to this indicator. Water quality monitoring data would be incorporated into project evaluation reports (PER). Suggestions made in the PERs may lead to updates in best management practices that can be applied to future projects.

3.2 Objective 2 – Improve the quantity and quality of habitat for migratory bird species

Performance Indicator 2A: Migratory Bird Use Rates

Rationale:
Migratory bird counts are commonly used to assess habitat use. Bird counts have been used as an effective sampling method in the past and can help to verify a biological response to the physical changes brought on by the project. Bird use data has been collected during the fall migration season in

this area for the past several years, providing a valuable baseline with which to compare post-project use rates. Changes in data collected during bird counts would be a strong indicator of the availability of nesting and resting habitat for birds.

Methodology:
Waterbirds would be counted at least weekly for 5 weeks during the peak of fall waterfowl/waterbird migration. Five survey points have been used for surveys of existing conditions. Survey points may need to be modified following construction of new features, and GIS software would be used to determine the minimum number of points needed to view at least 70% of the lake's surface. The new survey points would be accessed by paddling a small watercraft such as a canoe or kayak through the area to minimize disturbance to the birds. Start/stop times, coordinates, and waterbird species and numbers would be recorded.

Monitoring Targets (Desired Outcomes):
The desired response would be increases in bird use by year 5 following project construction. An increase of at least 10% in total bird numbers or any increase in species richness would be considered successful.

Adaptive Management:
Due to the many factors that can influence biological response, adaptive management for birds would be focused on maintaining the physical characteristics described in Performance Indicators 2B and 2C.

Performance Indicator 2B: Vegetation – 1-year planted seedling survival and growth

Rationale:
Successful vegetation survival and establishment is integral to providing the habitat benefits projected. Woody vegetation will provide thermal protection and function as a visual barrier for migratory birds.

The first year following planting is a critical period to determine whether tree seedlings and vegetative plantings will become established. Low seedling survival combined with low growth rates for surviving seedlings may indicate deficiencies in planting procedures or seedling stock, the presence of significant site related stressors, or seedling-site incompatibility. Regeneration surveys monitoring seedling survival and growth are standard in most large-scale planting programs, both within the Corps and in many public and private organizations throughout the country. Results from 1-year survival and growth surveys will allow for modifications in planting plans to account for agents responsible for low seedling survival and growth as well as for mitigation measures to account for these stressors.

Methodology:
1-year survival and growth surveys will be conducted on areas that were planted in the previous year. Monitoring will be conducted using methodology described in "*Habitat Rehabilitation and Enhancement Project Monitoring Design Handbook Section 1: Vegetation,*" Draft Final Version 31 March 2014.

Monitoring Targets (Desired Outcomes):
The monitoring target for initial monitoring is 75% survivorship of trees and evidence of a positive level of production and survivorship.

Adaptive Management:
If 1-year seedling survival is below 75%, supplemental planting may be required to replace lost seedlings. However, if it is determined that mortality was due to factors that cannot be easily controlled (e.g. inundated microsite, deer or beaver herbivory), re-planting in some locations may not be implemented. No action will be taken if first year condition codes do not meet targets, unless it can be clearly determined that herbivory is limiting seedling growth. If herbivory is the limiting factor, targeted animal repellant treatments may need to be considered. If natural regeneration targets are not met, supplemental seeding may be implemented on constructed features.

Performance Indicator 2C: Vegetation – Long-term seedling survival and growth

Rationale:
Successful vegetation survival and establishment is integral to providing the habitat benefits projected. Woody vegetation will provide thermal protection and function as a visual barrier for migratory birds.

1-year seedling survival is critical, but seedlings cannot be considered to be successfully established on a site generally until they reach 4.5 feet in height and are considered to be generally free from competition for light. Long-term seedling survival and growth will be critical for determining whether the restoration effort was successful or not in establishing self-sustaining levels of forest regeneration and forest cover.

Methodology:
The methodology for 1-year seedling survival and growth described above will also be used to assess long-term seedling survival and growth, though the timing will differ. For long-term seedling survival and growth, three surveys will be implemented. Surveys will be conducted 3 years, 6 years and 10 years following project completion.

Monitoring Targets (Desired Outcomes):
In year 3, the same targets are desirable for all areas as in year 1, that is, planted seedling survival >75% of sampled seedlings and evidence of a positive level of production and survivorship.

By year 6, planted seedling survival of 60% of sampled seedlings will be acceptable with >60% of seedlings and evidence of a positive level of production and survivorship.

By year 10, planted seedling survival of 50% of sampled seedlings will be acceptable with >75% of seedlings and evidence of a positive level of production and survivorship.

Adaptive Management:
If longer term monitoring targets are not met then additional management strategies may be required to reduce browsing or competition, and may include, but not limited to, fencing, herbicide application, or mowing.

Performance Indicator 2D: Vegetation – Marsh and Wet Prairie Establishment Success

Rationale:
Successful vegetation survival and establishment is integral to providing the habitat benefits projected. Success of the non-forest plantings proposed for the project, including the wet prairie and marsh plantings, are critical to increasing the habitat value for migratory birds and will serve as a food source, provide thermal protection, and function as a visual barrier for migratory birds.

Methodology:
Monitoring will be conducted using the Standardized HREP Non-Forested Monitoring Protocol described in "*Habitat Rehabilitation and Enhancement Project Monitoring Design Handbook Section 1: Vegetation,*" Draft Final Version 31 March 2014. Monitoring would be conducted in Years 1, 3, 6, and 10 following project construction.

Monitoring Targets (Desired Outcomes):
Monitoring targets would be evaluated separately for each plant community (i.e., wet prairie and marsh). The targets for species composition and quality include the following:

a. Density Threshold: A canopy cover of at least 50% in wet prairie and at least 10% in marsh
b. Species Richness Threshold: Greater than 8 species per sampling unit
c. Quality Threshold: Combined food value of top 4 dominant species greater than or equal to 3.5

Adaptive Management:
Adaptive management actions should be implemented if any of the monitoring targets are not met. Adaptive management strategies could include, but not limited to, physical disturbance (e.g., mowing, disking, rolling, prescribed fire), chemical control, or focused re-planting. The exact management action implemented will be decided by the site manager.

Performance Indicator 2E: Island Settlement

Rationale:
The elevation of the proposed islands have been designed to provide conditions suitable for growth of floodplain vegetation species. If material settlement of the islands is significantly greater than anticipated, the islands would be lower in elevation than expected which would lead to wetter

conditions on the islands. If they are significantly different, the islands may not support the desired vegetation.

Methodology:
Each of the islands would be surveyed at 2 and 5-years post construction. The top elevation of each island would be compared to the design elevation to determine how much settlement has occurred.

Monitoring Targets (Desired Outcomes):
The desired condition would be that the top of each of the islands are at or very close to the design elevation.

Adaptive Management:
Passive adaptive management would be applied to this indicator. Settlement monitoring data would be incorporated into project evaluation reports (PERs). Suggestions made in the PERs may lead to updates in best management practices that can be applied to future projects. If settlement leads to vegetation establishment problems, the monitoring data could be used to help tailor adaptive management plantings to the changing conditions.

3.3 Maintain or enhance the quantity of shoreline habitat

Performance Indicator 3A: Shoreline erosion rates

Rationale:
Examination of aerial imagery has indicated that the shoreline areas around Pig's Eye Lake have experienced significant and recurring erosion. The proposed islands have been designed to reduce wind-generated waves in the lake and are expected to protect the existing habitat on Pig's Eye Lake's shorelines.

Methodology:
Aerial imagery will be examined approximately 5 and 10-years post project to determine if any change can be detected. (Dates are approximate because aerial imagery would not be collected for this project in particular, but would be assessed as available from county, city, or other data source.)

Monitoring Targets (Desired Outcomes):
It has been estimated that the shoreline of Pig's Eye Lake has retreated at a rate of approximately 0.75 acres/year since 1991. The difference in shoreline area at 5 and 10 years post-project would be compared to the pre-project conditions. Success for this target would be achieved if the actual retreat of shoreline is less than the pre-project loss rate of 0.75 acres/year.

Adaptive Management:
Passive adaptive management would be applied to this indicator. Monitoring results would be incorporated into project evaluation reports (PER). Suggestions made in the PERs may lead to updates in

best management practices that can be applied to future projects. Structural solutions could be designed and implemented on the shorelines themselves if desired by the local landowner, but are considered outside the scope of this project.

4 Monitoring Costs

Water quality sampling, bird counts, vegetation surveys, elevation surveys, and GIS analysis of the lake's shoreline were included in the monitoring budget for the project.

The National Park Service would conduct fall bird counts at an estimated cost of $7,000 per year for the 10 year monitoring period. This would cost a total of $70,000.

An estimated cost for each survey event is $5,000, and surveys would be conducted 1, 3, 6, and 10 years following project implementation. Total cost for post-project monitoring surveys would be approximately $20,000.

Each post-construction elevation survey of the islands is estimated to cost approximately $6,000, for a total of $12,000 total.

Water quality sampling would be performed using two remote sensing buoys, at an estimated cost of $7,000 annually. After 5 years of monitoring this would total $35,000.

Analysis of aerial imagery for shoreline change would cost an estimated $2,000.

Monitoring components and costs are summarized in the table below.

Component	Cost Per Event	Total Cost
Fall Waterbird Counts	$ 7,000	$ 70,000
Vegetation Monitoring	$ 5,000	$ 20,000
Island Elevation Surveys	$ 6,000	$ 12,000
Water Quality Monitoring	$ 7,000	$ 35,000
Shoreline Erosion Analysis	$ 2,000	$ 2,000
Total		$ 139,000

The passive adaptive management actions identified for water quality and shoreline erosion targets would not require additional funding in this project.

6 Monitoring Roles and Responsibilities

The Corps is responsible for determining ecological success for the ecosystem restoration projects it constructs. Cost-shared monitoring and adaptive management may extend for up to 10 years following project completion. Monitoring tasks and project evaluation reports will be Corps responsibilities.

7 Project Close Out

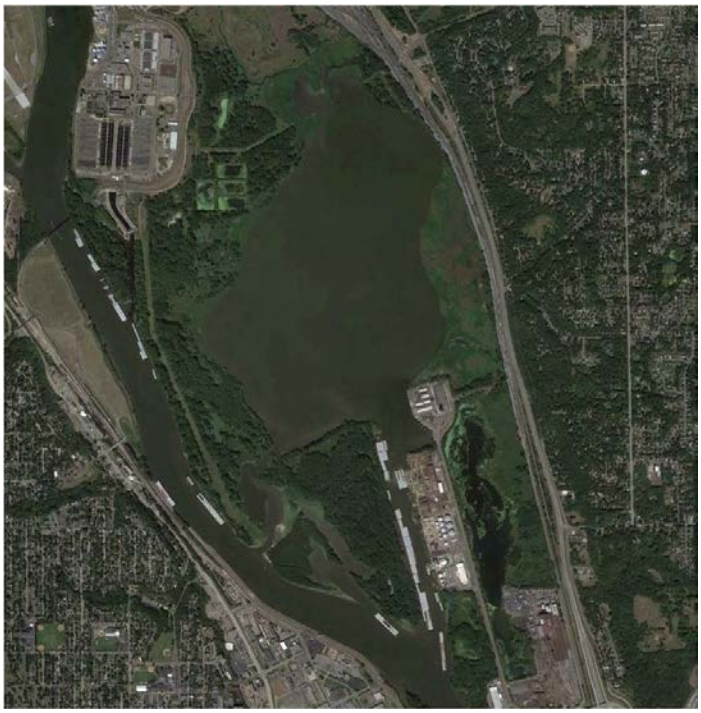
Close-out of the project would occur when the level of success of the project is determined adequate or when the maximum 10-year monitoring period has been reached. The level of success would be based on the extent to which the project objectives have been or will be met based upon the trends for the site conditions and processes.

Additionally, project close-out will include technology transfer. This includes the dissemination of project monitoring results, analyses performed, management decisions made (Adaptive Management features or adjustments), and lessons learned. Technology transfer will occur via publications, presentations, and discussions with LTRM, River Teams, EMP-CC, and stakeholders, among others.

US Army Corps of Engineers®
St. Paul District

Appendix O: Draft Finding of No Significant Impact (FONSI) Pigs Eye Lake Ramsey County, MN Section 204

Feasibility Study Report with Integrated Environmental Assessment



St. Paul District U.S. Army Corps of Engineers
May 2018

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
SAINT PAUL, MN, 55001

Regional Planning and Environment Division North
Environmental and GIS Branch

DRAFT FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the Corps of Engineers, St. Paul District, has assessed the environmental impacts of the following project:

PIGS EYE LAKE: CONTINUING AUTHORITIES PROGRAM SECTION 204 PROJECT

The purpose of the project is to enhance and restore backwater habitat by creating island and wetland features within Pigs Eye Lake using material dredged from the Mississippi River by the Corps of Engineers during routine maintenance of the navigation channel. The project area is located in Pool 2, just downstream of St. Paul, Minnesota. The recommended plan is to construct a complex of seven islands; three of which that would incorporate wetland creation and plantings in the centers of the islands. The project would benefit the area by: (1) Serving as wind barriers within the lake to reduce sediment resuspension and shoreline erosion; (2) Improving habitat for migratory birds; (3) Stabilizing the lake bottom; and (4) Providing a positive and productive use of dredged material.

This Finding of No Significant Impact is based on the following factors, as discussed in the environmental assessment: the project would have temporary minor adverse impacts on noise levels, aesthetic values, recreational opportunities, air quality, terrestrial habitat, aquatic habitat, biological productivity, and surface water quality; the project would have substantial beneficial effects on terrestrial habitat, wetlands, aquatic habitat, and habitat diversity and interspersion; the project would have additional minor beneficial effects on aesthetic values, recreational opportunities, commercial navigation, biological productivity, and surface water quality; and the project would have temporary, minor beneficial effects on employment.

Our environmental review indicates that the proposed actions do not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement will not be prepared.

_____
Date

Samuel L. Calkins
Colonel, Corps of Engineers
District Commander