Powers Lake Watershed Project Phase IV

Project Sponsor:
City of Powers Lake
218 N Main, PO Box 198, Powers Lake, ND 58773

City of Powers Lake
218 N Main, Box 198
Powers Lake, ND 58773
701-464-5055

STATE CONTACT PERSON: Greg Sandness
Phone: 701-328-5232
e-mail: gsandness@state.nd.us

STATE: North Dakota

WATERSHED: Powers Lake Watershed

HYDROLOGIC UNIT CODE: 10110101

PRIORITY WATERSHED: Yes

TMDL Development and/or Implementation: Yes

(Check any that apply)

PROJECT TYPES	**WATERBODY TYPES**	**NPS CATEGORY**
[] STAFFING & SUPPORT	[] GROUNDWATER	[X] AGRICULTURE
[X] WATERSHED	[X] LAKES/RESERVOIRS	[X] URBAN RUNOFF
[] GROUNDWATER	[] RIVERS	[] SILVICULTURE
[] I&E	[X] STREAMS	[] CONSTRUCTION
	[X] WETLANDS	[] RESOURCE EXTRACTION
	[] OTHER	[] STOWAGE/LAND DISP
		[] HYDRO MODIFICATION

PROJECT LOCATION: LATTITUDE: 48N 34' 19" LONGITUDE: 102W 40' 06"

MAJOR GOAL: The primary goal of Phase IV of the Powers Lake Watershed Project is to protect and restore recreational and aquatic life beneficial uses. Phase IV has 2 natural resource management objectives. One objective is designed to provide technical, financial, and educational assistance to landowners within the watershed to implement BMPs addressing potential nutrient sources in the watershed. A second objective, and the main focus of Phase IV, is to continue operating the dredge to remove nutrients stored in the bottom sediment of Powers Lake.

PROJECT DESCRIPTION: Project sponsors intend to 1) address in-lake nutrient cycling with selective dredging for phosphorus and nitrogen removal; 2) provide technical and financial assistance to landowners wishing to implement BMPs designed to reduce delivery of nutrients and sediments to the lake; 3) continue to develop and maintain partnerships in the local community to benefit water quality in the lake; 4) continue educational programs to inform the public of nonpoint source pollution concerns and solutions; and 5) monitor water quality for use in adaptive management throughout the period of the grant .

FY2021 319 Funds:	$298,348	Match:	$303,183
		Total project cost:	$601,531

2.0 Statement of Need

2.1

Initiated at the request of the local community, the 2000-2001 Water Quality Assessment conducted by the City of Powers Lake and the ND Department of Environmental Quality (NDDEQ) identified excess phosphorus as the main factor contributing to the hypereutrophic condition of the lake. From this study modeling results indicated that Powers Lake received an annual phosphorus load of 11,564lbs – 6,339 lbs from external sources and 5,225 lbs from internal sources (nutrient cycling). Phase I of the Powers Lake Watershed Project was initiated to address the water quality issue, focusing on the external sources (those from the watershed). Achievements of Phase I, II and III included over 20,000 acres of cropland BMPs implemented including no-till, nutrient management, and grass plantings (close to 50% of the watershed) and significant amount of feet of pipeline, fence, and tree plantings established, in addition to grazing systems, livestock wells, and wetlands created (see Appendix 2). The numerous conservation practices installed during this phase greatly benefited the water quality entering the lake.

During Phase I, the North Dakota Department of Environmental Quality (NDDEQ) developed a total maximum daily load (TMDL), for Powers Lake. This TMDL identified the load reduction needed to restore recreation and aquatic life beneficial uses as listed in the 2006 Section 303(d) List of Impaired Waters Needing Total Maximum Daily Loads (NDDEQ, 2006). Based on the modeling in the TMDL, nutrient loading to Powers Lake needed to be reduced by 75% from external sources and 50 % from internal sources (NDDEQ, 2008). Using Trophic State Indicators (TSI) as a target, chlorophyll a was chosen as the variable most accurate at predicting algal biomass for the lake as well as being the most easily identifiable to the general public. The restoration target TSI for chlorophyll a is 55.02, which corresponds to the needed phosphorus load reductions.

Phase I also began research into options for addressing the in-lake nutrient cycling. During the end of Phase I, Houston Engineering developed a Lake Restoration Feasibility Plan to examine potential nutrient management alternatives, along with cost and feasibility options to reduce internal nutrient cycling. Given the various cost/benefit options, the Powers Lake Advisory Committee felt that selective dredging provided the best alternative.

Phase II of the Powers Lake Watershed Project began the task of moving towards acquiring a dredge and land disposal site. This process was more time consuming than planned for initially, so it wasn't until the end of the grant period significant progress was made. Because of the limits on what could be accomplished in the remaining time period, a large portion of the grant funding was returned to the state.

Phase II of this project was considered a stepping stone for what the Powers Lake Advisory Committee hopes will complete the recovery process for Powers Lake. A significant portion of external nutrient loading has been addressed with the first two phases.

Phase III, the Powers Lake Watershed Plan is currently addressing the outstanding issue of in-lake nutrient cycling determined to be so critical in the initial investigations of the lake. With the dredge and pipe purchased, and the sediment disposal site established, Phase III of the Project began reducing the internal nutrient loading in the lake. The dredged sediment which is loaded with very high amounts of Nitrogen and Phosphorous will provide a great benefit to the water quality in the lake. In particular the removal of sediment is a direct removal of the phosphorous.

Phase IV the Powers Lake Watershed Plan is to continue making great strides in removing the excess nutrients out of the lake. With the removal of the nutrients and providing more water volume in return will show improved water quality results and get us closer to more of a natural equilibrium of nutrient ratio in the lake.

2.2

Powers Lake is located on the south edge of the City of Powers Lake and is used year round. Camping, fishing, picnicking, hiking, bird watching, swimming, boating and other activities are important to the City of Powers Lake and visitors.

Powers Lake is a 1,616-acre lake that serves as a recreational area for the town of Powers Lake and Mountrail and Burke Counties. The lake serves as a classroom for Powers Lake Public School, a bird and fish habitat, recreation, an aesthetic draw to the community, and many other uses.

The Powers Lake Water Quality Assessment Project carried out in 2001 shows the lake is in a hypereutrophic state. The TMDL report completed in 2008 by the NDDEQ, indicates that to support the beneficial uses of recreation and aquatic life, external phosphorus loading needs to be reduced by 75% in addition to an internal loading reduction of 50%.

Bottom sediment samples taken in 2009 indicate that there are no toxic elements in the sediment and that the dewatered sediment would be suitable for land application.

The Phase IV goal is removal of approximately 60,000 yd^3 of sediment. The current disposal/dewatering site is approximately 80 acres in size with three cells totaling about 13 acres. As the project progresses, a second disposal site may be needed, if the dredging operation is moved to another part of the lake.

2.3
See attached maps (Appendix #1)

2.4
The Powers Lake Watershed is fed by four tributaries draining a surface area of 44,458 acres. See Appendix 1.

For the entire Powers Lake watershed, approximately 65.63 percent of the watershed is cropped and 29.69 percent is in some form of permanent grass or herbaceous cover. Land use in permanent cover is divided into range/pasture land (17.19%), hayland (6.25 %), Conservation Reserve Program (6.25%), and other uses (4.68%). The primary crops in the watershed are durum wheat, spring wheat, canola, field peas, winter wheat and flax. There are eight livestock operations in the watershed as well. Since the implementation of Phase I of the project, no till farming has continued to grow, with a few farmers expanding their operations. Many landowners have acknowledged the benefits of BMPs and continue to use them even after contracts have expired. Interest in cover crops and grass seeding has also continued to grow.

The City of Powers Lake is located at the northwest end of the lake and has a park and campground for recreation enjoyment.

2.5
In Phase I of the Watershed Project, five locations within the Powers Lake watershed were monitored for concentrations of nitrogen, phosphorus, total suspended solids and fecal coliform bacteria from April through October, 2001 and again during the runoff events from 2006-2009. In-lake water quality data, collected during the 2001 sampling season, indicates that Powers Lake is hypereutrophic, nitrogen limited water body that does not thermally stratify. Also, the assessment project identified that Powers Lake is hypereutrophic from both external and internal pollution sources.

The internal sources are most likely stored in the lake sediments and become available for primary production through both wind/wave action and internal releases during anoxic and near anoxic conditions.

Conservation practices were installed during Phase I, II, and III (Appendix 2) of the project from 2003-2019 have greatly benefited and improved the water quality within the watershed.

The Water Quality Analysis Report 2019 (Appendix #3) compares the original sampling year of 2001 to subsequent years of sampling in 2006 – 2007 and again from 2015-2019. This data show the project is successfully reducing nonpoint source pollution loading into Powers Lake. Total phosphorus concentrations have trended downward (Figure 6 in Appendix 3), so progress is being made toward the TMDL target. Dissolved phosphorous is trending upward with a higher percentage of the total phosphorous (Table 1 in Appendix 3) which has some beneficial effects.

With much of the external sources of nutrients addressed in the Powers Lake watershed, it is only by addressing some of the internal sources that algae blooms, and the associated higher trophic state, can be reduced under these circumstances. This is the improvement in water quality the Powers Lake Advisory Committee is striving towards. Stream sampling will again be initiated during this Phase of the Project to gather information on loading from the watershed, as well as continued lake sampling to monitor concentrations and determine effectiveness of the project. By seeing an increase in the dissolved phosphorous compared to the particulate phosphorous, which is showing that the conservation practices in the watershed have been reducing the load entering the lake has been encouraging.

The Powers Lake Nutrient Management Alternatives report completed by Houston Engineering Inc. in October 2008 found that based on bathymetric measurements, dredging 3.6 feet of the soft bottom material would increase the average lake depth from about 5.6 to about 9.2 feet with a maximum depth of 13.6 feet. Dredging will add depth to the lake, which would also remove possible internal sources of phosphorous and other materials that could be detrimental to lake water quality. The increased depth resulting from dredging would make it more difficult for the wind energy to create enough turbulence to stir up bottom sediments. This phase of the project will only focus on dredging specific critical locations. The first selected area to be dredged to reduce the amount of internal cycling of nutrients, along with dewatering location, is shown in Appendix 6.

The Powers Lake Restoration Plan completed by Houston Engineering in 2010 summarized the total phosphorus content of the sediment. Provided in the report were maximum, minimum values for all samples. Based on this information and the estimated removal of 60,000 yd^3 of sediment (goal of Phase IV), the table below provides phosphorus removal values based on an Olsen Phosphorous test level. (Table #1) The sediment sampling that has been taken place every year since the start of the dredging has resulted in an Olsen Phosphorous test level on average 32-33ppm. The total phosphorous per cubic yard of sediment removed has been higher than previously predicted which is indicating the removal of more total phosphorous then originally was estimated. An analysis of total phosphate in the current sediment will be conducted to determine the actual amount of phosphate removed by the project.

While we realize that selective dredging will not yield the same results that dredging the entire lake would, given that the internal phosphorus load reduction needed as listed in the TMDL was 1,185 kg/yr, which is equal to 2,612 lbs/yr, we feel that continuing on removing the phosphorous out of the lake will go a long way towards improving water quality in Powers Lake. Based on Olsen Phosphorous test there has been 2,736 lbs of phosphorous removed by dredging. The total phosphorus amount estimated by using estimated proportion numbers (Table #1) is 137,430 pounds of phosphorous removed.

Table 1: Phosphorous Levels

Phosphorous in Sediment Samples	**Total Phosphorous ppm**	**lbs/yd^3**	**P removal in lbs (per 60,000 yd^3)**
Olsen Phosphorous Test Minimum 14ppm	406	1.0962	65,772
Olsen Phosphorous Test Maximum 24ppm	793	2.1411	128,466
Olsen Phosphorous Test Actual 33ppm	Estimated 1000	Estimated 2.7000	Estimated 162,000

3.0 Project Description

GOAL:

The goal of Phase IV of the Powers Lake Watershed Project is to continue to restore and protect the recreation and aquatic life beneficial uses of Powers Lake through reducing the amount of internal cycling of phosphorus in the lake by 50%. The TMDL target goal is for total phosphorous concentration of 0.041 mg/L. This will be accomplished through the continued implementation of BMPs, selective dredging, and an active information and education program

Objective 1:

Enhance the effectiveness of in-lake restoration activities by supporting the implementation of additional BMP that will ensure nutrient (N & P) inputs from the watershed are maintained at or below concentrations documented at the end of phase I.

Task: 1

City of Powers Lake will employ personnel to manage the project during the grant period. Responsibilities will include inventories, producer contacts, water quality sampling, permits, dredge operation, public relations, etc.

Product – Watershed Project Manager.
Cost – **$120,000**

Task: 2
City and landowners will install conservation practices within the watershed to address reducing nutrient load . Plans will include BMPs such as field borders, nutrient management, conservation tillage, grass or tree plantings, grazing management, or sediment dams.

Product – BMP contracts with individual producers.
Cost - **$10,000**

Objective 2:

Reduce the amount of phosphorous available for internal cycling through selective dredging and removal of 60,000 cubic yards of nutrient laden sediment.

Task: 3
The City will meet with the landowner to rent a site for the disposal area and offer a rental lease agreement for the land. The disposal site will be approximately 80 acres.

Product – Land Lease
Cost - **$10,000**

Task: 4
The City will hire a contractor to work on the disposal site, when needed to remove and distribute sediment stored in the cells. This will include land spreading of the sediment.

Product – Disposal Site work will include cleaning the sediment out of the cells, spreading the sediment in certain locations, and for landowners to land spread the sediment on their land.
Cost - **$83,348**

Task: 5
Utilize the City owned dredge to remove 60,000 cubic yards of sediment from selected sites in the lake. Costs include the In-kind depreciation value of the dredge purchased by the City and operating costs supported with Outdoor Heritage Funds. The depreciation value of $2,633.67/month is left for 64 months and a value of $148.16/month is available for 77 months.

Product – 60,000 cubic yards of sediment removed from the lake.
Cost - **$240,783**

Task: 6
The City will rent a Booster Pump that is needed to help pump sediment for a longer distance for a total 6 months.

Product – It will increase the amount of acres on the lake that can be reached to pump the sediment into a disposal site and the potential to double our cubic yards per hour rate. With the current floating hose that we have available, each new site could be a potential of an additional 25 acres.
Cost - **$40,000**

Task: 7
The City will work on constructing another disposal site to enable expansion of the dredging operation to another priority area in the lake.

Product – provide a different area of the lake to be dredged and the handling of the sediment spreading. The amount of sediment that will be removed into a new disposal site will depend on the area that it is located and the cost of development. This in return will be determined by the amount that will be available for land spreading adjacent to the location.
Cost - **$20,000**

Objective 3:
Increase awareness in the rural and urban watershed of the importance of daily practices to achieve and maintain fully supporting status of recreational uses of Powers Lake, by delivering a Watershed Information/Education Program on activities and accomplishments.

Task: 8
The City will conduct public meetings and/or events on watershed accomplishments. The City will carry out general information and education program on the Lake Restoration utilizing local media sources including, but not limited to; radio, newspaper, and web site. May include NDSU Extension meetings and SCD meetings. There will be a minimum of 5 educational events for the community.

Product – Lake Restoration updates
Cost - **$500**

Task: 9
The City will continue to provide landowner/producer awareness and understanding of practices and management systems that improve cropland nutrient management and reduce the transport of nutrients to the lake within the watershed. The city will advertise the availability of the sediment being available for spreading on their land. There will be a minimum of 25 people informed.

Product – Tours, workshops, newspaper articles, web site, displays, and one on one contacts.
Cost - **$500**

Task: 10
The City will implement a conservation education program with the Powers Lake Public School on watersheds and water quality as related to Powers Lake. There will be a minimum of 5 educational activities for Powers Lake School. This will include class projects for the students on collecting lake data, information data, conservation education, lake biology education, science projects, and planting trees.

Product – Education activities within the school. There will be a minimum of 60 students involved.
Cost - **$500**

3.3
See attached Milestone Table (Appendix #4)

3.4
Several permit requirements may be needed to complete a sediment dam or disposal site. The State Historic Preservation Office (SHPO) will also be contacted regarding requirements related to potential BMP impacts to cultural resources. May potentially need a Stormwater Permit from the NDDEQ in the future on the dredging operation, but do not need one at this time. We currently have a NDDEQ discharge permit to pump water back to the lake when needed.

3.5
The City of Powers Lake is the appropriate entity to coordinate and implement this project. The city council is a locally elected organization which serves all people in the community. This project was developed at the beginning stages by the City of Powers Lake Advisory Committee. The Powers Lake Advisory Committee and the City Council has been the leading organization since the beginning and would like to see this project to continue moving forward.

3.6
While the Powers Lake Advisory Committee is responsible for gathering community support and determining the direction of the Project, the City of Powers Lake will be responsible for auditing Operation & Maintenance Agreements (O&M) on BMPs during the project period through and completing yearly status reviews of EPA-319 contracts. The City of Powers Lake will also be responsible for O&M for the dredge material containment site. The lifespan of each BMP will be listed in the individual contract to ensure longevity of the practices. The producer signs the "EPA 319 Funding Agreement Provisions" form, which explains in detail the consequences of destroying a BMP before the completion of its lifespan. The Powers Lake Advisory Committee is a local volunteer conservation organization.

4.0 Coordination Plan

4.1
The City of Powers Lake with the Powers Lake Advisory Committee (PLAC) has cooperated with many organizations and individuals, including the; North Dakota Department of Environmental Quality (NDDEQ), North Dakota Industrial Commission-Outdoor Heritage Grant, NRCS, USFWS, Ducks Unlimited
and NDGF.
NDDEQ – has provided technical and financial assistance for the assessment phase of the project.
NRCS – will provide technical assistance with further watershed evaluation and producer contracts.
The Powers Lake Advisory Committee includes members from the following agencies/organizations:
Community Members, City of Powers Lake, Powers Lake Public School
The PLAC has been instrumental in organizing labor and community support for the project. They will continue to supervise the direction of this project, while the City of Powers Lake will act as the administrative office for the grant.

4.2
Local support for the project shows in the response received from the monitoring phase and public meeting held to discuss water quality results and project potential. Attendance was about 80 at a public meeting and requests for information on how to improve and protect the lake shows a broad-based support for actions necessary to accomplish this project. There has been a lot of excitement for the dredging portion of the Project. There was very little negativity about the City purchasing the dredge as they see Powers Lake to be a great asset to the community. There is constantly people asking about the dredging and how it is going.

4.3
The working relationship with numerous organizations during Phase I, II and III of the project shows the coordination with various agencies to succeed in the overall goal of establishing a quality lake once again. Organizations that we have coordinated with and expecting to continue working with to achieve our goals is the NRCS, SCD, NDG&F, and USFWS.

4.4
The City of Powers Lake will continue working with EQIP, CRP, WHIP, and other USDA programs. This EPA 319 project will be coordinated with these and other programs. The sponsor plans to coordinate with all agencies and individuals possible to carry out an efficient project and to utilize this project to fill in and offer assistance that is not available through programs listed. The sponsor will coordinate and communicate with other agencies to prevent the duplication of efforts with landowners.

5.0 Evaluation and Monitoring Plan

5.1
Monitoring strategy for Powers Lake Watershed and Lake, will be done according to North Dakota Department Environmental Quality- Water Quality Division recommendations and standards. The Quality Assurance Project Plan (QAPP) will be developed by the NDDEQ after the project is fully approved and included in the final PIP submitted to the EPA.

6.0 Budget

6.1 See Attachments (Appendix #5)

7.0 Public Involvement

7.1
Educational and informational meetings will be conducted to keep the community informed. Community leaders, commissioners, water resource board members, city council members, and district supervisors will be involved in decision-making processes involving the implementation of BMPs within the Powers Lake Watershed. The Powers Lake Watershed Advisory Council is open to all people that want to be involved.

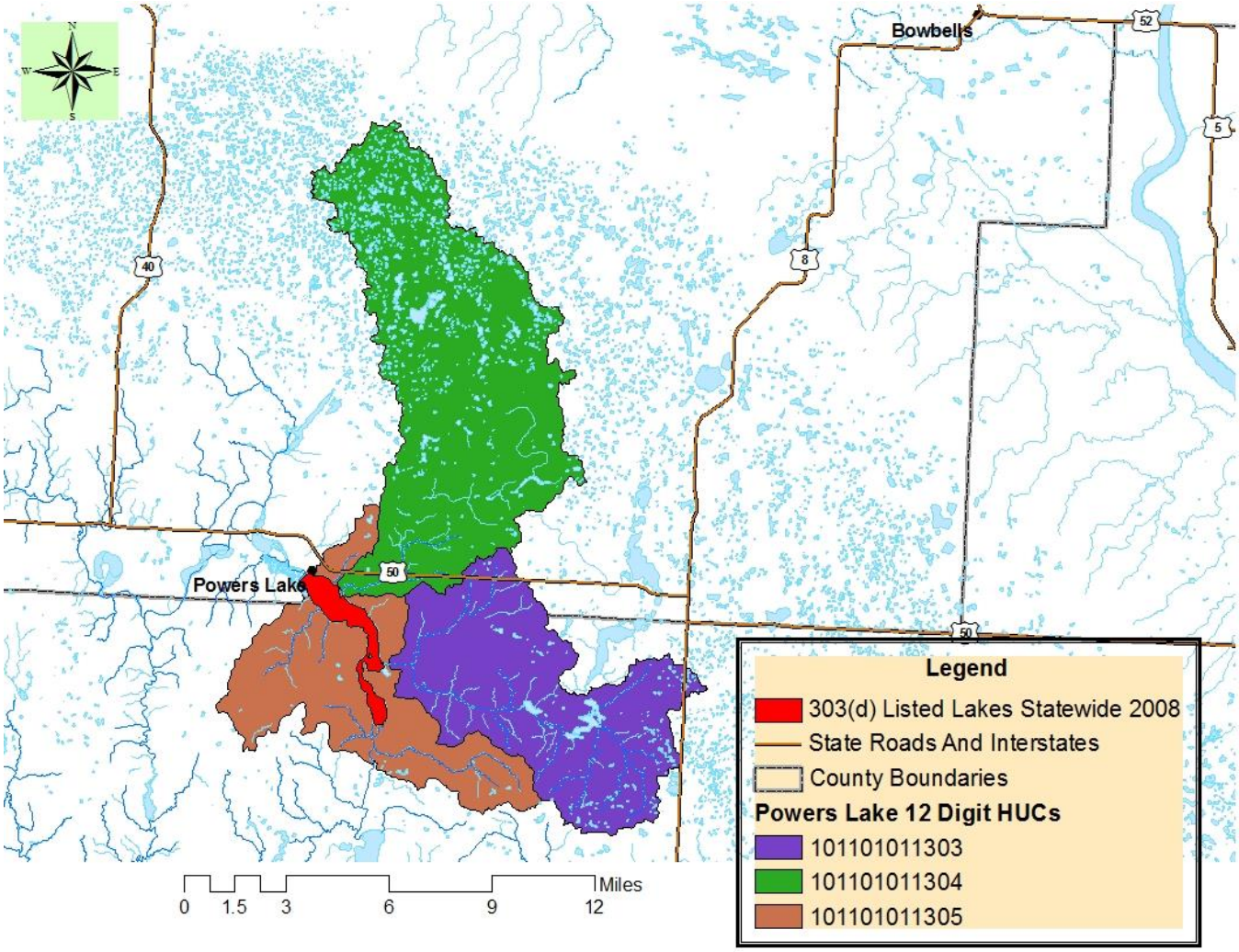
Powers Lake Watershed Project
Phase IV

Appendix List

1	Powers Lake Watershed Maps
2	Summary of Phase I, II, and III Accomplishments
3	NDDEQ Brief Water Quality Discussion
4	Milestone Table
5	Budget
6	Potential Dredging Area Locations

APPENDIX #1

Powers Lake Watershed Map


Bowbells
Powers Lake
52
5
40
8
50
50
Legend
303(d) Listed Lakes Statewide 2008
State Roads And Interstates
County Boundaries
Powers Lake 12 Digit HUCs
101101011303
101101011304
101101011305
0 1.5 3 6 9 12
Miles

APPENDIX #2

Summary of Phase I, II, III Accomplishments

Cumulative #'s for Practices completed through USDA programs, 319 BMP, NDGF, USFWS, NDNRT, DU during Phase I, II, & III.

BMP Type	Units
Res-Till 329A	19,144 ac.
Nutrient Mgt.	12,103 ac.
Past/Hay planting	1,053 ac.
Pipelines	32,320 ln. ft
Fence	66,349 ln. ft
Well	7 number
Tanks	23 number
Grazing Systems	4,790 ac.
Waste Mngt Sys.	1 number
Tree plantings	37,040 ln. ft
Well Decommissioning	1 number
Urban stormwater	1 number
Grass Easement	1,487 ac.
Wetlands created	9 number
Cover Crops	530 ac.

APPENDIX #3

NDDEQ Brief Water Quality Discussion

SUMMARY

1. Water Body Information

State: North Dakota
County: Burke and Mountrail

Major River Basin: Missouri River Basin
8-Digit Hydrologic Unit Code: 10110101

Water-body Name: Powers Lake
Location: Burke and Mountrail Counties

Water-body size: 1,616 acres
Watershed Area: 44,458 acres(approximate)

Discharges to: Tributary to White Earth River

Designated Uses Impaired: 1) Aquatic Life (eutrophication, sedimentation, low dissolved oxygen)
2) Recreation (Fishing, boating, swimming)

Constituent(s) of Concern: Phosphorus, Nitrogen, Sediment, Dissolved Oxygen

Applicable Water Quality Standard:

Aquatic Life:
The quality of water shall be such to support the propagation of life, of both of resident fish species and other aquatic biota. The standard for dissolved oxygen is 5 mg/L.

2. Water Quality Target Development

Bathtub Model:
In-lake water quality data and stream load were used to calibrate the U.S. Corps of Engineers Bathtub Model. Multiple simulations of the calibrated trophic response were run to identify the amount of reduction in external and internal loads of phosphorus and nitrogen required to get an improvement in lake trophic condition.

Water Quality Targets

Nutrient Target

The nutrient target as described in the 2008 Powers Lake TMDL is a 75 percent reduction in external phosphorus loads and 50 percent reduction in internal phosphorus loads, expressed as a chlorophyll-*a* TSI value of 55.02 or lower.

Dissolved Oxygen Target

The dissolved oxygen target is the state water quality standard of a minimum of 5.0 mg/L.

Water Quality Results

D1. Lake Water Quality Results

One of the major goals of the Powers Lake Project is to improve the lake's trophic level by reducing the nutrient load. This lowers the occurrence of algae blooms which are a factor in significantly decreased dissolved oxygen levels leading to fish kills. In the past Powers Lake's trophic response was tracked numerically using Carlson's Trophic Status index's for Chlorophyll-a and Secchi Disk, but due to current lab analysis issues with chlorophyll-a, this report will focus on phosphorus reduction. While chlorophyll-a and Secchi disk depth are visual indicators of algae growth from excessive nutrient loading, phosphorus is a primary driver in the production of algae and was identified as the parameter in need of reduction in the TMDL developed for this lake.

Phosphorus found in lake water includes dissolved and particulate/suspended forms. Each of these forms consist of both organic and inorganic components. Dissolved inorganic phosphorus it the component used by aquatic plants like algae for growth. Particulate or suspended phosphorus comes from dead or decaying plant or animal material or attached to soil particles that are transported to the lake through runoff. It tends to settle to the bottom in lake sediment and is resuspended during wind and wave action where it can be converted to dissolved phosphorus. Thus, phosphorus enriched lake sediment provides a continual source of nutrients to plants like algae, even after sources of particulate phosphorus are addressed in the watershed. Water quality data continues to show a reduction in particulate phosphorus entering the waterbody, so to address the in-lake sources Powers Lake began a selective dredging project aimed at phosphorus source removal.

Nutrient data was collected a both the deepest spot in the lake as well as at the dredging site. All data, and phosphorus in particular, showed identical to slightly lower (by hundredths of a milligram) concentrations at the dredge site. This data also followed similar spikes and valleys to the deepest site, which indicates that the chemical processes that occur are lake-wide in scale and that the lake is very well mixed (Figures 1 and 2). For this reason, and because the data from the deepest site is more robust for analysis, graphs and tables are based on data from the deepest site only.

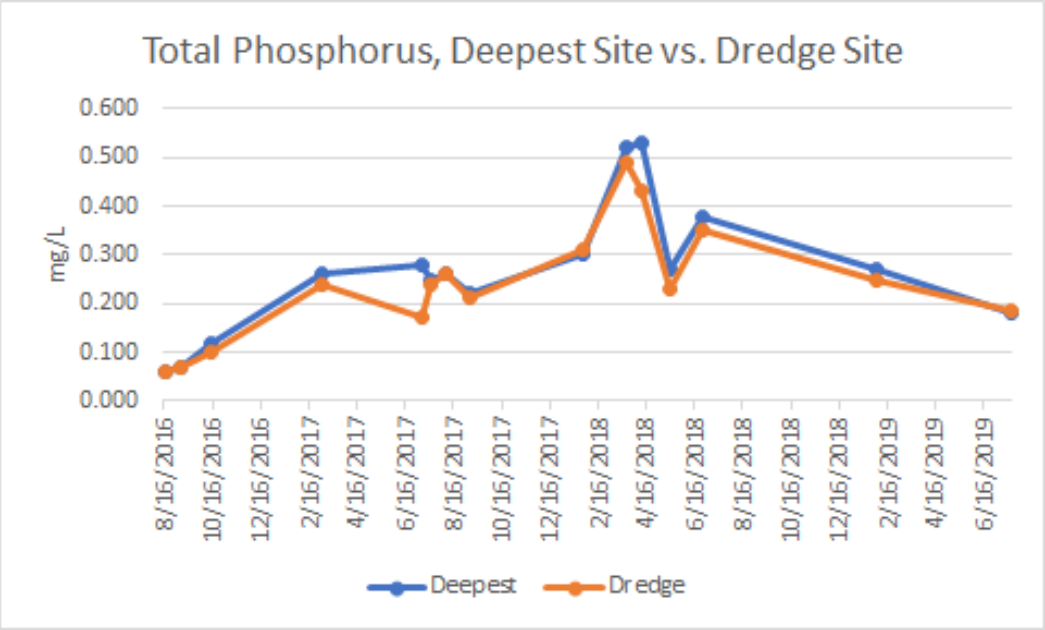


Figure 1. Comparison of Total Phosphorus Concentrations at Deepest and Dredge Sites.

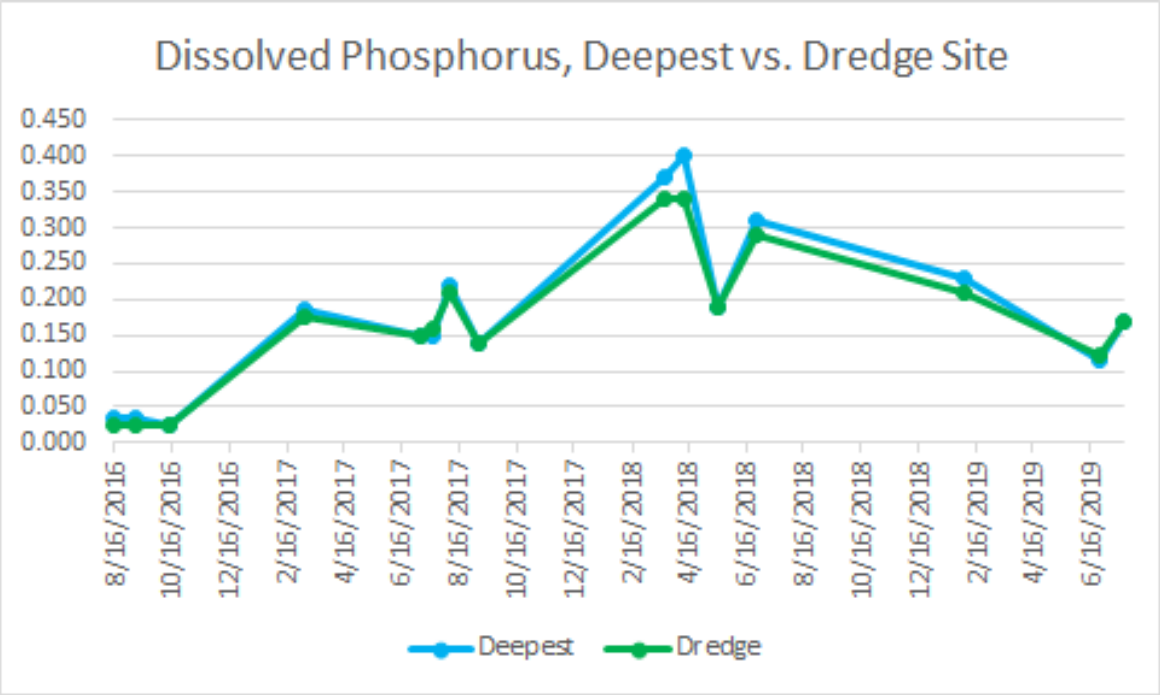


Figure 2. Comparison of Dissolved Phosphorus Concentrations at Deepest and Dredge Sites.

Total phosphorus is a combination of dissolved and particulate phosphorus. An indication of the reduction in particulate phosphorus loading is that it has been decreasing in composition of total phosphorus, as seen by an increasing composition of dissolved phosphorus. Prior to the initial project in 2001, dissolved phosphorus made up 45.9% of total phosphorus. During the conservation implementation phase in 2006 and 2007, dissolved phosphorus made up 50.3% of total phosphorus. During this last phase of the project, from 2015 to 2019 dissolved phosphorus has made up 72.6% of total phosphorus. This is a significant change in composition, indicating the current emphasis on in-lake nutrient sources is the appropriate focus.

Since dissolved phosphorus is made up of both organic and inorganic portions, some testing was done to determine how much of the dissolved phosphorus was in the inorganic form, so most available to algae. Limited data so far has shown that 99% is in the inorganic form, but more analysis needs to be done to determine if this is only during the growing season or year-round.

Results for the long-term monitoring of total phosphorus levels in Powers Lake are encouraging. The graphs below show that overall, total phosphorus has been decreasing, so progress is being made toward TMDL target. Dissolved phosphorus has remained stead to a slight increase, which has had some beneficial effects (Figures 3 through 6). Literature has indicated that a nutrient balanced lake has a TN to TP ratio of between 10 and 30. At ratios less than 10, cyanobacteria (blue green algae) can dominate. More recent years have shown fewer outbreaks of blue green algae which suggests this to be true for Powers Lake as well. A summary of this data can be seen in Table 1. The total nitrogen to total phosphorus ratios (TN:TP) included in previous grant applications and water quality reports for Powers Lake were calculated using only the data from the typical growing season through to be correct at that time (May-August). Research since then has indicated a much longer growing season in North Dakota. Research has also indicated that there are effects of nutrient spikes resulting from in-lake chemical processes over winter, under ice conditions where oxygen is limited, that continue into the next summer's season. For this reason data for the entire years indicated are included in calculating the ratios for this report.

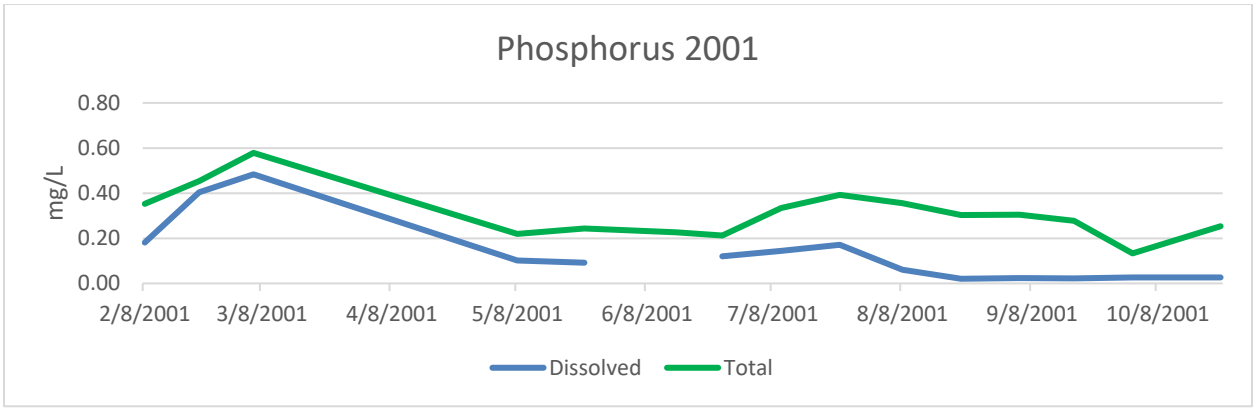


Figure 3. Dissolved vs Total Phosphorus Data, 2001.

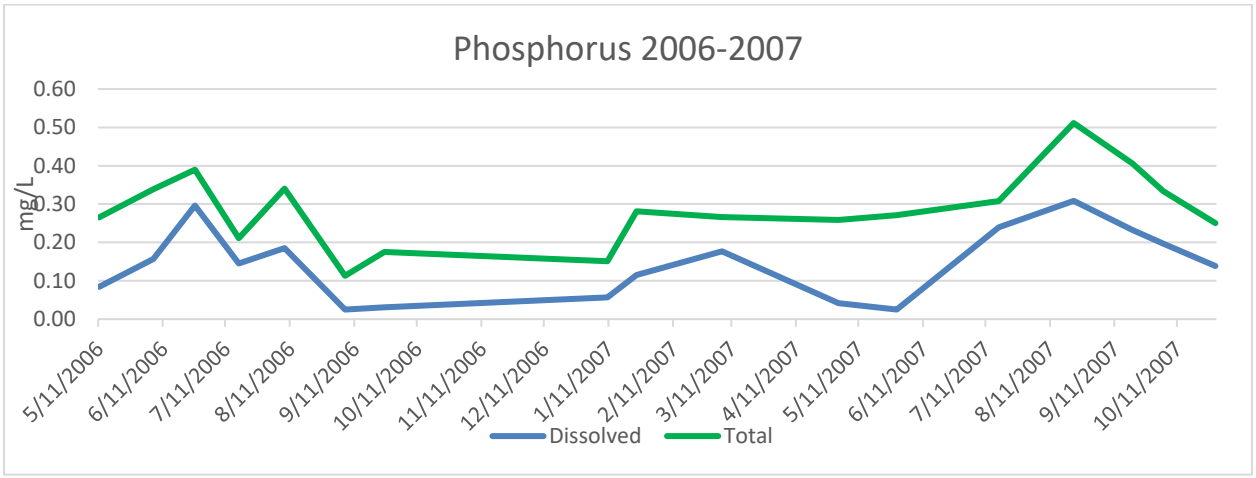


Figure 4. Dissolved vs. Total Phosphorus Data, 2006-2007.

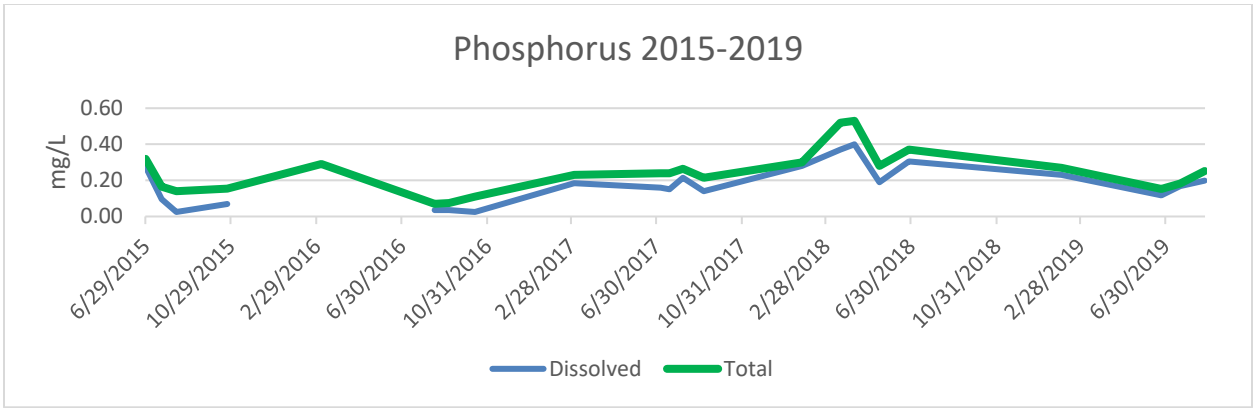


Figure 5. Dissolved vs. Total Phosphorus Data, 2015-2019

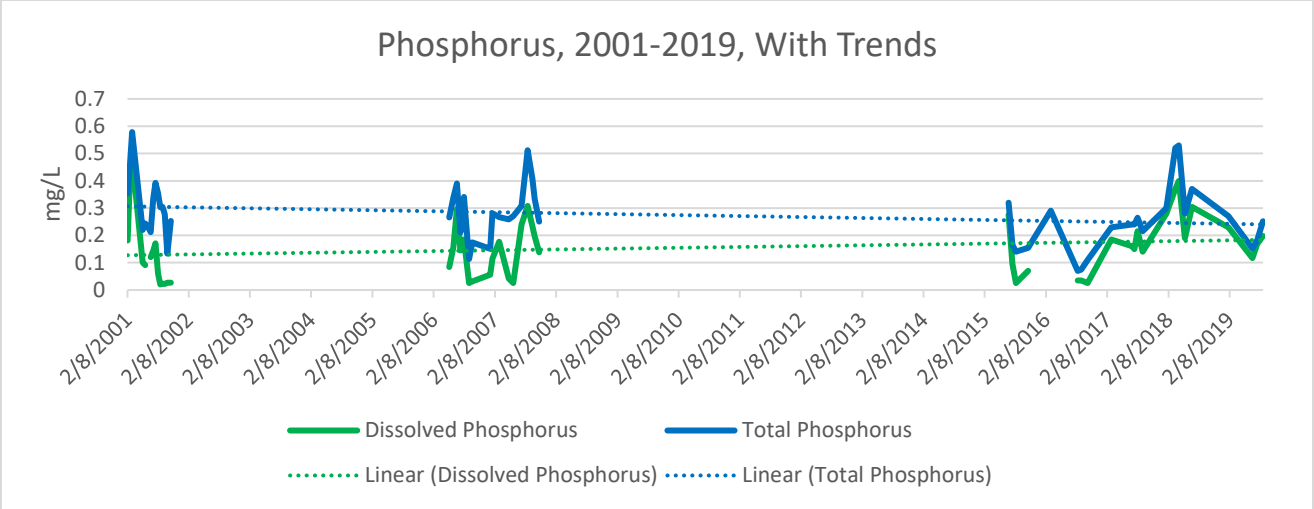


Figure 6. Trend in Phosphorus Data over Length of Project.

Table 1. Changes in Select Phosphorus Parameters.

Date Range	Average Dissolved Phosphorus	Average Total Phosphorus	Dissolved % of Total	TN:TP Ratio
2001	0.142 mg/L	0.309 mg/L	45.9%	8.78
2006-2007	0.144 mg/L	0.286 mg/L	50.3%	11.06
2015-2019	0.175 mg/L	0.241 mg/L	72.6%	10.83

Additional indications of continued lake improvement are the high dissolved oxygen concentrations. In 2001, the entire water column of the lake was below the state's dissolved oxygen standard of 5.0 mg/L from late September through the last sample in October. In 2012 only one date (July 18th) saw values below 5.0 mg/L, but the levels had rebounded throughout the water column by July 31st. In 2013, most of the state saw an extended winter ice cover period preventing reaeration. April 2013 had a low value of 0.85 mg/L near the sediment water interface at the bottom of the lake, but again rebounded throughout the year to have a value of 10.4 mg/L by October 9th. Levels in 2014 never dropped below the state standard of 5.0 mg/L, and in 2015 only one sample was below 5.0 mg/L. That sample was taken near the bottom while the upper part of the water column had a concentration of 13.36 mg/L. At the beginning of the project, dissolved oxygen concentrations were around 4.0 to 4.5 throughout the water column in the fall, dropping in the winter under ice cover, and not rebounding until after melt and spring flows. Values in 2015 ranged from 5.14 mg/L to 13.36 mg/L throughout the water column, with the exception of the one reading of 4.35 mg/L on June 29th, 2015 at 6 feet of depth. Values in 2019 ranged from 5.27 mg/L to 10.86 mg/L during the spring and summer period.

APPENDIX #4

Milestone Table

MILESTONE TABLE -- POWERS LAKE WATERSHED RESTORATION ACTION STRATEGY Page 1

Task	Quantities	Responsibility	Output	2020	2021	2022	2023	2024
Task 1: Employ Project Manager	1 employed	City of PL	Watershed Project Manager					
Task 2: BMP contracts with producers.	250 ac.	City of PL	Conservation practices					
Task 3: Land Lease	80 ac.	City of PL	Lease land from landowner					
Task 4: Disposal Site Work	80 ac.	City of PL	Dirtwork on disposal site					
Task 5: Sediment Removal	75,000 cuyds	City of PL	Dredge sediment					
Task 6: Rent Booster Pump	Booster pump setup	City of PL	Increase distance and effectiveness					
Task 7: Disposal Site Construction	1 New disposal site	City of PL	Develop another disposal site					
Task 8: Watershed/Lake Restoration meetings	5 meetings	City of PL	Public meetings					
Task 9: Conservation workshops	50 people	City of PL	Educational/Informational Meetings					
Task 10: Conservation education	5 activities	City of PL	Conservation education in Powers Lake School					

APPENDIX #5

Budget Tables

BUDGET TABLE
POWERS LAKE WATERSHED RESTORATION ACTION STRATEGY

PART 1: Funding Sources	FY2020	FY2021	FY2022	FY2023	FY2024	Totals
US EPA						
FY2020 Section 319 Funds (FA)	$45,800.00	$66,248.00	$68,890.00	$48,890.00	$68,520.00	$298,348.00
Other Federal Funds						
1) NRCS	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 2,000.00	$ 10,000.00
2) USFW&S (TA & FA)	$ 1,500.00	$ 2,000.00	$0.00	$0.00	$0.00	$ 3,500.00
3) NDDEQ (TA & FA)	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,600.00	$ 7,600.00
Subtotals	$ 5,000.00	$ 5,500.00	$ 3,500.00	$ 3,500.00	$ 3,600.00	$ 21,100.00
State & Local Match						
1) Landowners (FA)	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 2,000.00	$ 8,000.00
2) ND Game & Fish (TA & FA)	$200.00	$200.00	$200.00	$200.00	$200.00	$ 1,000.00
3) City of Powers Lake	$ 25,755.00	$ 47,362.00	$ 45,312.00	$ 45,392.00	$ 45,362.00	$ 209,183.00
4) Outdoor Heritage Funds	$ 17,000.00	$ 17,000.00	$ 17,000.00	$ 17,000.00	$ 17,000.00	$ 85,000.00
Subtotals	$ 44,455.00	$ 66,062.00	$ 64,012.00	$64,092.00	$64,562.00	$303,183.00
TOTAL BUDGET	$ 95,255.00	$ 137,810.00	$ 136,402.00	$ 116,482.00	$ 136,682.00	$622,631.00

FA: Financial Assistance
TA: Technical Assistance

SCD: Soil Conservation District
NRCS: Natural Resources Conservation Service
USF&WS: U.S. Fish & Wildlife Service

Part 2: Detailed Budget (Section 319/Non-Federal)								
	2020	2021	2022	2023	2024	Total Costs	Cash and In-kind Match	319 Funds
Objective 1: PERSONNEL/SUPPORT/ADMIN								
Salary/Fringe	$20,000	$25,000	$25,000	$25,000	$25,000	$120,000	$10,000	$110,000
Travel	$500	$500	$500	$500	$500	$2,500	$1,000	$1,500
Office Space ($650/month x 12 months)	$4,500	$7,800	$7,800	$7,800	$7,800	$35,700	$5,700	$30,000
Equipment/Supplies	$500	$500	$500	$500	$500	$2,500	$1,000	$1,500
Training	$300	$300	$300	$300	$300	$1,500	$600	$900
Telephone/Postage	$500	$800	$800	$800	$800	$3,700	$1,300	$2,400
Subtotals	$26,300	$34,900	$34,900	$34,900	$34,900	$165,900	$19,600	$146,300
Objective 2: Financial & Technical Assistance								
BMPs for Rangeland, Cropland, Riparian, etc.	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000	$4,000	$6,000
Land Lease (80 ac.)	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000	$4,000	$6,000
Site Work	$1,000	$1,000	$1,000	$1,000	$1,000	$5,000	$3,000	$2,000
Sediment Removal and Land Spreading Costs	$16,000	$16,348	$17,000	$17,000	$17,000	$83,348	$14,000	$69,348
Booster Pump (3 months rent/per year)	$0	$20,000	$0	$0	$20,000	$40,000	$12,000	$28,000
New disposal site construction		$0	$20,000			$20,000	$4,000	$16,000
Miscellaneous	$3,000	$5,000	$5,000	$5,000	$5,000	$23,000	$0	$23,000
Dredge and Pipe Depreciation Value	$22,255	$33,382	$33,382	$33,382	$33,382	$155,783	$155,783	$0.00
Outdoor Heritage Funds	$17,000	$17,000	$17,000	$17,000	$17,000	$85,000	$85,000	$0.00
Subtotals	$63,255	$96,730	$97,382	$77,382	$97,382	$432,131	$281,783	$150,348
Objective 3: Information/Education								
Public meetings/Tours/Education	$200	$200	$200	$200	$200	$1,000	$800	$200
Survey/Newsletters/News releases	$100	$100	$100	$100	$100	$500	$200	$300
Subtotals	$300	$300	$300	$300	$300	$1,500	$1,000	$500
Objective 4: Water Quality Monitoring								
Sampling/Transport/Supplies	$400	$400	$400	$400	$400	$2,000	$800	$1,200
Subtotals	$400	$400	$400	$400	$400	$2,000	$800	$1,200
Total for all Objectives/Tasks								
Total 319/Non-federal Budget	$90,255	$132,330	$132,982	$112,982	$132,982	$601,531	$303,183	$298,348

APPENDIX # 6

Potential Dredging Area Locations