Powers Lake Watershed Project Phase III

Project Sponsor:
City of Powers Lake
218 N Main, PO Box 198, Powers Lake, ND 58733

City of Powers Lake
218 N Main, Box 198
Powers Lake, ND 58733
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: no

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 III of the Powers Lake Watershed Project is to protect and restore recreational and aquatic life beneficial uses. This plan is designed to provide technical, financial, and educational assistance to landowners within the watershed for the implementation of BMPs and to address the outstanding issue of in-lake nutrient cycling not covered by Phase I or II.

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 for the continued reduction of nutrient and sediment deposition into 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 .

FY2016 319 Funds:	$176,827	Match:	$160,092
		Total project cost:	$336,919

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 Health 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 and II included over 20,000 acres of cropland BMPs implemented (close to 50% of the watershed) and significant amount of feet of pipeline, fence, and tree plantings established, in addition to grassland plantings, 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 Health (NDDoH) 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 (NDDoH, 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 (NDDoH, 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, and now with Phase III, the Powers Lake Watershed Plan can address 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 will begin the process of reducing internal nutrient loading to 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.

In-lake water quality data collected in 2000-01 indicates that Powers Lake is a nitrogen limited reservoir. A lake is assumed to be at nutrient equilibrium when the ratios of nitrogen to phosphorus is between 10:1 and 15:1, the ratio for Powers Lake was 5:1 in 2001 indicating it is nitrogen limited. The ratio has improved to 6.3:1 in 2015. The excess nutrient is still phosphorus.

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 NDDoH, 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 III goal is removal of approximately 75,000 yd^3 of sediment. The disposal/dewatering site is approximately 80 acres in size with three cells totally about 13 acres.

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 northeast 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 of the project from 2003-2010 have greatly benefited and improved the water quality within the watershed.

The Water Quality Analysis Report 2015 (Appendix #5) compares the original sampling year of 2001 to subsequent years of sampling in 2006 – 2009 and again in 2015. These data show the project is successfully reducing nonpoint source pollution loading into Powers Lake. Total nitrogen and total phosphorus concentrations have decreased (Figures 1 and 2 in Appendix 5) . Chlorophyll-a growing season averages have also seen a decline with the exception of 2015 (Figure 3, Appendix 5). As explained in more detail in Appendix 5, even with reductions like these it only takes one year, like this one, of long duration high temperatures, improved water clarity, and low flows into the lake for algae to make use of the excess nutrients brought up from bottom sediments during the turnover of spring melt or wind/wave action and create the intense algae blooms. Intense algal blooms were witnessed all over the state this year, including Powers Lake. In 2009, the average TSI score for chlorophyll-a was 53.24, which met the TMDL target of 55.02. However, as shown in 2015, keeping this score at an acceptable level will mean reducing phosphorus even more to protect against years of extremes.

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.

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 8.

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, and the mean values for all samples. Based on this information and the estimated removal of 75,000 yd^3 of sediment that is the goal of Phase III, the table below provides phosphorus removal values. 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 this project will go a long way towards improving water quality in Powers Lake.

Total P in Sediment Samples	**µg/g**	**lbs/yd^3**	**P removal in lbs (per 75,000 yd^3)**
Minimum	406	0.684335305	51,325
Maximum	793	1.336645067	100,249
Mean	672	1.132692919	84,952

3.0 Project Description

GOAL:

The goal of Phase III of the Powers Lake Watershed Project is 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%. 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, etc.

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

Task: 2

City and landowners will develop nutrient management and resource management system plans on 400 acres of cropland. Plans will include BMPs such as field borders, nutrient management, conservation tillage and filter strips with emphasis on the land located on the AnnAGNPS priority area cropland maps in Appendix #3.

Product – Nutrient management and BMP contracts with individual producers.
Cost - **$4,000**

Task: 3
The City and landowners will develop rangeland and pasture management plans for 100 acres of land. Management plans will include BMPs such as fencing, pipelines, planned grazing systems, proper grazing use, tree plantings and pasture and hay land plantings with emphasis on the land located on the AnnAGNPS priority area non-cropland maps in Appendix #4.

Product – Rangeland and pasture BMPs
Cost - **$3,000**

Objective 2:

Reduce internal nutrient cycling within Powers Lake by 50% as stated in the TMDL, through the selective dredging and removal of 75,000 cubic yards of nutrient laden sediment.

Task: 4
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 land will be used as a disposal site of approximately 80 acres.

Product – Land Lease
Cost - **$6,000**

Task: 5
The City will work with a contractor to work on the disposal site when needed for distribution and trap collection of the lake sediments.

Product – Disposal Site work
Cost - **$9,000**

Task: 6
Utilize the City owned dredge to remove 75,000 cubic yards of sediment from selected sites in the lake. Costs include the inkind depreciation value of the dredge purchased by the City.

Product – 75,000 cubic yards of sediment removed from the lake
Cost - **$154,179**

Objective 4:

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: 7
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 and newspaper. There will be a minimum of 3 educational events for the community.

Product – Lake restoration updates
Cost **- $750**

Task: 8
The City will work to increase landowner/producer awareness and understanding of practices and management systems that improve cropland nutrient management and reduce the transport of nutrients to the lake nutrient management within the watershed. There will be a minimum of 50 people informed.

Product – Tours, workshops, newspaper articles, local radio programs, web site, displays, and one on one contacts.
Cost - **$750**

Task: 9
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 3 educational activities for the Schools. This will include class projects for the students on collecting lake data, information data, conservation education, lake biology education.

Product – Education activities within the school.
Cost **- $300**

3.3
See attached Milestone Table (Appendix #6)

3.4
Several permit requirements may be needed to complete some of the practices, such as ag waste systems and shoreline stabilization work. Ag waste systems will require a permit/approval to operate from the NDDoH. 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 NDDoH in the future on the dredging operation, but do not need one at this time.

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 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) is cooperating with many organizations and individuals, including the; North Dakota Department of Health, NRCS, and FSA.
NDDH – 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
Burke County SCD
Burke County Water Board
Burke County Commissioners
Mountrail SCD
Mountrail County Water Board
Mountrail County Commissioners
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.

4.3
The working relationship with numerous organizations during Phase I and II 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, has not been developed, but will be done according to North Dakota Health Department Water Quality Division recommendations and standards. The Quality Assurance Project Plan (QAPP) will be developed by the NDDH after the project is fully approved and included in the final PIP submitted to the EPA.

6.0 Budget

6.1 See Attachments (Appendix #7)

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.

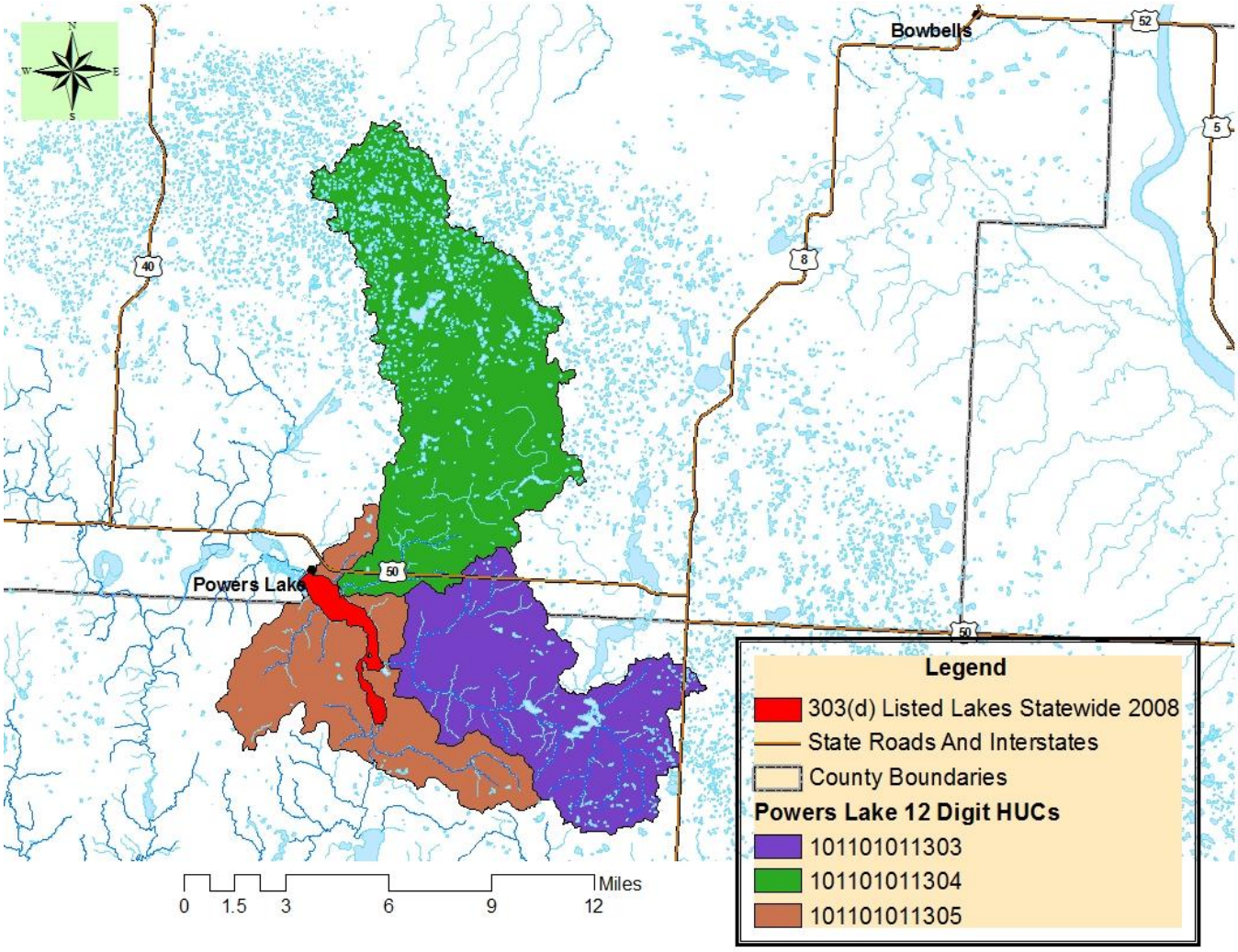
Powers Lake Watershed Project
Phase III

Appendix List

1	Powers Lake Watershed Maps
2	Summary of Phase I and II Accomplishments
3	Powers Lake AnnAGNPS Priority Cropland Map
4	Powers Lake AnnAGNPS Priority Non Cropland Map
5	NDDoH Brief Water Quality Discussion
6	Milestone Table
7	Budget
8	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
Miles
0 1.5 3 6 9 12

APPENDIX #2

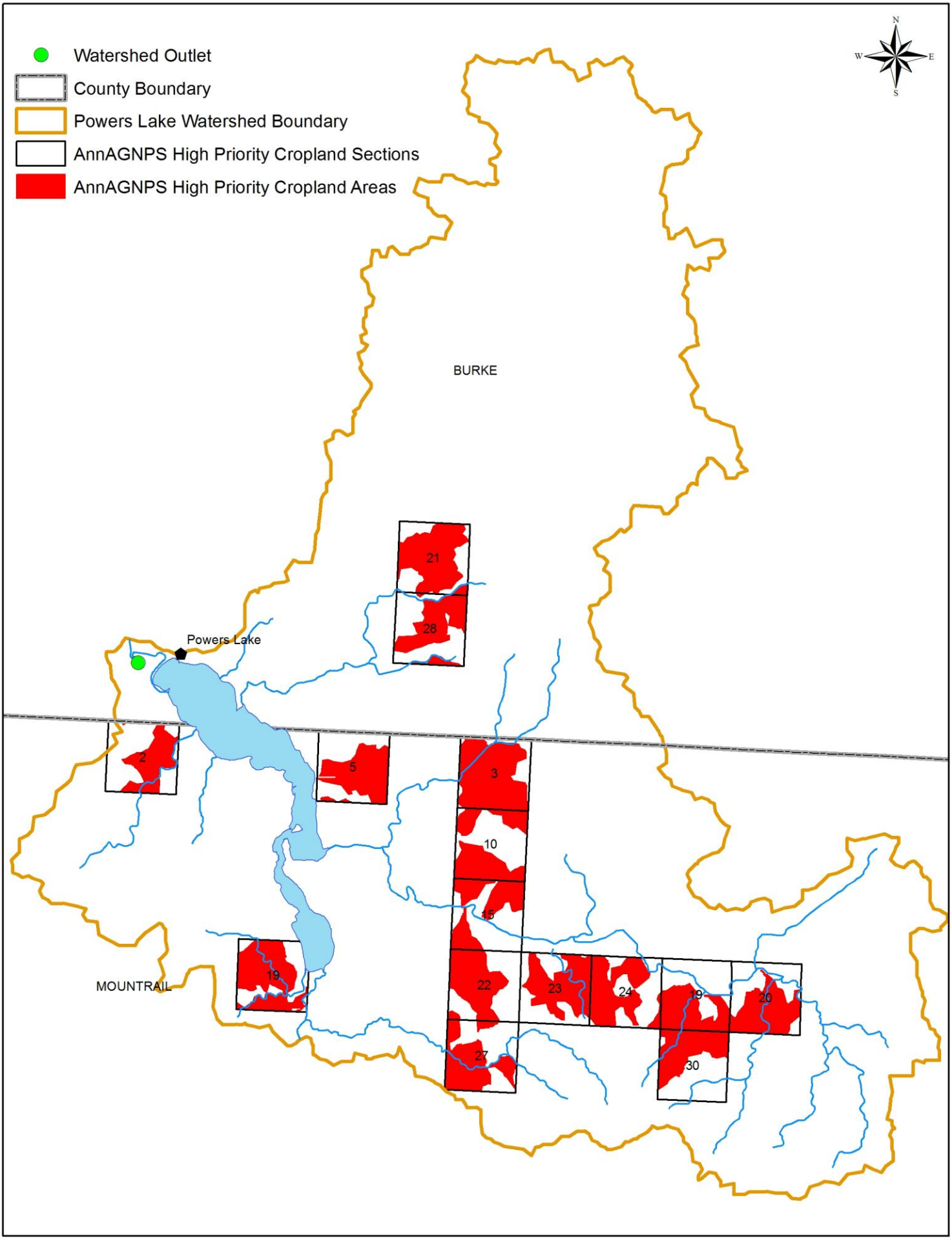
Summary of Phase I&II Accomplishments

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

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	35,840 ln. ft
Well Decommissioning	1 number
Urban stormwater	1 number
Grass Easement	1,487 ac.
Wetlands created	9 number

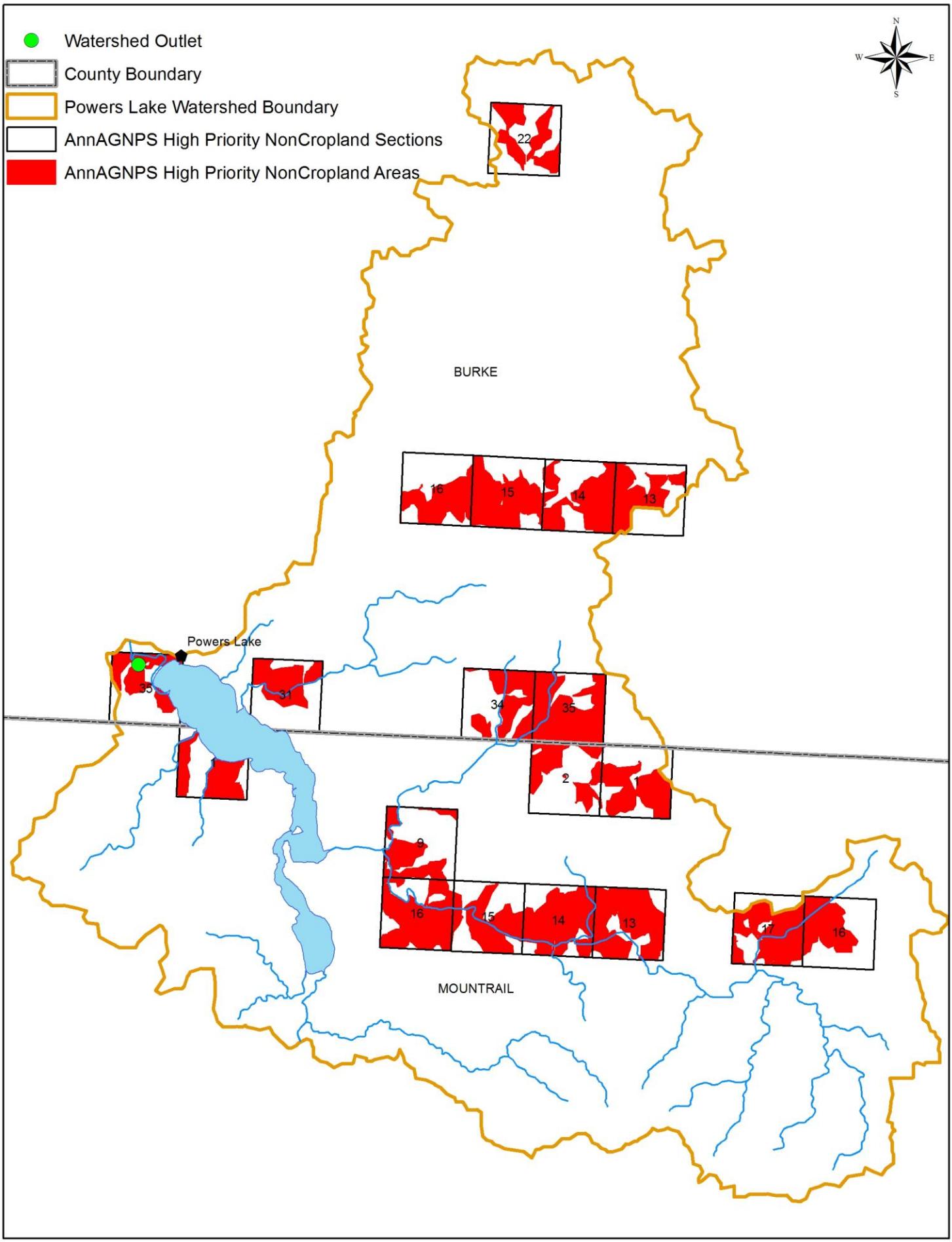
APPENDIX #3

Powers Lake AnnAGNPS Cropland Map


Watershed Outlet
County Boundary
Powers Lake Watershed Boundary
AnnAGNPS High Priority Cropland Sections
AnnAGNPS High Priority Cropland Areas
N
W
E
S
BURKE
MOUNTRAIL
Powers Lake
2
5
3
10
15
19
21
22
23
24
27
28
29
30
20

APPENDIX #4

Powers Lake AnnAGNPS Non Cropland Map


Watershed Outlet
County Boundary
Powers Lake Watershed Boundary
AnnAGNPS High Priority NonCropland Sections
AnnAGNPS High Priority NonCropland Areas
N
W
E
S
22
BURKE
16
15
14
13
Powers Lake
35
31
34
35
2
1
9
16
15
14
13
17
16
MOUNTRAIL

APPENDIX #5

NDDoH 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 response by reducing the nutrient load, which will also improve dissolved oxygen levels. Powers Lake's trophic response was tracked numerically throughout the project using Carlson's Trophic Status index's for Chlorophyll-a, Phosphorus and Secchi Disk.

While results for the long term monitoring of Powers Lake are encouraging, this year's data requires some explanation. Yearly average concentrations of total nitrogen and total phosphorus are showing declining trends (Figures 1 and 2). It is important to note that total phosphorus includes both dissolved and particulate phosphorus. This will play a role in the discussion of chlorophyll a concentrations. It is believed that the decrease in nutrient levels in the lake are related to the implementation of conservation practices throughout the watershed, reducing runoff. It is also important to note that 2011 and 2012 were years of flood conditions and high runoff, while 2015 had much lower precipitation, and therefore the tributaries that feed the lake were dry by late spring.

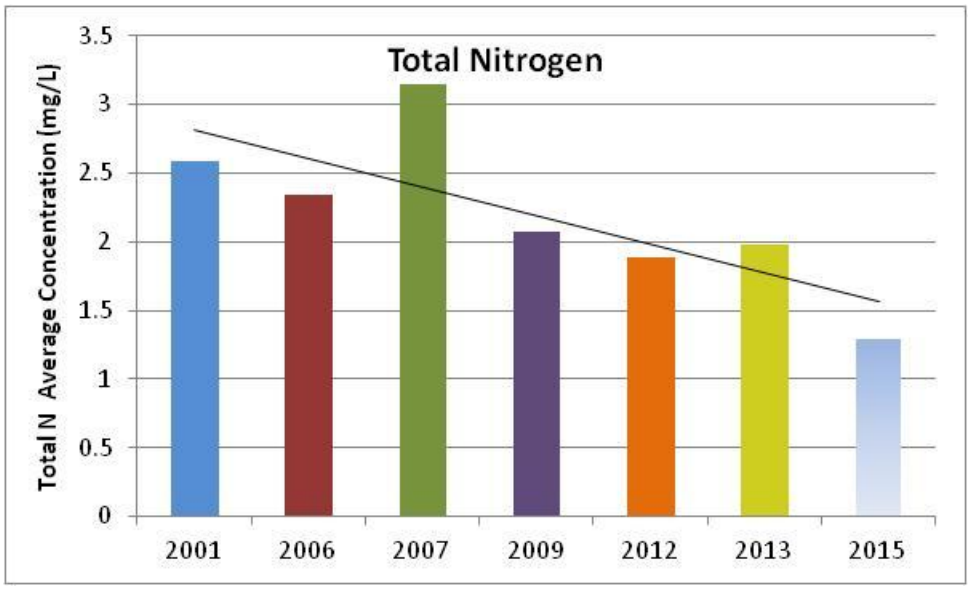


Figure 1. Total Nitrogen Concentration Averages for Powers Lake.

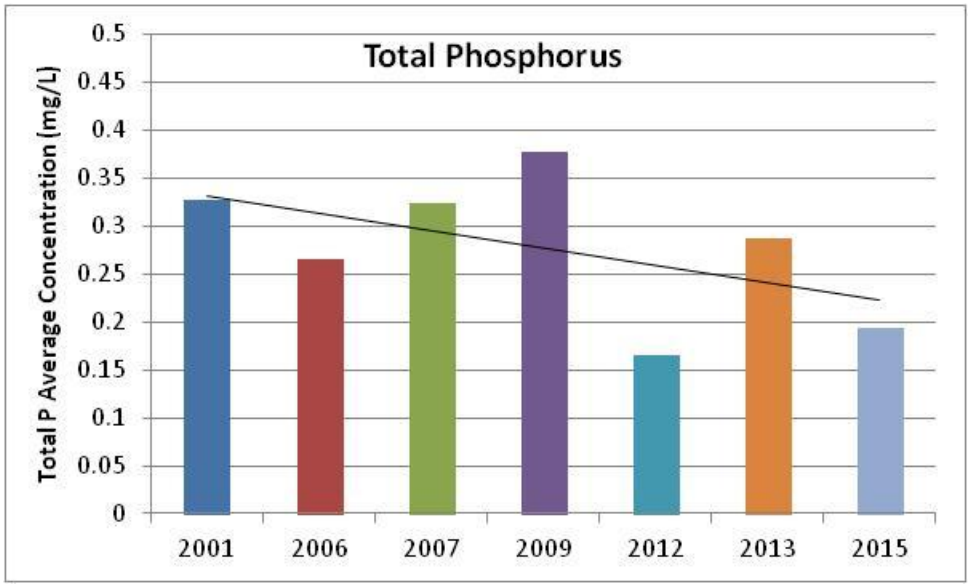


Figure 1. Total Phosphorus Concentration Averages for Powers Lake.

Chlorophyll a average growing season concentrations were showing declining trends until a spike this year (Figure 3). This is believed to be due to the increased clarity in the lake, as documented by improved Secchi Disk depths (Table 2), in addition to warmer temperatures throughout 2015. There were also limited chlorophyll samples (3 were taken in the middle of summer), so more data could have changed the average. The highest concentration recorded was also taken the day after very high winds from the northwest, causing a mixing effect along the long fetch of the lake, which resuspended sediment and nutrients. The temporary result is that while it appears that the Projects BMPs have been effective at reducing sediment and nutrients entering the lake, the improved clarity along with the abundance of nutrients in the bottom sediment has caused more algae to bloom in 2015.

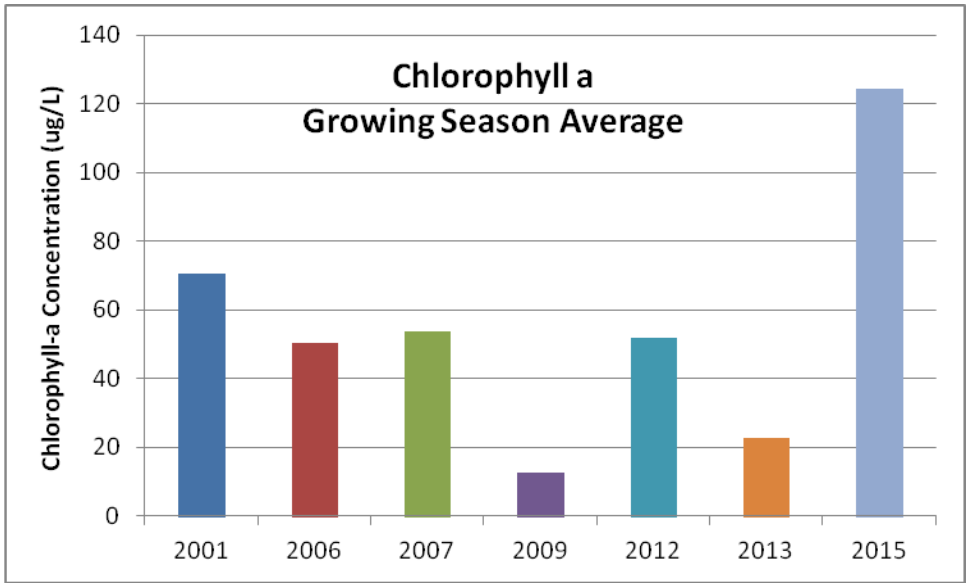


Figure 3. Growing Season Chlorophyll a Concentration Averages for Powers Lake.

Another indication that it is nutrients from the sediment and not runoff effecting the algae growth is the portion of total phosphorus that is made up of dissolved phosphorus. Dissolved inorganic phosphorus is the form most readily available to plants for growth. As discussed above, overall total phosphorus for the lake is seeing a declining trend. However, more of the total phosphorus is comprised of the dissolved form (Table 1). Particulate phosphorus associated with surface runoff has been making up less of the total phosphorus budget. Data for this comparison is only available for 2001, 2006, 2007, and 2015.

Table 1. Portion of Total Phosphorus Comprised of Dissolved Phosphorus.

Year	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Dissolved P % of Total
2001	0.302	0.138	46%
2006	0.262	0.132	50%
2007	0.300	0.160	53%
2015	0.200	0.123	62%

In 2008, a Total Maximum Daily Load (TMDL) was written for Powers Lake. That document supported the earlier assessment and determined that a 75 percent external load reduction of phosphorus was needed in addition to a 50 percent interal load reduction. Using the BATHTUB model developed by Walker, trophic state indicies (TSI) scores were obtained for this combination of external and internal load reduction. While it is most beneficial to use the combination of all three TSI scores (total phosphorus, chlorophyll a, and Secchi disk), the corresponding chlorophyll a TSI score of 55.02 was determined to be the target for ease in explanation to the general public. A table of the yearly TSI scores for all three variables is included below (Table 2). The chlorophyll a TSI target was met in 2009, but most likely did not account sufficiently for the internal nutrient

cycling of the lake. In the future it will be important to continue to use a combination of all three scores to determine improvments to the water quality of the lake.

Table 2. Average Growing Season TSI Scores for Powers Lake, 2001 - 2015.

Year	Average Phosphorus TSI	Average Chlorophyll-a TSI	Average Secchi TSI
2001	85.40	70.59	82.29
2006	83.29	62.45	80.54
2007	88.10	59.27	76.47
2009	87.74	49.72	76.48
2012	79.35	67.62	80.99
2013	77.81	61.19	ND*
2015	79.73	75.51	73.40

* No data available

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.

APPENDIX #6

Milestone Table

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

Task	Quantities	Responsibility	Output	2017				2018				2019			
Task 1: Employ Project Manager	1 employed	City of PL	Watershed Project Manager												
Task 2: Nutrient management plans .	250 ac.	City of PL	Nutrient Management Plan												
Task 3: Range management plans	100 ac.	City of PL	Rangeland/Pasture Mngt Plan												
Task 4: Land Lease	80 ac.	City of PL	Lease land from landowner												
Task 5: Disposal Site Work		City of PL	Dirtwork on disposal site												
Task 6: Sediment Removal	75,000 cuyds	City of PL	Dredge sediment												
Task 7: Watershed/Lake Restoration meetings	3 meetings	City of PL	Public meetings												
Task 8: Conservation workshops	50 people	City of PL	Educational/Informational Meetings												
Task 9: Conservation education	3 activities	City of PL	Conservation education in Powers Lake School												

APPENDIX #7

Budget Tables

BUDGET TABLE
POWERS LAKE WATERSHED RESTORATION ACTION STRATEGY

PART 1: Funding Sources	FY2017	FY2018	FY2019	FY2020	FY2021	Totals
US EPA						
FY2016 Section 319 Funds (FA)	$56,940.00	$58,940.00	$60,947.00			$176,827.00
Other Federal Funds						
1) NRCS	$ 8,000.00	$ 8,000.00	$ 8,000.00			$ 24,000.00
2) USFW&S (TA & FA)	$ 2,000.00	$ 2,000.00	$ 2,000.00			$ 6,000.00
3) ND Department of Health(TA & FA)	$ 4,000.00	$ 4,000.00	$ 4,000.00			$ 12,000.00
Subtotals	$ 14,000.00	$ 14,000.00	$ 14,000.00			$ 42,000.00
State & Local Match						
1) Local SCDs (TA & FA)	$ 750.00	$ 750.00	$ 750.00			$ 2,250.00
2) Landowners (FA)	$ 2,000.00	$ 1,200.00	$ 3,000.00			$ 6,200.00
3) ND Game & Fish (TA)	$200.00	$200.00	$200.00			$ 600.00
4) City of Powers Lake	$ 48,794.00	$ 49,594.00	$ 49,654.00			$ 148,042.00
5) Powers Lake Park District	$ 1,000.00	$ 1,000.00	$ 1,000.00			$ 3,000.00
Subtotals	$ 52,744.00	$ 52,744.00	$ 54,604.00			$160,092.00
TOTAL BUDGET	$ 109,684.00	$111,684.00	$115,551.00			$336,919.00

FA: Financial Assistance
TA: Technical Assistance

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

PART 2: Section 319/Non-federal Budget	FY2017	FY2018	FY2019	FY2020	FY2021	Total Costs	Cash Match	In-kind Match	319 Funds
Personnel/Support									
1) Salary/Fringe	$40,000.00	$40,000.00	$40,000.00			$120,000.00	$35,000.00		$85,000.00
2) Office Rent/Utilities	$6,000.00	$6,000.00	$6,000.00			$18,000.00	$7,200.00		$10,800.00
3) Travel	$800.00	$800.00	$800.00			$2,400.00		$1,200.00	$1,200.00
4) Equipment/Supplies	$200.00	$200.00	$200.00			$600.00	$240.00		$360.00
5) Training	$200.00	$200.00	$200.00			$600.00	$240.00		$360.00
6) Telephone/postage	$800.00	$800.00	$800.00			$2,400.00	$960.00		$1,440.00
Subtotals	$48,000.00	$48,000.00	$48,000.00			$144,000.00	$43,640.00	$1,200.00	$99,160.00
Objective 1: Additional BMP's in Watershed									
Task 1: Project Mngr. (see above)									
Task 2: Nutrient mngmt plans w/ BMPs(250 ac.)	$0.00	$2,000.00	$2,000.00			$4,000.00	$1,600.00		$2,400.00
Task 3: Range mngmt plans (100 ac.)	$0.00	$0.00	$3,000.00			$3,000.00	$1,200.00		$1,800.00
Subtotal	$0.00	$2,000.00	$5,000.00			$7,000.00	$2,800.00		$4,200.00
Objective 2: Disposal Site									
Task 4: Land Lease (80 ac.)	$2,000.00	$2,000.00	$2,000.00			$6,000.00	$0.00	$2,000.00	$4,000.00
Task 5: Site Work	$3,000.00	$3,000.00	$3,000.00			$9,000.00	$0.00		$9,000.00
Task 6: Sediment Removal costs (75,000 yd^3)	$51,104.00	$51,104.00	$51,971.00			$154,179.00	$0.00	$94,812.00	$59,367.00
Subtotal	$56,104.00	$56,104.00	$56,971.00			$169,179.00	$0.00	$96,812.00	$72,367.00
Objective 3: Information/Education									
Task 7: Lake Restoration updates (3 events)	$250.00	$250.00	$250.00			$750.00	$300.00		$450.00
Task 8: Conservation education (50 people)	$250.00	$250.00	$250.00			$750.00	$300.00		$450.00
Task 9: Conservation ed. in school (5 events)	$100.00	$100.00	$100.00			$ 300.00	$100.00		$200.00
Subtotal	$600.00	$600.00	$600.00			$1,800.00	$700.00		$1,100.00
Administrative – City of Powers Lake									
(City Auditor $50/mth X 12mths)	$600.00	$600.00	$600.00			$1,800.00		$2,650.00	
(City Council 1 hr/mth X 5 X 12mths X $25)	$1,500.00	$1,500.00	$1,500.00			$4,500.00		$6,625.00	
(Watershed Advisory Council 2hr/mth x 6 x 12 mth x $20)	$2,880.00	$2,880.00	$2,880.00			$8,640.00		$8,640.00	
Subtotal	$4,980.00	$4,980.00	$4,980.00			$14,940.00	$0.00	$14,940.00	$0.00
TOTAL 319/NON-FEDERAL BUDGET	$109,684.00	$111,684.00	$115,551.00			$336,919.00	$47,140.00	$112,952.00	$176,827.00

APPENDIX # 8

Potential Dredging Area Locations


Powers Lake, ND 58773
Proposed Dredge Area
Disposal/Dewatering Site
© 2015 Google
Google earth
1995
Imagery Date: 8/19/2013 48°31'50.44" N 102°37'19.29" W elev 2277 ft eye alt 32882 ft