BIG BUTTERNUT LAKE
WISCONSIN LAKE PLANNING GRANT
LPL-699
FINAL REPORT

Prepared for:

Big Butternut Lake Protection
& Rehabilitation District
Luck, WI 54853

April 2002

Prepared by:

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Project #: 2766-005-500

EXECUTIVE SUMMARY

On April 4, 2000, the Big Butternut Lake Protection and Rehabilitation District (BBLPRD) was awarded a Wisconsin Department of Natural Resources (WDNR) Lake Planning Grant for the Big Butternut Wet Detention Pond Feasibility Study. This study focused on a preliminary assessment of the project location to design the proposed wet detention pond. The second phase consists of purchasing the property and the construction the proposed wet detention pond.

The proposed pond location is on two parcels of property containing approximately 7.95-acres. The first parcel, fronting the lake, is owned by Dean Dversdall, 255th Avenue, Luck, WI 54853 and contains 4.00-acres. The second parcel is owned by Mark and Kathy Babcock, 2561-71A 140th Street, Luck, WI 54853 and contains approximately 3.62-acres, lying directly north of the Dversdall property.

Soil conditions are characterized as poorly drained soils with slow moving water and run-off from a watershed of approximately 1190-acres located north of the subject site location. Both properties are characterized as being low-level wetlands and is undeveloped and is surrounded by land forms of higher elevations suitable for residential development.

Review of the *1999 LPL-452 Big Butternut Lake Final Report* conclusions contain water quality trends, indicated by total phosphorus, chlorophyll-a, and Secchi disc transparency, that indicate the lake to be eutrophic to hypereutrophic. The *2000 Annual Report* for the Self-Help Lake Monitoring program's summary report from 1996-2000 shows the lake to be consistently eutrophic each year.

Craig Roesler, WDNR, collected surface water samples from an unnamed tributary that flows through the proposed wet detention pond and into the mouth of Big Butternut Lake. Tributary total phosphorus concentration increased from 36 μg/L in April 2000 to 157μg/L in June 2000. This pattern of increasing total phosphorus and dissolved phosphorus concentrations are found to be parallel with the *1999 LPL-452 Big Butternut Lake Final Report.*

A monitoring well (MW-1) was placed on site for groundwater to be sampled and tested. Groundwater and storm water monitoring was conducted over the summer of 2000 through the self-help efforts of Ben Kustelski, BBLPRD member. Storm water outfall monitoring on June 21, 2000, indicates location #8 discharged 63 μg/L TP and location #9 discharged 88 μg/L TP. Groundwater monitoring at MW-1 on June 21, 2002, resulted in 6810 μg/L TP. On July 26, 2000, sampling showed the storm water out fall location #8 discharged 80 μg/L TP and location #9 discharged 101 μg/L TP, and the groundwater sample at BL-1 on July 26, 2000, resulted in 6680 μg/L TP. These data show that the storm water is discharging high nutrients to the wetland, the unnamed creek is also discharging higher nutrients due to storm water runoff accumulations and from the (gaining stream or) regional perched groundwater flow, and the wetland is accumulating increased phosphorus concentrations. As this wetland reaches it's seasonal saturation state, more phosphorus is then exported into the waters of Big Butternut Lake.

The construction of a wet water quality pretreatment system (detention pond), aquatic and prairie plantings, and maintenance of the constructed wetland are recommended due to the 97% TSS and 69% TP P8 Urban Catchment predicted removal efficiency. The plantings will be placed throughout the site to decrease sediment and pollutants from reaching Big Butternut Lake.

I. INTRODUCTION

Cedar Corporation, on behalf of the Big Butternut Lake Protection and Rehabilitation District (BBLPRD) has completed the Big Butternut Wet Detention Pond Feasibility Study. The proposed project consists of two parcels both located at Section 27, Township 36 North, Range 17 West in Polk County, Wisconsin (Figure 1). This report has been prepared to present those activities, proceedings, designs, conclusions, and recommendations for mitigation of the phosphorus problem.

In a 1996 study using storm water run-off data, a phosphorus budget was calculated for Big Butternut Lake. The calculations show that the sub-watershed contributes 71% phosphorus to the lake (Barr 1997). The *1999 LPL-452 Big Butternut Lake Final Report* and *2000 Annual Report* for the Self-Help Lake Monitoring Program suggests that the Big Butternut Lake average summer water transparency is within the hypereutrophic (very poor water quality) to eutrophic (poor water quality) category.

On April 4, 2000, BBLPRD was awarded a Wisconsin Department of Natural Resources (WDNR) Lake Planning Grant for the Big Butternut Wet Detention Pond Feasibility Study to improve the phosphorus loading to the lake. The objective of this study was focused on a preliminary assessment of the project location to design the proposed wet detention pond. The following activities were completed during the study:

- Review historical information regarding the site and surrounding properties within the watershed,
- Monitor the groundwater, surface water, and storm water discharging to project location through 2000 for phosphorus and other nutrients,
- Delineate the wetland boundary on the project location;
- Evaluate site plans for compliance with treatment objective, expressed in terms of removal efficiency for total suspended solids (TSS) and pollutants, through water quality modeling, and
- Design plans for construction of a wet detention pond that would decrease sediment and pollutants from reaching Big Butternut Lake.

II. SITE DESCRIPTION

A. Location and Land Use

The project area is located east of Luck approximately ½ mile south of Hwy 48, off of 140th Street (Figure 1). The property is approximately 7.95-acres and consists of a creek, shallow marsh, alder thicket, lowland woods, and upland hardwoods. Adjacent properties consist of shallow marsh, alder thickets, lowland and upland hardwoods, and residential properties. A copy of the existing landuse map is included as Figure 2.

Site/Owner(s):	Mr. Mark and Mrs. Kathy Babcock 2561-71A 140th Street Luck, WI 54853 Part of Government Lot 2, Section 27, Township 36 North, Range 17 West, Village of Luck, Polk County, Wisconsin
Site/Owner(s):	Mr. Dean Dversdall 255th Avenue Luck, WI 54853 Part of Government Lot 2, Section 27, Township 36 North, Range 17 West, Village of Luck, Polk County, Wisconsin
Lake Protection District:	Marty Messar, President Big Butternut Lake Protection and Rehabilitation District 428 7th Street Luck, WI 54853 715-472-8216
Consultant:	Cedar Corporation 604 Wilson Avenue Menomonie, WI 54751 Phone: 800-472-7372 Fax: 715-235-2727 Contact: Russ Kiviniemi

B. Topography

Topographic information is referenced from the US Geological Survey (USGS), Luck, WI Quadrangle Map (7.5-minute series), 1983. Ground surface elevation at the site is mapped at 1,213-feet mean sea level (MSL), the unnamed tributary surface water elevation is at 1,211.7-feet MSL, and the Big Butternut Lake water elevation is at 1,211.5-feet MSL. The local topography in the area is relatively flat.

C. Surface Water and Drainage

Surface hydrology is influenced by the local topography of the glacial moraine. The Big Butternut Lake is a drainage lake. The lake has both an inlet and outlet and the main source of water comes from surface water.

III. PROJECT SCOPE: LAKE IMPROVEMENT

Big Butternut in Polk County, Wisconsin, is located in the part of the state geographically described as the Trade River Watershed of the Saint Croix River Basin. The Trade River Watershed consists of a large portion of both Polk and Burnett Counties and drains to the Saint Croix River via the Trade River. According to the 1994 Water Quality Management Plan by the WDNR, the Saint Croix Basin is a medium-priority watershed, while Big Butternut Lake remains a high priority within the watershed for planning grants, water quality monitoring, and implementation of previous studies. In conjunction, three additional planning studies have been conducted for the Big Butternut Lake and it's watershed in 1983, 1996, and 1999. The results of these studies confirm the recommendations represented in the 1994 Water Quality Management Plan and include:

- Assistance in funding to implement recommendations from the 1983 feasibility study (recommendation #2 within the 1994 Water Quality Management Plan)
- Diversion of run-off to a storage pond from creek on the Northeast end of Big Butternut Lake and storm water run-off mitigation along the north side of the Lake (recommendation #1 in the 1983 National Biocentric Study)
- Construction of storm water pretreatment ponds to reduce phosphorus loading from the BL-05 watershed and the installation of filtering chambers within the existing storm sewer pipe system along the North side of the Big Butternut Lake and within the Village of Luck (recommendations within the 1999 BARR Engineering Lake Planning Report)

The scope of this report is to present additional water quality information and to define the proposed area for construction. Design plans for construction of a wet detention pond are also presented within this document and represent that the implementation would decrease sediment and pollutants from reaching Big Butternut Lake.

IV. RESULTS OF EVALUATIONS

A. Water Quality Monitoring

The quality of water that we drink as well as the water is our lakes are important factors in determining the overall quality of our lives. Water quality is determined by compounds referred to as solutes that are dissolved in water, as well as the matter suspended in and floating on the water. An evaluation of the surface water, groundwater, and storm water run-off near the project location will give us the present water quality characteristics. Since water quality has been primarily tested in the surface water of Big Butternut Lake and incoming tributary watersheds in past studies, the new groundwater and storm water data are important to see if any trends or changes appear.

In order to test the groundwater at or near the proposed wet detention pond location, permission for access to an area of land in that general location has to be made. On April 14, 2000, an access agreement between BBLPRD and Craig & Mary Nelson was made (Appendix A). The Nelson's granted the District permission to install, operate, maintain, and abandon one monitoring well (MW-1).

Following this agreement, a monitoring well was installed. Ryan Yarrington, a Hydrogeologist from Cedar Corporation, supervised Boart Longyear Contracting Services Group in the construction and installation of the well. The well was drilled to 13.5-feet and screened up to 3.5-feet below surface. Depth to water from top of well casing was 1.82-feet. Soil boring, well construction, and well development reports are located in Appendix B.

Throughout the 2000 sampling year, Craig Roesler, WDNR and Ben Kustelski, District Self-Help volunteer collected water samples at various locations. Craig Roesler primarily sampled different surface water locations along the unnamed creek that flows into Big Butternut Lake (Figure 9). Ben Kustelski sampled the ground water from MW-1 and storm water run-off from the outfalls near the project location. The following data is reported for this period. Analytical reports are included in Appendix C.

Table 1
Surface Water Quality: Unnamed Creek

Date	Surface Water Site Location	Flow cfs	Total Phosphorus µg/L	Dissolved Phosphorus µg/L	Suspended Solids mg/L
4/17/00	F-6	--	49	16	17
	E-5	--	34	12	<5
	D-4	--	39	15	<5
	C-3	--	37	10	5
	B-2	--	36	12	<5
	A-1	3.2	36	12	<5
5/11/00	A-1	--	61	12	--
5/31/00	A-1	0.5	119	--	--
6/1/00	A-1	1	157	57	--

Table 2
Storm Water Quality: Outfalls #8 & #9

Date	Out Fall Location	Ammonia µg/L	Nitrate + Nitrite µg/L	Total Kjeldahl Nitrogen µg/L	Total Phosphorus µg/L	Dissolved Phosphorus µg/L	Suspended Solids mg/L	Temp Degree C
6/21/00	8	ND	ND	1330	63	22	<5	15
7/26/00	8	17	ND	1250	80	32	<5	21
6/21/00	9	283	115	880	88	23	36	15
7/26/00	9	488	327	730	101	61	22	21

Note: ND and <5 = no detect

Table 3
Groundwater Quality: MW-1

Date	Ground Water Location	Ammonia µg/L	Nitrate + Nitrite µg/L	Total Kjeldahl Nitrogen µg/L	Total Phosphorus µg/L	Dissolved Phosphorus µg/L	Suspended Solids mg/L	Temp Degree C
6/21/00	MW-1	1130	6.3	25300	6810	5	--	15
7/26/00	MW-1	1190	38	22100	6680	7	--	21

Tributary total phosphorus (TP) concentration ranged from 36 µg/L to 157µg/L in the summer of 2000; dissolved phosphorus (DP) concentrations ranged from 12µg/L to 57µg/L. Total and dissolved phosphorus concentrations appeared to be higher upstream locations during the April sampling event.

Storm water outfall monitoring at locations #8 and #9 had both increased in TP and DP concentrations. Total Kjeldahl Nitrogen (TKN) decreased over one month's time in both locations, where the ammonia (NH4-N) and Nitrate + Nitrate (NO2+NO3) concentration reflected an increased in concentration. Suspended Solids (TSS) were not detected in locations #8, but were present in location #9 and decreased from 36 µg/L TSS to 22 µg/L TP.

Groundwater monitoring at well (MW-1) was sampled over two month's time showed a decrease from 6810 µg/L TP to 6680 µg/L TP; TKN also showed a decrease. However, concentrations in NH4-N, NO2+NO3, and DP increased between sampling events. Suspended solids were not detected in the groundwater.

These data show that the storm water is discharging high nutrients to the wetland, the unnamed creek is also discharging higher nutrients due to storm water runoff accumulations and from the (gaining stream or) regional perched groundwater flow, and the wetland is accumulating increased phosphorus concentrations. As this wetland reaches it's seasonal saturation state, more phosphorus is then exported into the waters of Big Butternut Lake.

Wetlands, by definition, are characterized by water saturation in the root zone at or above the soil surface, for a certain amount of time during the year. Wetlands located along rivers have a high capacity for phosphorus adsorption as clay is deposited as alluvium in the floodplain. These clays incorporate aluminum (Al) and iron (Fe) in the clay mineralogy and these elements absorb other nutrients, metals, and pollutants. Combine the wetland with the discharging creek data, one will realize that the area has perched groundwater flow, which is contributing higher TKN and TP concentrations to the lake. The proposed ponds will capture the base flow and filter out the contaminants.

Collected data shows that the groundwater has considerably higher TKN and TP concentrations that reflects that nutrients are accumulating in the wetland from storm water run-off and the discharging creek. This pattern of increasing total phosphorus and dissolved phosphorus concentrations is found to be parallel with the *1999 LPL-452 Big Butternut Lake Final Report.* As this wetland reaches it's seasonal saturation state, more phosphorus and other nutrients are then discharged and end up in the surface water of Big Butternut Lake.

B. Wetland Delineation

1. Purpose

The purpose of this evaluation is to document historic data and on site soil, vegetation, and hydrology conditions and use this information to determine the presence of and delineate the extent of the wetland boundary on the subject properties. Areas classified as wetlands must meet the technical definitions of soils, vegetation, and hydrology as identified in the 1987 Corps of Engineers Wetland Delineation Manual (CEWDM).

2. Method

Mark Iverson, a Soil Scientist from Cedar Corporation, performed the wetland delineation at the project location. Prior to completing the on-site investigation, information was collected off-site through interviews and review of documents and maps.

a. Off-Site Information Sources

The 1983 USGS Topographic Map (Figure 1) was reviewed to determine the land elevations within the project area, as well as surface water locations and drainage patterns. The unnamed creek, an intermittent stream, is located in the middle of the site. The project area is at an elevation of approximately 1,213-feet mean sea level (MSL). Slopes across the project site is approximately 0 to 2 percent. The typical pedon for the area along the creek is the Cathro soil series (Cathro muck), which is a soil listed in the 1987 Corps of Engineers Wetlands Delineation Manual, Hydric Soils List.

b. On-Site Assessment Criteria

The on-site assessment was completed following the "1987 Corps of Engineers Wetland Delineation Manual" (1987, CEWDM). Areas classified as wetlands must meet the technical definitions of soils, vegetation, and hydrology as indicated in this manual. The criteria defining a wetland are:

i. Hydric Soils

Hydric soils are defined in the 1987 CEWDM as "soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation."

ii. Hydrophytic Vegetation

Hydrophytic vegetation is defined in the 1987 CEWDM as "the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produces permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present." Wetland areas are dominated by hydrophytic vegetation, that is more than 50% of the dominant species are obligate (obl), facultative wet (facw), or facultative (fac). Plant indicator categories are identified and defined in Table 1 below.

Table 4
Plant Indicator Status Categories

Indicator Category	Indicator Symbol	Definition
Obligate Wetland Plants	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in nonwetlands. Examples: *Spartina alterniflora, Taxodium distichum.*
Facultative Wetland Plants	FACW	Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33% in nonwetlands). Examples: *Fraxinus pennsylvanica, Cornus stolonifera.*
Facultative Plants	FAC	Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and nonwetlands. Examples: *Gleditsia triacanthos, Smilax rotundifolia.*
Facultative Upland Plants	FACU	Plants that occur sometimes (estimated probability 1% to 33%) in wetlands, but occur more often (estimated probability >67% to 99%) in nonwetlands. Examples: *Quercus rubra, Potentilla arguta.*
Obligate Upland Plants	UPL	Plants that occur rarely (estimated probability <1%) in wetlands, but occur almost always (estimated probability >99%) in nonwetlands under natural conditions. Examples: *Pinus echinata, Bromus mollis.*

iii. Wetland Hydrology

Wetland hydrology is defined in the 1987 CEWDM as "the sum total of wetland characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation." In order for wetland hydrology to be present the area must be inundated or saturated to the surface for at least 5% of the growing season (consecutive days) in more than half (>50%) of the past years.

The average growing season for Polk County is 127 days, from May 15 to September 19 (Appendix E). Five percent of 127 equals 6.35, therefore areas inundated or saturated for six or more consecutive days during the growing season for greater than 50% of the years on average would meet the hydrological definition of a wetland in this area.

c. On-Site Delineation Procedure

An initial walkover of the site was completed to identify potential transect locations that were representative of the majority of the area. Five transects were identified as being representative locations where the soils, vegetation, and hydrology would reflect the characteristics of the landform. Transects are identified as T-1, T-2, T-3, T-4, and T-5 on the routine wetland determination data forms and their locations are identified on Figure 3. Transects 4 and 5 are not identified on Figure 3 because property access was restricted by the landowner and the wetland vegetation was too thick to survey the locations.

Following the assessment of the conditions along each transect, the wetland boundary was marked with a four-foot lath and orange tape to delineate the wetland areas. The lath and tape were placed at the wetland boundary and labeled (Figure 2).

A series of two to five soil borings were completed at each lath location, perpendicular to the wetland boundary. The soils were observed at each of these locations to determine if the point was inside or outside of the boundary and if the soils were similar to those documented at the transects. Once a point inside and a point outside of the boundary were observed (within 10 feet of each other), a lath was placed to identify the delineated wetland boundary. The boundary and lath locations are shown on Figure 3.

3. Discussion of Results

a. Off-Site Delineation

The 1983 USGS Topographic Map is shown as Figure 1. This map shows the creek as an intermittent stream running through the middle of the project site. The map identifies the property to contain nearly level to gently sloping land.

The 1979 Polk County Soil Survey Map is shown as Figure 4. The soil survey map indicates that two primary soil types were present within the project area. Soil descriptions from the Polk County Soil Survey are included as Appendix E. Table 5 summarizes the soils and their properties.

Table 5
Soil Properties

Symbol	Series Name	Subgroup Name	Soil Type Confirmed within the Delineation Area	Hydric Soil*
AoC	Amery complex	Typic Glossoboralfs	No	No
Cc	Cathro muck	Terric Borosaprists	Yes	Yes*

* - Soils listed in the 1987 Corps of Engineers Wetlands Delineation Manual, Hydric Soils List.

b. On-Site Delineation

The on-site delineation of the project location began on May 25, 2000 and was completed on June 15, 2000. During the delineation, vegetation was thick and lush. Five transects were completed. The area was saturated at the time of delineation so the hydrology was determined using "Wetland Hydrology Indicators" shown on the data forms in Appendix A.

4. Wetland Conclusions

The wetlands within the project area have been delineated. The wetland was delineated using soil and hydrology criteria identified during completion of transects. This delineation has been completed using prescribed methods and meets the standards for current wetland evaluation at the time this study was completed. Any construction or development of the property in the wetland area will require regulatory approvals and permits (WDNR and US Army Corps of Engineers). During the permit approval process the regulatory agencies may disagree with the wetland boundary described in this report.

C. Water Quality Modeling

All activities relating to the control and management of rainfall runoff including subsurface groundwater and surface water drainage, flood control and water quality refers to storm water management. This management is more than a local issue; it is a regional issue that requires the consolidation and coordination of many independent efforts into a system that recognizes the nature of storm water, floodwater runoff, groundwater, and water quality pollutant loads.

The primary goal of the Big Butternut Lake Protection and Rehabilitation District (BBLPRD) is to first gather information necessary to identify potential water quality problems within a watershed and define their sources. Other phases that have been defined, including a comprehensive water quality study of Big Butternut Lake and its watersheds and lake response modeling. The implementation of the 2-celled wet water quality treatment ponds will collectively protect the watershed from impacts of future development (i.e., land use, site planning, riparian management, and storm water practices).

Our goal in this section is to evaluate site plans for water quality treatment objective through water quality modeling analysis. The P8 Urban Catchment Model will be used to determine what impacts or improvements the implementation of the 2-celled wet water quality treatment ponds will have on Big Butternut.

Wet water quality basins (or detention ponds) are the most effective and most commonly used best management practices for flood control, sedimentation control, and control of numerous pollutants found in storm water runoff. They are reliable and attractive systems that help and control storm water quality and quantity, and are the most cost effective systems to operate and maintain. These systems consist of a single or multiple permanent pools of water or a combination of a single permanent pool of water with a pretreatment sedimentation area that treats incoming storm water and discharges improved storm water quality to sensitive receiving water bodies and groundwater recharge areas. Wet detention basins are typically engineered with four to eight feet of standing water, allowing sediments and pollutants to settle out, with a defined sedimentation basin forebay, and outlet control structure.

Many studies have shown that wet detention basins consistently remove sediments and pollutants that attach to sediments. Removal rates can vary from 50 to 90 percent, depending on particle sizes and on the design size and shape of the system. Wet detention basins can also control pollutants such as heavy metals, phosphorus, and bacteria, but at lower removal rates than sediments. Pollution control rates can also vary depending on the construction system.

The change from existing to future land use is expressed as a decrease in run-off characteristics considering the effects of the recommended storm water best management practices. Significant pollutant loadings are apparent because of the increased high-density, residential, commercial, and increased presence of motor vehicles. The increase of pollutant loadings will be greatly reduced by the installation of structural controls and enforcement of non-structural controls. The affect of implementation of the recommendation storm water management practices is quite apparent. A detention (BMP) basin would store the pollutants, so the wetland and lake does not get filled in with sediment and that their habitat does not get altered from excess nutrients or pollutants.

We recommend a 10-15 year sediment clean-out cycle for wet detention basins. This schedule may need to be revised based on special site design and field observations. Extra storage in the lower stage can be provided to accommodate additional sediment deposition. To reduce removal costs, we recommend provisions be made for on-site disposal or the BBLPRD should plan for use of the accumulated sediment at some future date.

1. General Background

P8 Urban Catchment Model (Version 2.4) is the chosen method for predicting current and future water quality and quantity. This program is primarily used for "predicting polluting particle passage thru pits, puddles, and ponds." This program was derived form other urban runoff models, like SWMM, STORM, HSPF, D3RM, and TR-20.

While the program may serve a useful purpose in planning or design, it is intended primarily for use for evaluating runoff treatment systems (BMPs) for existing and/or proposed urban developments with minimal site-specific data. This model also predicts the generation and transport for storm water runoff pollutants in small urban catchments, much like Big Butternut. Continuous water-balance and mass-balance calculations on a user-defined system consisting up to:

- 192 watersheds,
- 48 treatment devices (BMPs),
- 5 soil particle classes; and
- 10 water quality components

Simulations are driven by hourly rainfall and daily air temperature time series. Since this frequent of data was not collected in Big Butternut Lake area, other known data was used. The model will be simulating rainfall and precipitation data collected from the Minneapolis/ St. Paul Airport. Also, the model was initially calibrated with certain water quality parameters under the EPA's Nationwide Urban Runoff Program (NURP, Athayede et al., 1983).

Primary uses of the program:

1. Evaluating site plans for compliance with treatment objective, expressed in terms of removal efficiency for total suspended solids (TSS) or a single particle class.
   An 85% TSS removal in "Sensitive Areas" is achievable (DNR proposed TMDL regulation).
2. In a design mode, selecting and sizing BMPs to achieve treatment objective. This program will automatically size BMPs to match user-defined watersheds, storm time series, target particle class, and target removal efficiency.

These two applications are insensitive to errors associated with predicting untreated runoff water quality and are therefore more accurate than predictions of concentrations or loads.

Secondary uses of the program ("Absolute Predictions"):

1. Predicting runoff water quality, loads, and violation frequencies.
2. Predicting water quality impacts due to proposed development.
   Upstream vs. downstream changes
   Existing vs. future changes
3. Calculating loads for driving receiving water quality models.
4. Watershed scale land-use planning.

These four types of applications are subject to greater error because of the high degree of variability (i.e., storm-to-storm and site-to-site) associated with urban runoff quality, as documented under the EPA's Nationwide Urban Runoff Program (NURP) (Athayde et al., 1983).

2. Water Quality Pollutant Loading Analysis

Water Quality Pollutant Loading Analysis Summary Tables 6 & 7 present loading per acre and annual pollutant loadings per acre for total suspended solids (sediment, TSS), dissolved solids, total phosphorus (TP), dissolved phosphorus, copper (Cu), lead (Pb), and zinc (Zn). The storm events used in this section of the report include a 1-year storm rainfall (Tables 6 & 7). Pollutant loads were determined using the EPA's Nationwide Urban Runoff Program (NURP) data and simulated rainfall and precipitation data collected from the Minneapolis/ St. Paul Airport.

Table 6: Proposed Catchment for PRIMARY CELL
Loading onto 2.39 +/- acres after 1 year storm

Pollutant	Annual Loading (lbs/year)	Annual Loading (lbs/acre/year)	Removal Efficiency (%)
Total Suspended Solids	15,128	6330	93
Total Phosphorus	48	20	65
Total Kjeldahl Nitrogen	218	91	56
Copper	5	2	56
Lead	3	1	85
Zinc	23	10	56

Table 7: Proposed Catchment for SECONDARY CELL
Loading onto 1.24 +/- acres after 1 year storm

Pollutant	Annual Loading (lbs/year)	Annual Loading (lbs/acre/year)	Removal Efficiency (%)
Total Suspended Solids	958	772	68
Total Phosphorus	17	14	13
Total Kjeldahl Nitrogen	95	77	9
Copper	2	2	9
Lead	0	0	26
Zinc	10	8	9

Pollutant loading data is provided above for the proposed 2-cell wet water quality treatment land use conditions (Attachment F). Tables 6 illustrates that the primary cell is removing a range from 56-93 % of the pollutants coming into the 2.39-acre pond. Looking more closely at TSS and TP removal, the primary cell is removing 14,170 lbs TSS and 31 lbs TP. The 93 % TSS removal efficiency is significantly better than any future proposed 85 %Total Maximum Daily Load (TMDL) pollutant removal. Table 7 indicates that the secondary cell is removing a range from 9-68% of the remaining pollutants coming from the primary cell and flowing into the 1.24-acre pond. Looking more closely at TSS and TP removal, the secondary cell is removing 653.24 lbs TSS and 2.21 lbs TP. These tables also indicate decreases in pollutant loadings of zinc, copper, and lead.

D. Proposed Design-A Multiple Wet Water Quality Pretreatment Pond System Construction Design

Figures 5-8 show the proposed multiple wet water quality treatment system design.

The water quality pretreatment facility will effectively reduce sediments, phosphorus, and other pollutants entering Big Butternut Lake from the BL-05 watershed, which consists of approximately 1,190-acres. The 1999 Barr Report indicated that this watershed contributed approximately 37% of the non-point source phosphorus loading to Big Butternut Lake, the equivalent of just over 400 pounds of phosphorus each year. The construction of a multiple pond system may treat as much as 60% to 80% of the total phosphorus from this watershed, creating a reduction of up to 30% of the lake's non-point source phosphorus loading or the equivalent of 327 pounds. In addition, the expected reduction of suspended solids is estimate at 70% to 90% for the watershed.

1. Design

The subject site consists of approximately 8-acres of wetland and upland area with the proposed multiple pond system using approximately 5-acres. The multiple pond system will incorporate two treatment cells:

- A 6-foot to 8-foot deep wet fore bay for primary sediment and pollutant settling and storage,
- A secondary 3-foot to 4-foot deep wet water quality basin to promote enhanced capture and storage of sediments and particulate phosphorus; and
- An existing and constructed 1-foot deep wetland to provide conversion of dissolved phosphorus to particulate phosphorus, chemical precipitation, soluble phosphorus plant absorption, and biological uptake to achieve the pollutant reduction goals.

Buffer zones with aquatic wetland plantings will also be located between the forebay and secondary cell as well as the outlet area to the lake to provide stabilization of the system, increase sediment capture, provide additional fish and wildlife habitat, and reduce the flow velocity of the stream. These systems are feasible when working in watersheds of greater than 10-acres with the presence of a reliable base flow and high water table, such as this site. In addition, the amount of useable space, wetland vegetation, and soil types are favorable for this type of treatment design.

During final design of the basin, additional considerations will be given to depth of groundwater, depth to bedrock, size and depth of the system, flood control design, and maintenance. The project will also act as an extended detention basin to minimize the damage caused by small storm events by providing increased storage capacity and reducing stream flow velocities and discharges. Adding vegetated buffer strips within the system design, planting prairie grasses in the upland areas, and incorporating large storm event overflow channels into the multiple pond system can achieve flow velocity reduction.

In addition to numerous water quality improvement benefits, the multiple pond system provides groundwater recharge, fish and wildlife habitat, property value appreciation, and captures debris and sediment deposits. Maintenance of the system includes the removal of sediments from the fore bay basin every 10 to 15 years. Please refer to Figures 5-8 for more detailed information regarding the design, cross-section, and specifications of multiple wet water quality detention pond system.

2. Work Tasks and Schedule

The acquisition of the property as outlined in Section 3 is still taking place. Excavation and construction of the multiple pond system will then proceed in January/February 2003 once everything is in order. The following is estimated time line for the work tasks necessary to complete the project:

- Chapter 30 Permit — August 2002
- Clear and Grub — January 2003
- Excavation and Shaping — February 2003
- Wetland Aquatic and Prairie Plantings — April 2003
- Gravel access driveway for future maintenance — May 2003

This schedule is subject to US Army Corps of Engineers and WDNR approval and permitting process and maybe subject to change. Spoil material will be removed from the site area to construct the multiple wet water quality pretreatment system will be disposed of at the Village of Luck owned disposal site or on adjacent non-wetland upland areas to the east of the site.

V. CONCLUSION

The Big Butternut Lake Protection and Rehabilitation District is committed to improving the water quality, fish and wildlife habitat, and recreational use of Big Butternut Lake. In addition to the before mentioned planning activities, the District has also been responsible for constructing handicap accessible fishing piers, aquatic weed control for the public beach, developing ordinances, maintaining public boat landings, and surveying septic systems around the lake.

The construction of a wet water quality pretreatment system is intended to capture any:

- perched groundwater baseflow pollutants,
- high nutrients discharging form storm water flow events,
- the excess nutrients and sediments form surface waters of the unnamed creek that are flowing to the wetland and the lake, and
- the higher nutrients coming from the gaining stream (or regionally perched groundwater influenced flow).

The District's progressive approach is also represented by their desire to implement recommendations from previous watershed management plans as well. The implementation of the project outlined above will make significant strides in reaching the goals of the BBLPRD by reducing the external loading of sediment by 97.5 % TSS removal efficiency (or approximately 14,823-lbs TSS overall removal and 69 % TP removal efficiency (or approximately 33-lbs TP overall removal). This will greatly reduce the amount of sediment being transported into the Lake, and by increasing the public awareness of this valuable resource.

Once the project has been completed, additional grant funding will be necessary to continue water quality monitoring to be used to verify project pollutant reductions as a tool to educate the public on the importance and effectiveness of reducing sediment transfer and phosphorus loading within the watershed. Updates of the projects monitoring data and its impact on the watershed will be provided to the public in yearly reports made available by the District at the annual meeting. Additional information will be incorporated into the Village of Luck's Land Use Comprehensive Plan.

VI. REFERNCES

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