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Wood Pile Lake Management Plan − DRAFT

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water | ecology | community

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PROJECT BACKGROUND

The Brown's Creek Watershed District (BCWD) Board of Managers identified development of management plans for District lakes as a priority implementation activity in their 2007 Watershed Management Plan. Wood Pile Lake (DNR ID# 82-132P) is the fourth lake in the District to have a management plan developed. Wood Pile Lake and its 86-acre watershed are located in the City of Grant, Minnesota, in the central portion of the Brown's Creek Watershed District (Figure 1).

Wood Pile Lake is a shallow 13-acre lake with a largely undeveloped shoreline. The lake does not have an active lake association but residents have expressed a desire to keep the lake in its current condition and have concerns about its appropriate management.

Regulatory Setting

Wood Pile Lake is identified as a Public Water Wetland by the Minnesota Department of Natural Resources (DNR) and as such is under the jurisdiction of the DNR. Public waters are all water basins and watercourses that meet the criteria set forth in Minnesota Statutes. The DNR regulates activities below the Ordinary High Water (see water level section for further information). Typical activities regulated by the DNR include modification to control structures, beach improvements and aquatic vegetation management.

The Brown's Creek Watershed District has the authority to protect and enhance water quality for lakes within its jurisdiction. The BCWD developed watershed Rules, which protect resources from negative impacts associated with land development activities. The rules primarily address the effect changes in land use have on stormwater runoff quality. The District also pursues ways in which to enhance its resources through active management. Development of this plan is the first step towards managing the quality and character of Wood Pile Lake.

The City of Grant has a role in managing the lake through its zoning ordinances, specifically its shoreland ordinance, which controls the placement of structures around the lakeshore. The City also administers the Wetland Conservation Act (WCA), which regulates the draining and filling of wetland areas.

The Washington Conservation District (WCD) conducts monitoring of lake levels and water quality on behalf of the Brown's Creek Watershed District. The WCD also collaborates with the District on water quality improvement through a stewardship assistance program.

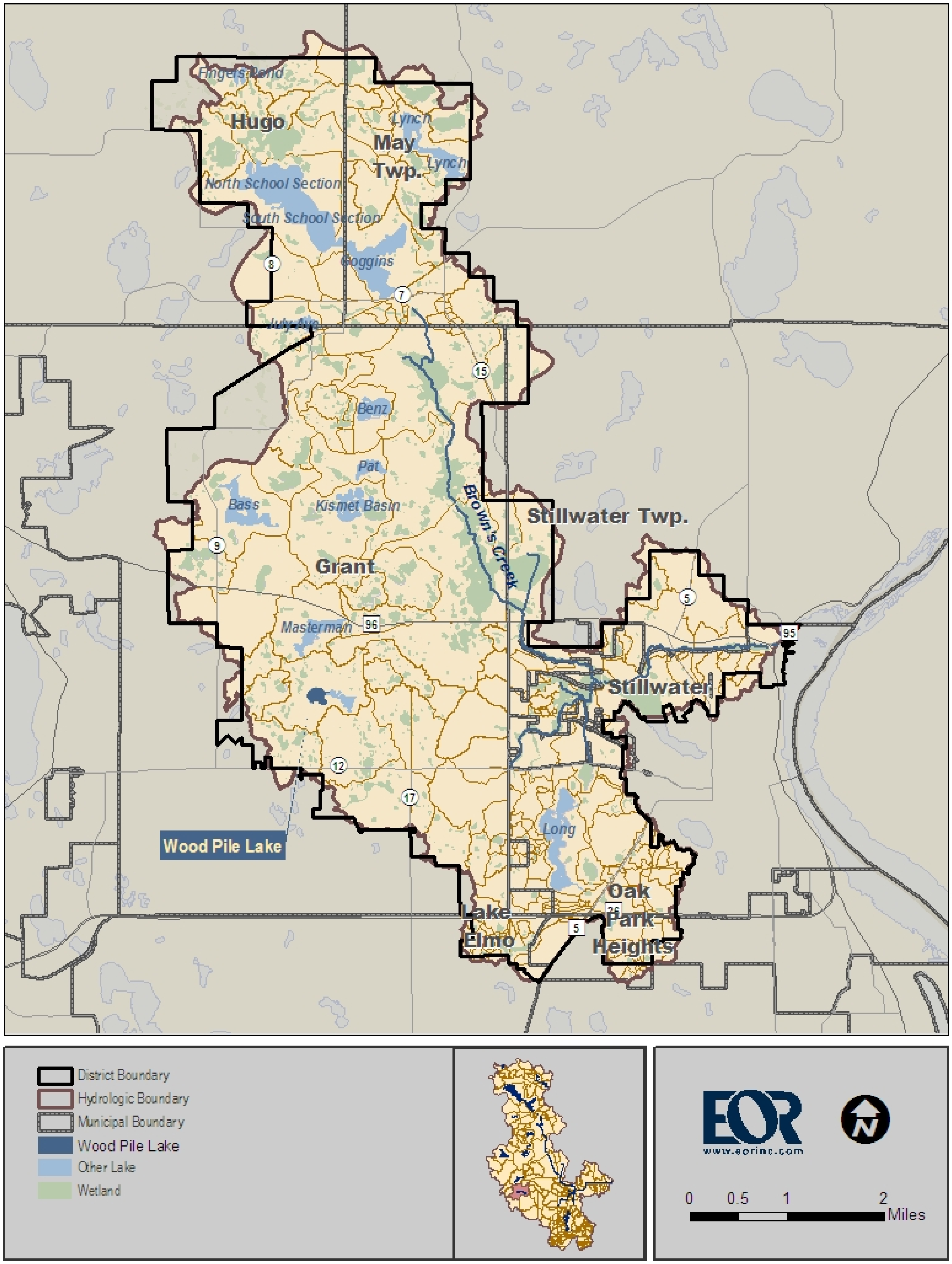

Figure 1. Wood Pile Lake location within the Brown's Creek Watershed District.

LAKE DATA ANALYSIS

The initial phase of the management planning process focused on data gathering and analysis. While some data had been previously collected for the lake, many aspects of the lake and its watershed had not been measured, quantified or analyzed.

Lake Morphometry

A bathymetric survey was conducted on Wood Pile Lake in August 2010. The elevation of the water surface was 961.9 feet; water depth as shown in the bathymetric map in Figure 2 was measured from the water surface. The lake has moderate relief around shoreline areas and a relatively deep hole in the center of the lake with a maximum depth of 24 feet.

The bathymetry data were used to derive various lake characteristics presented in Table 1. By Minnesota Pollution Control Agency (MPCA) standards, the lake is considered a shallow lake; more than 80% of the lake is less than 15 feet deep. Figure 3 represents how the lake volume changes with depth.

Table 1. Wood Pile Lake morphometry.

Lake Characteristic	Value
Surface Area	13 acres
Volume	98 acre-feet
Mean Depth	7.7 feet
Max Depth	24 feet
Shoreline	3,562 feet
Watershed Area	86 acres
Watershed Area: Surface Area	6.6

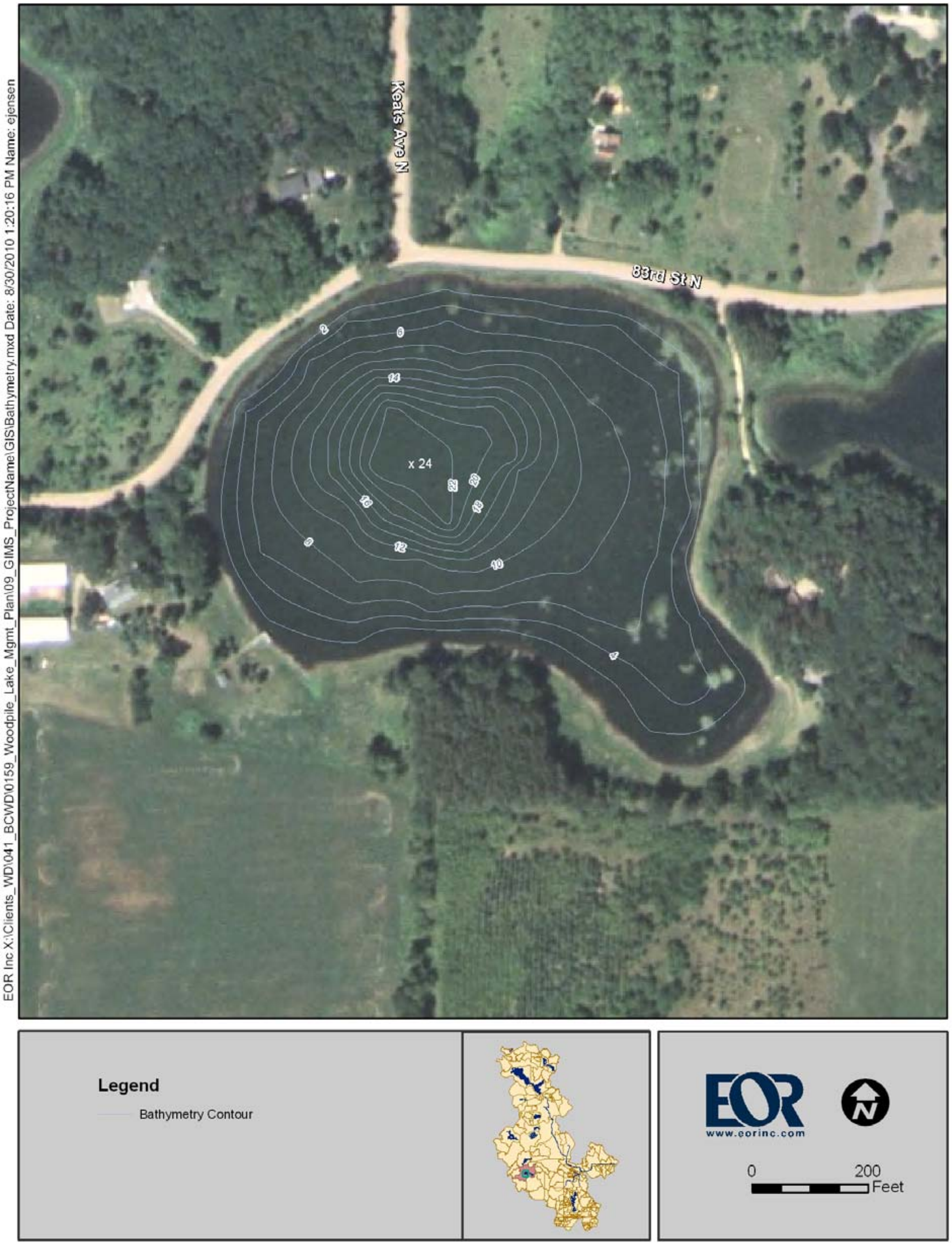

Figure 2. Wood Pile Lake water depth contour map.

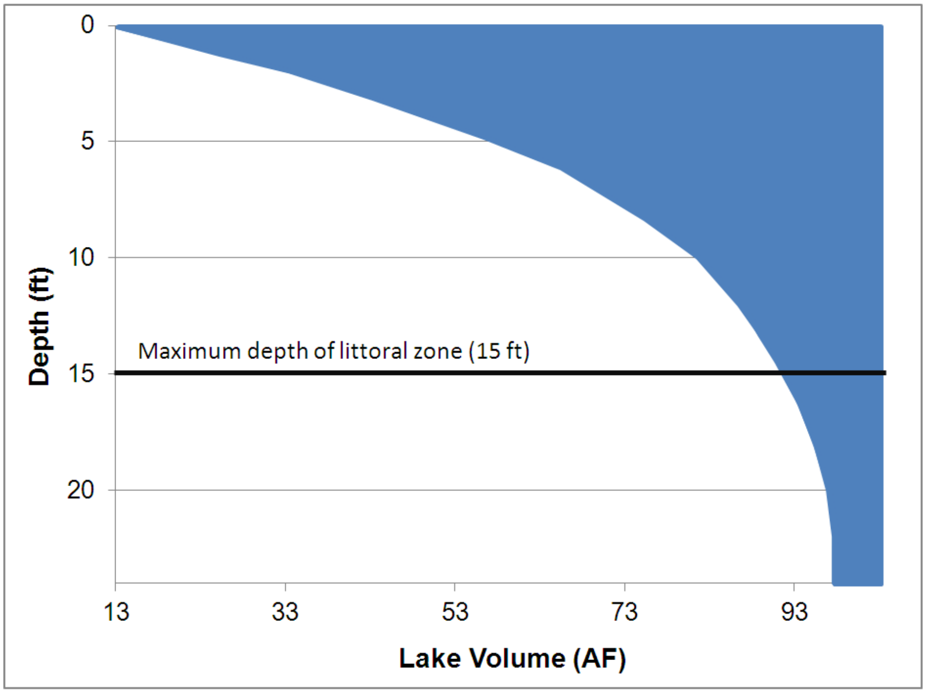

Figure 3. Lake volume by depth.

Water Levels & Connectivity

Water levels in Wood Pile Lake have been recorded since 1996 as shown in Figure 4 and summarized in

Table 2. Water levels have dropped approximately 8 feet since recording first began, which is consistent with trends seen in other nearby lakes and was a result of changing climatic conditions. Most recent recorded lake levels were approximately 962 feet and declining. According to the DNR, the ordinary high water level (OHW) of Wood Pile Lake is 962.5 (as of April 2011) and the highest recorded elevation is 969.9 (recorded in 1996) (

Table 2). Lake residents observed that water levels were higher between 1965 into the 1980's than in 2011.

Wood Pile Lake and its drainage area is part of a larger 361-acre watershed (WKL-3), which has a runout elevation of 971.5 feet (Figure 5). Based on the *BCWD Landlocked Basin Policy* study conducted in 2006, WKL-3 has a peak water storage elevation of 971.0 for the 100-year, 10-day rain event, which is 0.5 feet below the runout elevation making WKL-3 landlocked. This study simulated Wood Pile Lake and adjacent ponds as one contiguous storage basin.

Based on Washington County 2-foot contours, the lowest building in WKL-3 has a low floor elevation (LFE) just below 968.0. An additional building is at 970.0, and all other buildings are at or above 972.0. It may be possible to control water levels to limit future flooding at a desired elevation through installation of a culvert at the location of the current runout. However, the downstream watershed (WKL-4) is also landlocked. Storage below LFEs in WKL-4 would have to be explored in greater detail before making a feasibility determination. This action might be considered in greater detail if future development of WKL-3 would result in a net increase in runoff. No drainage alterations are recommended at this time.

As a part of this study, a field survey was conducted and subwatershed WKL-3 was subdivided based on Washington County 2-foot contours for determination of areas contributing to Wood Pile Lake. The farthest west subbasin was determined to be landlocked for the 100-year, 24-hour storm event (under the conservative assumption of 6 inches of rainfall with no infiltration). Based on the field survey, the general drainage direction is from west to east, away from Wood Pile Lake to the WKL-3 runout location, and Wood Pile Lake would have to rise approximately 4 feet to reach the culvert between Wood Pile Lake and the eastern basins (see Figure 6). Ultimately, only a portion of WKL-3 (Subwatershed B) drains to Wood Pile Lake and was modeled for determination of phosphorus loading to the lake.

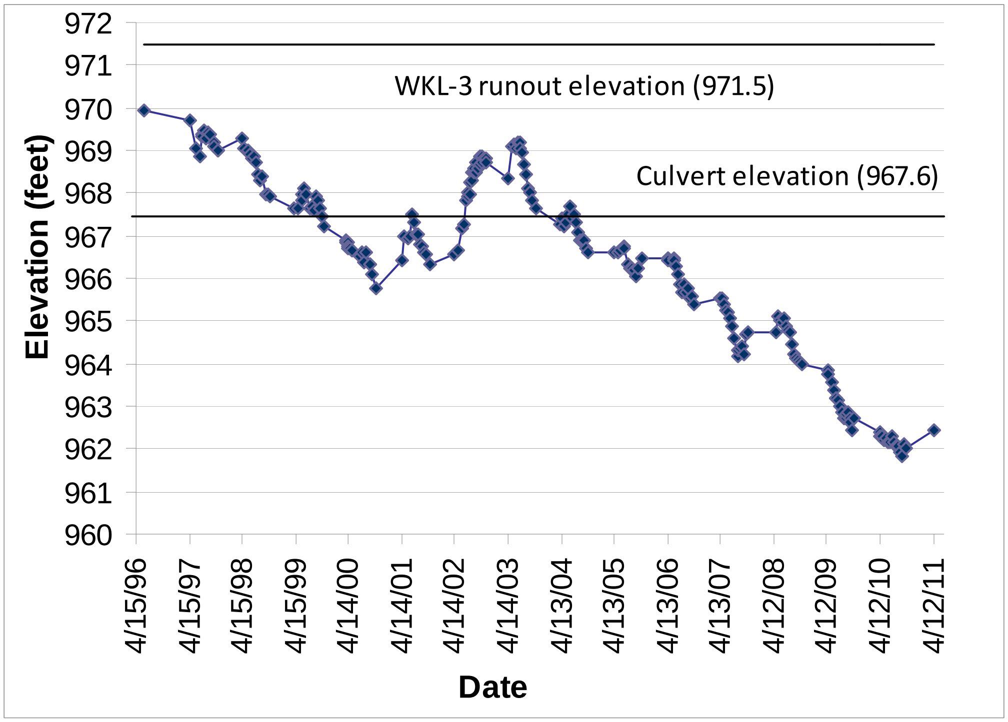

Figure 4. Historic Wood Pile Lake levels.
Vertical datum NAVD 88

Table 2. Summary of lake level recording.

DNR Parameters	Wood Pile Lake Data
Period of record	6/6/1996 to 4/12/2011
# of readings	215
Highest recorded	969.9 ft (6/6/1996)
Lowest recorded	961.8 ft (9/13/2010)
Recorded range	8.1 ft
OHW elevation	962.5 ft (4/12/2011)
Datum	NAVD 88 (ft)

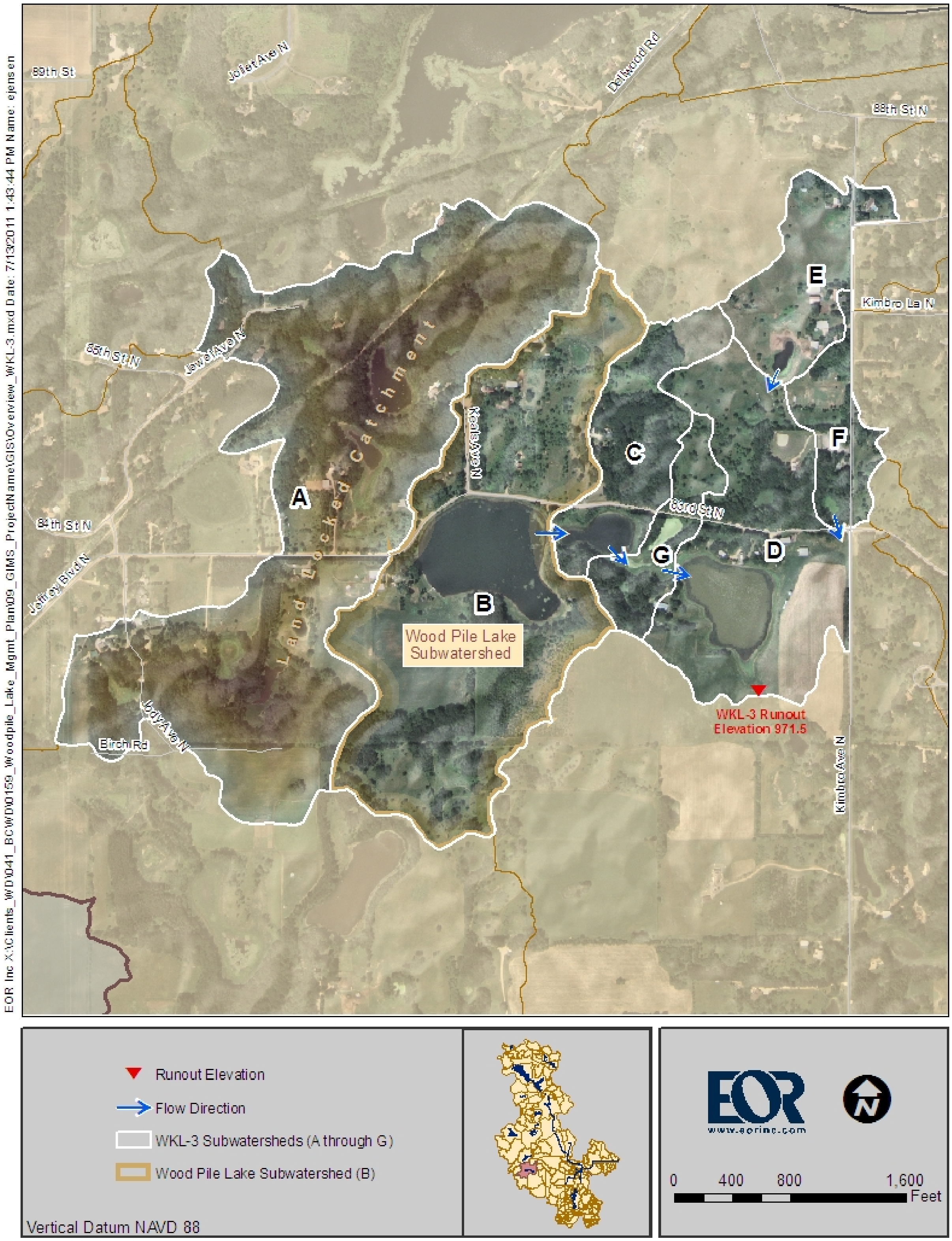

Figure 5. Wood Pile Lake watershed (B) in the greater WKL-3 watershed.

Figure 6. Watershed WKL-3 field survey results.

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Lake Substrate

The lake bottom sediment was assessed and determined to be composed of fairly consolidated inorganic material. At a few points, particularly along the southern shoreline, the bottom sediment was composed of decomposed organic material.

Zooplankton

Zooplankton samples were collected from Wood Pile Lake in 2009 and identified by major zooplankton group (complete species-level zooplankton survey data can be found in Appendix A). Rotifers are small (0.01 to 1 mm long) multi-cellular organisms that selectively feed on small bacteria and small phytoplankton. Copepods and Cladocerans are larger zooplankton (0.3 to 5.0 mm long) that selectively feed on large phytoplankton, such as cryptophytes and green algae. Copepods and Cladocerans are a preferable food source for small planktivorous fish, such as pan fish. In a typical lake food web, zooplankton abundance is controlled by pan fish feeding and phytoplankton abundance is controlled by zooplankton feeding. Therefore, excess planktivory by pan fish can deplete zooplankton abundance allowing phytoplankton abundance to increase.

The pie charts shown in Figure 7 illustrate the zooplankton community composition of major zooplankton groups in May and September of 2009. In May, Wood Pile Lake exhibits a balanced community of zooplankton, indicating the presence of moderate grazing pressure by pan fish and a wide range of phytoplankton food sources (smaller, less edible blue-green algae and larger, more edible green algae and cryptophytes). The abundance of rotifers increased from May to September. Rotifer dominance in the fall indicates heavy grazing by pan fish on larger zooplankton, such as Copepods and Cladocerans.

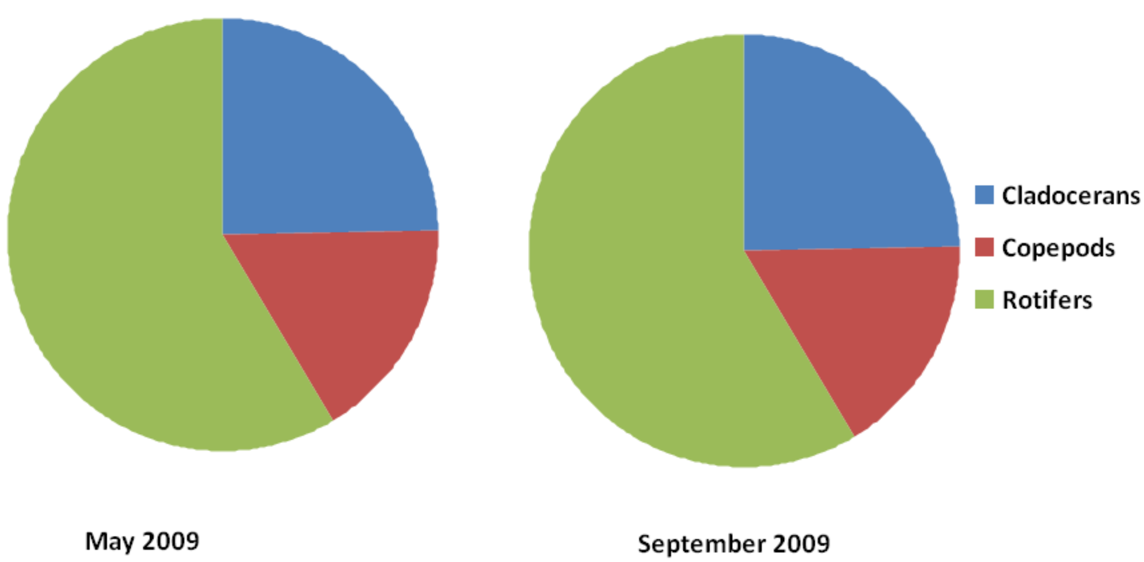

Figure 7. Community composition of major zooplankton groups. May and September 2009.

Phytoplankton

Noxious algal blooms are the most obvious effect of eutrophication. The response of the algal community to nutrients is well documented. A single lake may have several algal blooms over the summer, each composed of different species. In some cases, the algal bloom may contain species that produce toxins which can harm lake biota. For example, blue-green algal toxins can bioaccumulate in zooplankton and subsequently reduce the growth of fish larvae that feed on zooplankton (Karjalainen et al. 2005).

The presence of algae was noted throughout the littoral zone in Wood Pile Lake according to a May and September macrophyte survey conducted in 2009. In addition, the physical condition of Wood Pile Lake was noted as having *medium* algae, and in some cases *high* algae, each month throughout the growing season (June through September) from 2006 through 2010; the one exception was August 2007 where the highest ranking received was *low*.

Total phytoplankton production in lake water is commonly quantified through the measurement of chlorophyll-*a*. However, for this study we also assessed phytoplankton community composition in May and September of 2009 to investigate the specific mechanisms connecting nutrients to water quality and lake biota in Wood Pile Lake.

Dominant Phytoplankton Groups
According to a May and September survey of phytoplankton conducted in 2009 (Figure 8), the two most common groups of algae in Wood Pile Lake were blue-green algae (cyanobacteria) and green algae. The most abundant phytoplankton group on both sampling dates was **blue-green algae** (cyanobacteria), comprising a greater proportion of the total phytoplankton community in the fall than in the spring (79% and 56% of the total community, respectively). Blue-green algae can form noxious blooms and some species are capable of producing toxins that harm wildlife, pets, and humans. These organisms are also capable of producing nitrogen and tend to dominate the phytoplankton community during conditions of anthropogenic eutrophication because they can out-compete other algal species for phosphorus. **Green algae** comprised 17% and 18% of the of the total phytoplankton community in May and September, respectively. Green algae can also form noxious blooms which deplete oxygen when they decompose, resulting in poor living conditions for fish. They do not, however, produce toxins that directly harm other biota. In May of 2009, **cryptophytes** and **euglenoids** were also well represented in the phytoplankton community (11% and 10% of the total community, respectively), which are often abundant in spring and provide high quality food for zooplankton.

Dominant Phytoplankton Species
Table 3 illustrates the dominant phytoplankton species composition found in Wood Pile Lake during a May and September 2009 survey. The most abundant species of phytoplankton on both sampling dates was the blue-green algae *Anabaena sp.;* the fall population was nearly double the proportion of the total phytoplankton community than the spring population (39% and 72%, respectively). ***Anabaena sp***. is a blue-green algae capable of producing noxious odors and toxins. The third most common phytoplankton genera in the fall was ***Microcystis sp.*** but present at a considerably lower magnitude than *Anabaena sp.*; *Microcystis sp.* are also capable of producing noxious odors and toxins. The toxins produced by blue-green algae are can threaten lake biota when they are passed up the food chain to pike and other large organisms and

impair their growth, reproduction, and survival (Karjalainen et al. 2005). These results indicate that algal blooms and toxins could be a concern in Wood Pile Lake, especially during the fall.

In conclusion, the phytoplankton community did not exhibit typical lake succession (a diatom and green algae bloom in spring followed by a blue-green algae bloom in summer). In contrast, blue-green algae were the most dominant phytoplankton group in the spring and summer which indicates the presence of anthropogenic sources of phosphorus to the lake from the watershed.

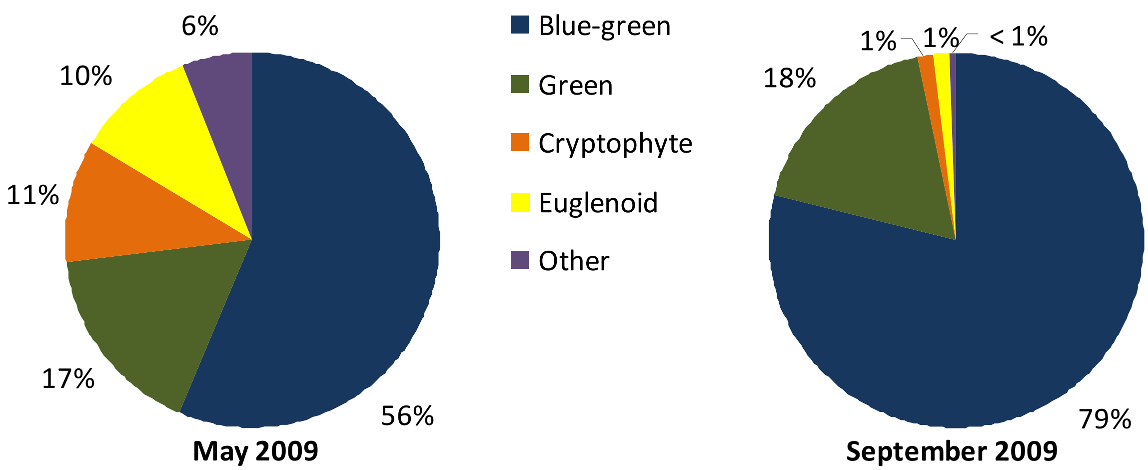

Figure 8. Community composition of major phytoplankton groups (%), May and September 2009.

Table 3. Dominant phytoplankton species, May and September 2009.

Sampling Date	Three most common phytoplankton genera (% of total)	Phytoplankton Group	Ecological notes
May 2009	*Anabaena* (39%)	Blue-green algae	Capable of producing noxious odors and toxins
	Cryptomonas (11%)	Cryptophyte	Often blooms under ice or in deep water; Does not produce toxins
	Trachelomonas (10%)	Euglenoid	Common in freshwater environments; Sometimes forms brown-colored blooms
September 2009	*Anabaena* (72%)	Blue-green algae	Capable of producing noxious odors and toxins
	Sphaerocystis (8%)	Green algae	Capable of producing large blooms which deplete lake oxygen levels; Does not produce toxins
	Microcystis (4%)	Blue-green algae	Capable of producing noxious odors and toxins

Aquatic Vegetation

To better understand the ecology of Wood Pile Lake, an aquatic vegetation survey was conducted in 2009. Aquatic vegetation species and density was recorded at 21 sampling locations evenly distributed throughout the lake on 2 June and 4 September using the point intercept method (Madsen 1999). See Appendix B for a map of sampling locations and complete survey data.

The summarized survey data in Figure 9 and Figure 10 identifies the regions where macrophyte species were found in June and September, respectively, of 2009. In June 2009, the most dense macrophyte species identified were **common waterweed** (*Elodea canadensis*), a native aggressive plant, and **coontail** (*Ceratophyllum demersum*), a minor food source for waterbirds; both species were distributed throughout the shallow, near-shore regions of Wood Pile Lake. In addition, **broad-leaved cattail** (*Typha latifolia*) was found in dense abundance in the northern near-shore region, **ribbon leaf pondweed** (*Potamogeton epihydrus*) was found in sparse density throughout the southern region, and **large leaf pondweed** (*Potamogeton amplifodius*) was found in moderate density throughout the eastern region of Wood Pile Lake. In September 2009, **common waterweed** and **coontail** remained the most common aquatic macrophytes throughout the near-shore regions of the lake with a dense abundance of **large leaf pondweed** in the southeastern region.

The invasive curly-leaf pondweed (*Potamogeton crispus*) was found in very sparse density throughout the shallow region of Wood Pile Lake in June and was not found at all in September; corresponding to its known life cycle of early spring emergence and mid-summer die back. Curly-leaf pondweed can be a significant contributor to internal phosphorus loading in lakes when it is found in very large quantities due to its dying back and decomposition in mid-summer.

In conclusion, there is a healthy macrophyte community established throughout the lake and no evidence of curly-leaf pondweed.

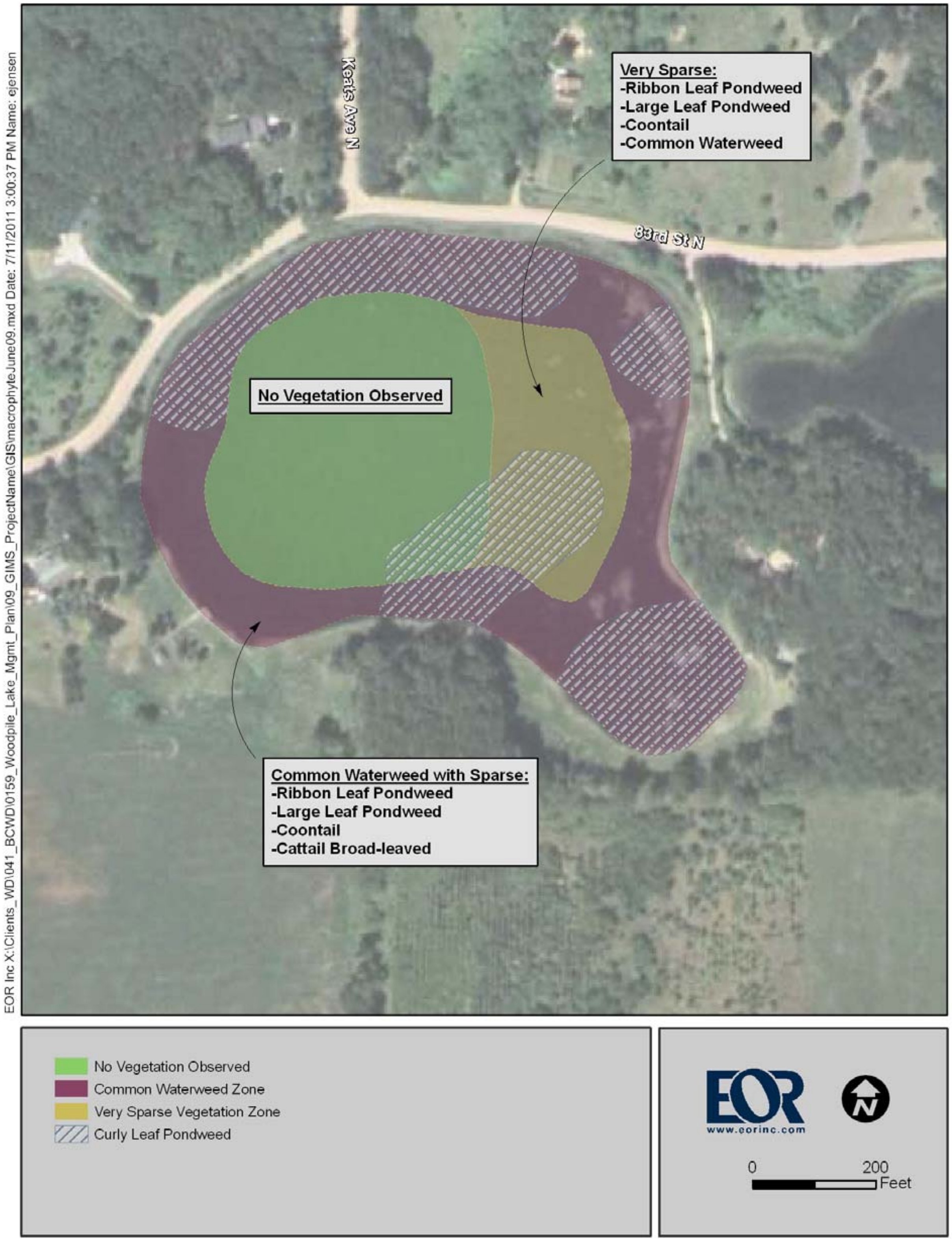

Figure 9. Aquatic vegetation distribution, June 2009.

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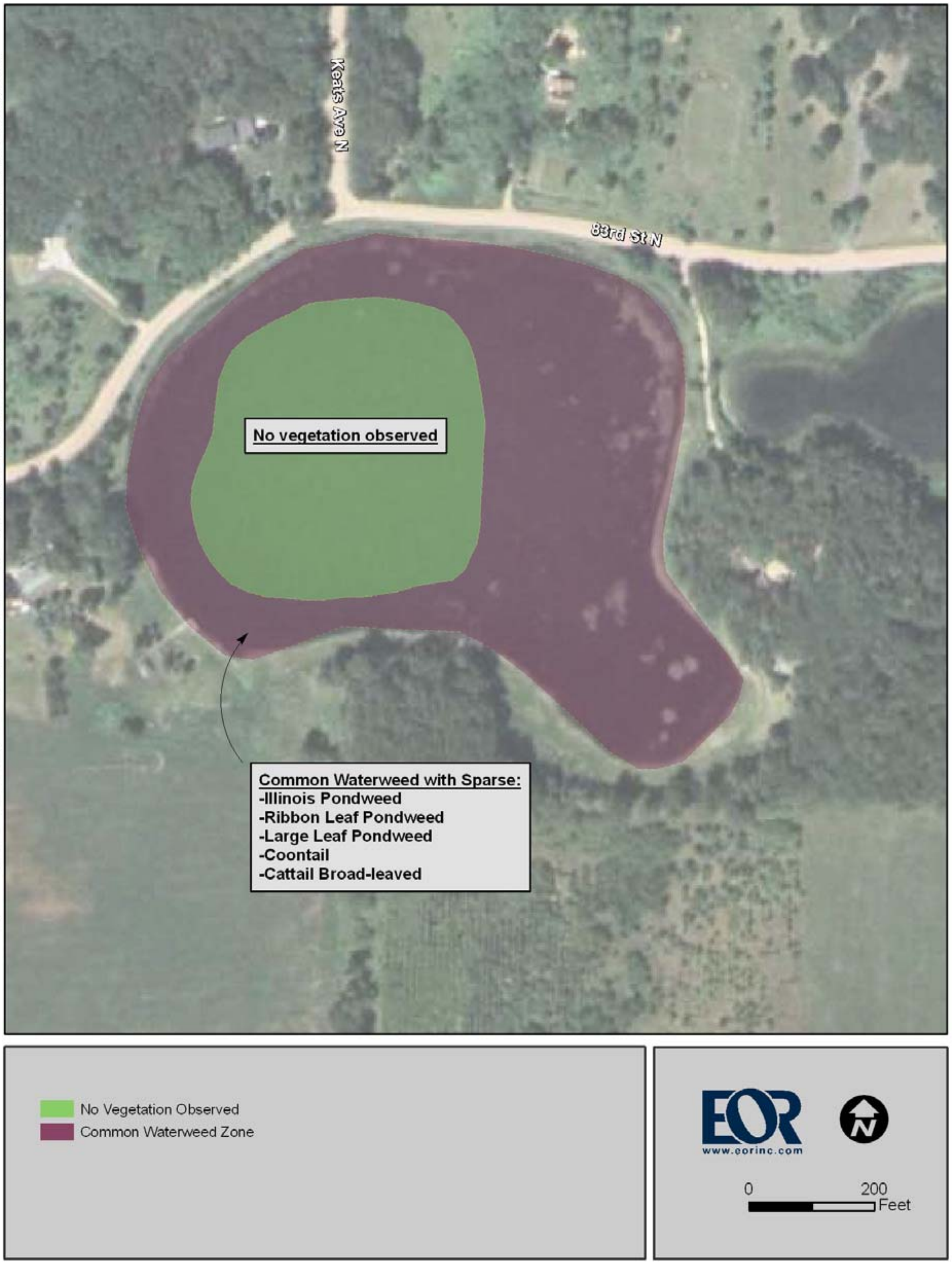

Figure 10. Aquatic vegetation distribution, September 2009.

Fisheries

In October 2010 EOR contracted Blue Water Science to conduct a fish survey under a permit granted from the Minnesota DNR (MnDNR) (Blue Water Science, 2010). The objectives were to characterize the fish community in Wood Pile Lake; turtles were also surveyed for the study. See Appendix C for the complete study including trap netting methodology and results. The main findings were as follows:

- The fish community appears to have a simple community structure; bluegill, black crappie, pumpkinseed, hybrid sunfish, and northern pike were found.
- Pumpkinseed sunfish were found in lower numbers than the standard range compiled by the MnDNR.
- The black crappie population was above average; at least two year classes of black crappies were found.
- Bluegill sunfish had a moderate to high count dominated by young-of-the-year, which were 3 inches or less in length; there are at least two year classes of bluegills, which indicated that annual winterkill conditions probably do not occur
- Northern pike ranged in length from 15-29 inches; the northern pike had a moderate population which should maintain predation pressure on the pan fish community.
- Snapping turtles and painted turtles were common in Wood Pile Lake; the number of painted turtles was typical for a lake that has a high percentage of a natural shoreline area

Fish communities change over time, but it appears that the current fish community has a simple structure. Five fish species were found in the survey, none of which were rough fish. Rough fish tend to disrupt the bottom sediment of lakes and thereby increase the release of phosphorus into the water column; this activity tends to have a negative effect on lake water quality. Figure 11 illustrates the fish community composition from the October 2010 survey grouped by trophic status. Biomass data by weight is typically used to represent the relative ecological impact of each trophic category. For this study, biomass was estimated from the cumulative length of all fish sampled in each trophic category. Based on cumulative fish length, top predators make up 7% of the total fish community.

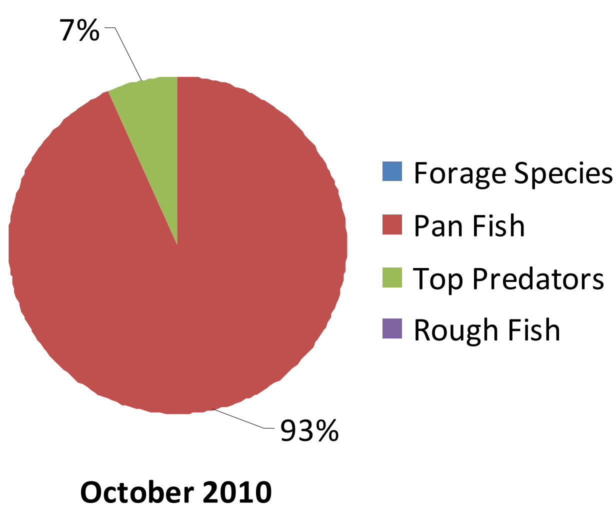

Figure 11. Fish community composition by cumulative length of fish, October 2010.

On April 15, 2011, EOR visited four lakes, including Wood Pile, in response to reports of fish kills on several lakes in the BCWD. A summary of findings was provided to the BCWD Board of Managers in a memo dated April 18, 2011. Contents of the memo related to Wood Pile Lake findings are provided here and include a comparison to the 2010 fish survey. Figure 12 is a photograph of the fish kill on Wood Pile Lake, which was also originally provided in the April memo. Based on this survey, it is likely that there was NOT a complete fish kill during the winter of 2010-2011 in Wood Pile Lake.

> Summary
>
> EOR was asked to visit water bodies in the BCWD following the reporting of fish kills on several lakes. EOR visited the Jackson WMA Lake, Woodpile Lake, Masterman Lake, and Bass Lake West. Of the lakes visited, only Woodpile Lake showed clear evidence of a recent fish kill. It is possible that fish kills occurred on the other lakes; however lake access and time limited the investigation. In addition, WCD observed fish kills at Goggins, Kismet and Plaisted Lakes.
>
> The large numbers of dead fish observed on April 15, 2011 at Woodpile Lake were likely the result of a "winter kill". According to the State Climatology Office, "The Winter of 2010-2011 is the fourth snowiest so far in the Twin Cities (over the past 127 years)". Winterkill commonly occurs during especially long and harsh winters. Fish mortality is the result of insufficient dissolved oxygen in the lakes water. The dissolved oxygen content of water depends primarily on the amount of mixing with the air above the lake, the rate of oxygen production by plants, and the rate of oxygen consumption (respiration) by living aquatic organisms. Periods of prolonged ice cover prevents the lake from mixing with air, reduces the generation of oxygen by plants due to the snow and ice blocking sunlight, and limits recharge to the lake by oxygen enriched runoff. On-going consumption of oxygen by fish and plant decay further depletes dissolved oxygen levels in the lake causing fish mortality. Shallow, productive lakes often have fish kills due to their low storage capacities and high rates of oxygen-consuming decomposition.
>
> In correspondence with Gerald Johnson, the MN DNR Fish and Wildlife East Metro Area Fisheries Supervisor, he stated, "Winterkill condition and dead fish were widespread this season". The MN DNR has additional winterkill information on their website. The information is available at:
> http://www.dnr.state.mn.us/areas/fisheries/eastmetro/winterkill.html
>
> The following observations were made [for Wood Pile Lake] during the rapid fish mortality investigation (RFMI).
>
> Clear evidence, both visual and miasmal, of a large scale fish kill at Woodpile Lake. Lake level at 1.54 feet on the staff gauge. I walked roughly 1,000 feet of shoreline and found approximately 190 dead black crappie (4-7"), 20 dead black crappie (8-12"), 9 northern pike (18"), and 4 northern pike (12"). Figure 1 shows a section of the northern shoreline as viewed on April 15, 2011. The majority of dead fish were along the

northern shoreline due to the prevailing winds. Few fish were observed along the eastern shoreline. In comparing the fish kill data to the fish survey that was conducted in October 2010 the Crappies are consistent with the fish that were found but the Northern Pike are not. Also, none of the Sunfish species were observed in the fish kill. The Crappies that were found dead are in the most prevalent size class from the fish survey. No northern pike in the size classes that were found in the fish kill had been observed in the Fish Survey. While a complete survey of the fish kill was not conducted, it is likely that it was NOT a complete fish kill.

Figure 12. Fish kill evidence on the northern shoreline of Wood Pile Lake, April 15, 2011.

Water Quality

The water quality of Wood Pile Lake has been regularly monitored since 2006. The monitoring consists of bimonthly sampling for chlorophyll-*a*, Secchi depth, and total phosphorus from April through October. Chlorophyll-*a*, a pigment found in most plants and algae, is used as an indicator of biological activity, primarily algal growth, in lake water. Secchi depth is a direct measurement of the clarity of lake water. Total phosphorus concentration strongly correlates with algal growth in Minnesota lakes. Growing season (June through September) means of chlorophyll-*a*, Secchi depth, and total phosphorus are shown in

Table 4, along with the eutrophication criteria for shallow lakes within the North Central Hardwood Forests (NCHF) Ecoregion as established by the MPCA. In general the water quality for Wood Pile Lake meets the NCHF Ecoregion shallow lake criteria for all three parameters: total phosphorus, chlorophyll-*a*, and Secchi transparency.

Table 4. Growing season means, 2006-2010.

Water Quality Parameter	Growing Season Mean 2006-2010	Eutrophication Standard (shallow lakes)
Total Phosphorus (µg/L)	57	< 60
Chlorophyll a (µg/L)	19	< 20
Secchi Transparency (m)	1.8	> 1.0

Trophic State Index (TSI) represents the trophic status, or productivity/fertility of a lake, based on a standard calculation methodology. As nutrients such as phosphorus increase, there is more food available for algal growth, which results in increased algal concentrations (expressed in increased chlorophyll-*a*). When algal concentrations increase, the water becomes less transparent and the Secchi transparency decreases. Wood Pile Lake has a mean TSI of 58 (out of 100) based on total phosphorus, chlorophyll-*a*, and Secchi transparency. TSI can also be calculated independently for each of these parameters, and values for Wood Pile Lake are shown in Figure 13. For Wood Pile Lake, total phosphorus and chlorophyll-*a* concentrations were within the eutrophic classification, while Secchi transparency levels were between the mesotrophic and eutrophic classifications.

For 2006 through 2010, growing season mean annual chlorophyll-a ranged between 11 and 31 µg/L, Secchi transparency between 2.3 and 1.3 m, and total phosphorus between 39 and 80 µg/L. Chlorophyll-*a* and Secchi transparency were negatively correlated (when Chlorophyll-a increased, Secchi transparency decreased) which indicates that algae are the primary contributor to transparency in Wood Pile Lake, which is typical for Minnesota lakes. There was not a strong correlation between total phosphorus and chlorophyll-a. This indicates that algal growth is limited by zooplankton grazing and not availability of phosphorus in Wood Pile Lake.

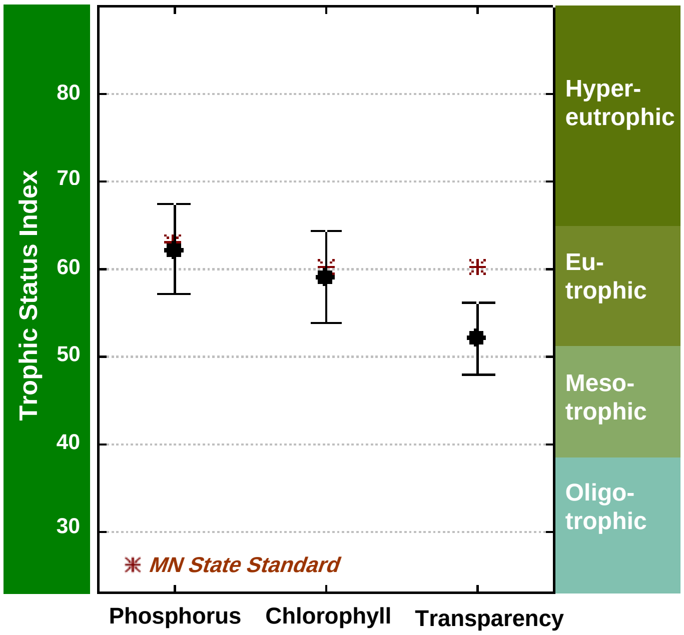

Figure 13. Trophic status index for total phosphorus, chlorophyll-*a*, and Secchi transparency with comparison to the state standard for 2006-2010.

Lake Stratification

Understanding lake stratification is important to the development of both the nutrient budget for a lake as well as ecosystem management strategies. Lakes stratify in the summer when cooler, denser water becomes trapped underneath warmer, surface water. This stratification is typically broken in the spring and fall when surface waters cool to the same temperature as bottom waters, or during strong storm events. During lake mixing, phosphorus from the sediments and bottom waters of a lake is transported to the surface waters, fertilizing phytoplankton growth and resulting in algal blooms. Stratification also has an effect on lake dissolved oxygen levels, a measure of the amount of oxygen dissolved in water that is available for aquatic organisms such as fish and zooplankton. During lake stratification, the bottom waters can become devoid of dissolved oxygen due to excessive decomposition without access to new sources of oxygen from the atmosphere or algal growth. The lack of oxygen in the bottom waters of a lake can cause phosphorus to be released from the sediments and fish kills.

Wood Pile Lake temperature and dissolved oxygen profiles for 2010 are shown in Figure 14 and Figure 15. Temperature and dissolved oxygen data were recorded from 2006 to 2010. Only 2010 data are presented here, which exhibit similar trends of dissolved oxygen as recent years. Temperature data indicate that the lake thermally stratified each year during the period of record. Dissolved oxygen sharply decreases with depth in mid- to late-summer. When dissolved oxygen concentrations decrease below 2 mg/L in the lake bottom waters, phosphorus is released from the sediments and large fish cannot survive.

According to the oxygen profiles, the bottom 1m of lake water was devoid of oxygen throughout the growing season. However, the lowest reading is likely a reading of dissolved oxygen in the sediment or macrophytes rather than the water column. In Figure 14 and Figure 15, the 7m depth is equivalent to the bottom 1 foot of the lake. Low oxygen levels in the bottom waters of Wood Pile Lake may contribute to internal phosphorus loading and enhanced algal growth.

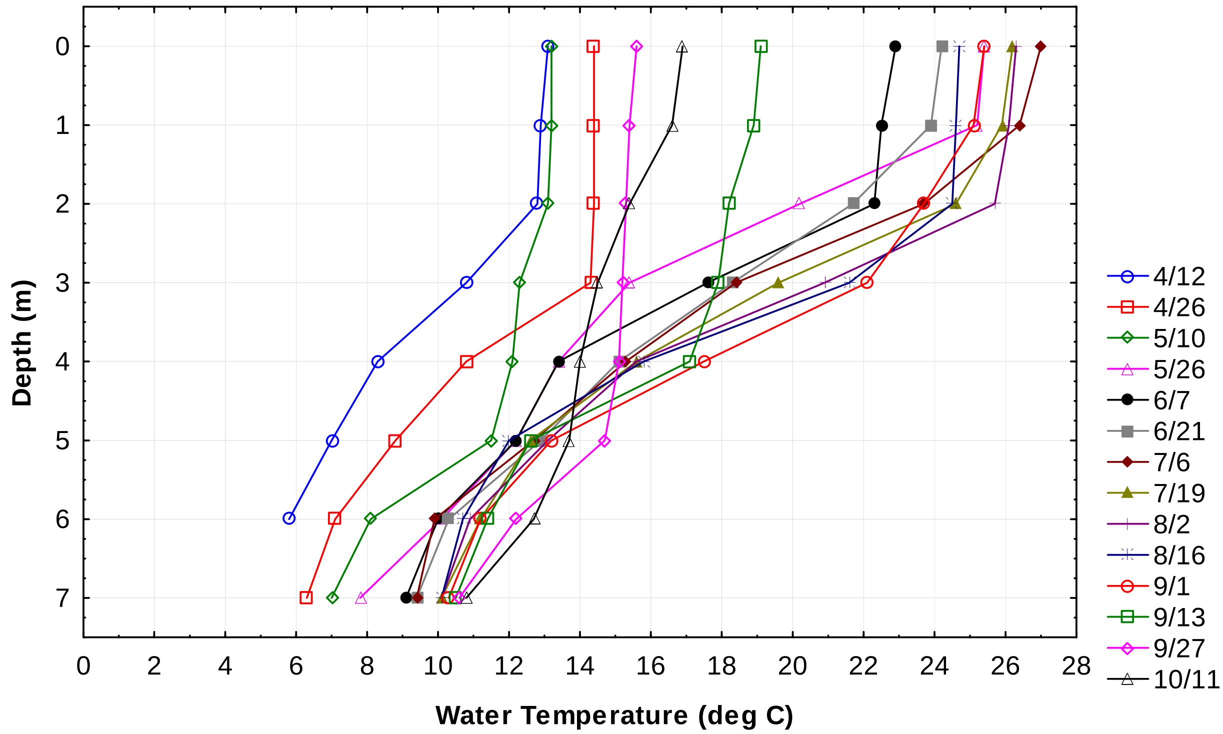

Figure 14. 2010 water temperature profiles.

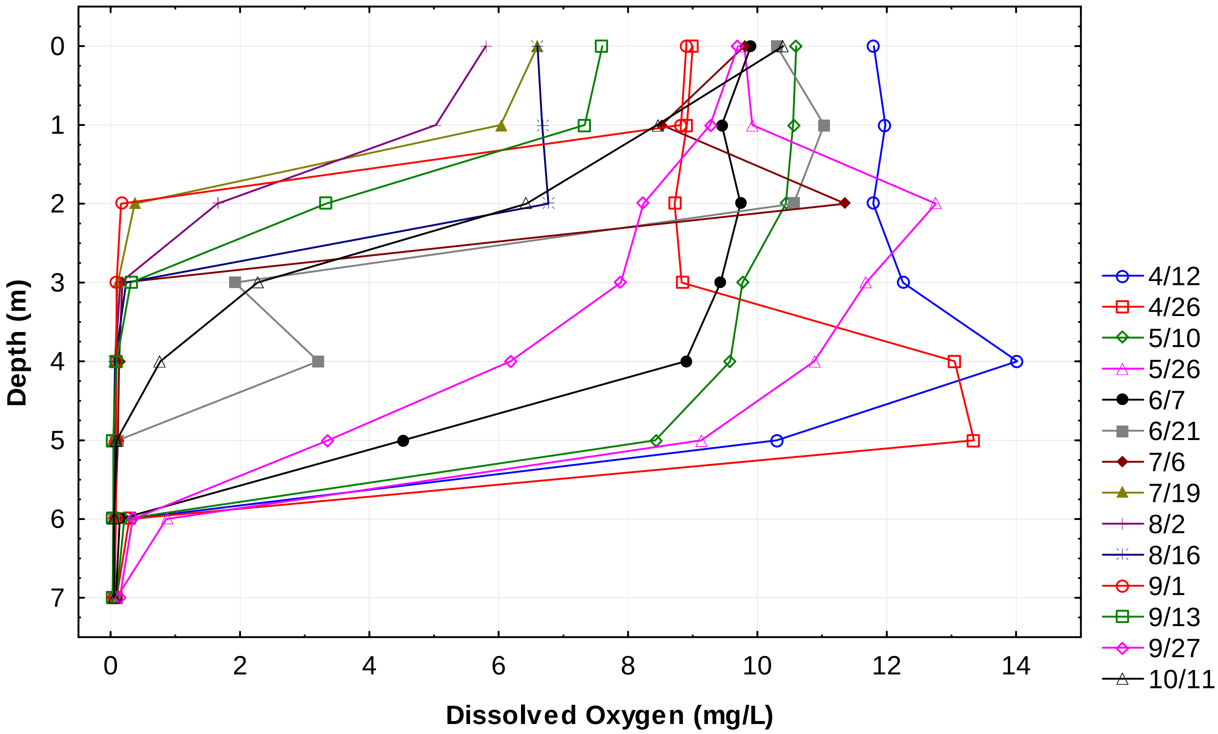

Figure 15. 2010 dissolved oxygen profiles.

SOURCE ASSESSMENT

Total phosphorus is the most important nutrient associated with lake fertility. In an effort to determine the specific sources of total phosphorus in the Wood Pile Lake system, water quality modeling was conducted. The models attempt to simulate the total phosphorus dynamics of the lake and its watershed. The primary sources of total phosphorus available for plant and algal growth are from the watershed, atmospheric deposition, and release from the lakes sediment. The following sections discuss the modeling used to determine the relative contribution of total phosphorus available for plant and algal growth.

Watershed Sources

Estimates of phosphorus contributed from watershed loading included watershed runoff and septic systems. No animal feeding operations were identified within the Wood Pile Lake watershed. Only an 86-acre portion of the WKL-3 watershed (Subwatershed B) drains to Wood Pile Lake (see Figure 6 and related discussions).

Watershed Runoff

Phosphorus is washed into the lake from the land surfaces of the watershed. The various land surfaces within the watershed contribute varying levels of total phosphorus. The Simple Method (Schueler 1987) was used to calculate direct watershed runoff and associated TP loads. The Simple Method uses an equation that relates watershed pollutant load to watershed drainage area, rainfall depth, percent impervious cover, and event mean runoff pollutant concentration (EMC) based on land use and land cover.

Land cover data were obtained from the Minnesota Land Cover Classification System (MLCCS) having field data from the year 1999. For land cover categories that have associated impervious area (MLCCS series below 20,000), the land cover data were combined (intersected in a spatial database) with the 2005 land use data (2005 Generalized Land Use for the Twin Cities Metropolitan Area, Metropolitan Council). For land cover categories that do not have associated impervious areas (MLCCS series at or above 20,000) and are therefore all natural communities, land use data were not combined with the land cover data. Land use and land cover may have changed in the watershed since the data that the models are based on were collected. To maintain consistency with these data sources, recent changes were not incorporated into the models.

Each land cover/land use category was assigned an event mean concentration (EMC), which is an estimate of the phosphorus concentration in watershed runoff based on literature values. For impervious areas (MLCCS series below 20,000), EMCs were based on land use. For pervious areas (MLCCS series at or above 20,000), EMCs were based on land cover. The EMCs were generated based on values in the literature and other similar studies (Table 5).

Table 5. Total phosphorus event mean concentrations (EMC) by land cover and land use.

Land Cover (applied to pervious surfaces)	Phosphorus Event Mean Concentration (mg/L)
Cropland	0.32
Exposed Earth	0.46
Forest/Shrub/Grassland	0.04
Open Water	0.01
Wetlands	0.01-0.04*
Land Use** (applied to impervious surfaces)	**Phosphorus Event Mean Concentration (mg/L)**
Commercial	0.28
Farmsteads	0.46
Industrial	0.28
Institutional	0.28
Multi-Family Residential	0.32
Park and Recreation	0.40
Single Family Residential	0.46
Vacant/Agricultural	0.32

*Vary based on wetland type.
**Land use categories are from 2005 Generalized Land Use database. These land use EMCs only apply to areas identified by land cover (MLCCS) data as containing impervious surfaces.

Each land cover/land use combination is also assigned an estimated impervious percentage, which is used to estimate average annual runoff depth. The impervious percentages assigned to the land cover/land use combination are based on the NRCS (Natural Resources Conservation Service) curve number methodology using GIS-based NRCS curve numbers. The impervious values were adjusted such that the runoff depth from the one-year storm using the NRCS method generated the same volume of runoff using the Simple Method runoff calculation. The annual depth of watershed runoff to which the watershed loading estimate was calibrated was 6.5 inches based on the Minnesota Hydrology Guide (SCS 1992).

Figure 16 and Figure 17 depict the land cover and 2005 land use, respectively, within the Wood Pile Lake watershed. The majority of the watershed is made up of natural and agricultural land cover types. The remaining watershed land cover type was single family residential.

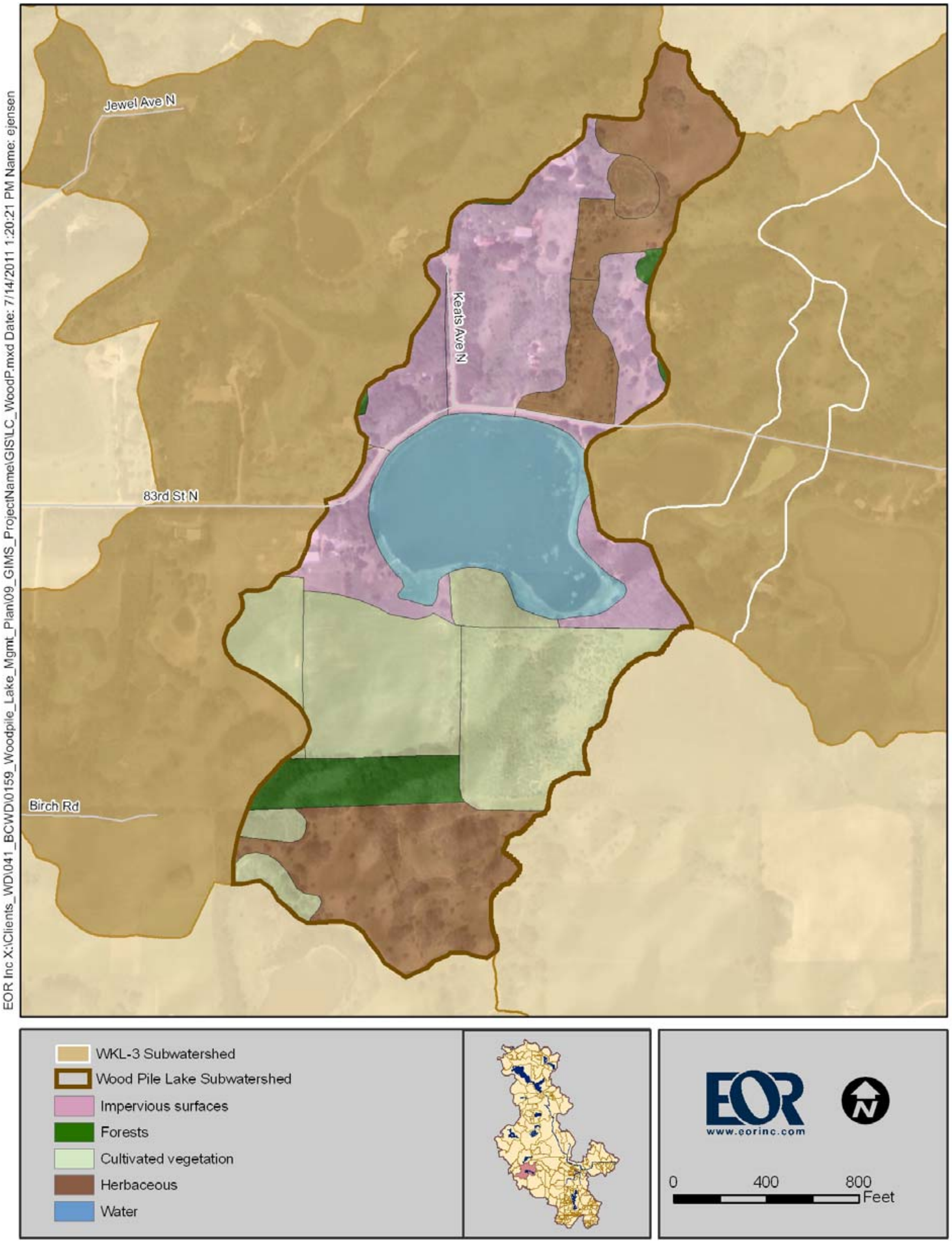

Figure 16. Wood Pile Lake watershed land cover.

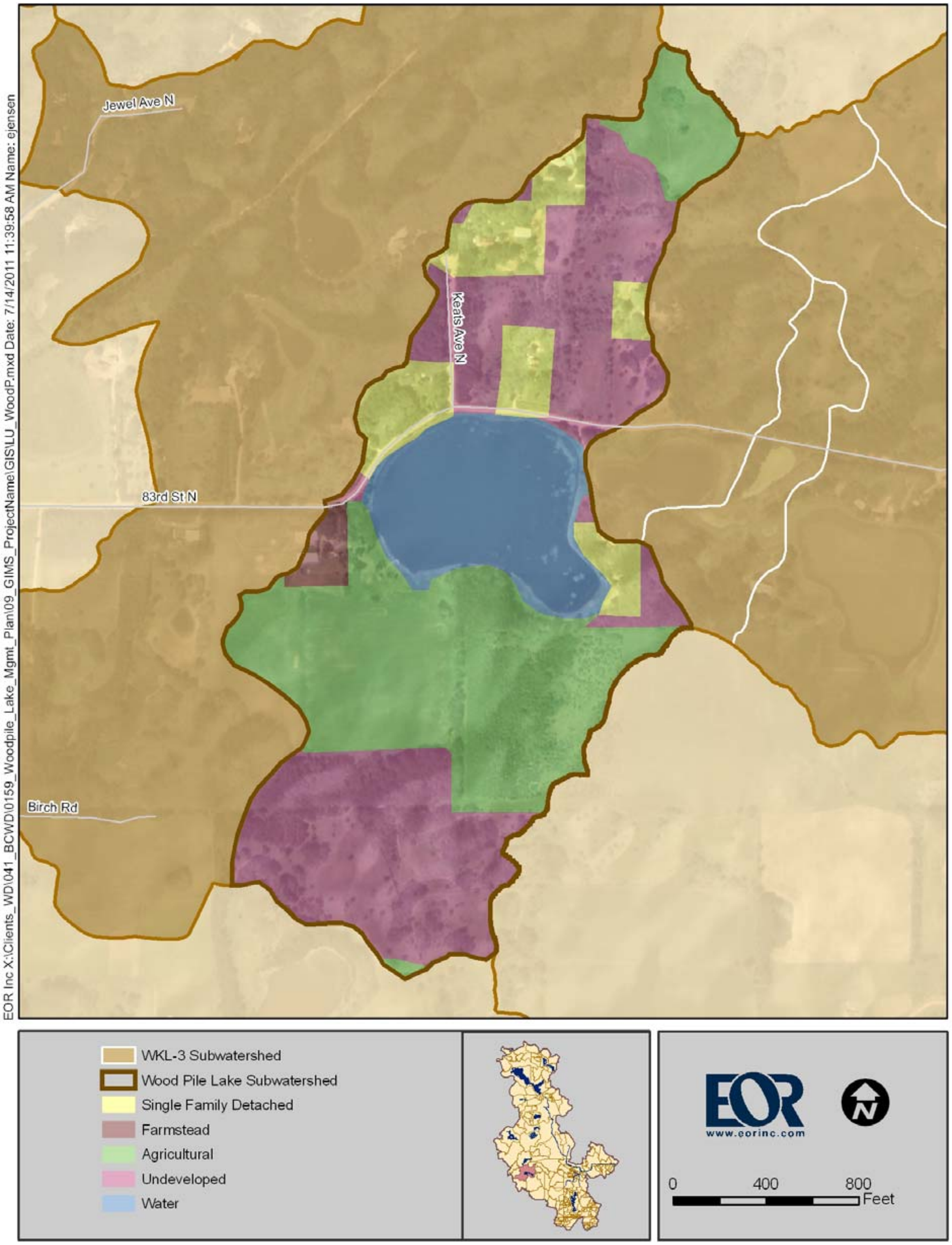

Figure 17. Wood Pile Lake watershed land use.

Septic Systems

Phosphorus loads attributed to subsurface sewage treatment systems (SSTS) adjacent to Wood Pile Lake were calculated using data provided by Washington County and the MPCA Detailed Assessment of Phosphorus Sources to Minnesota Watersheds (MPCA 2004). Total loading is based on the number of houses within 500 feet of the lake, whether the SSTS system is conforming or failing, the number of people using the system, and an average value for phosphorus production per person per year.

Aerial photography provided information for estimates for septic systems adjacent to Wood Pile Lake. An MPCA study estimated that 11.4% of SSTS are failing within the St. Croix River Basin (MPCA 2004); this estimate was used for Wood Pile Lake. The Washington County capita per residence value is derived from the 2000 Census. Values for phosphorus production per capita per year and the percentage of phosphorus passing through the SSTS for both conforming and non-conforming systems were derived from the MPCA Detailed Assessment of Phosphorus Sources to Minnesota Watersheds (MPCA 2004).

A summary of watershed phosphorus sources is provided in Table 6. Event mean concentrations combined with runoff volume yielded an estimate of 28 pounds per year of phosphorus loading to Wood Pile Lake from watershed runoff. Septic systems were estimated to contribute an additional 6.2 pounds per year of phosphorus.

Table 6. Watershed phosphorus source inventory.

Source	Phosphorus Load (lb/yr)	% of Total
Watershed Runoff	28	82%
Septic	6.2	18%
Total	**34***	**100%**

* Rounded

Atmospheric Deposition

Atmospheric deposition represents the small amount of phosphorus that is bound to particulates in the atmosphere and is deposited directly onto surface waters as the particulates settle out of the atmosphere. Atmospheric phosphorus loading is based solely on the lake surface area and average deposition rates. Average phosphorus atmospheric deposition loading rates were calculated for the St. Croix River Basin (MPCA 2004). The report determined that atmospheric deposition equaled 0.27 lb/ac of total phosphorus per year. In the case of Wood Pile Lake it is estimated that the average annual total phosphorus loading from atmospheric deposition is 3.5 lbs/year.

WiLMS In-Lake Model

The Wisconsin Lake Modeling Suite (WiLMS) Version 3.3 was developed by the Wisconsin Department of Natural Resources and predicts growing season mean total phosphorus concentration in lakes and includes tools to estimate internal loading and other in-lake characteristics. WiLMS is also typically used to identify phosphorus loading reductions needed to meet in-lake water quality goals for total phosphorus. The model uses an annual time step.

Internal Loading

Sediment within the lake contains phosphorus, which can be released when oxygen levels fall within the bottom waters of the lake. The dying back and decomposition of curly-leaf pondweed can also be a source of internal phosphorus loading.

A WiLMS internal loading estimator uses a mass-balance approach and shows near-zero internal loading for Wood Pile Lake. This estimate is conservative, so Wood Pile probably experiences higher internal loading than the model estimates but low internal loading overall.

Comparison with Ecoregion Lakes

Another tool associated with WiLMS is Lake Eutrophication Analysis Procedure (LEAP) developed by the Minnesota Pollution Control Agency. This tool compares the lake of interest to average characteristics of lakes in the same ecoregion. Wood Pile Lake exhibits average water quality characteristics in its ecoregion; growing season means of chlorophyll-*a*, Secchi depth, and total phosphorus were not statistically different (at the 90% confidence level) than average values for lakes in its North Central Hardwood Forest Ecoregion.

Nuisance Algae Frequency Estimates

LEAP also predicts growing season frequencies of a range of chlorophyll-*a* concentrations. Chlorophyll-*a*, a pigment found in most plants and algae, is used as an indicator of algal growth in lake waters. Table 7 reports the estimated frequency of algal nuisance conditions based on LEAP.

Table 7. Predicted algal nuisance conditions.

Chlorophyll-*a* Concentration (µg/L)	Nuisance Conditions	Frequency during Growing Season in Wood Pile Lake (%)
0-10	No problems encountered	19%
10-20	Algal scums evident	49%
20-30	Nuisance conditions encountered	21%
>30	Severe nuisance conditions encountered	11%

Conclusions

Wood Pile Lake meets the shallow lake water quality standard for transparency but phosphorus and chlorophyll-*a* levels occasionally exceed the standards. Macrophytes were found throughout the shallow regions of the lake and dominated by common waterweed, and the fish community is made up of several species of pan fish and northern pike. There was not evidence of rough fish or dense curly-leaf pondweed, two potentially major sources of internal phosphorus loading in shallow lakes. The healthy macrophyte community established throughout the lake contributed to low internal phosphorus loading due to plant uptake of sediment phosphorus and physical protection of sediment disturbance. Also, the apparent lack of motor boat activity, which can stir up bottom sediment, also may have contributed to low internal loading. In-lake modeling results support the findings that internal phosphorus loading is low in Wood Pile Lake.

There is anecdotal evidence of *medium* algae conditions recorded during macrophyte in-lake surveys and routine water quality monitoring throughout the growing season. Predictive in-lake modeling results support the findings that severe nuisance algal conditions occur infrequently. In 2009 Wood Pile Lake was composed of a mixed phytoplankton and zooplankton community in spring that progressed into a blue-green algae and rotifer dominated community by late summer. The phytoplankton community did not exhibit typical lake succession (a diatom and green algae bloom in spring followed by a blue-green algae bloom in summer). In contrast, blue-green algae were the most dominant phytoplankton group in the spring and summer which indicates the presence of anthropogenic sources of phosphorus to the lake from the watershed. Therefore, any additional external sources of phosphorus into Wood Pile Lake may result in noxious and toxic algal blooms throughout the summer.

Under existing conditions, Wood Pile Lake is not connected to the eastern basins in the greater WKL-3 watershed, and the general drainage direction throughout WKL-3 is from west to east. Wood Pile Lake would need to rise approximately 4 feet in order to reach the culvert between Wood Pile Lake and the eastern basins, which would require a long-term change in climatic conditions. Under changing climatic conditions, the culvert between Wood Pile Lake and the eastern basins may act as an equalizer, introducing waters from the east into Wood Pile Lake and visa versa. Having no water quality data on the eastern basins, it is unclear what effect this would have on Wood Pile Lake or the eastern basins. Water quality monitoring of these eastern basins would be beneficial if exploration of these effects would be warranted in the future.

ISSUE & GOAL IDENTIFICATION PROCESS

As part of the planning process input was gathered from the local stakeholders and the BCWD staff and managers to identify the issues of concern relating to Woodpile Lake. Another key to the planning process is developing goals to achieve an outcome that satisfies the concerns. In May of 2010 the BCWD Board of Managers initiated the planning process to develop a lake management plan for Wood Pile Lake. In July of 2011 a meeting was held with lakeshore residents and residents of the watershed to discuss past lake data, resident observations, issues concerning the residents and goals the residents have for this process.

The following is a list of issues that was developed through the various discussions during this process:

- Excessive macrophyte growth
- Excess sediment runoff from roadways
- Exploitation of fisheries, especially by non-residents

The goals for this project were developed from the analysis of the present conditions in Woodpile Lake and its watershed and the concerns of the BCWD and the local stakeholders.

Water Quality Goal

Manage the nutrient inputs (watershed loading and internal loading) to Woodpile Lake to prevent degradation of current water quality.

1. Maintain existing water quality levels.
2. Reduce sediment and nutrient loading from the watershed through stabilization of the riparian zone via an increase in width of the vegetative buffer and re-establishment of native vegetation.
3. Maintain current balance of in-lake biology.

Fisheries Management Goal

Maintain the fishery to ensure the existing balance of the fish community is maintained.

IMPLEMENTATION PLAN

The following implementation plan summarizes the potential actions to be taken within the Lake and it's watershed to meet the goals identified through the public involvement process. Participants of the July 2011 public meeting are listed in Appendix D.

Aquatic Vegetation

A common concern among residents was that macrophytes have been getting denser over the past 20 years. Increased productivity (greenness) of lakes as they age is a natural process, but this process can be sped up by human activities in the watershed, such as agriculture and development. Once the nutrients are in a lake, macrophyte harvesting would result in the transfer of nutrients from the macrophyte community to the algal community. Residents agreed that dense macrophyte growth is preferable to noxious algal blooms. One action that can be taken to maintain a healthy macrophyte community in Woodpile Lake is to establish a no-wake zone for the entire lake to reduce motorboat disturbance of macrophytes.

Road Runoff

There is also concern about sediment and nutrient runoff from Keats Avenue into Woodpile Lake. Some actions that can be taken to reduce runoff from Keats Avenue are to increase the vegetative buffer between 83rd Street and the north side of Woodpile Lake, alter the grade of 83rd Street to slope away from the shoreline, and install sediment traps at the intersection of Keats Avenue and 83rd Street.

Lake Shoreline

Under the current low lake levels, there is a wide vegetative buffer between the agricultural field and the south shoreline of the lake. We recommend that this buffer be surveyed for effectiveness if lake levels were to rise and decrease the width of this buffer. The buffer should be surveyed for vegetative species and soil condition. Invasive species and channels in the soil will decrease the effectiveness of a vegetative buffer. In addition, we recommend that the western lakeshore where 83rd Street comes in close proximity to the lake be restored to more effectively filter watershed runoff before it enters the lake.

Summary of Recommended Actions

1. Establish a no-wake zone for the lake to reduce motorboat disturbance of macrophytes
This implementation action would be a regulatory approach and would have a nominal cost.

2. Increase the vegetative buffer between 83rd Street and the north side of Woodpile Lake
Activity would consist of removing existing weedy vegetation, moderate slope grading, installation of erosion protection and planting. Estimated project cost $25,000.

3. Alter the grade of 83rd Street to slope away from the shoreline
This implementation activity would consist of minor grade alterations of the gravel street surface of 83rd Street to force drainage away from the lake. The activity could be

accomplished through alteration of the existing road grading procedure so the cost would be nominal.

4. Install sediment traps at the intersection of Keats Avenue and 83rd Street
This implementation activity would consist of minor regarding of the northern edge of 83rd Street on either side of Keats Avenue to allow for sediment capture. Esitimated initial cost would be $10,000 and there would be an on-going maintenance cost from removal of accumulated sediment that would be approximately $500 – $1,500 per year.

5. Evaluate the effectiveness of the agricultural buffer at the south end of the lake.
This implementation activity would be of nominal cost if the buffer is deemed to be functioning appropriately. In the event that improvements are needed, it is likely that the range of cost to improve the buffer would be in the $5,000 – $15,000 range.

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APPENDIX A WOOD PILE LAKE ZOOPLANKTON SURVEYS

Washington Co. CD Zooplankton 2009			
EcoAnalysts, Inc.			
	Water Body	Woodpile Lake	Woodpile Lake
	Site	82-0132	82-0132
	Tow Length	7m tow	10m tow
	Collection Date	05-12-2009	09-15-2009
	Collection Device	153um x 8"diam	153um x 8"diam
	Collection Note	Net lowered once	Net lowered once
	EcoAnalysts Sample ID	5327.1-5	5327.1-6
	Volume of Sample Received	250mL	250mL
	Whole Sample Boivolumes	7.00mL	3.00mL
	Percent Counted - Fine Count	100.00%	0.71%
	Percent Counted - Coarse Count	1.43%	1.43%
FINE COUNT			
Rotifera	Ascomorpha ecaudis	0	0
	Asplanchna brightwellii	0	0
	Asplanchna priodonta	0	0
	Bdelloidea	0	0
	Brachionus angularis	0	0
	Brachionus caudatus	0	0
	Collotheca sp.	0	0
	Conochiloides dossuarius	47	38
	Conochilus unicornis	0	400
	Euchlanis dilatata	1	0
	Euchlanis sp.	0	0
	Filinia terminalis	2	0
	Kellicottia bostonensis	5	22
	Keratella cochlearis	86	0
	Keratella cochlearis f. tecta	0	0
	Keratella quadrata	2	0
	Lecane inermis	0	0
	Lecane intrasinuata	0	0
	Lecane mira	0	0
	Lophocharis sp.	0	0
	Monostyla lunaris	10	0
	Polyarthra euryptera	0	10
	Polyarthra vulgaris	1	0
	Synchaeta oblonga	0	0
	Trichocerca capucina	0	0
	Trichocerca cylindrica	0	1
	Trichocerca multicrinis	2	0
	Trichocerca rousseleti	0	0
	Trichocerca similis	0	0
	Trichotria tetractis	0	0
	FINE COUNT SUB TOTAL	**156**	**471**
Not included in target:	*nauplii*	*500+*	*17*
COARSE COUNT			
Crustacea	Alona costata	0	0
	Alona sp.	0	0
	Bosmina longirostris	10	24
	Calanoid - copepodites	18	22
	Ceriodaphnia dubia	0	0
	Ceriodaphnia lacustris	2	91
	Chydorus sphaericus	2	0
	Cyclopoid - copepodites	97	24
	Daphnia dubia	0	0
	Daphnia galeata mendotae	0	23
	Daphnia rosea	148	14
	Daphnia sp.	0	44
	Diacyclops thomasi	0	9
	Diaphanosoma birgei	0	2
	Diaphanosoma sp.	0	0
	Diaptomidae	0	3
	Harpacticoida	0	0
	Leptodiaptomus siciloides	0	0
	Mesocyclops edax	0	16
	Skistodiaptomus pallidus	4	0
	Streblocerus serricaudatus	0	0
	Tropocyclops prasinus mexicanus	0	60
	COARSE COUNT SUB TOTAL	**281**	**332**
	GRAND TOTAL	**437**	**803**

APPENDIX B WOOD PILE LAKE MACROPHYTE SURVEYS

Woodpile Lake Macrophyte Survey
Date: 6/2/2009

Site	Depth at Point (ft)	cattail_broad-leaved (Typha latifolia)	ribbon leaf pondweed (Pontomageton epihydrus)	large leaf pondweed (Potamogeton amplifolius)	curly leaf pondweed (Potomageton crispus)	coontail (Ceratophyllum demersum)	common waterweed (Elodea canadensis)	algae present
1	4				1		3	
2	5.5		1			1	1	
3	3.5					1	4	
4	4		1			4	1	
5	11						1	
6	23							
7	2	2		1	1	1	4	
8	3	3		2	1		4	
9	18							
10	22							
11	4		1	1	1	1	4	
12	4			1		1	4	x
13	10				1	1	1	
14	11					1	1	
15	?	2		1	2	2	4	
16	4	2		1		1	3	
17	?		3	3		3		
18	4		1	2		4		
19	4				1	1	3	x
20	4			1	1	1	3	
21	4.5			1	1	1	2	x

Species Density: 1-very sparce (barely any in rake tines), 4-very dense (covering all of rake tines)

Species density estimate graphic http://files.dnr.state.mn.us/assistance/grants/habitat/2007Protocols_pre-trt_data.pdf

Note: Water Below Normal Level

Survey Protocol: Point Intercept Method for Aquatic Plant Management (Madsen, 1999)

Woodpile Lake Macrophyte Survey
Date: 9/4/2009

Site	Depth at Point (ft)	cattail_broad-leaved (Typha latifolia)	ribbon leaf pondweed (Pontomageton epihydrus)	large leaf pondweed (Potamogeton amplifolius)	Illinois pondweed (Potamogeton illinoensis)	coontail (Ceratophyllum demersum)	common waterweed (Elodea canadensis)	algae present
1	4		1	1		1	4	x
2	4		4			1	3	x
3	5						4	x
4	1						4	x
5	13.5							
6	23.5							
7	3	2	2			2	4	x
8	3		1			2	3	x
9	12							
10	17							
11	5			2		1	1	x
12	3.5		1			2	4	x
13	5					2	4	
14	6						4	
15	3	1				1	4	x
16	1			1			3	x
17	6.5		1	4	2	1	2	x
18	3.5		2	3	1	4		
19	4			1		1	4	x
20	3.5			2	1	1	4	
21	2.5			3		1	4	

Species Density: 1-very sparce (barely any in rake tines), 4-very dense (covering all of rake tines)

Species density estimate graphic http://files.dnr.state.mn.us/assistance/grants/habitat/2007Protocols_pre-trt_data.pdf

Note: Water Below Normal Level

Survey Protocol: Point Intercept Method for Aquatic Plant Management (Madsen, 1999)

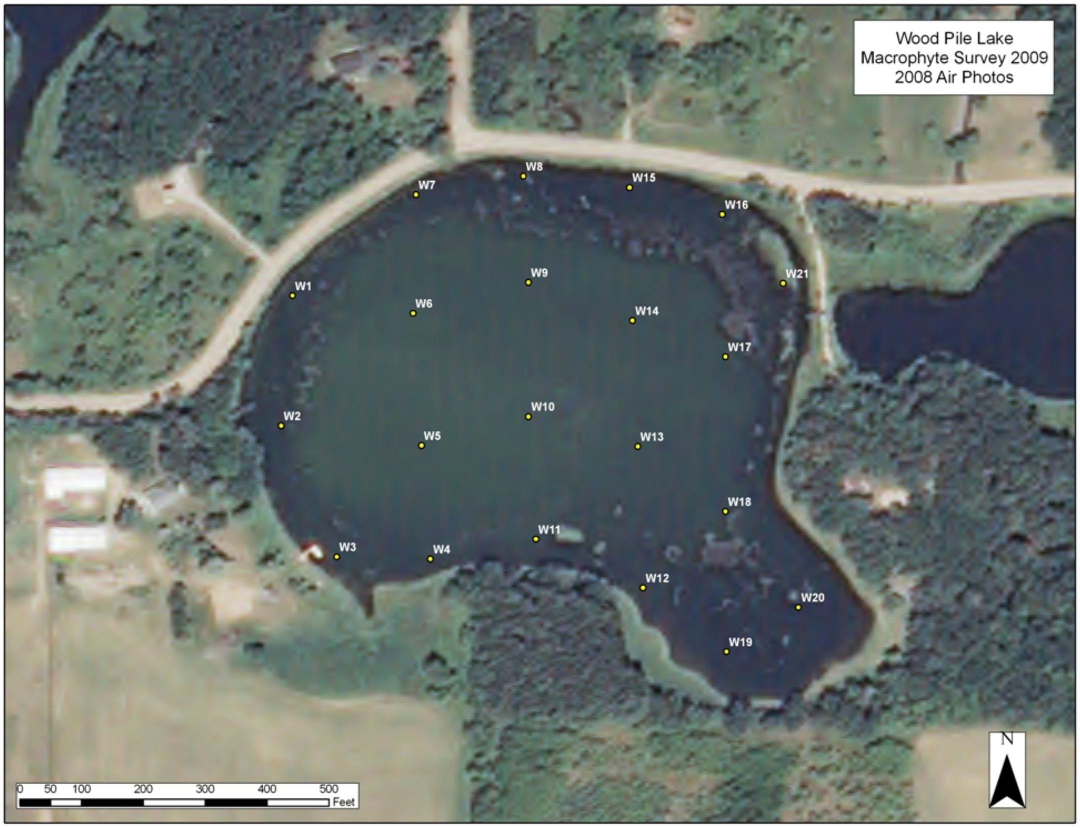

Figure 18. Macrophyte sampling locations. June and September 2009.

APPENDIX C FISH ASSESSMENT OF WOOD PILE LAKE

Wood Pile Lake, October 13, 2010

Fish Assessment of Wood Pile Lake (ID #82-0132), Washington County, Minnesota in 2010

Survey Dates: October 13, 14, 2010

MnDNR Permit Number: 16638

Prepared for:

EOR, Inc and MnDNR

Prepared by:

Steve McComas
Blue Water Science

March 2011

Introduction

Wood Pile Lake is a 14-acre lake, located in Washington County, Minnesota.

In October 2010, EOR, Inc. contracted for a fish survey with Blue Water Science with a permit number 16638 granted from the MnDNR. The objectives were to characterize the fish community in Wood Pile Lake.

Methods

Four standard trapnets were used for two days for a total of eight lifts to survey fish in Wood Pile Lake. The trapnet was a MnDNR-style with a 4 x 6 feet square frame with two funnel mouth openings and 50-feet lead. Net mesh size was ½ inch (bar length). Four standard trap nets were set on Tuesday morning October 12, 2010 Four nets were fished for the following 2 days (October 13, 14). Trapnet locations are shown in Figure 1 and pictures of a typical trapnet are shown in Figure 2.

Figure 1. Map of trapnet sets.

A trapnet is a live fish trap. Fish run into the 50-foot lead net and follow it back through a series of hoops with funnel mouths. Fish end up in the back hoop. The flag marks the end of the back hoop

A dip net is used to remove the fish from the back of the trapnet. In this case, it was mostly painted turtles.

Fish are transferred to tubs, then they are counted and measured and released.

Figure 2. Trapnet set and fish removal in the Wood Pile Lake fish survey.

Results

A total of five fish species were sampled in Wood Pile Lake on October 12 and 13, 2010. Black crappies were the most abundant species followed by bluegills. The number of black crappies caught per net was high with the average haul of 43.3 per net (Table 1). This is above the normal range of 2 to 18 black crappies per lift for a lake like Wood Pile Lake.

Bluegills were found at moderate numbers and within a typical range for a lake like Wood Pile, as defined by the MnDNR, pumpkinseed sunfish were found in low numbers based on a standard range compiled by the MnDNR. Northern pike were present and had a moderate population.

Table 1. Wood Pile Lake trapnet results for the fish survey conducted in October 2010.

Net	Bluegill	Crappie	Pumpkinseed	Hybrid	Northern Pike
Oct. 13, 2010					
1	16	100	--	--	1
2	3	37	--	--	1
3	10	43	--	1	1
4	71	56	3	1	1
subtotal	100	236	3	2	4
Oct. 14, 2010					
1	8	37	1	--	1
2	2	17	--	2	--
3	--	15	--	--	2
4	59	41	3	--	1
subtotal	69	110	4	2	--
Total Fish (8 nets)	169	346	7	4	8
Fish/ Trapnet (8 lifts)	**21**	**43**	**0.9**	**0.5**	**1.0**
MnDNR Normal Range	6 - 60	2 - 18	1 - 8	NA	NA

Fish lengths are shown in Table 2. Black crappies were mostly 7 - 8 inches. Bluegills were represented by fish that were from 2 inches up to 9 inches in length but the majority of the population was less than 6 inches. Northern pike were present and their lengths were measured up to 29 inches. At this length, the northern pike population should be able to keep black crappies and sunfish under control.

Table 2. Length frequency of fish species (as total length) for the Wood Pile Lake fish survey.

Size Range (in)	Bluegill	Crappie	Pumpkinseed	Hybrid	Northern Pike
2	2.3% (4)				
2.5	53% (90)				
3	11% (19)	10% (35)			
3.5	1.8% (3)	7.2% (25)			
4		0.9% (3)			
4.5		0.9% (3)	28.5% (2)		
5	6% (10)	12.2% (42)			
5.5	8.8% (15)	5.8% (20)			
6	9.5 (16)	1.2% (4)		100% (4)	
6.5	6% (10)		28.5% (2)		
7		10.8% (37)			
7.5		26% (89)			
8	0.6% (1)	22% (76)			
8.5		2% (7)	14%(1)		
9	0.6% (1)	0.2% (1)	28.5% (2)		
9.5		0.2% (1)			
10					
10.5					
11					
11.5					
12					
12.5					
13					
13.5					
14		0.2% (1)			
14.5					
15					
15.5					12.5% (1)
16					
16.5					
17					
17.5					
18					
18.5					
19					
19.5					
20					
20.5					
21					
21.5					
22					
22.5					
23					
23.5					
24					
24.5					
25					25% (2)
25.5					
26					12.5% (1)
26.5					12.5% (1)
27					12.5% (1)
27.5					
28					12.5% (1)
29					12.5% (1)

Representative Fish Species of Wood Pile Lake

Figure 3. Top left: Northern pike.
Top right: Black crappie.
Bottom left: Bluegill sunfish.
Bottom right: Pumpkinseed sunfish.

Turtle Results: Snapping turtles and painted turtles were also sampled in the trapnets and were common in Wood Pile Lake. Painted turtles were common although the number of turtles was typical for a lake like Wood Pile that has a high percentage of a natural shoreline area.

Table 3. Painted turtle and snapping turtle catch per net for the two netting days and the two day total and number per lift.

Net	Painted Turtles	Snapping Turtles
(Oct 13, 2010)		
1	22	1
2	46	0
3	10	0
4	8	2
subtotal	86	3
(Oct 14, 2010)		
1	10	0
2	11	0
3	3	1
4	1	2
subtotal	25	3
Total Turtle (8 nets)	111	6
Turtle/ Trapnet (8 lifts)	**14**	**0.8**

A Wood Pile Lake snapping turtle.

Conclusions

The fish community has a simple community structure based on trapnet catches. The black crappie population was above average in fish per trapnet catch rate. Bluegill sunfish had a relatively high count but most of the fish were young-of-the-year and were 3 inches or less in length.

There are at least a couple of year classes of black crappies and bluegills.

Northern pike ranged in length from 15-29 inches. The northern pike population should maintain predation pressure on the panfish.

Steve McComas (Blue Water Science) and Pat Conrad are working up fish from the trapnet.

Appendix A

Minnesota DNR Fish Survey Notification

Steve McComas

From:	Steve McComas <mccomas@pclink.com>
Sent:	Monday, October 11, 2010 2:11 PM
To:	Scott Carlson; Gerald Johnson
Cc:	Pat Conrad
Subject:	Woodpile Lake fish survey starting October 12

Hello All,

Steve McComas of Blue Water Science will be conducting a fish survey in Woodpile Lake (ID: 82-0132) Washington County) starting on Tuesday, October 12, 2010 and finishing on Thursday, October 14. We will set 4 fyke nets. All fish will be weighed and measured and returned to the lake. The fish survey is sponsored by the engineering firm EOR. This survey is conducted under MnDNR permit number 16638.

Thank you,

Steve McComas
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Wood Pile Lake Fish Survey

Sponsored by Brown's Creek Watershed District

Fish Community of Wood Pile Lake, Washington County (October 13, 2010)

Bluegill sunfish – common (5-6 inches)
Black crappie – abundant (6-9 inches)
Northern pike – abundant (25-28 inches)
Pumpkinseed sunfish – present

Painted turtles – abundant
Snapping turtles - common

APPENDIX D JULY 21, 2011 PUBLIC MEETING PARTICIPANTS

Name	Affiliation
Karen Kill	BCWD Administrator
Rick Vanzol	BCWD Board Manager
Pat Conrad	EOR
Meghan Jacobson	EOR
Lynda Bangston	Resident
Robert & Diane	Resident
Paul Johnson	Resident
Joyce & John Povolny	Resident