Highway 36 and 61 Intersection Enhanced Sand Filtration and Menards' Parking Lot Pervious Pavement

Feasibility Report

Prepared for
Ramsey-Washington Metro Watershed District

April 2007

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December 2006

BARR

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Executive Summary

Approximately 70 acres of commercial, residential and highway land drains untreated to Keller Lake through the Highway 36 cloverleaf interchange with Highway 61. Because of the highly-developed nature of this drainage area, ponding is not a feasible alternative. Three innovative treatment technologies have been identified as feasible options for treating stormwater runoff from this drainage area—enhanced sand filtration, constructed wetlands, and pervious pavement. The sand filter and constructed wetlands would reside within the cloverleaves of the highway interchange; the pervious pavement would treat approximately 5 acres of parking lot at Menards' Maplewood store.

Sand filters used for stormwater treatment are at-grade layers of sand placed over a network of perforated drain pipes. Surface water runoff is directed toward the sand layer filters through the sand and then discharges through the drain pipes. Research has shown that amending the sand filter media with steel fibers can enhance the removal of dissolved phosphorus from the influent stormwater.

Constructed wetlands are man-made wetlands designed to perform a specific purpose. The constructed wetlands would be designed to remove TSS and TP by providing a settling zone for sediment, fostering hardy vegetation that can adsorb solids, and allowing plant uptake of pollutants. The constructed wetlands would be used to provide treatment of untreated stormwater and to provide sediment removal from stormwater upstream of the enhanced sand filter.

Pervious pavement, which can be either asphalt or concrete, omits sand and fine particles from the aggregate mix thereby creating significant void spaces in the pavement. When placed over a layer of crushed rock, the pervious pavement functions as a filter for stormwater runoff. The system can be equipped with an underdrain to slowly drain the water from the subsurface, or if the soils are conducive, the water can be allowed to infiltrate into the ground.

Initial estimates predict the proposed system will remove up to 52 percent of the total influent phosphorus loading with the best removal efficiencies being achieved by the enhanced sand filter and the pervious pavement. Since these technologies are considered new and innovative, performance monitoring would be incorporated into the project.

The total estimated cost to design, construct ,and perpetually maintain the proposed treatment system is approximately $1.9 million. Due to the significant total project cost, it is anticipated that grant opportunities will be pursued to help cover a significant portion of the costs.

Highway 36 and 61 Intersection Enhanced Sand Filtration and Menards' Parking Lot Pervious Pavement Feasibility Report

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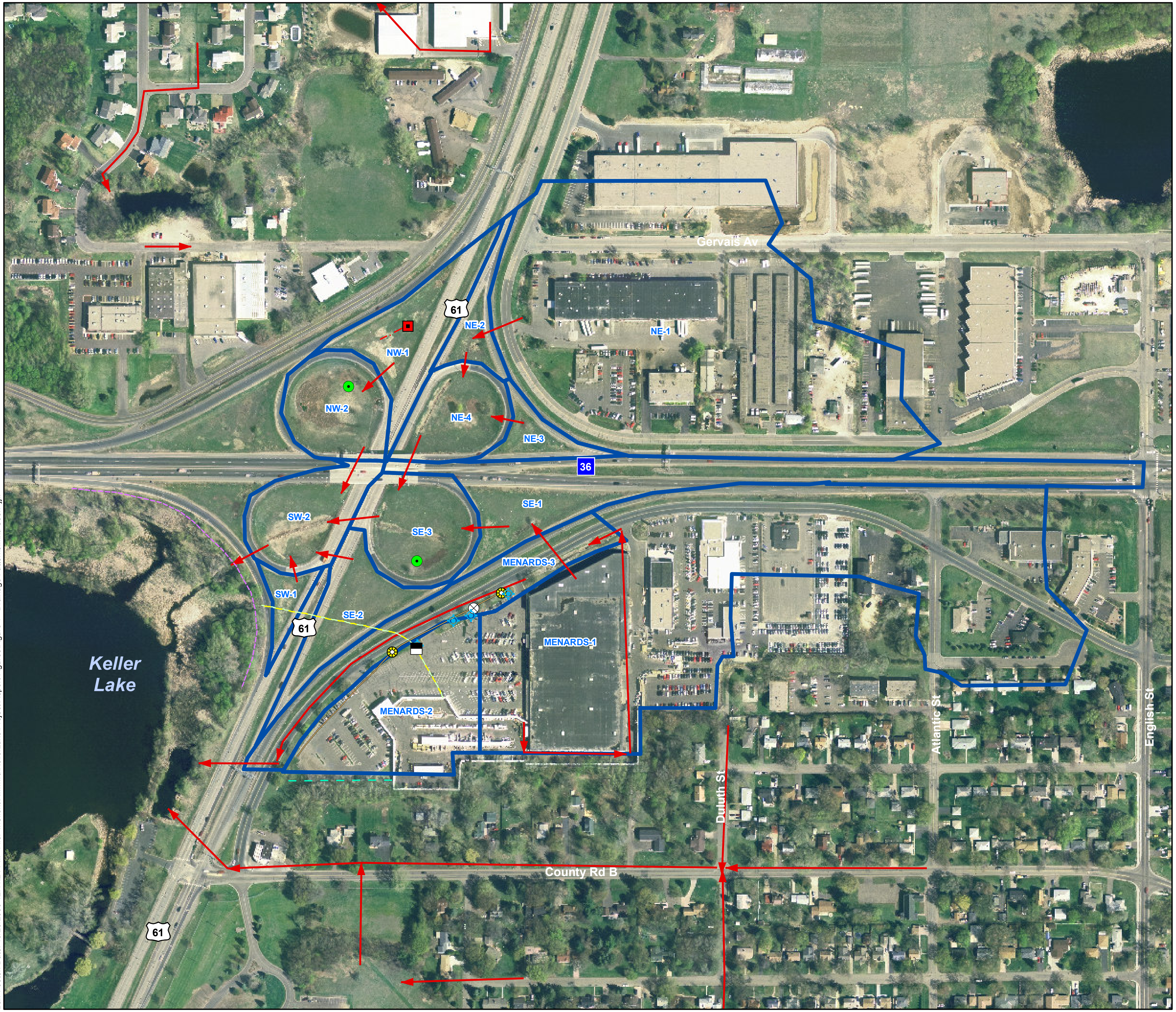
1.0 Introduction

Keller Lake, part of the Phalen Chain of Lakes, is located entirely within the City of Maplewood, and lies Southwest of the intersection of Trunk Highways 36 and 61 (T.H. 36 and T.H. 61). Keller Lake is listed on the Minnesota Pollution Control Agency's (MPCA) 2006 303(d) Impaired Waters List for excess nutrients. The proposed Cloverleaf Enhanced Sand Filtration/Constructed Wetland and Menards' Pervious Pavement projects seek to mitigate water quality problems by treating runoff that currently drains untreated (i.e. runoff does not drain through any ponds, wetlands, or treatment systems) into Keller Lake and thus move Keller Lake one step closer to being removed from the Impaired waters list. The water-quality treatment goal of these projects is to maximize the available space to provide pretreatment of runoff from the 49.8 acres of impervious surfaces that drain untreated to Keller Lake from the Northeast.

Approximately 67 acres of commercial land and highway right-of-way drains untreated through the T.H. 36 and T.H. 61 cloverleaf interchange, including 45 acres of impervious surface. An additional 4.8 acres of parking lot from Menards' Maplewood store drains to Keller Lake from the East. In total, the project area represents approximately one third of the untreated areas draining to Keller Lake. Figure 1 shows the existing drainage patterns through the project area.

This area of Maplewood developed before water quality requirements were incorporated into the development process. Since redevelopment is likely in the distant future, water quality retrofits are the only immediate option for providing treatment of runoff prior to its discharge into Keller Lake. Of the treatment best management practices (BMPs) available; sand filtration, constructed wetlands, and pervious pavement were selected for the following reasons:

- The cloverleaf areas are too small for traditional ponds.
- The selected BMPs are considered cutting-edge technologies that can be retrofitted to a site.
- The projects would not require the acquisition of land.
- The selected BMPs could be implemented within the constraints set by Minnesota Department of Transportation (MnDOT).
- The highway interchange and Menards' parking lot will continue to function as their intended use.



Legend

- Control Box
- Gas Pipeline Box
- Light Pole
- Sanitary Control Valve
- Sanitary Manhole
- Soil Boring
- Comcast Cable - Approximate
- Gas Main - Approximate
- Gas Pipeline
- MCES Sanitary Line
- MnDOT Cable - Approximate
- Existing Storm Sewers
- Subwatersheds

N

Feet

200 0 200 400 600

BARR

Figure 1

EXISTING DRAINAGE PATTERNS
Highways 36/61 Cloverleaf Treatment
Ramsey-Washington
Metro Watershed District

October 2006

Preliminary cloverleaf project plans include the construction of a sand filtration basin and two constructed wetlands within the T.H. 36 and T.H. 61 cloverleaves. The sand filtration basin, which would be constructed in the Northwest cloverleaf, would be enhanced with processed steel fiber, which has been shown to remove dissolved phosphorus. Low flows of stormwater runoff from the Northeast tributary areas would be diverted to the West side of T.H. 61 and first directed into a pre-treatment basin where debris and sediment can be removed from the runoff before the water would drain into the sand filtration basin. Water would then flow through the enhanced sand filter, which will have the capacity to further remove suspended solids and some dissolved nutrients. According to the MPCA, a well-designed sand filtration system can remove approximately 80 to 95 percent of total suspended solids and 40 to 60 percent of total phosphorus from water directed through the system. Research has shown that sand filters amended with steel wool fibers can achieve even higher removals – up to 90 percent (Erickson, et al, 2006).

Constructed wetlands, proposed for the Northeast and Southeast cloverleaf areas, are wetlands engineered to improve water quality. The wetland systems remove pollutants through physical (sedimentation and filtration), chemical (adsorption), and biological means (plant uptake). For the drainage area North of T.H. 36, a constructed wetland in the Northeast cloverleaf would provide treatment of the higher flows that are not diverted to the sand filtration system. The drainage area South of T.H. 36 would be routed through a constructed wetland in the Southeast cloverleaf.

The project plans for Menards' parking lot include placing pervious pavement (either concrete or asphalt) over a layer of porous granular material where further filtration and treatment can occur. A study of the effectiveness of pervious pavement in Prince William County, VA showed the pavement removed 83 percent of total suspended solids (TSS) and 65 percent of total phosphorus (TP) (www.perviouspavement.org). The location of the proposed cloverleaf and parking lot projects can be seen on Figure 2.

Legend

- Constructed Wetland
- Filtration Basin
- Porous Pavement
- Pretreatment Basin

N

Feet
200

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Figure 2

WATER QUALITY IMPROVEMENTS
Highways 36/61 Cloverleaf Treatment
Ramsey-Washington
Metro Watershed District

October 2006

2.0 Treatment Technologies

Before a treatment technology was selected, Menards and the Minnesota Department of Transportation (MnDOT) were contacted to gauge their interest in the project and to gather their comments and concerns. Both property owners are receptive to water quality improvement projects and each has conditions of approval to the project. Menards is unwilling to forfeit any parking spaces, so all treatment has to occur off site, under ground, or on the parking surface. MnDOT's primary concern is public safety, so their requirements are aimed at protecting their highways and limiting damages and injuries to errant vehicles and passengers. MnDOT requires a minimum of 5 feet of cover over the top of any pipe that is jacked under a highway. They also do not allow ponding in the gore areas of the interchange (the triangular areas created where roads merge or split), nor do they allow any solid, protruding objects, such as concrete structures or large diameter riprap, that could damage vehicles, to be installed in the right-of-way.

Several BMPs known to remove the targeted pollutant (phosphorus) were analyzed for compatibility with the unique site constraints at each project location. The BMPs were scrutinized for their ability to be retrofitted into existing spaces and were ranked based on the perception of being innovative treatment technologies. The results of the analysis are summarized in Table 1.

Based on the analysis of BMPs, the project is proposing to use three different types of treatment technologies –sand filtration, constructed wetlands, and pervious pavement. These technologies are constructible within the given site constraints and they maximize treatment capacity at each project location.

It should be noted that the technologies presented here are considered to be, to varying degrees, experimental. Although these technologies have been, to some degree, researched by different groups (results are provided in this report), these are new technologies that have not been implemented in the field by many organizations. This is likely due to the inherent risks that employing new technologies involve. It is likely that implementation of these types of projects would indeed be a "learning experience" and treatment success would improve over time as projects are fine tuned. This certainly introduces an element of risk (in terms of whether treatment goals are met, as opposed to a risk to the environment) for the District, but it also provides an opportunity to take the lead on implementing innovative technologies that hold promise. Creating significant improvement in lake water quality of Keller Lake may well require the District to take the lead on implementing new technologies that have a calculated risk, but also a reasonable expectation for success. The technologies described herein are thought to fit this category.

2.1 Sand Filtration

Sand filtration basins, also commonly called sand filters, are a common method for phosphorus reduction in stormwater runoff. Most sand filtration systems use a combination of sand and drain rock. New research has shown that the addition of enhancing media to the sand layer can greatly improve phosphorus removal efficiencies. Because sand filters tend to be one of the more expensive treatment technologies, they are typically reserved for areas that have high treatment goals, with very little land space to achieve them.

Sand filtration systems are typically designed to remove particulate matter and phosphorus from stormwater flows. With the addition of steel fiber or steel wool blankets, additional removal of soluble phosphorus is possible. Other types of filter amendments, such as peat, perlite, zeolite, calcareous sand, and limestone have been researched. However, these amendments currently hold less promise for the treatment of soluble phosphorus than steel wool amendments. Steel wool blankets are recommended to limit clogging and reduce maintenance.

When using a sand filtration system, pretreatment is essential to ensure the long-term effectiveness of the system. By having an upstream pond or settling basin, sediment particles that would otherwise quickly plug the sand filter can be removed before it reaches the filter. It is estimated that without pretreatment, the sand filters would need to be cleaned an additional two or three times per year (Shapiro 1999).

2.1.1 Enhanced Sand Filtration Design

The basic sand filtration system consists of a top layer of planting soil and sand (minimum depth of 18 inches), followed by geotextile filter fabric placed on top of a layer of drain rock or gravel backfill. An underdrain collector pipe is imbedded in the drain rock and discharges the filtered stormwater to a downstream discharge point. Figure 3 shows a typical section of a filtration system and Figure 4 shows a typical section of an enhanced sand filter and pretreatment basin.

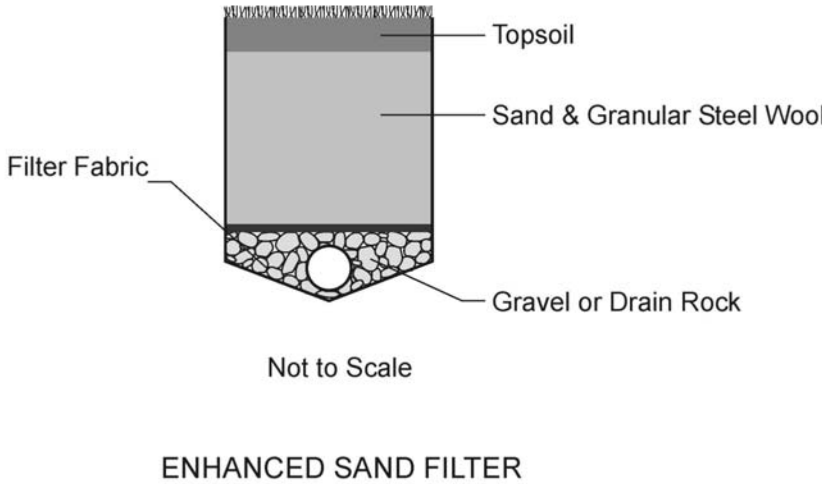


Figure 3 Cross Sectional Schematic of an Enhanced Sand Filter

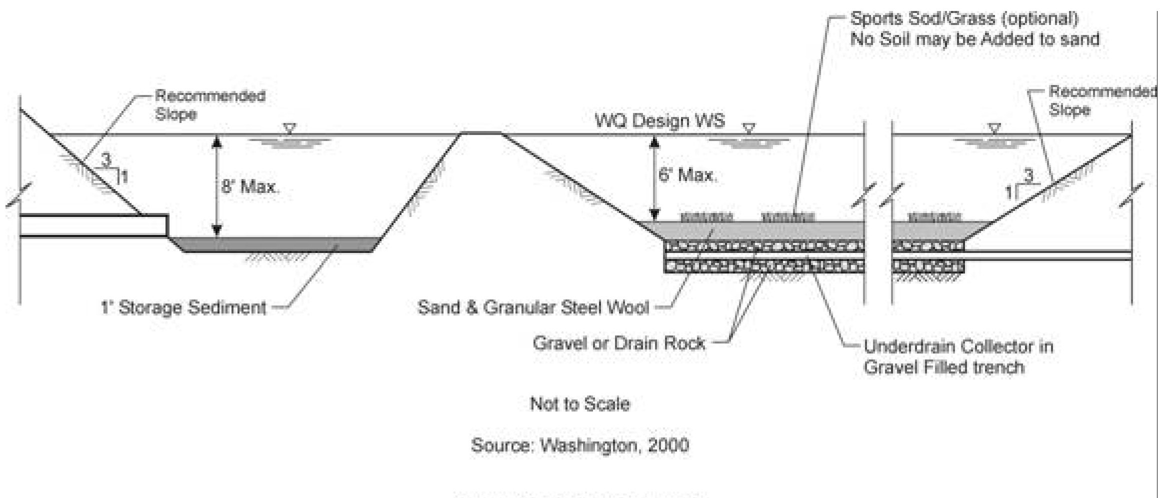


Figure 4 Cross Sectional Schematic of an Enhanced Sand Filter and Pretreatment Cell

2.1.2 Maintenance

Enhanced sand filters are maintenance intensive. Routine maintenance activities include:

- Cleaning of pre-treatment basin/vault at least every 5 years,
- Removing accumulated sediment from the surface of the filter 1 to 2 times a year (this could be done based on a visual inspection to preserve established vegetation). The surface scraping would be required an additional 1 to 2 times per year if no pre-treatment available,

- Rototilling of surface may be necessary every year to break up surface layer of sediment and maintain hydraulic capacity,
- Replacing the filter media every 10 years.

2.1.3 Performance

A sand filter facility in Bellevue, WA receiving stormwater with inflow concentrations of total and soluble phosphorus of 94 and 26 μg/L, reduced loading between 43 and 72 percent (City of Bellevue 1999). This facility used chopped granular steel wool that increased clogging and created anaerobic conditions within the filter, thereby reducing its effectiveness at removing phosphorus.

A column design by Erickson et al. (2006) provided between 40 and 90 percent removal of soluble phosphorus in a system comprised of C33 sand with granular steel wool or steel wool fabric as an amendment. Steel wool fabric was more efficient at removing phosphorus and was easier to use, but was also more expensive. A relationship between phosphorus sorbed and number of steel wool fabric layers was developed to determine fraction of phosphorus removed from the inflow. This information can be used to help design for a specific removal rate given a specific flow rate and influent TP concentration.

2.1.4 Landscaping

Construction of the sand filtration treatment system will include the restoration of native upland and emergent vegetation. Hardy plants within the wetland ponds and sand filtration basin serves two purposes—aesthetic and function. The native plants provide beauty and interest to the area adjacent to Keller Lake, while also helping to filter out pollutants before they enter the lake. These plants naturally bind pollutants and foster evaporation of excess water.

2.2 Constructed Wetlands

Constructed wetlands are defined as man-made wetlands designed to improve storm water quality. Constructed wetlands can provide natural, aesthetically pleasing zones of removal for TSS, TP, and other constituents before these pollutants enter critical systems. The wetland systems remove pollutants through physical (sedimentation and filtration), chemical (adsorption) and biological means (plant uptake). Stormwater is stored in shallow pools where sedimentation occurs and then flows through vegetated zones (mainly emergent or riparian) within which pollutant uptake and removal occurs. Constructed wetlands generally require a larger area than some other types of BMPs for stormwater treatment, but can be less intensive in terms of maintenance.

A constructed wetland for stormwater will generally consist of a pre-treatment settling area followed by a vegetated removal zone. Water pools in the settling area which allows for sedimentation and some adsorption of phosphorus to occur. The water then flows through the downstream portion of the system, coming into contact with mostly emergent vegetation where additional removal of sediment occurs in addition to removal of nutrients (phosphorus), metals, oils, etc.

2.2.1 Design of Constructed Wetlands

Constructed surface wetlands are designed to give storage capacity for water treatment and sizing is designed to achieve optimum residence time with available land. Treatment wetlands are created with a sedimentation area as the first section of the system, to allow for settling of larger particles as the water velocity slows. If high amounts of oil and/or grease are expected, an inlet skimmer is also required before entrance into the wetland area. The water then flows through a vegetated zone where additional pollutant removal occurs. Water depth is controlled for desired plant type (i.e. emergent macrophytes) and plant species are generally a mix of persistent emergent species that give resistance to water flow, supplemented with submergent species better suited for removing nutrients. Fine textured, clay-type soils are used and available calcium, iron, aluminum, and organic matter can all increase nutrient retention by the sediment.

2.2.2 Maintenance

Periodic visual monitoring of the wetland should be performed several times annually. Sediment and debris removal will be necessary every 3 to 6 years, depending on the loading, to assure the performance of the wetland. Additional planting and species substitution may be necessary if initial plantings survive at lower rates than expected. Undesired species may need to be controlled as well to keep the wetland functioning properly.

2.2.3 Performance

Because most parameters in stormwater are time dependent, removal is generally dependent upon detention time of stormwater within the constructed system with greater detention time corresponding to greater pollutant removal. Therefore, the larger the wetland, the greater the watershed area it is able to treat effectively. Relationships developed specifically for estimating area needed for treatment of a respective watershed have been developed. These relationships also make it possible to estimate TSS and phosphorus removal based on detention time of the stormwater. Designed properly, constructed wetlands can remove up to 60 percent of total phosphorus and between 60 percent and 85 percent of TSS.

2.3 Pervious Pavement

The use of pervious pavement is an effective way to convert a parking lot from an impervious surface to pervious surface. Pervious pavement, which can be made using asphalt or concrete, allows rainwater to permeate through the surface layer of pavement and travel to a porous subsurface layer (typically washed, crushed rock) where it can infiltrate into the ground or be removed with an underdrain system.

While both porous asphalt and pervious concrete are quite effective in infiltrating a large amount of stormwater, there are advantages and disadvantages to each option. Porous asphalt—which comprises the driveway to the RWMWD office – is less expensive to install and the procedure for installation is much easier. Pervious concrete, however, lasts much longer (thus making the life-cycle cost lower than that of porous asphalt), and is much more durable under heavier traffic. Pervious concrete is also more tolerant of hot weather conditions where porous asphalt will display surface raveling. Additionally, a common problem with porous asphalt is that it can be easily mistaken for non-porous asphalt and be seal-coated by a pavement contractor. This is much less likely to happen with pervious concrete where there is a greater visual difference between concrete and asphalt.

2.3.1 Pervious Pavement Design

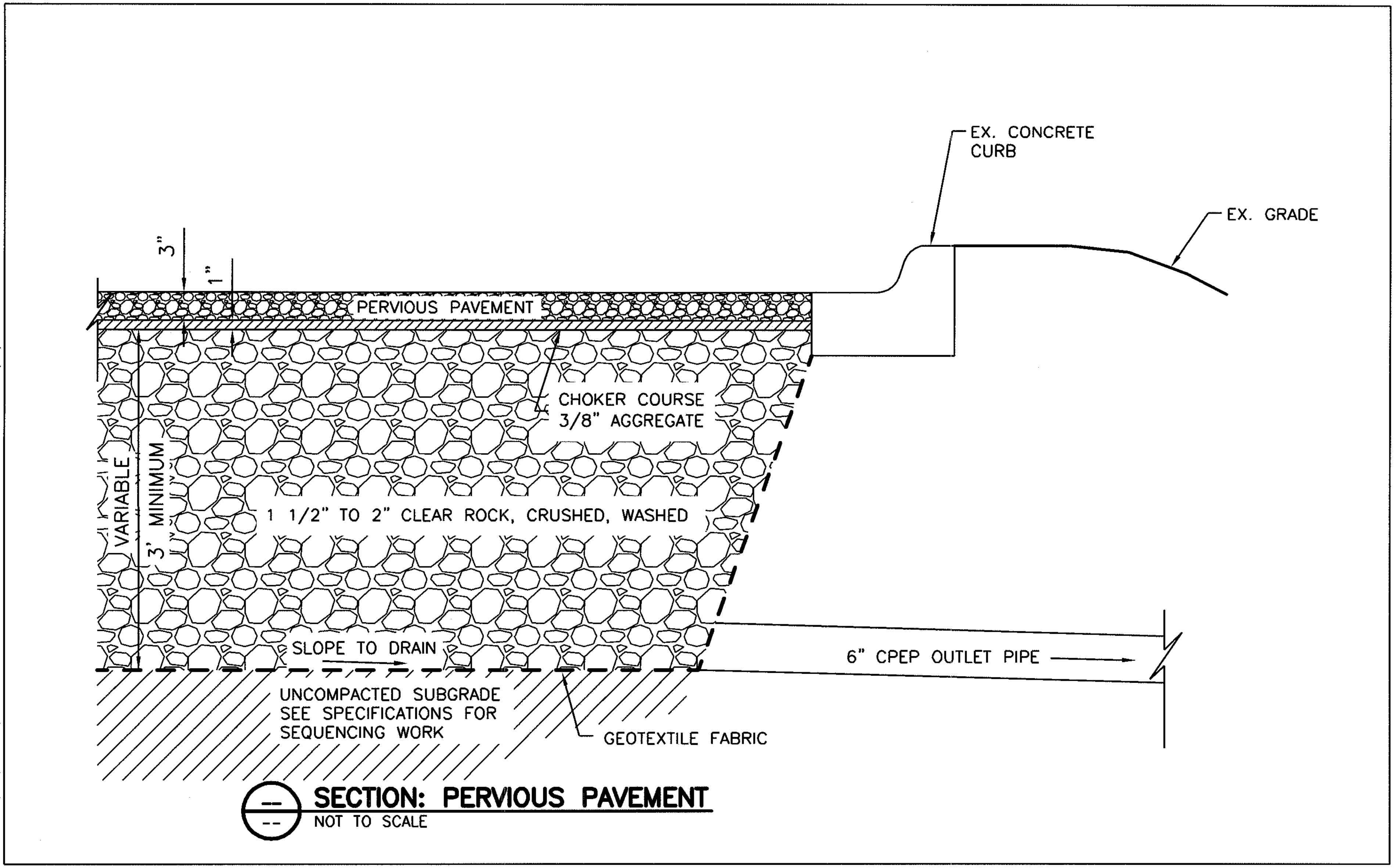
A pervious pavement system typically consists of a 3-foot sub-grade layer of clear rock placed over a geotextile filter. If the infiltration capacity of the underlying soils is low, an underdrain system may be installed that would discharge into a storm sewer system. Depending on the site soils, the underdrain pipe could be perched above the bottom of the sub-grade layer to ensure a design volume of water is infiltrated. A choker course of 3/8-inch aggregate is placed over the clean rock and the pervious pavement is placed on the choker course. Figure 5 shows a typical section of pervious pavement.

2.3.2 Maintenance

Proper maintenance is necessary to preserve the effectiveness of the pervious pavement. The surface use of sand and salt in the icy winter months can quickly plug the openings in the pavement and should be avoided. Deicing chemicals can break down the binding agents in the pervious pavement and should also be avoided. Standard maintenance activities include periodic vacuuming and power washing to remove sediments and other debris that reduce the efficiency of the pavement.

2.3.3 Performance

The use of pervious pavement as a stormwater BMP is relatively new, so there is not a lot of data available to determine the expected performance of pervious pavement. However, the results of a study performed in Prince William, VA showed removal efficiencies of up to 82 percent for total suspended solids and 65 percent for total phosphorus (www.perviouspavement.org).



CADD USER: Jason Westbrock FILE: M:\CAD\2362921\POROUSPAVEMENTDETAIL_FIGURES.DWG PLOT SCALE: 1:1 PLOT DATE: 10/25/2006 12:12 PM

Figure 5

PERVIOUS PAVEMENT PROFILE

Menards Parking Lot Treatment
Ramsey–Washington Metro Watershed District

3.0 Project Descriptions

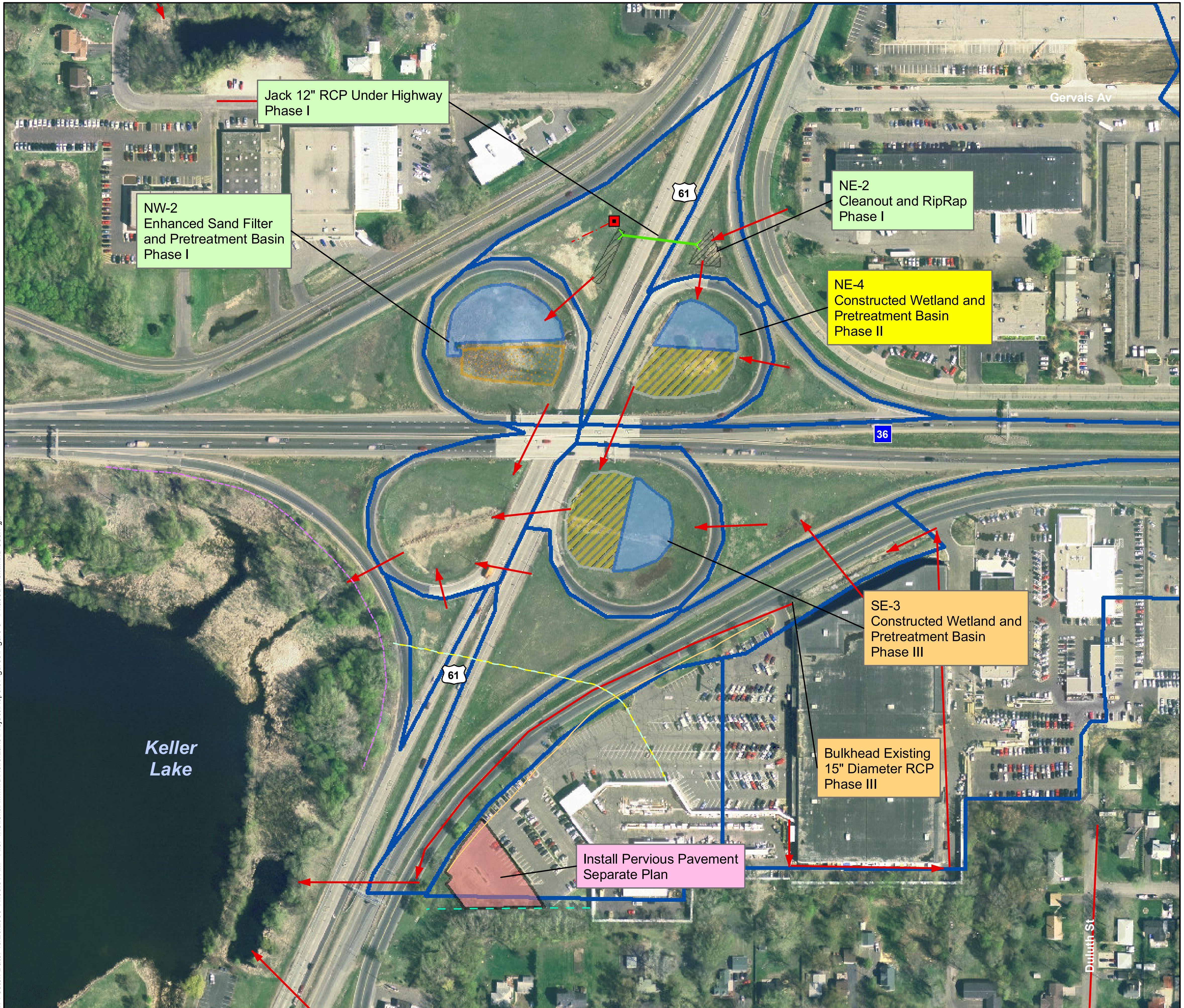
The projects described in this report could be completed as a single project, or split into multiple, separate projects as funds become available. Specifically, the sand filtration basin and constructed wetlands in the highway interchange cloverleaf areas could be broken into three separate projects – a Northwest cloverleaf project, a Northeast cloverleaf project, and a Southeast cloverleaf project. If the project were to be broken into phases, the Northwest cloverleaf project should be completed first and the Northeast and Southeast cloverleaf projects should be completed second and third, respectively. The Menards' parking lot project could be completed independently of the cloverleaf project. The projects are described in greater detail in the following sections and location and proposed phasing plan is shown on Figure 6.

3.1 Phase I—Northwest Cloverleaf Project

Approximately 18 acres of impervious surface drains into the highway cloverleaf system from the Northeast. The existing drainage system (as shown on Figure 1) directs runoff originating Northeast of the highway intersection through the Northeast cloverleaf (NE-4), then South through the Southeastern cloverleaf (SE-3), and finally West through the Southwest cloverleaf (SW-2) prior to discharging into Keller Lake. Since upstream runoff is not directed through NW-2, the Northwest cloverleaf project will take advantage of the space in the Northwest cloverleaf (NW-2) by jacking a new 12-inch diameter concrete pipe under T.H. 61, which will divert low flows from NE-2 to NW-1.

3.1.1 Enhanced Sand Filter

The flows diverted to NW-1 will then drain to NW-2, where the enhanced sand filter and pretreatment cells will be constructed. Flows will first be directed to the stormwater pretreatment cell which will be constructed in the Northern half of NW-2. The pretreatment cell will remove sediment and debris from the stormwater before it discharges to the enhanced sand filter. A berm will separate the pretreatment cell from the sand filter and an armored overflow will connect the two cells.



Legend

- Control Box
- Proposed Culverts
- Existing Storm Sewers
- Comcast Cable - Approximate
- Gas Main - Approximate
- Gas Pipeline
- MCES Sanitary Line
- MnDOT Cable - Approximate

Proposed Treatment

- Constructed Wetland
- Filtration Basin
- Porous Pavement
- RipRap
- Pretreatment Basin
- Subwatersheds

N

Feet

200 0 200

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Figure 6

WATER QUALITY IMPROVEMENTS
PHASED WORK
Highways 36/61 Cloverleaf Treatment
Ramsey-Washington
Metro Watershed District

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The enhanced sand filter will be constructed South of the pretreatment cell in the Southern half of NW-2. A basin will be created by excavating the cloverleaf area to Elevation 861.2 and the bottom will be lined with geotextile filter fabric. A series of 6-inch-diameter perforated drain tile pipes will be placed on top of the filter fabric and the pipes will connect into a modified outlet at Elevation 861.2. The basin area will then be backfilled with a 6-inch layer of pea rock, a 15-inch layer of filter sand blended with processed steel fiber, and a 3-inch layer of engineered topsoil. A geotextile filter fabric will separate the sand layer from the pea rock layer. The topsoil, which will be similar to the topsoil specified for rainwater gardens, will consist of 50 percent sandy loam and 50 percent compost.

In order to take full advantage of the existing outlet from NW-2, a 2-foot high concrete weir will be poured around the existing 18-inch-diameter outlet pipe. Holes will be core drilled into the weir to accommodate the drain tile pipes. The backfill will be level at Elevation 863.2 and will terminate at the lip of the outlet weir, which will allow any excess flows that may exceed the capacity of the filtration system to bypass the system without creating flooding problems.

The estimated cost to design, construct and perpetually maintain the enhanced filter in the Northeast cloverleaf area is approximately $700,000. This includes estimated engineering, contingency and maintenance costs (assuming a 30-year project life). Table 3 shows a breakdown of the project costs.

3.1.2 Northwest Cloverleaf Constructed Wetland

During the course of this study, an alternative to enhanced sand filtration was considered for the Northwest quadrant of the cloverleaf and so the cost and expected performance of a constructed wetland was evaluated for this area. Although the total cost of a constructed wetland was estimated to be roughly half of the cost of an enhanced sand filter, the phosphorus removal was halved as well. In the interest of maximizing phosphorus removal in the Northwest quadrant, an enhanced sand filter was deemed the preferred project alternative.

3.2 Phase II—Northeast Cloverleaf Project

The Phase I flow diversion will only divert low flows to NW-1, leaving higher flows to continue to drain through the existing system to NE-4. Treatment of the high flows that bypass the sand filter will be provided by excavating a constructed wetland in NE-4. Similar to the sand filter in NW-2, the constructed wetland will have two cells—a pretreatment cell and a wetland cell.

3.2.1 Northeast Cloverleaf Constructed Wetland

The pretreatment cell, located in the Northern half of the cloverleaf area, will be excavated down to approximately Elevation 858 and will provide initial sediment removal from the influent stormwater. A berm will separate the pretreatment cell from the wetland to prevent short circuiting through the pretreatment cell and an armored overflow will connect the two cells. The wetland area will be a pool approximately 1-foot deep that will be dominated by emergent vegetation. Region-specific emergent macrophytes will be planted in the shallow wetland area and the vegetation will trap pollutants and adsorb soluble phosphorus. The wetland will discharge into the existing 30--inch diameter outlet pipe at Elevation 861.1.

The estimated cost to design, construct and perpetually maintain the constructed wetland in the Northeast cloverleaf area is approximately $316,000. This includes estimated engineering, contingency and maintenance costs. Table 4 shows a breakdown of the project costs.

3.3 Phase III—Southeast Cloverleaf Project

Approximately 21 acres of impervious surface drains into the highway cloverleaf system from the Southeast. The existing drainage system (as shown on Figure 1) directs runoff originating from the area East of Menards' building into a storm sewer system that parallels the frontage road and discharges into a ditch adjacent to, and South of, the frontage road between the two driveway entrances that bound Menards' storefront. Low flows are directed into a 15-inch diameter storm sewer pipe that continues to parallel the frontage road, crosses T.H. 61 near the Southern edge of the Menards' property, and discharges into a treatment pond on the Northeastern end of Keller Lake. High flows in the ditch are directed into SE-1 via two manhole drop structures connected to 24-inch diameter pipes.

3.3.1 Southeast Cloverleaf Constructed Wetland

By bulkheading the 15-inch diameter low flow pipe and modifying the existing manhole drop structures, all of the runoff from the MENARDS-1 drainage area can be directed through the constructed wetland in SE-3. The basin will be similar to the constructed wetland in NE-4.

The Southern cloverleaf constructed wetland will be similar to the Northern constructed wetland. The bottom of the cloverleaf will be excavated to an approximate elevation of 856.0 for the pretreatment cell and the bottom elevation of the wetland area will be 858.0. A berm will separate the pretreatment cell from the sand filter to prevent short circuiting through the pretreatment cell and an armored overflow will connect the two cells. Region specific emergent macrophytes will be planted within the SE-3 basin to contribute in the removal of pollutants in the stormwater.

The estimated cost to design, construct and perpetually maintain the constructed wetland in the Southeast cloverleaf area is approximately $424,000. This includes estimated engineering, contingency and maintenance costs. Table 5 shows a breakdown of the project costs.

3.4 Phase IV—Pervious Pavement Project

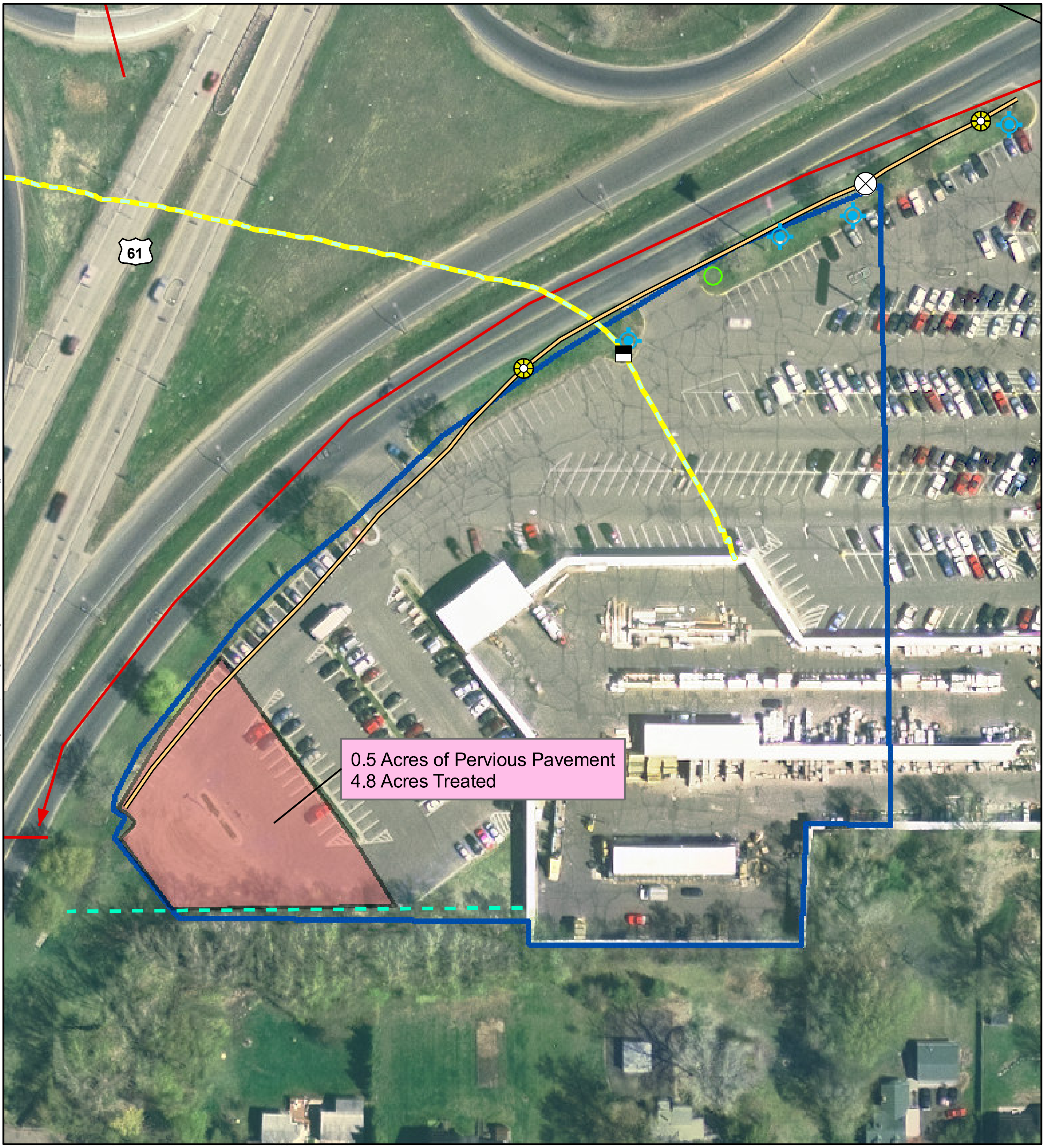
The pervious pavement project in Menards' parking lot will work with the existing layout, grades and curb lines of the parking lot to retrofit the pervious pavement as shown in Figure 7. Approximately one-half acre of impervious asphalt pavement will be replaced with pervious pavement. The existing asphalt will be saw cut and removed while the existing concrete curbing will remain in place.

Once the asphalt is removed, a minimum of 3 feet of subgrade will be removed. The bottom of the excavation will maintain the slope of the surface grade and will be directed to drain to a single outlet point. The bottom of the excavation will be covered with a geotextile filter fabric and the excavated subgrade will be replaced with a 1½-inch to 2-inch, clean washed, crushed rock. A 1-inch thick choker course of 3/8-inch aggregate will be placed on top of the crushed rock and the pervious pavement will be placed over the choker course.

A 6-inch diameter outlet pipe will be placed at the low point in the subgrade and the pipe will be connected to an existing manhole catch basin located along the frontage road, South and East of the parking lot. The small diameter outlet pipe will allow the system to take advantage of the pore storage in the crushed rock which will slow the discharges to Keller Lake. The slow release will also allow the project to take advantage of the infiltration capacity of the existing soils.

Once installed, the pavement will require continuous maintenance. A minimum of twice annually, the pervious pavement needs to be pressure washed and swept with a vacuum street sweeper. Snow and ice management practices will also have to change as sand and/or chemical applications within the drainage area can shorten the life of the pervious pavement. The District will work with Menards to develop a viable pavement management plan for the pervious pavement drainage area.

The estimated cost to design, construct and perpetually maintain the pervious pavement system in the Menards' parking lot is approximately $503,000. This includes estimated engineering, contingency and maintenance costs. Table 6 shows a breakdown of the project costs.



Legend

- Gas Pipeline Box
- Light Pole
- Sanitary Control Valve
- Sanitary Manhole
- Porous Pavement
- Comcast Cable - Approximate
- Gas Main - Approximate
- Gas Pipeline
- MCES Sanitary Line
- Existing Storm Sewers
- Drainage Area to Porous Pavement

N

Feet
50 0 50

BARR

Figure 7

MENARDS PERVIOUS PAVEMENT
Highways 36/61 Cloverleaf Treatment
Ramsey-Washington
Metro Watershed District

October 2006

4.0 Performance

The following sections describe the performance (in terms of phosphorus removal) that each phase of the cloverleaf and Menards' pervious pavement project is estimated to have. The P8 models created for the *Phalen Chain of Lakes Study of Untreated Tributary Drainage and Other Improvement Areas Report* (Barr, 2005) were modified for this study to reflect proposed project conditions.

4.1 Northwest Cloverleaf Enhanced Sand Filter Phosphorus Removal

Total phosphorus removal of flow through the system is expected to reach 70 percent. Because some flows will bypass the filter area and be sent towards NE-4, approximately 60 percent of TP will be removed by the sand filter when looking at all flow moving through the Northern portion of the cloverleaf area. An estimated 32 pounds of phosphorus would be removed by this sand filter (annually for an average year).

4.2 Northeast Cloverleaf Constructed Wetland Phosphorus Removal

The constructed wetland in NE-4 will remove approximately 60 percent of the total influent phosphorus loading (approximately 6 pounds annually for an average year). Total phosphorus removal for the overall Northern portion (Northwest and Northeast quadrants) of the cloverleaf will be approximately 80 percent (38 pounds annually for an average year) with the combination of sand filter and constructed wetland treatment methods.

4.3 Southeast Cloverleaf Constructed Wetland Phosphorus Removal

The Southern constructed wetland is estimated to remove 31 percent of TP (24 pounds annually based on an average water year) from the stormwater passing through the system.

4.4 Menards' Parking Lot Pervious Pavement Phosphorus Removal

The Menards' Parking Lot Pervious Pavement project is estimated to remove approximately 70 percent of the TP load coming from 4.8 acres of the existing impervious parking lot (in drainage area "Menards-2"). This results in a removal of approximately 9 pounds annually for an average year.

4.5 Summary of Cost and Performance Data

Table 7 presents the estimated costs and treatment performances of the projects described in Sections 3.1 through 3.4. Assuming a project life span of 20 years and a 6 percent rate of return on investments, the capital and annual costs can be combined to create and annualized cost in 2005 dollars (it is too early to put costs in terms of 2006 dollars). Dividing this annualized cost by the annual pounds of TP that are estimated to be removed by the proposed project yields an annualized cost per pound of TP removed. This is a useful metric that allows a clear comparison of worth between different proposed projects with different capital costs, annual costs and phosphorus reduction efficiencies.

4.6 Impact of Projects on Keller Lake's Phosphorus Concentration

When evaluating the impact that these projects would have on Keller Lake's TP concentration, it is important to consider these projects in the context of other projects and developments that are planned for the Keller Lake Subwatershed including West Keller Pond which is being constructed between Arcade Street and Keller Lake, and Gervais Avenue Pond which is under construction for the area between Gervais Avenue and Keller Parkway, West of Hwy 61.

The future impact of the 1-inch infiltration standard throughout the Keller Subwatershed must also be considered. In order to demonstrate the effect of the 1-inch infiltration standard after 10 years of enforcement throughout the Kohlman, Gervais and Keller Subwatersheds, the P8 models created for the *Phalen Chain of Lakes Strategic Lake Management Plan: Improvement Options and Recommendations* (draft, Barr, 2004) were altered to reflect the effect of increased infiltration implemented during future road redevelopment projects over the next 10 years. Some of these redevelopment projects have already been scheduled by the City of Maplewood. Others were randomly selected for the purposes of this modeling exercise. The depression storage in drainage areas that were expected (or randomly chosen) to undergo road reconstruction (and therefore, infiltration requirements) was increased to varying degrees to reflect the increased infiltration expected as a result of the road development projects. A more detailed description of how this modeling exercise was accomplished for the an infiltration study of the Kohlman Lake Subwatershed (albeit on a 20-year timeline) has been included as an appendix to the *Kohlman Basin Area Water Quality Enhancement Study* (draft, Barr, 2006).

Figure 8 shows the cumulative impact of these projects and infiltration requirements on Keller Lake's phosphorus concentration. This figure was created using the model that was created for the *Phalen Chain of Lakes Strategic Lake Management Plan* (draft, Barr, 2004). Model results for average, wet, and dry precipitation conditions (and the average of the three) are shown to convey the range of expected concentrations in the lake, given different climatic conditions. Figure 8 shows the impact of these projects in an order that roughly correlates to the implementation timeline of the projects—first West Keller Pond (which is currently under construction and will be operational in 2007), then Gervais Avenue Pond (which will also be operational in 2007). Next, the chart skips to 2015, when the impact of 10 years of enforcement of the 1-inch infiltration standard is estimated. Last, Figure 8 shows the cumulative effect of including the Hwy. 36-61 cloverleaf and Menards' parking lot project to the list of implemented projects.

The projects do contribute to the goal of reducing the TP concentration in Keller Lake, although their impact is tempered by the level of internal load that the lake experiences year-to-year (the internal load in Keller Lake also varies greatly from year-to-year. Model results indicate that the impact of internal load is greater in Keller Lake in average or dry years than in wet years, when the lake water (and its internal phosphorus load) is essentially flushed out. It should also be noted that all of the scenarios shown in Figure 8 essentially already meet or exceed the MPCA's proposed shallow lake criteria for total phosphorus.

However, it is the District's plan to try and de-list Keller Lake from the Impaired Waters List by demonstrating the impact of past water quality improvement projects and by describing its future plans for improving the Keller Lake Subwatershed (through the 1-inch infiltration standard, for example). Implementation of these projects would serve to further strengthen the case for de-listing Keller Lake from the Impaired Waters List.

Definition of CIP Scenarios

Before Existing CIPs: Conditions Before Owasso Basin, Gervais Mill Pond, Kohlman Basin, NSP Urban Ecology Center and PCU Environmental Learning Center

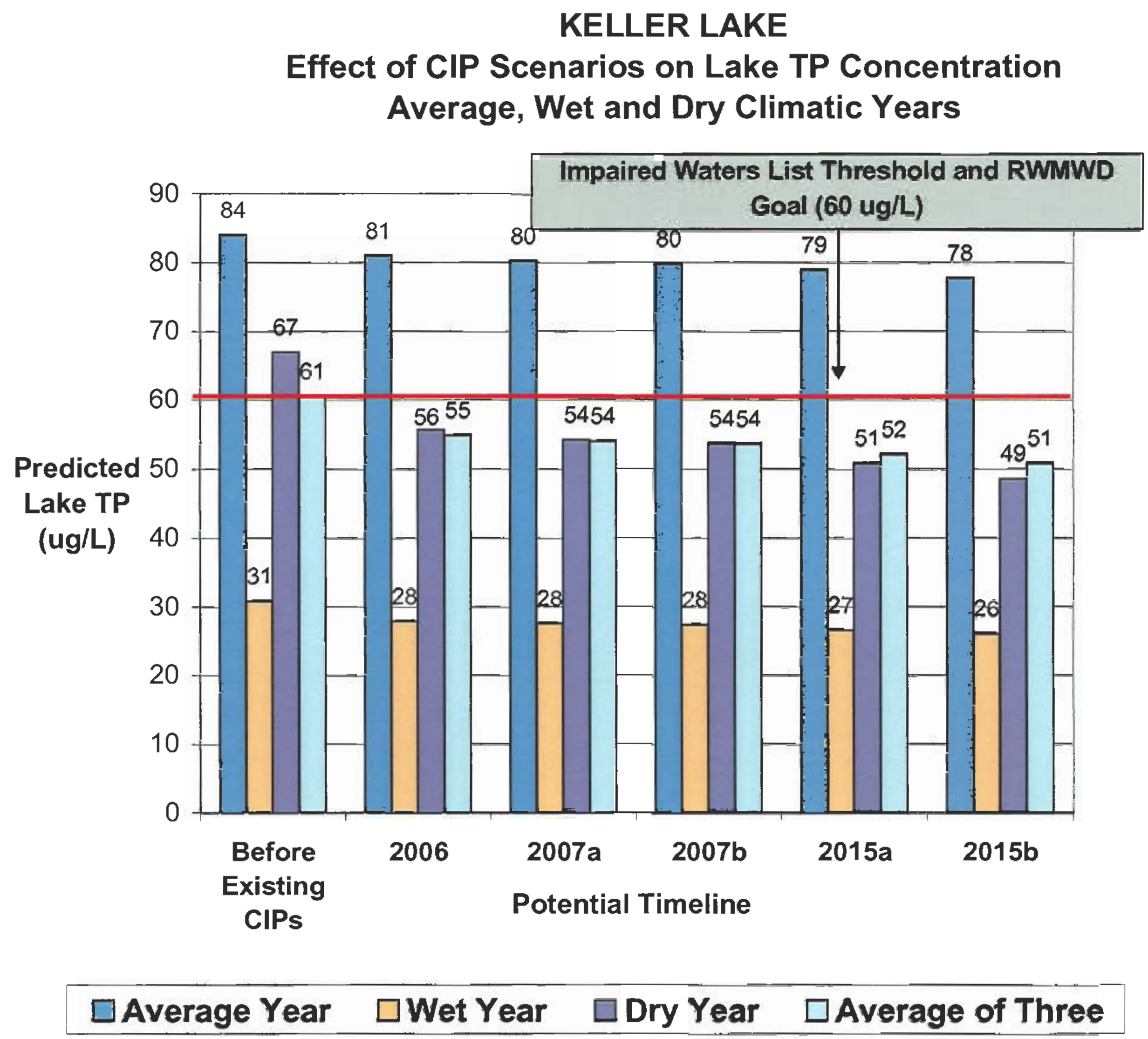
2006: Existing Conditions

2007a: West Keller Pond

2007b: West Keller Pond and Gervais Avenue Pond

2015a: Infiltration Standard Impact after 10 years of Enforcement, West Keller Pond and Gervais Ave Pond

2015b: Infiltration Standard Impact after 10 years of Enforcement, West Keller Pond and Gervais Ave Pond, and Hwy 36-61 Cloverleaf/Menard's Porous Pavement Project



P:\Rwmwd_Projects\2362797\In Lake Models\Final In Lake Models\In Lake Models CIP Analysis Final 2006

Figure 8

5.0 Funding Options

The estimated cost to design and construct all three projects is $1,943,000.00. This estimate includes perpetual operation and maintenance costs. Table 8 shows the contribution of each recommended phase toward the total project cost.

It is anticipated that grant opportunities will be pursued to help cover a significant portion of the costs of each of the projects discussed in this report. Table 9 contains a table of grant opportunities (current as of 9/1/2006) that may be relevant to the enhanced sand filter, the pervious pavement and the constructed wetland projects proposed in this report. A grant application for the first phase of the Hwy. 36-61 cloverleaf project (amended sand filter in the Northwest quadrant of the cloverleaf) has already been submitted for a MPCA/BWSR Clean Water Legacy grant. If the project is not selected for funding, other funding sources will be sought out.

Alternatively, each of the projects could be funded to some degree by the Storm Water Impact fund being developed for permit applicants that cannot meet the District's 1-inch infiltration standard.

6.0 Monitoring

After implementation, a statistical approach is recommended for monitoring effectiveness of both the enhanced sand filter and the constructed wetlands proposed in this report. This approach would involve:

- Independent sampling of inflow and outflow to determine pollutant concentration.
- Season-long measurement of flow through the system.
- Monitoring of water level in the pond or basin.

A statistical monitoring approach rather than an event-based approach is recommended to determine pollutant removal efficiency for the enhanced sand filter. The reason is that in order to compare upstream samples to those collected from downstream of the filter, flow conditions should be similar. Because of variable storm flows (residence time will vary based on storm size and duration) it is difficult to accurately sample the same water at the outlet that was sampled at the inlet before the filter treated the water during an event based sampling period. With a statistically based approach, average inflow and outflow concentrations are attained from random sampling dates (inlet and outlet sample dates are selected independently) throughout the season. These are then used with total flow during the season to determine phosphorus removal efficiency of the specific BMP. One of the additional benefits to using a statistical approach is that it allows sample schedules to be determined in advance and automatic samplers can be programmed based on this sampling schedule.

Constructed wetland monitoring would be conducted in a similar manner to monitoring for the sand filter. Grab samples from the pond inlet and outlet (assuming access is available), along with continuous flow measurements, will allow for phosphorus removal estimates within the pond.

Monitoring of the pervious pavement could be performed using more traditional monitoring practices. A paired watershed study would make the most sense for this circumstance. A sampling station could be set up to collect outflows from the 6-inch diameter discharge pipe from the pervious system and second sampling station could be installed elsewhere in the Menards' parking lot to collect untreated runoff for comparison.

7.0 Conclusions and Recommendations

The future management of Keller Lake depends upon controlling external sources of phosphorus to the lake. Previous studies have indicated that a reduction of the lake's internal load may not necessarily result in a significant improvement in lake water quality; therefore, external loads must be targeted to affect water quality improvements in the lake.

Some projects that will provide treatment of Keller Lake's subwatershed runoff are already underway. West Keller Pond is currently under construction; Gervais Avenue Pond is also under construction; and implementation of the infiltration standard throughout the District will provide further reduction in the lake's TP concentration.

The Hwy. 36-61 cloverleaf projects and Menards' pervious pavement project would provide additional phosphorus reduction in the Keller Lake Subwatershed. Although these reductions may not serve to dramatically affect the lake's overall TP concentration, they nonetheless offer opportunities to:

- Remove both particulate and dissolved phosphorus from runoff that is currently untreated.
- Make a stronger case for de-listing Keller Lake from the MPCA's Impaired Waters List by demonstrating a commitment to reducing phosphorus in the Keller Lake Subwatershed
- Implement innovative technologies with low environmental risks that could be useful in the District's future attempts in reducing particulate and dissolved phosphorus. The monitoring schedule proposed for these projects would verify performance and help the District use this technology effectively in the future.

When looking at the overall impact of these projects on Keller Lake (which are slight), it is important to remember that these projects would still provide a high level of treatment of their tributary inflows. Also, these options offer a way to reduce phosphorus loads without altering the land use in the area—after construction, the project areas could be used the same way they are today.

Some or all of the funding for these projects could be obtained through grant opportunities. Alternatively, the future Storm Water Impact fund could be used for these projects.

The projects proposed in this report are still considered experimental, to varying degrees. Few organizations have implemented these types of projects. Where they have been researched and implemented, however, they show promise in reducing both particulate and dissolved fractions of phosphorus in runoff. If the District wishes to further reduce the TP concentration in Keller Lake, these projects offer an innovative way to achieve that goal. Implementation of these projects will likely be difficult, and involve a process of problem solving for years to come. However, this effort will likely result in not only reductions in phosphorus to Keller Lake, but an enlightened approach to watershed management from which many other organizations, including the District itself, will benefit.

References

Barr Engineering Co. 2004 (draft). *Phalen Chain of Lakes Strategic Lake Management Plan: Improvement Options and Recommendations.*

Barr Engineering Co. 2005. *Phalen Chain of Lakes Study of Untreated Tributary Drainage and Other Improvement Areas Report.*

Barr Engineering Co. 2006 (draft). *Kohlman Basin Area Water Quality Enhancement Study.*

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Shapiro and Associates, Inc. November 1999. *Lakemont Storm Water Treatment Facility Monitoring Program—Final Report.*

Tables

Table 1 Analysis of Potential Stormwater Treatment BMPs

Project Location	BMP	Constructability Ranking	Innovation Ranking	Comment
Menards	Ponds	Low	Low	Cannot meet “no net loss of parking” condition
	Treatment Manholes	High	Moderate	Would require regarding of parking lot and several structures connected in parallel.
	Pervious Pavement	High	Moderate/High	Serves as a coarse filter for parking lot runoff. Provides opportunity for infiltration, depending on underlying soil types.
Highway Interchange	Ponds	High	Low	Ponds only allowed in cloverleaf areas
	Treatment Wetlands	High	Moderate	Flows too high to meet treatment goal.
	Rock Filter Berm	Low	Low	Large stones would not meet MnDOT conditions Low capacity for treatment.
	Floc Blocks	High	Moderate	Flows through area are too high to provide a settlement basin for flocs.
	Lime Barriers	Moderate	High	Flows through area are too high to meet minimum exposure time requirement
	Sand Filters	Moderate	Moderate/High	Site constraints make pretreatment difficult Innovation ranking increases if enhancing media is added to the sand

Table 2 Advantages and Disadvantages of a Pervious Pavement System

Advantages	Disadvantages
Removes TSS and TP	Requires additional maintenance for cleanout.
Reduces Impervious Area	Snow removal and repaving practices need to be adjusted.
Improved wet weather traction	More expensive than standard pavement.

Table 3: Phase I Estimated Project Costs

NE-2 and NW-1 Cleanout	Unit	Unit Price	Quantity	Extension
Strip, Stockpile and Replace Topsoil	ACRE	$5,000	0.4	$2,000
Removals	CY	$25	50	$1,250
Restoration	LS	$3,000	1	$3,000
Traffic Control	LS	$1,500	1	$1,500
Subtotal				**$7,750**
NW-2 Enhanced Sand Filter	**Unit**	**Unit Price**	**Quantity**	**Extension**
Strip, Stockpile and Replace Topsoil	ACRE	$5,000	0.9	$4,500
21-inch Diameter RCP - Jacked Installation	LF	$325	160	$52,000
Clearing and Grubbing	LS	$2,000	1.0	$2,000
Common Excavation	CY	$18	4,769	$85,842
Separating Berm (use excavated soil)	CY	$20	800	$16,000
Berm Overflow Protection	LS	$5,000	1.0	$5,000
Rip Rap - Class III	CY	$80	15	$1,200
6-inch Diameter Perforated HDPEP	LF	$25	550	$13,750
Geotextile Fabric	SY	$3	3,630	$10,890
Pea Rock	CY	$15	200	$3,000
Filter Sand	CY	$20	450	$9,000
Enhanced Steel Wool	CY	$100	150	$15,000
Poured Outlet Control Weir	EACH	$5,500	1.0	$5,500
Restoration	ACRE	$3,000	1.1	$3,300
Traffic Control	LS	$2,500	1.0	$2,500
Subtotal				**$229,482**
Subtotal of Estimated Phase I Construction Costs				**$237,232**
Mobilization		10%		$23,723
Erosion Control		10%		$23,723
Engineering		20%		$47,446
Contingencies		30%		$71,170
Lifetime Maintenance				$296,983
Total Estimated Phase I Project Cost				**$700,277**

Table 4: Phase II Estimated Project Costs

NE-4 Constructed Wetland	Unit	Unit Price	Quantity	Extension
Strip, Stockpile and Replace Topsoil	ACRE	$5,000	0.8	$3,750
Clearing and Grubbing	LS	$1,500	1.0	$1,500
Common Excavation	CY	$18	6,000	$108,000
Berm to divide cells (use excavated soil)	CY	$20	778	$15,560
Rip Rap - Class III	CY	$80	55	$4,400
Planting, Upland	ACRE	$3,800	0.16	$608
Planting, Emergent	ACRE	$6,000	0.62	$3,720
Poured Outlet Control Weir	EACH	$5,000	1.0	$5,000
Restoration	ACRE	$8,000	0.5	$4,000
Traffic Control	LS	$2,500	1.0	$2,500
Subtotal				**$149,038**
Mobilization		10%		$14,904
Erosion Control		10%		$14,904
Engineering		20%		$29,808
Contingencies		30%		$44,711
Lifetime Maintenance				$62,183
Total Estimated Phase II Project Cost				**$315,548**

Table 5: Phase III Estimated Project Cost

SE-3 Constructed Wetland	Unit	Unit Price	Quantity	Extension
Common Excavation	CY	$18	8,324	$149,832
Rip Rap - Class III	CY	$80	75	$6,000
Planting, Upland	ACRE	$3,800	0.41	$1,558
Planting, Emergent	ACRE	$6,000	0.84	$5,040
Berm to divide cells (use excavated soil)	LS	$10,000	1.0	$10,000
Berm Overflow Protection	LS	$5,000	1.0	$5,000
Bulkhead 15-inch Diameter Pipe	EACH	$500	1.0	$500
Remove and Dispose Manhole	EACH	$850	1	$850
Manhole - 48-inch Diameter (4'-8')	EACH	$5,500	1	$5,500
Restoration	ACRE	$3,000	1.3	$3,750
Traffic Control	LS	$2,500	1.0	$2,500
Subtotal				**$190,530**
Mobilization		10%		$19,053
Erosion Control		10%		$19,053
Engineering		20%		$38,106
Contingencies		30%		$57,159
Lifetime Maintenance				$100,283
Total Estimated Phase III Project Cost				**$424,184**

Table 6: Phase IV Estimated Project Cost

MENARDS-2 Pervious Pavement	Unit	Unit Price	Quantity	Extension
Agreement/Negotiations	LS	$10,000	1	$10,000
Saw Cut Asphalt	LF	$2	230	$460
Remove and Dispose Pavement	CY	$12	800	$9,600
Common Excavation	CY	$18	2,000	$36,000
Pourous Pavement	SF	$7	22,000	$154,000
Geotextile Fabric	SY	$3	4,850	$14,550
Subsurface Material	CY	$20	800.0	$16,000
Concrete Curb	LF	$6	700.0	$3,850
6-inch Diameter Perforated CPEP	LF	$25	450.0	$11,250
6-inch Diameter CPEP	LF	$35	180.0	$6,300
48-inch Diameter Manhole	EACH	$5,500	1.0	$5,500
Line Painting	LS	$1,750	1.0	$1,750
Subtotal				**$269,260**
Mobilization		10%		$26,926
Erosion Control		10%		$26,926
Engineering		20%		$53,852
Contingencies		30%		$80,778
Lifetime Maintenance				$45,500
Total Estimated Phase IV Project Cost				**$503,242**

Table 7: Proposed Project Capital, Maintenance, Total Annual Costs and Cost Per Pound of Phosphorus Removed

Proposed Project	Capital Cost (2005 dollars)[1]	Assumed Life Span (years)	Annual Maintenance (2005 dollars)[5]	Annualized Capital Cost (A/P I = 6%, n = 20, Factor = 0.0872)	Total Annual Costs (2005 Dollars)	Annual TP Removed (lbs TP removed)	Annualized Cost per Annual Pound TP Removed	Percent of Tributary Watershed Load Removed
Phase I - NW2 Enhanced Sand Filter	$403,295	20	$17,819	$35,200	$53,019	32	$1,657	60
Phase II - NE4 Constructed Wetland[2]	$253,366	20	$3,731	$22,100	$25,831	5.7	$4,538	10
Total of Phases I & II (northern half)	$656,661	20	$21,550	$57,300	$78,850	38	$2,092	70
Phase I Alternate - NW2 Constructed Wetland	$237,566	20	$5,055	$20,700	$25,755	16	$1,582	29
Phase II - NE4 Constructed Wetland	$253,366	20	$3,731	$22,100	$25,831	16	$1,601	28
Total of Alternate Phase I, Phase II (northern half[3])	$490,932	20	$8,785	$42,800	$51,585	32	$1,592	57
Phase III - SE3 Constructed Wetland	$374,328	20	$6,017	$32,600	$38,617	24	$1,620	31
Phase IV - Menards' Parking Lot	$457,743	20	$2,730	$39,900	$42,630	9	$4,737	75
NW2 Constructed Wetland[4]	$237,566	20	$5,055	$20,700	$25,755	24	$1,062	42

[1]Capital cost includes engineering (20%) and contingency/mobil. (40%).
[2]NW2 Bypass flows only
[3]Half of flow diverted to each wetland cell
[4]Maximum safe flow through this basin
[5]Includes 40% contingency

Table 8: Total Estimated Project Cost

Phase I - Northwest Cloverleaf	$700,277
Phase II - Northeast Cloverleaf	$315,548
Phase III - Southeast Cloverleaf	$424,184
Phase IV - Menards' Parking Lot	$503,242
Total Estimated Project Cost	**$1,943,251**

Table 9 Grant Resources

Agency/ Organization	Program/Criteria	Eligible Applicants	Deadline	Contact
Minnesota Pollution Control Agency (MPCA)	**Phosphorus Reduction Grant**—Assists municipalities with the costs of wastewater treatment projects, or portion thereof, that will reduce the discharge of total phosphorus from the facility to one milligram per liter or less; grants up to 75% of eligible project costs	Municipalities	June 30, 2008	www.pca.state.mn.us/grants/
MPCA	**Total Maximum Daily Load Grant**—Assists municipalities with the cost of publicly owned wastewater or stormwater projects needed to meet waste-load reductions under a TMDL study; grants up to 50% of eligible project costs	Municipalities	Money reserved for projects first in the order that their TMDL study was approved by the EPA, and second, in the order that their applications are received	www.pca.state.mn.us/grants/
MPCA	**Open Grant Program**—Funds projects to develop environmentally sustainable practices in Minnesota through voluntary partnerships and goal-oriented, economically driven approaches to pollution prevention and resource conservation; maximum grant $40,000; requires a 25% match	Any	Pre-proposals due in February; Final proposal due in May	www.pca.state.mn.us/grants/
MPCA	**319 Grant**—Funds projects that address a nonpoint-source pollution issue; cannot be spent on diagnostic work (other than TMDL development); requires a one-to-one match	All entities except federal agencies	September 20, 2006	www.pca.state.mn.us/water/cwp-319.html

Table 9 Grant Resources (Continued)

Agency/ Organization	Program/Criteria	Eligible Applicants	Deadline	Contact
MPCA	**Clean Water Partnership Program**—Funds projects that address a nonpoint-source pollution issue; cannot be spent on in-lake treatment; requires a one-to-one match; grant awards up to $500,000	Local unit of government must sponsor a CWP project. The applicant can be a lake association, joint powers board, or other entity but it must involve a local unit of government, which becomes the fiscal agent. The project is most likely to be successful if as many interested parties as possible are involved.	September 20, 2006	www.pca.state.mn.us/water/cwp-319.html
MPCA	**Clean Waters Legacy Act—**Provides funding for identified clean-water funding priorities; in 2007 will fund nonpoint restoration activities in targeted watersheds and/or lake basins that will have a TMDL implementation plan approved before the end of 2006	Specific list of eligible organizations or water bodies	September 30, 2006	www.pca.state.mn.us
Legislative-Citizen Commission on Minnesota Resources (LCMR)	**LCMR Grants**—Funds are recommended to the legislature for special projects that maintain and enhance Minnesota's natural resources.	Any	No new money will be available until July 1, 2007	www.lcmr.leg.mn/lcmr.htm

Table 9 Grant Resources (Continued)

Agency/ Organization	Program/Criteria	Eligible Applicants	Deadline	Contact
U.S. Environmental Protection Agency (EPA)	**Targeted Watershed Grants**—Governors and tribal leaders are invited to nominate their leading watersheds organizations for the grants. For 2006, EPA will award up to $16 million to as many as 20 of the nation's outstanding watershed practitioners; grant guidelines encourage innovative solutions to achieving measurable water quality improvements	Governors nominate watershed organizations	November 15, 2006	www.epa.gov/owow/watershed/initiative/implementation.html
Metropolitan Council	**MetroEnvironment Partnership Grants**—Grants to improve the water quality of metro-area lakes and rivers by reducing nonpoint source pollution through education and implementation grants.	Public entity located in metropolitan area	The MetroEnvironment grant program ended in 2005. There are no plans to fund a similar grant program in the future.	www.es.metc.state.mn.us/mepg/
Metropolitan Council	**Transportation Enhancement Grant—** Project categories for scenic/environmental enhancement and bicycle/pedestrian paths.	Municipality	On hold as of 2006; Generally due in July	www.metrocouncil.org/planning/transportation/TIP/tip2005_2008.htm

Table 9 Grant Resources (Continued)

Agency/ Organization	Program/Criteria	Eligible Applicants	Deadline	Contact
Board of Soil and Water Resources (BSWR)	**Local Water Management Planning Challenge Grants—**Proposed projects must implement priority action items in an approved local water management plan. Eligible projects include: land and water treatment (i.e., install erosion or water quality improvement practices) inventories (e.g., inventory public and private drainage systems) water quality monitoring education activities Up to $25,000, one-to-one match required	Local units of government including counties, watershed districts, and watershed management organizations.	March 2005 was the latest round	www.bwsr.state.mn.us/grants costshare/lwplanning/index.html
U.S. Department of Agriculture – Natural Resources Conservation Service	**Small Watershed Program (PL - 566) in Minnesota—**Provides technical and financial assistance to local organizations for planning and carrying out watershed projects. Limited to watersheds less than 250,000 acres in size.	Local organizations	Rolling	www.mn.nrcs.usda.gov/programs/water_resources/pl566_projects-new.html