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Lower St. Croix Watershed
Management Organization

O'Conner's Stream and Lake Management Plan

December 12, 2007

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O'Conner's Stream and Lake Management Plan

Final Report

Prepared for the Lower St. Croix Watershed Management Organization

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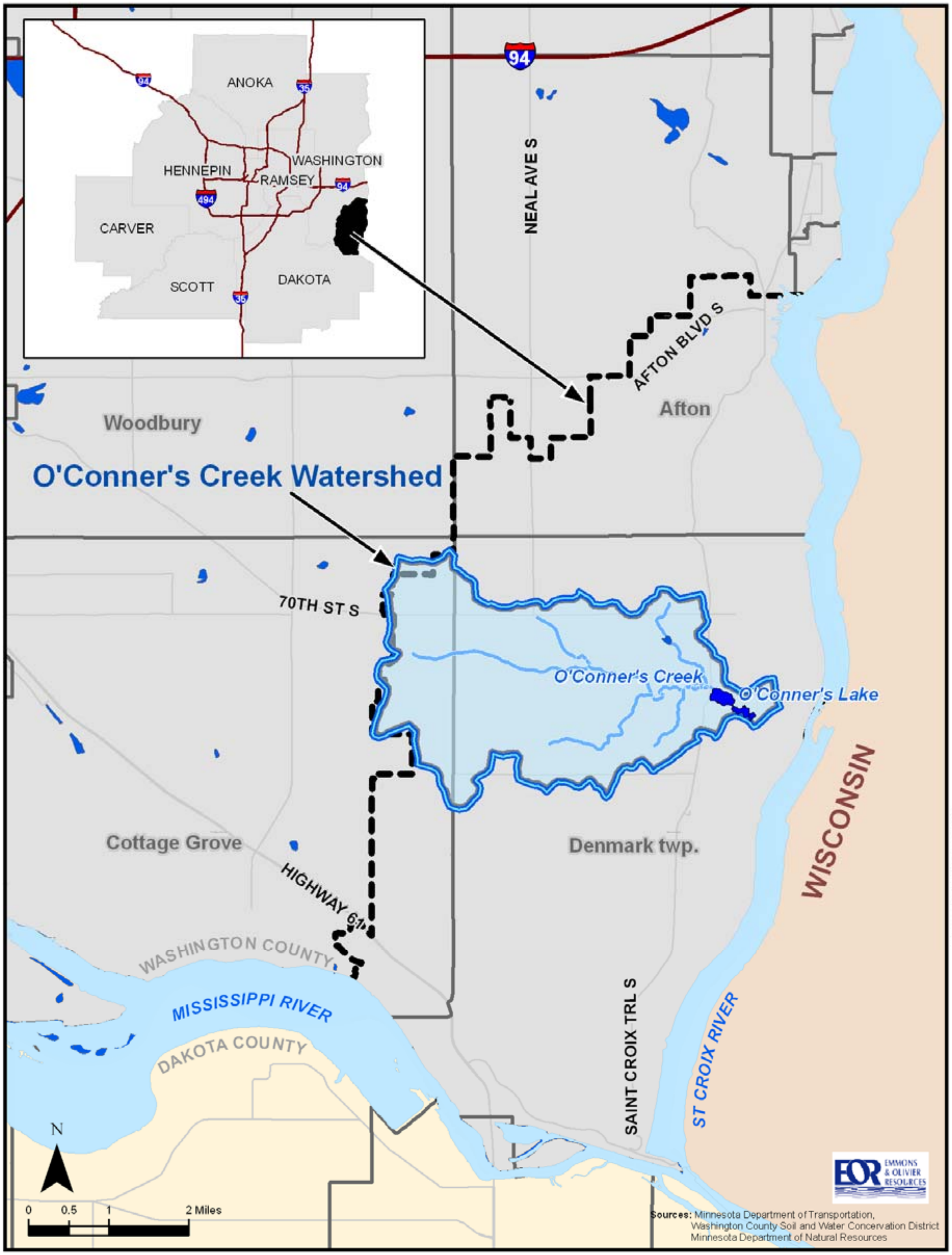
O’Conner’s Stream and Lake Management Plan

Figures:

Tables:

Location Map



Sources: Minnesota Department of Transportation,
Washington County Soil and Water Concervation District
Minnesota Department of Natural Resources

A. Plan Development

The O’Conner’s Creek and Lake watershed is a landlocked watershed located within the Lower St. Croix Watershed Management Organization (LSCWMO) in southeastern Washington County. In order to effectively manage LSCWMO resources, the O’Conner’s Stream and Lake Management Plan was developed with public participation for the ongoing protection of this unique resource.

The O’Conner’s Creek is spring fed, flowing perennially to landlocked O’Conner’s Lake. The Lake has historically been subject to fluctuating water levels as a result of changing climatic conditions. Land use along the stream and around the lake is predominately agricultural, with the exception of quarry activities to the southeast of the lake.

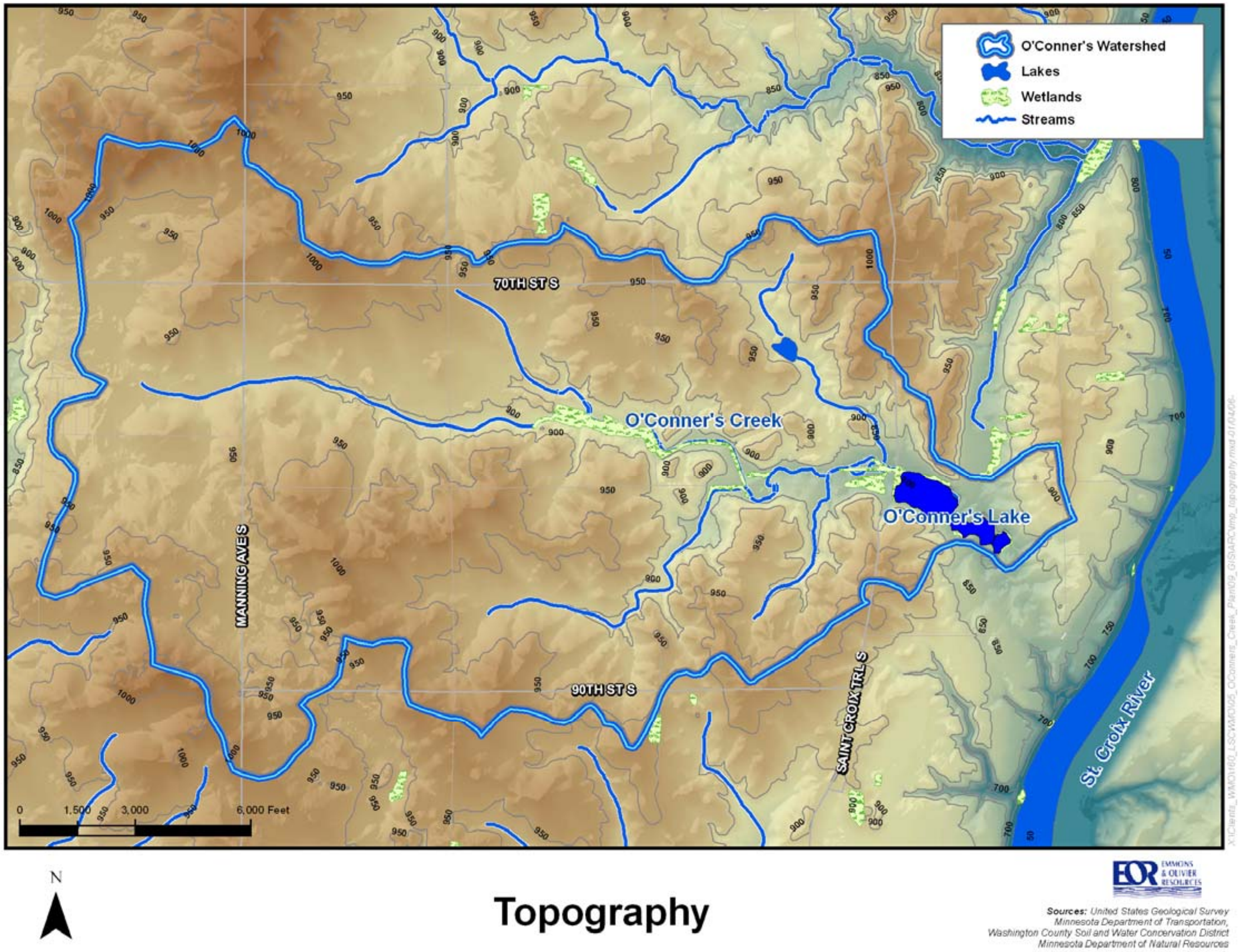
The public participation process consisted of two community meetings. Property owners within the O’Conner’s Stream and Lake watershed were invited to the meetings, along with agency representatives and the LSCWMO Board. During the first meeting, stream and lake data issues were presented to the group, after which residents discussed concerns and future goals for the stream and lake.

At the second meeting, a draft Stream and Lake Management Plan was presented to meeting participants. Short and long term goals for the lake were first discussed. The implementation plan was then addressed, with meeting participants giving input regarding how O’Conner’s Stream and Lake will be able to meet future goals.

B. Natural Resource Inventory

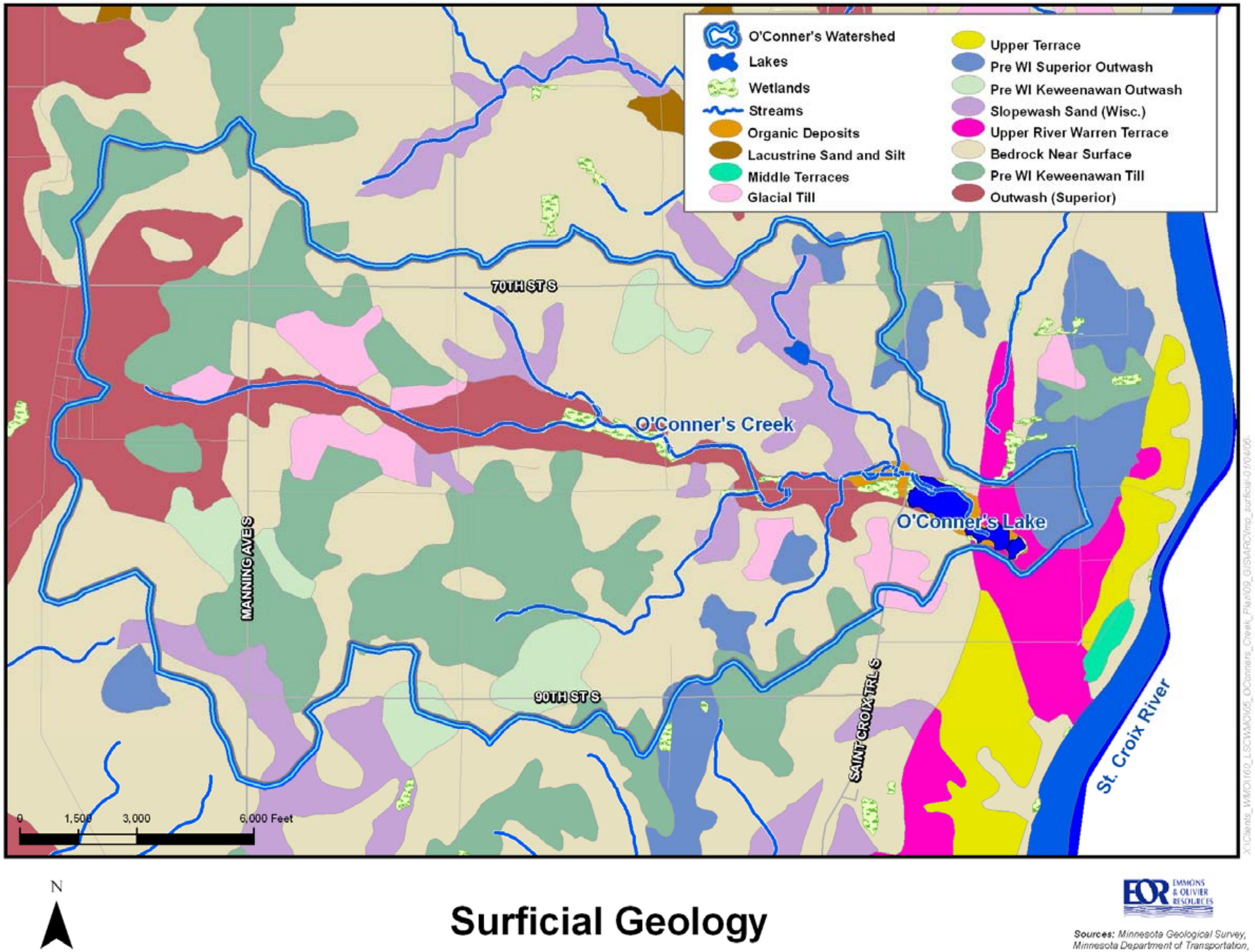
This section contains a series of maps with information regarding resources and land use within the O'Conner's Stream and Lake Subwatershed. Previous natural resource and water resource inventories covering the O'Conner's subwatershed have been conducted as part of the Denmark Township Natural Resources Inventory by Barr Engineering and the Washington Conservation District. Information regarding land cover classification, wildlife habitat, invasive species, and ecological quality is covered in the report titled, Maintaining and Enhancing Environmental Quality in Denmark Township: A Natural Resources Inventory with Stewardship Recommendations. Information regarding water resources in the O'Conner's subwatershed is available in the report titled: Denmark Township Natural Resources Inventory. In addition, a study conducted by the Tiller Corporation (Tiller, 2007) describes in detail O'Conner's Lake's geology and its interaction with shallow groundwater.

Figure1. Topography



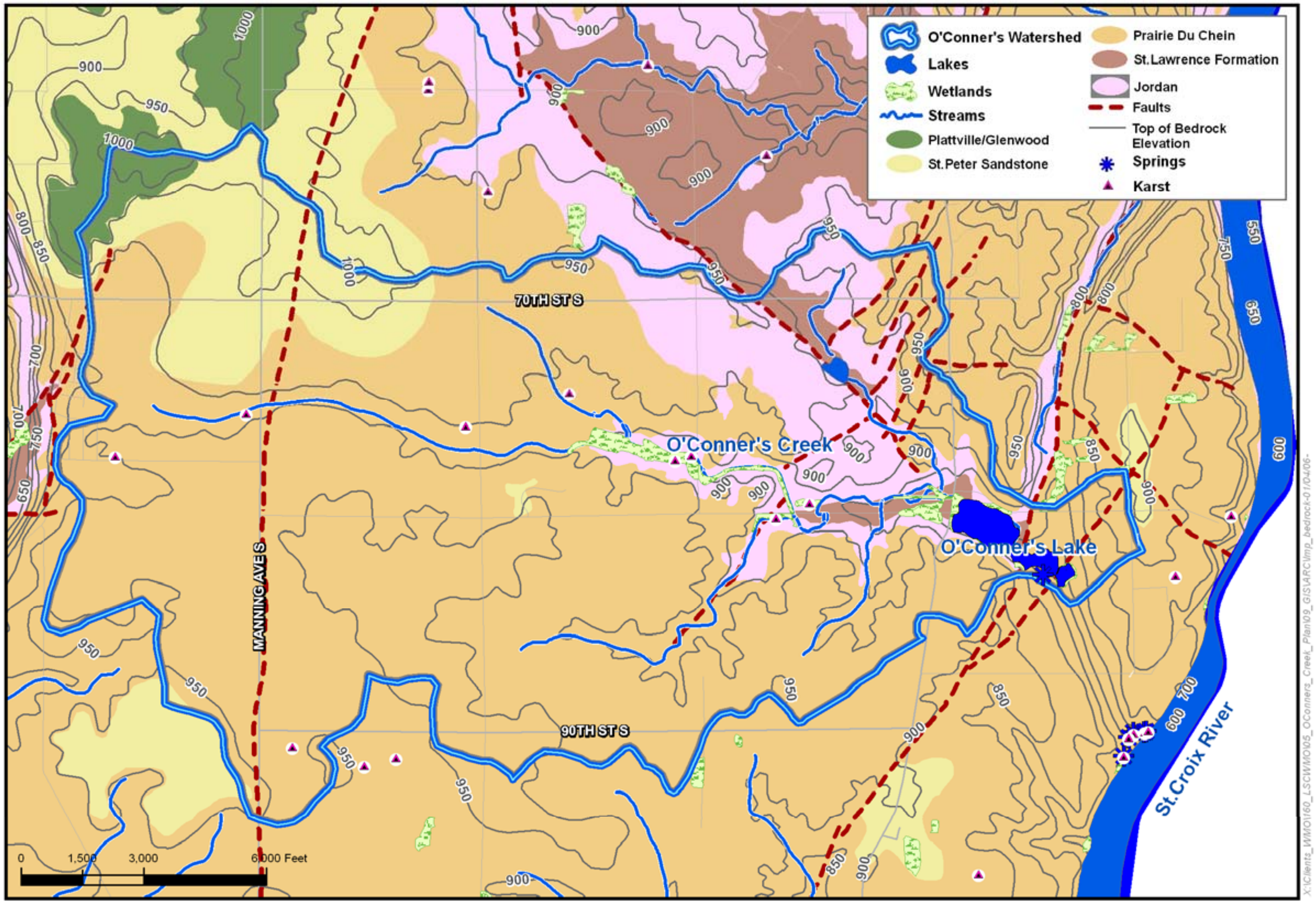
Sources: United States Geological Survey
Minnesota Department of Transportation,
Washington County Soil and Water Conservation District
Minnesota Department of Natural Resources

Figure 2. Surficial Geology



Sources: *Minnesota Geological Survey,*
Minnesota Department of Transportation,
Washington County Soil and Water Concervation District

Figure 3. Bedrock Geology



Bedrock Geology

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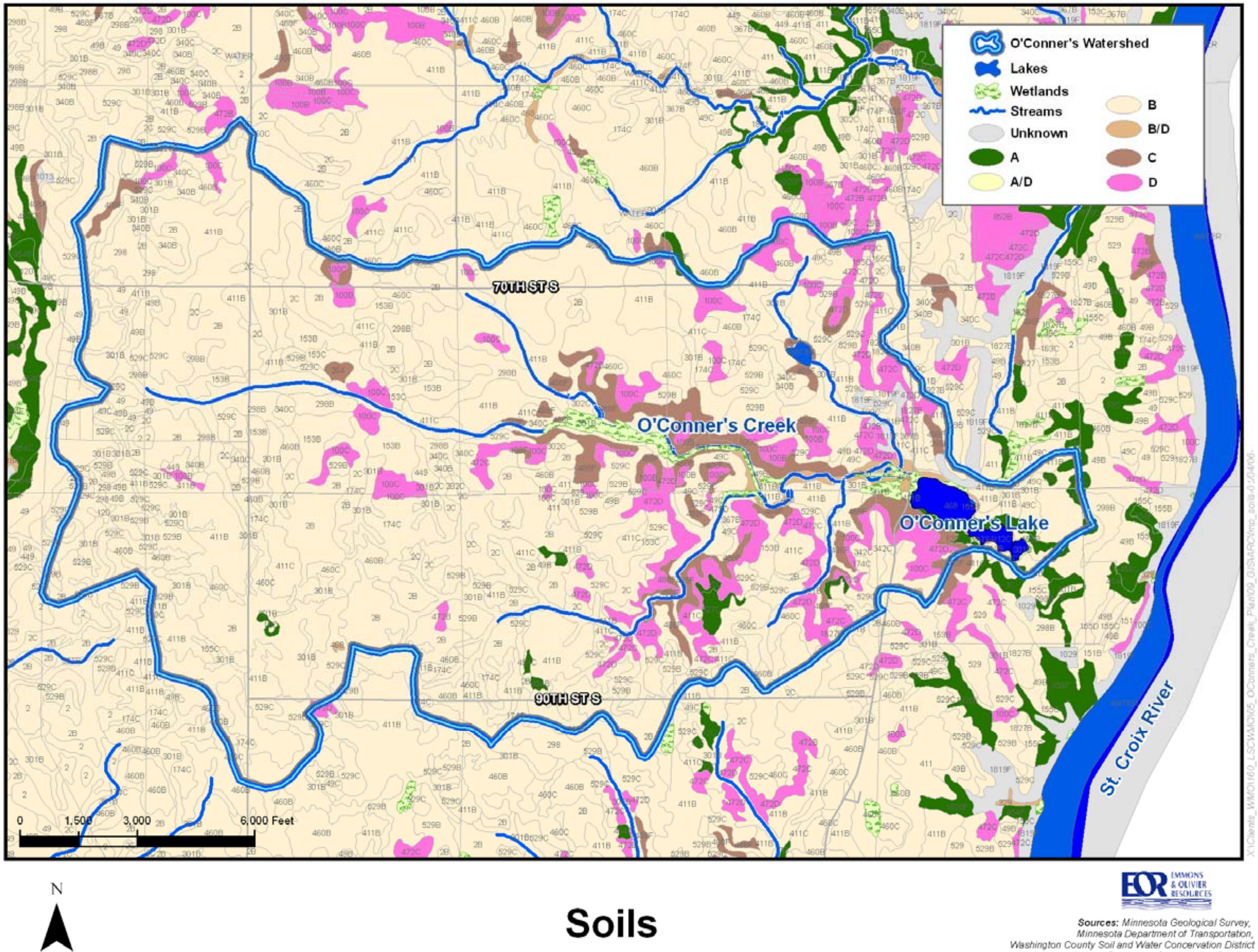
Sources: Minnesota Geological Survey,
Minnesota Department of Transportation,
Washington County Soil and Water Conservation District
Minnesota Department of Natural Resources

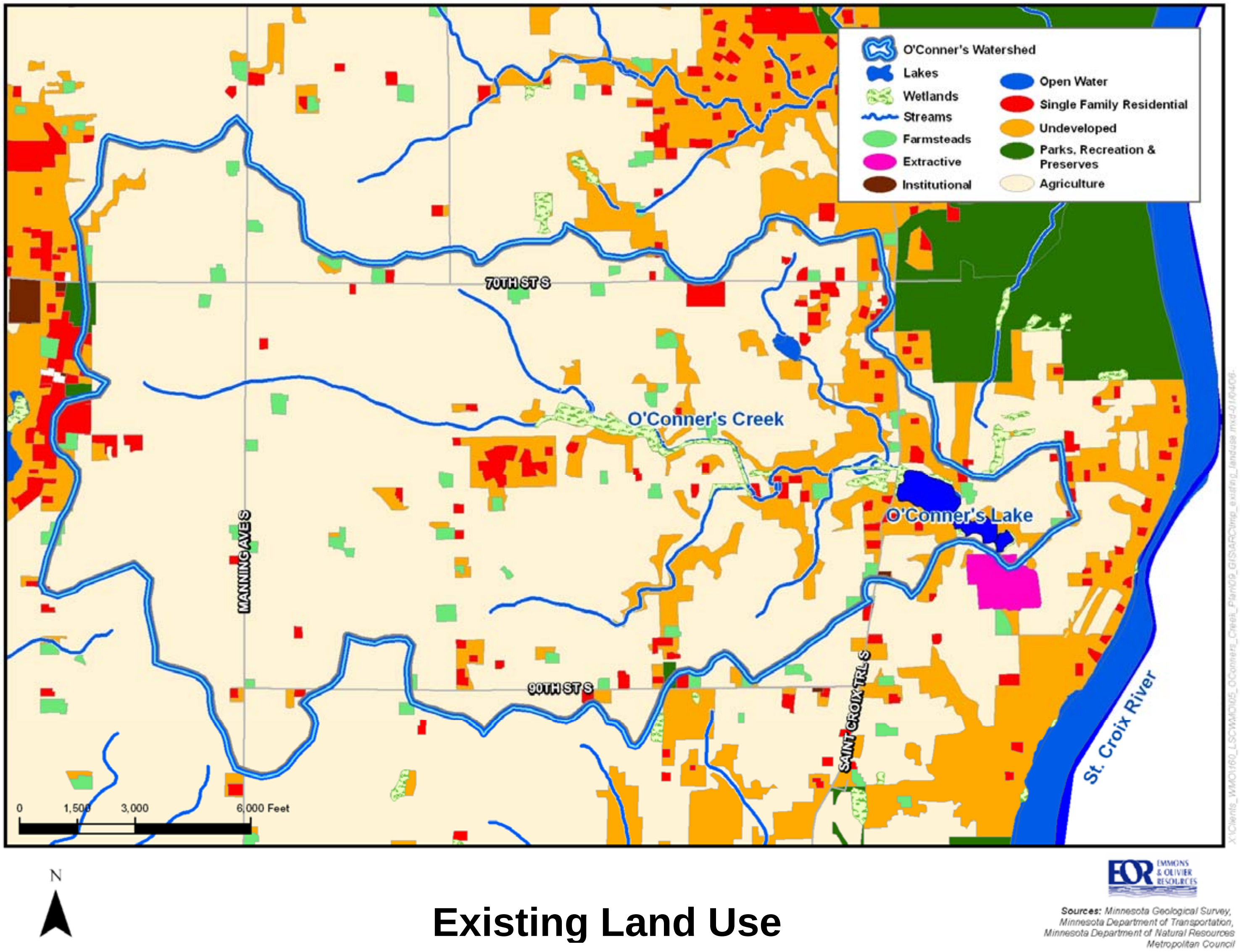
Figure 4. Soils



Soils

Sources: Minnesota Geological Survey, Minnesota Department of Transportation, Washington County Soil and Water Concervation District Natural Resources Conservation Services

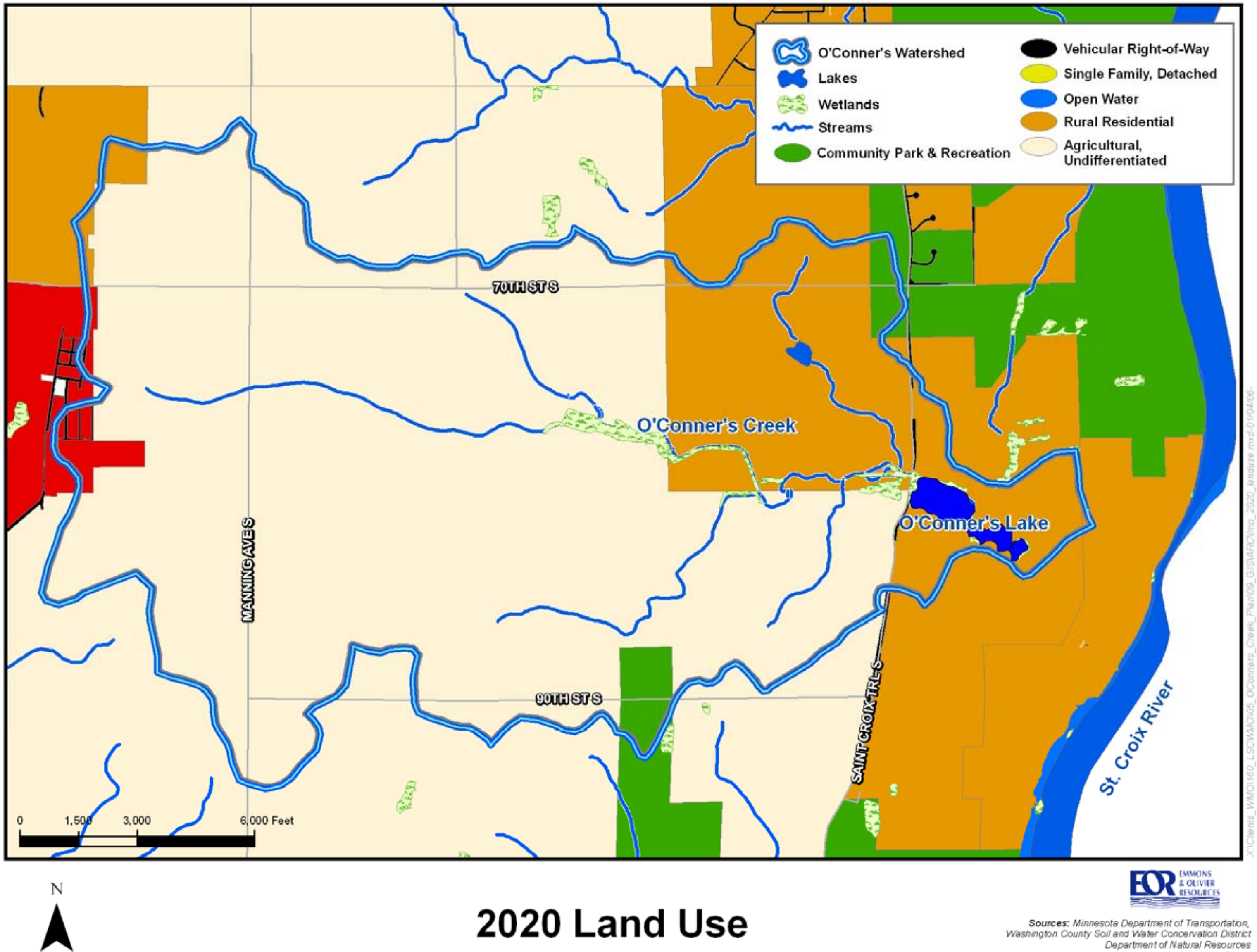
Figure 5. Existing Land Use



Existing Land Use

Sources: Minnesota Geological Survey, Minnesota Department of Transportation, Minnesota Department of Natural Resources Metropolitan Council

Figure 6. Metropolitan Council 2020 Land Use



2020 Land Use

Sources: *Minnesota Department of Transportation,*
Washington County Soil and Water Concervation District
Department of Natural Resources
Metropolitan Coucil

C. Data Collection

The following section contains descriptions and analysis of resource inventories and data collection conducted in the O'Conner's Watershed.

1.) Rosgen Stream Classification Summary

Knowing what a stream ought to look like and how it ought to behave is important in assessing the impact of flooding in the region of that stream and the health of that stream's ecology and wildlife habitat. Historically, comparing and contrasting streams has been difficult because the overall conceptual model of streams has been too simple to describe the variety of stream morphologies observed in the world's streams and rivers. Dave Rosgen (1996) has developed a method of stream classification that has been used for stream habitat preservation and erosion control.

The purpose of this system is to classify streams based on quantifiable field measurements to produce consistent, reproducible descriptions of stream types and conditions. There are four levels in Rosgen's classification hierarchy: geomorphic characterization (Level 1), morphological description (Level 2), stream condition assessment (Level 3), and validation and monitoring (Level 4).

Starting at the perennial flow source (wetland upstream of Oakgreen Avenue) O'Conner's Stream was classified using this applied stream morphology classification system. The entire reach of O'Conner's Stream is classified as an "E" Stream Type, with distinct E subcategories (E4, E5 and E6) reaches (Figure 7).

Example field observations and measurements (Table 1) indicate that all, or the majority of the stream alignment has been altered and impacted by past ditching and dredging.

While "E" stream types are considered highly stable systems, provided the floodplain and the low channel width/depth characteristic are maintained, they are very sensitive to disturbance and can be rapidly adjusted and converted to other stream types in relatively short time periods.

E Stream Type Characteristics

General Description:
Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.

Landform/Soil/Features:
Broad valley/meadows. Alluvial material with floodplains. Highly sinuous with stable, well vegetated banks. Riffle/pool morphology with very low width/depth ratio.

The high sinuosity typically associated with E Type streams is not found at O'Conner's Stream. Rather the lower sinuosity found here is attributed to the apparent historic ditching and dredging of the stream. This disturbance has "set back" the evolution of the stream. E type stream channels are conceptually designated as evolutionary in terms of fluvial process and morphology. The "E" stream type represents the developmental "end-point" of channel stability and fluvial process efficiency for certain alluvial stream undergoing a natural dynamic sequence of system evolution. O’Conner’s Stream is now working towards restoring it’s stability by slowly carving greater sinuosity.

Table 1: Stream Assessment Summary

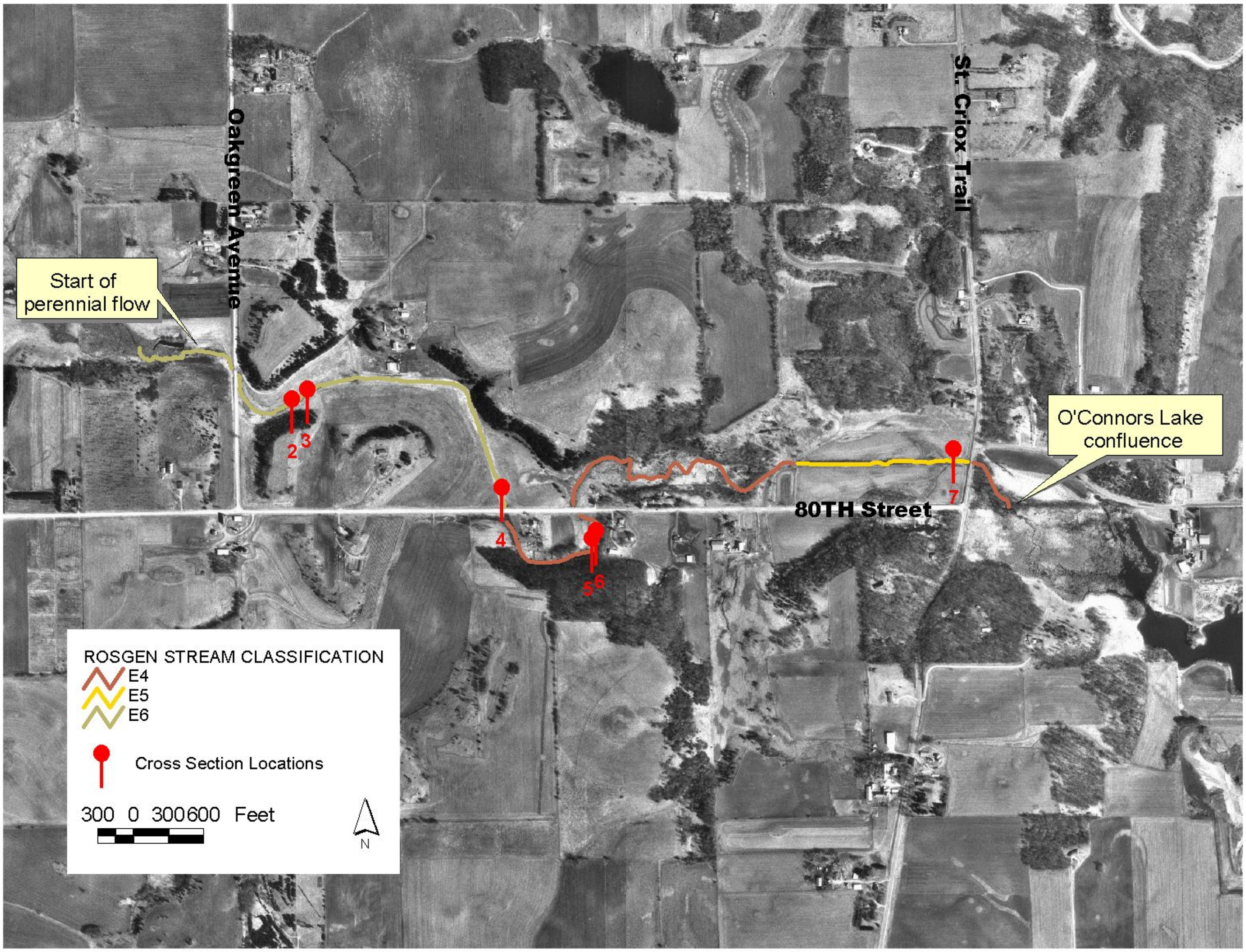
	CROSS SECTION #2		CROSS SECTION #3	
CHANNEL DIMENSIONS				
Width at bankfull stage (W)	6.5	ft	6.5	ft
Cross-section area (A)	8.51	sq ft	8.36	sq ft
Mean depth (D=A/W)	1.31	ft	1.29	ft
Width/Depth Ratio (W/D)	4.96		5.05	
Maximum depth at bankfull stage (D_{max})	1.83	ft	1.81	ft
Maximum depth x 2	3.66	ft	3.62	ft
Floodprone width (FPW)	85	ft	86	ft
Entrenchment ration (ER = FPW/W)	13.08		13.23	
PROFILE / ALIGNMENT				
Sinuosity	1.1		1.1	
Water Surface Slope	0.01		0.01	
D50 Category	6		6	

STREAM TYPE E6

	CROSS SECTION #5		CROSS SECTION #6	
CHANNEL DIMENSIONS				
Width at bankfull stage (W)	8.00	ft	12.50	ft
Cross-section area (A)	11.19	sq ft	24.50	sq ft
Mean depth (D=A/W)	1.40	ft	1.96	ft
Width/Depth Ratio (W/D)	5.72		6.38	
Maximum depth at bankfull stage (D_{max})	2.01	ft	2.56	ft
Maximum depth x 2	4.02	ft	5.12	ft
Floodprone width (FPW)	35.00	ft	36.00	ft
Entrenchment ration (ER = FPW/W)	4.38		2.88	
PROFILE / ALIGNMENT				
Sinuosity	1.2		1.2	
Water Surface Slope	0.01		0.01	
D50 Category	4		4	

STREAM TYPE E4

Figure 7: Rosgen Stream Type and Cross-Section Locations



2.) Riparian Vegetation Summary

The riparian vegetation of O'Conner's Stream varies substantially by stream type. The upper reach of the stream, classified as E6, is predominately a monoculture of Reed Canarygrass (*Phalaris arundinacea),* which is an extremely noxious/invasive grass.

Steeper slopes and a greater number of springs are found in reach E4. The result is a disturbed woodland riparian edge and herbaceous community associated with spring/seep waters. Plants such as Jewel Weed (*Impatiens capensis*) and Reed Canarygrass (*Phalaris arundinacea)* are common.

Reach E5 is comprised of a degraded woodland edge. The predominate tree species is Boxelder (*Acer negundo*).

3.) Fisheries Assessment

No fish were found in the stream upstream of the County Road 21 culvert. Fish are known to exist in O'Conner's Lake and may occasionally swim upstream. Conversations with local landowners found no historical evidence of fish in the creek. One landowner stated that there was a previous attempt to stock the stream with trout, but no viable population currently exists.

4.) Macroinvertebrate Assessment

Benthic macroinvertebrates are good indicators of water quality because they are found in all types of aquatic systems. They are long lived and are sensitive to changes in the physical, chemical, and biological characteristics of the water, allowing for an integrated perspective on water quality. Because of their sensitivity to various pollutants, benthic macroinvertebrate monitoring data can indicate water quality problems that are not detected by water quality/chemistry sampling and analysis alone.

Protocol for In-Stream Macroinvertebrate Sampling

A 100-meter reach was selected in each stream reach. Macroinvertebrates were collected from two randomly selected riffles using a 30 x 15 cm kick net with a 0.7µm mesh. The substrate was kicked for one minute from a $0.5m^2$ area. All macroinvertebrates were identified to genus.

Stream Biota Metrics

Standards of measurement that are useful in assessing the water quality of each site include:

- Taxa Richness – The number of different macroinvertebrate genera found at the site. Chironomidae Species Richness is the number of different species from the family Chironomidae. In general, more diversity indicates healthier ecosystems. Sites with taxa richness less than 15 are considered impaired. Therefore, a larger number of taxa (groups) reflect a healthier community. Sites with taxa richness greater than 25 are considered to be excellent.

- Hilsenhoff Biotic Index (HBI) – Summarizes the various organic pollution tolerance values of all families in a sample. FBI ranges from 0 to 10, with *lower* values reflecting *higher* water quality.

Table 2: Evaluation of water quality using Hilsenhoff's Family Level Biotic Index

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.0	Very poor	Severe organic pollution likely

- %EPT – The number of mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) families in the sample. These families represent the pollution intolerant insects. A higher EPT score reflects better water quality than a lower one.
- % Dominance – The percent of the population that is made up of the one most dominant taxa.
- Most Common Families – List the three most common families of macroinvertebrates found at each sample site.

Table 3: Macroinvertebrate Results

Number of Specimens Collected	382
Cumulative Taxa Richness	12
Hilsenhoff Biotic Index	3.68
Dominant Taxa (%)	22.5
EPT (%)	87

A total of 382 specimens representing 12 taxa were collected from O' Conner's Stream. Taxa richness indicates that there may be some impairment in the creek. However, results may be a reflection of the sampling period. Macroinvertebrates are most abundant during the late summer. The Biotic Index value, based on organic enrichment, indicates excellent water quality in O'Conner's Creek. EPT increases with decreasing disturbance and suggests little impairment at this site. The percent dominant taxa is a reflection of community evenness and redundancy, and a high percentage of dominant taxa (>40%) is indicative of water quality impairment. O'Conner's Stream value of 22.5 suggests slight water quality impairment.

5.) Stream Water Quality

Water chemistry samples were collected in the O'Conner's watershed in 2004 and 2005, with six water samples taken in 2004 (Barry, 2004) and four in 2005. Table 4 identifies the site types, locations and dates collected of samples analyzed in this study. Samples include four O'Conner's Creek stream grabs, one spring upstream of the lake, two wells near the lake, two springs near the elevation of the St. Croix River, and the St. Croix River. The O'Conner's stream water samples may serve as baseline chemistry of the creek prior to future development and may aid in documenting future water quality impacts and trends.

Samples were collected in Nalgene™ sample bottles and were analyzed at the Hydrochemistry Laboratory of the Geology & Geophysics Department at the University of Minnesota. Temperature and conductivity were measured with a digital YSI 85 field meter. Temperature was field checked to a glass analog thermometer. Anion concentrations were determined using Ion Chromatography and cation concentrations were determined using an Inductively Coupled Plasma Mass Spectrometer. Alkalinity was determined in the Hydrochemistry Laboratory using standard alkalinity titration methods.

Major cation and anion species were plotted on a tri-linear Piper diagram to identify their chemical similarities (Figure 8). Chemical similarities are visible when sampled waters cluster in a specific area of the diagram. The height of the data lines represents the concentration of the water, with higher lines equaling greater concentrations. All ten waters have similar chemical signatures, observable by the clustering of data points. The water type identified in the piper diagram, calcium-bicarbonate, is common for Minnesota waters.

Nitrate levels in the water samples ranged from 1.49 ppm to 12.01 ppm (Table 4). Nitrate samples obtained during baseflow conditions 3/17/2005 determined the creek at Oakgreen Ave South to have a level of 9.72 ppm and a small spring located off of 80th Street having a level of 12.01 ppm the same day. High nitrate in groundwater is of concern in Southern Washington County. Nitrate probability mapping done in the area as part of the Cottage Grove Nitrate Study predicts nitrate levels of the Jordon Sandstone in the O'Conner's watershed to be between 1ppm and 5ppm (Barr, 2003). These data show that nitrate levels in the Jordan Sandstone are similar to and can even surpass the probability concentrations developed in the study. National Primary Drinking Water Standards set the maximum contaminant level for nitrate at 10 ppm. Individuals inside the O'Conner's watershed that use the Jordan Sandstone for domestic water use should have their water tested to ensure that nitrate levels are at an acceptable level.

Figure 8: Geochemical Signature of Waters

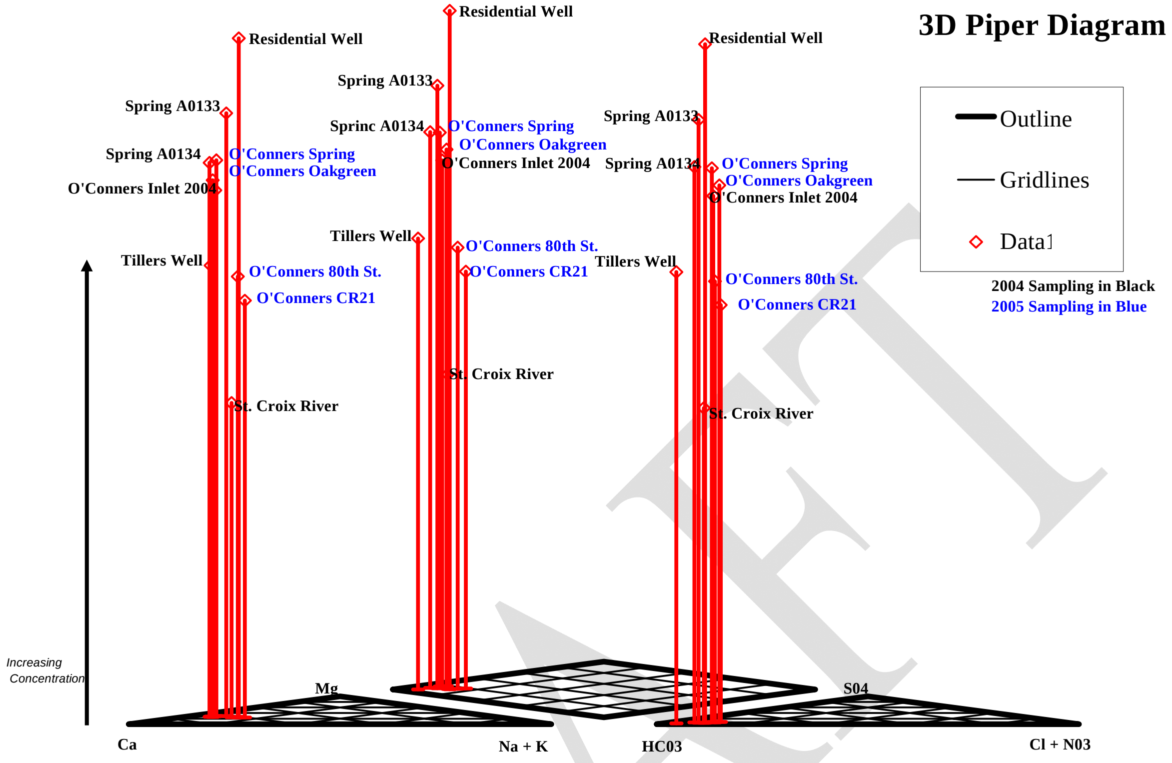


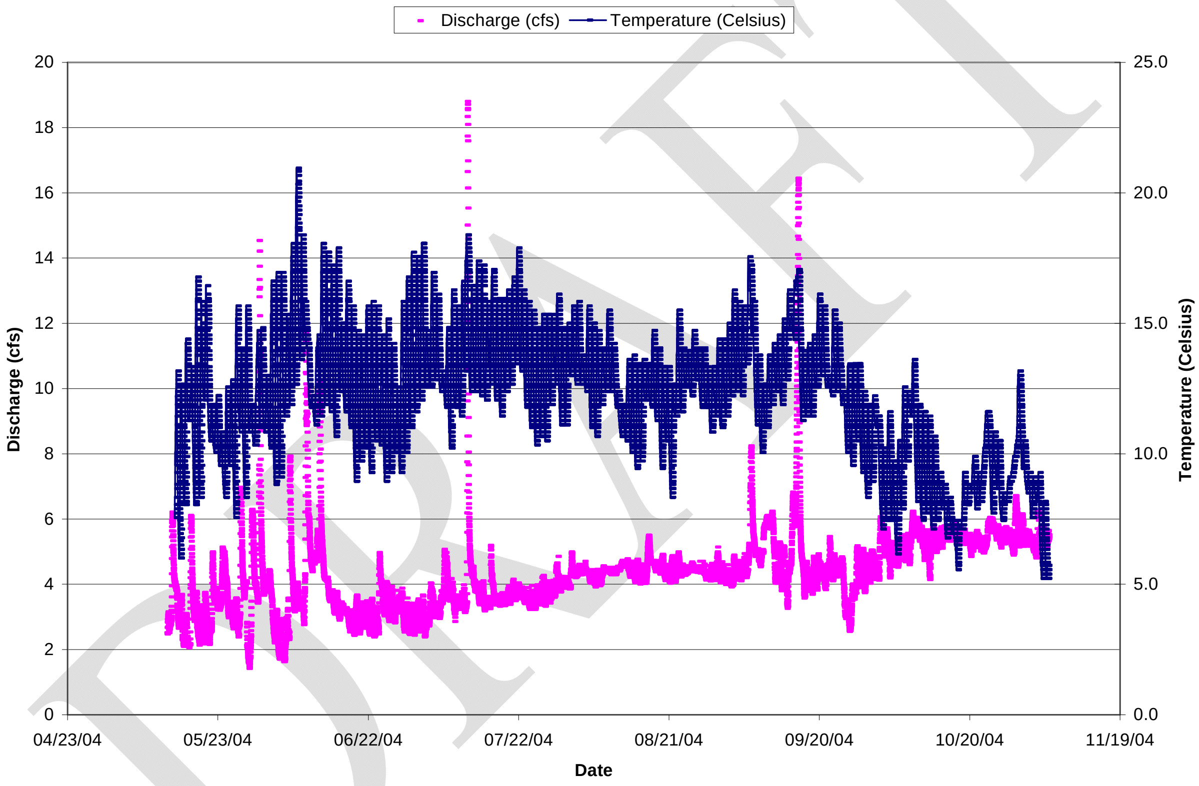
Table 4: Geochemical Data

Name	Balrath Bubbler	Skow's Spring	St. Croix	Skow	Tillers	O'Conners	O'Conners	O'Conners	O'Conners	O'Conners
Type	Spring	Spring	River	Well	Well	Creek	Creek	Creek	Creek	Creek
Unique #	A0133	A0134	N/A	N/A	460191	N/A	N/A	N/A	N/A	N/A
Depth (ft)	Spring	Spring	River	Well	Stream	Stream @ CR21	Stream @ Oakgreen Ave S.	Stream @ 80th Street	Stream @ CR21	Spring @ 80th
Aquifer								*west crossing		
UTM E 83	4962661	4962840	4962668	4963171	4963295	4964592	4964845	4964431	4964588	4964426
UTM N 83	517296	517447	517295	517547	517271	516022	514105	514834	516050	514823
Date	3/31/2004	3/31/2004	3/31/2004	4/27/2004	4/27/2004	3/31/2004	3/17//2005	3/17//2005	3/17//2005	3/17//2005
Temp (ºC)	9.6	9.2	6.7	10.2	11.1	10.3	2.3	0.9	1.5	3.9
pH	7.49	7.52	7.46	7.18	7.70	8.04				
Cond (µmhos)	510	456	250	171	162	404	452	187.4	192	N/A
Redox (mV)										
D.O. (ppm)										
Cations (in ppm)										
Ca	67.24	63.33	37.6	71.17	50.5	63.52	64.39	48.93	46.4	66.95
Mg	31.03	29.07	14.5	30.59	20.34	27.45	24.81	18.56	18.0	26.46
Na	5.64	3.93	5.34	12.15	2.46	4.86	4.76	5.28	5.31	4.78
K	3.59	1.88	1.82	2.98	1.91	1.32	1.82	5.67	6.63	0.92
Li	0.0007	0.0009	0.0010	<0.0001	0.0009	0.0007	0.0013	0.0013	0.0011	0.0018
Al	0.00462	0.00617	0.00919	0.02342	0.01042	0.02673	0.093	0.480	0.507	0.076
Fe	0	0	0.22255	0.07983	0.05353	0.1977	0.5068	0.7207	0.8035	0.4199
Mn	0.002	0.0002	0.033	0.008	0.027	0.135	0.0521	0.0409	0.097	0.0273
Sr	0.0631	0.0588	0.0507	0.0644	0.0462	0.0712	0.0606	0.0540	0.0529	0.0658
Ba	0.0291	0.0266	0.0212	0.0305	0.0321	0.0440	0.0458	0.0462	0.0457	0.0269
Si	7.45	8.13	7.54	8.44	6.82	6.86	6.56	6.07	5.98	6.69
Anions (in ppm)										
Alk. (as $CaCO_3$)	235.38	219.68	117.99	264.007	193.92	191.84	195	164	149	206
Cl	15.75	11.36	10.035	25.315	3.568	14.46	16.74	16.68	15.05	11.42
Br	0.035	0.032	0.014	0.040	0.026	0.029	0.023	0.014	0.018	0.022
NO_2-N	<0.005	<0.005	<0.005	<0.010	<0.010	<0.005	0.016	0.031	0.028	0.001
NO_3-N	4.016	3.852	1.487	2.124	2.862	7.926	9.719	4.594	5.67	12.01
NH_4-N	0.005	0.016	0.12	0.053	0.042	0.059	0.138	0.485	0.63	0.02
SO_4	13.7	13.87	7.5	15.38	6.10	17.01	17.82	11.61	14.18	17.33
$S_20_3^{2-}$	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
PO_4-P	0.045	0.021	0.018	<0.005	<0.005	0.014	0.07	0.071	0.088	0.016
total P	0.062	0.044	0.024	0.050	0.011	0.034	0.110	0.167	0.226	0.046
F	0.06	0.08	0.07	0.06	0.05	0.10	0.09	0.09	0.09	0.09

6.) Stream Water Temperature

O'Conner's Stream is continuously fed by the seepage of groundwater which in the region varies from 8° Celsius to 12°Celsius. Water temperature collected in the creek varies seasonally outside of the groundwater temperature range. The shift in stream temperature outside of the groundwater range is due to the seasonal ambient air temperature influence on stream temperature. Temperature data collected in 2004 by the WCD at County Road 21 illustrate the fluctuation of temperature through time (Figure 9). The maximum stream temperature recorded in 2004 was on June 7th and measured 20.9° Celsius (86°F). The minimum stream temperature recorded in 2004 was on November 4th and measured 5.2° Celsius (41°F).

Figure 9: O'Conner's Stream Temperature and Discharge, April-November 2004.



7.) Stream Sediment

O'Conner's stream sediments vary along the reach of the creek. Silt is the dominant channel material from the stream beginning at the wetland west of Oakgreen Avenue South to the north side of the western culvert on 80th Street South. Gravel is then the predominant channel material from the southern side of the western culvert on 80th Street South to the east side of the bluff located on the north side of 80th Street South. Sand is the dominant material in the ditched section of the stream from the east side of the bluff to the County Road 21 culvert. Downstream of the County Road 21 culvert gravel is again the dominant channel material.

There were no significant stream bank erosion sites identified by the WCD as part of the Denmark Township Natural Resource Inventory. Current and future development in the watershed has the potential to introduce sediment load to the creek. Emphasis should be placed on the proper installation and maintenance of construction site erosion and sediment control practices throughout the watershed during development.

8.) Base Flow

Stream gauging was performed at O'Conner's Creek on March 17th 2005 to quantify base flow contributions of the creek. Stream gauging was performed using a surveyor's level rod to accurately quantify stream width and increment widths. Velocity was measured with a Marsh-McBirney digital flow meter. The stream's width was broken into increments of one half foot and an average depth and velocity were taken for each increment. Flow at each cross section was then determined by summing the product of area and velocity for each increment.

Field maps were created in ArcView with Washington County stream/river shape files representing the creek to identify creek reaches. Western reaches of the creek were approached from Manning Ave. S. in order to determine ephemeral versus perennial creek stretches. Spring melt was found to be frozen in ephemeral channels in the western, northern, and southeastern sections of the creek. The Oakgreen Avenue South crossing presented the first stretch where water was perennially flowing. Stream gauging was performed on the west side of Oakgreen Avenue South. Volumetric flow was determined to be 0.57 cfs. Water flows from this point continuously to O'Conner's Lake.

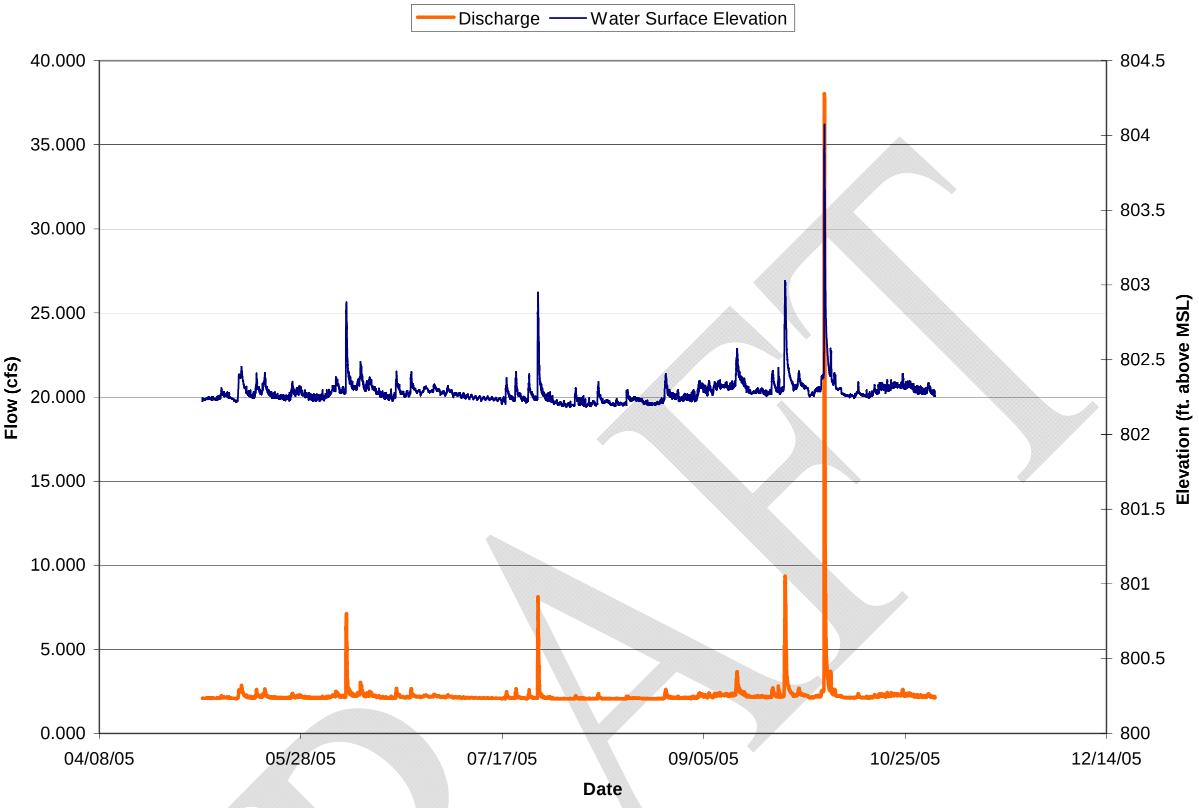
Gauging was performed on the south side of 80th Street South at the western (upstream) crossing. A confluence exists at this location where a perennial contribution of flow is introduced to the creek. Gauging was performed approximately 15 feet downstream of the confluence and was found to be 1.71 cfs. Groundwater seepage was noted on both the east and west banks, with a larger contribution from the west bank. Watercress, moss, and wetland grass was noted to be growing in the seepage area.

Gauging was performed upstream of O'Conner's Lake to the east of County Road 21. Volumetric flow was determined to be 2.26 cfs at this location approximately 20 feet east of the culvert. Volumetric flow values obtained on March 17th 2005 represent base flow conditions. Air temperatures were below freezing at this time and there was no overland flow of water.

9.) Stream Discharge

Stream flow data were collected in 2005 near the inlet to O'Conner's Lake on the west side of the County Road 21 Bridge. Equipment was set and data were collected and calibrated by the Washington Conservation District (WCD). Creek stage data were collected and converted to discharge from a rating curve developed by the WCD. Discharge data from the WCD indicate that creek baseflow is very close to 2 cfs for the months May through October.

Figure 10: Washington Conservation District Flow/Stage Data, 2005.



10.) Spring Inventory

An extensive spring inventory was conducted May 5, 2005 to identify recharge areas along O'Conner's Stream. The majority of groundwater resurging along the stream is through slow seep recharge. Many of the seepage areas are identifiable by a reddish iron precipitate visible at the surface. Notable recharge areas along the stream include the wetland region west of Oakgreen Avenue South where the perennial stream begins, north of 80th Street South along the south side of the bluff, and east of County Road 21 (Figure 11). Two small springs were identified along the creek, one located south of the 80th Street South bridge and the other located on the west side of the bluff located north of 80th Street South. Figure 12 depicts a seep region located east of County Road 21. Note the orange iron precipitate visible at surface.

Figure 11: Groundwater Discharge Regions

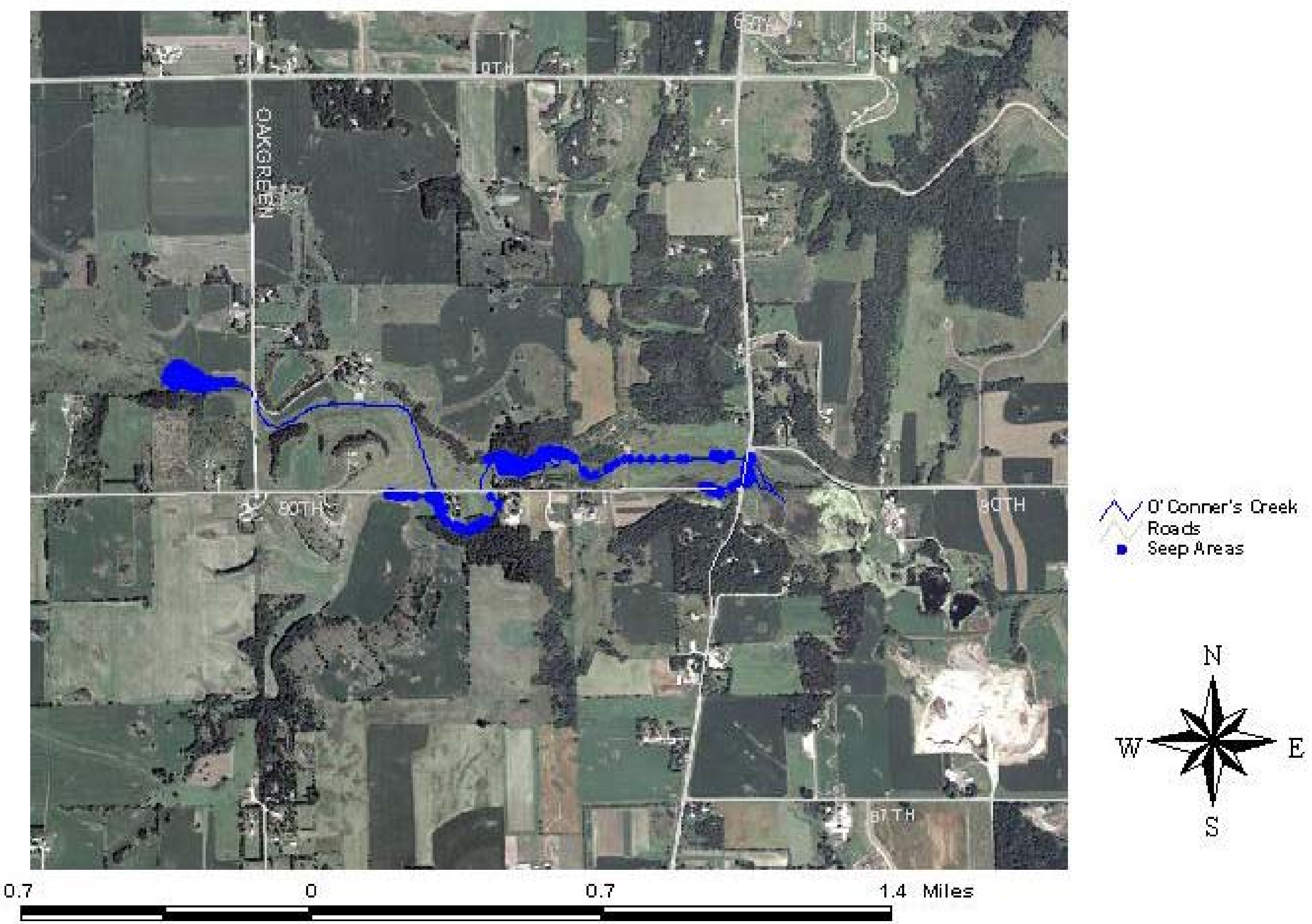


Figure 12: Groundwater Seepage Area South of Creek and East of CR 21.

11.) Geology and Hydrogeology

The headwaters to O’Conner’s Stream begins as marshy seeps from the Jordon Sandstone just west of Oakgreen Ave S. Seeps combine to form a stream that meanders across the confining shaley St. Lawrence formation gaining in volumetric flow as small springs and seeps from the Jordon Sandstone add to its baseflow. The creek then crosses a geologic fault located east of County Road 21 into the down thrown Prairie Du Chien geologic unit where it ends at O’Conner’s Lake. O’Conner’s Lake can be described under two distinctly different hydrogeologic conditions. The westernmost basin, which is mostly shallow wetland, is identified as groundwater dependent. The water level in this basin is approximately that of the regional groundwater in the area. A significant drop in groundwater elevation is noted to the east of the westernmost basin which results in the remainder of the lake being perched above the regional water table (Tiller, 2007). The Lake has no surface outlet and therefore lake water is recharged to the underlying aquifers through porous sand and gravels beneath the lakebed. Several springs located southeast of O’Conner’s Lake on the St. Croix River banks have been geo-chemically linked to O’Conner’s Creek and Lake water. These springs resurge through both outcrop of the Prairie Du Chien and sands and gravel in the region. Detailed geologic and hydrogeologic information can be found within the Tiller Corporation’s report entitled Hydrogeologic Investigation of O’Conner’s Lake (Tiller, 2007).

12.) Lake Bathymetry

Lake bathymetry was investigated at O’Conner’s Lake to determine the depth profile of the lake and the volume of water in the lake for use in modeling. Locations were given unique identification numbers and the associated depth to bottom values was recorded. Locations were accessed via canoe and the depth to bottom value was determined by lowering a weighted measuring tape to the lake bottom. The process of Linear Kriging, a geostatistical tool used to estimate unknown point values from known point values, was then used to generate lake bottom contours from the 101 data points collected. A maximum depth of 11 feet was measured.

Figure 13: Bathymetric Contours (depth in feet)

13.) Vegetative Inventory and Assessment

On June 21, 2005 an initial survey was conducted of the macrophyte distribution in the main open water part of O’Conner’s Lake. The survey was conducted on a series of transects across the lake, totaling 56 individual sites. A follow up survey was conducted on September 9, 2005 to note any changes in macrophyte distribution, collecting data at 33 additional sites. The surveys noted relative abundance but did not quantify mass of material present. The survey points are shown in Appendix A. Plant species of O’Conner’s Lake macrophytes growing within the littoral zone are listed in Appendix A in terms of High, Medium, or Low Relative Abundance. A general description of these macrophytes, as well as the emergent and riparian zone vegetation are discussed below.

Most of the lake contains a mix of submergents dominated by coontail and flat-stemmed pondweed, also including Canada waterweed, leavy pondweed, muskgrass, and some sago pondweed. Some algae are growing in scattered portions throughout the lake. The southwest corner of the largest basin in O'Conner's Lake is covered by yellow lotus which is a Protected Species. The abundance of yellow lotus in this section of the lake generally indicates decent water quality due to the plant's high sensitivity to excessive nutrients, sediment, and boat traffic. Other floating-leaf species occur throughout the shallow areas of the lake, including lesser duckweed and floating-leaf pondweed. The emergent fringe around the shoreline of O'Conner's Lake is mostly sparse until the system turns into a cattail marsh in the northwest basin. The riparian zone is mostly dominated by lowland hardwood and floodplain forest species. Trees of moderate size and age include boxelder (*Acer negundo*), silver maple (*Acer saccharinum*), and cottonwood (*Populus deltoids*). Understory riparian vegetation is dominated by reed canary grass (*Phalaris arundinacea*), spotted touch-me-not (*Impatiens capensis*), smartweed (*Polygonum spp.*), and beggarticks (*Bidens spp.*).

14.) Lake Water Quality Monitoring

Water quality monitoring was conducted for O'Conner's Lake through the Metropolitan Council's Citizens Aided Lake Monitoring Program (CAMP) (Appendix B). The program uses citizen volunteers to collect surface water quality data of Twin Cities Metropolitan Area Lakes. Water quality data are collected every two weeks through the months of April through October. Parameters collected as part of the program include total Kjeldahl nitrogen, total phosphorus, chlorophyll-a, Secchi transparency depth, temperature, and the volunteers' perception of the lakes physical and recreational condition. The water quality data collected as part of this program may aid in documenting future water quality trends.

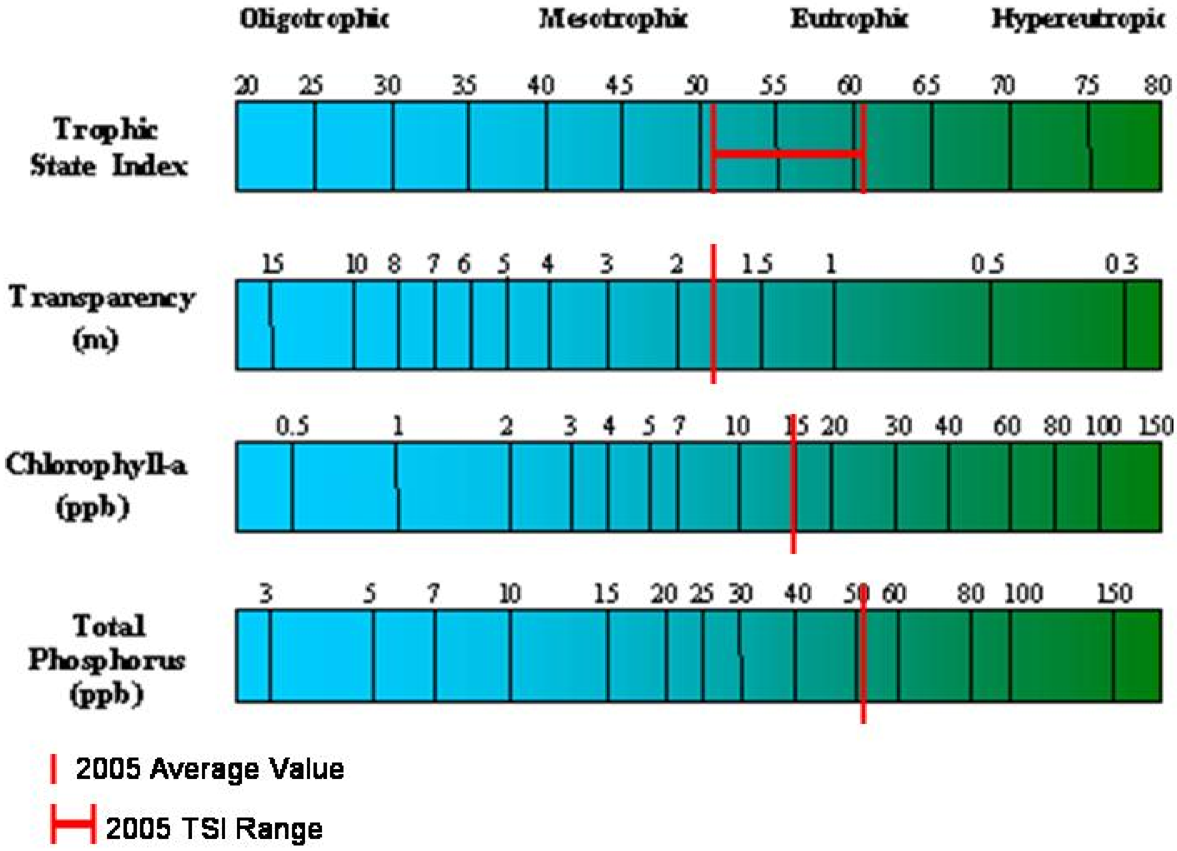
The quality of a lake may be expressed in terms of its trophic state which generally refers to the level of biological productivity within the lake. The Carlson's Trophic State Index (TSI) is used as a basis for estimating the trophic status of Minnesota lakes. Trophic status ranges from oligotrophic to hypereutrophic (and is viewed as a continuum) on this scale. Carlson's TSI is based on the interrelationships of TP, chlorophyll-a, and Secchi transparency.

O'Conner's Lake 2005 Monitoring Data – Trophic State Index Values

- Total Phosphorus TSI – 61
- Chlorophyll-a TSI – 57
- Transparency TSI – 51

Based on the 2005 monitored data, the trophic state of O'Conner's Lake is characterized as slightly Eutrophic (Figure 14). It is interesting to note that the transparency TSI value is lower than the other two indices. This suggests that the plentiful aquatic macrophyte population of the lake may have a significant role in utilizing the available phosphorus in the system.

Figure 14: Carlson's Trophic State Index (TSI) – Red Indicates O'Conner's Lake



Figures 15 and 16 depict the values for parameters collected at O'Conner's Lake for the CAMP program in 2005. It is important to note that the values reported above are from one year of monitoring data. To accurately characterize the quality of a lake the assessment should be based on several years of monitoring data.

Figure 15: CAMP Data 2005, Secchi Depth and a Chlorophyll

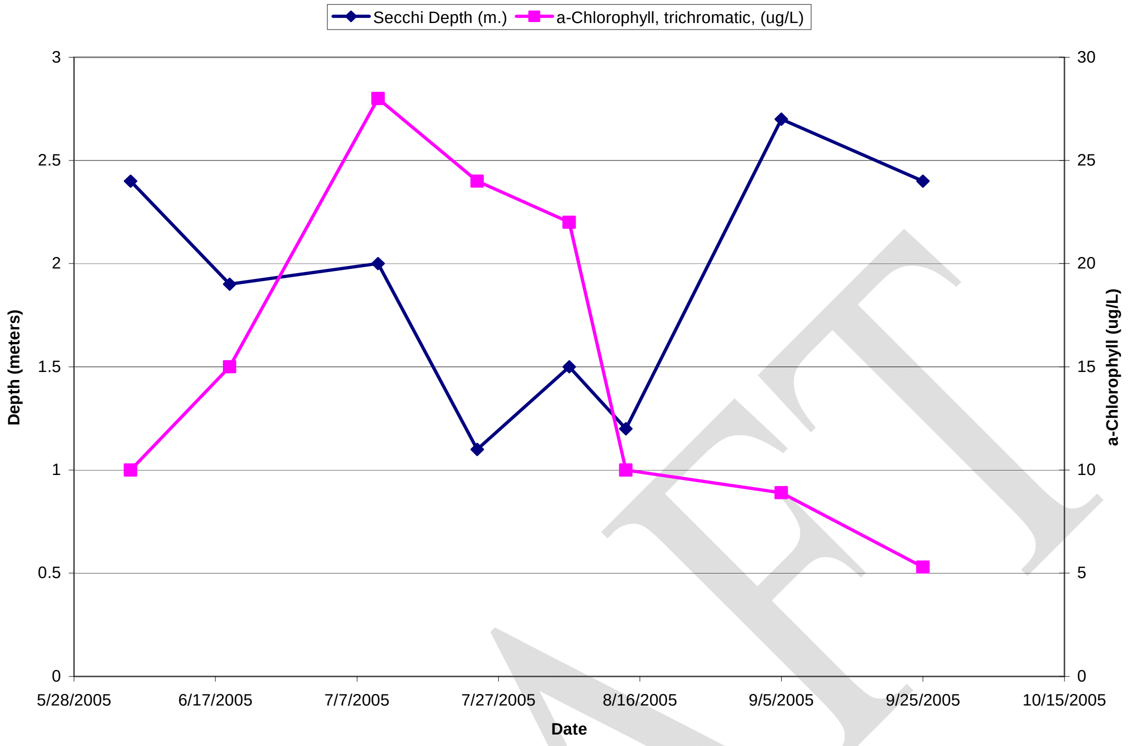
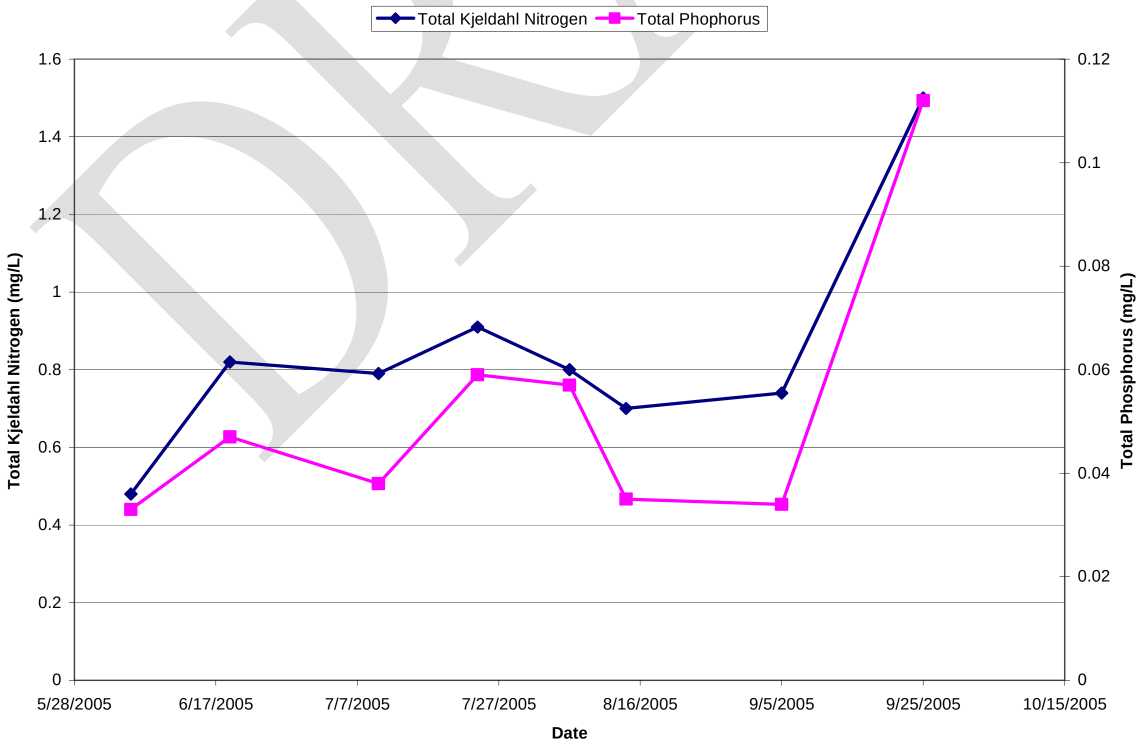


Figure 16: CAMP Data 2005, Total Kjeldahl Nitrogen and Total Phosphorus



D. Modeling

1.) Hydrologic Modeling

A hydrologic model of the O'Conner's Creek watershed was developed using XP-SWMM software. This computer model simulates the hydrologic processes of rainfall, runoff, evaporation, and streamflow. The effects of different land use or watershed management practices can be evaluated using the XP-SWMM model. Also, the model can be run using single event, design storms (e.g. 100-yr, 24-hr) to identify flood elevations, areas of high velocity/stream power, under-capacity culverts, etc.

The 6,100-acre watershed was subdivided into 7 sub-watersheds for the XP-SWMM model (Figure 17). The Green and Ampt methodology was selected to estimate infiltration/runoff characteristics. Runoff parameters for each sub-watershed were developed by using a lookup table to assign parameter values based on NRCS hydrologic soil group (Figure 4). Area-weighted average parameters were then developed in GIS for each sub-watershed. As part of the Rosgen stream classification, seven cross sections of O'Conner's Creek were taken. These cross sections were input to the model so that it had an accurate representation of watershed hydraulics. All culvert sizes and upstream and downstream inverts were surveyed and used in the model to define watershed hydraulic conditions.

The model was calibrated to streamflow for the period April, 2005 through October, 2005 from data collected by the Washington Conservation District (Figure 18). The Washington Conservation District has a streamflow monitoring station at Co Rd 21. Model calibration results are presented below in Figure 17. Modeled flow volume was 3.565E+07 ft^3 while measured flow was 3.559E+07 ft^3, indicating good agreement since the error between measured and modeled is less than 1%. In order to calibrate the model, flow from the contributing subwatersheds was regulated by intermediary storage nodes and links, which restricted the rate of flow of water entering the creek from each contributing area. These regulator nodes and links were adjusted until the overall hydrograph was in sufficiently close agreement with observed values.

The peak flow rate of October 4th and 5th is a good barometer for assessing model accuracy in terms of flood events. That storm produced 3.7 inches of rain, which is slightly greater than the 5-yr rainfall of 3.6 inches. Good agreement between measured and modeled flow for this storm indicates that estimated flow rates for the 10-yr and 100-yr events should be fairly accurate. The measured and modeled peak flows for that event were 38.0 and 39.4 cfs, respectively.

Results for the existing conditions model are presented below in Table 5. In-channel peak velocities are within acceptable ranges for the gravelly bottom material typifying this stream. The velocities indicated in the culvert at County Rd 21 are quite large. Adequate outfall protection appeared to be present when we examined the site, though it's possible that because there hadn't been a significant rainfall event in quite some time that any protection deficiencies wouldn't have been obvious. The peak water level within O'Conner's Lake was below the overtopping elevation of 807.2 feet above mean sea level for the 100-year rainfall event.

The 100-year snowmelt event was modeled by defining all subwatersheds as 100% impervious and simulating 7.2” of precipitation over the entire area. The resultant flow velocities and volumetric flow rates were substantially higher than those of the normal precipitation simulations. For the 100-year snowmelt conditions, the overtopping elevation of O’Conner’s Lake was exceeded by 1.8 feet, resulting in a significant amount of flow entering the open pit mining operation to the south.

Figure 17. Hydrologic Modeled Subwatersheds

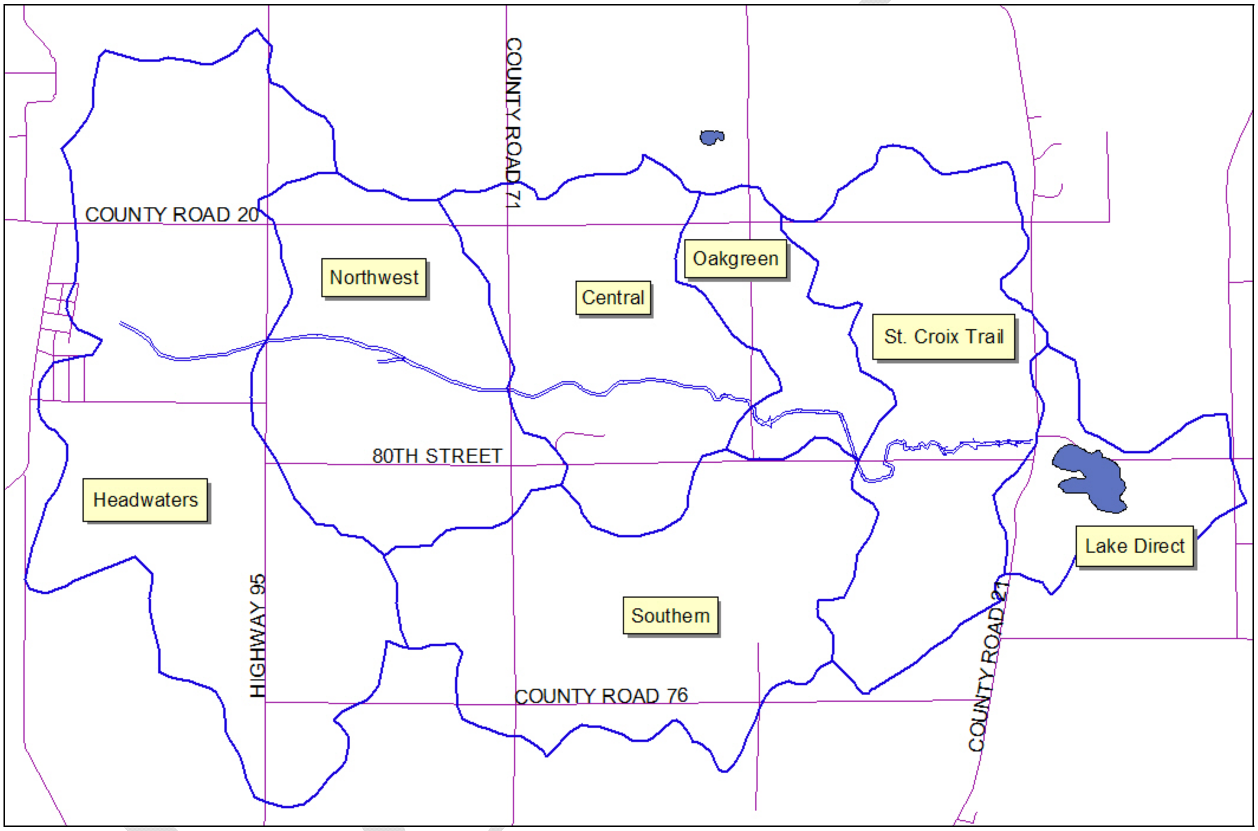


Figure 18: Model Calibration Results

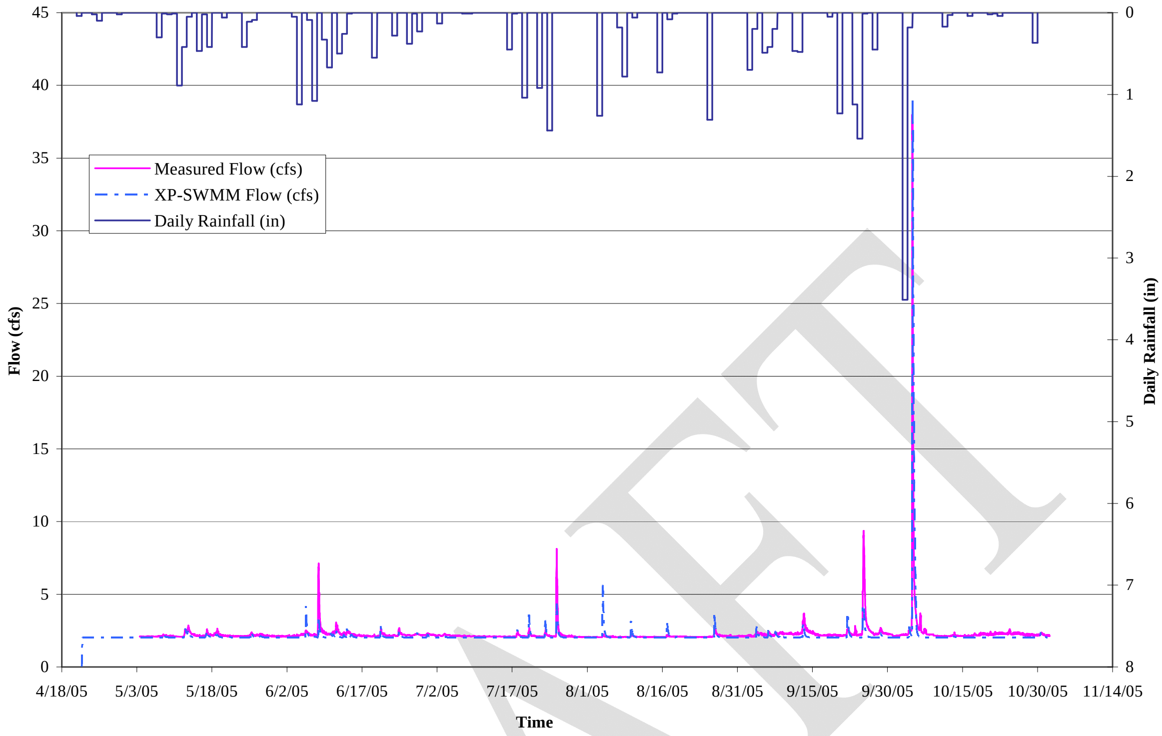


Table 5. Existing Conditions Model Results

Reach	2-yr		10-yr		100-yr		100-yr Snowmelt	
	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})
Manning-Neal	0.2	0.0	1.3	3.0	1.6	5.7	3.5	141.7
Neal-Oakgreen	0.5	0.8	1.1	8.2	1.3	15.0	3.8	492.2
Oakgreen-80th	1.9	4.4	2.8	16.1	3.0	29.3	3.0	774.9
80th – 80th	1.7	6.0	2.8	27.0	2.9	47.7	4.1	1245.6
80th – CR 21	1.6	6.0	2.6	26.9	2.7	47.0	3.5	1218.3
Culvert at CR 21	3.4	6.6	5.6	40.7	6.8	71.0	19.4	1094.9
Lake Elevation	799.8		800.5		803.3		809.0	

Future hydrologic conditions were simulated by using the 2020 anticipated land use from the Metropolitan Council. The future land use predicted by the Metropolitan Council is depicted in Figure 6. The change in impervious surface was used to adjust the Green Ampt infiltration parameters. Results for the 2-yr, 10-yr, 100-yr rainfall, and 100-year snowmelt events are shown below in Table 6. For the 2-yr, 10-yr, and 100-yr rainfall events, there are only modest increases in flow velocities and flow rates. Based on the modeling results, flow velocities are not likely to increase substantially enough to produce severe erosion problems. For the 100-year snowmelt event, the entire area was already modeled as 100% impervious area (representing frozen conditions), so the change in land use for the 2020 conditions does not affect the results of the snowmelt simulation.

Table 7 shows the percent increase in stream velocity and flow rate from existing to 2020 conditions. The Manning/Neal and Neal/Oakgreen reaches are expected to see a fairly significant increase in flow rate for the 2-year rain event. The 2-year event is commonly recognized as the channel-forming event. These two reaches may experience some erosion problems in the future. However, because these two reaches are in the headwaters of the watershed, where flow rates are fairly low, the erosion problems will be relatively minor.

Table 6. 2020 Build-out Conditions.

Reach	2-yr		10-yr		100-yr		100-yr Snowmelt	
	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})	Velocity (ft s^{-1})	Flow (ft^3 s^{-1})
Manning-Neal	0.3	0.1	1.4	3.2	1.6	5.8	3.5	141.7
Neal-Oakgreen	0.5	0.9	1.1	8.6	1.3	15.5	3.8	492.2
Oakgreen-80th	1.9	4.6	2.8	17.2	2.9	30.7	3.0	774.9
80th – 80th	1.7	6.5	2.8	28.7	2.7	49.0	4.1	1245.6
80th – CR 21	1.7	6.5	2.6	28.7	3.0	48.9	3.5	1218.3
Culvert at CR 21	3.5	7.3	5.7	43.8	6.9	74.5	19.4	1094.9
Lake Elevation	799.9		800.7		803.8		809.0	

Table 7. Percent Change in Flow Velocity and Rate from Existing to 2020 Build-out.

Reach	2-yr		10-yr		100-yr	
	Change in Velocity (%)	Change in Flow (%)	Change in Velocity (%)	Change in Flow (%)	Change in Velocity (%)	Change in Flow (%)
Manning-Neal	32	50	2	8	1	3
Neal-Oakgreen	8	18	1	4	0	3
Oakgreen-80th	2	6	1	7	0	5
80th – 80th	2	8	1	6	-5	3
80th – CR 21	3	8	1	6	11	4
Culvert at CR 21	3	11	2	8	1	5
Lake Elevation	0.1 ft		0.2 ft		0.5 ft	

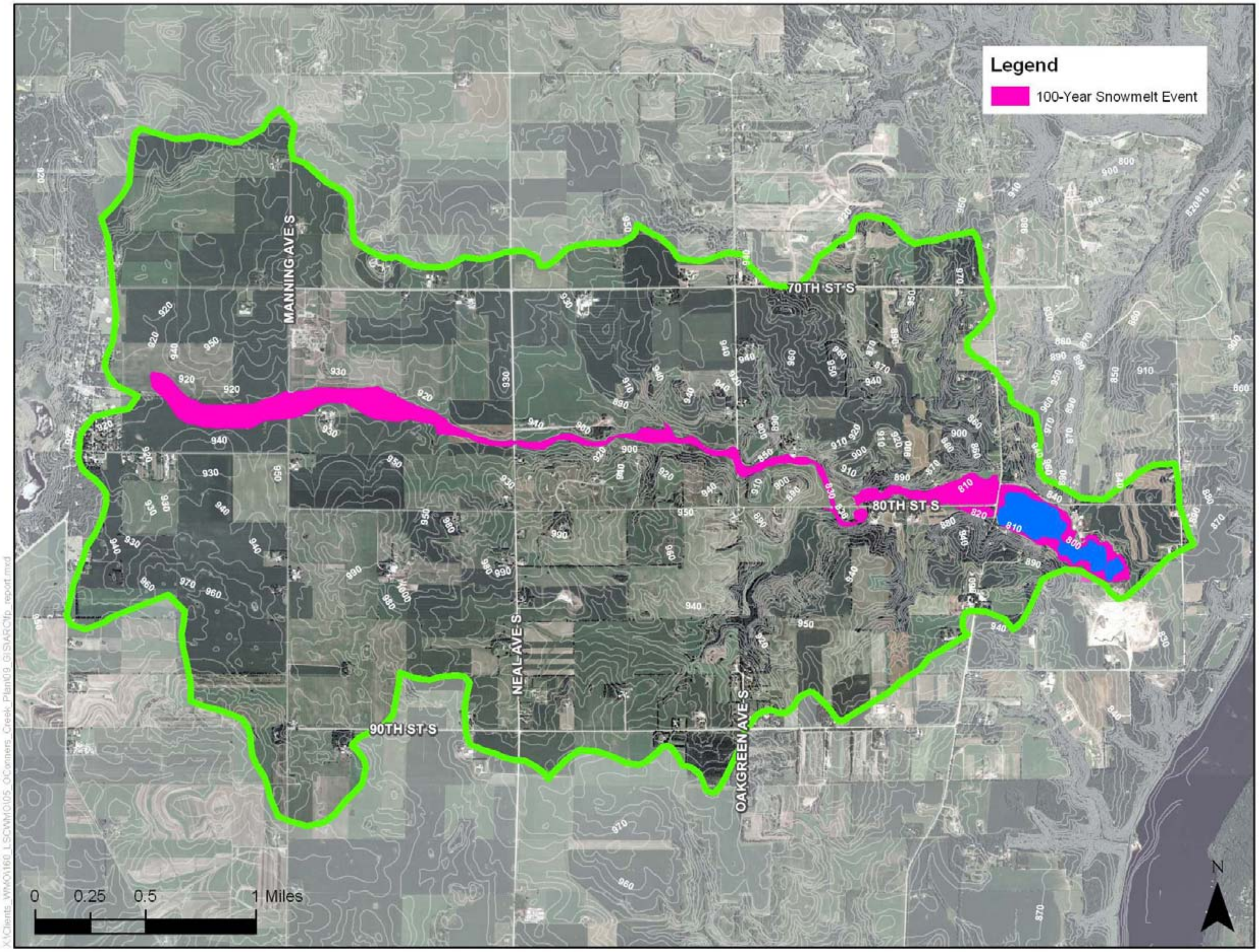
The approximate 100-yr floodplains for both existing rainfall and snowmelt are presented in Figure 19. Table 8 identifies the modeled stream elevations under the 100-year snowmelt event.

Table 8. Modeled Elevations During 100-year Snowmelt Event.

Location	Elevation
O'Conner's Lake – upstream of SE outlet	809.0
Just U/S of CR 21	809.7
80th St – Easternmost creek crossing – D/S	825.9
80th St – Easternmost creek crossing – U/S	825.9
80th St – Westernmost creek crossing – D/S	830.7
80th St – Westernmost creek crossing – U/S	831.0
Oakgreen Ave – D/S	848.6
Oakgreen Ave – U/S	849.3
Neal Ave – D/S	883.5
Neal Ave – U/S	883.7
Manning Ave – D/S	907.8
Manning Ave – U/S	911.7

D/S – Downstream side
U/S – Upstream side

Figure 19: 100-year Snowmelt Floodplain.



2.) Water Quality

A water quality model was constructed to simulate the load of total phosphorus generated throughout the watershed. The model was based on concentrations of total phosphorus by land use/land cover reported in research literature. The model was run using the land use/land cover that currently exists within the watershed as well as the anticipated condition for the year 2020.

Currently there is not enough water quality monitoring information for the O'Conner's Creek to appropriately calibrate the existing conditions water quality model. Providing the results from the model would simply be reporting the research values and would not be meaningful for this specific watershed.

The future conditions model is very dependent upon starting with a calibrated existing conditions model. As the watershed develops, the volume of water generally increases but total phosphorus concentrations can decrease with the land changing from agricultural to residential.

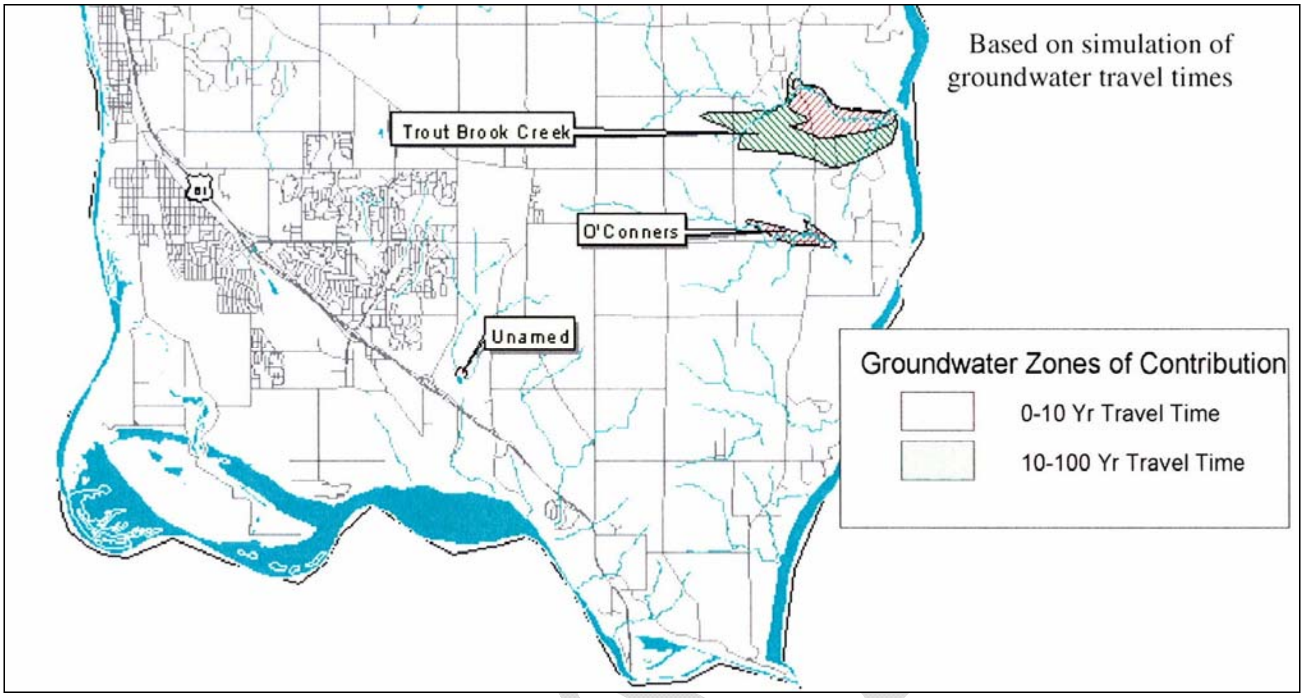
The watershed management organization currently is developing rules that will address the potential increase in total phosphorus loading in the watershed and significant water quality degradation is not anticipated.

It is recommended that water quality monitoring be conducted on O'Conner's Creek to provide baseline information. After adequate data has been collected, the water quality model could be calibrated.

3.) Groundwater Model

A groundwater model was developed as part of the Integrating Groundwater and Surface Water Management Southern Washington County Study completed by Barr Engineering. Barr developed a MIKE SHE model and developed groundwater zones of contribution for surface water features in Southern Washington County based on simulation of groundwater travel time. The shaded area illustrated in Figure 20 depicts the O'Conner's 0-10 year groundwater zone of contribution for O'Conner's Stream.

Figure 20: Groundwater Zones of Contribution to Surface Water Bodies Other Than the Mississippi and St. Croix Rivers (from Barr, 2005).



E. Management Goals

Data collected as part of the O'Conner's Stream and Lake Management Plan was presented at a public meeting where watershed residents were asked for their input for their desired future conditions of the stream and lake. Nine issues of concern were raised by watershed residents attending the preliminary meeting. In addition, issues of concern have been identified in existing studies and by Washington County.

Watershed residents issues of concern:

- What is the elevation of the ridge that separates O'Conner's Lake and the Tiller/Davies Quarry?
- Will an increase in future imperviousness in the watershed increase water levels in O'Conner's Lake?
- How will future development impact wildlife and vegetation in the watershed and along the creek and lake?
- Is it possible to stock the creek with trout?
- How are cattle affecting stream and lake quality?
- Recently constructed infiltration ponds are watershed holding water, what type of maintenance is needed and who is responsible?
- How do we protect private property concerns of residents along the creek and lake margins?
- How do we prevent pollution from degrading these resources?
- When will the resource plan be finalized and adopted?

Issues of concern from the Denmark NRI

- The Washington Conservation District noted twenty points where sediment could be entering the O'Conner's Stream. The WCD also noted stream bank erosion south of 80th Street. The erosion point is described by the WCD as being small in size and as a slight issue at the time observed (Appendix C).

Issues of concern from Washington County

- Washington County has asked the Tiller Corporation who operate the quarry located south east of O'Conner's Lake to do a hydrogeologic investigation to determine any potential affects expanded mining may have on local hydrologic conditions.

Each of the concerns is addressed as short term or long term issues.

1. Short term (by the year 2010) goals for O’Conner’s Stream and Lake:

- *Maintain lake water quality at the current TSI level.*

Current water quality conditions of O’Conner’s Lake are acceptable to the residents; residents expressed interest in maintaining current water quality conditions in the lake. Since only one year of monitoring data are currently available, it was decided to set general water quality goals as opposed to specific goals based on exact phosphorus and chlorophyll *a* concentrations and secchi transparency.

- *Implement Best Management Practices (BMPs) along shoreline.*

Portions of the O’Conner’s lakeshore currently have BMPs in use. This percentage should at a minimum be maintained.

- *Avoid hydrologic alterations that would raise or lower water levels in O’Conner’s Lake or would increase stormwater bounce.*

The O’Conner’s Lake subwatershed is currently being developed and water quantity and quality will change with increasing impervious area.

- *Manage invasive/exotic species within lake and subwatershed.*

Curly-leaf pondweed and Common Buckthorn, both invasive exotic species, exist in the subwatershed. These species should be monitored and managed to prevent the problem from worsening in the future.

- *Manage upland areas to prevent lake degradation.*

Managing upland areas of the watershed will help to limit phosphorous loading and lessen sediment loads due to erosion.

2. Long term (by the year 2020) goals for O’Conner’s Stream and Lake:

- *Improve water quality within the lake. Achieve a mesotrophic rating for the lake.*

The water quality of O’Conner’s Lake is typical of other shallow lakes in this region. Substantial improvements to the in-lake water quality are not realistic to expect but moderate improvement could be attained.

- *Implement Best Management Practices (BMPs) along 100% of the shoreline and stream corridor.*

Over the long term, the percentage of lakeshore and stream corridor with BMPs in use should increase to 90% to 100%.

- *Establish rooted aquatic vegetation along 100% of the shoreline.*

Over the long term, the percentage of shoreline with established aquatic vegetation should be increased from 90% to 100%.

F. Implementation Plan

There are two principles that will guide the management of the O'Conner's Subwatershed. The first is that the resources within the watershed, namely the stream and the lake, are currently in a non-degraded condition. There is not a tremendous need to improve the conditions of these resources. With the exception of a couple specific improvements detailed in the implementation plan, much of the management needed in the area will focus on maintaining the character and quality of the resources. The second management principle is that the O'Conner's Subwatershed is landlocked; there is currently no formal outlet from O'Conner's Lake. This situation provides unique challenges in managing stormwater. The WMO will develop watershed-wide standards during the Rule Development process, anticipated to be completed in 2007. The landlocked nature of the O'Conner's watershed may necessitate more stringent standards.

The following Management Standards and Capital Improvements were prioritized by the WMO Board after receiving significant input from residents within the subwatershed. The prioritization is as follows:

Priority 1: These activities are a priority for the WMO, will be funded in the WMO's annual budgeting process and will be implemented within the timeline of the Plan.

Priority 2: The activities are a lesser priority but the WMO acknowledges the benefit in conducting them. These activities will be implemented only if outside funding sources are procured.

Priority 3: These activities are not a priority for the WMO and will not be conducted.

1.) Lake Level Management - Priority Ranking 1

Lake level management is identified as a Priority 1 management strategy, indicating that the activity will be implemented annually within LSCWMO programs and projects. The WMO will actively monitor the level of O'Conner's Lake and use these data to assess changes in hydrology. Significant changes in the lake hydrology, i.e. increases in the normal water level of the lake, may create a situation whereby the lake will overflow into the mining operation to the east causing flooding and erosion problems. Minimizing these overflows is a goal of the WMO.

2.) Monitoring – Priority Ranking 1 and 2

1.) Stream flow monitoring and periodic water quality sampling at St. Croix Trail should continue into the future. This data set will be vital to assess long-term changes in the hydrology of the system. Monitoring of stream flow at St. Croix Trail is identified as a Priority 1 activity, and will be implemented on an annual basis.

2.) Manual lake level measurements at O'Conner's Lake taken by volunteer readers will be conducted in coordination with the DNR lake level program. Monitoring lake levels at O'Conner's Lake manually is identified as a Priority 1 activity and will be implemented on an annual basis.

3.) An automated monitoring station will be installed in the lake to provide level measurements. Automated level monitoring at O'Conner's Lake is identified as a Priority 2 activity indicating it will only be accomplished if outside funds are obtained or manual measurements are no longer feasible.

4.) Periodic stream flow measurements will be taken at the Oakgreen Road crossing to determine stream flow fluctuations in the stream's headwaters. This station does not need to be permanent; rather it could be installed at periodic intervals to determine if there are hydrologic changes. Periodic measurements at Oakgreen Road is a Priority 1 activity indicating that it will be implemented periodically in the future.

3.) Education Outreach - Priority Ranking 1

No specific educational program is recommended for the subwatershed. The overall education and outreach approach for the LSCWMO will apply to this subwatershed. This activity is a Priority 1 activity and will be implemented on an annual basis as part of the overall watershed education and information program.

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G. Capital Improvement Plan

1.) Water Quality Assessment - Priority Ranking 1

Generally, water quality within the watershed will be addressed through the Watershed Rules. The WMO will assess the water quality impacts of two existing developed areas in the subwatershed. The assessment is a Priority 1 activity and will be funded during implementation of this Plan.

Project Timeline – 2012-2014
Cost Range – $2,000
Consideration – The cost is for assessing 2 sites at $1,000/site and developing a letter report summarizing the findings and recommendations.

2.) Water Quality Feasibility Study - Priority Ranking 2

If a WMO assessment determines that water quality is being impacted by a specific developed area, a feasibility study will be conducted to determined recommendations for addressing the problem. The feasibility study is a Priority 2 activity and will not be conducted unless outside funds are obtained.

Project Timeline – 2012-2014
Cost Range – $10,000 - $15,000
Consideration: The cost range is for conducting a feasibility study to address the water quality issue. Plans and specifications will not be provided.

3.) Stream Riparian Zone Restorations – Priority Ranking 1

The stream reach downstream of the two crossings of 80th Street has been identified as having inadequate riparian zones and buffers from adjacent land use. The LSCWMO will provide technical expertise for design of riparian restoration including plant installation. Riparian zone restorations are a Priority 1 activity. This activity will be funded and conducted during implementation of this Plan.

Project Timeline - 2010-2011
Cost Range - $500-$2,000
Considerations –. This is a completely voluntary initiative and will only be conducted on property where there is a landowner willing to work with the WMO to improve the stream. Primary costs will be for plant material. The WMO will use volunteer labor for planting.

4.) Stream Structure Improvements – Priority Ranking 3

There are four structures within the stream which convey flow through road crossings. Each has been identified as having a unique role in the formation of the downstream stream reach. In addition, each structure provides a barrier to fish migration to a varying degree. Design and construction of stream structure improvements are a Priority 3 activity, and funding will not be planned.

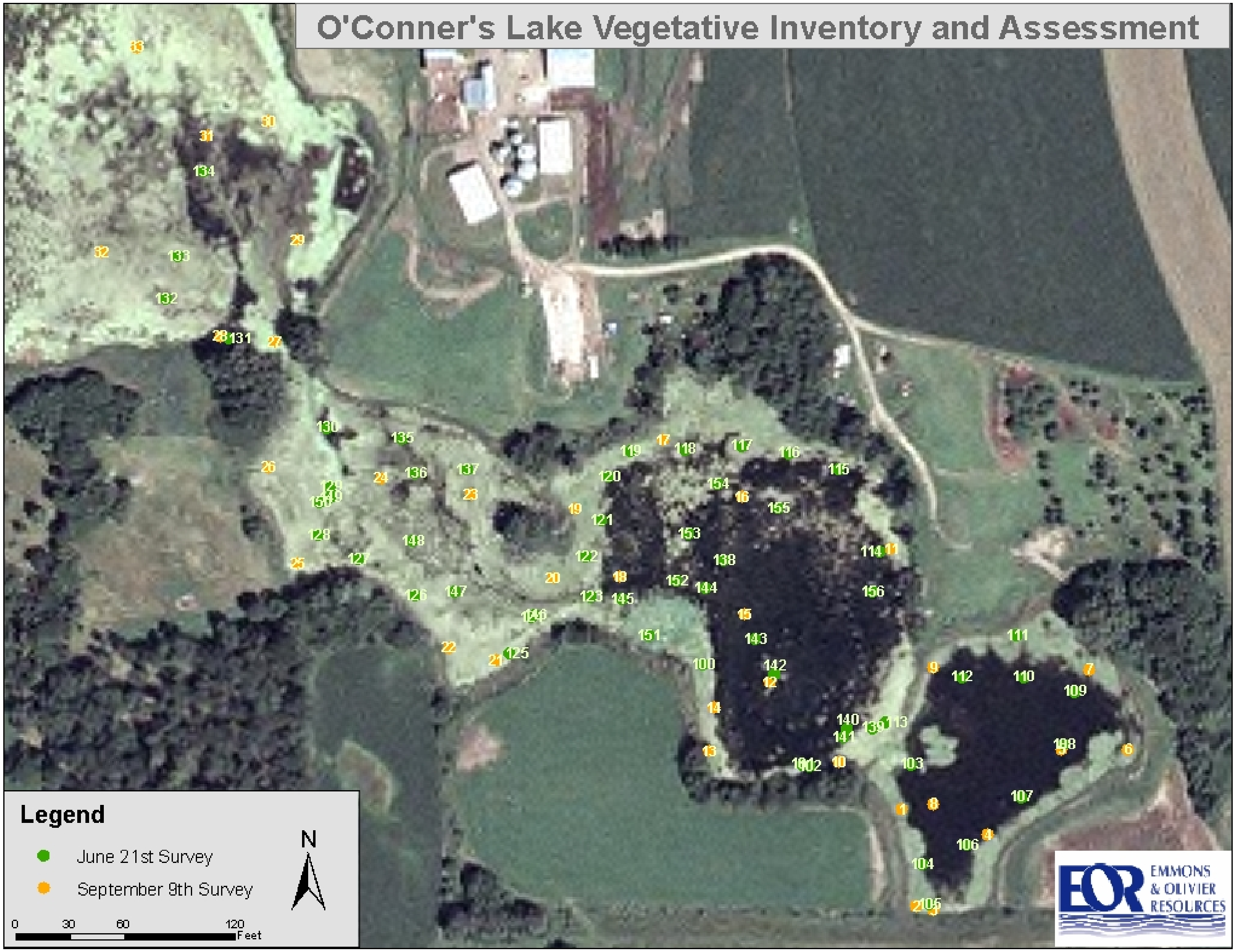
Project Timeline - 2012
Cost Range - $25,000 - $50,000
Considerations – Detailed hydraulic modeling and stream morphometry analysis will be conducted. Actual capital improvements may be simple structural improvements.

5.) Lake Outlet Feasibility Study – Priority Ranking 1

A feasibility study to determine the options for a lake outlet at O'Conner's Lake is a Priority 1 activity. Construction of an emergency overflow from O'Conner's Lake, through the downstream mining operation and eventually down to the St. Croix River may someday become a necessity. The feasibility study will identify the potential route in coordination with the eventual restoration of the mine. The LSCWMO will fund this activity during implementation of this Plan.

Project Timeline – 2014
Cost Range - $20,000 - $30,000
Considerations – Prior to conducting the study the WMO will begin a dialog with the mining company. An outlet to from the Lake could be incorporated as an amenity to the future state of the reclaimed mine land.

Appendix A – Lake Vegetation Assessment



Relative Abundance of Macrophyte Species in O'Conner's Lake

Data Points	Yellow Lotus	Floating-leaf Pondweed	Coontail	Lesser Duckweed	Flat-stemmed Pondweed	Canada Waterweed	Algae	Leafy Pondweed	Sago Pondweed	Muskgrass
100	H	M	M	M	L					
101		L	H	M	L		L			
102			H							
103		M	H		L					
105		L	L		L					
106			M		M	M				
107			H		L					
108		L	H		L					
109			H		L					
110			H		L					
111		M				M		M		
112					M	M				
113		M		L	M	M	L			
114	L		H		L					
115		L	M					L		
116		M	H	M				L		
117		L	H	L	L					
118			H		L					
119			H	L	L					
120			H		H					
121		M	H	L	M					
122		M	M	M	L					
123	L	H		H			M			
124			H	H	H		M			H
125				H	M			L		H
126		L		L			L	H		
127		M		M						M
128			L	M						H
129			L	M						M
130			H	H						
131			L	M	H					
132			L	M	H	L				
133			M	L	M					
134			H	H						
135		M	H	M				M		
136		L	H	L		L	L			
137		M		M						M
138			L							H
139			M							
140			M							
141			M							
142			H							
143			H							
144					M	L				M
145						M				H
146		M		M	H					M
147		H		M	M		M			
148			L	M	H		H			
149			H	H	M		M			
150			H	H	M		M			
151	H	L	L		L					

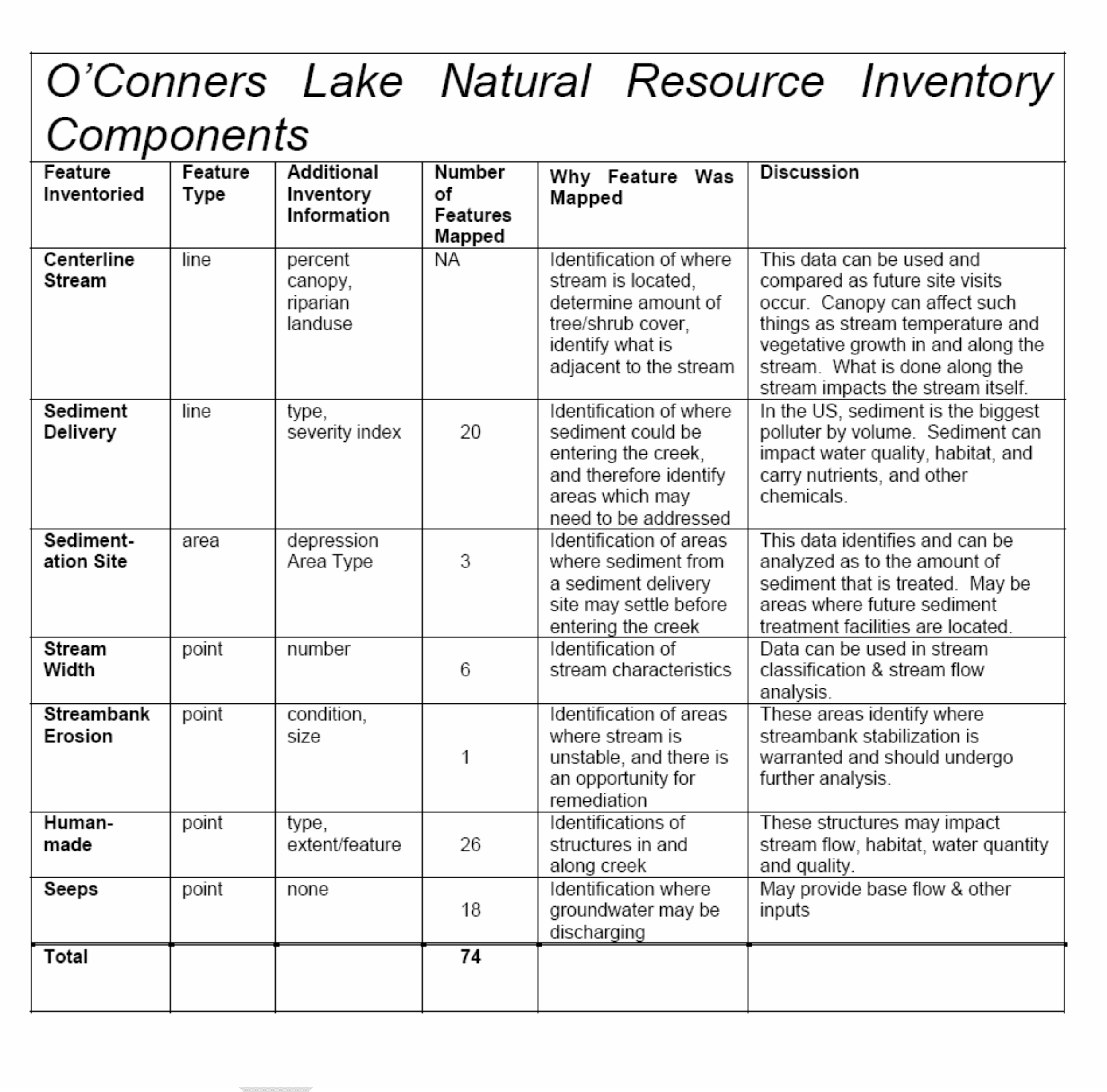
Data Points	Yellow Lotus	Floating-leaf Pondweed	Coontail	Lesser Duckweed	Flat-stemmed Pondweed	Canada Waterweed	Algae	Leafy Pondweed	Sago Pondweed	Muskgrass
152			H		L					L
153					M					
154			M		M					H
155			L		H					L
156			H							L
1		H	H							
2		H	H	L						
3		L				H		M		
4		H					L	L		
5			H			L	M	M		
6		H	L					L		
7		H						H		
8		L	L						L	
9		M	M				M		M	
10			M						M	
11		M	H	L					H	
12			H							
13		M	M	M			L			
14	H		M							
15	H		L						L	
16			H					M	L	
17		L	M	L				L	L	
18	H		M					L		
19		H	M	L					M	
20		H								
21		M	M	M						
22		H	M							
23		M	L							
24		M	L	L						
25		M	M				M			
26		M	L	M						
27		M	L							
28			L	M		M	M			
29			H	L			L		L	
30			H	M		L			H	
31			H	L						
32				L			L			
33			M	L						

Yellow Lotus (*Nelumbo lutea*)
Floating-leaf Pondweed (*Potamageton natans*)
Coontail (*Ceratophyllum demersum*)
Lesser Duckweed (*Lemna minor*)
Flat-stemmed Pondweed (*Potamogeton zosteriformis*)
Canada Waterweed (*Elodea canadensis*)
Algae (various spp.)
Leafy Pondweed (*Potamogeton foliosus*)
Sago Pondweed (*Potamogeton pectinatus*)
Muskgrass (*Chara spp.*

Appendix B – 2005 CAMP Data

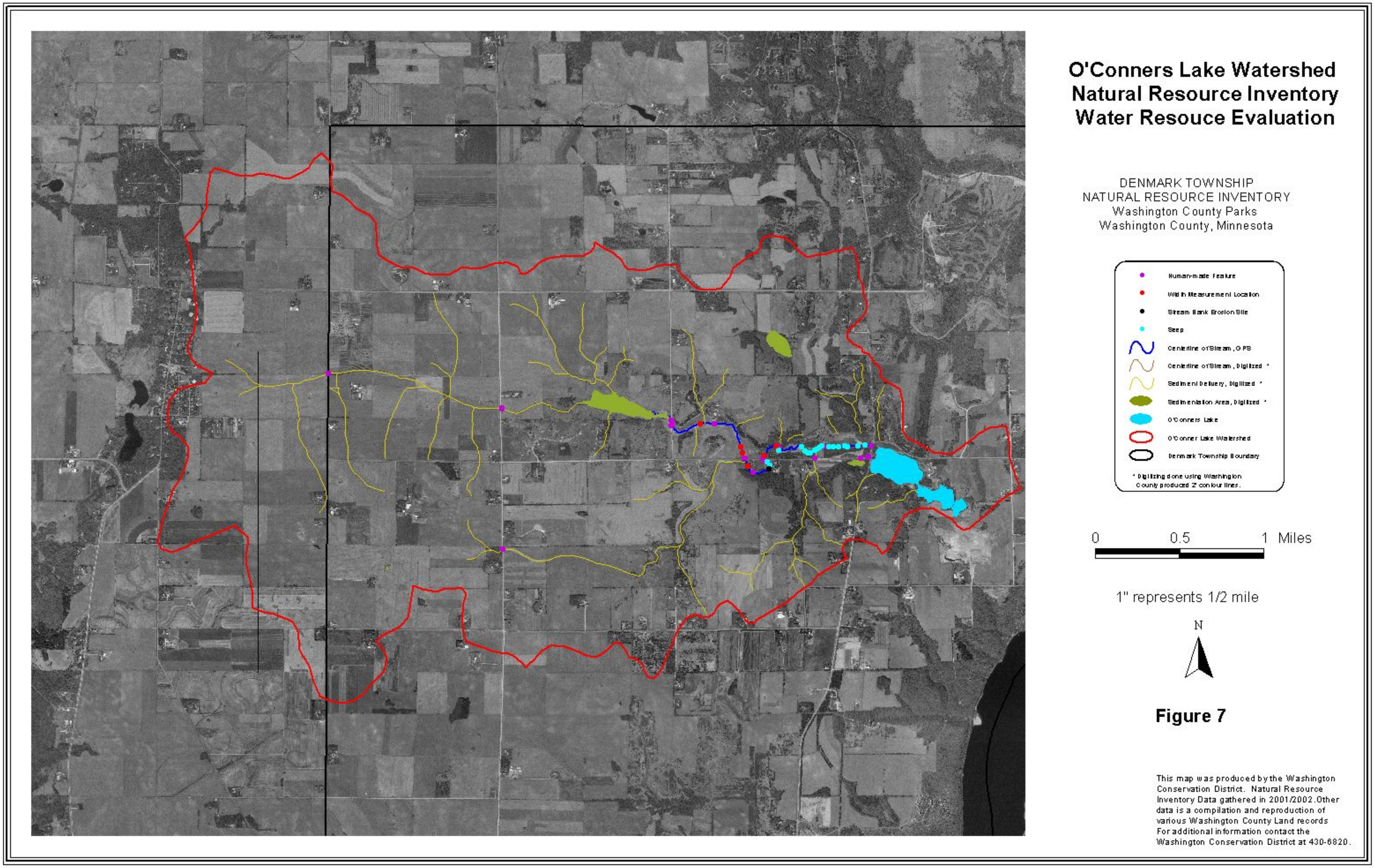
DATE	AQUATIC PLANTS	CLOUD COVER	LAKE LEVEL	Secchi Depth, m	PHYSICAL CONDITION	RECREATION SUITABLE
6/5/2005	Slight	75	Normal	2.4	2	4
6/19/2005	Moderate	0	Normal	1.9	2	4
7/10/2005	Slight	0	Normal	2	2	4
7/24/2005	Substantial	0	Normal	1.1	2	4
8/6/2005	Minimal	0		1.5	3	3
8/14/2005	Substantial	0	Normal	1.2	3	4
9/5/2005	Slight	50	Normal	2.7	2	4
9/25/2005	Slight	100	Normal	2.4	2	4
DATE	WIND	WATER_SURFACE	AIR_TEMPERATURE	WATER_TEMP	WATER_COLOR	WATER_ODOR
6/5/2005	Breezy East	Calm	61-80	23.1	Clear	None
6/19/2005	Breezy North	Ripple	81-90	27.4	Clear	None
7/10/2005	Breezy North	Ripple	81-90	28.9		None
7/24/2005	Breezy North	Calm	81-90	27.8		None
8/6/2005	Calm	Calm	81-90	26.2		None
8/14/2005	Calm	Calm	61-80	24.3		None
9/5/2005	Breezy North	Ripple	61-80	20.9	Clear	None
9/25/2005	Breezy North	Ripple	41-60	17.8	Clear	None
DATE	Total Kjeldahl Nitrogen, mg/L	Total Phosphorus, mg/L	a-Chlorophyll; trichromatic, ug/L	a-corr-Chlorophyll for pheophytin, ug/L	% Chlorophyll a, ug/L	Pheophytin a, ug/L
6/5/2005	0.48	0.033	10	10	87	1.1
6/19/2005	0.82	0.047	15	14	87	2.1
7/10/2005	0.79	0.038	28	25	87	3.9
7/24/2005	0.91	0.059	24	22	94	1.5
8/6/2005	0.8	0.057	22	19	81	4.5
8/14/2005	0.7	0.035	10	8.4	76	2.7
9/5/2005	0.74	0.034	8.9	7.6	78	2.1
9/25/2005	1.5	0.112	5.3	3.3	49	3.4

Appendix C – WCD-O’Conner’s Water Resource Inventory Data



O’Conners Lake Natural Resource Inventory Components

Feature Inventoried	Feature Type	Additional Inventory Information	Number of Features Mapped	Why Feature Was Mapped	Discussion
Centerline Stream	line	percent canopy, riparian landuse	NA	Identification of where stream is located, determine amount of tree/shrub cover, identify what is adjacent to the stream	This data can be used and compared as future site visits occur. Canopy can affect such things as stream temperature and vegetative growth in and along the stream. What is done along the stream impacts the stream itself.
Sediment Delivery	line	type, severity index	20	Identification of where sediment could be entering the creek, and therefore identify areas which may need to be addressed	In the US, sediment is the biggest polluter by volume. Sediment can impact water quality, habitat, and carry nutrients, and other chemicals.
Sediment-ation Site	area	depression Area Type	3	Identification of areas where sediment from a sediment delivery site may settle before entering the creek	This data identifies and can be analyzed as to the amount of sediment that is treated. May be areas where future sediment treatment facilities are located.
Stream Width	point	number	6	Identification of stream characteristics	Data can be used in stream classification & stream flow analysis.
Streambank Erosion	point	condition, size	1	Identification of areas where stream is unstable, and there is an opportunity for remediation	These areas identify where streambank stabilization is warranted and should undergo further analysis.
Human-made	point	type, extent/feature	26	Identifications of structures in and along creek	These structures may impact stream flow, habitat, water quantity and quality.
Seeps	point	none	18	Identification where groundwater may be discharging	May provide base flow & other inputs
Total			**74**		



O'Conners Lake Watershed Natural Resource Inventory Water Resouce Evaluation

DENMARK TOWNSHIP
NATURAL RESOURCE INVENTORY
Washington County Parks
Washington County, Minnesota

Figure 7

This map was produced by the Washington Conservation District. Natural Resource Inventory Data gathered in 2001/2002. Other data is a compilation and reproduction of various Washington County Land records For additional information contact the Washington Conservation District at 430-6820.

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