Stormwater Master Plan

City of Saint Peter, MN

BMI Project No. M14.36771

March 2008

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

Stormwater Master Plan

City of Saint Peter, MN

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

By: _____
William R. Douglass, P.E.
License No. 18240

Date: March 26, 2008

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY 1
II. STORMWATER MASTER PLAN PURPOSE AND GOALS 3
III. SUMMARY OF GOALS & POLICIES 4
1. Water Quality 4
2. Water Quantity - Runoff Management and Flood Control 4
3. Wetlands 4
4. Erosion and Sediment Control 4
5. Groundwater 4
6. Recreation, Habitat and Shoreland Management 4
7. Financing 5
IV. SUMMARY OF PROBLEMS AND ISSUES 5
V. SUMMARY OF POTENTIAL SOLUTIONS TO IDENTIFIED PROBLEMS 6
VI. PROJECT SUBMITTALS 8
VII. GENERAL DESCRIPTION 8
1. Topography 8
2. Soils 11
3. Natural Resources 11
4. Wetlands 12
5. Land Use and Land Cover 13
VIII. GENERAL PROCEDURES 14
1. General NPDES Requirements 15
2. Total Maximum Daily Load (TMDL) 16
3. Total Maximum Daily Load (TMDL) – Phosphorus 17
4. Regulation 20
5. Maintenance 22
6. Ownership – City Control 22
7. Covenants 22
8. Permits 22
IX. STORMWATER QUANTITY 22
1. Background 22
2. Design Criteria 24
3. Landlocked Basins 37
4. Volume Control 37
5. Design Summary 39
X. STORMWATER QUALITY 41
1. Background 41
2. Water Quality and Land Use 42
3. Stormwater Pollutant Removal 42
4. Permanent Sedimentation and Water Quality Stormwater Basins 42
5. Design Criteria 43
XI. NATURAL RESOURCES PROTECTION 44
1. Ravine Areas 44
2. Bluff Areas 45
3. Wetlands 46
XII. TREATMENT METHODOLOGIES 46
1. Individual Development Basins 47
2. Regional Wet Retention Basins 48
3. Constructed Wetland Treatment of High Nitrate Runoff 48
4. Infiltration Basins 48
5. Rain Gardens (also known as Bioretention Basins) 49
6. Filtration 49
7. Prefabricated Treatment Methodologies 50

8. Forebays 50
9. The Old Wastewater Treatment Ponds 51
10. Downstream Defender 52
11. Sand and Rock Weir 52
XIII. AREAS OF CONCERN AND STUDY 55
1. The North Highway 169 Median Area 55
2. Halletts Park Stormwater Basin 57
3. Drainage for Possible TH 169 Bypass of Downtown Saint Peter 57
4. The Western Growth Area 58
5. Stormwater Impact on Robart's Creek 59
6. Stormwater Discharge to the Saint Peter Regional Treatment Center (RTC) 59
7. The North Welco Basin 60
XIV. EXISTING STORM SEWER NETWORK 61
1. Stormwater Inlets 61
2. Existing Storm Sewer Network 62
3. Storm Sewer Manholes 62
4. Storm Sewer Network 62
5. Standard Design Rainfall 62
6. Storm Sewer System 63
XV. PROPOSED STORM SEWER NETWORK IMPROVEMENTS 64
1. The proposed storm sewer piping improvements include: 64
XVI. LIST OF POTENTIAL BASINS 65
1. General 66
2. Robart's Creek Watershed 66
3. Regional Basin 1 Watershed 67
4. Regional Basin 2 Watershed 67
5. Regional Basin 3 Watershed 67
6. Regional Basin 4 Watershed 68
7. Regional Basin 5 Watershed 68
8. West Industrial Basin Watershed 69
9. Regional Basin 6 Watershed 69
10. Warren Basin/Regional Basin 7 Watershed 69
11. Regional Basin 8 Watershed 70
12. North WELCO Basin 70
13. Regional Basin 9 Watershed 71
14. Regional Basin 10 Watershed 71
15. Regional Basin 11 Watershed 71
16. Regional Basin 12 Watershed 72
17. Regional Basin 13 Watershed 72
18. Regional Basin 14 Watershed 73
19. Regional Basin 15 Watershed 73
20. Regional Basin 16 Watershed 73
21. Regional Basin 17 Watershed 74
22. Regional Basin 18 Watershed 74
23. Regional Basin 19 Watershed 74
24. Regional Basin 20 Watershed 75
25. Regional Basin 21 Watershed 75
26. Watershed Currently Flowing to City Storm Sewer System 76
27. Gustavus Adolphus Basins Watershed 76
28. Oak Leaf Lake Watershed 76
29. The Minnesota River Watershed 77
XVII. OPERATIONS AND MAINTENANCE 78
1. Stormwater Basins 78
2. Sediment Removal 79

3. Open Channels 79
4. Piping System 79
5. De-Icing Practices 80
6. Detection of Illicit Connections 80
XVIII. EDUCATION 81
1. Development Community 81
XIX. ECONOMIC CONSIDERATIONS 81
XX. SUMMARY AND RECOMMENDATIONS 83
1. Summary 83
2. Recommendations 84
3. Implementation of Recommendations 85

APPENDIX A

Figure No. 1 Study Area
Figure No. 2 Soils Map
Figure No. 3 DNR Protected Waters
Figure No. 4 Wetlands Map
Figure No. 5 Conceptual Regional Stormwater Basin Locations
Figure No. 6 FEMA Floodways Map
Figure No. 7 Western Development Study Area Map
Figure No. 8 Recommended Easement Corridor Map
Figure No. 9 Existing Storm Sewer System
Figure No. 10 Proposed Storm Sewer Improvements

LIST OF TABLES

Table 1. Infiltration Rates Per Soil Type 38

LIST OF EXHIBITS

Exhibit 1. Geology of Saint Peter Area 10
Exhibit 2. Public Waters Jurisdiction – Water Course 21
Exhibit 3. Area of Changed Land Cover 29

LIST OF ACRONYMS

CIRP	Capital Improvement and Replacement Program
EOF	Emergency Overflow
FEMA	Federal Emergency Management Agency
GAC	Gustavus Adolphus College
GIS	Geographic Information Systems
HWL	High Water Level
LGU	Local Governmental Unit
Mn/DOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NURP	Nationwide Urban Runoff Program
NWI	National Wetland Inventory
NWL	Normal Water Level
OHWL	Ordinary High Water Level
REF	Residential Equivalency Factor
RTC	City of Saint Peter Regional Treatment Center
SWCD	Soil and Water Conservation District
SCS TR	Soil Conservation Service Technical Release
SWMP	Stormwater Master Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WCA	Wetland Conservation Act

I. EXECUTIVE SUMMARY

The findings of this Comprehensive Stormwater Master Plan are best summarized as follows:

- The existing storm sewer pipe network in the developed part of the City is predominately capable of handling the potential runoff from a ten-year storm event which is 4.2 inches of rainfall over a 24-hour period. The pipe sections needing additional capacity are described in Section XIV of this report.
- The existing storm sewer network cannot handle additional flow from the undeveloped growth areas around the City, as currently this water does not typically reach the existing storm sewer system because it infiltrates into the ground before reaching the storm sewer network. When land is developed, there is increased impervious area; therefore there is more runoff, which would overload the existing storm sewer system.
- The majority of the City that was developed prior to 1980 and includes storm sewers that discharge directly to the Minnesota River with no treatment or Best Management Practices applied. These untreated outfalls are addressed in the Stormwater Master Plan for management under the Municipal Separate Storm Sewer System permit that was submitted to MPCA on February 15, 2007.
- Through the use of current ordinances and proposed ordinance revisions, treatment Best Management Practices are now being incorporated in newly developing areas.
- The Minnesota Pollution Control Agency has designated the Minnesota River as an impaired water. This designation means that the City of Saint Peter will need to limit pollutants causing the problem. The Minnesota Pollution Control Agency typically sets a Total Maximum Daily Load limit for targeted pollutants known to cause the impairment. By the year 2010, preliminary indications are that the City needs to show that it is reducing its total phosphorus loading to the Minnesota River by 30 percent of the year 2000 baseline. The strategic Best Management Practices planning recommended in this report are anticipated to help the City meet the Total Maximum Daily Load requirements. The City's proactive approach of installing storm water basins since 1971 will reduce the cost impact of meeting this requirement.
- Although the Minnesota Pollution Control Agency requirements for Municipal Separate Storm Sewer Systems encourage infiltration as a viable form of treatment for runoff, this opportunity must be carefully considered relative to the vulnerable wellhead capture zones in the sand prairie plateau in the western development area.
- The design of all stormwater treatment Best Management Practices, including retention basins, infiltration basins, biofilters, etc., should consider the City's wellhead protection plan when finalizing the design. There is a significant area immediately west of the current City, hereinafter called the Western Development Study Area, a portion of which has been deemed a highly vulnerable wellhead protection zone. Pretreatment basins with synthetic, clay or soil bentonite lining may need to be included in the final designs prior to allowing infiltration within these sensitive areas.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- The Western Development Study Area serves a large agricultural drainage area. Runoff currently infiltrates through the porous soil without flowing into the developed parts of the City. Thus, any runoff from new development in the Western Development Study Area should be designed to bypass the existing City storm sewer network, which is designed to only handle the existing developed area.
- Emergency overflow "green corridors" need to be incorporated into future development designs. This creates a challenge in ensuring corridors are available for upstream developments. Planning and securing easements of logical green corridor routes is encouraged prior to any development in these areas. Linear park dedication and trail projects can be incorporated into the emergency overflow green corridor layout.
- Regional stormwater basins are recommended for all development areas, as they are the most easily adapted to unforeseen changes in the upstream development.
- The construction of regional stormwater basins will reduce or eliminate the flows downstream and decrease costs in downstream infrastructure improvements.
- Maps are attached in Appendix A for geographical references listed in the master plan.
- Any determined stormwater management charges or area charges to new developments should be reviewed on an annual basis to ensure that changes in land acquisition, construction cost, bonding cost, legal cost, etc. are included in the computed fee.
- This report is a working document and should be updated as the outlying areas develop, to review the differences between the actual and modeled conditions. The planning period covered by this report is 10 years.

© Bolton & Menk, Inc. 2008, All Rights Reserved

II. STORMWATER MASTER PLAN PURPOSE AND GOALS

- Protect, preserve, and use natural surface water and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Establish uniform local policies and official controls for surface water and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge (where it does not affect the drinking water supply);
- Protect and enhance fish and wildlife habitat and water recreational facilities;
- Analyze the existing storm sewer system for capacity deficiencies and propose improvements with costs;
- Indentify locations and drainage districts for proposal stormwater basins;
- Evaluate the North Welco Basin and expansion requirements;
- Review Halletts Pond system drainage;
- Evaluate Nicollet County and Gustavus Adolphus College's stormwater impact to the City;
- Evaluate City stormwater discharge to the Saint Peter Regional Treatment Center;
- Discuss how the Federally mandated National Pollutant Discharge Elimination System (NPDES) will affect the City;
- Evaluate using the old wastewater treatment ponds and compact drainage filter systems to meet NPDES requirements for discharge water quality to the Minnesota River;
- Evaluate the stormwater impact of a future TH 169 Bypass of the City and TH 169 interchanges at TH 22 north and south;
- Propose future storm sewer system design parameters, including treatment and time of concentration.

© Bolton & Menk, Inc. 2008, All Rights Reserved

III. SUMMARY OF GOALS & POLICIES

The SWMP was prepared with the following goals and policies in mind:

1. Water Quality

   Maintain or enhance the water quality of the Saint Peter area wetlands and watercourses. Nitrate infiltration in the wellhead protection areas and phosphorus loading into the Minnesota River are of greatest concern. High concentrations of nitrate are currently infiltrating untreated into the vulnerable wellhead protection zones from the current agricultural activities and practices. There is concern that residential fertilizers will compound the nitrate infiltration problem.

2. Water Quantity - Runoff Management and Flood Control

   Preserve, maintain and expand (where possible) the stormwater storage and detention systems to control excessive runoff volumes and rates, prevent flooding, protect public health and safety, and minimize public capital expenditures. Establish minimum building floor elevations relative to the modeled 100-year flood levels and established flood plains. Provide detention basin emergency overflows to protect property from events exceeding the 100-year design.

3. Wetlands

   Consider the Minnesota Wetlands Conservation Act (WCA) in attempting to limit the loss of wetlands that require mitigation in accordance with state law.

4. Erosion and Sediment Control

   Enforce the most recent extension of the 1987 Amendment to the Federal Water Quality Act which includes the National Pollutant Discharge Elimination System (NPDES) Phase II requirements for erosion and sediment control from construction sites disturbing greater than 1 acre. This effort is anticipated to protect the existing capacity of the City's stormwater system and reduce impact on the Minnesota River and Robart's Creek by:

   - Preventing sediment build-up.
   - Slowing flow to reduce flooding.
   - Maintaining the water quality of the runoff.
   - Correcting existing erosion and sedimentation problems.

   Enhancements to the City's stormwater management ordinance to enforce greater erosion controls are recommended.

5. Groundwater

   Protect and enhance the quality and quantity of groundwater resources.

6. Recreation, Habitat and Shoreland Management

   Protect and enhance fish and wildlife habitat and recreation opportunities.

   Increase public awareness, understanding and involvement in stormwater and natural resource management issues.

© Bolton & Menk, Inc. 2008, All Rights Reserved

7. Financing

Minimize and fairly distribute public expenditures for plan implementation. The potential local funding mechanisms include:

- The stormwater utility fees
- Development (access) charges
- Collaborating/partnering with other entities
- Grant opportunities.
- Assessments

IV. SUMMARY OF PROBLEMS AND ISSUES

Some of the stormwater-related problems and issues identified in and around Saint Peter include:

- Providing additional controls in the existing developed areas associated with the treatment of stormwater runoff.
- Ensuring that the sediment and hydraulic loads to the area creeks and river are reduced to the maximum extent practicable.
- Ensuring that the sediment loads to treatment and recreational stormwater basins are reduced as is practical.
- Ensuring that the Total Maximum Daily Load (TMDL) limits as set by the Minnesota Pollution Control Agency (MPCA) are met.
- Providing funding mechanisms to support the recommended projects and programs.
- Implementing recommended improvements and maintaining the City's stormwater system.
- Developing a more comprehensive Capital Improvement and Replacement Program and a 10-year plan for implementation.
- Protecting the wellhead protection area.
- Comparing regional versus localized stormwater basins to serve stormwater and recreational needs.
- Protecting down-gradient developments from high groundwater and seepage concerns associated with up-gradient infiltration basins.
- Protecting the Minnesota River from further deterioration because it is currently identified as an impaired water by the State of Minnesota.
- Protecting Robart's Creek from deterioration because it is currently identified as Minnesota Department of Natural Resources (DNR) protected water.
- Addressing the runoff flow rates upstream and through the Regional Treatment Center.

© Bolton & Menk, Inc. 2008, All Rights Reserved

V. SUMMARY OF POTENTIAL SOLUTIONS TO IDENTIFIED PROBLEMS

- Providing additional regionalized stormwater treatment as development and/or redevelopment occurs.
- Implementing funding sources such as the stormwater utility fees, the use of a development charge, assessments, and agreements with developers, bonding, or some combination thereof, to fund stormwater management projects.
- Upgrading the City's stormwater system to provide a 100-year level of protection from flooding and a 10-year level of service for storm sewer delivery.
- Developing and continually updating a 100-year flood protection map for all water bodies within City limits.
- Development and protection of overflow spillway corridors giving additional protection in the event of extreme rainfall conditions, extreme snowmelt, or both.
- Implementing the use of pretreatment BMPs, such as rain gardens or biofilters and wetland treatment, as a method of removing undesirable pollutants (nitrogen, phosphorus and some heavy metals) from the developed area stormwater runoff prior to infiltration in vulnerable wellhead protection zones.
- Revising/adding to City policies and ordinances to address stormwater management issues by providing guidelines and enforcement tools.
- Prohibit stormwater infiltration basins in wellhead protection areas and/or where groundwater levels are a concern.
- Limiting and/or treating stormwater runoff flowing into Robart's Creek, because of sensitivity to stormwater runoff. Runoff to the creek can be easily regulated by stormwater detention and controlled release. However, development runoff will also require pretreatment to remove nitrates, phosphorus and potentially harmful bacteria. A combination of wetlands and biofilters are proposed.
- Treating stormwater runoff flowing directly to the Minnesota River by constructing sand weir dikes on pipes outletting to the floodplains. In areas without floodplain, a Stormceptor or similar drainage treatment structure is proposed.
- Implementing a widened buffer requirement around stormwater treatment basins and wetlands. A widened buffer allows for the construction of a trail, access of maintenance equipment, and at the same time, provides a natural filter for surface drainage entering the basin.
    - The City will require a minimum WETLAND buffer of 50 feet, measured horizontally, from the OHWL of the wetland where the slope surrounding the wetland is flatter than 4:1 (4 feet horizontal to 1 foot vertical). If the slope is steeper than 4:1 at the OHWL surrounding the wetland, the 50-foot buffer shall be measured from the point where the slope is flatter than 4:1. The entire area shall be contained within an outlot that is owned and maintained by the City.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- The area of the STORMWATER BASIN plus a 50 foot buffer measured horizontally from the point where the basin slope is 6:1 (6 feet horizontal to 1 foot vertical) or flatter shall be contained entirely within an outlot that is owned and maintained by the City. The entire buffer shall be vegetated with the seed, including native prairie grasses, shrubs and trees according to City standards. The outer twenty-five feet of this buffer area may be used for maintenance access, recreation trails, and parks.

This report lists a variety of treatment alternatives that may be used individually or in combination. Details of these alternatives are in Section XII.

The following is a summary:

- Individual development basins.
- Regional wet retention basins.
- Wetland treatment of high nitrate runoff.
- Infiltration basins.
- Rain Gardens (also known as Bioretention Basins).
- Filtration, natural or man-made.
- Prefabricated treatment methodologies (i.e., Downstream Defender™).
- Forebays.
- Using the Old Wastewater Treatment Ponds as low flow stormwater treatment for the existing developed city.

© Bolton & Menk, Inc. 2008, All Rights Reserved

VI. PROJECT SUBMITTALS

This submittal is a culmination of many months of research, mapping, land use analysis/planning and hydraulic design. The end product is a detailed planning and design tool that can be used by the City of Saint Peter as:

- A planning tool for the management of City growth into the undeveloped areas within its currently anticipated city growth boundaries.
- A guide for design of stormwater detention and treatment methods for future development.
- An existing infrastructure assessment tool for:
  - Future replacement recommendations to be included with other infrastructure improvements in a Capital Improvement Plan (CIP).
  - An estimate of proposed improvement costs.
  - Recommending water quality improvements or BMPs to be retrofitted into the existing stormwater collection and delivery system.
- A reference document addressing a significant amount of design aspects needed for the Stormwater Pollution Prevention Plan (SWPPP) prepared by the City and submitted with the NPDES Phase II, MS4 permit.

VII. GENERAL DESCRIPTION

1. Topography

The City of Saint Peter (2007 demographic population 10,887) is located on the eastern border of Nicollet County. The Minnesota River forms the eastern City limits as well as the eastern Nicollet County limit. U.S. Highway 169 runs north-south through the Central Business district, which is only 2 to 3 city blocks west from the Minnesota River. Saint Peter's nearest neighbor is Kasota, which lies approximately 3 miles to the southeast in Le Sueur County along the eastern bank of the Minnesota River.

The topography of Saint Peter consists of rolling terrain with wide, relatively flat terrace plateaus. The general stormwater and groundwater flow pattern is from west to east, toward the Minnesota River. The uppermost portion of the comprehensive drainage area is agricultural and is served by county tile districts, agricultural drainage ditches, Robart's Creek and ravine type conveyances delivering runoff from the upper drainage areas. A significant part of the undeveloped western plateau area that is within the City's growth planning area is hereinafter called the Western Development Area and is generally defined as the area immediately west of Nicollet Avenue (CSAH 20) between Minnesota Trunk Highway 99 and Minnesota Trunk Highway 22.

© Bolton & Menk, Inc. 2008, All Rights Reserved

This Western Development Area is where the Jordan Sandstone Aquifer becomes unconfined and accepts infiltration to such magnitude that entering runoff almost never leaves the infiltration zone. The remote agricultural runoff reaches this Western Development Area, flows toward collection basins, and then infiltrates. As a consequence, the sandy infiltration zone tends to have very few wetlands except where up gradient water is delivered to the primary infiltration zones. From there, the infiltrated water continues to flow easterly toward the Minnesota River. Exhibit 1 shows the relationship between geologic units and groundwater conditions in the Saint Peter area (Brown-Nicollet-Cottonwood Clean Water Partnership Groundwater Assessment Project, 1992).

© Bolton & Menk, Inc. 2008, All Rights Reserved

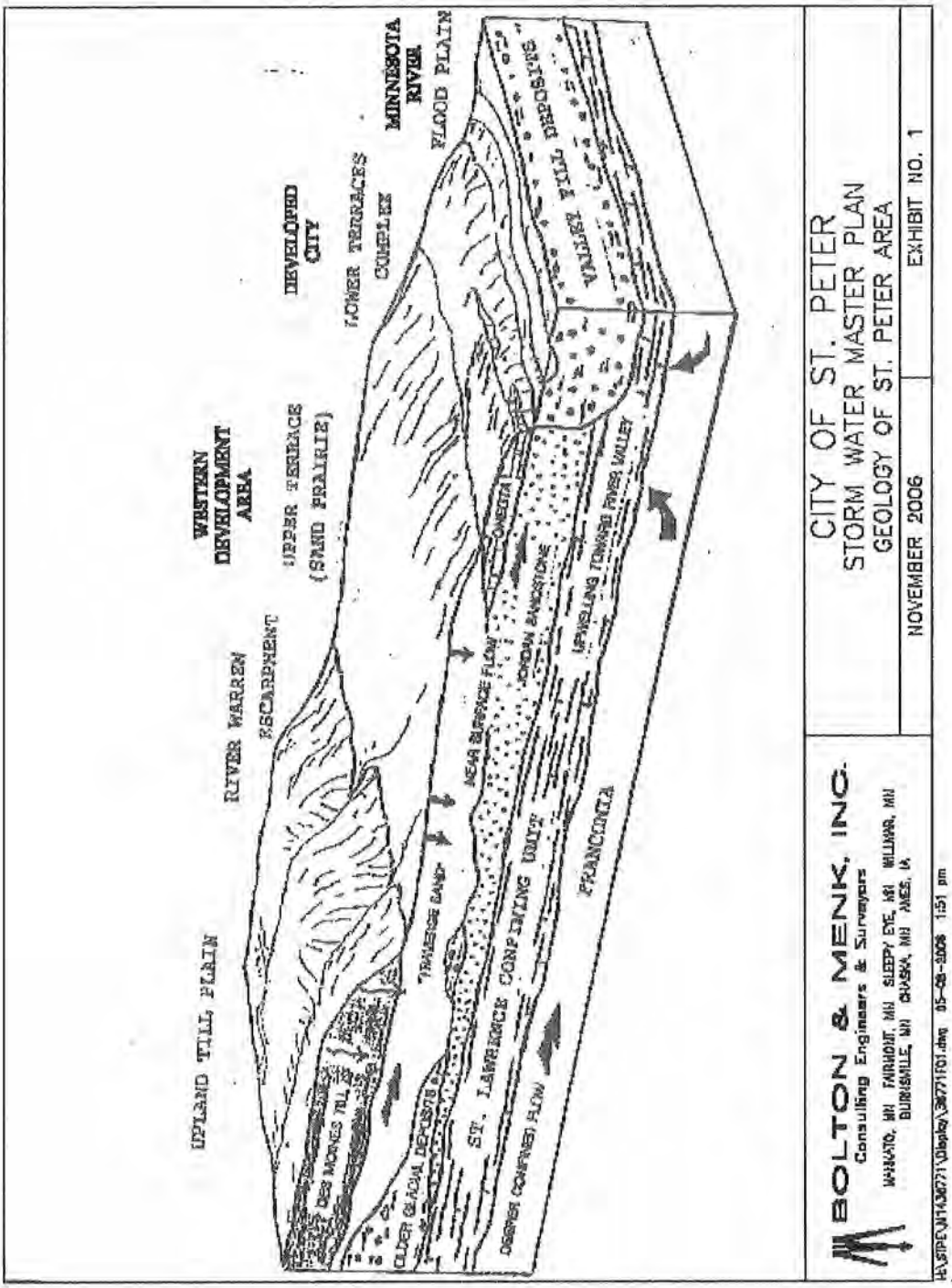


Exhibit 1. Geology of Saint Peter Area

© Bolton & Menk, Inc. 2008, All Rights Reserved

The best topographic elevation mapping for the City of Saint Peter is the aerial topographic contour map. This map has a 2-foot contour interval. However, this information is limited to specific areas. The aerial topographic contour mapping does not cover the entire study area. Where aerial topographic mapping is not available, the United States Geological Survey (USGS) Quadrangle maps, with a less accurate 10-foot contour interval, were used in determining the key features.

The total hydrological study area is over 12,250 acres of watershed and is shown in Figure 1. As can be seen from the map, the growth limits, or area of the study, includes all of the current City limits. It is presumed that continued development will be predominantly residential with potential expansion of the current industrial zones and expansion of a commercial corridor along Highways 169 and 22.

2. Soils

According to the Nicollet County Soil Survey, the underlying soils in the immediate area of Saint Peter are classified as Soil Conservation Service (SCS) type A and B soils. These soil classifications are prone to higher rates of infiltration. Above the infiltration zones, the soils tend toward SCS soil type C and D that are more prone to runoff than infiltration. Hence, the higher agricultural area drains to the western development area and infiltrates.

Figure 2 shows the soil hydrology groups in the Saint Peter area. For clarification, areas marked "A/D," "B/D" or "C/D" indicate soils that, when not tiled to remove water, are D soils; but when tiled, act as A, B or C soils, respectively.

3. Natural Resources

The Minnesota River bluffs and ravines are attractive features of the City of Saint Peter. The bluffs offer unique views of the river valley, and contain some remnants of oak savanna and woodland plant communities that covered the uplands in the City before the era of European settlement. The ravines are still largely wooded and provide corridors for drainage, wildlife movement and recreation, connecting upland areas with the Minnesota River and its floodplain.

Figure 3 shows natural resources including DNR protected waters such as the Minnesota River, Robart's Creek and Oak Leaf Lake (the large lake/wetland to the west of the Regional Treatment Center [RTC]). This map also includes a proposed green corridor to protect existing drainage ways, hydrologic connectivity and proposed emergency overflow green corridor routes. Preservation of the proposed green corridors will assist in the proper management for flood routing.

Halletts Pond is another unique natural resource. Located south of St. Julien Street and bordering the Nicollet County Fairgrounds, Halletts Pond was once an active gravel pit. The pit was excavated from 1964 to 1971 by Hallett Construction. The excavation exposed the groundwater table, which flows from the west to the east. In 1971, the City signed an agreement with Hallett Construction to use the excavated area as a stormwater treatment basin. As part of the agreement, a stormwater pretreatment basin, now called Halletts Park Stormwater Basin, would be constructed immediately to the west. In 2003, the City expanded the Halletts Park Stormwater Basin from 0.75 acres to 2.5 acres as part of the Wastewater Treatment Plant construction.

© Bolton & Menk, Inc. 2008, All Rights Reserved

In 1968, the DNR prepared an inventory of Minnesota Lakes, as directed by the state legislature. Its goal was to identify all natural enclosed depressions, 10 acres or more in area, which have substantial banks capable of containing water and which are detectable on aerial photographs. Halletts pond was placed in this inventory as unnamed wetland #52-1, although, it is a manmade body of water created through gravel mining.

In 1974, the federal government, through the United States Fish and Wildlife Service, established the National Wetlands Inventory to protect and manage wetlands, fish and wildlife resources. In 1979, Lewis Cowardin of the United States Fish and Wildlife Service assisted in the preparation of the book, "Classification of Wetlands and Deepwater Habits of the United States." From this work, maps were prepared showing probable wetland locations and their resulting Cowardin Classifications. As a result, Halletts Pond was classified as a PUBG (Palustrine, Unconsolidated Bottom, Intermittently Exposed) wetland. Wetlands with this classification are now called Type 5 Wetlands or, shallow (usually less than 10 feet deep) open water ponds and reservoirs fringed by emergent vegetation similar to open areas of Type 4 wetlands.

The following definition of a type 5 wetland is from the Minnesota DNR website:

Type 5 wetland - Shallow Open Water
Soil: Inundated
Hydrology: Usually covered with less than 10-foot-deep water; includes shallow ponds and reservoirs
Vegetation: Fringe of emergent vegetation similar to open areas of Type 4
Common sites: Shallow lake basins and may border large open water basins
NWI Symbols: L1; L2ABG and H; L2EMA, B, and H; L2RS; L2UB; PABH; PUBG and H

In 1980, the Nicollet County Commissioners moved with the DNR to declare Halletts pond a wetland.

4. Wetlands

A limited number of wetlands remain in the watershed outside the Minnesota River floodplain. Aside from the DNR protected waters, the pervious soils have removed the potential for the soil to remain saturated, which is a key component that defines wetlands. Both State and Federal laws protect these wetlands. Under the current stormwater permitting rules, wetlands cannot be used for stormwater detention unless the water is first treated to remove sediment. Wetlands play a role in stormwater management, and potentially provide nesting and feeding habitat for waterfowl and other birds and animals.

© Bolton & Menk, Inc. 2008, All Rights Reserved

For this report, we have reviewed the National Wetlands Inventory (NWI) maps as well as the aforementioned DNR protected waters maps. Figure 4 in the Appendix indicates the location of wetlands identified by the NWI. Some of the notable locations include:

- Halletts Pond
- Mill Pond
- Gluek Park
- Between TH 295 (Freeman Drive) and TH 169 near the RTC
- Minnesota River Floodplain
- Area approximately 500 feet west of the Welco West Subdivision
- Area northeast of Welco North Subdivision and north of Orchard Ridge Subdivision

It has been our experience that some wetlands indicated on the NWI maps do not exist. Also, some wetlands have been found that were not indicated on the NWI maps. The actual existence of these wetlands must be verified. There is no way to know for sure until a wetland delineation, by a certified engineer, is done for a given site. Since wetland delineations are only valid for three years, it is impractical to do a delineation of the entire growth area. Instead, it is recommended the City require developers to submit a wetland delineation for any site to be developed. The conceptual stormwater basin locations in relation to the wetlands and green corridors are shown on Figure 5. Visits to the proposed regional basin sites by BMI staff indicate an unlikely presence of wetlands.

The Federal Emergency Management Agency (FEMA) is a division of the Department of Homeland Security whose job it is to prepare, prevent and respond to natural and man-made disasters. One form of this resulted in the mapping of potential flood zones for large rain events. These maps are then used to help delineate floodplain and wetland zones. Figure 6 shows the FEMA flood zones for the Minnesota River near Saint Peter.

5. Land Use and Land Cover

Land use is one of the primary mechanisms that can cause flooding and water quality problems. As prairie and forested areas are converted to agricultural and urban uses, the volume and rate of stormwater runoff increases. This increase in stormwater runoff can cause significant erosion in steep ravine areas as well as downstream flooding. The conversion of natural land cover also increases the amount of pollutants in stormwater runoff such as the levels of pesticides and nutrients from agricultural land use, and trace metal concentrations from urban land use. Pollutant loading analysis has not been included in this report, but is expected to be an issue MPCA will address with the City in the future. This plan is based on the planned future land use throughout the study area to propose future improvements in the drainage system.

© Bolton & Menk, Inc. 2008, All Rights Reserved

VIII. GENERAL PROCEDURES

The scope for the Stormwater Master Plan (SWMP) called for the development of a design document to size and locate conceptual future regional stormwater basins and other drainage facilities within the City as affected by the future growth areas around the City. Procedures for preparation of the SWMP follow traditional design procedures. By necessity, the SWMP becomes a very technical document. The following summarizes the major activities associated with the plan's development:

- USGS topographic mapping and two-foot aerial contours were obtained and correlated with the existing stormwater data to determine and model the existing drainage patterns. Ultimate design criteria in undeveloped areas will need to be based upon the proposed land use and site-specific survey information.
- Each minor drainage area, flowing to a collection point; such as a manhole at a low intersection, an existing catch basin, or a natural, agricultural low area; was identified and mapped on a master drainage area and topography drawing. Regional watersheds districts were identified with approximately 71 subwatersheds making up the regional districts.
- All subwatersheds were transferred to a GIS compatible computer mapping system. Drainage areas were computed for each watershed.
- Many factors were considered in this planning/design process including, but not limited to, the following:
    - Including recent storm sewer improvements into the future plan to assure that maximum usage and benefit was achieved from prior City investments.
    - Incorporating regional stormwater basins for flood protection and cost effective pipe or channel sizing wherever open public space or future development permits such facilities. Such stormwater basins can be incorporated into the stormwater quality aspects of the plan for water quality enhancement and conformance with future NPDES stormwater permitting requirements.
    - Combining or rerouting parts of major watersheds to assure cost effective future storm sewer improvements and to reduce existing flooding problems.
    - Establishing basins that are self-contained to minimize stormwater flowing to the Minnesota River, thus minimizing impacts on the River.

Surface runoff, storm sewer and regional stormwater basin design is dependent upon the ground cover and the permeability of the soils. Representative runoff coefficients (C factors) for the rational method of stormwater modeling and Curve Numbers (CNs) for the Soil Conservation Service (SCS) method were computed for each major watershed to reasonably reflect the degree of existing industrial, commercial and residential development. Undeveloped areas were designed using runoff coefficients and curve numbers representative of the proposed land use. See Section IX.B for more in depth discussion of runoff rates.

© Bolton & Menk, Inc. 2008, All Rights Reserved

For each conceptual regional stormwater basin site, SCS Technical Release No. 20 (SCS TR-20) and Technical Release No. 55 (SCS TR-55) methods were used to size basins for flood mitigation potential. "HydroCAD", a computer program developed by Applied Microcomputer Systems, was used as a watershed-modeling tool to assist in regional stormwater basin sizing and location. HydroCAD calculations are included in Appendix B. Preliminary basin sizing was based on the guidelines recommended by the MPCA in the *"Minnesota Stormwater Manual"*(September, 2006), William Walker, Jr. in *Design Calculations for Wet Detention Ponds* (1987) and also in accordance with the recommendations of the Minnesota Board of Water and Soil Resources (BWSR) for wet detention basins and water quality enhancement. It is assumed that all regional stormwater basins in the City will be developed with treatment to improve water quality. This will assist the City in obtaining its NPDES municipal stormwater permitting.

1. General NPDES Requirements

In 1987, the Federal government amended the Clean Water Act to address stormwater discharges. The Environmental Protection Agency wrote the National Pollutant Discharge Elimination System (NPDES) permitting process to regulate stormwater discharges from municipalities. Phase I of this process came due in 1991 and included cities in excess of 100,000 in population. Phase II came due in 2003 and addresses cities in excess of 10,000 in population and includes the City of Saint Peter. The City of Saint Peter has prepared a Stormwater Pollution Prevention Plan (SWPPP) and submitted a Notice of Intent to meet the NPDES Phase II requirements on February 15, 2007.

Federal guidelines call for targeted cities to address in the SWPPP six minimum stormwater control measures as follows:

- Public education and outreach
- Public participation and involvement
- Detection and elimination of illegal discharges
- Control of large construction sites runoff
- Post construction stormwater management
- Pollution prevention or housekeeping for municipal operations.

Minnesota's NPDES Phase II stormwater discharge permit program is designed to reduce adverse impacts to water quality. The primary targets of acceptable SWPPPs are urban runoff and construction runoff.

Urban runoff carries pollutants from cars, lawn fertilizers, pesticide spills and other contaminants into our lakes, wetlands and streams without entering wastewater treatment systems.

Construction runoff is often laden with sediment that is loosened by excavation and grading operations and exposed to rainfall, wind and erosion through the lack of vegetation. The MPCA mandates are intended to regulate these sources of continued environmental degradation. To comply with Phase II requirements, the Saint Peter SWPPP has established measurable goals using a Best Management Practice (BMP) approach and sets benchmarks to be able to track performance and progress.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Erosion and sediment control measures must meet the standard for the *General Permit Authorization to Discharge Stormwater Associated With Construction Activity Under the National Pollutant Discharge Elimination System/State Disposal System Permit Program,* or Permit No. MN R100001 (NPDES General Construction Permit) issued by the Minnesota Pollution Control Agency on August 1, 2003.

If land disturbing activity is taking place on a site where the soils are currently disturbed (e.g. a tilled agricultural site that is being developed), areas that will not be disturbed as part of the development and areas that will not be disturbed according to the time frames and slopes specified in the NPDES General Construction Permit Part IV.B.2, must be seeded with temporary or permanent cover before commencing the proposed land disturbing activity.

Where five (5) or more acres of disturbed soil drain to a common location, a temporary (or permanent) stormwater basin must be provided prior to the runoff leaving the site or entering surface waters. The basins must be designed and constructed according to the standards in the NPDES General Construction Permit Part III.B. Construction, installation and maintenance of public utility lines or individual service connections are regulated under each series of City Ordinance No. 371.

The permittee or applicant must ensure final stabilization of the site in accordance with the NPDES General Construction Permit requirements. The site will be considered as having achieved final stabilization following submission of Certificate of Completion by the permittee or applicant, and inspection and approval by the City.

2. Total Maximum Daily Load (TMDL)

Section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's Water Quality Planning and Management Regulations require states to develop Total Maximum Daily Loads (TMDLs) for water bodies not meeting water quality standards.

In May 2004, the MPCA developed, "The Lower Minnesota River Dissolved Oxygen Total Maximum Daily Load Report." The report provides a basis for determining the pollutant reductions necessary from point and nonpoint sources to restore and maintain the quality of a water resource such as the Minnesota River. The report noted the following impairments for the Minnesota River:

- Low Dissolved Oxygen Levels (due to phosphorus loadings)
- Fecal Coliform Bacteria
- High Turbidity
- Polychlorinated Biphenyl (PCB) Levels
- Mercury Levels

The MPCA is in the process of multiple TMDL studies in the Minnesota River Watershed with a goal to set pollutant reduction goals to restore water quality. Presently, low dissolved oxygen and fecal coliform are being analyzed. Upon study completion, it is expected the MPCA will implement TMDL requirements for other impairments. Low dissolved oxygen phosphorus TMDL requirements are below.

© Bolton & Menk, Inc. 2008, All Rights Reserved

3. Total Maximum Daily Load (TMDL) – Phosphorus

In addition to the NPDES Phase II permitting process, the Minnesota River is designated as an impaired water with a Total Maximum Daily Load (TMDL) restriction on phosphorus. Current MPCA TMDL studies show that the increased phosphorus loading in the Minnesota River is cause for low dissolved oxygen in the Minnesota River, particularly the last 22 miles near its junction with the Mississippi River.

Phosphorus is a nutrient used by freshwater plants (such as algae) to promote growth. Excess phosphorus can lead to algae blooms and low dissolved oxygen in the water due to bacterial decay of dead algae. High dissolved oxygen levels are a key to providing a healthy environment for fish. Without enough dissolved oxygen, aquatic life such as fish will die thus multiplying the demand for dissolved oxygen by bacteria during fish decomposition. This led to the establishment of the 30% reduction of phosphorus loading to assist in correcting the low dissolved oxygen problem in the river.

The current MPCA guideline for SWPPP preparation requires the City to reduce its phosphorus load by 30% from its year 2000 impervious footprint by June 30, 2010. The MPCA defines impervious cover as, "...land surfaces with a low capacity for soil infiltration, such as any hard surface material including roof tops, asphalt, or concrete. Impervious cover limits water infiltration and induces high runoff rates." The City must estimate its phosphorus load from stormwater based on the city's size in the year 2000. Then it must prepare a plan to reduce its stormwater load by 30% from the year 2000 load. If the City grows, the phosphorus loading cannot exceed 70% of the year 2000 loading.

Rather than costly testing for actual phosphorus reduction levels, the MPCA will allow credit for each BMP installed. The City can get full credit for existing BMPs as well as proposed new BMPs. From the year 2000 impervious area footprint pixel map shown below and prepared by the Remote Sensing and Geospatial Analysis Laboratory at the University of Minnesota, the City will need to show that new and existing BMPs are removing sufficient phosphorus to meet the 30% reduction requirement. Hence, for every in-place BMP, including street sweeping, the MPCA will provide a resulting percent phosphorus reduction. The City will need to show its progress toward meeting the 30% reduction in its annual TMDL report to the MPCA. This is presumed to be a spreadsheet of the City's current impervious area compared to the year 2000 impervious area and a list of BMPs with removal efficiencies.

For the year 2000, Saint Peter's total area was 3,603 acres, of which 883 acres (24.8%) was impervious. Because the growth area for Saint Peter is in the upper sand plain, and because the treatment recommended in this report is infiltration which has 100% phosphorus removal efficiency, Saint Peter should have no difficulty meeting the TMDL requirement as it relates to future growth.

© Bolton & Menk, Inc. 2008, All Rights Reserved

2000 St. Peter City
Land Cover and Impervious Surface Area

Note: This map is being viewed at a resolution higher then 1/4 acre per pixel and may appear jagged.

Land Cover	Acres	Percent
Agriculture	518	14.38
Forest	518	14.38
Grass/Shrub/Wetland	746	20.7
Water	46	1.28
Urban	1,782	49.46

Impervious Intensity (%)	Acres	Percent	Weighted Impervious Area (%)
0	1,930	53.57	0
1-10	104	2.89	0.17
11-25	219	6.08	1.14
26-40	288	7.99	2.72
41-60	445	12.35	6.24
61-80	305	8.47	5.86
81-100	320	8.88	8.38

Total Area:	3,603	Acres
Total Impervious area:	883	Acres
Percent Impervious Area:	24.8	%

Created by the Remote Sensing and Geospatial Analysis Laboratory, University of Minnesota in cooperation with the Minnesota Pollution Control Agency.

rev2 2007
rslg@landus.umn.edu

© Bolton & Menk, Inc. 2008, All Rights Reserved

The following table from the Minnesota Stormwater Manual shows the typical percentage reduction allowance associated with various BMPs. The table heading, "TP" and "P" are acronyms for "Total Phosphorus" and "Phosphorus", respectively. The "ED" acronym under the BMP Design Variation column of the table stands for, "Extended Detention" which refers to a water body that holds water for an extended period of time (e.g. 72 hours).

Table L.8 General Summary of Comparative BMP Phosphorus Removal Performance [a]

BMP Group[e]	BMP Design Variation	Average TP Removal Rate	Maximum TP Removal Rate[c]	Average Soluble P Removal Rate[d]
Bioretention	Underdrain	50%	65%	60%
	Infiltration	60	75	70
Filtration	Media Filters	50	60	0
	Vegetative Filters (dry)	65	75	70
Infiltration	Infiltration Trench	65	90	80
	Infiltration Basin	65	90	80
Stormwater Ponds[f]	Flow-Through (Wet) Pond	50	70	60
	Wet ED Pond[b]	55	70	70
	Micropool ED Pond	40	75	30
Constructed Stormwater Wetlands	Shallow Wetland	45	65	50
	Pond/Wetland	55	75	65
	ED Shallow Wetland	40	75	30

[a] Removal Rates Shown in this Table are a composite of four sources: Caraco (2001), MDE (2000), and Winer (2001). They apply only to the volume of water that passes through the BMP and does *not* include water that bypasses the practice.
[b] Average removal efficiency expected under MPCA V_{wq} sizing Rules 1 and 3
[c] Upper limit on phosphorus removal with increased sizing and design features, based on national review
[d] Average rate of soluble phosphorus removal in literature
[e] See Issue Paper A (Appendix J)
[f] Does not include dry ponds as a water quality BMP

⚠ IMPORTANT NOTE: Removal rates shown here are composite averages intended solely for use in comparing performance between BMP designs and for use in calculating load reduction in site-based TP models. They have been adapted, rounded and slightly discounted from statistical values published in BMP performance databases.

© Bolton & Menk, Inc. 2008, All Rights Reserved

It should be noted that MPCA is planning on preparing a more detailed table with more precisely defined reduction credits to be used in the final TMDL permitting process. Currently the city's basins fall into the BMP Group of Infiltration and Stormwater Ponds in the table.

4. Regulation

Several agencies, including the City, have jurisdiction over the floodplain, wetlands and other waters of the U.S. within the City limits. A wetland delineation will determine wetland / non-wetland boundaries. Exhibit 2 illustrates the City, Minnesota state and federal jurisdiction over watercourses. The floodplain limits shown in Exhibit 2 pictorially represent water levels with a greater than 100-year frequency. On the other hand, the DNR and Federal OHWL's represent a 100-year frequency level.

The City has installed a permit process regulating land disturbing activity or the development or redevelopment of land.

© Bolton & Menk, Inc. 2008, All Rights Reserved

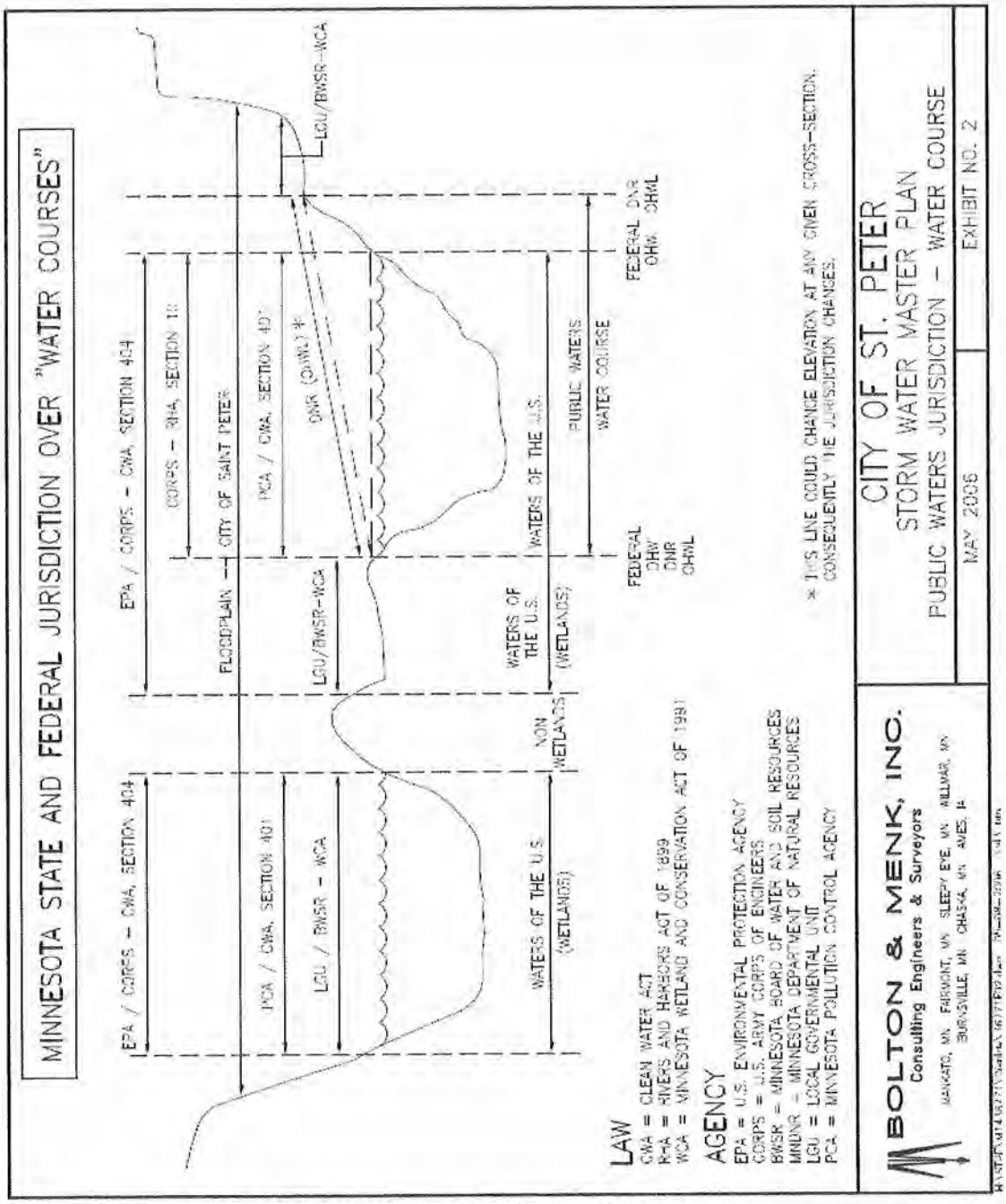


Exhibit 2. Public Waters Jurisdiction – Water Course

© Bolton & Menk, Inc. 2008, All Rights Reserved

5. Maintenance

As stated in the recommended stormwater ordinance, all stormwater management structures and facilities shall be maintained in perpetuity to assure that the structures and facilities function as originally designed. The City shall assume the responsibility for maintenance with jurisdiction over the structures and facilities.

6. Ownership – City Control

The City should require perpetual easements, or dedicated outlots, for ponding, flowage and drainage purposes over hydrologic features such as water bodies and stormwater basins. The City may consider permanent easements in justified situations for zoning or setbacks. The easements, or outlots, shall provide the right of reasonable access for inspection, monitoring, maintenance and enforcement purposes.

7. Covenants

The City may require that land be subjected to restrictive covenants or a conservation easement, in form acceptable to the City, to prevent the future expansion of impervious surface and the loss of infiltration capacity. Covenants are covered in the City's stormwater ordinance.

8. Permits

A city storm water permit is required for all Right of Way and private property work that is disturbing more than 120 square feet. No permit or project-specific stormwater management plan is required for the following land disturbing activities:

- Minor land disturbing activities such as home gardens, repairs and maintenance work.
- Installation of any fence, sign, telephone or electric poles, or other kinds of posts.
- Emergency activity necessary to protect life or prevent substantial harm to persons or property. Upon stabilization, a permit will be necessary.

IX. STORMWATER QUANTITY

1. Background

The main purpose of the stormwater quantity portion of the SWMP is to serve as a guide for the expansion of the storm drainage system. This chapter identifies opportunities for improving the capacity of the existing system and provides standards for the design of future facilities. The application of these standards will allow for the expansion of the storm drainage system as the City develops while minimizing the cost and inconvenience of local flooding and repair of stream bank damage.

The City's stormwater system consists of:

- Private property grading and construction to direct stormwater flow and reduce surface water contaminants.
- An underground storm sewer system to carry up to a ten year storm and streets designed to carry storms in excess of ten years or provide temporary stormwater storage.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Basins or treatment to remove contaminants.
- Stormwater discharge to the river or ground infiltration.

The storm drainage facilities discussed in this study consist of interconnected green corridors (open channels, wetlands, stormwater basins, and piped road crossings with designed Emergency Overflows, or EOFs). The preliminary design of the stormwater drainage system for the Saint Peter SWMP involved the following aspects:

- Dividing the City into sub districts based upon topographic information and future land use projections;
- Estimating runoff using ultimate land use projections within the study area;
- Selecting a consistent method for conveying runoff;
- Identifying and protecting high quality streams and water bodies;
- Utilizing stormwater basins for storage, sediment and pollutant trapping and nutrient uptake; and,
- Regulating peak flows in waterways and ravines to minimize erosion and impacts to stream morphology.

An essential part of the SWMP is the conceptual design of stormwater basins. Since the early-1970s, the City has emphasized the use of stormwater basins to control increased rates and volumes of runoff from developing areas. The City currently requires each individual development to analyze and design stormwater practices to control runoff to connect the development to the City's regional pond system.

The Saint Peter SWMP develops a regional stormwater basin approach. Figure 5 shows recommended conceptual locations for future stormwater basins. These basins are located to provide the most beneficial and cost-effective control of runoff from future development areas. Several individual stormwater basins can be combined into one efficiently designed basin to control runoff and provide better treatment for several developments. Regional basins provide a cost-effective approach to stormwater management by providing the following benefits:

- Combining engineering, design and construction cost for individual developments;
- Utilizing naturally occurring depressions and existing topography to minimize excavation costs;
- Larger basins provide for more effective stormwater treatment;
- Reducing total land required for stormwater management by providing efficiently designed central facilities in place of several individual facilities;
- Minimizing the cost to manage the system by creating fewer stormwater basins;
- Lowering the cost of maintenance and up-keep;
- Providing flexibility in design of larger central facilities to incorporate recreational opportunities, create wildlife habitat areas and improve aesthetic benefits for area residents; and,
- Integrating low areas with upland areas to improve wildlife habitat.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Outlet control structures are designed to reduce the outflow from a stormwater basin to a level that is equal to or lower than the capacity in the existing storm sewer system. Stormwater basins should be designed to include a skimmer device, meet the recommended William W. Walker Jr. design volume criteria and meet or exceed MPCA criteria. William W. Walker Jr., Ph.D., is an environmental engineer specializing in the affects and treatment of stormwater runoff. Since the early 1970's, he has authored numerous reports on successful stormwater treatment.

Trunk storm sewer conveys runoff from the upper portions of watersheds to the proposed regional stormwater basin facilities. Trunk storm sewers are defined as storm sewer pipes that are 24 inches or greater diameter. Storm sewers that convey runoff flows from a regional stormwater basin are also considered trunk storm sewers.

2. Design Criteria

A. Precipitation

Stormwater runoff is defined as that portion of precipitation, which flows over the ground surface during, and for a short time after, a storm. The quantity of runoff is dependent on the intensity of the storm, the length of storm, the amount of previous rainfall, and the type of surface the rain falls onto and the slope of the ground surface.

The intensity of a storm is described by the amount of rainfall that occurs over a given time interval. A specific rainfall amount over a given time interval will statistically occur in a given time span, usually years. This is called a return frequency. A return frequency designates the average time span during which a single storm of a specific magnitude is likely to occur. The return frequency is based on rainfall data compiled by the National Weather Service over the past 75 years. Thus, the degree of protection afforded by storm sewer facilities is determined by selecting a return frequency to be used for design based on good economic sense and current engineering practices. It should be noted the impact of general global climate change may change the return frequency design.

A hydrograph method based on sound hydrologic theory was used to analyze runoff for the design or analysis of flows and water levels. The general procedure used in this analysis has been performed using the HydroCAD Modeling Software as developed by Applied Microsystems, Inc. The typical analysis is based on Soil Conservation Service (SCS) TR-20. The SCS TR-20 methodology is widely accepted among drainage engineers across the United States. However, the SCS procedure is based on a standard rainfall hydrograph that is modified by local parameters (i.e., rainfall, soil type, time to peak flow, etc.). A general hydrology discussion is included in Appendix D.

A SCS 24-hour Type II storm distribution with 100-year intensity was used for the design of stormwater basins and drainage systems. The Type II distribution is the storm event recommended for the upper-Midwest portion of the United States that the SCS determined from National Weather Bureau data.

© Bolton & Menk, Inc. 2008, All Rights Reserved

For purposes of this report, we chose to analyze the effects of a 6.1-inch rainfall over a 24 hour period that has a probability of occurring once every 100-years. This is not to say that a 6.1-inch rainfall cannot occur multiple times within the same year; it is just to say that a 6.1-inch rainfall will occur *on the average* once every 100 years. It is often better to think of the 100-year rainfall as having a 1 percent chance of occurring in any given year.

Because it is not feasible to design storm sewer pipe systems to handle the 100-year storm, the typical recommendation is to design a collection system that can handle a 10-year storm with temporary storage areas or emergency overflows that convey larger storms to safe storage zones such as retention ponds. The SCS 24-hour rainfalls associated with other size storms also analyzed in the hydrological modeling used for this report are best summarized in the following table:

SCS 24-hour Storms		
Recurrence Interval	Annual Probability	Precipitation
100-year	1%	6.1-inches
10-year	10%	4.2-inches
2-year	50%	2.8-inches

Analysis of flood levels, storage volumes and flow rates for water bodies and detention basins are based on the range of rainfall and snow melt durations producing the critical flood levels and discharges. The City of Saint Peter uses a 10-year frequency storm event for storm sewer design, while the greater of the 100-year, 24-hour frequency rainfall event, or the 100-year, 10-day snowmelt event is used for overland drainage and stormwater basin storage design. These storm events were selected for the analysis and design of the drainage system for the SWMP. All stormwater basins will be analyzed with a 10-inch, 24-hour rain event in order to determine the emergency overflow functions as intended.

Stormwater basins with no, or limited emergency, overflow shall be designed for back-to-back 100-year storm events. These are typically basins which are landlocked with no emergency overflow available.

Stormwater detention facilities with peak discharge rates less than 2 cfs/40 acres are typically susceptible to exceeding high water levels during snowmelt conditions. Special consideration of the snowmelt condition becomes more critical for some areas with curve number values less than 70 that typically remain frozen later in the season (such as wooded areas). These areas produce low runoff rates under normal summer conditions. Final basin design must consider snowmelt conditions when sizing outlet structures.

© Bolton & Menk, Inc. 2008, All Rights Reserved

To customize the SCS methodology to fit the typical flows anticipated for Saint Peter, the peak watershed flows estimated from SCS methods were compared to the flows estimated from the regression equations from "*Techniques for Estimating the Magnitude and Frequency of Floods in Minnesota*" as generated by the USGS, Water-Resources Investigations Report 87-4170. Since these equations are extrapolated from actual historical data of river and creek gauging stations in Minnesota, they are considered to be an accurate representation of flows from the agricultural areas in excess of 60 acres in size.

Although the regression equations are considered to be the best representation of the flow generation characteristics in southern Minnesota, they only estimate the peak flow rates for the various probabilities of flooding. Detention storage studies are primarily concerned with flow volumes that are best modeled using SCS methodologies. In our experience in comparing the flows, the SCS peak flow rates are typically higher than that predicted by the regression equations for the same drainage area. Hence, a tailoring technique has been used to make the two modeling methods report similar results.

The general methodology used to model the existing flows from the larger agricultural watersheds was to calibrate the SCS peak hydrograph flow rates (as generated by the HydroCAD program) to match the USGS regression equation flows for the same area.

The excess runoff caused by storms greater than that used for design will be accommodated by ponding in low spots in streets for short periods of time and providing outflow through overland drainage routes. This short-term flooding and overland drainage must be included in the design to minimize the damage to property. It is required that provisions be made to provide or preserve overland drainage routes for emergency overflows.

B. Stormwater Runoff

The Rational Method of storm sewer pipe design requires the selection and/or computation of a time of concentration and a runoff coefficient. The time of concentration is the time required for the runoff from a storm to become established and flow from the most remote point (in time, not distance) of the drainage area to the design point. The time of concentration will vary with the type of surface and the slope of the surface.

A minimum concentration time of fifteen minutes for residential areas and ten minutes for commercial/industrial areas is used for design of the trunk storm sewer system. These minimum times are also used in the design of lateral systems. As the stormwater runoff enters the system, the flow time in the storm sewer is then added to the concentration time and compared to the downstream drainage area concentration time. The maximum of these values is used downstream which results in a longer concentration time and a lower average rainfall intensity as the flow moves downstream from the initial design point.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The percentage of rainfall falling on an area that must be collected by a storm sewer facility is dependent on watershed variables such as soil permeability, ground slope, vegetation, surface depressions, type of development and antecedent rainfall. These factors are taken into consideration when selecting a runoff coefficient (C) for the Rational Method or a runoff curve number (CN) for use in SCS methodology.

Under ultimate (fully developed) conditions, the values of the coefficient will increase with increases in the amount of impervious surfaces caused by street surfacing, building construction, and grading.

The antecedent moisture condition (AMC) relates to the moisture content of the soil prior to a given storm event. Curve numbers based on land use can be adjusted based on an assumed moisture condition. For purposes of the model, normal antecedent moisture condition (AMC II) was assumed. Curve number values can be adjusted for dry conditions (AMC I) or wet conditions (AMC III).

Curve numbers are also dependent on the type of soil in a given drainage area. Soil types are classified into four basic hydrologic groups as follows:

Soil Group A - Deep sand and aggregated silts.

Soil Group B - Sandy loams.

Soil Group C - Low in organic content and made up of clay loams and soils high in clay.

Soil Group D - Heavy plastic type clay soils.

Curve numbers that were assumed in the development of the model were based on the hydrologic soil group for each watershed based on the information contained in the County Soil Survey. It is recommended that future development plans consider post-development site soil conditions when choosing runoff curve numbers for final design.

Curve numbers are given in SCS TR-55. Average CN values for each land use type are used in the design of the storm drainage facilities in undeveloped areas. For the modeling of existing facilities, CN values were determined for each type of development and current zoned land use in each sub district.

1) Runoff Rate Control

Standard detention basin design procedure calls for stormwater basins to be sized to ensure that the immediate development in the area would not adversely affect the downstream peak flow conditions. Unfortunately, this type of uncoordinated and piecemeal stormwater basin development can have significant impacts when considered simultaneously.

Runoff rates for proposed activities in incorporated and unincorporated areas shall not exceed existing rates for the 2-, 10- and 100-year, 24-hour rainfall events. This means that once improvements are made to a previously unimproved area, the rainfall runoff cannot exceed that from the watershed prior to the improvement. This report addresses questions with respect to the application of this requirement.

© Bolton & Menk, Inc. 2008, All Rights Reserved

What is required when an area becomes annexed and incorporated?

When this happens, the Ordinances require control of runoff rates to existing conditions. With incorporation the area is being taken into the City, where with proper planning through the SWMP approval process, there is the ability to manage infrastructure and the stormwater system commensurate with development since the area is no longer relying on an infrastructure developed to support a largely agricultural setting. When the area is annexed the existing condition is used for the calculation of existing runoff rates whatever that condition is. For example, if at the time of annexation the land is agricultural, then agricultural is the existing condition for runoff rates. The condition without stormwater management is the existing condition for rate control calculations. Exhibit 3 shows an example of the areas of changed land cover when an existing road is being widened.

© Bolton & Menk, Inc. 2008, All Rights Reserved

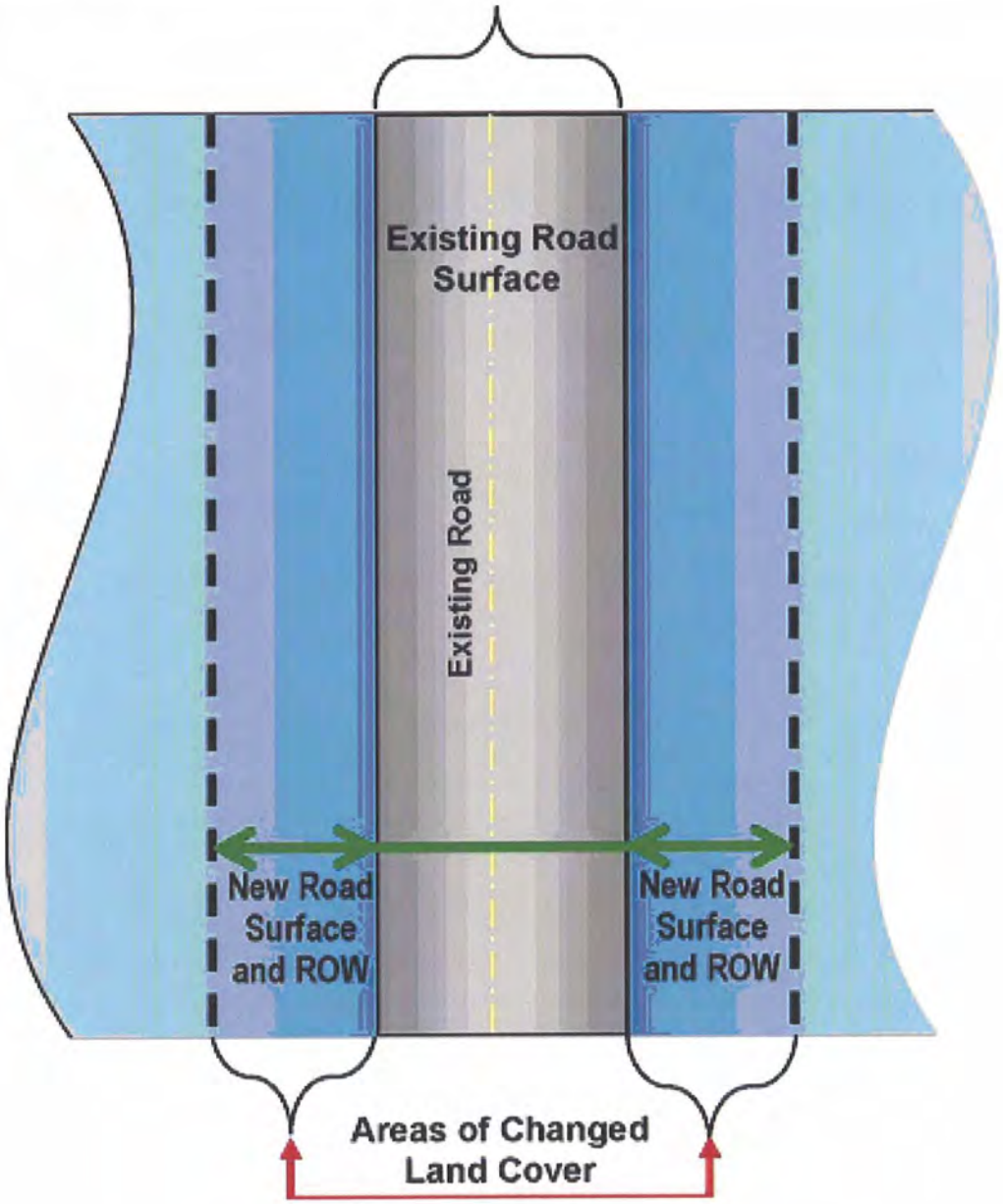


Exhibit 3. Area of Changed Land Cover

2). Runoff Rates in Incorporated Areas

Runoff rates for proposed activities, development or redevelopment within the City of Saint Peter shall:

- Not exceed existing runoff rates for the 2-year, 10-year and 100-year duration storm events.
- Not accelerate on or off-site water course erosion, downstream nuisance, flooding or damage.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- All stormwater basins will be analyzed with a 10-inch, 24-hour rain event in order to determine the emergency overflow functions as intended.
- For landlocked basins, two 100-year, 24-hour, back-to-back storms shall be used to determine the high water level (HWL). Landlocked basins should be avoided whenever possible.

3). Runoff Rate in Unincorporated Areas

Runoff rates for the proposed activities in unincorporated areas shall:

- Not exceed existing runoff rates for the 2-year, 10-year and 100-year, 24-hour rainfall events for land areas currently within unincorporated areas of Nicollet County (Note: as land is annexed into the City, the land being annexed carries with it the existing condition. If agricultural land is annexed, agriculture is the existing condition. If roads or streets are present they are part of the existing condition). This means regional basin design must consider the characteristics of undeveloped land currently draining to the basin site. The basin design must consider the current contributing runoff and that generated once the watershed is fully developed. A detail discussion on regional basin design is provided in the following sections.
- For post development runoff, drained hydric soils shall be assumed to revert to an undrained condition unless the applicant demonstrates that publicly owned and maintained drainage facilities will be adequate to maintain the drained condition.
- Not accelerate on or off-site water course erosion, downstream nuisance, flooding or damage.

Runoff rates may be restricted to less than the existing rates when necessary for the public health, safety and general welfare of the City.

C. Stormwater Conveyance Requirements

Storm sewers are the actual conduits used to transport stormwater runoff. The capacity of the storm sewer conduit is dependent on the pipe slope, pipe diameter, and the roughness of the inner surface of the pipe. Computations for storm sewer conduit capacity are based on the following Manning's formula:

$$Q = 1.49(A/P)^{2/3}\, S^{1/2}\, A/n$$

Where: Q = Storm sewer conduit capacity in cubic feet per second (cfs)

N = Roughness coefficient

A = Cross-sectional area of conduit in square feet

P = Wetted perimeter of conduit in feet

S = Slope of conduit

© Bolton & Menk, Inc. 2008, All Rights Reserved

A roughness coefficient (n) of 0.013 was used for concrete storm sewer pipe, and 0.024 for corrugated metal pipe. These roughness coefficients take into account the roughness of the inner pipe surface. Only major trunk storm sewers have been considered in this study.

A trapezoidal cross-section with 4:1 maximum side slopes (4 feet horizontal to 1 foot vertical) was the basis for design wherever existing and proposed open channels are utilized. The same Manning's formula was used to determine channel capacity with the roughness coefficient (n) increased to 0.030. For open channels, P in the equation becomes the wetted perimeter of the channel.

The storm sewer shall be sized using the Rational Method. Catchbasin laterals shall be sized with a maximum time of concentration (the time it takes water to get from the farthest point of the watershed to the catchbasin) of 20 minutes, with an average of 15 minutes being used. The minimum design capacity of all drainage systems shall be designed to accommodate the runoff and velocity of flow from a 10-year storm event, and all drainage systems and facilities shall be designed to withstand the runoff from the critical 100-year event or accumulative antecedent conditions without damage to the system or facility, downstream areas and/or significant risk to public health, safety and welfare unless waived by the City.

Proper design of a storm sewer system requires that all storm sewer lines be provided with access through manholes for maintenance and repair operations. Spacing of manholes shall be no greater than 400 feet for sewer lines 15 inches or less in diameter and 500 feet for sewer lines 18 inches to 30 inches in diameter. Intervals on larger diameter lines can be increased since the pipes are sufficiently large for a person to physically enter the storm sewer pipe itself for maintenance operations. Regardless of sewer size, manholes shall normally be provided at all junction points and at points of abrupt alignment or grade changes.

Although lateral systems are designed for 10-year storm events, their performance must be analyzed for storms exceeding the design storm. It shall be anticipated that surcharging of the system will occur when the design storm is exceeded. During surcharging, the system works as a closed conduit and the pipe network becomes pressurized with different pressure heads throughout the system. Low areas that are commonly provided with catch basins become small detention stormwater basins often performing like pressure relief valves (water rushing out in some locations). For this reason, it is extremely important to ensure that these low areas have an acceptable overland drainage route with proper transfer capacity.

Ponding on streets must meet all of the requirements of the 100-year design criteria as a minimum. For safety reasons, the maximum depth at any point in the street shall not exceed 6" at the deepest point and the lowest exposed building opening elevation shall be at least two feet above the emergency overflow level, or one foot above the high water level (HWL). The HWL for temporary street ponding is defined as the elevation to which water rises before overflowing through adjacent overland routes.

© Bolton & Menk, Inc. 2008, All Rights Reserved

All storm sewer facilities, especially those conveying large quantities of water at high velocities, shall be designed with efficient hydraulic characteristics. Manholes and other structures at points of transition should be designed and constructed to provide gradual changes in alignment and grade. Stormwater basin outlet control structures shall be designed to allow water movement in natural flow line patterns, minimize turbulence, provide good self-cleaning characteristics, and prevent damage from erosion.

Intake structures (catch basins) shall be liberally provided at all low points where stormwater collects and at points where overland flow is to be intercepted. Inlet structures are of special importance; since it is a poor investment to have an expensive storm sewer line flowing partially full while property is being flooded due to inadequate inlet capacity. Inlets shall be placed and located to eliminate overland flows in excess of 300 feet in streets. The City's standard catch basin grate, the Neenah R-3067L, has the capacity to collect the drainage from the 10-year storm event. When contributing flow exceeds the grates capacity, multiple catch basins shall be utilized. In unique situations, the use of special high capacity grates may be necessary. All intake grates and openings shall be of self-cleaning design to minimize capacity reduction when clogged with twigs, leaves and other debris. Grates in pedestrian areas shall be bicycle safe.

The following recommendations must be considered when designing storm sewers:

- Inlet and outlet pipes of stormwater basins shall be extended to the normal water level whenever possible.
- Outlets with velocities less than 4 feet per second (fps) that project flows downstream into a channel in a direction at less than 30 degrees from the normal channel axis generally do not require energy dissipaters or stilling basins, but do require riprap or articulated concrete protection.
- Where an energy dissipater is used, it shall be sized to provide an average outlet velocity of less than 6 fps, unless riprap is also used. In the latter case, the average outlet velocity shall not exceed 8 fps.
- Where outlet velocities exceed 8 fps, the design shall be based on the unique site conditions present. Submergence of the outlet or installation of a stilling basin approved by the City shall be required when excessive outlet velocities are experienced.
- Riprap or articulated concrete block such as Geolink shall be provided at all storm sewer outlets to drainage channels and natural streams. Riprap shall be placed on a suitably graded filter material over geotextile fabric to ensure that soil particles do not migrate through the riprap and reduce its stability. Riprap shall be placed to a thickness of at least 2.5 times the mean rock diameter so as to ensure that it will not be undermined or rendered ineffective by displacement. If riprap is used as protection for overland drainage routes, grouting may be necessary.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Overland drainage routes where velocities exceed 8 fps shall be reviewed and approved by the City. Permanent turf reinforcement mats must be provided if velocities exceed 7 fps to help maintain the soil structure during heavy rainfall events.

Where inlet capacity does not allow for total runoff capture, the street and storm sewer design shall account for overland routing into the stormwater basin(s). Since the storm sewer is designed for a 10-year storm event and the stormwater management system is designed for a 100-year storm event, street designs shall require routing by-pass flows into the stormwater system.

Open channels are recommended where flows and small grade differences prohibit the economical construction of an underground conduit and in areas where an open channel-type drainage will enhance the aesthetic or wildlife qualities of an area. A green corridor designed to protect existing open drainage ways is shown on Figure 5. A minimum slope of 1.0% shall be maintained in unlined open channels and overland drainage routes in developed areas whenever possible. Slopes of less than 1.0% are difficult to construct and maintain and can create problems with pocketing water (Side slopes shall be a maximum of 4:1 (4-feet horizontal to 1 foot vertical) with gentler slopes being very desirable).

Erosion protection must be provided at all points of juncture between two open channels and where storm sewer pipes discharge into a channel. The design velocity of an open channel shall be sufficiently low to prevent erosion of the bottom. Riprap or permanent turf reinforcement mats shall be provided in areas where high velocities cannot be avoided. Periodic cleaning of an open channel is required to ensure that the design capacity is maintained. Therefore, all channels must be designed to allow easy access for equipment including a 12 feet wide maintenance path with 15% maximum grade at storm sewer outfalls, road crossings and connections to other channels or streams.

Both storm drainage facilities and sanitary sewer lines should be designed to take advantage of natural draws and usually follow a ravine, creek or gully. As more area develops in the City, the total runoff in natural drainage ways will increase, and correspondingly the water level may rise. In certain areas, water could enter the sanitary sewer system, causing capacity problems and added costs for treatment of the wastewater.

For this reason, sanitary sewer manholes that could be subject to temporary inundation shall be equipped with watertight castings and added precautions shall be taken in construction of these manholes to prevent the entrance of stormwater.

Sanitary manholes located near stormwater basin areas shall be raised above the 100-year HWL and the adjacent areas filled when access is required at all times (if access is not required, watertight castings shall be installed). Future storm drainage construction shall include provisions for improving the water tightness of existing nearby sanitary sewer manholes.

© Bolton & Menk, Inc. 2008, All Rights Reserved

D. Regional Stormwater Basin Recommendations

Regional stormwater basins are recommended to manage peak flow rates and runoff volumes, and meet water quality objectives. They are recommended because of the following:

- Construction and maintenance of larger basins, serving a greater drainage area, have proven to be less costly on a watershed wide basis (cost per acre of drainage area) when compared to localized basins built on an individual development basis.
- Larger basins limit the maintenance and number of structural improvements that must be inspected as part of the City-wide MS4 permit.
- Potential future Total Maximum Daily Load (TMDL) limits to the Minnesota River can be more easily addressed with a limited number of regional basins rather than a significant number of individual development basins.
- Larger basins have been proven to be better hydraulic controls of the downstream conditions. Piecemeal, individual development basins could actually result in superimposed peak outflows that may be more hydraulically damaging than having no basin at all.

Accordingly, regional stormwater basins are proposed as large, wet treatment basins with areas above the normal water level that allow infiltration to take full advantage of the natural permeability of the soils. The regional stormwater basins are intended to treat the runoff through sedimentation, infiltration, and to dampen the discharge flow into ravines and other drainage routes en route to the Minnesota River. The stormwater basins are also intended to control runoff rates so that they do not exceed existing runoff rates for the 2-year, 10-year and 100-year critical duration storm events; and do not accelerate on or off-site water course erosion, downstream nuisance, flooding or damage.

A number of methods have been developed to determine the expected maximum rate of runoff for an area under a certain design storm. The regional stormwater basins were sized with permanent "dead-pool" storage volumes as calculated based on the criteria recommended by William Walker, Jr. in *Design Calculations for Wet Detention Ponds* (1987) (i.e., the volume equivalent to the runoff produced from a 2.5-inch rainfall event under a fully developed condition, plus additional volume based on the percentage of future impervious area). This design provides for 85-95 percent removal of suspended solids and 40-70 percent removal of total phosphorus.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Incorporating stormwater basin areas as recommended in the SWMP is important to maintaining stability of creeks and natural corridors. Stormwater basins provide the necessary storage required to retain high intensity stormwater runoff peaks and reduce the possibility of flooding downstream. The storage requirements established for each regional stormwater basin must be maintained to prevent flooding of property. The discharge flow rates computed for each stormwater basin must also be maintained to ensure that the storage volume provided is used and downstream flows are not exceeded. The peak flows indicated in the plan for proposed basins occur at the high water level, usually under pressurized conditions.

Permanent sedimentation and water quality stormwater basins shall be designed to meet the following wet stormwater basin design standards:

- Provide water quality features consistent with National Urban Runoff Program (NURP), William Walker, Jr. in *Design Calculations for Wet Detention Ponds* (1987) criteria, and best management practices.
- Provide a permanent wet pool with dead storage of at least the runoff from a 2.5-inch storm event or 2,250 cf per acre of drainage area served, whichever is greater; plus additional volume based on the percentage of future impervious area.
- Stormwater basin outlets shall be designed to prevent short-circuiting of the flow from stormwater basin inlets to the outlet.
- A normal water elevation above the Ordinary High Water Level (OHWL) of adjacent water bodies, or normal water level (NWL) where an OHWL is not established.
- An outlet skimmer to prevent migration of floatables and oils for at least the 1-year storm event (SCS rain event = 2.4" over 24-hours)
- An outlet structure to control 2-year, 10-year and 100-year critical storm events to runoff rates specified in Section IX.2.B of this SWMP.
- An identified overflow spillway and downstream route sufficiently stabilized to convey a 100-year critical storm event.
- Access for future maintenance.

Regional stormwater basins are recommended to follow the infiltration requirements of Section IX.4.

The western development growth area is unique as the area is relatively flat. Therefore, the proposed ultimate network would utilize the natural drainage routes as green corridors. One advantage of incorporating green corridors is the multi-functional uses for these areas. Although buildings would be prohibited in the direct drainage route, the open spaces may be used for walking trails, parks, and much more. For majority of the time, the green corridors will be relatively dry and the park use is similar to the way many river cities have parks in river flood plains.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Similarly, the regional basins and green corridor may be designed to reduce the quantity of trunk storm sewer pipe that would be required for inflowing and outflowing stormwater transport. When considering the proposed basins, the actual design of the regional stormwater basin does need to be a symmetrical depression to hold water, but can easily be designed as a non-uniform meandering waterway creating a more natural appearance while maintaining the design intent and saving the cost of interconnecting piping.

Any new residential, commercial, industrial and other habitable structures shall be constructed with the following elevation:

- The lowest ground elevation at the structure shall be a minimum of 2 feet above the emergency overflow, or 2 feet above the HWL of the nearby pond or water body, whichever is higher. This is also defined as freeboard.
- The ground level at the lowest opening elevation of structures that are adjacent to stormwater basins shall be indicated on the site grading plan.
- No footing tile shall be directly connected to the nearby water body unless its outlet is a minimum of 2 feet above the emergency overflow, or 2 foot above the HWL of the nearby pond or water body, whichever is higher.
- The lowest floor elevation of any structure within 200 feet of a stormwater pond shall be 2 feet above the NWL of the nearby pond or water body, whichever is higher.
- The emergency overflow shall be analyzed using a 10-inch, 24-hour rain event in order to determine the emergency overflow functions as the design intends.
- The overland flow routes shall be incorporated into the design for stormwater basins and maintained during development to ensure delivery of extreme events to and from the storage basin.
- The City will require additional freeboard for landlocked areas or stormwater basins where emergency overflows cannot be provided. In the case of landlocked basins, the HWL will be determined using two 100-year, 24-hour back-to-back rainfall events.
- The area of the stormwater basin plus a 50 foot buffer (measured horizontally from the point where the stormwater basin slope is 6:1 (6 feet horizontal to 1 foot vertical) or flatter shall be contained entirely within an outlot that is owned and maintained by the City.

Trees and shrubs, particularly willow species, have a significant influence on evapotranspiration and a capacity for nutrient uptake. Roots aid infiltration by acting as pathways for water flow. Fibrous roots absorb large amounts of water. Trees and shrubs are useful for bank stabilization and can often be planted as cuttings. Deeprooted species are particularly useful for anchoring soil to steep slopes and providing vertical structure in the landscape. Trees also provide important habitat for many wildlife species.

Some limitations on trees and shrubs include debris which may block outlets, planting location as they cannot be used where sediment will be excavated and they inhibit the growth of prairie species.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The entire buffer zone around basins shall be vegetated. Some approved trees and shrubs for upland areas of buffer zones include:

- Gray Dogwood
- Quaking Aspen
- Swamp White Oak
- Nanberry
- High Bush Cranberry

3. Landlocked Basins

Landlocked stormwater basins should be avoided whenever possible. If one already exists, it shall be provided with an outlet if an outcome based analysis and resource oriented management review regarding downstream impacts is completed and demonstrates that:

- Providing an outlet to the basin would not cause a hydrologic flow system that does not comply with applicable rules.
- Dead storage is provided to retain the fully developed future conditions water volume, above the highest anticipated groundwater elevation to the extent possible while preventing damage to property adjacent to the basin (i.e., emergency overflow is not lower than the 100-year back-to-back elevation). The City will require two feet of freeboard above the HWL determined by two 100-year, 24-hour back-to-back rainfall events
- The outlet does not create adverse downstream flooding or water quality conditions, or materially affect stability of downstream watercourses according to this SWMP and the Ordinances;
- Proposed development tributary to the landlocked basin has incorporated runoff volume control practices to the extent practical.
- There is a demonstrated need for an outlet to protect existing structures and infrastructure.
- The outlet design is part of an approved comprehensive local water management plan.

The need for an outlet could be demonstrated through the documentation of existing problems, such as high water levels affecting existing homes, or creating safety issues for roads.

4. Volume Control

Runoff volume control practices are recommended in the design of new developments and existing redevelopment that create impervious surfaces and increase runoff volumes above existing conditions for the 2-year critical storm event.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The recommended volume control design must explicitly address the use of BMPs to limit the loss of pervious area, and limit increases in runoff volume from impervious areas to the extent feasible considering site-specific conditions. The MPCA recommends volume control practices to provide a reduction in site runoff discharge volume of at least ½-inch of runoff from all new impervious surfaces. If necessary to mitigate downstream impacts in accordance with a downstream assessment, volume controls shall be greater than ½-inch from new impervious surfaces. Proposed regional infiltration basins will exceed this MPCA recommendation by infiltrating all runoff water rather than only ½-inch.

When using infiltration for volume control, infiltration volumes and facility sizes shall be calculated using the appropriate hydrological soil group classification and specified saturated infiltration rates from the table below:

Table 1. Infiltration Rates Per Soil Type

Hydrologic Soil Type	Infiltration Rate	Soil Texture
A	0.30 inches/hour	Sand, loamy sand, or sand loam
B	0.15 inches/hour	Silt loam or loam
C	0.07 inches/hour	Sandy clay loam
D	Not Recommended	Fat Clay

Source: Urban Hydrology for Small Watersheds (SCS, 1986), as amended, revised or supplemented.

For the most part, Saint Peter and the surrounding area consist of sandy porous soils. A large percentage of the soils found within the study area were classified as hydrologic type A and/or B, which are known to have very good to moderate water wicking capabilities. Figure 2 shows the soils hydrology for the area. Documented site-specific infiltration or hydraulic conductivity measurements completed by a licensed soil scientist or engineer may be used in place of the specified values.

Before infiltrating runoff, pretreatment shall be required for parking lot runoff and for runoff from new road construction that will enter the infiltration system. Infiltration areas must be designed to bypass higher flows. Infiltration areas must be fenced or otherwise protected from disturbance from heavy equipment before the land disturbing activity starts. The pretreatment shall be designed to protect the infiltration system from clogging and to protect groundwater quality. Pretreatment options may include, but are not limited to, oil/grease separation, sedimentation, biofiltration, filtration, swales or filter strips.

To minimize potential groundwater impacts it is desirable to infiltrate the cleanest runoff. To achieve this, a design may propose greater infiltration of runoff from low pollutant sources such as roofs, and less from higher pollution source areas such as parking lots.

The following are proposed for the design of infiltration basins:

- Infiltration areas should be limited to the horizontal areas subject to prolonged wetting.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Areas with permanent water pools tend to lose infiltration capacity over time and will not be accepted as an infiltration practice.
- Infiltration systems must be designed to bypass higher flows.
- Infiltration areas must be fenced or otherwise protected from disturbance before the land disturbing activity starts.

The following shall **not** be considered for infiltration:

- Runoff from fueling and vehicle maintenance areas.
- Areas with less than 3 feet vertical separation from the bottom of the infiltration system to the elevation of seasonal high groundwater or top of bedrock.
- On areas with Type D soils.
- The Wellhead Protection Area shown on Figure 3, and within 400 feet of a community water system or within 100 feet of a private well shall have pretreatment of runoff unless otherwise specified in the approved Wellhead Protection Plan.

As discussed previously in this document, left unmanaged, development and the creation of impervious surfaces increase both peak runoff rates and total runoff volumes. Runoff volume changes in particular are a cumulative impact issue such that any one development may have a small impact, but cumulatively large-scale unmanaged small volume increases from multiple sources can have significant adverse impacts. The overall decision process for runoff volume management allows for two approaches. The first approach is to plan ahead and address issues of increased volume through the SWMP approval process. The second approach is to address on a site-by-site basis as development proposals are made. In future permitting processes, the City may be required to address issues of increased volumes through the SWMP approval and more restrictive ordinances as well as the implementation of regional stormwater basins with infiltration components.

Because of the potential for cumulative impacts to protected streams, such as Robart's Creek, the DNR is likely to require volume controls such as the current MPCA design option to control ½-inch of runoff from newly created impervious surfaces. Proposed infiltration basins will be sufficient for meeting this MPCA recommendation.

5. Design Summary

The following list includes major parameters that must be included into the final design of the quantity portion of stormwater facilities. Site-specific details should be considered at the time of final design. It is recommended that the ordinance be modified in accordance with the following suggestions.

- Consult with City Staff and the SWMP for planned peak discharge rates at the proposed stormwater basin locations in relation to the overall ultimate drainage system plan.
- It is recommended that future development plans consider post-development site soil conditions when choosing runoff curve numbers for final design.
- Model 100-year, 24-hour storm event to calculate the HWL of the stormwater basin.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Model a multi-stage outlet for maximum peak discharge reduction for the 2-, 10- and 100-year events.
- Check stormwater basin outlet capacity to insure 10-day snowmelt event does not exceed 100-year HWL.
- Design a forebay or equivalent upstream pretreatment to remove coarse-grained particles prior to discharge into a watercourse or storage basin. Each pond should have a sediment forebay or equivalent upstream pretreatment. The forebay should consist of a separate cell, formed by an acceptable barrier including rock weirs or overflow spillways. The forebay shall be sized to contain 0.1 inches per impervious acre of contributing drainage area, and should be 4 to 6 feet deep.
- Any new residential, commercial, industrial and other habitable structures shall be constructed with the following low opening elevation: Elevation of the lowest opening or the overflow into a window well or lowest level stairwell shall be a minimum of 2 feet above the emergency overflow, or 1 foot above the HWL of the nearby pond or waterbody, whichever is higher.
- The area of a stormwater basin plus a 50 foot buffer (measured horizontally from the point where the slope is 6:1 (6 feet horizontal to 1 foot vertical), or flatter shall be contained entirely within an outlot that is owned and maintained by the City. Before the outlot will be accepted by the City, the entire buffer shall be vegetated with the seed mixture specified by the City and may include native prairie grass mixtures. The outer twenty-five feet of this buffer area may be used for maintenance access, recreation trails, and parks.
- Limit the side slopes leading to the normal water level to no steeper than 4:1.
- Provide a minimum aquatic bench 10 feet wide beginning at the normal water level and sloping down below the normal water level at a 10:1 slope.
- Design erosion control or energy dissipaters at stormwater basin inlets and the outfalls of basin outlet pipes or weirs.
- Provide a clear approach and trash rack at the basin outlet.
- Check that the proposed stormwater basin elevation will provide for the outlet of possible upstream landlocked areas.
- A 20-foot wide access outlot or access easement must be provided to the basin outlet structure, all inlets to the basin, and to the first cell or forbay of a multi-cell basin; complete with a 12-foot wide paved driveway. The paved access drive shall be designed to handle 9-Ton axle loading and shall have a longitudinal slope of less than 8-percent (12.5:1).
- Include other design parameters as required by regulatory agencies.
- Basin design must include the method and schedule for stabilizing adjacent slopes and consideration of wetland plantings around the perimeter.
- Provide overflow routes for added protection against flooding and local erosion.

© Bolton & Menk, Inc. 2008, All Rights Reserved

X. STORMWATER QUALITY

1. Background

The stormwater quality goal of the Saint Peter SWMP is to protect and improve the water quality of the City's wetlands and waterways for existing and future generations by meeting or exceeding State and Federal requirements and providing an efficient level of runoff treatment for future development areas. The only effective ways to achieve this goal are: 1) prevent undesirable sediments, nutrients and pollutants from entering the storm drainage system, 2) removing pollutants by treating stormwater at a mechanical treatment facility or 3) collect stormwater in a regional basin for treatmenet. Presently, the interception of stormwater at the point of discharge into the drainage system for treatment is neither practical nor economically feasible. The same comparison can be made for the treatment of wastewater as it is more feasible to treat wastewater at a single collection point (such as a wastewater treatment plant) rather than at individual locations (such as a home septic system).

The five main reasons for degradation of water quality are:

- Erosion and sedimentation;
- Solids and associated chemicals (including sodium chloride or salt) from street and parking lot runoff and placing sand and salt mix on streets in the winter;
- Composted organic matter such as leaves and grass clippings; and,
- Fertilizers and other chemicals from farming practices, impervious surfaces, and lawn care.
- "Floatables" being carried into the stormwater system.

Recognition of the problem sources and the implementation of reasonable control measures can minimize the degradation of water quality in the City. Regional stormwater basins used for rate control will be an essential part of reducing the amount of pollutants being transported downstream. Water quality stormwater basins, commonly known as wet stormwater basins, are designed with permanent water pools, which allow sediments and many pollutants to settle out and be effectively removed from stormwater runoff.

This plan utilizes the regional stormwater approach by locating large stormwater facilities to serve larger drainage areas. Infiltration is proposed for as many regional stormwater basins as possible. This will help maintain the natural recharge of the groundwater, lessen the load on the stormwater sewer piping system, and provide additional treatment as the water passes through the ground before reaching the Minnesota River. In each regional stormwater basin, the sides of the stormwater basin above the normal water level will be designed to allow infiltration. The recommended green corridor also helps preserve existing drainage ways and overflow routes while at the same time, improving stormwater quality by allowing vegetation to absorb and utilize nitrates and phosphates in the water.

The regional approach provides more efficient maintenance requirements by centralizing stormwater basin areas in fewer locations. This approach also provides cost effective design, land acquisition and construction expenditures for development by proposing stormwater basin facilities in locations that take advantage of natural terrain and provide the most efficient benefit for runoff water quality treatment.

© Bolton & Menk, Inc. 2008, All Rights Reserved

2. Water Quality and Land Use

Although pollutant concentrations may not vary greatly between land uses, pollutant loadings are a function of both runoff volume and concentration. The volume of runoff is directly related to the amount of impervious surface from a particular land use. For example, if Area A has twice the runoff volume due to higher impervious land cover as Area B with the same pollutant concentration, Area A will have twice the pollutant loading. This illustrates the potential difference in water quality between residential and commercial type land uses.

3. Stormwater Pollutant Removal

Permanent regional sedimentation and water quality stormwater basins are the most effective means of removing sediment and the pollutants associated with it, such as trace metals and nutrients. The removal of pollutants such as heavy metals can be estimated based on the removal efficiency of total suspended solids. The removal of water quality constituents such as total Kjeldahl nitrogen, zinc, lead and total phosphorus can also be associated with the removal of total suspended solids (Total Kjeldahl nitrogen refers to the method by which the nitrogen in the water sample is measured in the water quality laboratory. It is named for the person who developed the method.) The percent removal of these pollutants is based on the detention time that runoff is held in the basin. Settling column studies have shown that the majority of urban sediments will settle out within the first six to eight hours of detention. However, longer detention times are needed to remove finer sediments and establish ideal settling conditions.

Pollutant removal rates are based on detention time within a water quality stormwater basin. The removal rates asymptotically approach their maximum level after 50 hours of detention time, with the largest percentage of removal in the first 12 hours. Therefore, a stormwater basin that is designed to retain all runoff from a tributary area for periods in excess of 12 hours will provide a majority of the required water quality treatment.

What must be determined is the level of protection that is appropriate to downstream water bodies. This is determined by choosing a storm event that is retained in excess of 12 hours for maximum treatment levels. Once this event is determined, stormwater facilities can be designed with permanent pool volumes equal to the upstream runoff from this event. The stormwater management design criteria in the City's Stormwater Ordinance is designed to satisfy these requirements.

Stormwater must be treated before being allowed to infiltrate into the ground. If the water is not treated, it will not only affect groundwater quality, but the sediments in the water may cause the infiltration basin to silt in, thus lessening the infiltration capacity of the basin.

4. Permanent Sedimentation and Water Quality Stormwater Basins

Permanent sedimentation and water quality stormwater basins are an essential part of a storm drainage system. These areas provide locations where ponding caused by restricted flow can be allowed; thereby minimizing flood damage and stream bank failure. When used effectively, stormwater basins enable the installation of reduced sizes of outflow sewers. The design storm duration is effectively increased over the total time required to fill and empty the basins. This causes the peak flows to be shaved, or reduced.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Equally as important is the use of stormwater basin areas to:

- Improve water quality;
- Return stormwater to the groundwater table; and,
- Increase water amenities in developments for aesthetic, recreational and wildlife purposes.

Stormwater quality is improved by allowing nutrients and sediments carried by runoff to settle below the stormwater basin normal water level and allow fringe vegetation to assimilate additional pollutants. The restriction of outflow rates from stormwater basin areas promotes groundwater recharge by increasing the detention time and allowing the runoff to infiltrate. Careful planning in the initial development of an area to incorporate stormwater basin areas into recreational areas, parks and trail systems provides for better buffer zones and maximizes amenity aspects.

5. Design Criteria

Regional stormwater basin design characteristics are critical in achieving the maximum pollutant removal efficiencies. The minimum criteria listed below are recommended for use in the design of water quality aspects for future regional stormwater basins.

- Stormwater basins designed to improve water quality should be consistent with the Nationwide Urban Runoff Program (NURP) criteria and best management practices. This includes a permanent wet pool with dead storage no less than the total runoff from a 2.5-inch storm event or 2,250 cf per acre of drainage area served, whichever is greater, plus additional volume based on the percentage of future impervious area.
- Stormwater basin design must maximize detention time by preventing short-circuiting. This can be accomplished by maximizing the distance between inflow pipes and the stormwater basin outlet with a minimum length to width ratio of 3:1.
- Maintenance access to the stormwater basin must be provided for dredging sediment material from the stormwater basin.
- Meet or exceed MPCA stormwater basin design criteria.
- A normal water elevation above the Ordinary High Water Level (OHWL) of adjacent waterbodies, or normal water level (NWL) where an OHWL is not established.
- Basin outlet designed such that the water quality volume is discharged at no more than 5.66 cfs per acre of surface area of the pond.
- An outlet skimmer to prevent migration of floatables and oils for at least the 1-year storm event.
- An outlet structure to control 2-year, 10-year and 100-year critical storm events to runoff rates specified in Section IX.2.B of this SWMP.
- An identified overflow spillway and downstream route sufficiently stabilized to convey a greater than 100-year critical storm event.
- Basin outlets designed to prevent short-circuiting. This can be achieved by locating the outlet as far from the inlet as possible.

© Bolton & Menk, Inc. 2008, All Rights Reserved

XI. NATURAL RESOURCES PROTECTION

The Minnesota River bluffs and ravines are attractive features of the City of Saint Peter. The bluffs offer unique views of the river valley, and contain some remnants of oak savanna and woodland plant communities that covered the uplands in the City before the era of European settlement. The ravines are still largely wooded, and provide corridors for wildlife movement and recreation, connecting upland areas with the Minnesota River and its floodplain. There are fairly few wetland areas, either in the lower valley areas, or on top of the bluffs. There is a large lake/wetland to the southwest of the City called Oak Leaf Lake.

During the initial preparation phase of the SWMP, a study of the existing features of the Saint Peter area was completed. An evaluation of the bluff areas, ravines and wetlands provided information on the level of protection and recommended management strategies that will be needed to preserve these areas during future development. Natural resources are shown on Figure 3.

1. Ravine Areas

A major ravine is located within the SWMP study area. A description of the area and recommended management practices are indicated below.

A. Robart's Creek Ravine

The Robart's Creek Ravine runs along the northern edge of Saint Peter. The ravine is very steep and difficult to access. Robart's Creek is listed as a protected water by the DNR and is addressed by the Nicollet County Shoreland Ordinance. The DNR and Army Corp of Engineers have jurisdiction over the creek and ravine. Therefore, the City will be required to receive approval from these agencies prior to any proposed impact to the ravine and/or creek.

The following recommendations for consideration are provided to assist the City in managing the Robart's Creek ravine area:

- Maintain existing watershed runoff rates for the 2-, 10- and 100-year storm events to preserve the morphology of the streambed, prevent bank failures, and protect the existing vegetation.
- Utilize wetlands and biofilters to treat stormwater prior to discharging to the creek.
- Encourage use of the ravine by school and community groups interested in nature study. School or community groups could complete occasional clean-ups in the ravine, clear exotic species such as buckthorn, or complete plantings of native forest and prairie species.
- Protect hillside slopes of the ravine to prevent erosion of slopes. Identify and map existing erosion areas and stabilize as needed.
- Preserve as much of the native forest and underbrush community along the ravine as possible, particularly in steep slope areas, to prevent erosion. Work with adjacent landowners on both sides of the creek to encourage them to maintain the forest canopy and underbrush.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- As required in the Nicollet County Shoreland Management Ordinance, a setback of 30 feet from the edge of the ravine. No structures, including houses and garages, may be constructed within 30 feet of the top of the ravine slope. The top of the ravine slope is the point where there is a clearly identifiable break in the land from steeper land below the break to a gentler slope above the break. If a break is not apparent, the top of the ravine slope is determined to be the higher point of a 50-foot segment with an average slope exceeding 18 percent.

2. Bluff Areas

The bluffs along the Minnesota River Valley west of Highway 169 in Saint Peter offer attractive views of the valley, as well as home and business sites. The soils on the bluffs are extremely sandy and prone to erosion. The bluffs are a part of the ecology of the river corridor, and provide upland wildlife habitat and feeding and resting areas for species that migrate along the Minnesota River corridor.

Before settlement of the area by Europeans in the 1800's, oak woodlands, oak savanna, and prairie openings probably covered the bluff area, with Maple-Basswood forest in sheltered ravine areas. Prairie fires, set by lightning or native peoples to drive game animals, probably regularly burned the bluffs. Farming, grazing and residential development have changed these plant communities extensively in the Saint Peter area. While some groups of oaks remain, most of the ground and understory species have been replaced by lawns, or greatly simplified by grazing or cropping.

The following recommendations are provided to assist the City of Saint Peter in managing bluff areas:

- Regulate construction and land uses along bluffs, to prevent erosion.
- Encourage landowners to retain any areas of native vegetation, and to plant species native to the area, to protect and improve wildlife habitat and maintain the historic ecological role and appearance of the bluff lands along the river.
- As required in the Nicollet County Shoreland Management Ordinance a setback of 30 feet from the edge of the bluff. No structures, including houses and garages, may be constructed within 30 feet of the top of the bluff. The top of the bluff is the point where there is a clearly identifiable break in the land from steeper land below the break to a gentler slope above the break. If a break is not apparent, the top of the bluff is determined to be the higher point of a 50-foot segment with an average slope exceeding 18 percent.

© Bolton & Menk, Inc. 2008, All Rights Reserved

3. Wetlands

A limited number of wetlands remain in the watershed outside the Minnesota River floodplain. The prominent ones include Halletts Pond, the Mill Pond and the area between the Regional Treatment Center and TH 169. A few wetlands exist in the uplands to the west of the City, but because of the Type A and B soils in this area, there are not very many. These wetlands play a role in stormwater management: They improve water quality, including filtering pollutants out of surface water and groundwater, using nutrients that would otherwise pollute public waters, trapping sediments, protecting shoreline, and recharging groundwater supplies; assist in floodwater and storm water retention, including reducing the potential for flooding in the watershed; and likely provide nesting and feeding habitat for waterfowl and other birds and animals. Figure 4 indicates the location of wetlands that are identified by the National Wetland Inventory (NWI). One of these wetlands is Halletts Pond, which is on the DNR Protected Water list (DNR Number 52000100) and also appears on the NWI map.

The buffer requirements are determined by the Local Governmental Unit (LGU) as the Wetland Conservation Act (WCA) rules only apply to areas inside a delineated wetland boundary. DNR rules apply to only DNR protected waters and then only in areas below the OHW level. The City of Saint Peter is the LGU for the wetlands within its boundaries. The City will require a minimum wetland buffer of 50 feet, measured horizontally, from the OHWL of the wetland where the slope surrounding the wetland is flatter than 4:1 (4 feet horizontal to 1 foot vertical). If the slope is steeper than 4:1 at the OHWL surrounding the wetland, the 50-foot buffer shall be measured from the point where the slope is flatter than 4:1.

Wetland management recommendations:

- Occasional controlled burns (every 3-4 years) are a Minnesota Department of Natural Resources (MN DNR)-approved method of wetland management and would help to control the spread of reed canary grass, and may help to diversify the forbs (wildflowers) in the wetland. Fall burns may be preferred, to avoid affecting nesting waterfowl, and to encourage growth of forbs. Refer to the MN DNR's Prescribed Burn Handbook.
- For wetlands with low plant diversity, seeding of native plant species could provide some diversity in vegetation for the area. The City could coordinate with the DNR to seed some wetlands with native plant seed.
- Work with surrounding landowners to preserve upland vegetation, especially trees, to increase the habitat value of the wetland.

XII. TREATMENT METHODOLOGIES

A wide variety of treatment methodologies were investigated in an effort to find the best fit for Saint Peter's unique geology, growth potential, management capabilities and maintenance capabilities. The options included:

- Individual development basins.
- Regional wet retention basins.
- Wetland treatment of high nitrate runoff.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Infiltration basins.
- Rain Gardens (also known as Bioretention Basins).
- Filtration, natural or man-made.
- Prefabricated treatment methodologies (i.e., Downstream Defender™).
- Forebays.
- Using the Old Wastewater Treatment Ponds as low flow stormwater treatment for the existing developed city.

The following is a description of the merits and limitations of each alternative treatment methodology or Best Management Practice (BMP).

1. Individual Development Basins

Individual development basins or small wet retention basins have the advantage of being a proven technology that is readily accepted by the MPCA in its construction and MS4 permitting process. When designed properly, they use approximately 5% of the total developable area and can remove 90% of the sediment typically carried by stormwater. Since phosphorus is also carried by particulates, small wet retention basins can remove up to 60 percent or more of the total phosphorus carried by stormwater. This is a significant factor in choosing a design, because MPCA has already implemented a phosphorus restriction on the City of Saint Peter through its special basin wide stormwater NPDES permit (MS4 Permit) process.

Developers often prefer small wet retention basins because they can become amenities to the development and increase the property values adjacent to the basin. This increase in property value is also a benefit to the City in its property tax collections.

Individual development basins are ideal for governments trying to write laws that apply to every development. For example, a City ordinance can be simply written to say that if you develop, you must build a basin. It's clean and simple from an administrative viewpoint.

The drawback is that the design of development basins typically ensures that the outflow from each basin is slightly below the predevelopment peak rate, but the peak flow occurs over a longer duration. When multiple basins are in the same area, this extended peak flow condition increases the probability that the peak outflows from more than one basin will be at the same time. When uncoordinated, the result could cause cumulative peak outflows that create a downstream condition worse than no retention at all. It is believed that this drawback outweighs the merit of administrative simplicity.

Another drawback to small wet retention basins is the design collects the sediment and keeps it. To continue to be effective, they need to be maintained. This means providing access and dredging sediment from many small basins. Providing the same room for access to a few regional basins is more effective than providing access for multiple individual basins. Dredging should generally occur every 5 years, or as needed. The recommended ordinance includes a 25% over sizing of the wet basin size (volume) to allow for sediment storage.

It is recommended that permanent individual development basins not be allowed. Temporary development basins should be considered only when the proposed development location prevents stormwater from reaching a proposed regional basin.

© Bolton & Menk, Inc. 2008, All Rights Reserved

2. Regional Wet Retention Basins

Design of regional wet retention basins are similar to individual development basins but are built on a region-wide basis. Studies have proven that the larger the watershed area served, the greater the hydraulic benefit in dampening flow problems downstream. Hence, consolidating basins into larger regional basins eliminates the combined peak outflow problem previously cited for individualized development basins. The regional approach in locating wet retention basins also limits the number of basins and the amount of maintenance and monitoring needed. Finally, the cost per acre served is typically less for regional basins than it is for individual development basins.

One drawback to regional basins includes the need to dedicate the land. Land acquisition is often difficult, because the property owner may have other intended uses for the ideal basin location. The City must have a plan for the location of the regional basins. We recommend seeking right of first refusal agreements with the owners of potential regional basin sites as a means of reducing the immediate cost and establishing a fair market price for the low area. Typically, our preliminary siting of a regional basin is in an area where there is already a potential for flooding. This should include the potential for decreased land value in the proposed regional basin sites.

3. Constructed Wetland Treatment of High Nitrate Runoff

Constructed wetland treatment for high nitrate runoff is a very pertinent consideration because a portion of the Saint Peter Wellhead Protection Area overlaps with the area of the highest probability of future development. Staff at the Brown-Nicollet-Cottonwood Water Quality Board, has done some credible research in wetland installation and monitoring of nitrogen treatment capabilities. They have prepared a valuable report on the design, construction and monitoring of new wetlands in areas that have proven to be valuable in removing nitrogen from runoff. Because the western sand plain is a near direct link to the well capture zones, any development within the wellhead capture zones will include lined wetland treatment basins before ultimate infiltration to limit the nitrate component in the infiltrated water.

The drawback to wetland treatment is the cost of creating an impervious liner in a known infiltration area. The options for constructing a liner include importing clay and installing a synthetic liner. Both options are costly. However, the recommendation in the wellhead protection area is to pre-treat all stormwater runoff using wetland treatment prior to allowing infiltration.

4. Infiltration Basins

Infiltration basins are the option of choice in the western sand plateau, where large infiltration basins, similar to the proposed Warren Basin, are not only economical but also reflect the existing condition and are highly efficient in preventing phosphorus from entering the river. When stormwater can be slowed or stored prior to discharging from the infiltration basin, it allows phosphorus to connect to sedimentary particles in the water due to opposite charges. Once attached, the phosphorus will settle out with the sediment, making it available for land application by maintenance personnel. With the MPCA's 30% phosphorus reduction rule for stormwater prior to discharging to the Minnesota River, infiltration basins will provide a 100% reduction as no water from the basin drains overland to the river. Instead, the water infiltrates into the ground leaving the sediment and attached phosphorus behind.

© Bolton & Menk, Inc. 2008, All Rights Reserved

One drawback is that even though infiltration basins are favored by the MPCA, they are viewed with skepticism by the Health Department relative to wellhead protection and contaminants entering the drinking water supply. Hence, to adequately protect the current Saint Peter water source, a combination of constructed wetland treatment then infiltration is recommended so that pollutants (primarily nitrates) are removed in the constructed wetlands before being infiltrated in the infiltration basins. Since phosphorus and sedimentary particles are suspended in stormwater, phosphorus will attach itself to the sediment. Provided enough time, sediment (and attached phosphorus) settle to the bottom of properly sized stormwater detention basins. By attaching itself to sediment, phosphorus does not infiltrate or impact the groundwater aquifer below.

5. Rain Gardens (also known as Bioretention Basins)

Rain gardens can be best described as small infiltration basins that utilize both plant uptake and soil to filter runoff. They differ from general infiltration basins in that they can be built with an underdrain outlet and used in areas with poorly drained soils like clay. The typical design is to limit the drainage area served to less than one acre in size. That is, one rain garden for every 2 to 4 lots. Currently, rain gardens are being touted by the MPCA as the next great solution for low impact development design. They have been successful in Maple Grove for years where the whole city is built on sand plain and their water source is from a confined lower aquifer. Because the drinking water is drawn from a confined aquifer, there is a greatly reduced chance that pollutants from rain gardens could enter the drinking water supply - this virtually eliminates the wellhead protection zone concern for Maple Grove.

According to the MPCA's Stormwater Manual (http://www.pca.state.mn.us/publications/wq-strm9-23.pdf), rain gardens can remove 85% of total suspended solids, 65% total phosphorus, and 50% total nitrogen which means a percentage of contaminants do infiltrate into the groundwater.

Aside from the wellhead protection issue, one drawback to the use of rain gardens is the design life and maintenance. The filtering soil is anticipated to have a design life of 10 to 20 years after which the soil bed will need to be completely replaced. Accordingly, a long-term maintenance and cost recovery plan will need to be implemented whenever rain gardens are used. Another drawback is weeding. As with vegetable gardens, they need to be weeded regularly. It is our understanding that incessant weeding is necessary in the first 2 years of the garden's life, but once the preferred plant community is established; the need to weed is significantly reduced. When rain gardens are constructed on private property, maintenance is usually the responsibility of the property owner and therefore raingardens may not be maintained to acceptable standards.

6. Filtration

Filtration is essentially an above ground storage basin with a filtered outlet. The filters can range from sand weirs to geosynthetic fabrics. The general design is meet the following MPCA criteria:

1). Infiltration or filtration systems shall be sufficient to infiltrate or filter a **water quality volume** of ½ inch of runoff from the new **impervious surfaces** created by the project.

© Bolton & Menk, Inc. 2008, All Rights Reserved

2). The **water quality volume** shall discharge through the soil or filter media in 48 hours or less. Additional flows that cannot be infiltrated or filtered in 48 hours should be routed to bypass the system through a **stabilized** discharge point. A way to visually verify that the system is operating as designed must be provided.

Filtration designs are desirable in areas where standing water cannot be tolerated or areas confined by buildings and pavement. This treatment method would be appropriate at the end of storm sewer pipe outletting to the Minnesota River floodplain but would not be effective for pipes outletting directly to the river because of the limited space available for treatment at the outlet. Presently, Saint Peter's storm sewer system includes 6 pipes that outlet directly to the river and 11 pipe that outlet to its grass floodplain. Of the 6 pipes that outlet directly to the river, all but the Broadway Avenue at the TH 99 Bridge, Chestnut Street and Chatham Street outlets would be suitable for this type of treatment.

Drawbacks to filtration basins include the unsightliness of the temporary storage areas and the maintenance of the filter media. The temporary storage of the water quality volume may result in dead grass and withheld debris. These may result in the clogging of the filter media and leave a stagnant pool. Hence, regular maintenance of the filter must be anticipated as part of any filtration basin.

7. Prefabricated Treatment Methodologies

Prefabricated treatment methodologies are typically a last resort technology that may be accepted by the MPCA as an approved treatment method where it is proven that no other approved method can be used. They are predominately centrifugal separators and temporary sediment storage manholes but may be filter systems. They have been used successfully in fully developed areas similar to downtown Saint Peter where there is no room available for any of the aforementioned techniques.

The drawback to these systems is the need for constant maintenance. The City will need to use a vacuum truck to remove the collected sediment on a regular basis, which may be as often as weekly during rainy periods of the year. Another drawback is that the sediment removal is typically limited to larger particles while the smaller particles that contribute to the forthcoming turbidity Total Maximum Daily Load are not removed. Prefabricated treatment methodologies are generally cost prohibitive for watersheds larger than 10 acres.

In the future, as the stormwater mandate is expanded to existing areas, and space for other treatment methods is scarce, the City may have no choice but to consider prefabricated treatment methodologies.

8. Forebays

Forebays are smaller sediment collection basins that remove larger sediment particles prior to allowing the runoff to enter another type of treatment. They typically are designed with an easy maintenance access so that the accumulated sediment can be easily removed on a regular basis. The primary advantages to the use of forebays are that they remove the majority of the sediment volume, maintenance is primarily restricted to an easily accessed area, and they significantly reduce the need to maintain the downstream treatment system.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The benefits predominately outweigh the drawback of increased initial cost of constructing an additional pretreatment system. Forebays should be considered in conjunction with regional basins.

9. The Old Wastewater Treatment Ponds

The Old Wastewater Treatment Ponds (202-acre site) are available for stormwater treatment. An option is to construct low flow connection manholes wherever the existing storm sewer system is in the vicinity of the abandoned wastewater interceptor, primarily at the Skaro and Chatham intersections of North Front Street. Low stormwater flows could be diverted to the abandoned North Lift Station and pumped east across the Minnesota River to the 202-acre abandoned wastewater treatment basins. Since the basins have been decommissioned and classified as uncontaminated, they will not be viewed as a potential recontamination vehicle. The size of the existing basins is so large (202 acres) that the retention time for a flow through system will be far beyond any other treatment system. This is a unique way to treat the stormwater runoff from existing developed areas of Saint Peter that may not have room for typical recommended treatment.

The abandoned North Lift station was constructed in 1961 with dual 100 hp pumps capable of pumping 2,000-gpm individually or 3,000-gpm when running together. The pumps provided ample capacity for the volume of wastewater that they once handled. However, stormwater runoff results in greater volumes of water over shorter periods of time. With the majority of stormwater pollutants carried in the first ½ inch of rainfall, the MPCA requires stormwater treatment methods to be sized to detain the first ½ inch. In order to meet this requirement, only 8 to 10 City Blocks (approximately 33 acres) could be directed to the old interceptor sewer and lift station for treatment. In comparison, the Chatham Street storm sewer at North Front Street serves a total of 285 upstream acres while the Skaro Street storm sewer serves 237 acres. Each of the contributing drainage areas is approximately 8 times larger than the effective service area of the abandoned lift station. For example, if low flows from the smaller Skaro Street storm sewer system were diverted to the old sanitary interceptor, the lift station pumps could handle a rainfall intensity of less than 0.1 inch/hour over the entire 237-acre watershed. This is much less than the ½ inch/hour required by the MPCA. In order to pump ½ inch/hour over 237 acres, stormwater would need to be pumped at a velocity of 152 feet/second through the existing 12-inch polyethylene forcemain under the river. At velocities this high, severe scouring of the interior pipe wall and failure will occur. According to, "The Design and Engineering Guide for Polyethylene Piping" by PolyPipe Systems, fluids with particles larger than ¼ inch should be pumped at velocities between 12-16 feet/sec in a 12-inch diameter polyethylene pipe. To maintain 12-16 feet/second pumping velocity, a 36-inch diameter forcemain and larger pumps would be necessary to handle a ½-inch rainfall event over the entire 237 acres.

Drawbacks to this consideration are the limited pump capacity at the lift station, pumping costs and maintenance. Using the existing pump station and forcemain, the City cannot pump sufficient flow to get stormwater treatment credit from the MPCA without a major expenditure of energy, pump and pipe materials.

© Bolton & Menk, Inc. 2008. All Rights Reserved

10. Downstream Defender

A "Downstream Defender" or other equivalent device is a manhole structure placed on a storm sewer line. Depending on the flow in the pipe, one structure can be utilized at the outlet (for flows less than 25 cubic feet per second) or multiple structures on the same line for larger areas. These structures traps sediment and contaminated runoff such as oil. This type of structure works well for smaller drainage areas of less than 10 acres but are not feasible for larger. Structures cost up to $20,000 each, not including necessary routine maintenance. This system can be utilized in a floodplain wetland with proper wetland mitigation.

11. Sand and Rock Weir

Another option is a sand or rock weir similar to that shown in Exhibit 4. This filters stormwater by removing sediment and trapping floatables. They are inexpensive to build and require routine maintenance, including removal of accumulated sediment, to prevent the filter media from plugging. This system can be utilized in a floodplain and would be best for outlets that discharge at a 25-year or higher floodplain elevation. They would not be feasible on river outlets that are in the floodway (such as Broadway Avenue outlet). Since these would be utilized on floodplain outlets, a wetland delineation will be necessary to determine potential wetland impact, if any. As always, wetland impact is not proposed unless all other alternatives have been considered unfeasible.

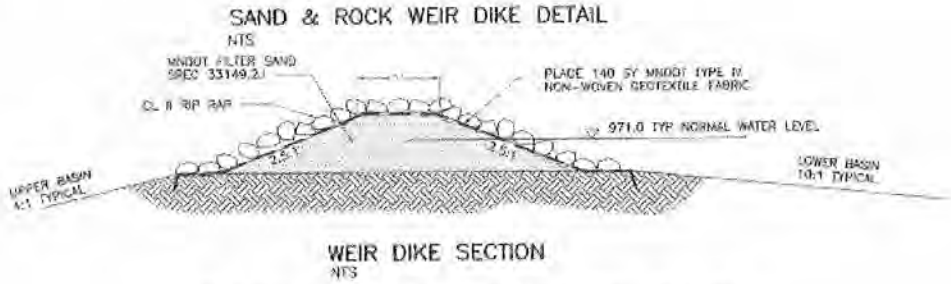


Exhibit 4. Sand & Rock Weir Dike Detail

The following map represents the existing City storm sewer system showing each of the 6 direct outlets to the Minnesota River.

© Bolton & Menk, Inc. 2008, All Rights Reserved

© Bolton & Menk, Inc. 2008, All Rights Reserved

The recommended outlet treatment strategies for the 6 **direct** stormwater outlets are:

Outlet Number	Pipe Size	Location	Proposed Treatment Method
1	48"	Intersection of North Front and Skaro Streets	Sand and Rock Weir
2	42"	Intersection of Chatham and North Front Streets	Downstream Defender or equivalent
3		Intersection of Chestnut and North Front Streets	Downstream Defender or equivalent
4	+/- 42"	Broadway Avenue at TH 99E Bridge	Downstream Defender or equivalent
5	36"	Intersection of Market and Mulberry Streets	Sand and Rock Weir
6	42"	Intersection of Market and Walnut Streets	Sand and Rock Weir

The recommended outlet treatment strategies for each of the 11 **indirect** stormwater outlets are:

1	48"	800' north of Intersection north TH 22 & MTH 169	Construction of stormwater basin for treatment and controlled discharge to outlet pipe
2	48"	400' south of Ritt Street and MTH 169	Piped to Regional Basin 19 (TH 169 Median Basin north of St. Julien Street) for treatment thereby eliminating existing outlet pipe to river.
3		1000' south of St Julien Street and MTH 169	Eliminate and combined with outlet No. 4
4		200' north of Union Street and MTH 169	Sand and Rock Weir
5	18"	Union Street and MTH 169	Sand and Rock Weir
6	42"	Intersection of Market and Walnut Streets	Sand and Rock Weir
7	15-18"	Intersection of South Front and St. Paul Streets	Downstream Defender or equivalent or Sand and Rock Weir
8		Intersection of Jefferson and South Front Streets	Downstream Defender or equivalent or Sand and Rock Weir
9	42"	Intersection of TH 22 South and MTH 169	Sand and Rock Weir or construction of stormwater basin

© Bolton & Menk, Inc. 2008, All Rights Reserved

10		1,000' south of Freeman Drive and MTH 169 Intersection	Sand and Rock Weir
11		1,800' south of Freeman Drive and MTH 169 Intersection	Sand and Rock Weir

XIII. AREAS OF CONCERN AND STUDY

City staff has identified several areas that are to be specifically addressed as part of this study. They are as follows:

- Using the North Highway 169 median area between Union and St. Julien Streets for stormwater treatment
- Review of the Halletts Park Stormwater Basin (previously known as the Gault Street Basin)
- Drainage for Possible TH 169 Bypass of Downtown Saint Peter
- Review of the Basin Recommendations in the Western Growth Area
- Stormwater Impact on Robart's Creek
- Stormwater Discharge to the Saint Peter Regional Treatment Center
- Welco North Basin Expansion Requirements
- Review of Regional Basins versus Individual Development Basins

1. The North Highway 169 Median Area

The North Highway 169 Median Area between Union and St. Julien Streets has been considered a potential opportunity for stormwater treatment. There is a definite possibility of using the low area between the northbound and southbound lanes of Highway 169 (called regional basin 19), which outlets into an existing culvert and into the Minnesota River. The roadway already defines the basin; all that would be necessary are some minor pipe routing changed and construction of an outlet control structure. A riser pipe could be added to the existing culvert basin to allow for dead storage or for the water quality volume filtration for all the area draining to the basin. Existing soils on site should be verified, but if the site has appropriate soils the basin could also utilize infiltration as another outletting opportunity.

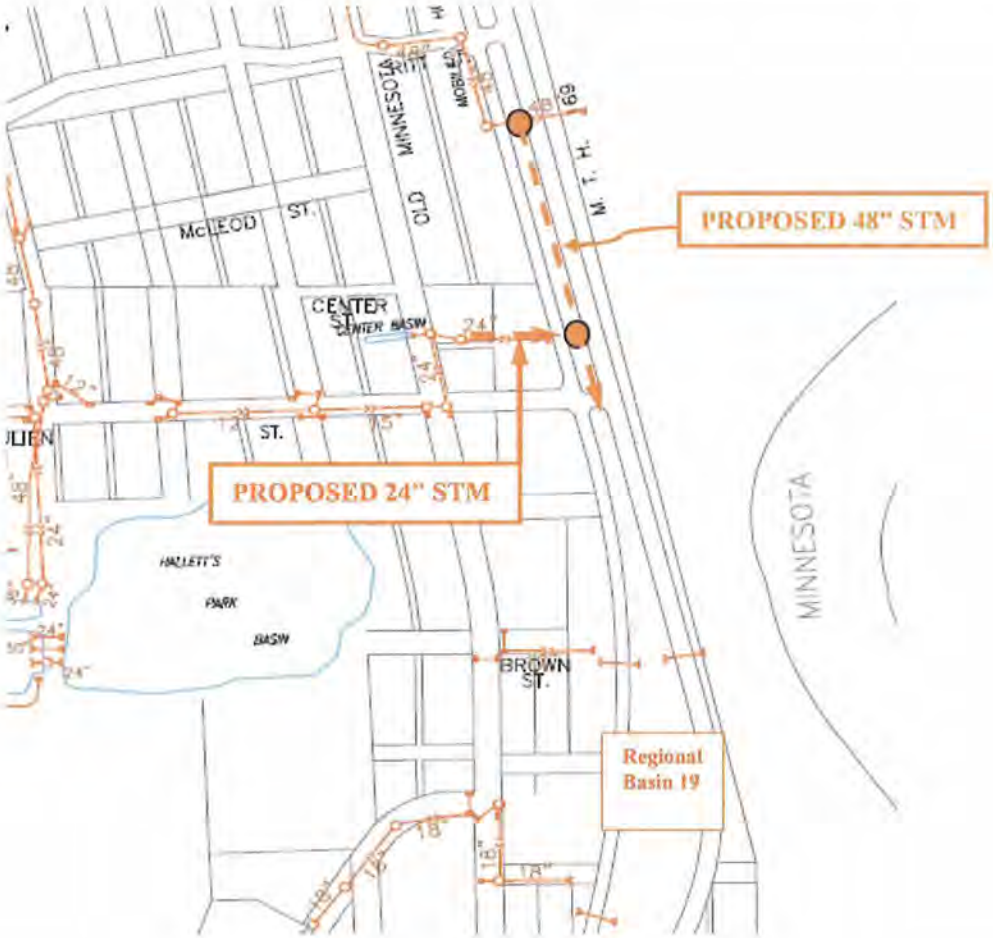
It should be noted that this basin is within the Minnesota Department of Transportation (Mn/DOT) right-of-way and the City would need Mn/DOT agreement for the proposed plan to become reality. This means that the basin will need to be a dry basin or a basin that fully drains within 48-hours for traffic safety. If Mn/DOT requires a dry basin, the design would only be altered slightly to include a lower, filtered outlet that drains the stored water below the standpipe. Sand filtered drains are one of the design considerations that could easily be used to meet the design criteria of both Mn/DOT and the MPCA.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The maximum drainage area that proposed regional basin 19 could serve would be approximately 180 acres which includes all of the following drainage areas being routed to the basin (they currently do not all flow there):

- Nichols Street and Highway 22 storm sewer system
- St. Julien Street storm sewer
- The area between Old Minnesota Avenue and Highway 169
- The 4th Street cul-de-sac.
- Old Minnesota Avenue and Union Street.
- Green Valley Court.

As shown in the figure below, these areas could be served by tying into the 48-inch storm sewer at Ritt Street and constructing a storm sewer in the west ditch or between the north- and south-bound lanes of Highway 169. The system could also pick up the 24-inch storm pipe south of Center Street.



© Bolton & Menk, Inc. 2008, All Rights Reserved

Any work involving this basin would need to be coordinated with Mn/DOT. By routing stormwater as proposed above, the existing 48" stormwater outlet south of Ritt Street to the Minnesota River floodplain would be eliminated.

2. Halletts Park Stormwater Basin

The Halletts Park Stormwater Basin (previously known as the Gault Street Basin) is a settling basin for stormwater prior to entering the Halletts Pond wetland. The settling basin was originally constructed in 1964 with dual 24-inch & a 30-inch CMP outlet pipes along with a valve control structure on one of the 24-inch pipes for draining the entire basin if necessary. The basin drains approximately 394 acres located in the northwest corner of the City through a 36-inch and 24-inch CMP that outlet into the northeast corner of the basin. With cooperation from the MPCA and DNR, the basin was modified as part of the wastewater treatment plant improvements in 2003. The improvements included expanding the size of the basin and constructing a rock peninsula to prevent short-circuiting of stormwater entering and leaving the basin. The perimeter of the basin was lined with clay and large rock riprap to protect the slopes from erosion.

Routine monitoring of Halletts Pond by the MPCA in June 2005 prompted a review of the stormwater treatment basin. After providing MPCA with the information requested, the MPCA determined the basin to be in compliance with NPDES requirements except that a means of preventing floatables from entering Halletts Pond was absent from the discharge pipes. To meet the MPCA requirements for stormwater discharge to a wetland, it is recommended to abandon or remove all existing outlet pipe and construct one skimmer structure with outlet control to detain the most volume of water possible without jeopardizing the integrity of the steep and narrow embankment between the pond and basin. Caution must be utilized when detaining water in the Halletts Park Basin to prevent changing the hydrology of the Halletts Pond wetland. That is, to prevent less water from entering the wetland than prior to the improvement.

3. Drainage for Possible TH 169 Bypass of Downtown Saint Peter

In year 2000, Trunk Highway 169 through downtown Saint Peter was classified as an Interregional Corridor by the Minnesota Department of Transportation. This classification meant the roadway was a primary route for the transport of goods and services between the regional commercial centers of Mankato and Twin Cities. The volume of traffic through the downtown has steadily increased from 16,000 vehicles per day in the year 2000 to approximately 21,500 vehicles per day in the year 2006. Traffic volumes are expected to continue rising.

To accommodate the increased volume of traffic and maintain average corridor speeds of 55-65 mph between Mankato and Twin Cities, a number of improvements were recommended along the corridor, one of which was a bypass of Saint Peter due to the 4 traffic stoplights present and a 30 mph speed for nearly 2 miles of roadway. To improve traffic flow, a bypass of the downtown is proposed to be constructed along Front Street which is located one block to the east. The proposed bypass route would parallel the Minnesota River thus making bypass drainage a priority.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Because the Minnesota River Floodway is approximately 100 feet from Front Street, stormwater from the bypass would be collected and piped to the west where it could be treated on the west side of the bypass. This opposes the natural drainage pattern from west to east but due to the existing gradual slope, it should be possible. The best location for a treatment basin would be on the west side of the bypass near the current Walnut Street intersection. The Walnut Street intersection is currently the low point on Front Street and would most likely be maintained assuming the new bypass followed the existing Front Street profile. One of the challenges of this location and others will be finding adequate space for construction of a stormwater basin. We estimate approximately 0.5 acres will be necessary assuming the basin will handle TH 169 bypass flow between Jefferson Avenue and Broadway Avenue. Once stormwater is treated, it would be discharged to the river through a pipe under the roadway.

Another option of treating bypass stormwater runoff would be by the construction of rain gardens. Rain garden have a compact design, allowing them to be located almost anywhere. Depending on the actual bypass location, rain gardens could be constructed on the east side between the bypass and river. This would be convenient for handling the first flush requirements of the MPCA with a overflow directly to the river. Rain gardens provide the flexibility to be located anywhere a stormwater discharge is necessary.

4. The Western Growth Area

The Western Growth Area is best described as the area immediately west and north of the currently developed city and the current growth boundary. It is upstream from the wellhead protection area. The general boundary of this area is shown in Figure 7. This area is also known as the western sand plain and it is the area where the Jordan Aquifer daylights and is most susceptible to surface water infiltration.

Currently, the Saint Peter drinking water is pumped from the Mount Simon, Franconia-Ironston-Galesville (FIG) and the Jordan Aquifers with the least amount of available flow coming from the FIG Aquifer, due to the FIG Aquifer's limitations. The Mount Simon Aquifer is the state's deepest and most protected aquifer, and is therefore increasingly more difficult to obtain appropriation permits to access. Due to the Jordan Aquifer's relative abundance, in the future the City may consider increasing use of the aquifer to accommodate growth.

The Jordan aquifer is subject to increasing contamination due to the exposure to surface runoff. The primary threat to this aquifer is associated with nitrates. This pollutant currently comes from agricultural sources, but can also come from residential sources. Although it is anticipated that someday the City will need a membrane water treatment plant to meet the increasingly stringent drinking water standards for nitrates, it is prudent to control the growth in this area in a manner that protects this aquifer. It is recommended that the City continue efforts to reduce nitrates in the runoff that is infiltrating in the wellhead protection area by first treating it with wetland vegetation.

On the other hand, the MPCA, with its TMDL limitations on phosphorus, encourages the use of infiltration as a treatment method. To complicate matters, the Western Development Area currently infiltrates all runoff and has only overflowed to adjacent areas once in the known history of the city. This occurred when the sand plain was frozen and infiltration was not possible.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Given these considerations, it is recommended to continue infiltration after the runoff has been pre-treated using constructed lined wetlands to naturally remove pollutants. It is also recommended to obtain general overflow easement corridors that are designed to flow by gravity from one wetland/infiltration pool to the next, to maintain flood levels below key area improvements. This could be done by developers dedicating the overflow easement land, or by the City obtaining right of first refusal and purchasing the land. In any case, the necessary drainage corridor should be included on the official Nicollet County Map to show future developers the parcels intended use.

The corridor would be necessary to handle spring snowmelts when the ground is still frozen. Figure 8 shows the recommended easement corridor (also called the recommended Greenway in other parts of this report). As shown in Figure 8, this Greenway can be part of a linear trail/park system that should enhance the value of the properties surrounding the Greenway.

5. Stormwater Impact on Robart's Creek

Stormwater impact on Robart's Creek is anticipated to be negligible. If the sand plain were not so porous, runoff from the Western Development Area would generally flow to the north and ultimately outlet into Robart's Creek. Hence the recommended overflow easement corridor follows this natural spillway route. Since runoff will be encouraged to infiltrate as it has for hundreds of years, no connection permit is anticipated for connecting the overflow easement corridor to Robart's Creek. The Easement corridor is only proposed to preserve the existing emergency overflow route in this northerly direction. When the ground is still frozen, but a spring snowmelt occurs, the ground may be unable to infiltrate the water and the resulting spring flood may cause emergency overflows that flow to Robart's Creek to be utilized. If an unusual snowmelt/frozen ground event occurs, new developments will be protected through the easement overflow preservation corridor. In this extreme event, runoff will affect Robart's Creek, but only in the same manner that it would be affected if no improvements were made. No DNR permit will be needed in this case.

6. Stormwater Discharge to the Saint Peter Regional Treatment Center (RTC)

Stormwater Discharge to the Saint Peter Regional Treatment Center (RTC) generally comes from a limited area of the previously developed part of the City. The outfall is through a 36-inch pipe under Highway 99. A field review of the outfall channel revealed an area of erosion at the immediate outlet and apparent sedimentation within 100 yards of the outlet pipe. The term apparent is used because the outfall channel is in obvious sand plain and it is difficult to discern whether the sand at the outlet is natural or deposited. Beyond the 100-yard distance, there is some natural channel erosion but as it approaches the RTC campus, the channel is dispersed. In some locations it is not possible to locate a main channel. Once reaching the RTC campus, water is directed along, then under South Washington Avenue at its intersection with TH 295. From here, the water runs east in a rock reinforced open ditch until it flows under TH 295 in a 60" culvert and discharges into the wetland located between Highway 169 and the RTC campus. Presently, the wetland serves as a stormwater detention basin with two culvert outlets to the Minnesota River floodplain. The wetland also takes water from the Marwey Mobile Home Court, TH 295 (Freeman Drive) and a portion of the RTC campus. Because these developments precede the storm water pre-treatment requirement for runoff entering a wetland, they are "grandfathered-in" and treatment is not mandated in this area. However, there may be an opportunity to construct stormwater treatment in this area to remove phosphorus TMDL

© Bolton & Menk, Inc. 2008, All Rights Reserved

to meet MS4 treatment requirements. If stormwater treatment, such as a basin, was constructed, the City would receive the corresponding phosphorus TMDL credit.

Some general riprap repair is recommended at the immediate pipe outlet. Otherwise the best recommendation is to continue monitoring the channel changes through the area to see if the downstream channel suffers significant change from year to year.

7. The North Welco Basin

When Rock Ridge and Washington Terrace Subdivisions are fully developed, increased stormwater runoff will require the North Welco Basin to be expanded. The basin is located on the east side of North Washington Avenue and north of the Welco II Subdivision. The basin was constructed as part of the Welco II project with plans to expand the basin for future drainage and stormwater treatment. A total of 215 acres is planned to directly contribute to the basin, excluding the area served by the Gault Park Detention Basin located in Washington Terrace. The North Welco Basin outlets through a 12-inch pipe and emergency overflow to the wetland area to the northeast. The pipe and overflow are in an easement.

When the basin was built in 1999, a 6-inch diameter orifice was placed over the basin's 12-inch outlet pipe with the intent of removing it when the contributing drainage area increased. With the construction of the North Industrial Park in 2004 and North Washington Avenue and Washington Terrace Subdivision in 2005, the increased impervious area has generated additional flow to the basin. As part of the North Washington Avenue project, 36-inch storm sewer is stubbed to the north of the Bunker Lane intersection for draining future development to the north of Washington Terrace.

Currently, the North Welco Basin is adequately sized to handle the 100-year design event with the 6-inch diameter orifice in place. This assumes a fully developed Washington Terrace Subdivision and 8 homes constructed in the Rock Ridge Subdivision. If the 6-inch diameter orifice is removed, the basin could accommodate the additional flow from a fully developed Rock Ridge Subdivision.

It will be necessary to upsize the basin when Rock Ridge Subdivision is fully developed and:

- North Washington Avenue is extended north of Bunker Lane

or

- New development occurs outside of the existing subdivisions.

Hydraulically, the basin outlet and overflow are proposed to remain unchanged after expansion. It is estimated that a rectangular piece of property approximately 325 ft by 777 ft will be needed to allow for the necessary storage and 50-ft buffer around the top. Exhibit 5 shows the land required to expand the North Welco Basin to serve the contributing drainage area. It is proposed to expand the basin by pushing the north wall of the existing basin to the north while leaving the east and west boundaries of the basin unchanged.

© Bolton & Menk, Inc. 2008, All Rights Reserved

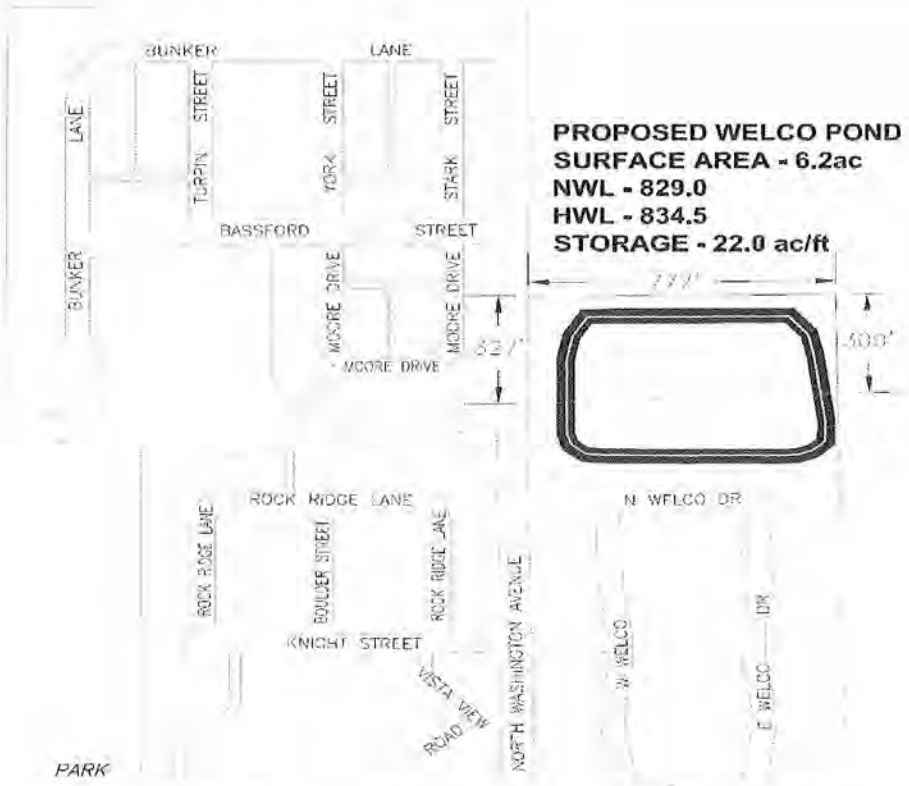


Exhibit 5. Proposed Expansion of North Welco Basin

XIV. EXISTING STORM SEWER NETWORK

A storm sewer network of inlets, pipes and manholes drains stormwater within the Saint Peter City Limits. The entire network is within city limits and drains approximately 1,300 acres of land containing homes, businesses, parks, roadways, schools, etc. Outlets for existing stormwater basins in the north and west growth areas do not connect to the existing storm sewer system but instead, drain by infiltration. This prevents overloading the existing downstream system. The existing storm sewer system is shown in Figure 9.

1. Stormwater Inlets

More than 1,400 stormwater inlets, also known as catch basins, are located throughout the city. Most are located at intersections with some found along curb & gutter roadways, spaced so that stormwater does not fill the driving lane and make the roadway impassable. Most catch basins are precast concrete structures with cast iron castings. Older catch basin structures made prior to the 1960's are brick and mortar. Depending on the type and size of grate, a typical catch basin on grade can handle between 1 and 3 cfs of stormwater. When in constructed in a low point on the roadway, they can handle 5 cfs or more. Most catch basins are 3-4 feet deep and those installed in the last 40 years are typically made of concrete. Current City policy requires catch basins to be constructed with a 2-foot sump below the outlet pipe to collect sand and rock particles. Old brick and mortar structures are susceptible to deterioration at the mortar joints. Once the joint weakens, it allows water and sediment to infiltrate causing a surface depression. Catch

© Bolton & Menk, Inc. 2008, All Rights Reserved

basins found to be in poor condition are replaced with a precast concrete structure. A chimney seal is placed over the adjusting rings and casting to prevent sediment from infiltrating.

2. Existing Storm Sewer Network

The existing storm sewer network consists of approximately 133,000 feet of mainline pipe between 12 and 54 inches in diameter. A total of 6 direct storm sewer outlets and 11 indirect stormsewer outlets, draining a total of 825 acres, discharge to the Minnesota River floodplain without first being stored and treated. This is primarily due to the limited space between dwellings and the Minnesota River floodplain. The City storm sewer network in Minnesota Avenue (Highway 169) between Grace Street and Broadway Avenue makes use of the old tunnel system which was once a combined sanitary and storm sewer conduit to the Minnesota River. The tunnel was constructed in sandstone in the early 1900's. A sewer project completed in 1970 separated flows so that wastewater is now properly treated and stormwater continues to flow to the river through an outlet pipe at Broadway Avenue (Highway 99 East).

3. Storm Sewer Manholes

Approximately 700 storm sewer manholes exist in the City of Saint Peter. Storm sewer manholes provide junctions for connecting pipe from catch basins. Depending on the layout of catch basins at an intersection, a manhole can connect anywhere from 2 to more than 4 pipe. Manholes typically have a cast iron casting and cover. Steps are also included for easy access. Like catch basins, manholes are precast concrete, block or brick and mortar. All new manholes are precast concrete and include a chimney seal.

4. Storm Sewer Network

The existing storm sewer network was analyzed with StormCAD Version 5.0 by Haestad Methods. The model uses the rational method of storm sewer design and considers factors such as storm event, pipe material and size, contributing drainage area, makeup of drainage area and time of concentration. The model also considers frictional flow losses through pipe and manholes. Based on the information inputted, the model will provide a profile of the storm sewer pipe showing the hydraulic and energy grade lines for the stormwater inside the pipe. The hydraulic grade line represents the theoretical elevation of water at that point in the pipe given its overall elevation and water pressure. The energy grade line represents the total energy of the flowing water given its elevation, pressure and velocity. Both hydraulic and energy grade lines are important to consider during storm sewer design given the existing City is located on a bluff with over 150 feet of elevation difference.

5. Standard Design Rainfall

The City of Saint Peter's standard design rainfall event is 10-years and generally, the existing storm sewer network has adequate capacity for this event. The analysis has flagged a few locations where the current system has inadequate capacity to carry the design event. The locations are shown in Figure 10 in the appendix.

© Bolton & Menk, Inc. 2008, All Rights Reserved

6. Storm Sewer System

Although the system is designed for a 10-year storm event, larger events with increased runoff not taken by the storm sewer system will tend to flow overland to the east. With the ample elevation available, flooding is not a concern for the existing part of the City east of the hilltop. Storm Sewer systems on the flatter hilltop should continue to be designed with emergency overflows to drainage ways or roadways to prevent flooding.

a. Existing Storm Sewer System Deficiencies

Piping in the following locations were determined to be inadequate for a 10-year storm event.

- Nichols Street – Gault Street to Old Minnesota Avenue – This segment includes approximately 1,100 feet of 36" pipe. The upstream drainage area includes Gault Street from Nichols Street to Dodd Avenue and Dodd Avenue from Gault Street to North Sunrise Drive. The analysis shows that this segment is undersized, and is acting as a bottleneck. This is causing stormwater to surcharge in upstream manholes. The 36" pipe is located under an existing gravel street.
- Mid Block of Swift Street Between St. Julien Street and Sumner Street to Halletts Detention Basin – This segment includes a 15" diameter pipe between Swift Street and Halletts Detention Basin. The pipe runs under the old Onan Building and handles flow from 5th Street, North Washington Avenue, Swift Street and the compost site. This segment contains approximately 800 feet of 15" storm sewer.
- Broadway Ave From the High School Parking Lot to Washington Ave – This segment is approximately 1,500 feet long and includes 18" and 24" pipe. This section was likely sized smaller than the upstream 30" pipe because of the increased pipe capacity due to the hill slope (the steeper the slope, the more volume of water it can carry). The upstream drainage area includes Broadway Avenue to approximately 500 feet west of Nicollet Avenue. Stormwater is surcharging upstream manholes and has been known to blow off manhole lids upstream as the water level increases. The pipe is located under an existing curb and gutter and bituminous city collector street.
- Minnesota Avenue – Park Row to Broadway Avenue and Broadway Avenue – Minnesota Avenue to the Minnesota River – This segment is approximately 1,050 feet in length and is part of the old combined sewer tunnel system. This section of tunnel was modified in 1987 to separate sanitary and storm sewer flows within the tunnel. This modification greatly reduced the size and capacity of the tunnel to carry stormwater. The decreased capacity is surcharging the upstream manholes and has been known to blow off manhole lids along Grace Street at both Minnesota Avenue and Third Street.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Recent storm sewer improvements at Grace and Third Street have provided a second outlet for water. The second outlet directs Grace Street stormwater to an existing 30-inch pipe in Third Street. The second outlet is designed as a backup being it is not utilized until water reaches a given elevation in the Grace Street pipe. Two outlet pipe reduce the volume of water reaching the tunnel at Minnesota Avenue therefore reducing the chance of the system surcharging.

Available tunnel cross sections indicate the tunnel in Minnesota Avenue is roughly equivalent to a 42-inch pipe. The tunnel is located under an existing bituminous trunk highway with curb and gutter.

The following section will describe the proposed storm sewer system piping improvements necessary for the system to meet the 10-year storm event.

XV. PROPOSED STORM SEWER NETWORK IMPROVEMENTS

Each of the undersized storm sewer segments was analyzed in detail to determine the size of pipe necessary to handle the 10-year design storm event. The existing storm sewer system downstream of the proposed improvement was then reviewed for potential capacity deficiencies due to the upstream upsizing. All storm sewer piping downstream of the proposed improvement locations was able to adequately handle the additional water generated by removing the bottleneck.

1. The proposed storm sewer piping improvements include:

   a. Nichols Street – This segment is proposed to be upsized from 36-inch to 42-inch diameter pipe at an estimated cost of $143,000. Cost estimates include removal and construction of a new concrete pipe and restoring the roadway to its present condition. They also include engineering and city administration but do not include costs for sanitary sewer or watermain improvements that also may be necessary.

   b. Swift Street – The segment between Swift Street and Halletts Detention Basin is proposed to be upsized from 15-inch to 30-inch. As part of this work, it is proposed to abandon the entire length of existing 15-inch pipe between Swift Street and Halletts Detention Basin, including the portion under the old Onan Building. The new 30-inch pipe is proposed to be routed north of the existing building and connected to the west side of Halletts Detention Basin. The estimated cost of the improvements is $95,000.

   c. Broadway Avenue – This entire segment is proposed to be upsized from 18 and 24 inch to 30–inch at an estimated cost of $260,000. Like the Nichols Street improvement, the cost estimate only considers storm sewer removal, replacement and existing surface restoration. City administration and engineering have also been included.

   d. Minnesota Avenue and Broadway Avenue – This section of storm sewer is proposed to be upsized to handle an equivalent 54-inch pipe. Being the existing tunnel system is under MTH 169 and TH 99 with the sanitary sewer encased inside the bottom of the tunnel, it would be costly to upsize the storm sewer portion of the actual tunnel. Alternately, a separate pipe could be installed parallel to the tunnel thus leaving the existing tunnel intact and capable of carrying stormwater and serving as a dual outlet. This would also be costly due to the high expense of installing the pipe in the bedrock.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Another option is to connect a second outlet pipe of 54" diameter to the tunnel storm sewer at the intersection of MTH 169 and Park Row. From here, it would drain east on Park Row ultimately outletting at the River. If land was available in Levee Park, a stormwater basin could be constructed between the Chamber of Commerce and the north Mill Pond access roadway to treat the water prior to discharging to the river.

Although construction of a second outlet for the Grace Street storm sewer will decrease surcharging of the system, the Grace Street and Minnesota Avenue intersection is still vulnerable to flooding because of its low elevation. The elevation of Minnesota Avenue (TH169) is high when compared to Grace Street and does not allow water to cross the road and drain east to the river. Presently, Municipal Parking Lot No. 5 at the southwest corner of Grace Street and Minnesota Avenue acts as a temporary holding basin and stores water until the Minnesota Avenue storm sewer system recovers. Development is being considered on this lot, thus eliminating the temporary storage it provides. If development occurs, it will be necessary to raise the site to prevent flooding or find a means of transporting water from the west side of Minnesota Avenue to the east side. One option may be to provide an equalizer pipe with intakes on the east and west sides of the highway. The equalizer pipe could contain a small drain pipe connection to the Minnesota Avenue tunnel for removing standing water under low flow conditions.

XVI. LIST OF POTENTIAL BASINS

As noted previously, several factors were considered in developing the proposed future storm plan for the City of Saint Peter. Because of the intricacies of the recommended improvements, this summary report will not discuss every detail of the recommended improvements. The HydroCAD data sheets of the existing and proposed conditions in Appendix B can be compared with existing storm sewer data as necessary to address specific questions. However, this report will highlight several key design features and recommendations.

During the analysis of the watershed area west of U.S. Highway 169, it was evident that uncoordinated and piecemeal development could result in a composite system that does not properly manage continued development drainage from the uplands to the west. From our analysis, the existing stormwater basin system and future storm sewer stub lines will function properly for smaller rainfall events. However, the larger rainfall events will need to be managed to prevent damage to the presently developed downstream properties by constructing emergency spillway channels, larger interconnecting conveyance or diversion piping and/or increased stormwater basin storage volume.

Conceptual stormwater basins are highlighted on the proposed conditions map (Figure 5). Basins have been generally located in strategic low areas that lie around the perimeter and upstream of the community to allow for future development (generally residential). They are intended to serve to both protect existing developments from upstream runoff and water quality enhancement.

Key design criteria have been noted on the map and are documented in greater detail in the design computations. Upstream basins have been sized to accommodate ultimate watershed development and have been preliminarily sited to fit natural low areas. In most cases, the location and shape of the basins can be modified to fit future development provided that the controlling design conditions are maintained (storage volume, maximum elevation, MPCA and BWSR requirements).

Of course, if ultimate development characteristics of the watershed change significantly, stormwater basin design and interconnected storm sewers will need to be modified accordingly.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Preliminary siting of regional stormwater basins is based on available open space and hydraulic requirements. Cursory consideration has been given to land use, development potential, boundary lines, etc. Many of the recommended stormwater basin sites are already prone to flooding and would require substantial fill for development.

Unfortunately, in the older, more densely developed portions of the community, such as the originally platted areas along U.S. Highway 169, open space for detention basin development is extremely limited. Throughout most of this drainage area new detention basins would require site clearing of previously developed properties.

Consequently, in these highly developed areas, drainage needs will need to be satisfied through the construction of major storm sewer interceptors.

The following is a brief description of the various major watershed areas studied. The areas and stormwater basin numbers described correspond to the numbers shown in Figures 1 and 5.

1. General

The City of Saint Peter was divided into watershed districts as shown in Figure 1. The growth limits are also shown on Figure 1. Proposed stormwater basin locations and green corridors are shown on Figure 5. The storage volume and outflow rate of a stormwater basin are attributes that are important to preserve for each ponding area in order to successfully maintain the integrity of the storm drainage system. Stormwater basin areas and water levels may change in the final design of the ponding area in order to best suit the proposed development, but care must be exercised so that the outflow rates do not impede the performance of the downstream drainage facilities.

2. Robart's Creek Watershed

The smaller Robart's Creek watershed within the growth area is south of Robart's Creek and is 671 acres in size. Currently this area is comprised of woods (including ravines along Robart's Creek), agricultural fields, farmsteads, grassland and gravel pits. The bluff line runs through this area. This watershed currently flows into Robart's Creek, some areas through gravel pits. This area is not within City boundaries, is partially within the growth limits, and is not within the wellhead protection area. The soils in this area are A, B, and C soils (mostly B and C soils below the bluffs, and a mix of B, B/D and C/D soils above the bluffs). There is a NWI wetland in this area. In general, there are no plans to develop this area as of the time of this report. In the proposed condition, it would be comprised of woods, and the runoff from this area would continue to flow into Robart's Creek. A small portion (51 acres) of this area will be developed into 0.25-acre residential lots and the storm water would need to be treated by localized small basins, as these areas don't flow to a workable regional basin location.

The larger Robart's Creek watershed is 16,685 acres in size. Currently this area is comprised of agricultural fields and farmsteads. It flows into Robart's Creek. The soils in this area are a mix of A/D, B, B/D, C, C/D, and D soils. This area is not within City boundaries, not within the growth area, and is not within the wellhead protection area. This area was included in the HydroCAD calculations to accurately model the amount of water in Robart's Creek. It is not delineated on the figures.

Robart's Creek receives flow from Regional basins 1 through 4, and 11 through 18. These regional basins are discussed below.

© Bolton & Menk, Inc. 2008, All Rights Reserved

3. Regional Basin 1 Watershed

The Regional basin 1 watershed consists of approximately 2,535 acres. This area is located southeast of the Township Road 205 and County Road 51 corner; a field north of County Road 5, along the bluff; north of County Road 5, on top of the bluff; as well as west of Township Road 206, along the bluff. Currently, only a small portion of this area is within City limits and the growth limits. A portion of the wellhead protection area runs through the southeastern portion of this watershed. There are several small NWI wetlands in this watershed. County Ditch No. 51 flows east through this area. The soils in the area are a mix of A, A/D, B, B/D, C, and C/D soils. There are no plans to develop a large portion of this watershed, but it was included because the runoff flowed towards Saint Peter. The area is proposed to be comprised of 16 acres of commercial development, 77 acres of grassy lawn, 137 acres of 0.25-acre lot residential, 131 acres of woods, 45 acres of stormwater basin, 16 acres of 2-acre lot residential (farmsteads), 2,094 acres of agricultural land, and 19 acres of pasture/grasslands.

The downstream benefits of the recommended Regional Stormwater basin 1 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

4. Regional Basin 2 Watershed

The Regional basin 2 watershed is a field along County Road 51; as well as west along the bluff and including a part of the town of Traverse. It is 845 acres in size. Currently the land is residential area within Traverse or in agricultural use, with farmsteads, 5 acres of bluffs/woods and an acre of pond. It is outside the City boundaries, and partially within the growth limits. A portion of this area is within the wellhead protection area. The soils in this area are a mix of A, B, B/D, C, and C/D. There are two small NWI wetlands in this area. The proposed use is agricultural use outside the growth limits and 0.25-acre residential lots within the growth limits. The runoff from this area would flow into Regional Stormwater basin 2.

Regional Stormwater basin 2 will receive runoff from this watershed, plus the runoff from Regional Stormwater basin 1, for a total of 3,381 acres flowing to this stormwater basin. This stormwater basin will outlet to the north to Regional Stormwater basin 3 and will also use infiltration.

The downstream benefits of the recommended Regional Stormwater basin 2 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

5. Regional Basin 3 Watershed

The Regional basin 3 watershed consists of 350 acres located near the intersection of County Road 51 and County Road 15. A portion of the area is within the wellhead protection area. The soils in this area are a mix of A/D, B, B/D, C, and C/D. Currently the land is either bluff areas (woods) or in agricultural use, with row crops, pasture, and pond, and is outside the City boundaries, but partially within the growth limits. The

© Bolton & Menk, Inc. 2008, All Rights Reserved

proposed use is agricultural use outside the growth limits and 0.25-acre residential lots inside the growth limits. The runoff from this area would flow into Regional basin 3.

Regional basin 3 will receive runoff from this watershed, plus the runoff from Regional basin 2, for a total of 3,730 acres flowing to this stormwater basin. This stormwater basin will outlet to the north to Regional basin 4 and will also use infiltration.

The downstream benefits of the recommended Regional basin 3 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

6. Regional Basin 4 Watershed

The Regional basin 4 watershed (surrounding the basin) is located between County Road 15 and Trunk Highway 22, as well as south of County Road 15 and is 145 acres in size. It is outside the City boundary, but inside the growth limits. The majority of this area is within the wellhead protection area. The soils in this area are a mix of A and B soils. The proposed use is 0.25-acre residential lots. The runoff from this area would flow into Regional basin 4.

There is another watershed, which is northwest of the City, and is 404 acres in size. The area is outside of the City boundary and the growth limits. There are no plans to develop this area as of the time of this report. It has been included in this study because the runoff from this area flows towards Saint Peter. The soils in this area are a mix of B, B/D, and C/D soils. This watershed is not within the wellhead protection area. Currently the land is either a small portion of the town of Traverse, bluff areas (woods) or in agricultural use, with row crops, pasture, and pond. The runoff from these areas would flow into Regional basin 4.

Regional basin 4 will receive runoff from these two watersheds, plus the runoff from Regional basin 3, for a total of 4,279 acres flowing to this stormwater basin. This stormwater basin will outlet to the north to a ponded area east of Trunk Highway 22 and west of County Road 20 in Area 57, then through gravel pits and into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 4 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

7. Regional Basin 5 Watershed

The Regional basin 5 watershed is located between Highway 22 and County Road 15; at the future intersection of Nicollet Avenue and County Road 15; the intersection of Nicollet Avenue and Highway 22; and at the southwest corner of County Road 15 and future Nicollet Avenue. This area is mostly inside the City boundary and completely within the growth limits. A majority portion of this area is within the wellhead protection area. The soils in this area are a mix of type A and B soils. In the proposed condition, this area would consist of 11 acres of industrial development and 61 acres of 0.25-acre

© Bolton & Menk, Inc. 2008, All Rights Reserved

residential lots and would flow to Regional stormwater basin 5. Regional stormwater basin 5 will receive runoff from a total of 76 acres.

The downstream benefits of the recommended Regional basin 5 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

8. West Industrial Basin Watershed

The West Industrial basin watershed is the industrial area north of Trunk Highway 22 and is 28 acres in size. Currently this area is comprised of industrial development. The soils in the area are a mix of A and B soils. Runoff from this area currently flows into West Industrial stormwater basin. This area is within City boundaries, is within the growth limits, and is not within the wellhead protection area. No changes are proposed to this area.

9. Regional Basin 6 Watershed

The Regional basin 6 watershed is located at the southwest corner of the intersection of Sunrise Drive and Highway 22 and is 53 acres in size. Currently, the majority of the area is in agricultural use, with 7 acres of commercial development. This area is partially inside the City boundary, and is completely within the growth limits. It is also within the wellhead protection area. The soils in this area are mostly type A soils, with some type B soils. This area presently flows to a depression near Sunrise Drive. In the proposed conditions, the area will be comprised of 38 acres of 0.25-acre residential lots and 15 acres of commercial development. The runoff will flow to Regional basin 6 and from there to the proposed Washington Avenue Link stormwater basin.

The downstream benefits of the recommended Regional basin 6 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an emergency outlet constructed to discharge to the east offers stormwater management for future development.

10. Warren Basin/Regional Basin 7 Watershed

The Warren Basin/Regional basin 7 watershed is located at the intersection of County Road 51 and Sunrise Drive and southwest of the Traverse Road and Sunrise Drive corner and is 150 acres in size. There are portions of this area outside the City boundaries, but it is entirely within the growth limits. The soils in this watershed are a mix of A, B and C soils. Currently, the majority of the land (113 acres) in this area is agricultural, with 21 acres developed as 0.25-acre residential lots and 15 acres of industrial development. A majority of this watershed is within the wellhead protection area. In the proposed condition, the entire area would be developed as 25 acres of industrial development and 125 acres of 0.25-acre residential lots.

In the developed stage, it is proposed to manage the watershed's stormwater runoff with the use of a regional stormwater basin. The Warren Basin has a total of 257 acres draining to it. The water leaves the basin by infiltration. The emergency overflow is

© Bolton & Menk, Inc. 2008, All Rights Reserved

proposed to be a broad crested weir that ultimately flows east through a swale to Sunrise Drive.

Two smaller basins flow to the Warren Basin/Regional basin 7: the Nicollet Basin and the Windsor Basin. These have been included in the Warren Basin/Regional basin 7 watershed shown on the figures.

- The Nicollet stormwater basin watershed is located north of Traverse Road and south of County Road 15 and is 68 acres in size. In the proposed condition, this area will consist of 59 acres of 0.25-acre residential lots, 7 acres of grass, and 2 acres of stormwater basin. The runoff would be routed into Nicollet stormwater basin and then to Warren Basin/ Regional Stormwater basin 7.
- The Windsor Basin watershed is located in the Windsor Pond subdivision and is comprised of 40 acres: 39 acres of 1/8-acre residential lots, and 1 acre of stormwater basin. This area presently flows to Windsor Basin, which outlets to the depression at intersection of Sunrise Drive and County Road 51, the future site of Warren Basin. In the proposed conditions, the stormwater basin will not change, but will outlet to the Warren Basin/Regional Stormwater basin 7.

The downstream benefits of the recommended Warren Basin/Regional basin 7 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an emergency outlet constructed to discharge to the east offers stormwater management for future development.

11. Regional Basin 8 Watershed

The Regional basin 8 watershed is east of the future Washington Avenue and is 19 acres in size. The soils in this area are Type A. This area is not within City boundaries and is not within the wellhead protection area, but is within the growth limits. In the proposed condition, it would be comprised of 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional stormwater basin 8. This stormwater basin will outlet to a wetland and then eventually into the Minnesota River.

The downstream benefits of the recommended Regional Basin 8 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

12. North WELCO Basin

The watershed for the WELCO North Basin is on the northeast side of the City. The soils in this area are a mix of A, B and C soils. This watershed area is not within City boundaries and is not within the wellhead protection area, but is within the growth limits. In the proposed condition, it would be comprised of 0.25-acre residential lots and a regional stormwater basin. The majority of this watershed currently flows into a wetland and then into the Minnesota River. The future North Washington Avenue runoff currently flows north into Robart's Creek. In the proposed conditions, the runoff from this area would flow into the proposed WELCO North Regional stormwater basin.

© Bolton & Menk, Inc. 2008, All Rights Reserved

This stormwater basin will receive runoff from Regional basin 8, and areas including North Washington Avenue, Washington Terrace Subdivision, WELCO developments, Rock Ridge Subdivision, and the eastern portion of the North Industrial Park, for a total area draining to the WELCO North stormwater basin of 215 acres. This stormwater basin will outlet into a wetland and then into the Minnesota River. Stormwater outflow by infiltration was not included for this basin as the present basin operates as a wet basin with standing water. Basin water is believed to represent the groundwater level in the area, as the basin is not lined.

The downstream benefits of the recommended WELCO Regional basin system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

13. Regional Basin 9 Watershed

The Regional basin 9 watershed is west of Highway 169 on the north side of the City and is 35 acres in size. Currently this area is comprised of farmsteads, agricultural fields and woods. It currently flows into the Minnesota River. The soils in this area are Type A. This area is not within City boundaries and is not within the wellhead protection area, but is mostly within the growth limits. In the proposed condition, it would be comprised of woods, 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 9. This stormwater basin will outlet to the east into the Minnesota River.

The downstream benefits of the recommended Regional basin 9 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

14. Regional Basin 10 Watershed

The Regional basin 10 watershed is on both sides of Daisy Lane and is 26 acres in size. It currently flows into the Minnesota River. The soils in this area are mostly A soils, with a small area of B soils. This area is not within City boundaries and is not within the wellhead protection area, but is within the growth limits. In the proposed condition, it would be comprised of woods, 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional stormwater basin 10. This stormwater basin will outlet to the east into the Minnesota River. Outflow by infiltration was not included for this basin due to its horizontal and vertical proximity to the Minnesota River.

The downstream benefits of the recommended Regional basin 10 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

15. Regional Basin 11 Watershed

© Bolton & Menk, Inc. 2008, All Rights Reserved

The Regional basin 11 watershed is north of Trunk Highway 22 and is 129 acres in size. This area is not within City boundaries and is not within the wellhead protection area. It is mostly within the growth limits. The soils in this area are a mix of A and B soils. In the proposed conditions, the area within the growth limits will be 0.125- and 0.25-acre residential lots and a regional stormwater basin.

Regional basin 11 will receive runoff from this watershed. This stormwater basin will outlet to the north into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 11 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

16. Regional Basin 12 Watershed

The Regional basin 12 watershed is on the east side of County Road 20 and is 103 acres in size. Currently this area is comprised of agricultural fields, 1-acre residential lots, and woods. It currently flows into Robart's Creek. The soils in this area are mostly Type A, with some B soils. This area is partially within City boundaries, is entirely within the growth limits, and is not within the wellhead protection area. In the proposed condition, it would be comprised of 0.125-acre and 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 12.

This stormwater basin will outlet to the north to Regional basin 13, then into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 12 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

17. Regional Basin 13 Watershed

The Regional basin 13 watershed is on the east side of County Road 20 and is 59 acres in size. Currently this area is comprised of agricultural fields, 1-acre residential lots, and woods. It currently flows into Robart's Creek. The soils in this area are a mix of A and B soils. This area is not within City boundaries, is completely within the growth limits, and is not within the wellhead protection area. In the proposed condition, it would be comprised of 0.125-acre and 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 13.

Regional basin 13 will receive runoff from this watershed, plus the runoff from Regional basin 12, for a total of 162 acres flowing to this stormwater basin. This stormwater basin will outlet to the north into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 13 system are:

© Bolton & Menk, Inc. 2008, All Rights Reserved

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

18. Regional Basin 14 Watershed

The Regional basin 14 watershed is south of Robart's Creek and is 14 acres in size. Currently this area is comprised of agricultural fields and woods. It currently flows into Robart's Creek. This area is not within City boundaries, is partially within the growth limits, and is not within the wellhead protection area. In the proposed condition, it would be comprised of 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional Stormwater basin 14.

Regional basin 14 will receive runoff from this watershed, plus the runoff from Regional basin 15, for a total of 44 acres flowing to this stormwater basin. This stormwater basin will outlet to the north into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 14 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

19. Regional Basin 15 Watershed

The Regional basin 15 watershed is south of Robart's Creek and is 30 acres in size. Currently this area is comprised of agricultural fields. The soils in this area are mostly A soils, with a small area of B soils. It currently flows into a shallow depression and then into Robart's Creek. This area is not within City boundaries and is not within the wellhead protection area, but is inside the growth limits. In the proposed condition, it would be comprised of 0.125-acre and 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 15.

Regional basin 15 will outlet to the north into Regional basin 14. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 15 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

20. Regional Basin 16 Watershed

The Regional basin 16 watershed is north of Trunk Highway 22 and is 15 acres in size. Currently this area is comprised of agricultural fields. It currently flows into a shallow depression and then into Robart's Creek. The soils in this area are A soils. This area is not within City boundaries and is not within the wellhead protection area, but is within the growth limits. In the proposed condition, it would be comprised of 0.125-acre and 0.25-

© Bolton & Menk, Inc. 2008, All Rights Reserved

acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 16.

This stormwater basin will outlet to the north into Regional basin 18. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 16 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

21. Regional Basin 17 Watershed

The Regional basin 17 watershed surrounds future North Washington Avenue and is 40 acres in size. Currently this area is comprised of agricultural fields. It currently flows into a shallow depression and then into Robart's Creek. The soils in this area are a mix of A and B soils. This area is not within City boundaries and is not within the wellhead protection area, but is within the growth limits. In the proposed condition, it would be comprised of 0.125-acre and 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 17. This stormwater basin will outlet to the north into Regional basin 18. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 17 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

22. Regional Basin 18 Watershed

The Regional basin 18 watershed is south of Robart's Creek and is 48 acres in size. Currently this area is comprised of agricultural fields and woods. It currently flows into Robart's Creek. The soils in this area are mostly A soils, with a small area of B soils. This area is not within City boundaries and is not within the wellhead protection area, but is mostly within the growth limits. In the proposed condition, the area inside the growth limits would be comprised of 0.125-acre and 0.25-acre residential lots and a regional stormwater basin. The runoff from this area would flow into Regional basin 18.

Regional basin 18 will receive runoff from this watershed, plus the runoff from Regional stormwater basins 16 and 17, for a total of 103 acres flowing to this stormwater basin. This stormwater basin will outlet to the north into Robart's Creek. The stormwater basin will also use infiltration.

The downstream benefits of the recommended Regional basin 18 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions.
- The large regional stormwater basin with an outlet constructed to discharge to the north offers stormwater management for future development.

23. Regional Basin 19 Watershed

© Bolton & Menk, Inc. 2008, All Rights Reserved

The watershed for Regional Basin 19 is on the northeast side of the City, just west of Highway 169, and between Old Minnesota Avenue and Highway 169, and is 179.6 acres in size. This area is within City boundaries and the growth limits, and the area is not within the wellhead protection area. The runoff from this area currently flows to Regional basin 19 located between the lanes of Highway 169, into a culvert and into the Minnesota River. The soils in this area are A soils, and the area between the lanes of Highway 169 are B soils. The area currently consists of urban commercial and 0.25-acre lot residential development. This area is not proposed to be re-developed at this time; therefore the proposed watershed conditions are the same as the existing.

The runoff from this area would flow to Regional basin 19 located between the lanes of Highway 169, into an existing culvert and into the Minnesota River. In the proposed conditions, a standpipe would be added to the existing culvert outletting the basin to allow for dead storage for all the area draining to the basin. The basin also uses infiltration.

The downstream benefits of the recommended Regional basin 19 system are:

- Water quality treatment for stormwater that is currently discharging to the Minnesota River.
- The basin is almost already built; all that would be necessary is some small piping rerouting and modifying an outlet structure.

24. Regional Basin 20 Watershed

The regional basin 20 watershed is north of Township Road 81, northwest of the Gustavus Adolphus College campus, and south of County Road 5. This area is mostly outside the current City limits, and is mostly inside the growth limits. This area includes bluffs. The soils in this area are generally B soils, with some A, C, B/D and C/D soils. There is a very small NWI wetland along the bluff line. A portion of the wellhead protection area runs through the area.

Regional basin 20 is actually a series of three stormwater basins that act together as a regional stormwater basin. The regional stormwater basin 20 serves a total of 483 acres. The new regional stormwater basin is proposed to promote groundwater infiltration and has no outlet.

In the proposed conditions, the area will consist of 0.25-acre residential lots, grasslands, agricultural fields, woods (bluffs), commercial development, industrial development, and the regional basin 20.

The downstream benefits of the recommended regional basin 20 system are:

- The dampening of the developed property runoff to match pre-developed flow rate conditions using infiltration.
- Recharge of the groundwater using infiltration.
- Proposed stormwater basin location makes use of existing local depression.
- The runoff velocities can be more easily controlled to reduce erosion.

25. Regional Basin 21 Watershed

The Regional basin 21 watershed is located north of County Road 5. The watershed is approximately 43 acres in size and currently is woods/grass, agricultural fields, a small

© Bolton & Menk, Inc. 2008, All Rights Reserved

area of commercial development, and an existing 2-acre stormwater basin. Currently, the majority of the area is inside the City boundary and it is completely within the growth limits. The soils in this area are a mix of A and B soils. When developed, this watershed is proposed to be comprised of 41 acres of 1/8-acre residential lots and 2 acres of stormwater basin. This watershed presently drains to Regional basin 21 by County Road 5, which outlets to the City's storm sewer system.

The stormwater basin uses infiltration and also has an outlet to the City storm sewer system.

26. Watershed Currently Flowing to City Storm Sewer System

A watershed currently flowing to city storm sewer system is located in the southwest corner of Broadway Avenue and Sunrise Drive. It is comprised of 24 acres of grass and 2 acres of commercial development and is entirely within the City boundary and within the growth limits. The soils are almost completely Type A, with a very small area of B soils on the west side of the area. No further development is currently planned for this area. This area presently flows to a catch basin, connecting to the City storm sewer system.

27. Gustavus Adolphus Basins Watershed

The Gustavus Adolphus Basins watershed are approximately 130 acres in size, and represents the south and north side of the Gustavus Adolphus College campus. The watershed is completely within City boundary and the growth limits. The soils in this area are mostly A soils, with some B soils on the western side of each area. The watershed consists of 69 acres of campus and 61 acres of brush. A portion of the wellhead protection area runs through the southern part of the watershed.

The runoff from this watershed runs into three existing stormwater basins: runoff from south runs into Stormwater basin 22C (on the south side of the campus), then either infiltrates or flows over a weir into Stormwater basin 22A on the west side of campus. Runoff from the north runs into Stormwater basin 22A, too. Then Stormwater basin 22A flows over a weir into Stormwater basin 22B, which has no outlet and uses infiltration only.

The downstream benefits of the Gustavus Adolphus Basins system are:

- The dampening of the developed property runoff.
- Sediment and pollutants settle out as the water goes through the series of stormwater basins.
- Recharge of the groundwater using infiltration.

28. Oak Leaf Lake Watershed

The Oak Leaf Lake watershed is on the both sides of Highway 99 to the southwest of the City and is 936 acres in size. It currently flows into Oak Leaf Lake (a Natural Environment Lake, Protected Water 52-10P). Oak Leaf Lake is shown as a NWI wetland on Figure 4. Oak Leaf Lake has no outlet other than infiltration. The soils in this area are a mix of B, B/D, C/D and D. This area is not within City boundaries, not within the growth limits and is not within the wellhead protection area. The area consists of 693 acres of agricultural fields, 115 acres of Oak Leaf Lake and 129 acres of wetland. There are no plans to develop this area as of the time of this report; therefore the proposed conditions are the same as the existing. When development is considered, the County and/or City's Shoreland Ordinance will be in effect.

© Bolton & Menk, Inc. 2008, All Rights Reserved

29. The Minnesota River Watershed

The Minnesota River watershed is on the west side of Highway 169, on the south side of the City, near the Regional Treatment Center and is 1,254 acres in size. This area is partially within City boundaries and the growth limits and the area is not within the wellhead protection area. The runoff from this area would flow into several unnamed creeks, then under Highway 169 and into the Minnesota River. The area consists of 691 acres of agricultural fields, 7 acre of pond, 538 acres of woods/ravine, and 18 acres of industrial development. There are several NWI wetlands in this watershed area. The soils in this area are mostly B, with some small areas of A, B/D and C/D soils. This area is not proposed to be developed at this time as it was previously determined that providing city water to the area would be impossible with the current system due to the elevation, therefore the proposed conditions are the same as the existing.

© Bolton & Menk, Inc. 2008, All Rights Reserved

XVII. OPERATIONS AND MAINTENANCE

1. Stormwater Basins

Stormwater basins represent a sizeable investment in the City's drainage system. General maintenance of these facilities can help insure proper performance and reduce the need for major repairs. Periodic inspections shall be performed to identify possible problems in and around the basin. Finally, water quality sampling can insure that stormwater basins are operating correctly and can detect abnormal pollutant discharges within the watershed.

The most important part of the inspection of stormwater basins is to insure the outlet of the basin can perform at design capacity. The area around the outlet shall be free and clear of debris, litter and heavy vegetation. Trash guards shall be installed and maintained over all outlets to prevent clogging of the downstream storm sewer. Trash guards must be inspected at least once a year, preferably in early spring, to remove debris that may clog the outlet. Emergency overflow outlets shall be clear of equipment or materials and properly protected against erosion.

Basin inlets shall be inspected for erosion. In cases where erosion occurs near an inlet, an energy dissipater such as riprap or articulated concrete block will be required. Sediment deposits or deltas may form at the inlet from poor erosion control practices upstream. This may occur during mass grading of sites within the drainage area. Large sediment deposits may reduce the ability of water to discharge from the storm sewer system during large storm events and cause surcharging upstream.

The side slopes of basins must be kept well vegetated, including turf, shrubs and trees, to prevent erosion and sediment deposition into the basin. Severe erosion along side slopes can decrease the quality of water discharging from the basin and require dredging of sediments from the basin. Noxious weeds may need to be periodically removed from around basins. Some basins in highly developed areas may require mowing. If mowing is performed, a buffer strip adjacent to the normal water level shall be maintained to provide filtration of runoff from side slopes and protection of wildlife habitat. The vegetated buffer strip width shall be a minimum of 50 feet, measured horizontally, the outer 25 feet of which may be used for maintenance access, trails and park area. The buffer shall be measured from the point where the basin side slope is 6:1 (6 feet horizontal to 1 foot vertical) or flatter.

Periodic inspection of stormwater basins shall include checking for evidence of illicit dumping or discharges. Under the City's MS4 permit, all retention basins must be inspected on an annual basis. The most common of these is dumping of yard waste into the stormwater basin. Signs should be posted in known problem areas prohibiting the dumping of yard waste in storm sewers or basins. Oil sheens can also be present in areas where waste motor oil is dumped into upstream storm sewers. Skimmer devices placed at outlets of basins can help prevent oil spills from being transported downstream. Skimmer structures shall be periodically inspected for damage from freeze-thaw cycles. Inspections performed during dry weather periods shall check for flows at basin inlets. Dry weather flows can indicate illicit dumping or unknown connections to the storm sewer system.

© Bolton & Menk, Inc. 2008. All Rights Reserved

2. Sediment Removal

The removal of sediment deposits will likely be the most expensive portion of maintenance for stormwater basins. The removal efficiencies of basins for water quality treatment can be significantly reduced if sediment is allowed to accumulate to excessive depths. As a general guideline for maintenance scheduling, stormwater basins will require dredging every 15 to 20 years to remove accumulated sediments. Some basins will require shorter or longer times between dredging based on the land use and rate of erosion within the drainage area.

Sampling of the sediments in basins shall be conducted prior to disposal to detect possible high levels of harmful materials. Phosphorus levels will vary and depend on the characteristics of the contributing drainage area. Nitrate levels are expected to be minimal with their uptake by plants during the treatment process. If excessive hazardous waste levels are detected in sediment tests, disposal of material must be conducted under MPCA guidelines. If high levels are not detected, sediment disposal sites shall be located where it will be stable and not in contact with humans (playgrounds or parks). Sediments shall be covered with topsoil and revegetated to prevent erosion of the material.

3. Open Channels

Overland routes constitute an important part of the surface water drainage system. Open channels are typically vegetated and occasionally lined with more substantial materials. The lined channels typically require little or no maintenance. Vegetated channels require periodic inspection and maintenance as high flows create erosion within the channel. Eroded channels will contribute to the water quality problems in downstream water bodies as the soil is continually swept away. If not maintained, the erosion of open channels will accelerate and the repair will become increasingly more costly.

4. Piping System

The storm sewer piping system constitutes a multi-million dollar investment for any City. A comprehensive maintenance program is recommended to maximize the life of the facilities and optimize capital expenditures. To accomplish this, the following periodic inspection and maintenance procedures are required in accordance with the City's MPCA NPDES MS4 permit. Inspection intervals are from the permit.

- Inspect the city's catch basin and manhole castings at least once every 5 years, clean and replace as necessary.
- Inspect the city's catch basin and manhole rings at least once every 5 years and replace and/or regrout as necessary.
- Inspect catch basin and manhole structures at least once every 5 years and repair or replace as needed. Check pipe inverts, benches, steps (verify integrity for safety) and walls. Cracked, deteriorated and spalled areas need to be grouted, patched or replaced.
- Inspect storm sewer piping either manually or by television to assess pipe condition at least once every 5 years. Items to look for include root damage, deteriorated joints, leaky joints, excessive spalling, and sediment buildup. The piping system shall then be programmed for either cleaning, repair, or replacement as needed to ensure the integrity of the system.

© Bolton & Menk, Inc. 2008, All Rights Reserved

5. De-Icing Practices

Minnesota receives approximately 54 inches of snow during a typical year. This requires a large amount of de-icing chemicals to be applied to roads and sidewalks each winter. The main chemical used for de-icing is salt or sodium chloride. Prior to utilization of a pre-wetter anti icing agent on roadways in 2008, the City of Saint Peter applied approximately 135 tons of road salt and 850 tons of sand to its roads each winter. Salt and sand mix are presently stored in a roofed building at the Public Works site. The building is enclosed on three sides with the south side open for material handling. The existing salt storage has been identified by the MDH as a factor to consider moving in relation to its proximity to the city wells.

- Addition of a door on the south side to completely enclose materials and protect from wind and rain. If this is not possible, stockpiles shall be covered with polyethylene.
- Berms and shallow drainage swales should be constructed to divert off-site runoff away from storage location.
- Place stockpiles on an impervious surfaces. Infiltration of runoff high in chloride content can pollute the ground water. High chloride concentrations can be toxic to fish, wildlife and vegetation. Impervious surfaces also provide easier year-end cleanup of the loading area and will not become muddy during the spring.
- Contain runoff from stockpile location by construction of a depression to prevent runoff from leaving the site.

Estimates indicate that 80 percent of the environmental damage caused from de-icing chemicals is a result of inadequate storage of the material (MPCA 1989). Therefore, proper storage of salt is critical in reducing the amount of chloride that is transported to the environment.

Practices shall also be followed to reduce the amount of salt that is applied to roads. One method is to limit the amount of salt applied to low traffic areas and straight level areas. Streets shall be inspected for the need for de-icing prior to application. Equipment shall be maintained in good working order to evenly distribute salt on roadways and shall be properly calibrated to prevent excessive application.

6. Detection of Illicit Connections

To satisfy one of the NPDES program requirements, a program to detect illicit connections to the City's drainage system shall be implemented. This program would involve the inspection of storm sewer outfalls during dry weather periods to identify possible illegal dumping or connections to the storm sewer system. Inspection shall be prioritized by focusing on industrial and commercial areas first, then extending to residential areas.

If dry weather flows are detected and illicit connections could be the source of the flow, a grab sample shall be collected for analysis to determine if pollutants are present. It is very important that all data collected under this program be saved in an organized fashion. This information will be valuable in NPDES permitting requirements for the City.

© Bolton & Menk, Inc. 2008, All Rights Reserved

XVIII. EDUCATION

The successful implementation of the SWMP will require that the individuals and groups involved in the SWMP have a clear understanding of the objectives of the management plan and policies. Since all City residents, staff, elected officials, developers and consulting firms will be impacted by the SWMP, all need to be informed of the pertinent policies.

Each of these groups needs a thorough understanding of the major objectives and policies of the SWMP. In addition, each group will require extensive training in specific aspects of the SWMP pertaining to the manner in which they impact water quality. Those utilizing the SWMP shall also reference the City's Storm Water Pollution and Prevention Plan.

1. Development Community

   The SWMP will have a major impact on the development community. Therefore, informing developers and their consulting engineers of the SWMP requirements will be an important component of the education program.

   In addition to a basic understanding of the overall SWMP policies, the development community will need a good understanding of the reasons for the development of the policies impacting their activities. Specifically, developers and consultants must understand the impact of development on:

   - The standard design requirements for the conveyance system;
   - The theory of stormwater detention ponding, and the rationale behind the selection of runoff coefficients;
   - General practices for erosion control;
   - Water quality preservation practices; and,
   - The economic and social value of maintaining high water quality for streams and the Minnesota River.

XIX. ECONOMIC CONSIDERATIONS

As with all improvements, there is a cost associated with prudent stormwater management. Implementation of a stormwater development and access charge on an area wide basis and building the regional ponding system as a City funded project is probably the best and fairest method of ensuring that new developments are adequately studied, sized and coordinated properly.

Perhaps the most advantageous strategy is to choose a single cost over the entire study area. This would eliminate the contention by the more expensive area developers and landowners that they are being treated unfairly. However, this should be approached with caution, as simply choosing an average cost could result in the City of Saint Peter financing the more expensive projects first. Accordingly, a thorough review with consideration of a reasonable contingency beyond the averages should be made with your financial consultant and planner.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Assessment rates for commercial and industrial areas are proportionately higher than for low-density residential areas. The higher rate is justified because these areas typically have a larger percentage of roofed and paved areas, which increase the amount of runoff. The velocity of runoff on impervious surfaces is also greater, which results in lower times of concentration, higher peak runoff rates, and larger required storm sewer pipe.

Stormwater Utility Rates per acre will be changing over the coming year. Here are the rates with their effective dates:

- March 1, 2006: $15 per acre
- September 2006: $19.50 per acre
- January 2007: $22.50 per acre

The charge is calculated as follows: Rate x Area x Residential Equivalency Factor (REF).

Single-family homes and multi-family homes with less than 5 units have an area of 1/3 acre. Other land uses are assigned a REF as follows:

Commercial	1.75 REF
Industrial	1.5 REF
Public school, RTC, Private school	0.5 REF
Manufactured Home Park	0.5 REF
Single-family or Multi-family less than 5 units	1 REF (1/3 acre)
Multi-family greater than 5 units	1 REF plus actual area

© Bolton & Menk, Inc. 2008, All Rights Reserved

XX. SUMMARY AND RECOMMENDATIONS

1. Summary

The Saint Peter SWMP has a dual purpose: it will serve as a guide for the construction of storm drainage facilities and along with the City SWPPP, provides a basis for a consistent approach to the preservation of ravines, wetlands, streams and the Minnesota River. The following issues have been incorporated into this plan:

- Division of the City into major watersheds based on contour maps, grading plans and natural topography;
- Determination of stormwater runoff under ultimate land use conditions;
- General layout and sizing of trunk storm sewers and open channels;
- Tributary areas, storage volumes, and high water levels of all required stormwater basins;
- Estimated construction and implementation costs of the SWMP;
- Recommendations for education of City residents, staff, and development community.

The primary function of an urban storm drainage system is to minimize economic loss and inconvenience due to periodic flooding of streets and other low-lying areas. Adequately designed storm drainage facilities provide flood control, minimize hazards and inconvenience associated with flooding, and protect or enhance water quality. The SWMP takes the entire drainage basin with future saturation development into consideration.

Any new residential, commercial, industrial and other habitable structures shall be constructed with the following elevation: Elevation of the lowest opening or the overflow into a window well or lowest level stairwell shall be a minimum of 2 feet above the emergency overflow, or 1 foot above the HWL of the nearby basin or water body, whichever is higher. The emergency overflow shall be analyzed using a 10-inch, 24-hour rain event in order to determine the emergency overflow functions as the design intent. The overland flow routes shall be incorporated into the design for stormwater basins and maintained during development. When the water body is landlocked, the 100-year back-to-back storm shall be used to determine the HWL. The City may require additional freeboard for landlocked areas or stormwater basins where emergency overflows cannot be provided. In the case of landlocked basins, the HWL will be determined using two 100-year, 24-hour back-to-back rainfall events. The ground level at the lowest opening elevation of structures that are adjacent to stormwater basins shall be indicated on the site grading plan to ensure adequate freeboard. The area of the stormwater basin plus a 50 foot buffer (measured horizontally from the point where the stormwater basin slope is 6:1 or flatter) shall be contained entirely within an outlot that is owned and maintained by the City. Twenty-five feet of this buffer nearest the basin will be vegetated, and the remaining twenty-five feet will be vegetated and can be used for maintenance access, recreation trails, and park area.

© Bolton & Menk, Inc. 2008, All Rights Reserved

The numerous natural depressions found throughout Saint Peter have been incorporated into the SWMP as ponding areas. The effective use of ponding areas enables the installation of outflow sewers with reduced capacities since the design storm duration is effectively increased over the total time required to fill and empty the ponding reservoirs. Storm sewers represent a sizable investment for the community and this investment can be more efficiently utilized by ponding stormwater in designated ponding areas and allowing smaller diameter pipes to be used as outfall lines.

Equally as important as flood control and cost considerations, is the use of ponding areas to:

- Improve water quality;
- Return stormwater to the groundwater table;
- Increase water amenities in developments for aesthetic, recreational and wildlife purposes.

For water quality stormwater basins, the wet volume is the most important consideration. The area and depth of the stormwater basins may differ from the values presented here, but the wet volume must be provided so that the prescribed pollutant loading of the system is not exceeded.

Amenity aspects are maximized by careful planning in the initial development of any residential or industrial area and by integrating the ponding system into an overall comprehensive SWMP.

The wildlife aspects of the ponding areas shall be maximized in design and the proper location of the trail system will allow good access to these areas for wildlife observation.

It is extremely important that each area be re-evaluated at the time of final design to confirm the criteria used in this study and to make any changes that a proposed development may dictate. Special consideration must be given to areas that develop differently than shown in the Comprehensive SWMP, especially when a higher runoff coefficient is likely to result from development.

All storm sewer facilities, especially those conveying large quantities of water at high velocities, shall be designed with efficient hydraulic characteristics. Special attention shall be given during final design to those lines that have extreme slopes and create high hydraulic heads.

The BMPs recommended by the MPCA shall be followed wherever necessary.

2. Recommendations

The following recommendations are presented for the City Council's consideration based upon the data compiled in this report:

- The SWMP as presented herein be adopted by the City of Saint Peter.
- Conceptual ponding areas be established as shown in Figure 5 and made a part of the stormwater management system.
- Standard review procedures be established to ensure all development within the City is in compliance with the SWMP.
- Detailed hydrologic analysis be required during final design of all ponding areas.

© Bolton & Menk, Inc. 2008, All Rights Reserved

- Final high water levels governing building elevations adjacent to ponding areas and floodplains be established as development occurs or when drainage facilities are constructed.
- Overflow routes be established and maintained to provide relief during extreme storm conditions, which exceed design conditions.
- A stormwater maintenance program be enforced to ensure the successful operation of the drainage system.
- The erosion and sedimentation control criteria for new developments be enforced.
- Amendments to the plan be adopted and implemented as warranted by future standards or regulations.
- That the plan be updated in five years.

The existing storm sewer system of the City of Saint Peter is not adequate to handle the continued development around the presently developed area. If development continues, the existing system will need major improvement and enlargements to effectively serve the community without excessive flooding. The proposed regional ponding scenario presents one method of accommodating the present growth of Saint Peter. However, this report and the proposed ponding scenario is not necessarily the only method of accomplishing the goal of comprehensive stormwater management.

Given this, it is imperative that this plan is updated on a regular basis to ensure that any adjustments in area developments continue to be coordinated. In addition, the proposed stormwater development charges shall be updated annually to ensure that the associated City costs are fully financed. In this manner, the plan can maintain its usefulness as a current document.

This stormwater management plan satisfies one of the requirements of the NPDES permitting process. As stated earlier, this report is predominantly based on information obtained from available topographic data, field verification of the watershed areas, and discussions with City staff relative to the historical flooding areas. Since the modeled existing system closely matches that described by observation, we feel that this plan has significant benefit as a planning and design tool. However, the quality and accuracy of this report could be further validated with more detailed survey data in the growth areas around the City.

3. Implementation of Recommendations

Capital Improvement Program (CIP) means an itemized program for a ten year prospective period, and any amendments to it, subject to annual review, setting forth the schedule, timing, and details of specific contemplated capital improvements by year, together with their estimated cost, the need for each improvement, financial sources, and the financial effect that the improvements will have on the local government unit or watershed management organization. A CIP already exists and is updated annually. The CIP includes projects to implement the recommendations in this SWMP.

The following is a implementation process list of the recommended actions, timing, responsible party, and the cost or funding source which are presented for the City Council's consideration based upon the data compiled in this report. Actions are listed in order of priority, from highest to lowest.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Action	Timing	Responsible Party	Cost/Funding Source
Maintain and implement Capital Improvement Program (CIP)	On-going, updated annually	City of Saint Peter	Stormwater area charge and monthly stormwater utility fee
A stormwater maintenance program be enforced to ensure the successful operation of the drainage system.	On-going	City of Saint Peter	Stormwater area charge and monthly stormwater utility fee
Corrective actions for stormwater problem areas	On-going, as problems come up	City of Saint Peter	Stormwater area charge and monthly stormwater utility fee
The erosion and sedimentation control criteria for new developments be enforced.	On-going, as developments are submitted to the City for approval	City of Saint Peter	Funding by developer's fees and building permits
Encourage low impact development / better site design for new developments.	On-going, as developments are submitted to the City for approval	City of Saint Peter	Developers
Conceptual stormwater basins be established as shown in Figure 5 and made a part of the stormwater management system.	On-going, as developments are submitted to the City for approval Right of first refusal purchasing at time of sale of property	City of Saint Peter	Cost sharing with Nicollet County, Developer Assessments
Standard review procedures be established to ensure all development within the City is in compliance with proper erosion control practices.	Currently in place. Update as necessary.	City of Saint Peter	Funding by developer's fees and building permits
Detailed hydrologic analysis be required during final design of all stormwater basins.	Currently in place. Update as necessary.	City of Saint Peter	Funding by developer's fees and building permits

© Bolton & Menk, Inc. 2008, All Rights Reserved

Action	Timing	Responsible Party	Cost/Funding Source
Final HWLs governing building elevations adjacent to stormwater basins and floodplains be established as development occurs or when drainage facilities are constructed.	Based on final design for Stormwater basins	City of Saint Peter	Funding by developer's fees and building permits
Overflow routes be established and maintained to provide relief during extreme storm conditions, which exceed design conditions.	On-going, as developments are submitted to the City for approval	City of Saint Peter	Developers
Amendments to the SWMP be adopted and implemented and the SWMP be updated.	As warranted by future standards or regulations – by 2010 or earlier if needed	City of Saint Peter	Stormwater area charge and monthly stormwater utility fee
Regulate construction and land uses along the bluff, to prevent erosion.	On-going, as developments are submitted to the City for approval	City of Saint Peter	Funding by developer's fees and building permits

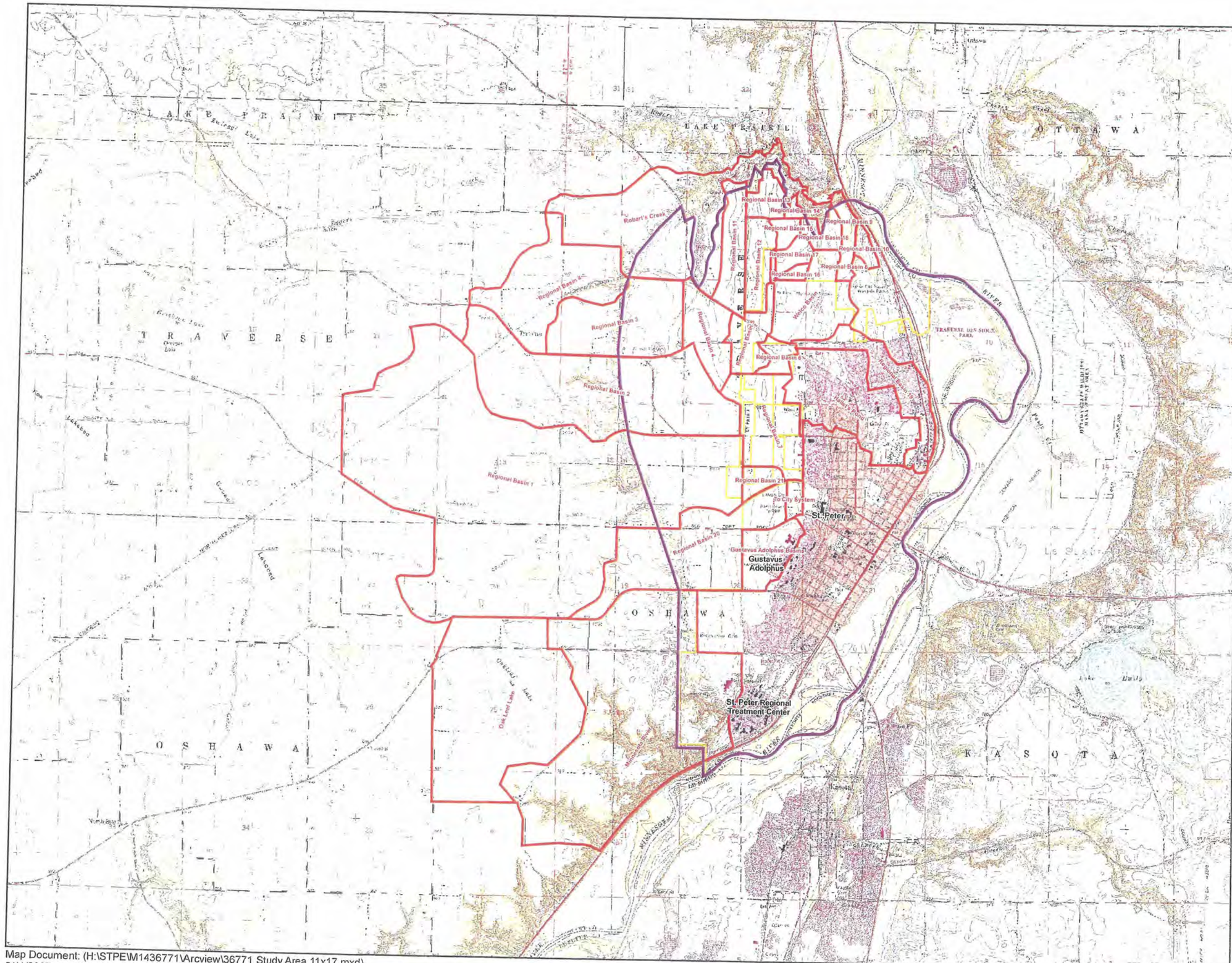
© Bolton & Menk, Inc. 2008, All Rights Reserved

Action	Timing	Responsible Party	Cost/Funding Source
Encourage landowners to retain any areas of native vegetation, and to plant species native to the area, to protect and improve wildlife habitat and maintain the historic ecological role and appearance of the bluff lands along the river. The existing housing developments along bluffs have addressed retention of native vegetation in one of two ways: platting of the property in an outlot and deeding that to the City or through a conservation easement.	On-going, as developments are submitted to the City for approval	City of Saint Peter	Cost sharing with the County
Develop an implementation strategy for TMDL	Once TMDL is formulated	City of Saint Peter.	City of Saint Peter.

© Bolton & Menk, Inc. 2008, All Rights Reserved

Appendix A

Figures



CITY OF ST. PETER STORMWATER MASTER PLAN STUDY AREA

FIGURE NO. 1
SEPTEMBER, 2007

Legend

- Proposed Watersheds
- Growth Limits
- County Boundary
- City Limits

N
W E
S

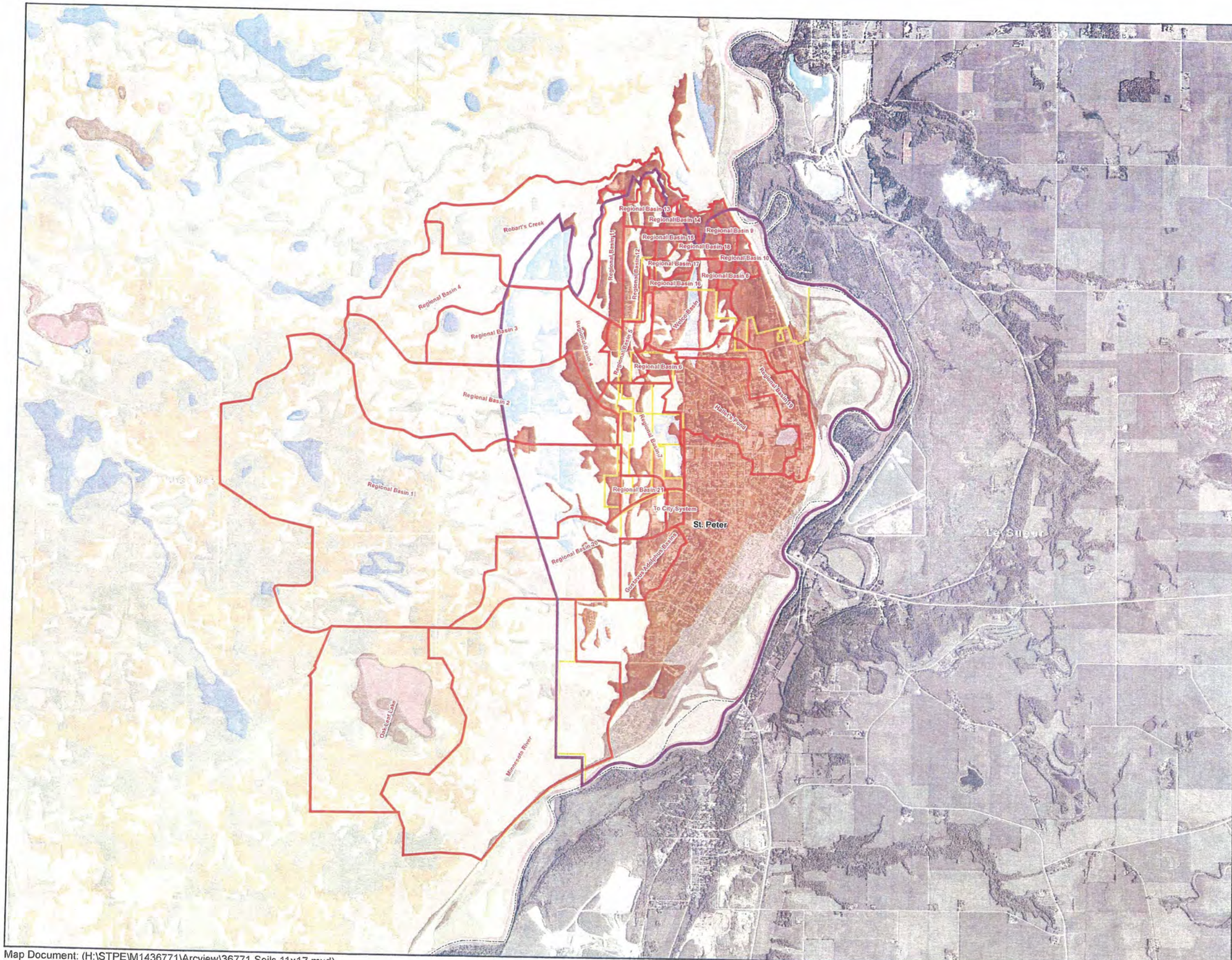
4,000 0 4,000
Feet

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Study Area 11x17.mxd)
9/11/2007 -- 9:35:34 AM

CITY OF ST. PETER
STORMWATER MASTER PLAN
SOILS MAP

FIGURE NO. 2
SEPTEMBER, 2007



Legend

Soil Hydrology

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not Classified
- Proposed Watersheds
- Growth Limits
- County Boundary
- City Limits

N
W E
S

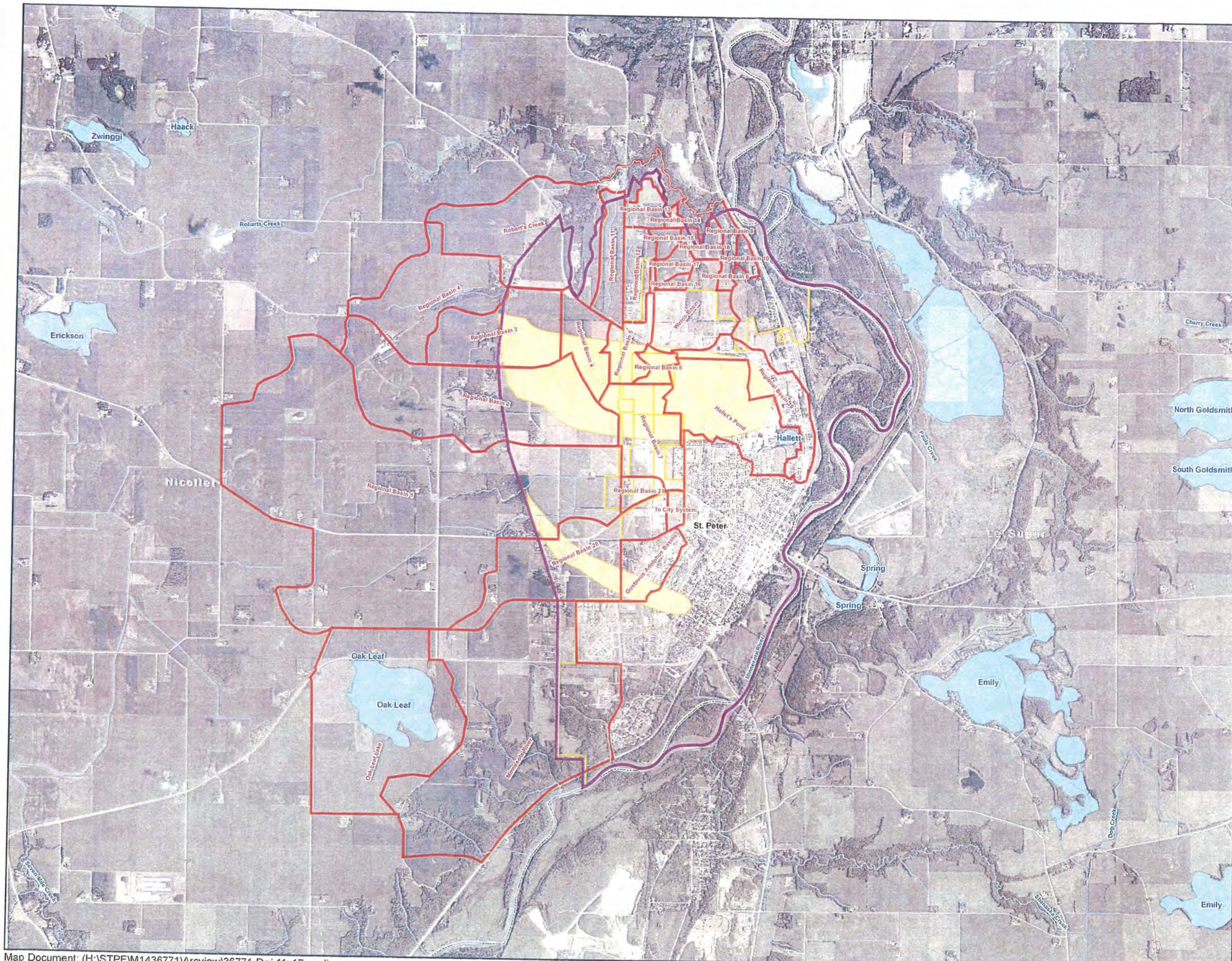
4,000 0 4,000
Feet

BOLTON & MENK, INC
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Soils 11x17.mxd)
9/11/2007 -- 9:23:29 AM

CITY OF ST. PETER
STORMWATER MASTER PLAN
DNR PROTECTED WATERS MAP

FIGURE NO. 3
SEPTEMBER, 2007



Legend

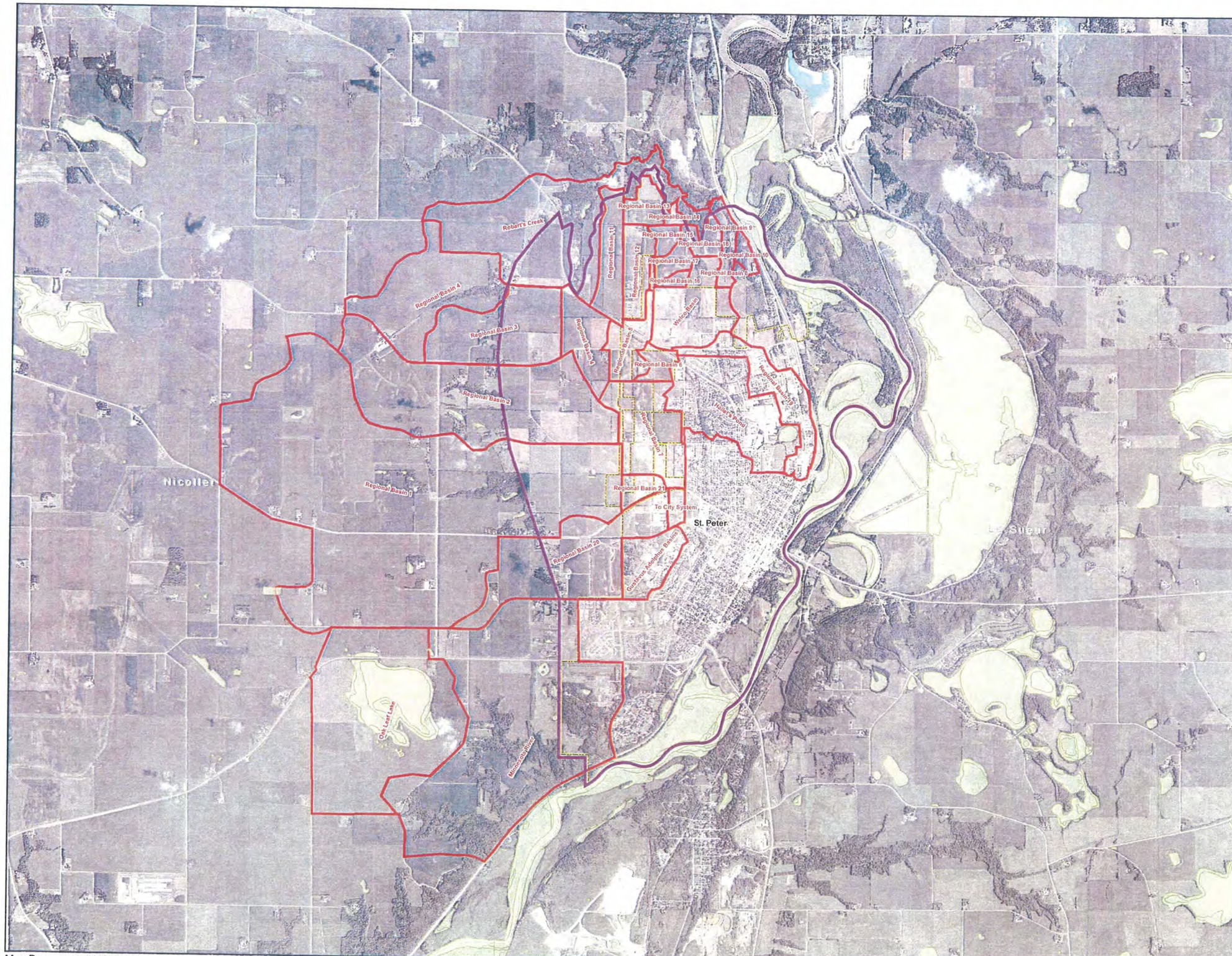
- DNR Protected Waters
- Proposed Watersheds
- Growth Limits
- Wellhead Protection Area
- County Boundary
- City Limits
- Rivers & Streams

N
W E
S

4,000 0 4,000
Feet

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Pwi 11x17.mxd)
9/11/2007 -- 9:14:56 AM



CITY OF ST. PETER STORMWATER MASTER PLAN NATIONAL WETLANDS INVENTORY MAP

FIGURE NO. 4
SEPTEMBER, 2007

Legend

- National Wetlands Inventory
- Proposed Watersheds
- Growth Limits
- County Boundary
- City Limits

NOTE:

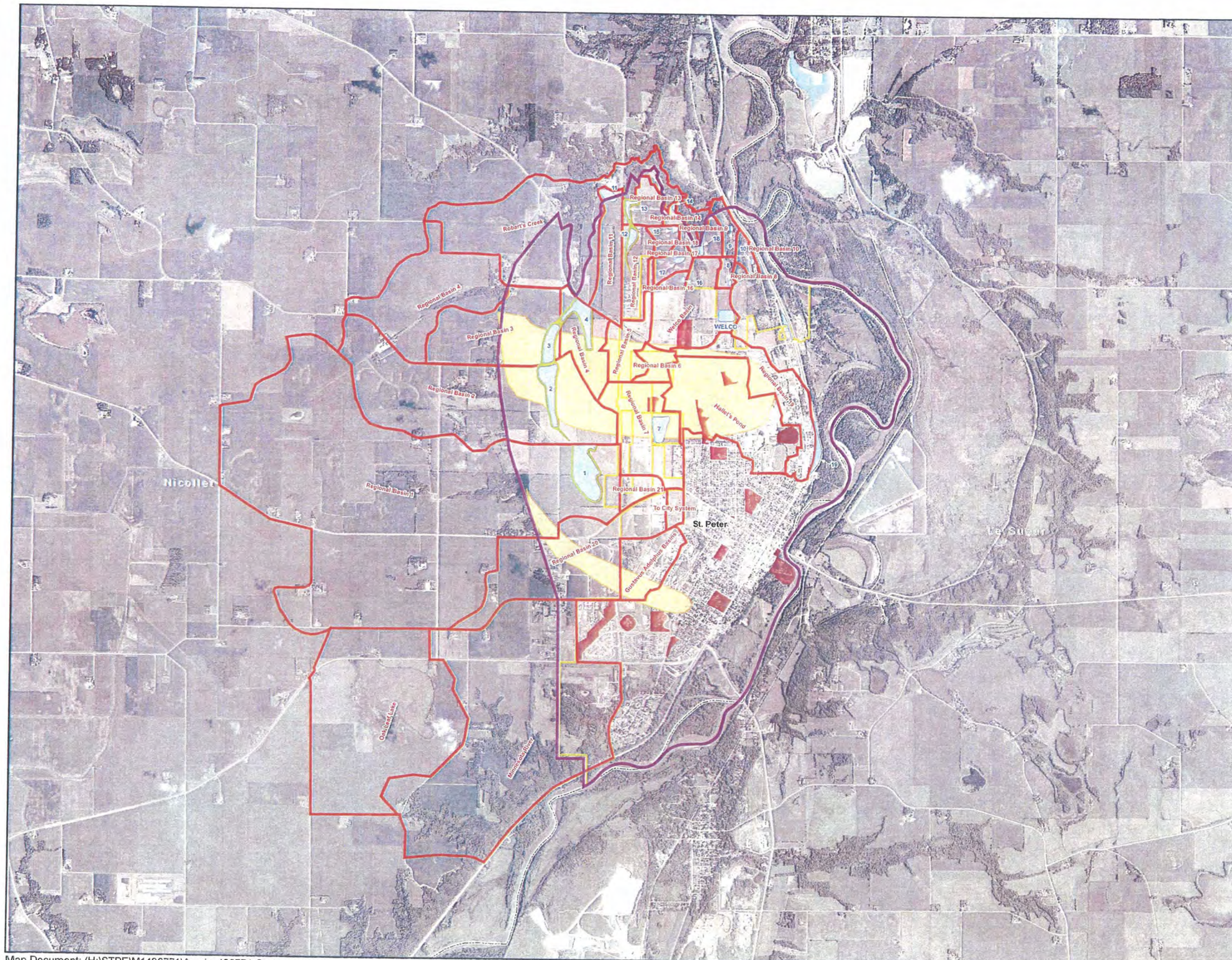
Wetlands shown represent the known and identified wetlands on the National Wetlands Inventory Map prepared by the U.S. Fish and Wildlife Service. If an area on this map does not show a wetland, it does not mean a wetland does not exist. A site-specific delineation is required to verify actual wetland locations and limits.

N
W E
S

4,000 0 4,000
Feet

EOLTON & MEINK INC.
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Nwi 11x17.mxd)
9/11/2007 -- 9:05:40 AM



CITY OF ST. PETER STORMWATER MASTER PLAN CONCEPTUAL REGIONAL STORMWATER BASIN LOCATIONS

FIGURE NO. 5
SEPTEMBER, 2007

Legend

- Proposed Basins
- Proposed Green Space
- Wellhead Protection Area
- Parks
- Proposed Watersheds
- Growth Limits
- County Boundary
- City Limits

N
W E
S

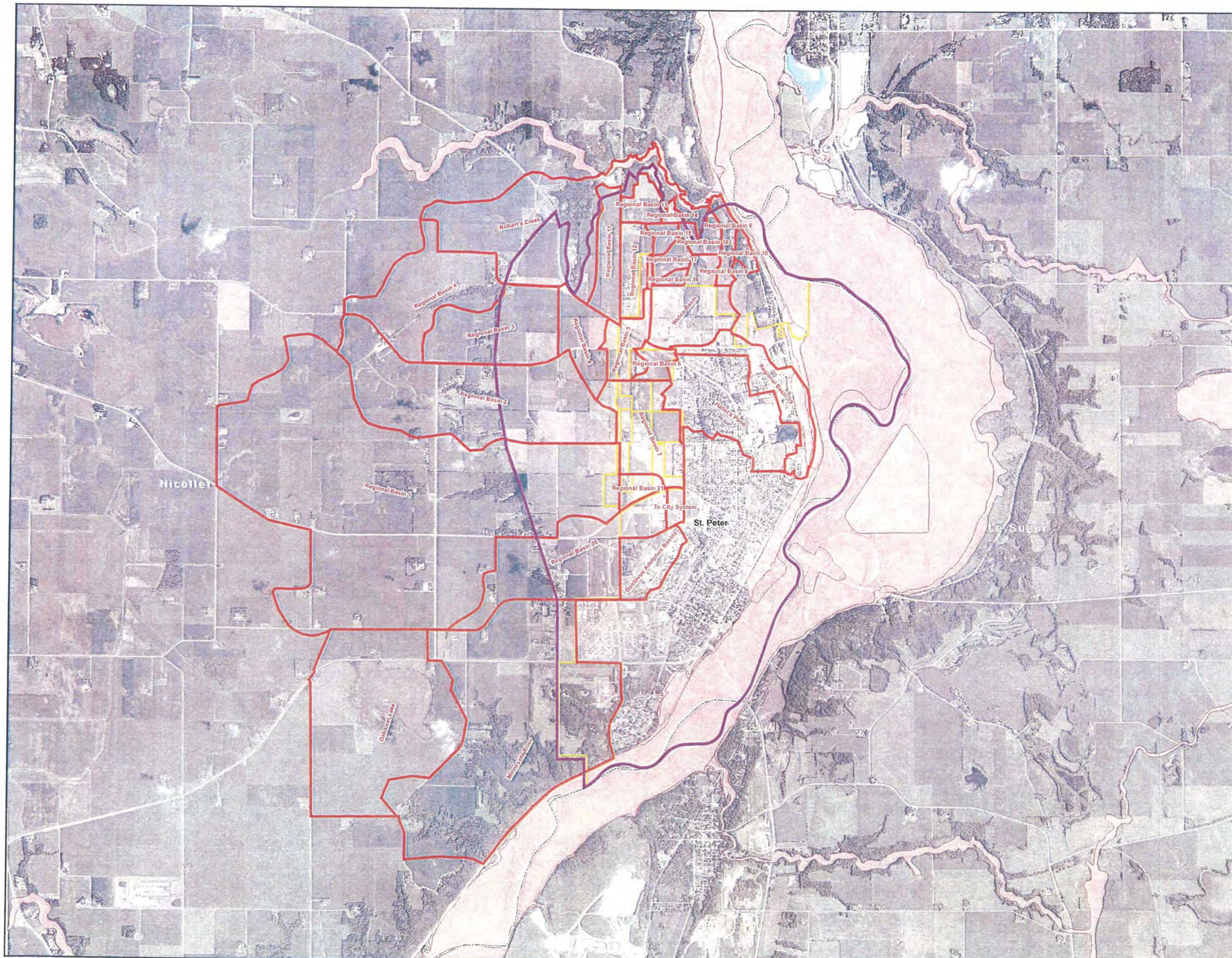
4,000 0 4,000
Feet

BOLTON & MENK INC
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Stormwater Basin Locations 11x17.mxd)
9/11/2007 -- 9:30:46 AM

CITY OF ST. PETER
STORMWATER MASTER PLAN
FEMA FLOODWAYS MAP

FIGURE NO. 6
SEPTEMBER, 2007



Legend

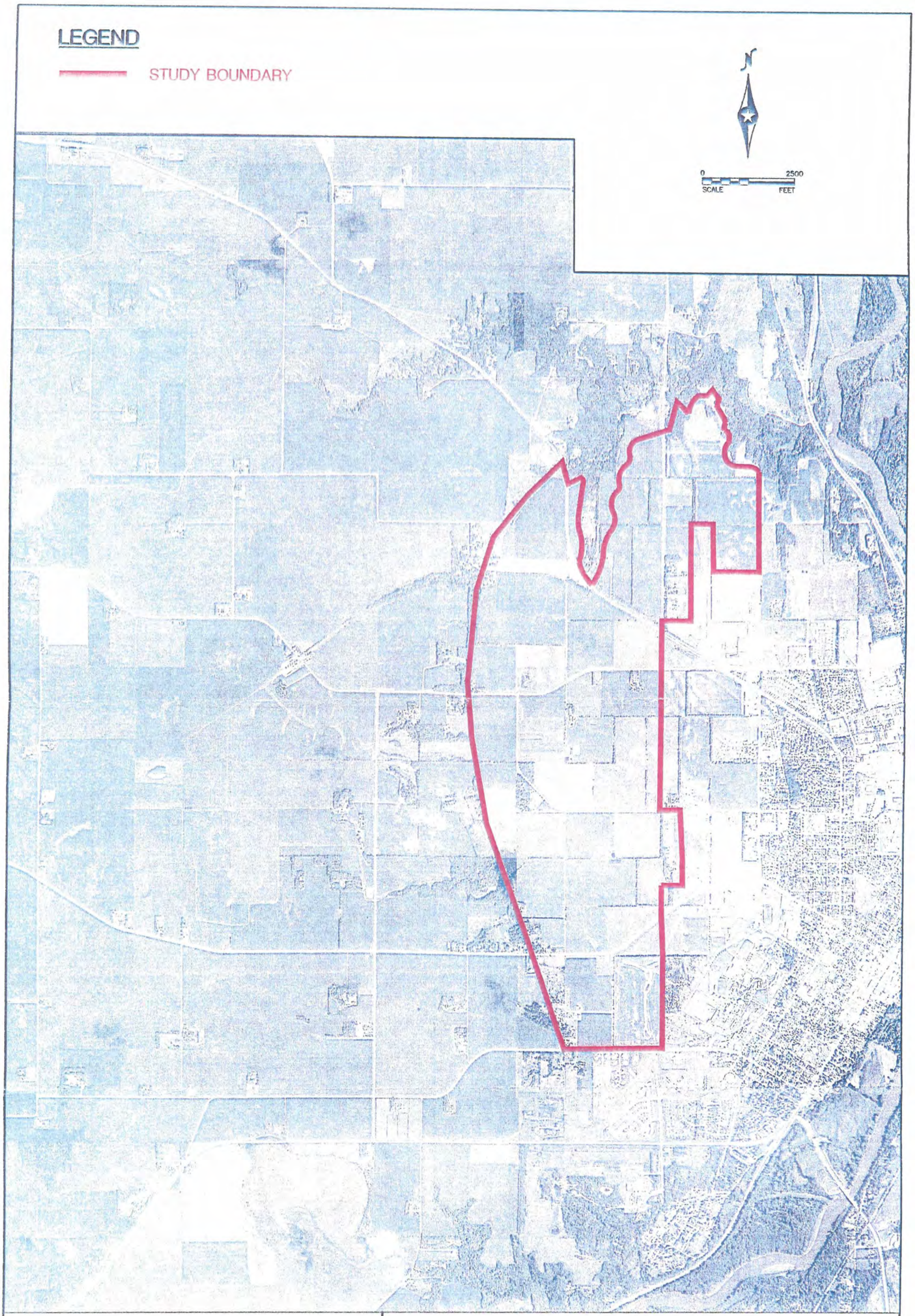
- FEMA Floodways
- Proposed Watersheds
- Growth Limits
- County Boundary
- City Limits

N
W E
S

4,000 0 4,000
Feet

BOLTON & MENK, INC.
Consulting Engineers & Surveyors

Map Document: (H:\STPE\M1436771\Arcview\36771 Fema 11x17.mxd)
9/11/2007 -- 9:10:11 AM

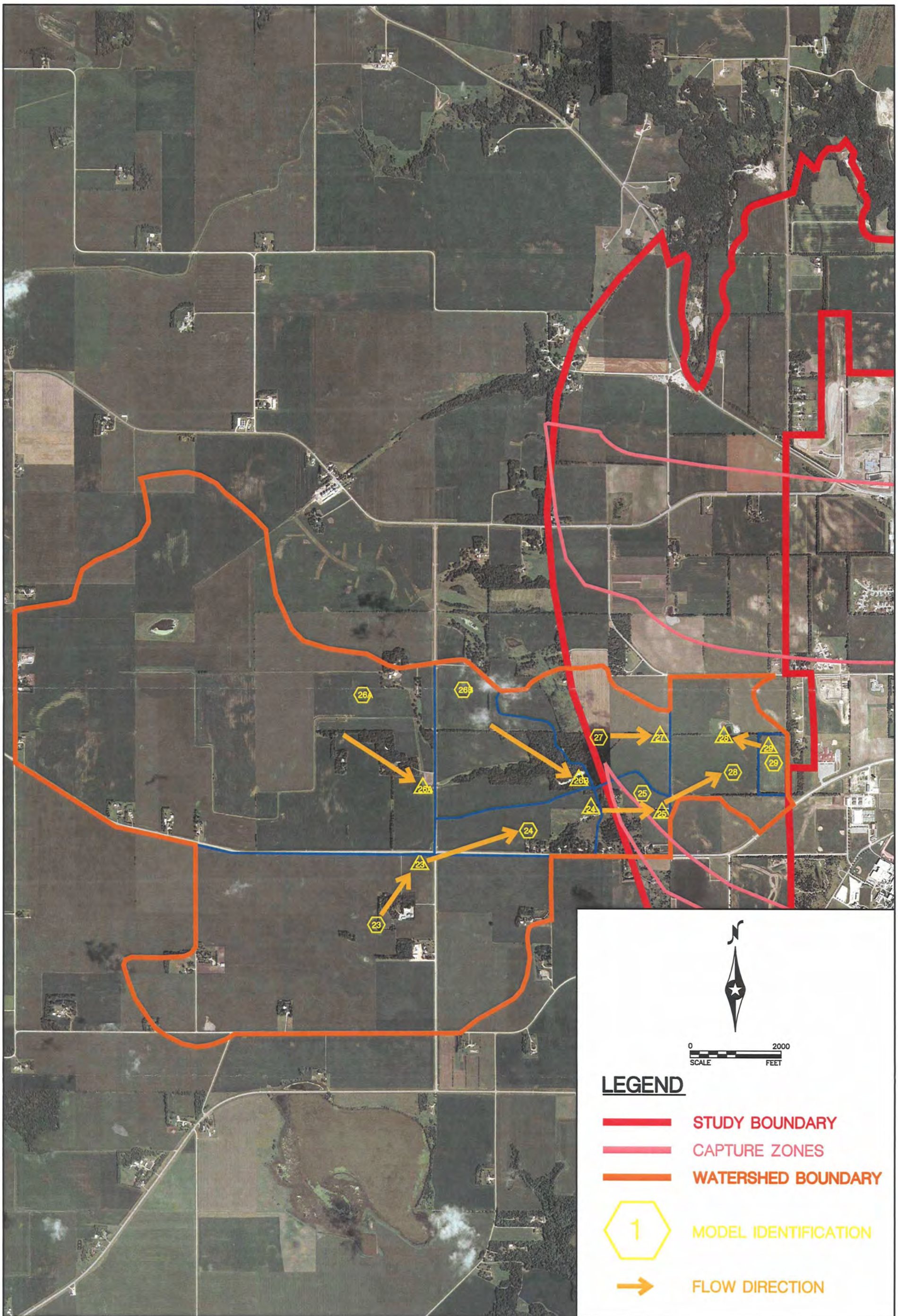


BOLTON & MENK, INC.
Consulting Engineers & Surveyors
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN WILLMAR, MN
BURNSVILLE, MN CHASKA, MN AMES, IA

CITY OF ST. PETER
WESTERN DEVELOPMENT STUDY AREA MAP

AUGUST, 2005 | FIGURE NO. 7

H:\STPE\M1436771\Cad\36771F01.dwg 03-28-2007 1:29 pm



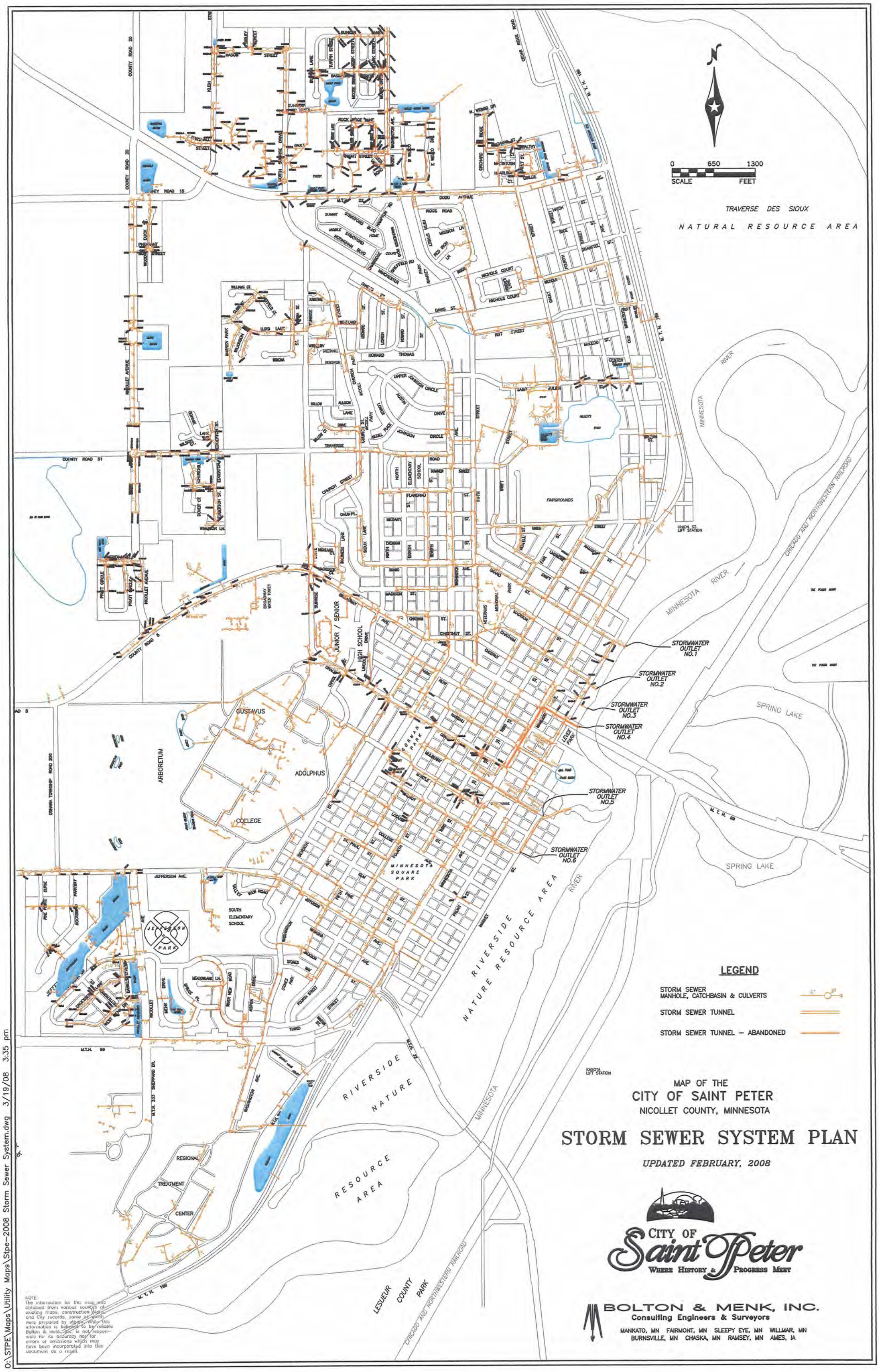
BOLTON & MENK, INC.
Consulting Engineers & Surveyors
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN WILLMAR, MN
BURNSVILLE, MN CHASKA, MN AMES, IA

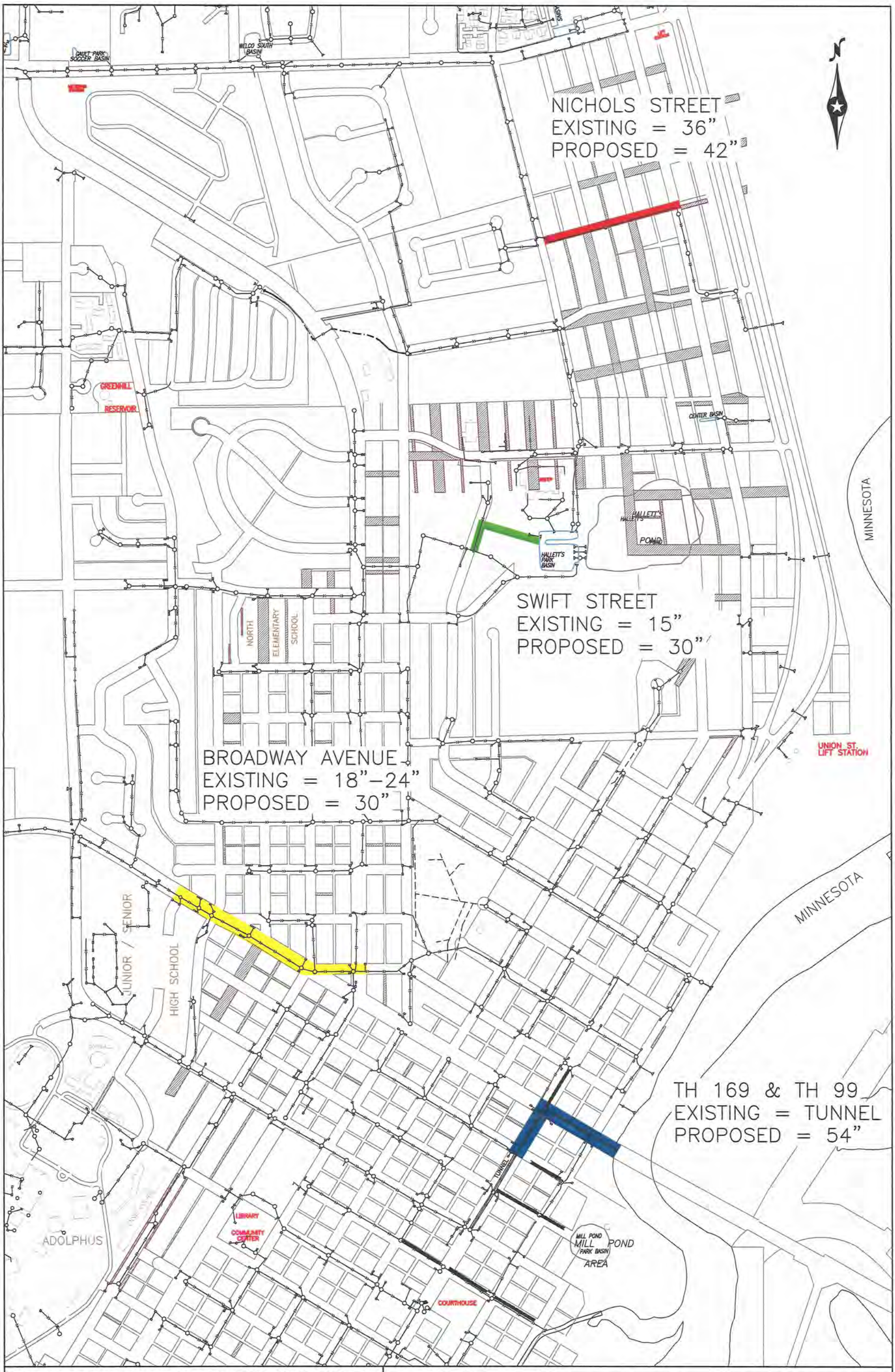
CITY OF ST. PETER
CO. DITCH 51/CO. DITCH 33 WATERSHED MAP

AUGUST, 2005

FIGURE NO. 8

H:\STPE\M1436771\Cad\36771F08.dwg 08-17-2005 3:33 pm


0 650 1300
SCALE FEET
TRAVERSE DES SIOUX
NATURAL RESOURCE AREA
STORMWATER OUTLET NO.1
STORMWATER OUTLET NO.2
STORMWATER OUTLET NO.3
STORMWATER OUTLET NO.4
STORMWATER OUTLET NO.5
STORMWATER OUTLET NO.6
MINNESOTA RIVER
SPRING LAKE
CHICAGO AND NORTHWESTERN RAILROAD
FAIRGROUNDS
GUSTAVUS
ADOLPHUS
COLLEGE
ARBORETUM
JUNIOR / SENIOR HIGH SCHOOL
SOUTH ELEMENTARY SCHOOL
MINNESOTA SQUARE PARK
RIVERSIDE NATURE RESOURCE AREA
RESOURCE AREA
REGIONAL TREATMENT CENTER
LESUEUR COUNTY PARK
LEGEND
STORM SEWER MANHOLE, CATCHBASIN & CULVERTS
STORM SEWER TUNNEL
STORM SEWER TUNNEL – ABANDONED
MAP OF THE
CITY OF SAINT PETER
NICOLLET COUNTY, MINNESOTA
STORM SEWER SYSTEM PLAN
UPDATED FEBRUARY, 2008
CITY OF Saint Peter
WHERE HISTORY & PROGRESS MEET
BOLTON & MENK, INC.
Consulting Engineers & Surveyors
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN WILLMAR, MN
BURNSVILLE, MN CHASKA, MN RAMSEY, MN AMES, IA
NOTE:
The information for this map was obtained from various sources of existing maps, construction plans and City records, some of which were prepared by others. While this information is believed to be reliable Bolton & Menk, Inc. is not responsible for its accuracy nor for errors or omissions which may have been incorporated into this document as a result.
O:\STPE\Maps\Utility Maps\Stpe-2008 Storm Sewer System.dwg 3/19/08 3:35 pm



BOLTON & MENK, INC.
Consulting Engineers & Surveyors

MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN WILLMAR, MN
BURNSVILLE, MN CHASKA, MN RAMSEY, MN AMES, IA

©Bolton & Menk, Inc. 2006, All Rights Reserved

H:\STPE\M1436771\Cad\Proposed Storm Improvements.dwg 3/28/08 4:47 pm

CITY OF SAINT PETER, MINNESOTA
STORMWATER MASTER PLAN

FEBRUARY 2007

FIGURE NO. 10