Nondegradation Load Assessment Report

Prepared for
City of Bloomington

Submitted by
Barr Engineering Company

August 2007

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1.0 Introduction

1.1 MS4 Permit Requirements

The Minnesota Pollution Control Agency (MPCA) revised the General NPDES/SDS Permit MNR040000 (Permit) for the city of Bloomington to Discharge Storm Water Associated with Municipal Separate Storm Sewer Systems (MS4), effective June 1, 2006. Bloomington had previously completed a Storm Water Pollution Prevention Program (SWPPP) to address the six minimum control measures required by the previous permit. This report has been developed to address modifications to the SWPPP for measures that may be necessary to meet the new, applicable requirements of Appendices C and D in the re-issued permit. Appendix C covers discharges to wetlands that are applicable to the city of Bloomington. Appendix D covers the nondegradation requirements for Selected MS4s (30 permittees including the city of Bloomington), including the development of a Loading Assessment and Nondegradation Report. The following sections describe the sections of the Permit that are relevant for the city of Bloomington.

1.1.1 Loading Assessment

Each Selected MS4 must assess the change in stormwater discharge loading for its permitted area using a pollutant loading water quality model that, at minimum, addresses changes in average annual flow volume, total suspended solids (TSS), and total phosphorus (TP). This modeling should be based on two time periods: from 1988 to the present, and from the present to 2020. The Selected MS4s must use a simple model, or another more complex model that they find to be more appropriate, that addresses the parameters of concern. This may include a model that the Selected MS4 has already used. Other assessment methods may be used if they can be shown to be as effective at quantifying the increase in loading as the modeling methods. The models and/or other methods will be used as part of the assessment to develop the Nondegradation Report, to help in selecting appropriate best management practices (BMPs) that address nondegradation, to determine whether additional control measures can reasonably be taken to reduce pollutant loading.

1.1.2 Nondegradation Report

Selected MS4s that have significant new or expanded discharges are required to complete a Nondegradation Report and, upon approval, to incorporate its findings on BMPs that address nondegradation into their SWPPP. The BMPs should address changes in pollutant loadings as far as is reasonable and practical through future development. Additionally, the BMPs shall address, as far as is reasonable and practical, the negative impacts of increased stormwater discharge volumes that cause increased depth and duration of inundation of wetlands having the potential for a significant adverse impact to a designated use of the wetland, or changes in stream morphology that have the potential for a significant adverse impact to a designated use of the streams.

The Nondegradation Report must include consideration of the Loading Assessment, which must include analysis of flow and may include removal of pollutants by BMPs already initiated. For purposes of the Permit, 1988 levels consistently attained means runoff that would have been produced under approximately average rainfall conditions and the land use present in 1988. Local stormwater management plans and other pertinent factors may also be considered. BMPs implemented by other parties may be considered when those BMPs affect the stormwater from the area of the Selected MS4. If the pollutant loadings cannot be reduced to levels consistently attained in 1988, the Nondegradation Report must describe reasonable and practical BMPs that the Selected MS4 plans to incorporate into a modified SWPPP. The Selected MS4 must consider alternatives, explain which alternatives have been studied but rejected and why, and propose alternatives that are reasonable and practical. The Nondegradation Report must give high priority to BMPs that address impacts of future growth, such as ordinances for new development. Where increases in pollutant loading have already occurred due to past development, the Nondegradation Report must consider retrofit and mitigation options (BMPs) that the Selected MS4 determines to be reasonable, practical and appropriate for the community. The Selected MS4 is responsible for developing any site-specific cost/benefit, social, and environmental information that the Selected MS4 wishes to bring to the Agency's attention. The Selected MS4 must incorporate the BMPs into a modified SWPPP and include an implementation schedule that addresses new development and retrofit BMPs it proposes to implement.

1.1.3 Proposed SWPPP Modifications and Submittals to MPCA

Prior to submittal to the MPCA, the proposed SWPPP modifications to address nondegradation will be public noticed at the local level. Each Selected MS4 shall also submit its SWPPP modifications to address nondegradation to the appropriate local water authority (e.g., watershed organizations or county water planning authority) in time to allow for their review and comment. The Nondegradation Report explaining the proposed BMPs and the entire SWPPP must be made available to the public and local water authority upon request.

Selected MS4s must submit their proposed changes to the SWPPP, reports addressing nondegradation for all waters, together with other supporting documents, to the MPCA in accordance with the schedule in Appendix E of the Permit. This submittal must include:

1. The Loading Assessment;
2. The Nondegradation Report;
3. The proposed SWPPP modifications to address nondegradation;
4. The public and local water authority comments on the proposed SWPPP modifications to address nondegradation, with a Record of Decision on the comments; and
5. An application to modify the Permit.

1.1.4 Discharges to Wetlands

The Permit does not authorize physical alterations to wetlands, or other discharge adversely affecting wetlands, if the alteration will have a significant adverse impact to the designated uses of a wetland. Any physical alterations to wetlands that will cause a potential for a significant adverse impact to a designated use must be implemented in accordance with the avoidance, minimization and mitigation requirements of Minn. R. 7050.0186 and other applicable rules.

1.1.5 Discharges Affecting Source Water Protection Areas

BMPs shall be incorporated into the SWPPP to protect any of the following drinking water sources that the MS4 discharge may affect, and a map of these sources shall be included with the SWPPP, if they have been mapped:

1. Wells and source waters for drinking water supply management areas identified as vulnerable under Minn. R. 4720.5205, 4720.5210, and 4720.5330, and
2. Source water protection areas for surface intakes identified in the source water assessments conducted by or for the Minnesota Department of Health under the federal Safe Drinking Water Act.

1.2 Discussion of MPCA Guidance

1.2.1 Responses to Comments

Following the close of the comment period on the draft permit, the MPCA issued responses to comments received through April 15, 2005 on the Permit. To provide further guidance on compliance with the Permit requirements, this section describes responses to comments that pertain to the following subjects:

- Loading Assessment modeling approach and complexity.
- Addressing volume as a parameter of concern for the Loading Assessment and Nondegradation Report.
- Nondegradation requirements for Wetlands.
- Nondegradation requirements for Special Waters.

1.2.1.1 Modeling Approach and Complexity

In response to several comments regarding the modeling approach and complexity required for the Loading Assessment described in the Permit, the MPCA stated that the Loading Assessment should include changes to pollutant loadings associated with changes due to past land use changes and changes due to anticipated land use changes. The Loading Assessment is intended to be used as a planning tool to compare 1988 levels to present and present to 2020 levels of discharge. It is to be presented as comparative results (increase), not absolute (accurate) flow, TSS, and TP discharge levels from the MS4. It is acceptable for MS4s to do more extensive modeling for design of BMPs, but it should be explained.

The Permit does not, however, specifically require that BMPs be factored into the Loading Assessment, but the MPCA clearly states that BMP analysis could be provided if any Selected MS4 so desires. The assessment can include changes due to BMPs that have already been implemented, if increase in the loading since 1988 is explicitly stated, as well as changes due to BMPs that are planned to be implemented and written into the MS4's ordinances or other regulatory mechanisms.

MPCA further states that the Loading Assessment was developed after considerable discussion, including discussion with consultants, cities, and the League of Minnesota Cities. It was determined that to limit costs the nature of the assessment must be limited. The MPCA chose not to include treatment options in this requirement since the level of modeling must be significantly increased to model treatment. Many communities will not be conducting other modeling, therefore this requirement will be a cost that needs careful distinction between what is desirable and what is required. The MPCA chose a level that will prevent undue burden while still developing useful information.

The Loading Assessment is comparable to an influent analysis, while the Nondegradation Report addresses the actual discharges of stormwater to receiving water. The permittees are allowed to show reduction in discharge or to make other arguments they believe are appropriate in the development of the Nondegradation Report. A detailed Loading Assessment can support the Nondegradation Report.

> *Under the provisions of Minn. R. 7050.0185, subp. 4, the MPCA must "determine whether additional control measures beyond those required by subpart 3 can reasonably be taken to minimize the impact of the discharge on the receiving water."*

The MPCA does not have absolute numeric or other criteria that it will use in making this determination for each of the Selected MS4s. The criterion of "reasonableness" requires flexibility and site-specific determinations. Reasonableness determinations will therefore be made on a case-by-case basis. Site-specific variations in situation, funding, population, and receiving water will be as critical to the determination of reasonableness as a specific increase in loading. Additionally, the MPCA must note that the required analysis and documentation for the Nondegradation Report are relative, not absolute, in nature. For example, the Loading Assessments required by the Permit are net changes; we do not request the actual pollutant loading, just estimates of the relative quantity of the change.

1.2.1.2 Average Annual Flow Volume

In response to several comments regarding the requirement for addressing volume as a parameter of concern for the Loading Assessment and Nondegradation Report described in the Permit, the MPCA stated that permit and guidance were revised to include more specifics on how flow volume will be addressed in BMPs and the Nondegradation Report. The responses were qualified by first stating that when an MS4 develops a Nondegradation Report, site-specific objections, costs and other considerations can be raised, which the MPCA must consider in its determinations. Reasonable measures, not any and all measures, must be installed. For this Permit, the reasonableness of volume control policy is not applicable for all MS4s, but is determined on an individual, site-specific basis. In some situations the problems created by increased flow volume can be reduced and minimized by effective implementation of appropriate BMPs based on site-specific conditions.

The MPCA asserts that based on the following statutory definition (**Minn. Stat. § 115.01 Definitions** *Subd. 13.* ***Pollution of water, water pollution, pollute the water.***) and actual environmental impacts, volume may qualify as water pollution under many specific conditions:

> *"Pollution of water," "water pollution," or "pollute the water" means: (a) the discharge of any pollutant into any waters of the state or the contamination of any waters of the state so as to create a nuisance or render such waters unclean, or noxious, or impure so as to be actually or potentially harmful or detrimental or injurious to public health, safety or welfare, to domestic, agricultural, commercial, industrial, recreational or other legitimate uses, or to livestock, animals, birds, fish or other aquatic life; or (b) the alteration made or induced by human activity of the chemical, physical, biological, or radiological integrity of waters of the state.*

MPCA staff looked at the rules that are applicable to nondegradation (Minn. R. 7050.0185) and studied the concept of increased loading of one or more pollutants as used in the rule. They determined that the rule directs the MPCA to consider the adverse effects of increased flow volume, and where effects are adverse, to consider flow volume as a pollutant. It is not volume per se that was asked to be addressed but the change in volume related to MS4 development. Additionally, it is well known that increases in flow can have a variety of negative environmental impacts. A discussion of the reasoning for the inclusion of volume of stormwater as a pollutant was provided in excerpts from Chapter 11 of the *Minnesota 2001-2005 Nonpoint Source Management Program Plan*. These excerpts are summarized below:

- Hydromodification, which involves changes in flow patterns in natural waterways such as rivers or streams and wetlands, is the second leading cause of impairment of fresh waters. Removal of perennial vegetation led to a decrease in infiltration and an increase in the volume of runoff. Exposing soils to wind and water increased sediment loads carried by runoff. Impervious surfaces and artificial drainage systems increased the volume of runoff and accelerated the rate at which water was removed from the landscape. Impervious surfaces in urban areas also transported runoff more rapidly and in greater volumes than before development.
- Minn. Stat. § 155.01, subd. 13 (b) defines pollution of waters as “the alteration made or induced by human activity of the chemical, physical, biological, or radiological integrity of waters of the state”. The basis for this statute is that human activity, such as hydromodification, affects these waters in many adverse ways. Under natural conditions and at bank-full capacity, studies have shown that streams can handle a flow approximately equal to the 1.5- to 2-year frequency peak discharge within their banks (Rosgen, 1994; Leopold *et al.*, 1964). After urbanization, increased runoff can cause bank-full flow to be exceeded several times each year. In addition to increased flooding, this condition causes previously

stable channels to erode and widen. Much of the eroded material becomes bed load and can smother bottom-dwelling organisms.

- In this process, stream habitat diversity is damaged or lost. Water that was once slowed by bends, pools, and woody debris in the water column moves faster and with greater volume cutting into the bed and eroding the banks. This faster flowing water carries with it an increased sediment load, some of which is deposited in the downstream reaches. Many fish and invertebrate species cannot use substrates that are laden with excessive silt for reproduction, feeding, or cover. Riffles and pools become scarce or absent as the stream is converted from riffle, run, pool sequences to long runs or pipes. Not only is habitat diversity affected but the stream hydrology becomes inherently less stable. As water leaves the system faster, the natural hydrologic timing is altered. The overall effect is an increase in the intensity of the high flows and decreased duration of low flow events. If the water is stored to prevent increased peak flows, then the flow duration is extended. Streams in which the surrounding vegetation has been removed or altered are usually compromised by an increase in the amount of silt-laden runoff. Also, water temperatures within the stream may rise as the overhead canopy is removed exposing the stream to full sunlight.
- Urbanization also changes the extent and duration of inundation in wetlands, which can modify the established wetland vegetation. Measures to control discharges to wetlands must control the peaks and volume of flow to wetlands, if they are to be protected. This also means that reduced surface and ground water flow caused by diversion to storm sewers is also an area of concern, especially for sensitive wetlands.
- Urbanizing areas increase runoff from small events in greater proportion than large events. This is important because, in Minnesota, more than 90% of the precipitation events are less than 1.0 inch. These rainfall events also account for approximately 65% of the cumulative runoff quantity in urban areas and proportionately large amounts of the pollutant loading associated with these rainfall events (Pitt, 1998). While the significance of large flood events should not be underestimated, the smaller flows with an approximately nine month to two-year return period frequency, are probably as important or more important to overall water quality. These flows can be very erosive and can be the major source of increased pollutant loading. Pollutant loading is more closely associated with total runoff volume than with peak runoff rates. Utilizing methods to maintain volumes and peaks closer to those that originally shaped the channel can reduce the channel reshaping process in a watershed. Examples of appropriate management techniques are the volume reduction that results from the use of swales instead of curb and gutter, reduced impervious surfaces or infiltration structures. Wetland and upland vegetation can affect or be significantly affected by hydrologic changes. For example, drainage can obviously change the vegetation at a site, but increased water that drains from a project area into an off-site drainage basin can impact trees and other vegetation, including wetland vegetation. In such cases, water itself is the damaging agent even if it is clean. The increase in water level, both surface and subsurface, can result in the death of roots. Roots require oxygen from the air, and saturated soils create an anaerobic condition that will eventually kill the roots. A case in point is a tamarack swamp that receives

water from several developments. As water levels increase through the swamp, the increased flow depth results in the death of many of the tamarack trees, even though they are tolerant of wet conditions. In Minnesota, we have several tree species that tolerate short periods of flooding, but we should be encouraging diversity and be mindful of sensitive areas downstream. Likewise vegetation in upland areas can change the infiltration capacity or evapotranspiration capacity of a watershed. By using native plantings that have denser canopies and/or deeper root networks the storage capacity of the upland areas are significantly increased reducing run-off volumes, especially in the smaller storms.

Addressing average annual flow volume in the Nondegradation Report may show that the modeling effort indicates a significant increase in flow from 1988. This is an indication to the MPCA that your loading of one or more pollutants has increased, and the Nondegradation Report will need to address what is reasonable and practical to get the flow back to 1988 levels. Alternatively, you may wish to demonstrate that your flow increase has not resulted in water quality degradation and therefore does not need to be addressed. The MPCA has found flow volume to be related to significant degradation, therefore claims to the contrary will be carefully scrutinized. To address flow volume some of the options include consideration of BMPs for flows existing before 1988, BMPs for flows developed since 1988, and limitations on future flows. The MPCA notes that the 1.0-inch event is about the 90^{th} percentile event for 24-hour storm on an average annual basis, and that this represents 67 percent of the cumulative volume of precipitation. This means that runoff reduction often can be related to BMPs that reduce flow from events smaller than 1.0 inches in depth. If properly designed the BMPs could also treat some percentage of flow related to larger events without loss of effectiveness for reasons such as re-suspension. Depending on development patterns, zoning, soils, water table, and other factors, many communities may be able to meet the nondegradation goal of returning the flow to pre-1988 levels. Treatment BMPs that reduce flow include infiltration basins, trenches, bio-retention, enhanced swales, evapo-transpiration, disconnection of impervious surfaces, reduced imperviousness, filterstrips, and variations and combinations of these and other BMPs.

In some instances, a community may not be able to reduce the flows to 1988 levels. If so, the basis for this conclusion should be explained. For example the current problems may be related to past development patterns, past or present zoning, soils, water table, and other factors that may be pertinent. In establishing the case, any cost information that is available, especially site-specific information, should be provided. The MPCA must consider the potential impact of the discharge on the receiving water and cumulative impacts of multiple discharges. While MS4s are not required to develop information on this aspect of the analysis, they may find it beneficial to supply information that supports their position.

1.2.1.3 Wetlands

In response to several comments and questions regarding the designated uses and nondegradation requirements for wetlands in the Permit, the MPCA clarified that the terms “designated uses” of the permit relate to MPCA rules and requirements and are set by MPCA through notice and comment rulemaking under state law and any changes to designated uses would have to be made through notice and comment rulemaking. The MPCA has included, in guidance, the pertinent parts of those rules to help describe the context of these terms. The permit and rules are under MPCA authority and the permit implements the rules.

Under this NPDES permit, the permittee is required to comply with conditions that are established to protect the water quality standards of wetlands as listed in Minn. R. 7050. One of the purposes of the NPDES permit is to establish requirements or conditions that the permittee must operate under in order to assure compliance with the water quality standards. While the Wetland Conservation Act (WCA) for local government units (LGUs) does regulate the activities that cause draining, filling and some excavation to certain wetlands, the WCA does allow for ten categories of exemptions to these requirements, does not have jurisdiction over all wetlands that are considered waters of the state, and does allow the LGU to vary wetland sequencing requirements if a local wetland plan is developed. The permittee must recognize the nondegradation standards for wetlands and the required mitigation sequence of Minn. R. 7050.0186 to mitigate for degradation of wetlands, apply to all wetlands that are considered waters of the state. The MPCA water quality standards provide more comprehensive water quality protection for all wetlands in Minnesota than is required of the LGU to implement under WCA. Application of the WCA by the LGU will provide comparable wetland protection to wetland impacts in many to most cases and the WCA determination would also satisfy the Minn. R. 7050.0186 determination. However, in the few projects where the requirements of the WCA are not as comprehensive as MPCA water quality standards, then the requirements of the NPDES permit will require an LGU to make a determination that will also satisfy Minn. R. 7050.0186. Considering those exceptions, allowing the permittee to only reference the WCA requirements for wetland protection would not be adequate to assure compliance with the NPDES permit for all cases.

The MPCA does not anticipate that it will review and make a separate determination (a duplicate effort) regarding the evaluation of the sequence mitigation requirements when that determination has been conducted by the permittee. MPCA enforcement of the NPDES permit requirements of Minn. R. 7050.0186 regarding wetland impacts associated with a component of the stormwater system should only be necessary if the LGU does not apply the permit requirements to their determinations. A separate determination by the permittee under the NPDES requirements that a wetland alteration activity satisfy Minn. R. 7050.0186 sequencing is only initiated when the WCA requirements exempt or consider the wetland or the activity nonjurisdictional or if the local wetland plan designation of the wetland does not require full sequence evaluation for impacts of a wetland alteration. It should be noted the WCA also recognizes that there may be other agencies or programs that have regulatory jurisdiction regarding wetland impacting activities. The WCA rules contained in Minn. R. 8420.0105, item B state that WCA rule is in addition to other regulations including those of the United States Army Corps of Engineers, United States Department of Agriculture, Minnesota state agencies, watershed districts, and local governments. Also, specifically the WCA requires that the person conducting an activity in a wetland under an exemption ensure the activity is conducted in compliance with all other applicable federal, state, and local requirements (see Minn. R. 8420.0115).

1.2.1.4 Special Waters Considerations

The evaluation for special waters is contained in Appendix C and the evaluation of other waters is contained in Appendix D of the Permit**.** The test for Outstanding Resource Value Waters (ORVWs) is that feasible and prudent alternatives must be used. The test for other waters is reasonable and practical BMPs to be implemented. These analyses have a different criteria and standard of judgment with a long history of precedent that must be considered. The exact format of the evaluation is not described, but this distinction should be kept in mind as evaluations are planned; the MPCA will also address this in guidance.

1.2.2 Guidance Manual for MS4s

The purpose of this draft report (MPCA, 2006) is to provide guidance for MS4s to comply with the Permit requirements, including the nondegradation policy. Nondegradation is achieved if 1988 levels of flow and pollutants can be maintained. If it is not feasible for a Selected MS4 to demonstrate that it has achieved 1988 levels of flow and pollutants, the MPCA must find if additional measures (BMPs) are “reasonable and practical” (Minn. R. 7050.0185). These measures are in addition to the minimum measures of the Permit. The MPCA will review required submittals such as the loading assessments, and other information such as water plans, population growth data and development plans to determine appropriate measures. During the review, the MPCA will consider what additional control measures would be reasonable to reduce the impact on the receiving water in light of the relative importance of the economic and social impacts. The objective is to allow the MPCA to make an informed, public decision that reasonably balances additional BMP costs against the adverse impact on the environment posed by the new or expanded discharge.

Under Minn. R. 7050.0185, the MPCA is free to consider whatever information is available while the MS4 has the opportunity, albeit the burden, to demonstrate to the MPCA why expanded discharges are necessary to accommodate important economic or social development and what treatment is reasonable and practical. This burden is appropriately placed upon the MS4 since the discharger is in the position to know the relative costs and benefits of the proposed actions. The MPCA must consider the economic and social development of the community; this means the houses, jobs, taxes, recreational opportunities, and other impacts on the public at large that will result from development. Therefore, the MS4 should point out to the MPCA how and why the public has benefited from the development that created the new or expanded significant discharge, and why the public costs associated with the proposed BMPs are reasonable.

1.2.2.1 Loading Assessment

Loading Assessment modeling must be conducted for the entire MS4, not for individual watersheds or areas unless the MS4 will model these for their own interests. Some communities may wish to use models that address peak flows, or site-specific increased loading. While this makes some sense in terms of overall plan development, it is not required by the Permit; it is an option that the MPCA encourages but does not require. Modeling examples of methods that may be acceptable include but are not limited to the following:

- The Simple Method
- PONDNET
- SLAMM
- P8 Urban Catchment Model
- XP-SWMM

Modeling or assessment methods will be used to estimate increases in loading based on two time periods, 1988 to current development and current to projected (2020 or ultimate, whichever is first) development. Modeling may also be used to help in the decision making process of determining appropriate BMPs to implement to bring those discharges back to 1988 levels, or maintaining those levels into the future if they are not already exceeded. Use of the models in this manner is not required but is encouraged.

The MPCA expects that the model will produce relative values. For this effort, the MPCA is more concerned with the average annual increases than about specific event increases. It is not as important for this particular requirement of the Permit to get the actual loads correct as it is to model consistently, showing the relative change in loads rather than the actual loads. Also note, the Permit does not require the development of annual rainfall tables or calculation of hydrographs and/or store and release calculation.

All models need to be adapted for use in the specific circumstances of each MS4. Gather available information on land use/imperviousness and other pertinent facts from conditions that existed or will exist from 1988 to 2020. Selection of the appropriate method is often dependant on the readily available or collectable data as well as on the outputs or results required. Since the MPCA's goal is to show relative increases or decreases in loading, a simple method can be used rather than a more complex model. MS4s may still want to use models that are more complex for your own purposes. The Permit requirement is to consistently model between time periods so that the result can be objectively compared. An MS4 may want to select a model that can model BMPs to show removal from various practices that you may have installed or that you may want to install. This is not necessary for compliance with the Permit, but makes sense when it comes to justifying your Nondegradation Report. The model does not need to calculate design features such as hydrographs, but can show removal rates based on design criteria which can be just as useful for planning purposes. Design calculations may need to be run before implementation but often these can be run on a much smaller scale. Runoff and loading factors should be developed based on available information. BMP modeling, while optional, can be used in Nondegradation Report development and could consider BMP measures taken since 1988 to present and proposed BMP measures for present to 2020 or ultimate development conditions. The MPCA has examples of how the "simple method" can be applied to every community in the metro area.

The modeler must provide an explanation of assumptions and calculation methods. The inputs will need to be listed and the values shown. All values will need to be explicitly stated. The modeler must also provide an explanation of assumptions and calculation used in the model, whether they are inherent to the model or assigned by the user. The exact algorithms must be shown. The results of the model must be examined to demonstrate reasonable results from the model runs. Outlier values that do not seem in line with reasonable results must be explained or discussed in enough detail to help the MPCA decide the significance of the results.

1.2.2.2 Nondegradation Report

Based on the modeling, local stormwater management plans, and other pertinent factors, permittees must develop a Nondegradation Report to get new or expanded discharges back to 1988 levels. Where increases in runoff or pollutant loading has occurred due to new or expanded discharges from stormwater runoff, the Nondegradation Report must include retrofit and mitigation options (BMPs) that the permittee has determined to be reasonable and practical to be included in the permittee's SWPPP.

Each Selected MS4 will submit its SWPPP, including BMPs proposed to be included, to the appropriate water authority, watershed organizations or county water planning authority, for their review and comment. The Nondegradation Report, as the basis for the SWPPP, will also be available to the water authority. The intention is that these groups will work together to create a Nondegradation Report that is acceptable to the public and other affected parties. As required in the Permit, the proposed SWPPP, as based on the Nondegradation Report, will be public noticed at the local level for public participation.

The Nondegradation Report explains the decisions made by the permittee regarding the incorporation of BMPs into their SWPPP to meet the nondegradation requirements. The purpose of the Nondegradation Report is "to allow the MPCA to make an informed, public decision that reasonably balances additional BMP costs against the adverse impact on the environment posed by the new or expanded discharge" (Minn. R. 7050.0185). The Nondegradation Report is an explanation of the nondegradation implementation plan proposed to be adopted by the MS4 community, explaining why some measures have been rejected and why the measures taken are reasonable and practicable given the circumstances for the community they serve.

To help the MPCA determine if discharge loads should be allowed to increase, Selected MS4s must submit pertinent information that demonstrates how potentially adverse water quality impacts from a new or expanded discharge have been addressed. The goal of the Nondegradation Report is to demonstrate what additional control measures would be reasonable to reduce the impact on the receiving water in light of the relative importance of the environmental, economic and social impacts. The Report should explain all aspects of the proposed Nondegradation Report that the permittee intends to implement. It is understood that the SWPPP itself may have already addressed some specific aspects of nondegradation, and it may be beneficial to note these in the Nondegradation Report. The Nondegradation Report should also address the alternatives that have been studied but rejected. It is not necessary to include all rejected alternatives, but it will be very important to establish the general thinking regarding why some option have been rejected and the basis for such rejection.

2.0 Loading Assessment

2.1 Land Use/Land Cover Compilation

An important parameter for estimating historical TP and TSS loading and stormwater runoff volumes is an accurate determination of land use for the city of Bloomington for the years of interest. These data are available in Geographic Information System (GIS) data format for various years in the Twin City Metropolitan area, but due to land use changes in Bloomington, the land use data available does not reflect the development status of the city during all of the years specifically analyzed for this study.

To meet the Permit requirements, it will be necessary to estimate average annual runoff volumes, TP and TSS loadings for 1988 (the base year), 2007 (existing conditions), and 2020. Bloomington was able to provide land use information for 1989, and this year was assumed to be the base year. To get a consistent comparison of land use for all three years using the data that were available, a generalized land use classification system was developed. The land use classes used are shown in Table 2-1.

Table 2-1 Land Use Classes

Class Name	Description
Agriculture	Hay/Pasture
Commercial	Commercial areas and corporate campuses
Developed Park	Park areas including ball diamonds, tennis courts, golf courses, and other sport areas
Forest	Forested areas within conservation or undeveloped areas
Grassland	Non forested open space, not including developed parks
High Density Residential	Duplexes, townhouses, apartments, condominiums, etc
Highway	Controlled and limited access highways
Industrial	Manufacturing, utilities, etc
Institutional	Schools, Churches, City buildings
Low Density Residential	Single family homes with up to 5 units per acre
Medium Density Residential	Single family homes with between 5 and 10 units per acre
Water	Wetlands, Lakes, Detentions Ponds

Land use for the city of Bloomington (excluding County and State right-of-ways) for the 1989, 2007 and 2020 are summarized in Table 2-2

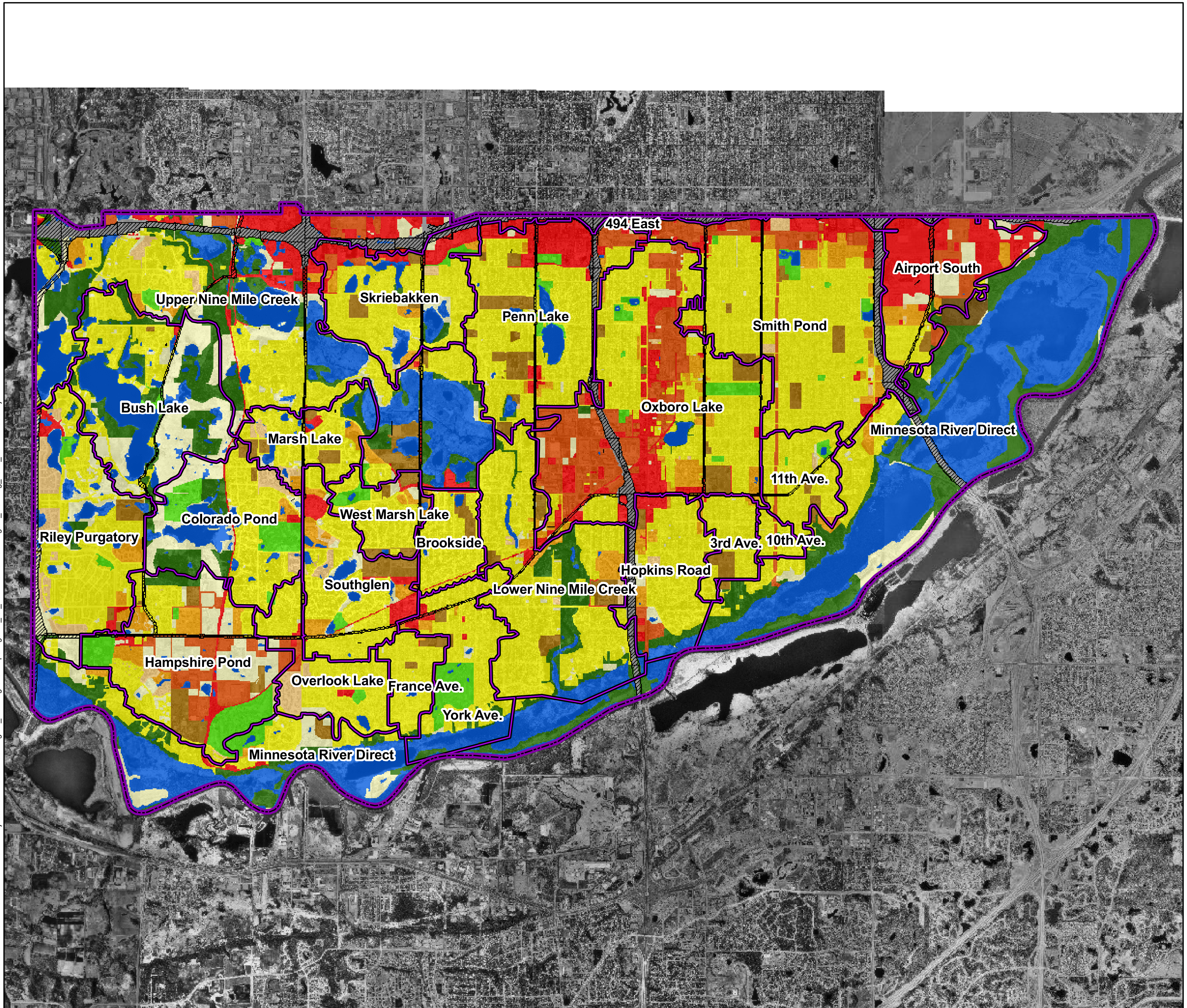
Table 2-2 Bloomington Land Use/Land Cover (LULC) for 1989, 2007 and 2020

	Area (acres) by year		
LULC	**1989**	**2007**	**2020**
Agriculture	58	57	0
Commercial	1634	1757	1850
Developed Park	660	778	770
Forest	2109	2292	2251
Grassland	1685	763	637
High Density Residential	855	922	1054
Highway	53	76	76
Industrial	1184	1285	1398
Institutional	831	895	855
Low Density Residential	9513	9646	9409
Medium Density Residential	394	489	671
Water	4495	4512	4500
Total	**23,470**	**23,470**	**23,470**
Area Imperviousness[1]	***6,400***	***6,583***	***6,760***
Percent Imperviousness[1]	***33.8%***	***34.7%***	***35.6%***

1 – Area of Impervious does not include the surface area of the water/wetland, which was assumed to be 100 percent impervious.

Sources used to derive the data for 1989 and 2007 include the 1989 City of Bloomington Geocoded Land Use Points in GIS, Hennepin County Parcel Data, USGS National Land Cover Database (NLCD, 1992), the City of Bloomington 2007 GIS Land Use Layer, the National Wetlands Inventory (NWI) GIS layer, the City of Bloomington Pond GIS layer, and 1991 and 2006 aerial photography. The city of Bloomington also provided the 2020 land use from data in the City of Bloomington's Comprehensive Plan combined with information from the City's Planning and Zoning departments Forecast Tracker program. Additionally, 1992 and 2005 Met Council Land Use data was also used to identify areas of Developed Park as well as Institutional land uses.

Figures 2-1, 2-2 and 2-3 show the land use coverages developed for 1989 (a surrogate for 1988), 2007 and 2020, respectively.



Legend

- City Boundary
- Drainage Basins
- County & State Right-of-Way

Land Use

- Agriculture
- Commercial
- Developed Park
- Forest
- Grassland
- High Density Residential
- Highway
- Industrial
- Institutional
- Low Density Residential
- Medium Density Residential
- Water

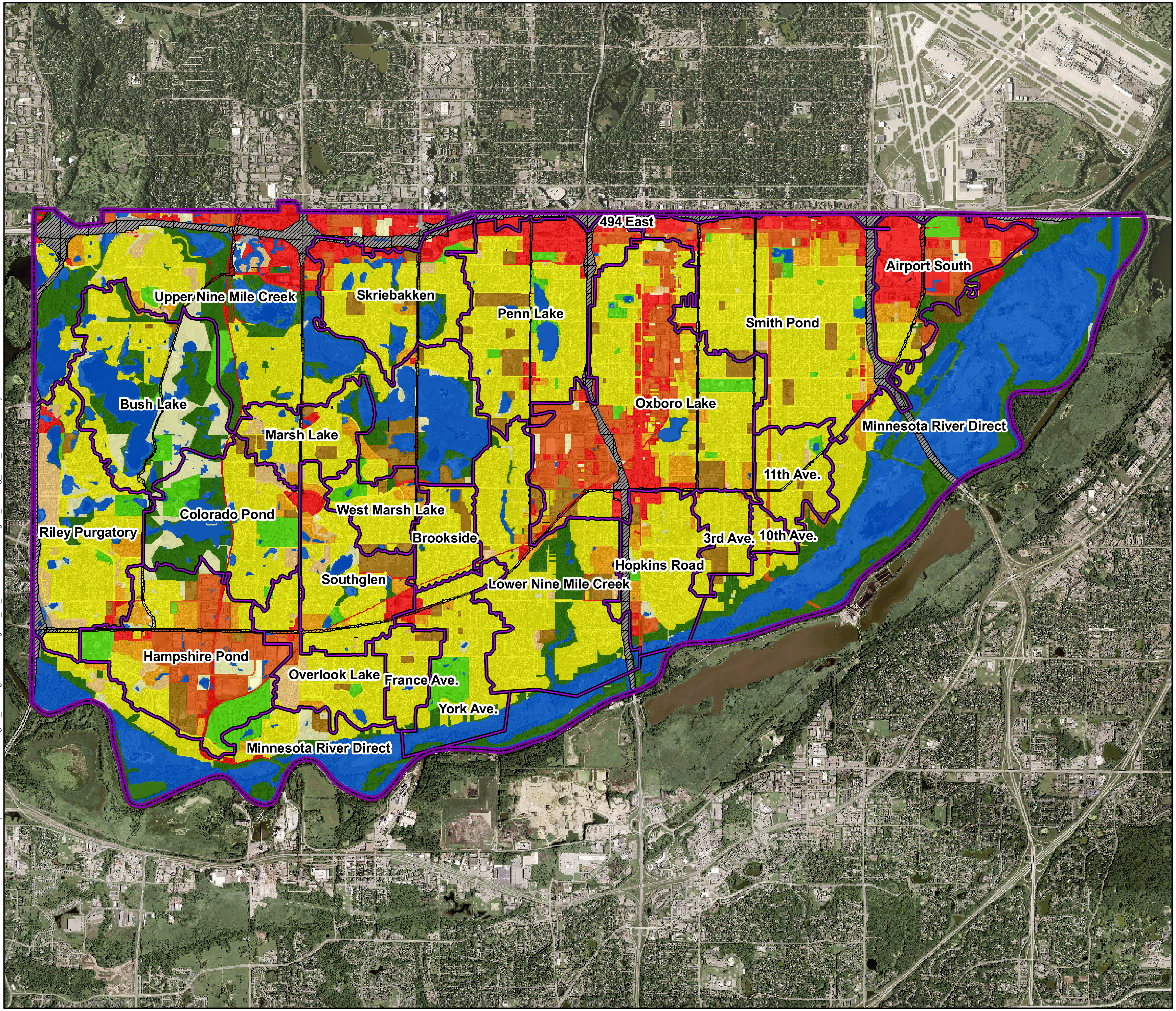
N

Feet

4,500 0 4,500

Figure 2-1
1989 Land Use

Bloomington Nondegradation Study
City of Bloomington, MN



Legend

- City Boundary
- Drainage Basins
- County & State Right-of-Way

Land Use

- Agriculture
- Commercial
- Developed Park
- Forest
- Grassland
- High Density Residential
- Highway
- Industrial
- Institutional
- Low Density Residential
- Medium Density Residential
- Water

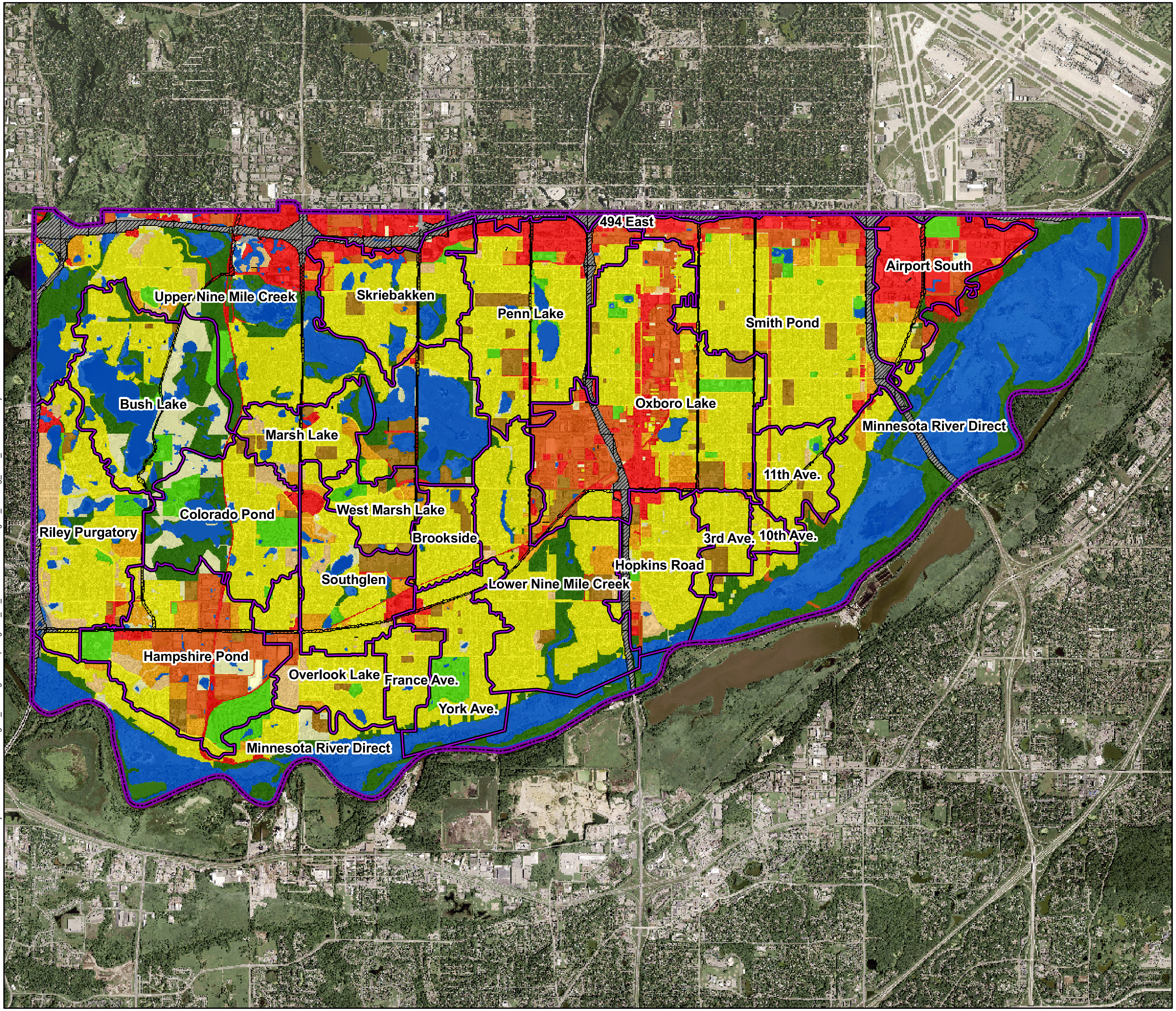
N

Feet

4,500 0 4,500

Figure 2-2
2007 Land Use

Bloomington Nondegradation Study
City of Bloomington, MN



Legend

- City Boundary
- Drainage Basins
- County & State Right-of-Way

Land Use

- Agriculture
- Commercial
- Developed Park
- Forest
- Grassland
- High Density Residential
- Highway
- Industrial
- Institutional
- Low Density Residential
- Medium Density Residential
- Water

N

Feet

4,500 0 4,500

Figure 2-3
2020 Land Use

Bloomington Nondegradation Study
City of Bloomington, MN

Barr Footer: Date: 7/1/2007 12:26:28 PM File: I:\Projects\23\27\G75\Bloomington_NonDeg\GIS\Maps\Figures_for_TechMemo\Bloomington_NonDeg_2020_LU.mxd User: jak2

2.2 Watershed Imperviousness Determination

Another parameter that is required to develop estimates of average annual runoff volume, TP and TSS loadings is imperviousness. Imperviousness was estimated using satellite-derived (LandSat) data developed by the University of Minnesota for the MPCA. These data are available for the entire Twin Cities Metropolitan areas for the years 1986, 1991, 1998, 2000, and 2002.

Once the Bloomington land use for 1989 and 2007 was reclassified with a consistent land use system, the percent imperviousness by land use was determined by overlaying the Bloomington 1989 land use with the 1991 LandSat-derived estimates of imperviousness for the Twin Cities metro area as well as a comparison of the 2007 land use data with the 2002 LandSat derived estimates of imperviousness.

With the exception of a few small areas, much of the city of Bloomington was completely developed by 1989, and it was assumed that the average percent impervious by land use for 1989 and 2007 would be applicable for the load calculations for all years of analysis. Additionally, a comparison of the 2000 impervious percentage coverage for Bloomington with the 2000 Met Council Land Use data resulted in a comparable percent impervious for similar land use classifications as the analysis performed on the 1989/1991 and 2007/2002 data.

The average imperviousness values for each land use type, based on the 1989 and 2007 analyses, are summarized in Table 2-3.

Table 2-3 Average Imperviousness and Runoff Coefficient by Land Use Type for Bloomington based on the 1989/1991 and 2007/2002 Land Use/Imperviousness Data

Land Use Class	Percent Imperviousness	Runoff Coefficient (RC)
Agriculture	9.4%	0.11
Commercial	75.2%	0.73
Developed Park	17.9%	0.21
Forest	4.2%	0.03
Grassland	18.1%	0.03
High Density Residential	50.3%	0.50
Highway	58.3%	0.57
Industrial	74.8%	0.72
Institutional	46.5%	0.47
Low Density Residential	29.0%	0.31
Medium Density Residential	40.7%	0.42

2.2.1 2020 Imperviousness Determinations

To estimate the acres of imperviousness for 2020, the average percent impervious for each land use class (see Table 2-3) was applied to the planned 2020 land use layer. The estimated imperviousness for Bloomington's future land use is summarized in Table 2-2.

2.2.2 Summary of Land Use/Land Cover by Watershed

ArcMap GIS was used to intersect the 24 drainage basin divides, provided by the city of Bloomington, with the land use and imperviousness data for 1989, 2007, and 2020. The city was further divided based on the jurisdictional extent of the MS4 permit. Therefore, Hennepin County and Mn/DOT right-of-way were removed from the analysis area. The data were summarized by land use for each basin to develop inputs for estimating runoff volume, TP and TSS loading. The land use/land cover characteristics are summarized for each of the 24 drainage basins (excluding County and State right-of-ways) in Table 2-4.

Table 2-4   Bloomington Land Use by Basin for 1989, 2007 and 2020

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Lower Minnesota River Watershed District	**10th Ave.**	Agriculture	0.0	0.0	0.0
		Commercial	0.0	0.0	0.0
		Developed Park	1.5	0.0	0.0
		Forest	0.0	0.0	0.0
		Grassland	0.2	1.5	1.5
		High Density Residential	0.0	0.0	0.0
		Highway	0.0	0.0	0.0
		Industrial	6.1	6.1	6.1
		Institutional	0.0	0.0	0.0
		Low Density Residential	80.2	79.7	79.7
		Medium Density Residential	0.0	0.7	0.7
		Water	0.0	0.0	0.0
		TOTAL	88.0	88.0	88.0
		Area Impervious[1]	28.1	28.2	28.2
		Percent Impervious[2]	31.9	32.1	32.1
	3rd Ave.	Agriculture	0.0	0.0	0.0
		Commercial	1.5	1.5	1.5
		Developed Park	2.4	2.4	2.4
		Forest	0.0	0.0	0.0
		Grassland	0.9	0.4	0.4
		High Density Residential	5.4	5.4	5.4
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	29.2	29.2	29.2
		Low Density Residential	193.0	193.5	193.5
		Medium Density Residential	0.0	0.0	0.0
		Water	0.0	0.0	0.0
		TOTAL	232.3	232.3	232.3
		Area Impervious[1]	74.0	74.0	74.0
		Percent Impervious[2]	31.8	31.9	31.9
	Airport South	Agriculture	14.8	14.8	0.5
		Commercial	326.6	373.3	409.7
		Developed Park	0.0	34.7	36.4
		Forest	9.1	15.4	10.4
		Grassland	86.4	16.2	12.3
		High Density Residential	59.2	51.7	42.9
		Highway	1.7	1.7	1.7
		Industrial	85.3	72.2	72.2
		Institutional	9.7	10.4	10.4
		Low Density Residential	85.5	81.5	75.5
		Medium Density Residential	2.6	4.9	4.9
		Water	0.1	4.3	4.3
		TOTAL	681.1	681.1	681.1
		Area Impervious[1]	388.1	403.5	422.8
		Percent Impervious[2]	57.0	59.6	62.5

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year 1988	2007	2020
Lower Minnesota River Watershed District (cont.)					
	France Ave.	Agriculture	0.0	0.0	0.0
		Commercial	1.1	1.1	1.1
		Developed Park	1.8	1.8	1.8
		Forest	3.7	3.7	3.7
		Grassland	1.9	2.1	1.1
		High Density Residential	1.8	1.8	1.8
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	18.1	18.1	18.1
		Low Density Residential	201.2	199.6	199.7
		Medium Density Residential	0.0	1.4	2.4
		Water	3.5	3.5	3.5
		TOTAL	233.0	233.0	233.0
		Area Impervious[1]	69.3	69.4	69.6
		Percent Impervious[2]	30.2	30.3	30.4
	Hampshire Pond	Agriculture	0.0	0.0	0.0
		Commercial	47.0	54.7	56.1
		Developed Park	159.3	160.6	160.5
		Forest	32.3	26.7	26.4
		Grassland	279.6	79.9	79.7
		High Density Residential	90.4	111.9	147.7
		Highway	0.0	0.0	0.0
		Industrial	188.1	362.5	364.4
		Institutional	85.4	71.7	47.5
		Low Density Residential	220.2	228.9	206.5
		Medium Density Residential	32.8	35.2	43.2
		Water	22.1	24.9	24.9
		TOTAL	1157.1	1157.1	1157.1
		Area Impervious[1]	418.9	527.0	533.0
		Percent Impervious[2]	36.9	46.5	47.1
	Hopkins Road	Agriculture	0.0	0.0	0.0
		Commercial	34.9	34.3	34.3
		Developed Park	0.0	6.7	6.7
		Forest	29.4	29.6	23.4
		Grassland	20.7	16.6	9.3
		High Density Residential	42.8	52.9	52.9
		Highway	6.3	6.3	6.3
		Industrial	29.0	29.0	17.5
		Institutional	13.6	13.6	13.6
		Low Density Residential	356.3	349.7	349.4
		Medium Density Residential	6.9	2.0	27.3
		Water	35.2	34.5	34.5
		TOTAL	575.0	575.0	575.0
		Area Impervious[1]	190.6	191.7	191.8
		Percent Impervious[2]	35.3	35.5	35.5

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year 1988	2007	2020
Lower Minnesota River Watershed District (cont.)					
	Minnesota River Direct	Agriculture	42.7	42.7	24.2
		Commercial	26.6	57.4	78.1
		Developed Park	34.5	34.5	34.5
		Forest	905.4	947.9	942.3
		Grassland	214.6	55.1	50.2
		High Density Residential	42.8	36.2	36.3
		Highway	6.7	9.6	9.6
		Industrial	8.4	11.4	11.4
		Institutional	24.6	31.1	31.1
		Low Density Residential	475.3	533.6	545.9
		Medium Density Residential	3.9	24.9	24.9
		Water	2615.0	2617.2	2612.0
		TOTAL	4400.5	4401.6	4400.5
		Area Impervious[1]	289.9	315.1	331.4
		Percent Impervious[2]	16.2	17.7	18.5
	Overlook Lake	Agriculture	0.0	0.0	0.0
		Commercial	11.0	5.9	3.6
		Developed Park	8.3	9.2	9.2
		Forest	1.6	0.7	0.6
		Grassland	20.4	0.7	0.3
		High Density Residential	0.0	10.8	10.8
		Highway	0.0	0.0	0.0
		Industrial	20.5	27.2	29.5
		Institutional	0.9	6.5	6.4
		Low Density Residential	356.3	355.2	353.5
		Medium Density Residential	54.6	57.4	59.7
		Water	6.7	6.7	6.7
		TOTAL	480.4	480.4	480.4
		Area Impervious[1]	154.9	161.5	161.8
		Percent Impervious[2]	32.7	34.1	34.1
	South Glen	Agriculture	0.0	0.0	0.0
		Commercial	71.1	63.2	63.2
		Developed Park	8.4	7.9	7.9
		Forest	0.0	17.2	17.2
		Grassland	37.3	13.0	13.0
		High Density Residential	61.2	68.5	68.5
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	51.6	60.2	59.5
		Low Density Residential	385.9	382.3	379.3
		Medium Density Residential	25.0	28.2	31.9
		Water	39.0	39.1	39.1
		TOTAL	679.6	679.6	679.6
		Area Impervious[1]	238.6	236.8	237.1
		Percent Impervious[2]	37.3	37.0	37.0

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Lower Minnesota River Watershed District (cont.)					
	York Ave.	Agriculture	0	0	0
		Commercial	17.68422	15.45888	15.45933
		Developed Park	94.25335	87.73682	87.7368
		Forest	31.78735	36.01252	27.50575
		Grassland	5.630084	3.929717	3.646495
		High Density Residential	12.42503	14.961	16.00729
		Highway	0	0	0
		Industrial	0	0	0
		Institutional	13.1903	15.41565	15.41565
		Low Density Residential	351.65	352.9808	357.8369
		Medium Density Residential	0	0	2.887194
		Water	102.844	102.9689	102.9689
		TOTAL	629.4643	629.4643	629.4643
		Area Impervious[1]	146.9331	146.6569	149.357
		Percent Impervious[2]	27.9	27.9	28.4

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Nine Mile Creek Watershed District	494 East	Agriculture	0.0	0.0	0.0
		Commercial	30.6	43.2	44.5
		Developed Park	0.0	0.0	0.0
		Forest	0.0	0.0	0.0
		Grassland	10.5	1.6	0.3
		High Density Residential	0.0	0.0	0.0
		Highway	0.9	0.9	0.9
		Industrial	6.0	1.9	1.9
		Institutional	0.0	0.0	0.0
		Low Density Residential	0.0	0.0	0.0
		Medium Density Residential	1.0	1.0	1.0
		Water	0.0	0.4	0.4
		TOTAL	49.0	49.0	49.0
		Area Impervious[1]	30.4	35.1	35.9
		Percent Impervious[2]	61.9	72.3	73.8
	Brook Side	Agriculture	0.0	0.0	0.0
		Commercial	8.2	5.1	5.1
		Developed Park	0.0	0.0	0.0
		Forest	0.4	0.9	0.9
		Grassland	2.3	1.8	1.8
		High Density Residential	5.3	5.3	5.3
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	29.0	32.1	32.1
		Low Density Residential	230.8	230.8	230.8
		Medium Density Residential	0.0	0.0	0.0
		Water	7.7	7.7	7.7
		TOTAL	283.8	283.8	283.8
		Area Impervious[1]	89.7	88.8	88.8
		Percent Impervious[2]	32.5	32.2	32.2

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Nine Mile Creek Watershed District (cont.)					
	Bush Lake	Agriculture	0.0	0.0	0.0
		Commercial	4.2	1.9	1.9
		Developed Park	11.5	56.2	56.2
		Forest	265.4	272.6	272.1
		Grassland	344.7	242.8	242.1
		High Density Residential	4.3	4.3	4.3
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	2.0	4.8	4.2
		Low Density Residential	264.7	309.9	311.8
		Medium Density Residential	0.0	3.5	3.5
		Water	286.8	287.5	287.5
		TOTAL	1183.5	1183.5	1183.5
		Area Impervious[1]	158.7	162.7	162.8
		Percent Impervious[2]	17.7	18.2	18.2
	Lower Nine Mile Creek	Agriculture	0.0	0.0	0.0
		Commercial	13.6	18.2	17.9
		Developed Park	0.0	0.0	0.0
		Forest	189.3	196.1	193.8
		Grassland	27.0	9.3	5.8
		High Density Residential	61.9	63.2	63.2
		Highway	1.3	1.3	1.3
		Industrial	3.1	2.4	4.7
		Institutional	71.0	56.6	56.6
		Low Density Residential	896.5	903.9	907.8
		Medium Density Residential	16.7	26.1	26.1
		Water	95.1	98.5	98.5
		TOTAL	1375.5	1375.5	1375.5
		Area Impervious[1]	357.1	357.1	358.9
		Percent Impervious[2]	27.9	28.0	28.1
	Marsh Lake	Agriculture	0.0	0.0	0.0
		Commercial	8.3	8.0	8.0
		Developed Park	0.0	0.0	0.0
		Forest	23.6	23.7	23.7
		Grassland	9.8	1.8	1.7
		High Density Residential	23.8	24.2	24.4
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	36.1	36.1	36.1
		Low Density Residential	247.2	252.8	252.5
		Medium Density Residential	26.4	28.4	28.6
		Water	55.3	55.4	55.4
		TOTAL	430.5	430.5	430.5
		Area Impervious[1]	120.2	121.2	121.3
		Percent Impervious[2]	32.0	32.3	32.3

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Nine Mile Creek Watershed District (cont.)					
	Oxboro Lake	Agriculture	0.0	0.0	0.0
		Commercial	267.1	251.7	255.6
		Developed Park	61.6	61.6	61.6
		Forest	9.3	3.8	3.8
		Grassland	41.8	30.7	18.2
		High Density Residential	124.9	143.2	145.1
		Highway	7.0	7.0	7.0
		Industrial	519.8	493.8	504.5
		Institutional	77.6	129.7	129.7
		Low Density Residential	862.1	842.5	839.2
		Medium Density Residential	5.3	9.8	9.3
		Water	25.6	28.1	28.1
		TOTAL	2002.1	2002.1	2002.1
		Area Impervious[1]	964.0	960.4	968.8
		Percent Impervious[2]	48.8	48.7	49.1
	Penn Lake	Agriculture	0.0	0.0	0.0
		Commercial	179.0	187.7	193.0
		Developed Park	28.7	36.0	36.0
		Forest	7.8	3.1	3.1
		Grassland	8.7	7.9	6.8
		High Density Residential	25.5	29.7	38.7
		Highway	4.1	4.1	4.1
		Industrial	52.1	42.6	42.6
		Institutional	110.7	102.0	89.0
		Low Density Residential	719.2	718.6	718.6
		Medium Density Residential	0.7	4.8	4.8
		Water	67.6	67.6	67.6
		TOTAL	1204.2	1204.2	1204.2
		Area Impervious[1]	456.3	456.3	458.5
		Percent Impervious[2]	40.1	40.1	40.3
	Skriebakken	Agriculture	0.0	0.0	0.0
		Commercial	104.6	106.6	106.6
		Developed Park	12.6	12.6	12.6
		Forest	15.0	42.0	42.0
		Grassland	35.4	4.0	4.0
		High Density Residential	41.2	41.6	51.0
		Highway	0.0	0.0	0.0
		Industrial	15.5	15.5	6.2
		Institutional	35.3	35.3	35.3
		Low Density Residential	428.3	429.5	429.5
		Medium Density Residential	7.4	7.4	7.4
		Water	83.7	84.6	84.6
		TOTAL	779.2	779.2	779.2
		Area Impervious[1]	264.1	261.5	259.2
		Percent Impervious[2]	38.0	37.7	37.3

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Nine Mile Creek Watershed District (cont.)					
	Upper Nine Mile Creek	Agriculture	0.0	0.0	0.0
		Commercial	304.8	316.3	340.3
		Developed Park	27.6	47.0	47.0
		Forest	439.2	477.1	468.1
		Grassland	222.5	102.4	86.2
		High Density Residential	67.7	69.3	69.4
		Highway	14.9	23.9	23.9
		Industrial	72.5	66.4	66.3
		Institutional	62.2	77.9	75.3
		Low Density Residential	741.4	740.6	746.4
		Medium Density Residential	33.3	61.8	59.8
		Water	814.6	817.9	817.9
		TOTAL	2800.6	2800.6	2800.6
		Area Impervious[1]	647.6	659.8	674.1
		Percent Impervious[2]	32.6	33.3	34.0
	West Marsh Lake	Agriculture	0.0	0.0	0.0
		Commercial	4.1	4.1	4.1
		Developed Park	25.5	25.0	25.0
		Forest	0.0	5.0	5.0
		Grassland	10.8	0.4	0.4
		High Density Residential	16.2	21.9	21.9
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	42.0	42.0	42.0
		Low Density Residential	193.5	194.1	194.1
		Medium Density Residential	0.0	0.0	0.0
		Water	5.8	5.5	5.5
		TOTAL	298.0	298.0	298.0
		Area Impervious[1]	93.5	94.7	94.7
		Percent Impervious[2]	32.0	32.4	32.4

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Richfield-Bloomington Watershed Management Organization	**Smith Pond**	Agriculture	0.0	0.0	0.0
		Commercial	129.4	162.5	162.5
		Developed Park	32.6	30.9	30.9
		Forest	2.9	3.1	3.1
		Grassland	12.7	8.2	8.2
		High Density Residential	104.6	104.9	110.9
		Highway	7.8	7.8	7.8
		Industrial	164.7	140.4	140.4
		Institutional	57.5	68.0	68.0
		Low Density Residential	1113.3	1111.6	1111.6
		Medium Density Residential	22.8	10.5	4.6
		Water	14.9	15.4	15.4
		TOTAL	1663.4	1663.4	1663.4
		Area Impervious[1]	645.0	650.1	650.7
		Percent Impervious[2]	39.1	39.4	39.5

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

Table 2-4: Bloomington Land Use by Basin for 1988, 2007 and 2020 (Cont.)

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Richfield-Bloomington Watershed Management Organization (cont.)					
	11th Ave.	Agriculture	0.0	0.0	0.0
		Commercial	0.0	0.0	0.0
		Developed Park	9.0	7.6	7.6
		Forest	0.0	0.0	0.0
		Grassland	2.6	3.5	3.5
		High Density Residential	4.4	0.0	0.0
		Highway	0.0	0.0	0.0
		Industrial	13.3	13.3	13.3
		Institutional	15.1	19.5	19.5
		Low Density Residential	292.7	292.7	292.7
		Medium Density Residential	3.2	3.8	3.8
		Water	2.1	2.1	2.1
		TOTAL	342.4	342.4	342.4
		Area Impervious[1]	107.5	107.4	107.4
		Percent Impervious[2]	31.6	31.6	31.6

WMO/WD	Basin	Land Use	Area (acres) by Year		
			1988	2007	2020
Riley-Purgatory-Bluff Creek Watershed District	Colorado Pond	Agriculture	0.0	0.0	0.0
		Commercial	14.8	17.0	17.0
		Developed Park	119.9	119.8	119.8
		Forest	114.1	150.8	150.8
		Grassland	155.7	114.1	114.1
		High Density Residential	14.6	15.3	15.5
		Highway	0.0	0.0	0.0
		Industrial	0.0	0.0	0.0
		Institutional	11.7	16.5	16.5
		Low Density Residential	301.2	299.4	299.4
		Medium Density Residential	38.4	39.5	39.3
		Water	120.6	118.4	118.4
		TOTAL	890.9	890.9	890.9
		Area Impervious[1]	181.4	179.6	179.6
		Percent Impervious[2]	23.5	23.2	23.3
	Riley Purgatory	Agriculture	0.0	0.0	0.0
		Commercial	27.7	27.5	27.5
		Developed Park	20.1	35.7	35.7
		Forest	28.8	36.9	36.6
		Grassland	133.3	44.5	43.7
		High Density Residential	45.0	45.0	45.0
		Highway	2.5	13.2	13.2
		Industrial	0.0	0.0	0.0
		Institutional	34.3	18.7	18.7
		Low Density Residential	516.0	562.2	563.2
		Medium Density Residential	112.6	137.4	137.4
		Water	90.2	89.5	89.5
		TOTAL	1010.4	1010.4	1010.4
		Area Impervious[1]	285.3	294.7	294.9
		Percent Impervious[2]	31.0	32.0	32.0

1 - Area of Impervious does not include the water/wetland area, which was assumed to be 100 percent impervious
2 - Calculation of the Percent Impervious does not include the Water/Wetland area in the Total Area

2.3 Modeling Approach and Methodology for Loading Estimates

Complex models used to answer simple questions are not advantageous and simple models that do not model important or required physical processes are not useful. In keeping with the Permit conditions and guidance discussed in Section 1.2 of this report, our modeling approach was developed based on the following requirements:

- The loading assessment should include changes to pollutant loadings associated with changes due to past land use changes and changes due to anticipated land use changes.
- The modeling will produce relative values, as the MPCA is more concerned with the average annual increases than about specific event increases. It is not as important to get the actual loads correct as it is to model consistently, showing the relative change in loads rather than the actual loads.
- The assessment can include changes due to BMPs that have already been implemented, if increase in the loading since 1989 is explicitly stated, as well as changes due to BMPs that are planned to be implemented and written into the MS4's ordinances or other regulatory mechanisms.
- The model does not need to calculate design features such as hydrographs, but can show removal rates based on design criteria, which can be just as useful for planning purposes. Design calculations may need to be run before implementation but often these can be run on a much smaller scale.

Currently, there are several water quality models available for simulating urban runoff and the treatment effectiveness of BMPs. Table 2-5 presents a qualitative comparison of several of the important attributes associated with some of the more common runoff water quality model capabilities based on the various selection criteria. The compiled model attributes and capabilities come primarily from peer-reviewed manuals (U.S. EPA, 1997; Burton and Pitt, 2001), with additional updated information based on our own experience and professional judgment. The water quality models included in the table are generally listed in increasing order of complexity (from left to right). For each attribute or selection criteria the models are categorized by possessing low, medium (intermediate) or high capabilities. Those capabilities that are not incorporated into a particular model, or were not applicable, were also indicated. Our approach for model selection for this assessment involved comparison of the advantages and limitations of the various models as they pertain to the Permit requirements, available data, and objectives of the City.

Table 2-5 shows that the only limitation with the P8 model, as it relates to the modeling requirements for the loading assessment, is that it is not intended to be used to determine pollutant loadings from non-urban land uses. However, the Simple Method, PONDNET and Generalized Watershed Loading Functions (GWLF) can be used to determine pollutant loadings from both urban and non-urban land uses. Both the Simple Method and PONDNET are typically used on an annual time scale. Table 2-5 also shows that the Simple Method, PONDNET and GWLF lack the ability to model the BMPs that would typically be considered for implementation by the City (such as vegetated drainage ways, extended detention, infiltration/filtration practices and street sweeping). Source Loading and Management Model (SLAMM) lacks a snowmelt runoff routine, does not have any capabilities for including baseflow in BMP analysis, and does not have the model output features contained in the P8 model. XP-SWMM is more complex, but is not in the public domain, is significantly more expensive, and BMP modeling is more cumbersome, less accurate and less intuitive than the P8 model.

Table 2-5 Comparison of Modeling Attributes/Capabilities by Selection Criteria

Criteria/Attributes		Simple Method	PONDNET	SLAMM	P8	GWLF	XP-SWMM
Time Scale	Annual	H	H	--	--	--	--
	Single Event	H	--	--	H	--	H
	Continuous	--	--	H	H	H	H
Hydrology	Runoff	L	L	H	H	H	H
	Baseflow	--	--	--	L	H	H
	Snowmelt	--	--	--	H	--	H
Pollutant Loading (Constituents)	Sediment (TSS)	H	--	H	H	H	H
	Nutrients	H	H	H	H	H	H
Pollutant Loading (Land Uses)	Urban	H	H	H	H	H	H
	Agricultural	H	H	--	--	H	--
Pollutant Routing	Transport	--	--	L	L	L	H
	Erosion	--	--	--	--	H	H
	Transformation	--	--	--	--	--	L
Hydraulic Flow Routing/Diversions		--	--	--	L	L	H
Model Output	Statistics	L	L	L	H	L	H
	Graphics	--	--	L	H	M	H
	Hydro/Pollutographs	--	--	--	H	--	H
	Format Options	L	L	H	H	H	H
	Sensitivity Analysis	--	--	--	H	--	--
Input Data	Requirements	L	L	M	M	M	H
	Calibration	L	L	L	M	L	H
	Default Data	L	H	H	H	H	M
	User Interface	L	L	H	H	H	H
GIS Compatibility		L	L	--	M	L	M
BMPs-General	Evaluation	--	H	M	H	L	H
	Design Criteria	--	H	L	H	--	H
Specific BMPs	Ponds/Wetlands	--	H	H	H	--	H
	Extended Detention	--	--	M	H	--	H
	Infiltration/Filtration	--	--	H	H	--	M
	Street Sweeping	--	--	H	H	--	M
	Others	--	--	H	H	--	L
Documentation	Peer Acceptance	H	H	H	H	H	H
	Technical Support	L	L	M	H	L	H
Cost	Software	L	L	M	L	L	H
	Use	L	L	M	M	M	H

H = High **M** = Medium (Intermediate) **L** =Low **--** = Not Incorporated (Not Applicable)

For this loading assessment, we have chosen to use the Simple Method to determine the pollutant loadings and runoff volumes from each of the land uses within each watershed and then use the P8 model to account for the effects of BMP implementation for the time periods of interest in the Permit conditions. In addition to the discussion associated with Table 2-5, the following information provides further justification for choosing the Simple Method/P8 model combination for the loading assessment modeling, in comparison to SLAMM, PONDNET, XP-SWMM, or some combination thereof:

- The Simple Method inputs can be directly derived within GIS.
- PONDNET does not model TSS loadings and is only intended for modeling TP within wet detention ponds.
- SLAMM is more detailed than P8 with respect to distinguishing source loading areas (such as driveways, parking lots, lawns, etc.), but P8 exceeds the capabilities of SLAMM when it comes to networking of watersheds/BMPs and many of the graphics and advanced output features.
- P8 provides routines for performing sensitivity analyses and can also be run in design mode to determine required sizes of BMP(s) to meet treatment criteria.
- P8 has the highest peer acceptance in Minnesota for urban runoff and BMP water quality modeling and enhancements have been supported by the MPCA.
- P8 is free, user-friendly and easy to learn with its menu driven system.
- P8 allows for some GIS compatibility via ASCII text file import of watershed data and export of results.
- P8 models actual hourly precipitation and climatic data as it occurs, with its associated antecedent moisture conditions, while SLAMM only reads in the total precipitation and duration of each rainfall event and does not model actual runoff events in real-time with their associated antecedent moisture conditions.
- Unlike SLAMM, P8 allows for hydrologic calibration within the program and can be calibrated/validated to time series runoff events continuously simulated from climatic data.

The city of Bloomington has conducted a significant amount of monitoring of stormwater runoff and receiving water quality/quantity. These monitoring locations were generally selected to isolate and monitor runoff from individual land uses or specific land cover types. Additionally, P8 Models have been developed, and calibrated with the available data, for portions of the city as part of diagnostic-feasibility studies. However, the P8 Models are not representative of either 1989 or current (2007) land use conditions, they include natural wetlands in the modeling network, and do not include all of the individual BMPs for each developed site within the watershed (typically due to a lack of site-specific BMP information for each site and the size limitation of the model). Since the presence of natural wetlands in the modeled drainage systems would affect the downstream water and pollutant loadings, it would not accurately distinguish between the expected treatment levels or provide a truly relative comparison between the predicted loadings, with and without the presence of the watershed BMPs.

Following the initial assessment of TSS, TP and volume contributions with the Simple Method, we will then assess the benefit that current BMP implementation has had on the flow, TP and TSS loadings within the city limits using the P8 water quality modeling for developments based on P8 model design criteria examples that are indicative of the ordinances and design standards that were in place by the City, the watershed management organizations, the WCA and the MPCA when development occurred. Based on the available data, combining the Simple Method and P8 Model for the loading assessment ensures full compliance with the Permit requirements, for the following reasons:

- The Simple Method ensures that a consistent method for calculating average annual volumes and loadings will be applied to all land uses to produce relative values across the two times periods of interest, as discussed in the Permit and Guidance Manual (see Sections 1.1.1 and 1.2.2.1 of this report).
- The P8 Model simulations of volume and pollutant loading reductions associated with BMP implementation, according to the various ordinances and design standards that were in place when development occurred, is consistent with the Permit conditions and Guidance Manual and provides a consistent method for calculating relative removal rates as suggested in Section 1.2.2.1 of this report.
- Excludes the effects that natural wetlands would have on improving the stormwater quality within each watershed, which ensures that the loading assessment estimates that include BMPs do not take credit for treatment by natural wetlands
- The City will not have to revise and update existing P8 models to exclude the effects of natural wetlands or collect significantly more data on every BMP to develop new P8 models for the rest of the city, which would represent significantly more cost for a product that would not provide a "distinction between what is desirable and what is required. The MPCA chose a level [in its loading assessment requirements] that will prevent undue burden while still developing useful information." (MPCA Guidance Manual, 2006).

The loading assessment modeling results were summarized for each of the 24 drainage basins to show the Simple Method loading and volume estimates for each time period, as well as the loading and volume estimates after applying the P8 model design criteria examples, based on the ordinances and design standards that were in place when the various developments occurred.

2.3.1 Average Annual Flow Volume

The conversion of land areas from agricultural or undeveloped areas to urban land uses and the redevelopment of urban lands to higher density uses leads to changes in watershed hydrology and pollutant load rates. The areal increase in impervious surfaces associated with development or redevelopment can lead to greater surface water runoff volumes. The increased runoff coupled with human activities increases the types of pollutants and delivery rate of these pollutants to surface waters. Impermeable surfaces shed water as surface runoff which reduces the infiltration and evapotranspiration components of the hydrologic cycle. Surface runoff in urbanized areas is generally directed to storm sewers and other conveyance systems to rapidly move the large volumes to receiving waters and prevent flooding. This section provides a general discussion about the methodology used to quantify the amount of runoff from the various land uses in the Bloomington watersheds during the two time periods of interest for the Permit conditions.

As previously discussed, the Simple Method was used to estimate the average annual runoff volumes, which in turn, are also used to calculate the TP and TSS loadings, for the various land uses present within the Bloomington watersheds. In the urbanized portion of each watershed, average annual runoff volume was calculated using the following relationships (as described in Schueler, 1987) by land use type:

Annual Runoff Coefficient [RC] = 0.05 + ((0.009) x (Impervious Fraction) x 100)

Annual Runoff Volume (acre-feet) = RC x Annual Rainfall (inches) x Land Use Area (acres) / 12

The annual runoff coefficients (percentage of rainfall resulting in runoff) are summarized in Table 2-6 by land use type. Runoff coefficients for grassland, hay/pasture, and forest land uses were based on a review of the available literature and estimates using curve number methodology and are also summarized in Table 2-3. Reckhow et al. (1980) summarized the TP and water yield monitoring results of several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available water runoff and rainfall volume data were taken from Reckhow et al. (1980) and used to determine the median runoff coefficient for the hay/pasture land use category. The median runoff coefficient for the hay/pasture land use category was 0.11. For the forested land use, curve number methodology, assuming good ground cover, was applied to the long-term Twin City rainfall records to estimate that the relative event-based cumulative runoff coefficient was 0.03. It was assumed that grassland would exhibit the same runoff coefficient as forestland. Each of these runoff coefficients, for non-urban land uses, show good relative agreement with the urban pervious runoff coefficient of 0.05 shown above (taken from Schueler [1987]).

There are several flow and water quality monitoring stations along the length of Nine Mile Creek within Bloomington. To verify that the runoff coefficients used in this analysis were reasonable, an analysis of the 2005 precipitation, slightly less than average precipitation, and flow data for the monitoring station located at 98th Street was evaluated to estimate a runoff coefficient representative of the development conditions within the city. Results of this analysis indicate that the unit runoff typical for the city of Bloomington is about 6 inches of runoff per year. The method used for this loading assessment results in an average unit runoff of 12 inches. Although the simple method appears to over-estimate the annual runoff volume for Nine Mile Creek, the methodology yields a conservative estimate of the runoff from Bloomington.

2.3.2 Total Phosphorus

As previously discussed, there is some monitoring data available for runoff volumes or quality from individual land uses or specific land cover types within the city of Bloomington. However, after reviewing this data, it was determined that the data was limited to a few monitoring locations with only a small number of runoff events monitored, incomplete coverage of the land uses used in this analysis, and unreasonably high values for some sampling events. Therefore, the expected TP concentration by urban land use type was estimated using the concentrations listed in the *2005 MPCA Minnesota Storm Water Manual* (Table 8.7). The land use specific TP concentrations used for Bloomington's loading assessment are summarized in Table 2-6.

Phosphorus loading from urbanized portion of each watershed was then calculated according to the following equation:

TP Load (lbs.) = Land Use Runoff Conc. (mg/L) x *Annual Runoff Volume (acre-feet)* x *2.72*.

The TP contributions from non-urban land uses were based on Reckhow et al. (1980), which summarized the TP export coefficients produced from several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available TP export coefficient data were taken from Reckhow et al. (1980) and used to determine the median export coefficients for the hay/pasture and forested land use categories. The median TP export coefficients for the hay/pasture and forested land use categories were 0.54 and 0.09 lbs/ac/yr, respectively. It was assumed that grassland would exhibit the same TP export coefficient as forestland. Because Bloomington is fully-developed and there was only one agricultural parcel of land in 1989 and 2007, the agricultural parcel was assumed to be hay/pasture as the land cover.

The average annual phosphorus loading from non-urban land uses in each watershed was then calculated according to the following equation:

TP Load (lbs.) = Land Use Area (acres) x TP Export Coefficient (lbs/ac/yr)

2.3.3 Total Suspended Solids

As previously discussed, there is some monitoring data available for runoff water quality from individual land uses within the city. However, for the same reasons discussed in the TP section above, this monitoring data was not used for the loading analysis. Therefore, the expected TSS concentrations by urban land use were taken from Pitt (2003). TSS loading from urbanized portion of each watershed was then calculated according to the following equation:

TSS Load (lbs.) = Land Use Runoff Conc. (mg/L) x *Annual Runoff Volume (acre-feet)* x *2.72*

The TSS contributions from non-urban land uses were based on several literature sources (MCES, 2004; DeByle and Packer, 1972; Harms et al., 1974; Webber and Elrick, 1967; Sonzogni et al., 1980), which summarized the TSS export coefficients produced from several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available TSS export coefficient data were taken from the literature sources and used to determine the median export coefficients for the hay/pasture and forested land use categories. The median TSS export coefficients for the hay/pasture and forested land use categories were 25 and 5 lbs/ac/yr, respectively. It was assumed that grassland would exhibit the same TSS export coefficient as forestland. The average annual TSS loading from each land use in each watershed was then calculated according to the following equation:

TSS Load (lbs.) = Land Use Area (acres) x TSS Export Coefficient (lbs/ac/yr)

Table 2-6 summarizes the TP and TSS concentrations and export coefficients used to estimate loads from each land use within the city of Bloomington.

Table 2-6 TP and TSS Concentrations and Export Coefficients by Land Use

Land Use	TP Concentration[1] (mg/L)	TP Aerial Loading Rate[2] (lbs/acre/yr)	TSS Concentration[3,4] (mg/L)		TSS Aerial Loading Rate[2] (lbs/acre/yr)
Agriculture		0.54			25
Commercial	0.22		43-54	48.5	
Developed Park	0.31		51-78	64.5	
Forest		0.09			5
Grassland		0.09			5
High Density Residential	0.3		68	68	
Highway	0.25		81-99	90	
Industrial	0.26		77-82	79.5	
Institutional	0.18		17	17	
Low Density Residential	0.3		48	48	
Medium Density Residential	0.3		48-68	58	
Water					

1 - Minnesota Stormwater Manual, Table 8.7

2 - Reckhow *et al*., 1980

3 - Table 9, Summary of Available Stormwater Data Included in NSQD, version 1.0 (From "The Design, Use, and Evaluation of Wet Detention Ponds for Stormwater Quality Management Using WinDETPOND," Pitt, 2003)

4 - For TSS loading calculations, the average of the range was used

2.3.4 BMP Implementation Modeling

As previously discussed, P8 water quality modeling was used to assess the benefit that current, and expected future, BMP implementation would have on the runoff volume and TP and TSS loadings within the city limits for developments based on the ordinances and design standards that control the treatment efficiency of the BMPs when development occurs. Watershed district rules and city ordinances were reviewed to determine the regulations that were in place between 1988 and 2007 in order to address the impacts of BMPs implemented during that time period. Prior to 1988 the City and watershed district focused on rate control. Between 1988 and 1992 both the Nine Mile Creek and Riley-Purgatory Bluff Creek Watershed Districts required developments to provide sufficient surface settling to remove the 0.1 mm particle based on a 10-year, 30-minute storm event. The NURP pond BMP design requirements have generally controlled the treatment efficiency of the BMPs associated with each new development since 1992, when the City adopted development requirements consistent with the NURP wet detention pond design standards (Walker, 1987; MPCA, 1989), and will likely be the design requirements that control the treatment efficiency for BMPs that are implemented through 2020 for each watershed in the city.

Several scenarios were evaluated to estimate the impact of water quality regulations on expected loads under future land use conditions. The first scenario evaluates expected loads related to land use only and does not account for the implementation on any BMPs (see discussion in Sections 2.3.1 to 2.3.3 of this report). A second scenario evaluates the impact of the construction of NURP ponds, as was required by past and current stormwater regulations. Because the city of Bloomington does not meet the baseline loading rates for volume under the current regulations, a third scenario evaluating the implementation of infiltration with NURP pretreatment standards was considered. A final scenario evaluated regional infiltration with NURP pretreatment on total loads from the city of Bloomington.

2.3.4.1 Implementation of NURP Ponds

The first BMPs evaluated were NURP ponds, which were the first water quality BMPs required by the City and are still currently required for new and redevelopment within the city. The NURP design scenario was run in P8 for a hypothetical low-density residential development with 25 percent imperviousness and a commercial development with 80 percent imperviousness to obtain a range of treatment efficiencies, as well as the average efficiency, that would be expected for the same design standard. For the NURP design scenario, the P8 Model estimated average TP and TSS load reductions of 56 percent and 87 percent, respectively. It was assumed that no volume reduction would be realized from implementation of the NURP design requirements.

To estimate the impact of NURP pond over the time period from 1989 to 2007 and from 2007 to 2020, it was assumed that all areas that have changed or are predicted to change in the type of land use would be regulated by the NURP-criteria. Additionally, areas that were redeveloped but not associated with a change in land use type were also identified for both periods of time. Similarly, it was assumed that redevelopment in these areas would implement NURP ponds or equivalent treatment systems.

2.3.4.2 Implementation of Infiltration Basins with NURP Pretreatment

Volume reduction will be necessary for the city of Bloomington to meet baseline conditions. As a result, P8 was used to estimate the treatment efficiency of infiltration basins with NURP pretreatment that provide for infiltration of 0.5 to 1.5 inches of runoff from the contributing watershed. The Nine Mile Creek Watershed District is currently considering an infiltration requirement of 0.75 inches as part of their 2008 rule making. The estimated volume reduction ranged between 79 percent and 96 percent for infiltration of 0.5 to 1.5 inches of runoff, respectively. Reductions in TP and TSS loads were estimated to range between 89 to 96 percent and 95 to 97 percent, respectively.

To estimate the impact of infiltration on loading from the period of 2007 to 2020, the same method used to estimate the impact of NURP ponds was used. Therefore, it was assumed that runoff from any parcels that are predicted to change in the type of land use or parcels that are expected to redevelop within the same type of land use during this period will implement the infiltration criteria mentioned above.

2.3.4.3 Implementation of Regional Infiltration Basins

Implementation of BMPs for new and redevelopment areas of Bloomington was not sufficient to reduce expected runoff volumes to baseline conditions. Therefore, potential sites for regional infiltration were identified along with the expected contributing area. City basins that contributed the largest portion of the total volume, TP, and TSS loads from Bloomington were the targeted watersheds.

Figure 2-4 shows the potential locations of the regional infiltration ponds. These sites were selected based on available open space, usually park or playlot areas, topography, and proximity to existing storm sewers. The P8 model was used to evaluate conceptual designs of each of the basins, considering the maximum amount of space available for the pond as well as the maximum potential contributing watersheds to each pond. General assumptions were made for the estimated infiltration basin depths as well as for the expected infiltration rates. A 55-year precipitation and temperature record (1949-2004) for the Minneapolis-St. Paul International Airport was used to estimate the total expected volume of infiltration over that time period. This was then converted to an expected annual infiltration volume.

Table 2-7 summarizes the input parameters for each of the regional infiltration basins as well as the results of the modeling. Results include the annual infiltration volume as well as the expected TP and TSS load reductions. The estimated volume reduction ranged from 18 to 99 percent, depending on the size of the basin and the expected contributing areas. Similarly, reductions in TP ranged from 27 to 91 percent and TSS loads were reduced by 50 to 97 percent.

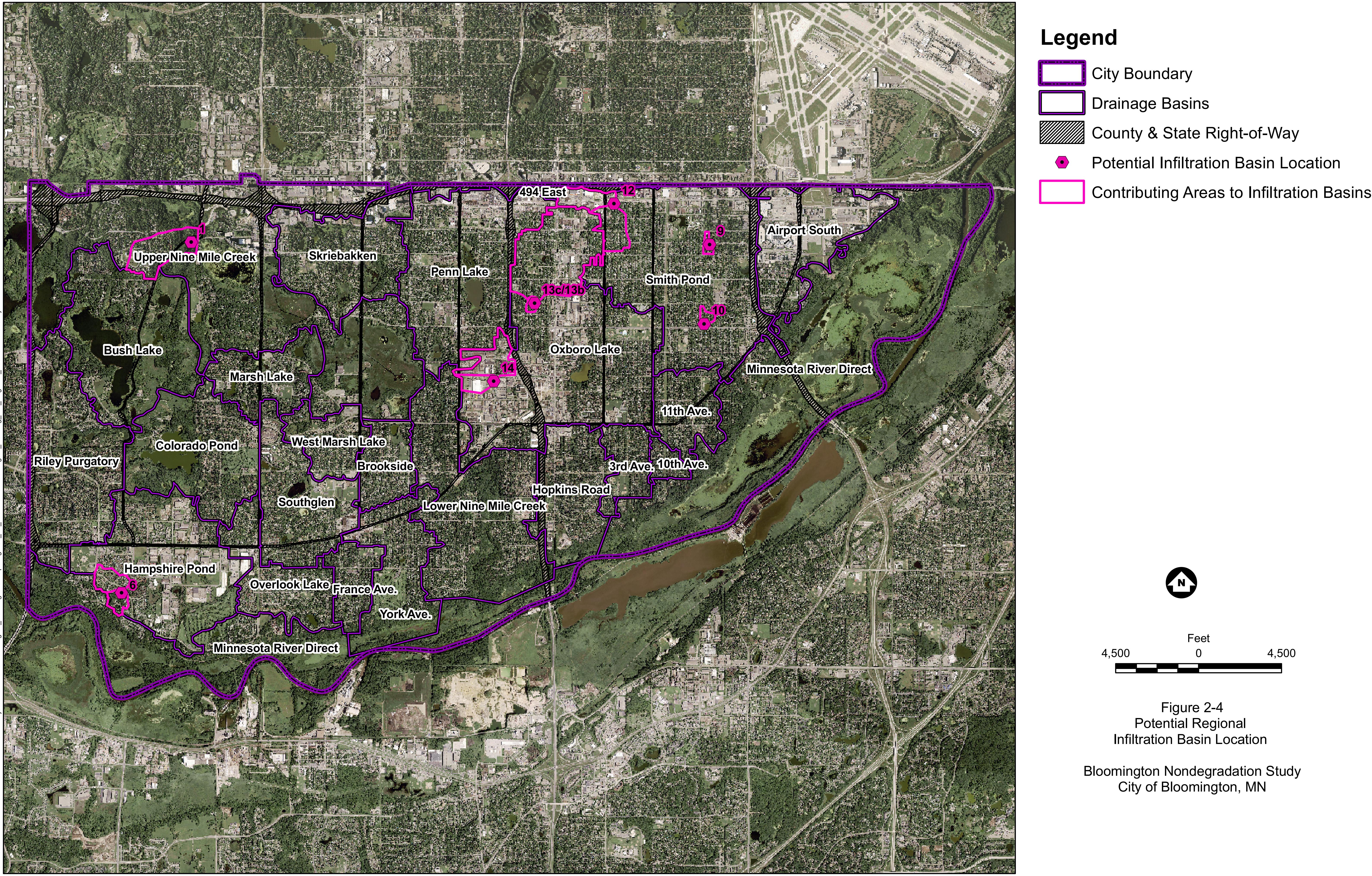


Figure 2-4
Potential Regional
Infiltration Basin Location

Bloomington Nondegradation Study
City of Bloomington, MN

Table 2-7 Regional Infiltration Basins Modeling Summary

Pond ID	Bloomington Basin	Location	Maximum Infiltration Area Available[1] (acres)	Potential Contributing Area (acres)[2]	% Impervious	Ground Elevation at Pond Location[3a]	Ground Elevation at Pond Location[3b]	Pipe Invert[4]	Pond Feasibility	Hydrologic Soils Group	Pond Depth (ft)	Pond Bottom Area[5] (Ac)	Infiltration Rate[6] (in/hr)	Maximum Expected Infiltration Volume[7] (acre-ft/year)	% Reduction in Runoff Volume	Maximum Expected TP Load Reduction[7,8] (lbs/year)	Maximum Expected TSS Reduction[7,8] (lbs/year)
1	Upper Nine Mile Creek	Hyland Ski Jump Area	4.8	144	27.6	812.5	813	810	Y	B/Undef	2	4.8	0.24	94	94	79	25214
10	Smith Pond	McAndrews Playlot	1.8	12	27.9	810.6	n/a	810.2/808.6	Y	Undef	2	1.8	0.24	8	99	7	2218
12	Smith Pond	Fenlason Park	2.3	78 - 147	52.7	821.6	822	820.8	Y	Undef	2	2.3	0.24	123	68	125	43566
13b/13c	Oxboro Lake	Dupont Playlot	0.8	10 - 435	35.8	811.3	812	813.5/809.7	Y	Undef	2	0.8	0.24	68	18	90	51031
6	Hampshire Pond	Quail Ridge Playlot	4.2	27 - 99	32.2	791.2-794.8	792-796	797.2/797	Y	A/B	2	4.2	0.24	76	96	64	20093
9	Smith Pond	Cooks Playlot	1.2	10	27.9	818	n/a	814.3/812.5	Y	Undef	2	1.2	0.24	7	98	6	1837
14	Oxboro Lake	John Deere Property	4.7	35 - 134	70.7	818.6	818	816.7	Y	Undef	2	4.7	0.24	185	86	171	55609
													TOTAL	**561**		**542**	**199,568**

[1] - This maximum available area typically includes the entire park parcel, assuming the removal of features such as baseball diamonds, other sport courts, and playground equipment.

[2] - Several ponds may have the option of diverting one or more storm sewers into the infiltration basin. Therefore, the range provided includes the smallest estimated watershed to the combined total potential contributing area. Additionally, diverting a portion of the flows through these systems may also be an option.

[3a] - Based on 5-foot contour information for Bloomington.

[3b] - Based on 2-foot contour information for Bloomington.

[4] - Based on Storm Sewer GIS from the City of Bloomington.

[5] - Assumes vertical sides.

[6] - Infiltration Rate for Loam soils (Rawls, et al. 1998).

[7] - Assumes maximum contributing area.

[8] - This scenario assumes no pretreatment before the infiltration basin. It is recommended that runoff be pretreated prior to entering the infiltration basin to prevent clogging and enhance infiltration.

3.0 Results and Discussion

Table 3-1 shows the results of the loading assessment modeling, which were summarized for each of the 24 drainage basins to show the Simple Method loading and volume estimates for each time period (Without BMPs [Land Use Only]). Additionally, this table shows the loading and volume estimates after the implementation of current regulations (With BMPs [NURP Ponds Only]) for past development/redevelopment and parcels expected to develop/redevelop from the present to 2020 as well as the future loading with the implementation of infiltration and water quality BMPs (With BMPS [0.5” and 1.5” Infiltration w/ NURP Pretreatment]).

Evaluation of impacts of BMPs on Runoff, TP, and TSS loads was limited to structural practices such as ponds designed to NURP standards and infiltration basins sized to manage a select volume of runoff. There are a number of non-structural practices that the city of Bloomington has implemented to address surface water quality runoff. These practices include the implementation of a (biannual) street-sweeping routine, construction of sump manholes and requiring the use of phosphorus-free fertilizers since 2005. Street sweeping can reduce both TP and TSS loads and studies of high-efficiency street sweeping indicated that TSS reductions can range from 25 to 40 percent (Pitt, Bannerman, and Sutherland, 2004). Studies evaluating the impact of a phosphorus fertilizer ban suggest that phosphorus loads from pervious areas that would typically be fertilized would result in a 17 percent TP load reduction (Barten and Jahnke, 1997). The impact of these practices on TP and TSS loads has not been factored into the city of Bloomington loading assessment and as a result, the estimates of TP and TSS loads for 2007 and 2020 in this report are likely over-estimated.

In addition to the a fore mentioned BMPs, the Nine Mile Creek Watershed District and the city of Bloomington implemented a stream stabilization project on Nine Mile Creek between Old Shakopee Road and the approximate intersection of Queens Circle in the late-1980/early-1990’s. This stabilization project and associated annual maintenance performed by the city of Bloomington was initiated to strengthen the stream banks, restore areas of existing erosion and enhance habitat.

Table 3-1 Bloomington Nondegradation Loading Assessment Summary

Without BMPs (Land Use Only)									
	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**
10th Ave.	73	72	72	58	58	58	10,445	10,375	10,375
11th Ave.	282	282	282	218	216	216	37,385	36,574	36,574
3rd Ave.	191	192	192	145	145	145	22,554	22,601	22,601
Airport South	899	973	1,018	594	629	647	133,815	140,895	146,593
494 East	68	84	86	43	50	52	10,021	11,352	11,660
Brook Side	249	247	247	174	173	173	27,673	27,100	27,100
Bush Lake	935	990	991	234	276	276	32,500	40,775	40,919
Colorado Pond	689	694	694	333	338	338	55,803	56,707	56,718
France Ave.	188	188	189	139	140	140	21,825	21,890	22,046
Hampshire Pond	985	1,320	1,333	686	917	936	151,437	224,611	231,599
Hopkins Road	555	558	562	362	366	371	68,772	70,046	69,610
Lower Nine Mile Creek	1,127	1,141	1,147	713	721	726	115,662	118,186	119,358
Marsh Lake	432	438	438	232	236	237	38,288	39,164	39,217
Minnesota River Direct	6,719	6,845	6,874	540	620	638	80,548	97,389	102,968
Overlook Lake	406	429	430	311	328	329	55,615	60,044	60,569
Oxboro Lake	2,408	2,411	2,436	1,684	1,673	1,689	389,452	381,513	386,462
Penn Lake	1,298	1,299	1,304	810	812	819	149,529	149,661	152,241
Riley Purgatory	888	946	947	534	585	585	91,535	103,945	104,045
Skriebakken	845	851	846	475	478	475	87,021	87,675	86,215
Smith Pond	1,653	1,668	1,669	1,216	1,215	1,216	240,600	237,360	237,756
South Glen	679	684	684	434	437	438	76,758	77,098	77,357
Upper Nine Mile Creek	3,406	3,489	3,529	1,093	1,141	1,165	208,196	218,759	224,367
West Marsh Lake	251	257	257	177	182	182	28,528	29,797	29,797
York Ave.	621	621	628	302	302	307	51,423	51,149	52,291
TOTAL	**25,848**	**26,678**	**26,855**	**11,508**	**12,036**	**12,159**	**2,185,388**	**2,314,667**	**2,348,439**

Table 3-1 Bloomington Nondegradation Loading Assessment Summary (Cont.)

With BMPs (Existing and Past Regulations (NURP Ponds))

	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**
10th Ave.	73	72	72	58	57	57	10,445	10,305	10,305
11th Ave.	282	282	282	218	215	215	37,385	36,343	36,340
3rd Ave.	191	192	192	145	145	145	22,554	22,573	22,573
Airport South	899	973	1,018	594	584	563	133,815	129,747	126,593
494 East	68	84	86	43	43	43	10,021	9,694	9,698
Brook Side	249	247	247	174	172	172	27,673	27,005	27,005
Bush Lake	935	990	991	234	235	235	32,500	32,833	32,821
Colorado Pond	689	694	694	333	332	332	55,803	55,981	55,958
France Ave.	188	188	189	139	139	139	21,825	21,762	21,777
Hampshire Pond	985	1,320	1,333	686	771	764	151,437	182,043	179,858
Hopkins Road	555	558	562	362	359	350	68,772	68,424	63,831
Lower Nine Mile Creek	1,127	1,141	1,147	713	707	706	115,662	115,224	114,551
Marsh Lake	432	438	438	232	231	231	38,288	38,070	38,053
Minnesota River Direct	6,719	6,845	6,874	540	558	556	80,548	85,432	84,602
Overlook Lake	406	429	430	311	314	312	55,615	56,764	56,199
Oxboro Lake	2,408	2,411	2,436	1,684	1,619	1,624	389,452	366,843	367,048
Penn Lake	1,298	1,299	1,304	810	798	790	149,529	146,746	145,945
Riley Purgatory	888	946	947	534	535	536	91,535	91,803	91,812
Skriebakken	845	851	846	475	471	462	87,021	86,173	82,637
Smith Pond	1,653	1,668	1,669	1,216	1,192	1,180	240,600	232,638	227,784
South Glen	679	684	684	434	428	427	76,758	75,404	75,143
Upper Nine Mile Creek	3,406	3,489	3,529	1,093	1,081	1,082	208,196	203,266	202,565
West Marsh Lake	251	257	257	177	178	178	28,528	29,027	29,027
York Ave.	621	621	628	302	299	301	51,423	50,673	50,780
TOTAL	**25,848**	**26,678**	**26,855**	**11,508**	**11,461**	**11,399**	**2,185,388**	**2,174,774**	**2,152,908**

Table 3-1 Bloomington Nondegradation Loading Assessment Summary (Cont.)									
With BMPs (0.5" Infiltration w/ NURP Pretreatment)									
	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**
10th Ave.	73	72	72	58	57	57	10,445	10,305	10,305
11th Ave.	282	282	282	218	215	215	37,385	36,343	36,340
3rd Ave.	191	192	192	145	145	145	22,554	22,573	22,573
Airport South	899	973	954	594	584	541	133,815	129,747	125,803
494 East	68	84	84	43	43	42	10,021	9,694	9,671
Brook Side	249	247	247	174	172	172	27,673	27,005	27,005
Bush Lake	935	990	990	234	235	235	32,500	32,833	32,807
Colorado Pond	689	694	694	333	332	332	55,803	55,981	55,955
France Ave.	188	188	188	139	139	139	21,825	21,762	21,765
Hampshire Pond	985	1,320	1,287	686	771	749	151,437	182,043	179,040
Hopkins Road	555	558	538	362	359	342	68,772	68,424	63,460
Lower Nine Mile Creek	1,127	1,141	1,137	713	707	703	115,662	115,224	114,386
Marsh Lake	432	438	438	232	231	231	38,288	38,070	38,047
Minnesota River Direct	6,719	6,845	6,830	540	558	544	80,548	85,432	84,030
Overlook Lake	406	429	425	311	314	311	55,615	56,764	56,102
Oxboro Lake	2,408	2,411	2,413	1,684	1,619	1,618	389,452	366,843	366,625
Penn Lake	1,298	1,299	1,283	810	798	781	149,529	146,746	145,643
Riley Purgatory	888	946	946	534	535	535	91,535	91,803	91,804
Skriebakken	845	851	833	475	471	458	87,021	86,173	82,451
Smith Pond	1,653	1,668	1,646	1,216	1,192	1,173	240,600	232,638	227,315
South Glen	679	684	681	434	428	426	76,758	75,404	75,097
Upper Nine Mile Creek	3,406	3,489	3,482	1,093	1,081	1,069	208,196	203,266	202,002
West Marsh Lake	251	257	257	177	178	178	28,528	29,027	29,027
York Ave.	621	621	622	302	299	299	51,423	50,673	50,688
TOTAL	**25,848**	**26,678**	**26,521**	**11,508**	**11,461**	**11,292**	**2,185,388**	**2,174,774**	**2,147,942**

Table 3-1 Bloomington Nondegradation Loading Assessment Summary (Cont.)									
With BMPs (1.5" Infiltration w/ NURP Pretreatment)									
	WATERSHED TOTAL RUNOFF (acre-feet)			**WATERSHED TP YIELD (LBS)**			**WATERSHED TSS YIELD (LBS)**		
WATERSHED	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**	**1988**	**2007**	**2020**
10th Ave.	73	72	72	58	57	57	10,445	10,305	10,305
11th Ave.	282	282	282	218	215	215	37,385	36,343	36,340
3rd Ave.	191	192	192	145	145	145	22,554	22,573	22,573
Airport South	899	973	941	594	584	536	133,815	129,747	125,627
494 East	68	84	83	43	43	42	10,021	9,694	9,665
Brook Side	249	247	247	174	172	172	27,673	27,005	27,005
Bush Lake	935	990	990	234	235	235	32,500	32,833	32,804
Colorado Pond	689	694	694	333	332	332	55,803	55,981	55,955
France Ave.	188	188	188	139	139	139	21,825	21,762	21,762
Hampshire Pond	985	1,320	1,277	686	771	746	151,437	182,043	178,858
Hopkins Road	555	558	533	362	359	341	68,772	68,424	63,377
Lower Nine Mile Creek	1,127	1,141	1,135	713	707	702	115,662	115,224	114,349
Marsh Lake	432	438	438	232	231	230	38,288	38,070	38,046
Minnesota River Direct	6,719	6,845	6,820	540	558	541	80,548	85,432	83,903
Overlook Lake	406	429	424	311	314	310	55,615	56,764	56,080
Oxboro Lake	2,408	2,411	2,408	1,684	1,619	1,616	389,452	366,843	366,530
Penn Lake	1,298	1,299	1,279	810	798	779	149,529	146,746	145,576
Riley Purgatory	888	946	946	534	535	535	91,535	91,803	91,802
Skriebakken	845	851	830	475	471	457	87,021	86,173	82,410
Smith Pond	1,653	1,668	1,641	1,216	1,192	1,171	240,600	232,638	227,211
South Glen	679	684	681	434	428	426	76,758	75,404	75,086
Upper Nine Mile Creek	3,406	3,489	3,471	1,093	1,081	1,066	208,196	203,266	201,877
West Marsh Lake	251	257	257	177	178	178	28,528	29,027	29,027
York Ave.	621	621	621	302	299	298	51,423	50,673	50,667
TOTAL	**25,848**	**26,678**	**26,448**	**11,508**	**11,461**	**11,269**	**2,185,388**	**2,174,774**	**2,146,838**

3.1 Average Annual Runoff Volume

Table 3-1 and Figure 3-1 show that the total average annual flow volume from the city has increased slightly since 1989. The majority of the city of Bloomington was already developed by 1989 and would likely not have been developed incorporating NURP water quality ponds before this time. However, this analysis assumes that the current regulations (NURP ponds) have no impact on volume reduction. Runoff volumes increased by 3.2 percent from 1989 to 2007 and it is expected to increase by another 0.7 percent by 2020, assuming the implementation of NURP ponds only. Figure 3-2 shows the breakdown of runoff volume contributions by basin within the city and the total increase of about 1,000 acre-feet between 1989 and 2020.

Current regulations require the implementation of NURP pond but the City and watershed districts currently do not have runoff volume standards in place to address runoff volumes from new and redevelopment within the city. However, the Nine Mile Creek Watershed District does have draft infiltration rules requiring infiltration of the first inch of runoff from new and redevelopment sites. The scenario evaluating volume reduction through infiltration from the present to 2020 (see Table 3-1) indicates that the implementation standards requiring infiltration of the first 0.5 inches of runoff for new and redevelopment within the city can reduce the expected runoff volumes by roughly 33 percent when compared to the loads estimated by the installation of NURP ponds only. Though runoff volumes can be reduced, the City will need to take further action to meet the baseline runoff volumes.

One alternative is the construction of several regional infiltration basins. As previously mentioned, Figure 2-4 shows the potential locations of the regional infiltration basins within the city of Bloomington, and Table 2-7 summarizes the conceptual modeling results of each infiltration basin, providing an estimate of the impact of regional infiltration on loads from the city of Bloomington as well as an estimate of the amount of acres that would require treatment to meet the baseline conditions for runoff volumes.

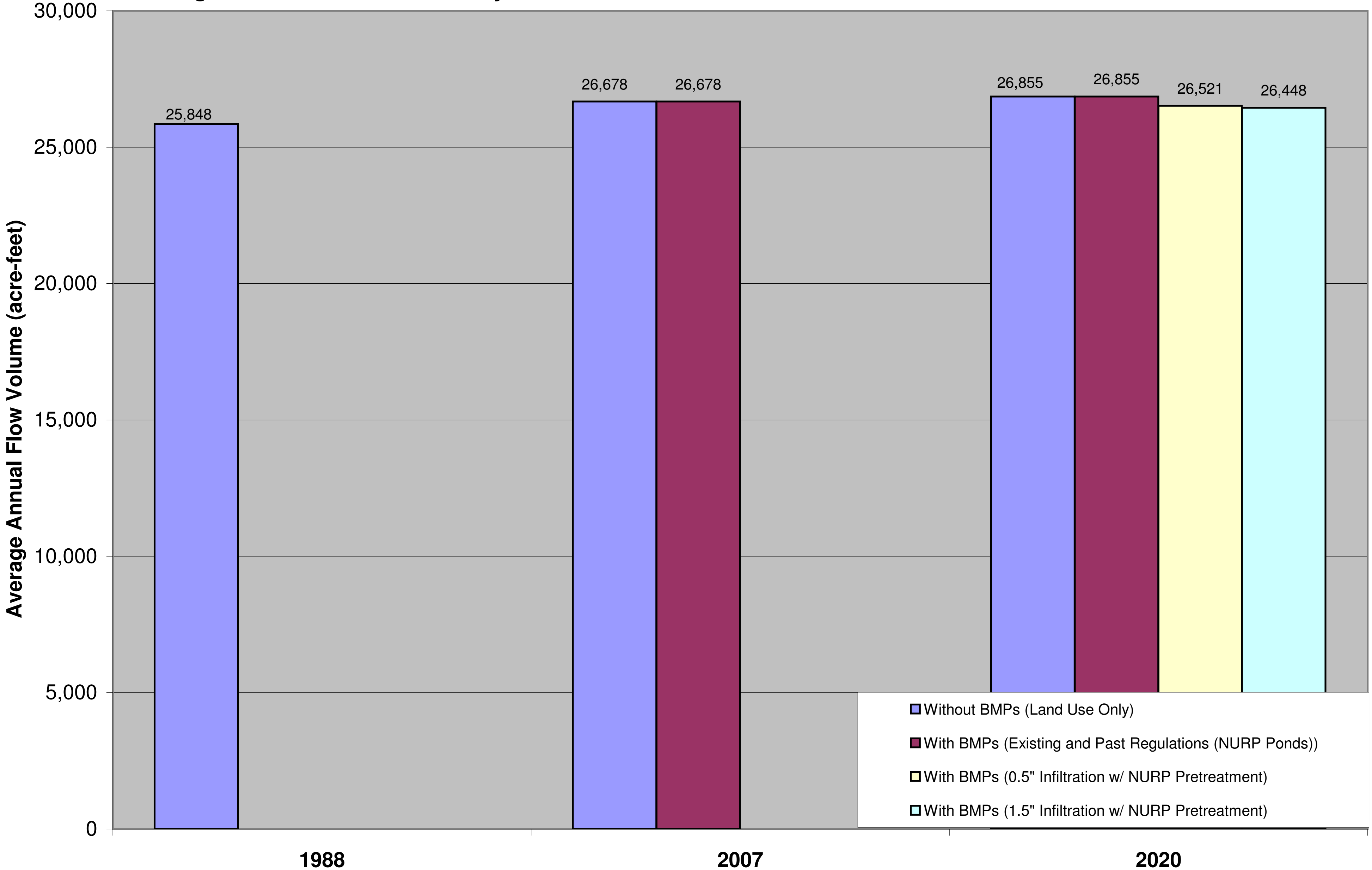
Another alternative to infiltrate the additional 673 acre-feet of runoff not managed through implementation of infiltration standards would be to implement small-scale infiltration measures, such as rainwater gardens, associated with neighborhood street reconstruction projects. These types of BMPs would further reduce the pollutant loads. The first 0.5 inches of runoff from about 1,130 acres of low density residential areas, or 12 percent of the low density residential areas in Bloomington, would need to be diverted to rainwater gardens to reduce the 2020 annual volume by 673 acre-feet. A similar reduction could be realized if runoff from 690 acres of high density residential (71 percent) or 500 acres of commercial area (27 percent) were diverted to infiltration facilities.

Additional alternatives to address runoff volumes in the city of Bloomington are related to the abstraction of stormwater. There are many opportunities at a variety of scales that can allow for reductions in stormwater runoff volumes through evapotranspiration, storage and reuse, and storage with restricted or delayed discharge. Use of native vegetation in landscapes, which typically has more developed root systems than turf grass, can promote the infiltration of runoff into the ground and uptake by plants can increase evapotranspiration. Roof downspouts can be directed into stormwater planters that provide storage of stormwater, promote evapotranspiration through the planted vegetation, and provide treatment of water infiltrating through the soils while also providing an opportunity to improve aesthetics. Similarly, rain barrels and cisterns can allow for the collection of runoff from small areas, such as residential roofs, for reuse, such as irrigation, or for improved infiltration into the soil with the slow release of the stored water. There is also the opportunity for the collection and storage of runoff at the development site scale in large underground storage tanks that can also be reused for irrigation or other uses.

The proposed development at 8200 Norman Center Drive provides an example of the use of a variety of runoff abstraction and infiltration practices. The proposed development includes an 11-story office complex with an adjacent parking ramp. This development has been designed to achieve the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standards. Part of the LEED certification process is related to site runoff and water management. This development has incorporated several rain gardens throughout the site along with including 97,000 gallons (approximately 0.35 acre-feet) of stormwater storage in a tank that will be constructed below the lowest floor of the parking ramp structure. This stored water will be used for site irrigation. Though this project will be constructed on a currently undeveloped site, it provides an example of variety of techniques that can be used to reduce the volume of runoff from both new development or redevelopment sites.

Finally, the Nine Mile Creek Watershed District has introduced the concept of volume banking. The District, in conjunction with participating municipalities, would provide a framework for those developments going above and beyond the District infiltration requirements to obtain volume credits. These credits would then be able to be sold to other permit applicants unable to achieve the infiltration requirements. The city of Bloomington could actively participate in this volume banking program and develop a process to obtain volume credits.

FIGURE 3-1
Bloomington Loading Assessment
Average Annual Flow Volume--City-Wide Basis



P:\Mpls\23 MN\27\2327G75\WorkFiles\PollutantLoadingModel\FINAL_Nondeg_Load_Assess_Results_TP_TSS_LU_70207_sas.xls: VolumeChart

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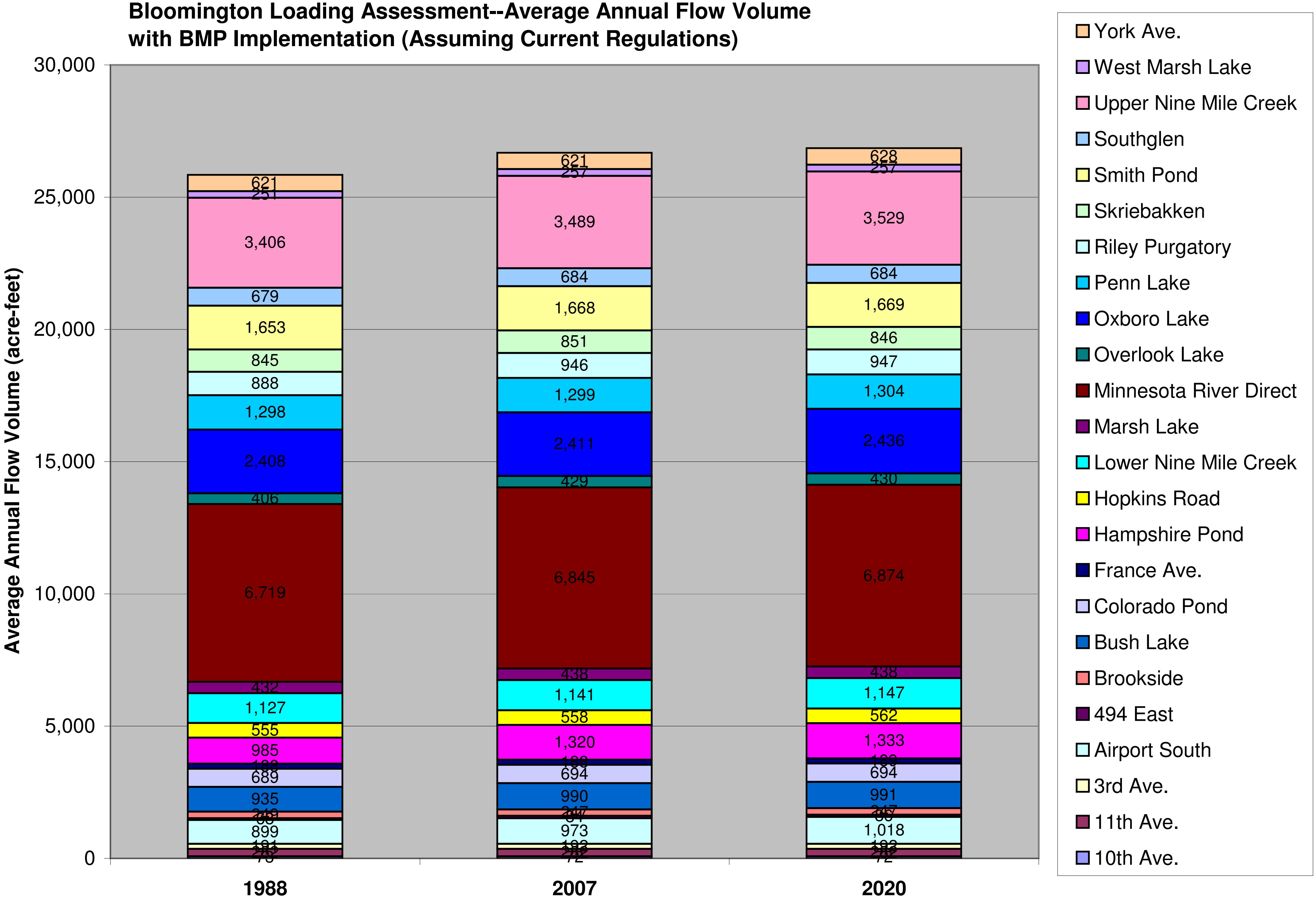
FIGURE 3-2
Bloomington Loading Assessment--Average Annual Flow Volume with BMP Implementation (Assuming Current Regulations)



P:\Mpls\23 MN\27\2327G75\WorkFiles\PollutantLoadingModel\FINAL_Nondeg_Load_Assess_Results_TP_TSS_LU_70207_sas.xls: StackedVolumeChart

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3.2 Total Phosphorus

Table 3-1 and Figure 3-3 show that the average annual TP loading from the city has increased since 1989 and would continue to increase slightly by 2020, without implementation of BMPs. As previously mentioned, the majority of the city of Bloomington was already developed by 1989 and would likely not have been developed incorporating NURP water quality ponds before this time. Table 3-1 shows that implementation of the NURP ponds within each of the city's watersheds has offset an increase in phosphorus load between 1989 and 2007. It is expected that the implementation of NURP ponds into the future will also help keep the total phosphorus loads in the future below baseline conditions, with 2020 TP loads expected to be about 2.1 percent lower than the estimated 1989 loads.

3.3 Total Suspended Solids

Table 3-1 and Figure 3-4 show that the average annual TSS loading from the city has increased since 1989 and would be higher by 2020, without implementation of BMPs. Table 3-1 and Figure 3-4 show that implementation of the NURP ponds within each of the city's watersheds has offset the increase in TSS load between 1989 and 2007 and resulted in an overall average annual TSS loading reduction in the city, compared to 1989 conditions.

Table 3-1 and Figure 3-4 also show that continued implementation of the NURP practices during new and redevelopment will continue to offset any estimated increases in watershed TSS loading between 2007 and 2020. Implementation of these practices will result in an overall TSS load decrease of 1.8 percent when compared to the 1989 TSS load.

FIGURE 3-3
Bloomington Loading Assessment
Total Phosphorus--City-Wide Basis

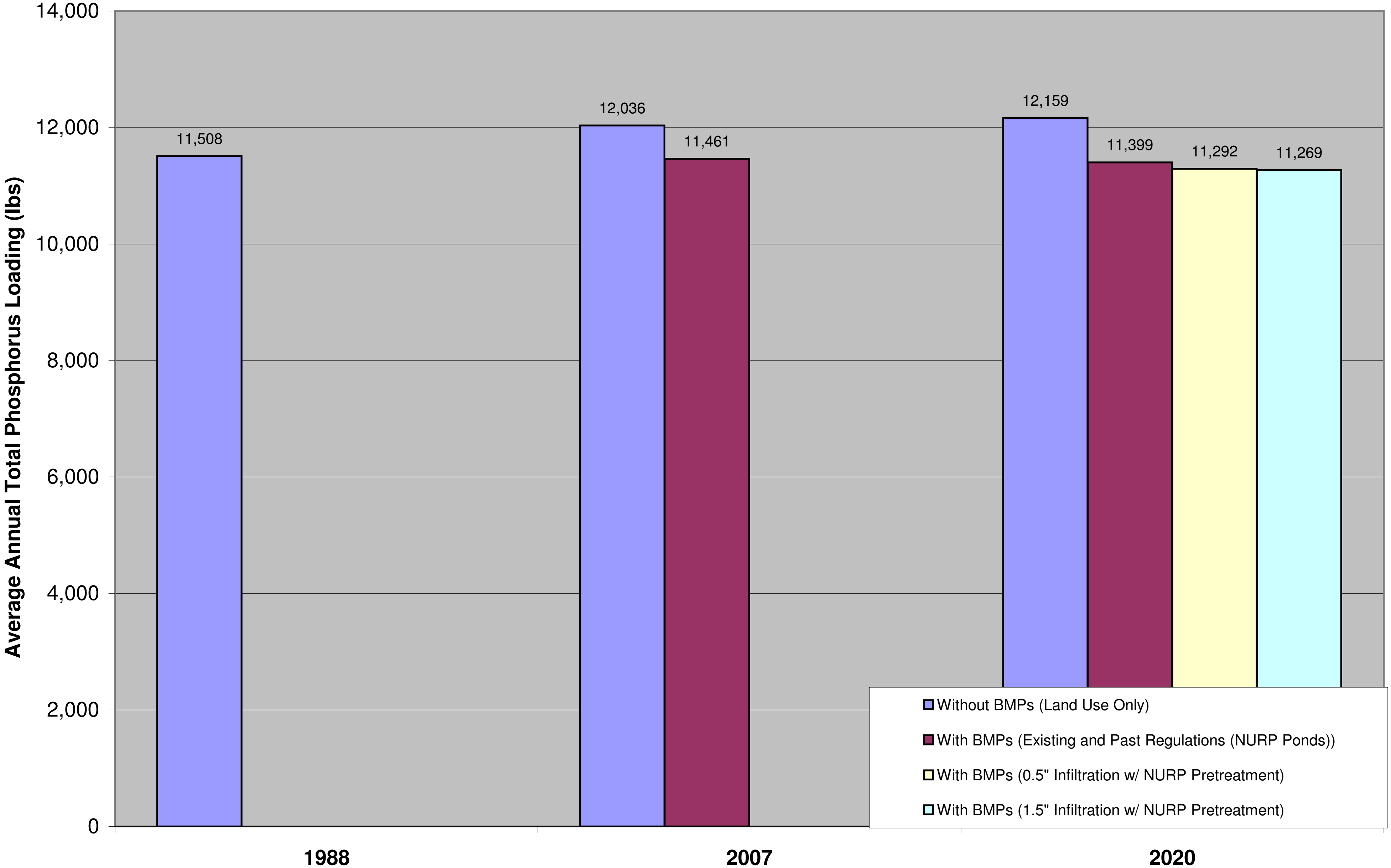
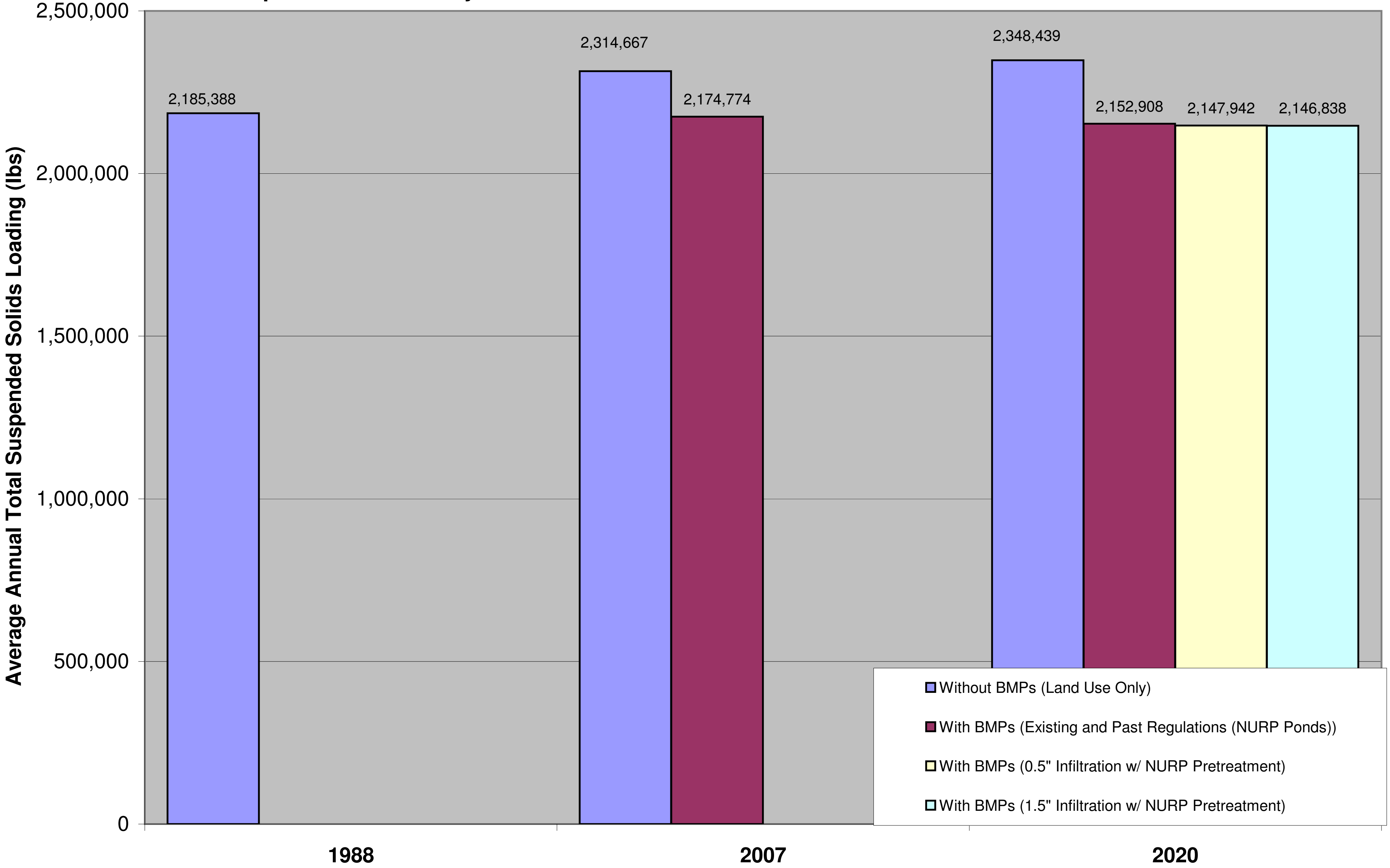


FIGURE 3-4
Bloomington Loading Assessment
Total Suspended Solids--City-Wide Basis



P:\Mpls\23 MN\27\2327G75\WorkFiles\PollutantLoadingModel\FINAL_Nondeg_Load_Assess_Results_TP_TSS_LU_70207_sas.xls: TSSChart

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3.4 Implications of Load Assessment Results

The results of the loading assessment indicate that, city-wide, the average annual flow volume loading estimates are only 3.9 percent higher in 2020 relative to the 1989 condition. The estimated increases in average annual flow volume constitute significant new or expanded discharges based on the Permit conditions. As discussed in Section 1.1.2 of this report, the Permit requirements state that a Nondegradation Report must be completed when Selected MS4s have significant new or expanded discharges, and upon approval, must incorporate its findings on BMPs that address nondegradation into their SWPPP. The BMPs should address changes in pollutant loadings as far as is reasonable and practical through future development. Additionally, the BMPs shall address, as far as is reasonable and practical, the negative impacts of increased stormwater discharge volumes that cause increased depth and duration of inundation of wetlands having the potential for a significant adverse impact to a designated use of the wetland, or changes in stream morphology that have the potential for a significant adverse impact to a designated use of the streams.

Since the city has experienced significant new or expanded discharges, the Permit requires that Bloomington prepare a Nondegradation Report that includes consideration of the Loading Assessment, which must include analysis of flow and may include removal of pollutants by BMPs already initiated.

4.0 Recommendations for Nondegradation Report

4.1 Water Quality Trend Analyses and Implications for Nondegradation Report

The results of the loading assessment indicate that, city-wide, the estimated TP loading is 0.4 percent lower in 2007 relative to the 1989 condition, after accounting for implementation of the applicable regulations. However, the average annual flow volume has increased by 3.2 percent during the same time period. As a result, the flow-weighted total phosphorus concentration of the runoff entering the receiving waters in the city would have decreased during the period between 1989 and 2007 and the receiving water quality would be expected to be maintained or improved during the same time period.

Appendix A of this report illustrates the results of the statistical trend analyses completed for lake water quality in each of the city lakes with a sufficient period of record of historical total phosphorus concentrations. For this report, the Mann-Kendall/Sen’s Slope Trend Test was used to determine water quality trends and their significance. To complete the trend test, the calculated summer average must be based on at least four measured values during the sampling season, and at least 5 years of data are required. A lakes’ water quality was considered to have significantly improved or declined if the Mann-Kendall/Sen’s Slope Trend Test is statistically significant at the 95 percent confidence interval.

Table 4-1 summarizes the results of trend analyses performed on a number of lakes within the city of Bloomington. Results show that statistically significant trends did not exist for Bush, Hyland, and Southeast Anderson Lakes. Trend analyses have not been completed for Normandale and Penn Lakes because of insufficient long-term total phosphorus data.

Table 4-1 Summary of Trend Analyses of Total Phosphorus in Lakes within Bloomington

Lake	Dates of Available TP Data	Statistically Significant Trend?
Normandale Lake	1990, 2002, 2005, 2006	No Trend Analysis Done (insufficient data)
Bush Lake	1975, 1982-1986, 1988, 1993, 1995, 2000-2001, 2004, 2006	No
Penn Lake	1973, 1979, 1980, 1990, 2001	No Trend Analysis Done (insufficient data)
Hyland Lake	1979-1981, 1988, 1990, 1992-1993, 1996, 1998, 2001-2002, 2004-2006	No
Southeast Anderson Lake	1988, 1991, 1996, 2000-2001	No

The results of the trends analyses are consistent with what would be expected for receiving water quality given the fact the flow-weighted TP concentration in the runoff entering the receiving waters, city-wide, would have decreased during the period between 1989 and 2007 and the receiving water quality would not be expected to degrade during the same time period. As a result, the trend analyses indicate that the NURP pond level of BMP treatment has likely ensured that the City can demonstrate that they have not degraded the receiving water quality for lakes, streams and wetlands due to new or expanded discharges of stormwater. Therefore, to satisfy the remaining Permit requirements, it is recommended that the Nondegradation Report focus special attention on addressing the concerns that the MPCA, public, and local water authorities might have about the increases in average annual runoff volume and its potential impacts on stream morphology and wetlands due to increased depth and duration of inundation.

4.2 Implications of Impaired Waters for Addressing Expanded Discharges in Nondegradation Report

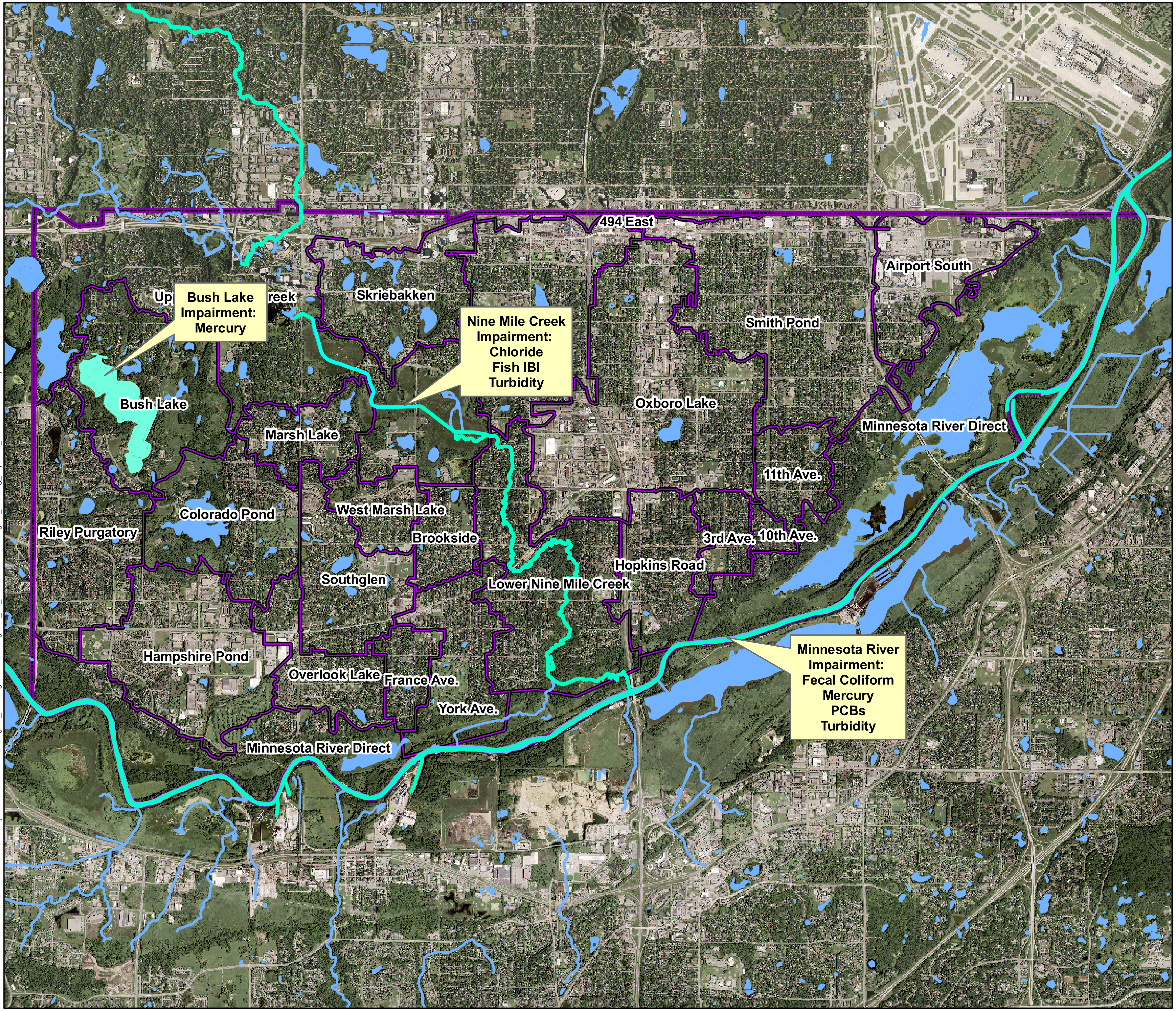
Figure 4-1 shows the receiving waters in the city that have been included on the 2006 MPCA 303(d) Impaired Water List because they do not meet the MPCA's water quality standards. There are only three water bodies in Bloomington listed and they include Bush Lake (listed for mercury), Nine Mile Creek (listed for chloride, fish IBI, and turbidity), and the Minnesota River (listed for fecal coliform, mercury, PCBs, and turbidity).

The U.S. Environmental Protection Agency (EPA) requires that the MPCA develop and submit Total Maximum Daily Load (TMDL) studies for each water body that they have on the impaired waters list. TMDL studies are used to determine what the maximum allowable pollutant loadings are for each water body without exceeding the water quality standards. The allowable pollutant loading is then allocated to each of the NPDES-permitted (including MS4s) and non-regulated sources of pollutants in the watershed.

Figure 4-1 shows that Nine Mile Creek is on the impaired waters list for chloride, turbidity, and biota-fish. The listing for Nine Mile Creek for turbidity may be the result of excess nutrient inputs. However, recent turbidity and fish biota data may lead to the Creek being delisted for these two impairments. Nine Mile Creek Watershed District is currently working with the MPCA to address this issue.

Although the Minnesota River is also listed on the impaired waters list, the city of Bloomington is a very small portion of the entire contributing watershed and load reductions within the City will likely have an insignificant impact on the overall quality of the Minnesota River. Additionally, it is important to note that the estimated current and future TP and TSS loads from the city of Bloomington are actually lower than the estimated loads from the City in 1988.

It is conceivable that the pollutant load allocations developed as part of future TMDL studies will dictate that the City will need to provide further loading reductions, beyond those currently projected in the nondegradation load assessment. As a result, it is recommended that as part of the development of the reasonable and practical BMPs for the Nondegradation Report, the City be cognizant of the potential implications of future TMDL allocations associated with the impaired waters that are receiving stormwater discharge.



Legend

- City Boundary
- Drainage Basins
- Streams
- Water Bodies
- Impaired Waters
- Impaired Streams

N

Feet

4,500 0 4,500

Figure 4-1
Impaired Waters

Bloomington Nondegradation Study
City of Bloomington, MN

4.3 Remaining Points to Address in Nondegradation Report

Since the City will be required to prepare a Nondegradation Report that includes consideration of the Loading Assessment, the following Permit requirements will also have implications for preparation of the Nondegradation Report:

- Local stormwater management plans and other pertinent factors may also be considered.
- BMPs implemented by other parties may be considered when those BMPs affect the stormwater from the area of the city.
- If the pollutant loadings cannot be reduced to levels consistently attained in 1989, the Nondegradation Report must describe reasonable and practical BMPs that the City plans to incorporate into a modified SWPPP. The City must consider alternatives, explain which alternatives have been studied but rejected and why, and propose alternatives that are reasonable and practical.
- The Nondegradation Report must give high priority to BMPs that address impacts of future growth, such as ordinances for new development. Where increases in pollutant loading have already occurred due to past development, the Nondegradation Report must consider retrofit and mitigation options (BMPs) that the city determines to be reasonable, practical and appropriate for the community.
- The City is responsible for developing any site-specific cost/benefit, social, and environmental information that they wish to bring to the Agency's attention.
- The City must incorporate the BMPs into a modified SWPPP and include an implementation schedule that addresses new development and retrofit BMPs it proposes to implement.

4.4 Recommendations for Using Load Assessment Modeling

As discussed in Section 2.3 of this report, the load assessment modeling consisted of a simplified approach that combined the results of the P8 modeling for the NURP pond level of BMP treatment with the Simple Method equations in a spreadsheet specifically developed to incorporate the land use/land cover information generated from GIS. Individual worksheets were developed in the spreadsheet for each of the three time periods of interest that determined the TSS, TP and volume contributions with the Simple Method equations. Another worksheet in the spreadsheet file contained the results of the P8 modeling that assessed the benefit that current and project future BMP implementation would have on the flow, TP and TSS loadings within the city limits for developments based on the design criteria examples that were indicative of the ordinances and design standards that were in place by the City, the watershed management organizations, the Wetland Conservation Act and the MPCA when development was supposed to occur. This same worksheet contains the remaining assumptions and inputs described in Section 2.3 of this report. Another worksheet was developed to combine all of the information generated from the Simple Method calculations in the worksheets for each time period with the results of the P8 modeling and calculate and summarize the volumes and TP and TSS loadings shown in Table 3-1.

Any changes that are necessary for the modeling should be made in the spreadsheet, following necessary changes to the GIS files or additional P8 models of BMP design criteria examples. The spreadsheet, GIS and P8 modeling files will be included as project deliverables for the City.

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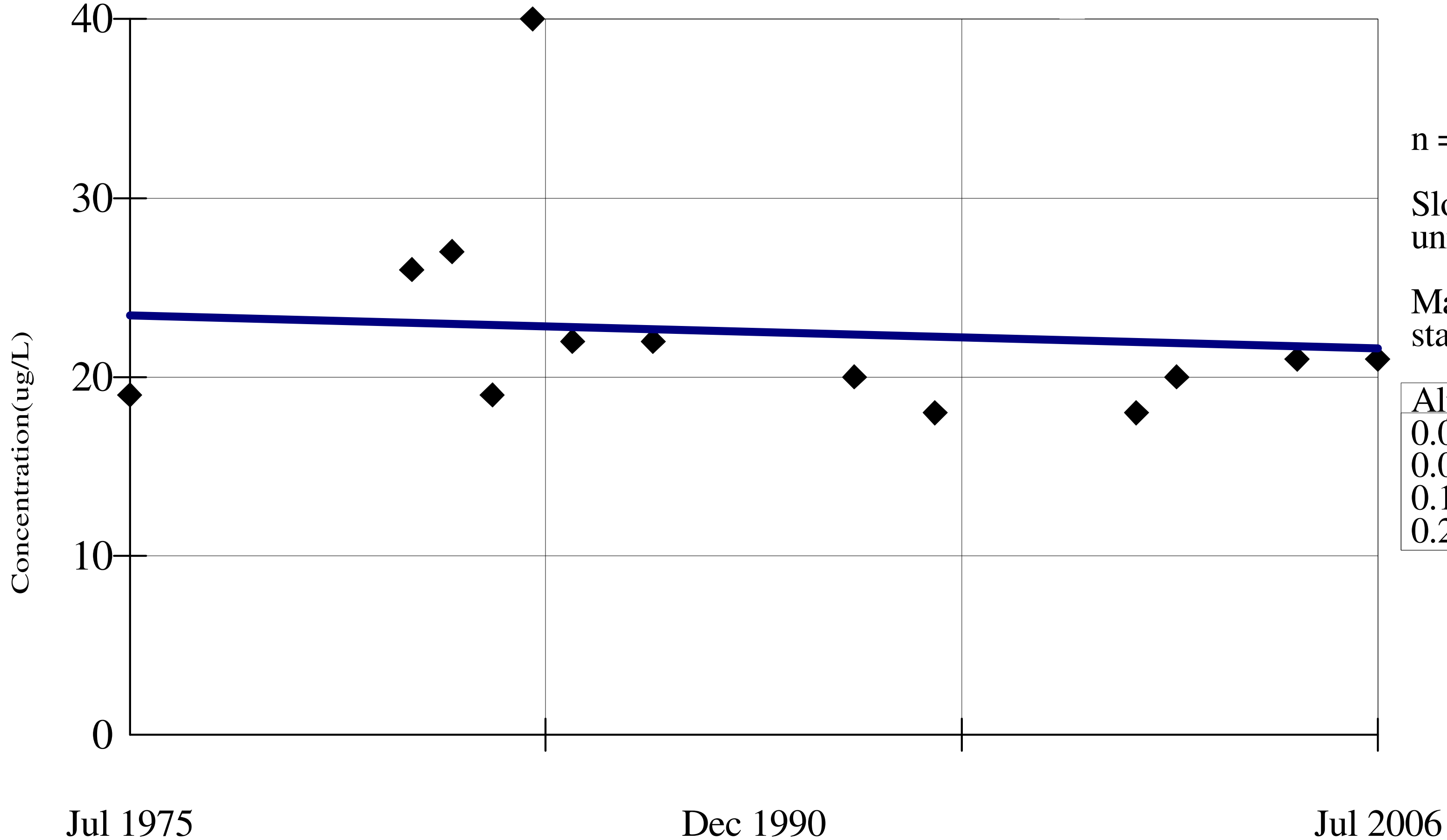
Appendices

Appendix A

Lake Water Quality Trend Analyses

SEN'S SLOPE ESTIMATOR
Bush



n = 13

Slope = -0.059 units per year.

Mann Kendall statistic = -15

Alpha	Critical	Signif.
0.01	-43	No
0.05	-34	No
0.1	-29	No
0.2	-23	No

Constituent: TP (ug/L)

Facility: Lake Trend Analysis

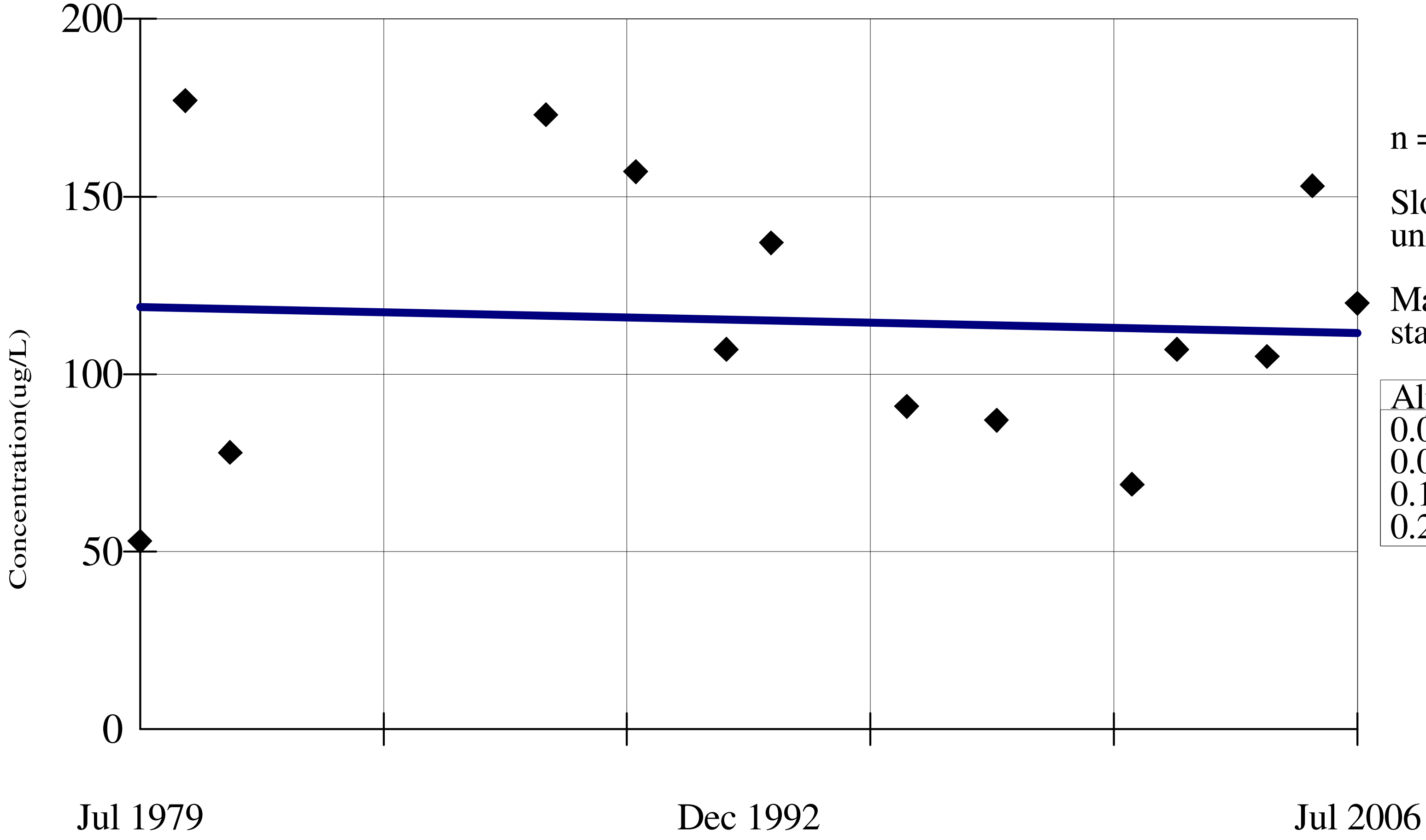
Data File: BUSH

Date: 7/2/07

Time: 11:05 AM

View: Bush_Trend

SEN'S SLOPE ESTIMATOR
Hyland



n = 14

Slope = -0.266 units per year.

Mann Kendall statistic = -4

Alpha	Critical	Signif.
0.01	-48	No
0.05	-37	No
0.1	-32	No
0.2	-25	No

Constituent: TP (ug/L)

Facility: Lake Trend Analysis

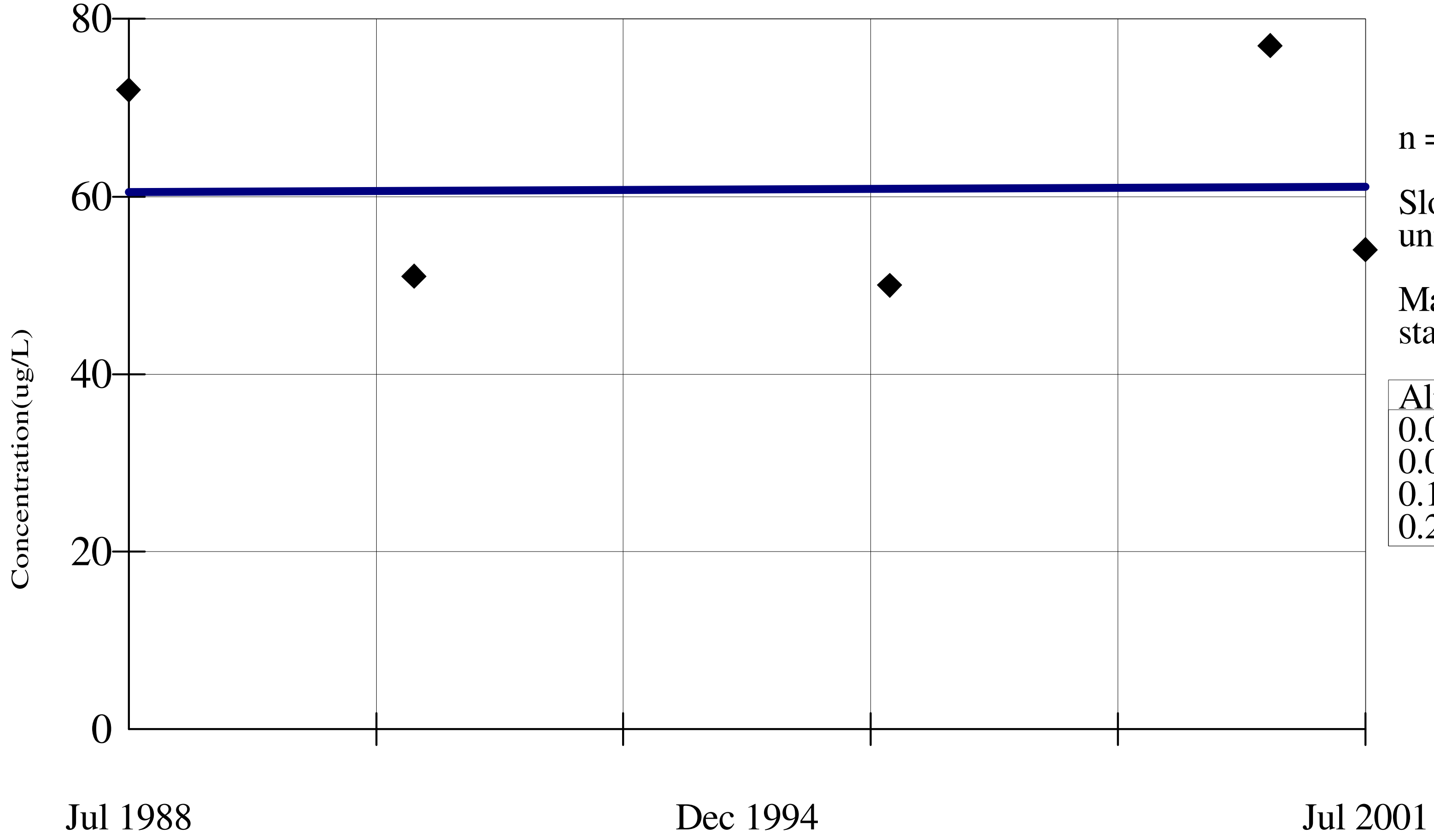
Data File: HYLAND

Date: 7/2/07

Time: 11:07 AM

View: Hyland_Trend

SEN'S SLOPE ESTIMATOR
SEAndrs



n = 5

Slope = 0.05
units per year.

Mann Kendall
statistic = 0

Alpha	Critical	Signif.
0.01	12	No
0.05	10	No
0.1	8	No
0.2	7	No

Constituent: TP (ug/L)

Facility: Lake Trend Analysis

Data File: SEANDRSN

Date: 7/2/07

Time: 11:08 AM

View: SEAnderson_Trend