LMR WMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

FEASIBILITY STUDY

MISSISSIPPI RIVER DIRECT DRAINAGE

December 13, 2024

Prepared for:

Lower Mississippi River WMO

4100 220th St. West, Suite 102

Farmington, MN 55024

WSB PROJECT NO. 024938-000

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Certification Sheet

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

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Date: December 13, 2024 Lic. No. 50820

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1. Executive Summary

Study Purpose and Need

The Lower Mississippi River WMO (LMRWMO) selected WSB to complete an engineering study of the Mississippi River Direct Drainage Area (MRDDA). The MRDDA is the area which drains directly to the Mississippi River within six of LMRWMO's member cities: Lilydale, Mendota Heights, St. Paul, West St. Paul, South St. Paul, and Inver Grove Heights. The MRDDA was a high-priority study area for the LMRWMO for the following reasons:

- Potential for erosion in existing ravines and bluff areas which adds sediment and pollutants to the Mississippi River
- High volumes of urban stormwater generated due to fully or nearly fully developed member communities
- Limited opportunities for treatment of urban stormwater due to limited land availability, land use conflicts, and topographic and geological limitations

On a regional basis, the section of the Mississippi River which forms the boundary of the MRDDA drains to Lake Pepin and has an approved Total Maximum Daily Load (TMDL) for both Total Suspended Solids (TSS) and Nutrients, which includes phosphorus. Water quality improvements will need to happen throughout the drainage area in order to achieve the targeted water quality standards and achieve outcomes such as reducing algal blooms and decreasing the rate of sedimentation which is filling in Lake Pepin.

As part of achieving pollutant reductions which will improve water quality in the Mississippi River and Lake Pepin, LMRWMO wished to determine what issues exist within the study area and what projects could be completed to reduce loading of sediment and phosphorus to the Mississippi River from the study area. This report describes the issues within the study area, presents recommendations for future action by both LMRWMO and member cities, and accelerates some recommendations by completing concept designs for certain BMPs. It is intended to serve as a prioritization and guidance document for both the LMRWMO and member cities as they plan future projects and complete ongoing capital improvement projects.This study also positions the LMRWMO and member cities to pursue grant opportunities as they are made available in the future.

Study Methodology

Following a holistic review of tributary subwatersheds, WSB analyzed the MRDDA watershed to determine locations for potential new stormwater BMPs and potential areas of erosion issues due to bluff formations, ravines, and steep slopes. WSB completed site visits to nineteen locations for site assessments and BMP analysis. From these nineteen sites WSB worked with the staff of LMRWMO and member cities to select nine sites to proceed to concept design.

During the concept design phase WSB completed cost estimates and estimated pollutant load reductions for each site. WSB also developed a decision matrix to rank projects on drainage area treated, removal efficiency for total phosphorus and total suspended solids, volume reduction capability and constructability. Table 1.1 below shows the nine concept designs and their estimated life cycle costs as ranked by the decision matrix. This table is intended to help LMRWMO and member cities prioritize concept designs developed in this study for grant funding, capital improvement planning, and future construction.

Next Steps

Overall the concept BMP designs within this study are meant to provide the LMRWMO and member cities with options for installing water quality projects that help meet load reduction goals laid out in the TMDL studies. These concept designs could either be constructed via stand-alone designs or be added on to existing public works or infrastructure projects. All concept designs within this report will need further engineering and design, as well as public input from regulatory agencies and community stakeholders.

Table 1.1 – Concept Design Summary									
Concept Design Name	City	BMP Type	Life Cycle Cost	Drainage Area Treated (ac) *Ranked 1-3*	Volume Reduction Capability Score *Ranked 0-2*	TSS Removal Efficiency *Ranked 1-5*	TP Removal Efficiency *Ranked 1-5*	Constructability *Ranked 1-3*	**Total Score**
Gisch Pond	Inver Grove Heights	Stormwater Pond	$3,441,479	3	0	5	4	3	**15**
Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	$278,810	1	1	4	4	1	**11**
St. John Vianney	South St. Paul	Infiltration/ Filtration	$490,814	1	1	4	3	2	**11**
West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	$276,074	1	1	4	1	2	**9**
City Pool Park	West St. Paul	Infiltration/ Filtration	$380,114	1	1	4	2	1	**9**
IGH Structural BMPs	Inver Grove Heights	Structural BMP	$760,869	3	0	1	1	3	**8**
Maltby Street Outlet	South St. Paul	Structural BMP	$1,173,278	3	0	1	1	2	**7**
Kennedy Park	West St. Paul	Structural BMP	$166,120	2	0	1	1	3	**7**
Alabama Street Outlet	St. Paul	Structural BMP	$670,970	2	0	2	1	2	**7**

2. Purpose and Background

2.1 Study Purpose

The Lower Mississippi River WMO (LMRWMO) selected WSB to complete an engineering study of the Mississippi River Direct Drainage Area (MRDDA) within the LMRWMO boundaries in March 2024. The boundaries of the MRDDA are shown in Figure 2.01 along with the boundaries of member cities within the LMRWMO. The LMRWMO, along with its Board and member cities, saw the need for a study which discussed the following issues:

- A comprehensive view of the Mississippi River direct drainage area which would result in an understanding of existing erosion issues and areas where stabilization projects may be needed to improve water quality or protect existing infrastructure.
- Identifying locations for large scale Best Management Practices (BMPs) within the Mississippi River direct drainage area which would result in water quality improvements
- Planning for projects which contribute to the health and improvement of the Mississippi River on a watershed basis.
- Completing concept plans for select projects to address existing erosion issues or implement water quality improvements which would help position LMRWMO and member cities to obtain grant funding for future project implementation.

2.2 Background Information

WSB reviewed the following documents, projects, and studies for additional context on the Mississippi River Direct Drainage Area.

- South Metro Mississippi River Total Suspended Solids Total Maximum Daily Load (Minnesota Pollution Control Agency, October 2015). This report provides the basis for WLA calculations for all the cities included in the study area.
- Lower Mississippi River WMO Watershed Restoration and Protection Strategy (WRAPS) and Total Maximum Daily Load (TMDL) Report. (Minnesota Pollution Control Agency, September 2014). Provides TMDL and water quality information for Pickerel Lake within the study area.
- Cherokee Heights Ravine Stabilization Design Presentation (Joe Barten and Nathan Campeau, presentation to MN Water Resources Conference, October 2021). Presentation describing past ravine stabilization and stormwater treatment projects completed by LMRWMO and City of St. Paul in 2018 and 2019.

- Cherokee Heights Culvert Analysis and Erosion Control Feasibility Study (Barr Engineering, April 2015). This report was one of the studies used in the Cherokee Heights Ravine Stabilization design and provides historical and geological context for the Brickyard Trail and Cherokee Park area.
- Brickyard Area of Lilydale Regional Park; Stormwater Management and Slope-Stability Analysis. (Barr Engineering, January 2015). Provides geotechnical analysis of slope stability in the Brickyard Trail and recommends stabilization options, some of which have been installed since the report was written.
- City of Inver Grove Heights Pollutant Load Analyses (Dakota SWCD, June 2011). This report provides analysis of stormwater pollutant loading for three subwatersheds in Inver Grove Heights that are included in the study area.
- Pine Bend Ravine Presentation, November 30, 2021. This presentation by Joe Barten to the LMRWMO board describes the results and recommendations of studies by Barr Engineering and Calyx Design Group regarding ravine erosion in Pine Bend Bluff Scientific & Natural Area.
- Lexington Avenue – Trunk Highway 13 Drainage and Erosion Feasibility Study (Barr Engineering, July 2010). This report provides information on past erosion issues along Highway 13 in Lilydale, particularly focusing on issues at Lexington-Riverside Condominums and Overlook Condominiums, as well as proposed solutions.

3. Watershed Analysis

WSB reviewed multiple datasets within the study area to determine possible locations for erosion stabilization and BMP projects.

3.1 Study Area Characteristics

The LMRWMO determined the boundaries of the study area as part of defining the project scope. The Mississippi River Direct Drainage Area (MRDDA) is shown in Figure 2.01. The MRDDA is located in both Ramsey and Dakota Counties within Minnesota. The Mississippi River forms the boundary of three sides of the study area, and all land within the study area drains to the Mississippi River either directly (overland flow) or indirectly via existing municipal storm sewers which use the Mississippi River as their final outfall.

There are six municipalities which make up the MRDDA: Lilydale, West St. Paul, Mendota Heights, St. Paul, South St. Paul, and Inver Grove Heights. All of these communities are nearly fully developed and do not have significant areas of agricultural or natural land use, though there are many parks, public natural areas, and land use restrictions in place which preserve remnants of the historic river corridor.

3.1.1 Hydrology and Floodplains

The Mississippi River is the defining hydraulic feature of the study area and is the receiving water for stormwater outfalls within the study area. The Federal Emergency Management Agency (FEMA) has delineated federally recognized floodplains within the study area which are shown in Figures 3.1.1A and 3.1.1B.

3.1.1.1 Study Area Floodplains

There are two types of Special Flood Hazard Areas. The regulatory floodway is the most intensely managed floodplain area and serves as the primary conveyance for sources of riverine flooding. The remaining Special Flood Hazard area is the floodplain, defined as the area with a 1% annual chance of flooding. Areas with a 0.2% annual chance of flooding are also delineated, and areas protected from flooding by levees in St. Paul, South St. Paul, and Inver Grove Heights are also visible.

From a stormwater perspective, WSB received requests from city staff to avoid placing above-ground BMPs within Special Flood Hazard Areas, as floodwaters would likely fill them with sediment and cause maintenance issues. River banks within the floodway and floodplain are active systems with areas of both erosion and deposition, but most Mississippi River banks within the study area are managed by state or federal agencies to preserve the stability of the river as a shipping and recreational channel.

3.1.2 Topography, Geology, and Soils

3.1.2.1 Study Area Topography and Slopes

The Mississippi River forms the boundary of three sides of the study area and bluffs are a primary topographic feature of the study area. The existing bluffs within the study area were carved by the River Warren, which drained the glacial Lake Agassiz following the retreat of the Laurentide Ice Sheet.

Because the study area was defined as areas which drain directly to the Mississippi River, the direction of drainage varies depending on the location within the study area. Within Lilydale and the small amount of Mendota Heights included within the study area, the general direction of drainage is to the west and north. Within the City of St. Paul and Ramsey County, the direction of drainage is primarily to the north, circling around to the east as the Mississippi River bends to the south. For South St. Paul and Inver Grove Heights, drainage to the Mississippi River is primarily to the east.

Calculating the slope of the land clearly marks drainage patterns as well as the presence of historic bluffs and other geologic features. Figures 3.1.2A and 3.1.2B show the percent slope of the existing ground based on 2022 Dakota County LiDAR. A 100% slope is equivalent to a 45 degree angle, or a rise of 1 foot vertical to 1 foot horizontal. A slope of greater than 100% is indicative of a bluff feature, which is often nearly vertical. The bluffs east of Pickerel Lake in Lilydale and along Plato Boulevard / Wabasha Street in St. Paul are visible in Figure 3.1.2A, as well as Simon's Ravine in South St. Paul. Figure 3.1.2.B shows the bluff geology in Pine Bend Bluff Scientific and Natural Area (SNA) as well as smaller steep formations along River Road and Concord Avenue in Inver Grove Heights.

WSB used topography and slope data when identifying sites to visit by noting the presence of bluffs and ravine developments on the slope figures, where they are clearly visible in shades of yellow, orange, and red. These sites were selected for further desktop review as well as consultation with city staff about any documented issues of erosion or sedimentation.

3.1.2.2 Study Area Soils

Figures 3.1.3A and 3.1.3B show the hydrologic soil groups within the study area. Per the USDA which assigns the classification as part of their Soil Survey Geographic Database (SSURGO), hydrologic soil groups indicate the amount of runoff that can be expected from a soil type under saturated conditions. Soil group A has high infiltration rates and yields little runoff, typically consisting of well-drained sands or gravels. In contrast, soil group D has very slow infiltration rates and may consist of clays, shallow soils over impervious layers and/or bedrock, or soils with a high permanent water table. When assessing sites for stormwater management, particularly infiltration, soil group A has the highest infiltration capacity and soil group D has the lowest.

Figures 3.1.3A and 3.1.3B show that large areas of St. Paul, South St. Paul, and West St. Paul have soil polygons which are listed without an assigned hydrologic soil group. These areas were likely highly developed before the area's soil survey was completed and have not been surveyed in detail. Stormwater projects within these areas or elsewhere where hydrologic soil groups have not been previously estimated should include soil borings or other subsurface exploration to indicate the capacity of local soils to provide infiltration.

WSB used soil maps to assess the suitability of potential project sites for infiltration if the site was located outside the karst buffer (see Section 3.1.3). Where no information on existing soils is available, any stormwater project should plan for soil borings as part of the design process.

3.1.3 Karst

Karst is a landscape formed by the dissolution of a layer or layers of soluble bedrock, most frequently layers such as limestone or dolomite, by the reaction of the rock with acidic water.[1] This water can be directly applied to exposed rock via rainfall or surface runoff or through the subsurface movement of groundwater. When subterranean rock dissolves it can contribute to cave formation and development of sinkholes underneath areas of significant groundwater flow or infiltration of surface runoff. The Minnesota Construction Stormwater Permit prohibits infiltration of stormwater runoff within 1,000 feet upgradient or 100 feet downgradient of active karst[2] features.

3.1.3.1 Karst and Karst Buffers Within Study Area

Figures 3.1.4A and Figure 3.1.4B show the presence of mapped karst formations within the study area as well as buffers showing the 1,000-foot and 100-foot distances noted in the Minnesota Construction Stormwater Permit. Karst has a significant presence in the study area boundaries within the cities of Lilydale, St. Paul, and South St. Paul and a moderate presence in Inver Grove Heights. The Minnesota Stormwater Manual also notes that karst geology makes up approximately 20 percent of the land surface in the United States. This is slightly higher than the percentage of the study area containing karst geology, which is approximately 12 percent of the total study area. However, when the required buffers are applied, approximately 30 percent of the total study area is within the 1,000 foot buffer, making approximately 1/3 of the study area unsuitable for stormwater treatment which uses infiltration. WSB used this

[1] Definition of karst is from the Minnesota Stormwater Manual section on karst - https://stormwater.pca.state.mn.us/index.php/Karst

[2] Active karst is currently defined by the Minnesota Stormwater Manual as having "distictive landforms and hydrology created primarily from the dissolution of soluble rocks within 50 feet of the land surface."

information to guide site selection for site visits as well as determine suitable treatment types by site.

3.2 Existing Infrastructure

3.2.1 Stormwater

All six municipalities located within the study boundaries operate municipal separate stormwater systems (MS4s) designed to drain roadways, ditches, and other public infrastructure. WSB has access to information about these networks through its DataFi system and can usually find information such as pipe size, pipe material, and flow direction. If information was not available in DataFi, WSB requested as-built information directly from cities. Figures 3.2.1A and 3.2.1B show the existing storm sewer system as well as outfalls to the Mississippi River that are larger than 42” in diameter. WSB looked for locations where stormwater systems had outlets to the Mississippi River that might be prone to erosion and also requested that city staff indicate if there were any known erosion issues at Mississippi River outfalls.

WSB also used the location of stormwater pipes to select sites for potential new BMP installations and to prioritize potential new BMP locations in areas which currently do not have any stormwater treatment options. WSB classified all mapped stormwater pipes as either treated (a pipe which eventually drains to an above-ground treatment structure such as a pond or stormwater basin), untreated (a pipe which does not drain to an above-ground treatment structure) or mixed (a pipe where treated and untreated stormwater are combined). Figures 3.2.2A and 3.2.2B show the results of the treatment mapping within the study area. WSB consulted these figures in order to site BMPs for untreated watersheds and to determine where stormwater pipes might be accessible for future BMP retrofits.

3.2.2 Public lands

Land ownership was an important consideration when planning site visits and looking for potential future project locations. WSB started by reviewing Dakota and Ramsey County parcel data and selecting all parcels owned by cities within the study area. These parcels are mapped in Figure 3.2.3A and Figure 3.2.3B.

WSB used this figure to guide the creation of a list of sites for site visits as well as concept designs for BMP stabilization, but WSB visited multiple locations that were either on private property, or on public property which is owned by public entities such as the State of Minnesota which is not mapped in Figures 3.2.3A and 3.2.3B. During the site visit planning WSB did not have to get access permission for most city-owned parcels, though if access required crossing private property WSB did attempt to contact landowners for permission to cross. Cities also do not need easements or land acquisitions to install BMPs on their own property which makes BMP design and installation faster and cheaper. Several cities also indicated during prioritization discussions that they would prefer to avoid impacts to private property during the project selection process (see Section 3.4 for further discussion on stormwater priorities by city).

3.3 Member City Priorities

During the site visits and concept design phase, WSB staff wanted to hear from cities about known stormwater and erosion issues in their communities as well as their stormwater management priorities. Collecting this information allowed WSB staff to

- Map and prioritize locations for site visits
- Consider the individual preferences of cities when proposing sites to advance to concept design
- Adjust concept designs to minimize impacts that city staff most wished to avoid.

WSB collected spatial data from cities using a webmap and information on stormwater management priorities using a survey for city staff to fill out.

3.3.1 Known Issues Mapping

WSB created a webmap where member cities could add points of known stormwater and erosion issues for the project team to consider for site visits. WSB sent a link to this webmap to member cities in April 2024 and considered all points provided by city staff when evaluating locations for site visits. Figure 3.3.1 shows all locations provided by city staff. These locations were given a high ranking during site visit planning due to the desire to document and potentially address known issues within member communities.

3.3.2 Stormwater Prioritization Survey

WSB sent the stormwater prioritization survey to member cities within the study area in June 2024. WSB received all survey responses by July 1, 2024. The survey consisted of the following questions:

1. Name and organization of survey respondent
2. What project characteristics do you want to prioritize in selecting stormwater sites for concept design? Please rank from highest to lowest.
    - Areas that have no existing BMPs or stormwater treatment
    - Total design and construction project cost
    - Aesthetic appeal to community members and stakeholders
    - Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed)
    - Environmental justice/providing value to underserved communities
    - Total life cycle cost (including annual maintenance)

- o Other (please explain in question 6)

3. What types of stormwater management do you want to prioritize? Please rank from highest to lowest.
   - o - Volume reduction (such as infiltration basins)
   - o - Sediment load reduction (such as ravine and/or bluff stabilization)
   - o - Stormwater Reuse (such as irrigation)
   - o - Filtration (such as filtration basins)
   - o - Structural BMPs (such as hydrodynamic separators or SAFL Baffles)
   - o - Other (please explain in question 6)
4. What stormwater management goals do you most want to achieve? Please rank from highest to lowest.
   - o - Reduced phosphorus loading
   - o - Reduced total suspended solids loading
   - o - Reduced stormwater volume
   - o - Rate control
   - o - Other (please explain in question 6)
5. Which impactsfrom constructing stormwater projects do you most wish to avoid? Please rank from highest to lowest.
   - o - Impacts to parks
   - o - Impacts to wetlands
   - o - Work on private property
   - o - Impacts to existing infrastructure (including but not limited to utilities, roads, and trails)
   - o - Removal of mature trees
   - o - Other (please explain in question 6)
6. Please explain any answers to “other” from questions 2-5 here.
7. Do you have any other comments or concerns to share with the Mississippi Direct Drainage project team?

3.3.3 Summary of Responses to Stormwater Prioritization Survey

Table 3.3 - Summary of Responses Received to Stormwater Prioritization Survey

Please enter your name and organization	What project characteristics do you want to prioritize in selecting stormwater sites for concept design? Please rank from highest to lowest.	What types of stormwater management do you want to prioritize? Please rank from highest to lowest.	What stormwater management goals do you most want to achieve? Please rank from highest to lowest.	Which impacts from constructing stormwater projects do you most wish to avoid? Please rank from highest to lowest.	Please explain any answers to "other" from questions 2-5 here.
Ryan Ruzek/Krista Spreiter Mendota Heights	Total life cycle cost (including annual maintenance); Areas that have no existing BMPs or stormwater treatment; Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed); Total design and construction project cost;Aesthetic appeal to community members/stakeholders;Environmental justice/providing value to underserved communities;Other (please explain in question 6);	Sediment load reduction (such as ravine and/or bluff stabilization);Volume reduction (such as infiltration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Filtration (such as filtration basins);Stormwater reuse (such as irrigation);Other (please explain in question 6);	Rate control;Reduced stormwater volume;Reduced total suspended solids loading;Reduced phosphorus loading;Other (please explain in question 6);	Work on private property ;Removal of mature trees;Impacts to wetlands;Impacts to parks;Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Other (please explain in question 6);	Karst geologic features my limit infiltration practices. Mendota Heights would prefer to infiltrate where feasible.
WSP	Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed); Total life cycle cost (including annual maintenance);Total design and construction project cost;Areas that have no existing BMPs or stormwater treatment;Environmental justice/providing value to underserved communities;Aesthetic appeal to community members/stakeholders;Other (please explain in question 6);	Volume reduction (such as infiltration basins);Sediment load reduction (such as ravine and/or bluff stabilization);Filtration (such as filtration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Stormwater reuse (such as irrigation);Other (please explain in question 6);	Reduced phosphorus loading;Reduced total suspended solids loading;Rate control;Reduced stormwater volume;Other (please explain in question 6);	Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Work on private property ;Impacts to wetlands;Impacts to parks;Removal of mature trees;Other (please explain in question 6);	Loss of Parking
Pat Murphy Saint Paul Public Works	Total life cycle cost (including annual maintenance); Total design and construction project cost;Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed);Areas that have no existing BMPs or stormwater treatment;Environmental justice/providing value to underserved communities;Aesthetic appeal to community members/stakeholders;Other (please explain in question 6);	Volume reduction (such as infiltration basins);Filtration (such as filtration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Sediment load reduction (such as ravine and/or bluff stabilization);Other (please explain in question 6);Stormwater reuse (such as irrigation);	Reduced phosphorus loading;Reduced total suspended solids loading;Reduced stormwater volume;Rate control;Other (please explain in question 6);	Removal of mature trees;Impacts to parks;Impacts to wetlands;Work on private property ;Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Other (please explain in question 6);	Saint Paul is not interested in stormwater reuse.
Kelsey Gelhar, South St. Paul	Total design and construction project cost; Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed);Total life cycle cost (including annual maintenance);Aesthetic appeal to community members/stakeholders;Areas that have no existing BMPs or stormwater treatment;Environmental justice/providing value to underserved communities;Other (please explain in question 6)	Volume reduction (such as infiltration basins);Sediment load reduction (such as ravine and/or bluff stabilization);Filtration (such as filtration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Stormwater reuse (such as irrigation);Other (please explain in question 6)	Reduced stormwater volume;Rate control;Reduced total suspended solids loading;Reduced phosphorus loading;Other (please explain in question 6)	Work on private property ;Impacts to parks;Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Removal of mature trees;Impacts to wetlands;Other (please explain in question 6)	NA
Jennifer Koehler (Barr Engineering on Behalf of the City of Lilydale, based on SWMP policies and recent comments from the City Council)	Total life cycle cost (including annual maintenance); Total design and construction project cost;Aesthetic appeal to community members/stakeholders;Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed);Areas that have no existing BMPs or stormwater treatment;Environmental justice/providing value to underserved communities;Other (please explain in question 6)	Sediment load reduction (such as ravine and/or bluff stabilization);Filtration (such as filtration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Stormwater reuse (such as irrigation);Volume reduction (such as infiltration basins);Other (please explain in question 6)	Rate control;Reduced total suspended solids loading;Reduced phosphorus loading;Reduced stormwater volume;Other (please explain in question 6)	Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Work on private property ;Removal of mature trees;Impacts to wetlands;Impacts to parks;Other (please explain in question 6)	City of Lilydale owns very little land (no city-owned parks, very small ROW) and most work would be implemented on private land (typically multifamily parcels with HOAs), so aesthetics are a big concern for the City Council as the HOAs need to buy off on anything done on their property. Because of shallow bedrock, the SWMP policies limit infiltration in much of Lilydale, especially north of TH13, though higher on the bluff (e.g. up by the Overlook Condos), infiltration may be possible. One of the big items in the SWMP and in ordinance is reducing uncontrolled discharge over the river bluff face/safe conveyance down the bluff (different than ravines, there are few ravines in Lilydale). Additionally, the City is small and extremely cost conscious as they have a very small annual operating budget.
City of Inver Grove Heights	Areas that have no existing BMPs or stormwater treatment; Total design and construction project cost;Cost effectiveness for pollutant reduction (dollars per pound of pollutant removed);Total life cycle cost (including annual maintenance);Environmental justice/providing value to underserved communities;Aesthetic appeal to community members/stakeholders;Other (please explain in question 6)	Sediment load reduction (such as ravine and/or bluff stabilization);Filtration (such as filtration basins);Volume reduction (such as infiltration basins);Structural BMPs (such as hydrodynamic separators or SAFL Baffles);Stormwater reuse (such as irrigation);Other (please explain in question 6)	Rate control;Reduced stormwater volume;Reduced total suspended solids loading;Reduced phosphorus loading;Other (please explain in question 6)	Impacts to wetlands;Impacts to existing infrastructure (including but not limited to utilities, roads, and trails);Impacts to parks;Work on private property ;Removal of mature trees;Other (please explain in question 6)	

Table 3.3 (above) shows a compilation of responses collected from cities during the stormwater prioritization survey.

Generally, cities indicated that cost and cost effectiveness were top priorities when selecting sites to move to concept design; three cities (Mendota Heights, St. Paul, and Lilydale) selected total life cycle cost as their top priority, West St. Paul selected cost effectiveness, and South St. Paul selected total design and construction cost. The top priority in Inver Grove Heights was providing treatment for areas without existing BMPs or treatment. Aesthetic appeal and environmental justice were consistently low priorities for all cities.

For types of stormwater management, three cities (Mendota Heights, Lilydale, and Inver Grove Heights) selected sediment load reduction as their top priority, while the other three cities (West St. Paul, South St. Paul, and St. Paul) selected volume reduction. Stormwater reuse was generally the lowest ranked type of stormwater management.

Finally, rate control was the highest ranked stormwater management goal for the majority of cities (Mendota Heights, Lilydale, and Inver Grove Heights). Reduced phosphorus loading was the highest ranked stormwater management goal for St. Paul and West St. Paul, and South St. Paul's top management goal was reduced stormwater volume.

WSB considered the ranking of impacts to be avoided on a city-specific and site-specific basis when considering project prioritization (see Section 5.4).

3.4 Site Visit Planning

WSB considered city priorities around stormwater management, watershed characteristics, and known erosion and stormwater issues when planning sites for the site visit. WSB's plan was to provide LMRWMO and member city staff with approximately 20 locations for site visits and discuss locations with them. City staff would have an opportunity to strike locations from the visit list before the site visits if they did not wish to proceed with further investigation into a project in that area.

The list of site visit locations discussed with LMRWMO and member city staff is shown in Table 3.4 and Figures 3.4.1 to 3.4.6. WSB's original list of site visit locations consisted of 27 sites. Three sites were selected based on stormwater network attributes such as pipe size and depth as possible locations for structural BMPs; since these BMPs would be underground and site suitability was based on attributes that are not visible aboveground, WSB did not plan to make a visit to these sites. City staff ultimately removed 8 sites from the list, meaning field reconnaissance site visits would include 19 sites.

Table 3.4 - Site Visit List			
SITE	**CITY**	**SITE VISIT (Y/N)**	**REASON IF NO SITE VISIT**
8020 Delano Ct E	Inver Grove Heights	N	City requested this site to be removed
8805 River Heights Way	Inver Grove Heights	N	City requested this site to be removed
Dawn Avenue	Inver Grove Heights	N	Site selected due to stormwater network attributes
Gisch Pond	Inver Grove Heights	Y	--
Ernster Park	Inver Grove Heights	Y	--
Dehrer Park	Inver Grove Heights	Y	--
Twin City Marina	Inver Grove Heights	Y	--
River Front Park	Inver Grove Heights	Y	--
Pine Bend Bluffs SNA	Inver Grove Heights	Y	--
Overlook Condominiums	Lilydale	Y	--
Highway 13 Bluff Inspections	Lilydale	Y	--
Highway 13 Slope Failure	Mendota Heights	Y	--
Brickyard Trail	Mendota Heights	Y	--
Alabama Street Outlet	Saint Paul	N	Site selected due to stormwater network attributes
Harriet Island Regional Park	Saint Paul	N	City requested this site to be removed
Cherokee Park Sledding Hill	Saint Paul	N	City requested this site to be removed
Our Lady of Guadalupe	Saint Paul	Y	--
Casa De Luz Church	Saint Paul	Y	City requested this site be removed
100 Grand Ave E	South St. Paul	N	City requested this site to be removed
2201 Congress St	South St. Paul	N	City requested this site to be removed
SSP Airport	South St. Paul	N	City requested this site to be removed

Maltby Street Outlet	South St. Paul	N	Site selected due to stormwater network attributes
St. John Vianney Church and Ravine	South St. Paul	Y	--
Grandview Park	South St. Paul	Y	--
Kaposia Landing	South St. Paul	Y	--
Simon's Ravine	South St. Paul	Y	--
Kennedy Park	West St. Paul	Y	--
City Pool Park	West St. Paul	Y	--
Harmon Park/Heritage Middle School	West St. Paul	Y	--
West St Paul Sports Complex	West St. Paul	Y	--

4. Field Reconnaissance

4.1 West St. Paul

WSB selected three sites for site visits in West St. Paul: Harmon Park, City Pool Park, and Kennedy Park. During pre-site visit meetings with City staff they approved the selection of all three sites and did not remove any sites from the visit list.

4.1.1 Harmon Park

Figure 4.1.1 shows the site visit map for Harmon Park. WSB staff visited Harmon Park in June 2024. WSB selected Harmon Park for a site visit because it was a city-owned parcel outside the karst buffer area, meaning infiltration would be possible on the site, and because there was an existing storm sewer trunk line running through the site which might be able to collect treated stormwater.

Upon arrival at Harmon Park, WSB staff determined that the runoff from the existing parking lot on the north side of the park was being treated via rain gardens. Further inspection indicated that this parking lot was a substantial portion of the impervious surface on the parcel and installing additional treatment structures was likely to have minimal benefit. Harmon Park did not proceed to concept design.

Photo 1 - Existing Rain Garden in Harmon Park

4.1.2 City Pool Park

Figure 4.1.2 shows the site visit map for City Pool Park. WSB staff visited City Pool Park in June 2024. WSB selected City Pool Park for a site visit because it was a city-owned parcel outside the karst buffer area, meaning infiltration would be possible on the site, and because there are two existing storm sewer lines running under West Moreland Avenue to the south and West Orme Street to the north. The presence of these two lines allowed for the possibility of running a stormwater structure between the two existing lines.

Photo 2 - Looking north from Moreland Avenue into City Pool Park

City Pool Park has an elongated open space to the west of an existing playground and paved trail. WSB determined that a potential infiltration/filtration basin could be installed in this area which was the top priority stormwater management type for the City of West St. Paul, and the project could be installed with minimal tree loss. City Pool Park was therefore selected for a concept design. The preliminary concept design for City Pool Park is discussed in detail in section 5.3.1.

4.1.3 Kennedy Park

Photo 3 - Looking north into Kennedy Park

Figure 4.1.3 shows the site visit map for Kennedy Park. WSB staff visited Kennedy Park in June 2024. WSB selected Kennedy Park for a site visit because it was a city-owned parcel with a fair amount of open space as well as an existing stormwater line running directly through the parcel from east to west. The parcel was also outside the karst buffer area, meaning infiltration would be allowable on the site.

During the site visit WSB determined that either a structural BMP or a infiltration/filtration basin would be suitable for this site. A structural BMP would have minimal impact on the public use of Kennedy Park but an infiltration basin would allow for volume reduction which was the top priority stormwater management type for the City of West St. Paul. The preliminary concept design for Kennedy Park will be discussed in detail in Section 5.3.2.

4.1.4 West St. Paul Sports Complex

Figure 4.1.4 shows the site visit map for West St. Paul Sports Complex. WSB staff visited West St. Paul Sports Complex in July 2024. City of West St. Paul staff suggested a stormwater installation in the West St. Paul Sports Complex that could work alongside existing stormwater installations. The Sports Complex is outside the karst buffer area, meaning infiltration is possible, and there are existing storm sewer lines that run through the park itself as well as under Wentworth Avenue to the north.

Photo 4 - Existing armored swale in West St. Paul Sports Complex

During the site visit, WSB determined that there would be room for an additional infiltration basin between the parking lot and the existing trail. There would be no tree loss and no realignment of the existing trail would be needed. Infiltration was also the top priority stormwater management type for the City of West St. Paul. The preliminary concept design for West St. Paul Sports Complex will be discussed in detail in section 5.3.3.

4.2 St. Paul

WSB visited two sites in the City of St. Paul, Our Lady of Guadalupe and part of the Brickyard Trail. WSB had selected three additional sites within the City of St. Paul: Casa de Luz church for a potential filtration basin, Cherokee Park for potential expansion of an existing basin, and Harriet Island for potential installation of a new basin. In meetings with City staff, they did not wish to move forward with these sites. Expansion of the Cherokee Park basin would have resulted in significant tree loss and the basin is within the karst boundary so it would not have been suitable for infiltration. Harriet Island is a highly used park and the City wished to avoid impacts to that space, plus it is within the existing levee system and any above-ground basin would have been frequently flooded and difficult to maintain. Finally, Casa de Luz was removed from the site visit list because the stormwater line below the property is too deep to connect to a surface filtration basin and mature trees would have been removed as a result of the project. A discussion of the Brickyard Trail can be found in Section 4.3.3 because the erosion issues documented were within the boundaries of the City of Mendota Heights.

4.2.1 Our Lady of Guadalupe

Photo 5 - Looking northeast at unpaved overflow parking area on Our Lady of Guadalupe parcel

Figure 4.2.1 shows the site visit map for Our Lady of Guadalupe Church on Concord Street in St. Paul. WSB staff visited Our Lady of Guadalupe in June 2024. WSB selected Our Lady of Guadalupe for a site visit because it is a parcel with some available green space outside the karst buffer within the study area. The City of St. Paul’s top priority for stormwater management was volume reduction and this was an area with potential. The parcel has existing stormwater lines which run through the site from Concord Street under the existing railroad tracks and to a drainage ditch along the railroad.

During the site visit WSB observed that there were two unpaved areas that were being used by the Church for overflow parking from their standard lot. The site has soccer goals in place, indicating that the community may be using it for recreation. Also, there is already infrastructure on this site, a lift station is located on the west side of the parcel alongside Robie Street. The site has generally flat topography and WSB decided the site should proceed to concept design for an infiltration or filtration basin, depending on soil type. The preliminary concept design for Our Lady of Guadalupe will be discussed in detail in section 5.3.4.

4.2.2 Alabama Street Outlet

Figure 4.2.2 shows the site map for the area draining to the Alabama Street Outlet. WSB did not do a site visit to this outlet but during the watershed analysis task WSB determined that there were several pipes in the area that might be suitable for filtration-based treatment structures. Filtration was the City of St. Paul's second priority for types of stormwater management, and filtration structures are often cost-effective methods of reducing TP and TSS loading, which also reflect city priorities.

Since this area is limited to non-infiltration treatment types due to the presence of karst, WSB followed a multi-step process to determine suitable locations for treatment structures upstream of the Alabama Street Outlet.

These locations were chosen by first determining which outlets to the Mississippi River in the city do not have existing treatment. The pipe networks were followed upstream to find manholes that have three or less pipe connections at the structure as close to the outlet as possible to get the most treatment. In addition, the maximum amount of pipe connections the structural BMP can have is three. As an option, the existing structure could be replaced with a structural BMP. The chosen locations have a minimum of an 18-inch inlet pipe and a maximum of a 36-inch inlet pipe.

4.3 Mendota Heights

WSB visited two sites within the City of Mendota heights, a slope failure along Highway 13 (that occurred during the study period) and the upper section of the Brickyard Trail. A very limited section of the study area falls inside City of Mendota Heights boundaries; for information on erosion, stormwater, and water quality issues within the Interstate Valley Creek watershed which is adjacent to the study area and also drains directly to the Mississippi River, see Interstate Valley Creek Stabilization and Volume Reduction Study (WSB 2023).

4.3.1 Brickyard Trail

The Brickyard Trail is a trail located in both Mendota Heights and St. Paul. There is a trailhead off of Highway 13 in Mendota Heights and a trailhead off of Water Street in St. Paul which is north and east of Pickerel Lake. The Brickyard Trail is a relatively steep trail with switchbacks down the bluff which indicated that it might be either experiencing erosion or provide a way to view any existing bluff erosion issues. St. Paul Parks signage asks visitors to remain on the trail due to the presence of archeological resources present in the area, so the site visit inspection consisted only of the trail itself and slopes visible from the trail. Figure 4.3.1 shows the location of the Brickyard Trail and the data collected during the site visit.

Photo 6- Existing scarp beneath upper Brickyard Trail trailhead

The only location of noticeable hillside erosion observed during the site visit was a single scarp formation directly below the Mendota Heights trailhead. Field notes indicate that the scarp is approximately 30’ by 20’ feet in size. The scarp is likely not new because vegetation has already begun to recolonize the area, though some of the visible rivulet formation may be due to heavy rains experienced in May and June of 2024.

Photo 7 - Geosynthetics in place along Brickyard Trail

There were limited instances of rill formation and erosion along the trail itself, as well as the presence of geosynthetics, biologs, and other erosion control methods that may have been installed to prevent or address erosion along the trail following the recommendations of the Barr slope stabilization study dated 2015. None of these issues appeared to be widespread or severe. The LMRWMO could partner with St. Paul Parks or the City of St. Paul to inspect the trail and the surrounding areas on a regular basis but the Brickyard Trail is not recommended for a concept stabilization design at this time.

4.3.2 Highway 13 Slope Failure

Photo 8 - Highway 13 washout in July 2024

MnDOT closed Highway 13 between Sylvandale Road and Wachtler Avenue in Mendota Heights in June 2024 due to a slope failure. The slope failure occurred on the shoulder of the southbound lane which is part of the bluffs above Pickerel Lake in Mendota Heights. WSB staff completed a site visit to the slope failure accompanied by MnDOT staff in July 2024. Figure 4.3.2 shows the location of the site visit and the slope failure.

During the site visit, MnDOT indicated that there had been past slope failures on this section of Highway 13 and repair projects had focused on installing slope containment systems such as soil nail walls that were more resilient to a variety of conditions and less prone to failure. MnDOT staff on site indicated that because Highway 13 was a state highway that was completely closed to traffic, it was a high priority for repair and would likely be completed and reopened in late 2024. Because of this accelerated timeline and MnDOT's ongoing design for repairs, the Highway 13 slope failure is not recommended as an erosion reduction or bluff stabilization project for LMRWMO to consider as part of this study.

4.3.3 Bluff Stabilization Issues in Mendota Heights

During the Brickyard Trail inspections WSB noticed bluff erosion that was visible from across Pickerel Lake. Reviewing aerial photographs and parcel data indicates that this bluff appears to be located on or near 635 Sibley Memorial Highway in Mendota Heights. There may also be some parts of the bluff which are located on City of St. Paul properties which make up Harriet mIsland and Cherokee. A review of LiDAR data in the area puts a rough estimate of the bluff height at 90 feet, and photos taken from across Pickerel lake indicate that they have little to no existing vegetation.

WSB did not attempt to contact the property owner at 635 Sibley Memorial Highway to get permission for a site visit, and conversations with LMRWMO staff indicate that they felt bluffs of this size and complexity were outside the scope of this study. WSB recommends that LMRWMO staff contact the landowners and discuss any erosion issues they are experiencing on their parcel. Depending on the outcome of those conversations, the next step may be additional study of these bluffs or frequent inspections to determine if the bluffs are continuing to erode. Grant funding may be an option to help fund these improvements if it is determined a project is the next step.

Photo 9 - Mendota Heights Bluffs visible from Water Street in St. Paul

4.4 Lilydale

WSB visited two sites within the City of Lilydale. The first site was Overlook Apartments which City staff had noted as experiencing erosion issues. The second site visit was focused on the multiple private discharges that the City of Lilydale is aware of around the bluffs. Due the number of private discharges and multiple landowners involved, WSB inspected these sites from the Big Rivers Regional Trail along the Mississippi River.

4.4.1 Overlook Apartments

WSB staff learned about erosion issues at Overlook Apartments via a pin left on the webmap from City of Lilydale staff. Notes and photos from City staff indicated erosion around a private outfall structure. WSB visited the site in July 2024. Figure 4.4.1 shows the location of the Overlook Apartments and data collected during the site visit.

During the site visit WSB staff observed an exposed structure which appeared to be leaking water from the cracked upstream concrete pipe. There was a large rock underneath the crack which may have been placed there to dissipate energy from the leak. Field estimates suggested that approximately a cubic yard (27 cubic feet) of soil may have been either washed away or removed from around the structure. There was no visible sediment delta in the vicinity of the eroded area, suggesting that at least some of the soil was likely removed, perhaps for access to the structure for investigation or repairs.

Photo 10 - Leaking structure at Overlook Apartments

WSB discussed the site with the property manager who indicated that they are working with a private company on repairs to the erosion and possible replacement of the leaking structure. There was also no indication that the sediment eroded from around the pipe was making its way to public drainage systems or the Mississippi River. WSB therefore does not recommend Overlook Apartments for concept design due to a pending private solution and negligible impact on public waters.

4.4.2 Bluff Inspections – Big Rivers Regional Trail

Photo 11 - Piped overflow along Big Rivers Regional Trail

The City of Lilydale has several bluffs which overlook the Mississippi River. The land at the top of these bluffs is generally private property, either commercial or multi-family residential. In order to inspect these bluffs for erosion issues, WSB decided to inspect them from the bottom of the bluffs via the Big Rivers Regional Trail. WSB completed inspections of the bluffs from the trail for two reasons. First, inspections from the bottom of the bluffs show erosion issues more clearly than trying to look over the bluff from the top, where views of the face of the bluff are generally obstructed by vegetation. Second, viewing the bluffs from the trail at the bottom would be more efficent and would reduce the obstacles in getting permission from multiple private landowners to access and inspect the bluffs from the top. WSB inspected the bluffs between the Lilydale Trailhead and the Mendota Post Office in July

2024 and focused on outfall locations which were posted to the webmap by City staff. Figure 4.4.2 shows the length of bluffs inspected within the City of Lilydale as well as the locations of data collected during the inspection.

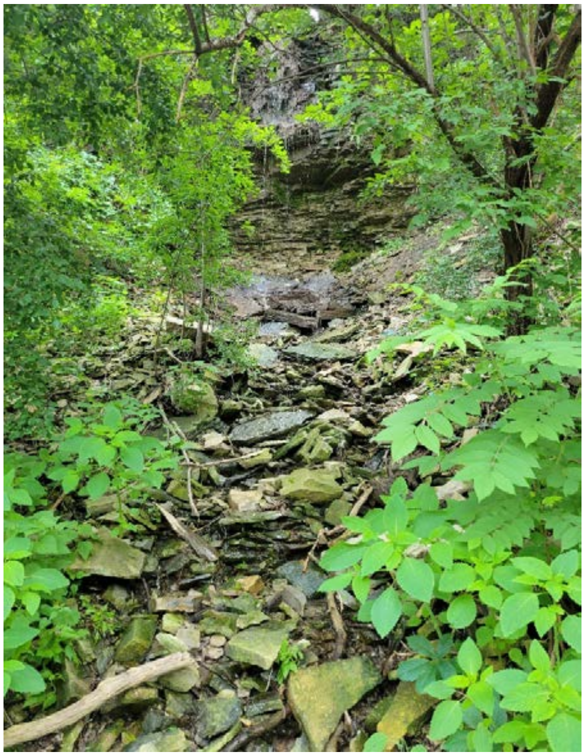


Photo 6 – Non-piped outfall along Big Rivers Regional Trail

During the inspection WSB observed two different classes of drainage which may cause future erosion issues for the bluffs along the Mississippi River. First was non-piped outlets or overland flow, which are visible from the trail and generally look like waterfalls. Some of these may be groundwater seeps rather than overland flow or stormwater flow, which could be verified with further investigation. These areas generally had large (>8 inch diameter) rockfalls at the bottom and all had substantial vegetation within the area, indicating that the flow is not moving fine material which would contribute sediment loading to the Mississippi River.

The second type of issue comes from piped outfalls which are conveying rooftop or impervious surface runoff from developed areas along the top of the bluff over and/or down the bluff. These outfalls are concentrating stormwater and increasing the flow rate and velocity of flows over the bluff, though there was no areas of severe erosion noted during the inspections.

4.4.3 Recommendations for further study/partnerships with City of Lilydale

The City of Lilydale has a robust understanding of the locations of current outfalls and bluff erosion issues present within Lilydale and has worked with multiple stakeholders on stormwater issues for many years. Section 406.09 of the current version of the city code (adopted in 2023) prohibits "new outfalls at the top of the bluff" and states that "private drainage systems that outlet in the river bluffs or at the top of the bluffs must be upgraded to safely convey the water to the drainage system at the Big Rivers Regional Trail or other stable receiving drainage system acceptable to the City and MNDOT on or before December 31, 2045." Section 406.09 also "encourages private property owners to direct [site] drainage to one of the existing City or MnDOT drainage systems where practical." This directive will result in fewer overland flow drainages to the Mississippi River with erosive potential because "safe conveyance" is defined as "a system for conveying stormwater flow that does not cause or contribute to erosion, specifically erosion of the bluffs along the Mississippi River."

The bluffs do not currently show evidence of erosion which would be detrimental to water quality, but it is more likely that the bluffs are at risk of more catastrophic failure which puts blufftop developments and residences at risk. Both the non-piped and piped outflows to the bluffs may be good sites for future inspections, which could be a partnership between the City of Lilydale and LMRWMO staff. Due to the vegetative cover during the growing season and the difficulty of the terrain for inspections, this area would be highly suitable for drone surveys either after leaf drop in the fall or before leaf on in the spring. This would be more efficient and also allow for detailed analysis of changes to the bluff face over time.

4.5 South St. Paul

WSB proposed six sites for site visits for the City of South St. Paul. Simon's Ravine is not within the study boundary but it is within the boundary of the City of South St. Paul and city staff had called it out as an area to be reviewed. Grandview Park, St. John Vianney Church, and Kaposia Landing were all approved by city staff for site visits.

WSB also identified a vacant lot at the corner of Grand Avenue East and Bridgepoint Drive as a location for a potential BMP, but city staff indicated that the lot was in the process of redevelopment and would not be suitable for an above-ground BMP. This site was therefore removed from the site visit list. Finally, WSB staff inquired about the possibility of a below-ground BMP at the south end of the Fleming Field airport property along 70th Street East. City staff indicated that access to the site would be too difficult for maintenance due to security concerns by the airport, so this site was also removed from the site visit list.

4.5.1 Simon's Ravine

Simon's Ravine is technically outside the study boundaries (see Figure 2.1) but City of South St. Paul staff had added a location to the project webmap indicating the presence of hillside erosion within Kaposia Park. WSB staff visited Kaposia Park and inspected Simon's Ravine during June 2024. Figure 4.5.1 shows the site visit map for Simon's Ravine.

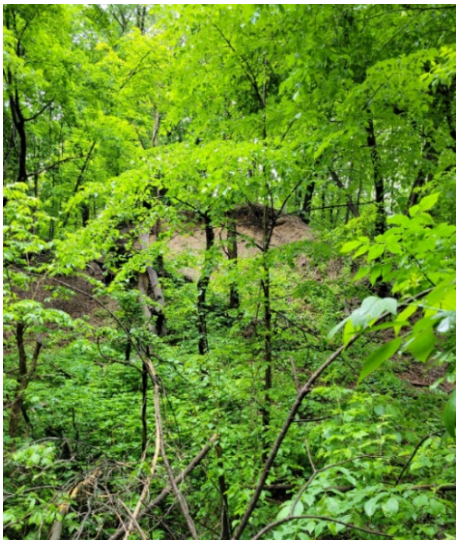


Photo 13 - Hillside erosion in Simon's Ravine

Simon's Ravine is within Kaposia Park and is generally well vegetated with mature trees and limited understory. Simon's Ravine is also part of the South St. Paul stormwater system and there is a trunk line with several intake structures traveling down the ravine to the Mississippi River.

Due to the frequency of intake structures, overland flows from runoff down the sides of the ravine generally travel less than 500 feet before reaching an intake structure. This limits the erosive power of runoff generated by the steep ravine slopes.

WSB staff did confirm the presence of limited hillside erosion within Simon's Ravine, but it was not widespread. No significant erosion issues were visible around intake structures, around the existing paved trail which follows the ravine through Kaposia Park, or along the trunk line alignment. LMRWMO could partner with South St. Paul staff to continue further inspections for hillside erosion within Kaposia Park, but Simon's Ravine is not recommended for a concept stabilization design.

4.5.2 Grandview Park

During the watershed analysis phase, City of South St. Paul staff noted erosion issues at Grandview Park on the webmap. City staff said that there had been a slope restoration project in the area in 2023 but there was an erosion issue being exacerbated by foot traffic up and down the slope. Figure 4.5.2 shows the site visit map for Grandview Park and the data that staff collected during the site visit.

Photo 14 - Photo submitted by City of South St. Paul documenting footpath erosion below Grandview Park

During the site visit WSB inspected the area where City staff had indicated erosion being caused by foot traffic. There is vegetation regrowth on the path and no current evidence of hillslope erosion. WSB also investigated the stormwater drainage system within the park as a potential site for a rain garden, but the site is within the karst buffer zone so infiltration would not be permitted. Since there is no current hillslope erosion and the site is not suitable for new BMP construction, Grandview Park is not recommended for a concept stabilization design.

Photo 15 - Current view of footpath leaving Grandview Park

4.5.3 Kaposia Landing

City of South St. Paul staff indicated there was erosion around and damage to an existing outfall south of Kaposia Landing Park. WSB staff visited Kaposia Landing in June 2024. Figure 4.5.3 shows the site visit map and data collected during the site visit.

Photo 16 - Damaged outfall to Mississippi River at Kaposia Landing

Stormwater GIS data from the City of South St. Paul indicates the outfall is a 24 inch reinforced concrete pipe. Photos from the City show a small channel cut from the outfall to the Mississippi River. During the site visit WSB staff observed pipe undercutting and the pipe's flared end section had fallen off and into the undercut channel. However, the volume of the eroded channel was field estimated at less than 1 cubic yard, and the recurrent flooding on the Mississippi River means that trying to establish more permanent vegetation on this site would be difficult. Additional rock could be placed around the outfall and the flared end section reattached, but the site's location inside the active river channel and the minimal size of the eroded channel means that Kaposia Landing is not recommended for a concept stabilization design.

4.5.4 St. John Vianney Church and Ravine

Photo 17 - Looking northwest from St. John Vianney parking lot

St. John Vianney is a Catholic Church located in South St. Paul. During the watershed analysis phase WSB staff identified the presence of green space on the St. John Vianney parcel, adjacent stormwater pipes which are carrying untreated runoff, and a lack of a karst buffer meaning that the site would be an option for infiltration if it proceeded to concept design. Volume reduction was the top priority for types of stormwater management that the City of South St. Paul wanted to complete. Figure 4.5.4 shows the site visit map for St. John Vianney.

During the site visit WSB staff spoke to the pastor of St. John Vianney who indicated that the community does not currently use the green space as a baseball diamond and that they continue to pay for mowing and general maintenance. He indicated that the community would be interested in further discussions with LMRWMO about using the space as a filtration or infiltration basin as long as they maintained ownership of the parcel. They were open to providing a maintenance easement and were particularly interested in creating a green space that could be better utilized by the community.

Following the site visit to St. John Vianney WSB also inspected the forested ravine to the south and east of the church property. This ravine is well vegetated and has several stormwater structures collecting surface runoff for the pipe which is buried below the bottom of the ravine. The combination of existing vegetation and minimal distance of overland flow before joining a piped outlet means that there are no existing erosion issues within this ravine and ravine stabilization was not recommended as part of the St. John Vianney concept design.

4.5.5 Maltby Street Outlet

Figures 4.5.5 and 4.5.6 shows the neighborhood which drains to the Maltby Street Outlet. WSB did not do a site visit to this outlet but during the watershed analysis task WSB determined that there were several pipes in the area that might be suitable for filtration-based treatment structures. Filtration was the City of South St. Paul's second priority for types of stormwater management, and filtration structures are often cost-effective methods of reducing TP and TSS loading in areas with limited space avaliable, which also reflect city priorities.

Since this area is limited to non-infiltration treatment types due to the presence of karst, WSB followed a multi-step process to determine suitable locations for treatment structures upstream of the Maltby Street Outlet.

These locations were chosen by first determining which outlets to the Mississippi River in the city do not have existing treatment. The pipe networks were followed upstream to find manholes that have three or less pipe connections at the structure as close to the outlet as possible to get the most treatment. In addition, the maximum amount of pipe connections the structural BMP can have is three connections. As an option, the existing structure could be replaced with a structural BMP. The chosen locations have a minimum of an 18-inch inlet pipe and a maximum of a 36-inch inlet pipe. Only city owned roads were considered for treatment options.

4.6 Inver Grove Heights

WSB selected six sites for site visits within Inver Grove Heights: Dehrer Park, Twin City Marina and Heritage Village Park, River Front Park, Ernster Park, Pine Bend Bluffs SNA, and Gisch Pond. Inver Grove Heights has many existing stormwater BMPs (see Figures 3.2.2A and 3.2.2B) so WSB decided to focus site visit efforts on public property with existing stormwater infrastructure that could support additional treatment which aligned with the city's top goal for project characteristics in the prioritization questionnaire (see table 3.3).

4.6.1 Dehrer Park

Photo 18 - Outfall with pavement beneath within Dehrer Park Ravine

Dehrer Park is a City of Inver Grove Heights Park located between Dawn Avenue and Dehrer Way shown in Figure 4.6.1. Dehrer Park is west of an existing forested ravine which recieves stormwater drainage from multiple area pipes. There is also an existing stormwater pipe running directly beneath the park. WSB selected this site because it was a city-owned parcel with available green space and a direct connection to existing stormwater drainage. The park is within the karst area meaning that infiltration is prohibited so WSB visited the site to determine the suitability of the site for filtration BMPs. WSB also wanted to inspect the downstream ravine for signs of bank erosion.

Photo 19 - Existing outfall at top of Dehrer Park ravine

During the site visit WSB did not observe any erosion issues in the ravine. The banks are well forested and the channel is lined with rock riprap. The large outlet structure at the top of the ravine has riprap at the bottom and no visible erosion at the wingwalls. The outlet structure at the middle of the ravine which drains from Dehrer Way has pavement below it rather than rock which means there is no erosion or undercutting around it. WSB considered a tree trench or other filtration system for an installation within the green space of Dehrer Park but the existing stormwater pipe was determined to be too low for an effective connection. Dehrer Park and the Dehrer Park ravine was not selected for a concept design.

4.6.2 Twin City Marina and Heritage Village Park

Twin City Marina is a marina and marine service facility on the Mississippi River just east of Heritage Village Park. It is privately owned and operated but has several public storm sewers which cross the property to outfall at the Mississippi River. Figure 4.6.2 shows the location of Twin City Marina. The Marina Property also contains an earthen levee which is visible on the existing flood maps. Heritage Village Park is owned by the City of Inver Grove Heights and contains green space, trails, and parking areas. Several of the parking areas have existing biofiltration basins to treat stormwater runoff. WSB selected Twin City Marina for a site visit because it had existing green space which might be suitable for pretreatment of existing storm sewer outfalls in the area. City of Inver Grove Heights staff also indicated that there was an outfall with a valve on it which, when closed, increased the pressure in upstream pipes and caused pipe joint issues, and that they would like to see the temporary levee structure replaced with something permanent. WSB staff visited Twin City Marina and Heritage Village Park in June 2024.

During the site visit WSB observed that the existing biofiltration basins are treating most of the impermeable surfaces within the park, and most impermeable surfaces within the levee drain directly to the river where pretreatment/treatment would be generally unfeasible. Heritage Park is also within a karst area and infiltration would not be allowed. Finally, most of Heritage Park is within the 100 year floodplain for the Mississippi River, indicating that any aboveground treatment facilities would likely be filled in with sediment following major floods. Due to the impracticability of installing additional or large-scale stormwater treatment structures in Heritage Village Park, Twin City Marina and Heritage Park were not selected for a concept design.

4.6.3 River Front Park

Photo 20 - Existing outfall in River Front Park

River Front Park is a City of Inver Grove Heights Park located directly on the Mississippi River and shown in Figure 4.6.3. River Front Park is east of River Road and consists of green space, a picnic area, and beach access to the Mississippi River. River Front Park also has a stormwater outlet to the Mississippi River which drains out of the Dorchester Circle pond in Skyline Village, and a second outlet which drains 77th Street East and part of Dickman trail. City staff indicated a desire for pretreatment of pipe discharges before reaching the Mississippi River. WSB staff visited River Front Park in June 2024.

The stormwater outfalls within River Front Park did not show any indication of erosion or other issues. The stormwater pipe is large and WSB staff did not find a suitable site for pretreatment between the pipe inlet and outlet. The pipe also crosses under two rail lines, Chicago Rock Island Pacific Railroad and Chicago Great Western Railroad. This would make access to the pipe for redirection and pretreatment extremely difficult. Finally, River Front Park is entirely within karst geology and the pipe drainage area is within the karst buffer, meaning that infiltration would not have been allowable for treatment/pretreatment structures. Due to access issues and lack of space and suitability for pretreatment or infiltration, River Front Park was not selected for a concept design.

4.6.4 Ernster Park

Ernster Park is a City of Inver Grove Heights Park located along 77th Street East and shown in Figure 4.6.4. Most of the park space is in use for recreation and it contains a picnic area, baseball field, basketball court, and playground. There is a high voltage power line running through the park. There is an existing stormwater pipe which drains the park which crosses under Dickman Trail and eventually outlets to the northernmost River Front Park Outfall. The area surrounding Ernster Park is entirely within the karst separation buffer, meaning that filtration would be the only suitable pretreatment for the site, and WSB was investigating methods such as tree trenches, treatment swales, or biofiltration basins. WSB staff visited River Front Park in June 2024.

Photo 21 - Paved swale along Ernster Park

The stormwater pipe which drains Ernster Park and 77th Street East was deemed to be too deep for a suitably sized tree trench, treatment swale, or biofiltration basin. Due to land use, and utility conflicts, Ernster Park was not suitable for pretreatment before connection to the existing pipe. Due to these limitations Ernster Park was not selected for a concept design.

4.6.5 Pine Bend Bluffs SNA

Pine Bend Bluffs Scientivic and Natural Area is located in Inver Grove Heights and shown on Figure 4.6.5. Scientific and Natural Areas (SNAs) are public lands which are owned and administered by the Minnesota Department of Natural Resources whose purpose is to "protect natural features of exceptional scientific or educational value." Pine Bend Bluffs is 256 acres in size and consists of many microbiomes, including bluffs which overlook the Mississippi River. These bluffs consist of steep slopes but are generally well vegetated; however, LMRWMO staff told WSB they had been notified about erosion issues along the trail as well as at the outlet of an existing stormwater pond on the property of I-State Trucking. Given the wide scope of potential erosion issues WSB walked the entire length of the Mississippi Regional Trail within Pine Bend Bluffs SNA and investigated several ravines that were visible on aerial photographs and contour maps within the SNA boundaries. WSB staff conducted two visits to the site, in July and August 2024.

Photo 22 - Map showing drainage from I-State Trucking Pond. Image by Calx Design Group.

WSB did not discover significant erosion issues along the Mississippi Regional Trail within Pine Bend Bluffs SNA, but there were multiple areas of minor erosion along the trail which should be inspected on a regular basis to prevent further trail damage. The LMRWMO will be receiving all photos and notes from the site visit and WSB recommends that they share these items with the DNR staff responsible for trail maintenance at Pine Bend Bluffs. There are areas where small installations such as seeding, geotextiles, or biorolls to address erosion at trail edges could help prevent existing bare and/or compacted soils from experiencing further damage or erosion.

Photo 23 - Minor trailside erosion along Mississippi Regional Trail inside Pine Bend Bluffs SNA.

WSB also did not discover significant erosion issues within the existing ravines within Pine Bend Bluffs SNA. There are multiple ravine complexes within the bluff system, but they are generally well vegetated with a mature tree canopy. There are few signs of active erosion such as mass wasting, scarp formation, or undercutting of ravine banks. Some of the ravines show evidence of stabilization efforts with geotextiles, riprap, or broken concrete. The understory contains large communities of invasive species, specifically common buckthorn (*Rhamnus cathartica*) and garlic mustard (*Alliaria petiolata*). These plants are not desireable from an ecosystem perspective but they may be assisting with preventing substantial erosion issues within the ravine complexes or moving in to colonize newly disturbed soils before large erosion events can occur.

Photo 24 - Vegetated cover over existing ravine downstream of I-State Trucking Pond

Due to concerns about erosion occuring at the outlet of the I-State Trucking Pond and the receiving ravine, WSB specifically investigated that location. There is an existing ravine which extends approximately 650 feet from the outlet and ends at a utility corridor which appears to be maintained for drive-in access to a substation located at the bottom of the bluff. The ravine has a maximum depth of approximately 5 feet and has been lined with rock riprap. Some of the riprap closer to the outlet appears to be recently installed, while the middle section of the ravine has moss-covered rock that appears to have been in place for several years or more. There are also multiple sections of silt fence along the ravine banks which appear to have been installed to function as ditch checks and

Photo 25 - Existing erosion control at downstream end of I-Strate Trucking Pond receiving ravine prevent additional overland flow from reaching the ravine. The ravine is generally well vegetated with both native and invasive species and there are no signs of undercutting or scarp formation. There is an existing silt fence on the northern boundary of the utility corridor which is preventing any sediment which erodes from the ravine from reaching the corridor and, by extension, the Mississippi River. Because the ravine is well-vegetated and any sediment loading is prevented from reaching the Mississippi River, the I-State Trucking Pond Ravine was not selected for a concept design because its effects on water quality are considered minimal. However, WSB recommends that LMRWMO partner with I-State Trucking and MN DNR to establish a monitoring program for the I-State Trucking Pond Ravine to ensure that the ravine is not destablized by future pond outflows and/or large precipitation events.

4.6.6 Gisch Pond

Gisch Pond is an existing City of Inver Grove Heights stormwater pond located on city-owned property between River Road and Dickman Trail. WSB originally visited the pond in June 2024 to look for erosion issues around the Dickman Trail culvert which had been mentioned by City of Inver Grove Heights staff. Figure 4.6.6 shows the location of Gisch Pond and the data collected by WSB staff during the site visit.

Photo 26 - Existing Gisch Pond outlet structure

WSB staff did not find any erosion issues at the culvert under Dickman Trail, but conversations with IGH staff indicated that there was interest in expanding Gisch Pond. Currently the pond fills in with sediment every two years, making it maintenance-intensive, but it is on a parcel that is large enough to accommodate resizing. This is also an opportunity for increased volume reduction in an area which currently has limited opportunities for infiltration due to the presence of karst.

WSB selected Gisch Pond for a concept design which will be discussed in section 5.3.8.

4.6.7 IGH Structural BPMs

Figure 4.6.7 and 4.6.8 shows the neighborhood and drainage network for the outfall from Dickman Trail and Dawn Avenue, respectively. WSB did not do a site visit to this area but during the watershed analysis task WSB determined that there were several pipes in the area that might be suitable for filtration-based treatment structures. Filtration was the City of Inver Grove Height's second priority for types of stormwater management, and filtration structures are often cost-effective methods of reducing TP and TSS loading.

Since this area is limited to non-infiltration treatment types due to the presence of karst, WSB followed a multi-step process to determine suitable locations for treatment structures surrounding Dawn Avenue.

These locations were chosen by first determining which outlets to the Mississippi River in the city do not have existing treatment. The pipe networks were followed upstream to find manholes that have three or less pipe connections at the structure as close to the outlet as possible to get the most treatment. In addition, the maximum amount of pipe connections the structural BMP can have is three. As an option, the existing structure could be replaced with a structural BMP. The chosen locations have a minimum of an 18-inch inlet pipe and a maximum of a 33-inch inlet pipe. Only city owned roads were considered for treatment options.

5. Analysis and Prioritization

5.1 Feedbank on concept design site selection

Following completion of the site visits described in Section 4, WSB met with staff from each individual city as well as LMRWMO to present the findings from the site visits and discuss the suitability of each site for concept design. All nine sites which proceeded to concept design were approved by city staff before concept design began.

Once the nine sites for concept design were finalized, WSB developed a decision matrix. The goal of the decision matrix is to facilitate comparison between different sites on a number of different project characteristics laid out in the original scope of work, including cost effectiveness, constructibility, water quality improvement, and project impacts. LMRWMO and member cities can use the decision matrix to prioritize high-scoring projects for grant funding applications, inclusion in capital improvement plans, and asset management planning.

5.2 Decision Matrix Development

The guiding principle of the decision matrix is to score each project based on multiple areas of assessment. Assessment scores are summed to reach a final project score. A higher final project score means a higher-priority project, and a lower final project score indicates a lower-priority project. The decision matrix gives quantitative scores for the following assessment areas

- Drainage area treated (acres)
- Volume reduction capability (does the project provide volume reduction potential)
- TSS removal efficiency ($/lb)
- TP load reduction ($/lb)
- Constructibility (index score describing construction impacts across multiple metrics)

5.2.1 Decision Matrix Scoring

Drainage area treated was scored on the following breakdown:

- 0-20 acres treated, score of 1
- 20-100 acres treated, score of 2
- >100 acres treated, score of 3

The drainage area score was not adjusted based on whether the drainage area for the BMP was previously treated.

The volume reduction capability was scored on a scale of 0 to 2 points as follows:

- 0: infiltration not allowed at the location or not achieved due to the BMP type.
- 1: infiltration likely allowed but soil type at the location is either unknown or classified as Hydrologic Soil Group C or D (low infiltration capacity)
- 2: infiltration likely allowed and soil type is Hydrologic Soil Group A or B.

TSS removal efficiency score consisted of life cycle cost (construction cost plus lifetime maintenance cost) divided by TSS removal in tons per year times 25 years (the assumed BMP life). The scoring for TSS removal efficiency was on a scale of 1 to 5 as follows:

- 1: Removal efficiency greater than $200,000/ton.
- 2: Removal efficiency between $100,000 and $200,000/ton.
- 3: Removal efficiency between $50,000 and $100,000/ton.
- 4: Removal efficiency between $10,000 and $50,000/ton.
- 5: Removal efficiency of less than $10,000/ton.

TP removal efficiency score consisted of life cycle cost (construction cost plus lifetime maintenance cost) divided by TP removal in pounds per year times 25 years (the assumed BMP life). The scoring for TP removal was on a scale of 1 to 5 as follows:

- 1: Removal efficiency of $3,200 to $4,000/pound.
- 2: Removal efficiency of $2,400 to $3,200/pound.
- 3: Removal efficiency of $1,600 to $2,400/pound.
- 4: Removal efficiency of $800 to $1,600/pound.
- 5: Removal efficiency of less than $800/lb.

5.2.2 Constructability Index Score development

Constructability consists of several attributes

- Access: projects which are more difficult to access for construction, maintenance, or both, have a lower score than those whose access is simpler.
    - Access from public roads with moderate to flat slopes and little clearing or grubbing required: 3
    - Access from public roads with steep slopes or moderate clearing and grubbing required: 2
    - Access from public roads with steep slopes or significant clearing and grubbing required: 1

- Tree removal: removal of multiple trees contributes to project cost and can influence the percieved value of the project to the public. Projects with significant tree removal scored lower than projects with little to no impact to trees. No differentiation was made between types of trees or whether the tree was located on public or private property when assigning this score.
    - Zero tree removal required: 3
    - 1 to 5 trees expected to be removed: 2
    - Greater than 5 trees expected to be removed: 1
- Impacts to Parks: construction projects within public parks pose a risk to park users and limit public enjoyment of public spaces. Projects which have extensive impact on park usage scored lower than projects which have limited impacts, or which do not impact public parks at all.
    - No impacts to public parks: 3
    - Moderate impacts to public parks, including closure of trails or limiting public access to park areas for short periods of time: 2
    - Extensive impacts to public parks, including closure of trails or limiting public access to park areas for long periods of time: 1
- Public vs. Private: construction on private land requires either land acquisition or purchase of construction and maintenance easements, which add to project costs. Projects located on public land scored higher than projects on private land.
    - Project is on public land: 3
    - Project is on private land: 1
- Impacts to existing infrastructure: Causing impacts to existing infrastructure can significantly impact a project's cost. WSB estimated the expected impacts to existing bituminous roadways as a proxy for estimating wider infrastructure impacts.
    - Estimated pavement impacts of 0-100 square feet and minimal subsurface utility impacts expected: 3
    - Estimated pavement impacts of 101-500 square feet and/or subsurface utility conflicts possible: 2
    - Estimated pavement impacts of > 500 square feet and/or subsurface utility conflicts likely: 1

Following scoring of all constructability attributes, the scores for all categories were added up and a single index score assigned for use in the decision matrix.

Table 5.2 as follows shows a summary of rankings for constructability attributes.

Table 5.2 – Constructability Scoring Summary			
	Score		
Impact Type	3	2	1
Tree Removal	0	1 to 5	More than 5
Impacts to Parks	None	Limited	Extensive
Public vs. Private	Public	n/a	Private
Access	Easy	Moderate	Difficult
Existing Infrastructure	0-100 sf of pavement impacts AND low potential for buried utility conflicts	101-500 sf of pavement impacts AND/OR moderate potential for buried utility conflicts	>500 sf of pavement impacts OR high potential for buried utility conflicts
Likelihood of Wetland Impacts	Low	Moderate	High
Constructibility Index	Sum greater than or equal to 16	Sum equal to 13, 14, or 15	Sum less than 13

5.3 Concept Design and Impacts Summaries

A summary of the proposed concept designs is shown in Table 5.3.

Table 5.3 – Concept Design Summary by City		
Concept Design	City	BMP Type
City Pool Park	West St. Paul	Infiltration/Filtration
Kennedy Park	West St. Paul	Structural BMP
West St. Paul Sports Complex	West St. Paul	Infiltration/Filtration
Our Lady of Guadalupe	St. Paul	Infiltration/Filtration
Alabama Street Outlet	St. Paul	Structural BMP
St. John Vianney	South St. Paul	Infiltration/Filtration
Maltby Street Outlet	South St. Paul	Structural BMP
Gisch Pond	Inver Grove Heights	Stormwater Pond
Dawn Avenue	Inver Grove Heights	Structural BMP

5.3.1 City Pool Park Concept Design

The concept design at City Pool Park consists of a 0.15 acre basin which will be used for infiltration or filtration, depending on the results of soil testing to determine infiltration capacity. This basin will treat approximately 11.1 acres of West St. Paul that currently has no treatment. The maximum depth of the basin will be four feet, and the basin will receive and treat stormwater flow from West Moreland Avenue and outlet via a new connection to the existing stormwater line under West Orme Street. Analysis of the West Orme line indicates that it has 4 cfs capacity to receive stormwater from this basin even if infiltration is limited or non-existent due to soil type.

This basin is expected to reduce TSS loading by 0.786 tons (1572 lbs) per year. Maintenance for this site will consist of vegetative maintenance, periodic sediment removal, and filtration media replacement if deemed filtration. Due to the small size of the basin this can be completed with small equipment and will not result in major disturbance to park landscaping or park use.

WSB presented this concept design for intial feedback to West St. Paul City staff in July 2024. City staff indicated that they were open to work on the pool property depending on the outcome of ongoing discussions regarding repairing, replacing, or redeveloping the existing pool facility. Potential stormwater management options for the site included an underground gallery which would be more expensive than the proposed infiltration basin but would allow the existing green space to remain as is. Further development of alternative options will follow on the City's decision regarding the future of the pool, but in the meantime City staff gave approval for concept planning for an infiltration basin on the site to proceed.

Table 5.3.1 - City Pool Park Design and Impacts Summary Table

		Constructability Score
BMP Type	Infiltration/ Filtration	
Drainage area (ac)	11.1	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.786	N/A
TP Reduction (lbs/yr)	5.308	N/A
Construction Cost	$ 305,114.40	N/A
25 Year Maint. Cost	$ 75,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 19,400.00	N/A
TP Cost/Benefit ($/ton)	$ 3,000.00	N/A
Tree Removal	Limited	2
Park Impacts	Extensive	1
Access	Easy	3

Impacts to Existing Infrastructure	Moderate	2
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	14
Index Constructability Score	N/A	2

The basin at City Pool park has been placed and sized to minimize tree impacts, but impacts to the park itself would be substantial. The playground to the west of the proposed basin site and the trail through the park would likely need to be closed during construction, though these impacts could be mitigated with winter construction. Access can be from either Moreland or Orme and slopes in the area are moderate. Impacts to existing infrastructure are expecte to be limited since the basin excavation area is outside the roadway right-of-way, though more information on area utilities should be part of further design development. Finally, wetland impacts are unlikely due to the presence of urban soils. City Pool Park has a total constructibility score of 15, which is indexed to a constructibility score of 2 for use in the decision matrix.

The estimated engineering and construction cost of the City Pool Park basin is $305,115. A concept-level cost estimate is included in Appendix B.

5.3.2 Kennedy Park Concept Design

The concept design at Kennedy Park is a structural BMP which will be used for sediment load reduction for a treated drainage area of 21.9 acres. The structure will be off-line treatment for the existing 36” pipe which passes under Kennedy Park. The structure is expected to reduce TSS loading by 0.023 tons (45 lbs) per year. Maintenance for this site will consist of annual cleanouts with a vacuum truck to remove trapped sediment from the structure.

Table 5.3.2 - Kennedy Park Design and Impacts Summary Table

		Constructability Score
BMP Type	Structural BMP	
Drainage area (ac)	21.9	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.023	N/A
TP Reduction (lbs/yr)	0	N/A
Construction Cost	$ 141,120.00	N/A

25 Year Maint. Cost	$ 25,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 288,900.00	N/A
TP Cost/Benefit ($/ton)	$ -	N/A
Tree Removal	None	3
Park Impacts	Limited	2
Access	Easy	3
Impacts to Existing Infrastructure	Low	3
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	17
Index Constructability Score	N/A	3

WSB originally presented a concept for a sedimentation or filtration basin to West St. Paul City staff but this was not the preferred concept due to a redesign and update of Kennedy Park facilities scheduled for 2026. A structural BMP at this location provides stormwater treatment without impacting use of the public park, and including a structural BMP in the forthcoming construction project can help minimize design and construction costs. However, costs and impacts in this report assume a stand-alone project in order to be conservative.

A structural BMP in Kennedy Park has moderate impacts. Zero tree removal is expected since the park is fairly open and impacts to the park of installing a structural BMP would be moderate and only visible to the public during installation; these impacts would be lowered if the BMP were included in the forthcoming park redesign. The structure does not impact private property and access from Dodd Road would be easy. The likelihood of wetland impacts is low. The impacts to existing infrastructure are moderate due to the placement within the Dodd Road ROW which may contain buried utilities. If during final design utility conflicts are problematic the structure could be moved east, farther into the park.

The estimated engineering and construction cost for a structural BMP in Kennedy Park is $141,120. A detailed construction cost estimate is available in Appendix B.

5.3.3 West St. Paul Sports Complex Concept Design

The concept design for the West St. Paul Sports Complex is an infiltration or filtration basin in the northeast corner of the park that would provide treatment to a drainage area of four acres. The maximum depth of the basin would be four feet and the total basin footprint would be 0.2 acres.

The basin would provide a TP reduction of 3 lbs/year and a TSS load reduction of 0.23 tons (460 lbs) per year. Maintenance for this site will consist of vegetative maintenance, periodic sediment removal, and filtration media replacement if the basin is used for filtration. Due to the small size of the basin this can be completed with small equipment and will not result in major disturbance to park landscaping or park use.

Table 5.3.3 - WSP Sports Complex Design and Impacts Summary Table

		Constructability Score
BMP Type	Infiltration/ Filtration	
Drainage area (ac)	4	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.23	N/A
TP Reduction (lbs/yr)	3	N/A
Construction Cost	$ 201,074.40	N/A
25 Year Maint. Cost	$ 75,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 48,000.00	N/A
TP Cost/Benefit ($/ton)	$ 3,700.00	N/A
Tree Removal	Limited	2
Park Impacts	Extensive	1
Access	Easy	3
Impacts to Existing Infrastructure	Low	3
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	12
Index Constructability Score	N/A	2

City of West St. Paul staff initially suggested investigating adding a BMP to the West St. Paul Sports Complex during the watershed analysis phase. WSB presented the idea for an infiltration/filtration basin in a meeting in July 2024 and city staff agreed that the design could proceed to concept stage.

Overall, this basin has moderate impacts. The basin has been sized to minimize tree removal. Impacts to the park during construction will be extensive, requiring closure of part of the existing bituminous trail and possibly the existing playground to the east in order to protect public safety, though these impacts could be mitigated by construction in the winter. Access to the site will be from the north off of Wentworth Avenue and impacts to existing infrastructure are expected to be limited to trails within the park. Wetland impacts are unlikely.

The estimated engineering and construction cost for a new basin in West St. Paul Sports Complex is $201,075. A detailed construction estimate is available in Appendix B.

5.3.4 Our Lady of Guadalupe Concept Design

The concept design for Our Lady of Guadalupe is an infiltration/filtration basin in the southeast part of the church complex between Robie and Concord Streets. The basin will provide treatment for approximately 9 untreated acres in St. Paul. The maximum depth of the basin will be 7 feet and it will connect to an existing 54" stormwater line which passes underneath the parcel from Concord Street under Robie Street and the existing rail line. The basin's outlet structure will reconnect to the same line.

The basin is expected to remove 4 lbs/year of TP and 0.663 tons (1326 lbs) of TSS per year. Maintenance for this site will consist of vegetative maintenance, periodic sediment removal, and filtration media replacement if the basin is used for filtration. Due to the small size of the basin this can be completed with small equipment and will not result in major disturbance to the property owner.

Table 5.3.4 - Our Lady of Guadalupe Design and Impacts Summary Table

		Constructability Score
BMP Type	Infiltration/ Filtration	
Drainage area (ac)	9.0	N/A
Ownership Type	Private	1
TSS Reduction (tons/yr)	0.663	N/A
TP Reduction (lbs/yr)	4	N/A
Construction Cost	$ 203,810.40	N/A
25 Year Maint. Cost	$ 75,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 16,900.00	N/A
TP Cost/Benefit ($/ton)	$ 1,000.00	N/A
Tree Removal	Limited	2
Park Impacts	N/A	3
Access	Moderate	2

Impacts to Existing Infrastructure	Low	3
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	13
Index Constructability Score	N/A	1

WSB presented ideas for this parcel to City of St. Paul staff in July 2024. This area of St. Paul is a difficult area for stormwater management because there is a large feature of karst (see Figures 3.1.4A and 3.1.4B) which makes infiltration impossible on many nearby sites. The area is also highly developed and prone to high groundwater levels due to the proximity to the Mississippi River. Due to limited options in the area City of St. Paul staff approved proceeding to concept design at this site.

Overall the basin at Our Lady of Guadalupe has moderate impacts. The basin has been sized to minimize tree impacts but limited tree removal is expected. Impacts to existing infrastructure are limited, though there is a possibility of underground utility conflicts that will need to be investigated during the design phase. Wetland impacts are unlikely. A major challenge for construction on this site will be partnership with the land owner and the community. Currently the area for the proposed basin is used as overflow parking for the church as well as a soccer field, and church members may see a stormwater basin as a loss of useable parking and green space in an area where street parking is restricted and access to ball fields is limited. The first step in further development of this concept design should be meeting with church leadership to determine if placement of a stormwater structure on this site is a viable option.

The estimated engineering and construction cost Our Lady of Guadalipe is $203,810. A detailed construction cost estimate is available in Appendix B.

5.3.5 Alabama Street Outlet Concept Design

The concept design for Alabama Street Outlet consists of four structural BMPs placed off-line on the upstream storm sewer to treat untreated water going to this outlet. The proposed structural BMP is a downstream defender with a size of 8 ft. Each structure would treat diverted stormwater to the downstream defender and connect back into the main trunk line of the storm sewer. A typical detail for a downstream defender is included in Appendix C.

Structural BMPs have very minimal TP reduction and mainly focus on removing TSS from stormwater. The estimated TSS removal for the Alabama Street Outlet design is 0.20 tons (394 lbs) per year. Maintenance for the site consists of annual cleanouts with a vacuum truck to remove trapped sediment from the structure and a visual inspection for any cracks in the structure.

Table 5.3.5 - Alabama St Outlet Design and Impacts Summary Table		
		Constructability Score
BMP Type	Structural BMP	
Drainage area (ac)	71.5	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.197	N/A
TP Reduction (lbs/yr)	0	N/A
Construction Cost	$ 645,969.60	N/A
25 Year Maint. Cost	$ 25,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 136,300.00	N/A
TP Cost/Benefit ($/ton)	$ -	N/A
Tree Removal	None	3
Park Impacts	N/A	3
Access	Moderate	2
Impacts to Existing Infrastructure	High	1
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	12
Index Constructability Score	N/A	2

WSB presented this idea to St. Paul and city staff requested downstream defenders to be consistent with structural BMPs already located in St. Paul and to be consistent on city staff maintenance procedures of these structures. The chosen locations for the structural BMPs have easy access for city staff to maintain them.

The structural BMPs for the Alabama Street Outlet have high impacts. No tree removal is expected since this will be contained within the right of way. Visual impacts of the structural BMP would be only visible to the public during the installation. The structure does not impact private property and access to these BMPs would be easy since they are located in the right of way. The likelihood of wetland impacts is low. The impacts to existing infrastructure are high due to the placement which may contain buried utilities and connecting into existing storm infrastructure. If during final design, utility conflicts are problematic, the structure could be moved online which is less preferred by the city or farther downstream on the storm line.

The estimated engineering and construction cost for structural BMPs along Alabama Street Outlet is $645,970. A detailed construction cost estimate is available in Appendix B.

5.3.6 St. John Vianney Concept Design

The concept design for St. John Vianney consists of a filtration basin or underground gallery that would provide treatment for a drainage area of 16 acres. The basin footprint is 0.36 acres and the depth of the basin is 7 feet. The basin would treat stormwater diverted from an existing 27" stormwater pipe that currently travels under the St. John Vianney parking lot. The filtered stormwater would be returned to the same line outside the parking lot before it enters the ravine behind the church.

The estimated TP reduction from this basin would be 8 lbs per year and the estimated TSS reduction would be 1.17 tons (2340 lbs) per year. Maintenance for this site will consist of vegetative maintenance, periodic sediment removal, and filtration media replacement if the basin is used for filtration. Maintenance frequency would be expected to be every 3-5 years and would be coordinated with the church to minimize impacts to the community.

Table 5.3.6 - St. John Vianney Design and Impacts Summary Table

		Constructability Score
BMP Type	Infiltration/ Filtration	
Drainage area (ac)	15.8	N/A
Ownership Type	Private	1
TSS Reduction (tons/yr)	1.17	N/A
TP Reduction (lbs/yr)	8	N/A
Construction Cost	$ 415,814.40	N/A
25 Year Maint. Cost	$ 75,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 16,800.00	N/A
TP Cost/Benefit ($/ton)	$ 2,300.00	N/A
Tree Removal	None	3
Park Impacts	N/A	3
Access	Moderate	2
Impacts to Existing Infrastructure	Low	3
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	14
Index Constructability Score	N/A	2

WSB presented ideas for this site to City of South St. Paul staff in August 2024. City staff were interested in an opportunity for a larger basin but were cautious about placing it on private property. When WSB staff indicated that St. John Vianney staff had been present during the site visit and indicated willingness to discuss the concept, staff approved the basin to proceed to concept designs.

Impacts of a stormwater basin at St. John Vianney are generally minimal. Tree removal would be limited and would be most likely in the area of reconnection to the existing stormwater pipe at the edge of the ravine; construction of the actual basin would not require tree removal since the area is currently maintained as a ball field. Access from 19th Avenue North or the St. John Vianney parking lot would be moderately challenging given the existing slopes (estimated at 3:1) down to the ballfield but it would not be impossible for large equipment. Wetland impacts are unlikely. The primary challenge for construction on this site would be negotiating easements and obtaining approval from the church community. Conversations with church staff indicate that the existing ball field is not heavily used but a stormwater basin may not be a desired feature for the property by all church members. The first step in further development of this concept design should be meeting with church leadership to determine if placement of a stormwater structure on this site is a viable option.

The estimated engineering and construction cost for St. John Vianney is $415,815. A detailed construction cost estimate is available in Appendix B.

5.3.7 Maltby Street Concept Design

The concept design for Maltby Street Outlet consists of eight structural BMPs placed off-line on the upstream storm sewer to treat untreated water going to this outlet. The proposed structural BMP is a downstream defender or similar BMP, 8 ft in size. Each structure would treat diverted stormwater to the BMP and connect back into the main trunk line of the storm sewer. A typical detail is included in Appendix C.

Structural BMPs have very minimal TP reduction and mainly focus on removing TSS from stormwater. The estimated TSS removal for the Maltby Street Outlet design is 0.16 tons (322 lbs) per year. Maintenance for the site consists of annual cleanouts with a vacuum truck to remove trapped sediment from the structure and a visual inspection for any cracks in the structure.

Table 5.3.7 - Maltby Street Outlet Design and Impacts Summary Table		
		Constructability Score
BMP Type	Structural BMP	
Drainage area (ac)	127.0	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.161	N/A
TP Reduction (lbs/yr)	0	N/A
Construction Cost	$ 1,148,277.60	N/A
25 Year Maint. Cost	$ 25,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 291,500.00	N/A
TP Cost/Benefit ($/ton)	$ -	N/A
Tree Removal	None	3
Park Impacts	N/A	3
Access	Moderate	2
Impacts to Existing Infrastructure	High	1
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	12
Index Constructability Score	N/A	2

WSB presented this idea to South St. Paul and city staff was receptive to the design. The chosen locations for the structural BMPs have easy access for city staff to maintain them.

The structural BMPs for the Maltby Street Outlet have high impacts. No tree removal is expected since this will be contained within the right of way. Visual impacts of the structural BMP would be only visible to the public during the installation. The structure does not impact private property and access to these BMPs would be easy since they are located in the right of way. The likelihood of wetland impacts is low. The impacts to existing infrastructure are high due to the placement which may contain buried utilities and connecting into existing storm infrastructure. If during final design, utility conflicts are problematic, the structure could be moved online which is less preferred due to potential blockages or farther downstream on the storm line.

The estimated engineering and construction cost for structural BMPs along Maltby Street Outlet is $1,148,280. A detailed construction cost estimate is available in Appendix B.

5.3.8 Gisch Pond Concept Design

Gisch Pond was identified as a potential option for expansion of the pond. While meeting with Inver Grove Heights, the city informed us that there is a design completed for Gisch Pond expansion and it is funded by a grant. WSB based the design for Gisch Pond, construction costs, and removals based on the information provided for the grant. The concept design consists of expanding the pond to the maximum extent while maintaining constructability.

The basin is expected to remove 111 lbs of TP and 18.35 tons of TSS per year. Maintenance for the site will consist of vegetative maintenance and periodic sediment removal. Pond maintenance projects generally require sediment removal every 25 years.

Table 5.3.8 - Gisch Pond Design and Impacts Summary Table

		Constructability Score
BMP Type	Stormwater Pond	
Drainage area (ac)	382.9	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	18.345	N/A
TP Reduction (lbs/yr)	111	N/A
Construction Cost	$ 3,191,479.20 *	N/A
25 Year Maint. Cost	$ 250,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 7,500.00	N/A
TP Cost/Benefit ($/ton)	$ 1,250.00	N/A
Tree Removal	High	1
Park Impacts	N/A	3
Access	Hard	1
Impacts to Existing Infrastructure	Low	3
Wetland Impacts	High	1
Total Constructability Score	N/A	9
Index Constructability Score	N/A	1

*Cost provided to WSB by the City on August 8, 2024

While meeting with City of Inver Grove Heights staff, they wanted to remove the forebay for Gisch Pond that was proposed with the initial design by the city. They noted concerns with the amount of water coming to the pond, that the berm between the forebay and the pond would be destroyed by the amount of water coming in. The design was altered so there is no forebay for the pond.

Overall, the basin expansion at Gisch Pond has high impacts. The pond is located on public property. The basin has been sized to the maximize the area while being constructable. Because of this, impacts to trees are high and significant tree removal is expected. Impacts to existing infrastructure are high because of the culvert replacement that goes under the railroad. Coordination of replacement for this pipe will need to be done with the railroad. In addition, utility conflicts may occur while replacing the culvert with existing underground utilities. Wetland impacts are likely. Access to the site is expected from River Road to the east, but due to the culvert replacement access should be coordinated with the railroad and is a moderate impact.

The estimated engineering and construction cost for Gisch Pond is $3,191,480. A detailed construction cost estimate is available in Appendix B.

5.3.9 IGH Structural BMPs Concept Design

The concept design for Dawn Avenue Outlet consists of six structural BMPs placed off-line on the upstream storm sewer to treat untreated water going to the Dawn Avenue and River Road outlets. One of the BMPs is on a separate outlet on River Road in Inver Grove Heights. The proposed structural BMP is a downstream defender or similar with 8 ft size. Each structure would treat diverted stormwater to the downstream defender and connect back into the main trunk line of the storm sewer. A typical detail for a downstream defender is included in Appendix C.

Structural BMPs have very minimal TP reduction and mainly focus on removing TSS from stormwater. The estimated TSS removal for the Dawn Avenue Outlet design is 0.28 tons (233 lbs) per year. Maintenance for the site consists of annual cleanouts with a vacuum truck to remove trapped sediment from the structure and a visual inspection for any cracks in the structure.

Table 5.3.9 - IGH Structural BMPs and Impacts Summary Table

		Constructability Score
BMP Type	Structural BMP	
Drainage area (ac)	162.7	N/A
Ownership Type	Public	3
TSS Reduction (tons/yr)	0.117	N/A
TP Reduction (lbs/yr)	0	N/A
Construction Cost	$ 735,868.80	N/A
25 Year Maint. Cost	$ 25,000.00	N/A
TSS Cost/Benefit ($/ton)	$ 260,200.00	N/A
TP Cost/Benefit ($/ton)	$ -	N/A
Tree Removal	None	3
Park Impacts	N/A	3

Access	Easy	3
Impacts to Existing Infrastructure	High	1
Wetland Impacts	Unlikely	3
Total Constructability Score	N/A	13
Index Constructability Score	N/A	3

WSB presented this idea to Inver Grove Heights and city staff was receptive to the design. They requested an additional BMP on the storm sewer on River Road. Downstream defenders were chosen for all BMPs to maintain consistency in maintenance procedures for the structures. The chosen locations for the structural BMPs have easy access for city staff to maintain them.

The IGH Structural BMPs have high impacts. No tree removal is expected since this will be contained within the right of way. Visual impacts of the structural BMP would be only visible to the public during the installation. The structure does not impact private property and access to these BMPs would be easy since they are located in the right of way. The likelihood of wetland impacts is low. The impacts to existing infrastructure are high due to the placement which may contain buried utilities and connecting into existing storm infrastructure. If during final design, utility conflicts are problematic, the structure could be moved online which is less preferred due to potential blockages or farther downstream on the storm line.

The estimated engineering and construction cost for IGH Structural BMPs is $735,870. A detailed construction cost estimate is available in Appendix B.

5.4 Prioritization and Ranking of Concept Designs

Following the concept design and cost estimating for each site, WSB ranked each site on several criteria valued by member cities. These rankings are meant to assist city and LMRWMO staff on determining which projects to prioritize in coming funding cycles as well as inclusion in city and watershed planning documents such as watershed-wide management plans and capital improvement plans.

5.4.1 Summary of Concepts By Cost

Table 5.4 shows a summary of the concept designs and the associated life cycle cost.

Table 5.4 - Concept Designs Cost Summary					
Concept Design	City	BMP Type	Construction Cost	25 Year Maintenance Cost	Life Cycle Cost
Kennedy Park	West St. Paul	Structural BMP	$141,120	$25,000	$166,120
West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	$201,074	$75,000	$276,074
Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	$203,810	$75,000	$278,810
City Pool Park	West St. Paul	Infiltration/ Filtration	$305,114	$75,000	$380,114
St. John Vianney	South St. Paul	Infiltration/ Filtration	$415,814	$75,000	$490,814
Alabama Street Outlet	St. Paul	Structural BMP	$645,970	$25,000	$670,970
IGH Structural BMPs	Inver Grove Heights	Structural BMP	$735,869	$25,000	$760,869
Maltby Street Outlet	South St. Paul	Structural BMP	$1,148,278	$25,000	$1,173,278
Gisch Pond	Inver Grove Heights	Stormwater Pond	$3,191,479	$250,000	$3,441,479

The life cycle cost was used as the basis for pollutant removal efficiency calculations in order to include the cost of maintenance in the project costs.

5.4.2 Ranking Concepts By TSS Removal Efficiency

Table 5.4.2 shows the ranking of all nine concept designs by removal efficiency for TSS. All nine projects had some level of removal of total suspended solids

Table 5.4.2 - Concept Design Ranking by TSS Removal Efficiency						
Ranking	Concept Design	City	BMP Type	TSS Reduction (tons/yr)	Life Cycle Cost	TSS Removal Efficiency ($/ton)
1	Gisch Pond	Inver Grove Heights	Stormwater Pond	18.345	$3,441,479	$7,500
2	St. John Vianney	South St. Paul	Infiltration/ Filtration	1.170	$490,814	$16,800
3	Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	0.663	$278,810	$16,900
4	City Pool Park	West St. Paul	Infiltration/ Filtration	0.786	$380,114	$19,400

5	West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	0.230	$276,074	$48,000
6	Alabama Street Outlet	St. Paul	Structural BMP	0.272	$670,970	$136,300
7	IGH Structural BMPs	Inver Grove Heights	Structural BMP	0.214	$760,869	$260,200
8	Maltby Street Outlet	South St. Paul	Structural BMP	0.295	$1,173,278	$291,500
9	Kennedy Park	West St. Paul	Structural BMP	0.029	$166,120	$288,900

Gisch Pond has the highest ranking of TSS removal efficiency. It is the most expensive project in terms of life cycle cost but because it also has the highest annual TSS reduction it is the most efficient project in terms of TSS removal. St. John Vianney and Our Lady of Guadalupe are ranked second and third.

5.4.3 Ranking Concepts By TP Removal Efficiency

Table 5.4.3 shows the ranking of all nine concept designs by removal efficiency for TP. Structural BMPs do not reduce TP so they are considered unranked in this table.

Table 5.4.3 - Concept Design Ranking by TP Removal Efficiency

Ranking	Concept Design	City	BMP Type	TP Reduction (lbs/yr)	Life Cycle Cost	TP Removal Efficiency ($/lb)
1	Gisch Pond	Inver Grove Heights	Stormwater Pond	111.1	$3,441,479	$1,300
2	St. John Vianney	South St. Paul	Infiltration/ Filtration	7.920	$490,814	$2,500
3	Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	4.435	$278,810	$2,600
4	City Pool Park	West St. Paul	Infiltration/ Filtration	5.308	$380,114	$2,900
5	West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	3.035	$276,074	$3,700
--	Alabama Street Outlet	St. Paul	Structural BMP	0	$670,970	--
--	IGH Structural BMPs	Inver Grove Heights	Structural BMP	0	$760,869	--
--	Maltby Street Outlet	South St. Paul	Structural BMP	0	$1,173,278	--
--	Kennedy Park	West St. Paul	Structural BMP	0	$166,120	--

Gisch Pond has the highest ranking for TP removal efficiency. St. John Vianney is second and Our Lady of Guadalupe is third.

5.4.4 Summary of concepts By Constructability

Table 5.4.4 shows the summary of constructability scores for all nine concept designs.

Table 5.4.4 - Concept Design Constructability Comparison

Concept Design	City	BMP Type	Tree Removal	Impacts to Parks	Public vs Private	Access	Impacts to existing infrastructure	Likelihood of Wetland Impacts	Total Score (Sum)	Constructability Index
			Ranked 1-3	*Ranked 1-3*	*Ranked 1 or 3*	*Ranked 1-3*	*Ranked 1-3*	*Ranked 1-3*		*Ranked 1-3*
City Pool Park	West St. Paul	Infiltration/ Filtration	2	1	3	3	2	3	14	1
Kennedy Park	West St. Paul	Structural BMP	3	2	3	3	3	3	17	3
West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	2	1	3	3	3	3	15	2
Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	2	3	1	2	3	3	14	1
Alabama Street Outlet	St. Paul	Structural BMP	3	3	3	2	1	3	15	2
St. John Vianney	South St. Paul	Infiltration/ Filtration	3	3	1	2	3	3	15	2
Maltby Street Outlet	South St. Paul	Structural BMP	3	3	3	2	1	3	15	2
Gisch Pond	Inver Grove Heights	Stormwater Pond	1	3	3	1	1	1	10	1
IGH Structural BMPs	Inver Grove Heights	Structural BMP	3	3	3	3	1	3	16	3

Kennedy Park and IGH Structural BMPs both scored high on constructability.

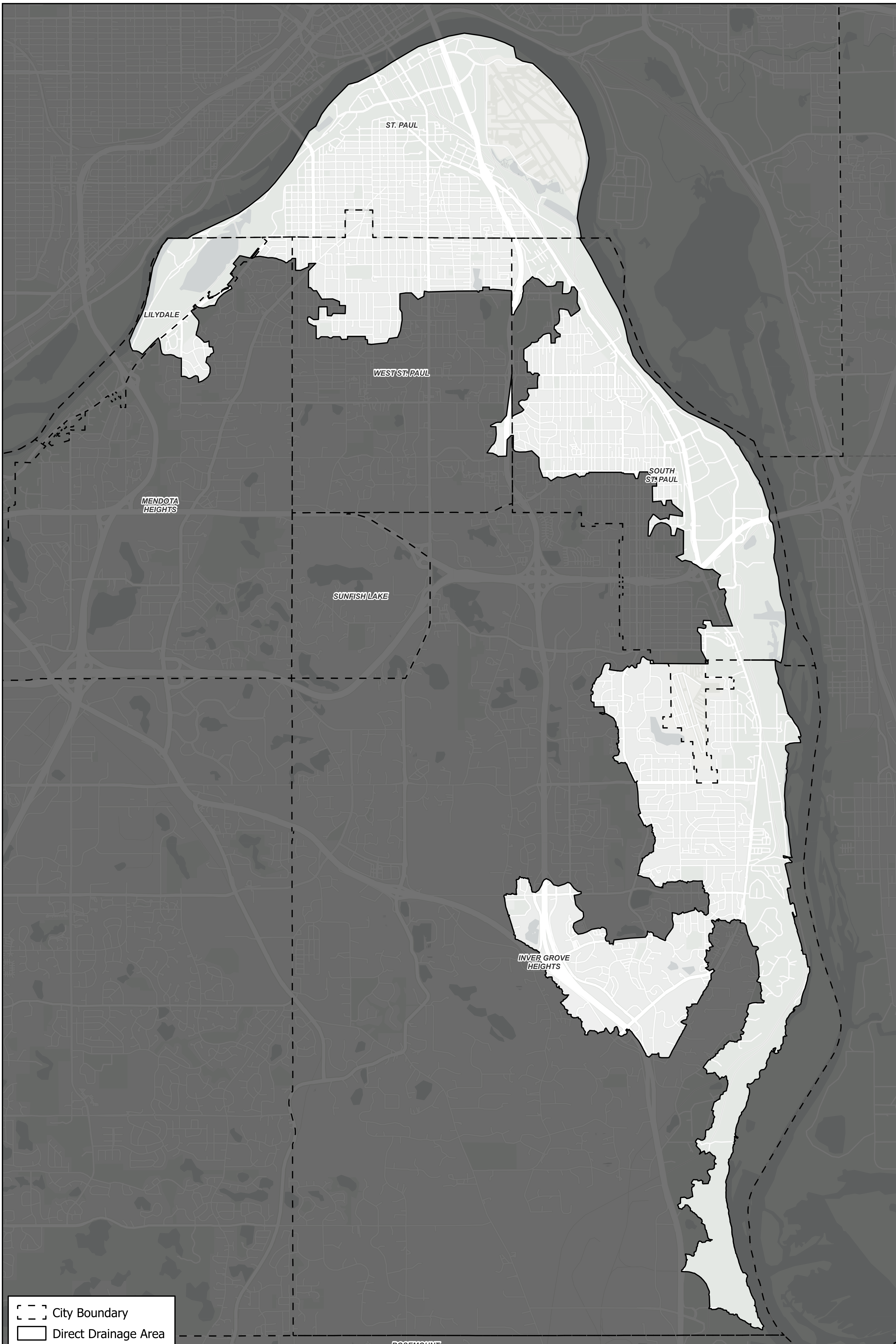
5.4.5 Overall Decision Matrix

The overall decision matrix is shown in Table 5.4.5.

Table 5.4.5 Overall Decision Matrix

Concept Design	City	BMP Type	Drainage Area Treated (ac) *Ranked 1-3*	Volume Reduction Capability Score *Ranked 0-2*	TSS Removal Efficiency *Ranked 1-5*	TP Removal Efficiency *Ranked 1-5*	Constructability *Ranked 1-3*	**Total Score**
Gisch Pond	Inver Grove Heights	Stormwater Pond	3	0	5	4	3	**15**
Our Lady of Guadalupe	St. Paul	Infiltration/ Filtration	1	1	4	4	1	**11**
St. John Vianney	South St. Paul	Infiltration/ Filtration	1	1	4	3	2	**11**
West St. Paul Sports Complex	West St. Paul	Infiltration/ Filtration	1	1	4	1	2	**9**
City Pool Park	West St. Paul	Infiltration/ Filtration	1	1	4	2	1	**9**
IGH Structural BMPs	Inver Grove Heights	Structural BMP	3	0	1	1	3	**8**
Maltby Street Outlet	South St. Paul	Structural BMP	3	0	1	1	2	**7**
Kennedy Park	West St. Paul	Structural BMP	2	0	1	1	3	**7**
Alabama Street Outlet	St. Paul	Structural BMP	2	0	2	1	2	**7**

Appendix A - Figures



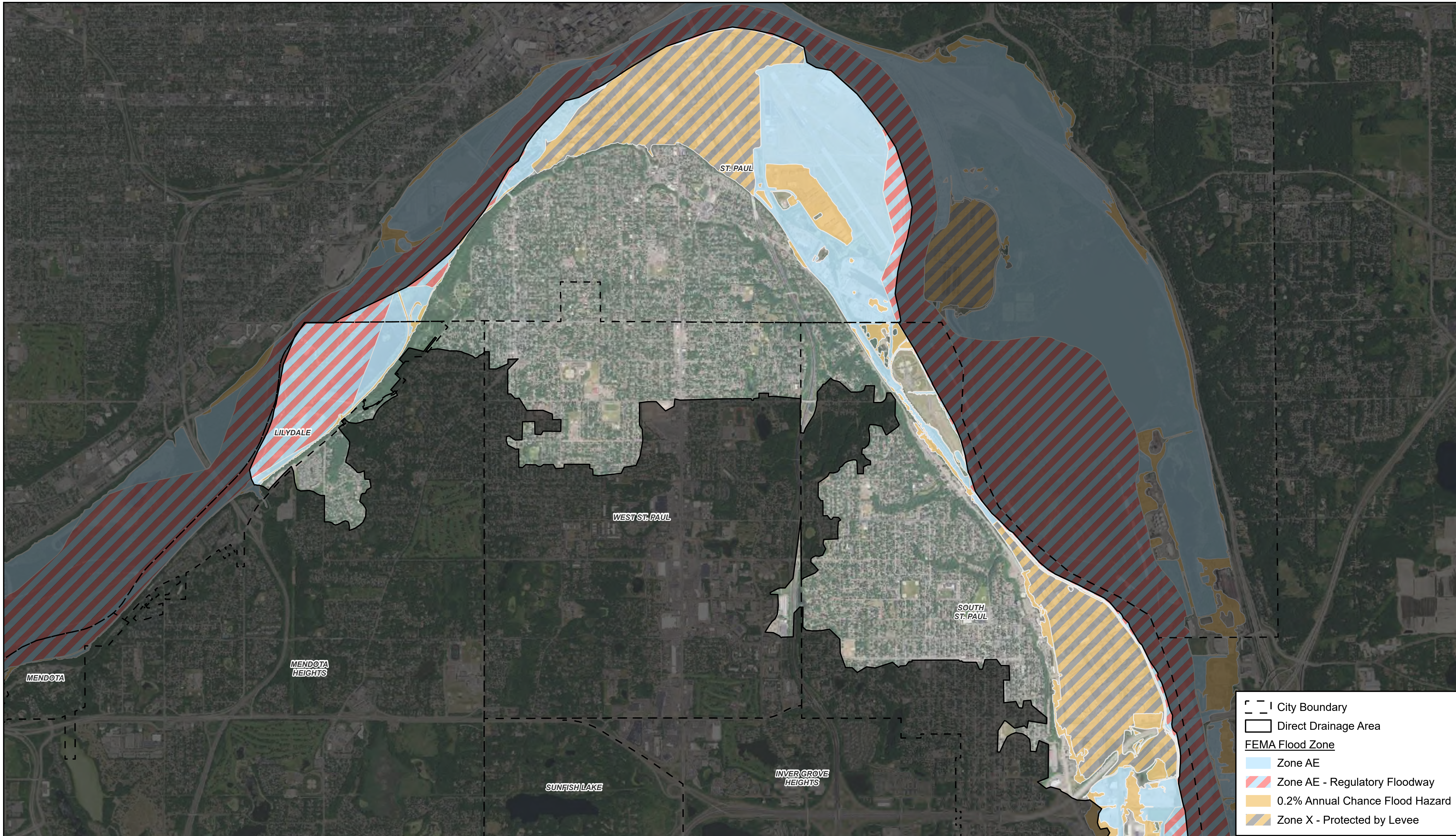
2.1 Study Area

Mississippi Direct Drainage Prioritization Study

N

0 0.8 Miles

1 inch = 0.8 MI



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LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 3.1.1A - FEMA Flood Zones

Mississippi Direct Drainage Project Prioritization Study
North of I-494

N
0 3,000
Feet
1 inch = 3,000 feet

wsb

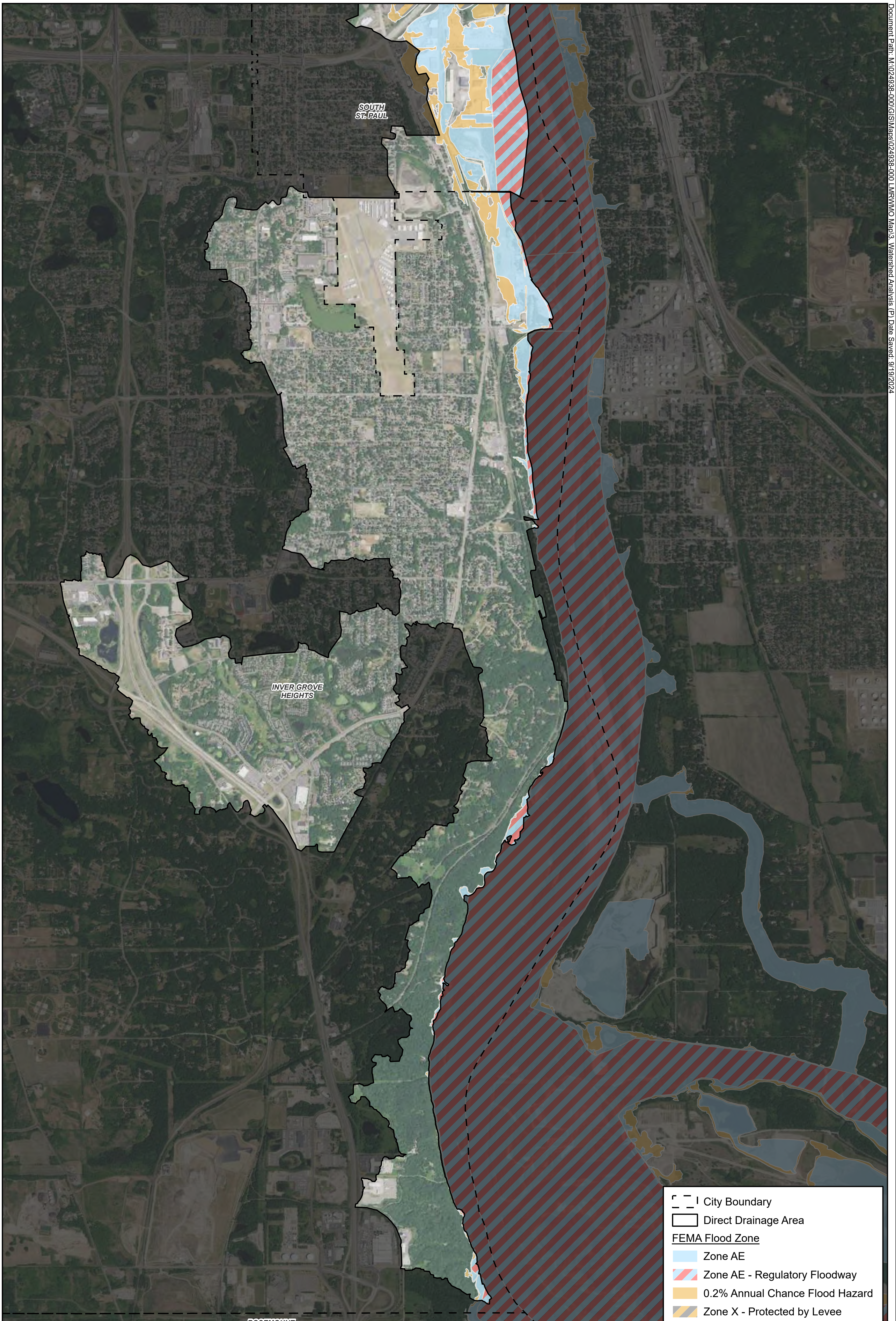

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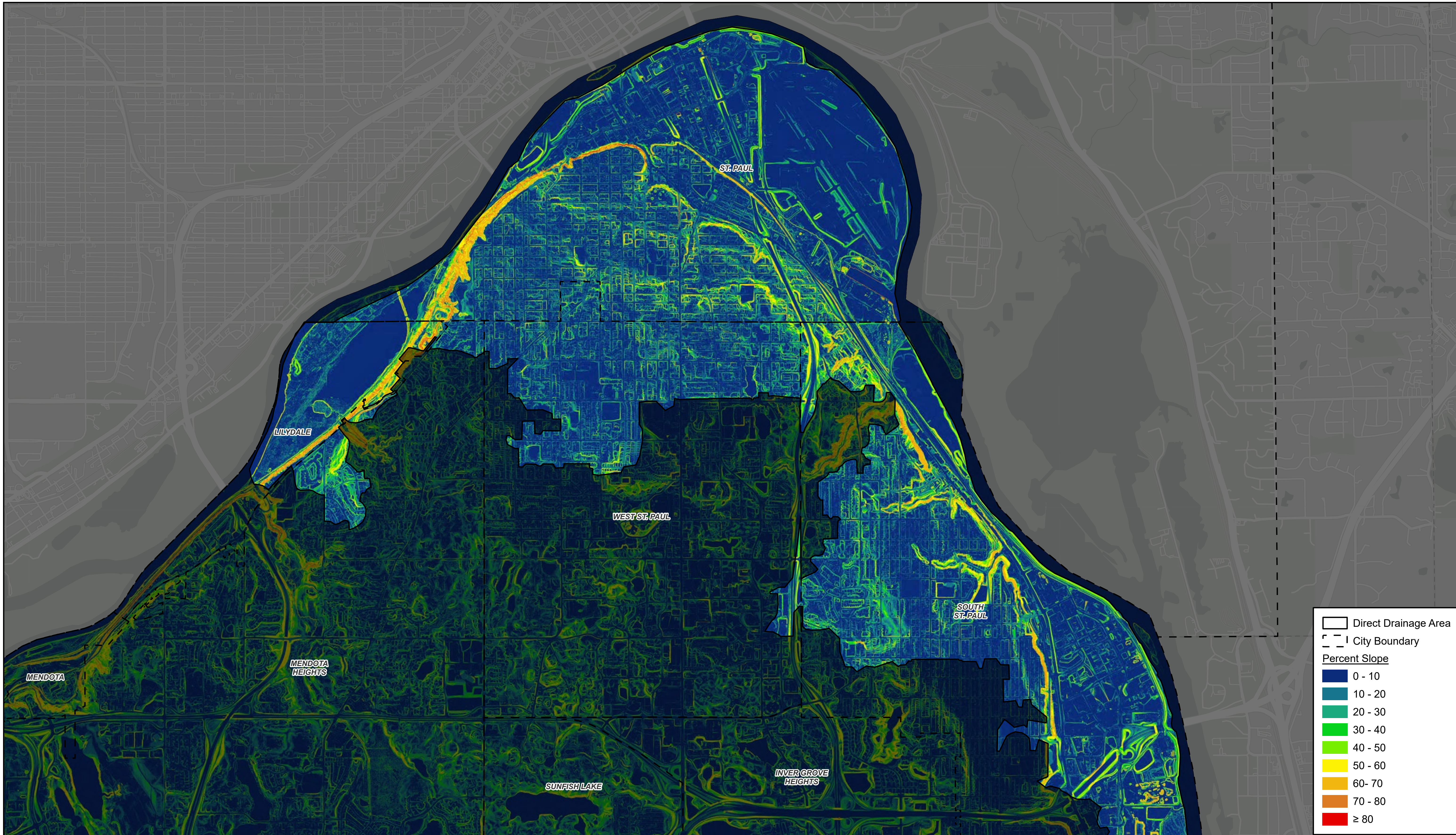
Figure 3.1.1B - FEMA Flood Zones

Mississippi Direct Drainage Project Prioritization Study
South of I-494

wsb



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WATERSHED MANAGEMENT ORGANIZATION

Figure 3.1.2A - Study Area Slopes

Mississippi Direct Drainage Project Prioritization Study
North of I-494

N
0 3,000 Feet
1 inch = 3,000 feet

wsb

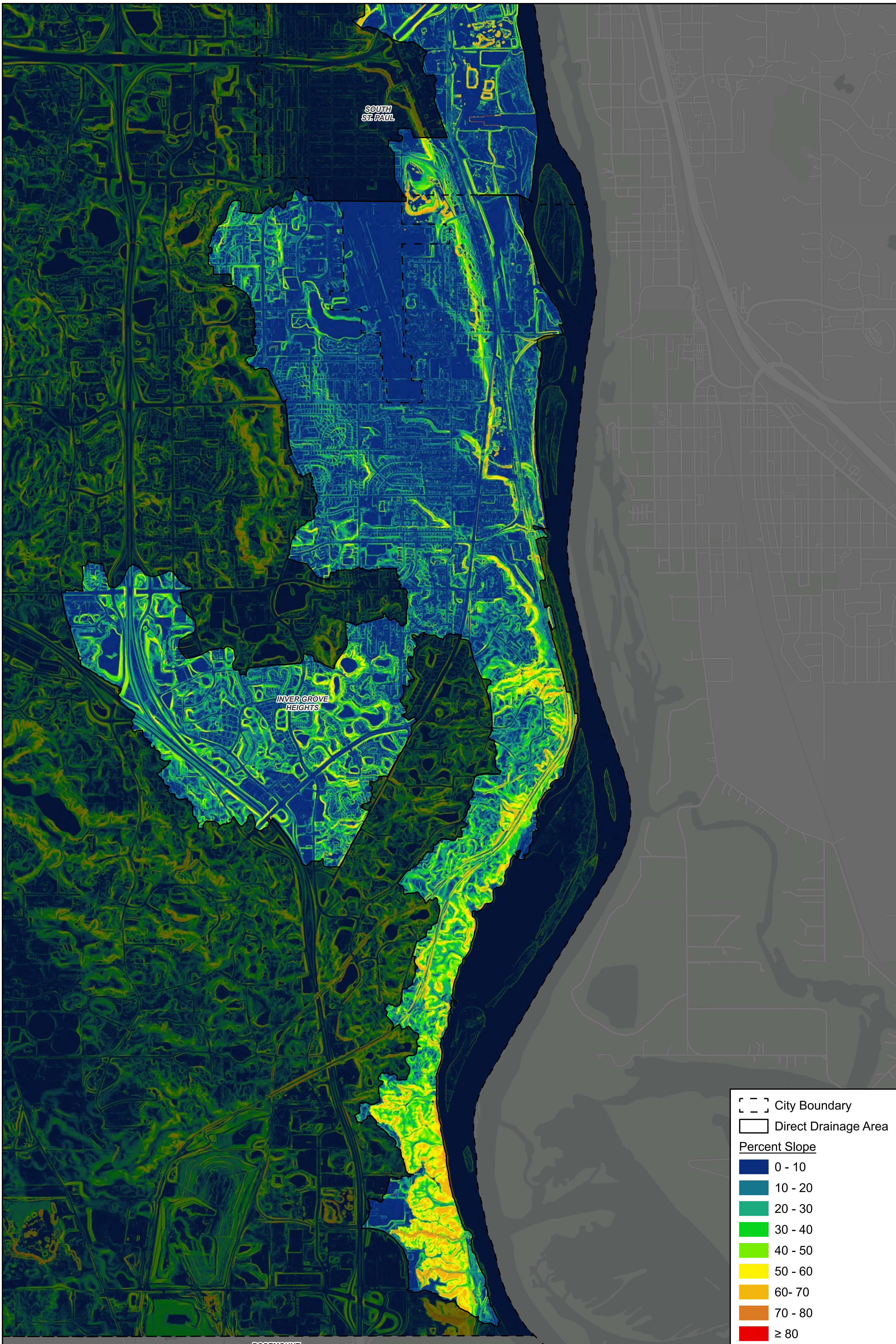

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Figure 3.1.2B - Study Area Slopes

Mississippi Direct Drainage Project Prioritization Study
South of I-494

N
0 2,500 Feet
1 inch = 2,500 feet

wsb

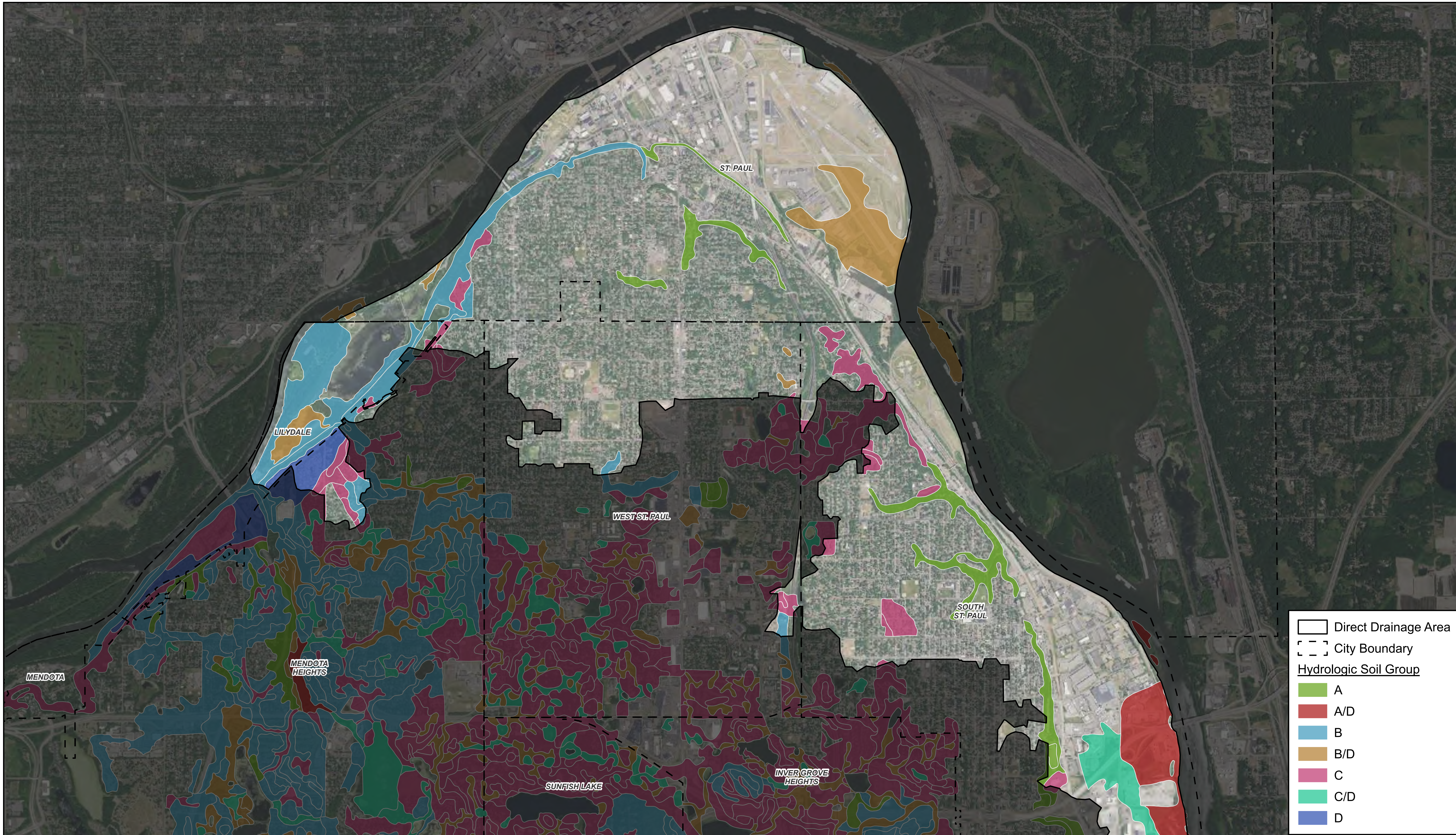

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Figure 3.1.3A - Study Area Soils

Mississippi Direct Drainage Project Prioritization Study
North of I-494

N
0 3,000 Feet
1 inch = 3,000 feet

wsb

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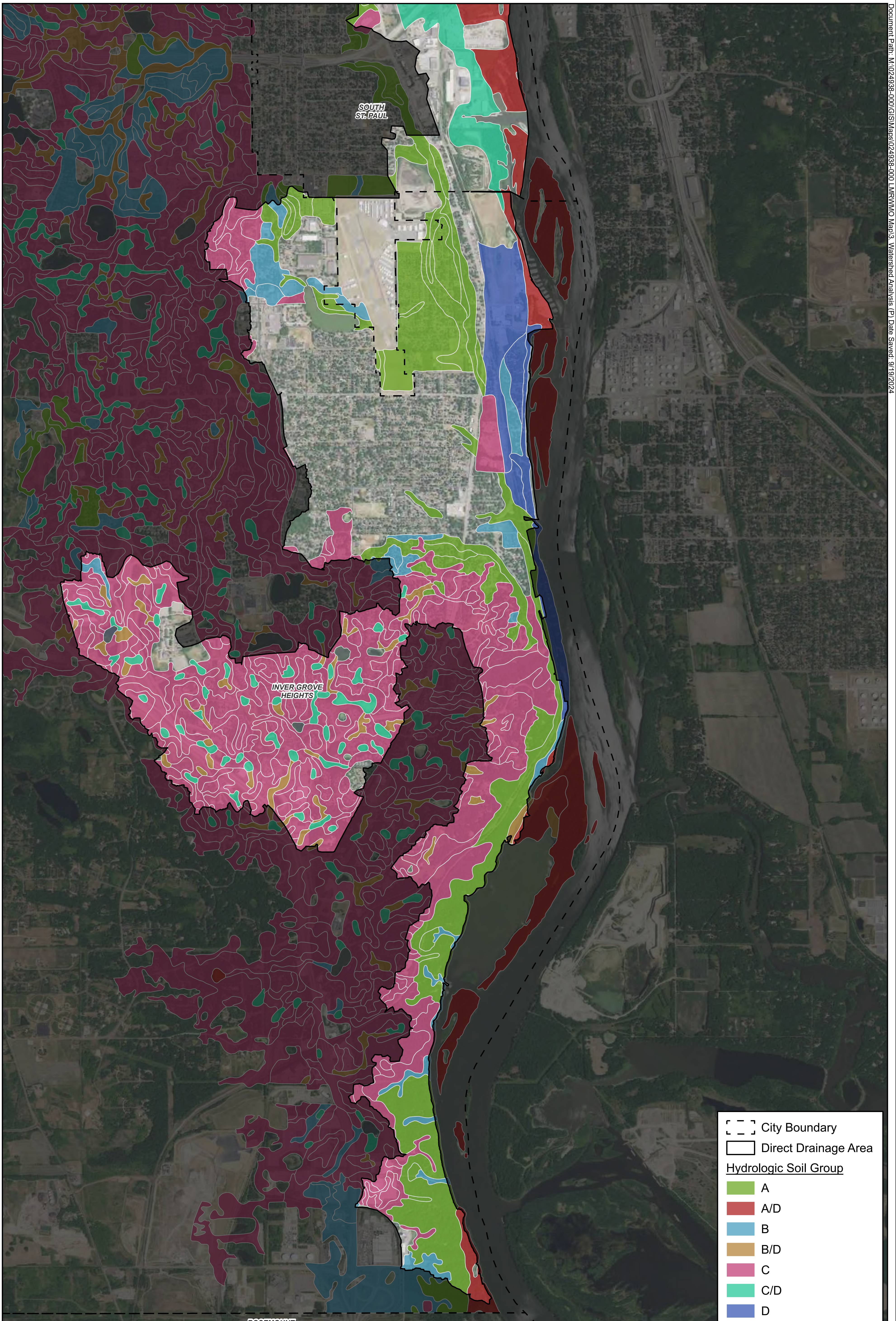

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Figure 3.1.3B - Study Area Soils

Mississippi Direct Drainage Project Prioritization Study
South of I-494

N

0 2,500 Feet
1 inch = 2,500 feet

wsb

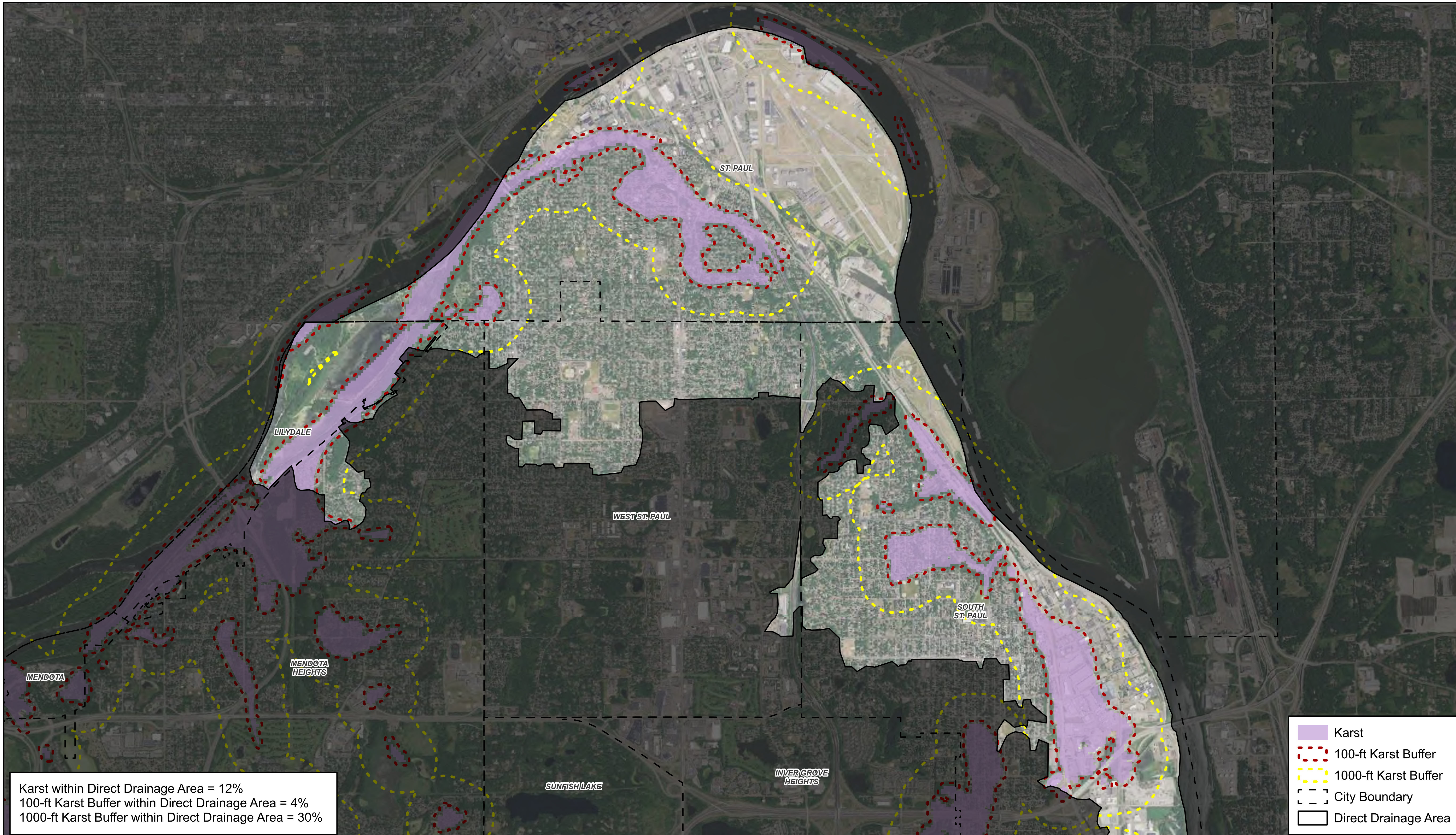

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Figure 3.1.4A - Study Area Karst Presence

Mississippi Direct Drainage Project Prioritization Study
North of I-494

N

0 3,000 Feet
1 inch = 3,000 feet

wsb

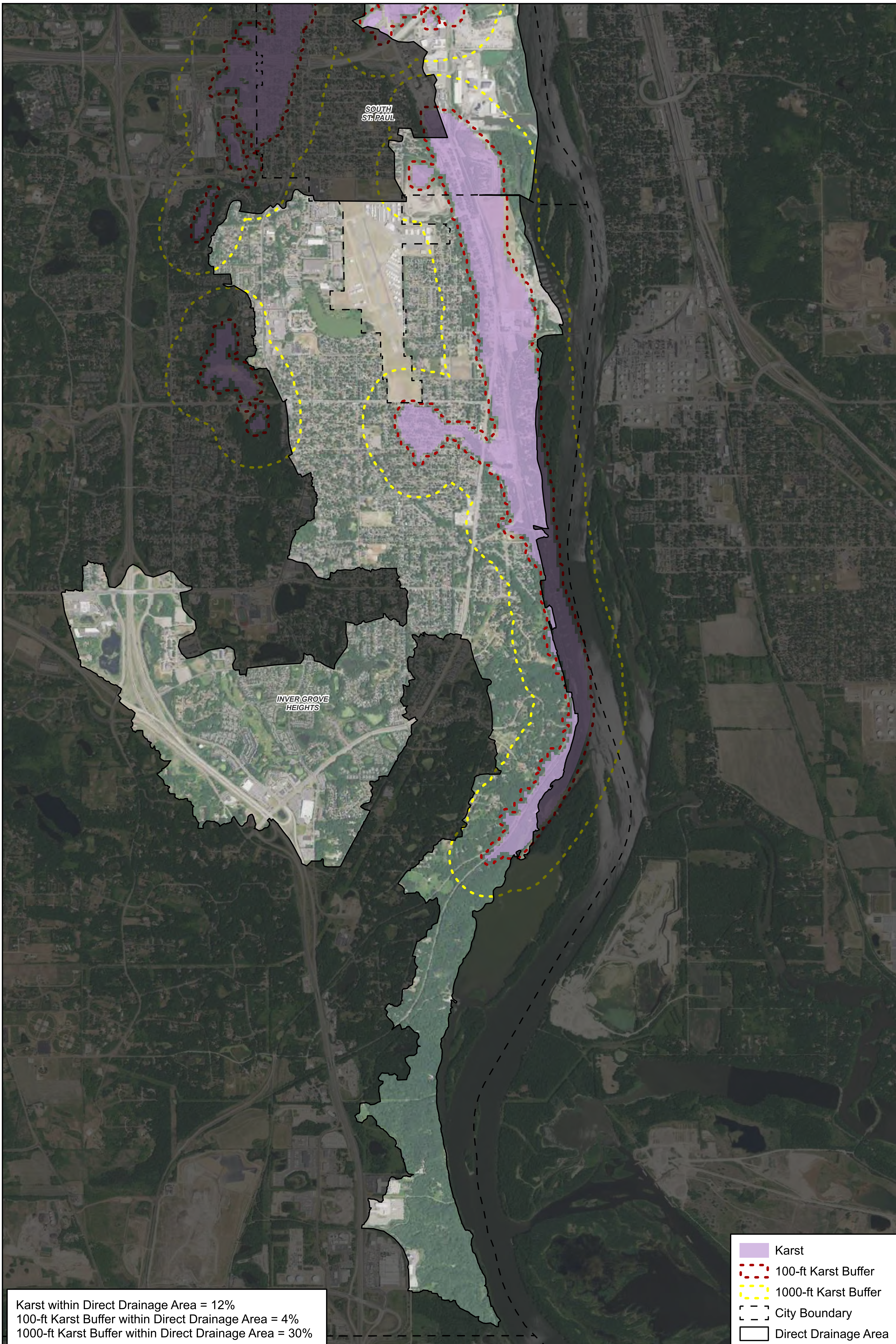
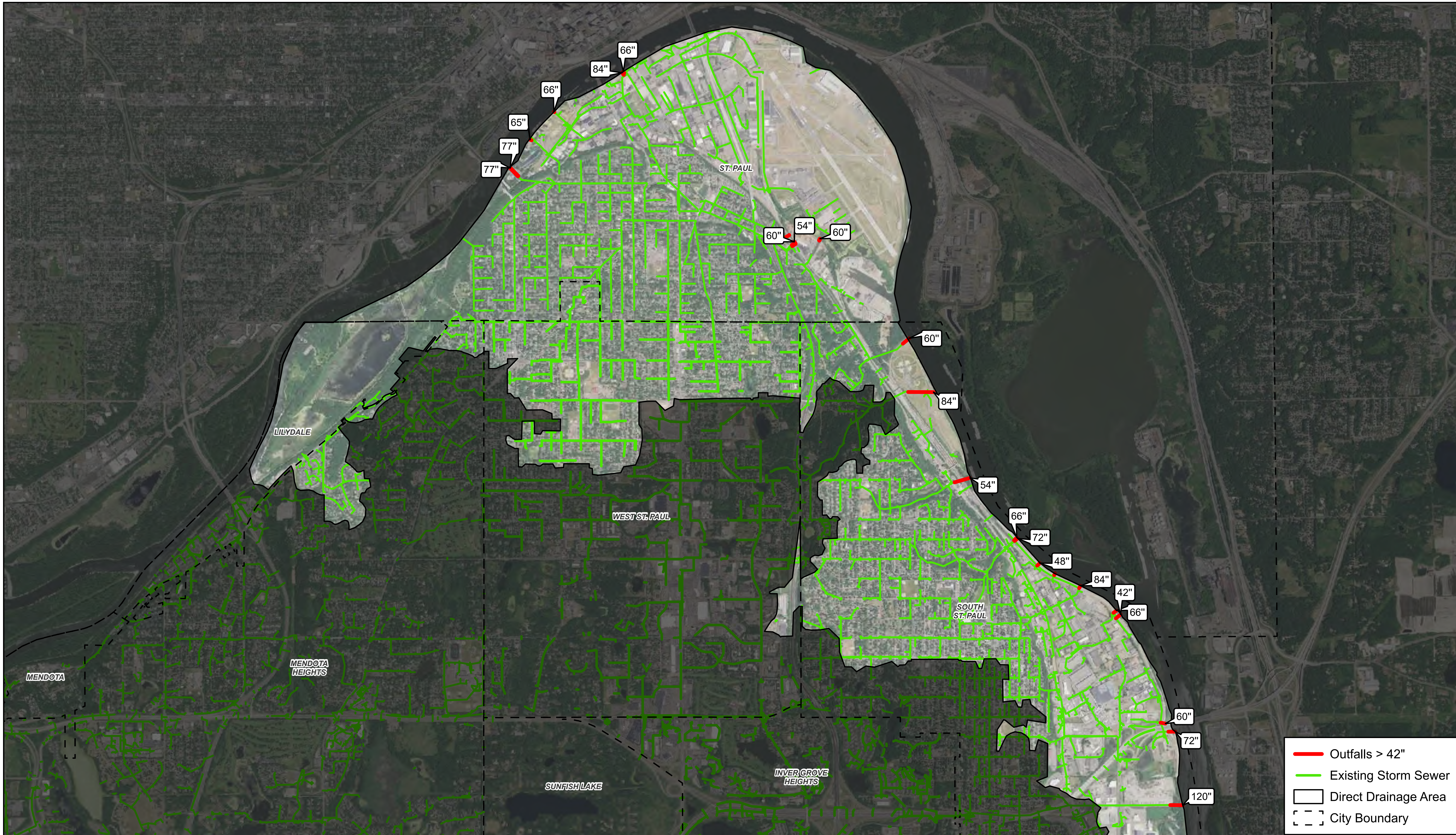


Figure 3.1.4B - Study Area Karst Presence

Mississippi Direct Drainage Project Prioritization Study
South of I-494



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WATERSHED MANAGEMENT ORGANIZATION

Figure 3.2.1A - Existing Public Stormwater Infrastructure

Mississippi Direct Drainage Project Prioritization Study
North of I-494

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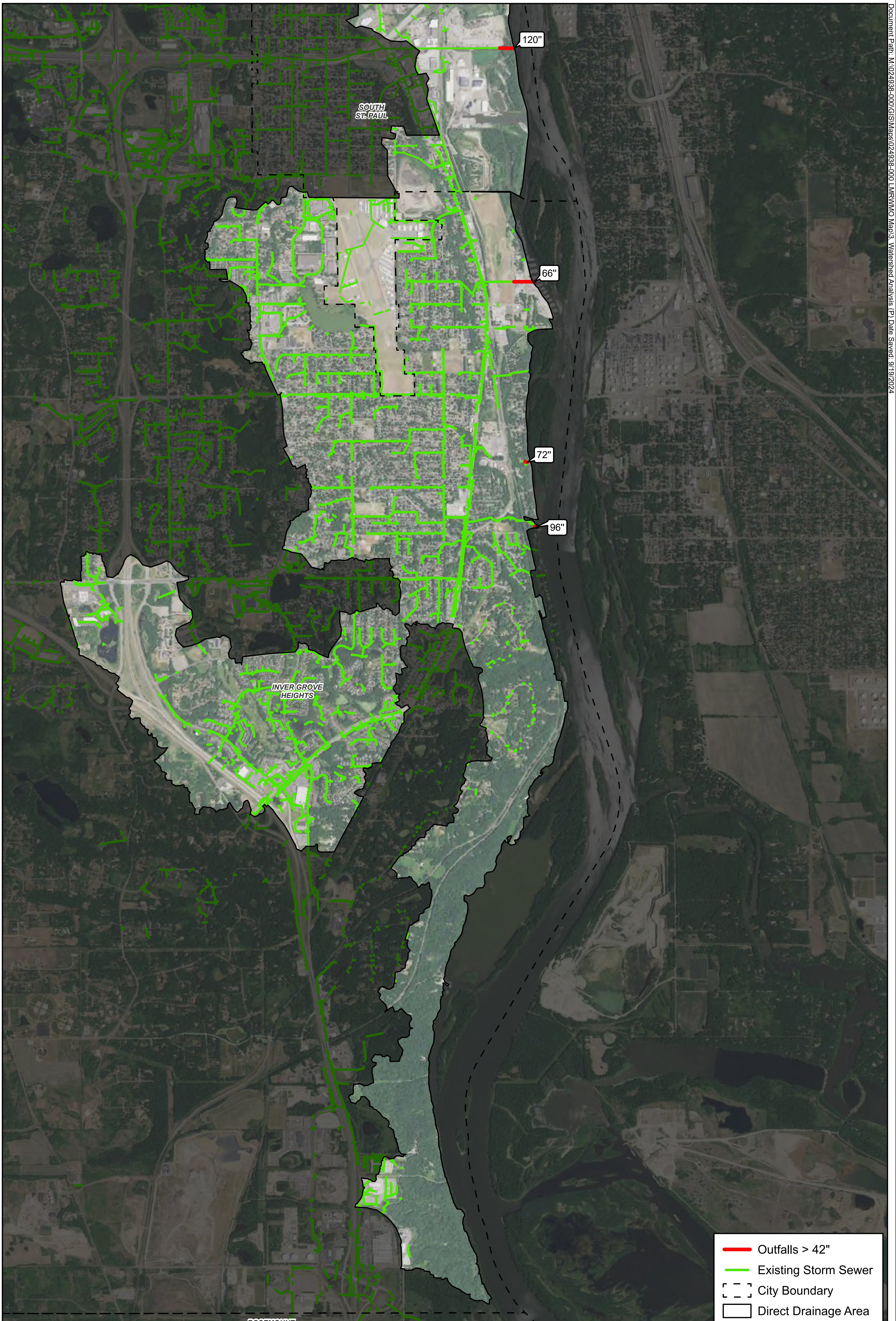

Figure 3.2.1B - Existing Public Stormwater Infrastructure

Mississippi Direct Drainage Project Prioritization Study
South of I-494

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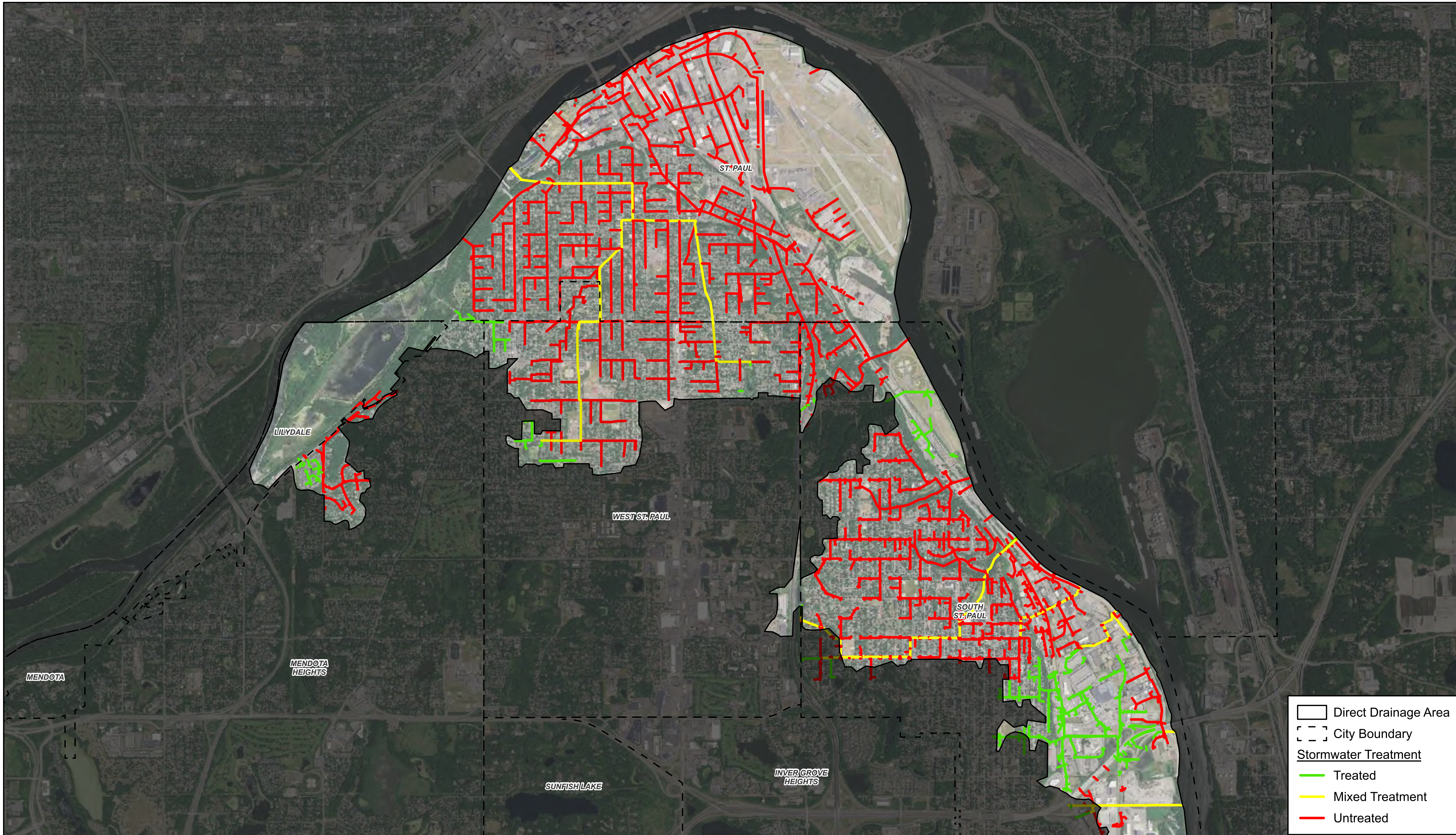

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 3.2.2A- Existing Stormwater Treatment

Mississippi Direct Drainage Project Prioritization Study
North of I-494

N 0 3,000 Feet
1 inch = 3,000 feet

wsb

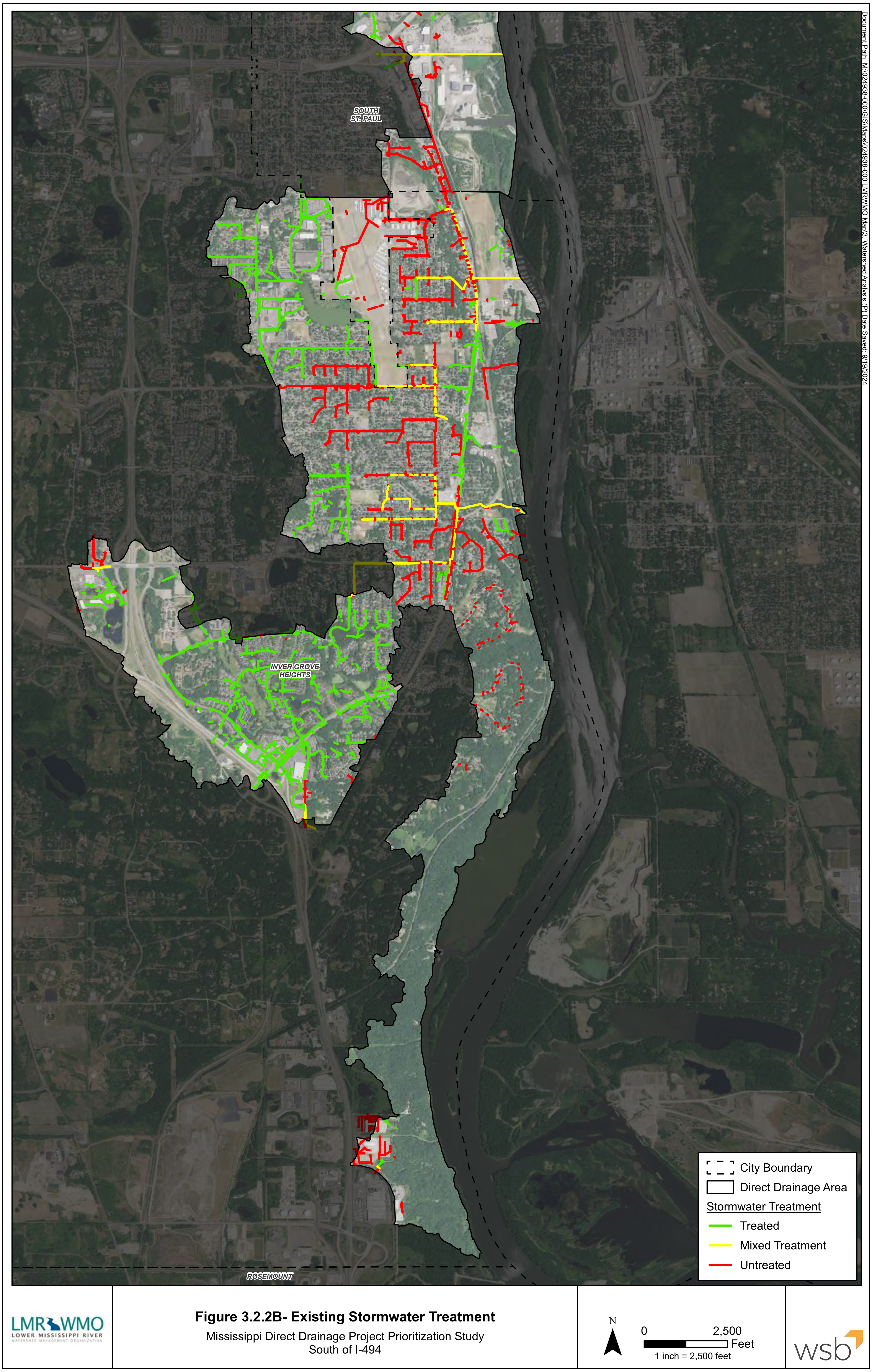

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Figure 3.2.2B- Existing Stormwater Treatment

Mississippi Direct Drainage Project Prioritization Study
South of I-494

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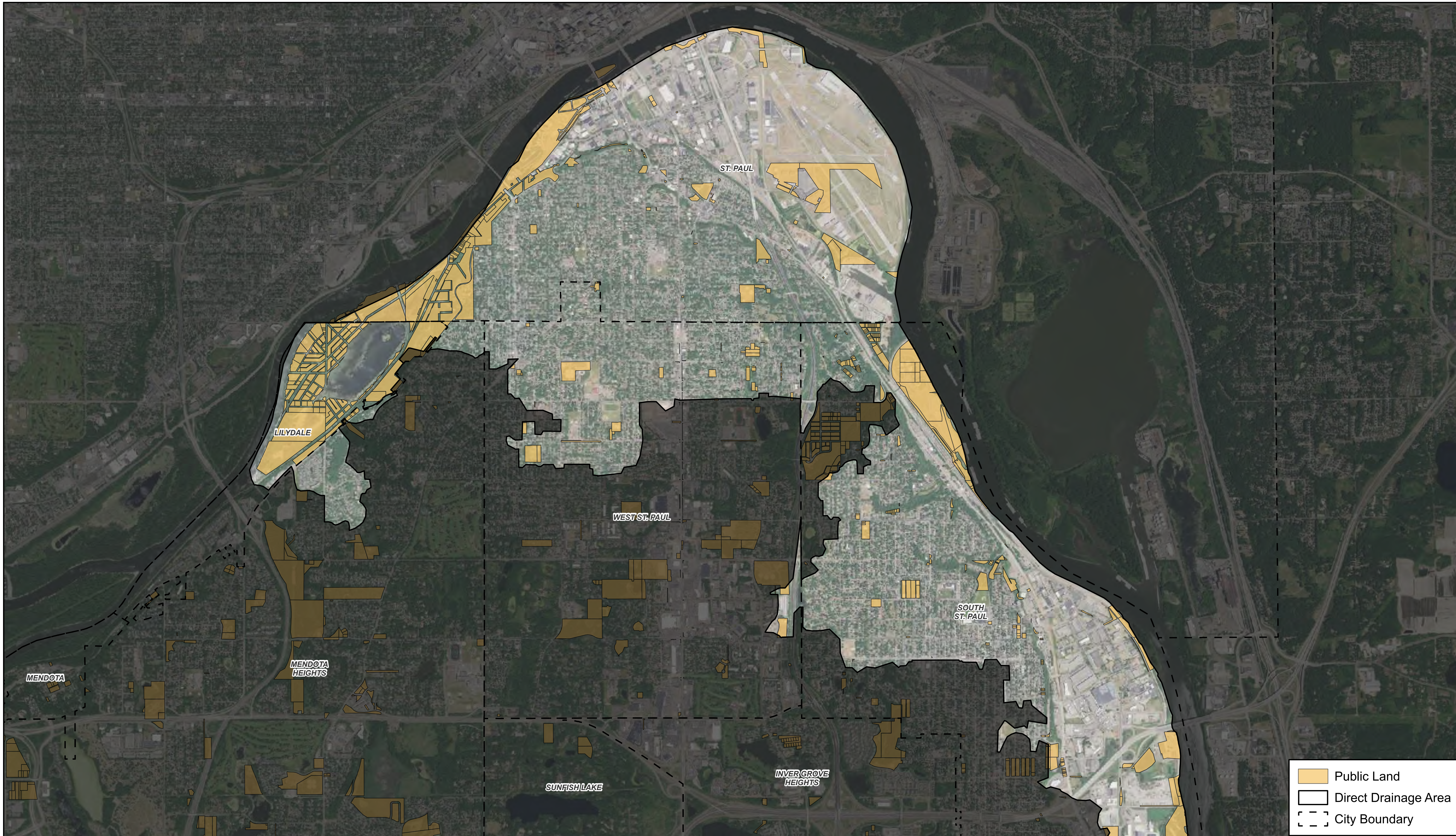

Figure 3.2.3A - Public Land

Mississippi Direct Drainage Project Prioritization Study
North of I-494

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WATERSHED MANAGEMENT ORGANIZATION

N

0 3,000 Feet
1 inch = 3,000 feet

wsb

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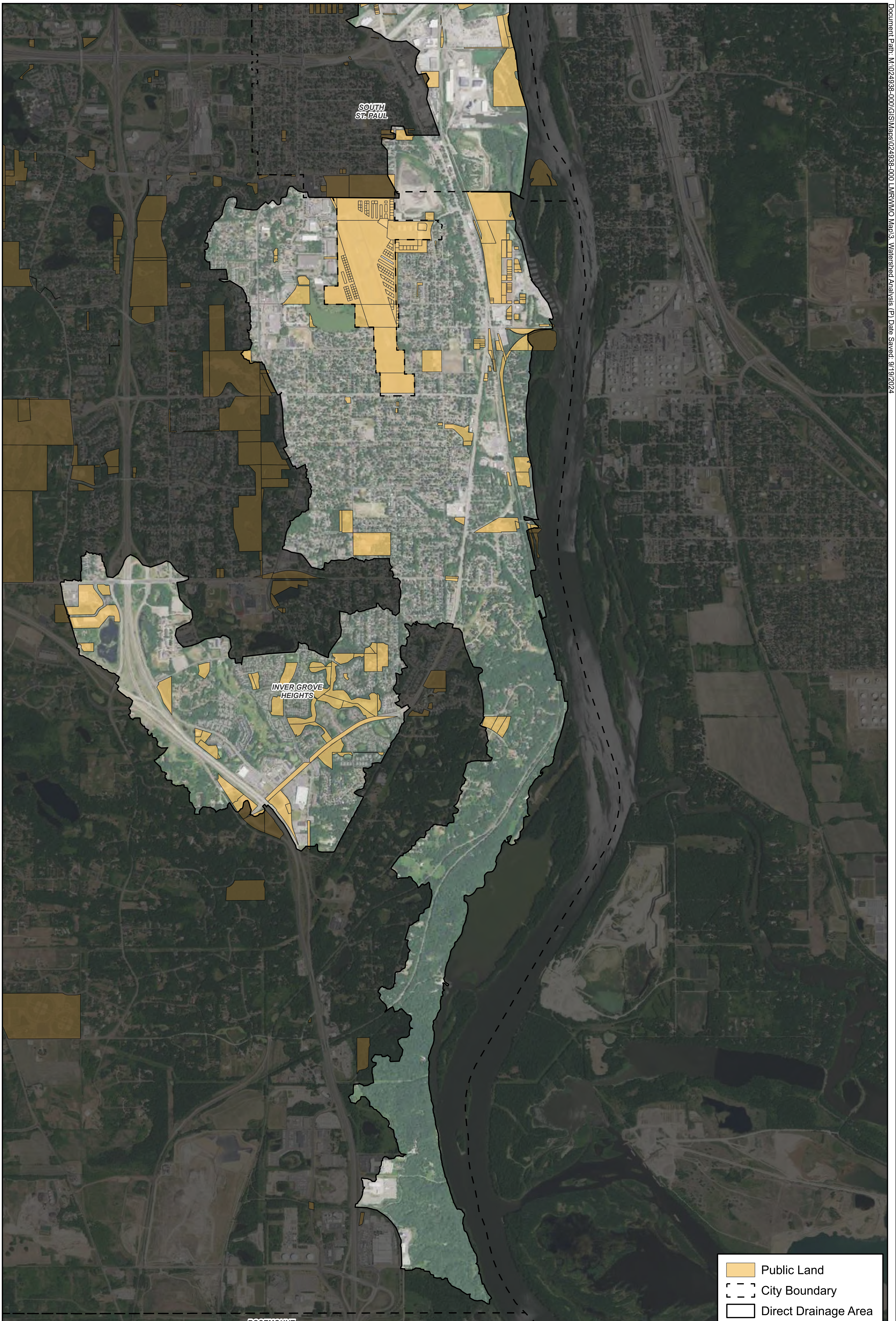

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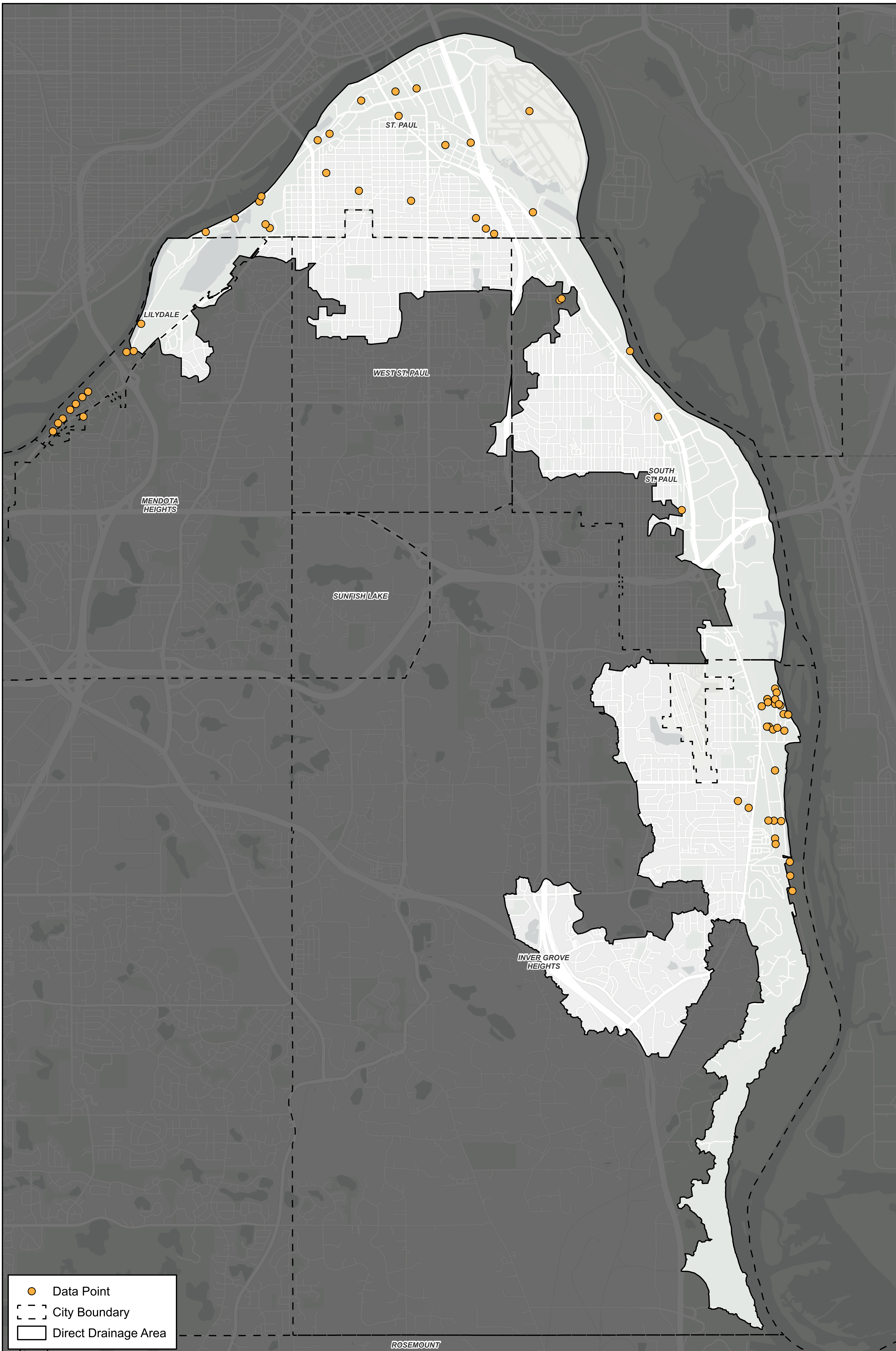
Figure 3.2.3B - Public Land

Mississippi Direct Drainage Project Prioritization Study
South of I-494

N

0 2,500 Feet
1 inch = 2,500 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

3.3.1 Known Issues Web Map Data

Mississippi Direct Drainage Prioritization Study

wsb

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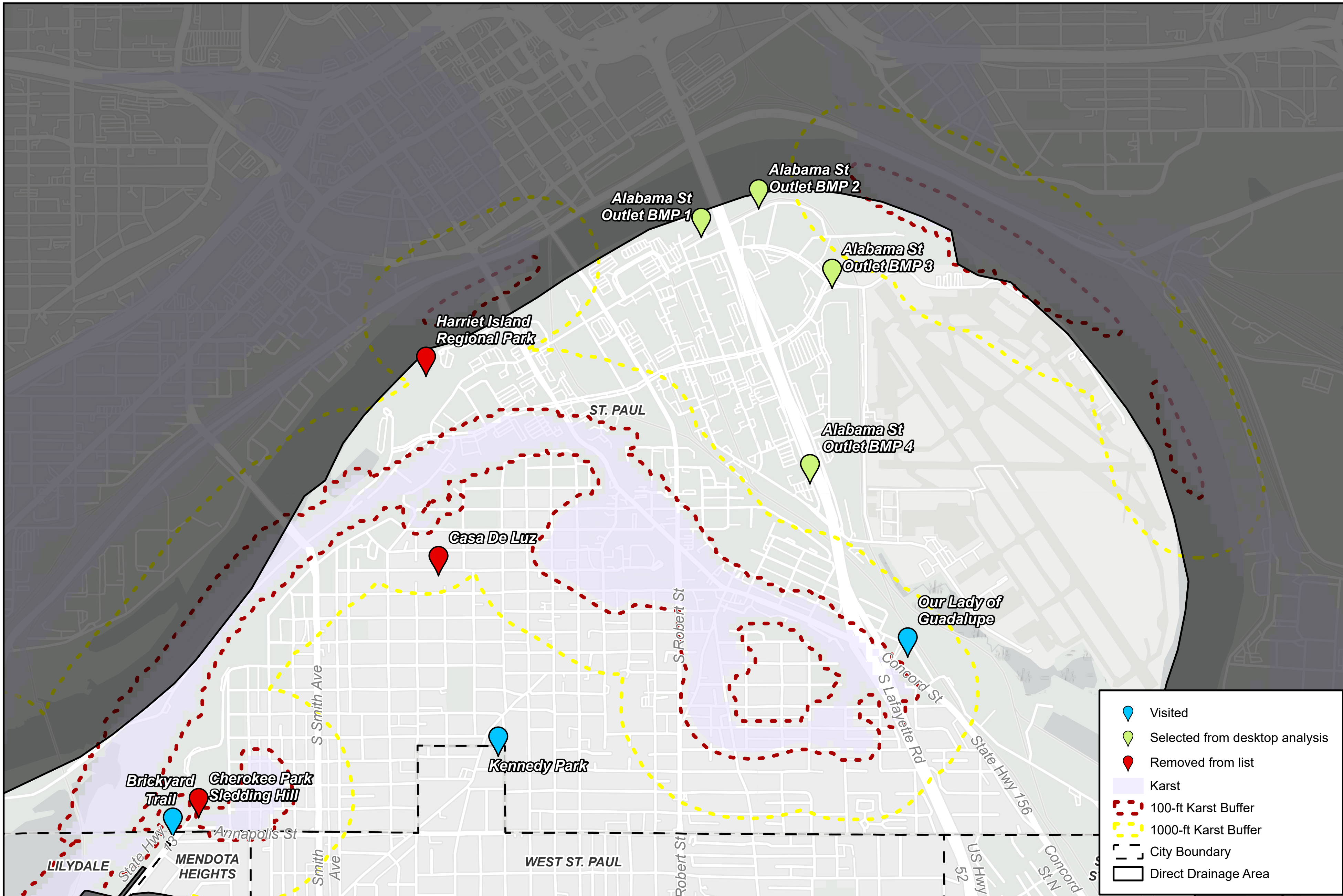

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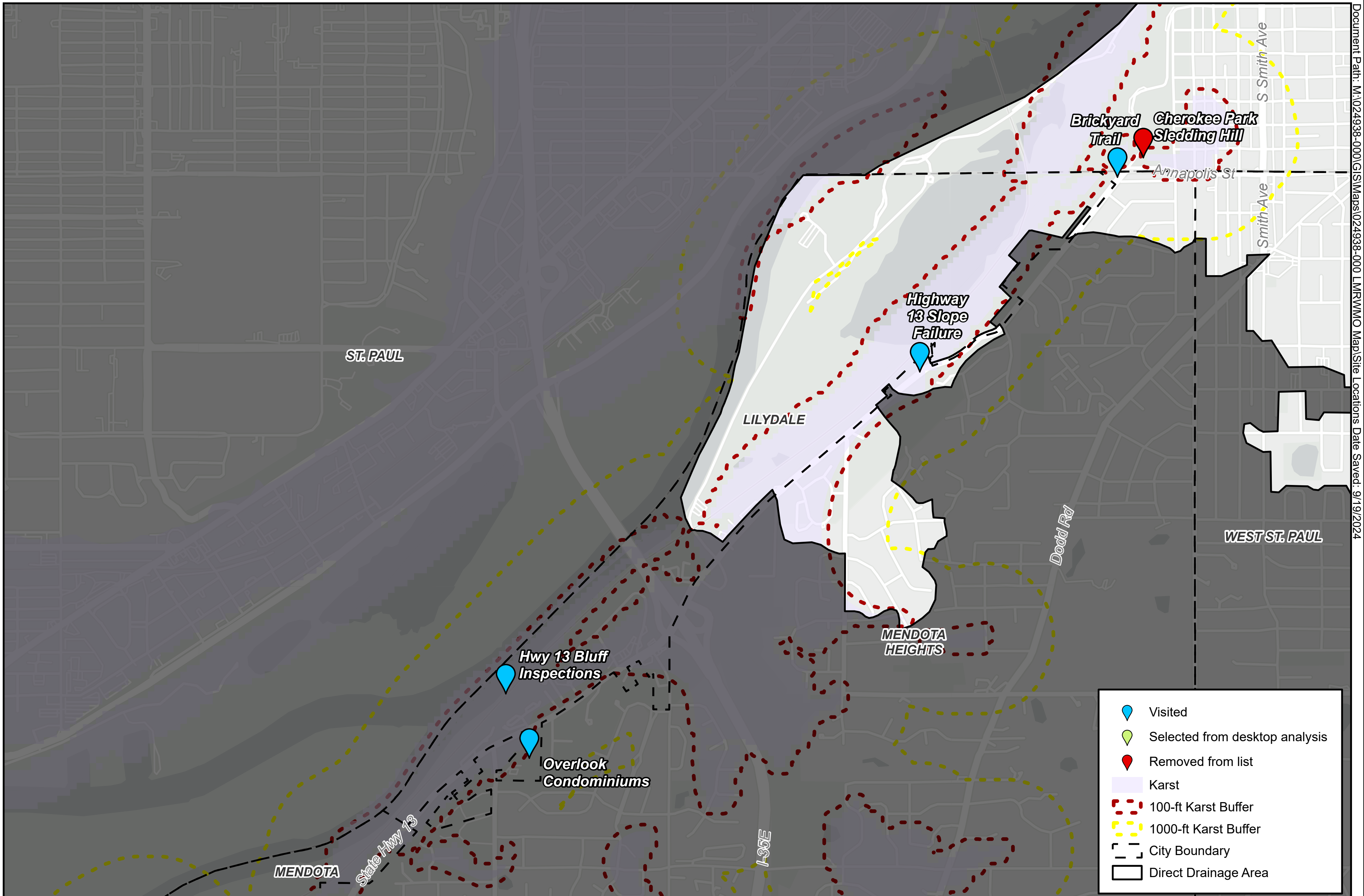
LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

3.4.1 - Site Locations

City of St. Paul
Mississippi Direct Drainage Project Prioritization Study

N
0 2,000 Feet
1 inch = 2,000 feet

wsb



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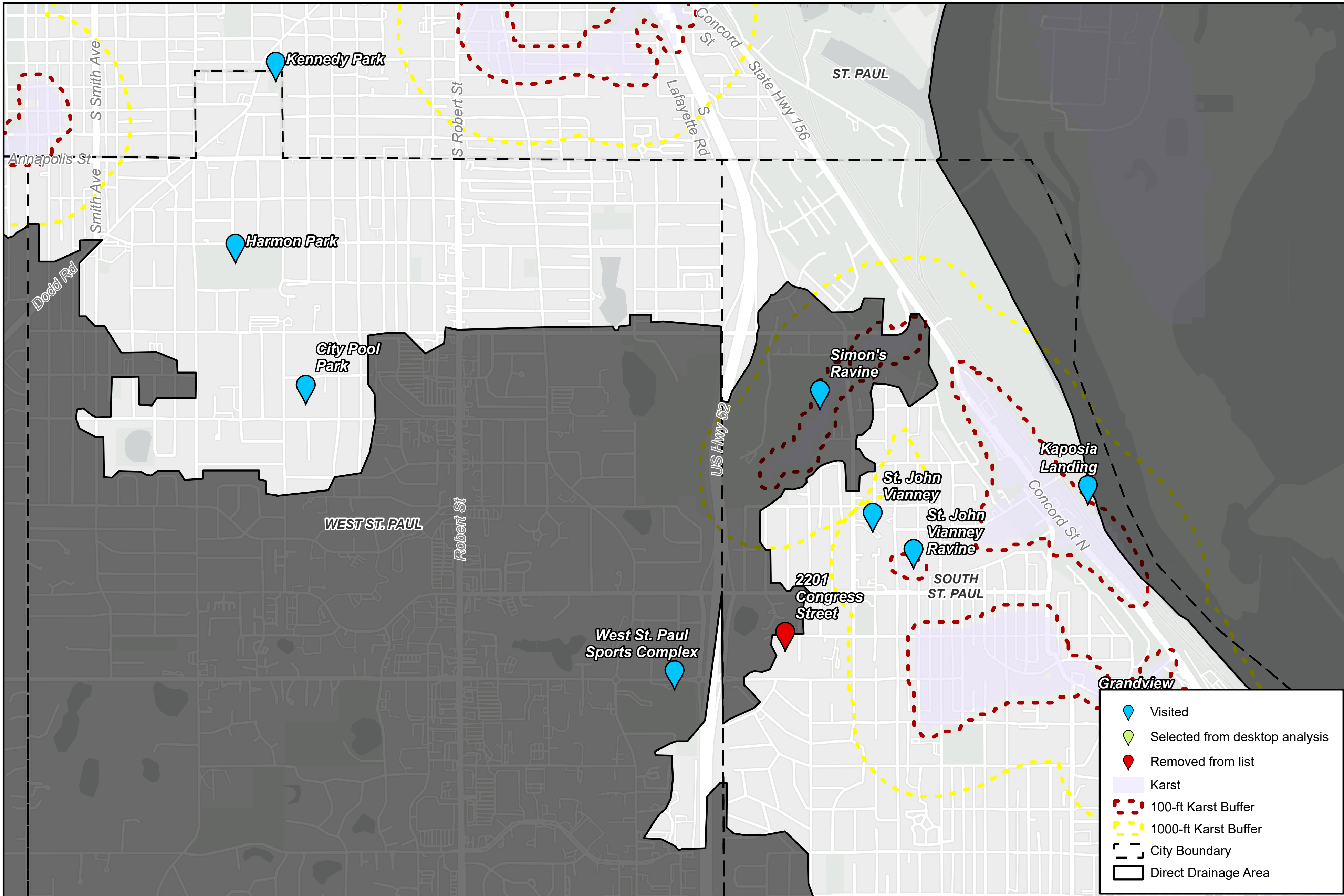
WATERSHED MANAGEMENT ORGANIZATION

3.4.2 - Site Locations

City of Mendota Heights & Lilydale
Mississippi Direct Drainage Project Prioritization Study

wsb



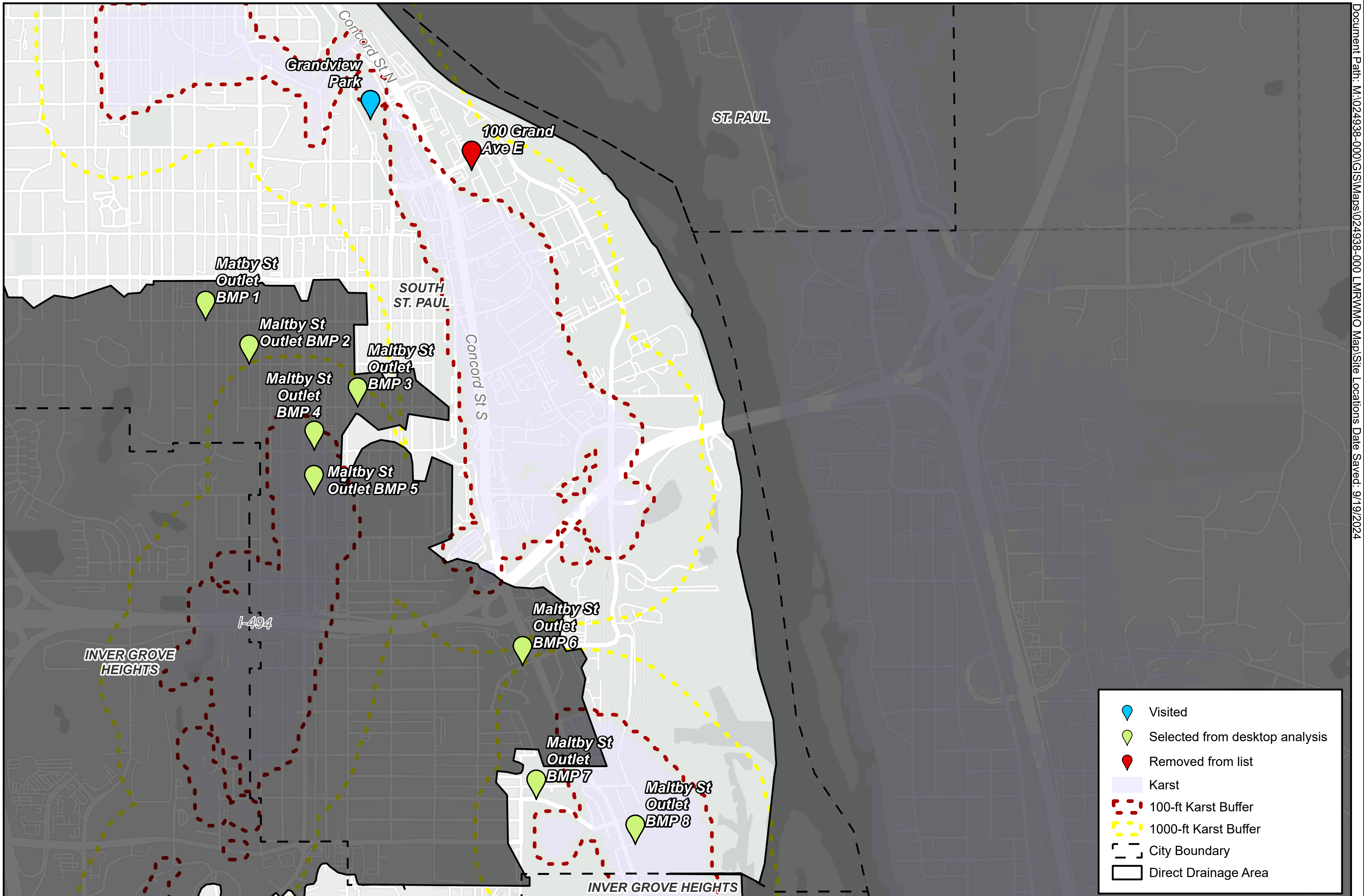
N
0 2,000 Feet
1 inch = 2,000 feet

3.4.3 - Site Locations

City of West St. Paul & South St. Paul
Mississippi Direct Drainage Project Prioritization Study

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

3.4.4 - Site Locations

City of South St. Paul

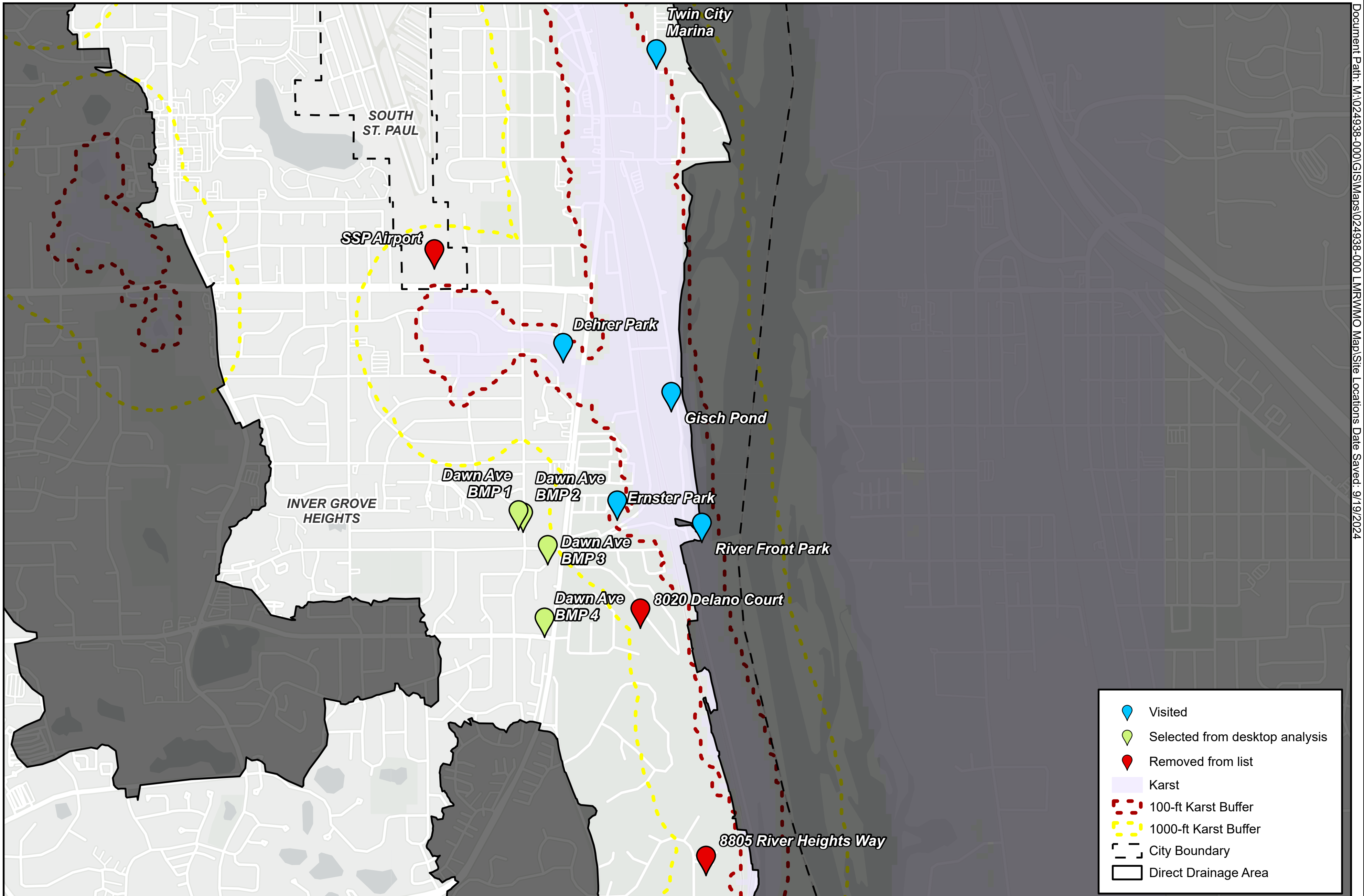
Mississippi Direct Drainage Project Prioritization Study

N

0 2,000 Feet

1 inch = 2,000 feet

wsb



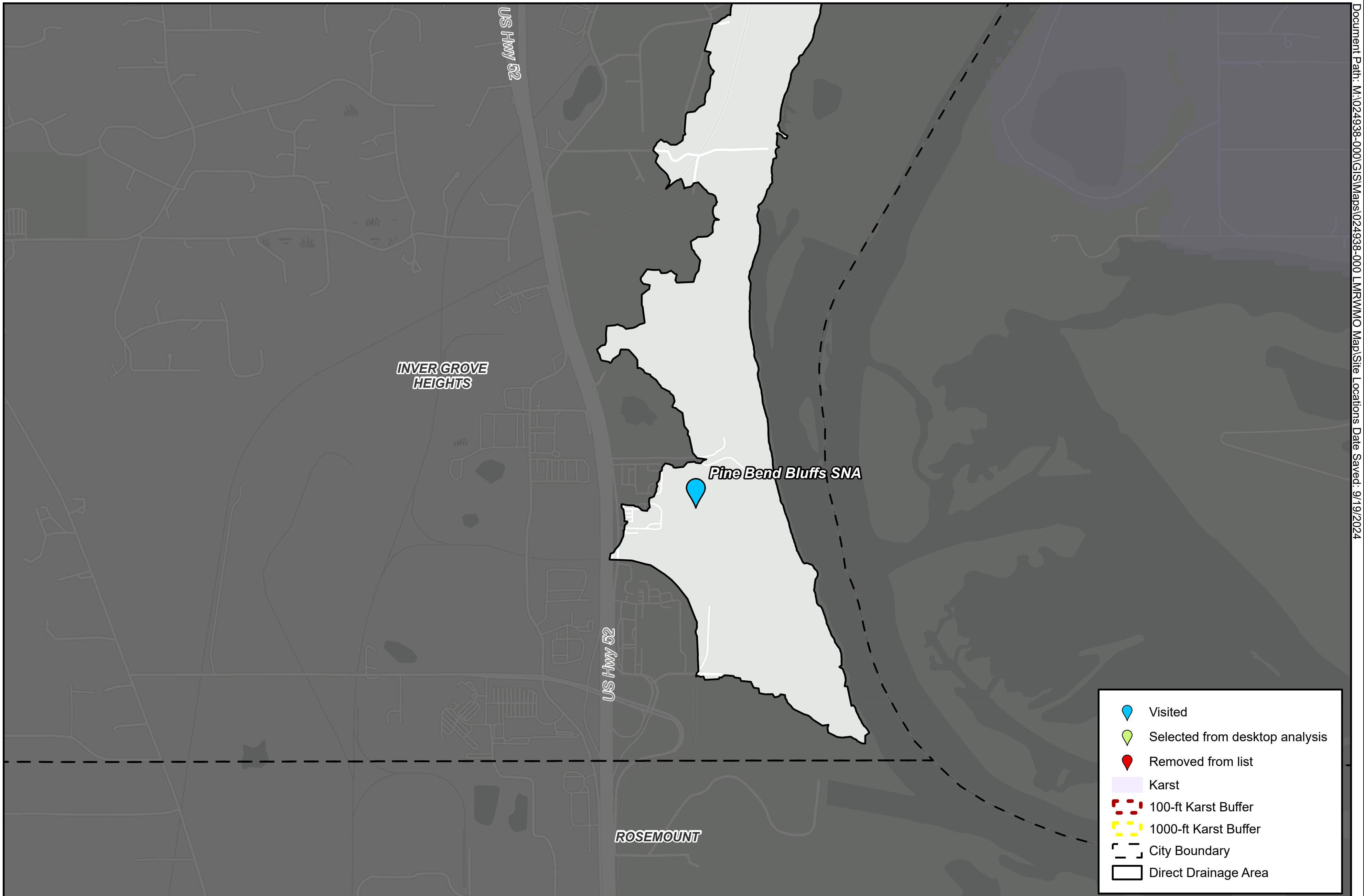
LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

3.4.5 - Site Locations

City of Inver Grove Heights
Mississippi Direct Drainage Project Prioritization Study

N
0 2,000 Feet
1 inch = 2,000 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

3.4.6 - Site Locations

City of Inver Grove Heights

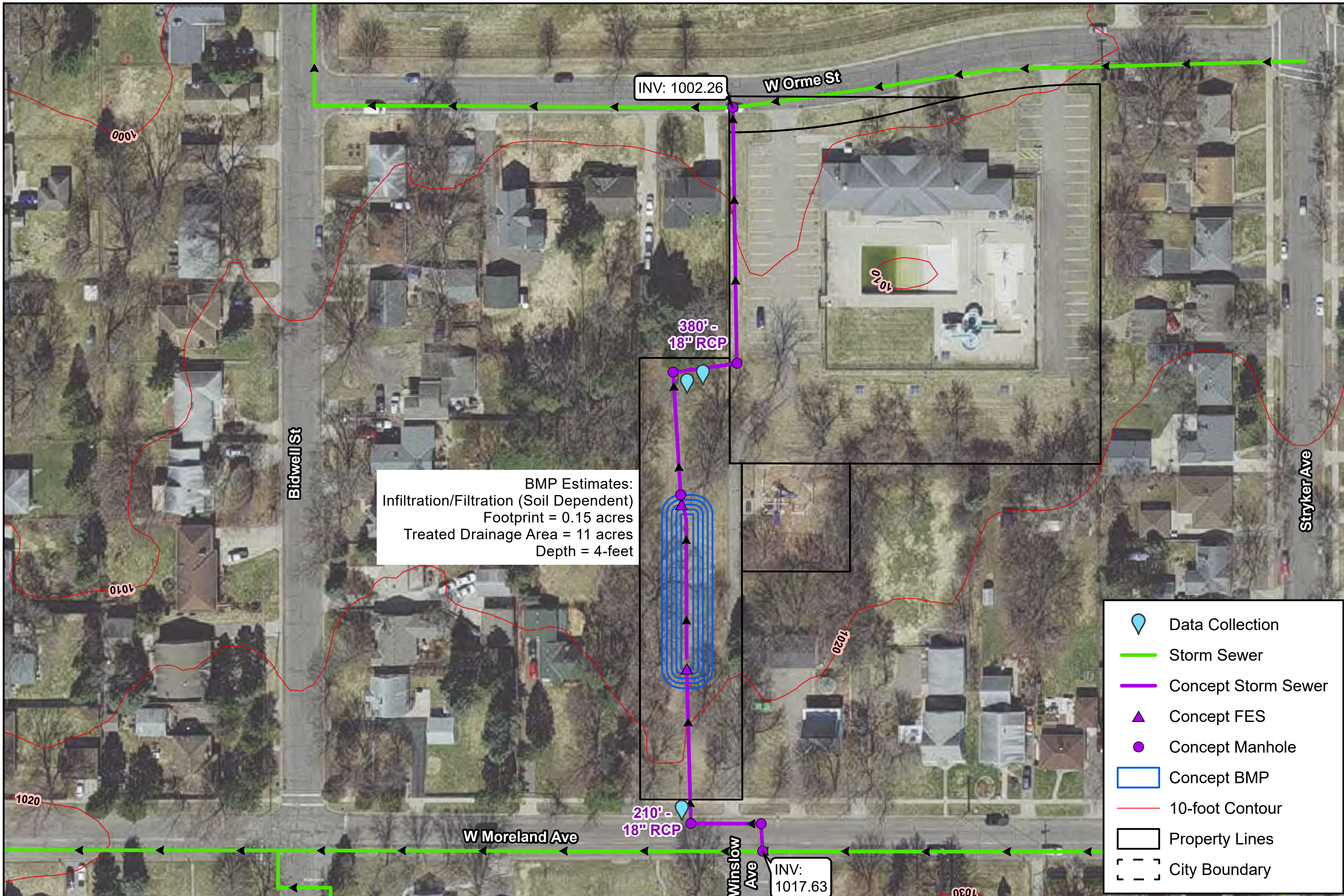
Mississippi Direct Drainage Project Prioritization Study

wsb

Figure 4.1.1 - Harmon Park

Site Visit
City of West St. Paul

N
0 170 Feet
1 inch = 170 feet



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.1.2 - City Pool Park

Concept BMP Design
City of West St. Paul

wsb

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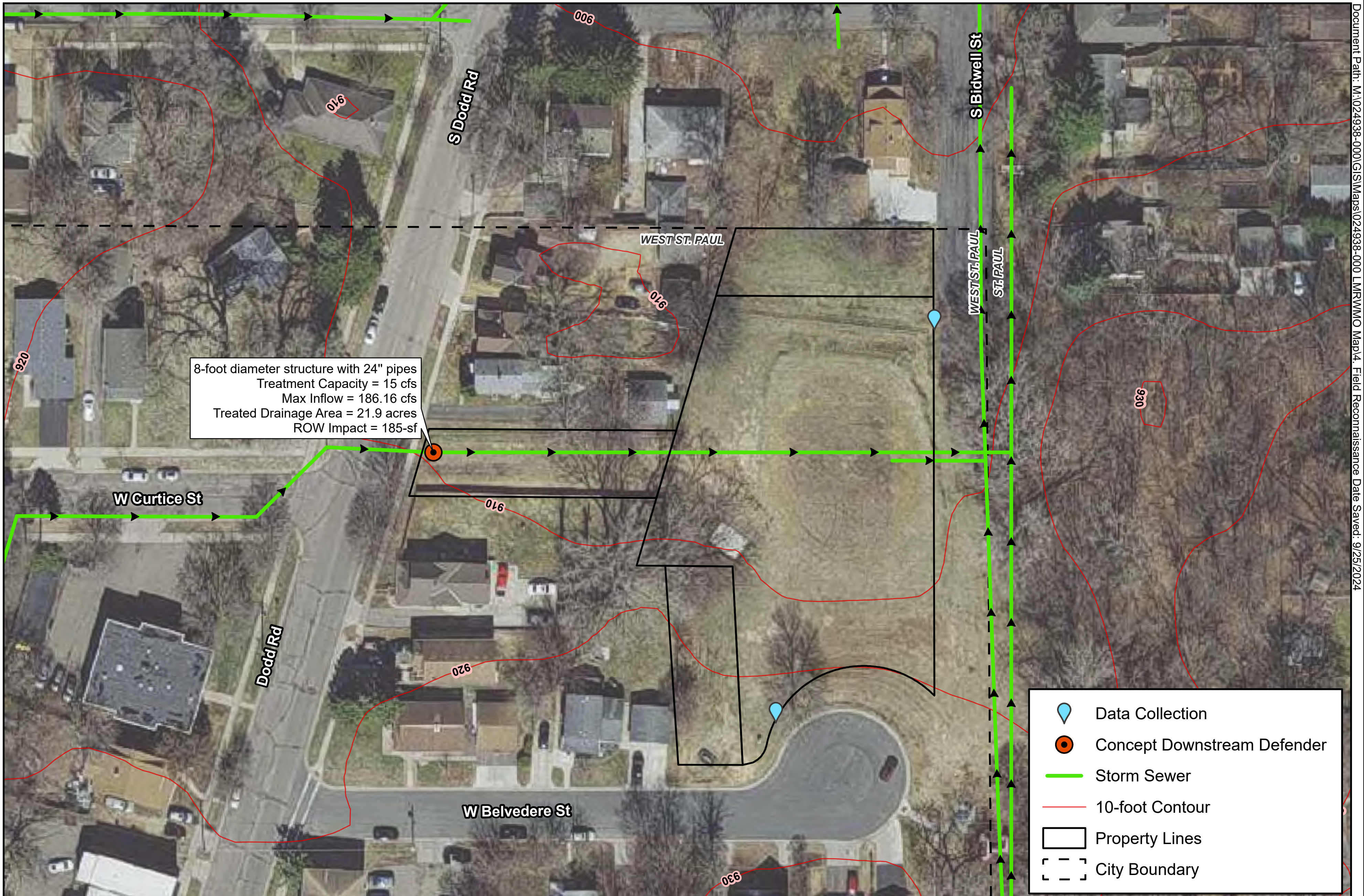


LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

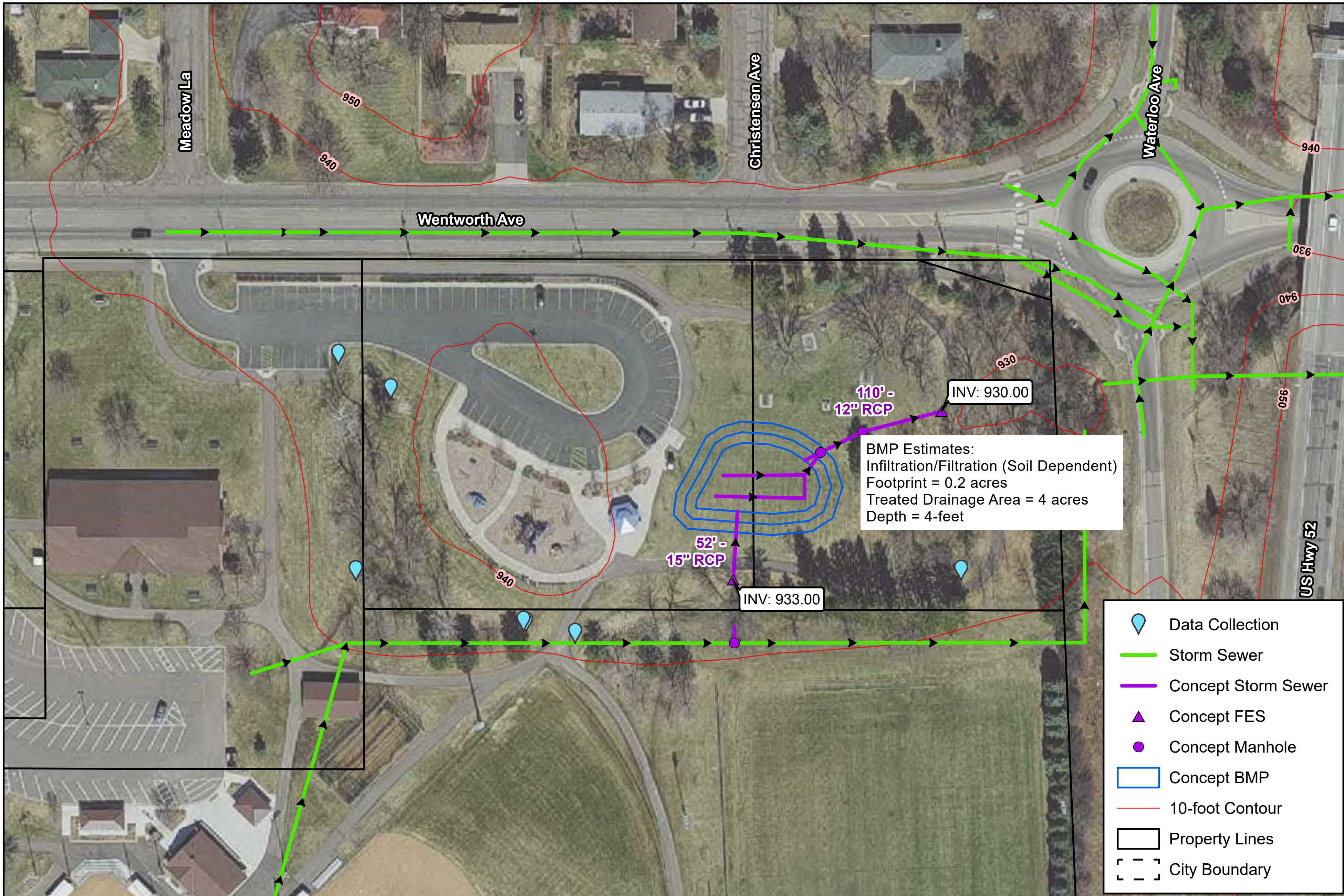
Figure 4.1.3 - Kennedy Park

Concept BMP Design
City of West St. Paul

N

0 80 Feet
1 inch = 80 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

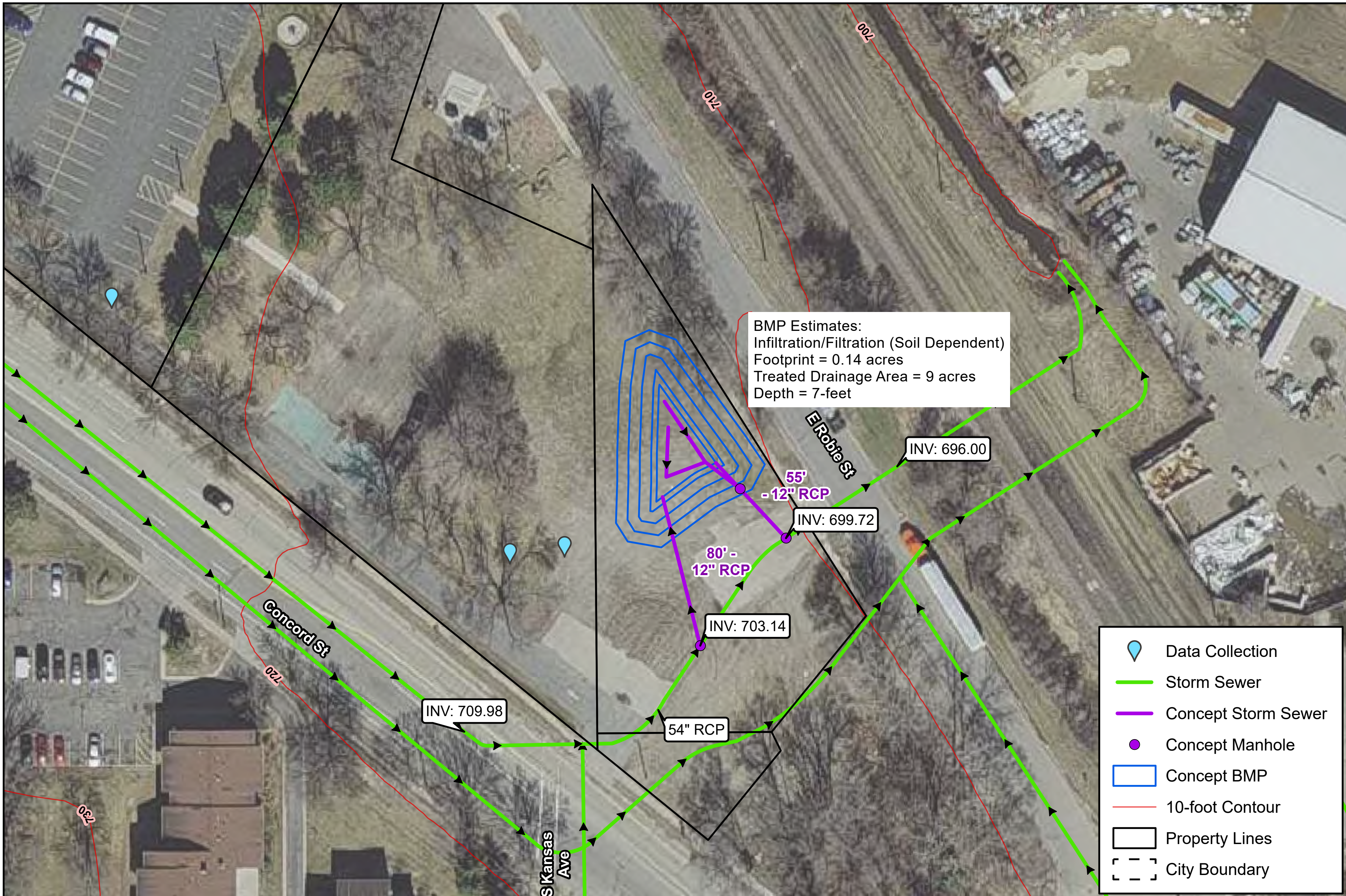
Figure 4.1.4 - West St. Paul Sports Complex

Concept BMP Design
City of West St. Paul

N

0 100 Feet
1 inch = 100 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.2.1 - Our Lady of Guadalupe

Concept BMP Design
City of St. Paul

N

0 70 Feet
1 inch = 70 feet

wsb

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LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.2.2 - Alabama Street Outlet

Concept BMP Design
City of St. Paul

N

0 750 Feet

1 inch = 750 feet

wsb

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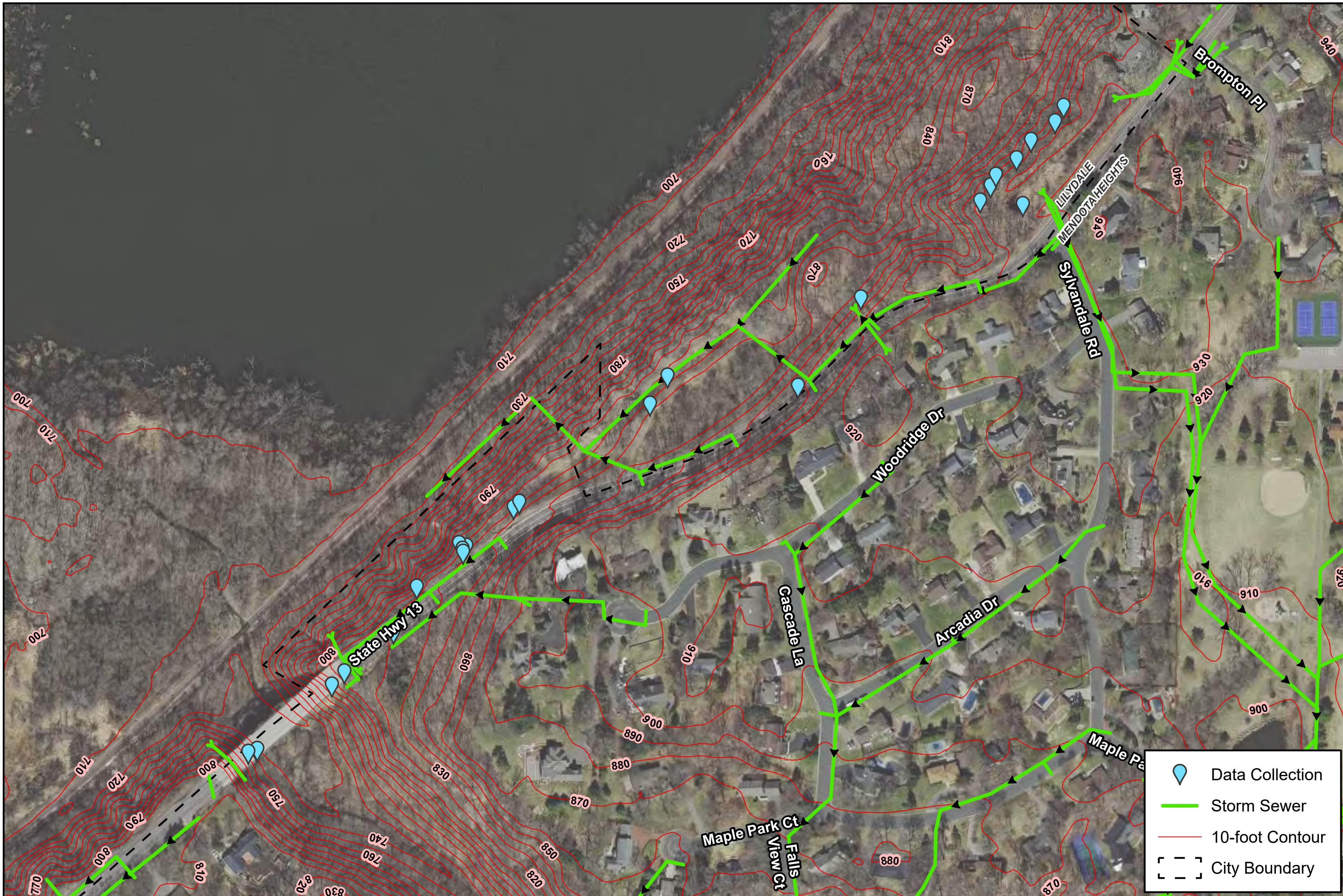
LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.3.1 - Brickyard Trail

Site Visit
City of Mendota Heights

N
0 500 Feet
1 inch = 500 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

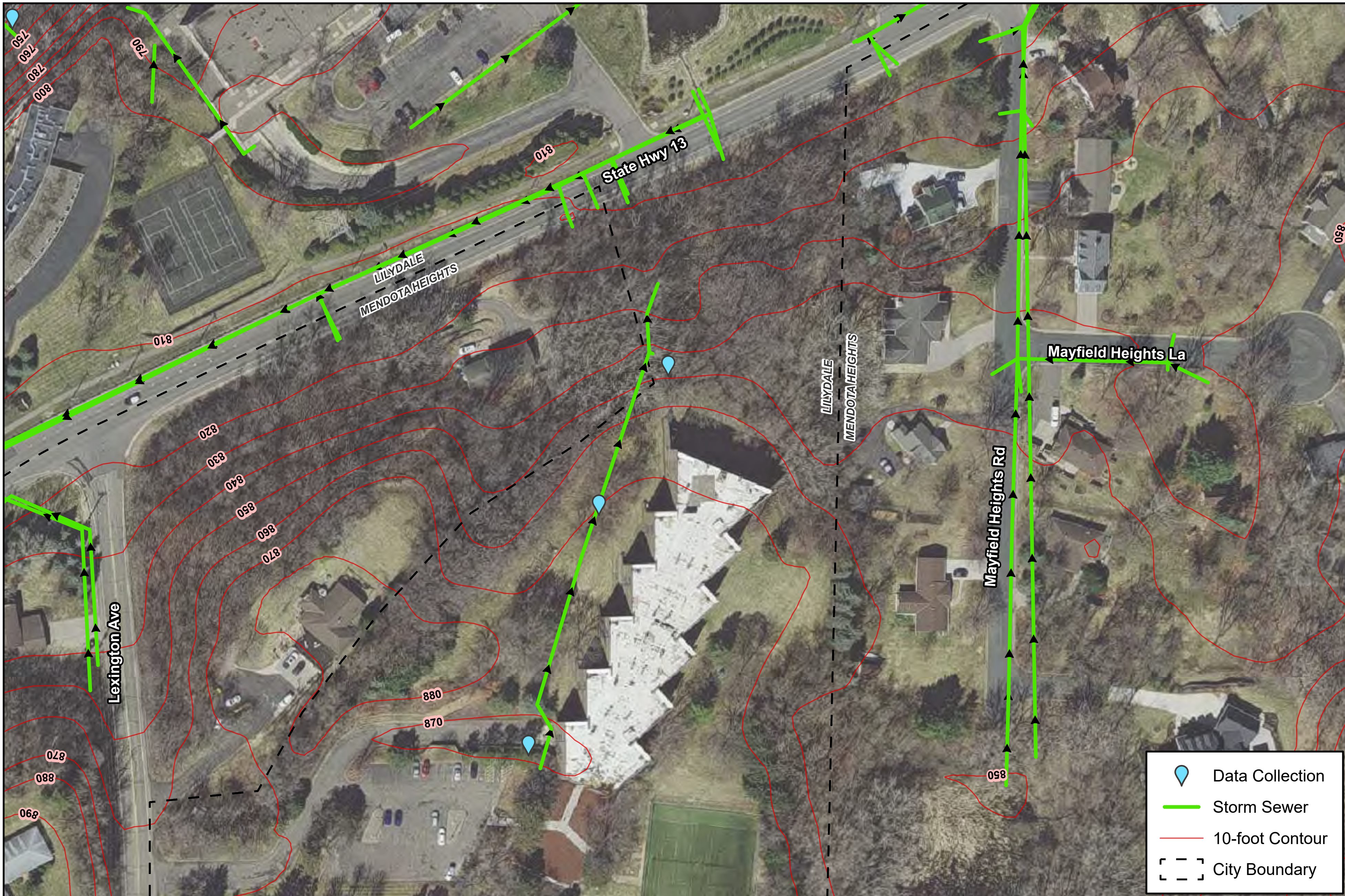
Figure 4.3.2 - Highway 13 Slope Failure

Site Visit
City of Mendota Heights

N

0 300 Feet
1 inch = 300 feet

wsb



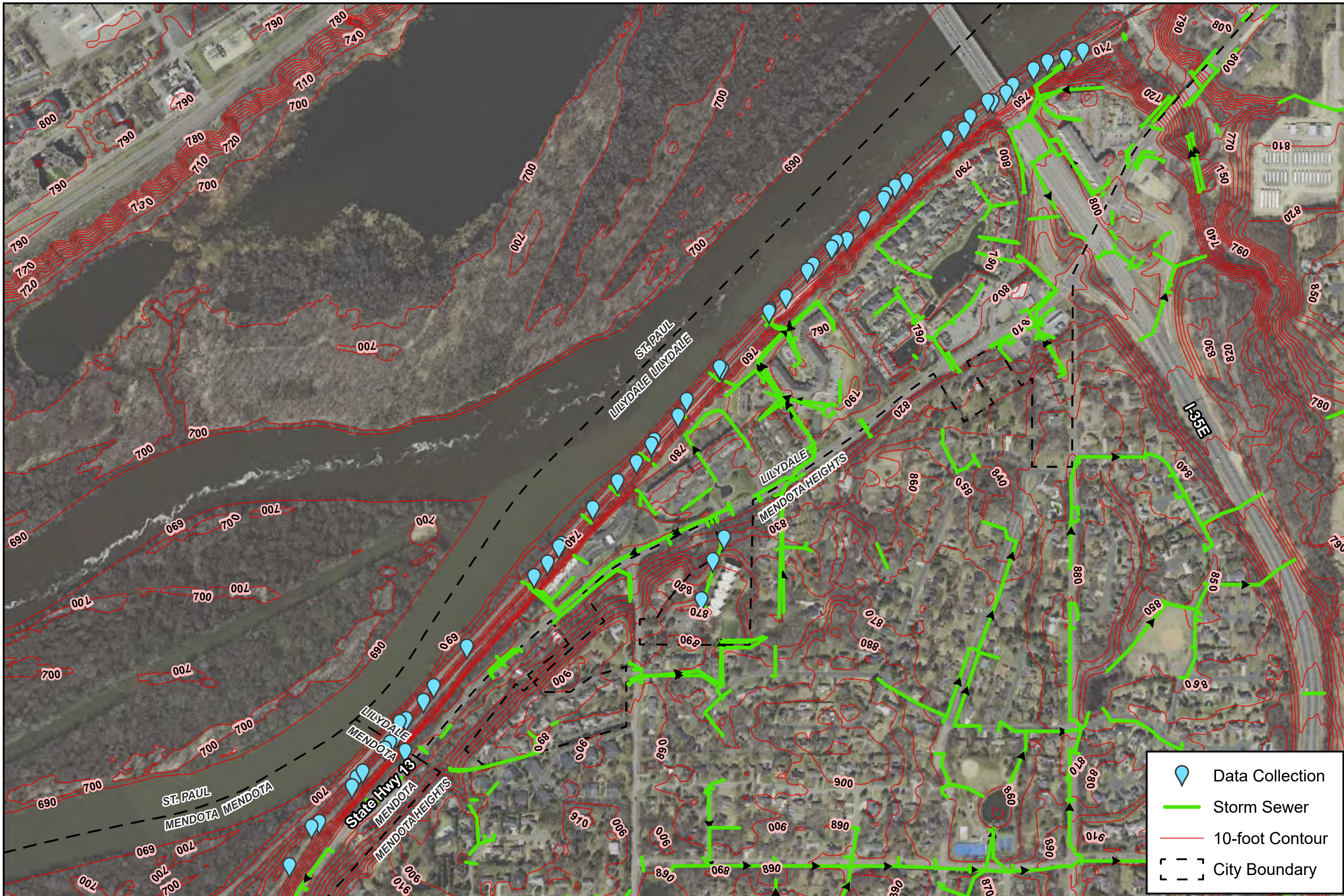
LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.4.1 - Overlook Condominiums

Site Visit
City of Lilydale

N
0 130 Feet
1 inch = 130 feet

wsb



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WATERSHED MANAGEMENT ORGANIZATION

Figure 4.4.2 - Highway 13 Bluff Inspections

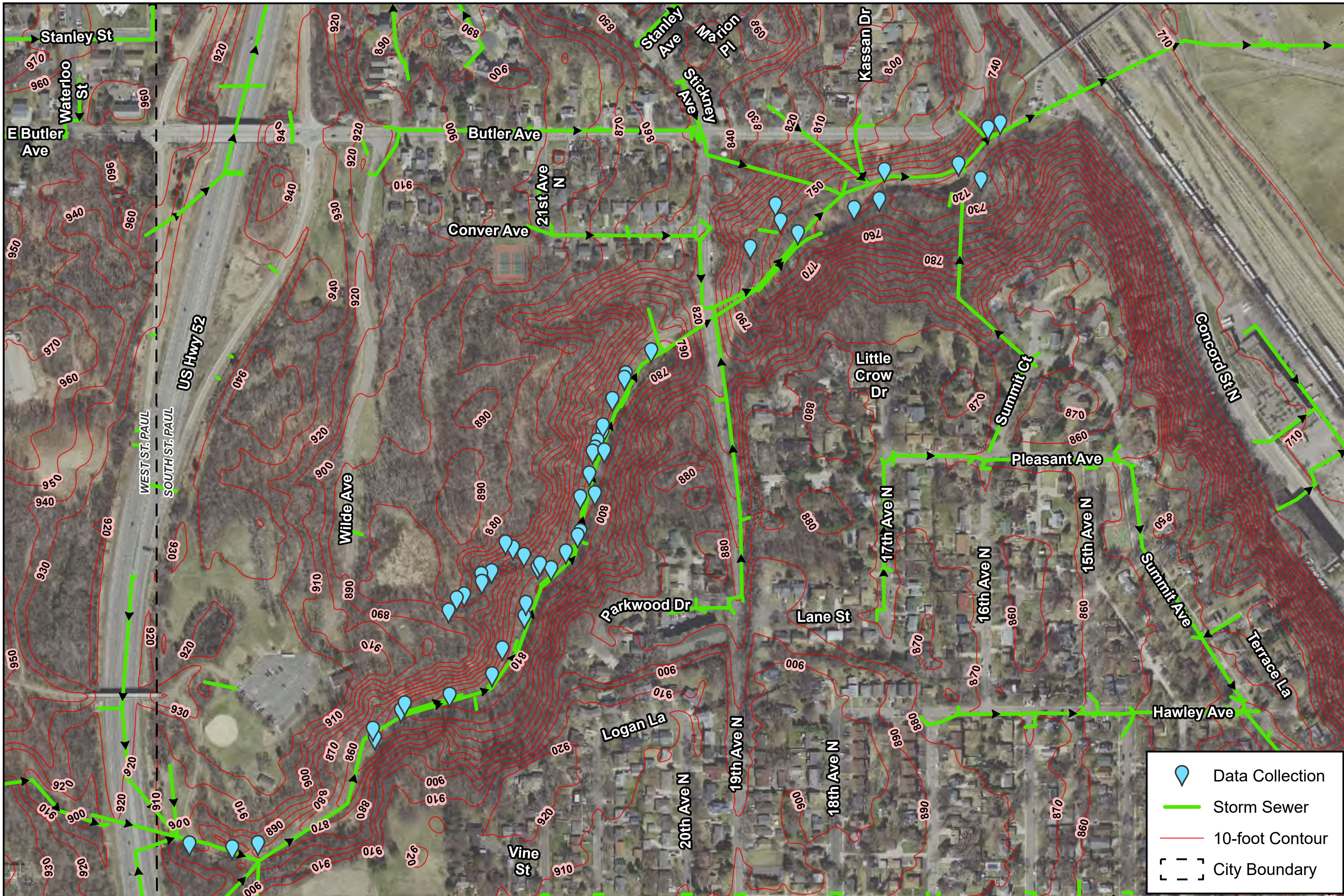
Site Visit
City of Lilydale

N

0 800 Feet

1 inch = 800 feet

wsb



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LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 4.5.1 - Simon's Ravine

Site Visit
City of South St. Paul

N

0 450 Feet
1 inch = 450 feet

wsb

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LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 4.5.2 - Grandview Park

Site Visit
City of South St. Paul

N

0 130 Feet

1 inch = 130 feet

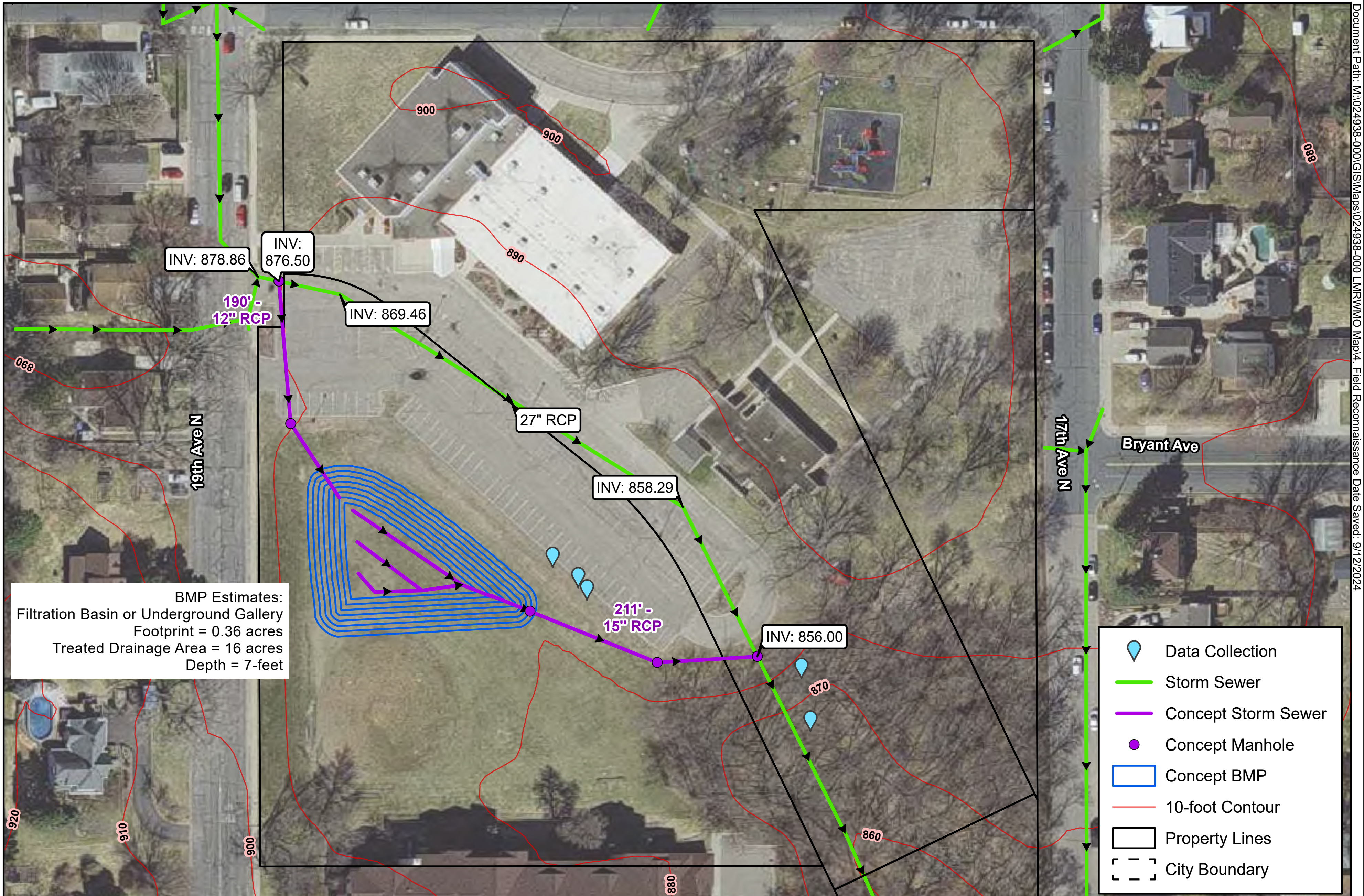
wsb

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.5.3 - Kaposia Landing

Site Visit
City of South St. Paul

wsb



LMR WMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.5.4 - St. John Vianney

Concept BMP Design
City of South St. Paul

N

0 100 Feet
1 inch = 100 feet

wsb

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LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

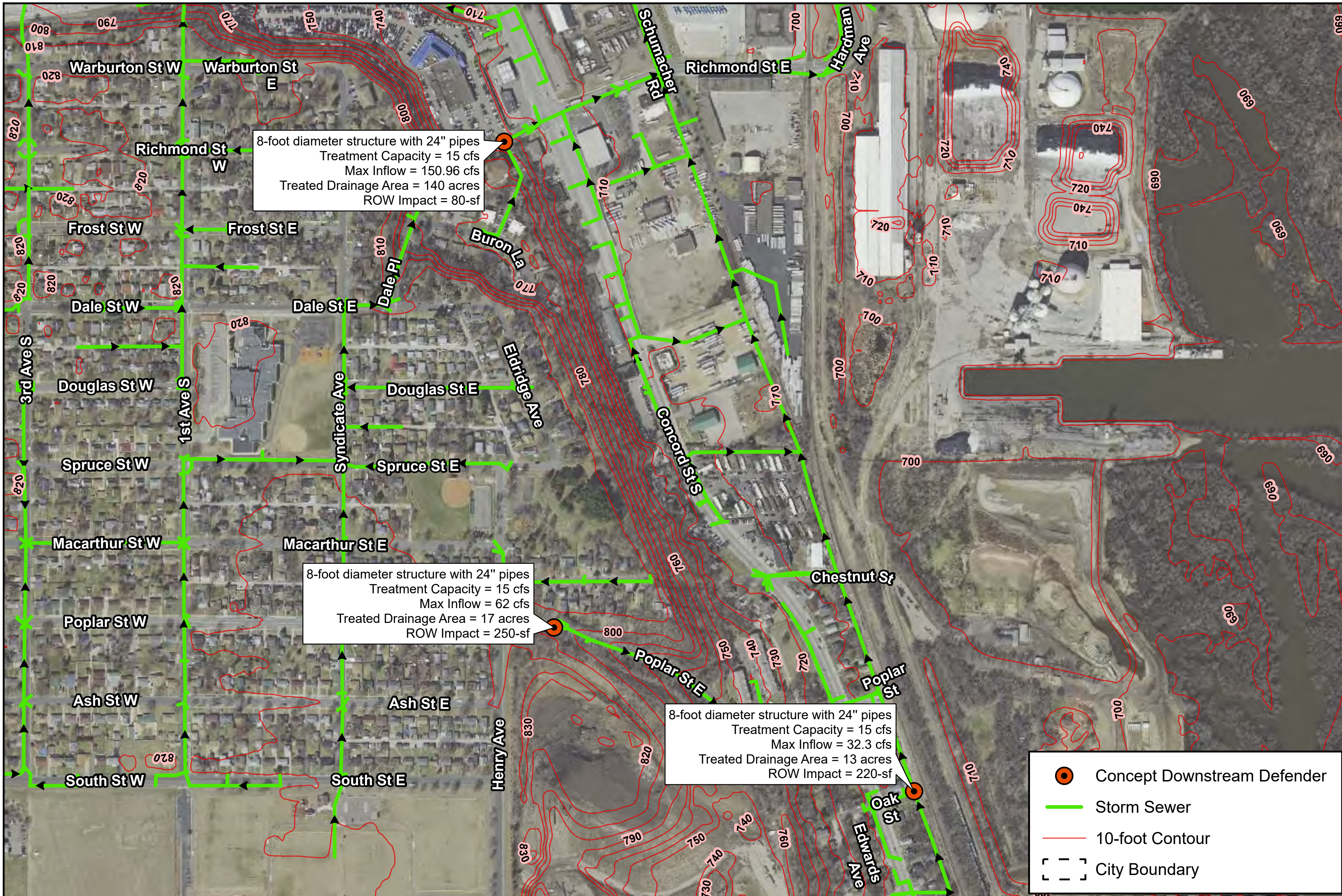
Figure 4.5.5 - Maltby Street Outlet (North)

Concept BMP Design
City of South St. Paul

N

0 550 Feet
1 inch = 550 feet

wsb



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WATERSHED MANAGEMENT ORGANIZATION

Figure 4.5.6 - Maltby Street Outlet (South)

Concept BMP Design
City of South St. Paul

N

0 550 Feet

1 inch = 550 feet

wsb

Figure 4.6.1 - Dehrer Park

Site Visit

City of Inver Grove Heights

N

0 150 Feet

1 inch = 150 feet

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

wsb

Figure 4.6.2 - Twin City Marina

Site Visit
City of Inver Grove Heights

N

0 500 Feet
1 inch = 500 feet

LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

wsb

Figure 4.6.3 - River Front Park

Site Visit
City of Inver Grove Heights

N

0 250 Feet
1 inch = 250 feet

LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 4.6.4 - Ernster Park

Site Visit
City of Inver Grove Heights

N

0 150 Feet

1 inch = 150 feet

wsb

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LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 4.6.5 - Pine Bend Bluffs SNA

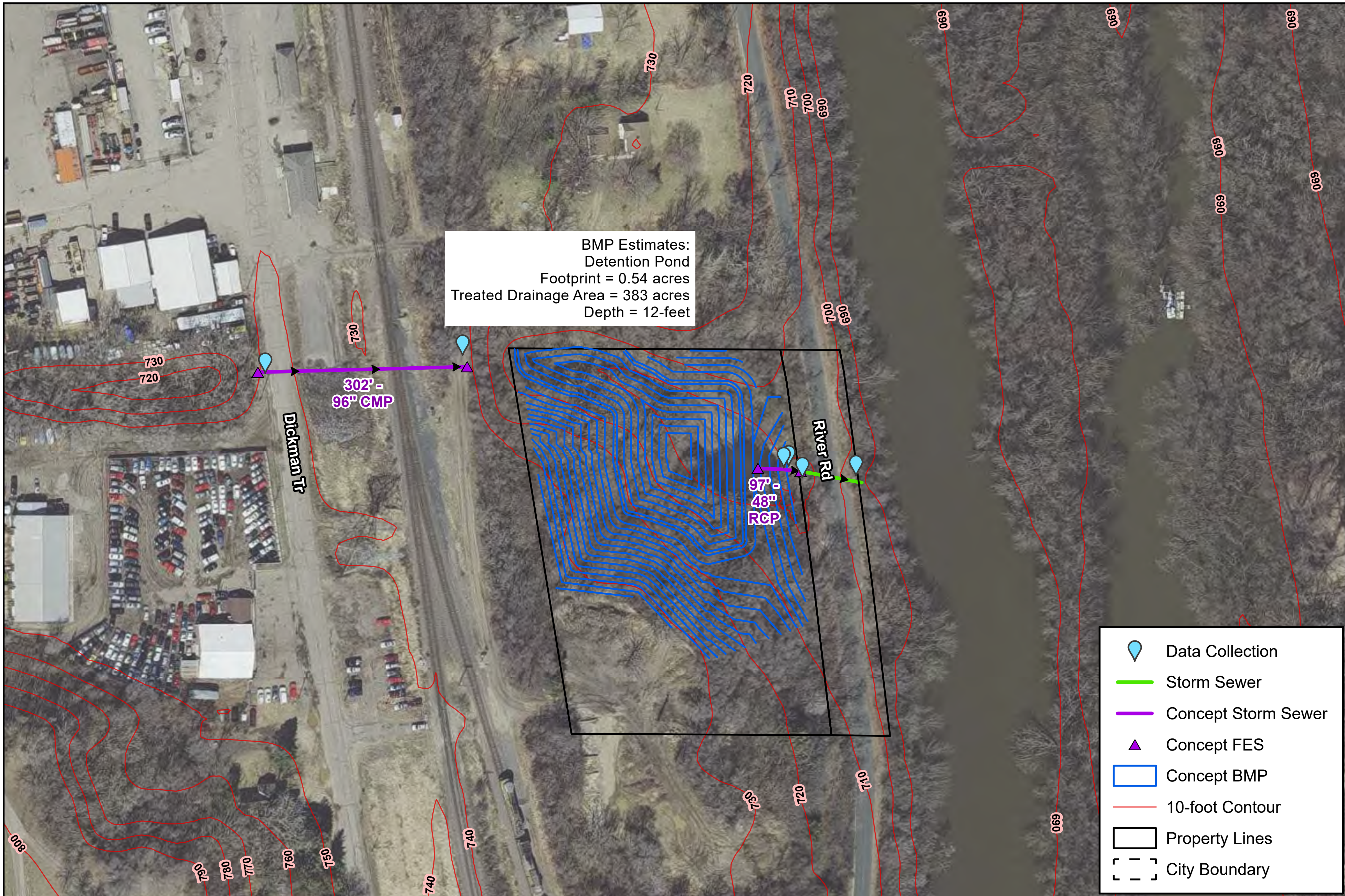
Site Visit
City of Inver Grove Heights

N

0 700 Feet

1 inch = 700 feet

wsb



LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.6.6 - Gisch Pond

Concept BMP Design
City of Inver Grove Heights

N

0 150 Feet
1 inch = 150 feet

wsb

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 4.6.7 - IGH Structural BMPs (North)

Concept BMP Design
City of Inver Grove Heights

N
0 200 Feet
1 inch = 200 feet

wsb

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LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 4.6.8 - IGH Structural BMPs (South)

Concept BMP Design
City of Inver Grove Heights

N

0 300 Feet
1 inch = 300 feet

wsb

Appendix B – Cost Estimates for Concept Designs

Opinion of Probable Cost

WSB Project:	City Pool Park	*Design By:*	SMR
Project Location:	LMRWMO	*Checked By:*	JHN
WSB Project No:	024938-000	*Date:*	9/27/2024

Item No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1	MOBILIZATION	L S		$10,000.00	$0.00
2	CLEARING AND GRUBBING	ACRE	0.2	$5,000.00	$1,000.00
3	GEOTEXTILE FABRIC TYPE 5	S Y	150	$3.00	$450.00
4	REMOVE BITUMINOUS PAVEMENT	S Y	40	$15.00	$600.00
5	FILTER MEDIA SPECIAL	C Y	75	$40.00	$3,000.00
6	COARSE FILTER AGGREGATE	C Y	3	$85.00	$255.00
7	EXCAVATION - COMMON (CV)	C Y	970	$25.00	$24,250.00
8	BITUMINOUS PATCHING MIXTURE	TON	4	$170.00	$680.00
9	18" RC PIPE APRON	EACH	2	$2,500.00	$5,000.00
10	6" PVC PIPE DRAIN	L F	136	$25.00	$3,400.00
11	6" PVC PIPE DRAIN CLEANOUT	EACH	2	$400.00	$800.00
12	18" RC PIPE SEWER DES 3006 CL V	L F	590	$100.00	$59,000.00
13	CONNECT TO EXISTING PIPE	EACH	2	$2,000.00	$4,000.00
	CONNECT TO EXISTING STRUCTURE	EACH	1	$2,000.00	$2,000.00
14	CONST DRAINAGE STRUCTURE 60-4020	L F	35	$1,400.00	$49,000.00
15	DIVERSION STRUCTURE	EACH	1	$20,000.00	$20,000.00
16	CONST DRAINAGE STRUCTURE DESIGN SPEC 1	EACH	1	$8,000.00	$8,000.00
17	RANDOM RIPRAP CLASS III	C Y	20	$125.00	$2,500.00
18	TRAFFIC CONTROL	L S	1	$10,000.00	$10,000.00
19	RESTORATION/EROSION CONTROL	L S	1	$15,000.00	$15,000.00
20	GEOTECHNICAL REPORT	L S	1.0	$5,000.00	$5,000.00
				SUBTOTAL	**$211,885.00**
				CONSTRUCTION CONTINGENCY (20%)	**$42,377.00**
				CONSTRUCTION SUBTOTAL	**$254,262.00**
				ENGINEERING COST TOTAL (20%)	**$50,852.40**
				TOTAL	**$305,114.40**

Opinion of Probable Cost

WSB Project:		St. Paul Structural BMPs			*Design By:*	SMR
Project Location:		LMRWMO			*Checked By:*	JHN
WSB Project No:		024938-000			*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$12,000.00	$12,000.00
2		CONNECT TO EXISTING PIPE	EACH	4	$2,000.00	$8,000.00
3		DIVERSION STRUCTURE	EACH	1	$20,000.00	$20,000.00
4		TREATMENT STRUCTURE	EACH	1	$60,000.00	$60,000.00
5		TRAFFIC CONTROL	L S	1	$5,000.00	$5,000.00
6		RESTORATION/EROSION CONTROL	L S	1	$5,000.00	$5,000.00
					SUBTOTAL	**$98,000.00**
					CONSTRUCTION CONTINGENCY (20%)	**$19,600.00**
					CONSTRUCTION SUBTOTAL	**$117,600.00**
					ENGINEERING COST TOTAL (20%)	**$23,520.00**
					TOTAL	**$141,120.00**

Opinion of Probable Cost

WSB Project:	WSP Sports Complex	*Design By:* SMR
Project Location:	LMRWMO	*Checked By:* JHN
WSB Project No:	024938-000	*Date:* 9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$10,000.00	$10,000.00
2		CLEARING AND GRUBBING	ACRE	0.2	$5,000.00	$1,000.00
3		GEOTEXTILE FABRIC TYPE 5	S Y	550	$3.00	$1,650.00
4		REMOVE BITUMINOUS PAVEMENT	S Y	20	$15.00	$300.00
5		FILTER MEDIA SPECIAL	C Y	220	$50.00	$11,000.00
6		COARSE FILTER AGGREGATE	C Y	3	$85.00	$255.00
7		EXCAVATION - COMMON (CV)	C Y	1,270	$20.00	$25,400.00
8		BITUMINOUS PATCHING MIXTURE (SPECIAL)	TON	20	$170.00	$3,400.00
9		12" RC PIPE APRON	EACH	1	$2,000.00	$2,000.00
10		15" RC PIPE APRON	EACH	3	$2,200.00	$6,600.00
11		6" PVC PIPE DRAIN	L F	170	$25.00	$4,250.00
12		6" PVC PIPE DRAIN CLEANOUT	EACH	4	$300.00	$1,200.00
13		12" RC PIPE SEWER DES 3006 CL V	L F	110	$75.00	$8,250.00
14		15" RC PIPE SEWER DES 3006 CL V	L F	68	$85.00	$5,780.00
15		CONNECT TO EXISTING PIPE	EACH	2	$2,000.00	$4,000.00
16		CONST DRAINAGE STRUCTURE DES 48-4020	L F	5	$1,100.00	$5,500.00
17		CONST DRAINAGE STRUCTURE DES 60-4020	L F	5	$1,400.00	$7,000.00
18		DIVERSION STRUCTURE	EACH	1	$15,000.00	$15,000.00
19		CONST DRAINAGE STRUCTURE DESIGN SPEC 1	EACH	1	$8,000.00	$8,000.00
20		RANDOM RIPRAP CLASS III	C Y	16	$125.00	$2,000.00
21		TRAFFIC CONTROL	L S	1	$10,000.00	$10,000.00
22		RESTORATION/EROSION CONTROL	L S	1	$15,000.00	$15,000.00
23		GEOTECHNICAL REPORT	L S	1.0	$5,000.00	$5,000.00
					SUBTOTAL	**$139,635.00**
					CONSTRUCTION CONTINGENCY (20%)	**$27,927.00**
					CONSTRUCTION SUBTOTAL	**$167,562.00**
					ENGINEERING COST TOTAL (20%)	**$33,512.40**
					TOTAL	**$201,074.40**

Opinion of Probable Cost

WSB Project:	Our Lady of Guadalupe				*Design By:*	SMR
Project Location:	LMRWMO				*Checked By:*	JHN
WSB Project No:	024938-000				*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$10,000.00	$10,000.00
2		CLEARING AND GRUBBING	ACRE	0.2	$5,000.00	$1,000.00
3		GEOTEXTILE FABRIC TYPE 5	S Y	160	$3.00	$480.00
4		REMOVE BITUMINOUS PAVEMENT	S Y	40	$15.00	$600.00
5		FILTER MEDIA SPECIAL	C Y	55	$40.00	$2,200.00
6		COARSE FILTER AGGREGATE	C Y	2	$85.00	$170.00
7		EXCAVATION - COMMON (CV)	C Y	1,500	$25.00	$37,500.00
8		BITUMINOUS PATCHING MIXTURE	TON	7	$170.00	$1,190.00
9		12" RC PIPE APRON	EACH	2	$2,000.00	$4,000.00
10		6" PVC PIPE DRAIN	L F	110	$25.00	$2,750.00
11		6" PVC PIPE DRAIN CLEANOUT	EACH	4	$400.00	$1,600.00
12		12" RC PIPE SEWER DES 3006 CL V	L F	135	$75.00	$10,125.00
13		CONNECT TO EXISTING PIPE	EACH	4	$2,000.00	$8,000.00
14		CONST DRAINAGE STRUCTURE DES 84-4020	L F	12	$2,000.00	$24,000.00
15		DIVERSION STRUCTURE	EACH	1	$10,000.00	$10,000.00
16		CONST DRAINAGE STRUCTURE DESIGN SPEC 1	EACH	1	$8,000.00	$8,000.00
17		RANDOM RIPRAP CLASS III	C Y	16	$125.00	$2,000.00
18		TRAFFIC CONTROL	L S	1	$10,000.00	$10,000.00
19		RESTORATION/EROSION CONTROL	L S	1	$15,000.00	$15,000.00
20		GEOTECHNICAL REPORT	L S	1.0	$5,000.00	$5,000.00
					SUBTOTAL	**$141,535.00**
					CONSTRUCTION CONTINGENCY (20%)	**$28,307.00**
					CONSTRUCTION SUBTOTAL	**$169,842.00**
					ENGINEERING COST TOTAL (20%)	**$33,968.40**
					TOTAL	**$203,810.40**

Opinion of Probable Cost

WSB Project:	Alabama Street Outlet	*Design By:*	SMR
Project Location:	LMRWMO	*Checked By:*	JHN
WSB Project No:	024938-000	*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$43,000.00	$43,000.00
2		REMOVE BITUMINOUS PAVEMENT	S Y	315	$15.00	$4,725.00
3		BITUMINOUS PATCHING MIXTURE (SPECIAL)	TON	51	$170.00	$8,670.00
4		24" RC PIPE SEWER DES 3006 CL III	L F	64	$120.00	$7,680.00
5		33" RC PIPE SEWER DES 3006 CL III	L F	32	$150.00	$4,800.00
6		36" RC PIPE SEWER DES 3006 CL III	L F	32	$170.00	$5,440.00
7		CONNECT TO EXISTING PIPE	EACH	16.0	$2,000.00	$32,000.00
8		DIVERSION STRUCTURE	EACH	4	$20,000.00	$80,000.00
9		TREATMENT STRUCTURE	EACH	4	$70,000.00	$280,000.00
10		TRAFFIC CONTROL	L S	1	$10,000.00	$10,000.00
11		RESTORATION/EROSION CONTROL	L S	1	$20,000.00	$20,000.00
					SUBTOTAL	**$448,590.00**
					CONSTRUCTION CONTINGENCY (20%)	**$89,718.00**
					CONSTRUCTION SUBTOTAL	**$538,308.00**
					ENGINEERING COST TOTAL (20%)	**$107,661.60**
					TOTAL	**$645,969.60**

Opinion of Probable Cost

WSB Project:	St. John Vianney		*Design By:*	SMR
Project Location:	LMRWMO		*Checked By:*	JHN
WSB Project No:	024938-000		*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$21,000.00	$21,000.00
2		CLEARING AND GRUBBING	ACRE	0.4	$5,000.00	$2,000.00
3		GEOTEXTILE FABRIC TYPE 5	S Y	600	$3.00	$1,800.00
4		REMOVE BITUMINOUS PAVEMENT	S Y	350	$15.00	$5,250.00
5		FILTER MEDIA SPECIAL	C Y	230	$50.00	$11,500.00
6		COARSE FILTER AGGREGATE	C Y	5	$85.00	$425.00
7		EXCAVATION - COMMON (CV)	C Y	4,050	$20.00	$81,000.00
8		BITUMINOUS PATCHING MIXTURE (SPECIAL)	TON	60	$170.00	$10,200.00
9		12" RC PIPE APRON	EACH	1	$2,000.00	$2,000.00
10		15" RC PIPE APRON	EACH	1	$2,200.00	$2,200.00
11		6" PVC PIPE DRAIN	L F	270	$25.00	$6,750.00
12		6" PVC PIPE DRAIN CLEANOUT	EACH	6	$300.00	$1,800.00
13		12" RC PIPE SEWER DES 3006 CL V	L F	190	$75.00	$14,250.00
14		15" RC PIPE SEWER DES 3006 CL V	L F	211	$85.00	$17,935.00
15		CONNECT TO EXISTING PIPE	EACH	4	$2,000.00	$8,000.00
16		CONST DRAINAGE STRUCTURE DES 48-4020	L F	35	$1,100.00	$38,500.00
17		CONST DRAINAGE STRUCTURE DES 60-4020	L F	28	$1,400.00	$39,200.00
18		DIVERSION STRUCTURE	EACH	1	$15,000.00	$15,000.00
19		CONST DRAINAGE STRUCTURE DESIGN SPEC 1	EACH	1	$8,000.00	$8,000.00
20		RANDOM RIPRAP CLASS III	C Y	16	$125.00	$2,000.00
21		TRAFFIC CONTROL	L S	1	$10,000.00	$10,000.00
22		RESTORATION/EROSION CONTROL	L S	1	$15,000.00	$15,000.00
23		GEOTECHNICAL REPORT	L S	1.0	$5,000.00	$5,000.00
					SUBTOTAL	**$288,760.00**
					CONSTRUCTION CONTINGENCY (20%)	**$57,752.00**
					CONSTRUCTION SUBTOTAL	**$346,512.00**
					ENGINEERING COST TOTAL (20%)	**$69,302.40**
					TOTAL	**$415,814.40**

Opinion of Probable Cost

WSB Project:	Maltby Street Outlet BMPs	*Design By:*	SMR
Project Location:	LMRWMO	*Checked By:*	JHN
WSB Project No:	024938-000	*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$95,000.00	$95,000.00
2		REMOVE BITUMINOUS PAVEMENT	S Y	172	$15.00	$2,580.00
3		BITUMINOUS PATCHING MIXTURE (SPECIAL)	TON	30	$170.00	$5,015.00
4		27" RC PIPE SEWER DES 3006 CL III	L F	32	$130.00	$4,160.00
5		30" RC PIPE SEWER DES 3006 CL III	L F	64	$140.00	$8,960.00
6		33" RC PIPE SEWER DES 3006 CL III	L F	96	$150.00	$14,400.00
7		36" RC PIPE SEWER DES 3006 CL III	L F	64	$170.00	$10,880.00
8		CONNECT TO EXISTING PIPE	EACH	32	$2,000.00	$64,000.00
9		TREATMENT STRUCTURE	EACH	8	$60,000.00	$480,000.00
10		DIVERSION STRUCTURE	EACH	8	$20,000.00	$160,000.00
11		TRAFFIC CONTROL	L S	1	$15,000.00	$15,000.00
12		RESTORATION/EROSION CONTROL	L S	1	$35,000.00	$35,000.00
					SUBTOTAL	**$797,415.00**
					CONSTRUCTION CONTINGENCY (20%)	**$159,483.00**
					CONSTRUCTION SUBTOTAL	**$956,898.00**
					ENGINEERING COST TOTAL (20%)	**$191,379.60**
					TOTAL	**$1,148,277.60**

Opinion of Probable Cost

WSB Project:		IGH Gisch Pond			*Design By:*	SMR
Project Location:		LMRWMO			*Checked By:*	JHN
WSB Project No:		024938-000			*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$176,500.00	$176,500.00
2		CLEARING AND GRUBBING	ACRE	2.0	$11,000.00	$22,000.00
3		REMOVE LIGHT POLE	EACH	1.0	$500.00	$500.00
4		REMOVE MANHOLE/CATCHBASIN	EACH	9.0	$1,000.00	$9,000.00
5		REMOVE STORM SEWER PIPE (STORM)	L F	64.0	$30.00	$1,920.00
6		REMOVE METAL CULVERT (96")(30' DEPTH)	L F	302	$90.00	$27,180.00
7		REMOVE SANITARY SEWER PIPE	L F	210	$25.00	$5,250.00
8		SAWING BITUMINOUS PAVEMENT	L F	200	$5.00	$1,000.00
9		REMOVE BITUMINOUS PAVEMENT (FULL DEPTH)	S Y	809	$5.00	$4,045.00
10		REMOVE CONCRETE PAVEMENT (FULL DEPTH)	S Y	457	$16.00	$7,312.00
11		EXCAVATION - COMMON (CV)	C Y	2,662	$10.00	$26,620.00
12		EXCAVATION - ROCK	C Y	6,665	$175.00	$1,166,375.00
13		DEWATERING	L S	1	$100,000.00	$100,000.00
14		BALLAST	C Y	275	$50.00	$13,750.00
15		AGGREGATE BASE (CV) CLASS 5	C Y	150	$40.00	$6,000.00
16		TYPE SP 12.5 WEARING COURSE MIXTURE (3,C)	TON	100	$100.00	$10,000.00
17		TYPE SP 12.5 NON WEARING COURSE MIXTURE (3,B)	TON	100	$100.00	$10,000.00
18		96" RC PIPE APRON	EACH	2	$7,000.00	$14,000.00
19		TRASH GUARD FOR 96" PIPE APRON	EACH	2	$4,000.00	$8,000.00
20		15" RCP CLASS IV	L F	15	$100.00	$1,500.00
21		27" RCP CLASS IV	L F	83	$148.00	$1,500.00
22		36" RCP CLASS IV	L F	17	$240.00	$4,080.00
23		48" RCP CLASS IV	L F	91	$350.00	$31,850.00
24		96" RC PIPE CULVERT	L F	327	$1,550.00	$506,850.00
25		CONNECT TO EXISTING SANITARY SEWER	EACH	3	$2,700.00	$8,100.00
26		SANITARY SEWER BYPASS PUMPING	DAY	14	$10,500.00	$147,000.00
27		CONSTRUCT SANITARY MANHOLE	EACH	3	$5,000.00	$15,000.00
28		CONSTRUCT DRAINAGE STRUCTURE DES 48-4020	L F	12	$700.00	$8,400.00
29		RANDOM RIPRAP CLASS V	TON	50	$500.00	$25,000.00
30		GABION	C Y	140	$600.00	$84,000.00
31		TRAFFIC CONTROL	EACH	1	$50,500.00	$50,500.00
32		SEEDING	ACRE	2	$2,200.00	$4,400.00
					SUBTOTAL	**$2,216,305.00**
					CONSTRUCTION CONTINGENCY (20%)	**$443,261.00**
					CONSTRUCTION SUBTOTAL	**$2,659,566.00**
					ENGINEERING COST TOTAL (20%)	**$531,913.20**
					TOTAL	**$3,191,479.20**

Opinion of Probable Cost

WSB Project:	IGH Structural BMPs	*Design By:*	SMR
Project Location:	LMRWMO	*Checked By:*	JHN
WSB Project No:	024938-000	*Date:*	9/27/2024

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
1		MOBILIZATION	L S	1	$60,000.00	$60,000.00
2		REMOVE BITUMINOUS PAVEMENT	S Y	381	$15.00	$5,715.00
3		BITUMINOUS PATCHING MIXTURE (SPECIAL)	TON	62	$170.00	$10,540.00
4		18" RC PIPE SEWER DES 3006 CL III	L F	32	$100.00	$3,200.00
5		24" RC PIPE SEWER DES 3006 CL III	L F	32	$120.00	$3,840.00
6		27" RC PIPE SEWER DES 3006 CL III	L F	32	$130.00	$4,160.00
7		30" RC PIPE SEWER DES 3006 CL III	L F	32	$140.00	$4,480.00
8		33" RC PIPE SEWER DES 3006 CL III	L F	32	$150.00	$4,800.00
9		CONNECT TO EXISTING PIPE	EACH	20	$2,000.00	$40,000.00
10		TREATMENT STRUCTURE	EACH	5	$60,000.00	$300,000.00
11		DIVERSION STRUCTURE	EACH	5	$20,000.00	$100,000.00
12		TRAFFIC CONTROL	L S	1	$15,000.00	$15,000.00
13		RESTORATION/EROSION CONTROL	L S	1	$25,000.00	$25,000.00
					SUBTOTAL	**$511,020.00**
					CONSTRUCTION CONTINGENCY (20%)	**$102,204.00**
					CONSTRUCTION SUBTOTAL	**$613,224.00**
					ENGINEERING COST TOTAL (20%)	**$122,644.80**
					TOTAL	**$735,868.80**

Appendix C – Standard BMP Details

Hydro International®

Downstream Defender®

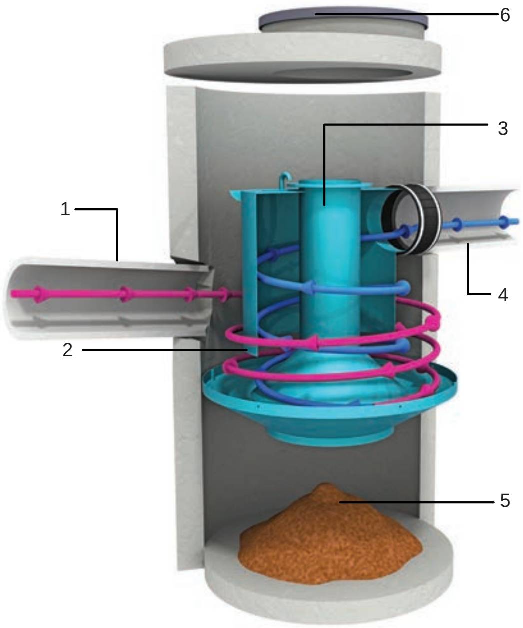
Advanced Hydrodynamic Separator

Product Summary

Exceptional Pollutant Capture in a Compact Profile

Downstream Defender is an advanced hydrodynamic vortex separator that provides impressive and reliable removal of fine and coarse particles, hydrocarbons, and floatable debris from surface water runoff, delivering high levels of stormwater treatment over a wide range of flow rates.

Available in a range of sizes, it can function as either pretreatment or as a stand-alone device, providing engineers and contractors with a flexible, cost-effective stormwater management option.



Product Profile

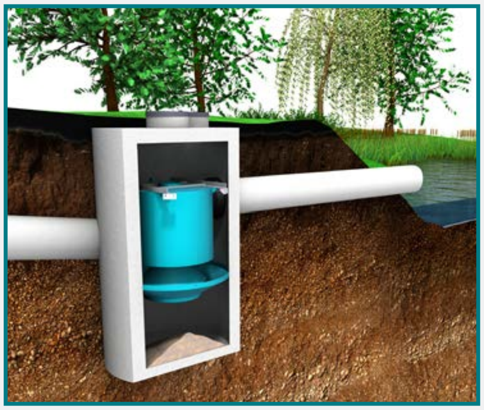
1. Inlet to Precast Vortex Chamber
2. Cylindrical Baffle
3. Center Shaft
4. Outlet Pipe
5. Sediment Storage Sump
6. Access Lid

Applications

- » Areas requiring a minimum of 50% TSS removal
- » Highways, parking lots, industrial areas and urban developments
- » Pre-treatment to ponds, storage systems, green infrastructure
- » Areas where high solids and trash capture are a must

How it Works

Tangential Inlet for Superior Vortex Action



Polluted stormwater is introduced tangentially into the side of the precast vortex chamber to establish rotational flow. A cylindrical baffle with an inner center shaft creates an outer (magenta arrow) and inner (blue arrow) spiraling column of flow and ensures maximum residence time for pollutant travel between the inlet and outlet.

Oil, trash and other floating pollutants are captured and stored on the surface of the outer spiraling column. Low energy vortex motion directs sediment into the protected sump region. Only after following a long three-dimensional flow path is the treated stormwater discharged from the outlet pipe.

Benefits

Tight & Mighty

- » Save space and money: treat high peak flows in as little as half of the footprint of other structural BMP systems.
- » Cut headloss: Low headloss means more site flexibility and provides engineers with design options for shallower sites.
- » Increase Pollutant Capture: Carefully designed internal components isolate the pollution storage areas, ensuring that what is captured is retained, even during high flows.
- » Adapt to Your Site: accommodate a change in outlet pipe direction to suit site-specific requirements.

Stormwater Solutions

→ hydro-int.com/downstreamdefender

Sizing & Design

The Downstream Defender can be used to meet a wide range of stormwater treatment objectives. It is available in 5 precast models that fit easily into the drainage network (**Table 1)**. Selection and layout of the appropriate Downstream Defender model depends on site hydraulics, site constraints and local regulations. Both online (**Fig.3a)** and offline (**Fig.3b**) configurations are common.

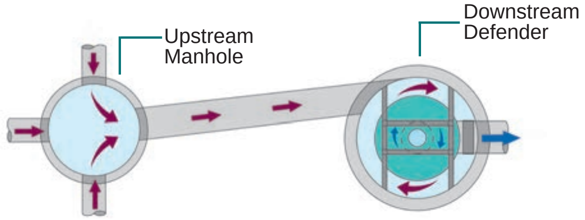


Fig.3a The Downstream Defender in an online configuration.

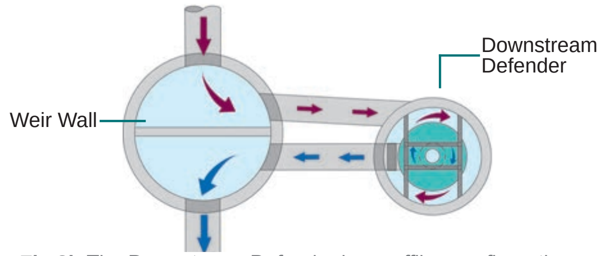


Fig.3b The Downstream Defender in an offline configuration.

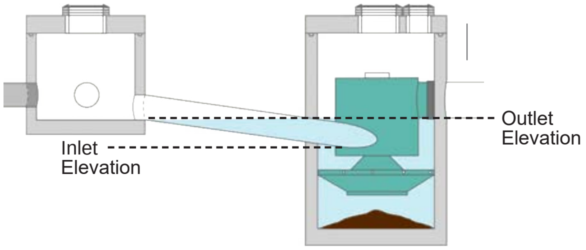


Fig.2 The Downstream Defender® has a submerged inlet that reduces headloss and improves efficiency of pollutant capture.

Online Sizing Tool

This simple online tool will recommend the best separator, model size and online or offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

Model Number and Diameter		Peak Treatment Flow Rate		Maximum Pipe Diameter		Oil Storage Capacity		Sediment Storage Capacity		Minimum Distance from Outlet Invert to Top of Rim		Standard Height from Outlet Invert to Sump Floor	
(ft)	(m)	(cfs)	(L/s)	(in)	(mm)	(gal)	(L)	(yd³)	(m³)	(ft)	(m)	(ft)	(m)
4	1.2	3.0	85	12	300	70	265	0.70	0.53	2.8	0.85	4.1	1.25
6	1.8	8.0	227	18	450	216	818	2.10	1.61	3.2	0.98	5.9	1.80
8	2.4	15.0	425	24	600	540	2,044	4.65	3.56	4.2	1.28	7.7	2.35
10	3.0	25.0	708	30	750	1,050	3,975	8.70	6.65	5.0	1.52	9.4	2.85
12*	3.7	38.0	1,076	36	900	1,770	6,700	14.70	11.24	5.6	1.71	11.2	3.41

**Not available in all areas. Contact Hydro Interational for details.*

Maintenance

The Downstream Defender® is designed with maintenance in mind. Floatable trash and debris can be removed from the surface with a net. Vactor hose access through the center shaft of the system makes for quick, simple sump cleanout. These design features expedite maintenance procedures, reducing long-term operational cost.

Hydro International

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200
Email: stormwaterinquiry@hydro-int.com
Web: www.hydro-int.com/downstreamdefender

DD_SS_C_2203

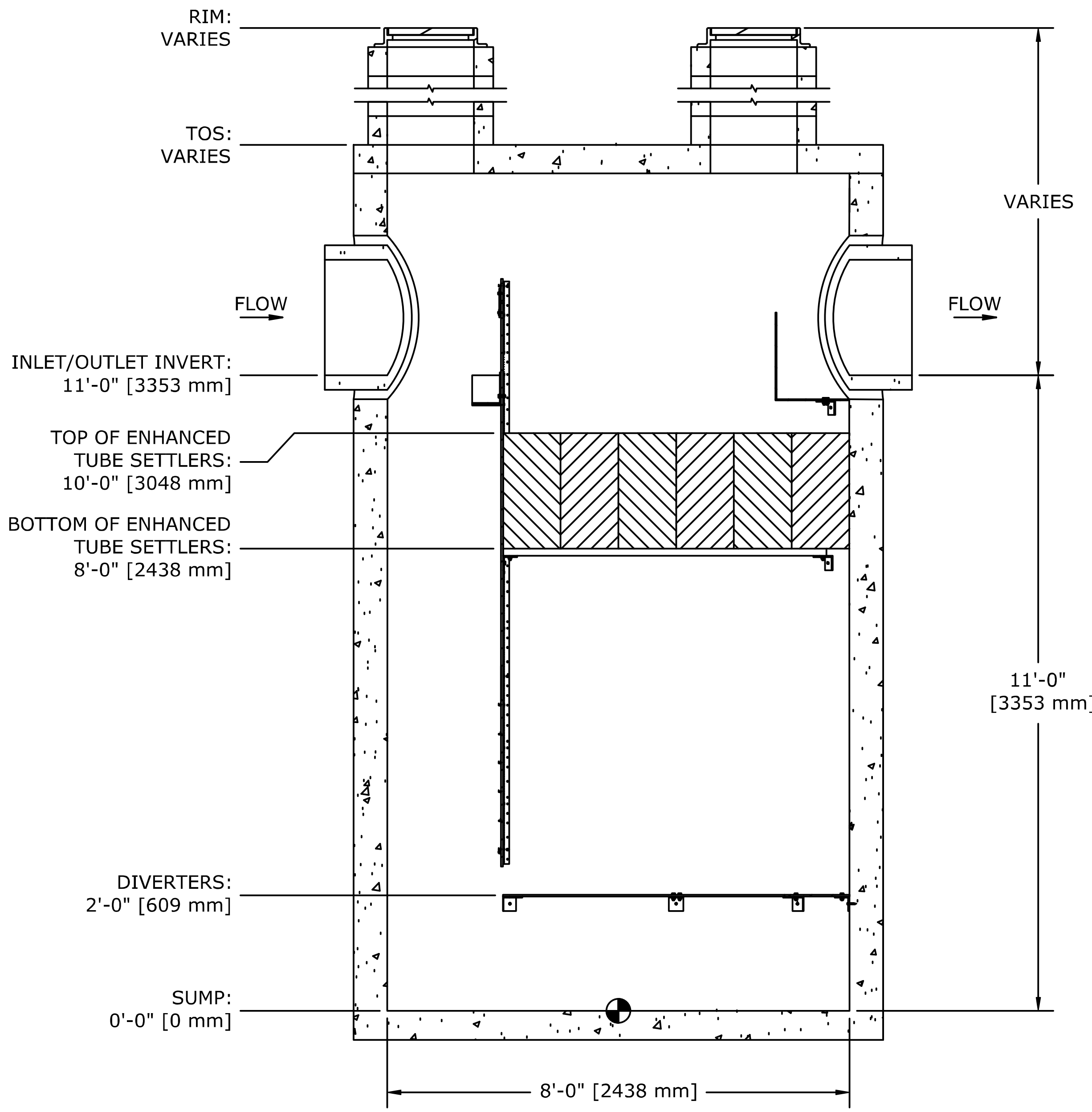
Download Drawings!

→ hydro-int.com/dd-drawings

Access the Operation & Maintenance Manual

→ hydro-int.com/dd-om

SITE SPECIFIC DATA			
STRUCTURE ID			-
WATER QUALITY FLOW RATE (CFS)			-
PEAK FLOW RATE (CFS)			-
SEDIMENT STORAGE CAPACITY (CF)			58.6
RIM ELEVATION			-
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	11.00	-	48" OR LESS
OUTLET PIPE	11.00	-	48" OR LESS



SECTION A-A
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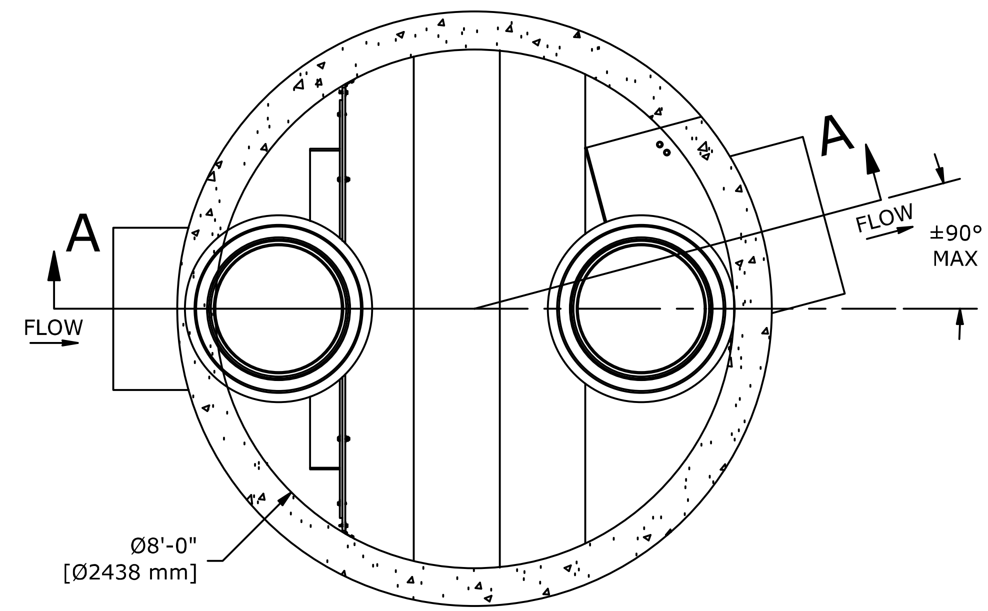


PLAN VIEW
N.T.S.

DESIGN NOTES:

1. DESIGN LOADING:
   a. LOAD RATING = AASHTO HS-20
   b. MINUMUM COVER = 0.50' [152 mm], MAXIMUM COVER = 5.00' [1524 mm]. CONTACT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
   c. WATER TABLE AT OR BELOW OUTLET PIPE INVERT ELEVATION.
   d. NO LATERAL SURCHARGE FROM ADJACENT STRUCTURES SUCH AS VEGETATION, BUILDINGS, WALLS, OR FOUNDATIONS.
2. ENGINEER OF RECORD TO CONFIRM THE DESIGN LOADINGS MEET PROJECT REQUIREMENTS. CONTACT STORMTRAP FOR ALTERNATIVE DESIGN LOAD OPTIONS.

GENERAL NOTES:

1. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS, WEIGHTS, AND ACCESSORIES, PLEASE CONTACT YOUR STORMTRAP REPRESENTATIVE.
2. CONCRETE COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C478.
3. CONTRACTOR TO INSTALL THE STRUCTURE IN ACCORDANCE WITH ASTM C1821.
4. CONTRACTOR TO PROVIDE ALL LABOR AND EQUIPMENT REQUIRED TO OFFLOAD AND INSTALL UNIT.
5. CONTRACTOR TO PROVIDE AND INSTALL ALL PIPES, FRAMES, COVERS, HATCHES, AND RISERS UNLESS SPECIFIED OTHERWISE.
6. CONTRACTOR TO ADD JOINT SEALANT (PROVIDED BY STORMTRAP) BETWEEN ALL STRUCTURE SECTIONS.

DRAWINGS ARE FOR REFERENCE ONLY AND SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.

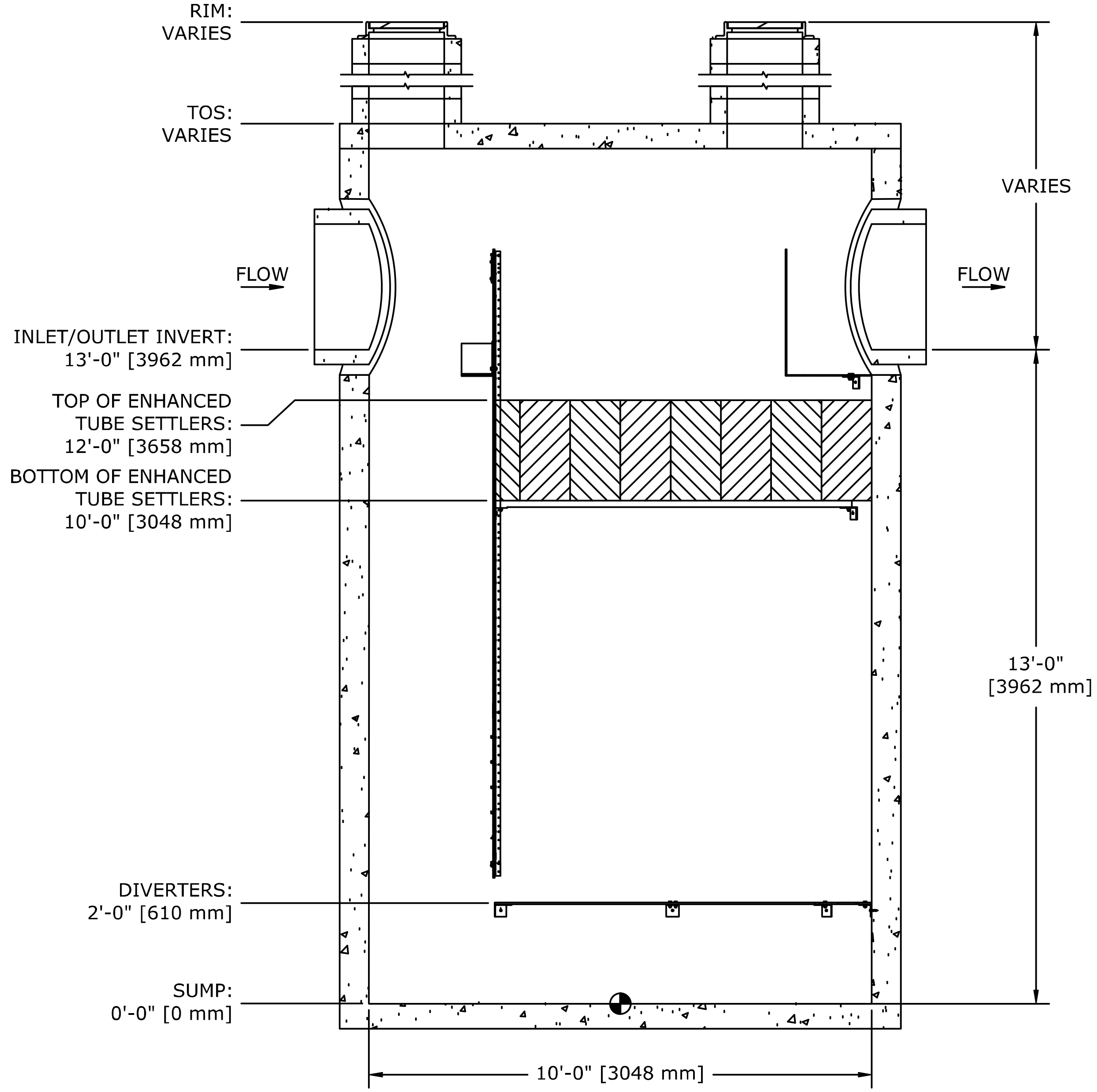
StormSettler™

STORMSETTLER 8 STANDARD DETAIL

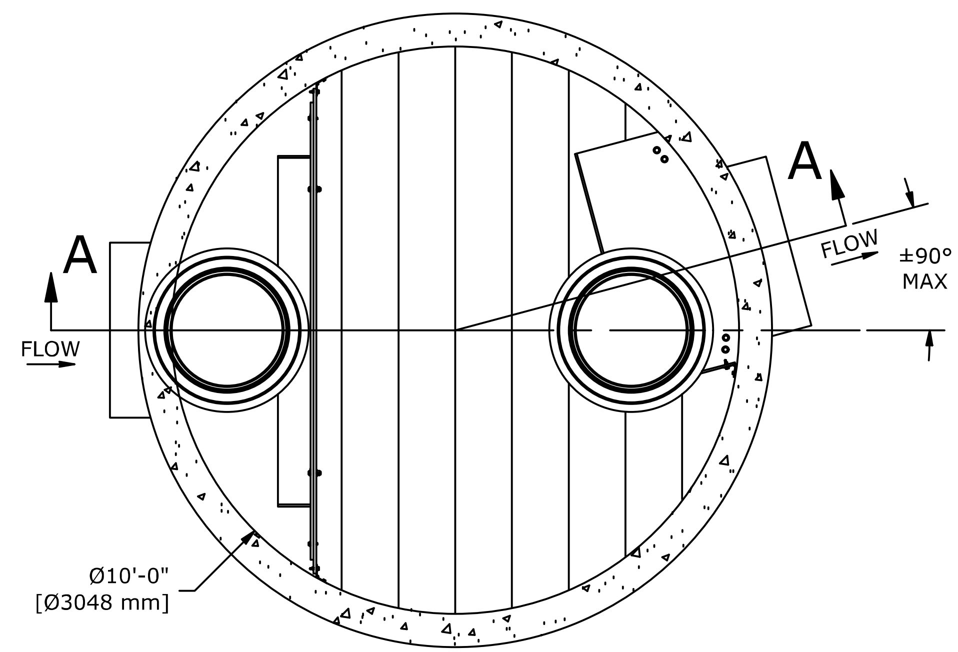
DRAWN BY:	DATE:	SCALE:		
TJF	3/13/24	NTS	V1	SHEET 1 OF 1

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549
F:331-318-5347

SITE SPECIFIC DATA			
STRUCTURE ID			-
WATER QUALITY FLOW RATE (CFS)			-
PEAK FLOW RATE (CFS)			-
SEDIMENT STORAGE CAPACITY (CF)			91.6
RIM ELEVATION			-
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	13.00	-	60" OR LESS
OUTLET PIPE	13.00	-	60" OR LESS



SECTION A-A
N.T.S.



PLAN VIEW
N.T.S.

DESIGN NOTES:

1. DESIGN LOADING:
   a. LOAD RATING = AASHTO HS-20
   b. MINUMUM COVER = 0.50' [152 mm], MAXIMUM COVER = 5.00' [1524 mm]. CONTACT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
   c. WATER TABLE AT OR BELOW OUTLET PIPE INVERT ELEVATION.
   d. NO LATERAL SURCHARGE FROM ADJACENT STRUCTURES SUCH AS VEGETATION, BUILDINGS, WALLS, OR FOUNDATIONS.
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GENERAL NOTES:

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DRAWINGS ARE FOR REFERENCE ONLY AND SHALL NOT BE USED FOR CONSTRUCTION PURPOSES.

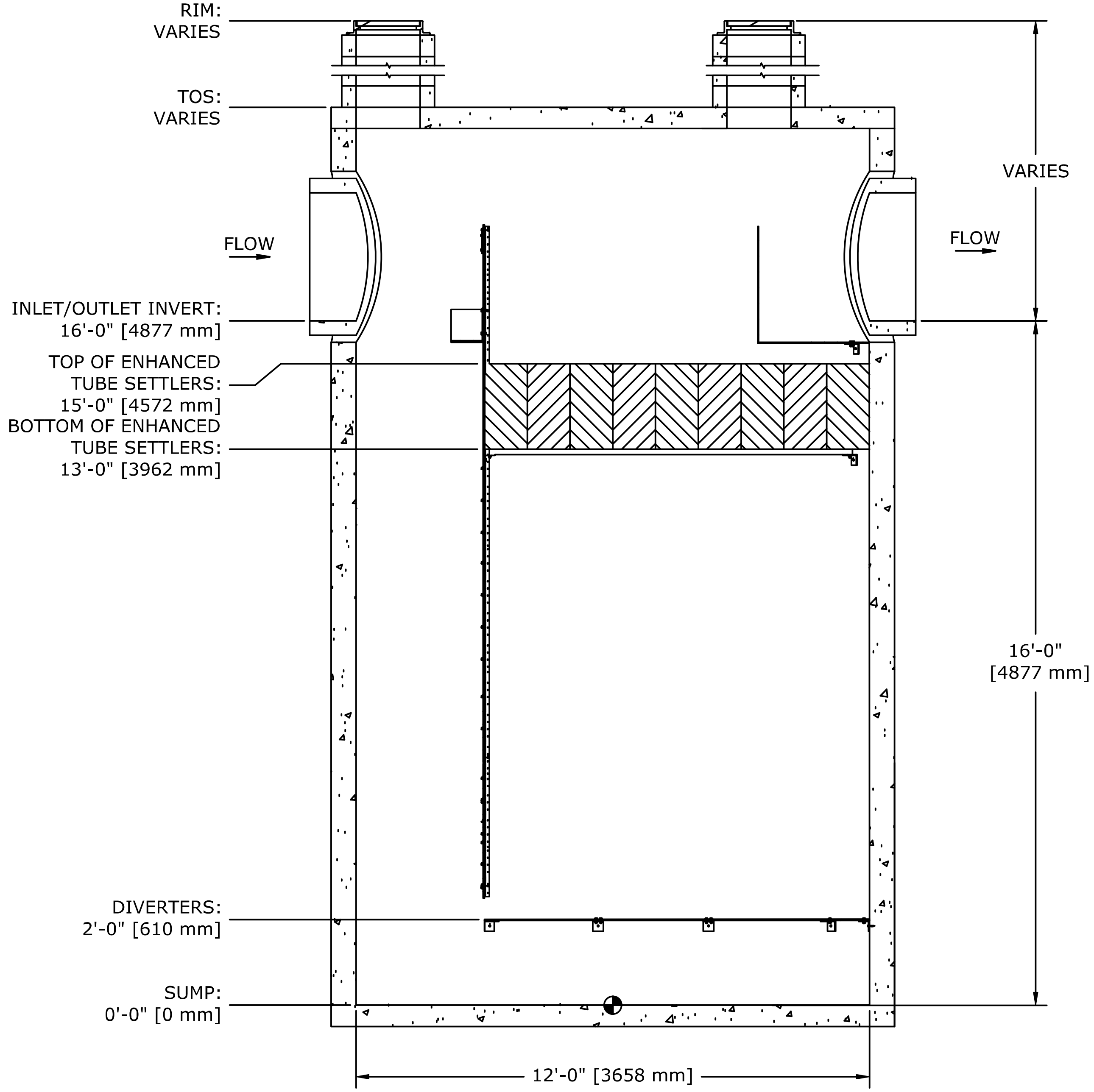
StormSettler™

STORMSETTLER 10 STANDARD DETAIL

DRAWN BY:	DATE:	SCALE:		
TJF	3/13/24	NTS	V1	SHEET 1 OF 1

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549
F:331-318-5347

SITE SPECIFIC DATA			
STRUCTURE ID			-
WATER QUALITY FLOW RATE (CFS)			-
PEAK FLOW RATE (CFS)			-
SEDIMENT STORAGE CAPACITY (CF)			131.9
RIM ELEVATION			-
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	16.00	-	72" OR LESS
OUTLET PIPE	16.00	-	72" OR LESS



SECTION A-A
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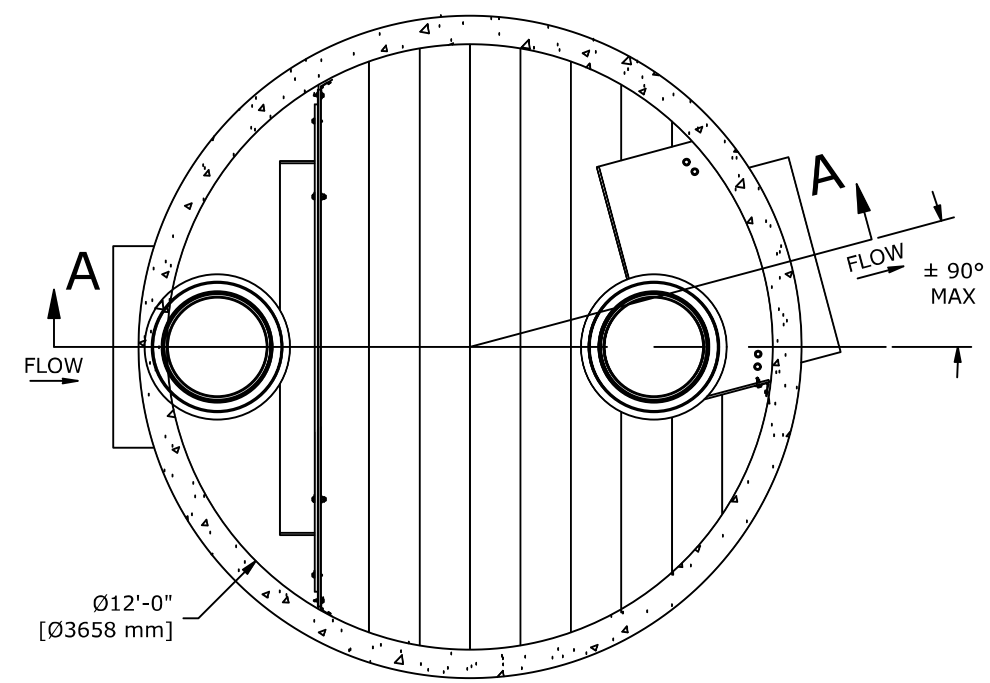

PLAN VIEW
N.T.S.

DESIGN NOTES:

1. DESIGN LOADING:
   a. LOAD RATING = AASHTO HS-20
   b. MINUMUM COVER = 0.50' [152 mm], MAXIMUM COVER = 5.00' [1524 mm]. CONTACT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
   c. WATER TABLE AT OR BELOW OUTLET PIPE INVERT ELEVATION.
   d. NO LATERAL SURCHARGE FROM ADJACENT STRUCTURES SUCH AS VEGETATION, BUILDINGS, WALLS, OR FOUNDATIONS.
2. ENGINEER OF RECORD TO CONFIRM THE DESIGN LOADINGS MEET PROJECT REQUIREMENTS. CONTACT STORMTRAP FOR ALTERNATIVE DESIGN LOAD OPTIONS.

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6. CONTRACTOR TO ADD JOINT SEALANT (PROVIDED BY STORMTRAP) BETWEEN ALL STRUCTURE SECTIONS.

StormSettler™

STORMSETTLER 12 STANDARD DETAIL

DRAWN BY:	DATE:	SCALE:		
TJF	3/13/24	NTS	V1	SHEET 1 OF 1

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1287 WINDHAM PARKWAY
ROMEOVILLE, IL 60446
P:815-941-4549
F:331-318-5347