Technical Report
Stormwater

1.0 Introduction

1.1 Purpose of Report

This *Stormwater Technical Report* has been prepared in support of the Bottineau Transitway Project Draft Environmental Impact Statement (Draft EIS). The objective of this report is to evaluate the Project's potential stormwater impacts within the study area and to identify potential mitigation measures. This includes the following:

- Identify regulatory requirements that will set forth mitigation standards that are specific to stormwater management.
- Determine how the proposed LRT improvements would affect existing drainage.
- Identify stormwater best management practices (BMPs) that would be used to satisfy current regulatory requirements for the corridor.
- Determine approximate size and location for BMPs along the corridor.

This report contains qualitative and quantitative design recommendations for each alignment in order to provide project staff and regulatory agencies with information on how the project would meet various regulatory requirements.

2.0 Technical Analysis

2.1 Regulatory Context/Methodology

The following agencies play a role in stormwater management within the study area:

- Bassett Creek Watershed Management Commission (BCWMC)
- Mississippi Watershed Management Organization (MWMO)
- Shingle Creek and West Mississippi Watershed management Organization (SCWMO)
- Minnesota Pollution Control Agency (MPCA)
- Cities of Minneapolis, Golden Valley, Robbinsdale, Crystal, Brooklyn Park and Maple Grove

Regulatory and permitting authority for stormwater management falls to the cities, the MPCA, and in some cases also the Watershed Management Organizations (WMOs). In the case of stormwater management facilities constructed on Minneapolis Park & Recreation Board (MPRB) property in either Minneapolis or Golden Valley, permits to construct will be needed from the MPRB and regulations will be those of the city in which the property is located. Each watershed organization is governed by the Joint Powers Agreement that is held between the watershed organization and the communities/members that are located within the boundaries of the WMO. See Table 1 for a list of WMO members. See Figure 1 for WMO boundaries and Table 3 for a summary of the WMO requirements as of July 2012. Regulations change from time to time, and the project will be subject to regulations in effect when the design is submitted for approval by the permitting authorities. It is recognized that cities have the lead role in stormwater management, and coordination regarding local requirements will take place between the lead transit agency and each city as the selected alternative is refined and the permit applications are prepared.

Table 1. WMO Members

BCWMC	MWMO	SCWMO / WMWMO
Crystal	Lauderdale	Brooklyn Center (Both)
Golden Valley	Minneapolis	Brooklyn Park (Both)
Medicine Lane	Minneapolis Park & Recreation Board	Champlin (WMWMO)
Minneapolis	St. Anthony	Crystal (SCWMO)
Minnetonka	St. Paul	Maple Grove (Both)
New Hope		Minneapolis (SCWMO)
Plymouth		New Hope (SCWMO)
Robbinsdale		Osseo (Both)
St. Louis Park		Plymouth (SCWMO)
		Robbinsdale (SCWMO)

Bassett Creek Watershed Management Commission (BCWMC)

The BCWMC manages waters within its boundaries (parts of Crystal, Golden Valley, Medicine Lake, Minneapolis, New Hope, Minnetonka, Plymouth, Robbinsdale, and St. Louis Park) through its Watershed Management Plan, which was adopted in 2004. This plan complies with the provisions of the Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420, the Metropolitan Surface Water Management Act, the Water Resources Management Policy Plan, and other approved regional plans. These requirements include protection of surface waters, groundwater, wetlands, and related natural resources.

BCWMC requires that all regulated stormwater be treated to Level I Standards, which are described below, relating to Best Management Practices (BMPs) for Infiltration Systems, Filtration Systems, and Detention Systems. BCWMC requires developers to consider and evaluate the use of BMPs in accordance with requirements of the BCWMC Watershed Management Plan.

Existing development and right-of-way constraints limit the types of BMPs that can be implemented as part of a linear roadway or reconstruction project. The BCWMC understands these constraints and identifies that at a minimum, temporary measures would be required to address erosion and sediment control during construction. The BCWMC would work with project planners to determine the appropriate temporary and permanent BMPs to be implemented as part of the project. As part of the permitting process, the BCWMC would require a description of the evaluation process used to identify feasible BMPs for the project.

BCWMC infiltration systems BMP requirements include:

- Design volume to be no less than 0.5 inch of runoff from the tributary impervious surfaces, while the remaining runoff bypasses the infiltration basin
- Ponding duration drawdown time of 48 hours (or up to 72 hours if justification can be provided)

BCWMC filtration systems BMP requirements include:

- Design volume to be no less than one inch of runoff from the tributary impervious surfaces, while remaining runoff bypasses the filtration basins
- System components are typically sized for the 15-minute peak flow of a two-year, 24-hour storm
- Bioretention filtration systems drawdown time of 48 hours (or up to 72 hours if justification can be provided)

BCWMC detention system BMP requirements include:

- Designing permanent pool volume to be greater than or equal to the runoff volume from a 2.5-inch, 24-hour storm over the project site, assuming full development.
- The flood pool volume above the principal spillway is designed so that the peak discharge rate from the 5-year and 100-year frequency does not exceed peak discharge for pre-development conditions.
- Slopes no steeper than 1:3 above the normal water level, a 10-foot wide safety bench at slope 1:10 immediately below the normal water level, and slopes no steeper than 1:3 extending to the bottom of the pond.
- The permanent pool average depth (basin volume/basin surface area) shall be greater than or equal to at least four feet, with a maximum depth of up to 10 feet. For small ponds (less than three acre-feet in volume), average depth shall be at least three feet, with a maximum depth of at least 10 feet.

Mississippi Watershed Management Organization (MWMO)

The MWMO manages waters within its boundaries (parts of Lauderdale, Minneapolis, St. Anthony, and St. Paul), as well as property owned by the Minneapolis Park and Recreation Board (MPRB), through its Watershed Management Plan, amended in 2011. This Plan is in compliance the water resource protection requirements under Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420.

MWMO requires its member cities to develop stormwater management ordinances that reduce runoff and promote increased stormwater management for construction and redevelopment projects. The MWMO Watershed Management Plan stipulates that:

- The design storm event that determines the maximum permissible runoff rate shall be established by each member community, but shall reduce the probability of flooding in areas that flooded during the wet summers of the 1990s.
- All development and redevelopment must include treatment of surface water runoff.
- Treated water from sites less than five acres should be directed into regional detention ponds established by local governments instead of being routed directly into waters and wetlands.
- Developments greater than five acres, including redevelopments, are required to implement stormwater controls on site for quantity and quality.

MWMO detention basin BMP requirements include:

- Keeping peak discharge rates at the pre-developed condition for one percent (100-year) to four percent (25-year) frequency, 24-hour duration storm event.
- Design permanent pool volume to be greater than or equal to the volume that contains the runoff from a two-inch storm that occurs over one hour over the entire contributing drainage area.
- Design flood pool volume above the principal spillway so that the peak discharge rate from one percent frequency, 24-hour duration storms are no greater than pre-development basin condition.
- Provide an emergency spillway to control the runoff from a one percent to four percent frequency, 24-hour duration storm event.

Storm sewers and ditches are regulated by local government policies. The MWMO requires governments to determine the level of service for storm sewers and ditches, which must provide capacity for 10-percent (10-year) to 50-percent (2-year) storm events.

MWMO does not issue permits, but relies on the existing permitting and enforcement bodies of its member communities. Local stormwater requirements would be coordinated with the City of Minneapolis.

Shingle Creek and West Mississippi Watershed Management Organization (SCWMO/WMWMO)

The SCWMO and WMWMO are two separate WMO's, however they plan and conduct business jointly, managing waters within its boundaries (parts of Brooklyn Center, Brooklyn Park, Crystal, Maple Grove, Minneapolis, New Hope, Plymouth, Robbinsdale, and Champlin) through its Second Generation Watershed Management Plan, adopted in 2004, amended six times since then, most recently in 2010. This Plan complies with the water resource protection requirements under Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420.

The SCWMO requires project reviews for single-family detached housing projects that are 15 acres or larger in size, or any other land use project that is five acres or larger in size, to confirm that land-disturbing activities are in conformance with BMPs, standards, and criteria included in its rules.

SCWMO requires a Stormwater Management Plan to be consistent with all applicable management rules and standards. Specific BMPs that are identified include detention and infiltration systems. The following provides a summary of the design requirements associated with each system.

SCWMO infiltration BMP requirements include:

- Design for volume that is no less than 0.5 inch of runoff from the tributary impervious surfaces, while the remaining runoff bypasses the infiltration basin. SCWMO has indicated that this requirement would change to be no less than one inch of runoff from the tributary impervious surfaces.
- Ponding duration drawdown time of 48 hours.

SCWMO detention basin BMP requirements include:

- Stormwater must be treated prior to discharge to remove 60 percent of phosphorus and 85 percent of total suspended solids.
- Outlet structure design that is able to control the two-year, 10-year, and 100-year critical storm events to pre-development conditions.
- Provide an emergency overflow (emergency outlet) to control the 100-year frequency critical duration rainfall event.
- Design permanent wet pool with dead storage of at least the runoff from a 2.5-inch storm event.
- Provide an outlet skimmer to prevent migration of floatables and oils for at least the one-year storm event; baffled weirs are not allowed.
- Slopes no steeper than 1:3 above the normal water level, a 10-foot wide safety bench at slope 1:10 immediately below the normal water level, and slopes no steeper than 1:3 extending to the bottom of the pond.
- Permanent pool average depth (basin volume/basin surface area) shall be at least four feet, with a maximum depth of up to 10 feet. For small ponds (less than three acre-feet in volume), average depth shall be at least three feet, with a maximum depth of up to 10 feet.

Each new or revised crossing over Shingle Creek is required to retain adequate hydraulic capacity with no adverse impact to conveyance of the 100-year flow.

SCWMO reviews proposed projects affecting water resources within the Shingle Creek and West Mississippi watersheds.

Minnesota Pollution Control Agency (MPCA)

The MPCA administers the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit program in the State of Minnesota (MN 115; MN Rule 7050). The NPDES permit program requires creation of a site-specific Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must detail temporary and permanent erosion prevention and sediment control BMPs that would be utilized during construction. The NPDES permit also requires permanent treatment of stormwater runoff at sites where construction activity results in a net increase of more than one acre of impervious area.

Section 303(d) of the Clean Water Act (CWA) requires states to asses all waters to determine if they meet water quality standards and to conduct total maximum daily load (TMDL) studies in order to set pollutant reduction goals. Areas of the project with outlets within one mile of MPCA-designated impaired or special waters must incorporate additional best management practices, including a stricter stormwater treatment requirement. There are 13 impaired waters identified within one-mile of the project area, of which five would receive runoff from the project area. Impaired receiving waters within one mile of the project area are included in bold in Table 2 and Figure 2. Existing drainage areas located within the limits of the Bottineau Transitway Project currently discharge into the Mississippi River, Wirth Lake, Bassett Creek, Crystal Lake, and Shingle Creek. The only impaired receiving waters that have an approved TMDL plan are Crystal Lake, (nutrients) and Shingle Creek (chloride and biotic integrity/dissolved oxygen). The Crystal Lake TMDL plan identifies BMPs such as increasing infiltration and filtration in the Crystal lakeshed through the use of rain gardens, native plantings, and reforestation and retrofitting existing detention ponds as ways to implement the TMDL plan. The biotic integrity/dissolved oxygen TMDL calls for making physical improvements to Shingle Creek to improve aeration and enhance habitat, as well as to undertake BMPs in the watershed to reduce nutrient loading, reduce stormwater volume to Shingle Creek, and increase infiltration to enhance baseflow. The chloride TMDL calls for a reduction in the use of sodium chloride for ice control in the watershed.

Table 2. Impaired Waters within One Mile of Project Area

Name	Impairment	TMDL Status
Wirth Lake[1,2]	**Nutrients, Mercury (Hg)**	**No action**
Bassett Creek (Medicine Lake to Mississippi River) [1]	**Chloride, Fecal Coliform, Fish Bioassessments**	**No action**
Mississippi River (Coon Creek to Upper St. Anthony Falls) [1,2]	**Fecal Coliform, Polychlorinated biphenyl (PCB), Hg**	**No action**
Sweeney Lake	Nutrients	No action
Crystal Lake[1,2]	**Nutrients**	**EPA approved TMDL plan for Nutrients**
Lower Twin Lake	PCB, Perfluorooctanesulfonic acid (PFOS), Hg, Nutrients	EPA approved TMDL plan for Hg and Nutrients
Middle Twin Lake	PCB, PFOS, Hg, Nutrients	EPA approved TMDL plan for Hg and Nutrients
Upper Twin Lake	PCB, PFOS, Hg, Nutrients	EPA approved TMDL plan for Hg and Nutrients
Meadow Lake	Nutrients	EPA approved TMDL plan for Nutrients
Shingle Creek[1]	**Aquatic Macroinvertebrate Bioassessment, Chloride, Biotic Integrity/Dissolved Oxygen (DO)**	**EPA approved TMDL plan for chloride and biotic integrity/ dissolved oxygen**
Eagle Lake	Nutrients	EPA approved TMDL plan for Nutrients
Cedar Island Lake	Nutrients	EPA approved TMDL plan for Nutrients
Bass Creek	Chloride, Fish Bioassessments	EPA approved TMDL plan for Fish Bioassessments

[1]Impaired waters located within drainage areas affected by the Bottineau Transitway Project.
[2]Impaired waters receive indirect discharge from existing drainage areas.

MPCA NPDES detention system BMP requirements include:

- Limiting the maximum discharge rate from a pond to 5.66 cubic feet per second, per acre of surface area.
- A minimum dead pool volume for treatment ponds of 1800 cubic feet per acre drained, or infiltration/filtration systems designed to remove 80 percent of total suspended solids (TSS).
- The permanent pool average depth (basin volume/basin surface area) shall be at least three feet, with a maximum depth of up to 10 feet.
- Slopes no steeper than 1:3 above the normal water level, a 10-foot wide bench at slope 1:10 immediately above the normal water level, a 10-foot wide safety bench at slope 1:10 immediately below the normal water level, and slopes no steeper than 1:3 extending to the bottom of the pond.

MPCA NPDES infiltration BMP requirements include:

- At least one half inch of runoff from the new impervious surface must be infiltrated, where site conditions allow.
- Ponding duration drawdown time of 48 hours.

Table 3. WMO and City Requirements Summary

WMO	Detention Requirements				Infiltration BMP Requirements	
	Permanent Pool Volume	Permanent Pool Depth	Flood Pool Volume	Slopes	Volume	Drawdown Time
BCWMC	Runoff from 2.5-inch, 24-hour storm over the contributing drainage area 100-year storm discharge < existing conditions	4-10 feet 3-10 feet for small ponds (less than 3 acre-feet)	5-year and 100-year storm peak discharge rate < existing conditions	1:3 above the NWL and below the safety bench 10-foot wide safety bench at slope 1:10 below the NWL	0.5 inch of runoff from tributary impervious surfaces	48 hours, up to 72 hours if justified
SCWMO	Runoff from 2.5-inch storm event over the contributing drainage area	Use Minnesota Stormwater Manual	Two-year, 10-year, and 100-year critical storm events < existing conditions	1:3 above the NWL and below the safety bench 10-foot wide safety bench at slope 1:10 below the NWL	0.5 inch of runoff from the tributary impervious surfaces (likely changing to 1 inch)	48 hours
MPCA	1800 cubic feet per acre of surface area drained	3-10 feet	5.66 cubic feet per second, per acre of surface area	1:3 above the NWL and below benches 10-foot wide bench at slope 1:10 above and below the NWL	0.5 inch of runoff from the new impervious surfaces	48 hours

2.2 Study Area

The study area for stormwater is defined as the estimated area of disturbance for each alignment alternative, and the receiving waters within and immediately adjacent to the project.

This study area for impaired waters, based on state regulation, includes impaired waters that are located within one mile of the project, which would receive discharge from it.

2.3 Affected Environment

In general, the study area is urbanized, highly altered as compared to natural conditions, and is characterized by commercial, industrial, or residential development. The following provides a description of the affected environment associated with the area required for the proposed LRT guidewayand stations, park-and-rides, and potential OMF facility options within each of the alignments.

Alignment A

Existing drainage areas within Alignment A are located within SCWMO and can be described as three distinct areas: the existing gravel mining area west of US 169, the existing roadway on Brooklyn Boulevard between US 169 and CR 81, and the existing railway adjacent to CR 81.

The proposed sites for the Hemlock Lane park-and-ride, Revere Lane park-and-ride, and OMF facility are located within the gravel mining area west of US 169. Stormwater runoff from this area currently flows into existing depressions that have been created as part of the gravel mining process. A Stormwater Management Plan for the gravel mining area has been approved by the Shingle Creek WMC. The Plan identifies both existing and future regional stormwater ponding for this area. Some of the area impacted by this project may be directed into existing water quality ponds.

There are regularly spaced catch basin structures along Brooklyn Boulevard that convey runoff from the roadway into existing detention basins located adjacent to the roadway, which ultimately flow into Shingle Creek. Shingle Creek is impaired for aquatic macro invertebrate bioassessment, chloride, and dissolved oxygen.

Stormwater runoff within the existing railway corridor currently flows directly into surrounding ditches, conveying the water into adjacent watercourses. Vegetated ditches may provide limited surface water quality treatment via sedimentation and filtration of stormwater. Currently there is no formal stormwater treatment to meet regulatory requirements.

North of 73rd Avenue, an existing wetland is located on both sides of the railway corridor. A stormwater pipe, owned by the city of Brooklyn Park, crosses under CR 81 to convey water from the east side of CR 81 into the wetland that is located on the east side of the railway.

Between 71st Avenue and 70th Avenue, a stormwater pipe, owned by the city of Brooklyn Park, crosses under CR 81 and the railway corridor to convey water from the east side of the CR 81 to the west side.

Alignment B

Existing drainage areas within Alignment B are located within SCWMO and can be categorized as undeveloped (pervious, naturally vegetated), roadway, or existing railway.

Existing conditions at the proposed sites for the 93rd Avenue park-and-ride station and OMF site, 97th Avenue Station, and the 101st Avenue OMF site are undeveloped parcels that do not have any formal stormwater treatment provided to meet current regulatory requirements.

A large portion of existing West Broadway roadway is a rural roadway section and does not include any curb and gutter. In these areas, stormwater runoff is directed into ditches that are located adjacent to the roadway. Within areas along West Broadway where curb and gutter is provided, there are regularly spaced catch basin structures that convey runoff from the roadway into adjacent watercourses, which include detention basins, wetlands, and Shingle Creek. Shingle Creek is impaired for aquatic macro invertebrate bioassessment, chloride, and dissolved oxygen.

Stormwater runoff within the existing railway corridor currently flows directly into surrounding ditches and is conveyed to adjacent watercourses. Vegetated ditches may provide limited surface water quality treatment via sedimentation and filtration of stormwater. Currently there is no formal stormwater treatment to meet regulatory requirements.

Between 71st Avenue and 70th Avenue, a stormwater pipe, owned by the city of Brooklyn Park, crosses under CR 81 and the railway corridor to convey water from the east side of the CR 81 to the west side.

Alignment C

Existing drainage areas within Alignment C are located within SCWMO and consist of the existing railway corridor.

Stormwater runoff within the existing railway corridor currently flows directly into surrounding ditches and is conveyed to adjacent watercourses. Vegetated ditches may provide limited surface water quality treatment via sedimentation and filtration of stormwater. Currently there is no formal stormwater treatment to meet regulatory requirements.

South of 63rd Avenue, three stormwater pipes cross under the railway corridor and CR 81 to convey water from drainage facilities on the west side of the corridor to the east side of the corridor. Two of these pipes are owned by the city of Brooklyn Park and one is owned by Hennepin County.

At TH 100, three storm drain pipes cross the existing railway corridor. One is located north of TH 100 and connects two ponds that are located on either side of the railway corridor (Scott and Graeser Pond). Two other storm drain pipes are located at the existing roadway elevation and cross under the existing BNSF bridge structure. These pipes are owned by the City of Robbinsdale.

At 40 ½ Avenue, a vitrified clay pipe (VCP) crosses under the railway corridor to convey water from the west side of the corridor to its ultimate outlet at Crystal Lake. This pipe is owned by the City of Robbinsdale.

Two existing wells are located near the Robbinsdale Station.

There are areas within the corridor where stormwater runoff from property located adjacent to the existing railway corridor, is conveyed directly into the ditches located adjacent to the railway corridor.

Alignment D1

Existing drainage areas within Alignment D1 are located within the BCWMC and consist of the existing railway and a small portion of the median on TH 55.

Stormwater runoff within the existing railway corridor currently flows directly into surrounding ditches and is conveyed to adjacent watercourses. Vegetated ditches may provide limited surface water quality treatment via sedimentation and filtration of stormwater. Currently there is no formal stormwater treatment to meet regulatory requirements.

There are areas within the corridor where adjacent stormwater runoff is conveyed directly into the ditches located adjacent to the railway corridor. Between 36th Avenue and 33rd Avenue in the City of Robbinsdale, there are several storm drain pipes that run parallel to (west side of the railway corridor) or located in an existing street on the east side of the existing railway corridor and directly outlet stormwater discharge onto the BNSF property.

There are several culverts that cross the railway corridor throughout Alignment D1 that were identified through the review of BNSF Track Charts. The following provides a summary of these culverts and approximate location on the relocated BNSF alignment:

- 17" Cast Iron Pipe (CIP) between 33rd Avenue and 34th Avenue (Realigned BNSF Station 2130+00)
- 24" CIP at Grimes Pond (Realigned BNSF Station 2111+00)
- 48" Corrugated Metal Pipe (CMP) south of Grimes Pond (Realigned BNSF Station 2101+00)
- 36" CMP at ponds north of Golden Valley Road (Realigned BNSF Station 2071+00)
- 24" CMP south of Theodore Wirth Parkway Bridge (Realigned BNSF Station 2061+00)
- 30" Concrete Pipe (CP) and 24" CMP: south of Theodore Wirth Parkway Bridge, near Zephyr Place (Realigned BNSF Station 2058+00)
- 36" CP: south of Theodore Wirth Parkway, near York Avenue (Realigned BNSF Station 2050+00)
- 36" CP: near 16th Avenue North (Realigned BNSF Station 2045+00)
- 30" CP: near 14th Avenue North (Realigned BNSF Station 2040+00)
- 36" CP: near Plymouth Avenue (north side of bridge) (Realigned BNSF Station 2033+00)
- 18" CIP: between Fairwell Avenue and Oak Park Avenue (Realigned BNSF Station 2024+00)
- 36" CIP: south of Oak Park Avenue (Realigned BNSF Station 2017+50)
- 2-48" CMP: north of TH 55 (Realigned BNSF Station 2004+00)

Alignment D2

Existing drainage areas within Alignment D2 consist of four overall drainage areas:

- 34th Avenue between BNSF and France Avenue, which is located in BCWMC
- 34th Avenue/West Broadway between France Avenue and Victory Memorial Parkway, which is located within SCWMO
- West Broadway and Penn Avenue (north of 23rd Avenue), which is located in BCWMC
- Penn Avenue (south of 23rd Avenue), which is located in MWMO.

The drainage area between BNSF and France Avenue includes several catch basin structures that convey runoff from the roadway into the ditches located adjacent to the existing railway corridor. Vegetated ditches may provide limited surface water quality treatment via sedimentation and filtration of stormwater. Currently there is no formal stormwater treatment to meet regulatory requirements.

The drainage area east of France Avenue is connected through a series of catch basin structures along Oakdale Avenue, France Avenue, 34th Avenue, and West Broadway, as well as within the Terrace Mall and North Memorial Medical Center properties, that ultimately convey runoff into Crystal Lake. Crystal Lake is impaired for nutrients. Runoff from West Broadway is conveyed into either the 35th Avenue Pond, Lakeview Pond, or France Pond prior to entering Crystal Lake.

There are regularly spaced catch basin structures along West Broadway and Penn Avenue that convey runoff from the roadway into a series of pipe systems. These systems ultimately flow into either Bassett Creek (West Broadway and Penn Avenue, north of 23rd Avenue), which is impaired for chloride, fecal coliform, and fish bioassessments, or the Mississippi River (Penn Avenue, south of 23rd Avenue), which is impaired for fecal coliform, PCB, and mercury.

Alignment D Common Section

Existing drainage areas within Alignment D Common Section are located within MWMO and consist of the existing roadway/median west of I-94 and the roadway/median east of I-94.

There are regularly spaced catch basin structures along TH 55 that convey runoff from the roadway into a series of pipe systems including the 'old Bassett Creek Tunnel' (which is not part of impaired Bassett Creek). These systems ultimately flow into the Mississippi River, which is impaired for fecal coliform, PCB, and mercury.

TPSS

There are 27 potential TPSS locations along the proposed alignments. A description of a TPSS footprint can be found in the Project Description Technical Report. The majority of the TPSS would be located on the east side of the proposed LRT track with some being associated with the LRT platforms and stations. Potential areas where a TPSS could be located are found in the Project Description Technical Report.

Existing conditions at TPSS locations vary throughout the corridor and would likely be composed of both impervious and pervious surfaces. These locations generally fit within the existing drainage areas described above for each of the alignments.

2.4 Environmental Consequences

2.4.1 Operating Phase Impacts

No-Build Alternative

No stormwater operating phase impacts would be associated with the No-Build alternative.

Transportation System Management Alternative

A transit center and park-and-ride facility in Brooklyn Park along West Broadway Avenue near Highway 610 would be constructed as part of the TSM alternative. Rough estimates indicate impervious surface could increase by up to 60 percent on the proposed park-and-ride site. The design for this facility would include BMPs that would meet rate control, volume control, and water quality requirements.

Build Alternatives

The following discussion provides a summary of the stormwater impacts anticipated for each alignment. The project will result in an increase in the impervious area that is located within the limits of construction. A summary of the existing and proposed (overall and new) impervious surfaces is provided in Table 3.

The LRT guideway includes construction of ballasted (Image 1), embedded (Image 2), and direct fixation track on aerial structures. Throughout Alignment A, B, C, D1 and D (common section), the LRT guideway consists of ballasted track, except at grade crossings and on aerial structures. Embedded track would be provided at grade crossings and direct fixation track would be used on aerial structures. Throughout Alignment D2, the LRT guideway consists of ballasted track on 34th Avenue between the BNSF railway and France Avenue, direct fixation track on aerial structures, and embedded track on West Broadway and Penn Avenue. Coordination with the regulating WMOs and cities would be required to determine whether ballasted track is considered an impervious or pervious surface for regulatory purposes. The areas included in Table 4 assume that ballasted track was impervious in order to account for the worst-case scenario in calculating impacts at this time.

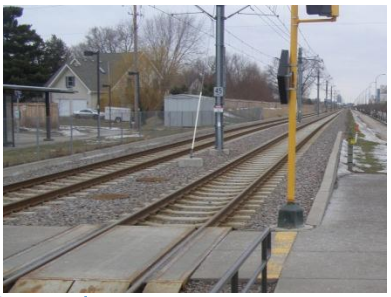


Image 1. Ballasted Track

Image 2. Embedded Track

Table 4. Existing and Proposed Impervious Areas

Location	Total Area (ac)[1]	Existing Impervious (ac)[1]	Existing Percent Impervious	Proposed Impervious Overall (ac)[1]	Proposed Impervious New (ac)[1]	Proposed Percent Impervious[2]	Percent Impervious Increase[3,4]
Shingle Creek / West Mississippi (SCWMO)							
Alignment A	56	11	20%	32	21	57%	37%
Alignment B	66	23	35%	35	12	53%	19%
Alignment C	57	11	19%	36	25	64%	45%
Alignment D2	2	0.3	14%	2	1.7	100%	86%
Bassett Creek (BCWMO)							
Alignment D1	39	10	25%	25	15	65%	40%
Alignment D2	21	13	62%	13.4	0.4	64%	2%
Middle Mississippi (MMWO)							
Alignment D2	18	14	80%	13.7	0	78%	-2%
Common Section D	21	16	80%	20	3	95%	15%

[1] Value represents the area that is located within the construction limits of the project.
[2] Value represents the percentage of impervious area that is located within the construction limits of the project.
[3] Value represents the increase of impervious area from the existing to proposed conditions.
[4] Based on detailed analysis; numbers rounded for summary purposes.

Alignment A

The proposed drainage areas within Alignment A can be described as three distinct areas: the corridor west of US 169, the corridor on Brooklyn Boulevard between US 169 and CR 81, and the freight/LRT corridor adjacent to CR 81.

The corridor west of US 169 includes the construction of a roadway with a median-running LRT guideway, two park-and-ride facilities at Hemlock Lane and Revere Lane, and an OMF facility. This analysis assumes that construction of the roadway would be done by separately and precedes LRT construction. As part of roadway construction, the sponsor of that project would be required to design and construct BMPs appropriate for both the roadway and the future LRT construction. Construction of the two park-and-ride facilities and the OMF facility would result in an increase of impervious area.

Brooklyn Boulevard would be reconstructed to provide a median-running guideway, adding approximately 30-plus feet of additional width and impervious area to the existing roadway cross section.

Reconstruction of the railway corridor would include relocating the BNSF freight rail track approximately 25 feet west of its current location and constructing two new LRT tracks within the east side of the BNSF right-of-way. The additional LRT tracks would result in an increase in impervious area.

Alignment B

One park-and-ride facility at 93rd Avenue and an OMF facility, either at 93rd Avenue or at 101st Avenue, would be constructed as part of Alignment B. These facilities would result in an increase in impervious area because they would be constructed on existing pervious areas.

Reconstruction of West Broadway between 93rd Avenue and Candlewood Drive to provide a median that would accommodate a future transit facility would be completed prior to construction of the LRT guideway. This project would be constructed by Hennepin County. The roadway project would design and construct BMPs sized to accommodate both the roadway and the future LRT guideway infrastructure.

South of Candlewood Drive, the project would reconstruct West Broadway to provide a median-running guideway, adding approximately 30-plus feet of additional width and impervious area to the existing roadway cross section.

Reconstruction of the railway corridor would include relocating the BNSF freight rail track approximately 25 feet west of its current location and constructing two new LRT tracks within the east side of the BNSF right-of-way. The additional LRT tracks would result in an increase in impervious area.

Alignment C

The existing park-and-ride facility at 63rd Avenue would be modified to provide additional on-site parking through modifications of the existing parking structure. No additional impervious area at the park and ride facility it anticipated.

Reconstruction of the railway corridor would include relocating the BNSF freight rail track approximately 25-feet west of its current location and constructing two new LRT tracks within the east side of the BNSF right-of-way. The additional LRT tracks would result in an increase in impervious area.

Alignment D1

Reconstruction of the railway corridor would include relocating the BNSF freight rail track approximately 25-feet west of its current location and constructing two new LRT tracks within the east side of the BNSF right-of-way. The additional LRT tracks would result in an increase in impervious area.

Regarding station sites, there would be no discernible difference in additional impervious area between the Golden Valley Road and Plymouth Avenue/Wirth Park station options.

Alignment D2

The existing 34th Avenue roadway between the BNSF Railway and France Avenue would be reconstructed to provide one travel lane on either side of the LRT guideway, as it transitions from the lower elevation within the BNSF right-of-way to a higher elevation at France Avenue. Retaining walls would be constructed on either side of the LRT guideway to accommodate the elevation difference between the LRT guideway (low) and roadway (high). A bridge structure over the LRT guideway would be provided at Halifax Avenue. Reconfiguration of the storm sewer utilities would be required to accommodate the new 34th Avenue roadway alignment; however, existing drainage patterns could be maintained. The reconstruction of 34th Avenue and construction of the LRT guideway would introduce new impervious area.

West Broadway would be reconstructed to provide a median-running guideway within the existing roadway cross section. A minimal amount of additional impervious area would be added to the overall roadway area. Reconfiguration of the storm sewer utilities would be required to accommodate the new West Broadway roadway alignment; however, existing drainage patterns could be maintained.

Penn Avenue would be reconstructed to provide a median-running guideway, adding additional width and impervious area to the existing roadway cross section. Reconfiguration of the storm sewer utilities would be required to accommodate the new Penn Avenue roadway alignment; however, existing drainage patterns could be maintained. The construction of the LRT guideway would introduce new impervious area.

Alignment D Common Section

The LRT guideway would be built within the existing grass median on TH 55, adding additional impervious area to the existing roadway cross section and would require reconstruction of TH 55 in some areas. Reconfiguration of the storm sewer utilities would be required to accommodate the new TH 55 roadway configuration and LRT guideway; however, existing drainage patterns could be maintained.

TPSS

There are 27 potential TPSS locations along the proposed alignments. A description of a TPSS station footprint can be found in the Project Description Report. The majority of the TPSS would be located on the east side of the proposed LRT tracks, with some associated with the LRT platforms and stations (potential TPSS locations are found in the accompanying project description memo).

The minimum clearance distance for TPSS sites and the LRT tracks is approximately eight feet; therefore, the TPSS would be located at least eight feet from the tracks. Individually, TPSS sites would generally not need to meet the various watershed requirements due to the small size of the sites (less than 10,000 square feet). As part of the overall Bottineau Transitway project, TPSS are included when considering various WMO and/or city requirements for addressing stormwater. To the extent feasible, onsite infiltration BMPs would be considered.

Summary of Impacts

Table 5. Stormwater Impacts by Alignment[3]

Alignment	Alignment/Station Impact	Park-and-Ride Impact	OMF Impact	Total Impact
	Percent Impervious Increase	Percent Impervious Increase	Percent Impervious Increase	Percent Impervious Increase[3]
Alignment A	40%	54%	25%	37%
Alignment B	3%	59%	25%[2]	19%
Alignment C	46%	24%	0%	45%
Alignment D1	40%[1]	0%	0%	40%
Alignment D2	5%	0%	0%	5%

1 There was no discernible difference in impact between the Golden Valley Road and Plymouth Avenue/Wirth Park station options.
2 Park-and-Ride Impacts are the same as the 93rd OMF impacts; therefore, they were only counted once in the total impact
3 Percent over existing; impacts represent the total area that is located within the construction limits of the project.

Table 6. Impacts By Alternative[4]

Alignment	Alignment/Station Impact	Park-and-Ride Impact	OMF Impact	Total Impact
	Percent Impervious Increase	Percent Impervious Increase	Percent Impervious Increase	Percent Impervious Increase[4]
No-Build Alternative	0%	0%	0%	0%
TSM Alternative	0%	60%[3]	0%	60%
Alternative A-C-D1	39%[1]	48%	25%	38%
Alternative A-C-D2	31%	48%	25%	29%
Alternative B-C-D1	30%[1]	53%	25%[2]	31%
Alternative B-C-D2	20%	53%	25%[2]	23%

1 There was no discernible difference in impact between the Golden Valley Road and Plymouth Avenue/Wirth Park station options.
2 Park-and-Ride Impacts are the same as the 93rd OMF impacts; therefore, they were only counted once in the total impact.
3 Percent impervious increase value to be confirmed with design development of TSM park-and-ride facility.
4 Percent over existing; impacts represent the total area that is located within the construction limits of the project.

2.4.2 Construction Phase Impacts

No-Build Alternative

No stormwater impacts are anticipated.

Transportation System Management Alternative

Construction activities would disturb soils and cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies. This could destabilize

slopes and affect water quality if temporary BMPs, required through the permitting process, are not in place prior to a storm event.

Build Alternatives

Construction activities would disturb soils and cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies. This could destabilize slopes and affect water quality if temporary BMPs, required through the permitting process, are not in place prior to a storm event.

For those areas in the project served by piped stormwater conveyance, construction activities could disturb soils and affect water quality by carrying sediment in runoff discharging to storm drains if temporary BMPs, required through the permitting process, are not in place prior to a storm event.

2.4.3 Indirect/Secondary Impacts

No-Build Alternative

No impacts are anticipated.

Transportation System Management Alternative

No impacts are anticipated.

Build Alternatives

The Bottineau Transitway Project and other related activities or induced transit-oriented development would require coordination and permitting from local, state, and federal water resource agencies. It is assumed that proposed construction activities would comply with applicable state, federal, and local regulations, and that BMPs to control and minimize erosion and potential impacts to surface water resources would be installed prior to construction and be properly maintained during construction. Operation of the transitway would not result in any further impacts to these resources; therefore, no indirect or secondary impacts are anticipated to water resources as a result of this project.

No indirect/secondary impacts are anticipated as a result of the TPSS sites.

2.5 Avoidance, Minimization, and/or Mitigation Measures

An NPDES Construction Stormwater Permit from the MPCA would be required because the Project will disturb one acre or more of land. Other Minnesota agencies requiring permits might include watershed districts, municipalities, and soil and water conservation districts. The NPDES permit requires that a Stormwater Pollution Prevention Plan (SWPPP) be developed and implemented during construction.

Short-term mitigation measures would include the development of erosion and sediment control plans to control runoff and reduce erosion and sedimentation during construction, limiting the amount of sediment carried into lakes, streams, and rivers by stormwater runoff. These plans, in combination with the SWPPP, would identify how to control runoff, stabilize slopes and exposed soils, and limit the movement of soils into drainage systems and natural areas. Construction activities would be phased in or to disturb a minimal amount of area as possible at any one time.

Long-term mitigation measures would include the design and construction of permanent BMPs, such as detention and infiltration facilities, which would control and treat stormwater runoff caused by an increase in impervious surfaces as a result of the Project. Due to the linear nature of the project, BMPs that are compatible with linear corridors would be used to the extent possible without the need to purchase additional right of way. The following provides a summary of the BMPs that could be considered to meet the appropriate rate control, volume control and water quality requirements.

Stormwater treatment ponds provide rate control and water quality treatment. General pond locations for each alignment are discussed below and in Table 7. Ponds should be sited near low points or adjacent to outfalls that are located within the proposed right-of-way. Opportunities to collaborate with corridor cities on combined stormwater management may also be considered as the selected alternative is developed and specific mitigation needs are refined.

Infiltration or filtration BMPs are used to provide volume control and water quality treatment. Areas that have soil categorized into soil groups A or B may be suitable for infiltration BMPs at some locations; see Appendix A for hydrologic soil information. Based on the "National Cooperative Soil Survey" from the Natural Resources Conservation Service, a large portion of the corridor contains soils that are categorized into soil groups A and B. Infiltration basins and infiltration trenches that are integrated into the guideway and sidewalk areas in urban areas would be considered in preliminary and final design. In areas where infiltration is not feasible (contaminated soils or low soil porosity), filtration BMPs would be considered instead of infiltration.

- Filtration BMPs can be utilized in locations where poorly draining soils or proximity to groundwater precludes the use of infiltration BMPs. They can also be used at treatment pond locations, by using the 10-foot bench above the normal water level as a filtration bench. This would allow a certain volume of water in the pond to filtrate through engineered soil and be collected in a drain tile that would flow to the pond outfall. Soil borings should be taken during preliminary and final design to determine where infiltration or filtration BMPs are appropriate.

- Outside ditches along the proposed railway corridor can be used for infiltration/filtration of stormwater. Ditch blocks would be installed along the east side of the railway corridor to provide storage capacity.

Table 7 includes a summary of the BMPs that could be utilized to meet the stormwater requirements for each alignment. To the extent feasible, additional BMPs would be considered during preliminary engineering and final design. See Figure 3 for potential pond locations at park-and-ride facilities.

Table 7. Proposed BMPs

Alignment	Section	Proposed BMPs
Alignment A	Roadway Section West of US 169	BMPs for the roadway and LRT guideway would be constructed as part of the roadway project.
Alignment A	Hemlock Lane P&R	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment A	Revere Lane P&R	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment A	OMF Facility	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment A	Brooklyn Blvd	Utilize existing Brooklyn Blvd BMPs to the extent feasible and construct additional BMPs to meet rate control, volume control, and water quality requirements
Alignment A	Freight Rail Corridor	Construct infiltration areas within adjacent ditches

Alignment	Section	Proposed BMPs
Alignment B	93rd / 101st Avenue OMF Facility	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment B	93rd Avenue P&R	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment B	Roadway Section between 93rd Avenue and Candlewood Drive	BMPs for the roadway and LRT guideway would be constructed as part of the roadway project.
Alignment B	Roadway Section south of Candlewood Drive	Utilize existing West Broadway BMPs to the extent feasible and construct additional BMPs to meet rate control, volume control, and water quality requirements
Alignment B	Freight Rail Corridor	Construct infiltration areas within adjacent ditches
Alignment C	63rd Avenue P&R	No additional BMPs anticipated
Alignment C	Robbinsdale P&R	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment C	Freight Rail Corridor	Construct infiltration areas within adjacent ditches; avoid existing well areas near the Robbinsdale station.
Alignment D1[1]	Freight Rail Corridor	Construct infiltration areas within adjacent ditches
Alignment D2[2]	34th Avenue	Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements, consistent with the Crystal Lake TMDL plan
Alignment D2[2]	West Broadway	No additional BMPs anticipated for this portion of the corridor
Alignment D2[2]	Penn Avenue	Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
Alignment D[2]	TH 55	Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements

1 Regarding station sites, there would be no discernible difference in stormwater impact between the Golden Valley Road and Plymouth Avenue/Wirth Park station options.

2 Due to the right-of-way constraints, infiltration trenches within the LRT guideway and adjacent sidewalk areas would be considered to provide additional infiltration capacity.

3.0 Summary

Table S-1. Summary of Impacts and Mitigation Measures

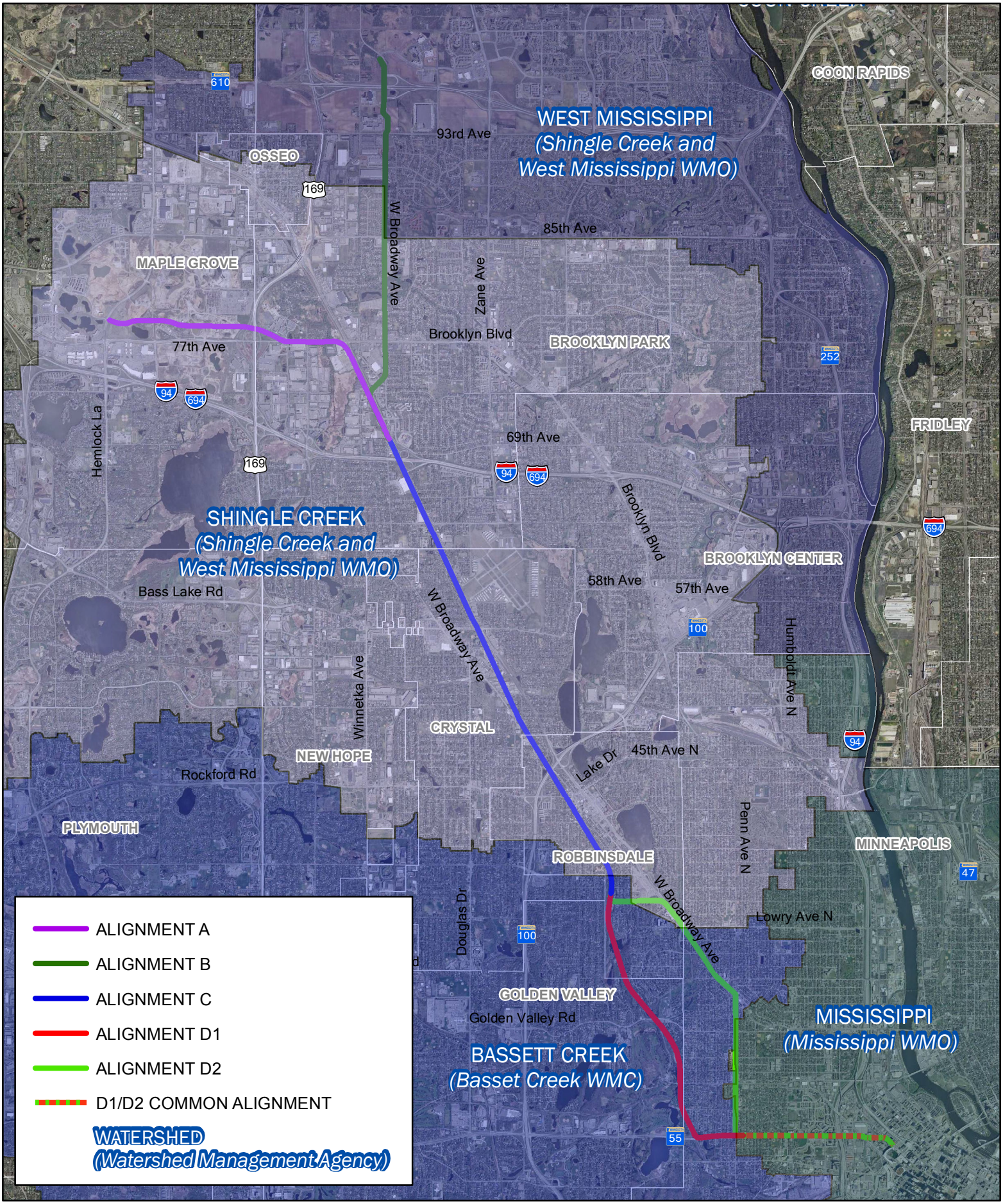
Impact Category	Impacts of Build Alternatives[1]	Avoidance, Minimization, and/or Mitigation Measures
Stormwater	The LRT guideway and associated improvements would result in additional impervious area for each of the alternatives. The increased percentage amounts of impervious area[2] for each alternative is estimated as follows: A-C-D1: 38 percent increase in impervious area A-C-D2: 29 percent increase in impervious area B-C-D1: 31 percent increase in impervious area B-C-D2: 23 percent increase in impervious area	Stormwater best management practices (BMPs), such as detention and infiltration facilities, would be incorporated into the design to the extent feasible within the right-of-way identified for the project. These areas would consist of existing railroad and public right-of-way as well as property that is procured as part of this project.

[1]The summary focuses on Build alternatives. There are no/negligible impacts associated with the No-Build and TSM Alternatives.
[2]The area identified represents the impervious area that is located within the proposed construction limits.

Table S-2. Summary of Construction Impacts and Mitigation Measures

Impact Category	Construction Impacts of Build Alternatives	Avoidance, Minimization, and/or Mitigation Measures
Stormwater	Construction activities would disturb soils and cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies if temporary BMPs are not in place prior to a storm event.	A Storm Water Pollution Prevention Plan (SWPPP) as well as erosion and sedimentation control plans would be developed as part of the project. These would require the contractor to implement erosion prevention and sediment control practices. Such practices may be used to stabilize slopes and drainage ways, protect inlets to stormwater conveyance systems, limit gully formation, and capture sediment.

FIGURES



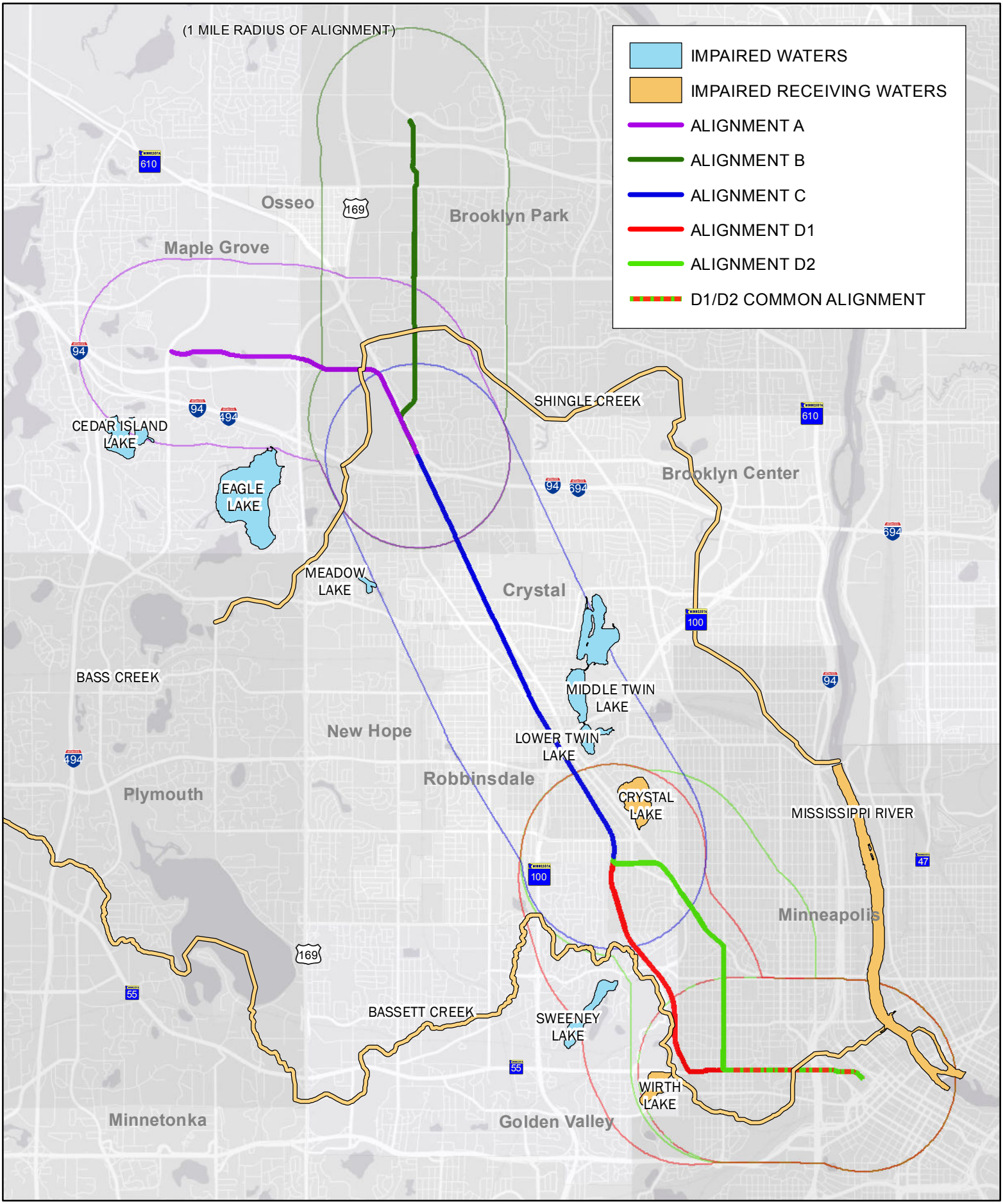
0 0.5 1 Miles

Bottineau Transitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Sources:
Aerial: Minnesota Geospatial Information Office, 2010
Watershed: MN DNR Data Deli, 2003

Hennepin County
Regional Railroad Authority
Metropolitan Council

FIGURE 1. BOTTINEAU CORRIDOR: WATERSHED DISTRICTS



0 0.5 1 Miles

Bottineau Transitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

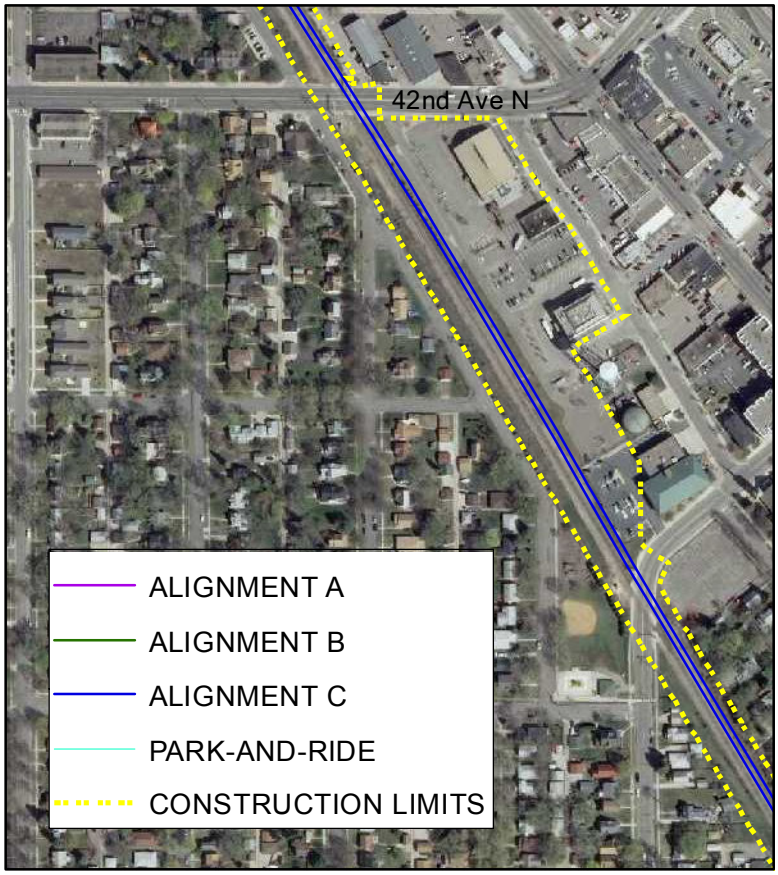
Sources:
Aerial: Minnesota Geospatial Information Office, 2010
Impaired Waters: Minnesota Pollution Control Agency, 2012

Hennepin County
Regional Railroad Authority
Metropolitan Council

FIGURE 2. BOTTINEAU CORRIDOR: IMPAIRED WATERS

ALIGNMENT A- Revere Lane Station

ALIGNMENT A- Hemlock Lane Station



ALIGNMENT C- Robbinsdale Station

ALIGNMENT B- 93rd Avenue Station

ALIGNMENT C- 63rd Avenue Station

0 0.05 0.1 Miles

Bottineau Transitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Sources:
Aerial: Minnesota Geospatial Information Office, 2010

Hennepin County
Regional Railroad Authority

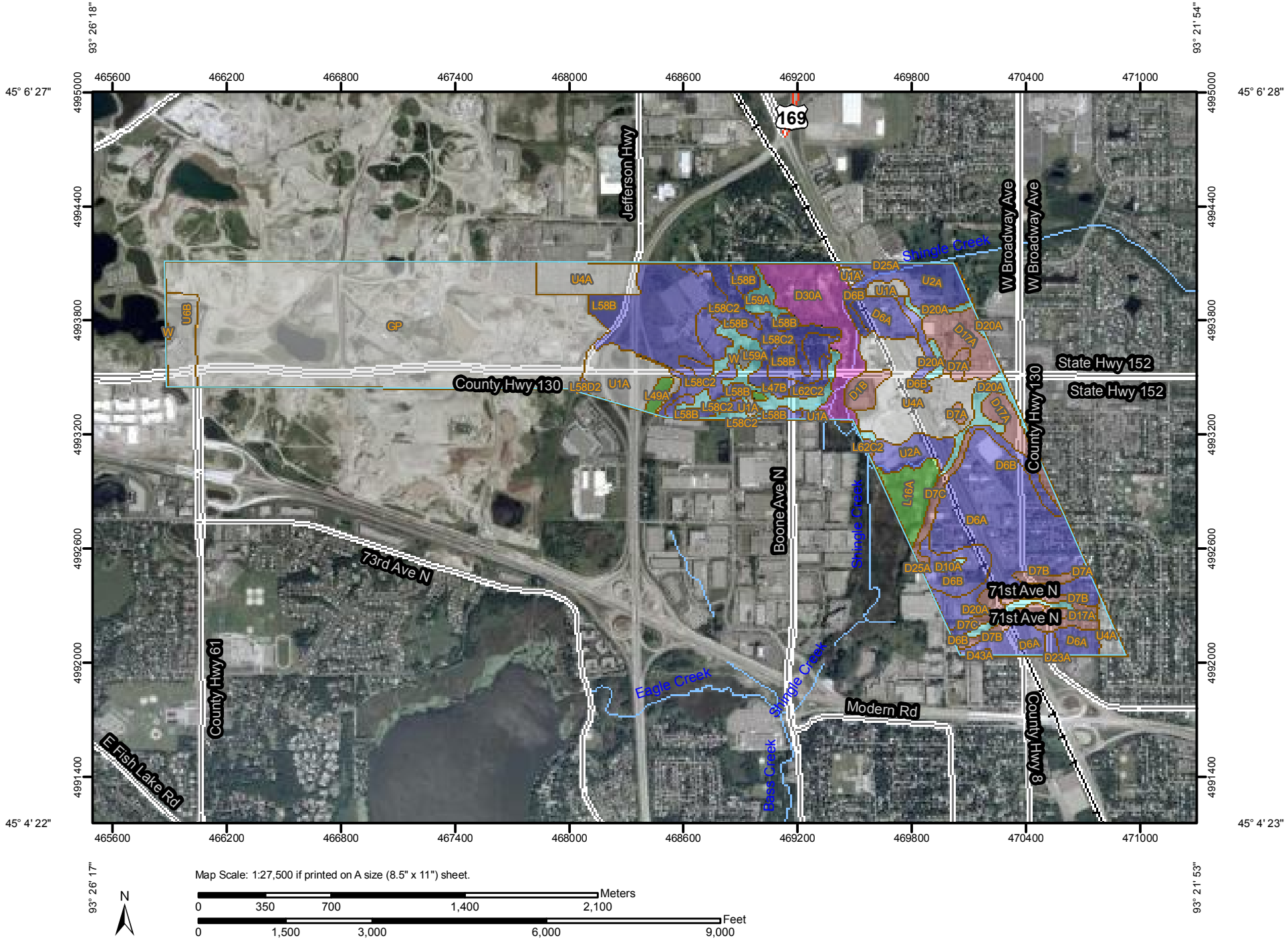
Metropolitan Council

FIGURE 3. ALIGNMENT A, B, & C: PARK-AND-RIDE LOCATIONS

APPENDIX A

HYDROLOGIC SOIL GROUPS

Hydrologic Soil Group—Hennepin County, Minnesota
(Alignment A)



Map Scale: 1:27,500 if printed on A size (8.5" x 11") sheet.

N

Meters
0 350 700 1,400 2,100

Feet
0 1,500 3,000 6,000 9,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:27,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 15N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hennepin County, Minnesota
Survey Area Data: Version 7, Aug 2, 2010

Date(s) aerial images were photographed: 7/18/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
D1B	Anoka and Zimmerman soils, terrace, 2 to 6 percent slopes	A	8.0	0.8%
D6A	Verndale sandy loam, acid substratum, 0 to 2 percent slopes	B	143.8	13.6%
D6B	Verndale sandy loam, acid substratum, 2 to 6 percent slopes	B	35.1	3.3%
D7A	Hubbard loamy sand, 0 to 2 percent slopes	A	5.1	0.5%
D7B	Hubbard loamy sand, 2 to 6 percent slopes	A	19.9	1.9%
D7C	Hubbard loamy sand, 6 to 12 percent slopes	A	12.7	1.2%
D10A	Forada sandy loam, 0 to 2 percent slopes	B/D	1.6	0.2%
D17A	Duelm loamy sand, 0 to 2 percent slopes	A	37.3	3.5%
D20A	Isan sandy loam, 0 to 2 percent slopes	B/D	25.0	2.4%
D23A	Southhaven loam, 0 to 2 percent slopes	B	2.0	0.2%
D25A	Soderville loamy fine sand, terrace, 0 to 3 percent slopes	A	0.6	0.1%
D30A	Seelyeville and Markey soils, depressional, 0 to 1 percent slopes	D	45.3	4.3%
D43A	Gonvick loam, terrace, 1 to 3 percent slopes	B	0.7	0.1%
GP	Pits, gravel-Udipsamments complex		334.7	31.7%
L2B	Malardi-Hawick complex, 1 to 6 percent slopes	B	0.5	0.0%
L16A	Muskego, Blue Earth, and Houghton soils, ponded, 0 to 1 percent slopes	A/D	18.4	1.7%
L47B	Eden Prairie sandy loam, 2 to 6 percent slopes	B	2.8	0.3%
L49A	Klossner soils, depressional, 0 to 1 percent slopes	A/D	4.2	0.4%
L58B	Koronis-Kingsley complex, 2 to 6 percent slopes	B	93.1	8.8%
L58C2	Koronis-Kingsley complex, 6 to 12 percent slopes, eroded	B	46.9	4.4%
L58D2	Koronis-Kingsley complex, 12 to 18 percent slopes, eroded	B	0.8	0.1%
L59A	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes	B/D	35.7	3.4%
L62C2	Koronis-Kingsley-Malardi complex, 6 to 12 percent slopes, eroded	B	5.0	0.5%
U1A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes		35.4	3.3%

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
U2A	Udorthents, wet substratum, 0 to 2 percent slopes	B	38.8	3.7%
U4A	Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes		83.0	7.9%
U6B	Urban land-Udorthents (cut and fill land) complex, 0 to 6 percent slopes		18.7	1.8%
W	Water		1.8	0.2%
Totals for Area of Interest			**1,057.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

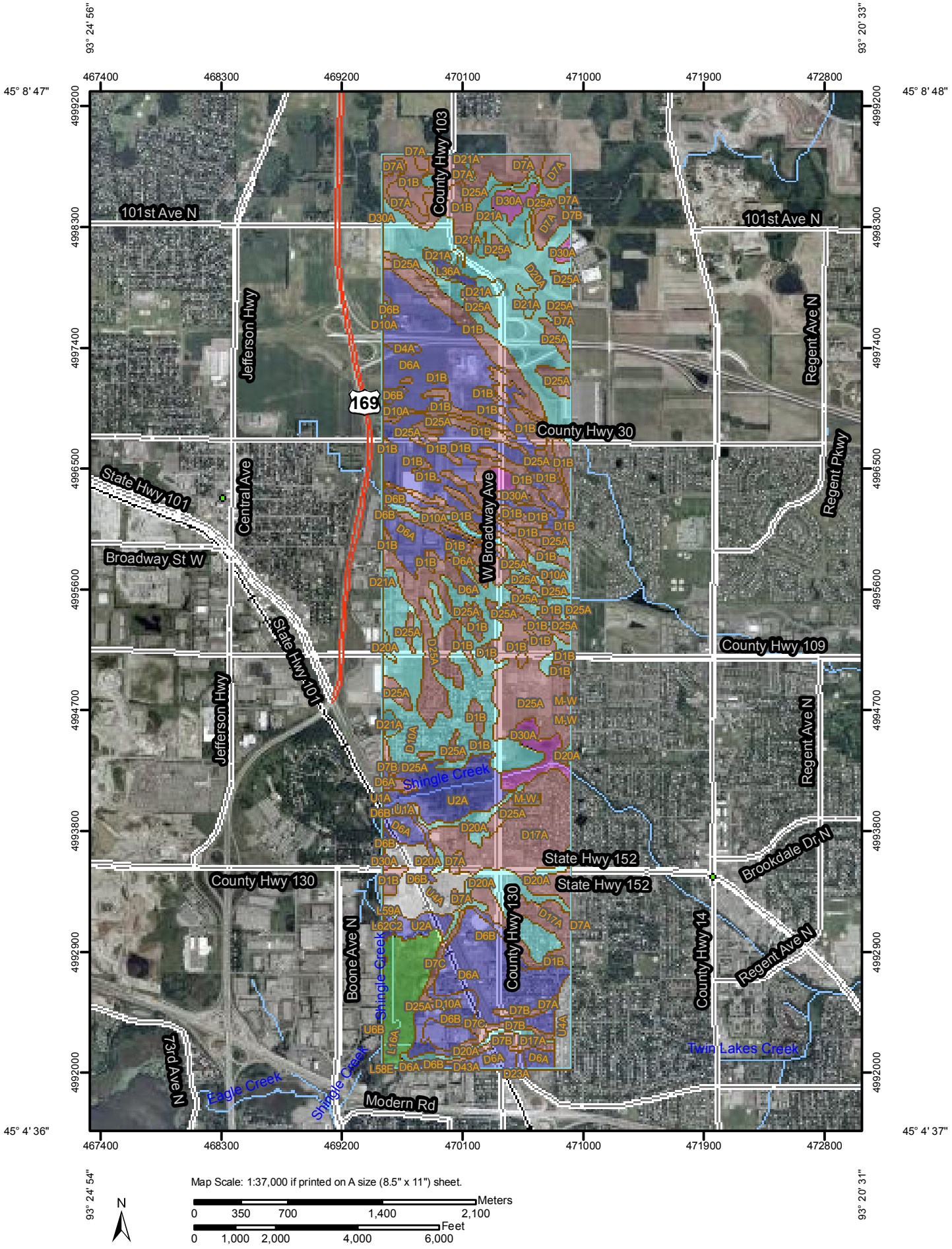
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Hennepin County, Minnesota
(Alignment B)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:37,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

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Coordinate System: UTM Zone 15N NAD83

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Date(s) aerial images were photographed: 7/18/2003; 8/7/2003

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
D1B	Anoka and Zimmerman soils, terrace, 2 to 6 percent slopes	A	271.3	11.4%
D4A	Dorset sandy loam, 0 to 2 percent slopes	B	3.3	0.1%
D6A	Verndale sandy loam, acid substratum, 0 to 2 percent slopes	B	474.9	20.0%
D6B	Verndale sandy loam, acid substratum, 2 to 6 percent slopes	B	56.1	2.4%
D7A	Hubbard loamy sand, 0 to 2 percent slopes	A	62.8	2.6%
D7B	Hubbard loamy sand, 2 to 6 percent slopes	A	25.6	1.1%
D7C	Hubbard loamy sand, 6 to 12 percent slopes	A	13.5	0.6%
D10A	Forada sandy loam, 0 to 2 percent slopes	B/D	264.4	11.1%
D17A	Duelm loamy sand, 0 to 2 percent slopes	A	172.5	7.3%
D20A	Isan sandy loam, 0 to 2 percent slopes	B/D	307.0	12.9%
D21A	Isan sandy loam, depressional, 0 to 1 percent slopes	B/D	53.1	2.2%
D23A	Southhaven loam, 0 to 2 percent slopes	B	2.0	0.1%
D25A	Soderville loamy fine sand, terrace, 0 to 3 percent slopes	A	360.2	15.2%
D30A	Seelyeville and Markey soils, depressional, 0 to 1 percent slopes	D	56.6	2.4%
D43A	Gonvick loam, terrace, 1 to 3 percent slopes	B	0.7	0.0%
L16A	Muskego, Blue Earth, and Houghton soils, ponded, 0 to 1 percent slopes	A/D	70.3	3.0%
L36A	Hamel, overwash-Hamel complex, 1 to 4 percent slopes	B	7.3	0.3%
L58E	Koronis-Kingsley complex, 18 to 25 percent slopes	B	0.0	0.0%
L59A	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes	B/D	1.5	0.1%
L62C2	Koronis-Kingsley-Malardi complex, 6 to 12 percent slopes, eroded	B	4.2	0.2%
M-W	Water, miscellaneous		3.3	0.1%
U1A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes		4.7	0.2%
U2A	Udorthents, wet substratum, 0 to 2 percent slopes	B	86.5	3.6%
U4A	Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes		75.0	3.2%

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
U6B	Urban land-Udorthents (cut and fill land) complex, 0 to 6 percent slopes		0.2	0.0%
Totals for Area of Interest			**2,376.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

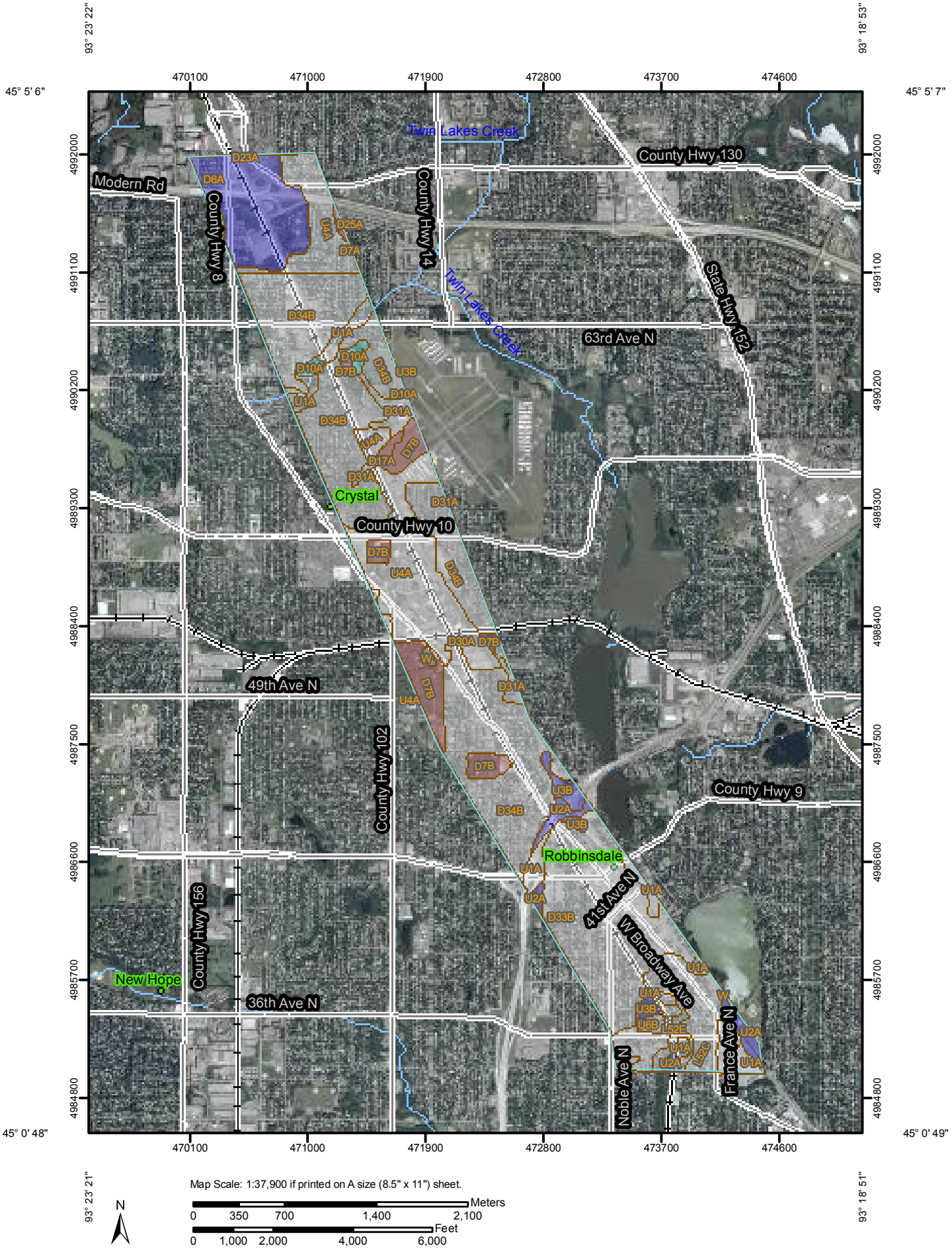
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Hennepin County, Minnesota
(Alignment C)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:37,900 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 15N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hennepin County, Minnesota
Survey Area Data: Version 7, Aug 2, 2010

Date(s) aerial images were photographed: 7/18/2003; 8/7/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
D6A	Verndale sandy loam, acid substratum, 0 to 2 percent slopes	B	135.8	8.5%
D7A	Hubbard loamy sand, 0 to 2 percent slopes	A	0.6	0.0%
D7B	Hubbard loamy sand, 2 to 6 percent slopes	A	81.1	5.1%
D10A	Forada sandy loam, 0 to 2 percent slopes	B/D	11.2	0.7%
D17A	Duelm loamy sand, 0 to 2 percent slopes	A	4.5	0.3%
D23A	Southhaven loam, 0 to 2 percent slopes	B	0.1	0.0%
D25A	Soderville loamy fine sand, terrace, 0 to 3 percent slopes	A	2.9	0.2%
D30A	Seelyeville and Markey soils, depressional, 0 to 1 percent slopes	D	1.4	0.1%
D31A	Urban land-Duelm complex, 0 to 2 percent slopes		28.2	1.8%
D33B	Urban land-Dorset complex, 0 to 8 percent slopes		252.1	15.8%
D34B	Urban land-Hubbard complex, 0 to 8 percent slopes		573.3	36.0%
L52C	Urban land-Lester complex, 2 to 18 percent slopes		95.1	6.0%
L52E	Urban land-Lester complex, 18 to 35 percent slopes		15.7	1.0%
L54A	Urban land-Dundas complex, 0 to 3 percent slopes		2.9	0.2%
U1A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes		57.4	3.6%
U2A	Udorthents, wet substratum, 0 to 2 percent slopes	B	31.6	2.0%
U3B	Udorthents (cut and fill land), 0 to 6 percent slopes	B	21.5	1.4%
U4A	Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes		254.4	16.0%
U6B	Urban land-Udorthents (cut and fill land) complex, 0 to 6 percent slopes		18.4	1.2%
W	Water		2.7	0.2%
Totals for Area of Interest			**1,591.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

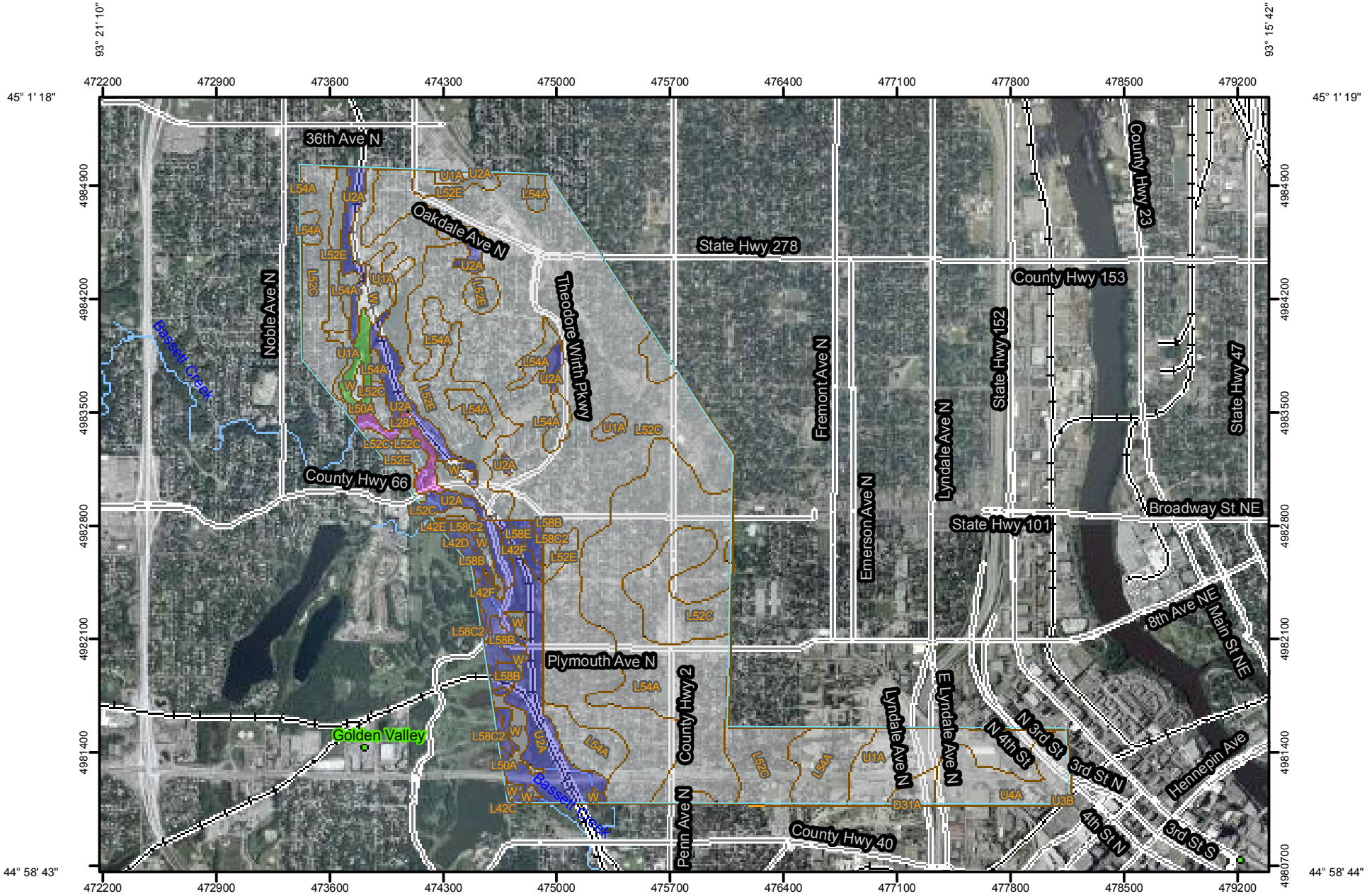
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Hennepin County, Minnesota
(Alignment D Options)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:34,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 15N NAD83

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Soil Survey Area: Hennepin County, Minnesota
Survey Area Data: Version 7, Aug 2, 2010

Date(s) aerial images were photographed: 7/18/2003; 8/7/2003

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Hennepin County, Minnesota (MN053)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
D31A	Urban land-Duelm complex, 0 to 2 percent slopes		10.8	0.5%
L28A	Suckercreek fine sandy loam, 0 to 2 percent slopes, occasionally flooded	D	16.9	0.9%
L42C	Kingsley-Gotham complex, 6 to 12 percent slopes	B	0.5	0.0%
L42D	Kingsley-Gotham complex, 12 to 18 percent slopes	B	3.9	0.2%
L42E	Kingsley-Gotham complex, 18 to 25 percent slopes	B	2.0	0.1%
L42F	Kingsley-Gotham complex, 25 to 35 percent slopes	B	14.7	0.7%
L50A	Houghton and Muskego soils, depressional, 0 to 1 percent slopes	A/D	16.9	0.9%
L52C	Urban land-Lester complex, 2 to 18 percent slopes		875.6	44.4%
L52E	Urban land-Lester complex, 18 to 35 percent slopes		189.6	9.6%
L54A	Urban land-Dundas complex, 0 to 3 percent slopes		423.1	21.5%
L58B	Koronis-Kingsley complex, 2 to 6 percent slopes	B	17.5	0.9%
L58C2	Koronis-Kingsley complex, 6 to 12 percent slopes, eroded	B	13.0	0.7%
L58E	Koronis-Kingsley complex, 18 to 25 percent slopes	B	7.5	0.4%
U1A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes		104.7	5.3%
U2A	Udorthents, wet substratum, 0 to 2 percent slopes	B	168.9	8.6%
U3B	Udorthents (cut and fill land), 0 to 6 percent slopes	B	1.4	0.1%
U4A	Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes		60.7	3.1%
W	Water		43.8	2.2%
Totals for Area of Interest			**1,971.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher