ENGINEERING REPORT

2025 STREET REHABILITATION PROJECT

October 21, 2024

Prepared for:

City of Lakeville

20195 Holyoke Avenue

Lakeville, MN 55044

CITY PROJECT NO. 25-02

WSB PROJECT NO. 026423-000

October 21, 2024

Honorable Mayor and City Council
City of Lakeville
20195 Holyoke Avenue
Lakeville, MN 55044

Re: C.P. 25-02
WSB Project No. 026423-000

Dear Honorable Mayor and City Council Members:

Transmitted herewith for your review is an Engineering Report which addresses improvements associated with the 2025 Street Rehabilitation Project. This Engineering Report describes the necessary improvements and associated costs for this street improvement project.

I am available at your convenience to discuss this report. Please do not hesitate to contact me at 612.523.7374 if you have any questions regarding this report.

Sincerely,

WSB

Jeff Oliver, PE
Senior Project Manager

Attachments

178 E 9TH STREET | SUITE 200 | SAINT PAUL, MN | 55101 | 651.286.8450 | WSBENG.COM

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Opinion of Probable Cost

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Draft Geotechnical Report, Braun Intertec

Certification Sheet

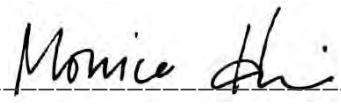
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed professional engineer under the laws of the State of Minnesota.

Rachel Scheu, PE

Date: October 21, 2024 Lic. No. 63257

Quality Control Review Completed By:

Monica Heil, PE



Date: October 21, 2024 Lic. No. 47497

Executive Summary

The 2025 Street Rehabilitation Project, City Project No. 25-02, was initiated based on the City's Pavement Management Program and is separated into two parts based on the proposed improvements. The 2025 Street Reconstruction portion will require reclaiming and paving while the 2025 Street Rehabilitation Project will require milling and overlaying. The streets proposed for improvements have deteriorated to a point where reclaiming and paving rehabilitation work is needed. Streets proposed for improvements in 2025 include roadways within the following subdivisions totaling approximately 2.2 miles:

Shady Oak Shores 7th Addition, Cherry Highlands 3rd Addition,Crossroads 1st Addition, Crossroads 2nd Addition, Crossroads 3rd Addition, Crossroads 5th Addition, Crossroads 6th Addition, Crossroads 7th Addition, and Crossroads 8th Addition.

- Glacier Way (175th Street West to 179th Street West)
- 175th Street West (Glasgow Avenue to Glacier Way)
- Glasgow Avenue (Dodd Boulevard to Glacier Way)
- 177th Street West (Glacier Way to Glasgow Way)
- Glasgow Way (Glacier Way to Glacier Way)
- 178th Street West (Glacier Way to Glasgow Way)

The project location map for Milled Streets is included in ***Figure 1*** of ***Appendix A*** of this report.

The 2025 Street Rehabilitation Project includes roadway mill and overlay based on pavement ratings, current roadway conditions, and utility needs in the area, as well as the overall Capital Improvement Plan budget. Surface improvements recommended for all streets within the project include milling or reclamation of the existing bituminous pavement, including full depth milling where necessary based on the geotechnical report, subgrade correction as necessary, replacement of structurally deficient or improperly draining concrete curb and gutter, sidewalks, and trails, ADA compliant pedestrian ramp installation, and new pavement installation.

Replacing portions of the City's deteriorating utility infrastructure in conjunction with the proposed street improvements provides an opportunity to minimize the replacement costs and traffic disruptions associated with the work. Proposed utility improvements include the following:

- Installation of corrosion protection for the existing watermain throughout a majority of the project area.
- Repair or replacement of structurally deficient storm sewer manholes and installation of stormwater quality best management practices (BMPs).
- Installation of additional storm sewer drainage structures and storm sewer, including drain tile in areas with poorly draining soils (drain tile services to individual properties will be evaluated in final design).

- Replacement of all structurally deficient storm sewer and sanitary sewer manhole castings, concrete adjusting rings, and installing inflow and infiltration (I&I protection) per current City Standards.

The total estimated project cost for the City of Lakeville's 2025 Street Rehabilitation Project is $2,086,089 which includes a 8% contingency and 25% indirect costs for legal, engineering, administrative, and financing costs. The project is proposed to be funded through various City funds and through special assessments to benefitting property owners in accordance with the City's current assessment policy.

Introduction

Authorization

On August 5, 2024, the Lakeville City Council authorized the preparation of an engineering report for the 2025 Street Rehabilitation Project. This project is included in the City's 2024-2028 Capital Improvement Plan (CIP) and is designated as City Project No. 25-02.

Scope

This report investigates the feasibility of proposed street and utility improvements identified by the City Pavement Management Program (PMP) and CIP for 2025. Streets proposed within the 2025 Street Rehabilitation Project were initially considered because of existing pavement conditions. The average Overall Condition Index (OCI) value for streets within the 2025 Street Rehabilitation Project area is 57.1 using an OCI scale of 0 to 100 (with zero representing a completely failed street section and 100 representing a new street section free of deficiencies). Streets with OCI values less than 40 are considered to be in failing condition. Streets with OCI values of 40 – 60 are considered to be in weakened condition and will deteriorate more quickly based on a typical pavement performance curve.

Improvements outlined within this report include street rehabilitation in the form of reclamation, including partial replacement of concrete curb and gutter and concrete sidewalk, replacement of bituminous trail, installing ADA compliant pedestrian ramps, installation of corrosion protection on select watermain facilities and watermain replacement or repairs, sanitary sewer repairs, and storm sewer improvements.

Data Available

Information and materials used in the preparation of this report include the following:

- City of Lakeville Record Plans
- City of Lakeville Sanitary Sewer, Watermain, and Storm Sewer inspection documentation
- City of Lakeville Water and Natural Resources Management Plan, Barr Engineering, dated January 2019
- Dakota County Topography Maps
- Topographic Survey
- Field Observations of the Area and Discussions with City Staff
- Draft Geotechnical Evaluation Report, Braun Intertec, dated October 10, 2024

Existing Conditions

Surface

Streets within the proposed improvement area are aging and experiencing differing severities of distress, including alligator, transverse, and longitudinal cracking. All streets within the project area are urbanized, with existing concrete curb and gutter. All of the curb and gutter is either full height curb or surmountable. The curb and gutter is in overall fair condition, with isolated instances of cracking, heaving, and settlements resulting in localized drainage issues.

Majority of the streets within the 2025 Street Rehabilitation Project Area are designated as local residential, while Glacier Way is designated as a minor collector.

The project area contains landscaping, trees, irrigation systems, and numerous other private improvements beyond the edge of the roadway and within City right-of-way.

The photos below illustrate some of the varying levels of pavement distress:

Photo 1. Glacier Way west towards 175th Street West.

Photo 2. Glasgow Way looking west towards Glacier Way.

Photo 3. 175th Street West looking southwest towards Glasgow Avenue.

Concrete sidewalks and bituminous trails exist throughout the project area, including connection points with Dodd Boulevard, Cedar Avenue, and 175th Street West.

The concrete sidewalks and bituminous trails are generally in good condition; however, many of the existing pedestrian ramps do not meet the current Americans with Disabilities Act (ADA) design standards, and there are isolated instances where concrete sidewalk panels have heaved, settled, or are otherwise structurally deficient.

Soil borings and corings for streets within the 2025 project area were collected in September of 2024. Ground penetrating radar (GPR) was employed in both directions on each street to collect interpretations on pavement layer thickness between boring and coring locations. The draft geotechnical report is included in ***Appendix C***, and the draft boring and coring logs were used to determine the feasibility of a mill and overlay or full depth reclamation. The final geotechnical report will be available with final design. The quantities included in the Opinion of Probable Cost, ***Appendix B,*** are based on the draft geotechnical report. ***Table 1*** Below provides a summary of existing street conditions within the 2025 Street Reconstruction Project.

Table 1- 2025 Street Rehabilitation Project

Summary of Existing Street Conditions

Street Name	Right-of-Way (feet)	Street Width (feet)	Curb Type	Sub-base (aggregate)[1] (inches)	Avg. Bituminous Section [1] (inches)	OCI	Approx. Year of Most Recent Construction
Glacier Way	80	40	B618 Curb & Gutter	7.6	* 4.3	54.6	2003
175th Street West	80	40	B618 Curb & Gutter	6.0	4.4	55.0	2003
Glasgow Avenue	80	40	B618 Curb & Gutter	13.2	4.3	55.0	2003
177th Street West	115	28	Standard Surmountable	11.5	* 3.6	65.0	2003
Glasgow Way	115	28	Standard Surmountable	7.5	3.8	60.0	2004
178th Street West	115	28	Standard Surmountable	16.5	* 3.5	60.0	2004

1. Information transcribed from coring data in Geotechnical Evaluation Report, Braun Intertec Corporation, dated October 10, 2024. Ground Penetrating Radar (GPR) interpolations are contained wtihin the report.

   * Indicates rehydrated concrete under bituminous sections as noted in the Geotechnical Report.

Public Utilities

Public Sanitary Sewer

All of the existing sanitary sewer located within the 2025 Street Rehabilitation Project Area consists of 8-inch polyvinylchloride pipe (PVC).

Public Water Main

All of the existing watermain located in the 2025 Street Rehabilitation Project Area is ductile iron pipe (DIP). The diameter of watermain pipes varies throughout the project area. Below is a list of watermain pipe size by street:

8-inch Watermain

- Glasgow Way
- 177th Street West
- 178th Street West

12-inch Watermain

- Glasgow Avenue
- 175th Street West
- Glacier Way (179th Street West to 175th Street West)

20-inch Watermain

- Glacier Way (175th Street West to 175th Street West)

City maintenance records indicate a sporadic and limited watermain break history throughout the 2025 Street Rehabilitation Project area that have required typical maintenance efforts.

Public Storm Sewer

City record drawing information indicates that public storm sewer facilities exist within the 2025 Street Rehabilitation Project Area. All areas within the project area are urban section with curb and gutter and storm sewer.

All runoff is discharged into the Vermillion River Watershed and is subject to review by the Vermillion River Watershed Joint Powers Organization (VRWJPO).

Most of the storm sewer facilities within the 2025 Street Reconstruction Project are constructed of reinforced concrete pipe (RCP) and appear to provide the necessary collection and conveyance capacity for the 10-year 24-hour design storm event. However, some segments do not allow for proper conveyance, but the headwater remains below the structure rim elevations in the 10-year 24 hour event. These locations are shown in the stormwater capacity analyis figures in ***Appendix A***.

All storm sewer structures have been inspected by City Public Works staff and repair recommendations have been incorporated into the Opinion of Probable Cost.

Proposed Improvements

Surface

Due to cost increases in recent years and the available funding for this project, several of the street originally included in this project have been removed from consideration. These streets will be moved back into the CIP for consideration in future years.

Surface improvements recommended with the 2025 Street Rehabilitation Project Area are intended to extend the life of the existing roadway systems, improve isolated drainage issues, and improve the ride quality of roadways.

Surface improvements include the variable depth pavement milling. Milling is the process by which the existing wear course of the road is ground off and hauled off site and. A new pavement layer is installed over the exposed underlying pavement layer. Street grades are typically not changed with a mill and overlay, however, the roadway crown will be restored where necessary. A significant portion of the existing curb and gutter within the project is in structurally adequate condition, so only partial curb and gutter replacement is proposed as a part of the project.

The local residential and minor collector streets within the project area will be milled and overlaid in accordance with the recommendations provided in the geotechnical report. ***Appendix A*** illustrates the proposed residential and minor collector roadway sections, which in general, consist of a new pavement layer of varying thickness over the existing bituminous road section. Certain areas have been identified by the Geotechnical Report as potentially needing a full depth mill and overlay or edge mill and overlay to remove the poor-quality pavement near the edges. These areas are limited to Glacier Way, Glasgow Avenue, Glasgow Way, 175th Street West, 177th Street West, and 178th Street West.

As part of the Street Rehabilitation Project, all City owned and maintained pedestrian curb ramps with the project area that do not meet current ADA accessibility design standards will be reconstructed. Additionally, spot replacement of structurally deficient concrete sidewalk and bituminous pathways is proposed.

Public Utilities

Public Sanitary Sewer

The City's Public Works Department has televised the sanitary sewer system. The sanitary sewer video inspection revealed that the existing sewer pipe is in relatively good condition and will not require full replacement.

Sanitary sewer manholes within the project are identified as needing new adjustment rings and/or castings will be repaired as a part of this project. Some existing structures have been identified as not having enough adjustment rings and will require reconfiguration. Additionally, all sanitary

sewer manholes within the street reconstruction area will receive external chimney seals as a part of the project to reduce the potential for inflow and infiltration issues and reduce the frequency of maintenance requests.

Public Water Main

It is proposed that in conjunction with the street improvements, the service life of the existing watermain systems be extended by replacing all bolts at select existing hydrants and watermain valves with stainless steel bolts, which are more resistant to the corrosive nature of the underlying soils.

The City's maintenance records show dispersed and limited watermain breaks and maintenance issues and therefor no watermain replacement is proposed with the 2025 Street Rehabilitation Project.

Storm Sewer

Rehabilitaion of the streets provides a timely opportunity to improve drainage conditions and increase the longevity of the streets within the project area by repairing existing and installing additional storm sewer facilities. City staff completed an inspection of the storm sewer system in the fall of 2024 and provided recommendations for repairs and replacement including castings, adjustment rings, and structure replacement, as well as replacement of failing or deteriorating reinforced concrete pipe (RCP). Structures identified as needing rehabilitation will undergo necessary interior concrete/grout invert and doghouse replacement. Those structures identified as having existing sumps, but are not the last accessible structure in the street, will have their sumps filled with grout.

Sections of storm sewer that have been identified in ***Appendix A*** as not meeting capacity are proposed to be upsized to increase capacity to keep the headwater below the upstream structure rim elevation. Additional catch basins are also proposed at the locations identified in the capacity figures in order to increase the inlet capacity and reduce localized flooding. Costs for this work are included in the Opinion of Probable Cost. Any new storm sewer that is upsized or structure replaced due to upsizing of pipes or if the structure needs to be upsized itself, shall be funded by the stormwater infrastructure fund and shall not be assessed.

Existing inlets and outlets of storm sewer runs within the project area that were identified as needing improvements such as repair, replacement, tree removal, and/or delta excavation will be improved with the project.

Public Street Sign Replacement

Existing street signs within the project will not need to be replaced unless it is due to utility work, in which case they will be salvaged and reinstalled.

Mailbox Replacement

It is the City's intent to salvage and reinstall all existing mailboxes and mailbox supports that may be impacted with construction. In the event the condition of the existing mailbox support warrants replacement prior to reinstallation, the City is proposing to salvage the existing mailbox and install a new mailbox support that will meet both City Standards and United States Postal Service (USPS) requirements.

Permits/Approvals

An NPDES permit for construction activity will be required if more than one acre will be disturbed by construction activities within the project, which will be determined in final design of the project.

A Dakota County Work in Right-of-Way user registration will be required for the contractor for any county roads (i.e. CR 9, CSAH 23 etc.) that may be used as a haul route for the project. Work in Right-of-Way permits will be also required for construction within Dakota County Right-of-Way.

Construction Access/Staging

The contractor will be responsible for providing access to all properties throughout the project. Adequately signed detours will be identified to direct traffic around the construction zones and notify users of the increased truck and construction activity.

Construction will be phased such that construction truck traffic will not need to access newly reconstructed streets to complete the project. Detailed construction phasing plans will be developed with final design of the project.

Financing

Opinion of Probable Cost

A detailed opinion of probable cost for the project area can be found in the Appendix B of this report. The opinion of cost incorporates estimated 2025 construction costs and includes a 8% contingency factor. Indirect costs are projected at 25% of the construction cost and include engineering, legal, financing, and administrative costs.

Table 2 below provides a summary of the opinion of probable cost for the 2025 Street Rehabilitation Project:

Funding

Table 2 – 2025 Street Rehabilitation Project	
Opinion of Probable Cost Summary	
Schedule	Amount
Street Improvements	$1,745,662
Storm Sewer Improvements	$247,970
Watermain Improvements	$45,686
Sanitary Sewer Improvements	$46,771
TOTAL	$2,086,089

Financing for the street, storm sewer, watermain, and sanitary sewer improvements within the 2025 Street Rehabilitation Project will come from City CIP Funds, Stormwater Infrastructure Fund, Water Operating Fund, and Sanitary Sewer Operating Fund.

Table 3 below provides a funding summary for the 2025 Street Rehabilitation Project.

Table 3 – 2025 Street Rehabilitation Project	
Funding Summary	
Funding Source	Amount
City CIP Funds – Street/Storm	$1,955,988
City Water Operating Fund	$46,770
City Sanitary Sewer Operating Fund	$45,686
City Stormwater Infrastructure Fund	$37,645
TOTAL	$2,086,089

The 2025 Street Reconstruction Project, City Project No. 25-02, was separated into two parts based on the proposed improvements. The 2025 Street Reconstruction

portion total cost is $4,268,257 while the 2025 Street Rehabilitation Project total cost is $2,086,089. Combined the 2025 Street Reconstruction Project, City Project No. 25-02 overall cost will be $6,354,346.

Project Schedule

The proposed schedule for the 2025 Street Reconstruction Project is as follows:

Task Description	Completion Date
Present Feasibility Report and Set Public Hearing	October 21, 2024
Neighborhood Meeting	Early November
City Council Approves Plans and Specifications	January 20, 2025
Open Bids	February 19, 2025
Neighborhood Meeting	Late March
Award Contract	April 7, 2025
Begin Construction	April/May 2025
Substantial Completion	October 2025
Final Completion	November 2025

*Schedule assumes any necessary private utility work is completed prior to the start of construction.

Feasibility and Recommendation

The 2025 Street Rehabilitation Project includes roadway milling and overlaying, watermain improvements, sanitary sewer improvements, storm sewer improvements, pedestrian ramp installation, sidewalk improvements, and partial repair and repalcement of structurally deficient concrete sidewalk and concrete curb and gutter.

The total estimated cost for the 2025 Street Rehabilitation Project including roadway, storm sewer, sanitary sewer, and watermain improvements is $2,379,142. Proposed funding for the project is provided through City Funds. Construction costs are based on anticipated construction costs for 2025.

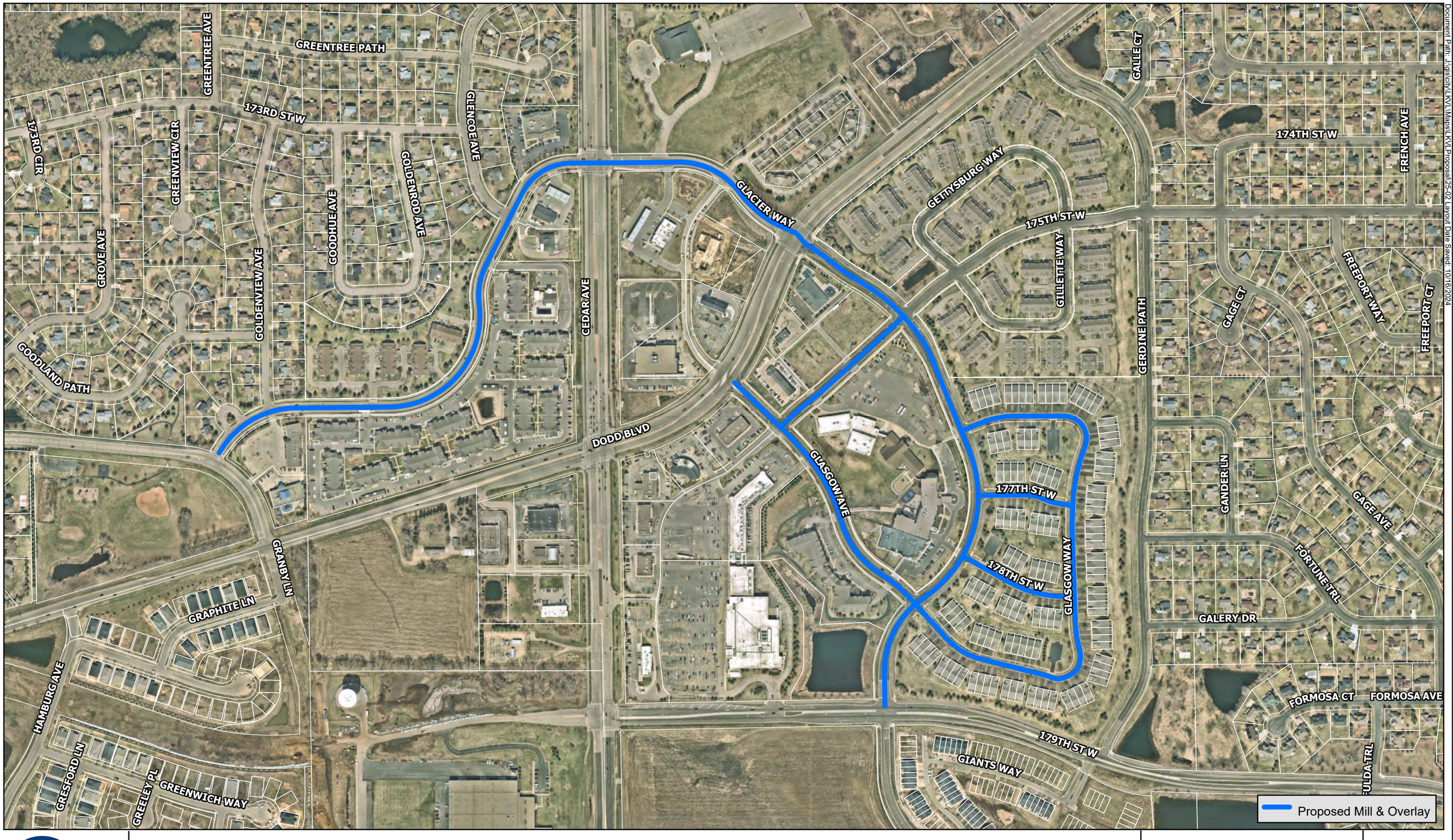
This project is feasible, necessary, cost-effective from an engineering standpoint. The project feasibility is subject to financial review by the City. Based on information contained in this report, it is recommended to proceed with the improvements as outlined in this report.

Appendix A

Figure 1 – Project Locations Map

Figure 2 – Typical Section

Figure 3 – Stormwater Capacity Analysis



Project Location Map

2025 Street Reconstruction Project
Lakeville, MN

N

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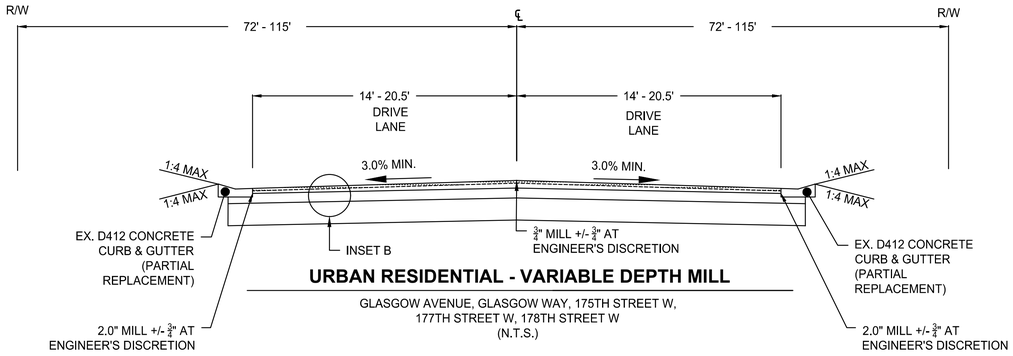
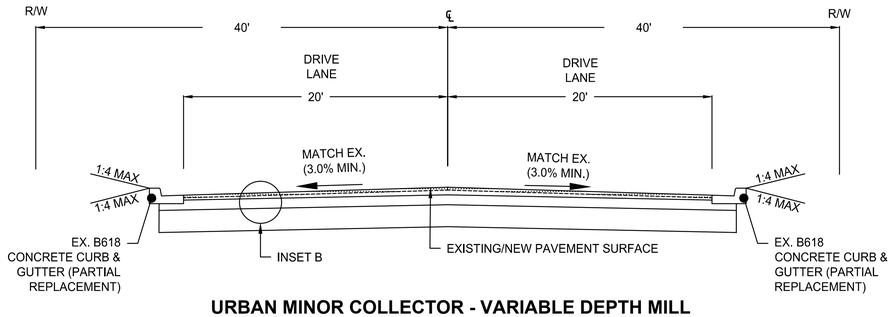
1 inch = 400 feet



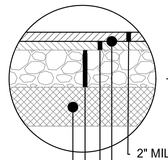
URBAN RESIDENTIAL - VARIABLE DEPTH MILL

GLASGOW AVENUE, GLASGOW WAY, 175TH STREET W,
177TH STREET W, 178TH STREET W
(N.T.S.)



URBAN MINOR COLLECTOR - VARIABLE DEPTH MILL

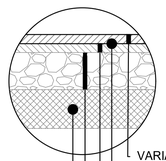
GLACIER WAY
(N.T.S.)



INSET A

MILL AND OVERLAY SECTION

- 2" MILL / 2.0" TYPE SP 9.5 WEARING COURSE MIX (3,B) (SPWEA340B)
- 2357 BITUMINOUS TACK COAT ON MILLED SURFACE (INCIDENTAL)
- EXISTING BITUMINOUS PAVEMENT
- EXISTING AGGREGATE BASE
- EXISTING SUBGRADE

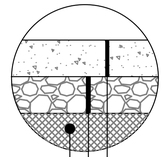


INSET B

VARIABLE DEPTH
MILL AND OVERLAY SECTION

- VARIABLE MILL / 2.0" TYPE SP 9.5 WEARING COURSE MIX (3,B) (SPWEA340B)
- 2357 BITUMINOUS TACK COAT ON MILLED SURFACE (INCIDENTAL)
- EXISTING BITUMINOUS PAVEMENT
- EXISTING AGGREGATE BASE
- EXISTING SUBGRADE

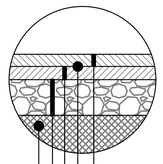
THE ENGINEER MAY ALSO REQUEST VARIABLE DEPTH MILLING FOR AREAS NOT IDENTIFIED IN THE PLANS.



DETAIL

CONCRETE DRIVEWAY & APRON SECTION
(CITY STD. PLATE NO. LV-ST-3 & LV-ST-4)

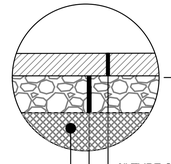
- 7" CONCRETE (MNDOT 3F52)
- 6" AGGREGATE BASE CLASS 5 MODIFIED (100% CRUSHED LIMESTONE; INCIDENTAL)
- APPROVED SUBGRADE (INCIDENTAL)



DETAIL

BITUMINOUS DRIVEWAY SECTION

- 1.5" TYPE SP 9.5 WEARING COURSE MIX (2,B) (SPWEA240B)
- 2357 BITUMINOUS TACK COAT (INCIDENTAL)
- 1.5" TYPE SP 9.5 WEARING COURSE MIX (2,B) (SPWEA240B)
- 6" AGGREGATE BASE CLASS 5 MODIFIED (100% CRUSHED LIMESTONE; INCIDENTAL)
- APPROVED SUBGRADE (INCIDENTAL)



DETAIL

BITUMINOUS TRAIL
(CITY STD. PLATE NO. LV-ST-10)

- 3" TYPE SP 9.5 SPWEA240B WEAR COURSE
- 6" CL 5 AGGREGATE BASE (100% CRUSHED LIMESTONE; INCIDENTAL)
- APPROVED SUBGRADE (INCIDENTAL)

wsb

Lakeville

SCALE:	DESIGN BY:
AS SHOWN	XXX
PLAN BY:	CHECK BY:
XXX	XXX

REVISIONS

NO.	DATE	DESCRIPTION

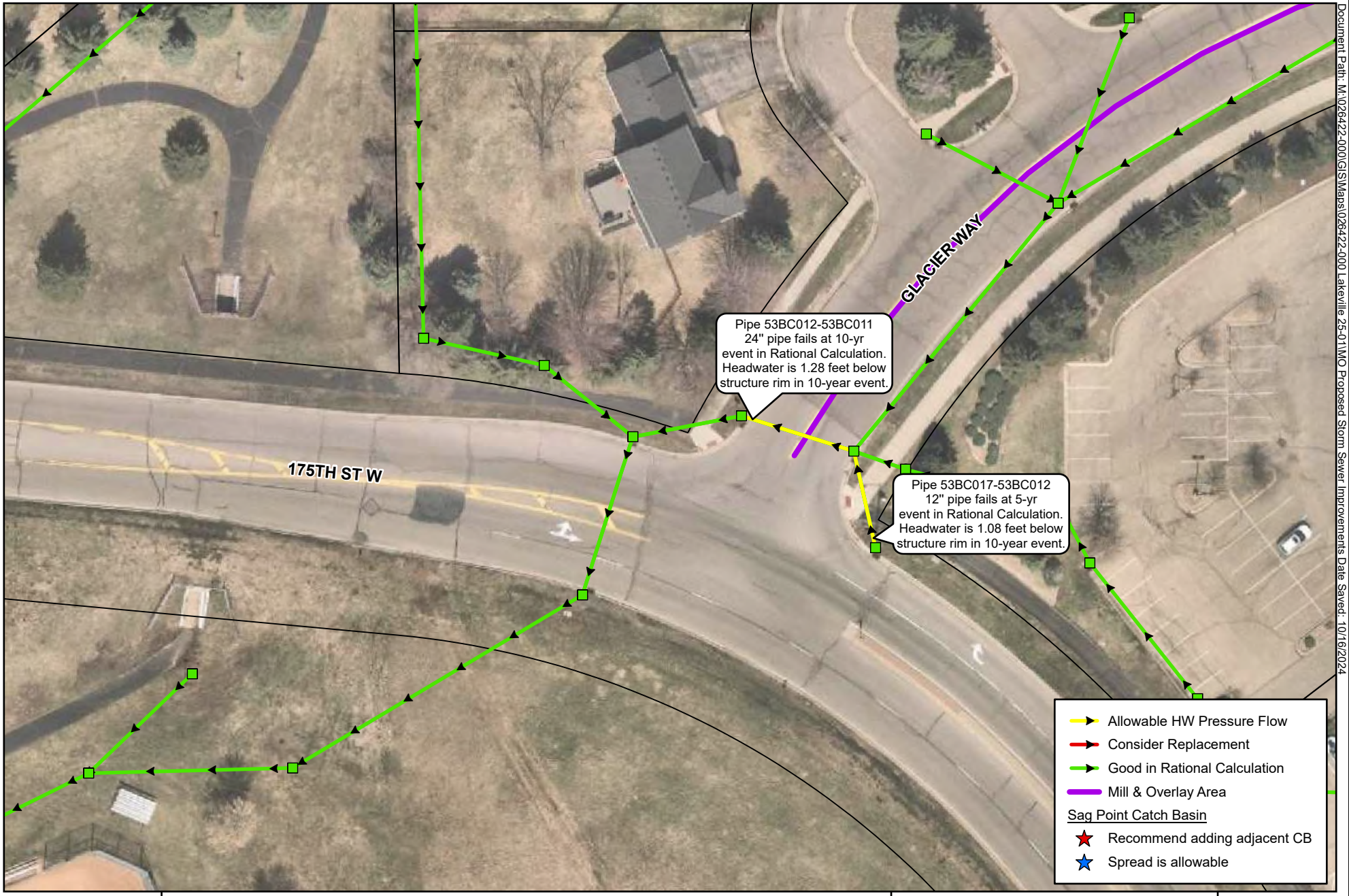
TYPICAL SECTIONS

2025 STREET REHABILITATION PROJECT
CITY OF LAKEVILLE

CLIENT PROJECT NO.
25-02

WSB PROJECT NO.
026423-000

SHEET
1 OF 1



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

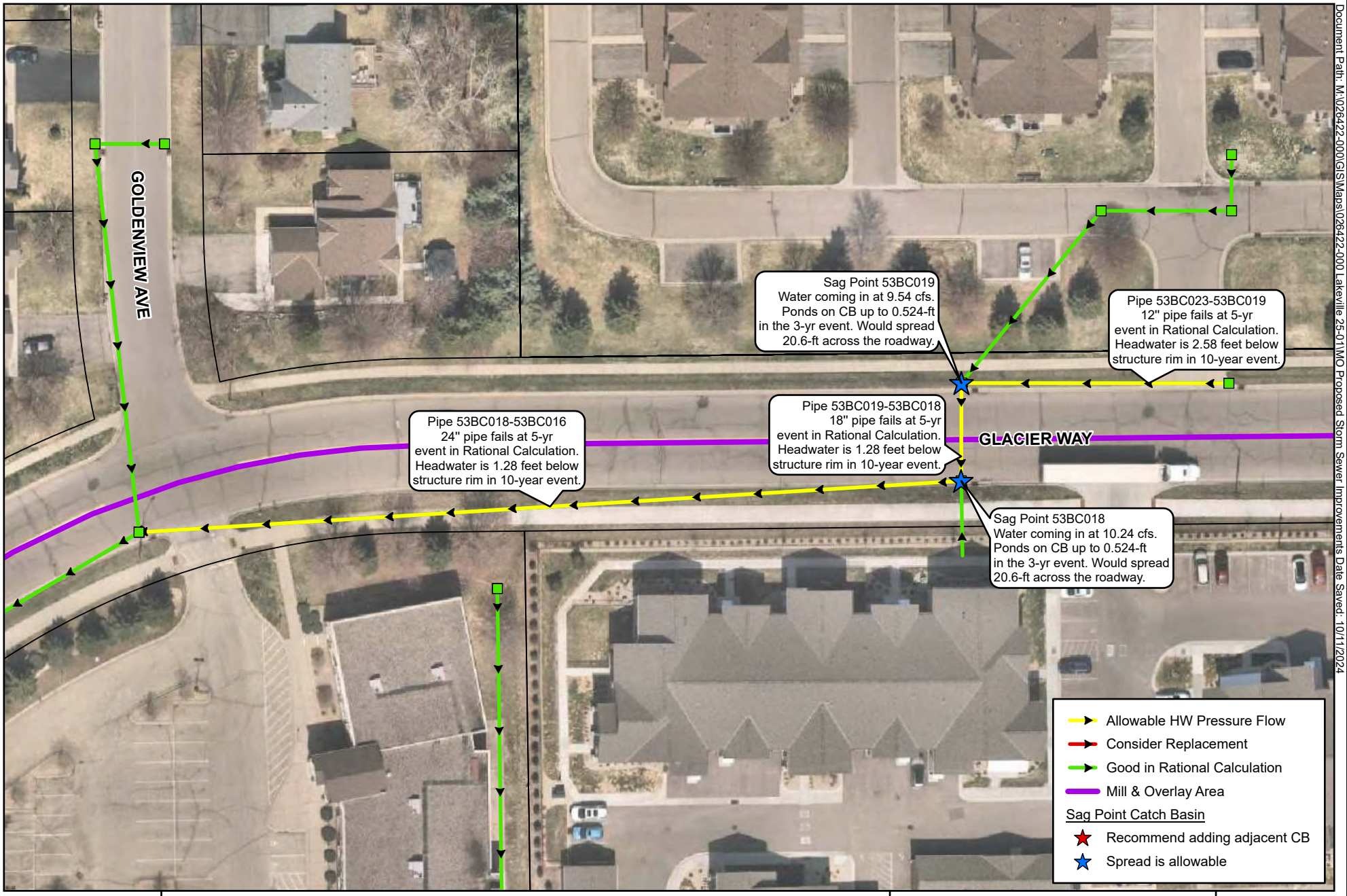
2025 Street Reconstruction Project (25-02) - Page 1
City of Lakeville, MN

N

0 50 Feet

1 inch = 50 feet

wsb



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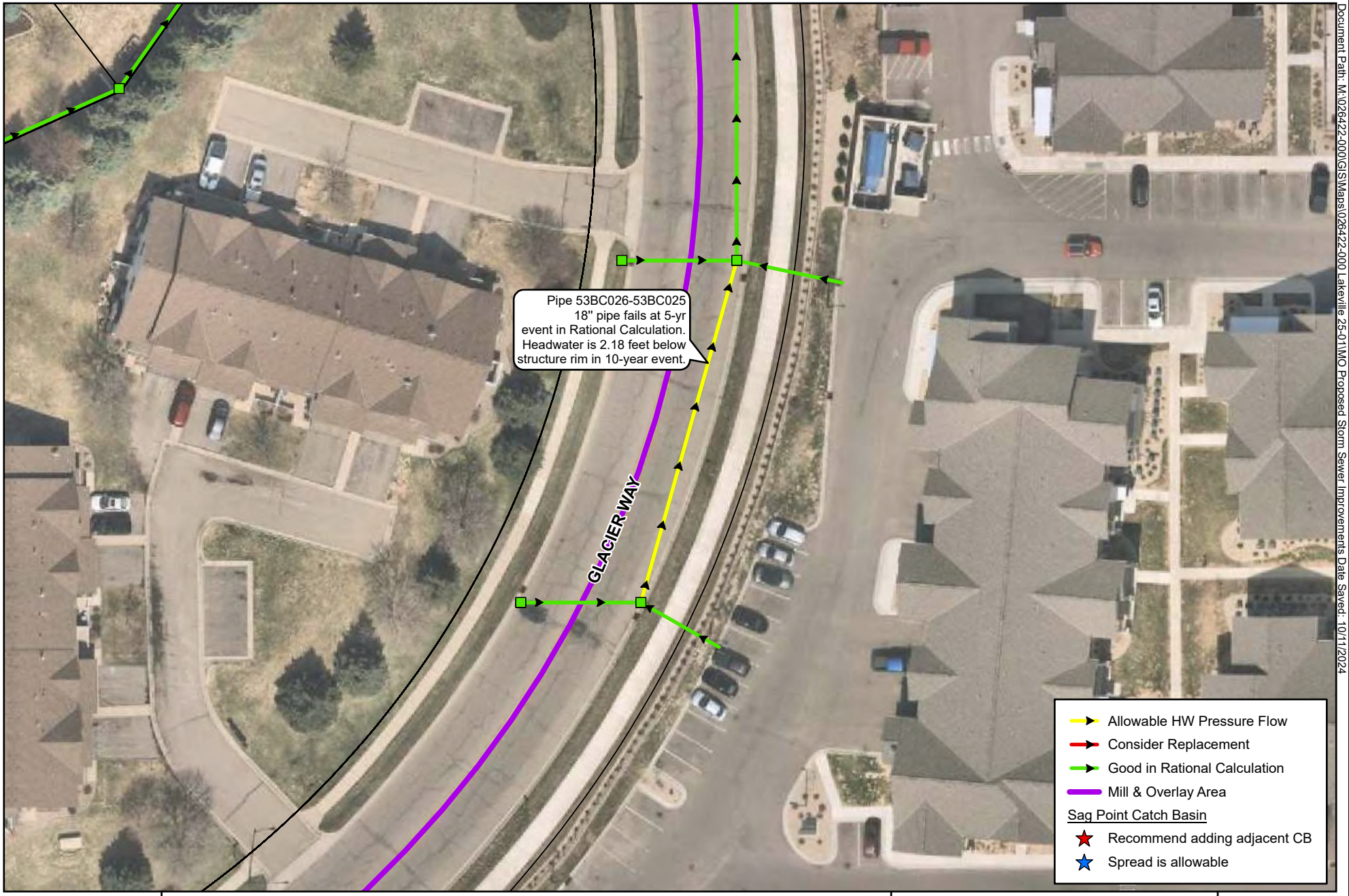
Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 2
City of Lakeville, MN

N

0 60 Feet

1 inch = 60 feet



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

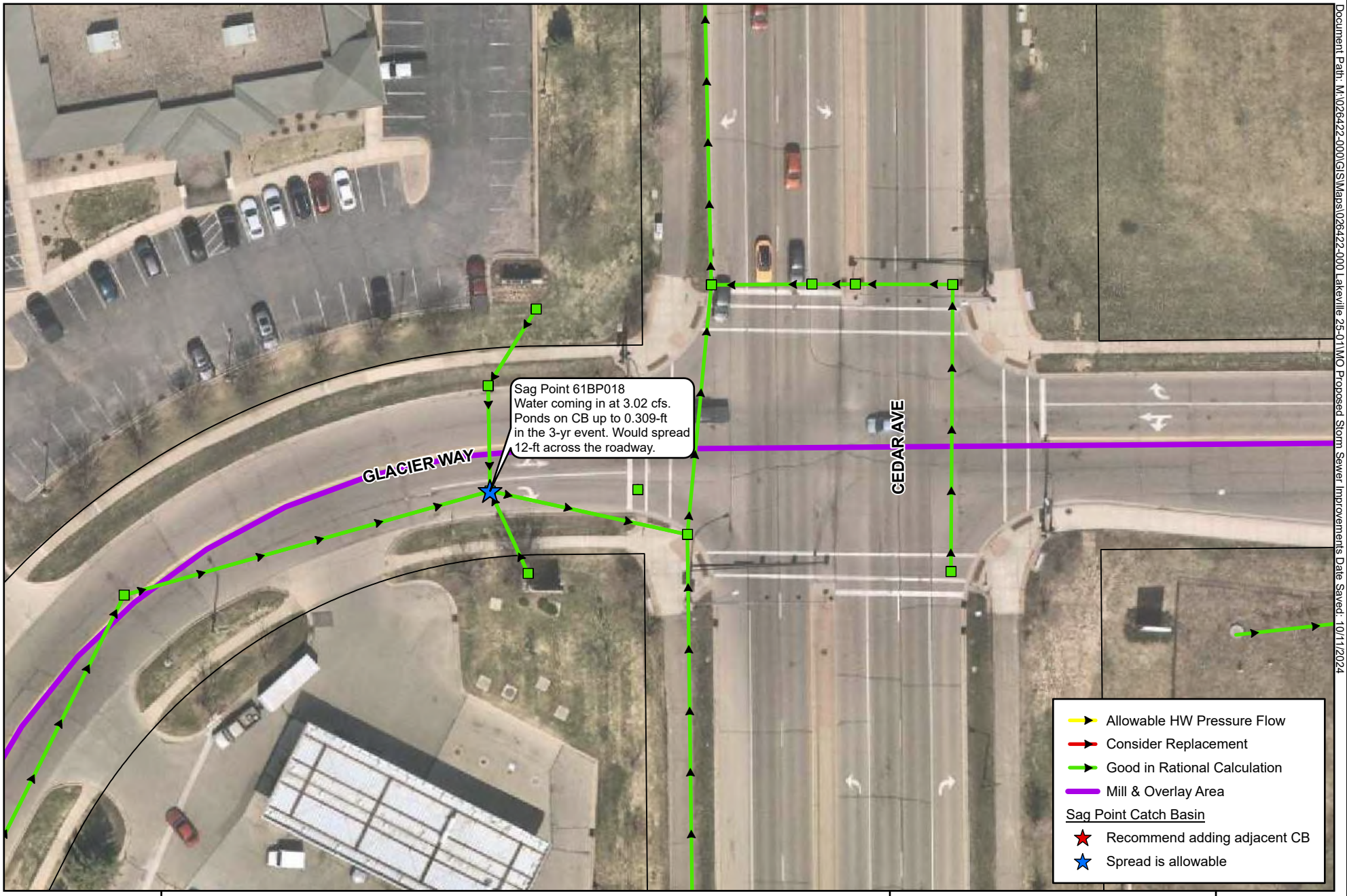
2025 Street Reconstruction Project (25-02) - Page 3
City of Lakeville, MN

N

0 50 Feet

1 inch = 50 feet

wsb



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Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 4
City of Lakeville, MN

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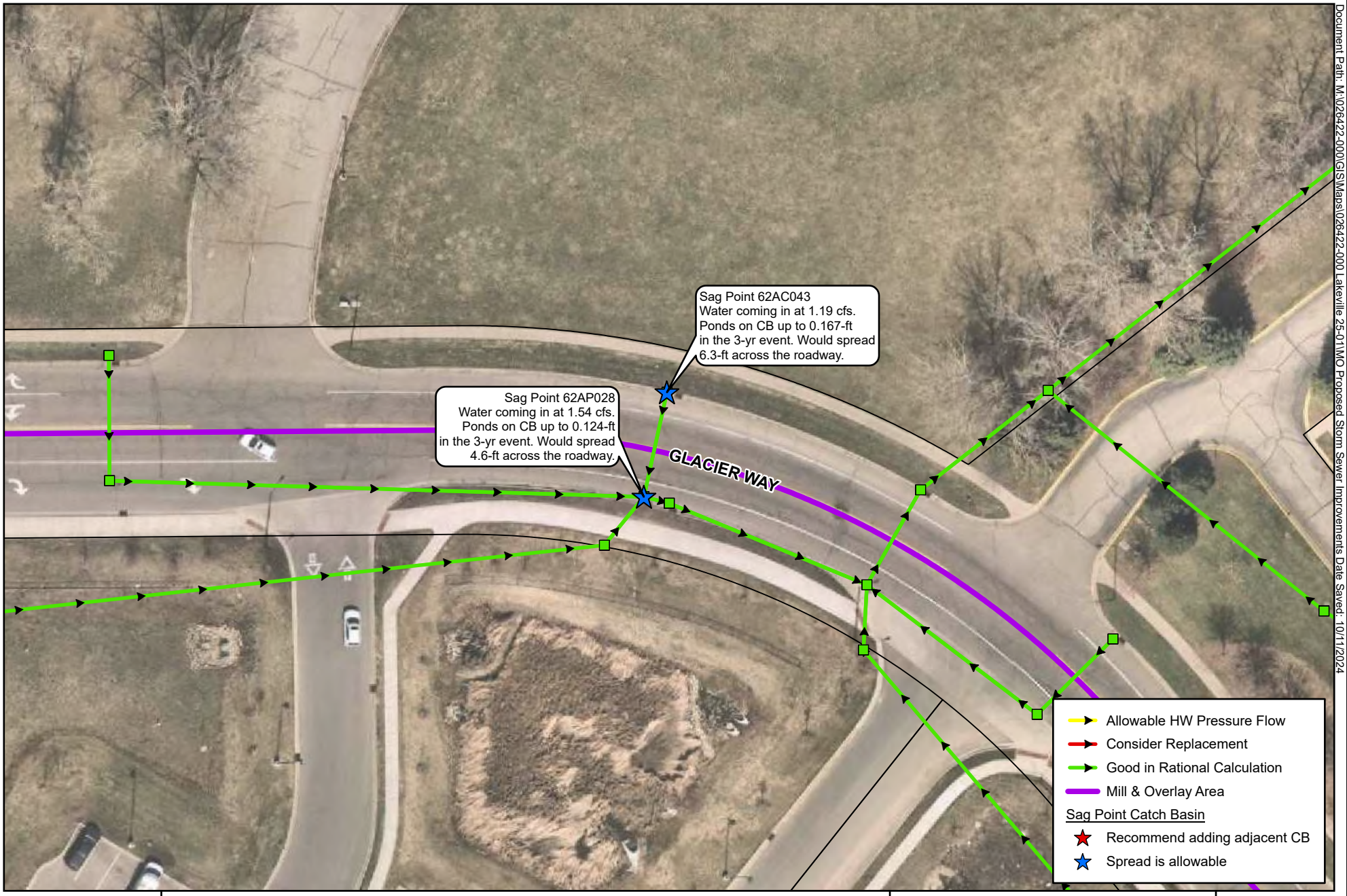
0 50 Feet

1 inch = 50 feet



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

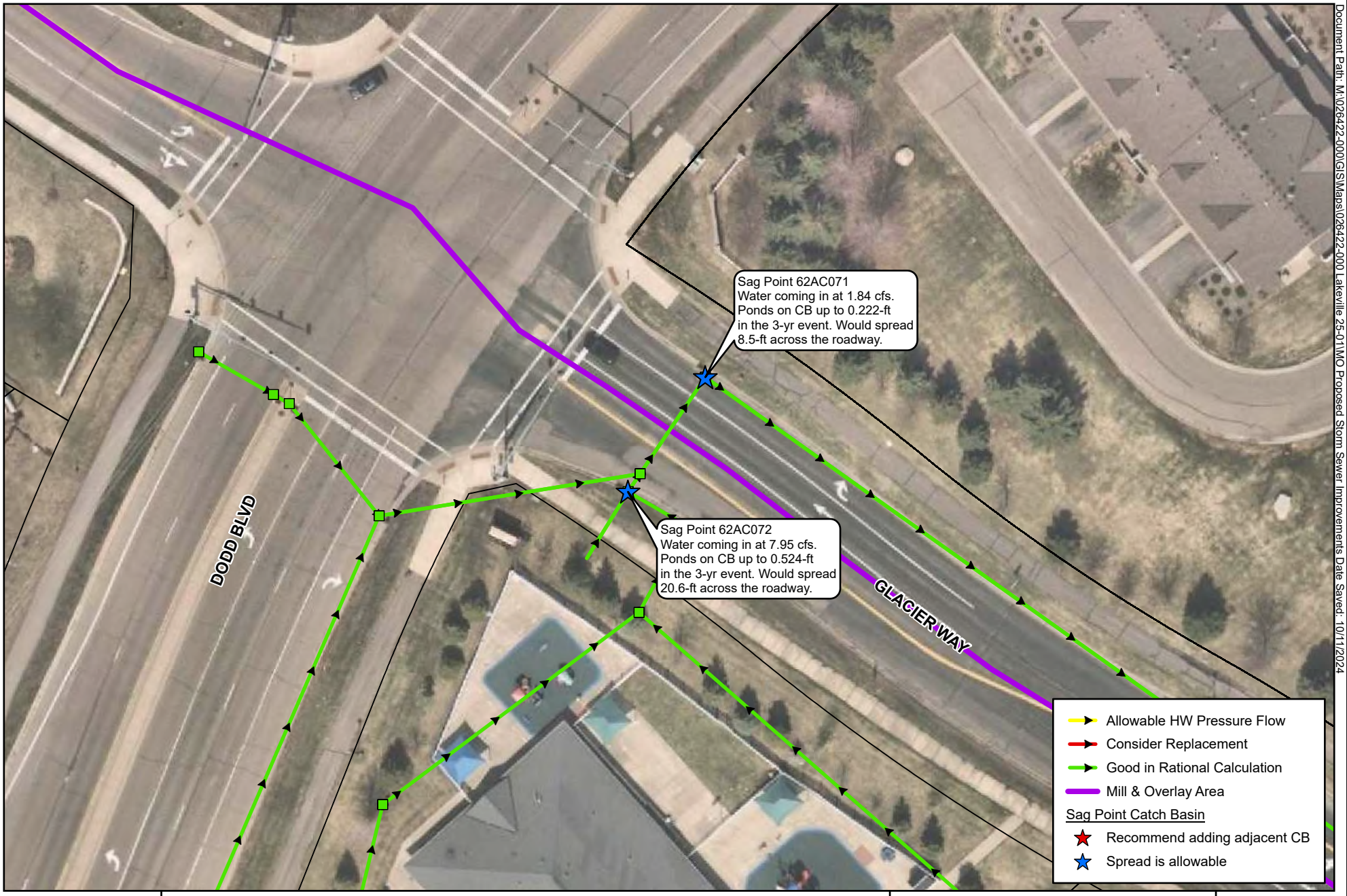
2025 Street Reconstruction Project (25-02) - Page 5
City of Lakeville, MN

N

0 50 Feet

1 inch = 50 feet

wsb



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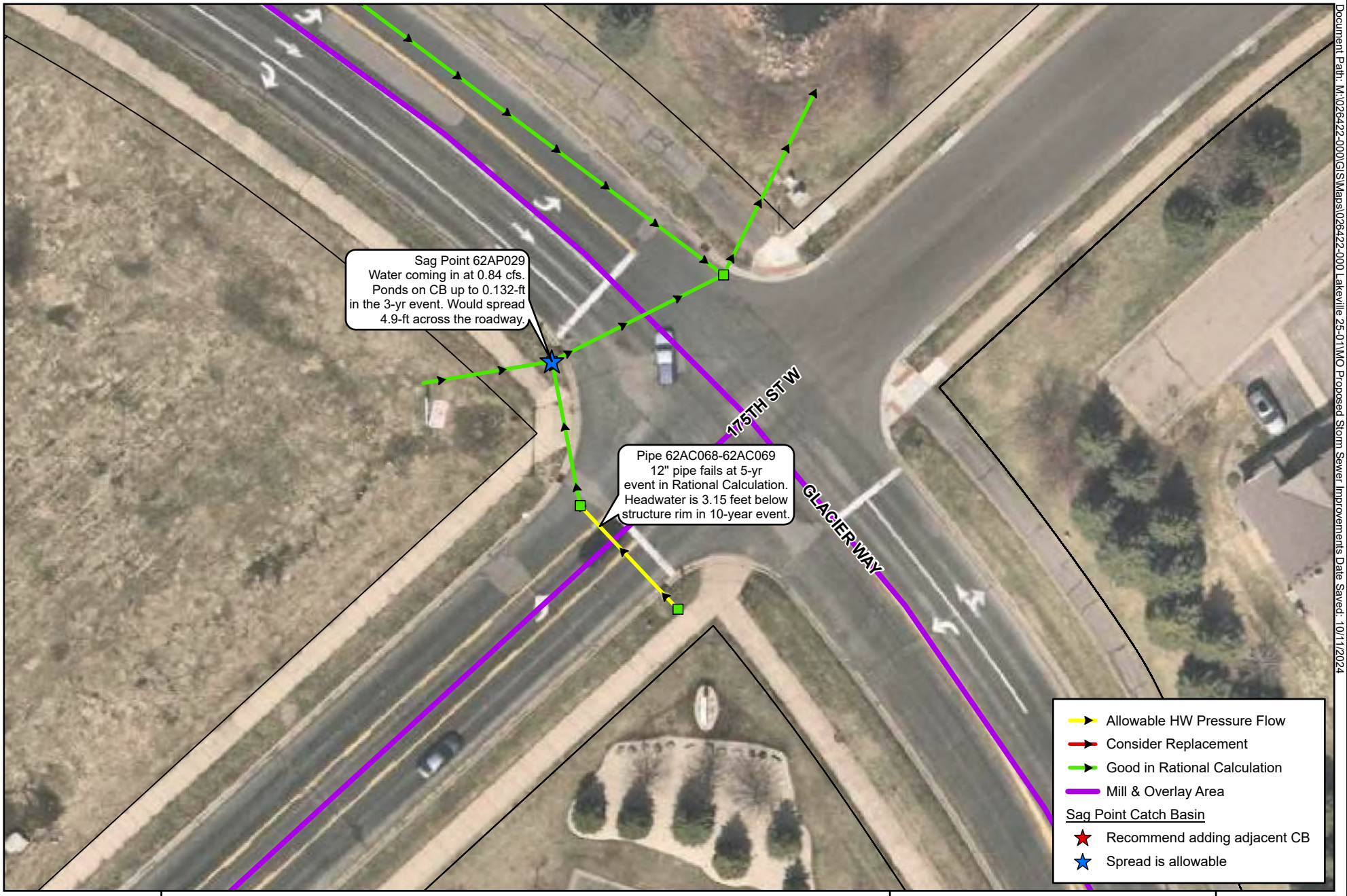
Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 6
City of Lakeville, MN

N

0 50 Feet

1 inch = 50 feet



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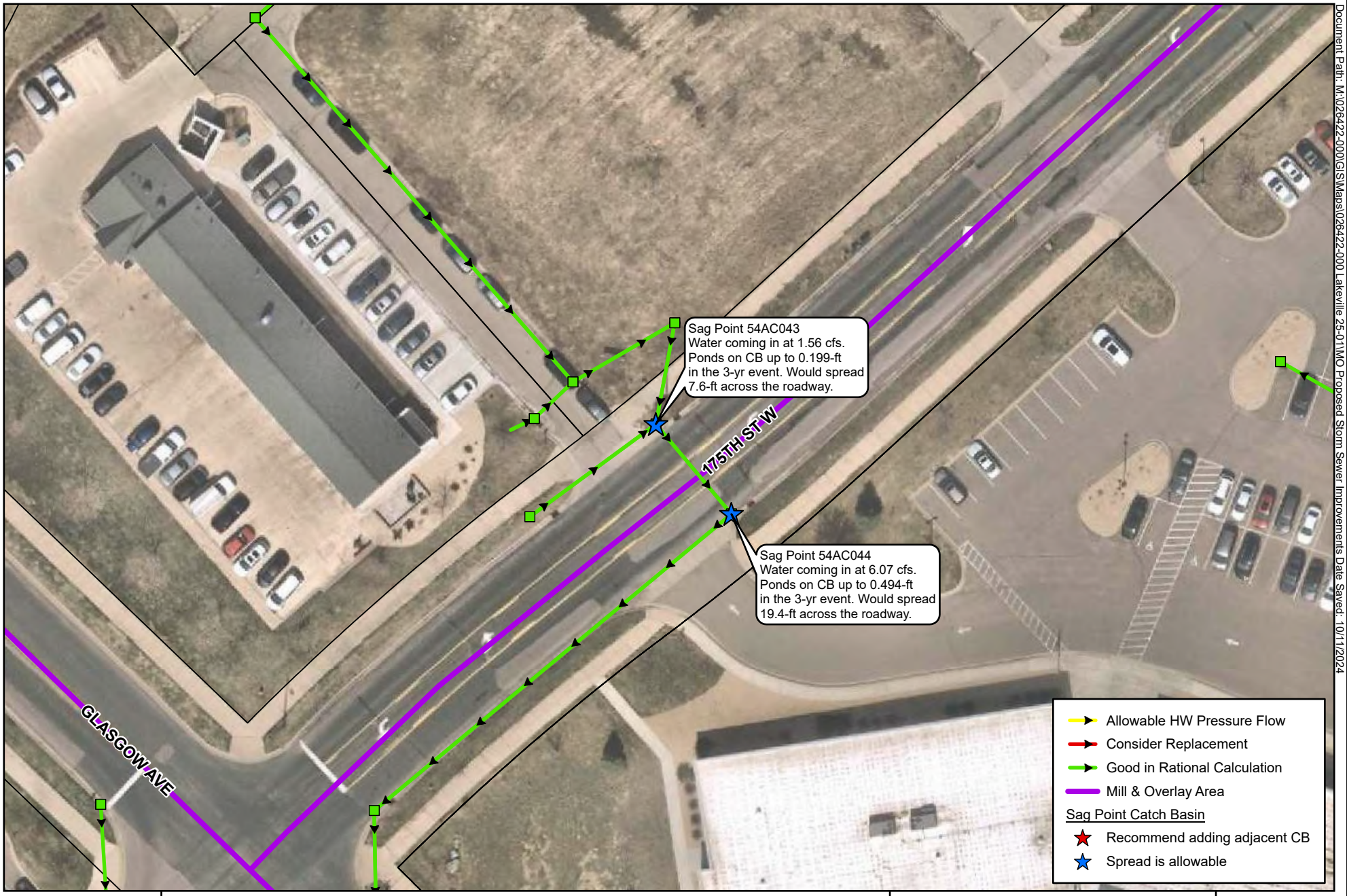
Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 7
City of Lakeville, MN

N

0 40 Feet

1 inch = 40 feet



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Storm Sewer Improvements Proposed for Additional Capacity

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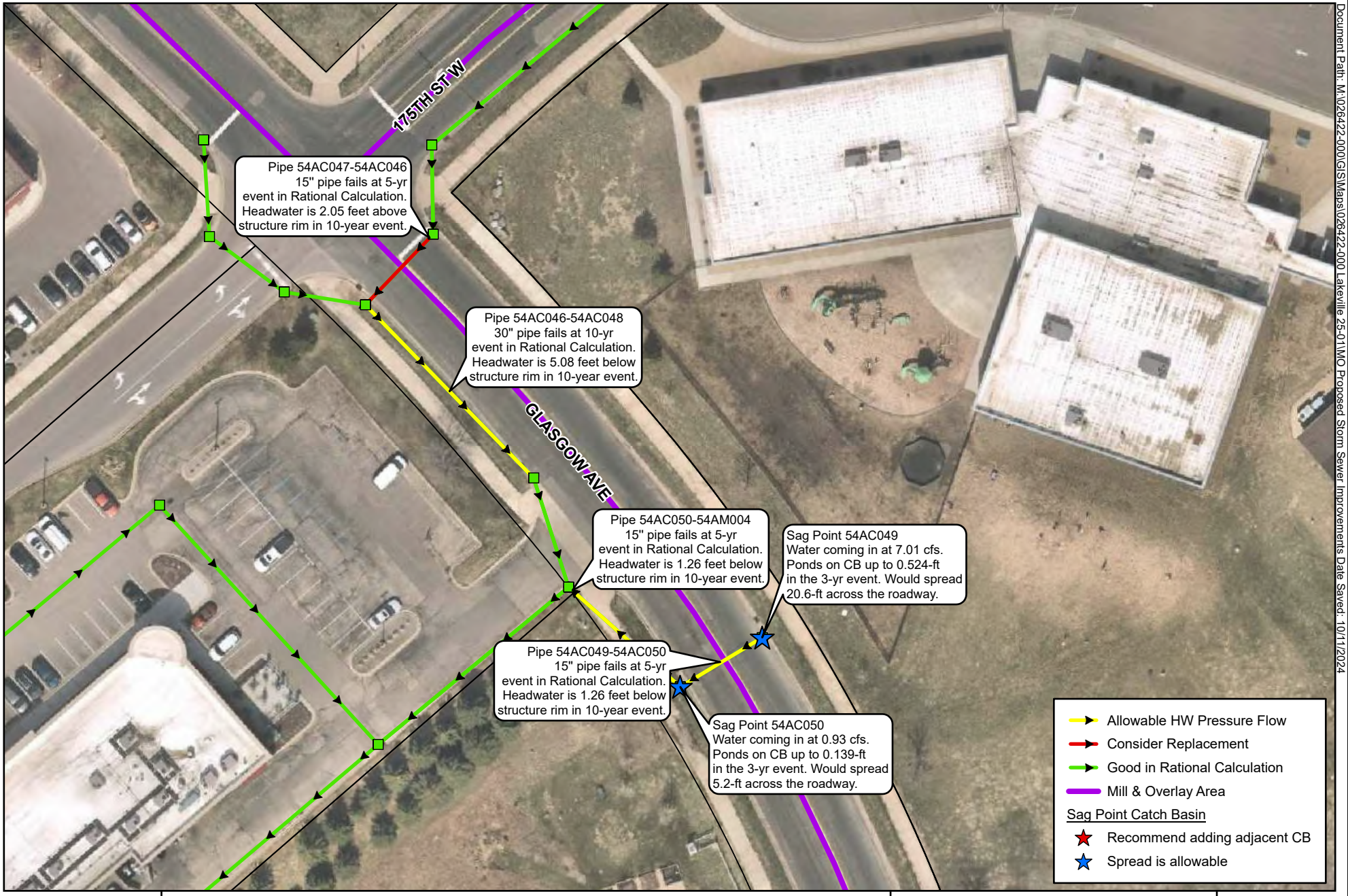
City of Lakeville, MN

N

0 50 Feet

1 inch = 50 feet



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Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 9
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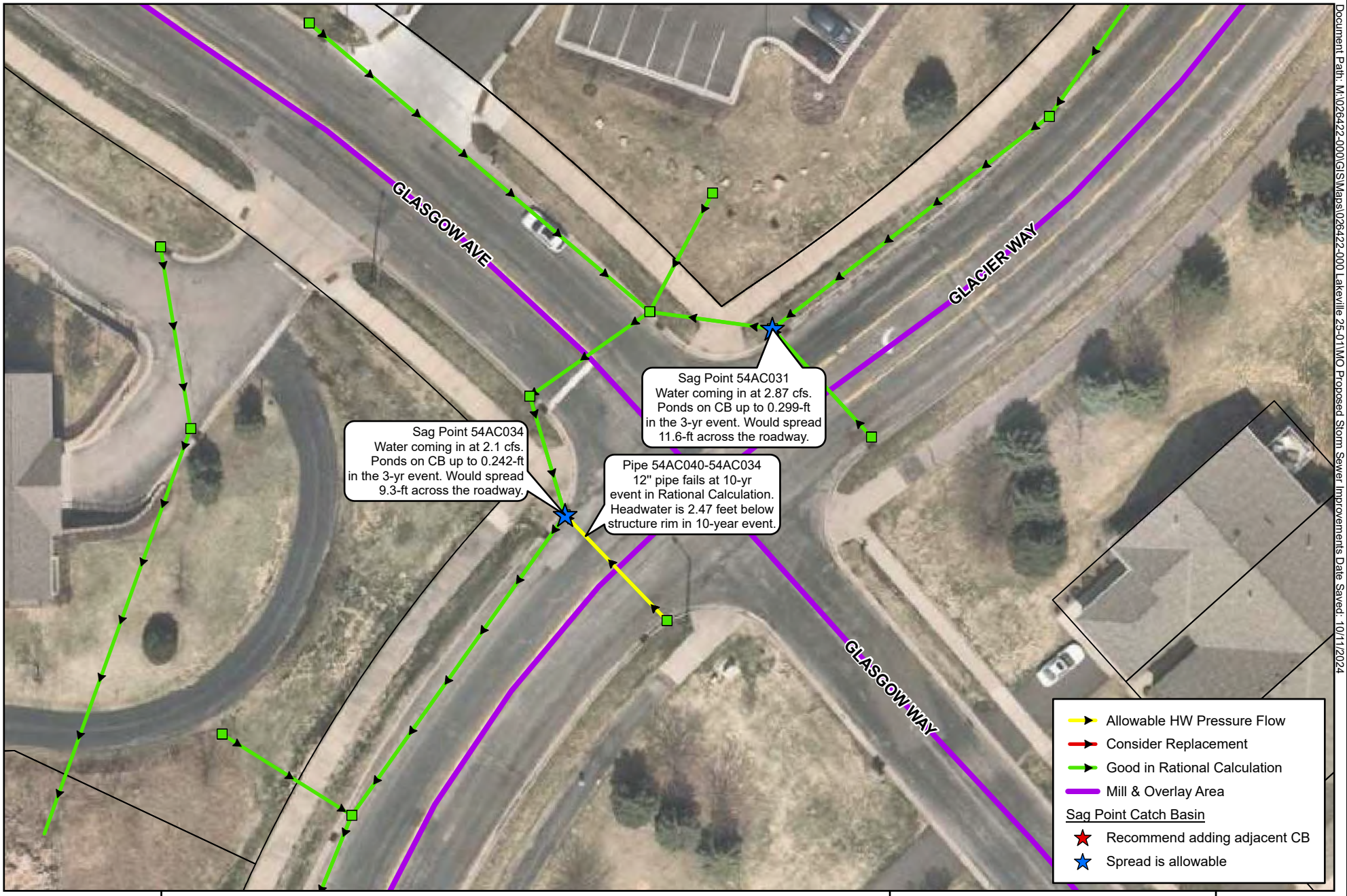
N

0 60 Feet

1 inch = 60 feet



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

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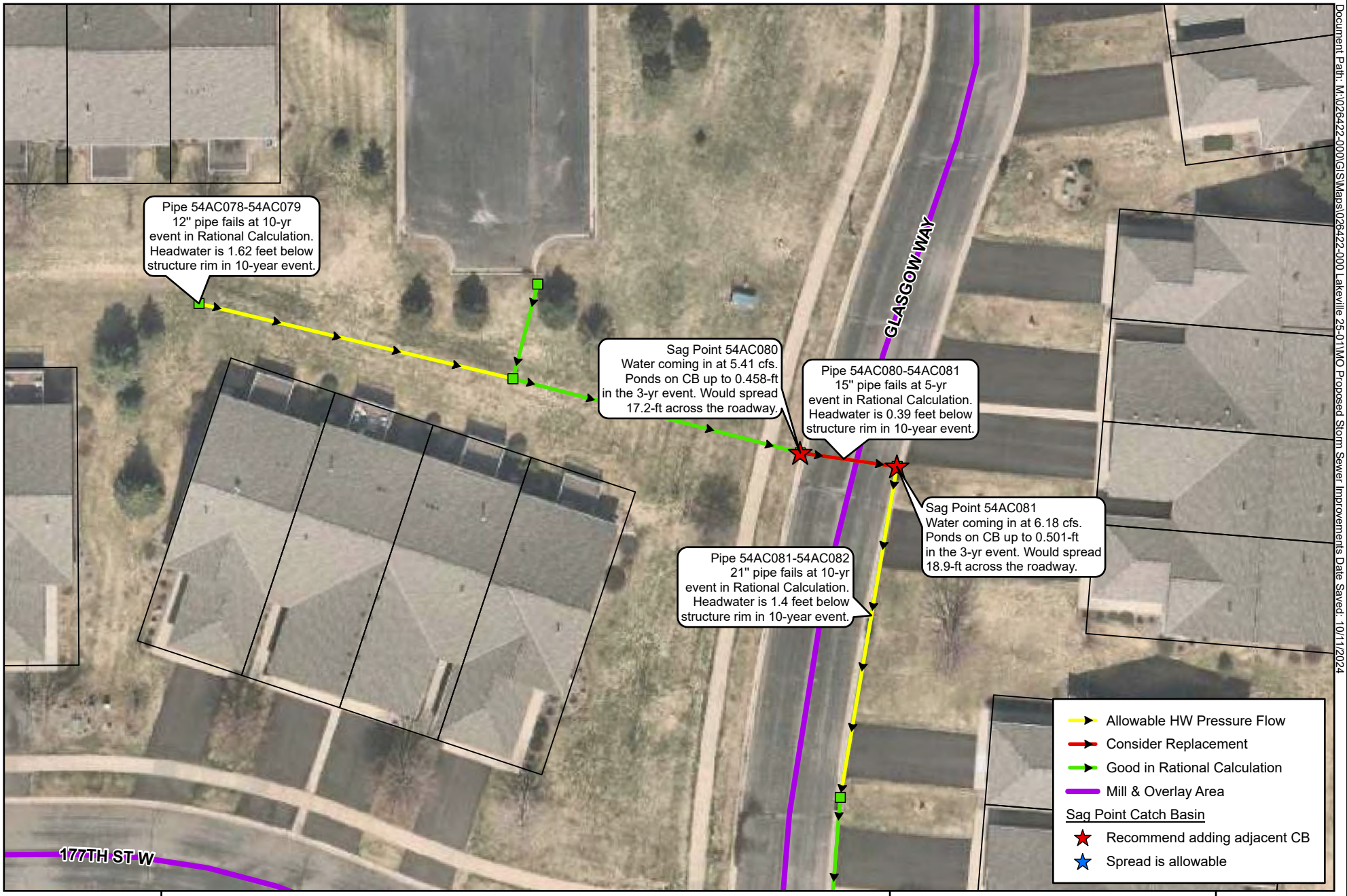
N

0 40 Feet

1 inch = 40 feet

wsb



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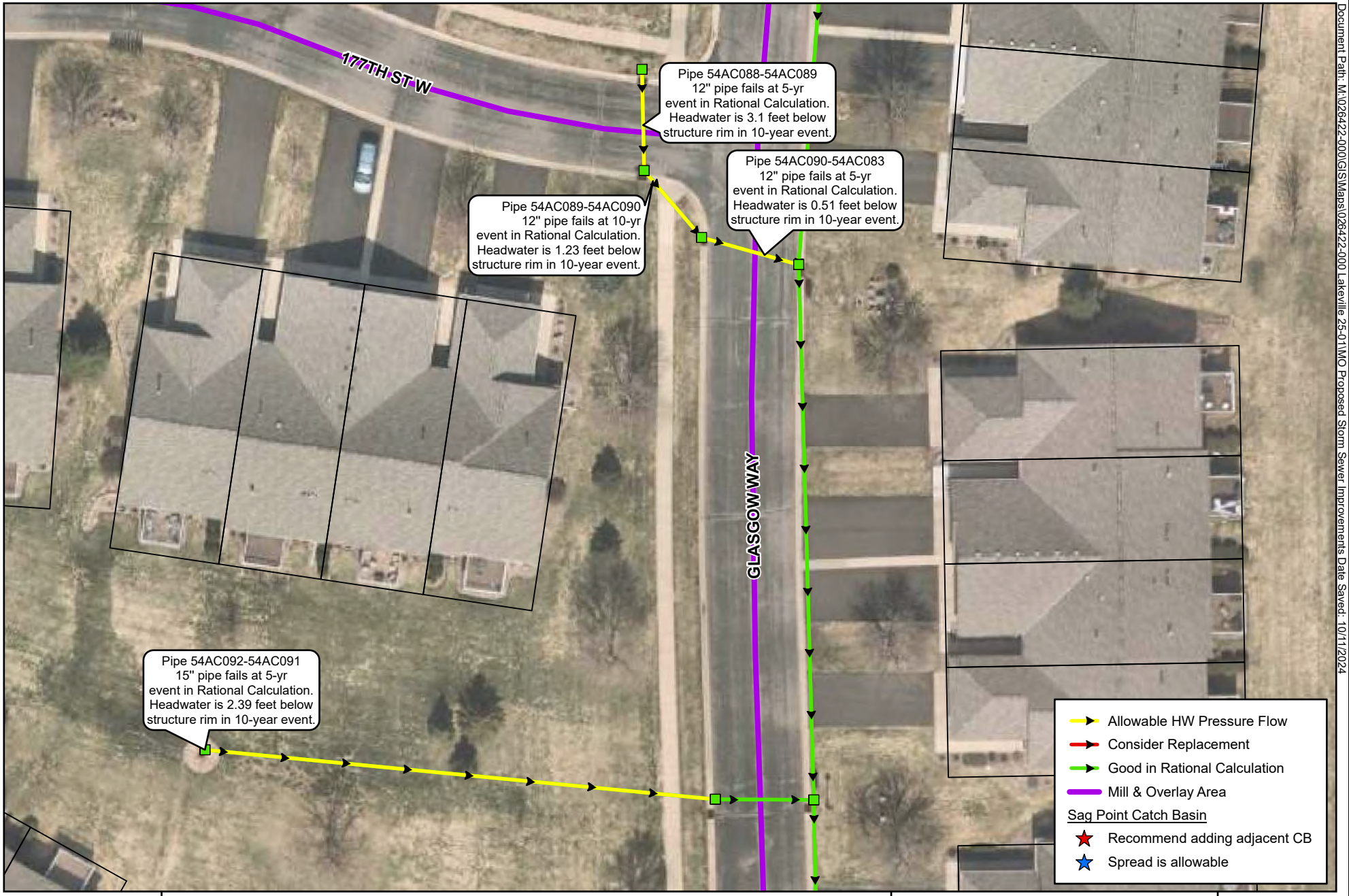
Storm Sewer Improvements Proposed for Additional Capacity

2025 Street Reconstruction Project (25-02) - Page 11
City of Lakeville, MN

N

0 40 Feet

1 inch = 40 feet



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

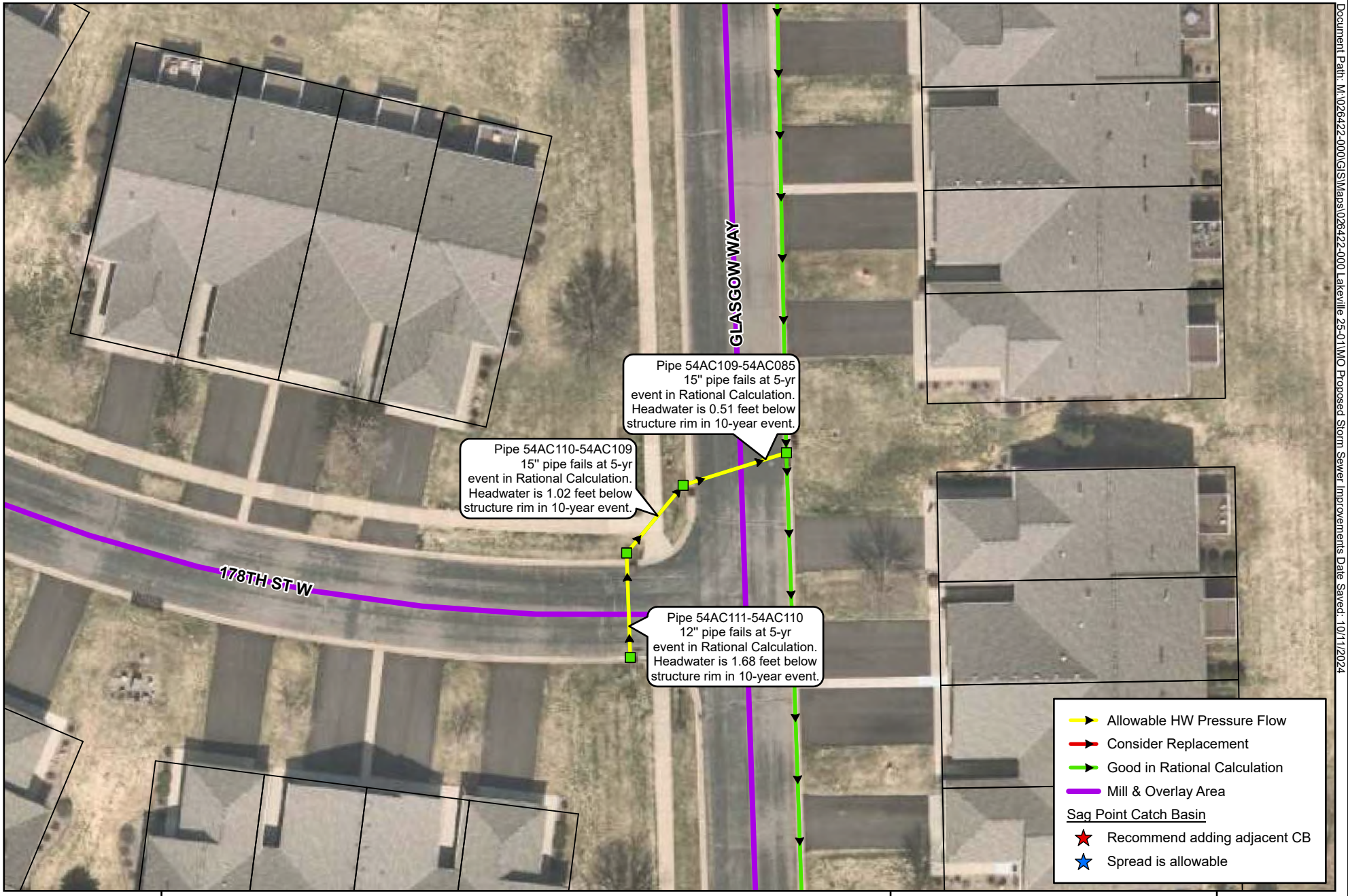
2025 Street Reconstruction Project (25-02) - Page 12
City of Lakeville, MN

N

0 40 Feet

1 inch = 40 feet

wsb



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

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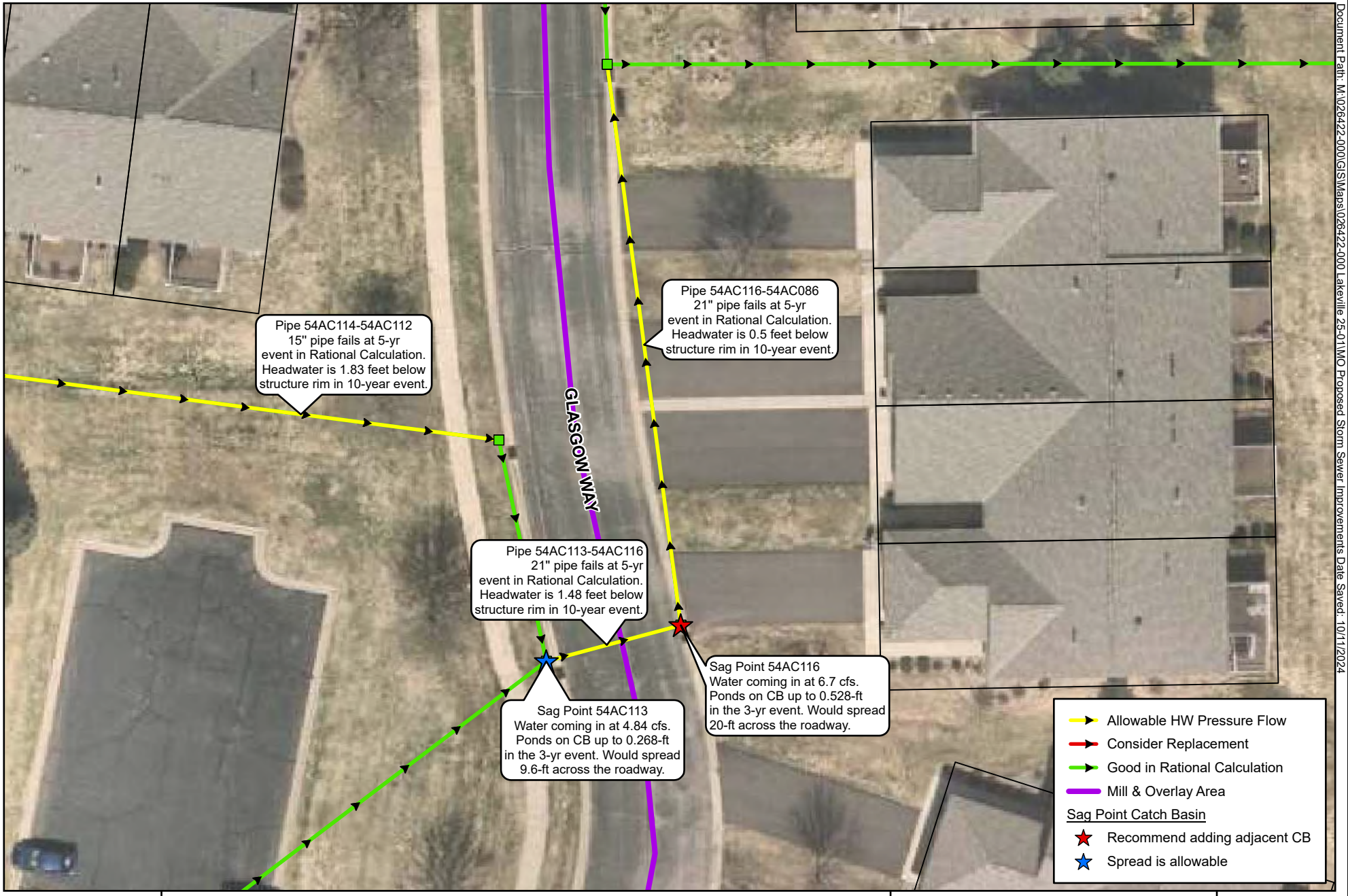
N

0 40 Feet

1 inch = 40 feet

wsb



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Storm Sewer Improvements Proposed for Additional Capacity

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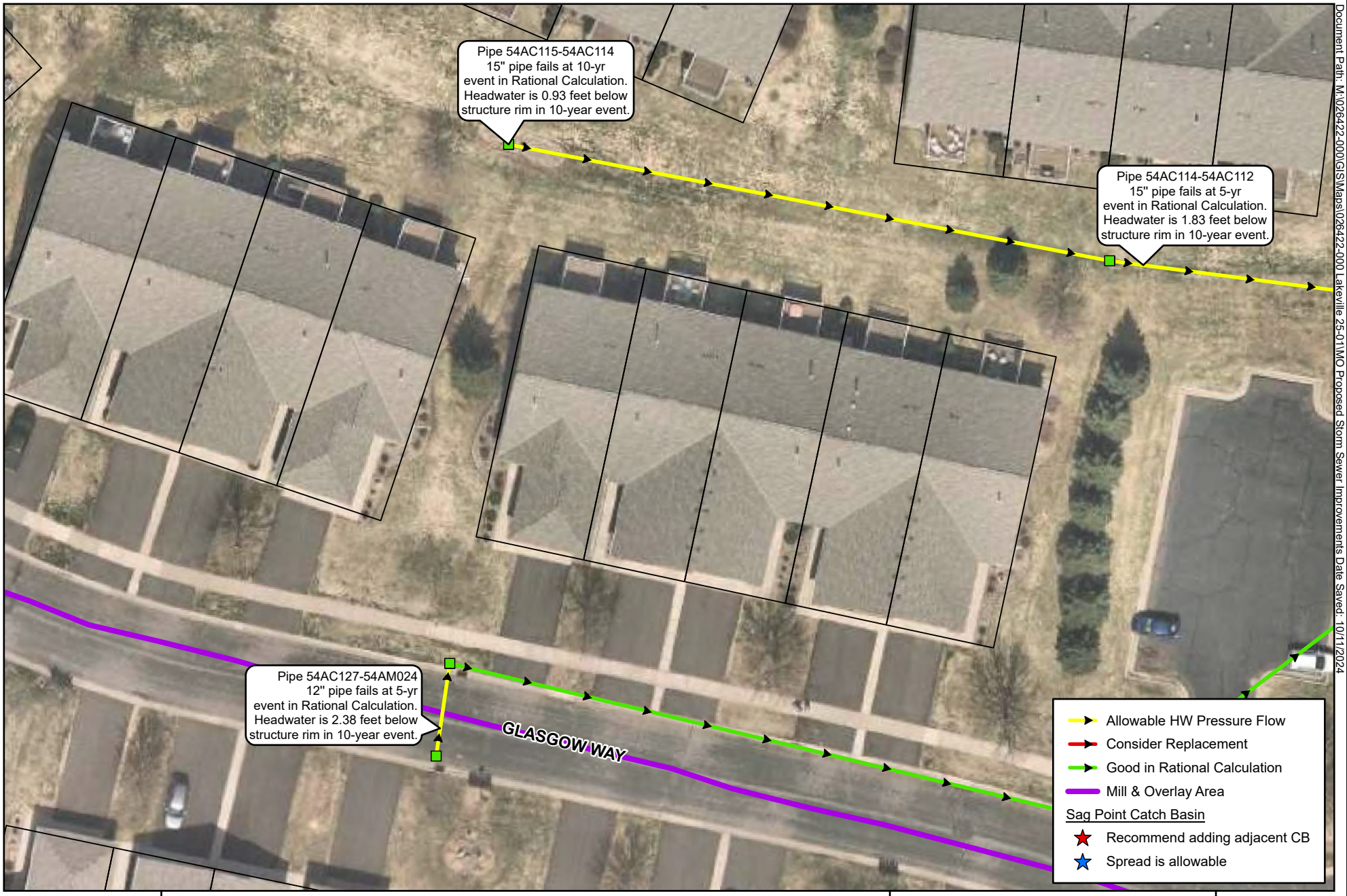
N

0 30 Feet

1 inch = 30 feet



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Lakeville

Storm Sewer Improvements Proposed for Additional Capacity

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N

0 40 Feet

1 inch = 40 feet

wsb

Appendix B

Opinion of Probable Cost

OPINION OF PROBABLE COST

WSB Project: 2025 Street Rehabilitation Project
Project Location: City of Lakeville
City Project No.: 25-02
WSB Project No: 026423-000

Design By: RJS
Checked By: JAO
Date: 10/17/2024

Item No.	MnDOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
A. Street Improvements						
1	2021.501	MOBILIZATION	LS	1	$ 61,575.39	$ 61,575.39
2	2101.502	CLEARING	EACH	2	$ 500.00	$ 1,000.00
3	2101.502	GRUBBING	EACH	2	$ 400.00	$ 800.00
4	2104.502	SALVAGE MAIL BOX SUPPORT	EACH	5	$ 125.00	$ 625.00
5	2104.502	SALVAGE SIGN	EACH	10	$ 50.00	$ 500.00
6	2104.503	REMOVE CURB & GUTTER	L F	4043	$ 8.00	$ 32,344.00
7	2104.503	SAWING BIT PAVEMENT (FULL DEPTH)	L F	750	$ 4.00	$ 3,000.00
8	2104.503	SAWING CONCRETE PAVEMENT (FULL DEPTH)	L F	170	$ 7.00	$ 1,190.00
9	2104.504	REMOVE BITUMINOUS DRIVEWAY PAVEMENT	S Y	417	$ 12.00	$ 5,004.00
10	2104.504	REMOVE BITUMINOUS PAVEMENT	S Y	205	$ 12.00	$ 2,460.00
11	2104.504	REMOVE CONCRETE DRIVEWAY PAVEMENT	S Y	0	$ 15.00	$ -
12	2104.518	REMOVE CONCRETE WALK	S F	10509	$ 2.50	$ 26,272.50
13	2104.601	SALVAGE AND REINSTALL LANDSCAPE STRUCTURES	LS	1	$ 5,000.00	$ 5,000.00
14	2106.507	EXCAVATION - SUBGRADE	C Y	798	$ 40.00	$ 31,920.00
15	2106.507	STABILIZING AGGREGATE (CV)	C Y	798	$ 37.00	$ 29,526.00
16	2106.509	STABILIZING AGGREGATE	TON	192	$ 37.00	$ 7,104.00
17	2112.519	SUBGRADE PREPARATION	RDST	119	$ 30.00	$ 3,570.00
18	2123.610	STREET SWEEPER (WITH PICKUP BROOM)	HOUR	50	$ 160.00	$ 8,000.00
19	2130.523	WATER	MGAL	50	$ 70.00	$ 3,500.00
20	2231.609	BITUMINOUS PATCH SPECIAL	TON	417	$ 105.00	$ 43,785.00
21	2232.504	MILL BITUMINOUS SURFACE (2.0")	S Y	47849	$ 1.75	$ 83,735.75
22	2360.504	TYPE SP 9.5 WEAR CRS MIX(2,B)3.0" THICK	S Y	1594	$ 31.00	$ 49,414.00
23	2360.509	TYPE SP 9.5 WEARING COURSE MIX (3;B)	TON	5948	$ 80.00	$ 475,840.00
24	2504.602	IRRIGATION SYSTEM REPAIR	EACH	15	$ 190.00	$ 2,850.00
25	2521.518	5" CONCRETE WALK	S F	7109	$ 10.00	$ 71,090.00
26	2521.518	6" CONCRETE WALK	S F	3400	$ 15.00	$ 51,000.00
27	2531.503	CONCRETE CURB & GUTTER DESIGN B618	L F	2428	$ 25.00	$ 60,700.00
28	2531.503	CONCRETE CURB & GUTTER DESIGN D412	L F	2503	$ 25.00	$ 62,575.00
29	2531.601	ADA COMPLIANCE SUPERVISOR	LS	1	$ 5,000.00	$ 5,000.00
30	2531.618	TRUNCATED DOMES	S F	560	$ 65.00	$ 36,400.00
31	2540.602	MAIL BOX	EACH	5	$ 50.00	$ 250.00
32	2540.602	MAIL BOX SUPPORT	EACH	5	$ 50.00	$ 250.00
33	2540.602	TEMPORARY MAIL BOX	EACH	137	$ 40.00	$ 5,480.00
34	2563.601	TRAFFIC CONTROL	LS	1	$ 8,000.00	$ 8,000.00
35	2573.501	STABILIZED CONSTRUCTION EXIT	LS	1	$ 5,000.00	$ 5,000.00
36	2575.504	ROLLED EROSION PREVENTION CATEGORY 25	S Y	1950	$ 5.00	$ 9,750.00
37	2575.523	RAPID STABILIZATION METHOD 3	MGAL	20	$ 50.00	$ 1,000.00
38	2575.523	WATER	MGAL	44	$ 70.00	$ 3,080.00
39	2575.604	PERMANENT TURF ESTABLISHMENT	S Y	1950	$ 20.00	$ 39,000.00
40	2575.604	TEMPORARY STABILIZATION	S Y	1950	$ 20.00	$ 39,000.00
41	2582.503	4" BROKEN LINE PAINT	S Y	383	$ 0.75	$ 287.25
42	2582.503	4" DBLE SOLID LINE PAINT	L F	5547	$ 1.25	$ 6,933.75
43	2582.503	4" SOLID LINE PAINT	L F	5398	$ 0.75	$ 4,048.50
44	2582.503	6" SOLID LINE PAINT	L F	504	$ 1.25	$ 630.00
45	2582.503	24" SOLID LINE PAINT	L F	311	$ 3.00	$ 933.00
46	2582.518	PAVT MSSG PAINT	S F	610	$ 6.00	$ 3,660.00
					CONSTRUCTION TOTAL	**$ 1,293,083.14**
					CONTINGENCY TOTAL (8%)	**$ 103,446.65**
					SUBTOTAL	**$ 1,396,529.79**
					INDIRECT COST TOTAL (25%)	**$ 349,132.45**
					TOTAL	**$ 1,745,662.24**
B. Storm Sewer Improvements						
47	2021.501	MOBILIZATION	LS	1	$ 8,746.75	$ 8,746.75
48	2101.502	CLEARING	EACH	1	$ 500.00	$ 500.00
49	2101.502	GRUBBING	EACH	1	$ 400.00	$ 400.00
50	2104.502	REMOVE CASTING	EACH	9	$ 250.00	$ 2,250.00
51	2104.502	REMOVE DRAINAGE STRUCTURE	EACH	8	$ 600.00	$ 4,800.00
52	2104.503	REMOVE SEWER PIPE (STORM)	L F	111	$ 20.00	$ 2,220.00
53	2106.601	DEWATERING	LS	1	$ 10,000.00	$ 10,000.00
54	2503.503	15" RC PIPE SEWER CLASS V	L F	111	$ 65.00	$ 7,215.00
55	2503.503	18" RC PIPE SEWER CLASS V	L F	30	$ 70.00	$ 2,100.00
56	2503.602	CONNECT INTO EXISTING DRAINAGE STRUCTURE	EACH	3	$ 2,000.00	$ 6,000.00
57	2506.502	ADJUST FRAME & RING CASTING	EACH	45	$ 650.00	$ 29,250.00
58	2506.502	CASTING ASSEMBLY	EACH	12	$ 950.00	$ 11,400.00
59	2506.503	CONST DRAINAGE STRUCTURE DES 48-4020	L F	32	$ 900.00	$ 28,800.00
60	2506.602	6" TOP SLAB FOR 48-4020 STRUCTURE	EACH	5	$ 2,000.00	$ 10,000.00
61	2506.602	6" TOP SLAB FOR 60-4020 STRUCTURE	EACH	2	$ 2,200.00	$ 4,400.00
62	2506.602	CHIMNEY SEAL	EACH	4	$ 275.00	$ 1,100.00
63	2506.602	CONST DRAINAGE STRUCTURE DESIGN SPEC (2'X3')	EACH	3	$ 2,500.00	$ 7,500.00
64	2506.602	FILL STRUCTURE SUMP	EACH	11	$ 400.00	$ 4,400.00
65	2506.602	GROUT CATCH BASIN OR MANHOLE	EACH	98	$ 300.00	$ 29,400.00
66	2573.502	STORM DRAIN INLET PROTECTION	EACH	88	$ 150.00	$ 13,200.00
					CONSTRUCTION TOTAL	**$ 183,681.75**

					CONTINGENCY TOTAL (8%)	**$ 14,694.54**
					SUBTOTAL	**$ 198,376.29**
					INDIRECT COST TOTAL (25%)	**$ 49,594.07**
					TOTAL	**$ 247,970.36**
C. Sanitary Sewer Improvements						
67	2021.501	MOBILIZATION	LS	1	$ 1,611.50	$ 1,611.50
68	2104.502	REMOVE CASTING	EACH	1	$ 230.00	$ 230.00
69	2506.502	ADJUST FRAME & RING CASTING	EACH	33	$ 750.00	$ 24,750.00
70	2506.502	CASTING ASSEMBLY	EACH	1	$ 1,300.00	$ 1,300.00
71	2506.602	CHIMNEY SEAL	EACH	34	$ 175.00	$ 5,950.00
					CONSTRUCTION TOTAL	**$ 33,841.50**
					CONTINGENCY TOTAL (8%)	**$ 2,707.32**
					SUBTOTAL	**$ 36,548.82**
					INDIRECT COST TOTAL (25%)	**$ 9,137.21**
					TOTAL	**$ 45,686.03**
D. Watermain Improvements						
72	2021.501	MOBILIZATION	LS	1	$ 1,649.75	$ 1,649.75
73	2105.610	EXPLORATORY EXCAVATION	HOUR	10	$ 500.00	$ 5,000.00
74	2106.601	DEWATERING	LS	1	$ 3,000.00	$ 3,000.00
75	2451.507	GRANULAR BEDDING	C Y	10	$ 250.00	$ 2,500.00
76	2504.602	ADJUST VALVE BOX	EACH	27	$ 185.00	$ 4,995.00
77	2504.602	BOLT & VALVE BOX REPLACEMENT - VALVE	EACH	2	$ 3,500.00	$ 7,000.00
78	2504.602	VALVE BOX SECTION	EACH	14	$ 750.00	$ 10,500.00
					CONSTRUCTION TOTAL	**$ 34,644.75**
					CONTINGENCY TOTAL (8%)	**$ 2,771.58**
					SUBTOTAL	**$ 37,416.33**
					INDIRECT COST TOTAL (25%)	**$ 9,354.08**
					TOTAL	**$ 46,770.41**
					GRAND TOTAL	**$ 2,086,089.04**

DISCLAIMER:

In review of this Opinion of Probable Cost, the Client understands that the Consultant has no control over the availability of labor, equipment or materials, market conditions, or the Contractor's method of pricing. This Opinion of Probable Cost is made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied, regarding the ultimate bids or negotiated cost of the Work.

Appendix C

Draft Geotechnical Report, Braun Intertec

Geotechnical Evaluation Report

City of Lakeville 25-02 – Street Reconstruction
Lakeville, Minnesota

Prepared for

City of Lakeville

Professional Certification:
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.

Richard S. Jett, PE
Project Engineer
License Number: 58781
October 10, 2024

Project B2407625

Braun Intertec Corporation

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

October 10, 2024 Project B2407625

Mr. Steve Ferraro
City of Lakeville
20195 Holyoke Avenue
Lakeville, MN 55044

Re: Geotechnical Evaluation Report
City of Lakeville 25-02 – Miscellaneous Overlays
Lakeville, Minnesota

Dear Mr. Ferraro:

We are pleased to present this Geotechnical Evaluation Report for the above-referenced project. The following report provides the results of our evaluation and should be read in its entirety.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Richard Jett at 815.545.7059 (rjett@braunintertec.com) or Matt Ruble at 952.995.2000 (mruble@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Richard S. Jett, PE
Project Engineer

Matthew P. Ruble, PE
Vice President, Principal Engineer

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Description **Page**

Table of Contents (continued)

Description **Page**

Appendix

A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and rehabilitation of various local roadways throughout the City of Lakeville, Minnesota. As part of City of Lakeville Project 25-02, this project will include rehabilitation of the following bituminous roadways using Mill and Overlay techniques:

- **Glacier Way** from 175th Street West to 179th Street West
- **Gerdine Path** from Dodd Boulevard to 179th Street West
- **Gettysburg Way / Gillette Way** from 175th Street to 175th Street
- **Glasgow Avenue** from Dodd Boulevard to Glacier Way
- **Glasgow Way** from Glacier Way to Glasgow Avenue
- **178th Street** from Glacier Way to Glasgow Way
- **177th Street** from Glacier Way to Glasgow Way
- **175th Street West** from Glasgow Avenue to Glacier Way
- **Galle Court** from Gerdine Path to Cul-De-Sac

In addition, the following roadways will be rehabilitated using full depth reclamation techniques:

- **Hayes Avenue / 170th Street West** from 175th Street West and Cedar Avenue
- **Harbor Court** from 170th Street West to Cul-De-Sac

We also understand that the existing watermain beneath a portion of 170th Street from Cedar Avenue to Hayes Avenue will be replaced as part of this project.

Table 1 outlines descriptions of the existing roadways.

Table 1. Existing Roadway Descriptions

Roadway	Roadway Designation	Average Annual Daily Traffic (AADT)
Hayes Avenue / 170th Street West	Urban Minor Collector	3,336 (2023)
Harbor Court	Residential	Less than 600
Glacier Way	Urban Major Collector	4,651 (2021)
Gerdine Path	Urban Minor Collector	1941 (2023)
Galle Court	Residential	Less Than 600

Roadway	Roadway Designation	Average Annual Daily Traffic (AADT)
Gettysburg Way / Gillette Way	Residential	Less Than 600
Glasgow Way	Residential	Less than 600
177th Street	Residential	Less Than 600
178th Street	Residential	Less Than 600
Glasgow Avenue	Residential	Less Than 600
175th Street West	Residential	Less Than 600

Figure 1 below show an illustration of the existing roadway alignments.

Figure 1. Existing Roadway Layout – City of Lakeville 25-02

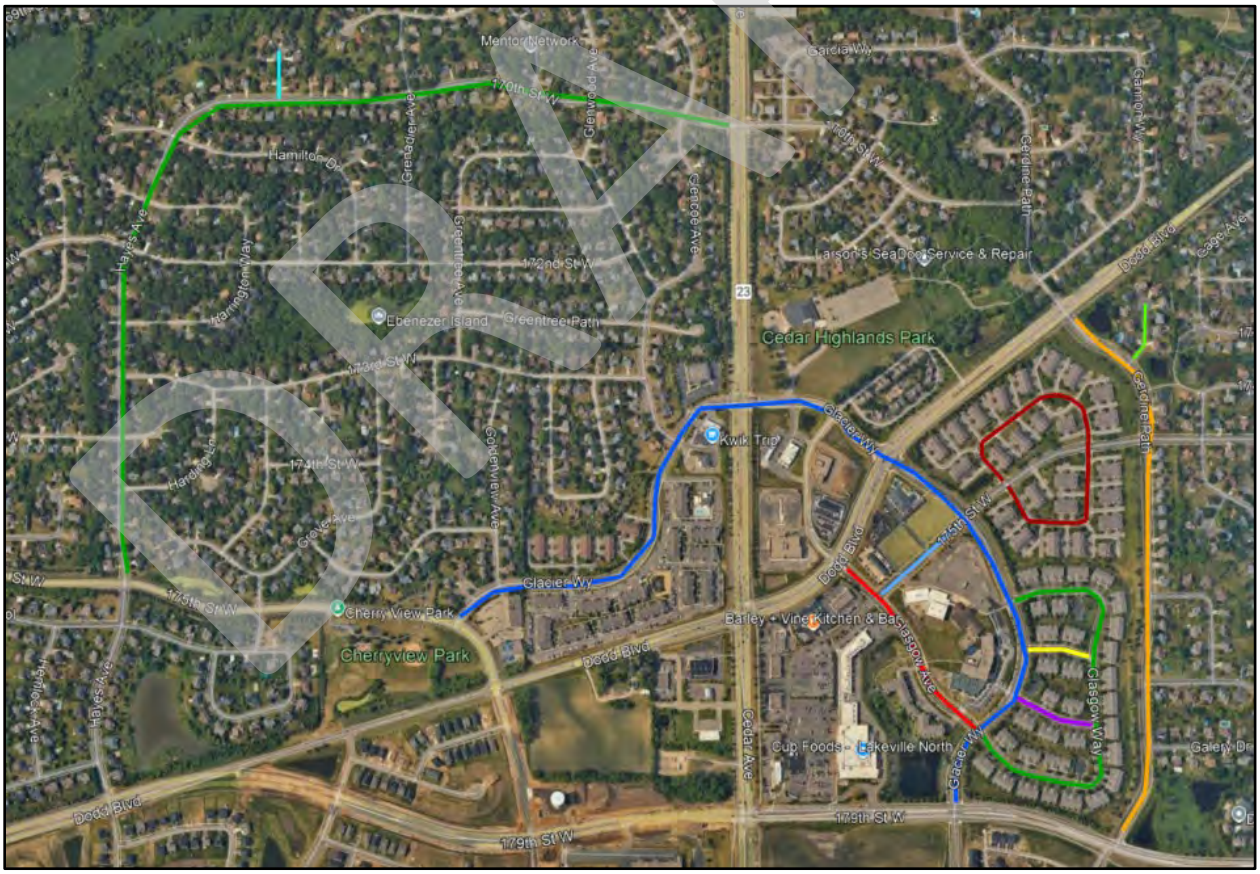


Figure taken from Google Earth. Hayes Avenue / 170th street is marked in green, Harbor Courtis marked in teal, Glacier Way is marked in blue, Gerdine Path is marked in orange, Glasgow Avenue is marked in red, Glasgow way is marked in dark green, 178th Street is marked in purple, 177th Street is marked in yellow, 175th Street West is marked in light blue, Galle Court is marked in light green, and Gettysburg Way / Gillette Way are marked in dark red.

A.2. Site Conditions and History

A majority of the roadways are generally classified as low volume residential roadways with a few exceptions. Hayes Avenue / 170th Street and Gerdine Path are generally classified as a Minor Urban Collector with Glacier Way classified as a Major Urban Collector. All roadways included within this project are bituminous. We understand that these roadways are currently maintained under the existing City of Lakeville street maintenance program.

A.3. Purpose

The purpose of the geotechnical services was to characterize existing pavement conditions throughout the proposed corridors and provide geotechnical recommendations for use in the design and rehabilitation of the outlined roadways.

A.4. Background Information and Reference Documents

We reviewed the City of Lakeville 25-02 Project Map, provided by the City of Lakeville (undated). In addition, we have used several publicly available sources of information including topography maps obtained from the Minnesota Department of Natural Resources (MnTOPO website) and Google Earth aerial photographs.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses, and/or recommendations.

A.5. Scope of Services

We performed our scope of services for the project in accordance with our Proposal for a Geotechnical Evaluation (QTB200001) dated July 30, 2024. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.

- Staking and clearing the exploration location of underground utilities. The City of Lakeville selected, and we staked the exploration locations. The Soil Boring and Pavement Core sketch included in the Appendix shows the approximate locations of the pavement cores and soil borings.

- Performing Gound Penetrating Radar (GPR) scans in both travel directions along the length of each roadway included in this project.

- Performing five Standard Penetration Test (SPT) soil borings, denoted as ST-1 through ST-5, to depths ranging from approximately 5 to 15 feet below existing grade along Hayes Avenue / 170th Street.

- Performing 24 pavement cores and shallow power auger borings, denoted as C-1 through C-24, near the client-designated locations throughout the remaining project areas. Our original scope of 22 pavement cores was increased to 24 pavement cores at the clients request shortly after the start of the project.

- Performing eight (8) companion pavement cores, designated as C-1a, C-3a, C-11a, C-13a, C-14a, C-16a, C-19a, and C-21a, near the curbline of the roadways.

- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this report containing a soil boring and pavement core location sketch, pavement core photographs, a summary of the soils and pavements encountered, results of laboratory tests, recommendations for rehabilitation of the existing pavements, and recommendations for use in the design and construction of water main replacement.

Our scope of services did not include environmental services or testing and our geotechnical personnel performing this evaluation are not trained to provide environmental services or testing. We can provide environmental services or testing at your request.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Soil Boring Results

Table 2 provides a summary of the soil boring results in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 2.

Table 2. Subsurface Profile Summary – ST-1 through ST-5

Strata	Soil Type - ASTM Classification	N values	Commentary and Details
Pavement section	N/A	N/A	▪ Observed at all five soil boring locations with total pavement thicknesses ranging from approximately 12 1/2 to 16 inches. ▪ Bituminous thicknesses ranged from approximately 6 1/2 to 9 inches. ▪ Apparent aggregate base thicknesses ranged from approximately 4 to 9 inches.
Fill	SM, SC, CL	6 to 25	▪ Observed at the boring locations below the pavements and extended to depths ranging from approximately 10 to 11 feet below existing grade. ▪ Borings ST-4 and ST-5 terminated within the fill zone. ▪ Moisture conditions were generally moist. ▪ Generally consisted of brown to dark brown clay and silt laden soils. ▪ Apparent hydrocarbon odor (detected by human perception only) was observed in Boring ST-4. ▪ Variable amounts of gravel; may contain cobbles and boulders.

Strata	Soil Type - ASTM Classification	N values	Commentary and Details
Glacial deposits	CL, SM	7 to 35	▪ Observed in Borings ST-1 through ST-3 below the pavements and fill soils and extended to the termination depths of these borings. ▪ Generally light brown to brown in color. ▪ Relative consistencies of the clay soils were generally stiff to hard. ▪ Relative densities of the silty sand soils were generally loose to medium dense. ▪ Variable amounts of gravel; may contain cobbles and boulders. ▪ Moisture conditions were generally moist to wet.

We did not perform gradation analysis on the apparent aggregate base material encountered as part of the pavement section, in accordance with our scope of work. Therefore, we cannot conclusively determine if the encountered material satisfies a particular specification.

For simplicity in this report, we define existing fill to mean existing, uncontrolled, or undocumented fill.

B.3. Pavement Coring and Power Auger Results

Table 3 outlines the results of our pavement coring and power auger borings performed as part of this project.

Table 3: Pavement Coring and Power Auger Summary

Location	Associated Roadway	Bituminous Thickness (inches)	Apparent Aggregate Base Thickness (inches)	Subgrade Soils	Pavement Core Conditions
ST-1	Hayes Avenue / 170th Street	7	9	SM	N/A
ST-2	Hayes Avenue / 170th Street	6 1/2	6	SP	N/A
ST-3	Hayes Avenue / 170th Street	8	8	CL	N/A
ST-4	Hayes Avenue / 170th Street	6 1/2	7	CL	N/A
ST-5	Hayes Avenue / 170th Street	9	4	CL	N/A

Location	Associated Roadway	Bituminous Thickness (inches)	Apparent Aggregate Base Thickness (inches)	Subgrade Soils	Pavement Core Conditions
C-1	Hayes Avenue / 170th Street	3 1/2	9 1/2	SM	Moderate stripping and raveling
C-1a	Hayes Avenue / 170th Street	4	---	---	Moderate stripping and raveling
C-2	Hayes Avenue / 170th Street	6 1/4	6 1/4	SC	Moderate stripping and raveling, debonded
C-3	Hayes Avenue / 170th Street	7	6 3/4	CL	Moderate stripping, debonded
C-3a	Hayes Avenue / 170th Street	5 3/4	---	---	Moderate stripping, debonded
C-4	Hayes Avenue / 170th Street	6 3/4	16	SC	Severe stripping and raveling, debonded
C-5	Glacier Way	4 1/4" bituminous over 4 1/2" rehydrated concrete	3 1/4	SC	Good condition, 4 1/2" of rehydrated concrete observed below the bituminous layer
C-6	Glacier Way	3 3/4" bituminous over 9 1/2" rehydrated concrete	0	SP-SM	Good condition, 9 1/2" of rehydrated concrete observed below the bituminous layer
C-7	Glacier Way	3 1/2	8	SM	Good condition
C-8	Glacier Way	3 1/2	8	SM	Moderate stripping and severe raveling
C-9	Glacier Way	3 1/4	8	SM	Severe stripping and raveling, debonded
C-10	Glacier Way	4	10 1/2	SM	Good condition
C-11	Glasgow Avenue	3 1/4	13 1/4	SP-SM	Mild stripping
C-11a	Glasgow Avenue	3 3/4	---	---	Mild stripping
C-12	175th Street	4	6	SP-SM	Mild stripping
C-13	Gillette Way / Gettysburg Way	4 1/2	5 1/2	SM	Severe stripping and raveling, debonded
C-13a	Gillette Way / Gettysburg Way	4	---	---	Severe stripping and raveling, debonded
C-14	Gillette Way / Gettysburg Way	3	14	SM	Good condition
C-14a	Gillette Way / Gettysburg Way	3 1/2	---	---	Mild stripping
C-16	Glasgow Way	4	6 3/4	SM	Moderate raveling, mild stripping
C-16a	Glasgow Way	4	---	---	Debonded, mild stripping, moderate raveling
C-19	Glasgow Way	4 1/4	8 1/4	SP-SM	Mild stripping

Location	Associated Roadway	Bituminous Thickness (inches)	Apparent Aggregate Base Thickness (inches)	Subgrade Soils	Pavement Core Conditions
C-19a	Glasgow Way	4 1/4	---	---	Moderate stripping and raveling, debonded, 2" of rehydrated concrete observed below the bituminous layer
C-17	177th Street	3 1/2" bituminous over 6 1/2" rehydrated concrete	11 1/2	SM	Good condition, 6 1/2" of rehydrated concrete observed below the bituminous layer
C-18	178th Street	3 3/4" bituminous over 3 3/4" rehydrated concrete	16 1/2	SP-SM	Mild stripping, 3 3/4" of rehydrated concrete observed below the bituminous layer
C-15	Gerdine Path	3 3/4	5 1/4	SM	Moderate raveling
C-20	Gerdine Path	4	8 1/4	SP-SM	Moderate stripping, debonded
C-21	Gerdine Path	4" bituminous over 2" rehydrated concrete	10 3/4	SP	Mild stripping, 2" of rehydrated concrete observed below the bituminous layer
C-21a	Gerdine Path	4	---	---	Debonded, severe raveling
C-22	Gerdine Path	4 1/4" bituminous over 4" rehydrated concrete	3 3/4	SM	Severe stripping, moderate raveling, 4" of rehydrated concrete observed below the bituminous layer
C-23	Harbor Court	3 1/2	4 1/4	SC	Moderate stripping
C-24	Galle Court	3 1/2	3	SP	Good condition, 2" of rehydrated concrete observed below the bituminous layer

B.4. Groundwater

Groundwater was observed at two of the completed five SPT soil borings (Borings ST-1 and ST-2) at depths of approximately 13 feet below existing grade (approximate elevations of 965 and 959 1/2 feet respectively). Groundwater was not observed in the remaining soil borings or power auger borings performed as part of this project and the static groundwater level is likely below the depths explored at these locations. If the project team identifies a need for more accurate determination of groundwater depth, we can install piezometers and complete a groundwater monitoring program. Project planning should anticipate seasonal and annual fluctuations of groundwater.

Given the presence of silt and clay laden soils encountered throughout complete soil borings, the project team should anticipate that perched groundwater may be a concern in this area. The project team should anticipate that perched groundwater may be encountered during construction and should have a plan in place to manage any encountered perched groundwater.

B.5. Laboratory Test Results

Table 4 outlines the results of the laboratory testing program completed on the recovered soil samples within the SPT soil borings and subgrade samples from the pavement core locations.

Table 4. Laboratory Test Summary

Laboratory Test	Range of Results
Moisture content (MC) tests, percent (per ASTM D2216)	Sandy Soils: 3 to 15 percent moisture Clay Soils: 7 to 26 percent moisture
Percent of particles passing the #200 Sieve, percent (per ASTM D1140)	6 to 62 percent particles

In addition to the above laboratory testing program, we also completed corrosivity testing with composite subgrade samples obtained from both Borings ST-1 and ST-3 at a depth of approximately 5 to 10 feet below existing grade. The results of these laboratory testing suites, performed by Project X Corrosion Engineers, indicated that the subgrade soils in both borings are considered mildly to highly corrosive according to the National Academy of Corrosion Engineers (NACE). Full results of the laboratory tests are included in the appendix.

B.6. Ground Penetrating Radar (GPR) Results

GPR was used to approximate pavement layer thicknesses along each of the roadways for this project. The data was collected at a nominal 1-foot interval in both directions of travel. Where “ground truth” (soil boring) data was obtained, the interpreted layers from the GPR scan were compared directly to the measured thicknesses to validate the accuracy of the GPR analysis.

Based on our analysis using the RADAN software program, Table 5 provides the interpreted average pavement layer thicknesses and statistical data for the roadways in this project. The graphs in the Appendix show the interpreted layer depth per foot along the roadway. We recommend referring to these graphs to see how thicknesses vary.

Table 5. Statistics of GPR-Estimated Bituminous Pavement Thicknesses

Segment	Direction	Bituminous Thickness (inches)				
		Avg	Std Dev	Min[1]	Max	10th Pctl
175th Street West	EB	4.6	0.6	3.0	7.0	3.8
	WB	4.2	0.6	2.9	6.6	3.5
177th Street West	EB	3.3	0.4	2	4.3	2.9
	WB	3.9	0.6	3.0	5.5	3.2
178th Street	EB	3.5	0.4	2.7	4.8	3.1
	WB	3.6	0.4	2.7	4.7	3.2
Galle Court	NB	3.9	0.4	1.4	4.9	3.5
	SB	3.6	0.4	2.9	5.0	3.2
Gerdine Path	NB	3.8	0.5	2.5	5.9	3.3
	SB	4.0	0.6	1.8	6.9	3.4
Gillette Way	EB	3.8	0.6	2.5	7.5	3.8
	WB	3.7	0.8	2.3	8.2	2.9
Glacier Way	EB	4.2	1.0	1.7	11.2	3.4
	WB	4.3	1.2	1.7	13.4	3.5
Glasgow Way	NB	3.8	0.4	2.8	6.0	3.4
	SB	3.8	0.5	2.1	7.5	3.2
Glasgow Avenue	NB	4.1	0.4	2.8	5.6	3.6
	SB	4.4	0.5	2.9	6.5	3.9
Harbor Court	NB	4.2	0.6	3.0	5.7	3.5
	SB	4.3	0.6	2.8	6.3	3.6
Hayes Avenue	NB	5.6	0.8	3.2	9.2	4.7
	SB	5.7	1.0	1.8	11.8	4.6

1. Minimum values can be extreme outliers resulting from noise and other erroneous readings. We recommend using 10th percentile values and consulting the graphics attached to this report.

Substantial ambient interference of the GPR signal made it difficult to interpret layer transitions below those of the bituminous layer. As such, a second layer (likely aggregate base) was generally not visible consistently throughout the project alignment. A lack of a visible layer in the GPR scan does not imply an absence of one within the pavement section. Our borings and pavement cores suggested a probable aggregate base layer within the pavement section.

C. Recommendations

C.1. Design and Construction Discussion

C.1.a. Overview

We understand that a portion of the project roadways (Hayes Avenue/ 170th Street West and Harbor Court) will be rehabilitated using full depth reclamation (FDR) techniques and the remaining project roadways (Glacier Way, Gerdine Path, Glasgow Avenue, Glasgow Way, 178th Street, 177th Street, 175th Street, Galle Court, and Gillette Way) will be rehabilitated using Mill and Overlay techniques. Traffic information used for our analysis is included in Section A.1.

C.1.b. Full Depth Reclamation

Based on the results of the pavement cores, shallow hand auger borings, SPT soil borings, and ground penetrating radar scans performed along the Hayes Avenue / 170th Street West and Harbor Court, these roadways are generally considered suitable for rehabilitation using FDR techniques.

In general, the soil borings and power auger borings performed along Hayes Avenue / 170th Street encountered bituminous pavements ranging from approximately 4 to 8 inches (10th percentile thicknesses of GPR scans observed was 4.6 and 4.7 inches) with apparent aggregate base thicknesses ranging from approximately 4 to 16 inches and total pavement section thicknesses generally ranging from approximately 12 to 16 inches.

Power auger borings and GPR scans performed along Harbor Court indicated a bituminous pavement thickness of 3 1/2 inches (10th percentile thicknesses of GPR scans observed was 3.5 and 3.6 inches) with apparent aggregate base thickness of approximately 4 1/4 inches with a total pavement section thickness of approximately 7 3/4 inches.

Based on these results, Hayes Avenue / 170th Street appears suitable for rehabilitation via FDR techniques. Harbor Court, however, does not appear suitable due to its relatively thin existing pavement section. We recommend that Harbor court be rehabilitated using shallow mill and overlay techniques.

C.1.c. Mill & Overlay

Based on the results of our pavement cores, shallow power auger borings, and ground penetrating radar (GPR) scans, the roadways included within the City of Lakeville CP 25-01, as outlined in Section A.1. are generally considered suitable for rehabilitation using mill and overlay techniques.

The encountered bituminous thicknesses, through both pavement cores and GPR scans, generally averaged between 3 and 4 inches with isolated zones of thicker or thinner bituminous pavement. The project team should anticipate that a mill depth of approximately 2 inches with a 2-inch overlay can be performed across these project areas. It should be noted that mill depths will likely need to be adjusted during milling in areas where debonding was encountered. We do not generally recommend a mill depth deeper than 2 inches unless a full depth mill is being performed or in localized areas where debonding occurred deeper than 2 inches below the existing pavement surface. Cores C-13A, C-16A, and C-19A found at Gilette Way and Glasgow Way had debonding with competent base thicknesses less than 2 inches in thickness and represent more difficult situations for mill and overlay.

In general, a majority of the project areas exhibited pavements which were in good to fair condition with mild to moderate stripping, raveling and debonding within the top 1 1/2 inches of existing pavement.

A detailed evaluation of pavement surface conditions, which will influence the suitability and service life of the overlay, was outside of the scope of our evaluation. This will be the primary factor influencing the performance of the selected rehabilitation option. The risk and additional cost of repairs with additional milling and/or excavation to reach a suitable surface for overlay placement must also be considered. In general, this will include areas with surface distresses such as fatigue/alligator distress and edge cracks. We recommend further reviewing the condition data from the city's pavement management system for signs that these types of distresses are prevalent within the project area.

C.2. Site Grading and Excavations

C.2.a. Overview

We understand that the roadways included in this project will be rehabilitated using either FDR or mill and overlay techniques with limited subgrade corrections as needed in areas which exhibit poor subgrade soils. However, we also understand that a portion of Hayes Avenue / 170th Street between ST-1 and ST-3 will also include a full replacement of the existing water utilities and subsequent reconstruction of the roadway above.

C.2.b. Pavement Subgrade Preparation

In areas where new water utilities are being installed and the existing pavement subgrade is disturbed, we recommend the following steps for pavement subgrade preparation. We recommend roadway construction be completed in accordance with MnDOT Specification 2106.

1. Reclaim and stockpile the top 10 inches of pavement section as outlined in Section C.3.a.

2. Remove the exposed unsuitable soils, including organic soils, soft clay soils, from below the proposed pavement grade following installation of the water main utility. Soils used as engineered backfill should be moisture conditioned, placed, and compacted as outlined in Section C.2.g.

3. Have a geotechnical representative observe the excavated subgrade to evaluate if additional subgrade improvements are necessary. Hand auger borings and dynamic cone penetrometer testing should be completed on the exposed subgrade prior to the placement of new engineered fill.

4. Slope subgrade soils to allow the removal of accumulating water.

5. Test roll the exposed subgrade as described in Section C.2.c. Areas that yield or rut in excess of project requirements should be corrected.

6. Test roll the final subgrade, following placement of reclaimed aggregate base material, as described in Section C.2.c.

C.2.c. Pavement Subgrade Test Roll

After preparing the subgrade as described above and prior to the placement of the aggregate base, we recommend test rolling the subgrade soils with a fully loaded tandem-axle truck. We also recommend having a geotechnical representative observe the test roll. Areas that fail the test roll likely indicate soft or weak soils that will require additional correction work to support pavements.

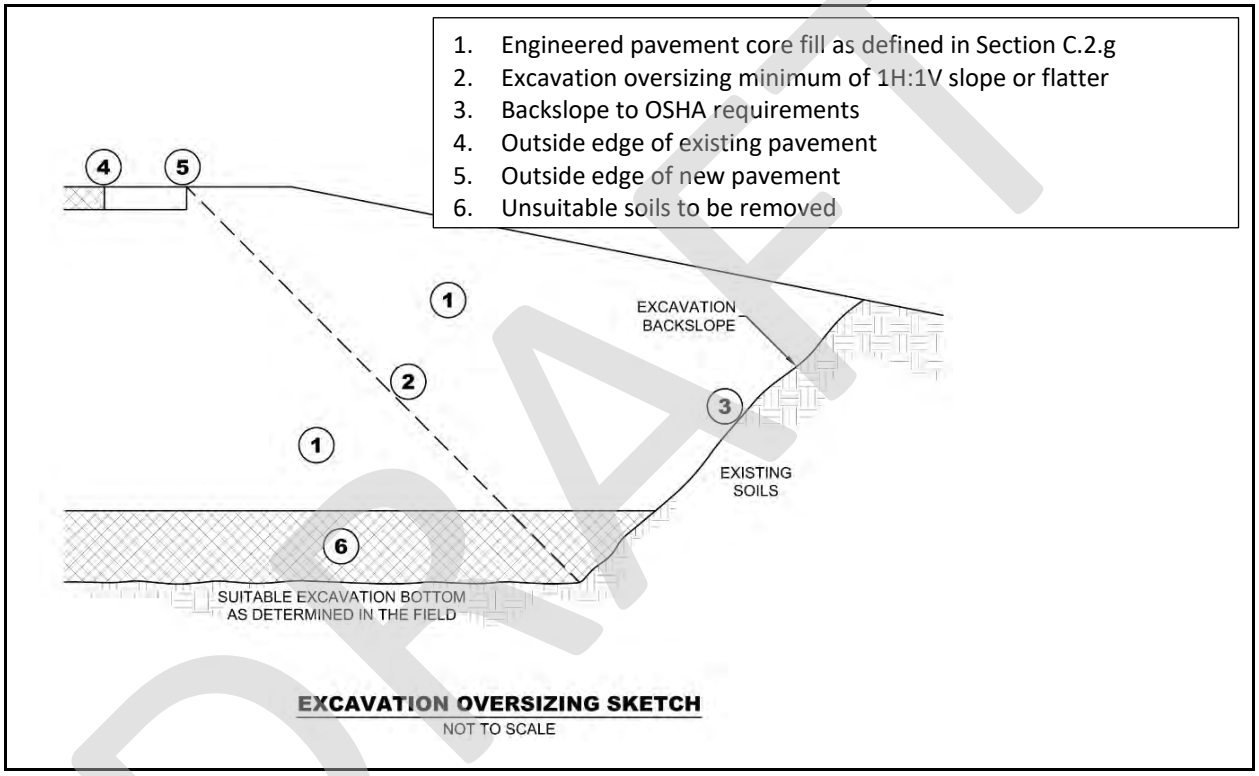
The contractor should correct areas that fail to meet the test roll acceptance criteria. Possible options for subgrade correction include moisture conditioning and recompaction, subcutting and replacement with soil or crushed aggregate, and/or geotextiles. We recommend performing a second test roll after the aggregate base material is in place, and prior to placing bituminous pavement.

We recommend performing test rolls in accordance with MnDOT Specification 2111.

C.2.d. Excavation Oversizing

When removing unsuitable materials below pavements for utility installation, we recommend the excavation extend outward and downward at a slope of 1H:1V or flatter. See Figure 2 for an illustration of excavation oversizing.

Figure 2. Generalized Illustration of Oversizing



C.2.e. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations for utility installations will consist of silt and clay-laden fill soils. These soils are typically considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1 1/2H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, “Excavations and Trenches.” This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

C.2.f. Excavation Dewatering

We do not anticipate that static groundwater will be encountered during project excavations. If perched water or accumulated runoff water is encountered, we recommend it is removed from the excavations to facilitate proper backfilling and concrete placement. If needed, project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays.

C.2.g. Engineered Fill Materials and Compaction

Table 6 contains our recommendations for engineered fill materials and compaction specifications.

Table 6. Recommended Fill and Compaction Specifications*

Material	Material Specification	Compaction Specification
New road core fill (<3 feet below Grading Grade of Road Core)	Select Grading Material MnDOT 2106.1.B.1	MnDOT 2106.3.G.1
New road core fill (>3 feet below Grading Grade of Road Core)	Select Grading Material MnDOT 2106.1.B.1	MnDOT 2106.3.G.1
Below landscaped surfaces, where subsidence is not a concern	Non-Structural Grading Material MnDOT 2106.1.B.8	MnDOT 2106.3.G.2

*More select soils comprised of coarse sands with < 5% passing #200 sieve such as MnDOT 3149.2G Fine Filter Aggregate may be needed to accommodate work occurring in periods of wet or freezing weather.

In areas of where new engineered fill is placed as pavement subgrade, new engineered fill soils should be consistent with the classification, moisture content, and performance characteristics of the soils with those in the upper 5 feet of the existing road core.

We recommend placing engineered fill in accordance with MnDOT Specification 2106. We recommend compacting engineered fill in accordance with the MnDOT specifications listed in Table 6. The project documents should specify relative compaction of engineered fill, based on the structure located above the engineered fill, and vertical proximity to that structure.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under pavements during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.3. Pavements

C.3.a. Rehabilitation via Full Depth Reclamation (FDR)

Based on the results of our completed soil borings and GPR scans, we anticipate the existing Hayes Avenue / 170th Street generally consists of approximately 4 to 8 inches of bituminous pavement over an aggregate base layer with a thickness of approximately 4 to 16 inches (total pavement thicknesses ranging from approximately 12 to 16 inches). In our opinion, the GPR data representing the 10th percentile of values will provide a general representation of the existing pavement section. For reference, the 10th percentile of the recorded GPR data provides a bituminous thickness of approximately 4 1/2 inches.

In our opinion, a reclamation with a depth of 10 inches can generally be used along Hayes Avenue / 170th Street. Based on the pavement measurements from the completed soil borings and power auger borings, these reclamation depths will generally avoid subgrade soils through much of Hayes Avenue / 170th Street. In areas where subgrade may be penetrated due to an isolated area of thin aggregate base, the reclamation depth may need to be adjusted. Variation of existing pavement depth should be anticipated across the alignment, which will require adjustment of the reclaim depth.

We recommend implementing through quality control practices, including frequent sieve analyses, to achieve a desirable gradation of the reclaimed material. The gradation requirements of MnDOT Specification 2215 (Reclamation) or Specification 3138 (Aggregate for Surface and Base Courses) can be used for the aggregate base; the latter specification's controls on gradation and asphalt content are stricter and will generally be more difficult to meet. We suggest that the contractor assume some contingency for importing clean, crushed rock that can be blended with the reclaimed material to improve the uniformity of the resulting gradation prior to reuse as an aggregate base.

Minor soil corrections may be needed in areas where subgrade instabilities are exhibited during the test roll prior to the placement of bituminous.

As previously outlined, the thinner total pavement sections found at Harbor Court make that roadway less desirable for FDR.

C.3.b. Rehabilitation via Mill and Overlay

A detailed visual assessment of the pavement surface condition was not included in the scope of this evaluation. However, based on the completed pavement cores and power auger borings performed along the roadways as outlined in Section A.1, it appears the cores were generally in fair to moderate condition

with some stripping raveling and debonding. We recommend an experienced engineer walk the milled surface to delineate areas for these repairs based on conditions exposed by the milling process.

As typical for an overlay, reflective cracking will occur quickly, and crack sealing and other maintenance will be necessary. We recommend a mill thickness of 2 inches, with the replacement mix meeting SPWEA340C. We do not recommend that the mill thickness select for the project exceed 2 inches, as there are specific areas where the existing pavement has more significant stripping or a generally thinner bituminous section where the entire bituminous section may be milled (namely along portions of Glacier Way and Gillette Way). The mill and overlay should proceed in general accordance with MnDOT Specifications 2232 and 2360.

The surface condition prior to milling can also indicate where repairs may be necessary. This includes distresses such as severe longitudinal and transverse cracking, alligator/fatigue cracking of any severity, potholes, and other similar failures. MnDOT defines these distresses in their surface rating procedure as follows:

- High-severity transverse cracking: Any crack running transverse to the centerline of the roadway with significant adjacent random cracking (12 inches or more apart), have large areas of spalling, missing material, and/or potholes.

- High-severity longitudinal cracking: Any crack running parallel to the centerline of the roadway with significant adjacent random cracking (12 inches or more apart), large areas of spalling, missing material, and/or potholes.

- Alligator cracking: A series of interconnected cracks forming many-sided, sharp-angled pieces, 6 inches or less in size typically located in the wheel paths or where traffic loads are concentrated.

C.3.c. Design Sections

Our scope of services for this project did not include laboratory tests on subgrade soils along Hayes Avenue / 170th Street to determine an R-value for pavement design. Based on our experience with similar soils anticipated at the pavement subgrade elevation, we recommend pavement design assume an R-value of 15. Note the contractor may need to perform limited removal of unsuitable or less suitable soils to achieve these values. Table 7 provides minimum recommended pavement sections, based on the soils support and traffic loads, for the bituminous pavement section with reclaimed aggregate base. It should be noted that we used historical AADT counts and the State Aid 10-Ton ESAL Traffic Forecast

Calculator to provide an ESAL forecast of 582,000 for Hayes Avenue / 170th Street. This assumes a growth of 4.4 percent with a truck traffic volume of 4 percent.

Table 7. Recommended Bituminous Pavement Section – Reclaimed Pavement

Material	Thickness (inches)	Designation	Specification
Bituminous	4	SPWEA340C	2360
FDR*	6	Class 5 or 6, modified aggregate base	3138 or 2215
Existing aggregate base	2+	---	---

*Thickness of FDR material will vary based on reclamation depth

C.3.d. Subgrade Drainage

Based on the possible presence of perched groundwater conditions, subgrade drainage will be vital for a high performing pavement. In areas where the pavement is being removed, we recommend installing perforated drainpipes throughout pavement areas at low points, around catch basins, and behind curb. In areas where saturated subgrade soils are encountered during excavations or anticipated based on the results of the test roll, we recommend that additional drain tile may be installed to manage perched groundwater in these areas.

C.3.e. Performance and Maintenance

We based the pavement design in Section C.3.c. on a 20-year performance life for pavements. This is the amount of time before we anticipate the pavement will require major rehabilitation. This performance life assumes routine maintenance, such as seal coating and crack sealing. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

It is common to place the non-wear course of bituminous and then delay placement of wear course. For this situation, we recommend evaluating if the reduced pavement section will have sufficient structure to support construction traffic.

Many conditions affect the overall performance of the pavements. Some of these conditions include the environment, loading conditions and the level of ongoing maintenance. With regard to bituminous pavements in particular, it is common to have thermal cracking develop within the first few years of placement and continue throughout the life of the pavement. We recommend developing a regular maintenance plan for filling cracks in exterior slabs and pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade.

C.4. Utilities

C.4.a. Subgrade Stabilization

For watermain construction, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils, or perched water at invert grades, the unsuitable soils may require some additional subcutting and replacement with rushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of foundations.

C.4.b. Utility Backfill

We recommend utility trench backfill adhere to the recommendations of Section C.2.g. depending on what overlies the trench. The contractor should anticipate that moisture conditioning of the clays as well as separation of any zones of unsuitable or organic soils will be needed prior to replacement of backfill in utility trenches. We note that moisture conditioning and compaction of clays can be difficult in confined areas such as utility trenches.

C.4.c. Dewatering

If perched groundwater conditions are encountered during excavations for utility installation, we recommend the contractor remove any water that collects in work areas before performing further work. We recommend project planning anticipate temporary excavation dewatering during construction. Project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays. Should static groundwater be encountered, we recommend keeping the groundwater level a minimum of 2 feet below the bottom of excavation to help facilitate a more stable working platform.

C.4.d. Corrosion Potential

As part of our geotechnical analysis, we performed corrosion testing on two select soil samples recovered during drilling operations along Hayes Avenue / 170th Street. The results of the corrosivity testing are presented in the Appendix.

Based on the Corrosion Severity Ratings outlined by the National Association of Corrosion Engineers (NACE), the above results indicate that the on-site clay soils generally range from Mildy Corrosive to Highly Corrosive in their current state. We recommend that metallic conduits and similar metallic structures will need to be protected from corrosion. It should be noted that these test results as outlined in the Appendix are representative of the soil at the specific sample location and may not be representative of other soils at different locations across the site. The corrosivity of the on-site soils at different depths and locations throughout the project site will vary.

D. Procedures

D.1. Penetration Test Borings

We drilled the penetration test borings with a truck-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance to ASTM D1586. The boring logs show the actual sample intervals and corresponding depths. We also collected bulk samples of auger cuttings at selected locations for laboratory testing.

We sealed penetration test boreholes in general accordance with MDH procedures.

D.2. Ground Penetrating Radar

D.2.a. GPR Data Collection

GPR data was collected in August of 2024. GPR collection occurred at posted speed limits and data was recorded continuously along each street (scan interval of 1-foot), in both directions of travel except for cul-de-sac sections. A calibration file, required for data post-processing, was collected at the onset of testing.

D.2.b. GPR Analysis

Data collected by the GPR unit was returned to our office and analyzed to estimate the pavement thickness using RADAN 7.0, a software package included with the GSSI RoadScan system. The software includes tools to delineate pavement layer transitions with thickness estimates based on measured signal time and amplitude.

Where “ground-truth” data (ores) were performed, the interpreted layers from the GPR scan were compared directly to the measured thicknesses from the borings to validate the accuracy of the GPR analysis, with adjustments if necessary to improve accuracy or data clarity.

D.3. Power Auger Borings

We obtained core samples of the pavement using a portable coring machine advancing a 4-inch diameter core barrel. Immediately after completing the coring, we repaired the bituminous pavement with a coldmix bituminous patch. We measured the cores to obtain approximate bituminous thickness and noted their material conditions based on visual observation. The Appendix includes images of the cores.

We performed the power auger borings using a truck mounted auger. We inferred the soil classifications and strata depths from the cuttings brought to the surface by dead pulling the auger after screwing it to selected depths in the ground. At desired depths, we placed auger cuttings in bags and jars.

D.4. Exploration Logs

D.4.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples and groundwater measurements.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.4.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.5. Material Classification and Testing

D.5.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.5.b. Laboratory Testing

The exploration logs in the Appendix note the results of the laboratory tests performed on geologic material samples. We performed the tests in general accordance with ASTM or AASHTO procedures.

D.5.c. Groundwater Measurements

The drillers checked for groundwater after auger withdrawal. We then filled the boreholes as noted on the boring logs.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses, and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation, and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the

designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

DENOTES APPROXIMATE LOCATION OF PAVEMENT CORE

200' 0 400'

SCALE: 1" = 400'

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Drawing Information

Project No:	B2407625
Drawing No:	B2407625
Drawn By:	BJB
Date Drawn:	8/20/24
Checked By:	RSJ
Last Modified:	9/11/24

Project Information

Geotechnical Evaluation

City of Lakeville - 25-02
Street Reconstruction

Lakeville, Minnesota

Soil Boring and Pavement Core Location Sketch

Sheet: 1 of 2

Fig:

DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

DENOTES APPROXIMATE LOCATION OF PAVEMENT CORE

200' 0 400'

SCALE: 1" = 400'

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Project Information

Geotechnical Evaluation

City of Lakeville - 25-02
Street Reconstruction

Lakeville, Minnesota

Soil Boring and Pavement Core Location Sketch

Sheet: 2 of 2

Fig:

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2407625
Geotechnical Evaluation
City of Lakeville - 25-02 Street Reconstruction
Minnesota

BORING: **ST-1**
LOCATION: Captured with RTK GPS.
DATUM: NAD 1983 HARN Adj MN Dakota (US Feet)
NORTHING: 184388.8 EASTING: 525164.7
DRILLER: C. McClain LOGGED BY: R. Jett START DATE: 09/04/24 END DATE: 09/04/24
SURFACE ELEVATION: 977.7 ft RIG: 7514 METHOD: 3 1/4" HSA SURFACING: Bituminous WEATHER: Clear

Elev./ Depth ft	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
976.4	ASPHALT, 7 inches of bituminous over 9 inches of apparent aggregate base		AU 16"			
1.3	FILL: SILTY SAND (SM), fine to medium-grained, trace Gravel, dark brown, moist		4-10-8-7 (18) 14"			
975.7 2.0 973.7	FILL: CLAYEY SAND (SC), trace Gravel, brown, moist		4-5-6-8 (11) 18"		7	P200=26%
4.0 969.7	FILL: SANDY LEAN CLAY (CL), trace Gravel, contains seams of Silty Sand, brown, moist		9-9-13-11 (22) 18"		17	
8.0 966.7	FILL: CLAYEY SAND (SC), trace Gravel, slightly organic, black to dark gray, moist		10-10-9-9 (19) 18"		15	OC=3%
11.0 963.7	SANDY LEAN CLAY (CL), contains seams of Silty Sand, gray, moist to wet, stiff to hard (GLACIAL TILL)		5-4-5-6 (9) 22"		26	
14.0	END OF BORING Boring then backfilled with auger cuttings		11-14-18-11 (32) 10"			Water observed at 13.0 feet while drilling.

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2407625
Geotechnical Evaluation
City of Lakeville - 25-02 Street Reconstruction
Minnesota

BORING: **ST-2**
LOCATION: Captured with RTK GPS.
DATUM: NAD 1983 HARN Adj MN Dakota (US Feet)
NORTHING: 184474.1 EASTING: 523820.8
DRILLER: C. McClain LOGGED BY: R. Jett START DATE: 09/04/24 END DATE: 09/04/24
SURFACE ELEVATION: 972.3 ft RIG: 7514 METHOD: 3 1/4" HSA SURFACING: Bituminous WEATHER: Clear

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
971.3		ASPHALT, 6 1/2 inches of bituminous over 6 inches of apparent aggregate base		7-10-12-7 (22) 16"			
1.0 969.3		FILL: POORLY GRADED SAND (SP), fine to coarse-grained, trace Gravel, light brown, moist		8-11-7-6 (18) 14"		9	
3.0 966.3		FILL: CLAYEY SAND (SC), trace Gravel, brown, moist		4-11-14-12 (25) 16"			
6.0 964.3		FILL: SANDY LEAN CLAY (CL), trace Gravel, blue to brown, moist		8-8-6-7 (14) 18"			
8.0 962.3		FILL: CLAYEY SAND with GRAVEL (SC), brown, moist		3-5-6-10 (11) 6"			
10.0 960.3		SILTY SAND (SM), fine to medium-grained, trace Gravel, contains seams of Silt, reddish brown to light brown, moist, medium dense (GLACIAL TILL)		4-8-12-10 (20) 10"		11	
12.0 958.3	▽	SILTY SAND (SM), fine to coarse-grained, trace Gravel, CLAY layers, brown, wet, loose (GLACIAL TILL)		2-3-4-4 (7) 22"			
14.0		END OF BORING					Water observed at 13.0 feet while drilling.
		Boring then backfilled with auger cuttings					

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2407625
Geotechnical Evaluation
City of Lakeville - 25-02 Street Reconstruction
Minnesota

BORING: **ST-3**
LOCATION: Captured with RTK GPS.
DATUM: NAD 1983 HARN Adj MN Dakota (US Feet)
NORTHING: 184406.1 EASTING: 522694.3
DRILLER: C. McClain LOGGED BY: R. Jett START DATE: 09/04/24 END DATE: 09/04/24
SURFACE ELEVATION: 989.1 ft RIG: 7514 METHOD: 3 1/4" HSA SURFACING: Bituminous WEATHER: Clear

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
987.7		ASPHALT, 8 inches of bituminous over 8 inches of apparent aggregate base		AU 6"			
1.3		FILL: SANDY LEAN CLAY (CL), trace Gravel, brown, moist		2-2-4-5 (6) 16"			
				3-4-6-5 (10) 18"		16	P200=62%
				7-9-9-10 (18) 24"			
				3-5-7-11 (12) 24"			
979.1							
10.0		SANDY LEAN CLAY (CL), trace Gravel, dark gray, moist, very stiff to hard (GLACIAL TILL)		3-7-10-14 (17) 24"		14	
				14-17-18-14 (35) 24"			
975.1							
14.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with auger cuttings					

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2407625
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BORING: **ST-4**
LOCATION: Captured with RTK GPS.
DATUM: NAD 1983 HARN Adj MN Dakota (US Feet)
NORTHING: 183287.4 EASTING: 521990.1
START DATE: 09/04/24 END DATE: 09/04/24
DRILLER: C. McClain LOGGED BY: R. Jett
SURFACE ELEVATION: 1008.2 ft RIG: 7514 METHOD: 3 1/4" HSA
SURFACING: Bituminous WEATHER: Clear

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
1007.0		ASPHALT, 6 1/2 inches of bituminous over 7 1/2 inches of apparent aggregate base		AU 12"			
1.2		FILL: SANDY LEAN CLAY (CL), trace Gravel, dark brown to brown, moist		2-3-4-7 (7) 23"			
1006.2 2.0		FILL: CLAYEY SAND (SC), trace Gravel, hydrocarbon like odor, light brown, moist		3-6-9-10 (15) 24"			
1004.2 4.0		FILL: SILTY SAND (SM), fine to medium-grained, trace Gravel, light brown, moist	5			15	
1002.2 6.0		END OF BORING Boring then backfilled with auger cuttings					Water not observed while drilling.
			10				
			15				
			20				
			25				
			30				

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

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Geotechnical Evaluation
City of Lakeville - 25-02 Street Reconstruction
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BORING: **ST-5**
LOCATION: Captured with RTK GPS.
DATUM: NAD 1983 HARN Adj MN Dakota (US Feet)
NORTHING: 182219.4 EASTING: 522003.4
START DATE: 09/04/24 END DATE: 09/04/24
SURFACING: Bituminous WEATHER: Clear

DRILLER: C. McClain LOGGED BY: R. Jett
SURFACE ELEVATION: 1030.2 ft RIG: 7514 METHOD: 3 1/4" HSA

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
1029.1		ASPHALT, 9 inches of bituminous over 4 inches of apparent aggregate base					
1.1		FILL: SANDY LEAN CLAY (CL), trace Gravel, dark brown, moist		AU 6" 2-4-7-9 (11)		12	P200=62%
				22" 6-6-6-10 (12) 24"			
1024.2							
6.0		END OF BORING					Water not observed while drilling.
		Boring then backfilled with auger cuttings					

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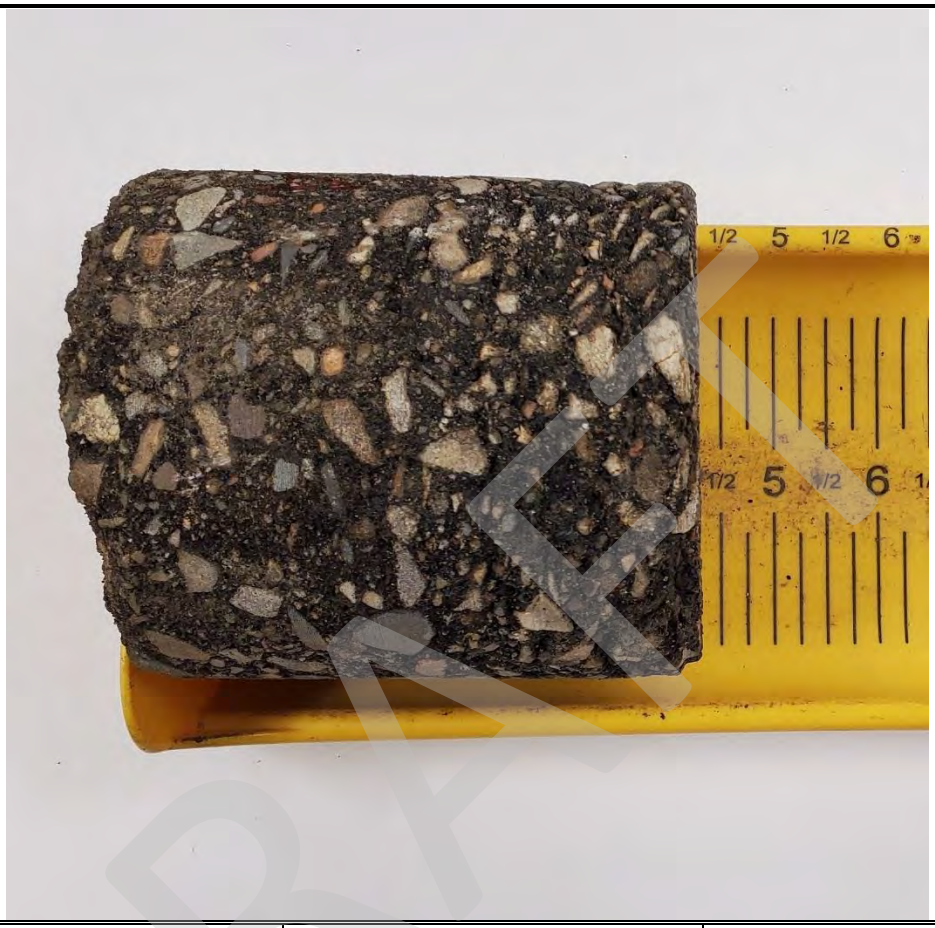
Core Photo Log

C-1



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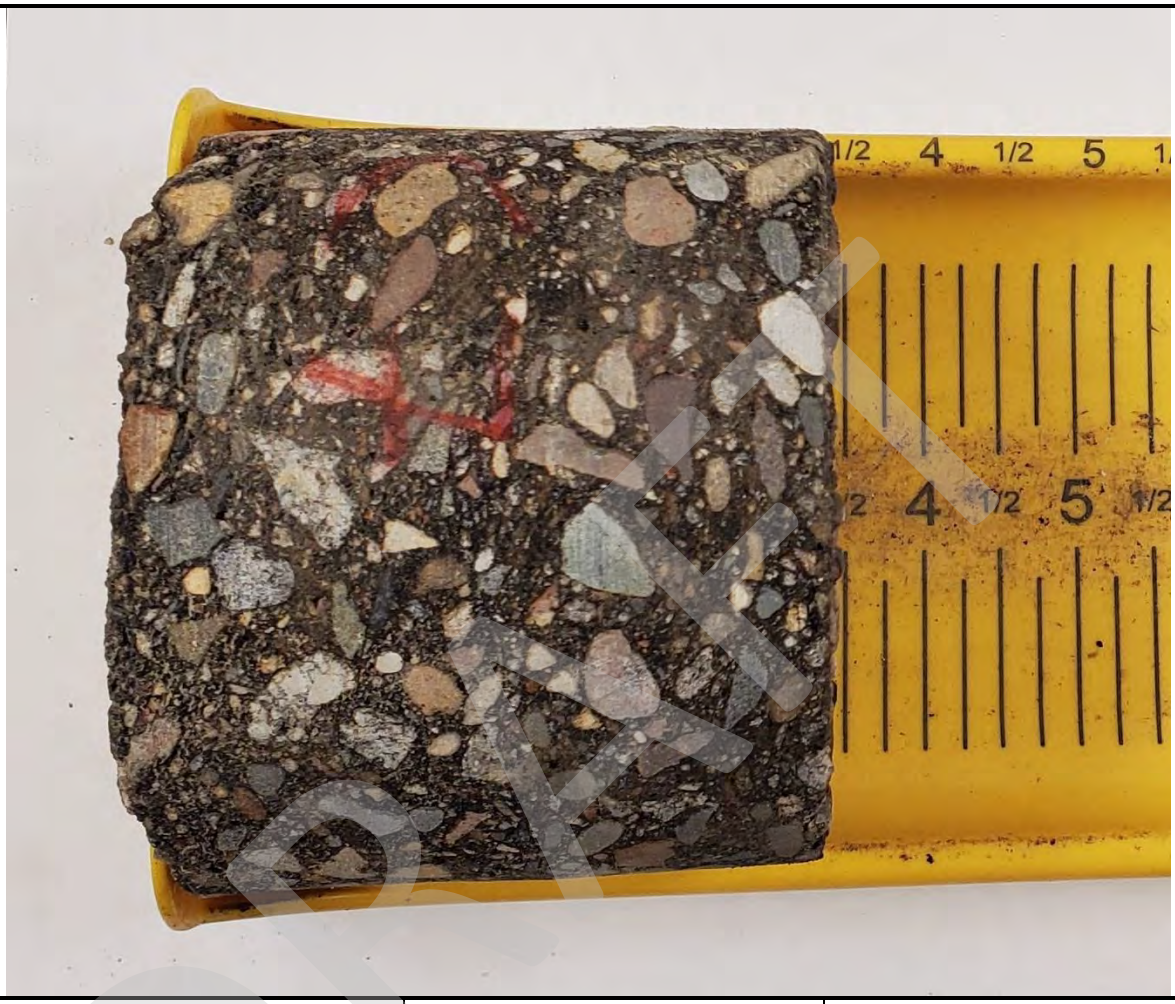

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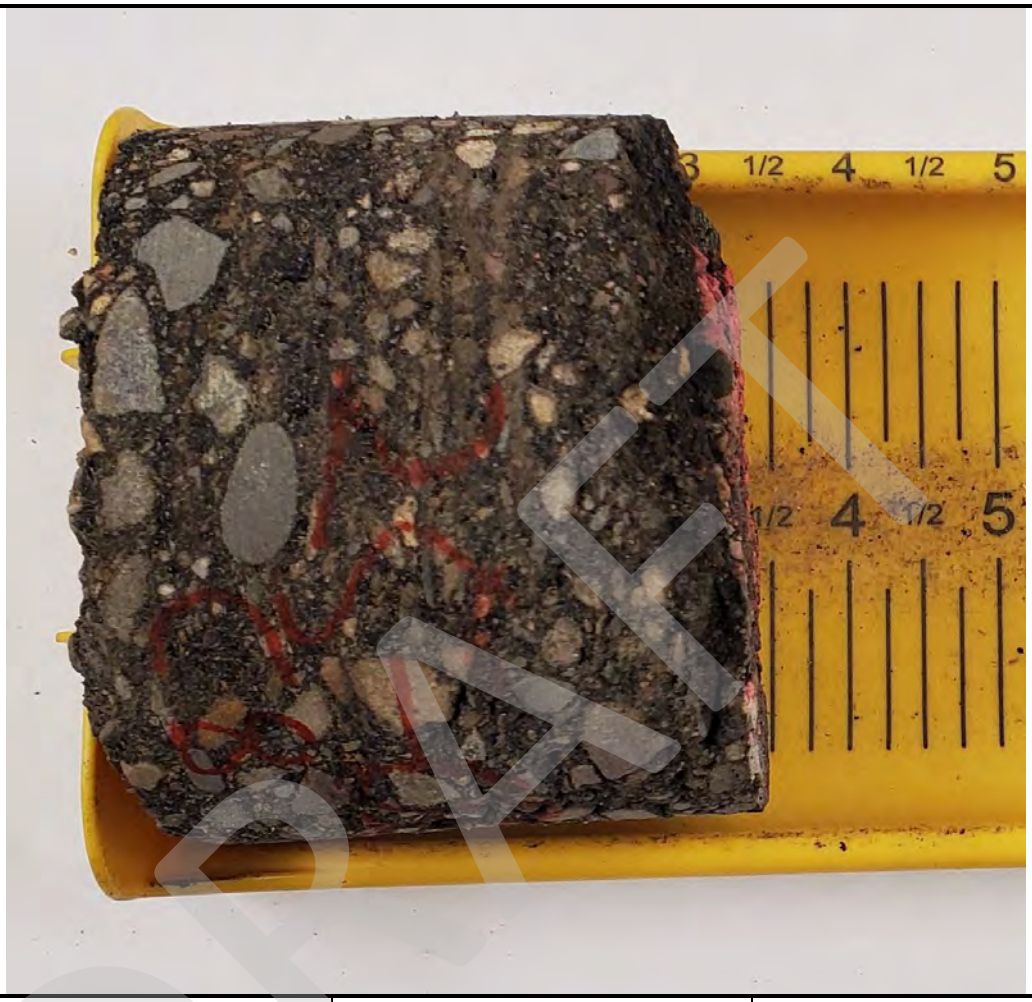

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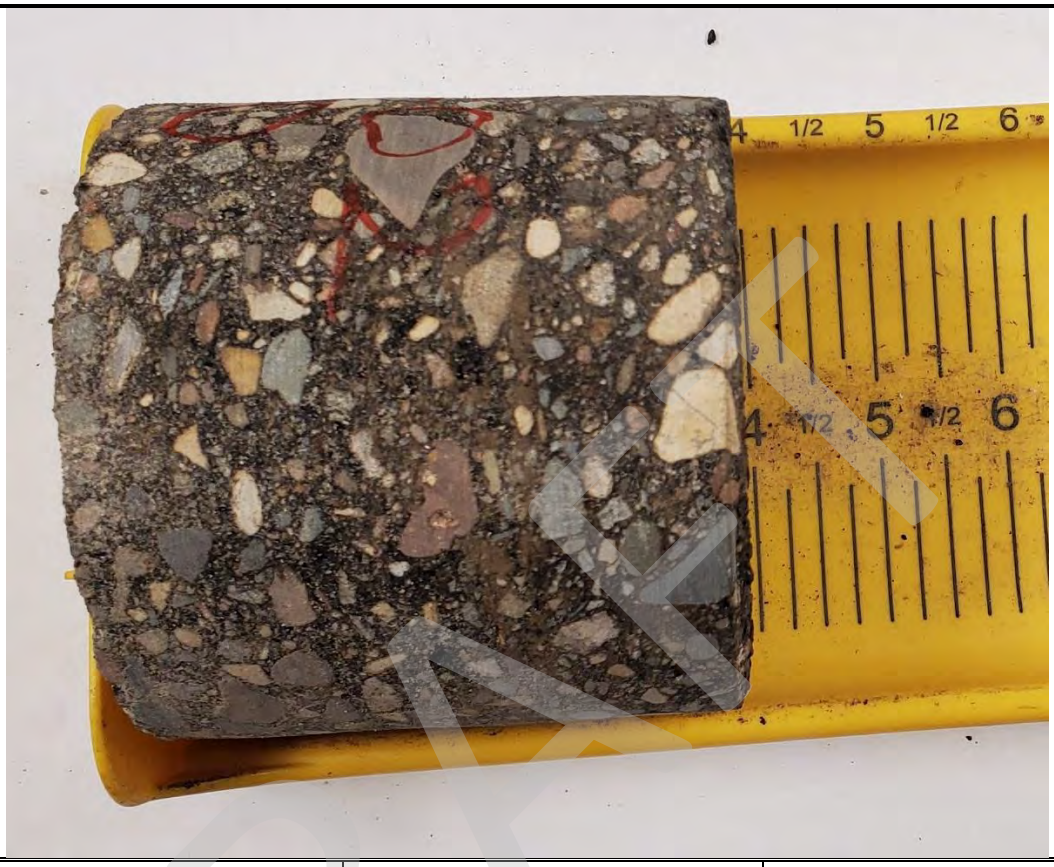

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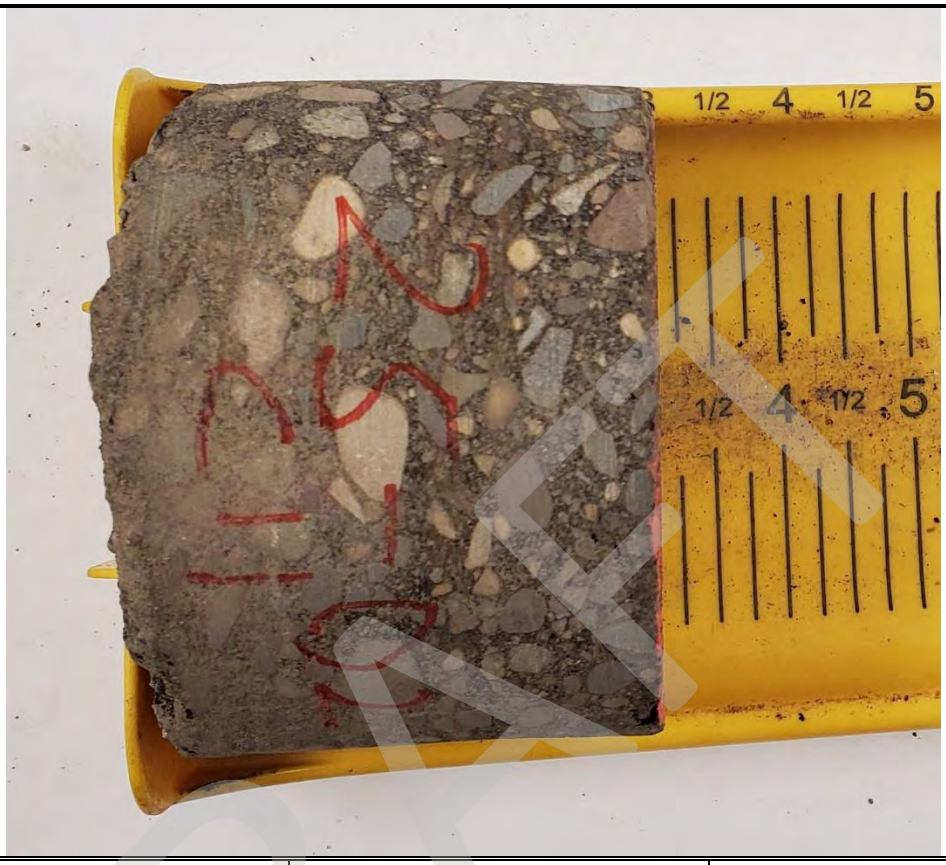

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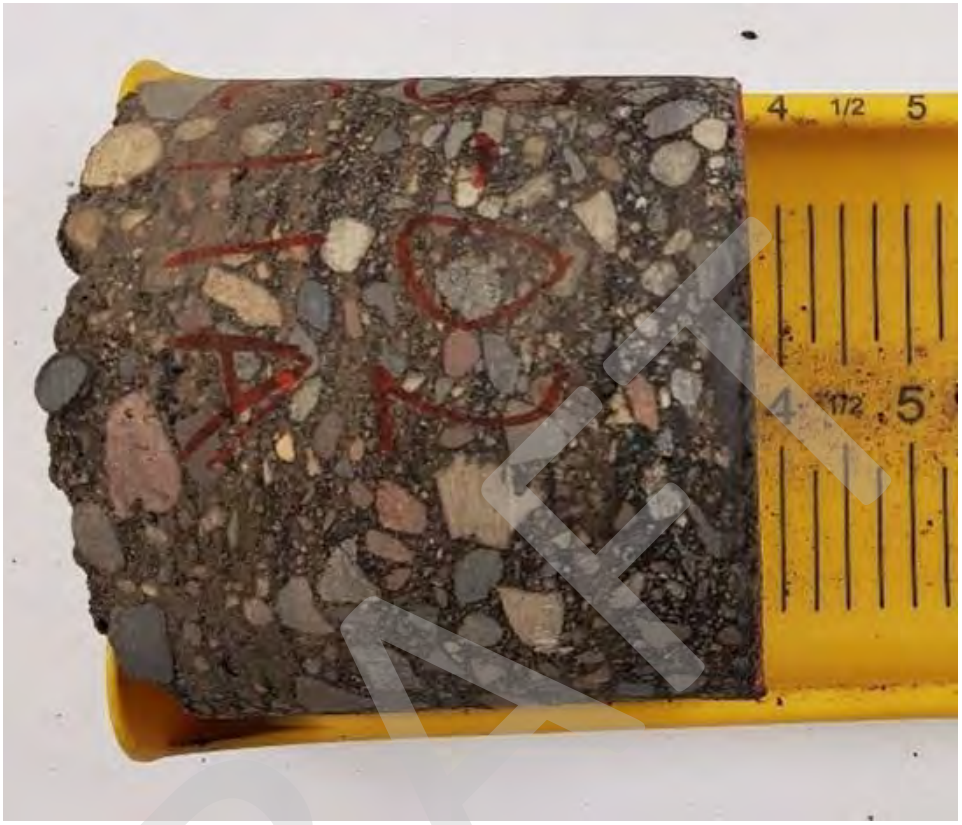

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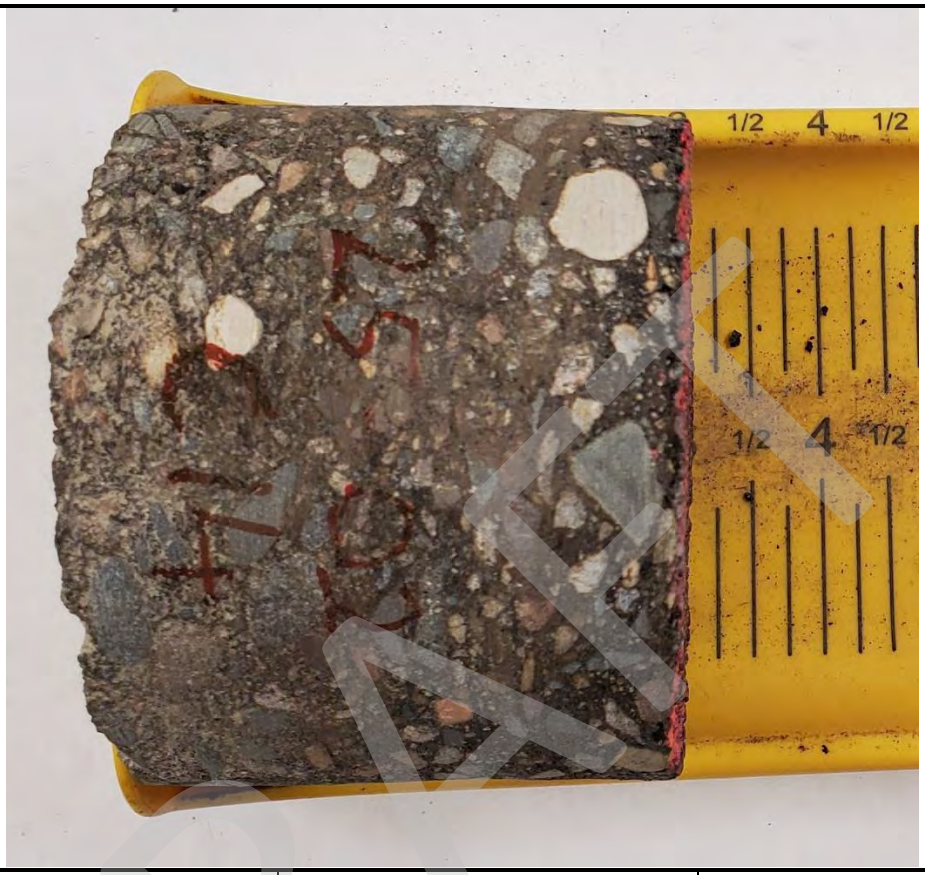

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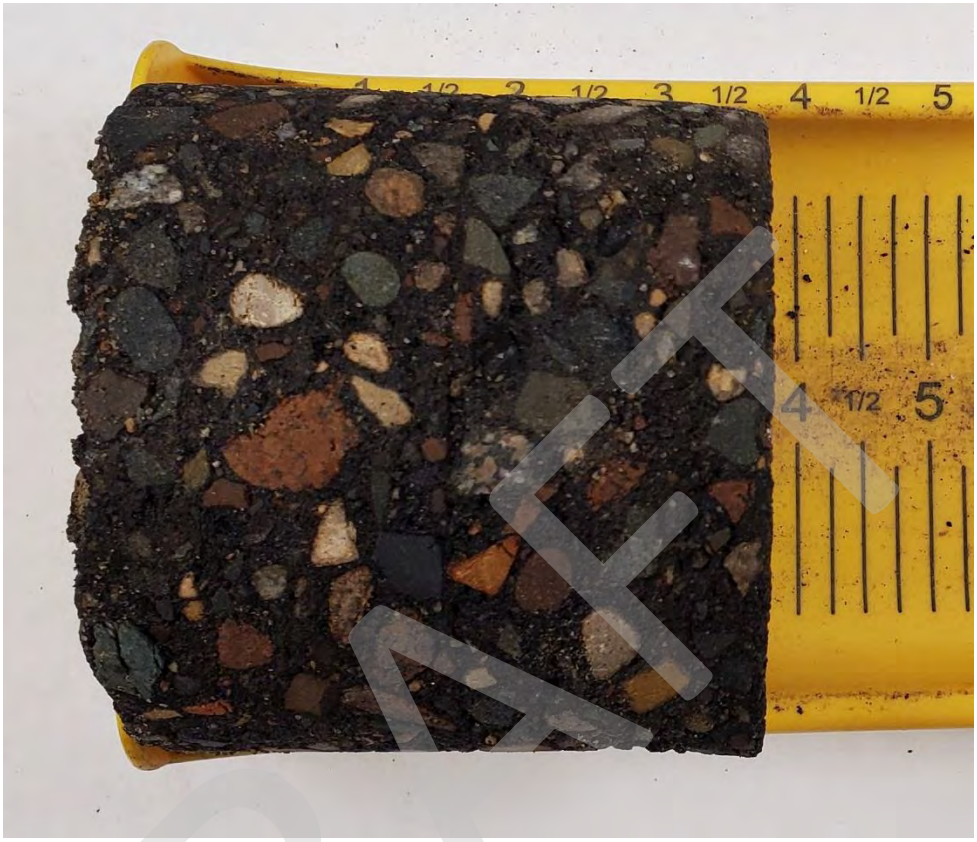

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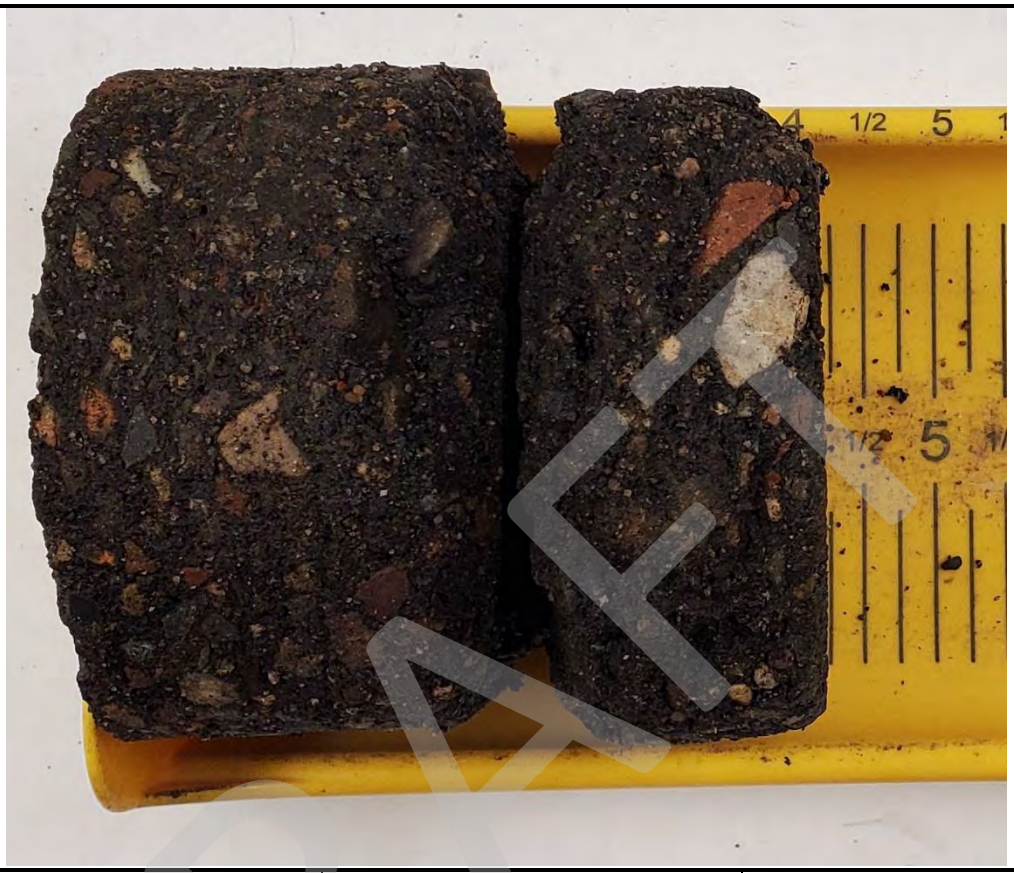

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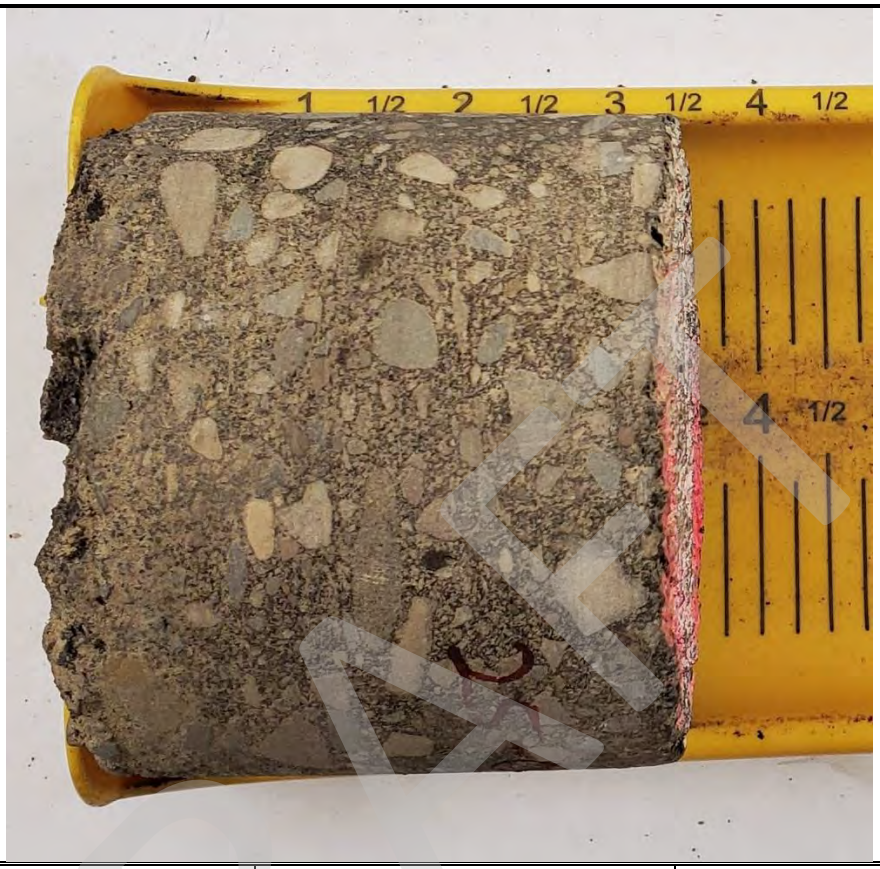

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Results Only Soil Testing for City Of Lakeville 25-02

September 10, 2024

Prepared for:

Richard Jett
Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438
rjett@braunintertec.com

Project X Job#: S240909C
Client Job or PO#: B2407625

Prepared by:
D. Bobrova

Respectfully Submitted,

Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: Braun Intertec Corporation
Job Name: City Of Lakeville 25-02
Client Job Number: B2407625
Project X Job Number: S240909C
September 10, 2024

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{2-}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ω-cm)	(Ω-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
ST-1	5-10	43.5	0.0043	30.3	0.0030	14,740	2,613	7.3	119	0.7	1.4	5.5	ND	50.4	2.6	18.6	56.8	7.7	1.7
ST-3	5-10	24.6	0.0025	153.5	0.0153	1,943	871	6.9	123	ND	0.8	7.1	ND	46.3	4.9	19.6	66.6	5.3	2.8

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Note: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

Try out our new online forms: SOIL CORROSIVITY & THERMAL RESISTIVITY LAB REQUEST FORM & IN-SITU WENNER 4 PIN QUOTE REQUEST FORM

Project X
Corrosion Engineering
Corrosion Control · Soil, Water and Metallurgy Lab

Lab Request Sheet Chain of Custody
Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com
Ship Samples To: 29990 Technology Dr, Suite 13, Murrieta, CA 92563

Project X Job Number: S240909C BRAUN-MN B2407625 City of Lakeville 2 Fall

IMPORTANT: Please complete Project and Sample Identification Data as you would like it to appear in report & include this form with samples.

Company Name:	Braun Intertec	**Contact Name:**	Rich Jett
Phone No:	815-545-7059	**Mailing Address:**	11001 Hampshire Ave S, Minneapolis, MN 55438
Contact Email:	RJett@braunintertec.com	**Accounting Contact:**	Rich Jett
Invoice Email:	" "	**Client Project No:**	B2407625
Project Name:	City of Lakeville 25-02	**P.O. #:**	

(Business Days) Turn Around Time: 3-5 Day Standard: X | 3 Day Guarantee 50% mark-up | 24 Hour RUSH 100% mark-up

For Corrosion Control Recommendations (350g soil sample):
NEED (1) Groundwater depth and
(2) Soil Sample Locations Map

FOR THERMAL RESISTIVITY PROVIDE (1,500g soil sample):
(1) Optimal Moisture %
(2) Dry Density{PCF}
(3) Desired Compaction
Date & Received By:

METHOD ANALYSIS REQUESTED (Please circle)

	SAMPLE ID - BORE # - Description	DEPTH (ft)	DATE COLLECTED
101	1 ST-1	5-10'	9/3/24
102	2 ST-3	5-10'	9/3/24
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	13		
	14		
	15		

Default Method	Soil Resistivity	pH	Sulfate	Chloride	Redox Potential	Sulfide	Ammonia	Nitrate	Flouride	Phosphate	Lithium	Sodium	Potassium	Magnesium	Calcium	Full Corrosion Series	Soil Corrosivity Evaluation Report	Water Corrosivity Mini Report	Moisture Content	Total Alkalinity	Soil Remolding	Thermal Resistivity	(ANC) Alk Neutr Cap	(SRB) Sulfate Reducing	Puckorius Index	XRF Elemental Analysis	Water Hardness
	Caltrans CTM643	Caltrans CTM643	Caltrans CTM643	Caltrans CTM417	Caltrans CT422											350g Sample	*Req: Min. 3 Samples, site map, and groundwater info					IEEE 442 6" 3lbs 1.5kg	1,500g Sample				ASTM A52	
	AASHTO T288	AASHTO T289	AASHTO T290	AASHTO T291	SM 2580B		SM 4500-NH3	SM 4500-NO3													ASTM D2216		ASTM D2216	ASTM D698	ASTM 3piles D5314 8"		HACH BART		ASTM E1621	ASTM A572	
	ASTM G187	ASTM G51	ASTM D4327	ASTM D4327	ASTM G200	SM 4500-S2	ASTM D4327	ASTM D4327	SM 2320B	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327				ASTM D2216	SM 2320B										
	Geo Quad				Full Corrosion Series												Reports												

GPR Results: 175th Street West - Glasgow Avenue to Glacier Way

Location	**City of Lakeville 25-01**
Project No.	**B2407618**
Roadway	**175th Street West**
From	**Glasgow Avenue**
To	**Glacier Way**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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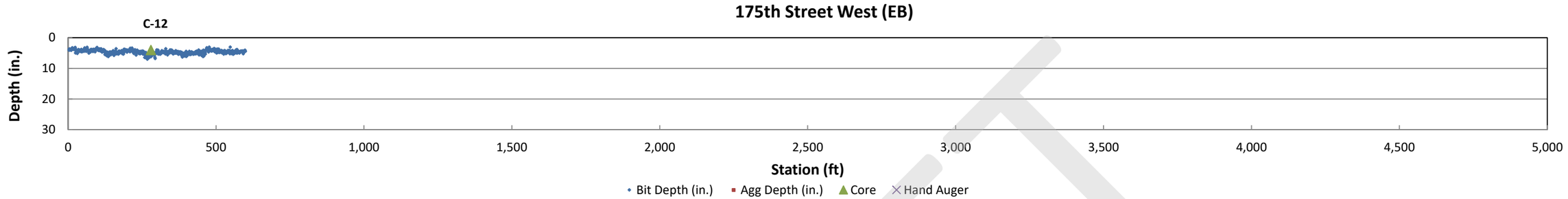

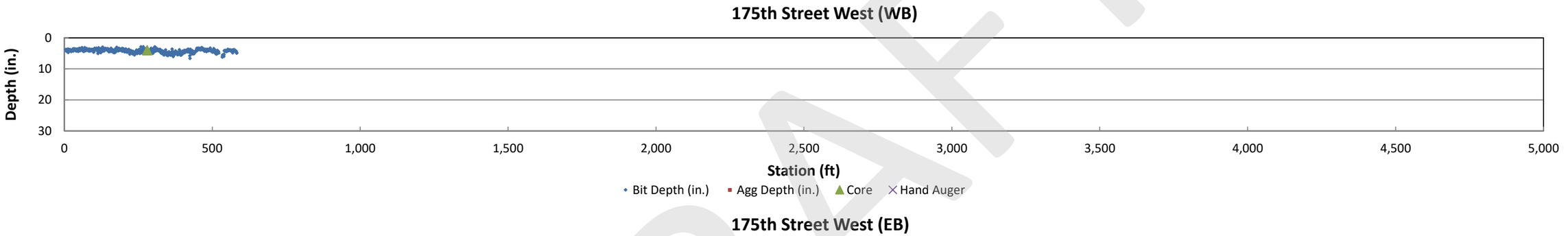

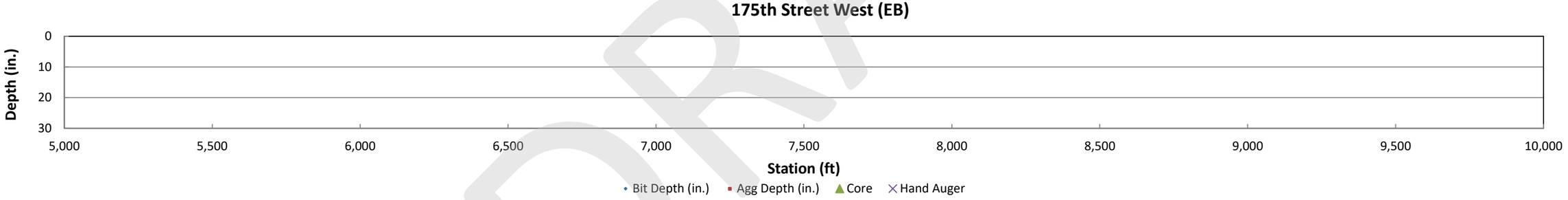

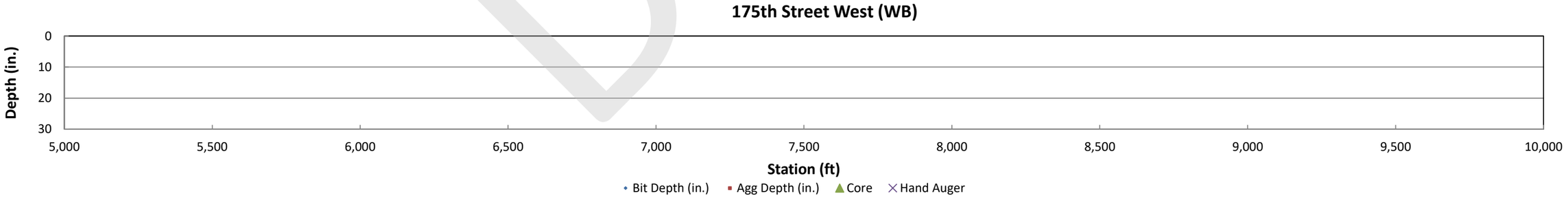

GPR Results: 177th Street - Glacier Way to Glasgow Way

Location	**City of Lakeville 25-01**
Project No.	**B2407618**
Roadway	**177th Street**
From	**Glacier Way**
To	**Glasgow Way**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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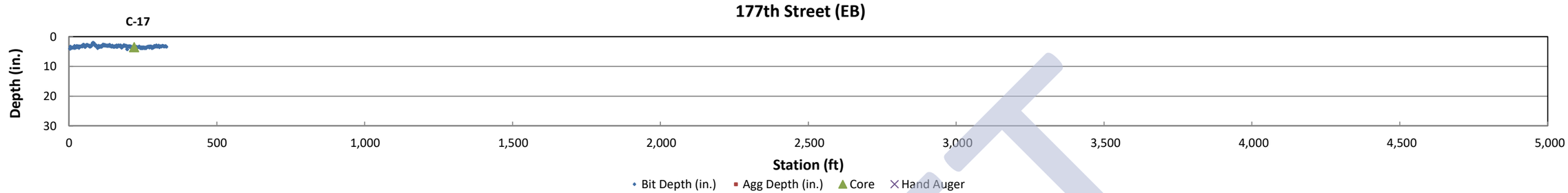

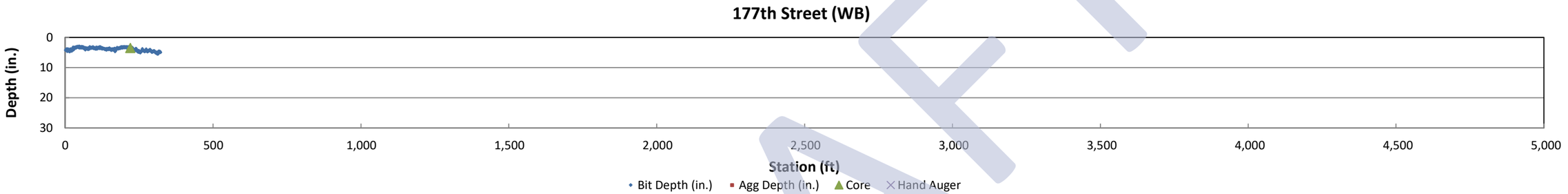

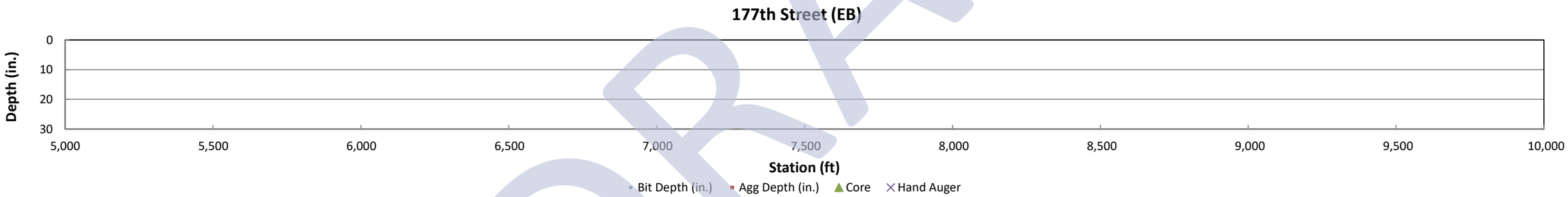

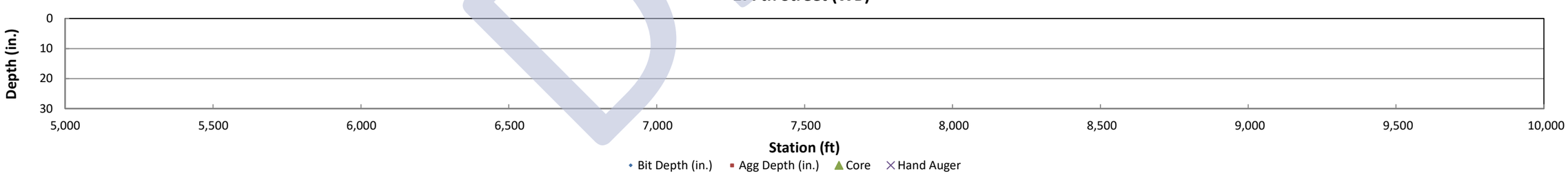

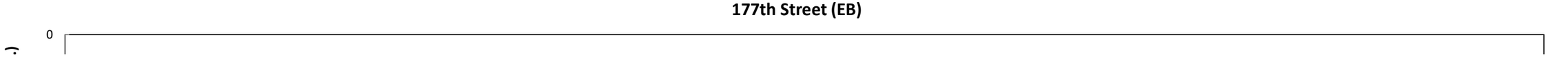

GPR Results: 178th Street - Glacier Way to Glasgow Way

Location	**City of Lakeville 25-01**
Project No.	**B2407618**
Roadway	**178th Street**
From	**Glacier Way**
To	**Glasgow Way**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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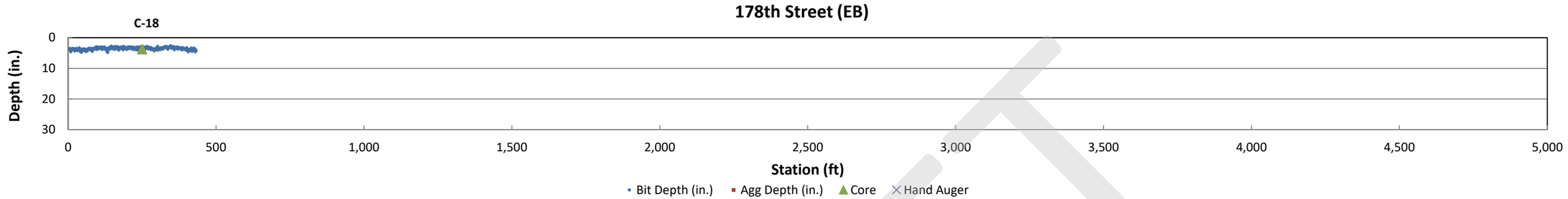

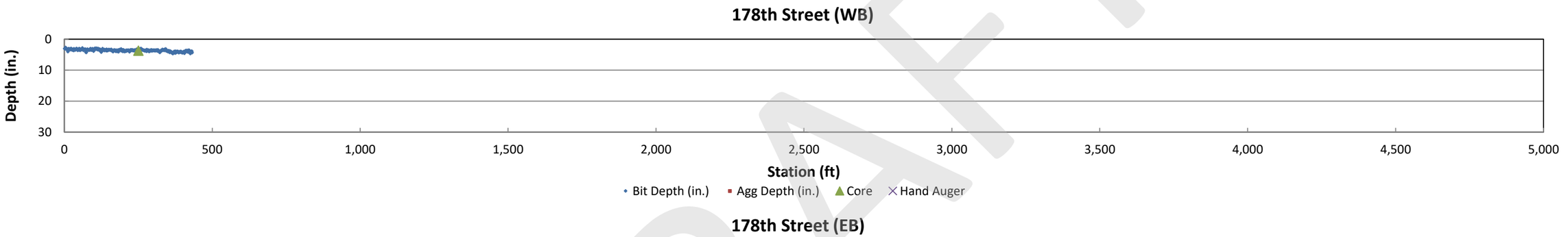

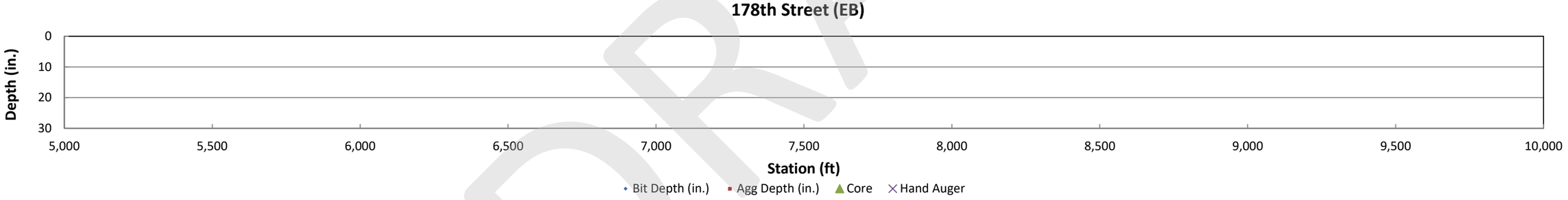

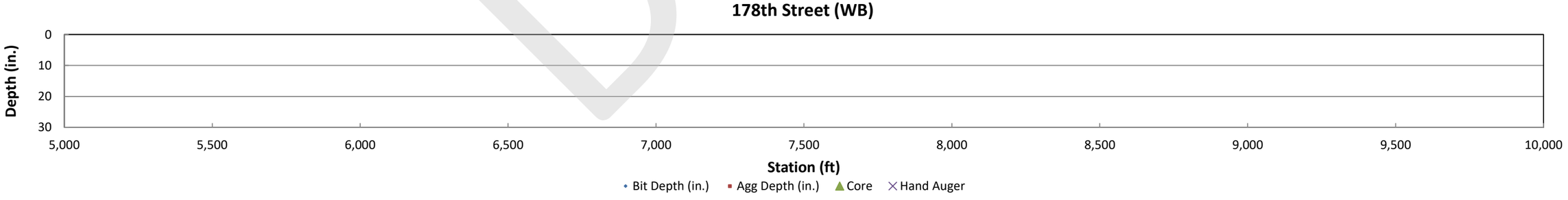

GPR Results: Galle Court - Gerdine Path to Cul-De-Sac

Location	**City of Lakeville 25-01**
Project No.	**B2407618**
Roadway	**Galle Court**
From	**Gerdine Path**
To	**Cul-De-Sac**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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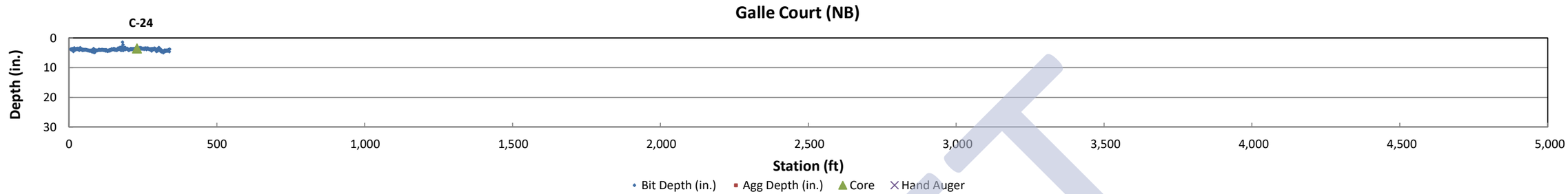

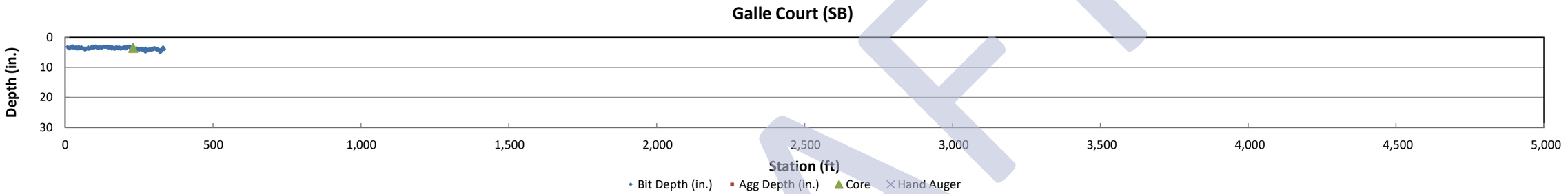

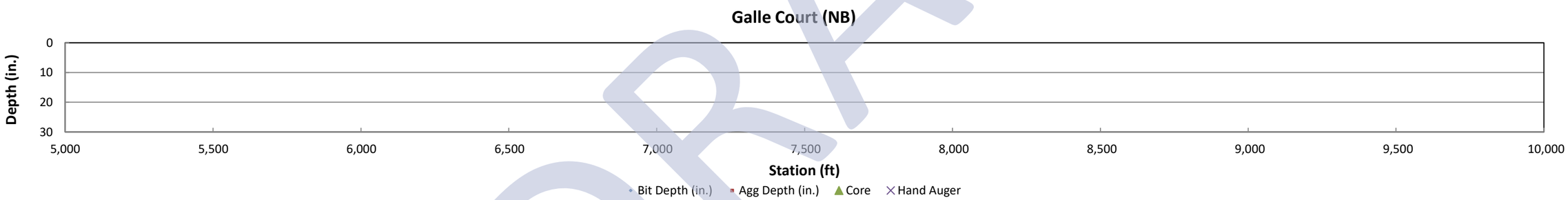

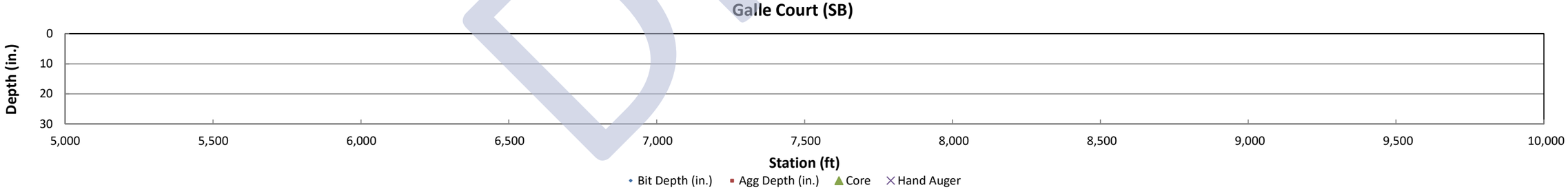

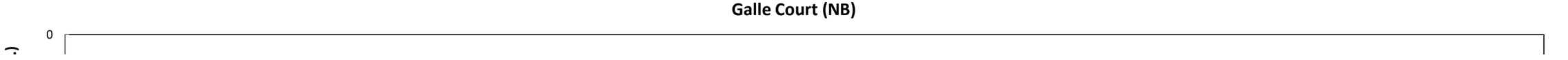

GPR Results: Gerdine Path - 179th Street West to Dodd Boulevard

Location	**City of Lakeville 25-01**
Project No.	**B2407618**
Roadway	**Gerdine Path**
From	**179th Street West**
To	**Dodd Boulevard**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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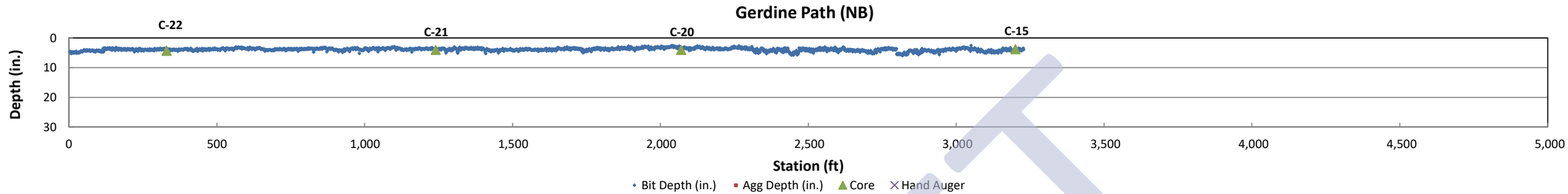

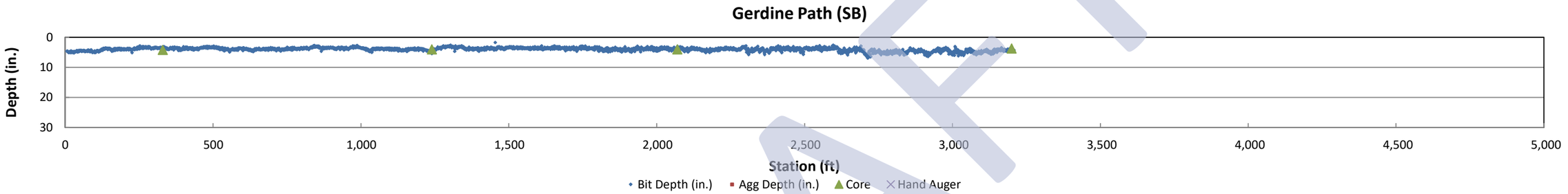

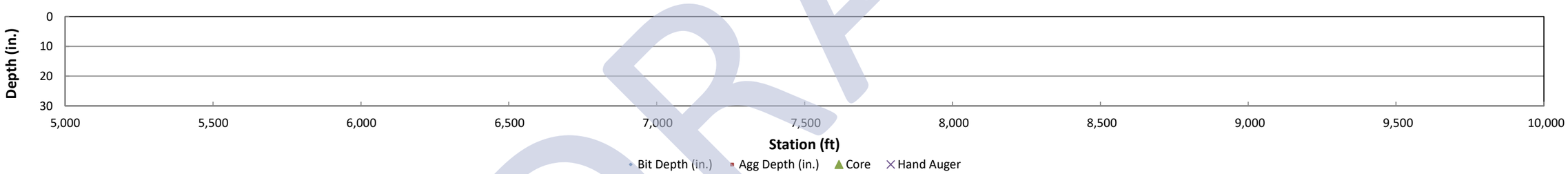

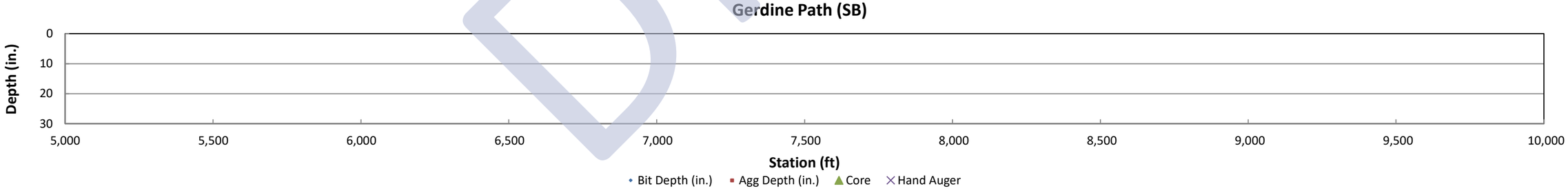

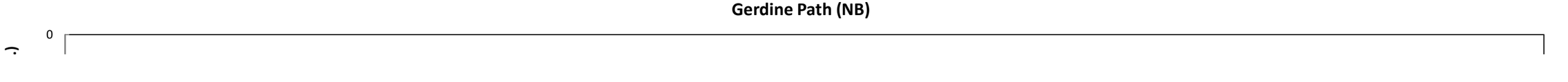

GPR Results: Gillette Way - NB 175th Street to SB 175th Street

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Gillette Way**
From	**NB 175th Street**
To	**SB 175th Street**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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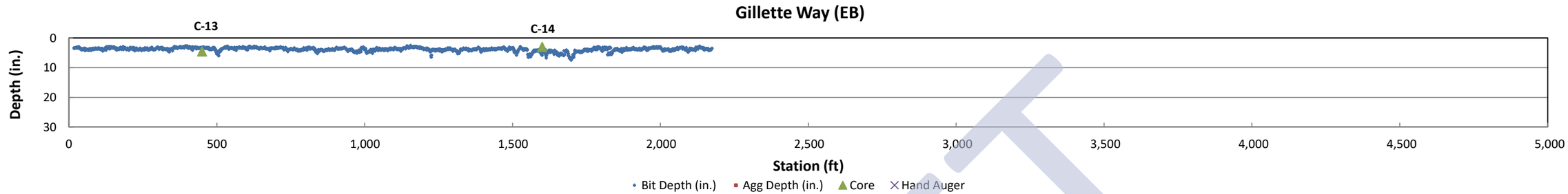

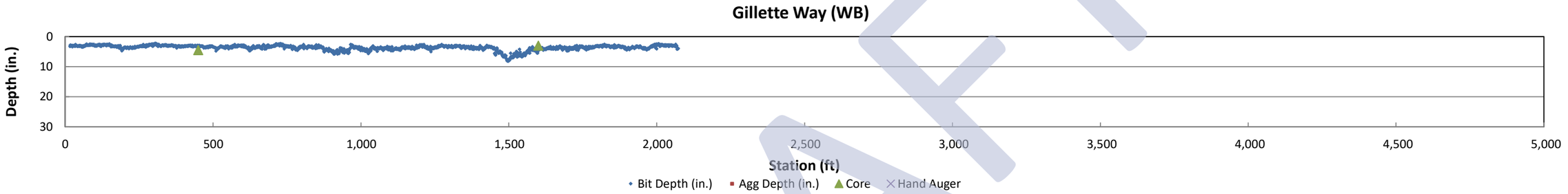

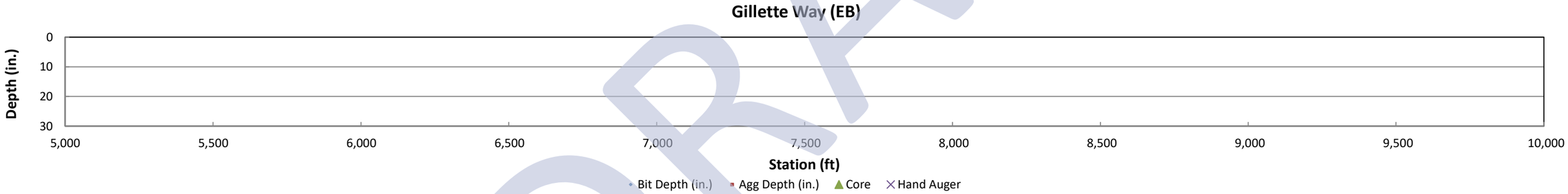

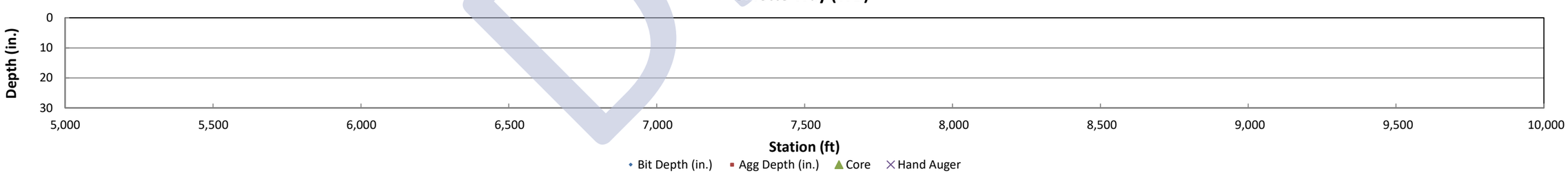

GPR Results: Glacier Way - 175th Street West to 179th Street West

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Glacier Way**
From	**175th Street West**
To	**179th Street West**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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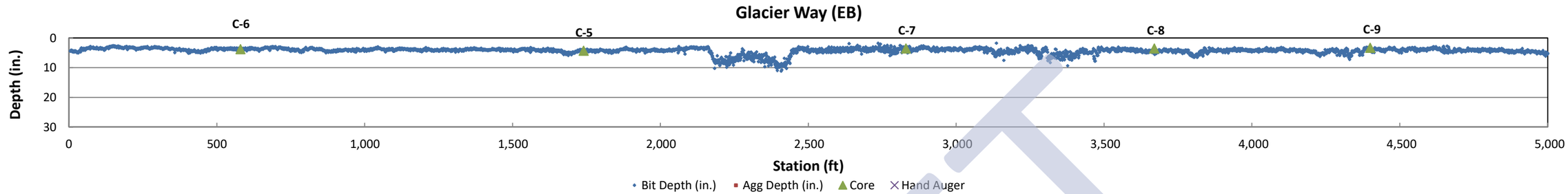

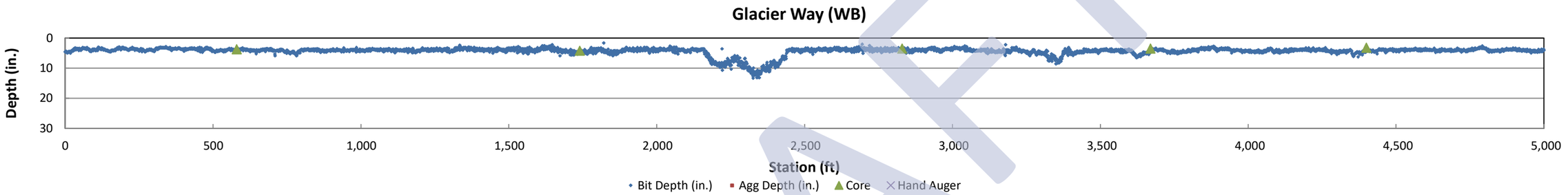

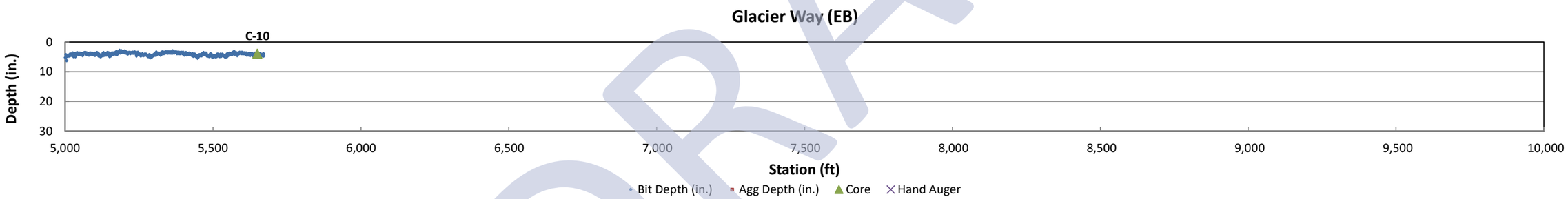

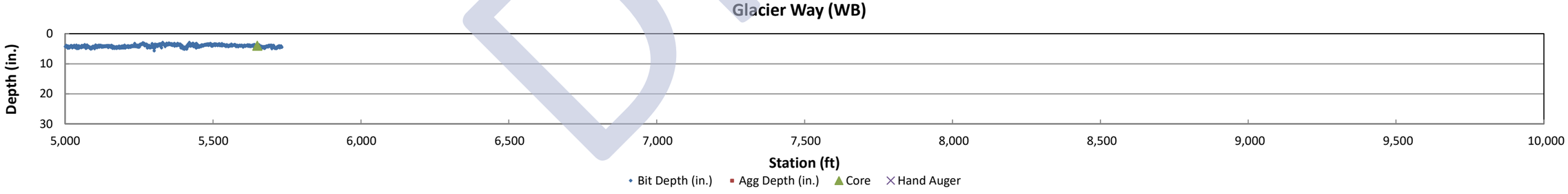

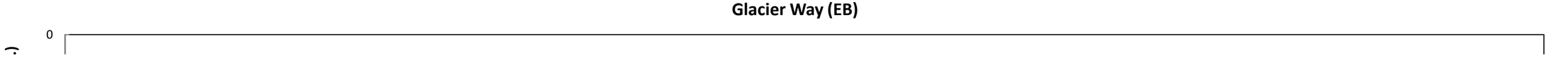

GPR Results: Glasgow Way - Glasgow Avenue to Glacier Way

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Glasgow Way**
From	**Glasgow Avenue**
To	**Glacier Way**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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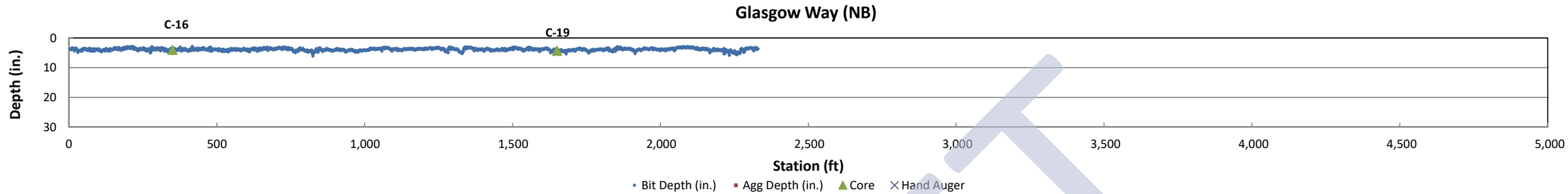

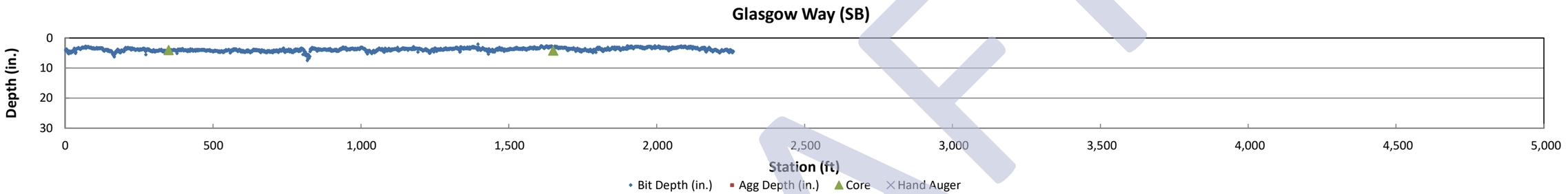

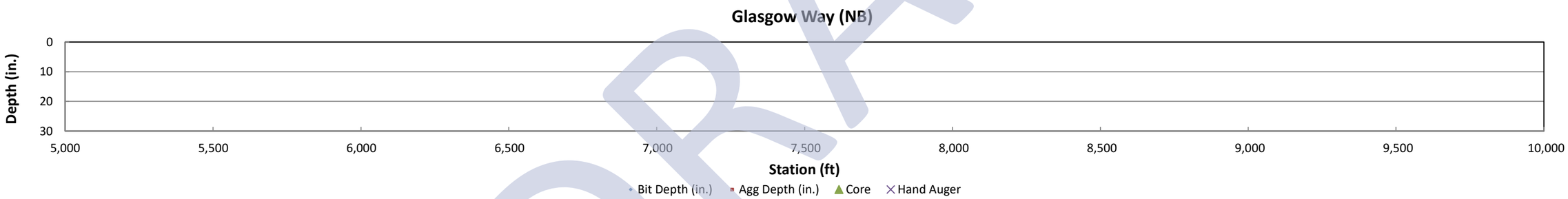

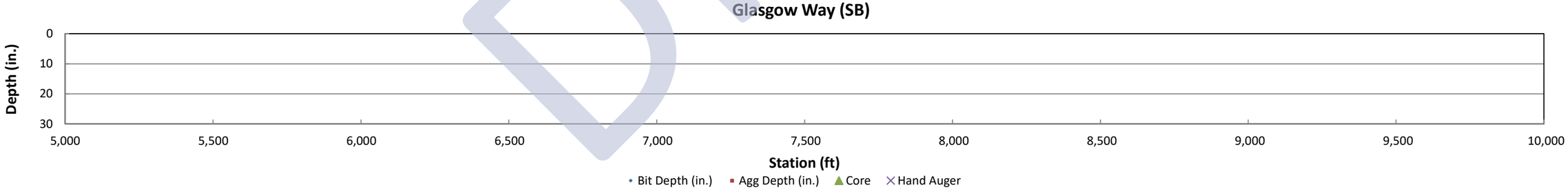

GPR Results: Glasgow Avenue - Dodd Boulevard to Glacier Way

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Glasgow Avenue**
From	**Dodd Boulevard**
To	**Glacier Way**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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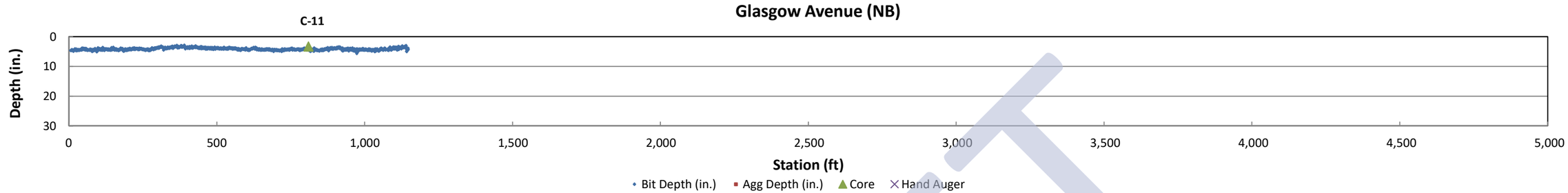

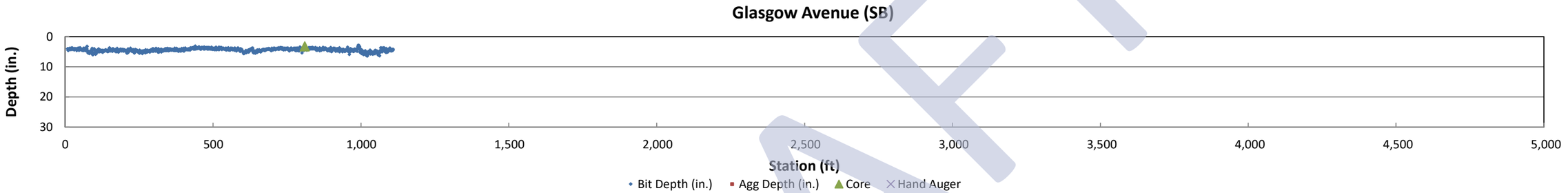

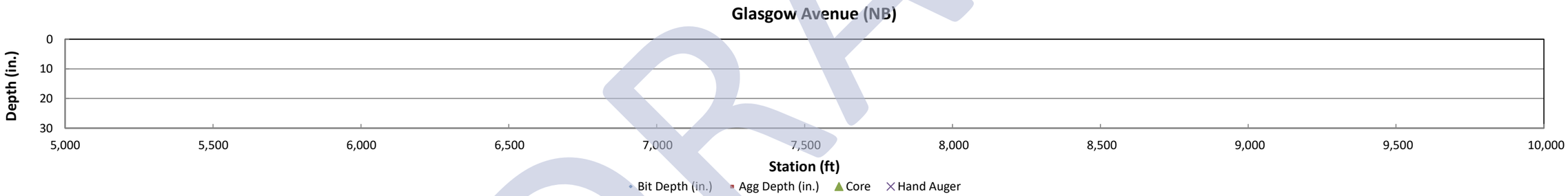

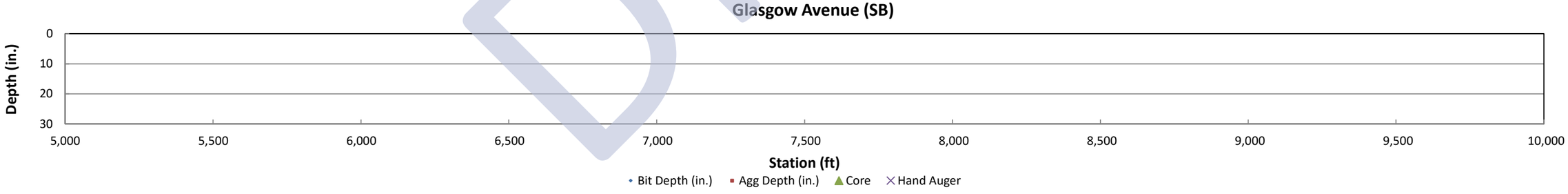

GPR Results: Harbor Court - 170th Street South to Cul-De-Sac

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Harbor Court**
From	**170th Street South**
To	**Cul-De-Sac**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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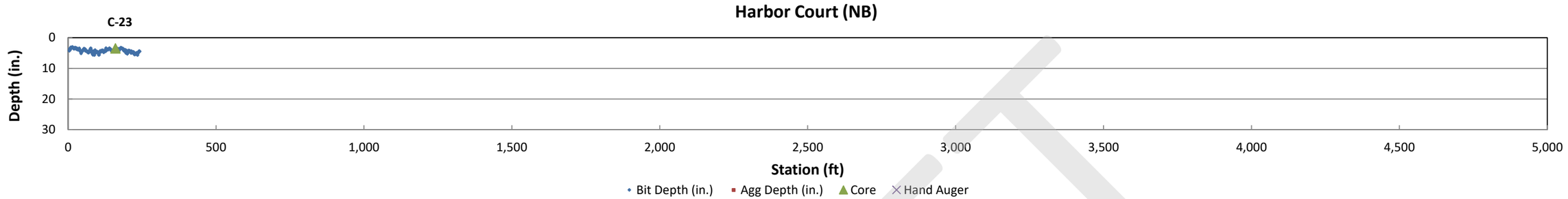

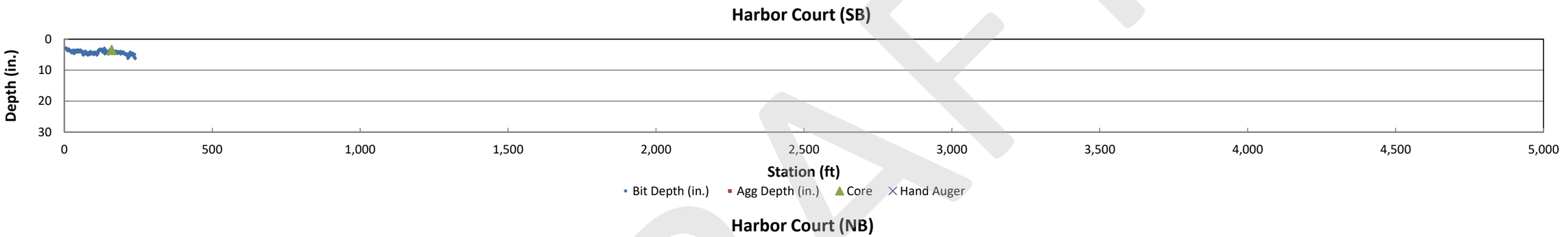

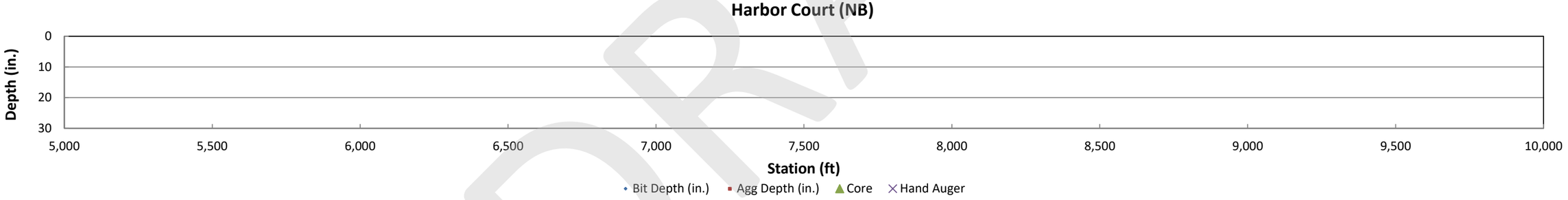

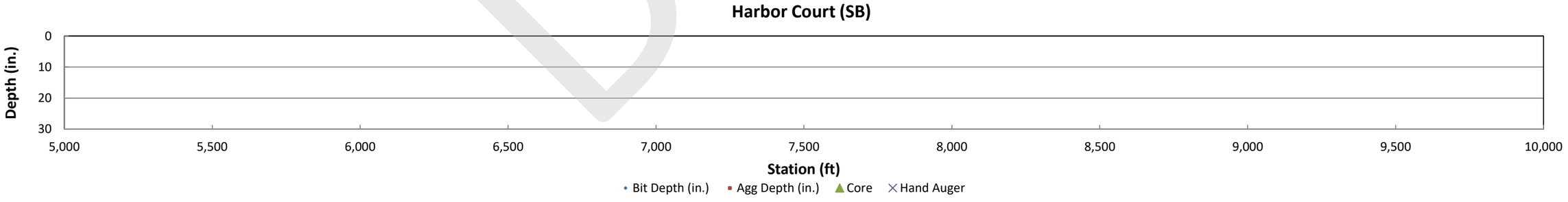

GPR Results: Hayes Avenue - 175th Street West to Cedar Avenue

Location	**City of Lakeville 25-02**
Project No.	**B2407625**
Roadway	**Hayes Avenue**
From	**175th Street West**
To	**Cedar Avenue**

Note: stations are positive in the NB or EB direction; SB or WB scans have been reversed

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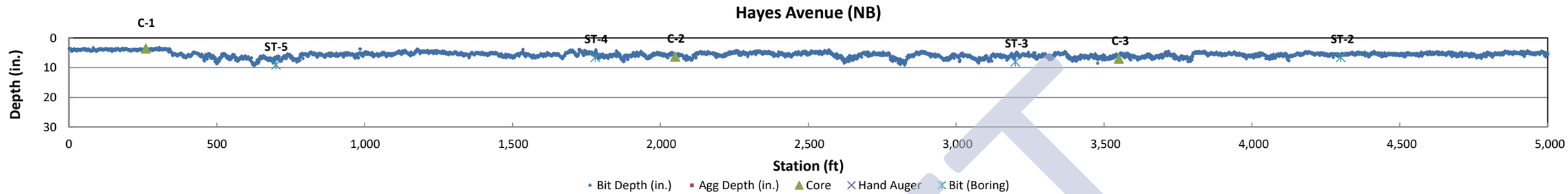

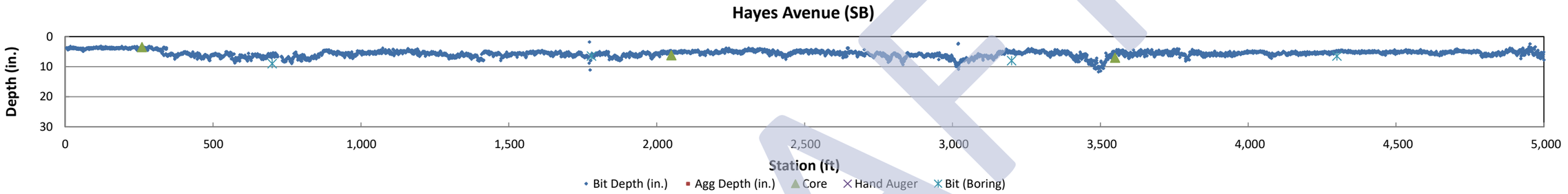

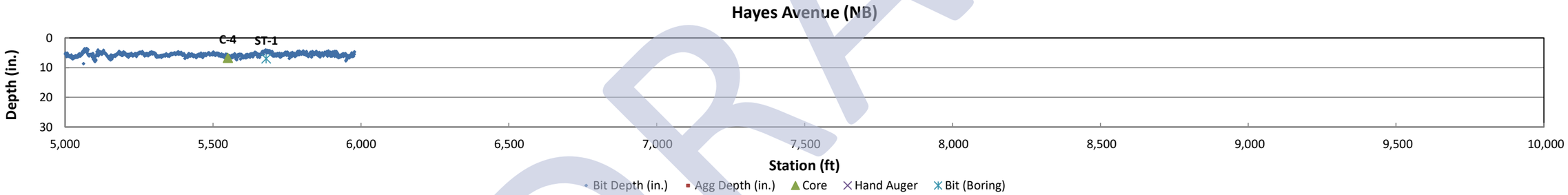

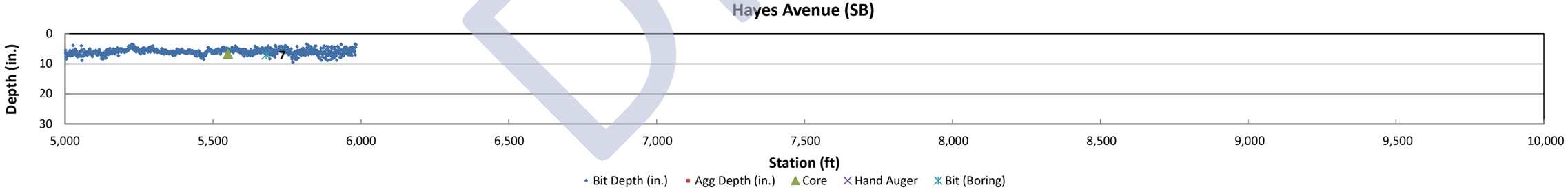

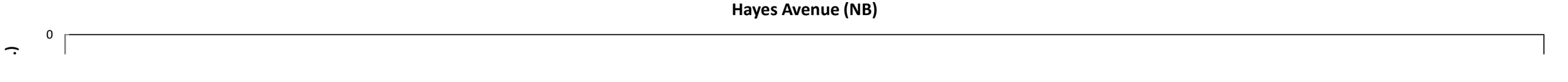

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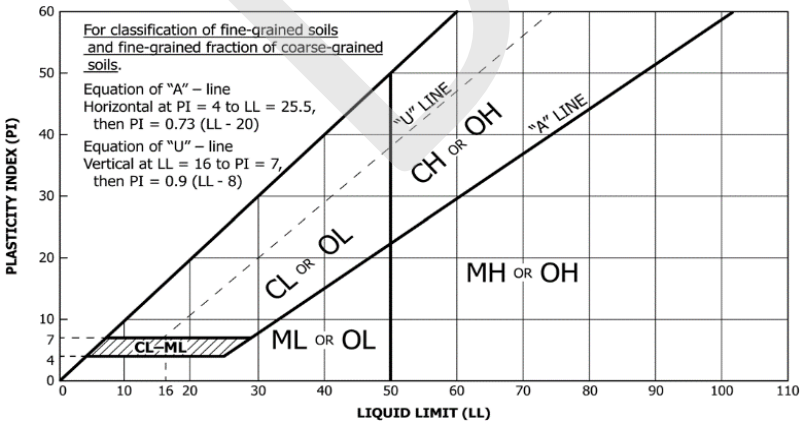
Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay[K L M N] / Organic silt[K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay[K L M P] / Organic silt[K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**q_p**	Pocket penetrometer strength, tsf
WD	Wet density, pcf	**q_U**	Unconfined compression test, tsf
P200	% Passing #200 sieve	**LL**	Liquid limit
MC	Moisture content, %	**PL**	Plastic limit
OC	Organic content, %	**PI**	Plasticity index

Particle Size Identification

Boulders..... over 12"
Cobbles..... 3" to 12"
Gravel
  Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt..... No. 200 (0.075 mm) to .005 mm
Clay..... < .005 mm

Relative Proportions[L, M]

trace..... 0 to 5%
little..... 6 to 14%
with..... ≥ 15%

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 1"

Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF
Loose ..... 5 to 10 BPF
Medium dense..... 11 to 30 BPF
Dense..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Sample Symbols

Standard Penetration Test
Modified California (MC)
Auger
Grab Sample
Rock Core
Thinwall (TW)/Shelby Tube (SH)
Texas Cone Penetrometer
Dynamic Cone Penetrometer