



**CITY OF DULUTH, MN
REQUEST FOR PROPOSALS (RFP) FOR
HILLSIDE CREEK TUNNEL CONDITION INSPECTION**

RFP Number 22-99767

Issued November 1, 2022

Project No.: 2124

**Proposals Due: November 30, 2022
2:00 PM, Central Time**

Submit to:
City of Duluth
Attn: Purchasing Division
City Hall, Room 120
411 West 1st Street
Duluth, MN 55802

PROJECT OVERVIEW

The City of Duluth is seeking a consultant to provide engineering services to complete a condition report for the hillside tunnels that convey Coffee Creek, Buckingham Creek, Clarkhouse Creek, Greys Creek and Oregon Creek through Duluth. To facilitate the City's selection of a consultant, we are requesting that interested parties submit a proposal for this work as outlined in this RFP.

BACKGROUND

The City of Duluth has numerous streams and creeks that run through the city and outfall into Lake Superior or the Duluth Harbor. The creeks and associated tunnels for this project extend from the west at 23rd Ave West – Coffee Creek, to the eastern creek, Oregon Creek at 23rd Ave East.

Each of the creek's conveyance system is unique and is a combination of culverts, storm sewer pipes / tunnels and open channel sections that traverse between City of Duluth right-of-way and private property. The project will be broken into 5 phases or segments, with Phase 1 starting with Coffee Creek and subsequent phases: Phase 2 being Buckingham Creek, Phase 3 -Clarkhouse Creek, Phase 4 – Greys Creek and the final Phase 5 being Oregon Creek. The exhibits attached as Appendix B show each creek conveyance system that include sewer segment data (structure size, material and alignment), aerial image and street names. The information provide in the exhibits is the current GIS data; actual sizes and material may differ in the field.

The City of Duluth will provide the following:

- All available street and utility drawings from previous projects.
- Assistance in obtaining other related information in City files pertaining to the project if needed.

SCOPE OF SERVICES

- Inspection of the storm sewer for each phase and each segment of each phase as shown. The selected Consultant will provide all equipment and staff needed to perform the work meeting OSHA standards. The Consultant is responsible for all safety precautions that include training and equipment.
- The inspection shall require personal to enter the storm sewer system to conduct the work. For storm sewer sections that are too small for human entry, the consultant shall provide inspection through remote camera inspection systems.
- Stationing shall be established for each segment to establish a point of reference for the inspection report. Stationing will be physically marked on the sewer ceiling/roof every 25' and at each point where size, construction type and/or material changes occur.

- Verification / documentation of the storm sewer cross sectional configuration and material type by station. The City will provide all information it has on the current alignment, pipe material and configuration, but the information is aged and has not been confirmed within the City. This shall be included in the final report.
- Locate all manholes and pipe penetrations (including pass-thru pipes, i.e. gas, watermain, sewer mains, steam) and note stationing and entry location within the sewer, material type, diameter, active or not (if possible) and condition of pipe connections and manholes.
- Prepare an inspection / condition report discussing condition issues and general repair and/or replacement recommendations referenced to the sewer stationing, and to include photographs of general condition, general issues and significant condition issues. An example condition report is attached for reference and provides the level of detail the City is seeking.
- A structural integrity determination shall be made for each portion of the sewer that is located below or within a building's foundation bearing zone.

PROJECT COMPLETION DATES

All 5 phases of the work shall be completed by September 1, 2023. Each phase shall be completed as a separate report and submitted by the date shown below. Each phase shall be considered completed with the submittal of a final draft condition report containing the items discussed above. Below are the dates that each phase's final draft report is due. The order of phasing can be discussed with the exception of Phase 1, Coffee Creek, this shall be the first phase due. The goal is for the City to start addressing condition issues as each phase is completed.

November 1, 2022	RFP Issued
November 30, 2022	Proposals Due
December 7, 2022	Selection of Consultant
December 19, 2022	Council Approval to Award Contract
March 17, 2023	Phase 1 Completion - Coffee Creek
April 28, 2023	Phase 2 Completion – Buckingham Creek
June 2, 2023	Phase 3 Completion – Clarkhouse Creek
July 14, 2023	Phase 4 Completion – Greys Creek
September 1, 2023	Phase 5 Completion – Oregon Creek

QUALIFICATION PROPOSAL CONTENTS

The proposal shall be submitted in the following format broken into the 6 sections identified below. Proposals not following the specified format will not be reviewed. No additional sections or appendices are allowed. The proposal shall be limited to 20 pages plus a cover letter (The page limit includes all resumes. Proposals that exceed this limit will not be reviewed. Dividers, covers, and any addenda pages included as acknowledgment are not included in the page limitation). The proposal format shall be as follows:

1. Goals and Objectives

A restatement of the goals and objectives and the project tasks to demonstrate the responder's view and understanding of the project. Also include a background of the firm in this section.

2. Experience

An outline of the responder's background and experience with similar projects. Project descriptions shall include a list of key staff and their role. Within the experience, the consultant should demonstrate and provide proof of competency in structural inspections.

3. Personnel

Identify personnel to conduct the project and detail their training and work experience. Identify how personnel proposed for this project were involved with the projects listed as experience. Identify a professional engineer registered in the State of Minnesota who will oversee the overall project. No change in personnel assigned to the project will be permitted without approval of the City.

4. Work Plan

Describe in detail the consultant's view of the work required (project approach) relative to the project. Additionally, describe in depth how the "structural integrity determination" will be completed (methodology, field work and reporting). Include a detailed work plan identifying the work tasks to be accomplished and the budget hours to be expended on each task and subtask for inspection. The work plan shall be in spreadsheet format and shall list each task and the number of hours for each staff person on that task. The work plan shall also identify the deliverables at key milestones in the project as well as any other services to be provided by the City. The City staff intends to be actively involved with the project, that includes a meeting at the start of project, and a meeting to discuss each phase report submission, all to be held at City Hall. City staff shall be notified immediately of any condition that is discovered that is deemed critical and has a high risk to public safety. Do NOT include any costs in the work plan.

5. Work Schedule

An anticipated work schedule shall also be provided. The work schedule shall identify all key milestone dates.

6. References

A listing of names, addresses and telephone numbers of at least three (3) references for whom the respondent has performed similar street and utility construction services.

COST PROPOSAL CONTENTS

Provide, in separate sealed envelope, one copy of the cost proposal, clearly marked on the outside "Cost Proposal" along with the responder's official business name and address. Terms of the proposal as stated must be valid for the project length of time.

The consultant must include a not to exceed total project cost, as well as subtotals for each phase and any sub consultant fees. The cost proposal shall include all of the following:

- A cover/transmittal letter
- A breakdown of the hours by task for each employee. This shall be in the same format as the work plan in the Qualifications proposal with the addition of costs.
- Hourly rates for each specific employee proposed. (not general rates by category)
- Identification of anticipated direct expenses and rates for miscellaneous charges such as mileage and copies.
- Identification of any assumption made while developing this cost proposal.
- Identification of any cost information related to additional services or tasks. Include this in the cost proposal, but identify it as additional costs and do not make it part of the total project cost.
- The Consultant must have the cost proposal/cover letter/transmittal signed in ink by an authorized member of the firm.
- The consultant must not include any cost information within the body of the RFP qualification proposal response.

MANDATORY DISCLOSURES

By submitting a proposal, each Bidder understands, represents, and acknowledges that:

A. Their proposal has been developed by the Bidder independently and has been submitted without collusion with and without agreement, understanding, or planned common course of action with any other vendor or suppliers of materials, supplies, equipment, or services described in the Request for Proposals, designed to limit independent bidding or competition, and that the contents of the proposal have not been communicated by the Bidder or its employees or agents to any person not an employee or agent of the Bidder.

B. There is no conflict of interest. A conflict of interest exists if a Bidder has any interest that would actually conflict, or has the appearance of conflicting, in any manner or degree with the performance of work on the project. If there are potential conflicts, identify the municipalities, developers, and other public or private entities with whom your company is currently, or have been, employed and which may be affected.

C. It is not currently under suspension or debarment by the State of Minnesota, any other state or the federal government.

D. The company is either organized under Minnesota law or has a Certificate of Authority from the Minnesota Secretary of State to do business in Minnesota, in accordance with the requirements in M.S. 303.03.

SELECTION

The proposals will be reviewed by City Staff. The intent of the selection process is to review proposals and make an award based upon qualifications as described herein. A 100-point

scale will be used to create the final evaluation recommendations. The factors and weighting on which proposals will be judged are:

	Item	Percent
1	Goals and Objectives	5%
2	Experience	20%
3	Personnel	20%
4	Work Plan	30%
5	Work Schedule	5%
6	Project costs/fees	20%

Proposals will be evaluated on a best value basis with 80% qualifications and 20% cost consideration. The review committee will not open the cost proposal until after the qualification points have been awarded. Cost proposals will only be opened for the three top ranked firms.

SUBMITTAL

Submit original and five (5) copies in an envelope marked, RFP 22-99767, Hillside Tunnel Inspection to the Purchasing Office by the deadline indicated on the cover page. The City reserves the right to reject or deduct evaluation points for late proposals.

Proposals must be signed by an authorized official. If the official signs the Proposal Cover Sheet attached as Appendix A, this requirement will be met. Proposals must remain valid for 60 days or until a contract is fully executed.

CONTACT

All questions concerning the project shall be submitted by email to:

Tom Johnson, Project Engineer
City of Duluth - Engineering Division
411 W. 1st Street, Room 240 City Hall
Duluth, Minnesota 55802-1191
tajohnson@duluthmn.gov

LIMITATIONS

This Request for Proposal does not commit the City of Duluth to award a contract or pay costs incurred in the preparation of the proposal, or to procure a contract for services or supplies.

The Proposal shall not in any way include any restrictions on the City of Duluth. The Consultant shall NOT provide proposed contract language.

The City of Duluth specifically reserves the right to accept or reject any or all proposals, to negotiate with any qualified source, to cancel in part or in its entirety the Request for Proposal, to waive any requirements, to investigate the qualifications of any proposal, to obtain new proposals, or proceed to have the service provided in any way as necessary to serve the best interests of the City of Duluth.

The selected consultant must sign the City of Duluth standard Professional Engineering Services Agreement, a sample of which is available at <https://www.duluthmn.gov/purchasing/forms/>. Any questions concerning this agreement should be asked PRIOR to proposal submittal. These questions should be directed to Eric Shaffer in the City Engineering Office.

All materials submitted in response to this RFP will become property of the City and will become public record after the evaluation process is completed and an award decision made.

Prior to entering into an agreement with the city, the consultant shall furnish proof that it has all legal requirements for transacting business in the State of Minnesota.

APPENDICES

Appendix A – Proposal Cover Sheet

Appendix B – Exhibits

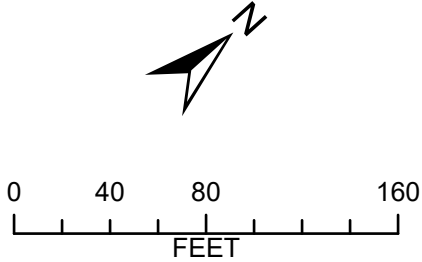
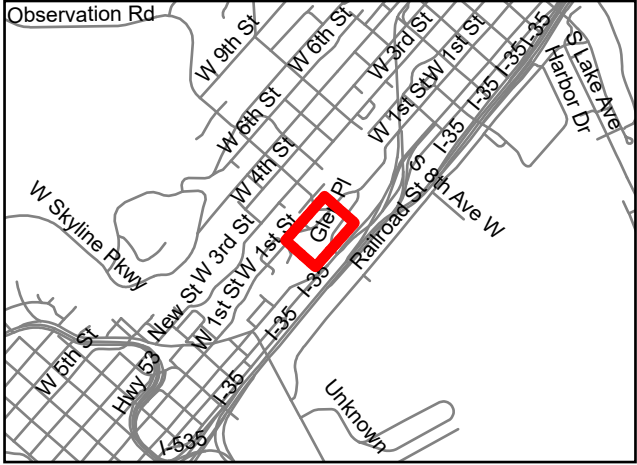
Appendix C – Tunnel Inspection Report Example

**APPENDIX A - PROPOSAL COVER SHEET
CITY OF DULUTH
RFP# 22-99767**

Bidder Information:	
Bidder Name	
Mailing Address	
Contact Person	
Contact Person's Phone Number	
Contact Person's E-Mail Address	
Federal ID Number	
Authorized Signature	
Name & Title of Authorized Signer	
Email of Authorized Signer	

APPENDIX B - EXHIBITS
CITY OF DULUTH
RFP# 22-99767

- Buckingham Creek
- Clarkhouse Creek
- Coffee Creek
- Greys Creek
- Oregon Creek



LEGEND

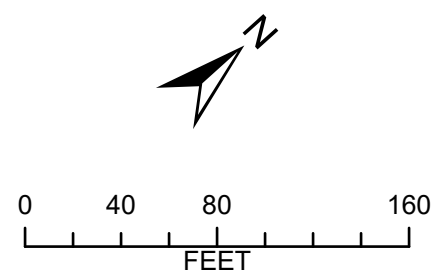
- BUCKINGHAM SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

**BUCKINGHAM CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
BUCKINGHAM 1



LEGEND

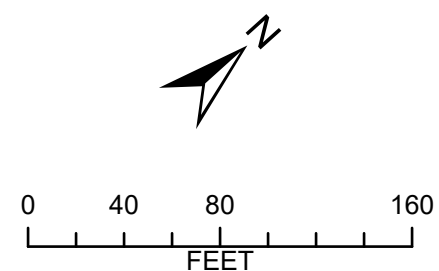
-  BUCKINGHAM SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN



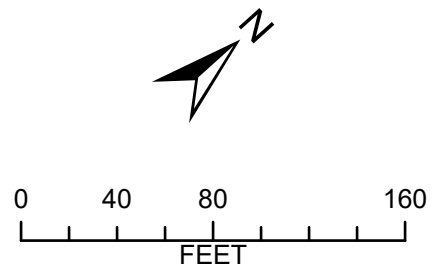
**CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802**

BUCKINGHAM CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
BUCKINGHAM 2



MAP EXTENT:
BUCKINGHAM 3



LEGEND

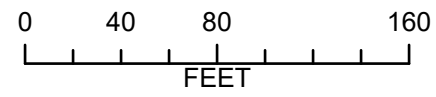
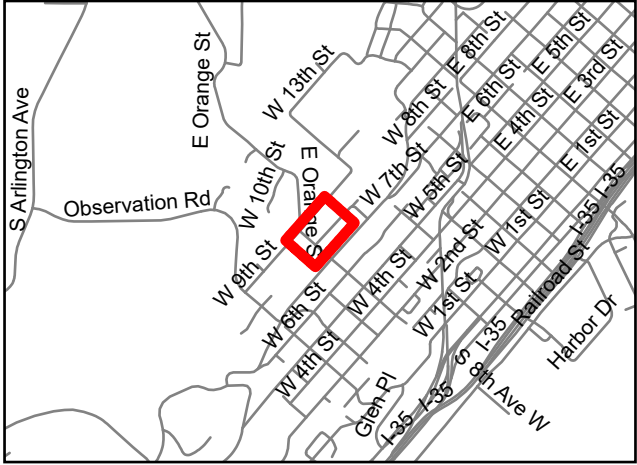
- BUCKINGHAM SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

BUCKINGHAM CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
BUCKINGHAM 5



LEGEND

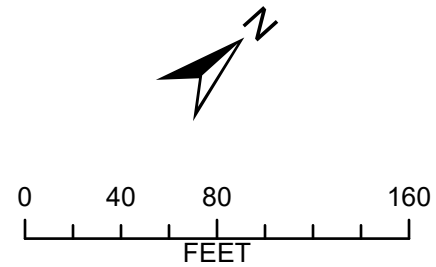
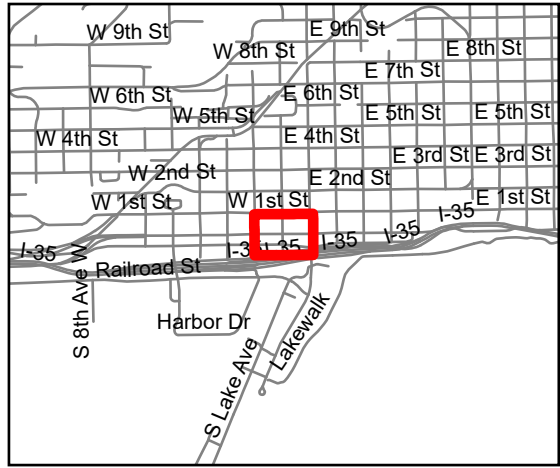
- BUCKINGHAM SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

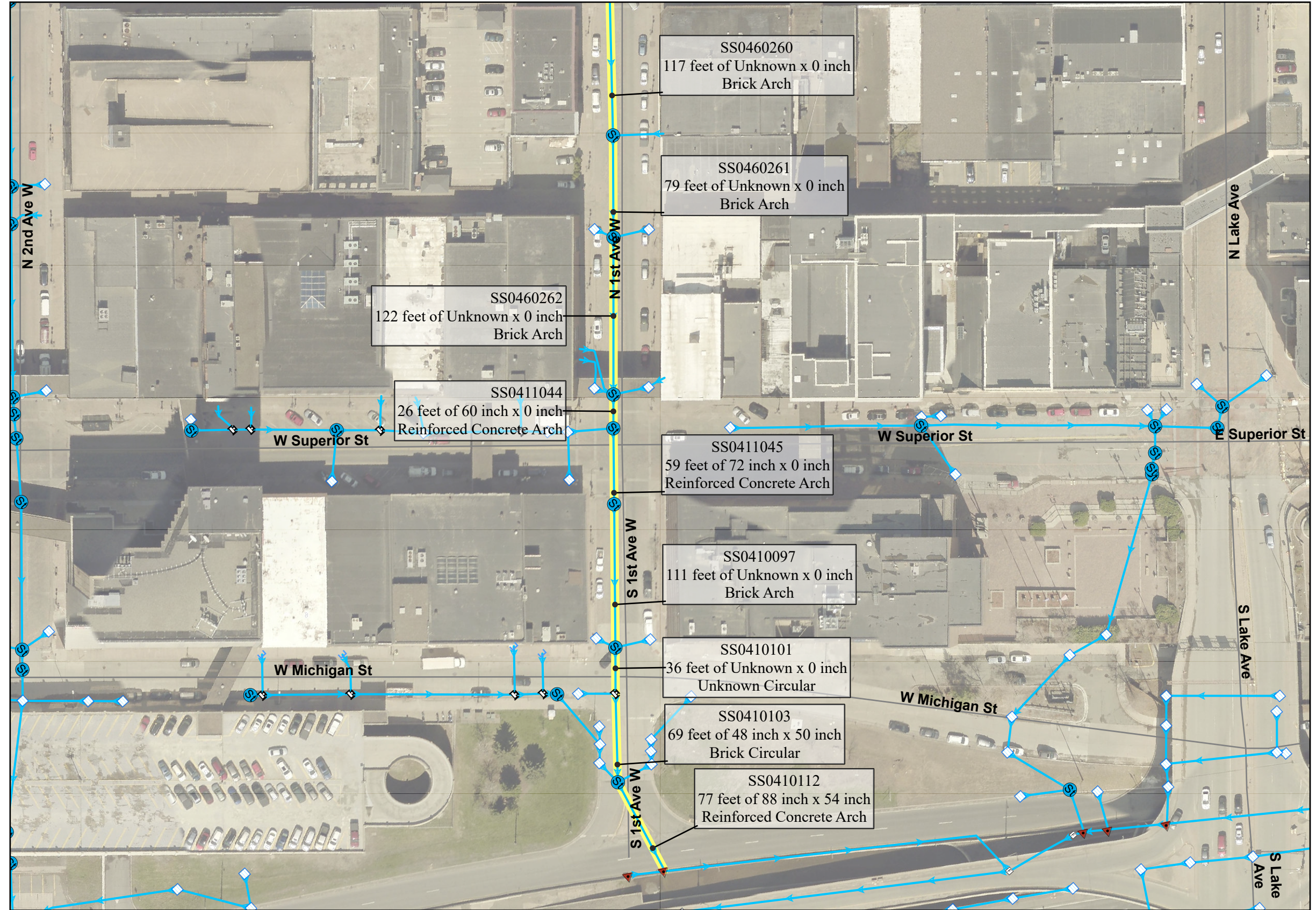
**BUCKINGHAM CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
BUCKINGHAM 6



LEGEND

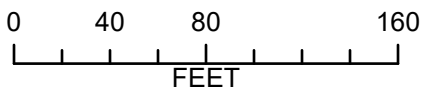
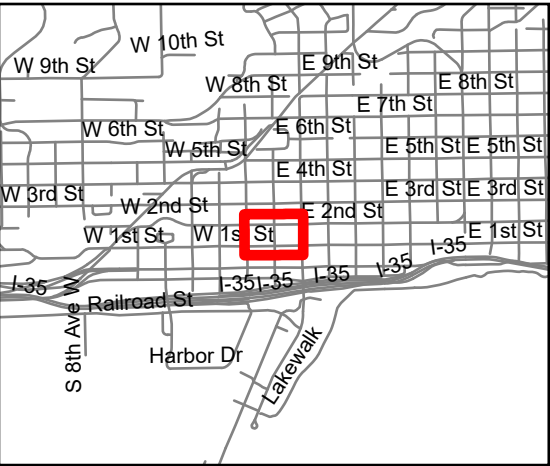
- CLARKHOUSE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

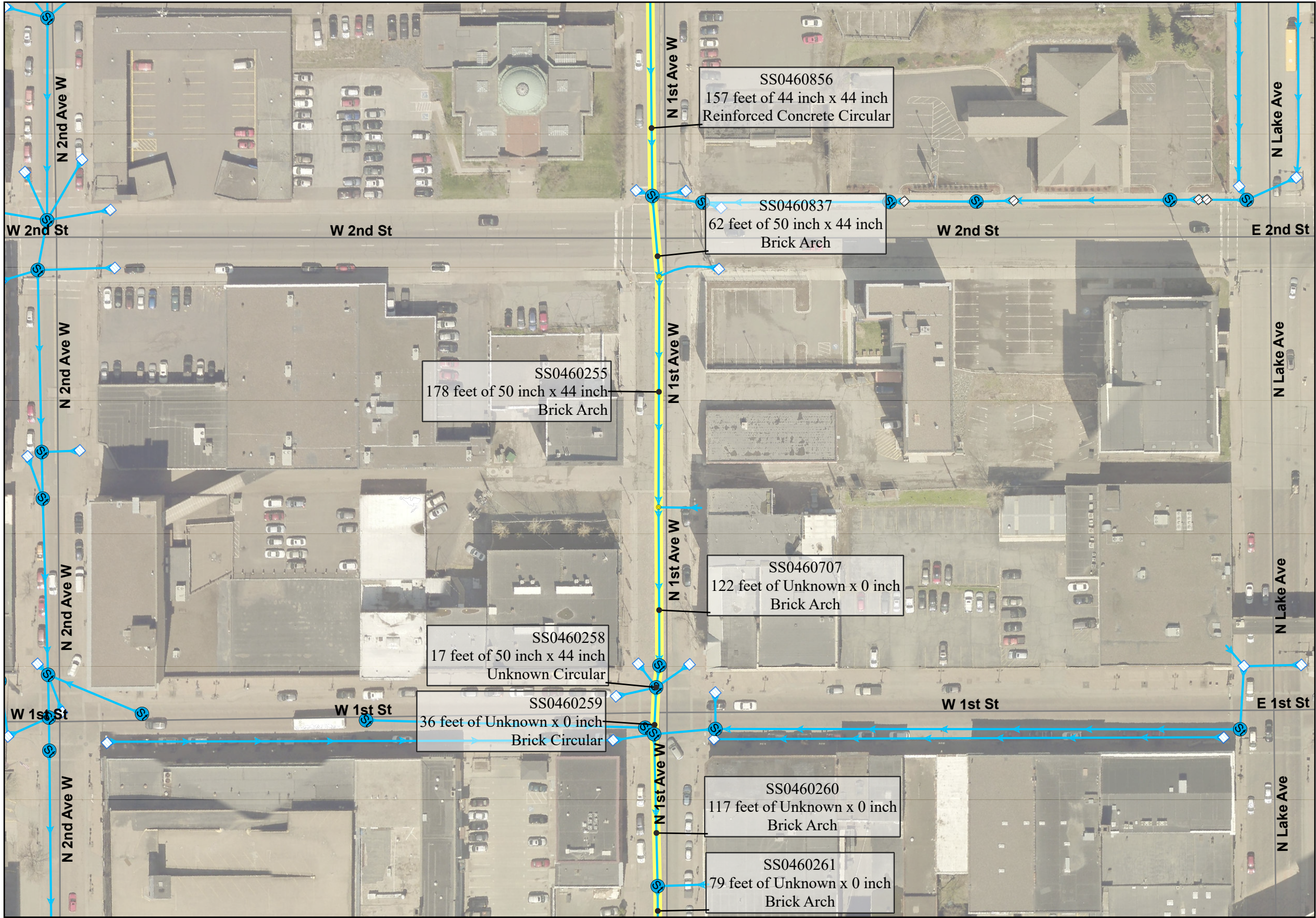
CLARKHOUSE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
CLARKHOUSE 1



LEGEND

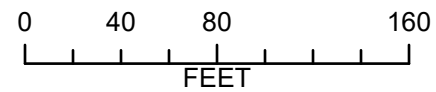
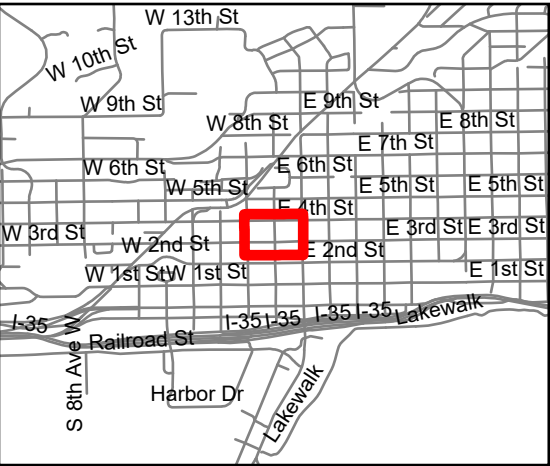
-  CLARKHOUSE SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

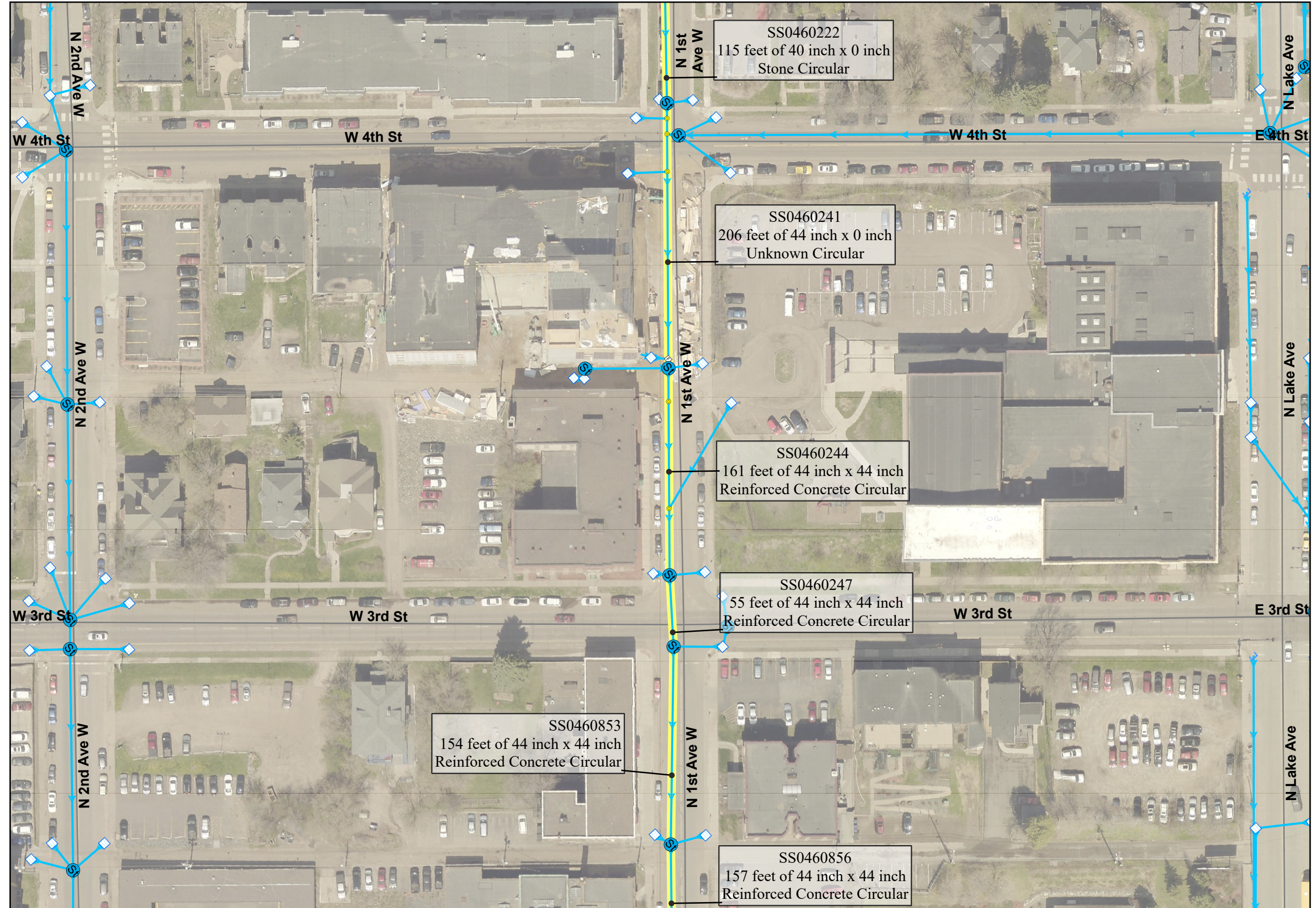
CLARKHOUSE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
CLARKHOUSE 2



LEGEND

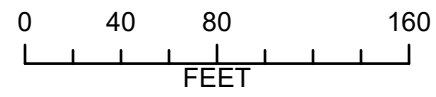
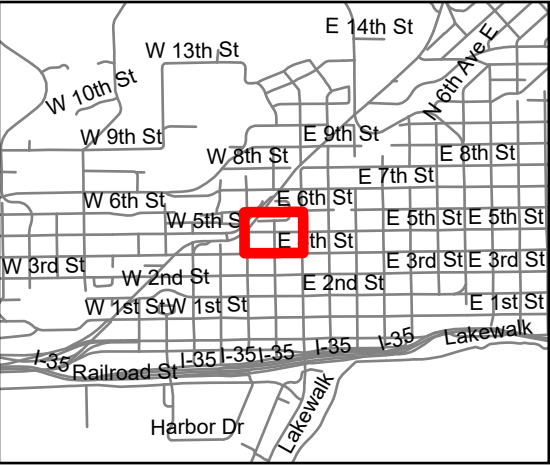
-  CLARKHOUSE SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

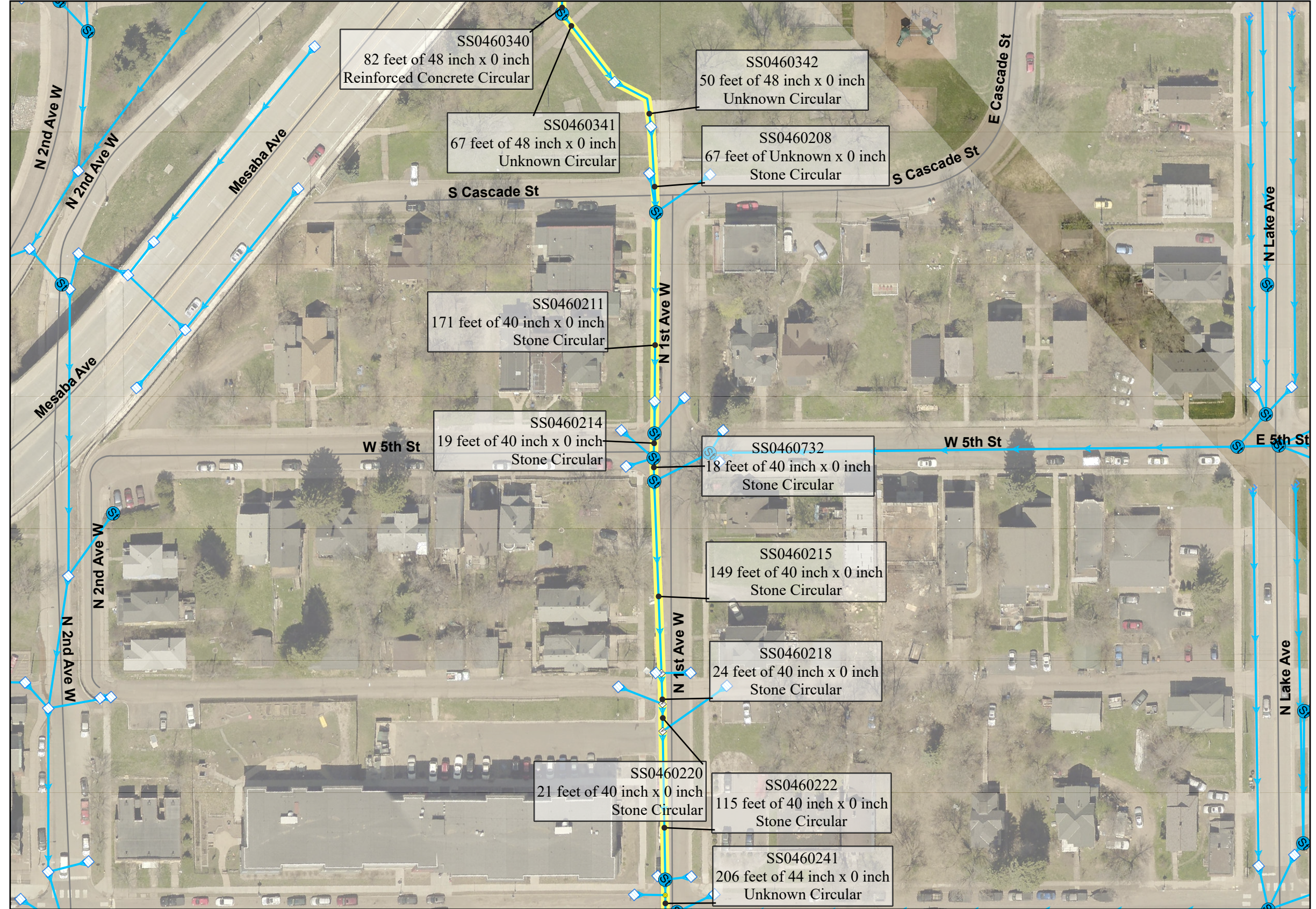
CLARKHOUSE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
CLARKHOUSE 3



LEGEND

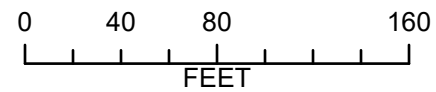
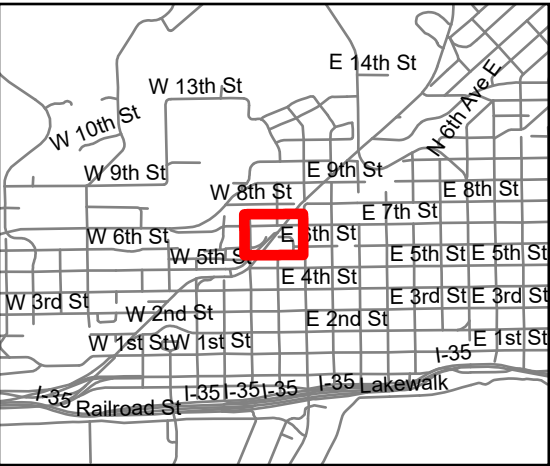
- CLARKHOUSE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

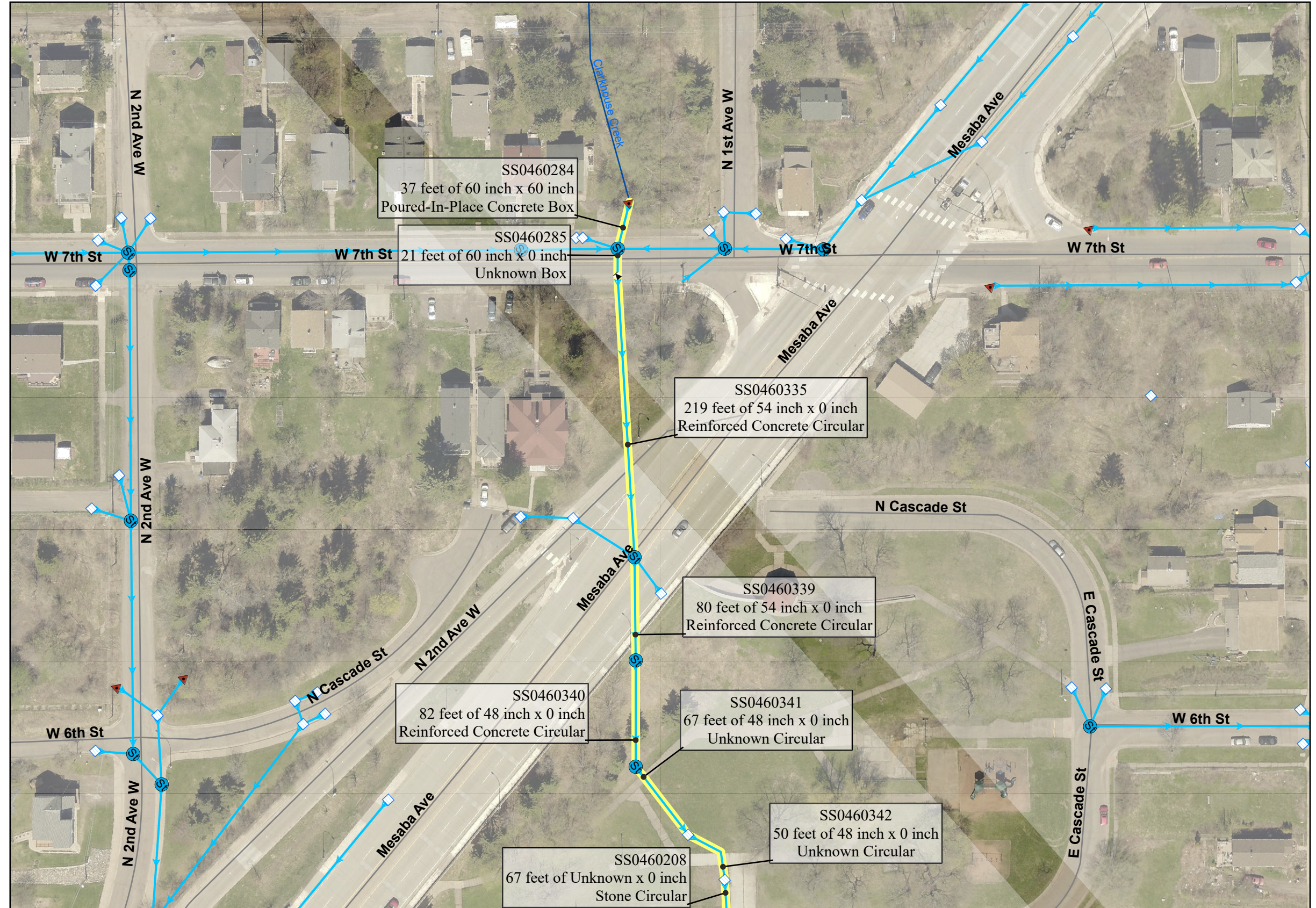
CLARKHOUSE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
CLARKHOUSE 4



LEGEND

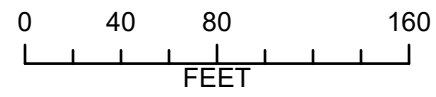
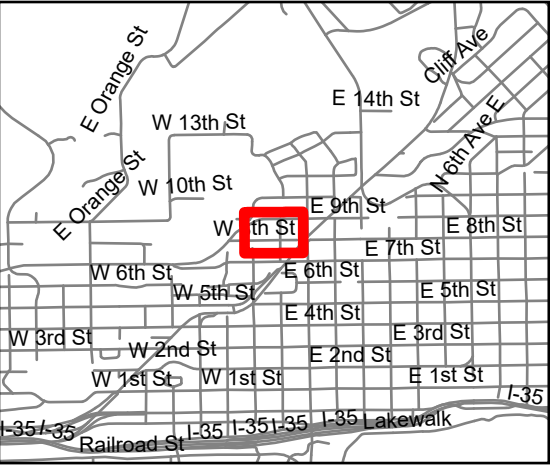
- CLARKHOUSE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

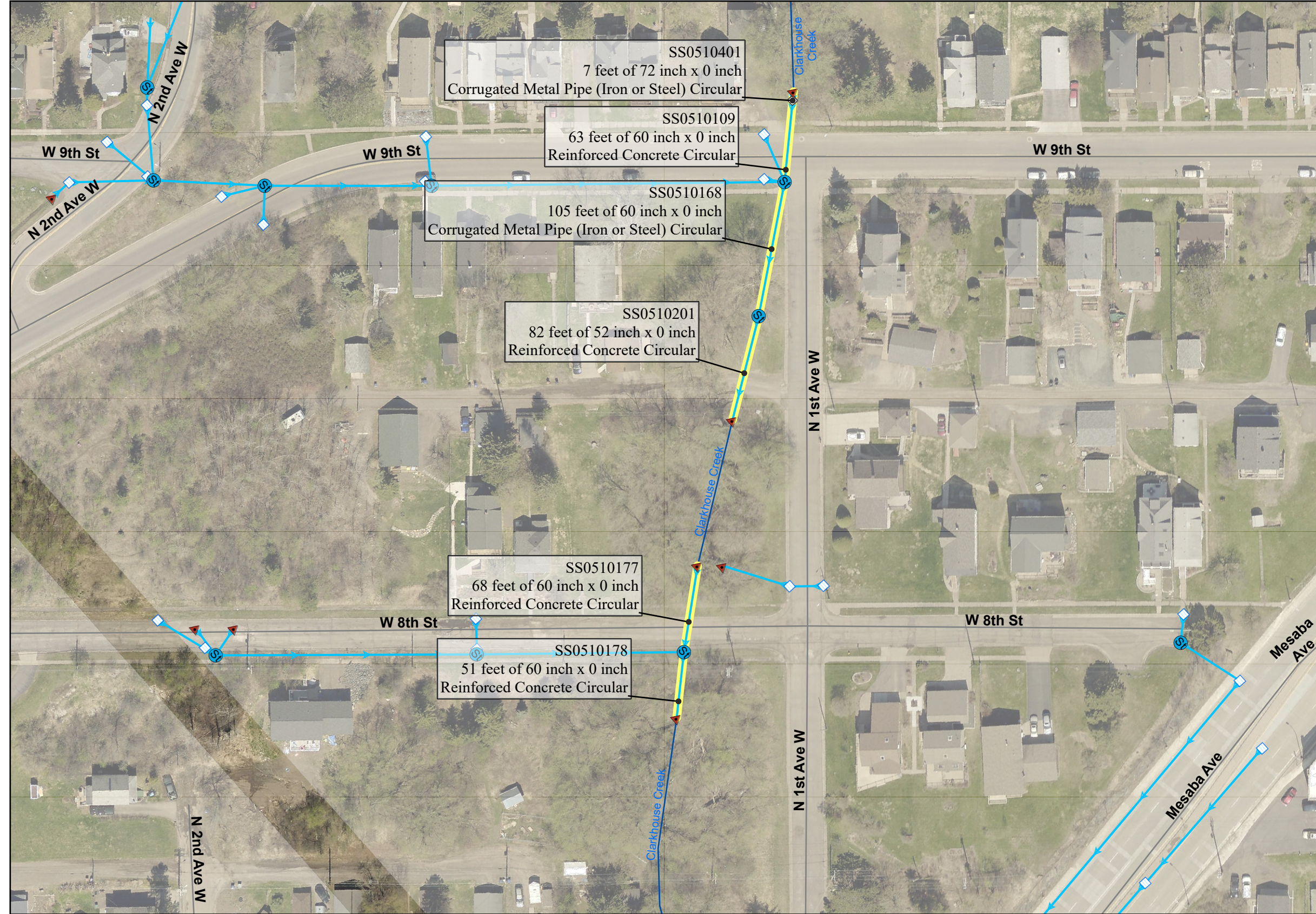
**CLARKHOUSE CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
CLARKHOUSE 5



LEGEND

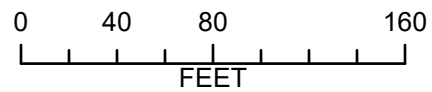
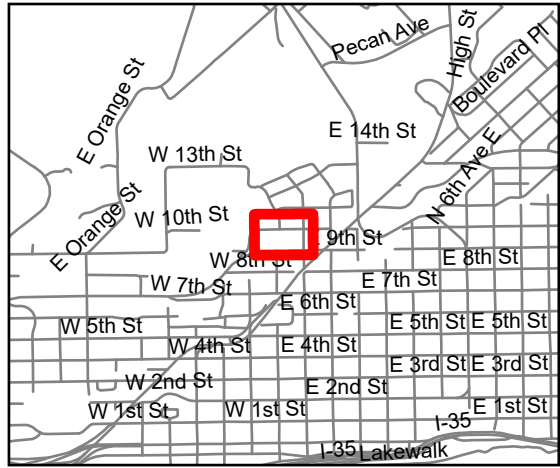
- CLARKHOUSE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

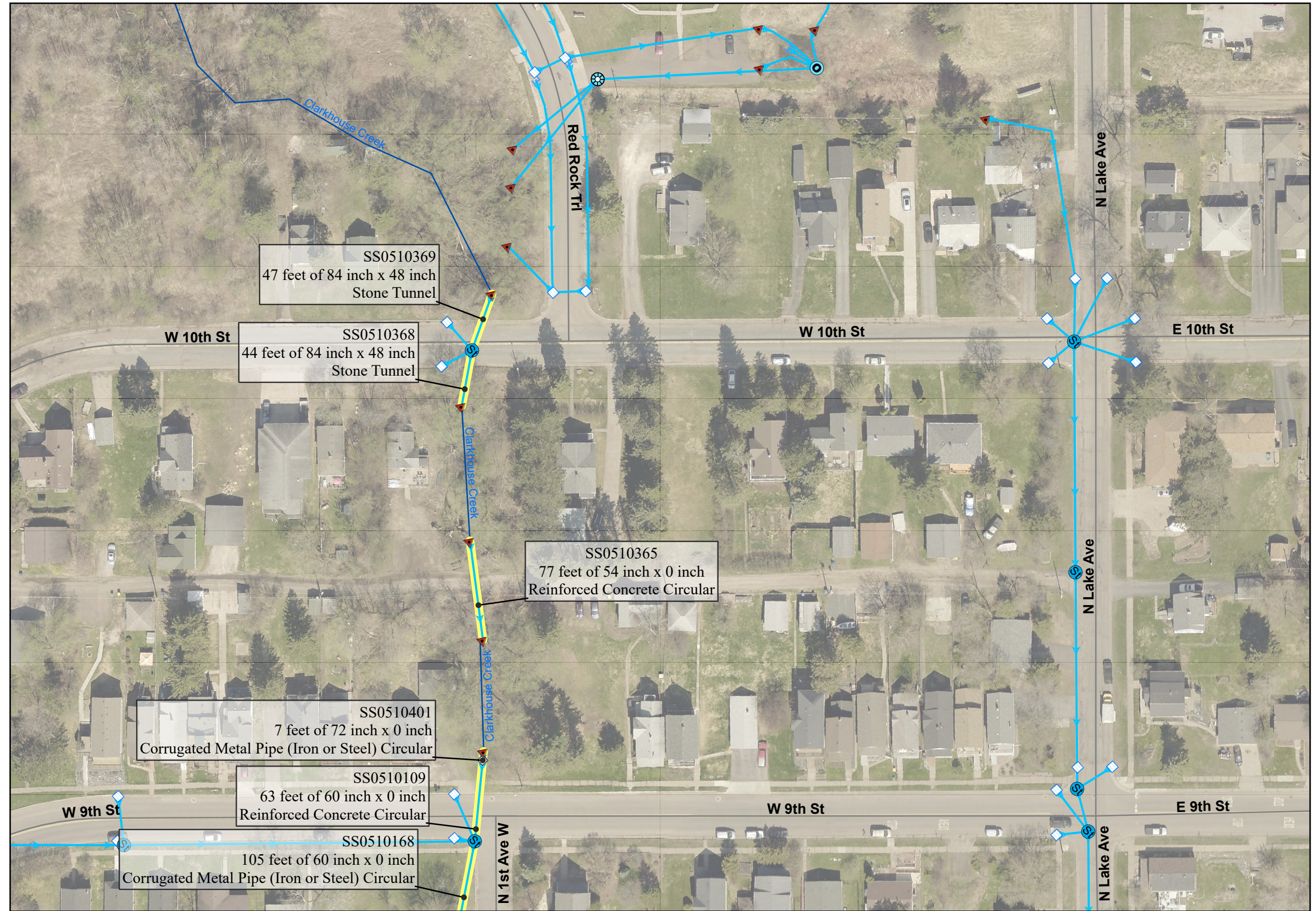
**CLARKHOUSE CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
CLARKHOUSE 6



LEGEND

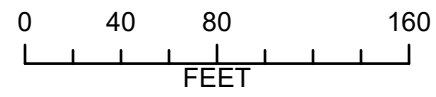
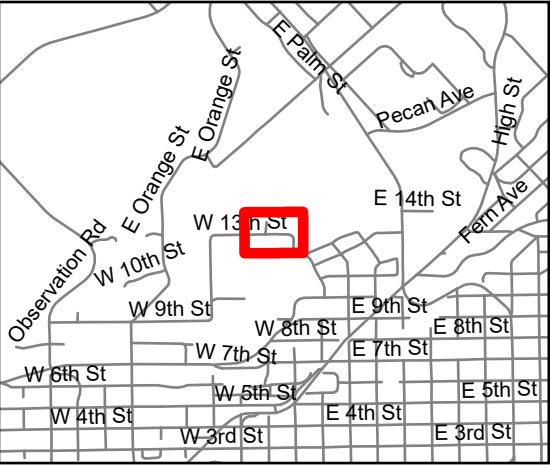
-  CLARKHOUSE SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

CLARKHOUSE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
CLARKHOUSE 7



LEGEND

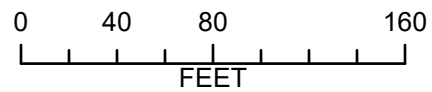
- CLARKHOUSE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

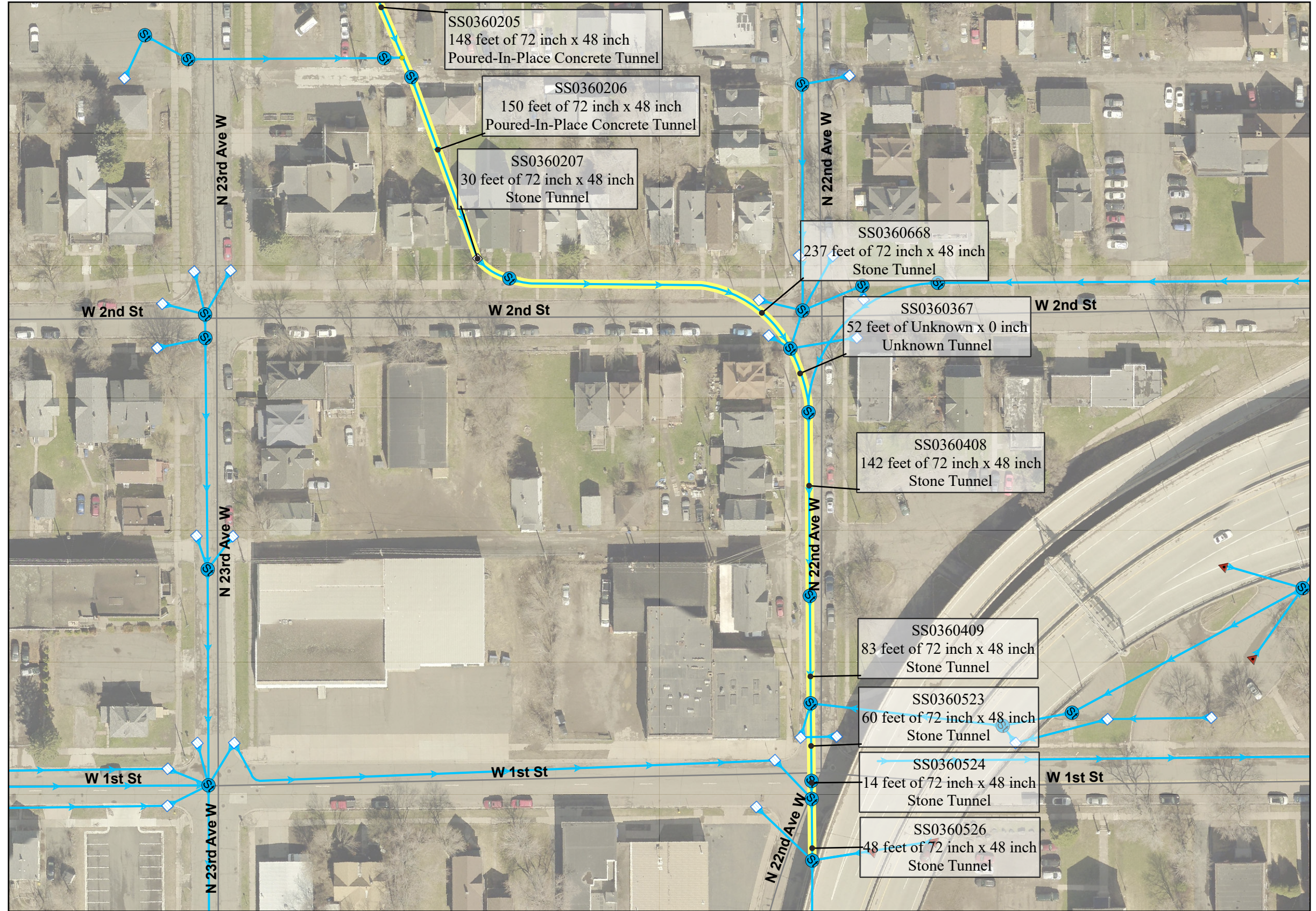
**CLARKHOUSE CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
CLARKHOUSE 8



LEGEND

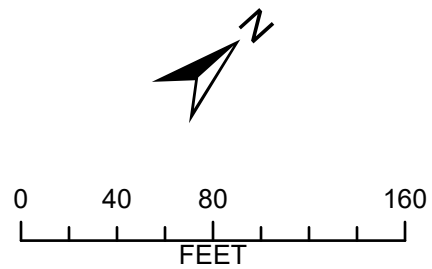
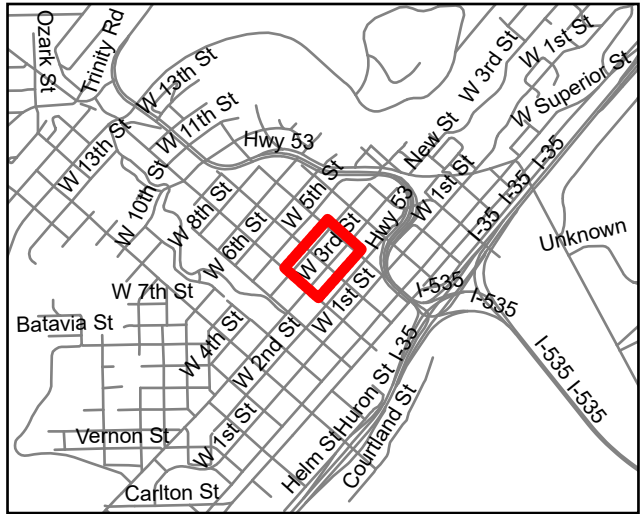
- COFFEE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

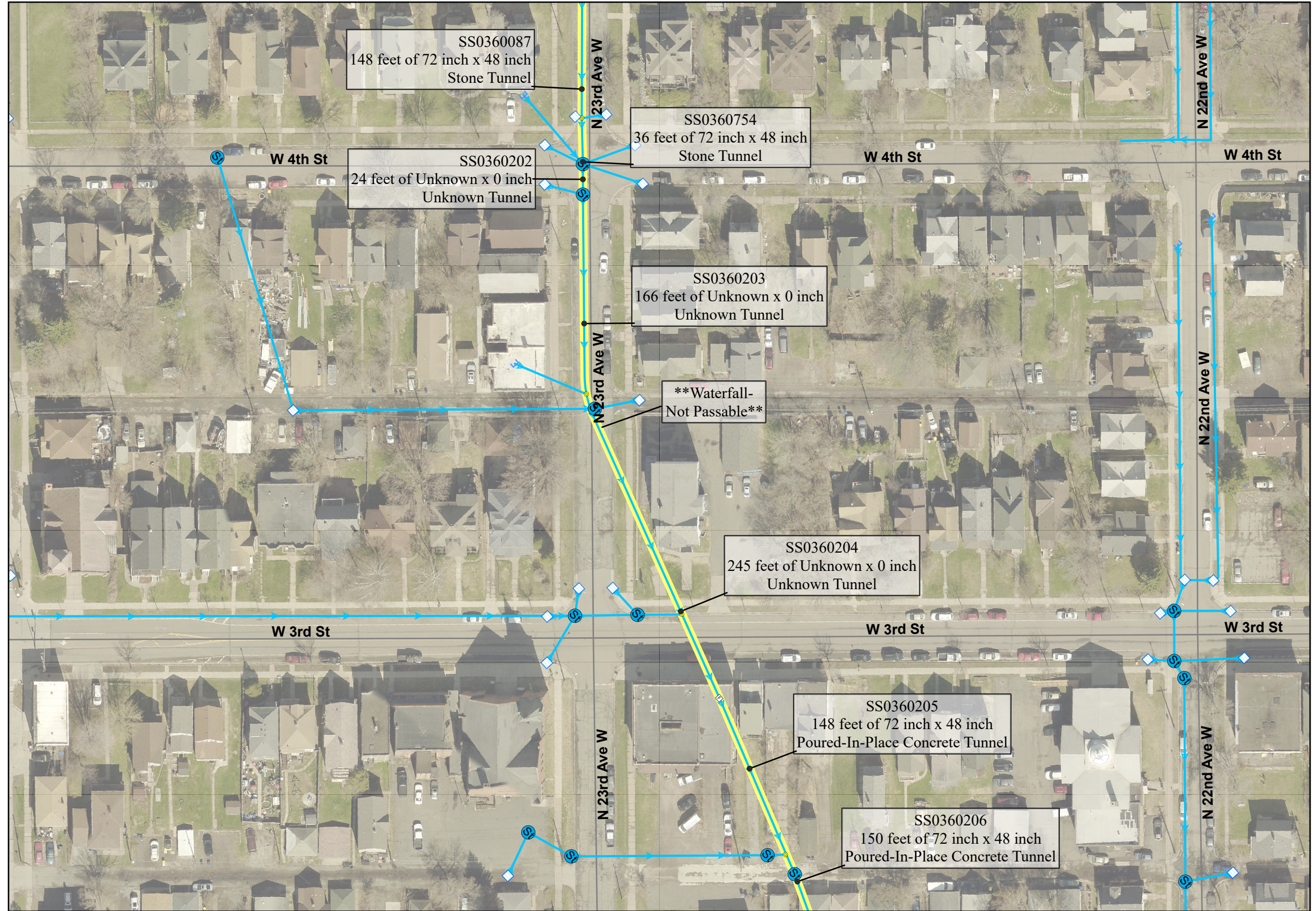
COFFEE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
COFFEE 1



LEGEND

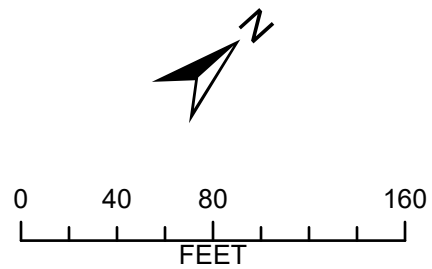
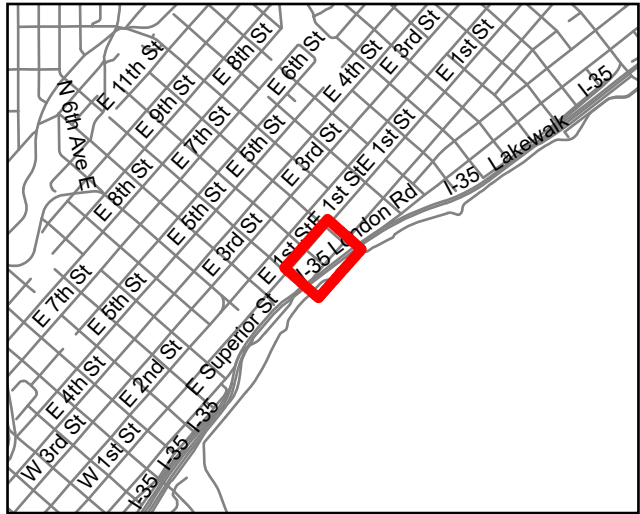
- COFFEE SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

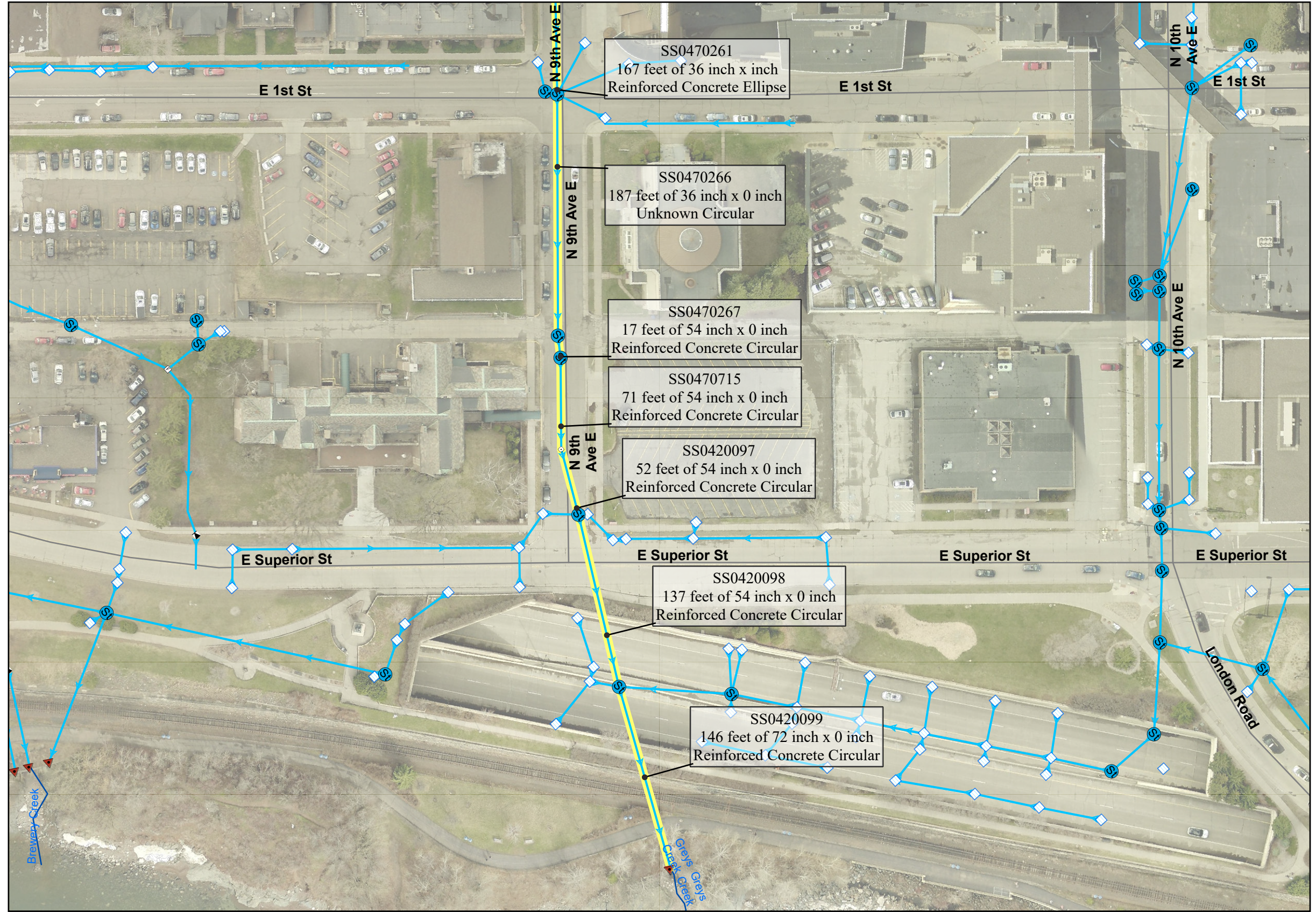
COFFEE CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
COFFEE 2



LEGEND

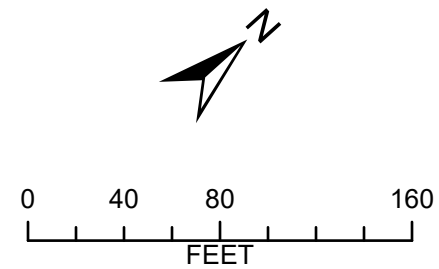
- GREYS SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- S STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

**GREYS CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
GREYS 1



LEGEND

GREYS SURVEY LIMITS

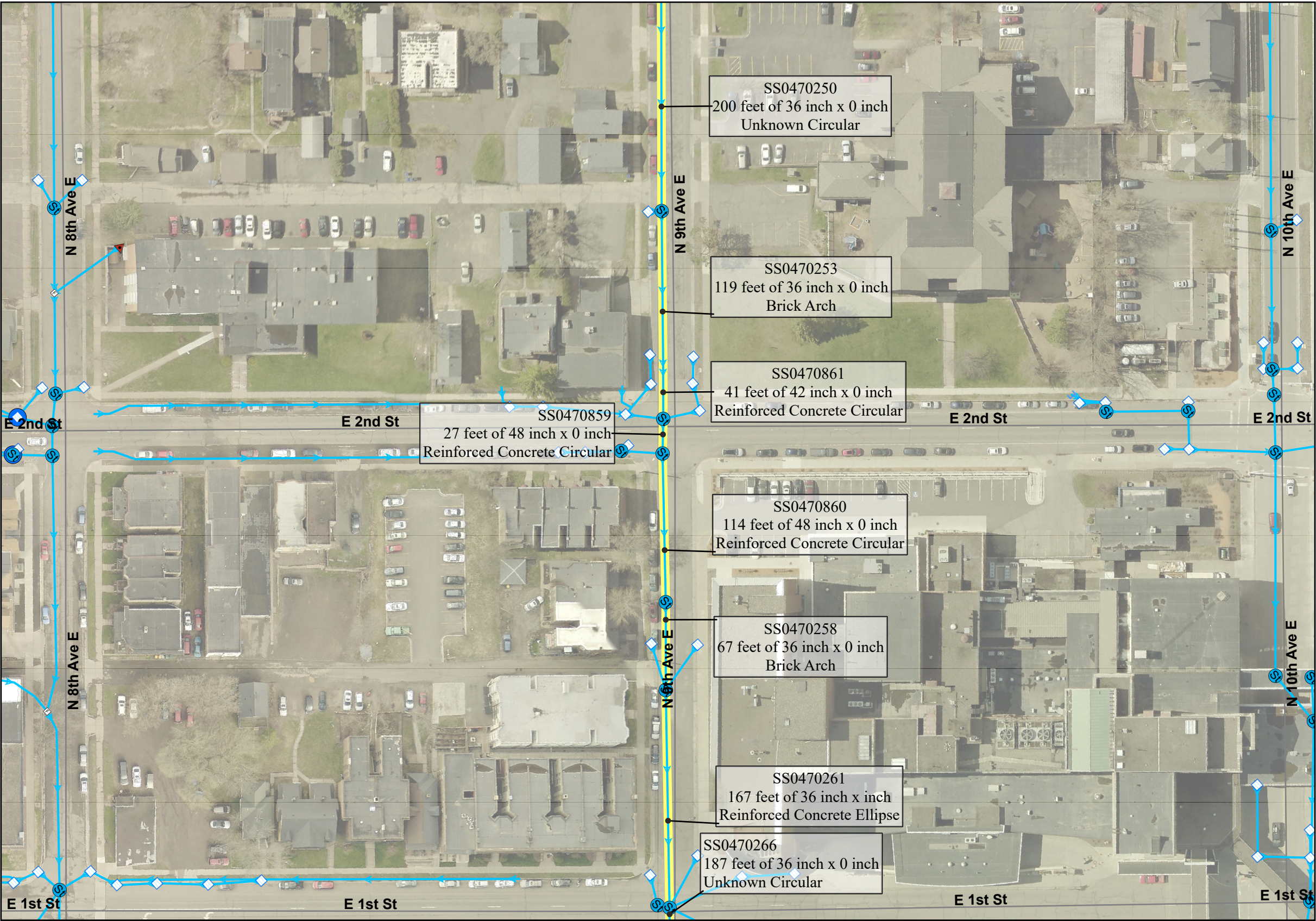
STORM SEWER

STREAMS

PIPE END

STORM MANHOLE

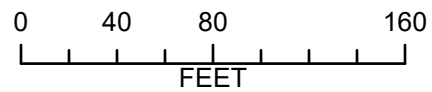
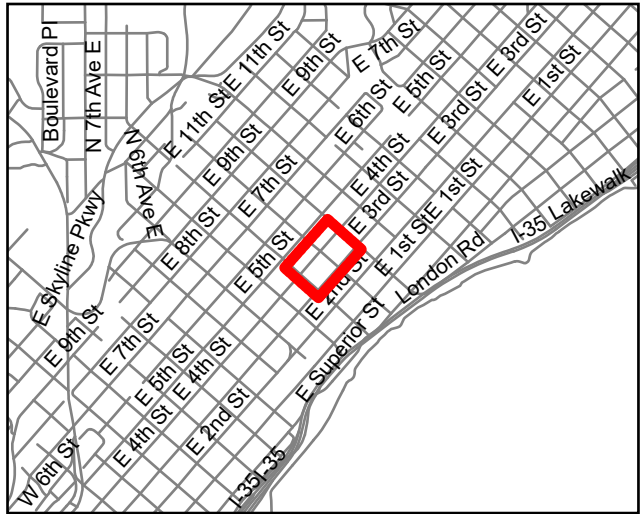
STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

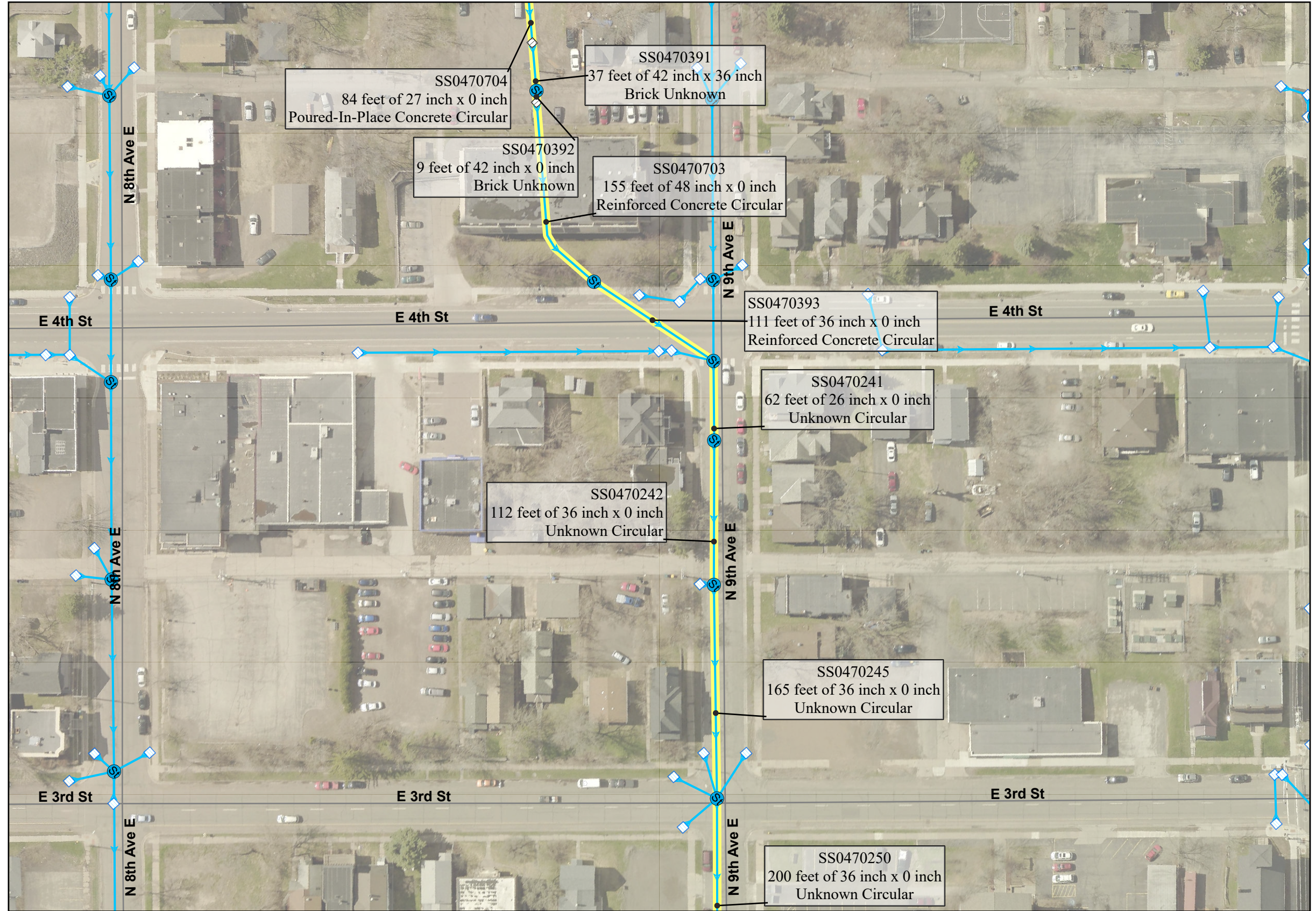
**GREYS CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
GREYS 2



LEGEND

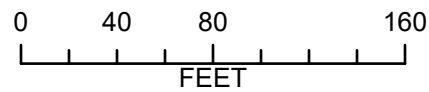
- GREYS SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

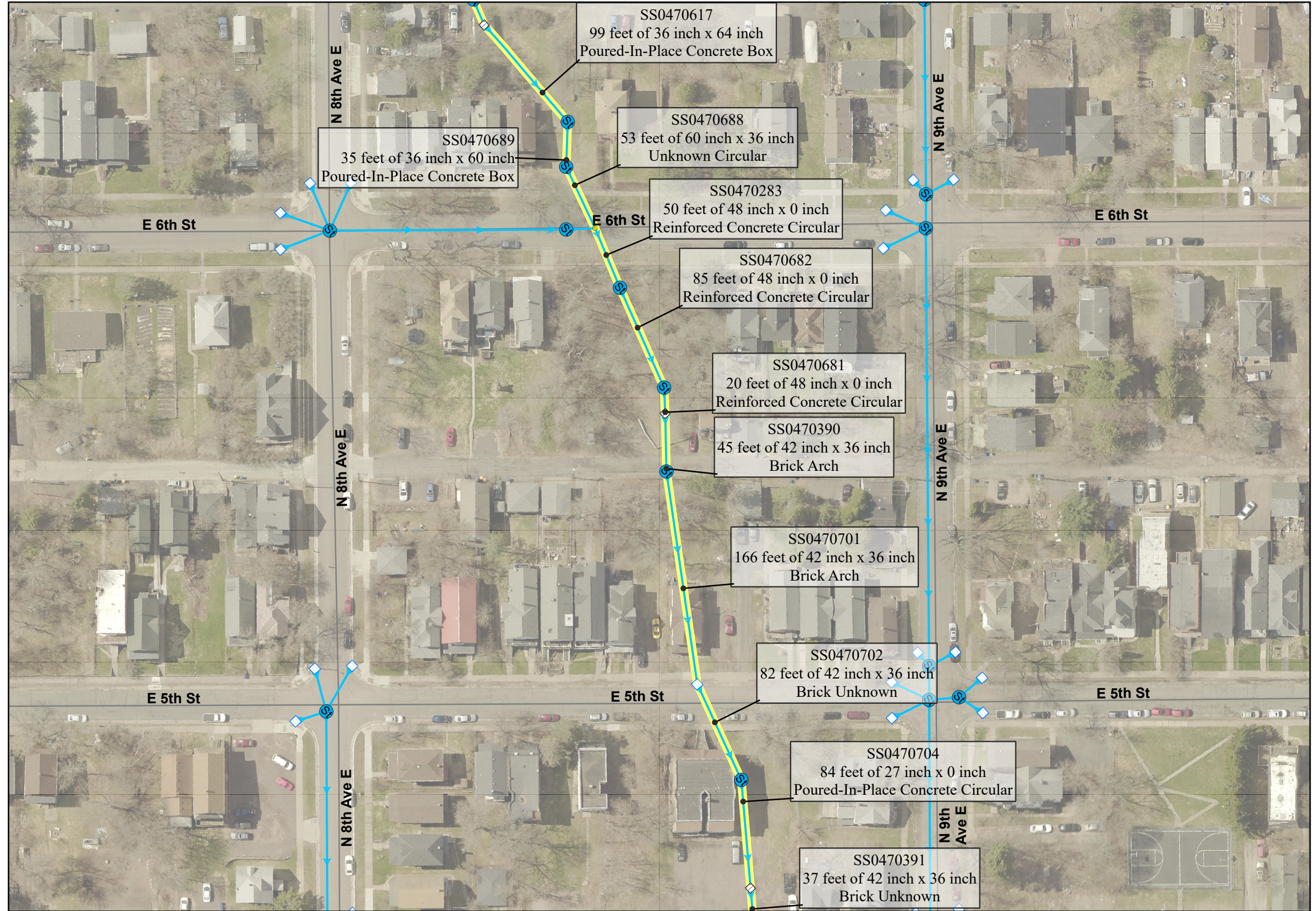
**GREYS CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
GREYS 3



LEGEND

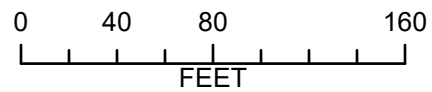
- GREYS SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

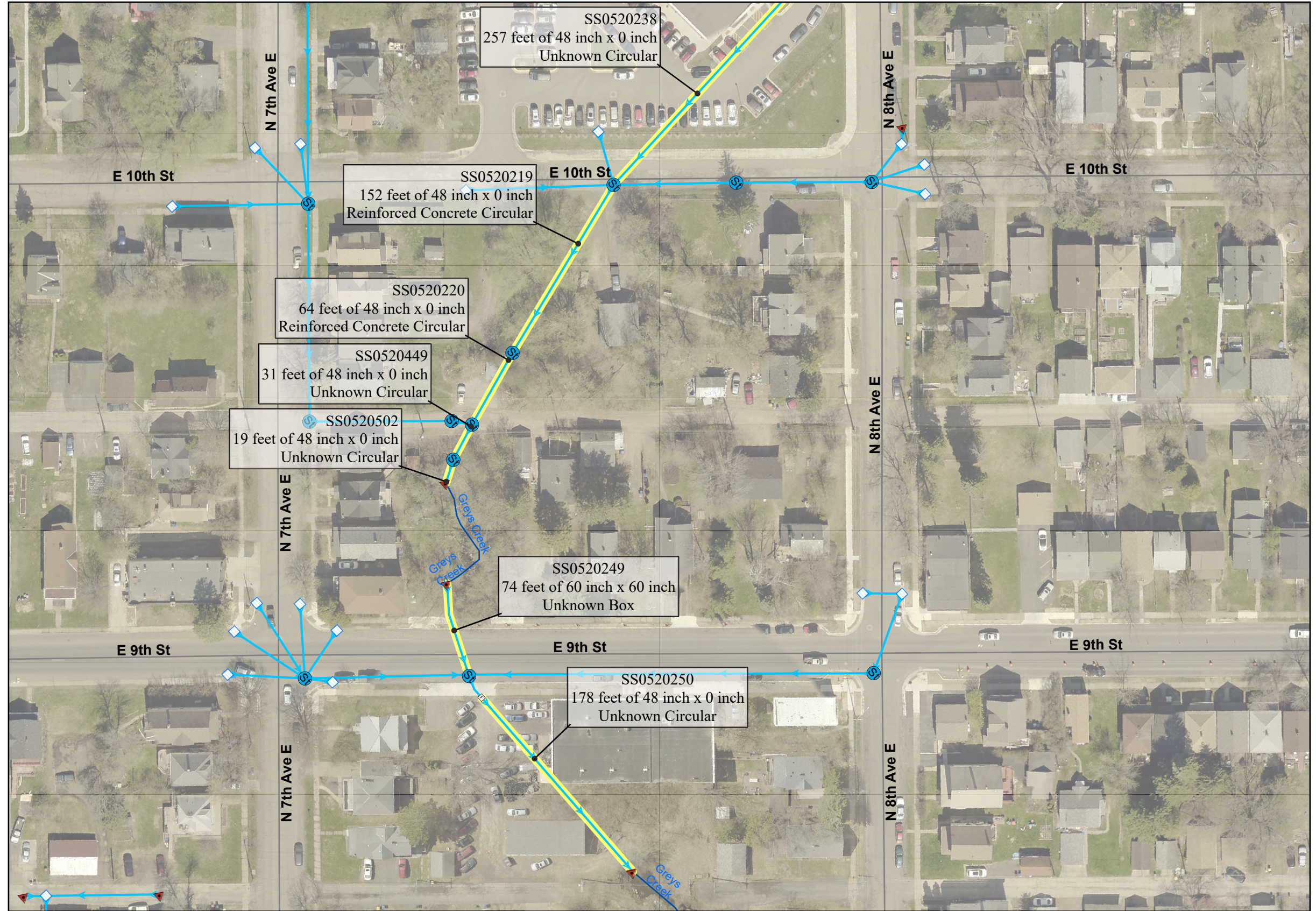
GREYS CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
GREYS 4



LEGEND

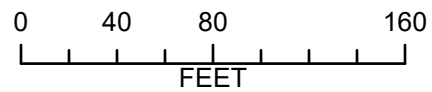
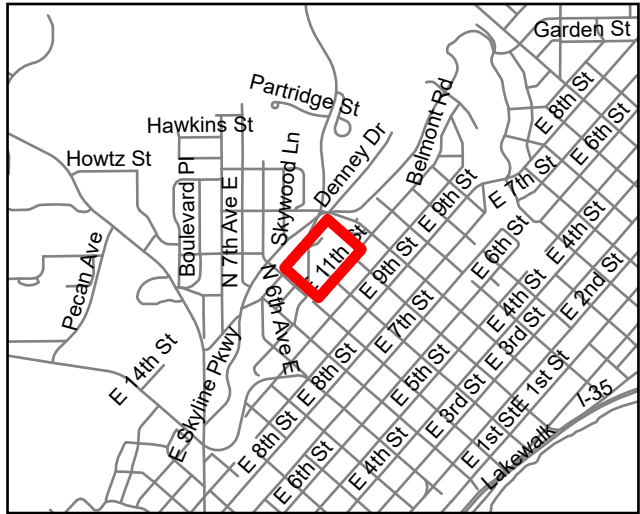
-  GREYS SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

GREYS CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
GREYS 6



LEGEND

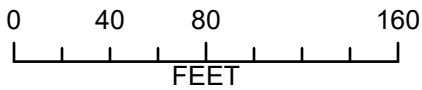
- GREYS SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

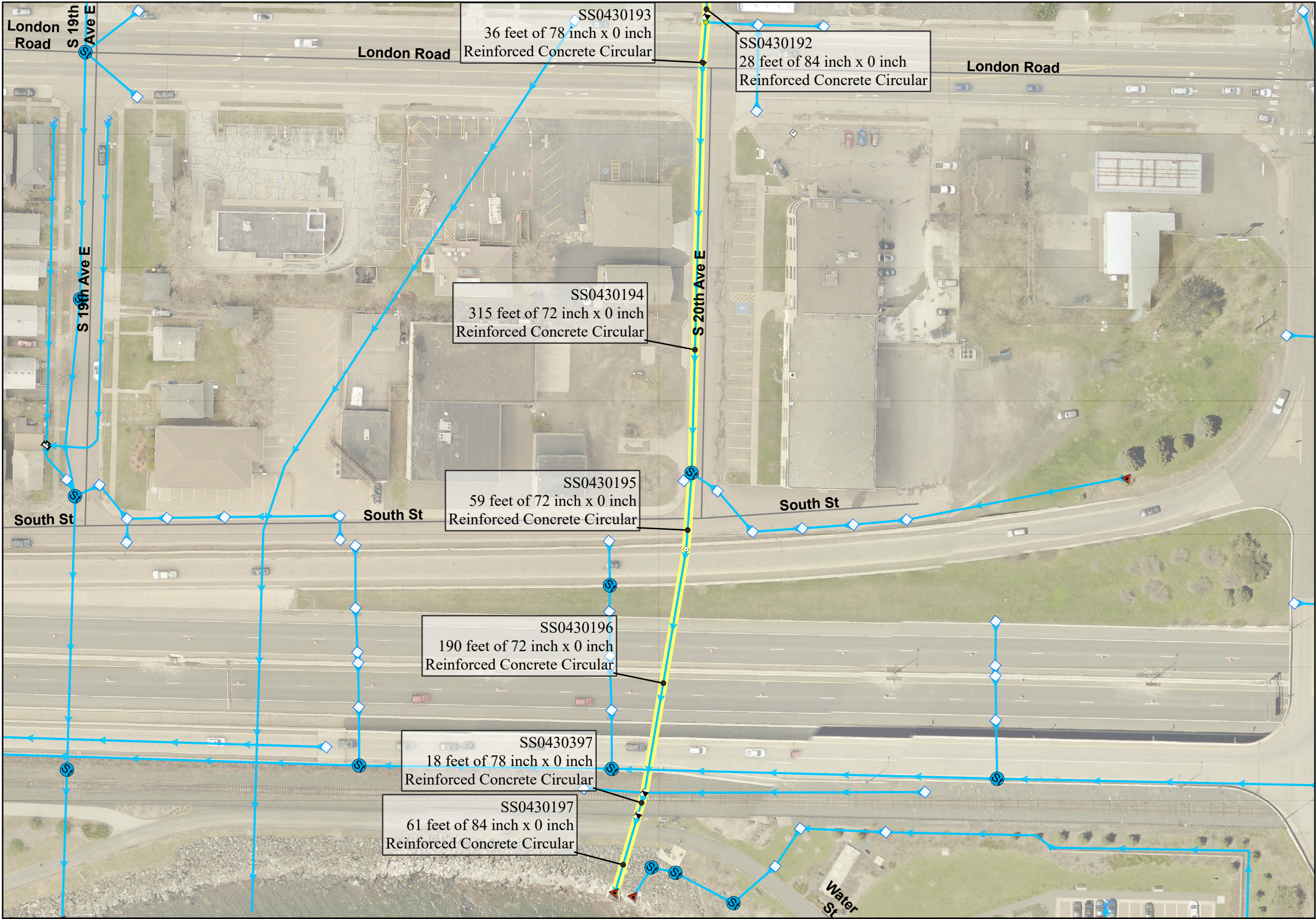
GREYS CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
GREYS 8



LEGEND

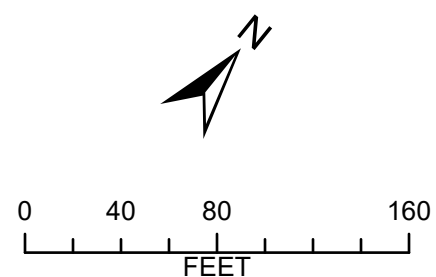
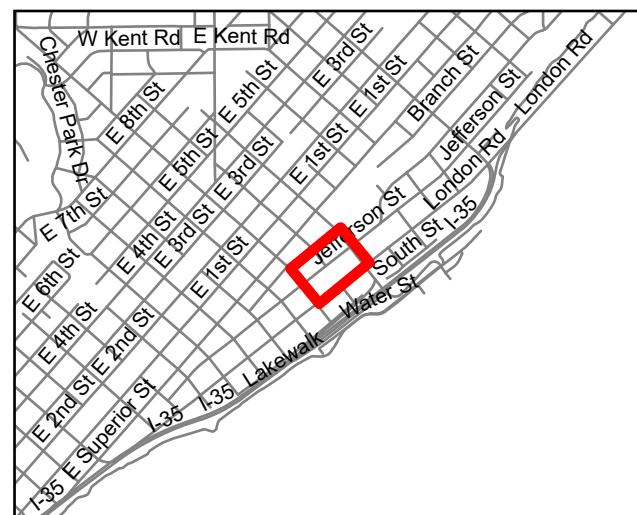
- OREGON SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN









CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

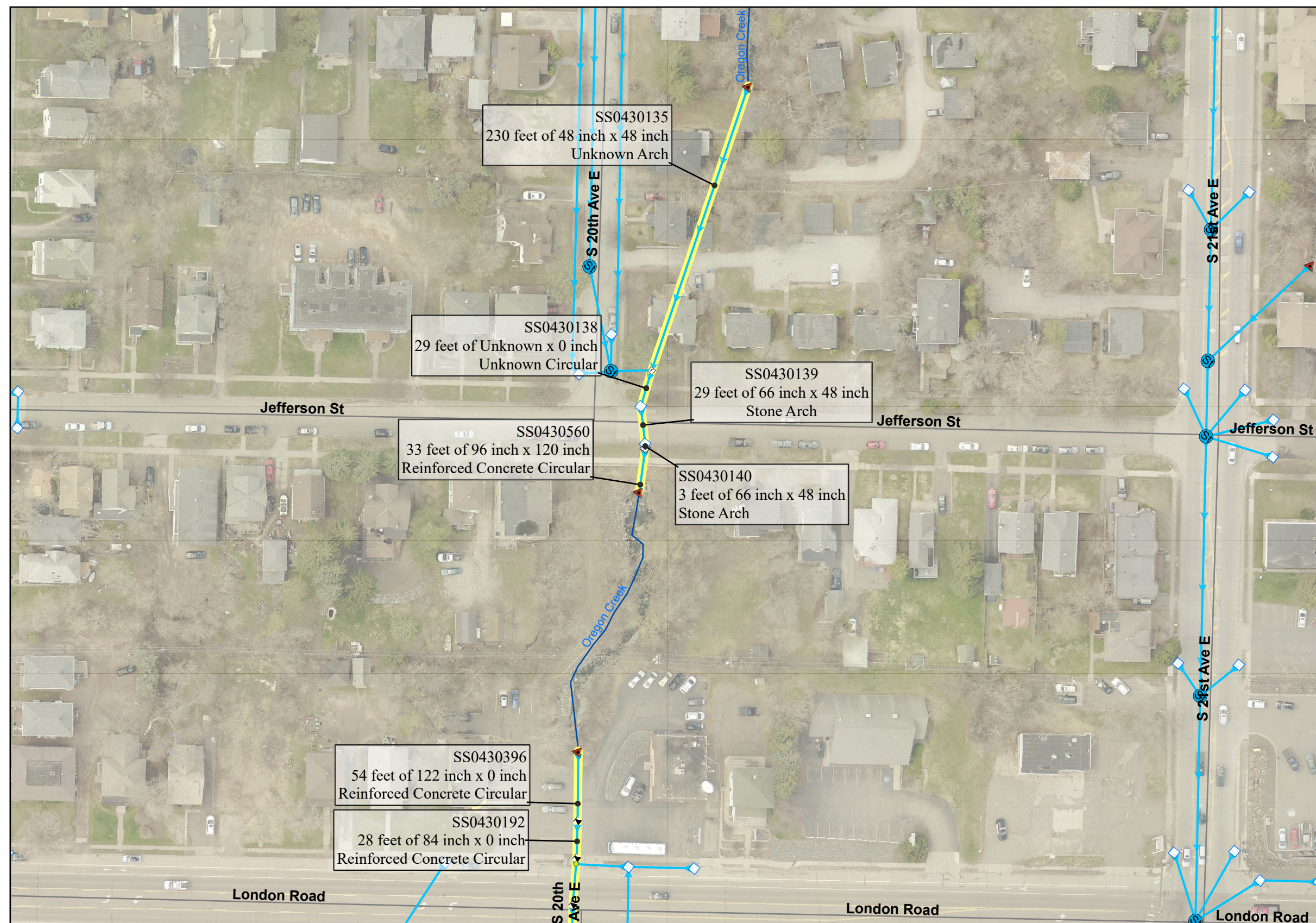
**OREGON CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
OREGON 1



LEGEND

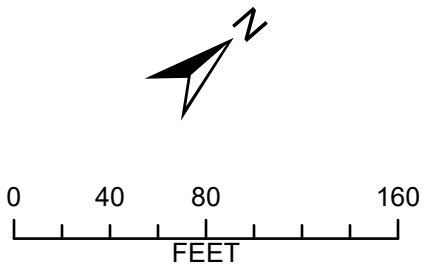
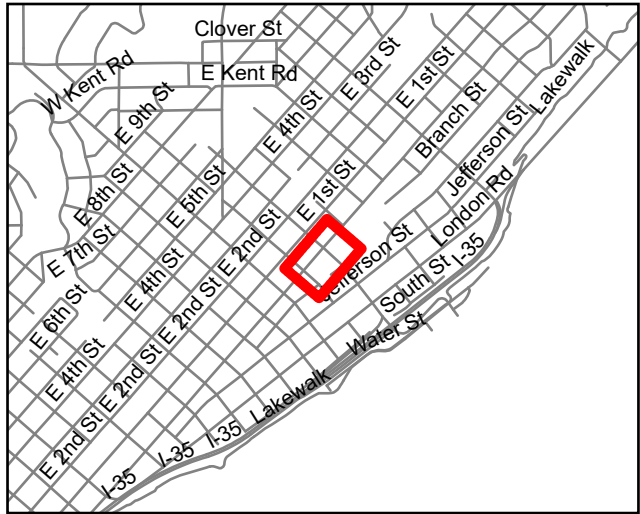
-  OREGON SURVEY LIMITS
-  STORM SEWER
-  STREAMS
-  PIPE END
-  STORM MANHOLE
-  STORM CATCH BASIN



**CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802**

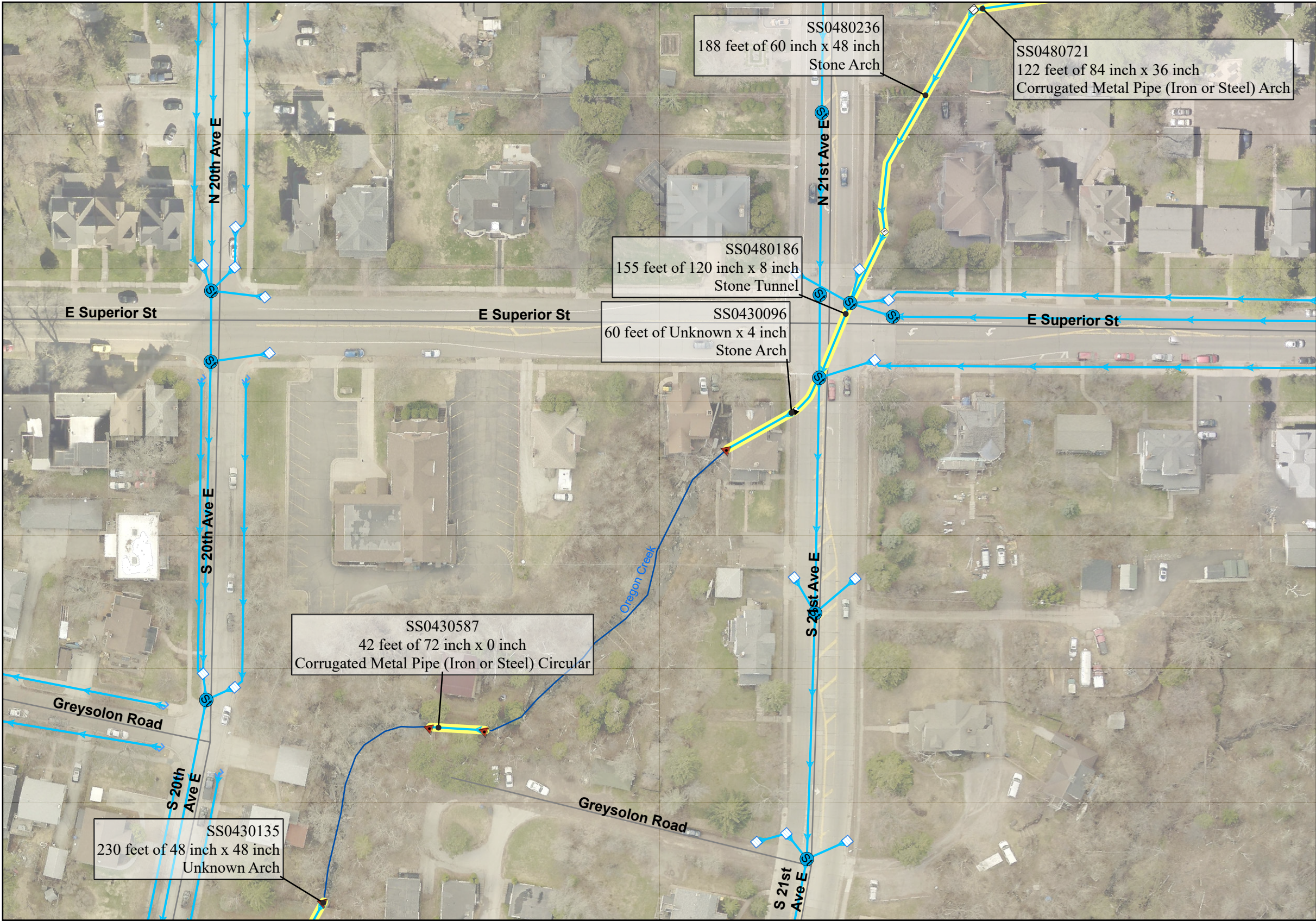
OREGON CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
OREGON 2



LEGEND

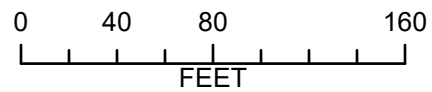
- OREGON SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

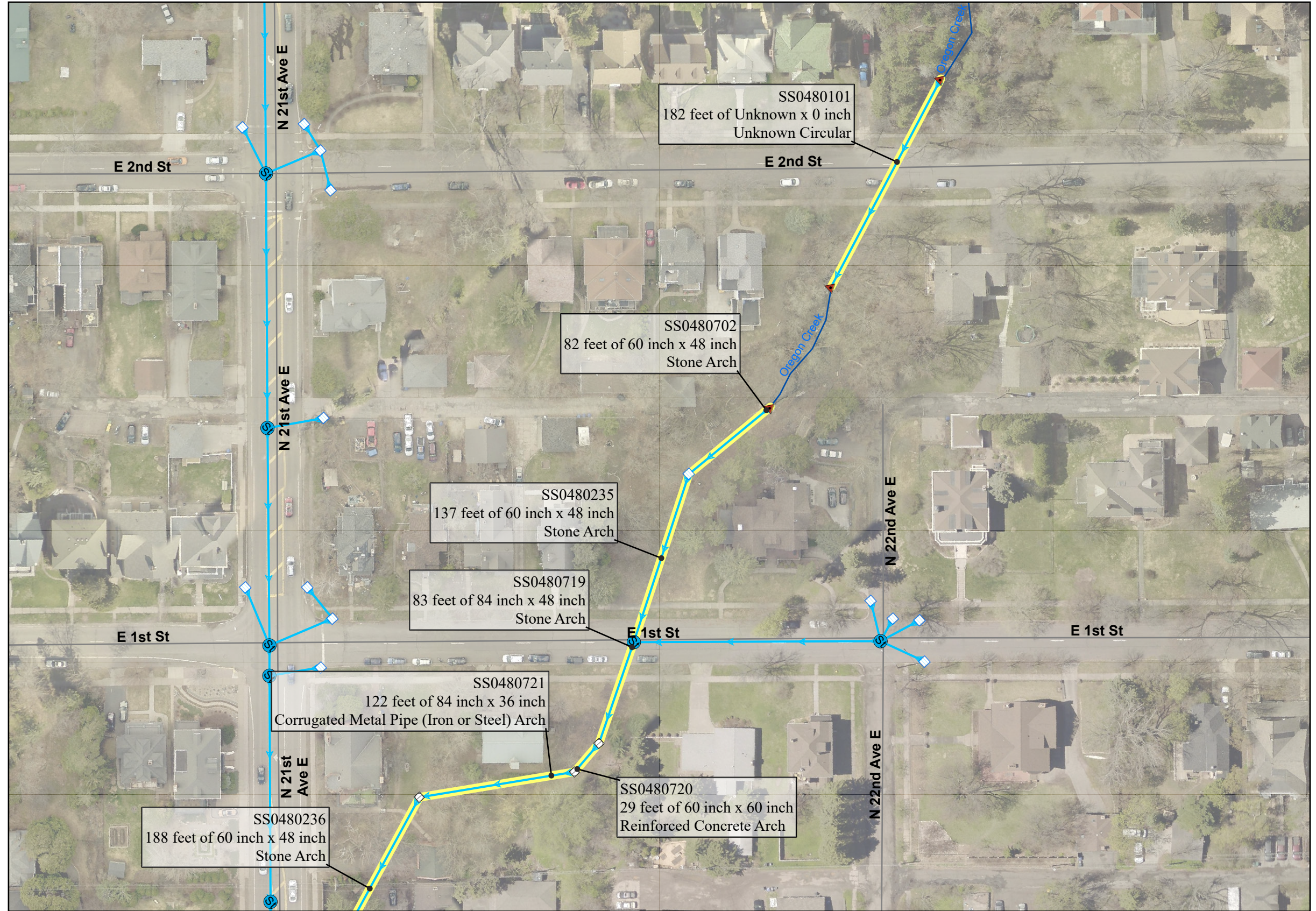
**OREGON CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
OREGON 3



LEGEND

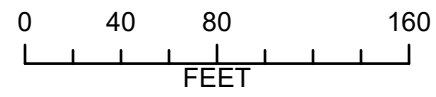
- OREGON SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

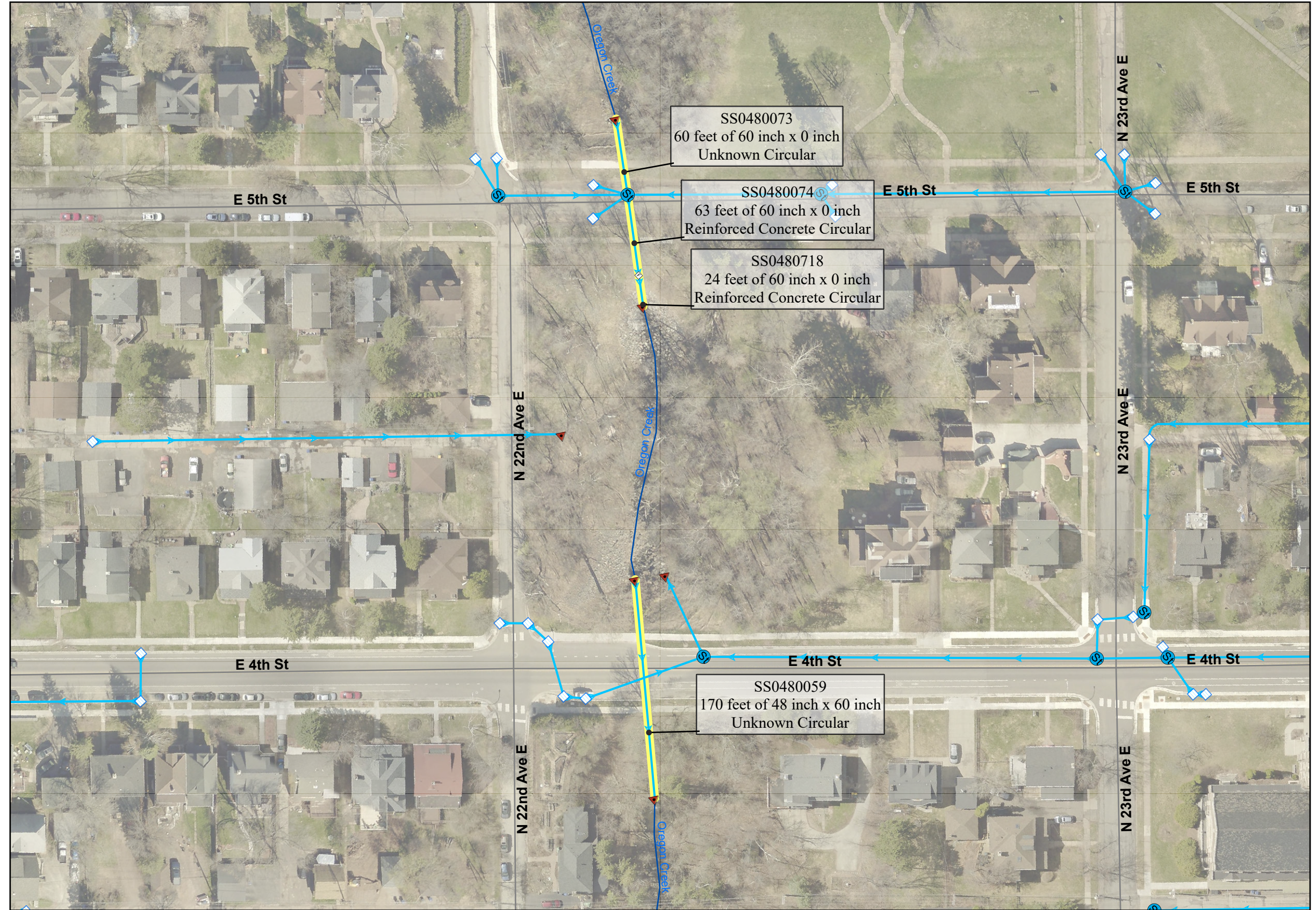
OREGON CREEK TUNNEL & CULVERT INSPECTION

MAP EXTENT:
OREGON 4



LEGEND

- OREGON SURVEY LIMITS
- STORM SEWER
- STREAMS
- PIPE END
- STORM MANHOLE
- STORM CATCH BASIN



CITY OF DULUTH
ENGINEERING DIVISION
411 W. 1ST ST. RM. 240
DULUTH, MN 55802

**OREGON CREEK
TUNNEL & CULVERT INSPECTION**

MAP EXTENT:
OREGON 5

**APPENDIX C – TUNNEL INSPECTION REPORT EXAMPLE
CITY OF DULUTH
RFP# 22-99767**

City of Duluth Public Works & Utilities Department

Engineering Division – Transportation Section

**Report on Existing Condition and Recommendations
for the Brewery Creek Storm Culvert**

LHB Project No. 110251.00
City of Duluth Project No. 0036ST



Prepared By:
LHB, Inc.
21 W. Superior Street
Duluth, MN 55802

TABLE OF CONTENTS

Table of Contents and Certification	i
Purpose of Report	1
Background	1
Inspection Findings	2
Segment 1 (Station 10+00 to 22+67)	3
Segment 2 (Station 23+57 to 51+51.5)	7
Segment 3 (Station 52+08 to 54+47)	15
Existing Building Foundations	16
Conclusions and Recommendations	19
Appendix	
Photographs	
Table: Deficiency and Recommendation Summary	
Table: Minimum Hydraulic Opening of Culvert Sections	
Structure General Layout (Sheet 1 of 13)	
Structure Plan & Sections (Sheets 2-10 of 13)	
Aerial Plan (Sheets 11-13 of 13)	
Attachments	
Culvert Walkthrough Video	

INSPECTED BY: Lisa M. Karlgaard, P.E., Joseph D. Litman, P.E. & Jon W. Siiter, P.E.

REPORT PREPARED BY: Lisa M. Karlgaard, P.E.

REPORT CHECKED BY: Joseph D. Litman, P.E.

I HEREBY CERTIFY THAT THIS PLAN, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Engineer under the laws of the State of Minnesota.


Jon W. Siiter

25128
Reg. Number

4/24/13
Date

Brewery Creek Storm Culvert

Report of Existing Condition and Recommendations

PURPOSE OF REPORT

The purpose of this report is to assess the existing condition of the Brewery Creek culvert sections and to provide recommendations for rehabilitation or replacement. Field inspections were conducted in April, June, July and August of 2012 and January of 2013 to investigate the current condition of the culvert. Inspections were conducted using visual methods for all accessible areas of the culvert. Hammer soundings were used in some areas to gain information concerning integrity of the existing masonry and cement-based elements. For purposes of documentation, the condition of the inside of the structure was recorded using digital photography, written notes and sketches, and a narrated video walkthrough. The video is intended to give a better visual representation of the culvert, not to address specific inspection findings. Inspection findings are documented within the body of this report and on the plan sheets in the appendix. The geometrics of the structure were field measured and recorded. Refer to the appendix for approximate in-place structure geometry.

BACKGROUND

Very little information about this structure was available for use in determining the make-up of the structure. The primary information sources used for the investigation of the structure were City of Duluth utility layout maps and manhole depth information (furnished by the City) and the field investigation LHB undertook. During the LHB inspection, stationing was placed in 25 foot increments on the walls of the culvert in white survey marking paint. Some markings were faded during the June 2012 flood event. Attempts were made to re-paint the faded stationing, however conditions since have been too moist to touch up the paint. These stations are referred to in this report and represented on the drawings in the appendix.

In general, the 4450 foot long, three segment, structure carries Brewery Creek from north of Central Entrance to approximately 90 feet southeast of the intersection of East 1st Street and 8th Avenue East where it connects to a MnDOT owned reinforced concrete pipe (RCP) that carries the creek to Lake Superior. Since the RCP structure is not large enough to be considered a bridge, there is no inventory information available for this MnDOT owned structure. However, the condition was visually observed. The invert of the RCP is scoured with exposed reinforcing throughout.

The geometry of the various Brewery Creek structure segments vary greatly depending upon depth of cover and type of construction. Cross sections and approximate

geometry can be found on the plan and section sheets in the appendix for each associated section. The construction type of the culvert varies. The most dominant sections include reinforced concrete pipe with a poured concrete invert, arch sections constructed of bluestone walls and brick masonry arches and cast-in-place concrete box structures. The floor throughout the culvert is mostly reinforced concrete with some areas of stone masonry or natural bedrock.

The Appendix of this report contains photographs highlighting specific deficiencies of each section as well as their general construction. A table has been created to summarize the recommendations for repair or monitoring of each section and identifies the urgency of each item recommended for repair (0-5 years, 5-10 years or 10+ years). Select deficiencies identified to be repaired within the next 5 years have been given an additional designation of “critical” or “immediate”. “Immediate” refers to an identified issue that could lead to partial to total collapse of the culvert section. A repair should be programmed in the next 6 months. “Critical” refers to a condition that could potentially become an “immediate” concern. Due to the lack of inspection records and condition history of the culvert, the progression or severity of these issues cannot be known. For “critical” issues, it is recommended that in lieu of an immediate repair, a rigorous monitoring program be implemented and the repair programmed based the results of the monitoring. An additional table can be found in the appendix summarizing the minimum measured hydraulic opening of each section. This table highlights the sections that are controlling the hydraulic capacity of each culvert segment. A set of drawings has been prepared to graphically depict the layout, section geometry, culvert construction, and current condition of the culvert. There are also aerial photographs with the culvert overlaid to visually represent the topography and existing structures above the culvert sections.

INSPECTION FINDINGS

Field inspection of the structure was performed in segments in the months of April, June and July of 2012. During these inspections, accessible areas of the structure were inspected using visual methods. The condition of the inside and adjacent exterior areas of the culvert was recorded using digital photography as well as hand sketches and notation. Hammer soundings were used on masonry and cement-based materials to aid in the detection of deterioration in the material. Due to the limited access available to the structure, a narrated video was made to aid in the understanding of the condition and construction of the structure. The video was filmed from downstream to upstream from Station 10+00 to 20+35 and 52+08 to 54+47. It was filmed from upstream to downstream from station 52+08 to 20+35.

Overall, the condition of the structure is considered fair. The individual roof, wall and floor elements of each section were classified as good, fair or poor. A classification of “good” refers to a section that requires no work. “Fair” indicates that repairs are

needed, but they do not pose immediate danger to the structure. And, "poor" refers to items that require repair in the IMMEDIATE future. Specific areas of deterioration, failure or other deficiencies were noted and are discussed in further detail below on a section by section basis. Recommendations for repair or monitoring have been given in each section.

The culvert consists of three segments with two open channel areas between segments and 35 defined sections. The section divisions occur wherever there is an obvious change in construction/ material type or where a significant change in geometry was observed. Refer to the Appendix for section locations and descriptions.

Segment 1

The first segment contains Section 1 through Section 10 (Stations 10+00 to 22+67). It begins after the open channel segment below the alley between East 4th Street and East 3rd Street and ends 90 feet southeast of the intersection of East 1st Street and 8th Avenue East. The average hydraulic opening in this segment is approximately 29 square feet. Section 6 has the smallest hydraulic opening of 21.5 square feet. See the attached table "Minimum Hydraulic Opening of Culvert Sections" for more detailed information.

Section 1 – Station 10+00 (Connection to MnDOT RCP) to 14+12

Section 1 was observed to be in fair to poor condition. The walls are constructed of bluestone masonry and are considered to be in poor condition (Photo 1A) and are estimated to require 50-100% tuckpointing. The roof is constructed of brick masonry and is in fair condition with a select area requiring tuckpointing in the next 5 years (stations 10+50 to 11+50). The floor in this section is in fair condition. It consists of areas of stone masonry, unreinforced concrete and exposed bedrock. The floor shows signs of erosion, but there are no immediate repair needs at the present time.

At Station 11+00 a roof failure was discovered during the April 2012 inspection. The failure was located at a manhole at the intersection of East 1st Street and 8th Avenue East which penetrates the roof of the storm culvert. This failure was repaired in the summer of 2012 (Photos 1D and 1E). During inspection it was also discovered that from station 13+60 to 13+65 there was deep scour into the south wall at the flow line and at station 13+75 the south wall was noted to be bulging and hollow behind. The scour at station 13+65 was greatly accelerated following the June 2012 flooding as documented in Photos 1B & 1C. The City of Duluth had this area repaired in the summer of 2012. This area should be monitored to ensure the bulged area that was repaired at station 13+75 does not continue to move.

Section 2 – Station 14+12 to 14+89

Section 2 was observed to be in overall fair condition. This section is constructed of a 72" reinforced concrete pipe with a cast concrete floor. The majority of the pipe is in fair condition except for at the flow line (Photo 2A). The unreinforced concrete invert is heavily eroded and there is scour occurring at the bottom of the precast pipe (Photo 2B). Some areas are worn up to 1 ½" deep with exposed reinforcing bar/mesh. It is recommended that all exposed reinforcement be cleaned and epoxy coated and a new concrete invert be placed over the entire length of this section. Since the reinforced concrete pipe strength relies on the pipe having a full section / full strength along its entire circumference, maintaining strength throughout the flow line area is essential.

Section 3 – Station 14+89 to 15+75

Section 3 was observed to be in overall fair condition. The walls and roof are constructed of cast in place concrete and the floor is comprised of natural bedrock with some concrete infill (Photos 3B & 3C). There was a roof failure discovered during the early inspection phase (Photo 3A) and deep scour in the north wall that was repaired in the summer of 2012. The floor is scoured and uneven. Scour walls have been placed to protect the walls where they have previously failed to guard against future failure where water is directed along the walls by the contour of the floor. Scour was noted at the bottom of the north wall from Station 15+40 to 15+50 that should be monitored (Photo 3C). At the end of this section, there is an abrupt profile change. The natural bedrock floor creates an 8' tall waterfall with a scoured pool at the bottom. Access across this waterfall is difficult and requires at least a 10' ladder and chest waders.

Section 4 – Station 15+75 to 16+06

Section 4 was observed to be in overall good condition. The walls and roof are constructed of cast in place concrete. The roof is in good condition. The walls are in fair condition with some scour occurring at the bottom of the walls. The floor is in good condition and is composed of natural bedrock with unreinforced concrete infill in areas. There is a 5' waterfall at the upstream end of section 4, station 16+06 (Photo 4A). This is also the approximate location of the southeast edge of the building at 701 East 2nd Street. Refer to "Existing Building Foundations" section of this report for additional information.

Section 5 – Station 16+06 to 17+14

Section 5 was observed to be in good to fair condition. It runs under a building at 701 East 2nd Street as well as under East 2nd Street from station 16+02 to 16+48, see "Existing Building Foundations" section of this report for additional information.

There are manholes that enter into the culvert both under the building and at the southern curb of East 2nd Street. This section is constructed of a cast-in-place reinforced concrete arch pipe and floor (Photo 5A). The arch is in good condition but is beginning to erode at the pipe penetrations, however no reinforcing is exposed. The floor is eroding but is in fair condition, no repairs are recommended at the present time.

Section 6 – Station 17+14 to 17+86

Section 6 was observed to be in overall good condition (Photo 6A). There is a building structure above the culvert from station 17+41 to 18+04, see “Existing Building Foundations” section of this report for additional information. The roof is a cast-in-place concrete arch which is in good condition. The bluestone masonry walls are also in good condition. The concrete floor is in fair condition. It contains beveled concrete edges that protect the bluestone walls but also concentrate the flow to the center of the floor where evidence of scouring can be seen. However, the floor remains in fair condition.

Section 7 – Station 17+86 to 18+84

Section 7 was observed to be in good to fair condition. The section is constructed of a cast-in-place reinforced concrete arch pipe and floor (Photo 7A). Like Sections 5 and 6, the floor contains a fillet on both sides protecting the bottom of the wall from scour. The floor is in fair condition with concrete scour in the middle of the floor throughout the section and a concentrated area of accelerated scour from station 18+50 to 18+75 where the floor reinforcement is exposed. Immediate repair is not required here, but the condition should be monitored and the floor patched if necessary. The walls and roof are in good condition overall with a small area near station 18+25 that indicates the reinforcing in the north wall of the arch is beginning to rust (see right side of Photo 7A). Again, immediate repair is not required. It is recommended to monitor the condition of the walls visually and by sounding to ensure the walls remain structurally sound. There is an abrupt change in grade of the culvert floor of Section 7. It changes from 5% to approximately 50% slope at station 18+00, then back to 5% at station 18+50.

Section 8 – Station 18+84 to 19+57

Section 8 was observed to be in overall fair condition. The culvert was constructed as a cast-in-place 3-sided reinforced concrete box with a reinforced concrete floor. The profile is steep (25%) from station 19+15 to 19+50, and 5% for the remainder of the section. The floor is in fair condition with scour and erosion of the concrete visible. The roof is in fair condition except for from station 19+25 to 19+38 where the steel beams are exposed and severely corroded (Photo 8A) and from station 19+38 to 19+51 where the roof is comprised of timber beams with a car parked on

top. It is recommended that the roof be replaced from station 19+25 to 19+50. The walls are generally in fair condition, but are in poor condition from Station 19+20 to 19+51. The south wall is honeycombed and is scouring along the flow line (Photo 8B). It is recommended that the south wall at this location be stabilized using concrete underpinning.

Section 9 – Station 19+57 to 20+35

Section 9 was observed to be in fair to poor condition. There is a building structure above the culvert from station 19+54 to 20+27, see “Existing Building Foundations” section of this report for additional information. The floor is constructed of reinforced concrete with some weathered bedrock exposed in areas. The floor is in fair condition with scour and erosion visible. The walls are constructed mostly of cast in place concrete and are in fair condition. However, from station 19+65 to 20+35 the north wall is constructed of bluestone masonry as well as the south wall from station 20+15 to 20+35. The bluestone walls are in poor condition and require 100% tuckpointing in the next 5 years. Since there is a building foundation above these walls, this condition is considered to be **critical** and should be monitored closely prior to tuckpointing. The roof is constructed of reinforced concrete and is in fair condition except for at station 19+79 where there is a hole (daylight visible, Photo 9A) that should be patched, but is not currently compromising the competency of the structure.

Section 10 – Station 20+35 to 22+67 (inlet)

Section 10 was observed to be in overall fair condition. There are two building structures above this culvert section from station 21+72 to 22+19 and station 22+35 to 22+67, see “Existing Building Foundations” section of this report for additional information. The section construction consists of a concrete/bedrock floor, bluestone masonry walls and a brick masonry roof (Photo 10A). The floor is constructed of concrete up to station 21+80 then changes to bedrock to the end of the section. The floor is in fair condition. The lower 18” of the walls are scoured and require 100% tuckpointing and the upper portions of the wall require 50-100% tuckpointing throughout. Since there are building foundations above these walls, this condition is considered to be **critical** and should be monitored closely prior to tuckpointing to determine the urgency of repair. There are two specific areas of the wall that require stone masonry repair due to deep scour and missing stones. These areas are at station 20+60 (Photo 10B) and 22+48 (Photo 10D). At 22+48, the wall is undermined up to 4’ deep and should be repaired by means of a concrete scour wall or curb. An **immediate** repair is required at this location (within next 6 months). This scour was accelerated during the June 2012 flood event. The roof is in fair condition except for from station 20+75 to 21+70, where it is recommended that the masonry joints be 100% tuckpointed. There is a corroded beam through the roof at station 21+50 (Photo 10C). It has been roughly located to lie beneath the southern

curb of 7th Avenue East. There is no immediate structural concern, however the beam should be removed and a short section of roof replaced concurrent with the next scheduled road projects on 7th Avenue East and it should be monitored until such repairs can occur.

Segment 2

The second segment contains Section 11 through Section 32 (Stations 23+57 to 51+51.5). It begins after the open channel segment below Central Entrance and ends below the alley between East 4th Street and East 3rd Street. The average hydraulic opening in this segment is approximately 24 square feet. Five Sections have openings of 20 square feet and below. These sections from smallest to largest are Section 24 (18.3 sq. ft.), Section 23 (19.0 sq. ft.), Section 11 (19.2 sq. ft.), Section 27 (19.3 sq. ft.) and Section 26 (20.0 sq. ft.). See the attached table "Minimum Hydraulic Opening of Culvert Sections" for more detailed information. The manhole casting elevations and associated culvert floor elevations were recorded during a survey by the City of Duluth for the manholes within Segment 2. This information is provided within the appropriate sections below.

Section 11 – Station 23+57 (outlet) to 24+01

Section 11 was observed to be in overall fair condition. This section runs under the alley between 3rd Street and 4th Street and its construction consists of a concrete floor, bluestone masonry walls and a brick masonry arch roof (Photo 11B). The outlet headwall at station 23+57 was severely deteriorated by the June 2012 flood (Photo 11A) and it is recommended that it be repaired or replaced in order to maintain the fill of the alley and adjacent parking lot. The concrete floor is in fair condition with minor erosion occurring. The walls are in poor condition. The masonry joints require 50-100% tuckpointing throughout. The brick arch roof is in poor condition with the masonry joints requiring 100% tuckpointing. There is a utility vault through the middle of this section which creates low clearance and reduces the hydraulic capacity of the section (Photo 11B).

Section 12 – Station 24+01 to 25+03

Section 12 was observed to be in overall good condition. This section of the culvert lies below the Whole Foods Co-op parking lot between East 4th Street and the alley. Prior to September 2012, it was constructed of a 96" corrugated metal pipe (Photo 12A). This pipe had partially collapsed prior to the June 2012 flood and during the flood failed and washed out the southeast half of the parking lot. This section of pipe was replaced in the summer of 2012 with a 72" diameter reinforced concrete pipe. The pipe is in good condition, however was laid with a 4" gap between the first two sections and 2.5" to 1.5" gaps between the remaining pipe sections (Photo

12B). Extensive hairline cracking can be seen at the top of the pipe. This cracking is presumed to have occurred during construction and there is no reason to believe that it will progress. However, the structure should be routinely inspected to ensure that this condition remains unchanged.

Section 13 – Station 25+03 to 26+25

Section 13 was observed to be in overall fair condition. There is a manhole into this section located at the edge of East 4th Street, station 25+54, with a surveyed depth of 19'-2" from the top of casting to the culvert floor. Upon initial inspection, it was found that this manhole had failed, St. Louis County was notified and repaired the structure and roof in March of 2012 from station 25+48 to 25+61 (Photo 13C). Bury depths throughout the rest of the section vary depending upon location. The section is constructed of a reinforced concrete floor, bluestone masonry walls and a brick masonry roof. The roof changes shape at station 25+33 where there is a taller rise upstream than downstream (Photo 13A). The condition of the roof is poor. The bricks downstream of 25+33 are spalling and eroding back. The masonry joints require 100% tuckpointing throughout the entire roof within 5 years. There is a 10" deep hole in the interface between the wall and roof at station 25+35 that should be repaired by reconstructing the stone masonry to prevent further deterioration (Photo 13B). The walls are in fair condition and will likely require tuckpointing in the next 5-10 years. The floor is eroded throughout the section with a deep hole at station 26+25 that is scoured 18" under the concrete on the downstream side. This portion of the floor is considered to be in **critical condition**. It is recommended that this condition be repaired in the immediate future or a monitoring program be put in place to prevent continued scour under the concrete floor compromising the structural integrity of this section.

Section 14 – Station 26+25 to 27+03

Section 14 was observed to be in overall fair condition. The section is constructed of cast-in-place concrete roof, walls and floor (Photo 14A). The south wall is integral with the foundation of the building at 619 East 4th Street (Last Chance Liquor), see "Existing Building Foundations" section of this report for additional information. The floor is in fair to poor condition, it is deeply scoured and reinforcement is exposed at stations 26+67 and 26+50. These areas are perceived to be in **critical condition** and should be closely monitored to determine the timeline in which to program a repair. The floor failure at station 26+67 has led to a 6" deep scour into the wall. This should be repaired along with the floor repair. Besides the scour location, the walls are both in good condition with some minor deterioration below the weep at station 26+61. The south wall is near vertical and the north wall was constructed with a taper, making the culvert wider at the top than the bottom. The roof is in generally good condition except for at station 27+00 where the roof has failed and open air

can be seen through the hole (Photo 14B). This hole is recommended to be patched within the next 5 years.

Section 15 – Station 27+03 to 27+21

Section 15 was observed to be in overall good condition. The floor, walls and roof are constructed of reinforced concrete (Photo 15A). The walls transition back to vertical and the roof is formed with a peak in the center. They are both in good condition. The floor is showing signs of erosion, but is in fair condition.

Section 16 – Station 27+21 to 27+97

Section 16 was observed to be in overall fair condition. The section is constructed of a concrete floor, bluestone masonry walls and an arched brick masonry roof. The floor is scoured, but functional (fair condition). The walls are in fair condition as well. No immediate repairs are required, although the mortar of the walls is beginning to show signs of deterioration. The floor is also beginning to deteriorate and scour but is in fair condition. The arch is in poor condition. The arch bricks are spalling and eroded up to 1 course deep (Photo 16A) throughout and at station 27+97 they are eroded 2 courses. This issue is considered to be **critical**. The erosion of the roof was accelerated by the June 2012 flood. It is unknown how many courses deep the roof was constructed. Therefore, the urgency of the repair cannot be determined. It is recommended that this section be rigorously monitored and the repair programmed based upon the inspection findings. Repair options recommended to be investigated are lining by means of cast in place concrete walls and a grout filled segmental corrugated metal arch or excavation and removal and replacement of the culvert roof.

Section 17 – Station 27+97 to 29+31

Section 17 was observed to be in overall good condition. The section is constructed of a concrete floor, bluestone masonry walls and a reinforced concrete arch roof (Photo 17A). The walls and roof are in good condition. The floor is in fair condition. It is showing signs of erosion but is still functional. There are no repairs recommended for this section at the present time.

Section 18 – Station 29+31 to 30+64

Section 18 was observed to be in overall fair condition. There is a manhole into this section located at the edge of East 5th Street, station 30+13, with a surveyed depth of 25'-0" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. The section is constructed of a concrete floor, bluestone masonry walls and a brick masonry arch roof. The floor is eroded but functional and is in fair condition. The walls have minor voids

throughout the section on the lower 2'. They require tuckpointing and are considered to be in **critical** condition. The urgency of the repair shall be determined by monitoring the condition through a monitoring program. The brick is in good condition and the mortar of the brick arch is in fair condition. Tuckpointing will likely not be necessary within the next 5 years. The manhole at station 30+13 is constructed of a brick riser that appears to be bulging (Photo 18B). Although the riser may have been constructed asymmetrically, it is recommended that this manhole be monitored and repaired if the shape of the circumference continues to change. There is a building foundation (Auto Value, 502 North 6th Avenue East) above the upstream end of section 18 from station 30+49 to 30+64. The majority of the building is above section 19. See "Existing Building Foundations" section of this report for additional information.

Section 19 – Station 30+64 to 31+25

Section 19 was observed to be in overall fair condition. There is a building foundation (Auto Value, 502 North 6th Avenue East) above the downstream half of section 19 from Station 30+64 to 31+09. See "Existing Building Foundations" section of this report for additional information. The section is constructed of cast-in-place concrete floor, walls and roof. The floor is in fair condition with signs of erosion. The walls are in good condition. The roof is in good condition except from station 30+64 to 30+80 where there is a crack in the roof generating from the 8" clay pipe penetration through the roof (Photo 19A). The roof appears to be sagging and separating at the crack. This portion of the roof is in **critical** condition. Rigorous monitoring of this roof is recommended. Not only is this portion of the roof under a building structure, but its hydraulic opening is smaller than the average at 22.15 sq. ft. The smallest opening in the segment is 18.33 sq. ft. The roof cannot easily be excavated for repair since it is beneath the Auto Value building nor can the opening be reduced significantly without potential unacceptable impact to the waterway area. A recommendation to be considered would be to place a new reinforced concrete roof below the existing roof formed with a metal deck held up with angles attached to the existing walls.

Section 20 – Station 31+25 to 37+32

Section 20 was observed to be in overall poor condition. The repair recommendations below are all considered **critical** issues. There are two manholes into this section. One is located near the intersection of East 6th Street and North 6th Avenue East, station 34+25, with a surveyed depth of 11'-10" from the top of casting to the culvert floor. The other is located near the edge of North 6th Avenue East between East 6th Street and East 7th Street, station 36+13, with a surveyed depth of 9'-7" from the top of casting to the culvert floor. Bury depths throughout the rest of the section vary depending upon location. There is a building structure above the

culvert from station 34+78 to 35+74, see "Existing Building Foundations" section of this report for additional information.

This section is constructed of a cast-in-place concrete floor, walls and roof. Access is difficult in this section due to low headroom due to the short wall height of 3'-6". The floor is in fair to poor condition. It is scouring and eroded throughout the section. There is a washout in the floor from station 34+00 to 34+70 where the reinforcement is exposed and the substrate is visible in the most deeply scoured areas (Photo 20B). This section of floor is recommended to be repaired within the next 5 years. The deteriorated floor should be cut away and replaced with new concrete and reinforcing.

The walls are in poor condition. From stations 31+95 to 32+88 the walls are scoured 6" to 8" deep at the flow line (Photo 20A). These areas should be repaired with a concrete surface repair or concrete curb within the next 5 years. The hydraulic opening of this section is smaller than average. Care should be taken in designing repairs to ensure that the opening is not significantly reduced. See the attached table for further hydraulic opening information. There is also a large amount of water seeping and flowing through the walls from station 32+25 to 35+00. In this area there is minor spalling throughout and more accelerated spalling below weeps in the walls. Immediate wall repair is not required, but it is recommended to inspect this section frequently, as the moisture in the walls could accelerate the deterioration of the walls significantly.

The roof is in poor condition. There are areas of major to moderate spalling (up to 1½" deep) from stations 32+00 to 32+88 (Photo 20A). The roof should receive a concrete surface repair in this area. The roof is eroding where the manhole riser abuts the roof at station 34+25 (Photo 20C). It is recommended that the deteriorated concrete be saw-cut and chipped back to competent concrete and the roof section repaired back to its original structure. There is also a very deep spall (3") in the roof from station 35+30 to 35+35 (Photo 20D). This area should also receive a concrete surface repair. All three of these deteriorated roof areas should be repaired in the next 5 years.

Prior to completion of the repairs to the floor, walls and roof, the section should be inspected no less than every 12 months. Any of these deficiencies could lead to a partial or total collapse of this culvert section. Repairs should be programmed as soon as possible if there is any observed change in condition from that described in this report.

Section 21 – Station 37+32 to 38+68

Section 21 was observed to be in overall fair condition. There is a manhole into this section located in East 7th Street near the intersection of North 6th Avenue East,

station 38+28, with a surveyed depth of 9'-10" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 21B). The concrete floor is in fair condition. It is scoured for the entire length of the section. Although it is not in need of immediate repair, its condition should be closely monitored by routine inspections. The walls are in good condition with only minor corrosion at the drip line of the pipe penetration in the north wall at station 38+28. The roof is in fair to poor condition. It is spalling at station 37+40 and 37+65 (Photo 21A). A concrete surface repair should be done within 5 years. There is also corrosion of the roof where the manhole at station 38+00 enters the culvert. The manhole structure is not properly seated on the roof and there is evidence of fill being lost at this interface. It is recommended that this portion of the roof be repaired by removing the compromised concrete and replacing it with a concrete patch/repair that overlaps the roof and the manhole structure. These issues in the roof are considered to be **critical** and should be routinely monitored until the repairs are complete.

Section 22 – Station 38+68 to 39+47

Section 22 was observed to be in overall good condition. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 22A). There is a building structure above the culvert from station 38+83 to 39+67, see "Existing Building Foundations" section of this report for additional information. Located at station 39+31, there is a shallow manhole (lid at top of roof) which is in good condition.

Section 23 – Station 39+47 to 40+51

Section 23 was observed to be in overall good condition. There is a manhole into this section located in the alley between East 7th Street and East 8th Street, station 40+00, with a surveyed depth of 12'-7" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 23A). There is a building structure above the culvert from station 38+83 to 39+67, see "Existing Building Foundations" section of this report for additional information. Where the manhole at station 40+00 meets the roof of the culvert, the concrete is corroding and spalling. The roof concrete is still in fair condition and the riser is in good condition. This location does not require an immediate repair, but should be monitored for deterioration and potential future repair.

Section 24 – Station 40+51 to 40+79

Section 24 was observed to be in overall fair condition. This section is constructed of a cast-in-place concrete floor and roof with a combination of concrete and bluestone masonry walls (Photo 24A). The floor is in fair condition with its invert heavily

eroded, but functional. The walls are in fair condition, tuckpointing of the stone masonry will likely be required within the next 5-10 years. The roof is in good condition. There is exposed reinforcing at station 40+70. It appears that this is a flaw left when the roof was originally constructed. The condition of the concrete at this location is good with no cracking or sagging.

Section 25 – Station 40+79 to 41+30

Section 25 was observed to be in overall good condition. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 25A). The floor is eroding but in fair condition. The walls and roof are in good condition except at station 41+30, where there is a minor washout at the floor/wall interface. No repair is required here at the present time. The roof contains a concrete patch that appears to be an old access. It appears structurally competent.

Section 26 – Station 41+30 to 43+13

Section 26 was observed to be in overall fair condition. There is a manhole into this section located in East 8th Street near the intersection of North 6th Avenue East, station 42+00, with a surveyed depth of 18'-2" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 26A). The floor is in poor condition. The invert is heavily eroded. No failures were observed, but it should be routinely inspected and repaired as required to maintain the structural integrity of the culvert. The walls and roof are in good condition.

Section 27 – Station 43+13 to 43+66

Section 27 was observed to be in overall good condition. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 27A). The floor is eroding but in fair condition. The walls and roof are in good condition.

Section 28 – Station 43+66 to 44+77

Section 28 was observed to be in overall fair condition. There is a manhole into this section located in the alley between East 8th Street and East 9th Street, station 44+27, with a surveyed depth of 20'-1" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 28A). The floor is eroding but in fair condition except at station 44+00 (Photo 28B) where it has failed and a hole has formed where reinforcement is exposed. This area should be patched within 5 years. The walls and roof are in fair condition with

some erosion of the lower portions of the walls but no immediate repairs are required.

Section 29 – Station 44+77 to 47+45

Section 29 was observed to be in overall poor condition. There is a building structure (UDAC) above the culvert from station 46+44 to 48+02, see “Existing Building Foundations” section of this report for additional information. There is a manhole into this section located at the edge of East 9th Street, station 45+98, with a surveyed depth of 34’-3” from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location.

This section is constructed of a 72” reinforced concrete pipe with a poured concrete invert. The culvert invert is in poor condition as the invert is severely eroded (Photo 29A). The sides of the culvert are in fair shape with an area of scour at the bottom of the pipe at 47+35 at the flow line where the pipe is worn through (Photo 29B). There is a 20’ section of pipe that is cracked, spalled and squashed/sagging from station 47+00 to 47+19 (under the north end of the UDAC building, Photo 29C). Although not a severe, the pipe is also showing signs of sagging from station 46+00 to 47+00. Section 29 is in **critical** condition from station 46+00 to 47+19 and at the flowline over the entire section (especially at 47+35). The structural composition of the pipe is unknown. And, the duration of which the pipe has been in its current condition is also unknown due to lack of prior inspection information. Therefore, it is recommended that either repairs be made or, in lieu of an immediate repair, a rigorous monitoring program be implemented and that the repair is designed and scheduled based upon the results. The bury depth of this pipe is at least 28 feet, and the noted deficiency is approximately 400 feet from the inlet of this segment. It is recommended that the option of placing a new concrete invert over the existing floor and lining the sides and top of the existing pipe be investigated. The sequence of floor and lining work will depend upon the design of the pipe lining.

Section 30 – Station 47+45 to 48+32

Section 30 was observed to be in overall fair condition. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 30A). The floor is heavily eroded on the surface. The condition of the floor should be monitored but is currently in fair condition. The walls and roof are in fair condition with some erosion of the surface of the concrete, but no repair required.

Section 31 – Station 48+32 to 49+58

Section 31 was observed to be in overall poor condition. There is a manhole into this section located in the parking lot for the UDAC property, station 48+34, with a surveyed depth of 42’-7” from the top of casting to the culvert floor. Bury depths

throughout the rest of the section will vary depending upon location. This section is constructed of a 72" reinforced concrete pipe with a poured concrete invert (Photo 31A). The floor is in fair condition as the invert is beginning to erode and scour but no immediate repair is required. The sides of the culvert are in fair shape, however the top of the culvert is in poor condition from station 48+32 to 49+25. The pipe is slightly deformed/squashed and the roof is cracked in this area (Photo 31B). The last 3 joints of the section are disjointed with up to a 6" separation. These joints have been previously patched. There is a stamp on the pipe that reads "POLARIS RR-DULUTH 1938," which indicates that there is a possibility that the makeup of the pipe can be determined. However, an initial search has not turned up such information. The condition of this pipe should be considered **critical** and either repairs should be made or a monitoring program be implemented in lieu of an immediate repair. One recommendation for repair to be investigated would be pipe lining.

Section 32 – Station 49+58 to 51+51.5 (inlet)

Section 32 was observed to be in overall fair condition. There is a manhole into this section located in the intersection of East 10th Street and North 5th Avenue East, station 50+76, with a surveyed depth of 20'-1" from the top of casting to the culvert floor. Bury depths throughout the rest of the section will vary depending upon location. This section is constructed of a cast-in-place concrete floor, walls and roof (Photo 32A). The floor is eroding but in fair condition. The walls and roof are in fair condition with some erosion of the lower portions of the walls but no immediate repairs are required. The brick in the lower half of the manhole riser at station 50+76 should be tuckpointed (Photo 32B). The inlet of the culvert is being obstructed by concrete, silt and rubble (Photo 32C) and should be cleared to allow the stream to flow freely from the open channel to the culvert.

Segment 3

The third segment contains Section 33 through Section 35 (Stations 52+08 to 54+47). It carries Brewery Creek under Dark Angel Ink (918 Central Entrance Drive) and Central Entrance Drive. The average hydraulic opening in this segment is approximately 24.5 square feet. Section 34 has the smallest hydraulic opening of 19.4 square feet. See the attached table "Minimum Hydraulic Opening of Culvert Sections" for more detailed information.

Section 33 – Station 52+08 (outlet) to 53+25

Section 33 was observed to be in overall poor condition. This section is constructed of a cast-in-place concrete floor, walls and roof. The end 1 foot of the floor at the outlet of the section has failed (Photo 33A). It is recommended that a drop wall be

constructed at the end of the outlet in order to protect the in-place structure from further erosion and deterioration. The remainder of the floor is eroded but in fair condition. The walls and roof are cracked with exposed rotting rebar (Photo 33B). It is recommended that concrete surface repairs be performed on these areas of the walls and roof, in the next 5 years, in order to halt or decelerate the corrosion.

During the inspection of this section, a 3.5 foot diameter hole was observed at station 52+35 in the roof of the culvert. The fill above was exposed and consisted of rubble and large boulders with voids as deep as 5.5 feet. This area was later formed from below and filled with grout from above to fill these large voids in the summer of 2012.

Section 34 – Station 53+25 to 54+36

Section 34 was observed to be in overall poor condition. This section is constructed of cast-in-place concrete walls and roof with a natural bedrock floor. The floor is uneven and scoured, but in fair condition. The walls are undermined approx. 12" (Photo 34B). A cast-in-place concrete underpinning is recommended to be constructed in front of these scoured areas. At the beginning of the section (53+25 to 53+34) there is a deep pool with 3'-4' scour under the walls (Photo 34A). This is the result of a pipe penetration with steady discharge into the culvert and a waterfall discharging in the same location. It is recommended that the entire pool be filled with concrete and underpin walls be built in front of the currently scoured walls to prevent further deterioration. This repair should take place **immediately** (within next 6 months) in order to maintain the structural capacity of this culvert section. Also in this section, the roof appears to be sagging from station 53+60 to 54+35 (Photo 34C). One repair option recommended to be investigated is casting of a new roof under the existing as recommended in section 19. The undermined walls and sagging roof are considered to be **critical** issues. It is recommended that this section be rigorously monitored and the repair programmed based upon the findings.

Section 35 – Station 54+36 to 54+47 (inlet)

Section 35 was observed to be in overall poor condition. This section is constructed of cast-in-place concrete walls and roof with a natural bedrock floor. The floor is uneven and scoured, but in fair condition. The walls are undermined approx. 12"-24" and the roof is collapsed (Photo 35A). It is recommended that the walls and roof be removed and replaced.

Existing Building Foundations

This section will identify all the areas presumed to be beneath existing building foundations. These areas have been described with respect to their general makeup within the "Inspection Findings" portion of this report. This section will elaborate on the culvert condition directly below buildings. It will be clearly noted within this section of the report if, in the judgment of the engineer, the section can reasonably be expected to carry the applied loads from the above structure's foundation. If not, recommendations for repair will be offered and a timeline will be provided as to when the repairs should be completed.

701 East 2nd Street: Station 16+02 to 16+48 (Section 5)

The culvert structure beneath this building is in good condition. There is no indication that it cannot carry the current loads applied to it. See "Section 5" for additional inspection information.

711 & 711 ½ East 2nd Street: Station 17+41 to 18+04 (Section 6)

The culvert structure beneath this building is in good condition. There is no indication that it cannot carry the current loads applied to it. See "Section 6" for additional inspection information.

702 East 3rd Street: Station 19+54 to 20+27 (Sections 9 & 10)

The culvert structure beneath this building is in fair condition. Directly outside of the foundation the culvert requires roof repairs from station 19+25 to 19+38. Beneath the building, from Station 19+65 to 20+35 (Section 9) and 20+35 to 20+27 (Section 10), the bluestone masonry walls require 100% tuckpointing and are considered to be in **critical** condition. The wall condition should be monitored closely prior to repair work to document any changes of condition and determine the urgency of repair. Although not directly under the building, there is a scour hole in the culvert wall approximately 10 feet from the building foundation in the south wall at station 20+60 that should be repaired within the next 5 years. See "Section 9" and "Section 10" for additional inspection information and repair recommendations.

631 East 3rd Street: Station 21+72 to 22+19 (Section 10)

The culvert section beneath this building is in fair to poor condition. The masonry joints of the bluestone walls require tuckpointing of the lower 18" to avoid loosening of lower stones and compromising the structural integrity of the walls. The upper portions of the wall should also be tuckpointed at the same time. The wall condition should be monitored closely prior to repair work to document any changes of condition and determine the urgency of repair. See "Section 10" for additional inspection information and repair recommendations.

623-629 East 3rd Street: Station 22+35 to 22+67 (Section 10)

The culvert section beneath this building is in poor condition. The masonry joints of the bluestone walls require tuckpointing of the lower 18" to avoid loosening of lower stones and compromising the structural integrity of the walls. The upper portions of the wall should also be tuckpointed at the same time. The wall condition should be monitored closely prior to repair work to document any changes of condition and determine the urgency of repair. Additionally there is a deep scour at station 22+48 (Photo 10C) that should be repaired with a concrete curb or stone repair **immediately** (within the next 6 months) in order to avoid a collapse of the above wall. See "Section 10" for additional inspection information and repair recommendations.

619 East 4th Street (Last Chance Liquor): Station 26+11 to 26+94 (Section 14)

The culvert section beneath this building is in fair condition. It is recommended that the floor be repaired at stations 26+67 and 26+50. The floor is considered to be in **critical** condition and should be monitored closely prior to repair work to document any changes of condition and determine the urgency of repair. The roof is recommended to be repaired at station 27+00 in the next 5 years to maintain the structural capacity of the culvert. See "Section 14" for additional inspection information and repair recommendations.

502 North 6th Avenue East (Auto Value): Station 30+49 to 31+09 (Sections 18 & 19)

The culvert sections beneath the building are in fair condition. The lower portions of the walls from station 30+49 to 30+64 are recommended to be tuckpointed. The walls are considered to be in **critical** condition and should be monitored closely prior to repair work to document any changes of condition and determine the urgency of repair. There is a crack in the roof and the roof appears to be sagging and separating from station 30+64 to 30+80 on either side of the 8" clay pipe penetration through the roof at station 30+70 (Photo 19A). This portion of the roof is in **critical** condition and a rigorous monitoring program should be implemented in order to determine the urgency of repair. See "Section 18" and "Section 19" for additional inspection information and repair recommendations.

601 North 6th Avenue East: Station 34+78 to 35+34 (Section 20)

The culvert section beneath the building is in fair condition. Beneath the southeast edge of the building, there is a significant flow through the north wall of the culvert at station 34+80. This area should be closely monitored to ensure the wall condition does not deteriorate. Beneath the northwest edge of the building the culvert roof is deeply spalled from station 35+30 to 35+35 (Photo 20D). The roof is recommended to be repaired with a concrete surface repair within the next 5 years, however the condition is classified as **critical** and should be closely monitored for changes in condition to determine the urgency of repair. See "Section 20" for additional inspection information and repair recommendations.

701 North 6th Avenue East (Apria Healthcare): Sta. 38+83 to 39+67 (Sect's 22 & 23)

The culvert structure beneath this building is in good condition. There is no indication that it cannot carry the current loads applied to it. See "Section 22" and "Section 23" for additional inspection information.

500 East 10th Street (UDAC): Station 46+44 to 48+02 (Section 29)

The culvert section beneath the building is in poor condition. The floor is heavily eroded (Photo 29A). There is a hole through the pipe at the flow line at station 47+35 (Photo 29B). And, beneath the north corner of the building, there is a section of pipe from 46+00 to 47+19 that is cracked spalled and squashed at the top of the pipe (most critically from 47+00 to 47+19). This portion of the pipe is in **critical** condition, however past condition history is not available. Therefore, it should be placed in a rigorous monitoring program to determine the urgency of repair. It is anticipated that this repair may be needed in 2013. See "Section 29" for additional inspection information and repair recommendations.

918 Central Entrance (Dark Angel Ink): Station 53+51 to 53+91 (Section 34)

The culvert section beneath the building is in fair to poor condition. Under the parking area/driveway of the building, station 53+29, there is deep scouring in the culvert walls and floor. This location is recommended to be repaired **immediately** (within next 6 months). The culvert roof is sagging with minor spalling and the walls are undermined for the entire length of the section. The walls and roof are in **critical** condition and should be closely monitored to determine the urgency of repair. See "Section 34" for additional inspection information and repair recommendations.

CONCLUSIONS AND RECOMMENDATIONS

The overall condition of this structure is fair with localized areas in poor condition. The various deficiencies noted in each section are also categorized in a table in the appendix where deficiencies and recommendations are categorized on a priority basis in increments of 5 years. Repairs that will most likely need to be completed in less than 5 years have been categorized as **immediate** or **critical** in this report and on the attached table. **Immediate** repairs are recommended to take place in the next 6 months and **critical** repairs should be monitored and a repair programmed based upon the progression of the condition. The locations that are considered **immediate** or **critical** are summarized in the table on the next page. It is recommended that items noted to be repaired in the near future (0-5 years) should be addressed in sequence of priority (**immediate**, **critical** and unclassified) in order to prevent continued deterioration and potential localized failures.

SUMMARY OF IMMEDIATE AND CRITICAL DEFICIENCIES:

<u>Section</u>	<u>Location</u>	<u>Deficient Feature</u>	<u>Under Building?</u>
Immediate:			
10	22+48	Wall	Yes
34	53+25 to 53+34	Wall/Floor	No
Critical:			
9	19+65 to 20+35	Walls	Yes
10	20+35 to 22+67	Walls	Yes
13	26+25	Floor	Adjacent
14	26+50	Floor	Yes
14	26+67	Floor/Wall	Yes
16	27+21 to 27+97	Roof	No
18	29+31 to 30+64	Walls	Yes
19	30+64 to 30+80	Roof	Yes
20	31+95 to 32+88	Walls	No
20	32+00 to 32+88 & 35+35	Roof	No/ Yes (35+35)
20	34+00 to 34+70	Floor	No
21	37+40, 37+65 & 38+00	Roof	No
29	44+77 to 47+45	Floor	Yes
29	47+00 to 47+19	Wall/Roof	Yes
29	47+35	Wall	Yes
31	48+32 to 49+58	Roof	No
34	53+25 to 54+36	Walls	Yes
34	53+64 to 54+36	Roof	Yes

Brewery Creek Storm Culvert Photographs



Photo 1A (Approx Station 10+50) – Section 1 Typical Wall Condition



Photo 1B & 1C (Station 13+75) –Sect. 1 Bulge and Voids in Wall Before (4/11) and After (6/29) the Flood

Brewery Creek Storm Culvert Photographs



Photo 1D & 1E (Station 11+00) – Manhole Failure Before and After Repair



Photo 2A & 2B (Station 14+25) –General Condition of Section 2 (A) and Eroded Floor Invert (B)

Brewery Creek Storm Culvert Photographs



Photo 3A (14+95) – Roof Failure (Relaced Sum. 2012)



Photo 3B– Station 14+00 to 14+25 (Gen. Cond.)



Photo 3C (15+40 to 15+75) - Scour in wall & Underpin



Photo 3D (15+75) - Scour & Waterfall



Photo 4A (16+06) – Profile Change (Waterfall)



Photo 5A (16+56) – Section 4 Typical Condition

Brewery Creek Storm Culvert Photographs



Photo 6A (17+25 to 17+50) – General Condition



Photo 7A (18+25 to 18+50) – General Condition



Photo 8A (19+25) – Failing Roof



Photo 8B (19+50) – Scour at Bottom of Wall



Photo 9A (19+75) – Hole in Roof & Poor Masonry



Photo 10A (20+50) – General Construction

Brewery Creek Storm Culvert Photographs



Photo 10B (20+60) – Scour of Lower 18” of Wall



Photo 10C (21+50) – Corroded Support Beam in Roof



Photo 10D (22+48) – 4’ Scour in South Wall (6/29)



Photo 11A (23+57) – Deteriorated Headwall



Photo 11B (23+65) – General Cond. & Const.



Photo 12A (24+50 ±) – Condition Prior to June 2012

Brewery Creek Storm Culvert Photographs



Photo 12B (25+00) – Condition & RCP Joints



Photo 13A (25+25) – Condition and Transition



Photo 13B (25+33 to 25+48) – Condition



Photo 13C (25+54) – New Roof and Manhole @ 4th St.



Photo 14A (26+75 to 26+25) – Construction



Photo 14B (Sta 27+00) - Hole in Roof

Brewery Creek Storm Culvert Photographs



Photo 15A (27+03 to 27+21) – General Condition



Photo 16A (27+75) – Eroded Brick Roof



Photo 17A (28+25) – General Cond. & Const.



Photo 18A (29+75) – General Cond. & Const.



Photo 18B (30+13) – Bulged Manhole Riser



Photo 19A (30+75) – Cracked and Sagging Roof

Brewery Creek Storm Culvert Photographs



Photo 20A (32+25) – Roof & Wall Spalling



Photo 20B (34+25) – Floor Failure



Photo 20C (34+25) – Roof Failure @ Manhole



Photo 20D (35+35) - Severe Spalling of Roof



Photo 21A (37+40) – Spall in Roof



Photo 21B (38+50) – General Condition

Brewery Creek Storm Culvert Photographs



Photo 22A (38+25) – Gen. Condition/Construction



Photo 23A (39+75) – Gen. Condition/Construction



Photo 24A (40+70) – Gen. Condition/Construction



Photo 25A (41+00) – Hatch in Roof



Photo 26A (42+00) – Manhole and Gen Condition



Photo 27A (43+25) – Gen Construction/Condition

Brewery Creek Storm Culvert Photographs



Photo 28A (44+75) – Gen. Condition/Construction



Photo 28B (44+00) – Failure of Floor



Photo 29A (47+45) – Eroded Invert and B/Pipe



Photo 29B (47+35) – Hole in pipe @ Flow Line



Photo 29C (47+10) – Squashed Pipe



Photo 30A (48+25) – General Condition

Brewery Creek Storm Culvert Photographs



Photo 31A (49+50) – Gen. Cond. & Separated Joint



Photo 31B (48+75) – Cracking of RCP Roof



Photo 32A (51+00) – General Condition



Photo 32B (50+76) – Brick Riser to be Tuckpointed



Photo 32C (51+51) – Debris at Inlet



Photo 33A (52+08) – Outlet with Failing Floor

Brewery Creek Storm Culvert Photographs



Photo 33B (52+70) – Exposed Bar and Cracking in Roof



Photo 34A (53+25 – 53+34) – Floor Failure



Photo 34B (54+00) – Scour in Wall



Photo 34C (54+00) – General Condition and Sagged Roof



Photo 35A (54+47) - Inlet

BREWERY CREEK CULVERT CONDITION STUDY
SUMMARY OF DEFICIENCIES

BY: LHB, INC.
12/12/2012

SECTION	STATIONS	CONDITION(GOOD/FAIR/POOR)			RECOMMENDATIONS:		
		ROOF	WALLS	FLOOR	0-5 YEARS	5-10 YEARS	10+ YEARS
1	10+00 to 14+12	Fair	Poor	Fair	<ul style="list-style-type: none"> Walls to be 50-100% tuckpointed throughout section. Photo 1A Tuckpoint roof: 10+50 to 11+50 Monitor wall for future movement where repair of hollow wall and bulge was done at station 13+75. 	<ul style="list-style-type: none"> Review tuckpointing needs of roof 	<ul style="list-style-type: none"> Review condition of culvert floor.
2	14+12 to 14+89	Fair	Fair	Poor	<ul style="list-style-type: none"> Clean and epoxy coat exposed reinforcing, and place a new concrete invert (Photo 2B) 		<ul style="list-style-type: none"> Review condition of sides and top of pipe.
3	14+89 to 15+75	Good	Fair	Fair	<ul style="list-style-type: none"> Monitor scour at bottom of north wall from sta. 15+40 to 15+50 (Photo 3C) 	<ul style="list-style-type: none"> Review walls and roof for scour and cracking. 	
4	15+75 to 16+06	Good	Good	Good			<ul style="list-style-type: none"> Review condition of section
5	16+06 to 17+14	Good	Good	Fair		<ul style="list-style-type: none"> Review condition of floor and arch particularly under building (16+02 to 16+48) 	
6	17+14 to 17+86	Good	Good	Fair		<ul style="list-style-type: none"> Review condition of floor and arch particularly under building (17+41 to 18+04) 	
7	17+86 to 18+84	Good	Good	Fair		<ul style="list-style-type: none"> Review condition of section particularly at areas where rebar is exposed (18+25 (Photo 7A) & 18+50 - 18+75). 	
8	18+84 to 19+57	Fair	Fair	Fair	<ul style="list-style-type: none"> Replace failing roof (19+25 to 19+51), Photo 8A Underpin south wall (19+20 to 19+51), Photo 8B 		<ul style="list-style-type: none"> Review condition of culvert floor, walls and roof.
9	19+57 to 20+35	Fair	Poor	Fair	<ul style="list-style-type: none"> CRITICAL: Walls to be 100% tuckpointed from station 19+65 to 20+35 	<ul style="list-style-type: none"> Review condition of culvert floor, walls and roof particularly under building (Station 19+54 to 20+27) 	
10	20+35 to 22+67	Fair	Poor	Fair	<ul style="list-style-type: none"> CRITICAL: Walls to be 100% tuckpointed in lower 18" and 50-100% in upper portions particularly beneath building Stone Repair at bottom of wall at station 20+60, Photos 10B Repair scour hole in bottom of wall at station 22+48 (IMMEDIATE REPAIR REQUIRED), Photo 10D Roof to be tuckpointed 100% from stations 20+75 to 21+70. 	<ul style="list-style-type: none"> Review condition of culvert floor, walls and roof particularly under building foundations from 21+72 to 22+19 and 22+35 to 22+67. 	<ul style="list-style-type: none"> Remove corroded support beam and concrete in roof (Station 21+50) and replace concurrent with next scheduled road project of 7th Ave E (Photo 10C).
11	23+57 to 24+01	Poor	Poor	Fair	<ul style="list-style-type: none"> Headwall @ 23+57 to be repaired or replaced (Photo 11A) Roof to be 100% tuckpointed Walls to be 50-100% tuckpointed 	<ul style="list-style-type: none"> Review condition of culvert floor 	
12	24+01 to 25+03	Good	Good	Good			<ul style="list-style-type: none"> Review condition of section

**BREWERY CREEK CULVERT CONDNTION STUDY
SUMMARY OF DEFICIENCIES**

BY: LHB, INC.
12/12/2012

SECTION	STATIONS	CONDITION(GOOD/FAIR/POOR)			RECOMMENDATIONS:		
		ROOF	WALLS	FLOOR	0-5 YEARS	5-10 YEARS	10+ YEARS
13	25+03 to 26+25	Poor	Fair	Fair	<ul style="list-style-type: none"> Tuckpoint Roof 100% Repair hole @ t/wall 25+35 (Photo 13B) CRITICAL: Repair floor at 26+25 	<ul style="list-style-type: none"> Tuckpoint Walls 100% 	<ul style="list-style-type: none"> Review condition of section
14	26+25 to 27+03	Fair to Poor	Good	Good	<ul style="list-style-type: none"> CRITICAL: Repair floor at station 26+50 CRITICAL: Repair failure in floor and scour in wall at station 26+67 Patch concrete roof failure at station 27+00 (Photo 14B) 	<ul style="list-style-type: none"> Review condition of section (shares wall with building foundation). 	
15	27+03 to 27+21	Good	Good	Fair		<ul style="list-style-type: none"> Review condition of section, especially floor 	
16	27+21 to 27+97	Poor	Fair	Fair	<ul style="list-style-type: none"> CRITICAL: Repair Roof due to severely deteriorated arch bricks (Photo 16A) 	<ul style="list-style-type: none"> Review condition of floor and walls 	
17	27+97 to 29+31	Good	Good	Fair			<ul style="list-style-type: none"> Review condition of section
18	29+31 to 30+64	Fair	Fair	Fair	<ul style="list-style-type: none"> CRITICAL: Tuckpoint lower 2' of masonry walls Monitor condition of manhole @ 30+13 (Photo 18B) 	<ul style="list-style-type: none"> Review condition of floor and arch 	
19	30+64 to 31+25	Good to Poor	Good	Fair	<ul style="list-style-type: none"> CRITICAL: Repair separated and sagging roof from 30+64 to 30+80 below building (Photo 19A) 	<ul style="list-style-type: none"> Review condition of floor and walls 	
20	31+25 to 37+32	Poor	Poor	Fair to Poor	<ul style="list-style-type: none"> Inspect section every 12 months until all recommended repairs are complete. CRITICAL: Repair washout in floor: 34+00 to 34+70. (Photo 20B) CRITICAL: Repair scoured walls : 31+95 to 32+88. (Photo 20A) CRITICAL: Repair roof spalls: 32+00 to 32+88 & 35+35. And, repair deteriorating roof at manhole (34+25) (Photos 20A, 20C & 20D) 		
21	37+32 to 38+68	Fair to Poor	Good	Fair	<ul style="list-style-type: none"> Monitor floor condition and repair as required. CRITICAL: Repair roof spalling: 37+40 (Photo 21A) & 37+65 CRITICAL: Repair roof and manhole interface @ 38+00 		<ul style="list-style-type: none"> Review condition of culvert walls
22	38+68 to 39+47	Good	Good	Good		<ul style="list-style-type: none"> Review condition of section 	
23	39+47 to 40+51	Good - Fair@MH	Good	Good	<ul style="list-style-type: none"> Monitor roof/manhole interface at station 40+00 	<ul style="list-style-type: none"> Review condition of section 	
24	40+51 to 40+79	Good	Fair	Fair		<ul style="list-style-type: none"> Monitor condition of floor and roof Assess stone masonry and tuckpoint where required 	

BREWERY CREEK CULVERT CONDITION STUDY SUMMARY OF DEFICIENCIES							BY: LHB, INC. 12/12/2012
SECTION	STATIONS	CONDITION(GOOD/FAIR/POOR)			RECOMMENDATIONS:		
		ROOF	WALLS	FLOOR	0-5 YEARS	5-10 YEARS	10+ YEARS
25	40+79 to 41+30	Good	Good	Fair		<ul style="list-style-type: none"> Monitor condition of walls, floor and roof, especially at washout (41+30) 	
26	41+30 to 43+13	Good	Good	Poor	<ul style="list-style-type: none"> Monitor floor condition every 2 years at a minimum. 	<ul style="list-style-type: none"> Monitor condition of walls and roof 	
27	43+13 to 43+66	Good	Good	Fair			<ul style="list-style-type: none"> Review condition of section
28	43+66 to 44+77	Fair	Fair	Fair	<ul style="list-style-type: none"> Patch hole in concrete floor at 44+00 (Photo 28B) 		<ul style="list-style-type: none"> Review condition of section
29	44+77 to 47+45	Poor	Poor	Poor	<ul style="list-style-type: none"> CRITICAL: Monitor condition of culvert especially under building. CRITICAL: Remove and replace concrete invert over entire section length (Photo 29A) CRITICAL: Repair pipe at 47+35 concurrent with floor invert replacement (Photo 29B) CRITICAL: Line Pipe from station 46+00 to 47+19. Coordinate with replacement of concrete invert. (Photo 29C) 		
30	47+45 to 48+32	Fair	Fair	Fair	<ul style="list-style-type: none"> Repair concrete invert with replacement or overlay 	<ul style="list-style-type: none"> Review condition of walls & roof 	
31	48+32 to 49+58	Poor	Fair	Fair	<ul style="list-style-type: none"> CRITICAL: Monitor condition and repair RCP for entire length of section based upon monitoring results (Photo 31A & 31B) 		
32	49+58 to 51+51.5	Fair	Fair	Fair	<ul style="list-style-type: none"> Brick in lower 1/2 of manhole riser requires tuckpointing (50+76). Photo 32B Clear concrete debris obstructing inlet (Photo 32C) 	<ul style="list-style-type: none"> Review condition of section 	
33	52+08 to 53+25	Poor	Poor	Fair	<ul style="list-style-type: none"> Construct drop wall at end of box (Photo 33A) Repair surface of concrete on walls and roof over entire section (Photo 33B) 		
34	53+25 to 54+36	Poor	Poor	Poor	<ul style="list-style-type: none"> IMMEDIATE REPAIR REQUIRED: Fill Pool with concrete and construct underpin walls to protect existing eroded walls 53+25 to 53+34 (Photo 34A) CRITICAL: Construct Underpin curb on both sides of culvert over entire length of section. (Photo 34B) CRITICAL: Repair Roof from 53+60 to 54+35. (Photo 34C) 		
35	54+36 to 54+47	Poor	Poor	Fair	<ul style="list-style-type: none"> Replace collapsed Roof and Deteriorated Walls. (Photo 35A) 		

Minimum Hydraulic Opening of Culvert Sections

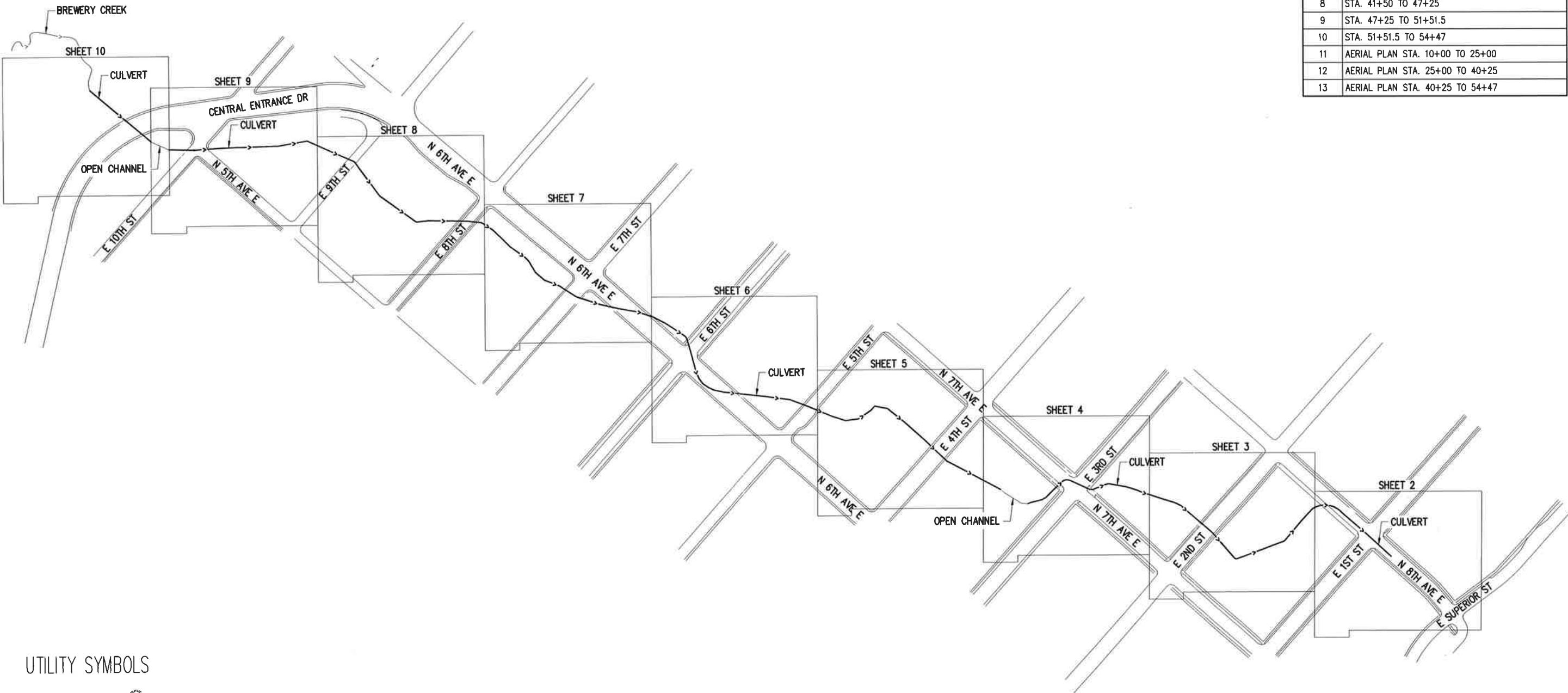
	Section	Rectangular		Arch		Circular	Total Area (sf)
		Width (ft)	Height (ft)	Width (ft)	Height (ft)	Radius (ft)	
Lower Segment	1	5.00	3.67	5.00	2.50		28.15
	2					3.00	28.27
	3	6.00	6.00				36.00
	4	6.50	19.00				123.50
	5			6.50	5.67		28.93
	6	5.00	3.25	5.00	1.33		21.49
	7			6.83	5.17		27.73
	8	6.00	5.33				32.00
	9	5.67	4.08				23.14
	10	5.00	6.00	5.00	1.17		34.58
							Average = 28.92

Middle Segment	11	5.00	3.83				19.17	Average = 24.32
	12					3.00	28.27	
	13	5.00	4.17	5.00	1.00		24.76	
	14	3.71	7.25				26.89	
	15	4.67	6.25				29.17	
	16	4.67	5.00	5.00	2.00		31.19	
	17	5.00	5.25	5.00	2.33		35.41	
	18	5.00	4.00	5.00	2.50		29.82	
	19	4.83	4.58				22.15	
	20	6.00	3.50				21.00	
	21	5.00	4.17				20.83	
	22	5.00	4.17				20.83	
	23	6.00	3.17				19.00	
	24	5.00	3.67				18.33	
	25	5.00	4.83				24.17	
	26	5.00	4.00				20.00	
	27	4.83	4.00				19.33	
	28	5.08	4.17				21.18	
	29					3.00	28.27	
	30	5.00	4.55				22.75	
31					3.00	28.27		
32	5.00	4.83				24.17		

Upper Segment	33	6.00	4.17				25.00	Average = 24.51
	34	5.17	3.75				19.38	
	35	5.00	5.83				29.17	

BREWERY CREEK CONDITION STUDY

LIST OF SHEETS	
NO.	DESCRIPTION
1	GENERAL PLAN
2	STA. 10+00 TO 12+75
3	STA. 12+75 TO 18+75
4	STA. 18+75 TO 24+25
5	STA. 24+25 TO 29+75
6	STA. 29+75 TO 35+75
7	STA. 35+75 TO 41+50
8	STA. 41+50 TO 47+25
9	STA. 47+25 TO 51+51.5
10	STA. 51+51.5 TO 54+47
11	AERIAL PLAN STA. 10+00 TO 25+00
12	AERIAL PLAN STA. 25+00 TO 40+25
13	AERIAL PLAN STA. 40+25 TO 54+47



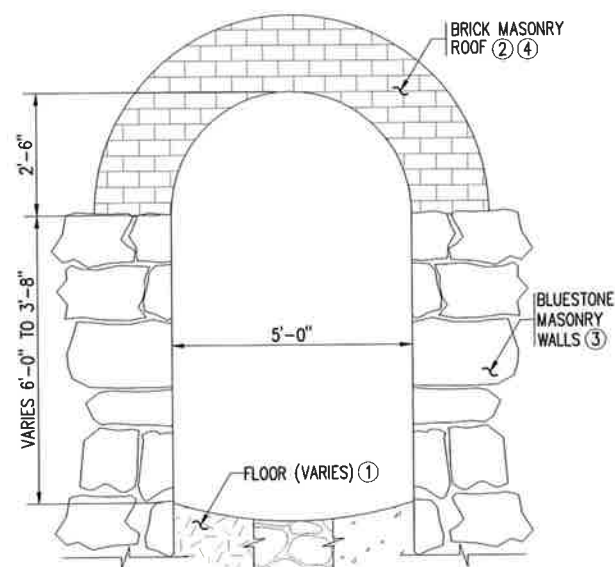
UTILITY SYMBOLS

- GAS MANHOLE
- STORM MANHOLE
- SANITARY MANHOLE
- WATER MANHOLE
- STEAM HANDHOLE
- STORM SEWER CATCH BASIN
- STEAM MAIN
- STORM SEWER
- SANITARY SEWER
- GAS MAIN
- WATER MAIN



LHB ENGINEERS & ARCHITECTS
DULUTH • MINNEAPOLIS
21 W. Superior St., Ste. 500, DULUTH, MN 55802
TEL 218/727-8448 • FAX 218/727-8456

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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13



SECTION 1 - STA 10+00 TO 14+12

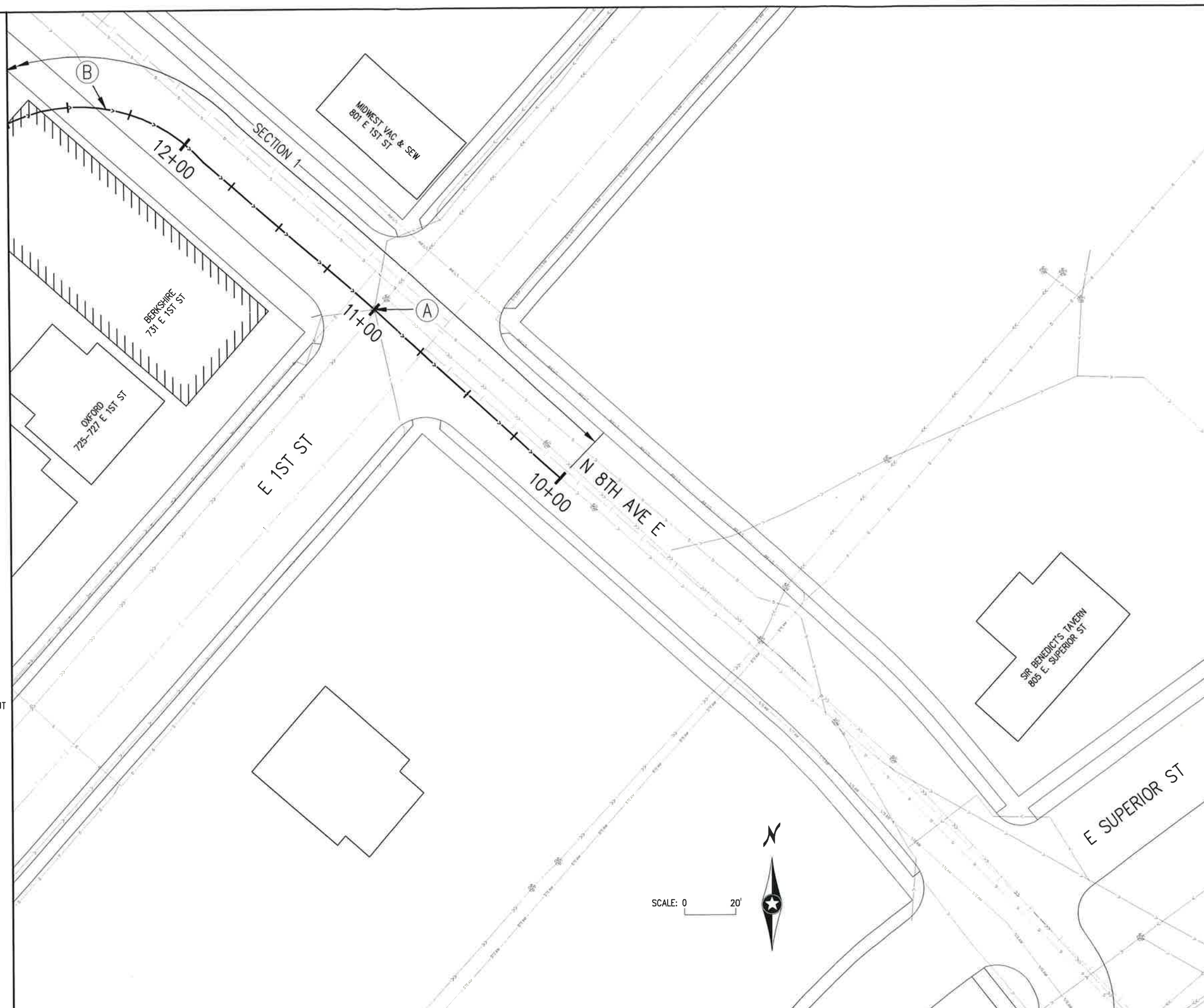
SCALE: 0 2'

KEY NOTES

- ① FLOOR CONSTRUCTION VARIES THROUGHOUT SECTION BETWEEN BEDROCK, STONE MASONRY AND UNREINFORCED CONCRETE. FLOOR IS IN FAIR CONDITION THROUGHOUT.
- ② CONCRETE ROOF FROM STATION 13+80 TO 14+12 ONLY.
- ③ WALLS IN POOR CONDITION. LOOSE STONES AND FAILED MORTAR.
- ④ BRICK IN POOR CONDITION FROM STA 10+50 TO 11+50, AND IN FAIR CONDITION THROUGHOUT THE REMAINDER OF SECTION 1.

INLET STRUCTURES & PIPE PENETRATIONS

- (A) STA 11+00: MANHOLE WITH BRICK RISER. REPAIRED IN SUMMER OF 2012.
- (B) STA 12+35: BRICK STORM INLET STRUCTURE AT BOTTOM OF NORTH WALL & 12" CLAY WEEP IN ROOF.



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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE:

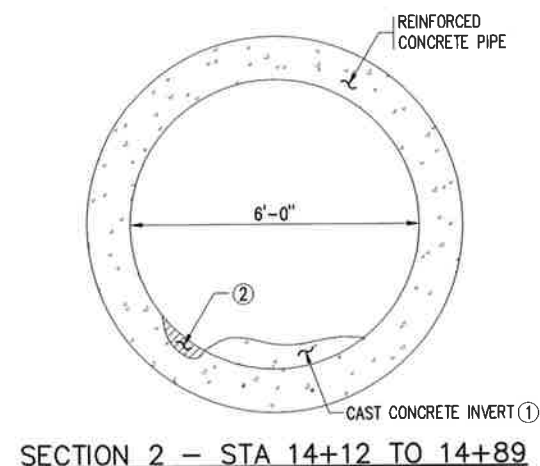
PLAN & SECTIONS
(STA. 10+00 - 12+75)

DES: DR: JRM
CHK: CHK: LMM

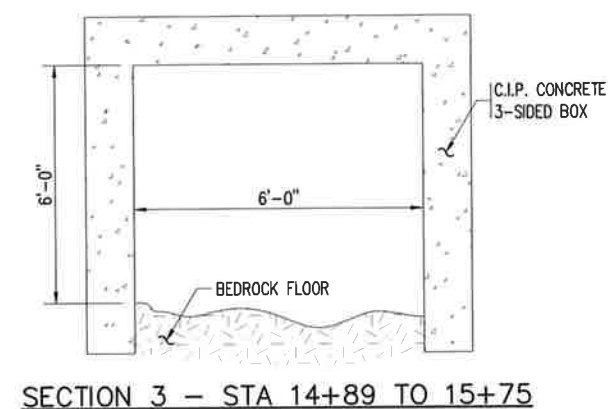
APPROVED:

Sheet No. 2 of 13 Sheets

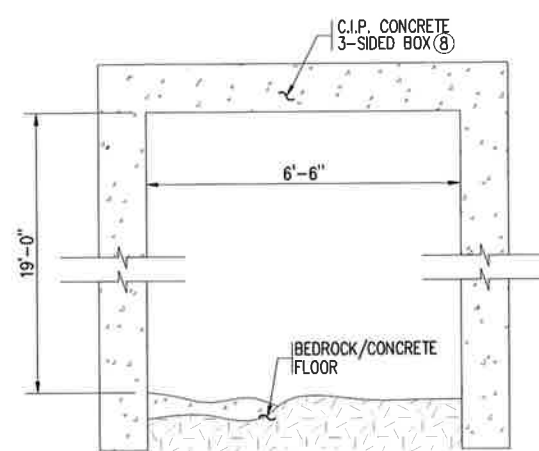
Bridge No.
BREWERY



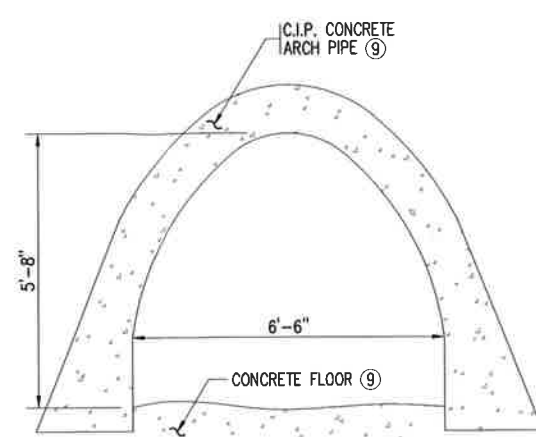
SCALE: 0 2'



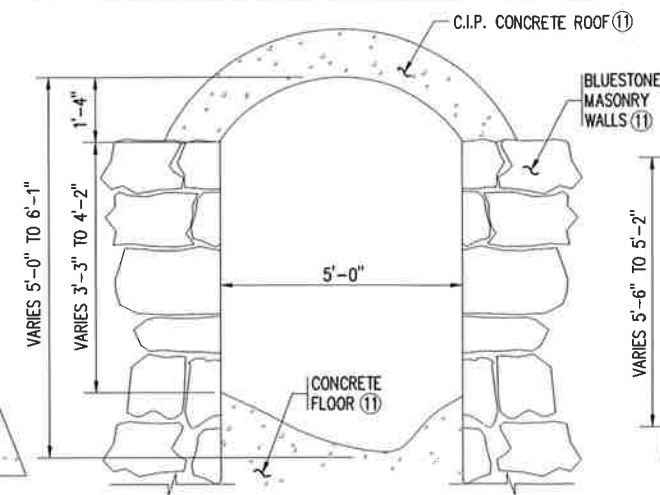
SCALE: 0 2'



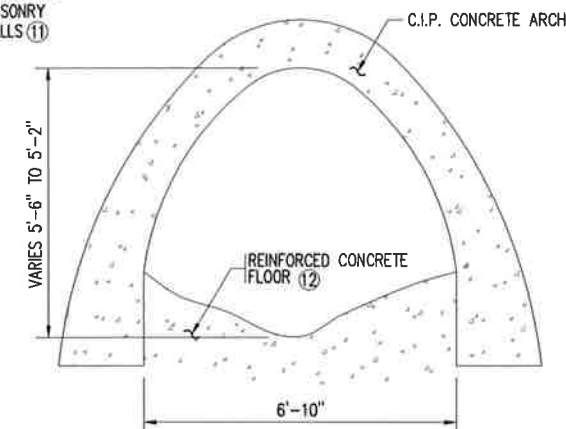
SCALE: 0 2'



SCALE: 0 2'



SCALE: 0 2'



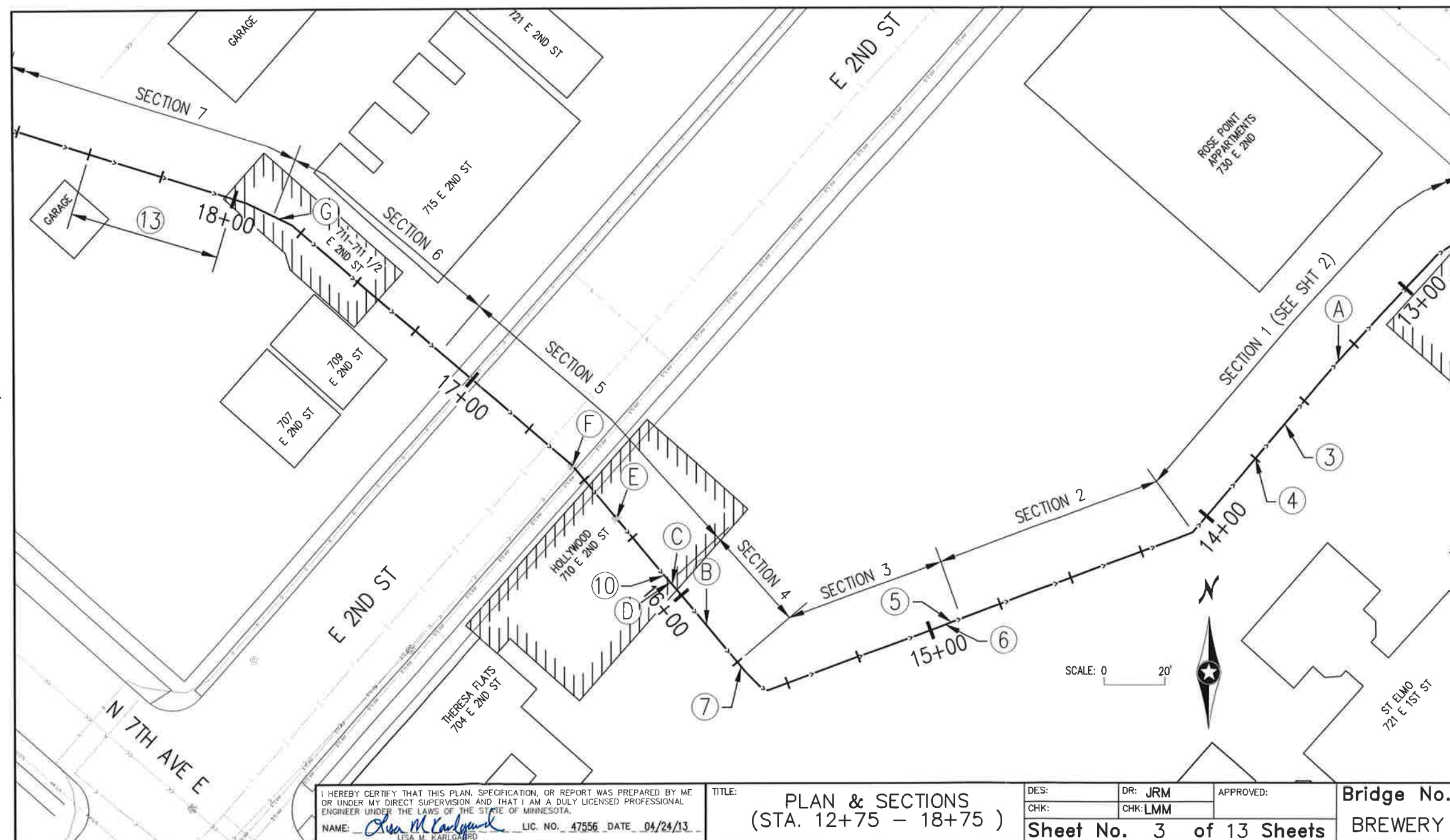
SCALE: 0 2'

KEY NOTES

- (1) FLOWLINE CONCRETE MOSTLY ERODED AND BEGINNING TO SCOUR PIPE.
- (2) IN SOME AREAS SCOUR IS AS DEEP AS 1 1/2" AND BAR IS EXPOSED.
- (3) SOUTH WALL UNDERMINED FROM STATION 13+60 TO 13+65. REPAIRED IN SUMMER OF 2012.
- (4) LARGE BULGE IN SOUTH WALL (7' LONG X 5' HIGH) IN WALL AT STATION 13+75, WITH HOLLOW AREA BEHIND BULGE. REPAIRED IN SUMMER OF 2012.
- (5) NORTH WALL SCOURED ALONG FLOOR APPROX 2' DEEP (8' LENGTH @ STA 14+95). REPAIRED IN SUMMER OF 2012.
- (6) CONCRETE ROOF FAILURE REPAIRED IN SUMMER OF 2012. STA 14+89 TO 15+07.
- (7) WATERFALL LOCATED AT STA 15+75 WITH POOL BELOW. LADDER REQUIRED FOR ACCESS ACROSS (HOWEVER, STILL DIFFICULT). NORTH WALL IS SCOURED AT THE END OF THE POOL.
- (8) WALLS AND ROOF IN GOOD CONDITION EXCEPT AS NOTED.
- (9) STRUCTURE IN GOOD CONDITION, FLOOR IN FAIR CONDITION.
- (10) ABRUPT CHANGE IN FLOOR ELEVATION (APPROX. 5'). LADDER REQUIRED FOR ACCESS ACROSS. CAST CONCRETE SURFACE. (STA 16+06)
- (11) WALLS AND ROOF IN GOOD CONDITION. FLOOR IN GOOD TO FAIR CONDITION, (SCOURED BUT FUNCTIONAL).
- (12) FLOOR SCOURED AND REBAR EXPOSED (STA 18+50 TO 18+55).
- (13) STEEP (APPROX. 50% - 15%) GRADE FROM STA 18+00 TO 18+50.

INLET STRUCTURES & PIPE PENETRATIONS

- (A) STA 13+33: 12" RCP IN ROOF (GOOD CONDITION).
- (B) STA 15+87: 16"x16" SQUARE WEEP IN ROOF (PLUGGED).
- (C) STA 16+05: 10"x10" SQUARE WEEP IN ROOF.
- (D) STA 16+06: 4" CLAY PIPE IN SOUTH WALL.
- (E) STA 16+35: 24" CHISELED OPENING FOR MANHOLE IN ROOF (STRUCTURE LARGER)
- (F) STA 16+56: MANHOLE WITH BRICK RISER, 4' WIDE AT ROOF.
- (G) STA 17+84: 12" CLAY PIPE IN NORTH WALL.



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.
 NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

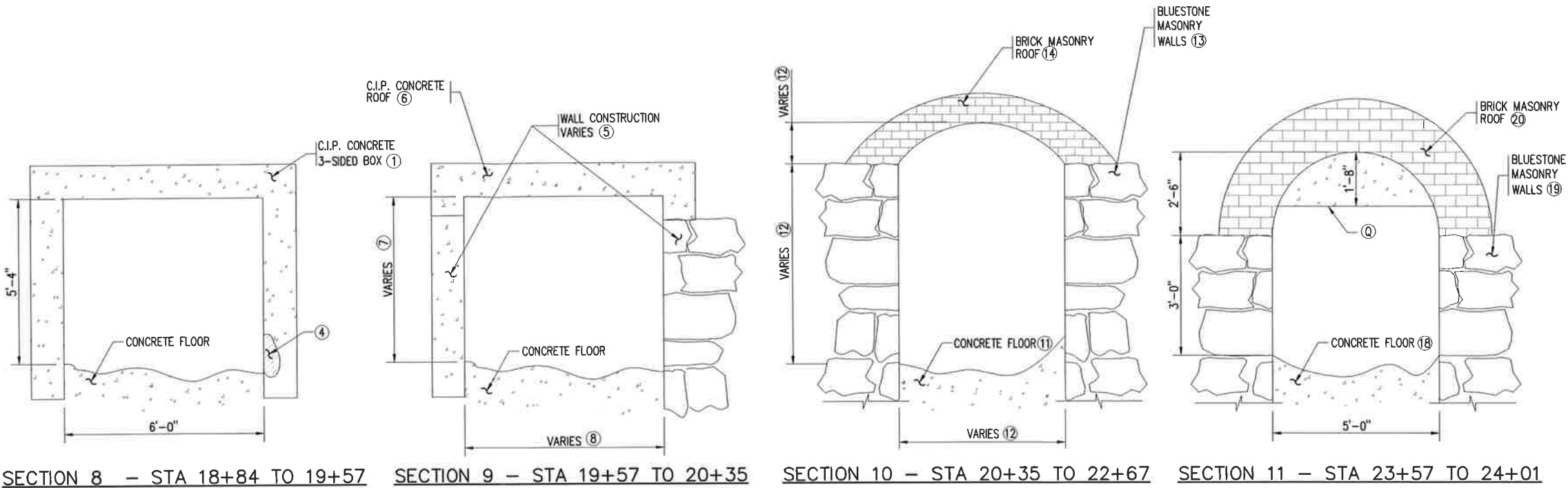
TITLE: PLAN & SECTIONS
 (STA. 12+75 - 18+75)

DES: _____ DR: JRM
 CHK: _____ CHK: LMM
 APPROVED: _____
 Sheet No. 3 of 13 Sheets

Bridge No.
 BREWERY

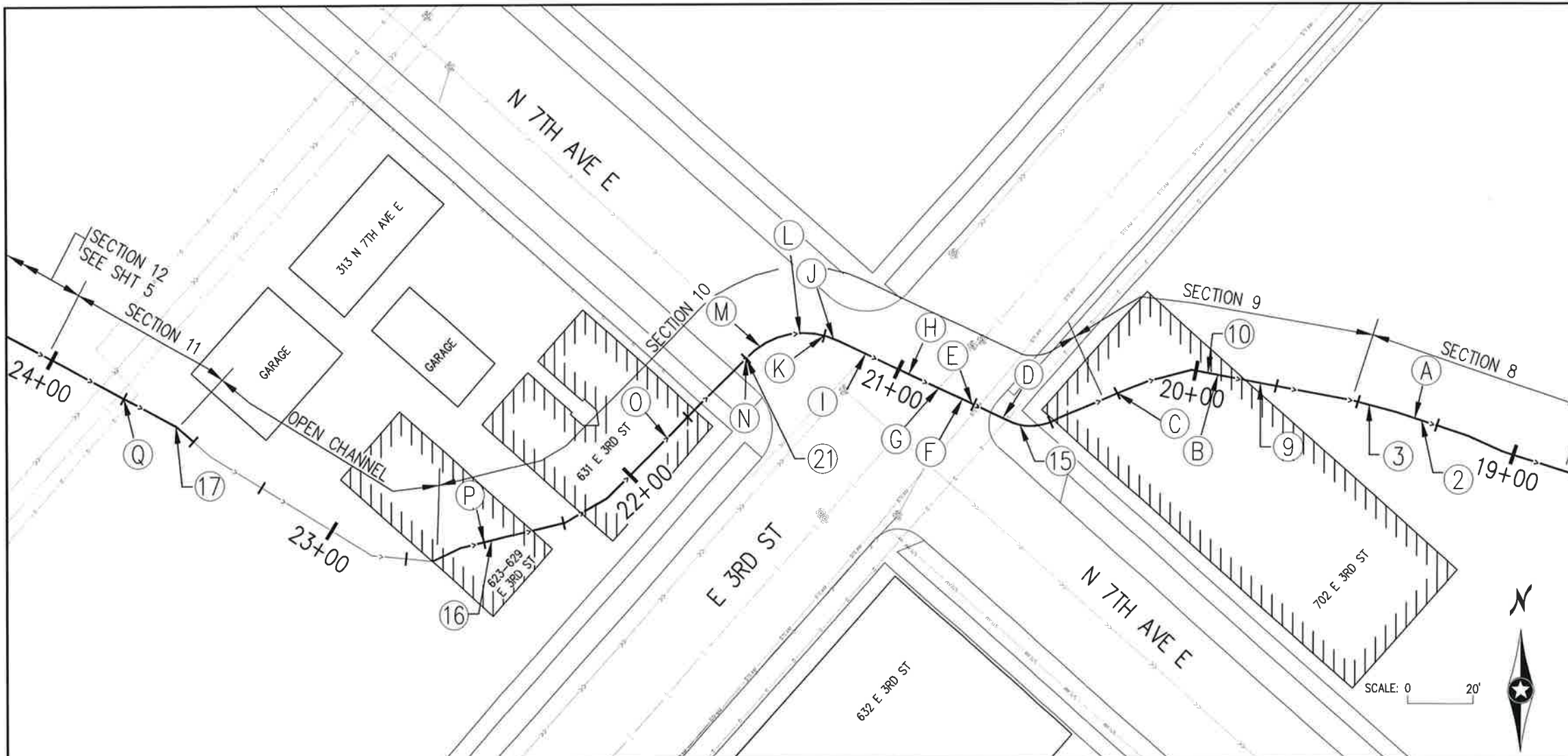
KEY NOTES

- 1 WALLS, ROOF AND FLOOR ARE IN OVERALL FAIR CONDITION EXCEPT AS NOTED.
- 2 CONCRETE ROOF FAILING FROM STA 19+25 TO 19+38.
- 3 OPEN CHANNEL FROM STA 19+38 TO 19+51. CHANNEL IS COVERED BY TIMBER. A CAR HAS BEEN PLACED ON TIMBER.
- 4 THERE IS HONEY COMB PRESENT ON WALLS AND THE LOWER PORTION OF THE SOUTH WALL IS SCOURED AT THE FLOWLINE FROM STA 19+20 TO 19+50.
- 5 NORTH WALL IS CONSTRUCTED OF BLUESTONE MASONRY WITH A CONCRETE FACING FROM STA 19+51 TO 19+65 AND STONE MASONRY FROM STA 19+65 TO 20+35. (MASONRY JOINTS ARE IN POOR CONDITION.) SOUTH WALL IS CONSTRUCTED OF CONCRETE FROM STA 19+51 TO 20+15 (FAIR CONDITION) AND STONE MASONRY FROM STA 20+15 TO 20+35. (MASONRY JOINTS ARE IN POOR CONDITION.)
- 6 CONCRETE ROOF IS IN FAIR CONDITION.
- 7 CULVERT WALL HEIGHT DECREASES FROM 5'-9" @ STA 19+51 TO 4'-1" @ STA 20+01, AND MEASURES 4'-9" FROM STA 20+01 TO 20+35.
- 8 CULVERT WIDTH INCREASES FROM 5'-0" @ STA 19+51 TO 5'-8" @ STA 20+01 AND MEASURES 5'-9" FROM STA 20+01 TO 20+35.
- 9 STA. 19+79: HOLE IN ROOF. EDGE OF BUILDING CAN BE SEEN FROM BELOW.
- 10 WEATHERED BEDROCK EXPOSED IN FLOOR @ STA. 19+92.
- 11 CONCRETE FLOOR IS IN FAIR CONDITION THROUGHOUT. CONSTRUCTION CHANGES TO BEDROCK @ STA. 21+80.
- 12 CULVERT WIDTH, WALL HEIGHT AND ARCH RISE VARY. DIMENSIONS RESPECTIVELY FOR STA 20+35 TO 20+75 ARE 5'-6", 7'-0" & 1'-3"; FOR STA 20+75 TO 21+25 ARE 5'-0", 6'-0" & 1'-2"; FOR STA 21+25 TO 21+70 ARE, 6'-0", 6'-0" & 1'-0"; FOR STA 21+70 TO 22+67 ARE 6'-9", 5'-6" & 1'-0". THERE IS A STEP IN THE ROOF W/ AN ABRUPT WALL HEIGHT CHANGE AT STATION 21+70 (8 1/2" STEP).
- 13 MASONRY WALLS ARE SCOURED AT THE BOTTOM 18". THE MORTAR IS 100% FAILED. 50-100% OF THE MORTAR HAS FAILED OF THE UPPER PORTIONS OF THE WALL.
- 14 ROOF IS IN FAIR CONDITION FROM STA 20+35 TO 20+75 AND STA 21+70 TO 22+67, BUT IN POOR CONDITION FROM STA 20+75 TO 21+70 (50-100% OF MORTAR HAS FAILED).
- 15 STA 20+60: MISSING STONE/HOLE IN BOTTOM OF SOUTH WALL 5' LONG AND 1'-6" TALL.
- 16 STA 22+48: SEVERE SCOUR IN BOTTOM OF SOUTH WALL (APPROX. 4' DEEP).
- 17 HEADWALL SEVERELY DETERIORATED FOLLOWING JUNE 2012 FLOOD.
- 18 CONCRETE FLOOR IS IN FAIR CONDITION.
- 19 BLUESTONE MASONRY WALLS ARE IN POOR CONDITION.
- 20 BRICK MASONRY ROOF IS IN POOR CONDITION.
- 21 STA 21+50: CORRODED SUPPORT BEAM THROUGH ROOF.



INLET STRUCTURES & PIPE PENETRATIONS

- A STA 19+36: 5" CLAY PIPE WEEP IN NORTH WALL.
- B STA 19+91: 5" CLAY PIPE WEEP IN SOUTH WALL.
- C STA 20+25: 18" MANHOLE W/STEEL LID IN ROOF. (NO RISER)
- D STA 20+68: DUCTILE IRON PIPE THROUGH ROOF.
- E STA 20+75: INSULATED UTILITY THROUGH ROOF, 15" O.D..
- F STA 20+78: 16" CLAY PIPE IN SOUTH WALL.
- G STA 20+81: 18" STEEL PIPE THROUGH ROOF (ABANDONED).
- H STA 20+96: 12" CLAY PIPE IN NORTH WALL.
- I STA 21+16: 12" CLAY PIPE IN SOUTH WALL (DISCONNECTED 2' BACK).
- J STA 21+22: 12" RCP IN NORTH WALL.
- K STA 21+25: 4" ELECTRICAL CONDUIT @ T/WALL.
- L STA 21+32: 12" RCP IN NORTH WALL.
- M STA 21+42: 14" CLAY PIPE IN NORTH WALL.
- N STA 21+50: 2-5" RAILROAD RAILS THROUGH ROOF (ROTTED).
- O STA 21+84: 12"XB" BLOCKOUT W/FAILED PIPE AT BOTTOM OF NORTH WALL. WATER STILL FLOWING THROUGH. AND, 18" MANHOLE IN ROOF.
- P STA 22+50: 5" CAST IRON PIPE IN NORTH WALL.
- Q STA 23+75: CONCRETE ROOF PENETRATION FOR UTILITIES (5'-10" WDE).



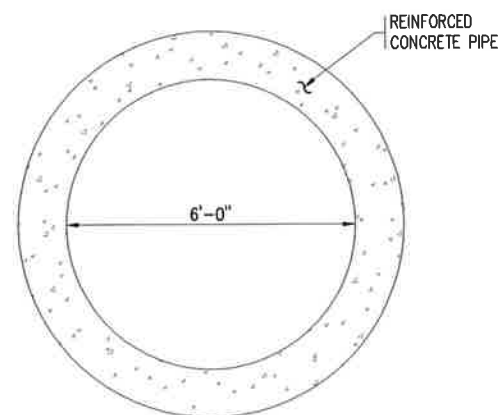
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE: PLAN & SECTIONS (STA. 18+75 - 24+25)

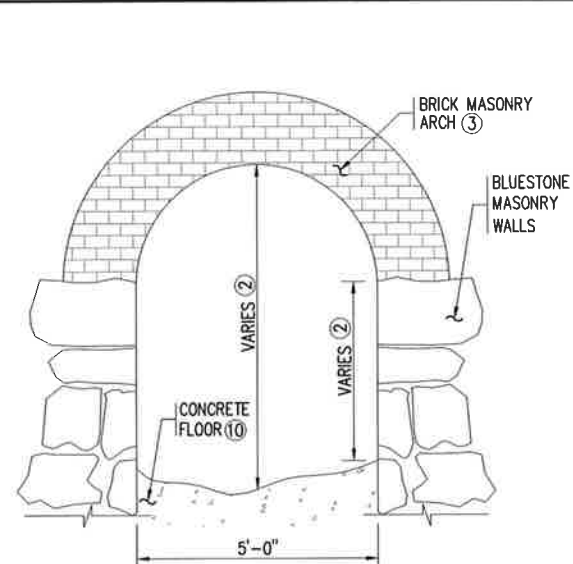
DES:	DR: JRM	APPROVED:	Bridge No. BREWERY
CHK:	CHK: LMM		

Sheet No. 4 of 13 Sheets



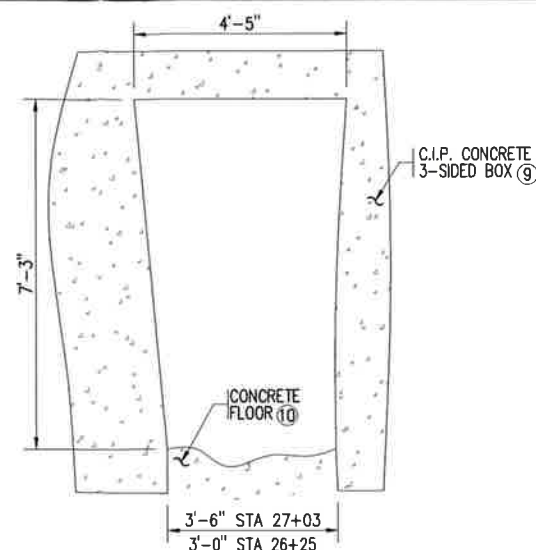
SECTION 12 - STA 24+01 TO 25+03 ①

SCALE: 0 2'



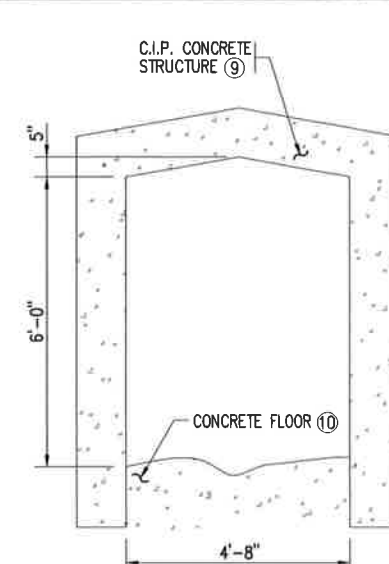
SECTION 13 - STA 25+03 TO 26+25

SCALE: 0 2'



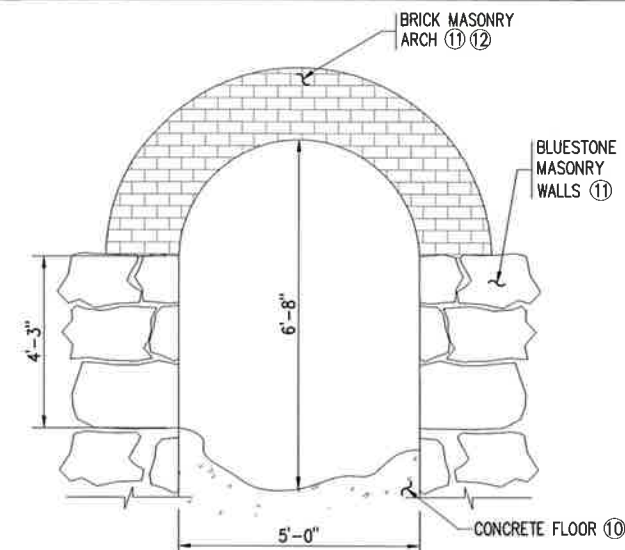
SECTION 14 - STA 26+25 TO 27+03

SCALE: 0 2'



SECTION 15 - STA 27+03 TO 27+21

SCALE: 0 2'



SECTION 16 - STA 27+21 TO 27+97

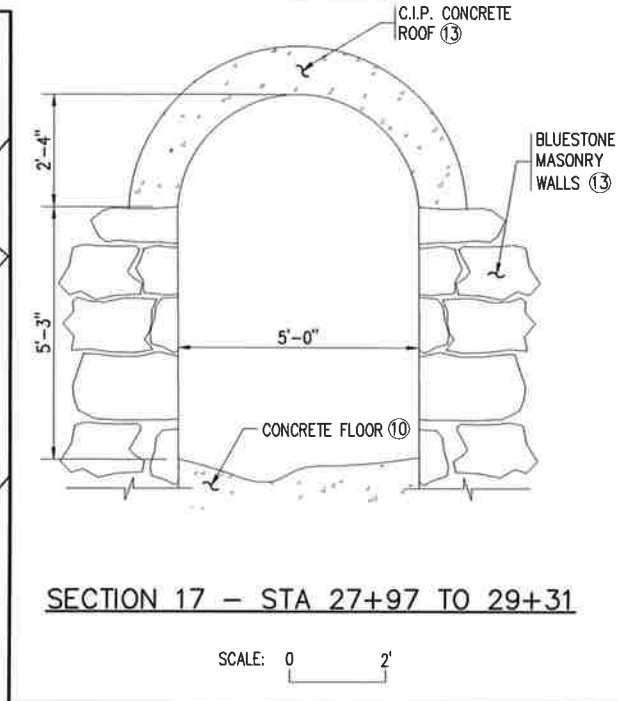
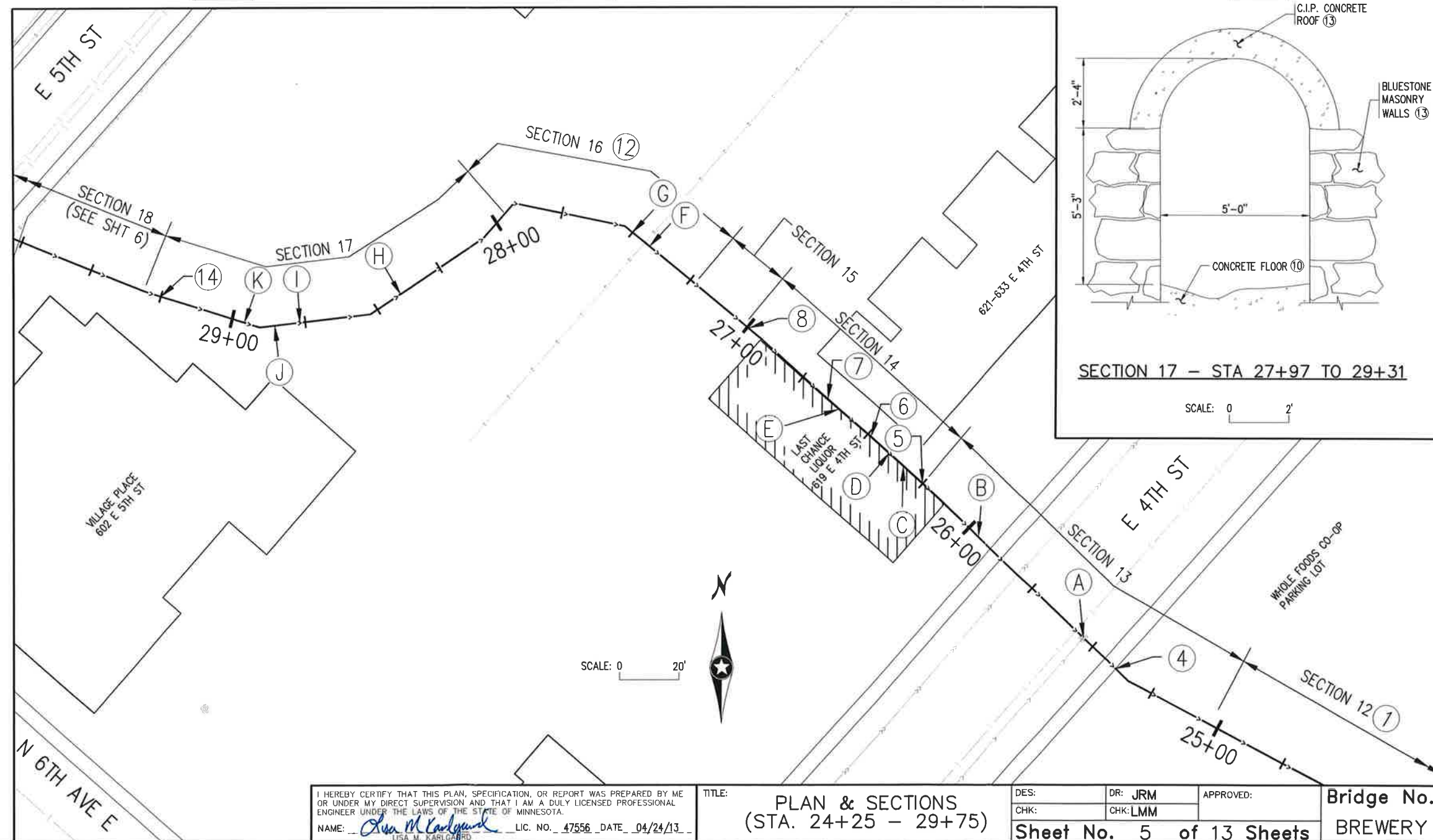
SCALE: 0 2'

KEY NOTES

- ① FORMER 8'-0" CMP REPLACED AFTER JUNE 2012 FLOOD WITH 6'-0" RCP. SECTIONS OF NEW PIPE WERE LAID WITH 1 1/2" TO 4" GAPS BETWEEN SECTIONS.
- ② OVERALL HEIGHT OF CULVERT AND HEIGHT OF WALL RESPECTIVELY IS 7'-2" AND 4'-2" FROM STA 25+03 TO 25+33 AND FROM STATION 25+33 TO 26+25 IS 6'-8" AND 5'-0". WALLS ARE IN FAIR CONDITION EXCEPT AS NOTED.
- ③ THERE IS A CHANGE IN ARCH SHAPE AND RISE AT STATION 25+33. BANDING STONES ARE LOCATED AT THE TRANSITION, INDICATING A FORMER HEADWALL/END SECTION. BRICK IS IN FAIR TO POOR CONDITION.
- ④ HOLE AT TOP OF WALL 18" LONG X 6" HIGH X 10" DEEP, STATION 25+35.
- ⑤ HOLE IN FLOOR 14" LONG X 2'-6" TALL X 1' DEEP.
- ⑥ SCOUR HOLE IN FLOOR WITH EXPOSED BAR, STA 26+50.
- ⑦ STA 26+67 TO 26+61, DROP IN ELEVATION OF FLOOR "WATERFALL". 6" DEEP SCOUR IN NORTH WALL, 2' WIDE BY 1' TALL.
- ⑧ STA 27+00, FAILURE IN ROOF, OPEN AIR CAN BE SEEN FROM INSIDE OF CULVERT. HOLE IS 4'-5" WIDE BY 12" LONG.
- ⑨ WALLS AND ROOF ARE IN GOOD CONDITION EXCEPT AS NOTED.
- ⑩ FLOOR SHOWS SIGNS OF EROSION - FAIR CONDITION.
- ⑪ STA 27+21 TO 27+40 AND STA 27+88 TO 27+97, CONCRETE PATCH OVER SOUTH WALL AND ROOF.
- ⑫ ARCH BRICKS SEVERELY ERODED THROUGHOUT SECTION. BRICKS ARE SPALLED BACK TO AN AVERAGE OF 1 COURSE WITH DEEPER SPALLING AT SELECT LOCATIONS, ESPECIALLY NEAR STA 27+97.
- ⑬ WALLS AND ROOF ARE IN GOOD CONDITION.
- ⑭ WATERFALL IN FLOOR AT STA 29+25.

INLET STRUCTURES & PIPE PENETRATIONS

- A STA 25+54: 3'-0"Ø MANHOLE. THIS STRUCTURE WAS REPLACED IN MARCH OF 2012 AND THE ROOF SURROUNDING THE MANHOLE WAS REPAIRED FROM STATION 25+45 TO 25+61. MANHOLE MEASURES 19'-2" FROM T/C TO CULVERT FLOOR.
- B STA 25+90: 16"Ø ABANDONED MANHOLE.
- C STA 26+30: WEEP IN ROOF
- D STA 26+61: 2 WEEPS IN SOUTH WALL. 4" Ø PVC PIPE.
- E STA 26+59: 24"Ø MANHOLE.
- F STA 27+35: 3" Ø CLAY PIPE IN NORTH WALL.
- G STA 27+50: 3" Ø CLAY PIPE IN NORTH WALL.
- H STA 28+41: 8" Ø CLAY PIPE IN NORTH WALL.
- I STA 28+77: 8" Ø CLAY PIPE IN NORTH WALL.
- J STA 28+79: 8" Ø CLAY PIPE IN SOUTH WALL.
- K STA 28+95: 6" Ø CLAY PIPE IN NORTH WALL.



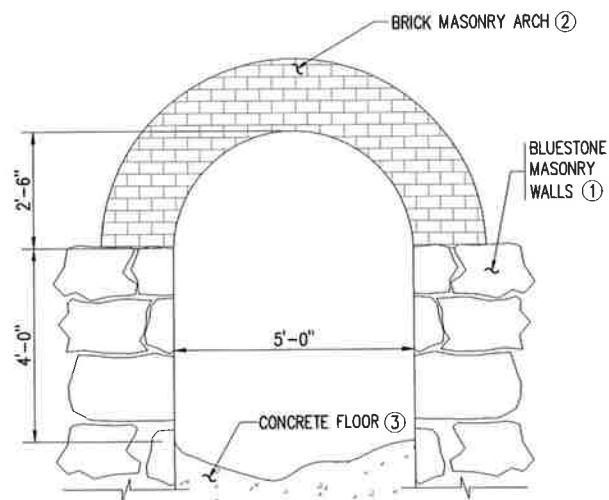
SECTION 17 - STA 27+97 TO 29+31

SCALE: 0 2'

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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE: PLAN & SECTIONS
(STA. 24+25 - 29+75)

DES: DR: JRM
CHK: CHK: LMM
APPROVED:
Sheet No. 5 of 13 Sheets
Bridge No. BREWERY



SECTION 18 - STA 29+31 TO 30+64

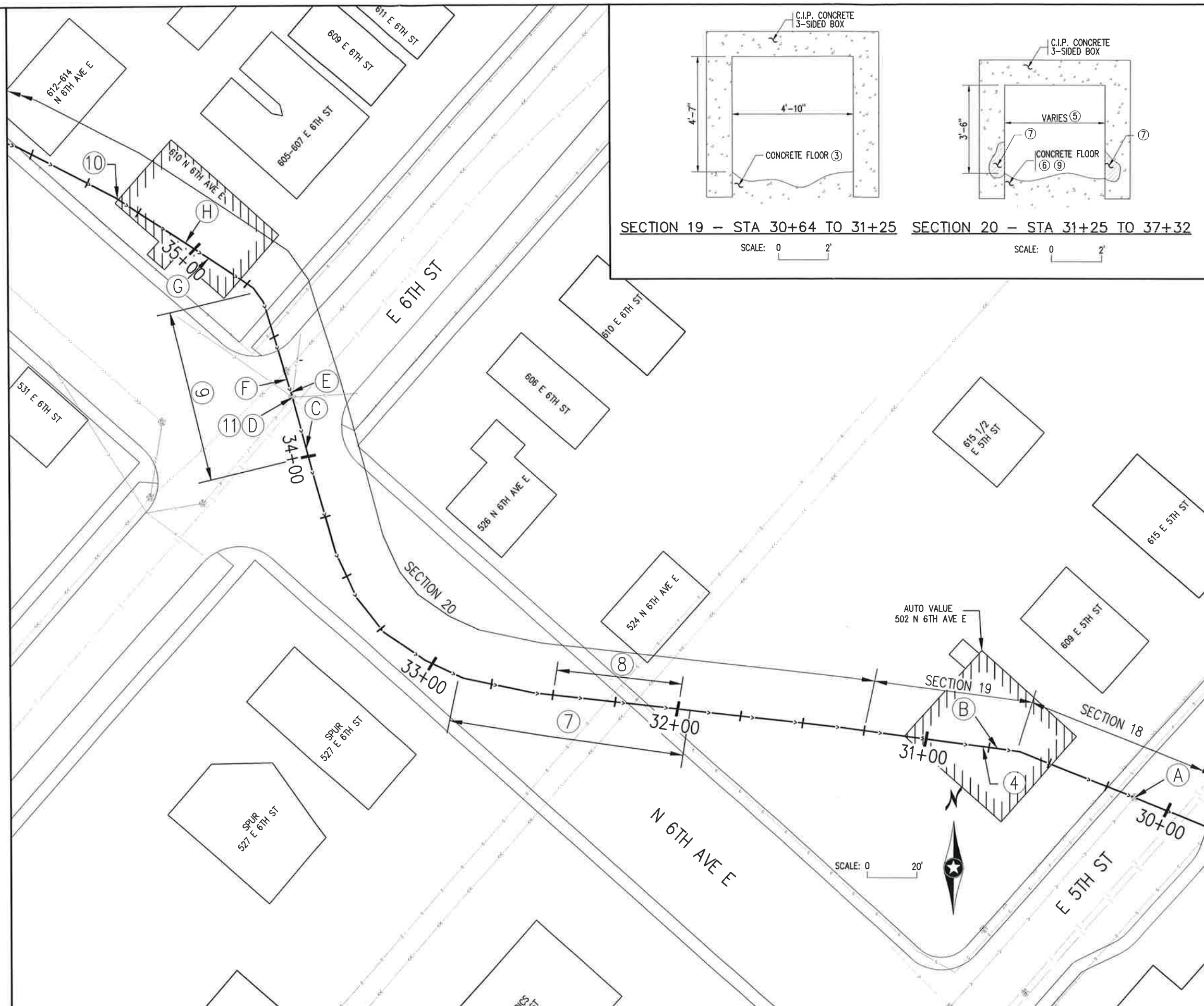
SCALE: 0 2'

KEY NOTES

- ① THERE ARE MINOR VOIDS PRESENT ALONG BOTH WALLS ON THE BOTTOM 2'.
- ② TUCKPOINTING IS IN FAIR TO GOOD CONDITION.
- ③ FLOOR SHOWS SIGNS OF EROSION, BUT IS IN FAIR CONDITION.
- ④ ROOF HAS A CRACK DOWN THE MIDDLE THAT IS SEPARATED AND SAGGING FROM STATION 30+64 TO 30+80.
- ⑤ CULVERT WIDTH IS 6'-8" FROM STA 31+25 TO 34+70 AND 6'-0" FROM STA 34+70 TO 37+32.
- ⑥ FLOOR IS IN FAIR CONDITION, EXCEPT AS NOTED.
- ⑦ WALLS SCoured ALONG FLOWLINE 6" TO 8" DEEP FROM STA 31+95 TO 32+88.
- ⑧ MAJOR ROOF SPALLING, 1 1/2" DEEP OVER ENTIRE AREA, STA 32+00 TO 32+50.
- ⑨ WASHOUT IN FLOOR FROM STA 34+00 TO 34+70.
- ⑩ MAJOR SPALL IN ROOF, APPROX 3" DEEP, AT STATION 35+35. SPALL IS 5' LONG AND 6' WIDE.
- ⑪ ROOF IS ERODING AT INTERFACE WITH MANHOLE RISER.

INLET STRUCTURES & PIPE PENETRATIONS

- (A) STA 30+13: 36"Ø MANHOLE WITH BRICK RISER. RISER APPEARS TO BULGING. MANHOLE MEASURES 25'-0" FROM T/C TO CULVERT FLOOR.
- (B) STA 30+70: 8"Ø CLAY PIPE IN ROOF.
- (C) STA 34+07: 24"Ø STEEL LID IN ROOF.
- (D) STA 34+25: MANHOLE IN ROOF. MEASURES 11'-10" FROM T/C TO CULVERT FLOOR.
- (E) STA 34+27: 24"Ø RCP IN NORTH WALL. SCOUR IN FLOOR BELOW.
- (F) STA 34+32: 16"Ø CLAY PIPE IN SOUTH WALL. SCOUR IN FLOOR BELOW.
- (G) STA 34+90: 4"Ø STEEL PIPE IN SOUTH SIDE OF ROOF.
- (H) STA 35+06: 8" DIAMOND SHAPED CIP WEEP IN NORTH WALL.



SECTION 19 - STA 30+64 TO 31+25 SECTION 20 - STA 31+25 TO 37+32

SCALE: 0 2'

SCALE: 0 2'

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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE:

PLAN & SECTIONS
(STA. 29+75 - 35+75)

DES:

CHK:

DR: JRM

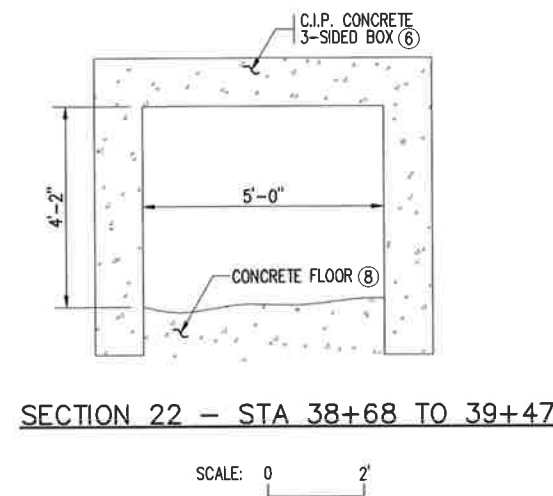
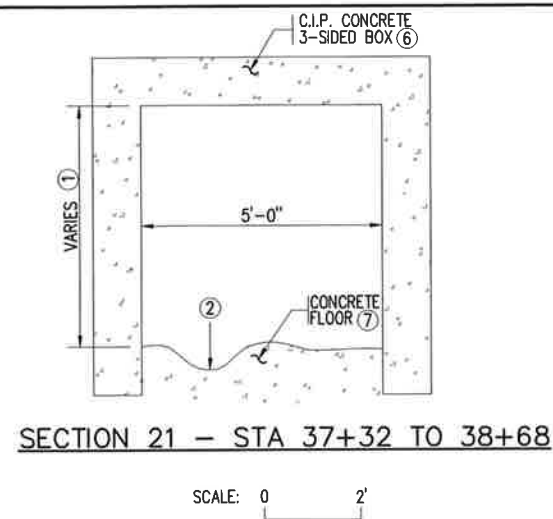
CHK: LMM

APPROVED:

Sheet No. 6 of 13 Sheets

Bridge No.

BREWERY

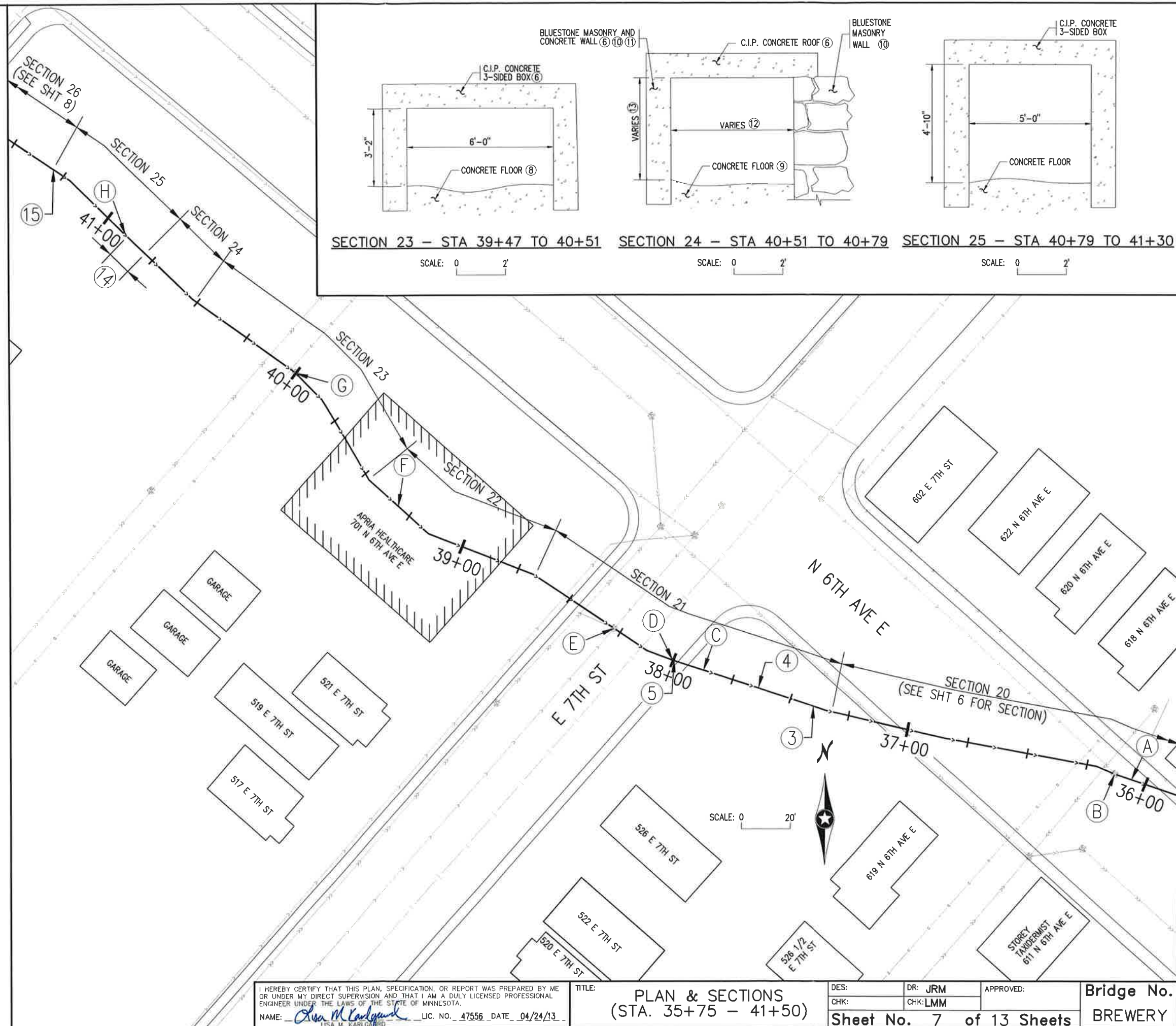


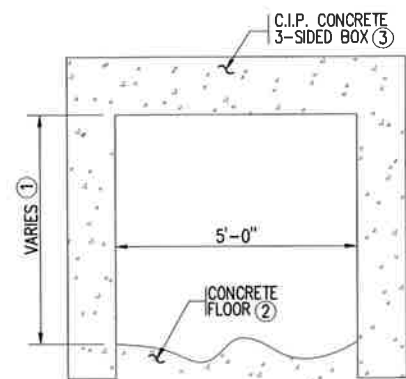
KEY NOTES

- ① CULVERT HEIGHT IS 4'-8" FROM STA 37+32 TO 38+68 AND 4'-2" FROM STA 38+68 TO 39+47.
- ② SCOUR IN FLOOR AT EDGE OF INVERT FROM STA 37+32 TO 38+68.
- ③ ROOF IS SPALLING FROM STA 37+40 TO 37+42.
- ④ DEEP SPALLING OF ROOF (FULL WIDTH) FROM STA 37+64 TO 37+67.
- ⑤ SCOUR IN SOUTH SIDE OF FLOOR AT STA 38+00 (10' LONG).
- ⑥ CONCRETE ROOF AND WALLS ARE IN GOOD CONDITION EXCEPT AS NOTED.
- ⑦ CONCRETE FLOOR IS IN FAIR CONDITION EXCEPT AS NOTED.
- ⑧ CONCRETE FLOOR IS IN GOOD CONDITION.
- ⑨ CONCRETE FLOOR IS HEAVILY ERODED (POOR CONDITION).
- ⑩ TUCKPOINTING IN FAIR CONDITION.
- ⑪ BLUESTONE MASONRY WALLS FROM STA 40+51 TO 40+61 ONLY.
- ⑫ TAPERS FROM 6'-0" AT STA 40+51 TO 5'-0" AT STA 40+79.
- ⑬ TAPERS FROM 3'-2" AT STA 40+51 TO 3'-8" AT STA 40+79.
- ⑭ ROOF TAPERS FROM STA 40+79 (3'-8" WALL HEIGHT) TO 40+89 (4'-10" WALL HEIGHT).
- ⑮ MINOR WASHOUT AT FLOOR AND SOUTH WALL AT STA 41+30.

INLET STRUCTURES & PIPE PENETRATIONS

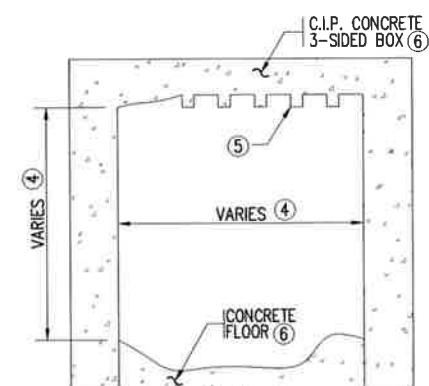
- (A) STA 36+04: 8" Ø PVC (INSIDE CLAY PIPE) IN NORTH WALL.
- (B) STA 36+13: 32" Ø MANHOLE IN ROOF. MEASURES 9'-7" FROM T/C TO CULVERT FLOOR W/ 30" RCP COMING INTO MANHOLE.
- (C) STA 37+87: 12" Ø CLAY PIPE IN NORTH WALL.
- (D) STA 38+00: 36" Ø MANHOLE/CURB CATCHBASIN.
- (E) STA 38+28: 48" Ø MANHOLE IN ROOF. MEASURES 9'-10" FROM T/C TO CULVERT FLOOR AND 24" Ø RCP IN NORTH WALL.
- (F) STA 39+31: 24" Ø MANHOLE IN ROOF.
- (G) STA 40+00: 42" Ø MANHOLE IN ROOF MEASURES 12'-7" FROM T/C TO CULVERT FLOOR.
- (H) STA 40+90: GROUTED PATCH IN ROOF, ASSUMED FORMER ACCESS.





SECTION 26 - STA 41+30 TO 43+13

SCALE: 0 2'



SECTION 27 - STA 43+13 TO 43+66

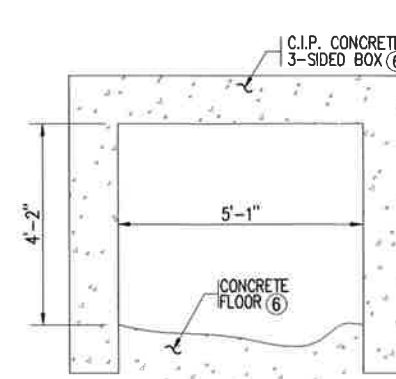
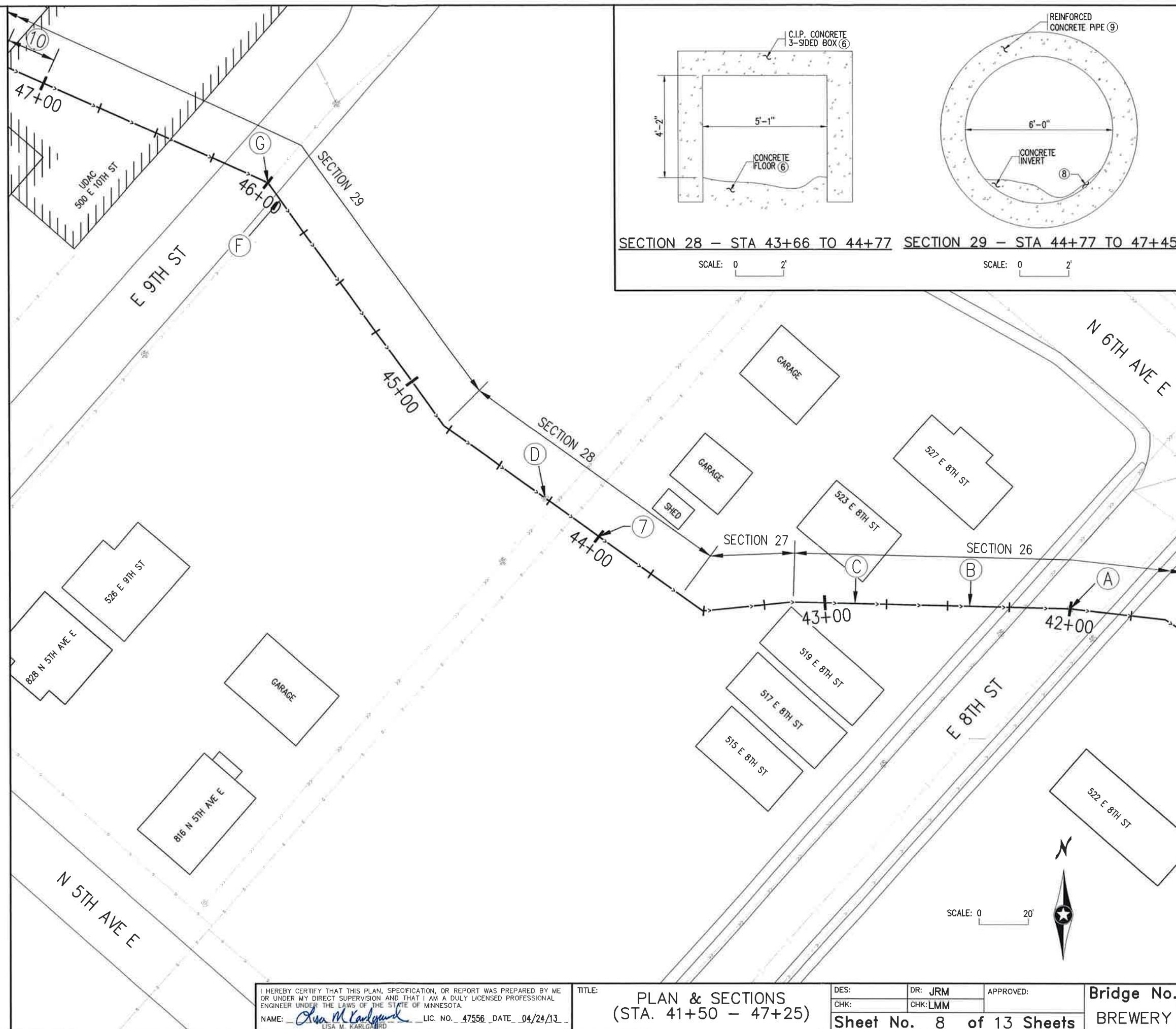
SCALE: 0 2'

KEY NOTES

- ① WALL HEIGHT IS 4'-9" FROM STA 41+30 TO 42+80 AND 4'-0" FROM STA 42+80 TO 43+13.
- ② CONCRETE FLOOR IS HEAVILY ERODED (POOR CONDITION).
- ③ CONCRETE WALLS AND ROOF IN GOOD CONDITION.
- ④ WALL HEIGHT AND CULVERT WIDTH FROM STA 43+13 TO 43+42 ARE 4'-0" AND 4'-10" RESPECTIVELY, AND FROM STA 43+42 TO 43+66 ARE 4'-2" AND 5'-1".
- ⑤ METAL ROOF FORM USED FROM STA 43+13 TO 43+42.
- ⑥ CONCRETE IS IN FAIR CONDITION, EXCEPT AS NOTED.
- ⑦ FAILURE IN CONCRETE FLOOR AT STA 44+00. REINFORCEMENT IS EXPOSED AND THERE IS A DEEP HOLE.
- ⑧ CONCRETE INVERT IS ERODED ON ONE SIDE AND IS IN NEED OF REPLACEMENT.
- ⑨ PIPE IS IN GOOD CONDITION, EXCEPT AS NOTED.
- ⑩ STA 47+00 TO 47+19: PIPE IS SQUASHED FROM STA 46+00 TO 47+19 ESPECIALLY BETWEEN FAILURES AT STA 47+00 AND 47+19 IN ROOF. WIDTH OF PIPE AT STA 46+75 IS 6'-2".

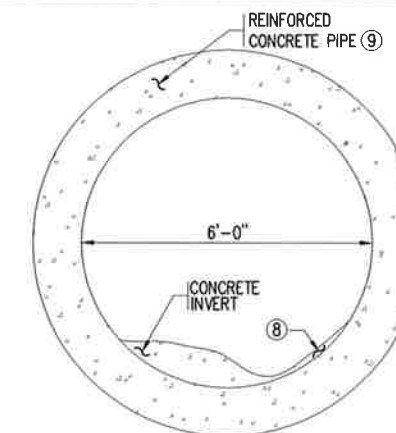
INLET STRUCTURES & PIPE PENETRATIONS

- (A) STA 42+00: 36" Ø MANHOLE IN ROOF. MEASURES 18'-2" FROM T/C TO CULVERT FLOOR.
- (B) STA 42+41: 10" Ø CLAY PIPE IN NORTH WALL.
- (C) STA 42+88: 4" Ø CLAY PIPE IN NORTH WALL (PLUGGED).
- (D) STA 44+27: 48" Ø MANHOLE IN ROOF. MEASURES 20'-1" FROM T/C TO CULVERT FLOOR.
- (E) STA 44+78: 4" Ø CLAY PIPE IN NORTH WALL.
- (F) STA 45+89: 12" Ø RCP IN SOUTH WALL.
- (G) STA 45+98: 54" Ø MANHOLE IN ROOF. MEASURES 34'-3" FROM T/C TO CULVERT FLOOR.



SECTION 28 - STA 43+66 TO 44+77 SECTION 29 - STA 44+77 TO 47+45

SCALE: 0 2'



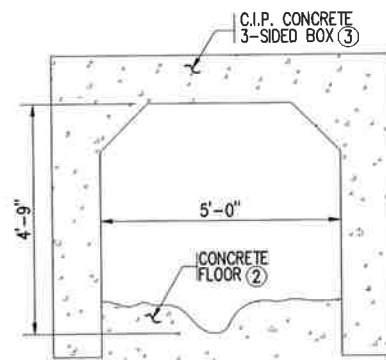
SCALE: 0 2'

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.
NAME: *Lisa M. Karlo* LIC. NO. 47556 DATE 04/24/13

TITLE: **PLAN & SECTIONS**
(STA. 41+50 - 47+25)

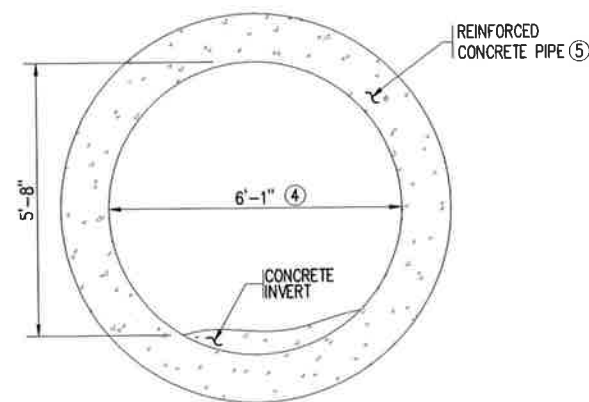
DES: _____ DR: **JRM** APPROVED: _____
CHK: _____ CHK: **LMM** SHEET No. 8 of 13 Sheets

Bridge No. _____
BREWERY



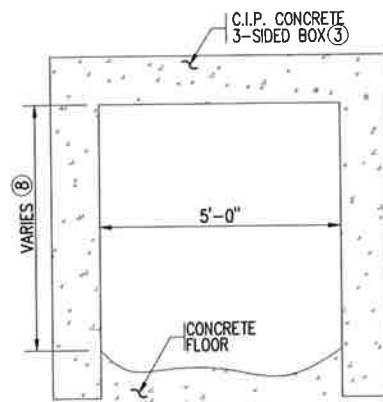
SECTION 30 - STA 47+45 TO 48+32

SCALE: 0 2'



SECTION 31 - STA 48+32 TO 49+58

SCALE: 0 2'



SECTION 32 - STA 49+58 TO 51+51.5

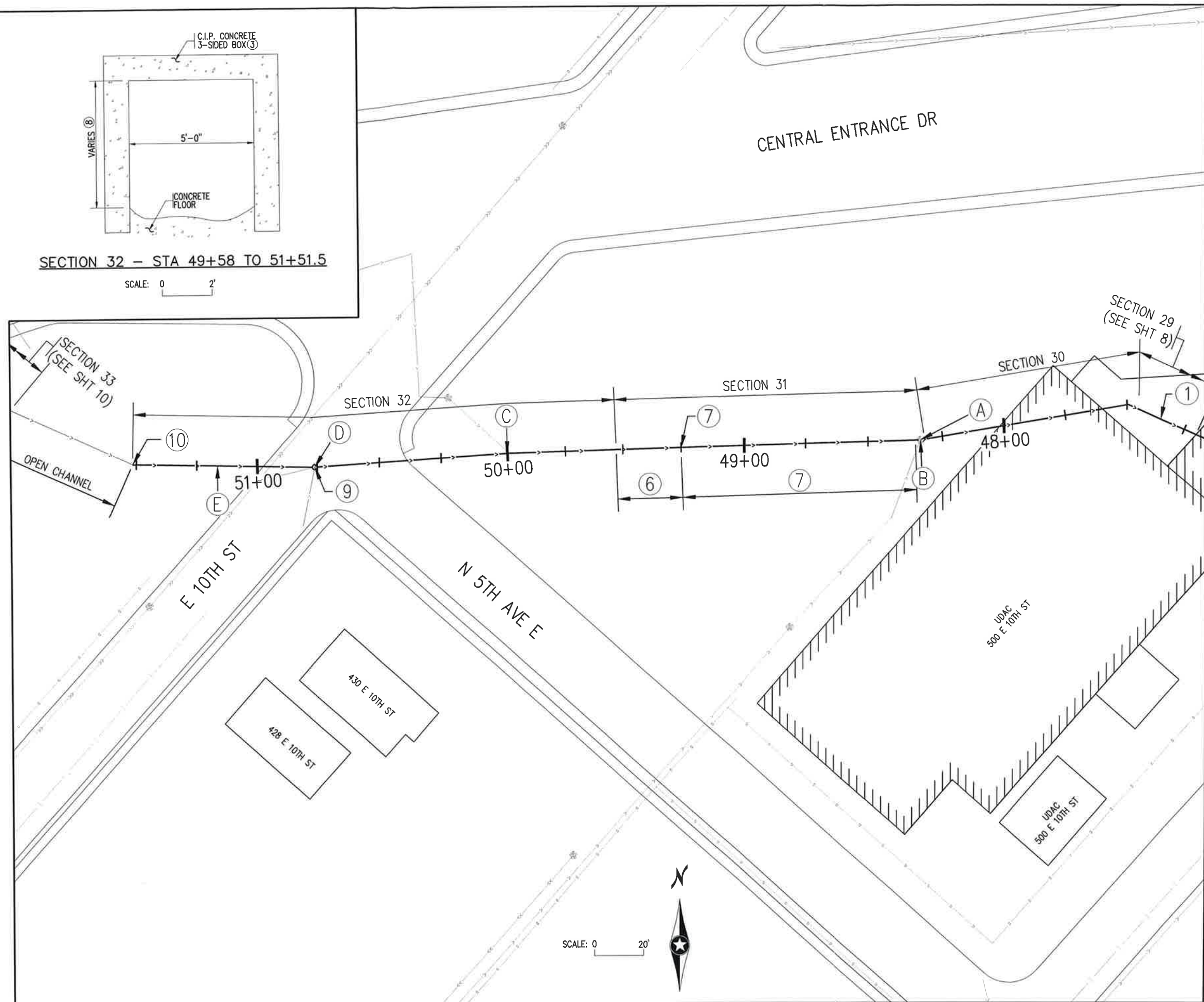
SCALE: 0 2'

KEY NOTES

- ① FAILURE OF PIPE AT FLOOR INVERT, STATION 47+35. HOLE IS 4'-0" LONG X 2'-6" HIGH X 3'-0" DEEP.
- ② FLOOR IS HEAVILY ERODED. APPEARS TO BE UNREINFORCED.
- ③ CONCRETE IS IN FAIR CONDITION.
- ④ PIPE IS SQUASHED. THE ORIGINAL DIMENSION IS 6'-0"Ø.
- ⑤ STAMP ON PIPE READS "POLARIS RR - DULUTH 1930".
- ⑥ PIPE DISJOINTED AT LAST 3 JOINTS (APPROX. 6" SEPARATION). JOINTS HAVE BEEN PREVIOUSLY PATCHED.
- ⑦ PIPE SLIGHTLY COLLAPSED AT STATION 49+25 (WIDTH=6'-2") AND ROOF CRACKED FROM STA 48+32 TO 49+25.
- ⑧ HEIGHT VARIES FROM 4'-10" TO 5'-1".
- ⑨ MORTAR JOINTS IN LOWER 1/2 OF MANHOLE RISER (BRICK) ARE DETERIORATED.
- ⑩ CONCRETE DEBRIS IS OBSTRUCTING INLET.

INLET STRUCTURES & PIPE PENETRATIONS

- (A) STA 48+34: MANHOLE IN ROOF, CIP CONCRETE RISER. MEASURES 42'-7" FROM T/C TO CULVERT FLOOR.
- (B) STA 48+34: 18"Ø RCP IN SOUTH WALL.
- (C) STA 50+00: 18"Ø CLAY PIPE NEAR FLOW LINE IN NORTH WALL.
- (D) STA 50+76: MANHOLE IN ROOF, BRICK MASONRY RISER, MEASURES 20'-1" FROM T/C TO CULVERT FLOOR.
- (E) STA 51+16: 18"Ø CLAY PIPE IN SOUTH WALL (COLLAPSED, BUT STILL FLOWING).

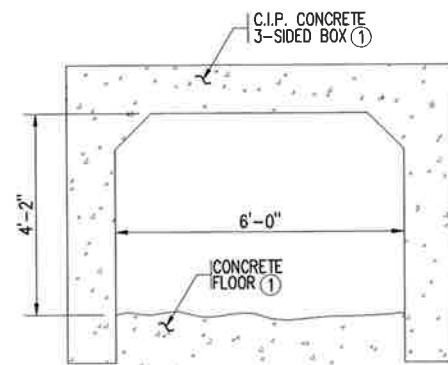


I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
 NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE: **PLAN & SECTIONS**
 (STA. 47+25 - 51+51.5)

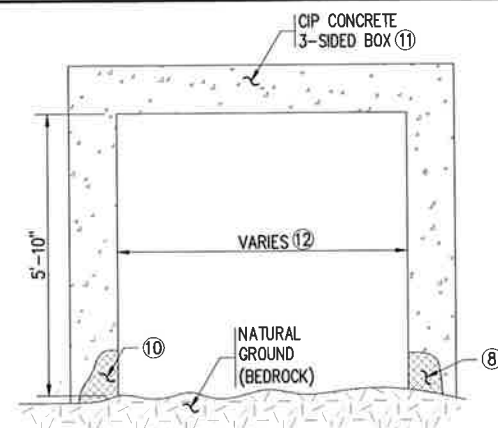
DES:	DR: JRM	APPROVED:	Bridge No. BREWERY
CHK:	CHK: LMM		

Sheet No. **9** of 13 Sheets



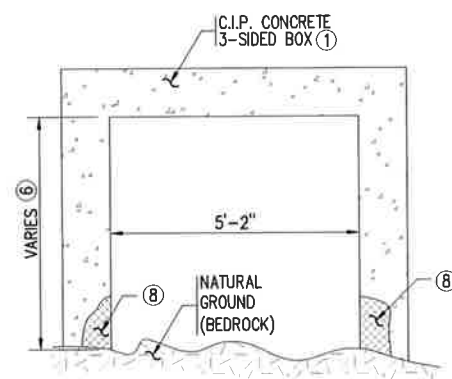
SECTION 33 - STA 52+08 TO 53+25

SCALE: 0 2'



SECTION 35 - STA 54+36 TO 54+47

SCALE: 0 2'



SECTION 34 - STA 53+25 TO 54+36

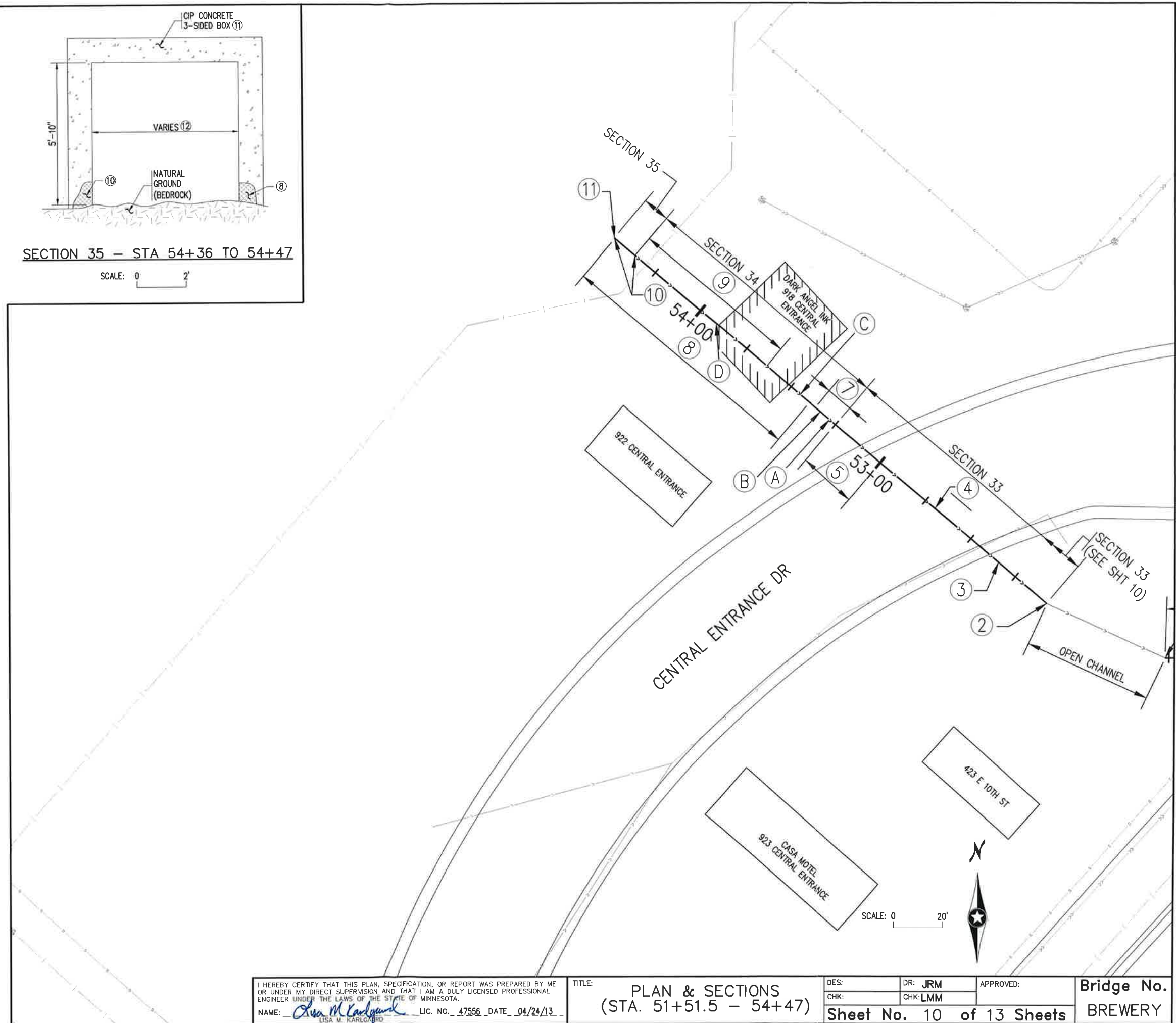
SCALE: 0 2'

KEY NOTES

- ① CONCRETE IS IN FAIR CONDITION EXCEPT AS NOTED.
- ② FLOOR HAS FAILED AT END OF BOX (ERODED APPROX. 12", FULL WIDTH).
- ③ FULL HEIGHT CRACK (3" WIDE) IN EACH WALL AT STA 52+35. THERE WAS A HOLE IN THE ROOF (APPROX. 3'-6"Ø). RUBBLE FILL WAS EXPOSED AND VOIDS WERE AS DEEP AS 5'-6". VOID WAS FILLED IN SUMMER OF 2012.
- ④ STA 52+70, BOX IS CRACKED THROUGH BOTH WALLS AND ROOF.
- ⑤ EXPOSED REBAR IN ROOF THROUGHOUT SECTION, ESPECIALLY FROM STA 53+00 TO 53+25.
- ⑥ HEIGHT VARIES FROM 3'-9" TO 4'-10" FROM STA 53+25 TO 53+64 AND MEASURES 4'-10" FROM STA 53+64 TO 54+36.
- ⑦ DEEP SCOUR HOLE IN FLOOR STA 53+25 TO 53+34. POOL MEASURE APPROX. 4' DEEP AND 9' WIDE. NORTH WALL IS SCoured/UNDERMINED 4' DEEP AND SOUTH WALL IS 3' DEEP.
- ⑧ BOTTOM OF BOTH WALLS IS SCoured 12" HIGH AND UP TO 12" DEEP FROM STA 53+40 TO 54+47 (END).
- ⑨ ROOF IS IN POOR CONDITION FROM STA 53+60 TO 54+35. APPEARS TO BE SAGGING AND MINOR SPALLING IS VISIBLE THROUGHOUT.
- ⑩ SOUTH WALL UNDERMINED 2' DEEP X 2' TALL OVER LENGTH OF SECTION.
- ⑪ END 6' OF ROOF FAILED AND COLLAPSED. REMAINING ROOF IN POOR CONDITION.
- ⑫ WIDTH VARIES FROM 5'-0" AT STA 54+36 TO 8'-10" AT STA 54+47.

INLET STRUCTURES & PIPE PENETRATIONS

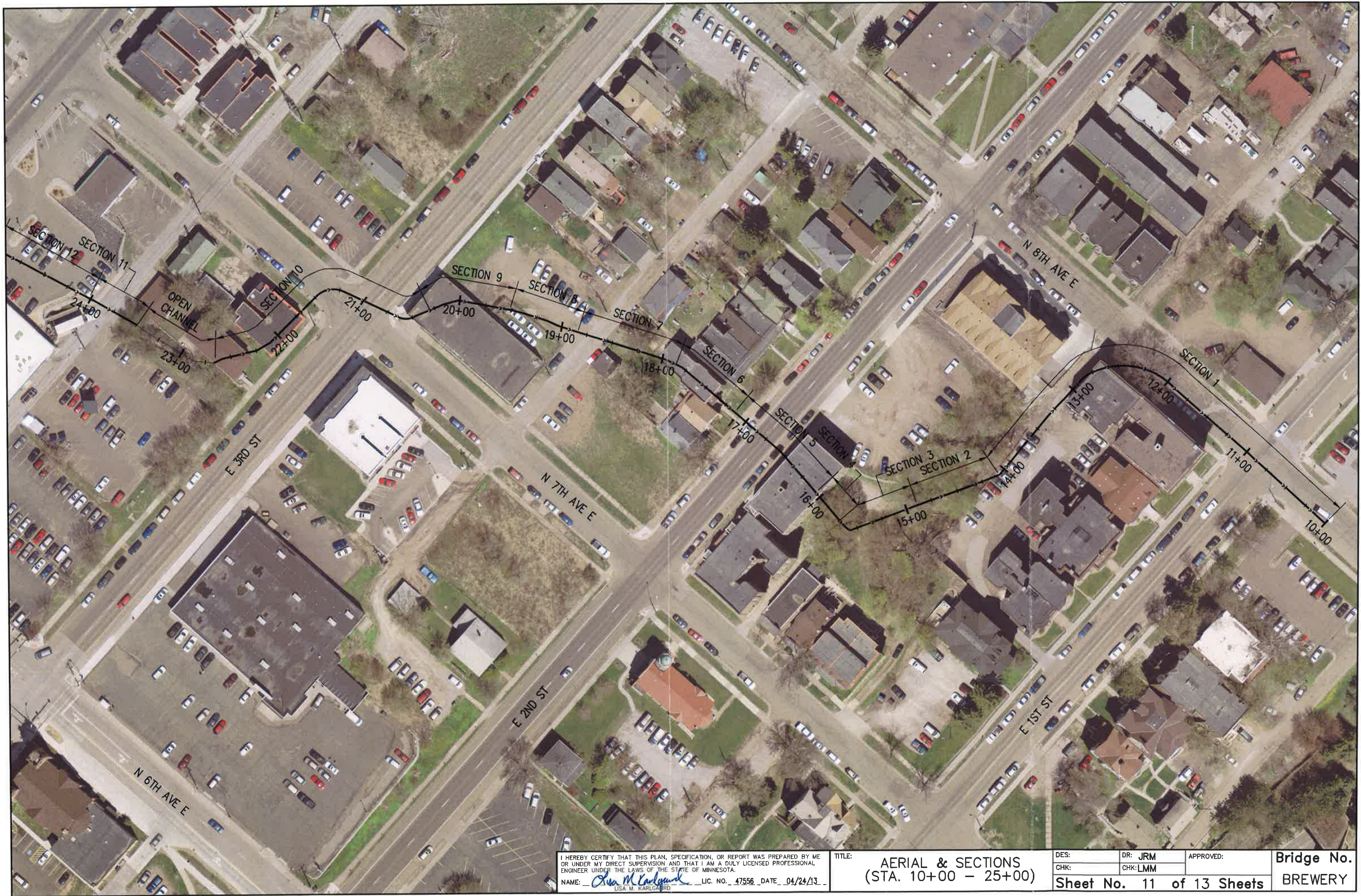
- (A) STA 53+29: 18"Ø RCP IN SOUTH WALL.
- (B) STA 53+34: 6"Ø CLAY PIPE IN SOUTH WALL.
- (C) STA 53+45: 18"Ø CLAY (BOTTOM) AND 4"Ø CLAY (TOP) PIPES IN NORTH WALL.
- (D) STA 53+92: 12"Ø CLAY PIPE IN ROOF.



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.
 NAME: *Lisa M. Karlov* LIC. NO. 47556 DATE 04/24/13

TITLE: PLAN & SECTIONS
 (STA. 51+51.5 - 54+47)

DES:	DR: JRM	APPROVED:	Bridge No. BREWER
CHK:	CHK: LMM		
Sheet No. 10 of 13 Sheets			



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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE:

AERIAL & SECTIONS
(STA. 10+00 - 25+00)

DES:

CHK:

DR: JRM

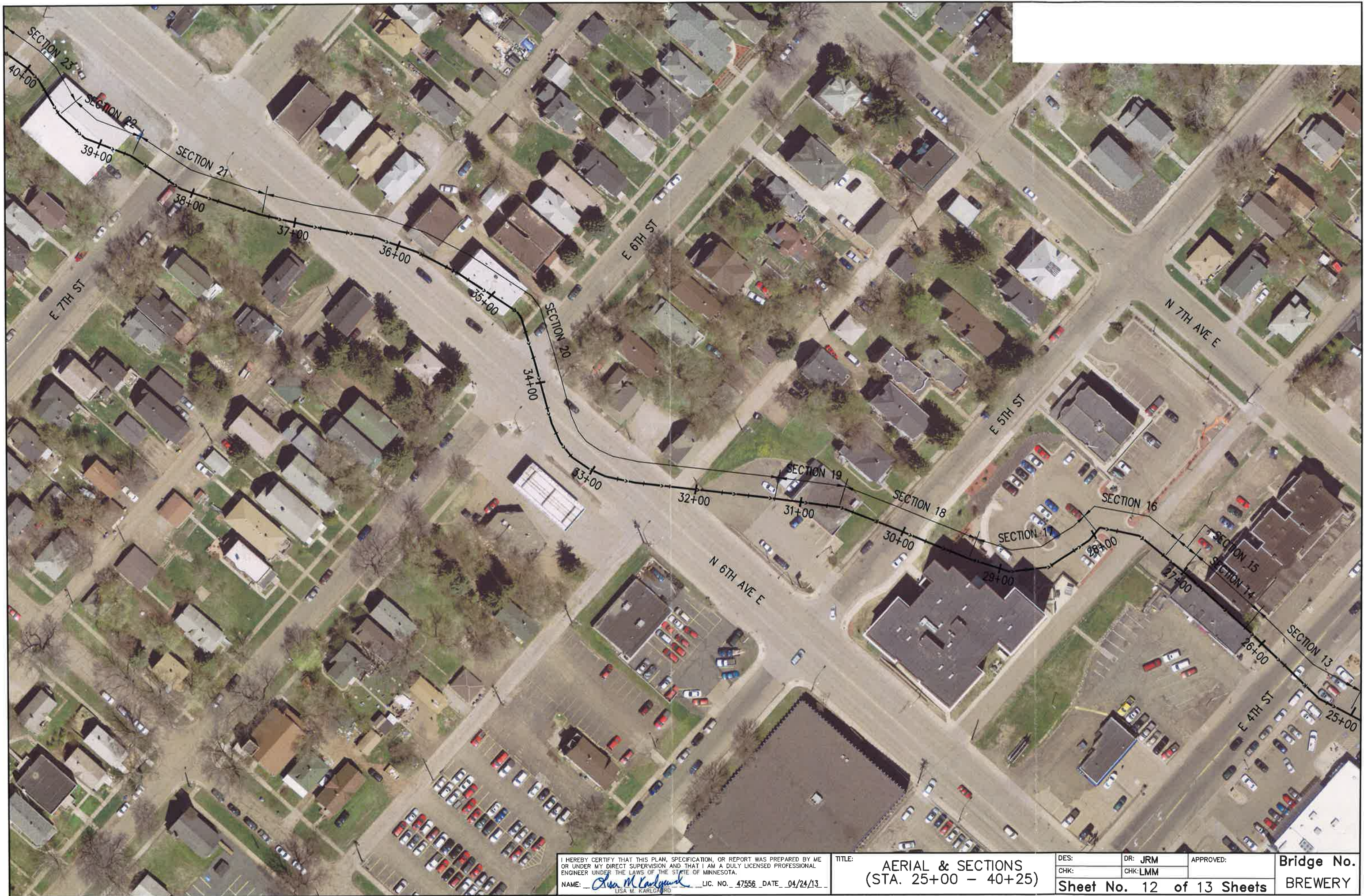
CHK: LMM

APPROVED:

Sheet No. 11 of 13 Sheets

Bridge No.

BREWERY



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.
NAME: Lisa M. Karlgaard LIC. NO. 47556 DATE 04/24/13

TITLE: AERIAL & SECTIONS (STA. 25+00 - 40+25)

DES:	DR: <u>JRM</u>	APPROVED:	Bridge No. <u>BREWERY</u>
CHK:	CHK: <u>LMM</u>		
Sheet No. <u>12</u> of 13 Sheets			



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.
NAME: *Lisa M. Karlgaard* LIC. NO. 47556 DATE 04/24/13

TITLE: AERIAL & SECTIONS
(STA. 40+25 - 54+47)

DES:	DR: JRM	APPROVED:	Bridge No. BREWERY
CHK:	CHK: LMM		
Sheet No. 13 of 13 Sheets			