Professional Utility Engineering

Phase 1 SUE – QL B Utility Investigation

Gordon Drive Viaduct Project

Project #NHS-012-1(37)—19-97; PIN #19-97-012-010; PCN 19970121037

Woodbury County

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TABLE OF CONTENTS

Introduction 1
Project Specific Scope of Work 2
Phase 1 SUE – QL B Utility Investigation 2
Project Limits 1
Utility Ownership and Utility Records Provided for Investigation 1
Project Survey 1
Phase 1 SUE Achieved ASCE 38 Quality Levels for Depicted Utilities 7
Supplemental Comments Regarding Existing Facilities 7
Utility Descriptions 7
General Comments 9
Aerial Clearance Measurements 10
Electric, Street Luminaires, and Traffic Signals 10
Fiber Optic (F/O), Telephone, and Cable TV (CATV) 12
Natural Gas 19
Sanitary Sewer, Storm Drain, Culverts 21
Water 23
3D Utility Modeling 24
Multi-Channel Ground Penetrating Radar (MCGPR) 25
3D Existing Utilities Modeling 36
Recommendations 39
Submittal Information 40
Data Limitations 41
State Law Caveat 42
SEAL 44
Appendix A - Utility Designating Synopsis 45
Appendix B - Geophysical Instruments and Methodologies 50
Appendix C – SUE Kickoff Meeting Minutes 54

Introduction

This report summarizes the results of a professional utility engineering (UE) utility investigation and subsurface utility engineering (SUE) effort:

- Phase 1 SUE - QL B Utility Investigation - investigating and documenting existing utilities up to and including Quality Level B in accordance with ASCE 38[1] standard guidelines[2].

This work was performed by Utility Mapping Services, P.C. (UMS) under a subcontract agreement with HDR Engineering, Inc. (a.k.a., "Client") for the Iowa Department of Transportation (a.k.a., "Owner", "Iowa DOT") for design project: **Project #NHS-012-1(37)—19-97; PIN #19-97-012-010; PCN 19970121037: Gordon Drive Viaduct Project**. The purpose of this professional investigation is to: 1) acquire a variety of geophysical and observation field data, record information, verbal reports, and other evidence of existing utility infrastructure; 2) reasonably interpret the presence of existing utility infrastructure within the specified project limits identified by the Client/Owner; 3) obtain accurate dimensions and 3D position coordinates at inverts, and other discrete locations where utilities are accessible for direct observation; and, 4) develop standardized depictions with reliability qualifiers (Quality Level or QL) in accordance with ASCE 38. Work is performed under the direct oversight and direction of a qualified professional utility engineer.

Professional judgment has been exercised to reasonably investigate, develop, and present findings in a pragmatic manner for the ensuing project design, utility coordination, and bid document preparation, while staying within the allotted budget and schedule. The users of this data are reminded that this information is for *design purposes only*, and not intended to be used in-lieu of the Iowa One Call utility construction ticket. The contractor is legally required to call One-Call (Call 811) two business days prior to construction. The data presented here are time sensitive and represent the interpretation of the obtained data at the time of the Phase 1 field investigation (July-December 2023). The data, interpretation and corresponding utility depictions presented in this submittal are to be considered a *work-in-progress* and should be updated and revised with new observation data as information becomes available throughout the project development and delivery effort.

This report documents records acquisition, field investigation, data interpretation, and depiction. Particular attention has been given to special conditions including difficult interpretations, unusual installations or contradictory information obtained from record data and field findings. Properly integrated, the information included herein should enable: 1) systematic determination of potential conflicts between existing utilities and proposed design and construction; and 2) proactive activities between the project development team and utility owners to value engineer resolutions.

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[1] *Standard Guideline for Investigating and Documenting Existing Utilities* (Standard ASCE/CI/UESI 38-22, Construction Institute of the American Society of Civil Engineers, Reston, VA, July 2022)

[2] The work was initially scoped to comply with ASCE/CI 38-02 but UMS has shifted over to performing investigations in accordance with the latest revision which is ASCE/CI/UESI 38-22 which includes all criteria specified in the earlier 2002 standard and more.

The results of the subject utility investigation and depiction are presented in digital deliverables (see File Information section) including this report, a standardized existing utility computer aided design (CAD) reference file, hydraulic structures report, and a set of PE sealed sheets (.pdf) depicting the existing utilities. To ensure meaningful and proper usage, and to minimize risk of misinterpretation, this data must be kept, regarded, and interpreted in a collective, integral manner and in accordance and with understanding of ASCE 38 standard guidelines. Refer to Appendix A for an overview of the utility investigation process.

Project Specific Scope of Work

The project scope of work and work plans for the UE Phase 1 SUE - QL B Utility Investigation included records research, field operations, data management, QA review and CAD development tasks, to produce deliverables outlined in the **File Information** section of this report.

Phase 1 SUE – QL B Utility Investigation

The Phase 1 SUE - QL B Utility Investigation encompasses developing qualified depictions up to QL B, based on systematic geophysical investigative measures, direct observations, records information, communications with utility operators and owners, geologic and topographic conditions, historical development, intuitive observations, and professional judgment. This project effort includes investigating and depicting buried utilities and above ground utility features within specified project limits identified by the Client/Owner. The Phase 1 utility investigation is focused on developing standardized 2-D depictions of existing infrastructure and includes discrete vertical observations of accessible and exposed features obtained from manhole, vault, inlet, and outfall locations. The work included the following activities:

- 2-D QL B Utility Acquisition and Depiction – records research, designating field effort and data acquisition, characterization, and depiction of existing utility infrastructure data to develop a reliably qualified base map and data set from which to develop and support future design, coordination, and construction decisions.
- Preparation of an existing utility CAD reference file and 2-D line work with attribution including assessed quality levels, to convey varying reliability of depicted features.
- Preparation of a drainage structure report, including ownership, depth, elevation, size, material, and direction documentation for structures observed during the field effort.
  Note: The investigation typically includes both storm drainage and sanitary sewer systems; however, storm drainage structures were initially eliminated entirely from the scope of work, but later investigation of specific segments of storm drainage facilities was added back into the effort.
- Preparation of ASCE 38 compliant depictions of existing utilities sealed by the qualified professional engineer of record.
- Preparation of this SUE professional engineering report, detailing the findings of this investigation and sealed by the qualified professional engineer of record.

Project Limits

The specified project boundaries for the utility designating effort as requested by the Client and identified in the Detailed Work Plan dated January 13, 2023. The project area is located in Sioux City, Iowa and generally extends along Gordon Avenue, from Virginia Street to Rustin Street, and along Lewis Boulevard from 3rd Street to Leech Avenue. The full project area can be seen in Figure 1 below.

Note: Depiction of some facilities may extend outside these project limits to capture surface features and appurtenances (e.g., manholes, inlets, pedestals, power poles, etc.) that are needed to establish utility alignments, such as storm drains, power lines, etc. Such depiction of these specific utilities that are outside the project limits does not infer a complete search has been performed for all utilities outside of the project limits.

Figure 1. SUE and Utility Investigation Project Area

Utility Ownership and Utility Records Provided for Investigation

The Iowa 811 website was used as a source to identify known utility companies registered with Iowa 811 which are within the project vicinity. Iowa 811 tickets #223410762, 223410763, 223410764, 223410765, 223410766, 223410767, 223410768 were submitted for the project on 12/7/2022 and ticket #240330517 was submitted for the project on 2/2/2024.

Table 1 specifies utility ownership, representative contact information, and record information received for utilities identified within the subject utility designating investigation project limits. This list was used to initiate the utility investigation and complete the records research process. Record data from utilities have been compiled and reviewed in their entirety during the utility investigation effort and have been checked in detail against the resulting existing utility reference file.

During the utility "kick-off" meeting the obtained records were reviewed with facility owners along with project limits. The kick-off meeting prompted facility owners into action and UMS subsequently received additional utility record information which yielded adequate coverage of the entire project area. Utility representatives present at the meeting or receiving a copy of the meeting minutes were asked to help identify other utility facilities which may lie within the project area but were not listed or registered within the Call 811 system. A copy of the kickoff meeting minutes is available in *Appendix C – SUE Kickoff Meeting Minutes.* The minutes provide a list of the participating utility representatives, project design team members, and project stakeholders, along with comments relevant to the utility investigation.

Project Survey

Project survey control data was supplied by the Client's survey consultant prior to the start of the field work. Coordinates provided were in the **Iowa Regional Coordinate System, Zone 4**

Horizontal Datum: Northing and Easting Coordinates are NAD83, U.S. Survey Feet.
Vertical Datum: NAVD88 (Geoid 18); Elevations are U.S. Survey Feet.

The following points were utilized for survey control and check in points for survey operations on this project: **FENO2, FENO3**

For this investigation, QL B data is tied to project horizontal coordinates provided by the Client; elevations for recorded QL B data represent the ground surface.

Usage of the term "survey" within this utility investigation report is strictly in reference to engineering survey methods employed for georeferencing utilities respective to project survey control established by others and do not infer professional land surveyor certification. Engineering survey methods mean depicted utilities are based on position observations tied to project survey control points which were established by others (presumably professional land surveyors) and projected to project horizontal datum coordinates. Likewise, elevations presented in this investigation for utility infrastructure are referenced to existing survey control points which were established by others.

Table 1. Utility ownership, contacts, and obtained record information.

Utility	Utility Type and CAD Line style Identifier	Contact	Utility Records or Correspondence Provided
AT&T	Fiber Optic (FO7)	Gabriel Perez 786-650-4336 gp8061@att.com	AT&T Transmission Sioux City Lewis Blvd.pdf S Lewis Blvd.png Fwd External Lewis Blvd Prints.msg IMG_4464.jpg
Aureon Network Services (Aureon)	Fiber Optic (FO2)	Jeff Klocko 515-830-0445 jeff.klocko@aueron.com	2022 SXCY-Dace&Floyd.pdf 2022 SXCY-Leech&Hwy75.pdf RE External Aureon Mapping - Sioux City.msg
City of Sioux City (Sioux City)	Fiber Optic (FO5) Power, Traffic, Street Lighting (E3) Sanitary Sewer (SAN1) Storm Sewer (ST S1) Water (W1)	Nick Bos, Dwayne Schueller, Gordon Phair 712-279-6332, 712-279-6364, 712-279-6330 Nbos@sioux-city.org Dschueller@sioux-city.org gphair@sioux-city.org	Block Map jpg's Intersection Map jpg's Gordon Drive fiber.png Gordon Drive fiber structures.png Gordon Drive street lights 2.png Gordon Drive street lights.png Digitized_Utilities.dgn Gordon On-alignment_2021-07.dgn SanitarySystem.dgn StormSystem.DGN WaterSystem.dgn RE External Gordon Drive Utility Record Maps.msg
Cogent (formerly T-Mobile and Sprint)	Fiber Optic (FO12)	Mike Chebul 402-316-8218 mchebul@cogentco.com	Cogent-Sprint-TMobile.pdf Floyd River.png NTWRK307-00-000-880-00546-01.pdf NTWRK307-00-000-880-00546-02.pdf RE External Sioux City Utility Record Request.msg 3rd St.png

Utility	Utility Type and CAD Line style Identifier	Contact	Utility Records or Correspondence Provided
FiberComm	Fiber Optic (FO4)	Rick Welch 712-224-2020 rwelch@FiberComm.net	223410762.png FiberComm.pdf RE External COMPLIANT 223410762.msg
Iowa Department of Transportation (Iowa DOT)	Fiber Optic (FO6) Power (E2)	Kelly Mulvihill, Jason Klemme 712-274-5828, 515-571-7073 Kelly.Mulvihill@iowadot.us jason.klemme@iowadot.us	Duct bank.pdf Local Data.png FW External GISOpen Data QuestionComment - Other.msg External Duct Bank.msg RE External Gordon Drive Utility Record Request.msg
Long Lines	Fiber Optic (FO3)	Tom Connors tconnors@Long Lines.biz	01.03.23 Gordon Drive Utility Record Request Sioux City Woodbury Co IA.pdf Gordon Drive Utility Request Sheet 1.jpg Gordon Drive Utility Request Sheet 2.jpg Gordon Drive Utility Request Sheet 3.jpg Gordon Drive Utility Request Sheet 4.jpg Long Lines.pdf RE External Gordon Drive Utility Record Request.msg Floyd Blvd 3rd Street pic.jpg

Utility	Utility Type and CAD Line style Identifier	Contact	Utility Records or Correspondence Provided
Lumen (Formerly CenturyLink)	Fiber Optic (FO1) Telephone (T1)	Sean Hostetter, Tim Kemper 712-435-4861, 651-378-2641 sean.hostetter@lumen.com tim.kemper@lumen.com	above Gordon Drive Sioux city Iowa.pdf below Gordon Drive Sioux city Iowa.pdf Gordon Drive Sioux city Iowa.pdf Gordon Drive Sioux city Iowa.pdf2.pdf Morgan St.jpg Virginia St.jpg Westcott St.jpg FW External Gordon Drive Utility Record Map Request.msg RE External Sioux City Iowa NI EENG.msg
Metronet	Fiber (FO8)	Lori Kemper 812-213-1050 lori.kemper@metronet.com	Gordon Dr. and Floyd Blvd..pdf FW External Gordon Drive Sioux City Iowa Utility Records.msg Dace Ave. and S Court St..pdf RE External Gordon Drive Sioux City Iowa Utility Records.msg
MidAmerican Energy (MEC)	Fiber Optic (FO9) Gas (G1) Power (E1)	Pat Lee, Casey Meinen, John Mingo 712-233-4832, 712-233-4831, 605-770-3797 pwlee@midamerican.com Cjmeinen@midamerican.com John.mingo@midamerican.com	gordon drive 2019 mec facility_CONFIDENTIAL.dwg MidAmerican - Electric.pdf MidAmerican.JPG MidAmerican1.JPG Cunningham Dr. Main.pdf Gordon Drive and S Fairmount St.pdf GORDON DR S COURT TO S FAIRMOUNT ST.pdf Prelim. East Gas Map.pdf Prelim. West Gas Map.pdf S Lewis and 3rd St.pdf RE External INTERNET Gordon Drive Utility Kickoff Meeting 629 .msg

Utility	Utility Type and CAD Line style Identifier	Contact	Utility Records or Correspondence Provided
Midwest Fiber Networks (MFN)	Fiber Optic (FO10)	Nathan Wright 414-459-3546 nwright@midwestfibernetworks.com	Lewis Blvd map.pdf MWFN Facility Overview - Sioux City.jpg S Lewis Blvd.png S Lewis Blvd_2.png RE External PCN 19970121037 Gordon Drive Viaduct - Subsurface Utility Engineering (Utility Mapping) Kickoff Meeting 76.msg RE External Sioux City Utility Record Map Request.msg
Northwest Iowa Power Cooperative (NIPCO)	N/A	Tim Hansen Thansen@nipco.coop	RE External COMPLIANT 223410762.msg RE External Sioux City NIPCO Utilities.msg
Private/Unknown Ownership	Fiber Optic (FO15) Telephone (T2) Power (E4)		
Redflex Traffic Systems (Clear)	N/A	Randy Bass 480-443-7000	
Sparklight	Fiber Optic (FO11) CATV (TV1)	David Burrell 712-233-2000 David.Burrell@sparklight.biz	1- S Rustin St.png 2- S Lewis Blvd.png 3- S Lewis Blvd.png 4 - 3rd St.png 5 - Morgan St.png 6 - Floyd River.png 7 - West Limits.png Sparklight.pdf 240330517.png Re External GORDON DR SURVEY FOR DESIGN.msg

Utility	Utility Type and CAD Line style Identifier	Contact	Utility Records or Correspondence Provided
Verizon/MCI	Fiber Optic (FO13)	Lawrence Currin, Greg Allen 612-619-9602(Greg) Lawrence.currin@verizonwireless.com greg.allen@verizon.com	Overview.png Re External E Sioux City Utility Record Request.msg

Phase 1 SUE Achieved ASCE 38 Quality Levels for Depicted Utilities

Among other ASCE 38 activities, the Phase 1 SUE investigation includes: 1) designating buried infrastructure in a pragmatic manner using systematic procedures and geophysical methods to achieve a target quality level B (QL B) depiction; and 2) direct survey observations of exposed utilities within accessible structures or visible above the ground surface. UMS utilized multi-channel ground penetrating radar to collect data within the roadway footprint of the project area.

Note: Use of other advanced geophysical methods such as time domain electromagnetics (TDEM) **was not authorized** for the Phase 1 SUE investigation.

Table 2 summarizes achieved depiction quality levels. **In some situations, QL B objectives could not be met in a pragmatic manner due to geophysical limitations such as excessive depth of facility, lack of tracer wire, non-conductive nature of pipe material, lack of surface features, lack of access, and/or insufficient records.** Therefore, identified utility facilities eluding affirmative detection with conventional electromagnetic inductive methods are currently depicted as QL C or D in the Phase 1 SUE existing utility CAD file submittal.

Following utility conflict assessment to be completed by others, a work scope for additional Phase 2 SUE investigation, including advanced geophysical methods, vacuum excavations, and other measures to overcome Phase 1 limitations and improve depictions and understanding, should be developed to facilitate the completion of conflict analytics and resolutions, risk mitigation efforts, and to finalize designs.

Supplemental Comments Regarding Existing Facilities

Users of this information are reminded that resulting utility depictions with this submittal are representative for conditions at the time of the field investigation (December 2023) and are a pragmatic interpretation based on the systematic designating effort executed. Limitations may still exist as discussed later in this report.

Utility Descriptions

The following utility specific sections are general, non-inclusive overviews of utilities encountered within the project limits and corresponding achieved depiction quality levels. The SUE investigations have produced considerable data and digital information. In all cases, please refer to the existing utility CAD reference file for details.

The following general comments pertain to resulting depictions of utility infrastructure:

- Direct observation coordinates are tied through engineering survey methods to project survey control (established by others).
- Horizontal coordinates for field designating paint marks and pin flagging are considered reliable; however, recorded elevations for QL B depictions are of topographic ground surface above buried utility feature and do not represent the true utility elevation or depth.
- QL C depictions are based on engineering judgment, record information, direct observations, other evidence including audible and optical methods to assert connectivity between: a) visible, identified, and accessible surface features and access points (e.g., pole drops,

manholes, vaults, drain inlets and outlets, etc.); and b) where possible, adjoining QL B designated segments obtained through geophysical method. Resulting depictions are typically interpolations between identified and accessed surface features, appurtenances, or between affirmative QL B designations, therefore will not reflect vertical undulations (which may occur along with topographic undulations) nor resolve blind ties and blind bends.

- QL D CAD depictions are based on record data, verbal exchange, and/or reasonable professional conjecture stemming from limited field observations and knowledge of utility system construction. These depictions are unreliable horizontally, and vertical coordinates are indeterminate.

Table 2. Summary of utilities Investigated and Depicted, and Achieved Quality Levels

Utility Type	Depicted Mains & Primaries	Depicted Services and Secondary Laterals
Storm Drain	**N/A**	**N/A**
Sanitary Sewer	**QL B, QL C and QL D**	**Record data partially included service connections to mains. Information on service connections is considered incomplete.**
Culverts	**N/A**	**N/A**
Telecommunications	**Aerial, QL B and QL D**	**QL B and QL D**
Cable Television	**Aerial and QL B**	**QL B and QL D**
Natural Gas	**QL B and QL D**	**QL B and QL D**
Traffic Signals	**Discrete survey grade observations of surface appurtenances. Depictions of aerials are direct interpolations between poles. Buried segments depicted as QL B and QL D**	**N/A**
ATMS	**N/A**	**N/A**
Lighting	**Aerial, QL B and QL D**	**N/A**
Water	**QL B and QL D**	**Record data partially included service connections to mains. Information on service connections is considered incomplete.**
Power	**Aerial, QL B and QL D**	**QL B**
Petroleum	**N/A**	**N/A**

***Note**: ASCE 38 quality levels (QL) are applicable only to subsurface utility feature depictions. Depictions of surface appurtenances, accessible inverts, and other features which can be observed directly are based on direct survey observations. Aerials are depicted based upon direct observations of connecting support structures (e.g., poles, buildings, signs, towers, anchor points)*

In addition to utilizing record, topographic and verbal information, and performing geophysical searches, field crews performed reconnaissance searches for apparent surface features indicating utility services (sewer cleanouts, water curb stops, meters, etc.). Despite systematic efforts, it is still possible for abandoned-in-place features and utilities lacking apparent surface features or adequate record information to elude depiction on the resulting existing utility CAD file.

Note: In many situations, QL D depictions result from a contradiction between SUE investigative field observations and records; specifically, records will sometimes indicate something is there, but field crews cannot find evidence to support the record information. As a conservative measure, UMS typically depicts the record information on the existing utility records as QL D and this depiction will remain in place until: 1) the facility owner can confirm otherwise, such as the facility was never installed or has since been removed or abandoned; 2) the facility can be detected and identified using more advanced geophysical and/or vacuum excavation methods; or 3) sweeping with appropriate geophysical survey methods indicates with confidence that the facility is not present. UMS may also change the depiction's location in a revision cycle if new credible evidence from additional source(s) comes into our possession. An example might be new information gathered through the excavation of a test hole.

Explanation of areas where geophysical detection was poor or non-existent, degrading the quality of designation and utility depiction to QL C and D, will be provided in the following utility specific descriptions.

General Comments

- Based on correspondence with Jeremy Harris at the Iowa DOT Office of Design, the Iowa DOT CAD standards have only one overhead utility code, "UE – Utility Elevation". This code came in on the default level. All overhead linework has been depicted using the field code "UE"; however, the following customized feature codes have been imbedded in the CADD polyline chains to better understand aerial utility depictions:
    - OHFO – Overhead Fiber Optic Cable
    - OHTV – Overhead Cable Television Coaxial Cable
    - OHTL – Overhead Telephone cable
    - OHEL – Overhead Electric cable
- Aside from duct banks with sole ownership, there are two distinct multi-owner duct banks within the project area:
    - The first joint ownership duct bank is located along the southern side of Gordon Drive extending from the westernmost SUE project limits to Court Street. This duct bank is owned by Long Lines, City of Sioux City, Iowa DOT, and FiberComm as indicated by Kelly Mulvihill with Iowa DOT.
    - A second joint ownership duct bank extends through the SUE project area along the western side of Lewis Blvd. This duct bank is owned by FiberComm, Long Lines, MidAmerican Energy, NIPCO, and Sioux City as indicated by Rick Welch with FiberComm. This duct bank consists of two (2) 1.25-inch ducts with a 144ct F/O in each duct and a spare/empty 2-inch duct.
- Confusion on the SUE coverage area for One-Call Design Ticket information request resulted in the delivery of insufficient record information; specifically, the project area at 3rd Street west of the Floyd River lacked record data during the initial Phase 1 SUE investigation. Records were

subsequently requested again; however, budget and time constraints became controlling factors, therefore some utility installations within this area have not been fully investigated and designated at this time. This area will be picked up for designating efforts during the SUE Phase 2 investigative effort. In the meantime, the received utility records for non-designated facilities have been used to develop QL D depictions.

- *Redflex Traffic Systems (Verra Mobility)* was marked as reportedly clear per the One Call tickets that were submitted for this project corridor. UMS made attempts on November 29th, 2023, February 8th, 2024, and March 20th, 2024 to call the (480) 443-7000 contact number posted on their website. We left voicemails asking to get in touch with anyone in the engineering and/or GIS department as well as another voicemail asking to speak with Randy Bass (Senior Systems Engineer). UMS was unable to get in contact with a viable representative for confirmation of their being clear. **During utility coordination activities UMS recommends confirming with Redflex Traffic Systems that their facilities are clear of the project corridor**.

Aerial Clearance Measurements

Per the initial scope of work, aerial clearance measurements were attempted for all aerial facilities crossing Gordon Drive and at all major roadways intersecting with Gordon Drive. Due to traffic related safety concerns, initial aerial utility clearance measurements were not directly observed at the visual sag point, but instead taken from the safety of the walkway along the northern side of the viaduct. As directed through correspondence with Paul Knievel, P.E., HDR project manager on 1/31/2024, HDR determined that aerial height observations would not provide value to this project due to the proposed design and associated utility conflicts; therefore, there wasn't need for additional aerial clearance measurements and observations ceased at that time.

Aerial heights obtained prior to the correspondence are provided in the submitted existing utility reference MicroStation CAD file (.dgn). Height and elevation information is contained on the "**UMS - Annotations - Aerial Utility Heights"** Level within the SUR_UTL_UMS_97012037Z04.dgn file provided.

Electric, Street Luminaires, and Traffic Signals

Buried and aerial electric installations were observed throughout the project area. These facilities are owned by:

- City of Sioux City
- Iowa DOT
- MidAmerican Energy

Some privately owned facilities were also witnessed in the project area.

The buried installations are primarily depicted as QL B based on the Phase 1 designating effort. Utility designating results for each owner are further described below along with explanations for any QL D facilities or abnormal findings. Aerial installations have been depicted by straight line connections between observed poles.

<u>City of Sioux City (Sioux City)</u>

Sioux City has buried traffic, street lighting, and electric facilities throughout the project area.

- UMS field personnel initially logged structure 674 and 711 as sanitary sewer manholes; these were originally found to be full of water and field personnel could not see down through the murk. However, upon further investigation and discussion with Dwayne Schueller these structures were confirmed to have been converted from sanitary sewer to electric manholes. UMS field personnel were unable to induce a discernable EM signal on the cable that was fished out. The cable route has been drawn in QL D based on verbal recollection provided by Dwayne. Figure 1Figure 2 shows the electric cable observed within Structure 674. Further investigation can be made of this feature during the Phase 2 SUE investigation as required.

Figure 2. Electric cable observed in Structure 674

Iowa Department of Transportation (Iowa DOT)

Iowa DOT has a power line at Lewis Blvd at the ramp of Gordon Drive; however, it was indicated by Rick Welch with *FiberComm* that *FiberComm* is responsible for locating the cable for *Iowa DOT*. An email exchange with Kelly Mulvihill of *Iowa DOT* confirmed that *Iowa DOT* "does not have much if anything else" of their own infrastructure within the project extents.

MidAmerican Energy (MEC)

MEC has aerial Transmission power, as well as buried and aerial 3-phase distribution power, street lighting and other electric facilities throughout the project area.

- Buried street lighting crosses into the fenced off substation area just west of Floyd Blvd and UMS field personnel were unable to access the restricted area.
- The EM signal on the buried street lighting along the eastern side of Floyd Blvd became too undiscernible to designate QL B from just south of Jennings St to the northern limits along Floyd Blvd. A small portion of the buried cable has been depicted QL D.
- Due to traffic and lack of pedestrian space, UMS field personnel, for safety reasons, did not designate power for two street luminaries along the ramp connecting east bound Gordon Drive to south bound Lewis Blvd (see Figure 3). The power for these two street luminaries has been depicted as QL D based on record information and visual evidence.

Figure 3. Luminaries along ramp from EB Gordon Dr. to SB Lewis Blvd. for which safety concerns restricted access.

- UMS field personnel were unable to identify apparent appurtenances or geophysical evidence for a power cable depicted in *MEC* records along the western side of Floyd Blvd from the south side of Gordon Drive to Jenings St. This cable has been depicted as QL D based on record information.

Fiber Optic (F/O), Telephone, and Cable TV (CATV)

Telecommunications installations were observed throughout the project corridor. These facilities are owned by the following:

- *AT&T*
- *Aureon Network Services*
- *City of Sioux City*
- *Cogent (formerly T-Mobile and Sprint)*
- *FiberComm*
- *Iowa Department of Transportation*
- *Long Lines (formerly Northwest Iowa Telephone Company)*
- *Lumen (formerly CenturyLink*
- *Metronet*
- *MidAmerican Energy*
- *Midwest Fiber Networks*
- *Northwest Iowa Power Cooperative*
- *Private Ownership*
- *Sparklight*
- *Verizon/MCI*

These installations are primarily QL B, based on the Phase 1 designating effort. Utility designating results for each owner are further described below along with explanations for unsuccessfully designated / QL D depicted facilities or abnormal findings. Aerial installations have been depicted based on interpolations between observed poles.

<u>AT&T</u>

AT&T has buried fiber optic (F/O) facilities extending along Lewis Blvd and along 3rd Street, east of Floyd Blvd.

- During the field investigation, UMS field personnel did not observe visual evidence of the handholes depicted on AT&T records along Lewis Blvd. These handholes have been drawn in based on the locations identified on records. **Further coordination with AT&T is recommended to identify whether the handholes exist and, if so, where these facilities are supposedly located.**
- New records for 3rd St between Floyd Blvd and the Floyd River provided by Gabriel Perez depict a F/O along the northern side of 3rd St. This 144-count (144ct) F/O has been depicted QL D based on a conversation with Gabriel; the 144ct F/O cable and has been slated for pickup and QL B designating during the SUE Phase 2 investigation effort.

<u>Aureon Network Services (Aureon)</u>

Aureon has buried fiber optic facilities within the western portions of the project area and crossing Lewis Blvd along the northern side of Leech Ave.

<u>City of Sioux City (Sioux City)</u>

Sioux City has buried and aerial fiber optic facilities throughout the project area. *Sioux City* has joint ownership in both duct banks mentioned previously under the General Comments section of this report.

- *Sioux City* has a 96ct F/O in the duct bank located along the southern side of Gordon Drive from the westernmost limits to Court St.
- A 24ct F/O and 96ct F/O were designated by UMS field personnel at the southeast corner of Virginia St and Gordon Dr. These F/Os connect into the traffic system and have been depicted showing *Sioux City* ownership.

<u>Cogent</u>

Cogent has buried fiber optic facilities extending along the railroad tracks just east of Floyd Blvd.

- Conduit size and innerduct placement information has been notated per information contained on record information.

<u>FiberComm</u>

FiberComm has buried fiber optic facilities throughout the project area.

- The following information was shared with UMS by Rick Welch about their records:
    - The fiber optic crossing depicted on records at Lewis Blvd at the ramp of Gordon Drive is a power line that feeds an *Iowa DOT* cabinet. *FiberComm* is responsible for locating this for *Iowa DOT.*
    - The joint duct at the western end of the project area has several owners utilizing the duct; however, *FiberComm* is currently not utilizing the duct.
    - The joint duct bank extending along Lewis Blvd consists of two (2) 1.25-inch ducts with a 144ct F/O cable in each duct and a spare/empty 2-inch conduit.

- According to a conversation with Rick Welch, *FiberComm* and *Long Lines* each own a 144ct F/O extending from the southwest corner of Leech Avenue and Lewis Boulevard toward the east and beyond project limits. However, UMS field personnel were unable to identify evidence within an apparently connected vault of these 144ct F/O extending toward the east. It is possible the F/O cables do not pass through the identified vault, or the eastward alignment is positioned somewhere else. Further clarification is needed. In the meantime, these routes have been depicted as QL D stemming from the discussion with Mr. Welch.

Figure 4. Vault at SW corner of Leech Avenue and Lewis Blvd (US 75 Business) did not review F/O cables extending toward the east and crossing Lewis Blvd. (Google™ Streetview Images)

- Stemming from a conversation with Rick Welch, UMS field personnel were able to designate two routes of F/O from the vault located at the southwest corner of Leech Ave and Lewis Blvd. One route contained (2) 12ct F/O and the other contained a 24ct F/O and (2) 12ct F/O.

Ownership of the route without the 24ct F/O was verbally communicated by Mr. Welch to be *FiberComm* although this is not displayed on the records provided for the Phase 1 SUE effort.

- Records received (subsequent to the SUE Phase 1 field effort) for 3rd Street between Floyd Blvd depict a F/O along the northern side of 3rd Street. This F/O has been depicted as QL D and has been noted to be picked up during the SUE Phase 2 designation.

<u>Iowa Department of Transportation (Iowa DOT)</u>

Iowa DOT has jointly buried F/O facilities at the intersection of Gordon Drive and Court Street, extending west along Gordon Drive.

<u>Long Lines (formerly Northwest Iowa Telephone Company)</u>

Long Lines has buried fiber optic facilities throughout the project area.

- Per conversation with Rick Welch, *FiberComm* and *Long Lines* each have a buried 144ct F/O facility extending eastward from the southwest corner of the intersection at Leech Avenue and Lewis Boulevard. UMS field personnel observed only one (1) F/O alignment with two (2) 12ct cables and one (1) 24ct cable apparently owned by *Long Lines*.
- Records for 3rd St between Floyd Blvd depict two (2) F/O cables along the northern side of 3rd St. These F/O cables have been depicted QL D and have been noted to be picked up during the SUE phase 2 designation.

<u>Lumen (formerly CenturyLink)</u>

Lumen has buried F/O facilities as well as buried and aerial twisted pair copper telephone communication facilities throughout the project area.

- UMS field personnel designated multiple telecommunication facilities that apparently are not in-service. These facilities are identified in the existing utility CAD file.
- Lumen has a communications duct along the western side of Court St.
- Lumen has a communications duct along the southern side of Dace Ave.
- Reportedly abandoned facilities depicted on the Lumen records have been included on the existing utility CAD reference file and notated as reportedly abandoned.
- UMS field personnel noted that “Leadcore” cables were present along Fairmount St.
- UMS field personnel were unsuccessful in finding evidence of some cables and surface features depicted on Lumen records. These facilities have been depicted as QL D based on the record information and are described below. **UMS recommends further coordination with Lumen to verify the status of these facilities.**
    - Records depict a short segment of telecommunication cable extending eastward from the vault at the northwest corner of 3rd Street and Lewis Blvd. UMS field personnel did not observe this facility within the vault structure that appears to correlate with the structure shown on the record data.
    - Records depict a telephone service line extending to 422 Floyd Blvd. UMS field personnel did not observe this facility in the manhole at the northwest corner of Dace Avenue and Court Street and did not have access into the gated section of Lechner Lumber Co. where the service appears to enter the building.
    - A buried telecommunication cable positioned on the east side of the Floyd River and crossing under Gordon Drive could not be designated. UMS field personnel

attempted to use electromagnetic induction methods to trace the cable from the pedestal on the south side of Dace Avenue; however, the induced EM signal could only be carried to a point just north of the curbline before becoming undetectable. The field crew could not identify any visible indications of a related appurtenance or detect a discernable EM signal in the field to the north where the cable is depicted in the records.

- A facility and structure is shown on records to exist along the eastern side of Lewis Boulevard, extending from the southeast corner of Leech Avenue toward the south for 220-feet. This facility may be proposed as the field crew did not identify and observe the related structure shown on records.
- Records indicate a telephone service extending from a structure at the western corner of the Westcott Street and Correctionville Road intersection to the property at 2420 Correctionville Road; however, UMS field personnel did not observe a telephone structure nor a telephone drop from the support pole at that corner.
- Records indicate a F/O crossing Gordon Drive along the western side of Westcott Street. This facility may be proposed as the field crew did not identify and observe the related structure shown on records.
- Lumen records indicate a manhole structure along the southern side of Gordon Drive toward the east of Fairmount Street with a cable connection extending westward. This manhole was not observed and records appear to indicate that it may have been removed or abandoned and buried.

- Records for 3rd St between Floyd Blvd and the Floyd River provided by Joseph Bennett depict multiple cables along the northern side of 3rd St. These cables have been depicted QL D as (1) 200 pr copper, (2) 24ct fibers, and (1) 18ct fiber per conversation with Joseph and have been noted to be picked up during the SUE phase 2 designation effort.

<u>Metronet</u>

- *Metronet* has both buried and aerial fiber optic facilities throughout the project area. Unfortunately, UMS efforts to contact Metronet were met with delayed responses to email and phone call communications. This hampered efforts to investigate Metronet facilities during the SUE Phase 1 effort.
- At survey point 26013 (on the southern side of Correctionville Road between Westcott Street and Linn Street), a 24ct F/O cable was observed connecting with a splice case. No other cables were observed exiting the splice case. This appears to currently serve as a dead-end cable; however, the splice case indicates the possibility of a future cable expansion in the area.
- *Metronet* records depict proposed buried and aerial facilities at the western end of the project area. QL D depictions of these proposed facilities are provided along Steuben Street, Dace Avenue, Court Street and Gordon Avenue. **UMS recommends verifying the planned installation date with *Metronet*.**

MidAmerican Energy (MEC)

MEC has buried and aerial F/O facilities throughout the project area.

- *MEC* has an optical ground wire (OPGW) that extends eastward in overhead fashion with the high voltage transmission power lines from the substation (positioned at the northwest corner of where Floyd Boulevard passes beneath Gordon Drive) across the Floyd River and then southward to cross over Gordon Drive and Dace Avenue.
- *MEC* records identify a 12ct F/O in the shared communications duct bank along the western side of Lewis Boulevard; however, UMS field personnel did not observe a 12ct F/O in any of the vaults along this route. This fiber has therefore been depicted as QL D based on record information and warrants further discussion with MEC to verify whether it is a proposed cable, has been removed, or is wrongly depicted on the records.
- *MEC* has a buried F/O which enters an Aureon hand hole and shares a route crossing Gordon Drive along the western side of Floyd Blvd.
- Latent records for 3rd Street near Floyd Boulevard depict F/O along the southern side of 3rd Street. This has been depicted as a QL D 144ct F/O per communication with John Mingo and have been noted to be picked up for designating during the SUE Phase 2 investigation.

Midwest Fiber Networks (MFN)

MFN has a fiber optic facility extending along the eastern side of Lewis Blvd.

- At 3rd Street and Lewis Boulevard records depict a F/O facility crossing Lewis Boulevard. During the field investigation, UMS personnel designations indicate that, contrary to records, the F/O facility remains on the eastern side of Lewis Boulevard. **UMS recommends verification of the location with *MFN*.**

Northwest Iowa Power Cooperative (NIPCO)

NIPCO has a communications facility within the joint duct bank extending along the western side of Lewis Boulevard.

Sparklight

Sparklight has buried and aerial cable television, as well as F/O facilities throughout the project area.

- At Gordon Drive and Rustin Street, Sparklight has two aerial F/O facilities and one aerial cable television facility bundled together.
- Records depict an aerial cable television facility extending along the southern side of Dace Avenue to the west of College Street. UMS field personnel were unable identify apparent evidence of this aerial facility. However, since some records mistakenly show aerial where in fact buried facilities exist, this facility has for now been depicted as a buried QL D alignment until further clarification can be made with Sparklight regarding its existence.
- UMS field personnel did not observe apparent evidence of the three (3) CATV services to the buildings along the eastern side of Cunningham Dr. However, these services have been depicted as QL D until further clarification can be made regarding the existence of these services.
- UMS field personnel were unsuccessful in creating a reliable EM signal for designating the cable television cable extending along the western side of the Floyd River. This facility has been depicted as QL D based on a combination of One-Call flagging, visual evidence, and

record information. The depiction includes annotation that this is a trench installation based on record information.

- Sparklight records (Figure 5) depict a trenched facility installation extending along the south side of Gordon Avenue, west of Court Street. Based on a discussion with David Burrell, Sparklight does not have any facilities at this location. There is a shared trench that extends along the southern side of Gordon Drive from the western limits to the east side of Court Street and it's possible the Sparklight records are simply showing this installation. As also shown in Figure 5 a related situation appears to exist along a record depiction east of Floyd Boulevard where a dashed alignment indicates a shared trench used by others and a solid alignment indicates a Sparklight trenched F/O installation. **UMS recommends additional verification with Sparklight of the line style convention used in their records (Figure 6).**

Figure 5. Sparklight record appears to indicate existing trenches used by others (dashed green) and Sparklight trenched installations (solid green)

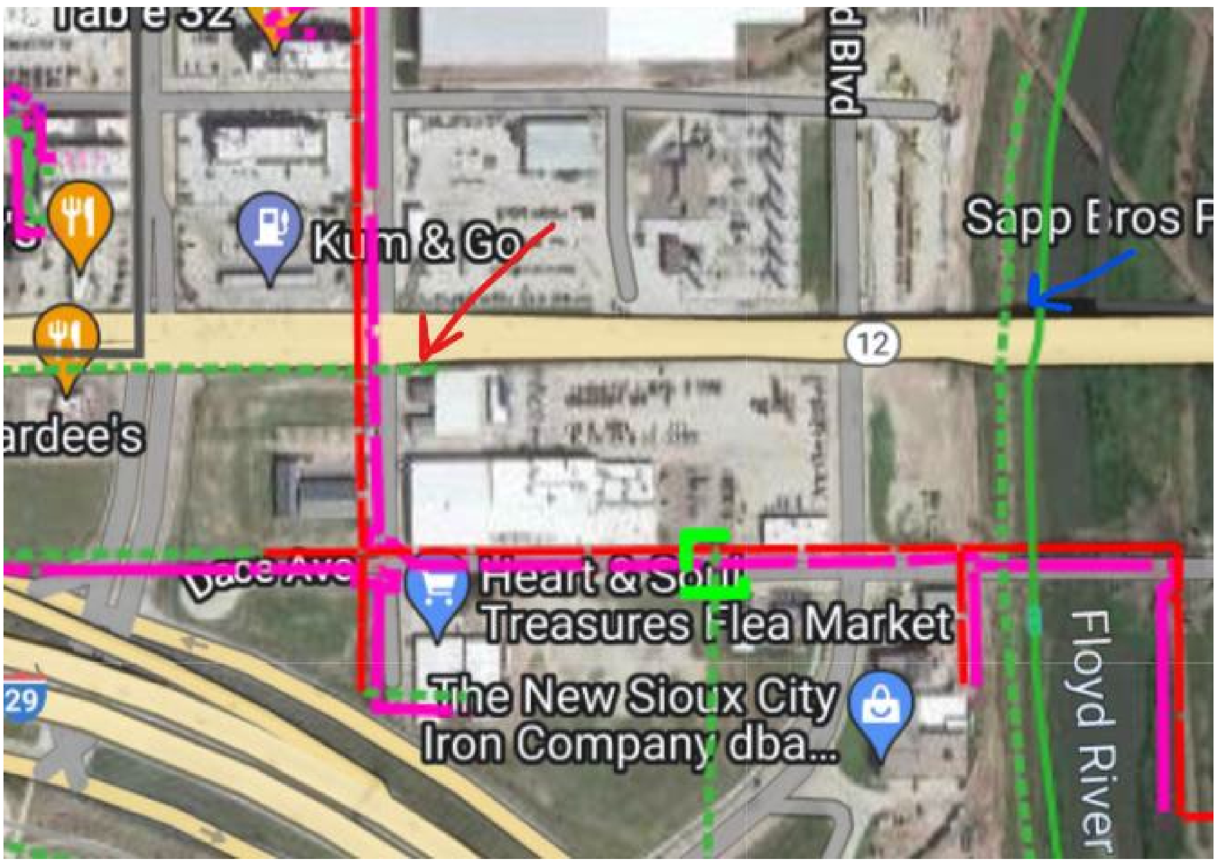
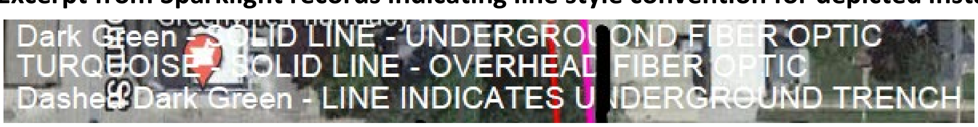


Figure 6. Excerpt from Sparklight records indicating line style convention for depicted installations.



Verizon/MCI (Verizon)

Verizon has buried and aerial fiber optic facilities throughout the project area.

- UMS field personnel were only able to generate weak EM signals for designating many of the buried Verizon facilities within the project area. (Note: Weak EM signals sometimes indicate the target cables have been cut-off or are not connected at the opposite end.) To address this situation a field meet with Verizon personnel was scheduled on site. During the field meet, the Verizon representative and UMS field personnel worked through the various facilities to verify and designate the facilities.
- The Verizon representative also indicated that a few of the cables west of the Floyd River have been abandoned. UMS noted these facilities and they have been identified on the existing utility file. UMS recommends verifying the status of these facilities with Verizon.
- Records and collaboration with Verizon personnel indicate a reportedly abandoned cable along the south side of Jenings Street, crossing Floyd Blvd, then following the Union Pacific Railroad tracks north out of limits. UMS field personnel did not identify apparent evidence of this structure near the railroad tracks and did not see or detect evidence of this cable. This cable route has been depicted as QL D.
- Latent records for 3rd Street near Floyd Boulevard depict a F/O along 3rd Street. This F/O has been depicted QL D has been noted to be designated during the SUE Phase 2 investigation.
- Due to weak or lacking EM signal, UMS field personnel were unsuccessful in designating the cable crossing Gordon Drive West of Floyd Blvd. Records did not clarify if this cable is a F/O or copper telecom. This facility has been depicted as QL D based on record information and visual evidence.

Natural Gas

MidAmerican Energy (MEC)

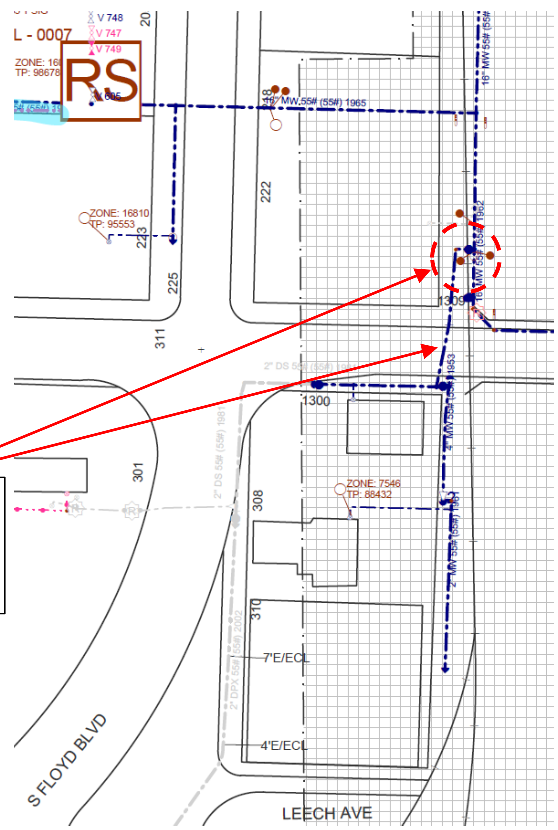
MEC has natural gas facilities throughout the project area.

- *MEC* has a regulation station to the southwest of the intersection at Floyd Blvd and Gordon Drive.
- Size and material information notated on the existing utility file has been transcribed per utility records.
- There are a few locations where the utility records depict a stub pipe, these stubs have been depicted as QL D as it is often very difficult to generate a discernable EM signal along a stub segment for designating. Some of these pipes are steel, but the induced EM signal along the gas pipe typically becomes very weak beyond the point of the last service line.
- A segment of the 16-inch steel gas main is attached to the viaduct over Bacon Creek, shown in the images below. This segment of the gas main has been depicted based on visual inspection by UMS field personnel. The gas main can be viewed in Figure 7 images.

Figure 7. MEC 16-inch steel gas main attached to Gordon Drive viaduct structure over Bacon Creek.

- UMS field personnel could not generate a discernable EM signal along the gas main crossing Dace Ave, just east of Floyd Blvd. The MCGPR also did not reveal a positive indication of this gas main crossing. This segment has therefore been drawn in QL D. Records appear to indicate this line is active and serves as a connector between a gas main to the north and on the east side of the railroad tracks, and the gas main to the south Dace Avenue, which parallels along the west side of the railroad tracks (see Figure 8).

Figure 8. MEC gas record showing crossing at Dace Avenue and crossing of railroad tracks.



- UMS field personnel could not generate a discernable EM signal along the gas main extending along the western side of Steuben Street. The segment between Gordon Drive and Dace Avenue has been drawn in QL D. The tracer wire for the plastic gas main may have been damaged through this area as attempts to utilize it were fruitless.

Sanitary Sewer, Storm Drain, Culverts

The sanitary sewer installations within the project area were investigated and depicted as part of the SUE Phase 1 effort. In accordance with the authorized work scope, UMS did not investigate, designate, or map storm drainage or culverts except for the large box culverts. The remainder of the storm drainage/culvert investigation is to be performed by others.

The *City of Sioux City* has sanitary sewer installations throughout the project area. Structures identified by the field personnel were assigned unique structure numbers. Apparent pipe sizes, flow directions, and pipe materials were recorded at accessible structures and exposed pipe ends. The QL C pipe connectivity between manholes is based on correlating field personnel observations with available record data. Refer to the sanitary sewer structures report **(UTL_UMS_97012037_Sanitary Sewer Structures.pdf)** for more detailed information on each of the sanitary sewer structures mapped during this field campaign.

<u>City of Sioux City (Sioux City)</u>

- Exposed storm drainage pipe inverts surveyed through line-of-sight survey were utilized throughout the north, middle, and south tunnels to aid in the alignment of scans.
- Reportedly abandoned facilities and permit services depicted on record information have been drawn into the existing utility file as QL D alignments.
- Four sanitary permits are depicted on records along Gordon Dr to the east of Cunningham Dr without the depiction of a collector pipe. UMS field crews investigated this area and found no evidence of these permits or a collection pipe. After discussion with David Montague of HDR, it was determined that it is unnecessary for UMS to depict these permits.
- UMS field personnel encountered cracked manhole lids at structures 637 and 642 and did not attempt to open them. Size, material, and invert elevations are based on adjacent structures and records for pipes within structure. Because these structures could not be accessed, the alignments connecting to these structures must be depicted as QL D in accordance with the ASCE 38 standard.
- UMS field personnel searched for the manhole connection to the north of UMS structure number 634 but were unsuccessful in finding it with the use of a magnetometer. Two manholes were observed and surveyed; however, neither appeared to be active sanitary sewer manholes. The north pipe connection from UMS structure 634 has been depicted QL D to the northern limits.
- Structures removed from structure report because they are believed to be electric manholes include UMS structures 674 (Figure 2) and 711, the latter of which is located outside of the project limits.
- UMS unsuccessfully searched for a sanitary structure reportedly near Structure 674. The structure and alignment have been depicted as QL D.

- Access to Structure 639 was not achieved. Accordingly, the structure (Figure 9) is outside of the project limits and is depicted based on coordinates obtained for each of the four corners of the visible structure. The purpose of this hydraulic structure is not clear but perhaps a lift-station or a form of outflow during a flood event. Further discussion with Sioux City officials is required.

Figure 9. Structure 639 location (beyond project limits).

- Records for connecting pipes do not always correspond with UMS structure observations. The following is a list of structures for which observed pipes have been depicted as QL D for a short segment based upon the orientation of the pipe invert observed within the structure:
    - UMS structure 615: UMS field personnel observed an apparent pipe connecting from the southwest not depicted on records.
    - UMS structure 618: UMS field personnel observed apparent pipes connecting from the north and south not depicted on records.

  - UMS structure 620: UMS field personnel observed an apparent pipe connecting from the north not depicted on records.
  - UMS structure 631: UMS field personnel observed apparent pipes connecting from the southwest and southeast not depicted on records.
  - UMS structure 646: UMS field personnel observed an apparent pipe connecting from the north not depicted on records.
  - UMS structure 653: UMS field personnel observed an apparent pipe connecting from the east not depicted on records.
  - UMS structure 656: UMS field personnel observed an apparent pipe connecting from the northeast not depicted on records.
  - UMS structure 661: UMS field personnel observed apparent pipe connecting from the west and east not depicted on records. The west bound pipe was designated for a short segment using a rodder before encountering refusal and is designated as QL B.
  - UMS structure 666: UMS field personnel observed an apparent pipe connecting from the southeast not depicted on records.
  - UMS structure 672: Records only depict a pipe connecting from the south. UMS field personnel designated apparent pipes connecting from the north, east and southwest.
  - UMS structure 706: UMS field personnel observed an apparent pipe connecting from the east not depicted on records.
- Per invert measurements, flow direction, and imagery recorded by UMS field staff, professional judgment determined that it is more likely that the southwest bound sanitary pipe from UMS structure 624 connects to UMS structure 627. City of Sioux City records depict a blind tie into the 625-626 pipe.
- There are numerous buildings along the project corridor for which City records did not indicate sanitary services and for which manhole structures did not clearly indicate connections between the buildings and the sanitary sewer mains. For these buildings UMS has added a “placeholder depiction” for both water and sanitary sewer services. It is apparent these buildings have services, so a recommendation is made to investigate these buildings further during the Phase 2 SUE and utility investigation to determine better the locations and alignments for these services.

Water

City of Sioux City potable water installations were designated throughout the project area. The existing utilities reference CAD file presents QL B and QL D depicted alignments throughout the project corridor. Some segments of water main, fire-hydrant supply lines and services were designated using inductive EM methods to directly detect and trace conductive water pipes or tracer-wire installed along PVC water installations. Remaining water system elements of record have been transcribed as QL D alignments based on a combination of record information, professional judgement and observed surface features. Observed features such as water main valves and water service valves were used to develop QL D depictions of water services where QL C could not be judged, and designation was unsuccessful. The pipe size noted on the utility reference CAD file is based on obtained record information.

The following notes are provided regarding the Phase 1 SUE investigation of water facilities:

- Services have been depicted as QL D as the provided records indicate and where UMS field personnel were able to survey curb stops/water valve surface features.
- There are numerous buildings along the project corridor for which City records did not indicate water services and for which curb stops were not surveyed or apparent. For these buildings UMS has added a “placeholder depiction” for both water and sanitary sewer services. It is apparent these buildings have services, so a recommendation is made to investigate these buildings further during the Phase 2 SUE and utility investigation to determine better the locations and alignments for these services.
- Pipe sizing and materials have been added based upon the ArcGIS data provided to UMS by Nick Bos of the City of Sioux City.
- Many of the water pipes depicted in the provided ArcGIS system were labeled as unknown material. UMS field personnel attempted pipe detection using inductive EM methods on all pipes identified. Pipes that could not be designated using inductive EM methods have been depicted as QL D based on City of Sioux City information within: 1) the “WaterSystem.dgn” reference file; and 2) the block and intersection maps.
- Reportedly abandoned water mains and pipes have been depicted as QL D based on City of Sioux City information derived through the “WaterSystem.dgn” file, block and intersection maps, and ArcGIS system.

3D Utility Modeling

The Phase 1 SUE work scope includes developing a 3D model of the existing utilities. **This effort is ongoing at this time and will be included in a subsequent submittal package.** Information sources for the 3D modeling effort include the following:

- The SUE Phase 1 Utility Designating effort in accordance with ASCE 38 included utility depth information gathered with non-invasive geophysical equipment, along with physical measurements at isolated, accessible structures.
- 3D QL B mapping using Vivax-Metrotech Spar 300© electromagnetic induction system. The Spar 300 derives calculated 3D alignment data (elevation tied to project control) for conductive utilities and can provide useful 3D profiles. The Spar 300 utilizes electromagnetic induction detection, model-based solution methods, and RTK GNSS observations to estimate 3D coordinate observations at discrete positions which are selectively used to create 3D alignments.
- Multi-Channel Ground Penetrating Radar (MCGPR) processed to obtain estimated depth information on detected subsurface features and buried unknowns, including both conductive and non-conductive utilities within the specified project limits.

- LiDAR on selected accessible underground drainage structures to obtain point cloud information used to determine pipe and structure dimensions, depth data, pipe connectivity, and offset measurements.
- Vacuum excavation (a.k.a. test hole) data, if authorized during a Phase 2 SUE effort.

UMS staff was responsible for management of the data, evaluation of findings, interpretation and reconciling of an array of evidence and disparate data to develop a qualified, standardized model of existing infrastructure. This effort included the merging of data acquired during both initial and supplemental utility investigations. The result will be development of a Bentley OpenRoads Designer 3D CAD utility reference file of the existing utilities with discrete reliability qualifiers (quality levels) for both the horizontal alignment and vertical alignment along each depicted utility segment.

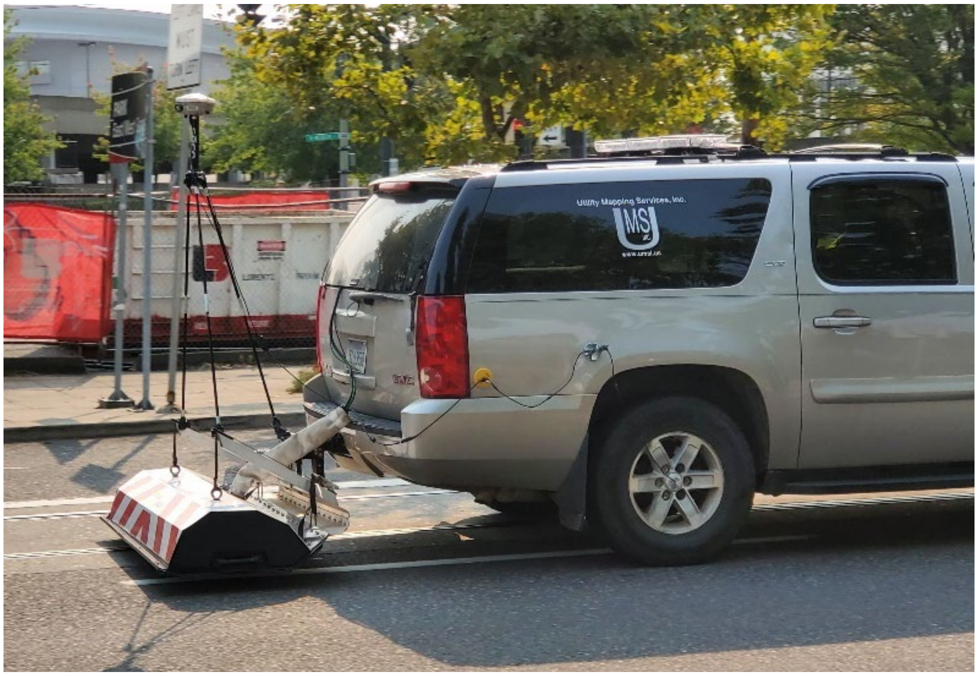
Multi-Channel Ground Penetrating Radar (MCGPR)

UMS used an ultra-wide band 18-channel ImpulseRadar© Raptor™ GPR array centered on 450 MHz System (Figure 10) to sweep for unknown utility infrastructure and better define known existing infrastructure, including better discernment of the horizontal footprint and depth of vaults, pipes and duct banks.

GPR data was integrated with Real-Time Kinematic (RTK) global navigation satellite system (GNSS) for high accuracy positioning. All GPR observation data was tied to the U.S. National Spatial Referencing System maintained by the National Oceanic and Atmospheric Administration's Nation Geodetic Survey and projected to project coordinates (Iowa Regional Coordinate System, Zone 4). Data was processed, assessed for quality, and analyzed.

The Raptor GPR array has a swath width of approximately 4.5-feet. Each pass provides more coverage enabling each pass to provide closer to 100% coverage of the target area with fewer passes. With ideal soil conditions, frequencies centered on 450 MHz are well suited to achieve penetration of approximately 13-feet while maintaining adequate resolution to identify potential voids. Varying subgrade conditions (such as variations in the soil matrix and clay content, soil moisture, groundwater presence, salt and other conductive ion content, bedrock depth, boulder fields, etc.) may suddenly alter the effectiveness of GPR by attenuating the radar signal. This means that it may be possible to detect and image a utility feature of a particular size, geometry and depth at one location and/or time, and at another location and/or time the system may be incapable of detecting a void of similar size, geometry and depth. See Appendix B for additional information on GPR methodology.

Figure 10. UMS ImpulseRadar Raptor MCGPR



For this project the MCGPR data was effective to three or four feet of depth in general and contains a lot of good, useful information, detecting known and unknown subgrade features. As a preliminary sampling, the following are a few selected images extracted from the MCGPR sweep along Gordon Drive. The entire MCGPR data set is available for further viewing. A separate, and complimentary report on covering the analysis of the MCGPR data for the Gordon Drive project is currently being prepared and will be available in June 2024.

UMS encourages the project team to utilize the MCGPR or ask UMS to exam specified and discrete locations further:

- For evidence of subgrade features of concern which may be of geotechnical, cultural, or archeological interest; and
- In areas for which excavation or pier driving may be required; UMS can scrutinize the MCGPR for anomalies or lack thereof within the subgrade at specific locations.

As identified, GPR anomalies will be transcribed onto the Phase 1 SUE CAD submittal.

Figure 11. Court Street, South of Gordon Drive - Plan view without and with aerial overlay showing identified linear and intersecting perpendicular subgrade anomalies (dark green within red dashed boundary) which appears not associated with the QL B utility designating results. Also provided is a Google™ Maps view with approximate location for anomaly overlaid.

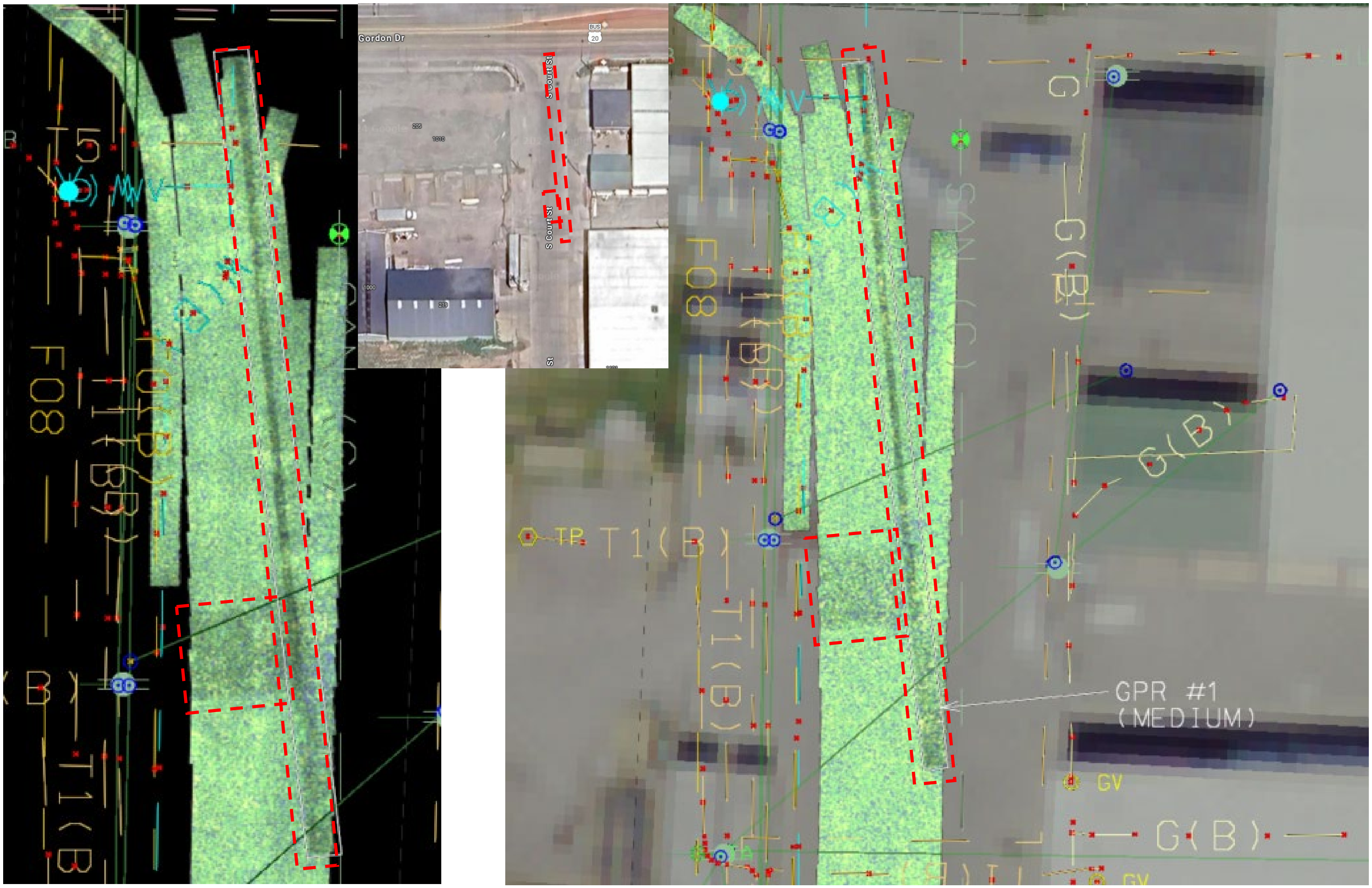


Figure 12. Lot west of Steuben Street, North of Gordon Drive GPR #2 - plan view and plan-view with CAD overlay of an unknown parallel, linear features extending along a N-S alignment (dark green within red dashed area). Based on proximity to the railroad tracks, these anomalies may represent remnant ballast used for railroad spurs. The dark green outlined with light grey dashed boxes appears to be an artifact resulting from processing and merging "chunks" of gpr data; further analysis is required.

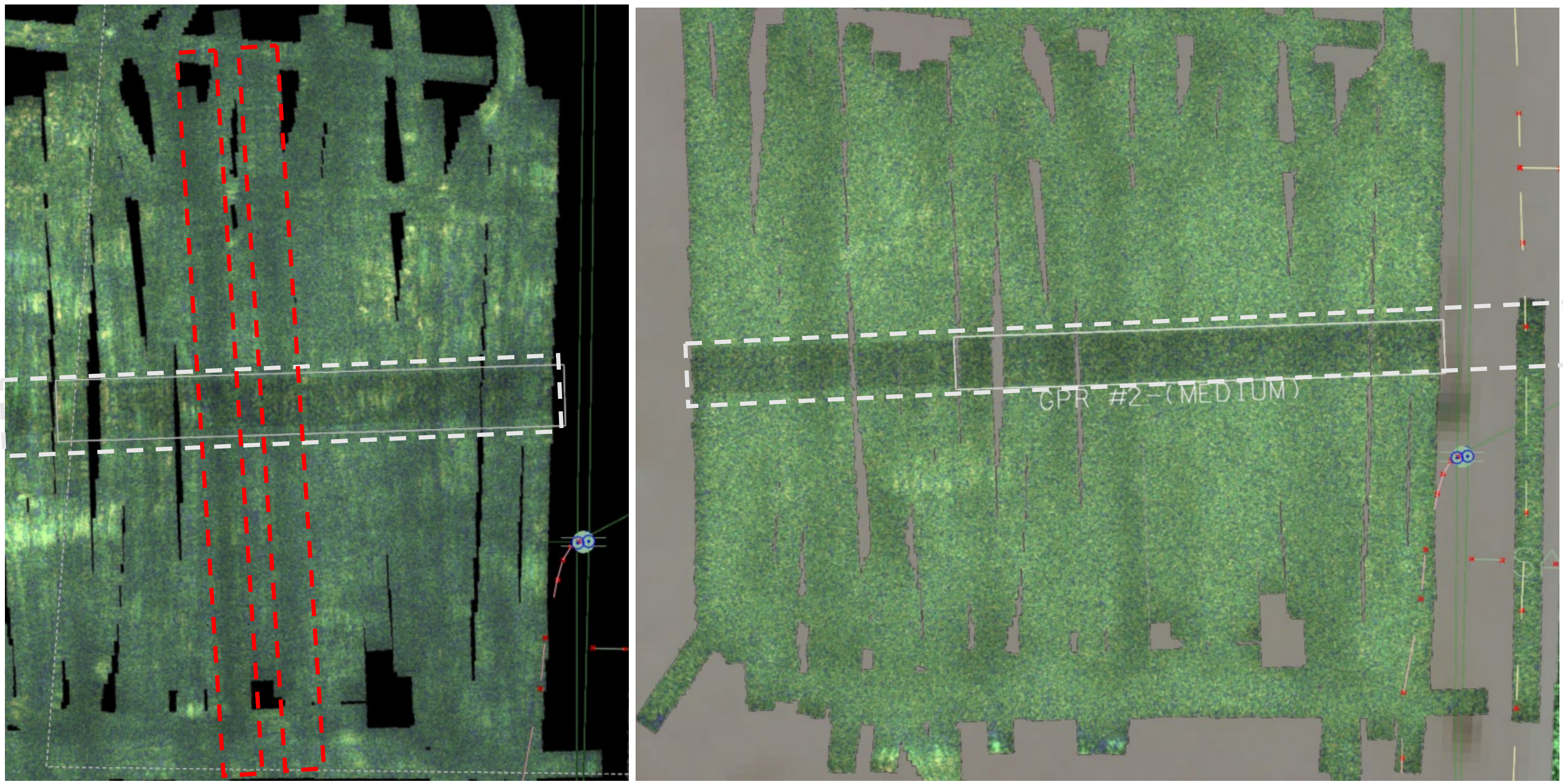


Figure 13. Approximate GPR anomaly location overlaid on Google™ Maps aerial.

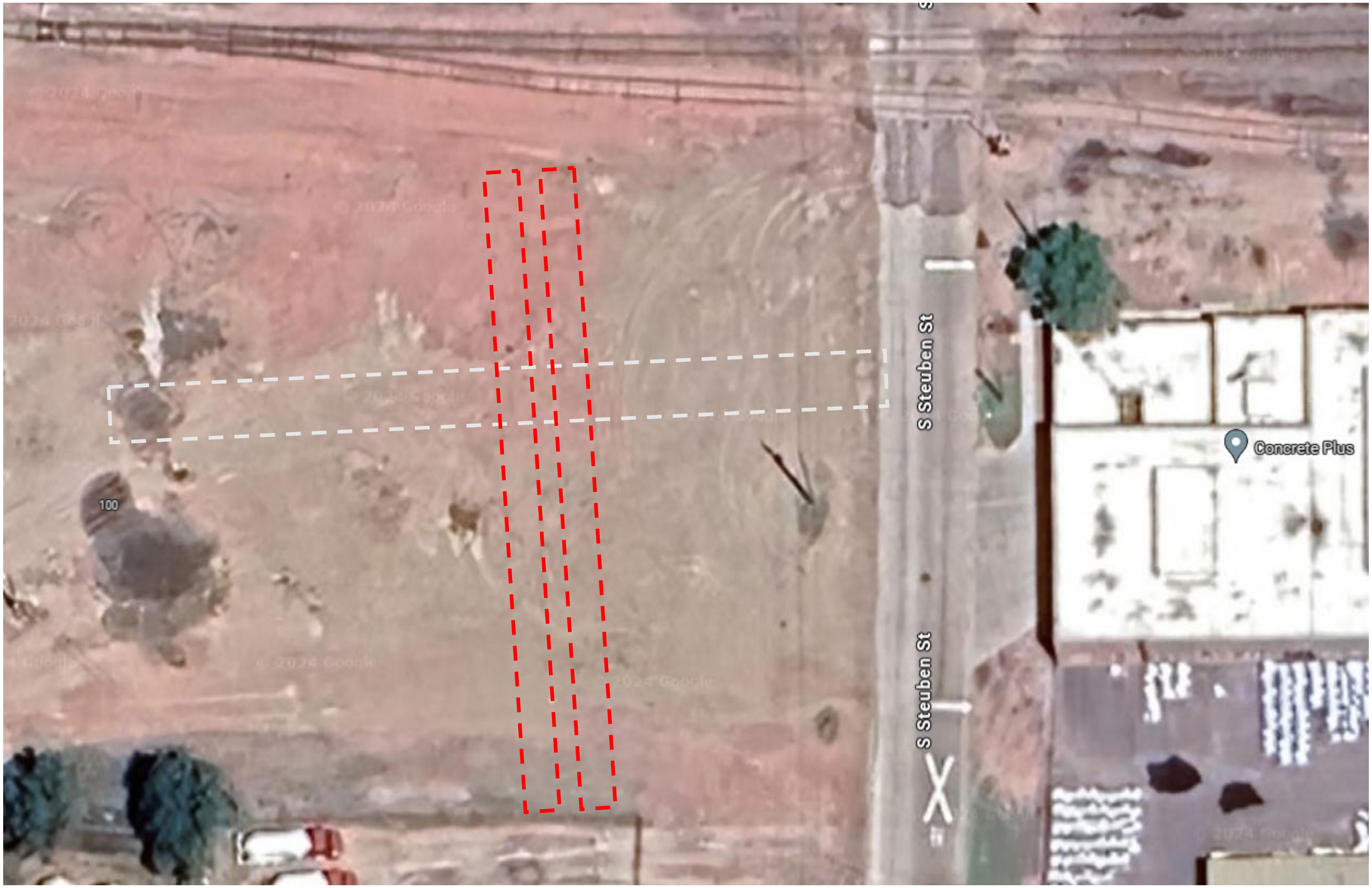


Figure 14. Dace Avenue, east of Lewis Blvd - GPR anomaly on plan view and Google™ street view with approximate location for anomalies superimposed.

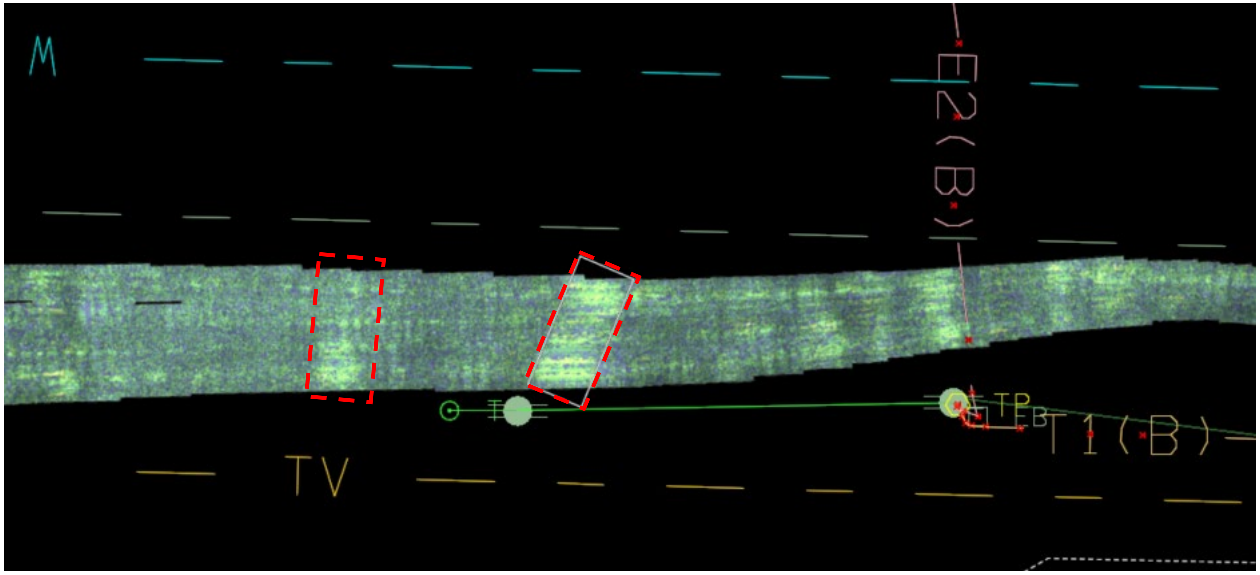


Figure 15. Dace Avenue, east of Lewis Blvd - GPR anomaly on plan view with aerial and Google™ aerial with approximate location for anomalies superimposed.

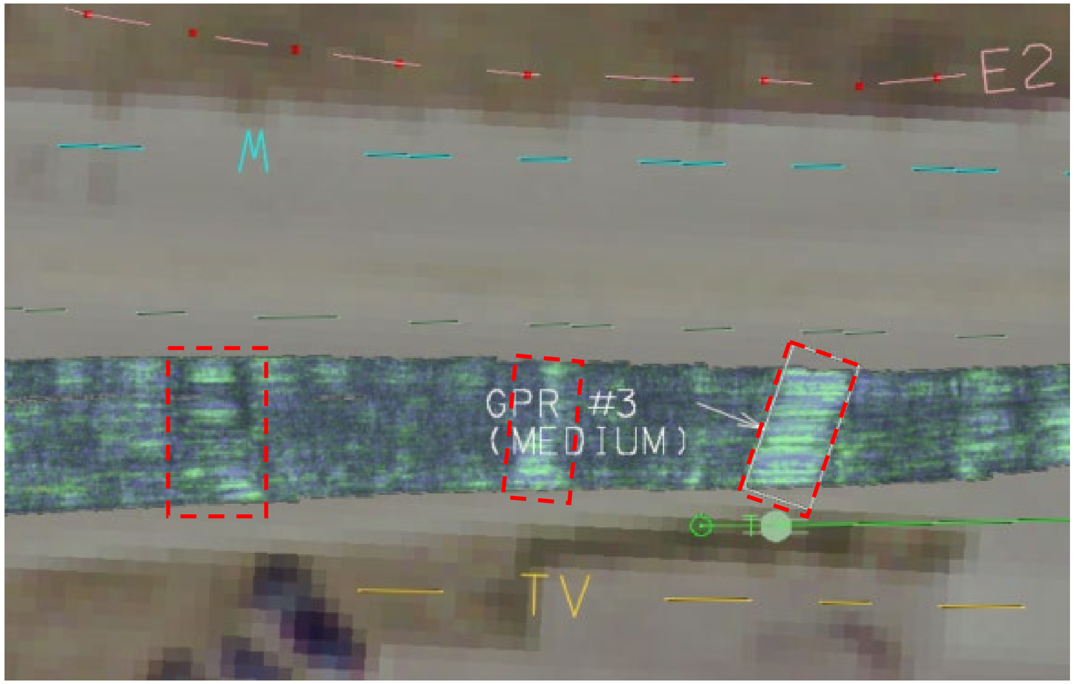


Figure 16. Along NB Lewis Blvd, just north of Gordon Drive, plan view of GPR anomalies apparently revealing the Bacon Creek viaduct footprint. Also shown is a Google™ Map aerial view showing approximate location of the GPR anomaly. The offset shown is a result of the GNSS satellite coverage getting blocked by the Gordon Drive bridge structure and will be corrected with further processing.

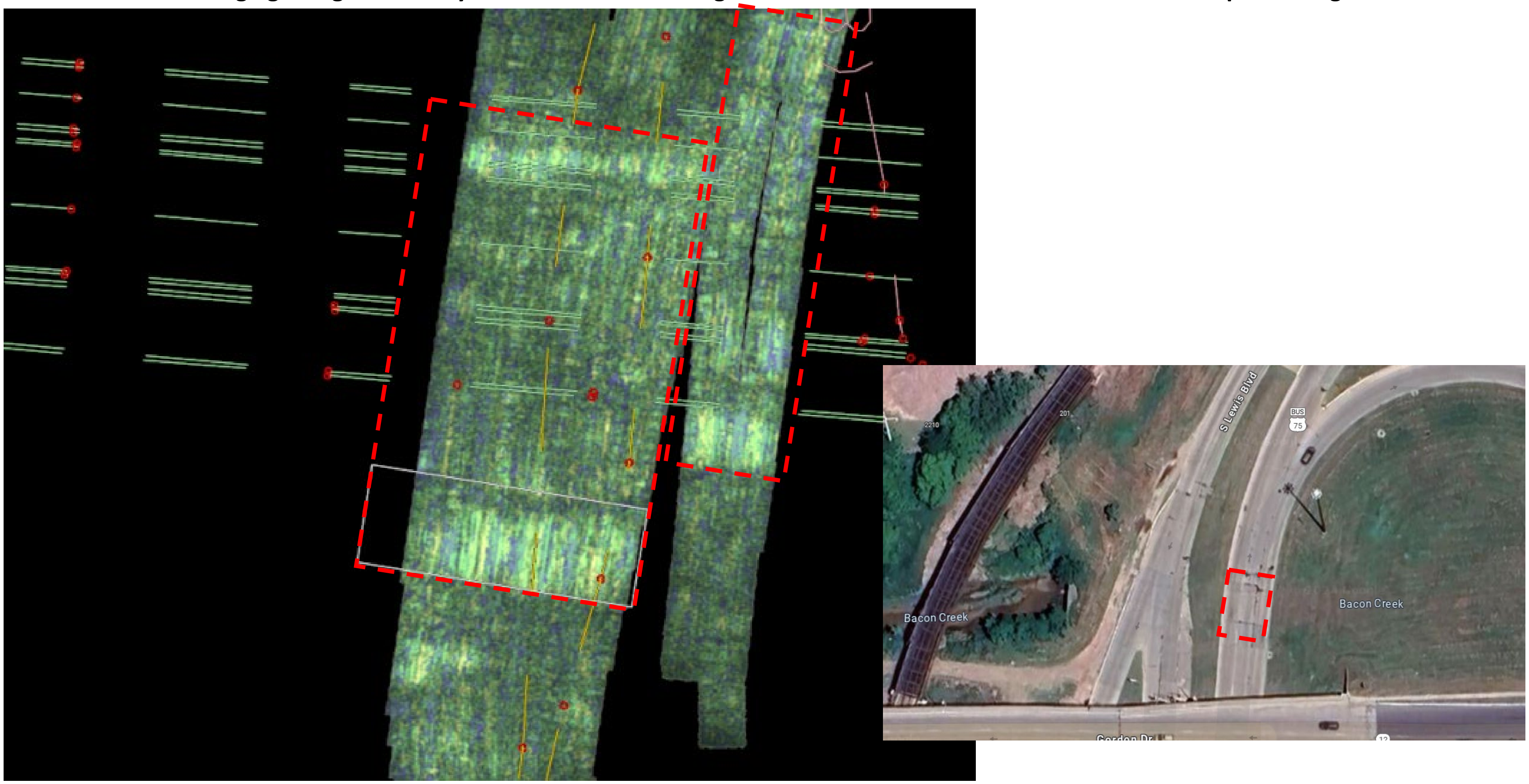


Figure 17. Lewis Boulevard crossing, north of on-ramp from Gordon Drive, GPR anomaly overlaid with existing utilities and again with aerial. The approximate location for the anomaly is also shown on a Google™ Map aerial. This anomaly aligns with the overhead sign structure, but apparently represents conduit running under the road section beneath the sign structure. (The MCGPR system is shielded which typically prevents interference from overhead features; however, further analysis is required to confirm the anomaly is due to a subgrade feature.)

Figure 18. MCGPR data along Dace Avenue revealing apparent buried historic railroad or trolley car tracks.

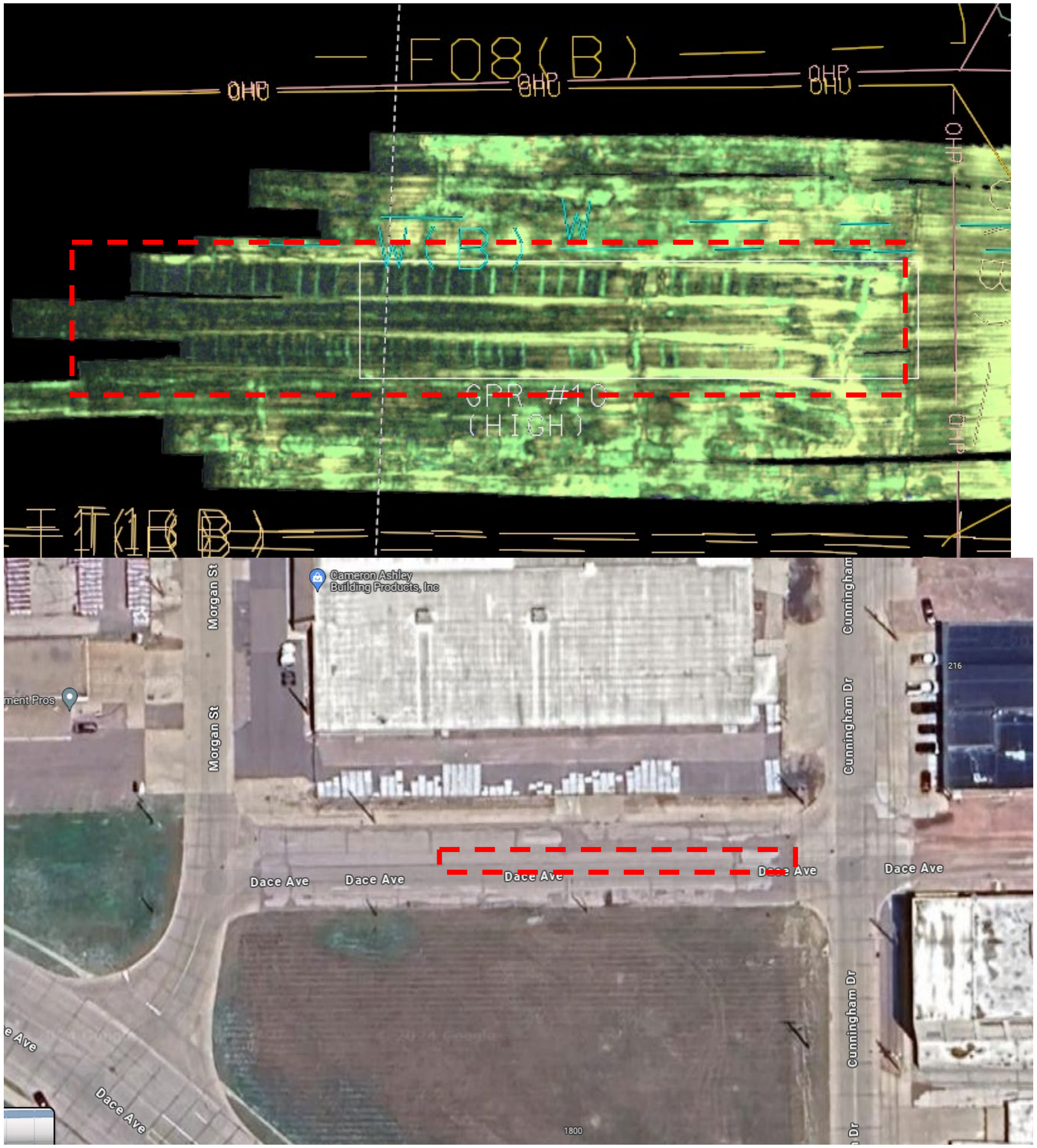
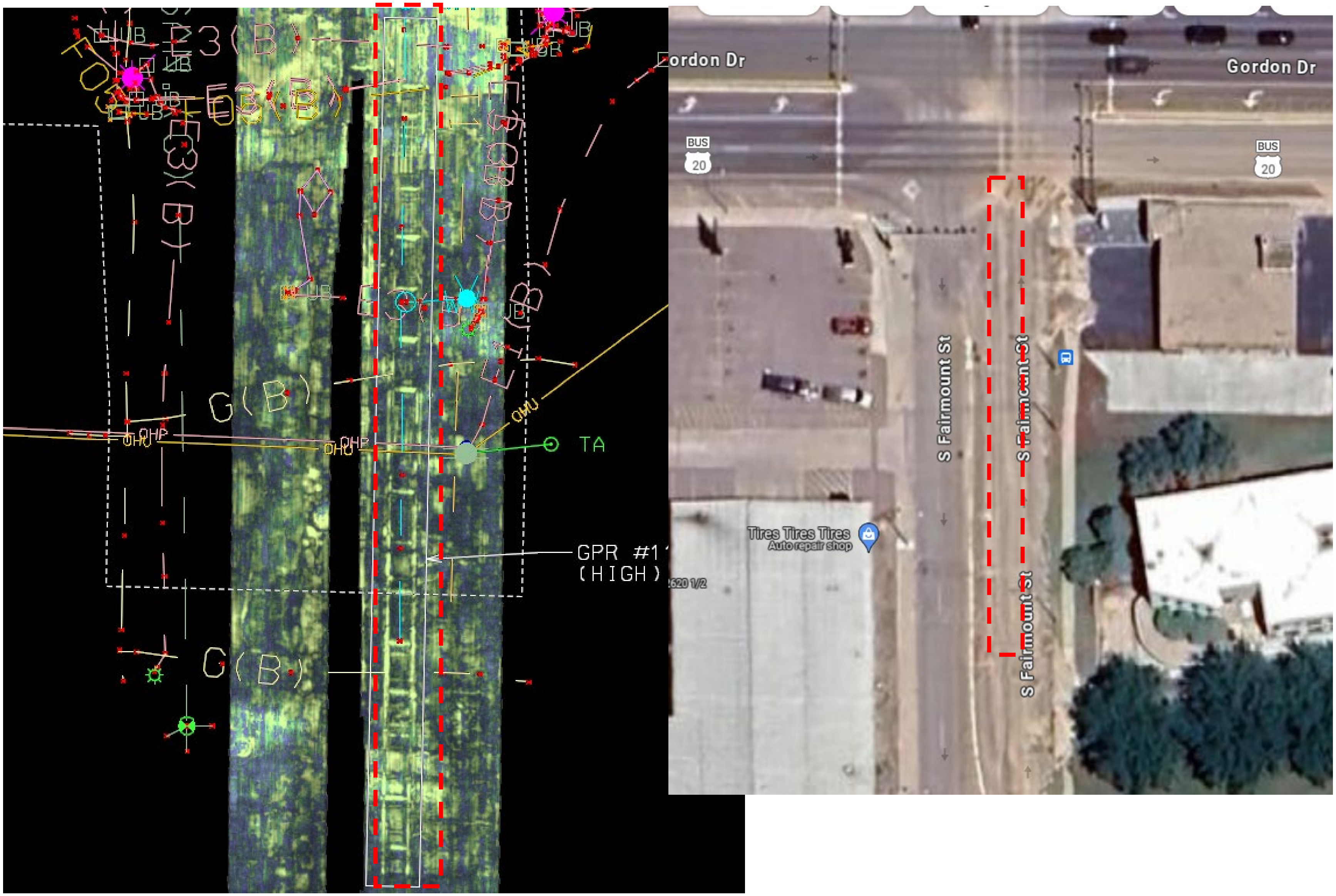


Figure 19. Buried street car rail tracks along South Fairmount Street leading up to Gordon Drive intersection.



3D Existing Utilities Modeling

A 3D model was developed within Open Roads Designer depicting each utility feature as denoted or as a representative (approximate) size and depth within the project area. These depictions are a product of the SUE investigation efforts described above. This 3D utilities model can be utilized by the project to improve efficiency in various ways. Along with facilitating automated clash detection, the model allows the design team to automate depiction of utilities at-size and depth within cross sections and profiles.

The 3D CAD model provided is to be considered an interpretation and "**work in progress**" based upon the latest, often limited, information obtained from a variety of sources. Horizontal alignments are typically based on visible appurtenances, QL B designated alignments, record information, topographic/cultural/vegetative factors, and engineering judgment. Vertical is based on engineering judgment stemming from discrete direct observations (e.g., structures, test holes), geophysical indicators, topographic data, record information, policy and practices, age, installation method (if known), and parameters typical for each facility type and installation (e.g., casing, duct bank, rigid or flexible, pressurized or gravity, etc.). Updates stemming from newly acquired information should be systematically documented and applied in near real-time fashion in accordance with specifications. These updates to the model can result from newly acquired direct (e.g., Utility Locating test holes or excavation activity) and indirect (e.g. 3D QL B EM or GPR survey), newly uncovered record data on existing facilities, and dynamic changes such as new construction or changes to the operational status. 3D model users must understand and consider the "Vertical Quality Levels" (V-QL) denoted within the DGN file **"SUR_UTL_UMS_97012037Z04_3D Model.dgn"** which indicates the engineer's judgment on the reliability of the vertical utility position depicted. The ASCE/CI/UESI 38-22 standard was published in 2022 and currently does not address how to "designate" the "z or elevation" component for 3D depictions; however, in keeping with the spirit and framework for ASCE 38, UMS has derived an unofficial, but useful "Vertical" Quality Level designating convention that mirrors ASCE 38 definitions for horizontal designations and depictions. Utilities modeled in 3D for this project have been depicted with a variety of horizontal and vertical quality levels which varies spatially from node to node and segment by segment. For example, a segment of fiber optic cable can be depicted with a horizontal QL B designation, but the vertical may be based only on an "assumed depth" and accordingly designated as QL B (horizontal) and V-QL D (vertical). If the same cable was surveyed using 3D QL B EM or GPR equipment, and the depth/elevation thought to be reliable and/or representative, then the depicted 3D feature would be designated as QL B (horizontal) and V-QL B[3] (vertical). It is possible for observations along a utility alignment to have "vertical" quality levels that vary between V-QL A, B, C, and D. **The users of the 3D model are reminded to pay careful attention to both the horizontal and vertical quality levels as annotated along at each utility alignment. 3D modeling and depiction of**

[3] Note: The engineering judgment used to develop a Vertical QL B depiction is significant, and stems from consideration and assessment of numerous factors and evidence. It is not simply utilizing a computed depth reading from a geophysical instrument.

utility infrastructure is currently non-standardized; therefore, the user is advised to contact UMS for guidance and clarification regarding the interpretation and use of this data set.

UMS's application of the "V-QL" concept is summarized below.

Vertical Quality Level Acronyms and General Summary:

- **V-QL A** = Discrete, direct survey-grade observations of a confirmed and visible utility feature, +/- 0.1' (e.g., Utility Locating test holes, survey-grade observation of a pipe within a manhole, etc.)
- **V-QL B** = Geophysically derived utility depth estimates which the UE professional judges to be of a reliable quality (e.g., inductive EM derived estimates, GPR utility profiles with frequent and consistent depths) and within a rational realm of reason for the particular installation type, location, topography, subgrade, and other factors.
- **V-QL C** = Straight-line interpolation between known utility positions where the UE professional judges a straight-line interpolation to be reasonable based correlation of field observations, topographic and geotechnical data, utility record information, and utility material and construction (such as: rigid-type gravity flow pipe depicted between drainage structures with confirmed connectivity or, rigid-type pipe or duct bank between two adjacent test holes, etc.).
- **V-QL D** = Assumed and/or estimated depths, as shown within Table 3 below.

The following general notes are applicable to the utility alignments within the **"23-071_Existing Utilities_3D Model.dgn"** 3D model for this SUE Phase 1 submittal:

- All sanitary sewer pipe alignments and profiles shall be considered Horizontal Quality Level C (H-QL C) and Vertical Quality Level C (V-QL C) unless noted otherwise.
- All storm drainage pipe depths shall be considered Vertical Quality Level D (V-QL D, estimated depth) unless noted otherwise.
    - Storm drainage pipe inverts connecting into the drainage viaduct shall be considered a direct observation or H-QL A and V-QL A at the point of outfall into the viaduct or tunnel; otherwise, the depicted pipe segments extending away from viaduct shall be considered H-QL D and V-QL D.
- All non-drainage utility infrastructure (Electric, Comm, Gas, Water, etc.) shall be considered Horizontal Quality Level B (H-QL B) and Vertical Quality Level D (V-QL D) unless noted otherwise.
- Aerial utilities have not been included in this 3D Model, see SUR_UTL_UMS_972037Z04.dgn for aerial height information.

Note: Utility depiction quality levels can be targeted for improvement during a subsequent Phase 2 SUE investigative effort as conflict issues and design needs are identified.

3D Modeling Assumptions

For the 3D model development performed by UMS, professional judgement and various assumptions on many utility features were used to complete modeling efforts. This is due to varying data limitations which may include the following:

1. Limitations of the Iowa DOT ORD 3D Modeling Library. This prevented depiction of various utility features due to limitations within the library regarding material type, size and/or shape;
2. Lack of information within utility records provided, such as missing utility size and/or configuration information etc.; and
3. Scope and/or budget limitations limiting efforts to obtain additional information beyond a conventional SUE designating investigation for the Phase 1 SUE effort. To-date UMS has not completed any Utility Locating Test Holes. If/when additional information is desired, UMS can scope and conduct a subsequent field investigation and can update the 3D model to reflect new information.

Table 3 provides default sizes and depth assumptions used for the developed 3D existing utility model.

Table 3: 3D Model Feature Size and Depth Assumption values utilized.

Utility Type	Horizontal and Vertical Quality Levels Unless Noted Otherwise	ORD Default Pipe/Cable Size for unknown material/size pipes	Assumed Pipe/Cable Depths or Heights
Water	H-QL B; V-QL D	IowaDOT ORD System Default = Water Line HDPE 12” for RPTD ABND; 2” for service/laterals	5’ depth of cover
Gas	H-QL B; V-QL D	IowaDOT ORD System Default = Gas Line HDPE/Ductile Iron 2”	Under/parallel to roadway – 4’ depth of cover; Elsewhere 3’ depth of cover
Communications (CATV, Phone, Fiber)	H-QL B; V-QL D	IowaDOT ORD System Default = Comm Circular Duct 2”	Under/parallel to roadway – 4’ depth of cover; Elsewhere 3’ depth of cover
Electric	H-QL B; V-QL D	IowaDOT ORD System Default = Electrical Direct Buried Cable	4’ depth of cover
Street Lighting and Traffic	H-QL B; V-QL D	IowaDOT ORD System Default = Electrical Direct Buried Cable	2’ depth of cover
Sanitary Sewer	H-QL C; V-QL C	IowaDOT ORD System Default = Sanitary Sewer Circular RCP 4”	Depth estimated based on nearest invert and professional judgment where interpolation not available
Storm Sewer	H-QL A; V-QL A (at tunnel connection) H-QL D; V-QL D (pipe extensions)	IowaDOT ORD System Default = Storm Water Concrete 12”	Depth Assumed from Nearest V-QL A point
Storm Tunnel	H-QL A; V-QL A from scans and rubber sheeting	IowaDOT ORD System Default = Electrical Box Duct (set to storm level)	N/A

The data collection and modeling process is iterative in nature and should continue as new information becomes available. The depicted model represents a time sensitive interpretation of acquired evidence and reasonable assumptions on existing utilities at a point in time. The depiction should be:

1. **immediately updated with new discoveries** of existing utilities and resulting modifications reviewed by the project design team to assess impacts for conflicts, construction, damage prevention, and utility coordination;
2. **systematically sustained with standardized as-built data** on recorded changes, adjustments, and new installations; and
3. **continually augmented with proposed alignments and installations** for planned infrastructure.

UMS also recommends utility owners are provided opportunities to regularly review the 3D models and updates to provide review comments and improvements based on any internal knowledge regarding size, depth location information etc.

Annotations within the **"23-071_Existing Utilities_3D Model.dgn"** and **"23-071_Existing Utilities.dgn"** files note size and material types as observed within the field and/or made known to UMS within utility record information provided. Although not all-inclusive, the following summary presents common features for which assumptions and/or estimates of size, orientation, extents were made by UMS to complete the 3D model:

- **Communications**: Configuration and/or orientation of hand-hole/pull-box sizes and orientation, duct sizes and configuration.
- **Electric**: Configuration and/or orientation of hand-hole/pull-box sizes, duct sizes and configuration, electrical box and meter sizes, pole size/height/depth-of-bury.
- **Natural Gas**: Pipe size and pipe material type (e.g. services), features sizes such as gas meters, gas valves and gas manhole structures.
- **Sanitary Sewer**: pipe sizes and pipe material type, manhole structure sizes, configuration/orientation, inverts may have been assumed where field designated data was not acquired (QL D alignments). Due to 3D model library and budgetary limitations, "generic" structure sizes were utilized throughout the project.
- **Storm Drainage**: pipe sizes and pipe material type, manhole/inlet structure sizes, configuration/orientation, inverts may have been assumed where field designated data was not acquired (QL D alignments). When visible, field crews surveyed the outline of the storm drainage structures. Due to 3D model library and budgetary limitations, "generic" structure sizes were utilized throughout the project.
- **Water**: pipe sizes and pipe material type, manhole structure sizes, configuration/orientation, features sizes such as valves, meter boxes, curb stops. Photographic documentation was used to determine the shape and approximate structure size.

Recommendations

UMS recommends a Phase 2 SUE to utilize additional advanced geophysical methods and/or supplemental vacuum excavations (test holes) to further investigate utilities in potential conflict with the proposed designs to better define positional and facility characteristics, iteratively improve the resulting 3D existing utilities model, and explore and advance conflict mitigation alternatives, project risk reduction, and cost saving project delivery strategies.

Advanced geophysical methods include, but are not limited to, the following:

- A project area sweep using a Geonics EM61-MK2 time domain electromagnetic (TDEM) high sensitivity metal detector. This equipment is suitable for applications in the detection of both ferrous and non-ferrous metal.
- Profiling using a magnetic gradiometer. This equipment will effectively detect and isolate ferrous based metals such as ductile iron pipe.
- Sonde, EM rodder, and acoustic pipe locator to upgrade buried pipe depictions from QLC or QLD, where critical.

UMS should be kept advised throughout the design process to: 1) evaluate designer usage of the existing utility reference data from the utility designating and locating effort; and 2) provide recommendations for further utility investigations as deemed prudent based on previous UE investigation results.

The MCGPR project data contains a significant amount of data. Due to the amount of data acquired, an in-depth analysis of the entire data set is not practical; however, UMS can scrutinize the MCGPR data within specified areas of concern for anomalies which may impact excavation. It is advised that as the project design evolves and excavation work is defined, a meeting is held with the design team to look over the MCGPR data covering areas of interest to see if anything of concern or interest can be identified.

A pre-bid job walk or a pre-bid meeting is recommended with contractors or construction teams to allow UMS the opportunity to discuss results from this investigation and the usage and limitations of this data.

Submittal Information

The resulting data from the SUE Phase 1 Utility Designating and investigation effort are available in the following submittals:

File Name	Description
SUR_UTL_UMS_97012037Z04.dgn	**Existing Utilities Reference CAD File** **Utility ownership, specification, ASCE Quality Level, and notes are provided along the utilities.**
UTL_UMS_97012037_Utility Engineering Report.pdf	**Utility Engineering Report (this document)**
UTL_UMS_97012037_Sanitary Sewer Structures.pdf	**Sanitary Sewer Structures Report**
UTL_UMS_97012037_Existing Utility Plan Sheets.pdf	**SUE Existing Utility Plans**

Data Limitations

UMS performed professional utility investigation services in accordance with ASCE/CI 38-02 guidelines and generally accepted engineering principles and practices at this time. However, a possibility will always exist that abandoned, forgotten, non-detectable, undocumented, or newly installed utilities may not get mapped using standardized records research and geophysical survey procedures. While the ASCE/CI 38-02 standard guidelines greatly mitigate these issues, utilities possessing characteristics mentioned below can be missed while following standard utility designating and locating procedures:

1. Utilities lacking apparent available records and without apparent surface features.
2. Utilities with record information, which is illegible, misleading, or incomplete.
3. Utilities which are inaccurately reported or inaccurately represented by the utility owner as lying a significant distance from the true position.
4. Abandoned utilities without apparent surface features.
5. Utilities buried excessively deep, beyond detection limits of standard utility designating equipment.
6. Non-conductive utilities, without apparent surface features, which lie, for example, buried in conductive soils or beneath reinforced concrete surfacing. (Such conditions inhibit GPR detection).
7. Facilities installed after the utility designating field investigation effort.
8. Utilities in a common trench. Designating of common trench utilities can be difficult due to EM signal bleed over and difficulties in separating EM signals. Cathodic Protection connections between individual pipelines also increases the difficulty of determining individual pipe alignments.
9. Utilities installed in highly utility congested environments whereby isolating a particular installation using geophysical methods becomes extremely difficult from a pragmatic stance.
10. QL B depictions of pipe alignments developed by means of tracer wire direct connect methods is dependent on the assumption that the tracer wire has been placed in relatively close proximity to the associated pipe. Events such as lightning strike surges along tracer wires have caused damages to pipes, so installation practices now require that tracer wire is offset a safe distance (e.g., 1 to 2 feet) from the pipes. Users are cautioned that it is the tracer wire alignment that is recorded and depicted on the existing utility reference file and the assumption is made that this alignment represents the alignment of the target pipe sufficiently to achieve QL B designation

A common problem occurs when the project involves facility owners and operators with insufficient records and non-conductive buried facilities, a situation often encountered with public works installations (e.g., water, storm drainage, and sanitary sewer services, and irrigation systems that have non-conductive water mains). Facilities mapped under these circumstances are often depicted as QL D during the utility designating (UE Phase 1) field effort to keep operations and budgets at a practical level. As the design project progresses some depicted facilities deemed to be a source of sufficient risk may have to be upgraded to a higher quality level through more advanced geophysical prospecting and utility locating methods (UE Phase 2) to properly identify and assess utility conflicts for design and construction. Designers, utility coordinators, and contractors must realize the ASCE/CI 38-02 utility mapping effort is an **iterative acquisition and interpretation process**; unless subsequent endeavors are made to upgrade designated quality levels, facilities depicted at lower quality levels, such as QL D, may be completely in error.

In addition, depicted facilities and corresponding data are pertinent at the time in which field investigation operations are completed, and are subject to change. Final utility data is for mapping and asset management purposes only and reflect utility conditions at the time surveyed. Unless authorized to maintain and keep data sets current, UMS cannot be held responsible for changing utility scenarios after completion of field operations. Utilities newly installed or relocated after the field investigation may be overlooked if the Owner does not have a process for acquiring and managing standardized as-built data, and updating the existing utility infrastructure depictions.

Users of this data set must understand and adhere to the limitations associated with the designated quality levels assigned to the depicted facilities. QL C and QL D depictions are based on interpolations, extrapolations, and available record data; this source data can be erroneous and should not be used alone for design development and bidding purposes. Additional utility investigative efforts to upgrade data to QL B and A are strongly recommended for areas where accurate final design and construction planning and bidding is required.

UMS strongly recommends users of this data, especially project engineers-of-record, become orientated with the ASCE/CI 38-02 standard guidelines and the corresponding data limitations inferred by the designated quality levels prior to employing the data set for design purposes. **In addition, this report must always accompany the existing utility reference CAD file to ensure proper interpretation and usage of the data set.** Any questions regarding this submittal should be directed to the UE professional engineer-of-record.

State Law Caveat

A pragmatic professional effort has been made to systematically designate and depict buried utilities within the corridor to the extent practical for the authorized project budget. Final utility plans are for design purposes only and reflect subsurface utility conditions at the time surveyed. Existing utility locations depicted on the plans do not supersede One Call demarcations of buried utilities or relieve the contractor from the legal requirement to call Blue Stakes of Utah two business days prior to construction. UMS and the project design engineer should be notified of any discrepancies between the utility designating survey and One Call markings, and the contractor shall use caution until discrepancies are resolved. **Contractor shall call the utility notification service, Iowa 811, 1-800-292-8989 (or Call 811), before excavating as required by Law.**

IOWA 811 ONE CALL

SEAL

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

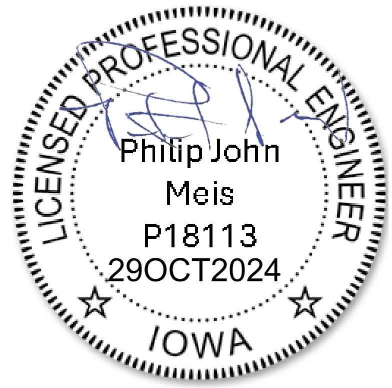
Philip J. Meis, P.E. Digitally signed by Philip J. Meis, P.E. Date: 2024.10.29 13:52:47 -06'00'

29 October 2024

Philip J. Meis, P.E. Date

License Number: P18113

My license renewal date is: 31 December 2025



Appendix A - Utility Designating Synopsis

The project utility designating investigation was performed in a systematic and practical manner, complying with policies promoted by the Federal Highway Administration (FHWA) and adhering to established standard guidelines published by the American Society of Civil Engineers (ASCE), Construction Institute (CI) and Utility Engineering and Surveying Institute (UESI), *Standard Guideline for Investigating and Documenting Existing Utilities* (ASCE/CI/UESI 38-22) Reston, VA 2022, herein referred to as "ASCE 38".

SUE and ASCE 38 Standard Guidelines

Perhaps the most significant contribution of ASCE 38 is the development of a formalized procedure for qualifying and designating the general quality of the depicted individual facilities. Table A1 provides a summary of the four quality level (QL) definitions included in ASCE 38 with comments on the relative positional accuracy for the corresponding quality levels. Table A1 is intended for providing supplemental information only; please refer to ASCE 38 for a full and official definition of the QLs and the standardized methods for collecting and depicting subsurface utilities.

A significant professional investigative effort is required to achieve and assign the ASCE 38 Quality Levels associated with the resulting depictions of existing utilities. The services rendered also results in the assumption of a significant level of professional liability by the Subsurface Utility Engineer (SUE) professional who must achieve an associated standard of care and be able to produce sufficient documentation to prove this in court. The following excerpt from the latest version of ASCE 38 helps to differentiate this effort from that performed by the damage prevention industry (i.e., Call 811 and contract locating services).

> The damage prevention industry calls marks on the ground a "Utility Locate" whether the utility is confirmed or not. A specific engineering term (i.e., **designating**) was defined in 1983 to differentiate:
>
> a. SUE markings placed on the ground solely by appropriate geophysics for subsequent survey and judged depiction by professionals or staff under their direct supervision (a **designation**), from
> b. marks on the ground placed by utility owners or their contractors (from any source such as records, limited geophysics, guesses) for damage prevention purposes (a utility locate)
>
> A common misperception of marking accuracy is promulgated through non-engineers or surveyors involved in crafting One-Call legislation where their term for an "accurate" locate mark is not referring to physical accuracy but rather a statutory mechanism for who pays for a damage repair if the utility company marks the utility in error by more than 2 feet (0.6 meter).
>
> ASCE 38 deals with ***utility position engineering uncertainty*** rather than statutory language that incorrectly uses or implies the term "accuracy." **Engineers** use the term "**utility locate**" to mean that an underground utility has been ***exposed and can be measured with an accuracy and precision***.

Therefore, ASCE 38 uses two specific terms, ***designating*** and ***locating***, to distinguish professional SUE activities associated with assigning quality levels to a utility depiction used for design purposes. The following are definitions from ASCE 38:

> **Designating**: The application and interpretation of shallow-earth geophysical methods to infer (with or without surface markings) the existence and the approximate horizontal position and when possible and part of the scope of work, depth, of a subsurface utility segment and/or utility feature.
>
> *Additional context*: Designating is not utility quality level B; however, referencing the geospatial locational accuracy of the designations to the project survey datum and applying professional judgment for potential alignment adjustments that considers other relevant information in hand at that time may lead to a horizontal documentation of that investigated subsurface utility segment or utility feature as utility quality level B.
>
> **Locating**: The process of exposing and verifying a utility for purposes of determining its function, type, position, outside dimensions, and other observable attributes at its exposed point.
>
> *Additional context*: Locating is not utility quality level A; however, referencing the locational accuracy of the exposed utility to the Project Survey Datum and applying professional judgment that considers other relevant information in hand at that time can lead to the assignment of utility quality level a to the exposed portion of that utility segment or utility feature. Measured and observed attributes may be used to confirm, add, or edit attributes of contiguous existing utility segments.
>
> When performing work in accordance with ASCE 38, deliverables are sealed as professionally prepared documents by an appropriate professional(s). For the purposes of this standard, the term “professional” represents mainly professional civil engineers with the applicable training and experience; however, the term may also include licensed surveyors, geophysicists, or geologists, depending upon jurisdictional requirements or allowances for responsible charge of performing and sealing such work.

Adherence to ASCE 38 depiction standards, along with the use of records research, geophysical methods, vacuum excavation, and engineering survey combined in a phased approach and guided by professional judgment, has often been referred to as Subsurface Utility Engineering (SUE). In proper context SUE is part of a rather complex and important series of Utility Engineering (UE) tasks, procedures and associated responsibilities established to: 1) identify and manage utility related risk; and 2) engineer solutions to integrate utilities within the project to promote efficiency and reduce costs. SUE, in fact, provides the data set with which the utility engineering process begins.

Utility engineering involves utilizing the SUE qualified utility data sets for a variety of activities including:

- systematically identify, itemize, and define apparent conflicts between proposed designs and existing utilities;
- optimize design development and mitigate utility conflicts;

- identify and accommodate other infrastructure, planned betterments and new installations;
- conduct effective utility coordination in which resolutions to conflicts are derived that serve the best interests of the public and all stakeholders involved;
- develop construction plans and bid documents which concisely identify and provide details of outstanding conflicts for construction planning, bidding, and execution;
- encourage value engineering and mitigation of cost implications to all infrastructure systems which provide service to commerce, government, and the general public;
- implement practices and standards for efficiently acquiring accurate utility data on new installations as they are built; and
- implement lifecycle asset management practices for resiliency preparedness and optimizing use of valuable public right of way.

Table A1. ASCE 38 quality levels (QLs) for depicting facilities in accordance with SUE protocol (with supplemental explanation shown in red).

QL	Description	Resulting Positional Accuracy and Data Completeness
A	A value assigned to that portion *(x-, y-, and z-geometry)* of a Utility Segment of subsurface Utility Feature that is directly exposed and measured and whose location and dimensions are tied to the Project Survey Datum. The assignment of QLA conveys the lowest level of relative (nonquantifiable) uncertainty of measurable and judged Attributes and location. QLA is more certain that QLB, QLC, or QLD.	The Utility Segment or subsurface Utility Feature shall be tied to the Project Survey Datum with an accuracy of 0.1-ft (30 mm) vertical and to 0.2-ft (60 mm) horizontal for the measurements of the outside limits of the Utility Feature or Utility Segment that is exposed. Other measurable, observable, and judged Utility Attributes are also recorded. If obtained by means of a Test Hole observation, a verification effort is made, and professional judgment is used to assert that the exposed infrastructure is indeed the sought target.
	*In some cases, an **apparent** minimum depth of clearance is provided. This is not QL A data as the utility has not been exposed. The utility apparently lies in line with the Test Hole but is deeper than can be reached via vacuum excavation based on the detected geophysical signal. However, the minimum depth data is provided for informational purposes for planning consideration.*	
B	A value assigned to a Utility Segment or subsurface Utility Feature whose existence and horizontal position is based on Geophysical Methods combined with professional judgment and whose location is tied to the Project Survey Datum. QLB is more uncertain that QLA and more certain than QLC or QLD.	A QLB value is assigned to a Utility Segment when the following conditions are met: (1) the Utility Segment was detected through the application of appropriate Geophysical Methods; (2) the geophysical signal was judged to be reliable; (3) the interpreted position was judged based on knowledge and use of geophysical science, Utility design and installation practices, available records, visual features, and influence of site conditions; and (40 the source Designation has been tied to the Project Survey Datum with an accuracy of 0.2-ft (60 mm) horizontally.
	QLB data should be reproducible at any point of their depiction using surface geophysical methods. However, only the point of peak signal is mapped; consequently, while a QLB point can be reproducible using geophysics, the signal can be distorted due to the superposition of EM fields from adjacent conductors and not lie horizontally above the target. Experienced SUE operators help identify and mitigate these issues. However, QLA data is often recommended for design / construction work to be performed in the immediate proximity of QLB depicted utilities to provide definitive positional accuracy. Positional accuracy statement with confidence level **is not feasible** unless electromagnetic (EM) fields are completely mapped and statistical analysis is used to derive alignments from the linear anomalies; in addition, sufficient ground truth sampling (e.g., test holes) is required. This level of geophysical survey and analysis effort required is often not practical or cost effective. In practice, experienced SUE designators can determine utility alignments reasonably well. Professional judgment is exercised to distinguish incidents of "bleed-over" and when apparent alignments don't make sense. Available utility records are compared with field findings to confirm completeness of the QL B data. QL B rating, as a rule of thumb, is generally estimated to +/- 1 foot horizontally for utilities less than 5 feet deep. Inductive electromagnetic signals diverge spherically, which is to say deeper targets have broader and weaker peak inductive signals; consequently, horizontal accuracy degrades with depth. Utilities over 10 feet deep are very difficult to position horizontally using standard inductive EM equipment. Vertical accuracy cannot be reliably derived using conventional inductive EM methods as computed depths are often inconsistent and can be highly misleading unless regular ground truth (i.e., test holes) are available to confirm accuracy. However, recent research indicates combined and systematic usage of independent geophysical methods can produce reliable depth information if performed with careful analysis and professional judgment.	

C	A value assigned to a Utility Segment not visible at the ground surface whose estimated position is judged through correlating Utility records or similar evidence to Utility Features, visible aboveground and/or underground. A QLC value judgment is assigned to a Utility Segment by using visible Utility Features to approximate the position of a Utility Segment between or in proximity to the visible Utility Features and in context with other achieved Utility Quality Levels. QLC only pertains to the underground Utility Segment(s), not the Utility Feature(s). QLC data is more certain that QLD and is more uncertain than QLB and QLA.	The Utility Anchor Point on the Utility Features shall be tied to the Project Survey Datum with an accuracy of 0.2-ft (60 mm) horizontal.
	QLC is usually used to map non-conductive pipes, deep utilities, or when EM signal interference and distortion is too significant. The alignments between surface features (e.g., vaults, manholes, pedestals, etc.) is to schematic levels, providing general direction of alignment. Typically, according to FHWA studies, 15% to 30% of the utility data may be erroneous or missing.	
D	A value assigned to a Utility Segment or Utility Feature not visible at the ground surface whose estimated position is judged through Utility records, information from others, or from visual clues such as pavement cuts, obvious trenches, or existence of service.	Data may be completely erroneous. Only the records, verbal accounts, or visual clues indicate the depicted utility may be in the vicinity.

Appendix B - Geophysical Instruments and Methodologies

Ground Penetrating Radar Method

Ground penetrating radar (GPR) is an active geophysical method that transmits electromagnetic pulses from surface antenna into the ground and records the time elapsed between when the pulses are sent and received back (two-way travel time) and the waveform of the returned signal. As radar pulses are transmitted through various materials on their way to the target feature their velocity will change depending on the physical and chemical properties of the material through which they are traveling. When the travel times of the energy pulses are measured and their velocity through the ground is known the depth below ground surface can be accurately measured.

A multichannel GPR unit provides a ribbon of high-density data in the same amount of time a conventional single-channel GPR can provide a strand of high-density data. Advancements in GPR acquisition technology have enabled an escalation in collection speed to include the addition of rapid vehicle mounted collection in areas with limited obstacles.

Survey Design

An estimation of the GPR radiation footprint is important when designing transect spacing and determining which antenna frequency to use to ensure all target subsurface features and enough of the extended subsurface region are contacted by the transmitted radar energy to generate enough reflections to differentiate subsurface features.

The depth to which radar energy can penetrate depends largely upon two factors: 1) the frequency of the antenna being used to transmit the radar energy, and 2) the characteristics of the soil being surveyed, most specifically water content. Soil water content has been shown to have the highest impact on the depth to which an EM pulse can travel by affecting how much energy attenuation occurs. The other two major characteristics affecting energy propagation are the electrical and magnetic permeability of the subsurface materials.

A trade-off exists between depth of penetration and subsurface resolution. Low frequency antennas (10-120 MHz) are best at resolving large deep subsurface features due to the generation of long wave-length radar energy that can penetrate down to 50-meters or more under ideal conditions. High frequency antennas such as a 900 MHz antenna can resolve features down to a few centimeters in diameter in the near subsurface with a shallow penetration depth of about 1-meter under ideal conditions.

GPR antenna radiates radar energy into the ground in a cone-shaped footprint with the apex at the source of the transmitting antenna. The lower the emitting antenna frequency the broader the transmission cone footprint. High frequency antenna (900 MHz or higher) GPR instruments produce narrow cones of propagation while lower frequency GPR antennas (200 or 300 MHz) can extend the radar energy-footprint a meter or more at depths of only one or two meters below the ground surface. The propagation of the cone of radar energy through the subsurface is further affected by the characteristics of the encountered materials. For example, the higher the relative dielectric permittivity (RDP) of the subsurface material through which the energy passes the lower the velocity of the transmitted radar energy and the narrower the conical transmission footprint becomes.
Reflection of emitted radar waves off any buried surface that contains ridges, troughs, or other irregular features can also focus or scatter reflected radar energy depending on the orientation of the reflecting surface and the location of the antenna on the ground surface. Radar scatter occurs when a

subsurface plane is convex-shaped or is inclined away from the surface antenna causing most of the reflected energy to be transmitted away from the receiving antenna and very little or no reflected energy to be received and recorded by the GPR instrument. When a buried surface is concave-shaped or is inclined toward the receiving antenna the reflected energy will be focused creating a very high amplitude reflection from the additional portions of the buried surface being received and recorded by the GPR instrument.

Recorded Data

The waveform structure of the wavelet (individual reflected waves) returned from the ground are digitized into a reflection trace. A reflection trace is a composite of many wavelets recorded from all depths contacted by the transmitted radar energy composed as a series of reflections generated at one location. When many traces are stacked next to each other a two-dimensional vertical profile is produced along the transect. Reflections are recorded about every 5 centimeters along transects as the GPR antennas are moved along the ground surface. Radar travel time is recorded in nanoseconds (billionths of a second).

Tomography

To create two-dimensional tomography of the recorded reflection data, all recorded reflection traces are displayed in a format where the two-way travel time of the reflected wavelets are plotted on the vertical axis with the surface location (or trace number) is plotted on the horizontal axis. In traditional two-dimensional GPR tomography a computer displays these profiles as black, white, and gray undulating horizontal bands which represent the combined recorded radar reflections. The distance along the profile is usually measured in meters and the two-way radar travel time is measured in nanoseconds, which can be converted to depth below the surface using the soil velocity of the scanned subsurface. Strong reflections generate distinct black bands, while medial reflections produce gray bands.

Additional processing using thousands of reflection traces and many profiles within a grid can then be used to produce three-dimensional tomographic images of changes detected in the subsurface features. Advanced processing of both two and three-dimensional tomography can provide clear indications of all recorded subsurface changes, including any anomalies.
Many bed boundaries and other discontinuities will reflect a wavelet of energy (a positive and negative amplitude wave) back to the surface to be recorded. Buried discontinuities occur where reflections are created by changes in the electrical or magnetic properties of the rock, sediment, or soil-matrix. Variations in water content, lithologic changes, or changes in bulk density at stratigraphic interfaces are indicated by these discontinuities. Reflections are generated when radar energy passes through interfaces between archaeological features and the surrounding soil-matrix, appearing as anomalies in the resulting profile. Void spaces in the ground, which may be encountered in burials, tombs, tunnels, caches or pipes, will also generate significant radar reflections due to the change in radar wave propagation velocity.

Each MCGPR pass along the roadway is recorded concurrently with the global navigation satellite system (GNSS) positioning. Real-time kinematic (RTK) positioning, a technique used to enhance the precision of position data derived from satellite-based positioning system (e.g., global positioning system or GPS) or a tower-based virtual referencing system (VRS), is integrated with MCGPR data recordings and used to derive 3D coordinates that could be related to the observed MCGPR anomalies.

Limitations

Limitations of MCGPR includes the ability to distinguish individual anomalies adjacent to one another. For example, anomalies immediately adjacent or vertically aligned may appear as an individual anomaly. As stated previously, quality of MCGPR data depends on the relative dielectric permittivity of the material through which the waves pass, and the frequency of the radar energy emitted from the antenna. This corresponds to the depth to which anomalies can be detected.

ImpulseRadar Raptor® High-Speed Ground Penetrating Radar

The Raptor® is a Federal Communications Commission certified high-speed ground penetrating radar (GPR) array manufactured by ImpulseRadar AB in Sweden. The system is the first multichannel GPR array to incorporate real-time digital sampling technology that allows the collection of 3D GPR data at posted highway speeds. Advanced digital technology provides increased depth penetration in most soils and a large bandwidth facilitates greater resolution of utility and other targets.

The data is then integrated into UMS's 3D underground utility mapping software allowing us to provide our clients with quality subsurface utility engineering (SUE) 3D mapping deliverables.

Providing superior data faster than any other system. This translates into more utilities detected in complex urban and industrial settings than is achievable with conventional SUE tools. The goal is to reduce overall project costs by mitigating unforeseen utility conflicts; and the Raptor®, coupled with UMS's rigorous approach using all available technology, is already delivering results.

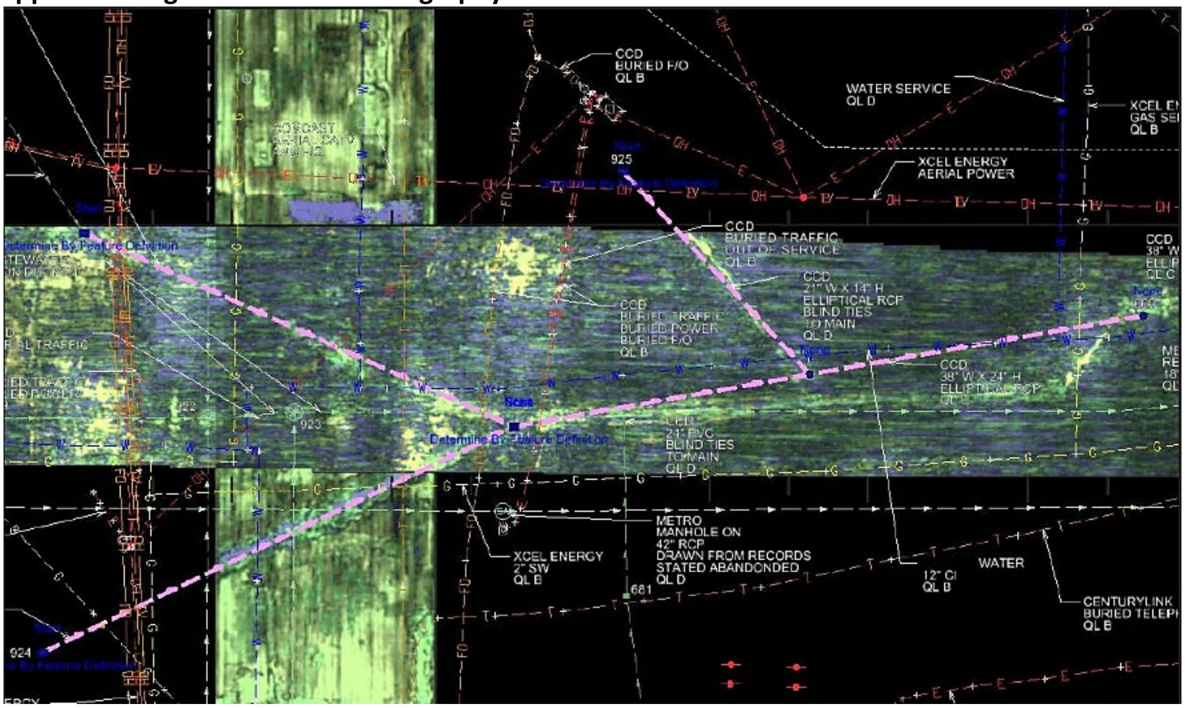
Features

- Collect data at posted highway speeds in most areas.
- High-resolution, dense 3D data coverage.
- Positioning to survey grade.
- Utility and other features are directly mapped to CAD software.

Benefits

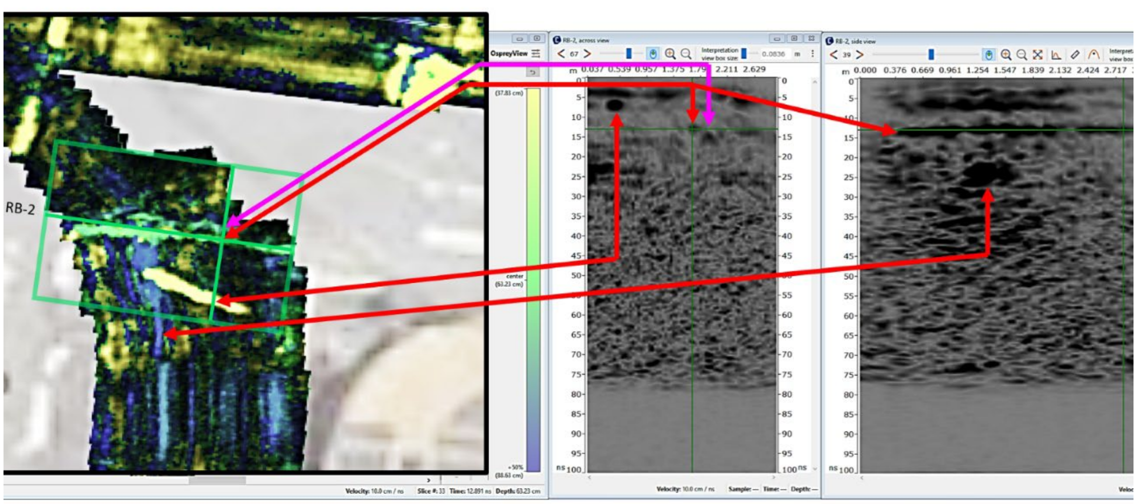
- Reduces project data collection costs and time.
- No lane closures or traffic control for most projects.
- Augments all sensor data for SUE investigations over large areas not practical with 2D GPR systems.
- Provides higher quality dense data to detect more underground facilities and other buried objects.

Appendix B Figure 1: MCGPR tomography overlaid with CADD.



Appendix B Figure 2: MCGPR tomography and time slice / depth cross section and profile views

Depth Centered at 2.07 feet



Appendix C – SUE Kickoff Meeting Minutes

Gordon Drive Viaduct Project Phase 1 Utility Investigation (SUE) Kickoff Meeting

7/6/2023
3:00 PM
Microsoft Teams

Meeting called by:	Utility Mapping Services, P.C.	Type of meeting:	SUE Phase 1 Kickoff Meeting
Facilitator:	Collin Kubinski	Note taker:	Nate Greer, Collin Kubinski
Timekeeper:	Collin Kubinski		

Attendees:

Nate Greer – UMS – Project Coordinator
Collin Kubinski – UMS – Staff Engineer/Assistant Project Manager
Paul Knievel – HDR – Transportation Engineer
Kelly Mulvihill – Iowa DOT – Engineering Operations Technician
Jason Klemme – Iowa DOT – Construction Engineer
Sean Hostetter – Lumen – Engineer
Justin Melohn – Lumen – Engineering/Construction Manager
Tom Connors – Long Lines
Tyler Ahlquist – MidAmerican (Natural Gas) – Local Engineer
Evan Hoffman – MidAmerican (Electric) – Engineer
Mark Hoogwerf – MidAmerican (Natrural Gas) – Engineering Manager
Alexander Karpuk – MidAmerican (Electric) – Distribution Engineering Manager
Casey Meinen – MidAmerican (Electric) – Distribution Lead
Max Balzer – MidAmerican
Sam Wagner – MidAmerican

<u>Invited, but not in attendance</u>
AT&T
Aureon
Sioux City
FiberComm
Midwest Fiber Networks
Redflex
Sparklight
T Mobile
Verizon

Meeting Notes/Minutes

Agenda item: Introductions, SUE Project Description and Location **Presenter:** Collin Kubinski (UMS)

Discussion:

- Noted that meeting is being recorded
- Subsurface utility mapping project location in Sioux City, IA

Agenda item: Meeting Agenda Overview **Presenter:** Collin Kubinski (UMS)

Discussion:

- Overview of the meeting, discussion items, and goals of the utility mapping project.
- UMS is aware of the following utility owners within the project limits, and please notify UMS, HDR and/or IOWADOT if aware of any other utility owners not listed:
    - AT&T
    - Aureon Network Services
    - BNSF Railway
    - CenturyLink (Lumen)
    - FiberComm L.C.
    - Iowa Department of Transportation (IOWADOT)
    - Long Lines Broadband
    - MidAmerican Energy Company
    - Midwest Fiber Networks
    - Redflex Traffic Systems (**Reportedly Clear**)
    - Sparklight (Cable One)
    - T-Mobile (Sprint Nextel)
    - Union Pacific Railroad
    - Verizon

Action Item (**UMS**): Metronet was called out as expanding into the area, need to reach out to them for possible records.

Agenda item: Existing Utility Mapping Standards, Project Limits, Proposed Improvements **Presenter:** Paul Knievel (HDR)

Discussion:

- The project limits were visually presented.
- Proposed Improvements
    - Paul – Introduced limits, viaduct replacement, connections into stockyards, viaduct originally constructed in 1936, newer part built in 60s, full reconstruction.
    - Replacing bacon creek conduit
    - Currently in location study, confirmed alternative by years end and displayed likely option of alternative
        - Alternative shown displayed viaduct over railroads and second structure over bacon creek
- Dates
    - Public hearing will be after January 1st of 2024
    - Design start around January 1st of 2024
    - Field exam plan set June 2024
    - Utility coordination shortly after (October 2024)
    - Bid letting fall of 2027

Agenda item: SUE Project Goals **Presenter:** Collin Kubinski (UMS)

Discussion:

- UMS will follow ASCE/CI 38-22 standards when developing the existing utilities base map.
- Explanation of Quality Levels A, B, C and D per CI/ASCE 38-22 Standards
- UMS has scoped and will attempt to map everything to Quality Level B
    - Discussed limitations that exist with existing utilities and where each different Quality Level (A, B, C, or D) may be anticipated during the SUE Phase 1 Mapping effort.
        - Storm and Sewer will most likely be mapped to a Quality Level C.
        - Non-conductive utilities without tracer wire will likely be mapped to Quality Level D.
        - Non-conductive utilities with surface features (e.g. water mains with valves) will likely result in Quality Level C alignments when records can provide definitive confirmation of presumed straight-line connectivity; however, QL C designation and depiction means the alignment is interpolated between surface features and is without geophysical confirmation of the true alignment. Significant horizontal deviations of the true alignment from that depicted are still possible with QL C designation.

Agenda item: SUE Field Ops and Utility Owner Participation **Presenter:** Nate Greer (UMS)

Discussion:

- UMS and Utility owner records review/exchange, for purposes of requesting QA/QC review, data will likely be shared
- Schedule field meets as needed
- Access to facilities/field knowledge
- Some records show abandoned, UMS prefers to depict them. Let a contractor know if out there.
- Verified that all field designation and utilities are accessed

Tom Connors requested to be notified before UMS field personnel accesses Long Lines

Casey Meinen suggested UMS field personnel notify MidAmerican prior to accessing facilities **on property** of service center and the north side of Kellogg

Sean Hostetter provided Dale Mruz 402-533-3991 dale.mruz@lumen.com construction administrator to add to contact list

Sean asked what UMS does when utility manholes are involved as Lumen has some in the project

> Nate-historically we are not trying to enter the manhole, it depends on if there's trace wire up by the lid or there is not. Our guys are confined spaced trained, and they will follow those procedures if they need to get in. We are trying not to as much as possible. New standard requires us to measure inside of vault. We have different equipment that allows us to not have to enter, for example the LiDAR.
>
> Sean- that is fine with me, if you do need to get in, just give us a heads up and we can get someone out there to make sure everything goes smoothly

Action Item (**UMS**): Give notice to Long Lines, MidAmerican and Lumen prior to accessing facilities

Nate- Made a general comment about what UMS does is for the benefit of everyone, the better job they do of mapping utilities, the happier the DOT is and the easier it is to coordinate down the line. UMS Field personnel is used to personnel from utility companies coming out and checking them out. They like to leave everything in as good or better condition as we found it. They will also let you know if we find anything unsafe or abnormal in any of the facilities they access and notice.

Sean- Will we see the end results of the mapped-out product?

> Nate- UMS will turn our information into HDR who turns it into the DOT, so UMS does not mind but it would be up to HDR and the DOT since it is their project
>
> Paul- I don't know that we would have a problem with that, we would defer that to Kelly
>
> Kelly – My experience with it is it has always been on the construction plans, but I don't think so. We are going more to a GIS system. I don't have a clear-cut answer, might be more of a question for Jessic or Shane
>
> Paul – we can follow up on that and let you know Sean

Nate- I prefer to share it, you might see stuff we mapped that you didn't know was locatable, vice versa you may see something that you know about that we didn't find and can point out.

Jason- I think we can achieve sharing information electronically, let's route it through HDR and make sure everything is "mapped" and not share the raw data. Want each entity to review the results and then let us know.

Action Item (**HDR and IowaDOT**): Determine if mapped data can be shared with utility owners and follow up with Sean

Collin- Do any utility owners have any long lead or high priority utility facilities

Alexander- At the west end of viaduct we have both full circuits that come out of substation and travel along the south side of viaduct, quite a bit in the area and would take quite a long time for us to relocate.

Mark- 16" steel gas main will have a long lead time associated with it

Tom- once we get more of a plan, we will know what long-lead facilities we need to worry about

Collin- Any new installments planned

Casey- not MidAmerican on electric side

Sean- not aware but always growth, I will have to contact city engineers to keep you updated or I can keep you updated. On west end at Court Street and south of Fairmont Street.

Mark – don't have new installations planned

Agenda item: Equipment Utilized on The Project **Presenter:** Collin Kubinski (UMS)

Discussion:

- UMS uses non-destructive equipment, EM pipe and cable locators, magnetometers, rodders etc.

Agenda item: Phase 2 SUE Services **Presenter:** Collin Kubinski (UMS)

Discussion:

- Description of the operations and the data collected from the SPAR
- Description of the operations and the data collected from the MCGPR
- Explanation of the need of test holes
    - Used to identify elevation to confirm, refute, or more accurately coordinate relocations
    - Used to collect accurate depth information
- Description of the operations and the data collected from the LiDAR

Agenda item: SUE Phase 1 and 2 Schedule **Presenter:** Collin Kubinski (UMS)

Discussion:

- UMS field work starting mid-July 2023
    - Anticipated completion October 2023
- UMS field work tentatively starting spring/summer 2024
    - Elevation is possible to be wanted in 2024 but may be more likely in 2025
        1. If beginning spring/summer 2024, anticipated completion fall of 2024
        2. If beginning spring/summer 2025, anticipated completion fall of 2025

Agenda item: Question and Answer **Presenter:** Nate Greer (UMS)

Discussion:

- Nate- if you know the maps that are typically provided by your company aren't the best and you know you can access better stuff, please provide us with better mapping
- No other questions asked
- The meeting adjourned at 4:05 PM

Please utilize the link below, copy and paste or type it into your web browser to access or download the meeting Agenda, Meeting Minutes, a recording of the meeting, or a copy of the Power Point presentation viewed during the meeting.

Link to Teams Meeting