

SURVEYING THE UNDERGROUND

**Maryland Society of Surveyors
Fall Conference
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A/I/DATA**

SURVEYING THE UNDERGROUND

We are here to discuss the professional practice of locating, surveying and mapping underground utilities

- Review MD One Call (Miss Utility) law and practices; some One Call laws in adjoining States
- Review the standard known as ASCE 38-02 which describes the practice of Subsurface Utility Engineering (SUE).
- Look at some technical aspects of locating UG utilities
- Answer your questions about locating UG utilities

SURVEYING THE UNDERGROUND

Audience Q&A

- Why are you here today?
- What are your experiences with underground utility locating?
- What do you want to know about surveying and mapping underground utilities?
- What are the challenges associated with underground utilities faced by the surveying community?
- How do you deal with liability issues associated with underground utility systems?
- Do you want to locate underground utilities in-house?
 - All projects or just selected ones?
- What do you know about SUE? How about ASCE 38-02?
- What are your One Call experiences?

How should this shape our presentation today?

THE CHALLENGE



Source: Federal Laboratory Consortium for Technology Transfer

COMPLEX UTILITY LAYERS UNDERGROUND

THE CHALLENGE



INCREASING COMPLEXITY UNDERGROUND



INCREASING COMPLEXITY UNDERGROUND



TRACE WIRE NEEDED IF UTILITY MATERIAL IS NON-CONDUCTIVE

NEPTCO DATA



RT Series - 19 gauge conductor

Description

Water blocking reinforced tracer wire used for direct burial locating purposes in the telecommunications, gas, sewer or water utilities. Insulated metallic conductor enables location of all-dielectric cables, gas lines, sewer lines or water pipes.

Features & Benefits

- ▲ Durably printed with sequential footage or meter markings*
- ▲ Conductor additionally protected by product construction
- ▲ Market specific coloring for easy identification
- ▲ Water blocking yarns
- ▲ Polyethylene jacket
- ▲ Low elongation for enhanced worker safety
- ▲ Lightweight and easy to handle and install
- ▲ Packaged on sturdy recyclable plastic reels
- ▲ Corrosion-resistant conductor functions at a wide range of frequencies and is compatible with any standard transmitting/receiving equipment
- ▲ Fungus Resistant
- ▲ NEPTCO TRACE-SAFE identification tags included with every reel



Please refer to NEPTCO's TRACE-SAFE Water Blocking Tracer Wire Splicing Instructions.

TRACE-SAFE WATER BLOCKING TRACER WIRE PRODUCT ORDERING INFORMATION

PRODUCT	COLOR CODE	MARKET	STRENGTH lbs (kg)	Nominal Diameter
RT1800W	Orange	Telecommunications	1800 (818)	.235*
RT1801W	Yellow	Gas	1800 (818)	.235*
RT1802W	Blue	Water	1800 (818)	.235*
RT1803W	Green	Sewer	1800 (818)	.235*
RT1804W	Purple	Reclamation	1800 (818)	.235*

* Also available unprinted
** Patent Pending

PLEASE SEE REVERSE SIDE FOR ADDITIONAL INFORMATION



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Phone: 401.722.5500 • Toll-free: 800.354.5445 • Fax: 401.722.6378 • Web: www.neptcotracewire.com

NEPTCO DATA



RT Series - 19 gauge conductor

Conductor Data

AWG	19 Tin Coated Solid Copper
Diameter	.0358" Nominal
Resistivity	16.85 OHMS per MFT
Tensile Strength	38,500 psi Nominal
Break Strength	38.95 lbs. Nominal
Elongation	30%

Conductor Insulation Data

Type	Polyethylene - Black Color
Thickness	.006" Nominal
Overall Thickness	.048" Nominal
Maximum Voltage	300 V Insulated
Dielectric Constant	2.29 @ 1 MHz

Core Material

Type	Woven polyester and water blocking polyester yarns
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Outer Jacket

Type	High Density Polyethylene
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WARNING TRACE-SAFE™ Water Blocking Tracer Wire: To promote detection of underground cables and utilities – As with any conductor, it has the potential to transfer electrical energy. Do not pull, strap, bind or lift items with this product.

NEPTCO warrants that its products will work in a manner consistent with the capabilities described in the data sheet. This warranty shall be void if the product has been tampered with or improperly used. Except for the express warranty and limited remedies described above, NEPTCO disclaims all other warranties including implied warranties. NEPTCO and its authorized agents shall have no other liability beyond the price of the product for damages to a purchaser, including consequential damages, occurring in connection with the use or performance of the product.



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WHAT ARE TRADITIONAL METHODS TO MAP UTILITIES?

Records research

Field survey of surface features

- Valves, hand boxes, meters, manholes, hydrants

Perhaps locate One Call marks

Fit record information to surface evidence & marks

Disclaim responsibility for underground utilities – “per plan”

TRADITIONAL METHODS MAY RESULT IN INACCURATE DEPICTIONS

Subsurface utilities are underground and all covered up

- One Call marks are not necessarily reliably accurate

Utility records :

- Not Always Available
 - Homeland Security
 - Privacy concerns
 - Lost
 - Not drawn
 - Personnel and other costs for utilities to share records
- Not Always Reliable
 - Not As-built
 - Surrounding conditions have changed

MD ONE CALL LAW

Designer Tickets

§12–131 (a) In connection with a project that may require excavation or demolition, a designer may initiate a ticket request by notifying the one–call system serving the geographic area covering the planned project.

(b) A designer initiating a ticket request under this section:

- (1) may initiate **only one ticket request for a single project**; and
- (2) shall, in connection with a ticket request:
 - (i) indicate that the request is for **design purposes only and may not be used for the purpose of excavation** or demolition;
 - (ii) notify the one–call system of any owner–members from which the designer does not require underground facilities information; and
 - (iii) on the request of an owner–member, provide the owner–member with a preliminary drawing that indicates the scope of the project.

MD ONE CALL LAW

§12–131.

(c) (1) Within 15 business days after receiving notice from a one–call system that a designer has made a request under this section, an owner–member of an underground facility in the area of the project shall notify the designer of the type and approximate location of the underground facility.

(2) An owner–member may provide notice of the approximate location of an underground facility through the use of:

- (i) field locates; (ii) maps; (iii) surveys;
- (iv) installation records; or
- (v) other similar means.

(d) (1) Information provided to a designer under this section is for informational purposes only.

(2) An owner–member or agent of an owner–member may not be held liable for any inaccurate information provided to a designer under this section.

VA ONE CALL LAW

VA Law - § 56-265.17:3. Procedures for operators in response to a designer notice.

An operator, upon notification by a designer in accordance with § 56-265.17:1, shall:

- 1. Respond to the designer's request for underground utility line information within fifteen working days in accordance with subdivisions 2, 3, and 4 of this section;**
- 2. Provide designers with the operator's name, the type of underground utility line, and the approximate horizontal location of the utility line. The foregoing information may be provided to the designer through the means that include, but are not limited to, field locates, maps, surveys, installation records or other means. If the designer requests field locates, the operator shall provide field locates in accordance with the accuracy set forth in subsection A of § 56-265.19 (“the operator shall mark the approximate horizontal location of the underground utility line on the ground to within two feet of either side of the underground utility line by means of stakes, paint, flags, or a combination thereof”).**

VA ONE CALL LAW

Marking shall be done by both paint and flags whenever possible;

3. Provide such information about the location of the utility lines to designers **for informational purposes only. Operators will not be liable for any incorrect information provided or for the subsequent use of this information, nor will they be subject to civil penalties for the accuracy of the information or marks provided.** Any concerns about the accuracy of information or marks should be directed to the appropriate operator; and
4. Respond to the operator-excavator information exchange system by no later than 7:00 a.m. on the sixteenth working day following the designer's notice to the notification center.

PA ONE CALL

Project Owner

The Project owner is any person who or which engages an excavator for construction or any other project which requires excavation or demolition work.

The Project owner responsibilities under the Act during design stage are as follows :

To utilize sufficient quality levels of Subsurface Utility Engineering or other similar techniques whenever practicable to properly determine the existence and positions of underground facilities when designing known complex projects having an estimated cost of four hundred thousand dollars (\$400,000) or more.

"Subsurface utility engineering" or "(SUE)" means those techniques set forth in the American Society of Civil Engineers (ASCE) standard CI/ASCE38-02 or its successor document.

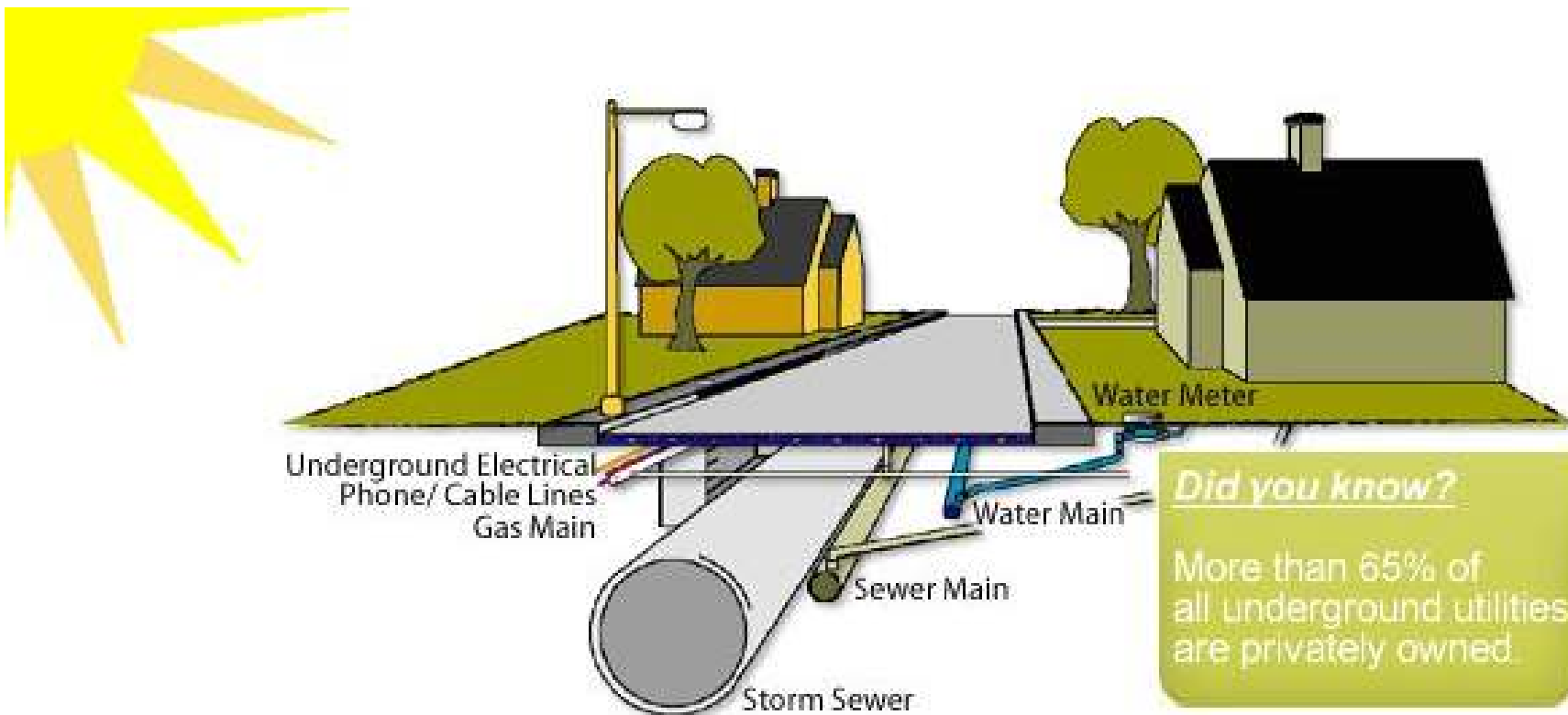
To not release to bid or construction any project until after final design is completed;

To participate in design and preconstruction meetings either directly or through a representative.

The designer is required to attend preconstruction meeting on complex projects.

Designers who comply with the terms of the act and not otherwise negligent not subject to liability for injury to persons or property as a result of his excavation or demolition planning work

PRIVATE UTILITIES NOT MARKED BY ONE CALL PROCESS



Hot & Chilled Water
Systems
Steam Systems
Telecommunication

MTA – Light Rail
JHH – Steam
UMMC
JHU - APL

OUR ONE CALL EXPERIENCES

Gas line mis-mark – Carroll County – an excavator ticket

“It’s just a designer ticket” – Arcola Avenue

Designer ticket areas tend to be larger than excavation ticket areas.

- Financial disincentive (fixed fee per ticket) and lack of liability

WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?



WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?



WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?



WHAT IF RELIABLE INFORMATION IS NOT AVAILABLE?

**Incomplete or inaccurate
data models**

Poorly informed designs

**Designs that cannot be
executed or constructed as
planned**

Construction delays

Re-designs

Change orders

Cost increases

Back charges

Lawsuits

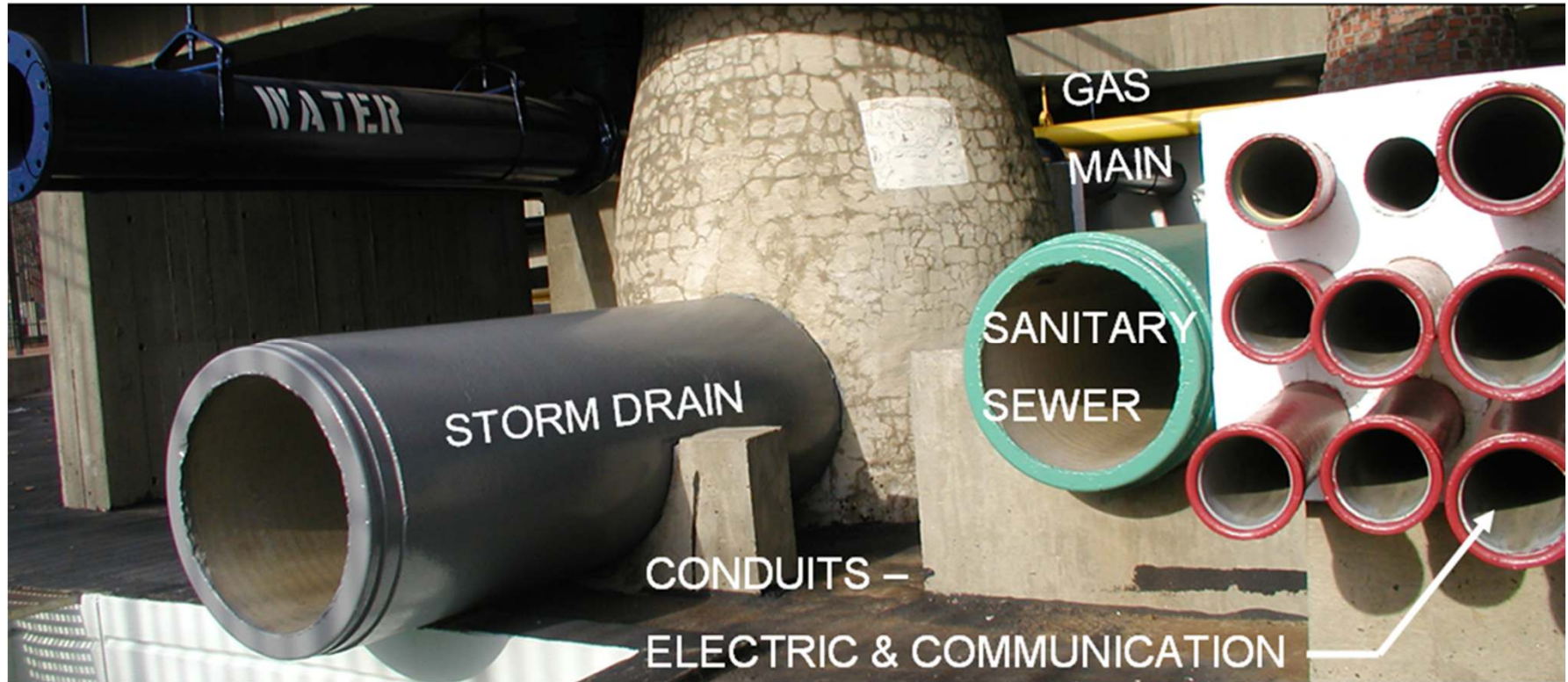
Damages

Insurance claims

**Increased operating
costs**

Loss of profits

**Loss of client
confidence, loss of
client**



THE NEED TO KNOW HORIZONTAL AND VERTICAL POSITIONS & TYPE, SIZE AND LOCATION OF EXISTING SUBSURFACE UTILITIES LED TO THE DEVELOPMENT OF SUBSURFACE UTILITY ENGINEERING

SUE HISTORY

1981 So-Deep, Inc. founded to dig A/V test holes

1983 – Jim Anspach adds geophysics

1984 – VDOT successful use of SUE

**1989 – Subsurface Utility Engineering named – FHWA
National Highway Utility Conference**

1995 FHWA SUE handbook developed

SUE & FHWA

1990'S – (Early) – Federal Highway Administration (US DOT)

- Aggressively promotes use of SUE
- Defines “quality level” outcomes
 - ‘D’ –records only
 - ‘C’ – adds surveyed utility features
 - ‘B’ – includes surface geophysical techniques to determine the existence and horizontal position of utilities
 - ‘A’ –excavation to determine the precise H & V position, and type, size, material and condition of underground utilities and structures

1990's – (Late)

- FHWA funds Purdue University study published in 2000
 - \$4.62 in avoided costs for every dollar spent on SUE activities
- FHWA helps fund development of national standard

CI/ ASCE 38-02

Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data

©2003 – American Society of Civil Engineers

- Increasing complexity of national subsurface infrastructure
- Subsurface “unknowns” create risks on construction projects
 - Many records are inaccurate, incomplete, out of date
- Utility Owners (One Call)– in most states a **construction excavation period service**
 - Post-design & after bidding
 - VA & MD have Designer Tickets – Informational only,
 - NO LIABILITY FOR INACCURATE INFORMATION
 - When conflicts arise during construction solutions are costly
 - change orders, extra work orders, insurance payouts and contingency pricing

ASCE 38-02

Scope of 38-02

- Consensus standard
- Defines quality of utility depictions
 - Associated attribute data
- Addresses implementation
 - Methods
 - Available technologies
 - Communication of data

Intent of 38-02

- Establish classification system to describe quality of data associated with existing subsurface utilities
- Facilitate Communication about the quality of utility data needed or provided for construction documents

DEFINITION

Subsurface Utility Engineering – A branch of engineering practice that involves managing certain risks associated with: utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design.

KEY TERMS

Designating

- Interpret the presence of subsurface utility through surface geophysical methods
- Mark its approximate horizontal position on the ground

Locating

- Expose and record the precise vertical and horizontal location of a utility.

Surface Geophysical Method

- Any of a number of methods designed to utilize and interpret ambient or applied energy fields for the purpose of identifying properties of, and structure within, the earth. Such methods typically include variants of electromagnetic, magnetic, elastic wave, gravitational, and chemical energies.

Utility Depiction

- A visual image of existing utility information in a computer-aided design and drafting system (CADD) or on project plan sheets.

Utility Quality Level

- A professional opinion of the quality and reliability of utility information.

QUALITY LEVEL 'D'

QL D

- Information derived from existing records
- Sources
 - State and local utility departments
 - One Call Center
 - Landowners
 - Internet
 - Utility companies
- Types of Records
 - Construction Drawings
 - Conduit , Distribution and Transmission Maps
 - As-builts
 - Oral Histories
- May include a field visit to look for visual cues to utility systems
- Composite drawing plotted for schematic representation without registration to ground features – all representation are at QL D
- May be adequate for preliminary planning purposes

QUALITY LEVEL 'C'

QL C

- Perform QL D tasks
- Identify and field survey, process and plot utility surface features
- Correlate applicable utility records to surveyed features considering record utility system geometries
- Determine conflicts between records and surface features and attempt to resolve discrepancies, if possible
- The Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to QL D
- May result in a combination of QL C and QL D depictions

QUALITY LEVEL 'B'

QL B

- Perform QL C Tasks
 - May be done in conjunction with QL B activities
- Select an appropriate suite of surface geophysical methods
- Apply surface geophysics to search for utilities
- Interpret the geophysics in the field or office depending on method
- Mark and survey indications of subsurface utilities
- Depict approximate horizontal positions of all detected utilities
- *Surveys of depicted positions must be merged with field records & historic documentation through professional analysis and judgment to produce final mapping.*
 - QLB data to be reproducible by surface geophysics at any point of depiction
 - Positions surveyed to applicable project standards
- Recommend to project owner when additional methods such as test holes may be needed to determine positions

QUALITY LEVEL 'A'

QL A

- Perform QL B tasks at appropriate project locations
- Excavate test holes to expose the utility to be measured
- Minimally intrusive excavation
 - Air-vacuum & sometimes hydro-vacuum extraction
 - Hand dig
 - Sometimes as built measurements during construction
- Actual exposure or verification of previously exposed and surveyed utilities and subsequent measurement of subsurface utilities, usually at a specific point
- Horizontal and vertical position, existing grade at ground surface, size and configuration of utility, material type, general condition, ground condition encountered
- Precise horizontal and vertical positions reported
 - Accuracy is typically set to 15-mm (0.05 feet) vertical and to the specified horizontal survey and mapping accuracy of the project

ENGINEER'S RESPONSIBILITIES

Advise owner of potential utility impacts on project
Inform and educate the project owner about quality levels

- costs and benefits of each

Recommend QL, scope, depiction

- required quality level may vary across project
- Recommend formatting of deliverables to be maintained across the project team and throughout the project life

Discuss sequence of acquiring appropriate quality level data

Recommend quality level upgrades as indicated by design needs

Follow one-call statutes, if any apply; e.g. designer ticket number in VA.

OWNER'S RESPONSIBILITIES

Review scope with engineer; amend or approve as appropriate

Assist in contact with existing utility owners; may improve access to records

Review quality levels with project team; approve format of deliverables for all team members

Notify the engineer of suspected deficiencies in the utility depiction if familiar with site and utility systems in place

Furnish utility information to utility owners for utility marking for construction (one-call systems)



Subsurface Utility Engineering is not confined to highways. It can be used with good results on airport, railroad, transit, building construction, military, sanitation, nuclear, and any other public works project where underground utilities may be encountered. It can also be used for environmental purposes, such as detecting and mapping underground storage tanks, septic fields, and even contaminants. SUE adds value, quality, and accountability to any project.

Testimonials

"The Federal Highway Administration has been encouraging the use of Subsurface Utility Engineering on Federal-aid highway projects since 1991. Proper use of this cost-effective professional engineering service will eliminate many of the utility problems typically encountered on highway projects. Using this technology, it will be possible to avoid many utility relocations before construction and many unexpected encounters during construction, thereby eliminating many costly, time-consuming project delays."

Dwight A. Home
Director, Office of Program Administration
Federal Highway Administration

"The SUE process, specifically the assignment of "Quality Levels" to the utility data collected, provides valuable engineering information from which to make risk-based decisions that characterize the delivery of transportation projects. At TxDOT the use of SUE in project planning and design allows us to avoid unnecessary impacts to existing utilities and to save the incalculable costs of adjustments not required and delays never imposed on the progress of a transportation project's construction."

John P. Campbell, P.E.
Chair, AASHTO Subcommittee on ROW & Utilities
Director of Right of Way, Texas DOT



Subsurface Utility Engineering



FHWA REMAINS AN ADVOCATE



U.S. Department
of Transportation
Federal Highway
Administration

SUBSURFACE UTILITY ENGINEERING

Over the decades, highway designers have had a difficult time obtaining reliable subsurface utility information. Now, this information is available through the use of an engineering process called Subsurface Utility Engineering

MAJOR SUE ACTIVITIES:

Scope of Work – The process of developing a written project-specific work plan package that consists of scope of work, levels of service vs. risk allocation, project schedule and desired project delivery method. This SUE work plan package is agreed upon by the SUE provider and the client, describing the SUE work to be performed.

Designating – The process of using a surface geophysical method or methods to interpret the presence of a subsurface utility and mark its horizontal position on the ground surface or on above-ground surface markers.

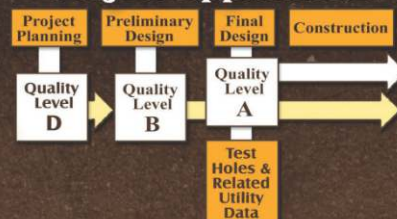
Locating – The process of exposing and recording the precise vertical and horizontal location and providing utility size and configuration of a utility.

Data Management – The process of surveying, designating, and locating information to project control and transferring it into the client's CADD system, GIS files, or project plans.

Conflict Analysis – The engineering process of using a conflict matrix to evaluate and compare depicted designating information with proposed plans (highway, bridge, drainage, and other) in order to inform all stakeholders of potential conflicts, potential resolutions and costs to cure.



Project Application



STANDARD OF CARE

The American Society of Civil Engineers (ASCE) has developed an important standard of care guideline, *Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data*, CI/ASCE 38-02.

This standard guideline describes four quality levels of utility depiction:

Quality Level D – Information derived from existing records or oral recollections.

Quality Level C – Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to Quality Level D.

Quality Level B – Information obtained through the application of appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities.

Quality Level A – Precise horizontal and vertical location of utilities obtained by the actual exposure and subsequent measurement of subsurface utilities, usually at a specific point.

To order a copy of ASCE Standard 38-02, please go to the ASCE Bookstore: <http://www.pubs.asce.org> or call 1-800-548-2723.

SUE EXPERTISE

Competence. SUE providers should be able to demonstrate a thorough knowledge and understanding of the major SUE activities and should be able to provide these services to the extent desired by the contracting agency.

Experience. Individuals assigned by the SUE provider to carry out the work should be well-trained, experienced, and capable. Those in responsible charge of the work and responsible for certifying deliverables should be engineers, geologists, and land surveyors employed by the SUE provider in accordance with state professional registration requirements.

Equipment. A wide range of equipment is necessary to detect the variety of subsurface utilities that may be present. Equipment available for utilization by the provider should include, but not be limited to, state-of-the-art designating equipment; vacuum excavation or comparable non-destructive locating equipment; state-of-the-art surveying and data recording equipment; and software systems compatible with those of the contracting agency.

Timeliness. Resources of the provider should be adequate to carry out the SUE work in a timely manner, considering other possible commitments of work and the contracting agency's anticipated needs.

Financial Capacity. SUE providers should have the financial capacity to provide the required services.

Insurance. SUE providers should have adequate insurance covering all aspects of work. Minimum amounts should be in accordance with the contracting agency's requirements.

ASCE 38-02

Originally established for transportation (highway) projects

- Generally public utilities (with records) involved

Can be applied to site specific design projects

- Shortage of available (private) utility records add to challenges on site specific projects
- Patterns of utility configurations are often less regular (and predictable) than in or through transportation corridors

SURVEYING THE UNDERGROUND

Professional SUE providers use ASCE 38-02 as their professional framework for methods and procedures to achieve standard of professional care

SUE is distinctly different from One Call

- Meticulous care in research, field investigation – from mains to mechanical room, search & trace unknowns, all conductors, active & abandoned , survey, map, correlate with records
- Comprehensive consideration of all utilities; known and unknown; public & private, active & abandoned
- QL labels inform designer about the reliability of utility
- Test holes are excavated to validate utility designating
- Comprehensive investigation enables SUE providers to assume professional liability

QUESTIONS?

What's next

- Locating Theory and Practice
- QLB and QLA

LOCATING THEORY & PRACTICE

Basic introduction to common detection theory and methods

- Electromagnetic Pipe and Cable Detection
- Ground Penetrating Radar

Utility Designating – Quality Level B

- making a more accurate, more complete horizontal map

Utility Locating (Test Holes) – Quality Level A

- when accuracy and precision are critical and to validate mapping; including vertical depth

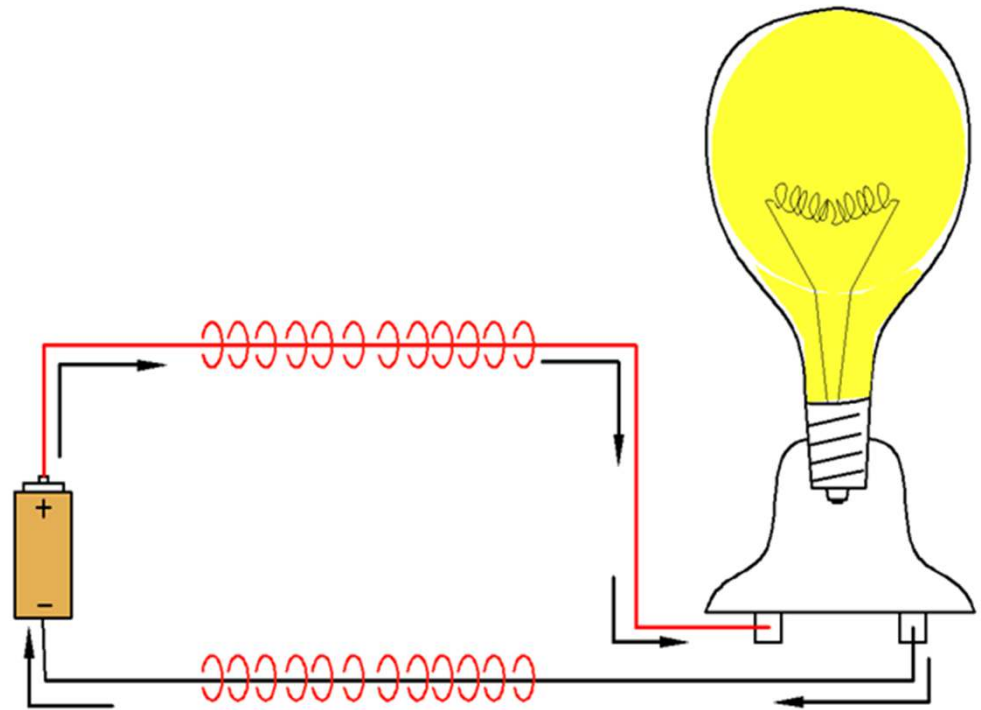
ELECTROMAGNETIC PIPE AND CABLE LOCATING

SOME DEFINITIONS:

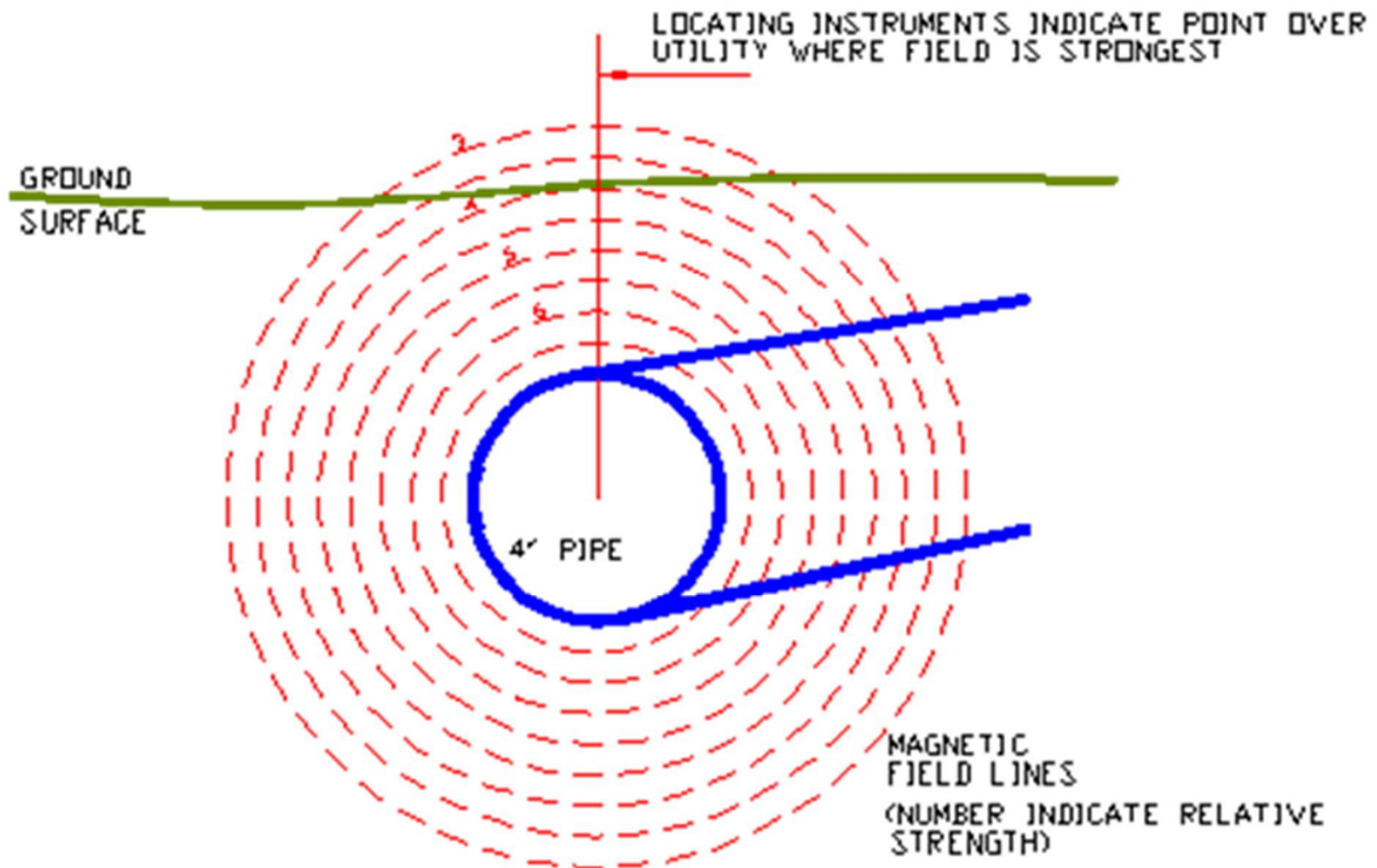
Signal: a flow of **electrical current** at a specific frequency on conductors such as metallic pipes, wires or cables

Conductor: a linear object that electrical current can travel through (in our case... a utility pipe, wire or cable)

Magnetic Field: a cylindrical field that forms around a conductor when current is flowing through it

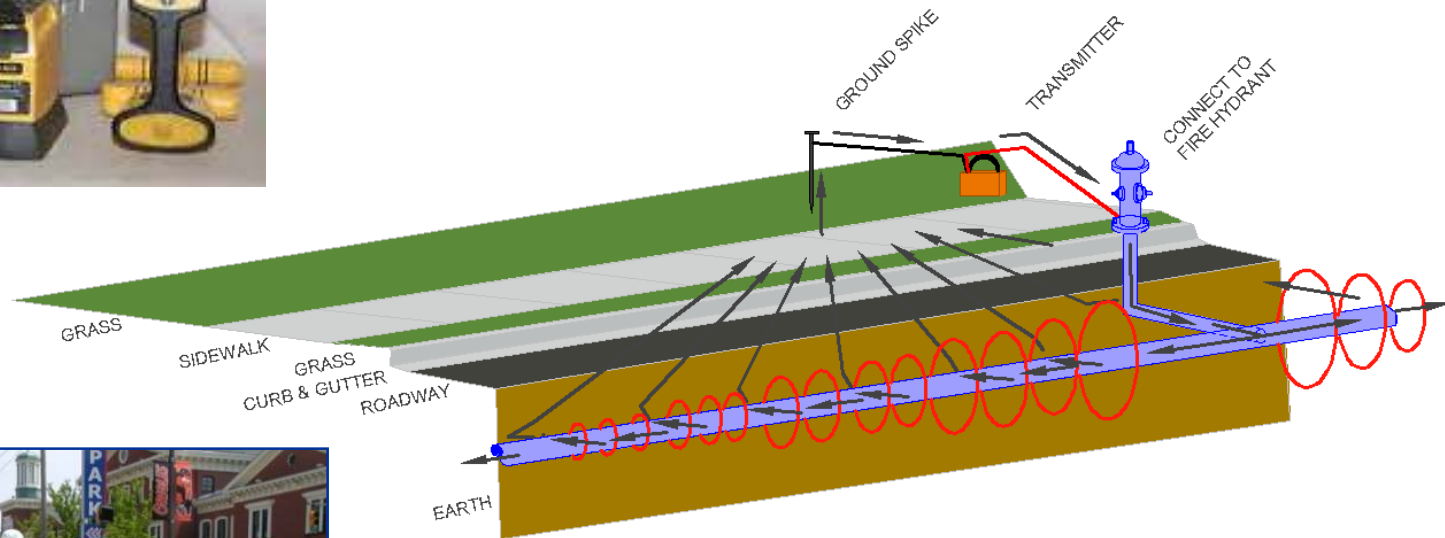


CURRENT CAUSES THE MAGNETIC FIELD TO FORM



DIRECT CONNECT

WHEN YOU HAVE ACCESS TO THE CONDUCTOR

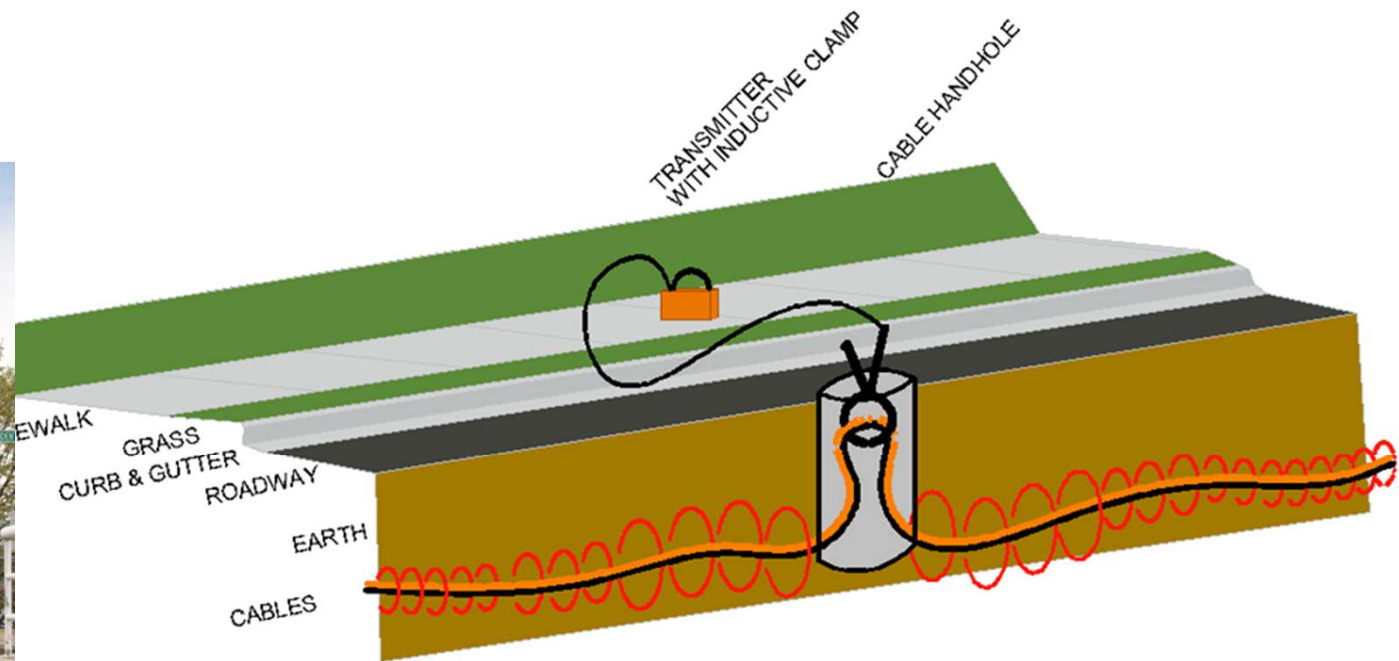


DIRECT CONNECT LOCATING CIRCUIT

CURRENT = 
MAGNETIC FIELD (SIGNAL) STRENGTH = 

INDUCTION WITH CLAMP

WHEN CABLES OR SMALL PIPES ARE ACCESSIBLE

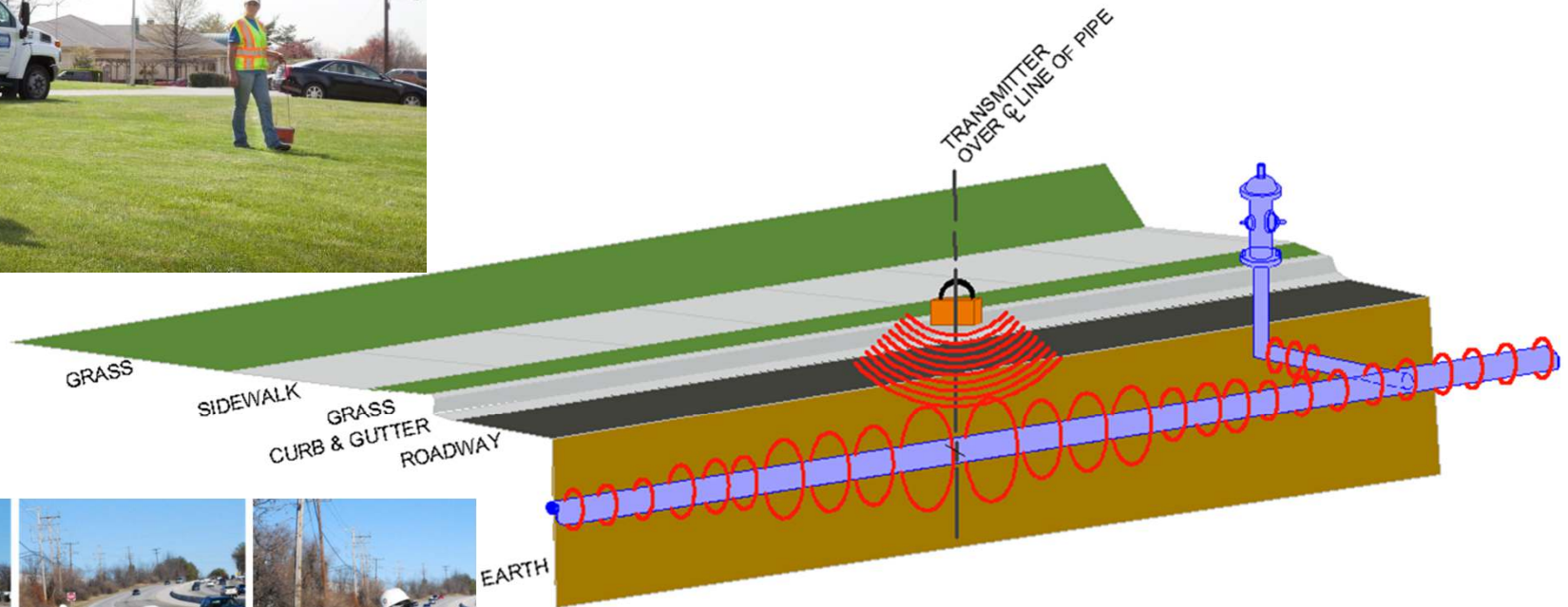


INDUCTIVE CLAMPING

SIGNAL STRENGTH =



SURFACE INDUCTION AND SWEEP NO ACCESS TO THE CONDUCTOR



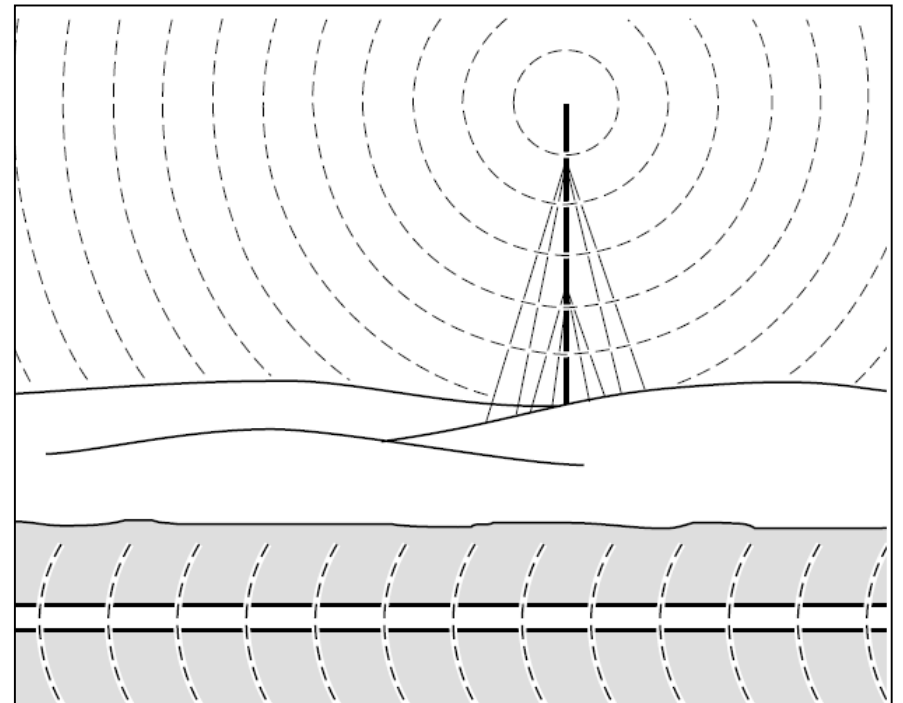
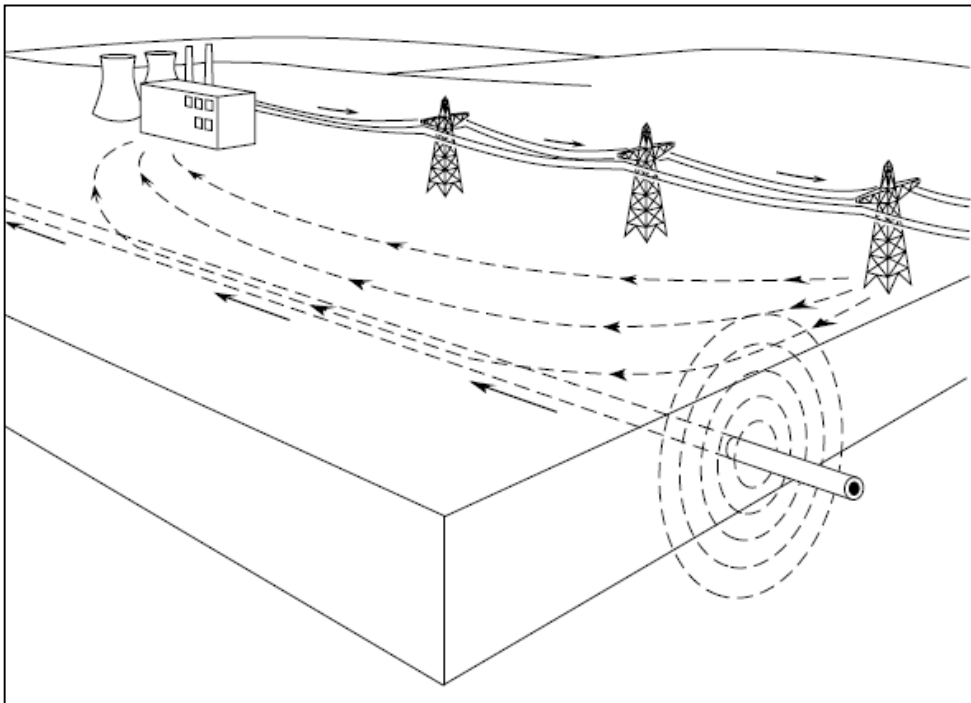
INDUCTION

SIGNAL STRENGTH =



PASSIVE SIGNAL DETECTION

**POWER AND RADIO SIGNALS ARE
NATURALLY OCCURRING MAGNETIC FIELDS**



INFLUENCING FACTORS: ELECTROMAGNETIC PIPE AND CABLE LOCATING

Depth of bury

- Shallow - stronger field easily detected
- Deep – weaker field, more difficult to detect

No physical access to utility

- surface induction may be the only option for applying signal

Utility type/ material

- conductive cables and pipes with minimal disruptions to signal flow are best

Conductor congestion both above and below ground

- causes signal bleed to adjacent conductors making it difficult to interpret the multitude of magnetic fields

Pavement/ soil characteristics

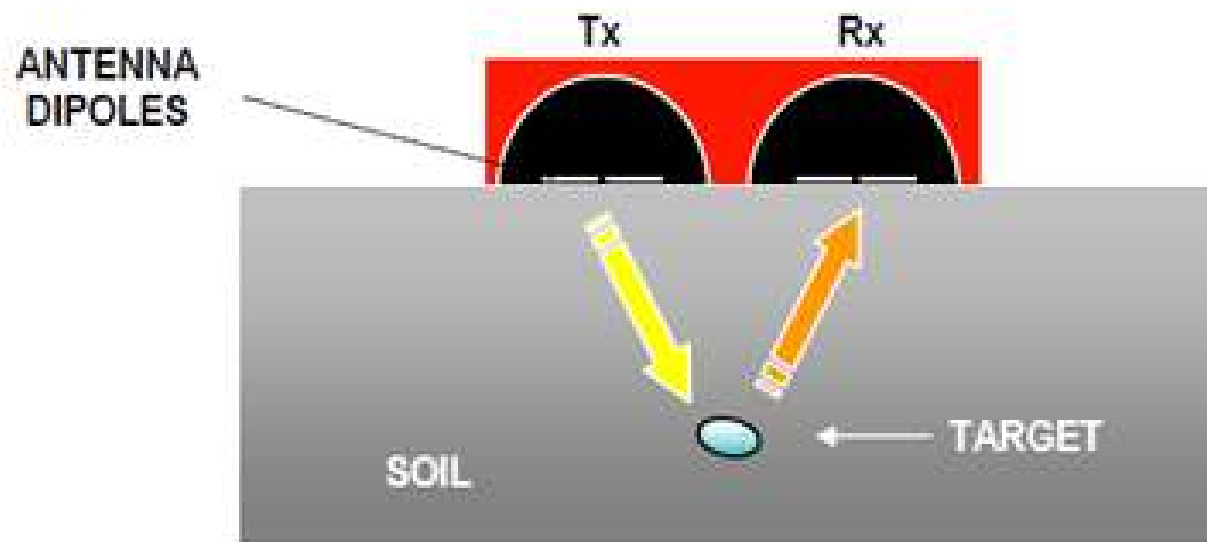
- rebar and slag

BASIC GPR PRINCIPALS

Electromagnetic “pulses” of energy are emitted from transmitting antenna downward through the ground

The pulses reflect back from objects that contrast with the surrounding soils

The reflections are detected by the receiving antenna and processed through circuitry and software to produce an “image” of the reflections



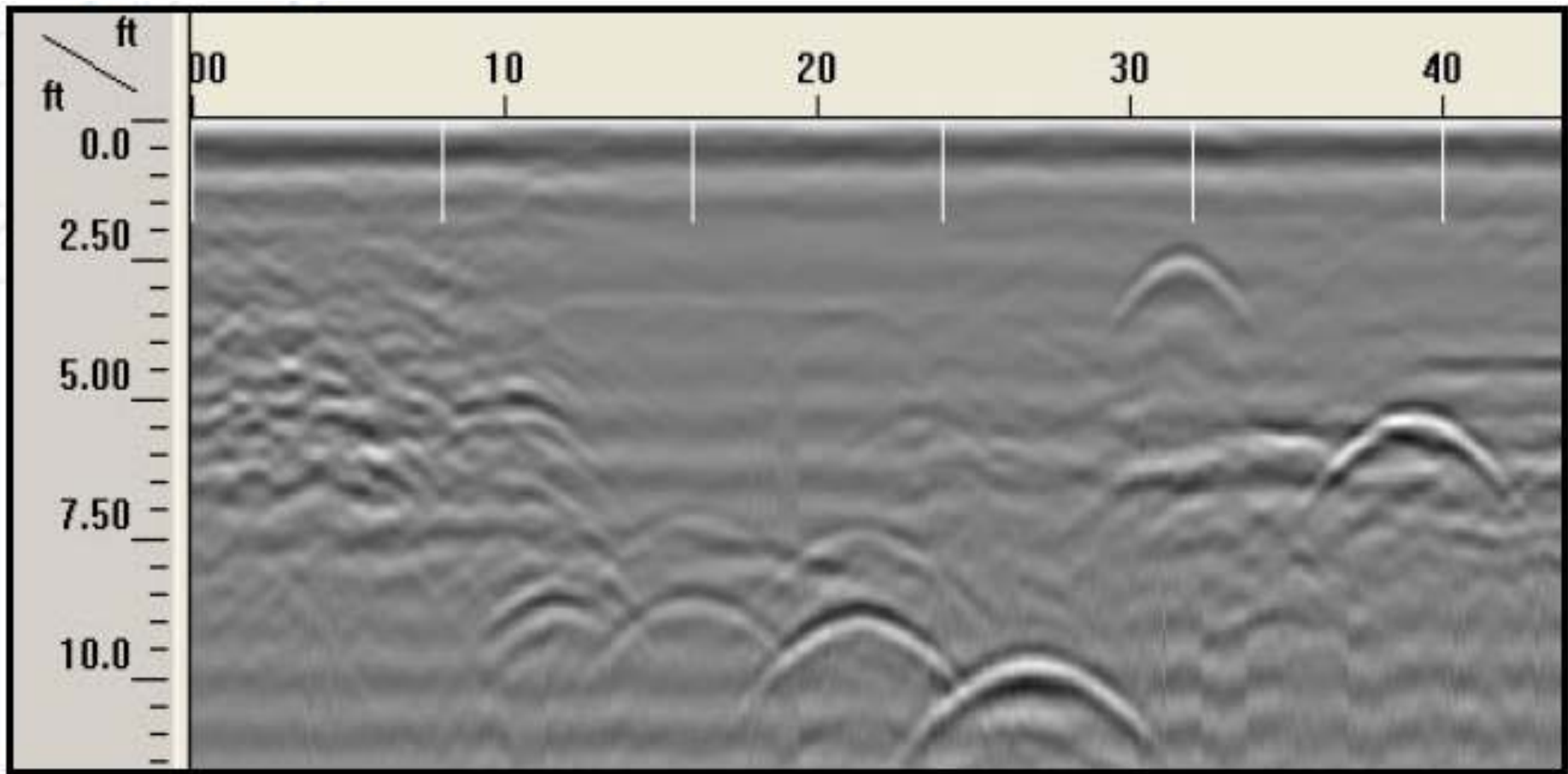
Signals reflected from target are detected and amplified

MODERN GPR UNITS



CLASSIC GPR DATA

A SINGLE SCAN (CROSS SECTION)



GPR PENETRATION:

EFFECT OF SOIL TYPES

Favorable

- Sandy soils, especially dry or well drained
- Gravelly soils, again preferably dry/ well drained
- Homogeneous soils (uniform)

Unfavorable

- Clay soils... worse when wet
- Soils with dissolved salts and minerals... increases conductivity
- Any soils with a high salinity content as may be found near ocean and brackish water tidal areas
- Non-homogeneous soils (varied)

MD & DE soils are rated “moderate” by Natural Resources Conservation Service for GPR suitability
– in our experience about a 25% success rate

CONTRAST AND COMPARE

EM Pipe and Cable

vs

GPR

Works in a wide variety of soils	Soil can limit or completely prevent effective use
Utilities need to be conductive *	Can detect non-conductive utilities
Small utilities can be detected	Small utilities cannot be imaged
Instrument detects a magnetic field	Instrument detects interface between objects
Technician interprets real time data and marks position in field	Operator can interpret for field marking and collect data for post processing/ office evaluation
Magnetic field can be detected but no image or data is created or stored	Data and radar images can be recorded and saved
Lower cost to detect most utilities	Higher cost to detect fewer utilities
Should be employed on nearly all SUE projects	Should be employed when circumstances warrant use on SUE projects
Useful for linear utilities/ conductors	Useful for non-linear objects such as buried tanks, drums, vaults, voids, etc.

*or can be accessed with sonde or rodder

THE SUE PROCESS

HOW IT GETS DONE

- **Normally a progression through the Quality Levels D through A**
 - QL B and QL A are unique to SUE
- **Procedures**
- **Methods**

DESIGNATING – QL “B”

TYPICAL APPROACH

Records Research (Utility Inventory)

Field Investigation

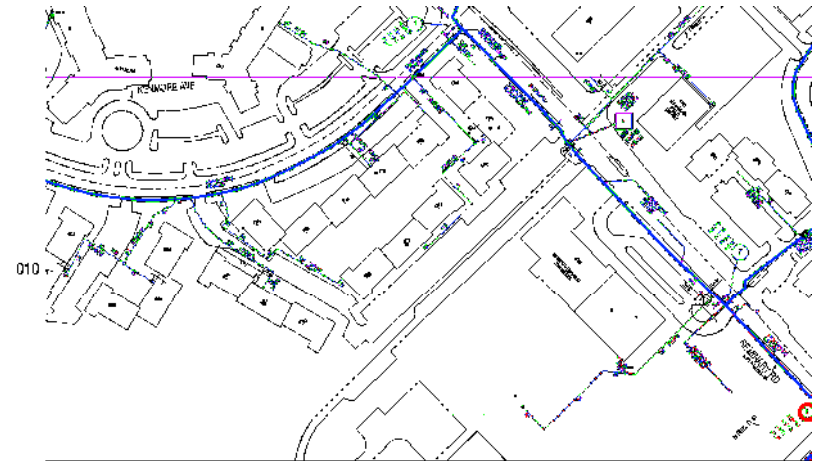
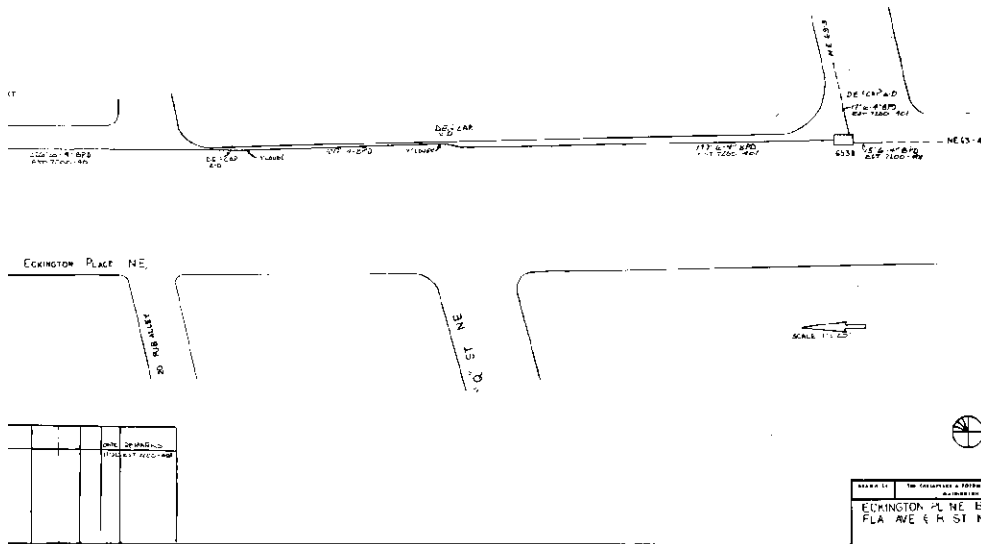
- Geophysical Properties
 - Pipe & Cable Locators
 - Visible Light
 - Ground Penetrating Radar

APWA-ULCC Field Marking (Red–electric, blue–water, etc.)

Field Sketch And/ Or Survey & Map

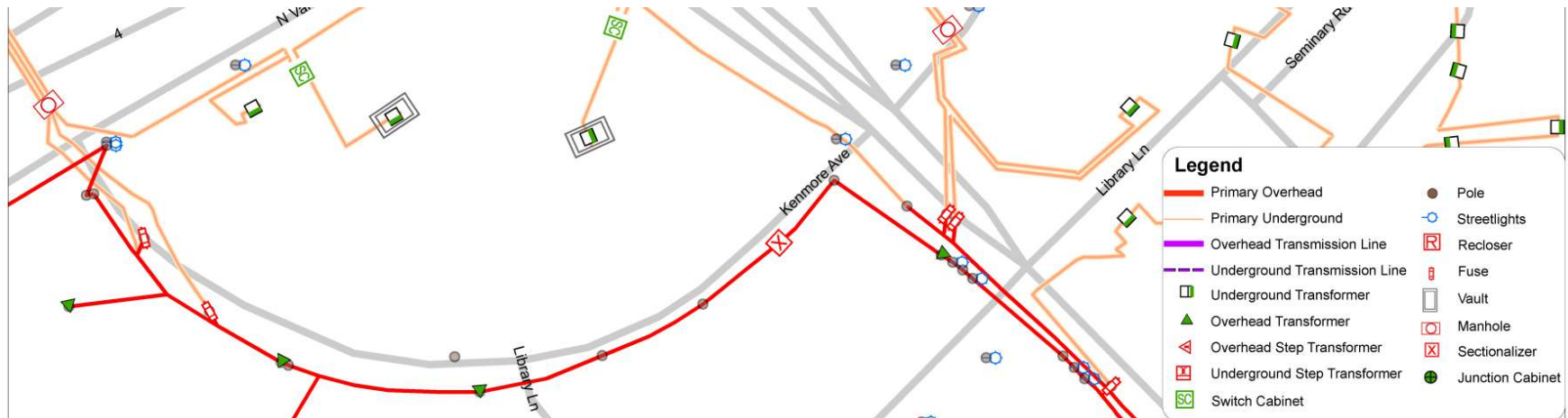
- Documented Results Represent “Professional Opinion”
 - Most Reliable Non-excavated Utility Location
 - Includes Private, Public, Abandoned Utilities

THE FIRST CONSIDERATION



SW
DATE AND TIME: 2008/10/15 10:44:55
Map= WG-14050
{233901438110171867}

Scale 1:2668
Copyright 2004 by Washington Gas Light Co.
WG confidential. Data not warranted.



Dominion Utility Information
4661 Kenmore Ave.
Alexandria, Virginia



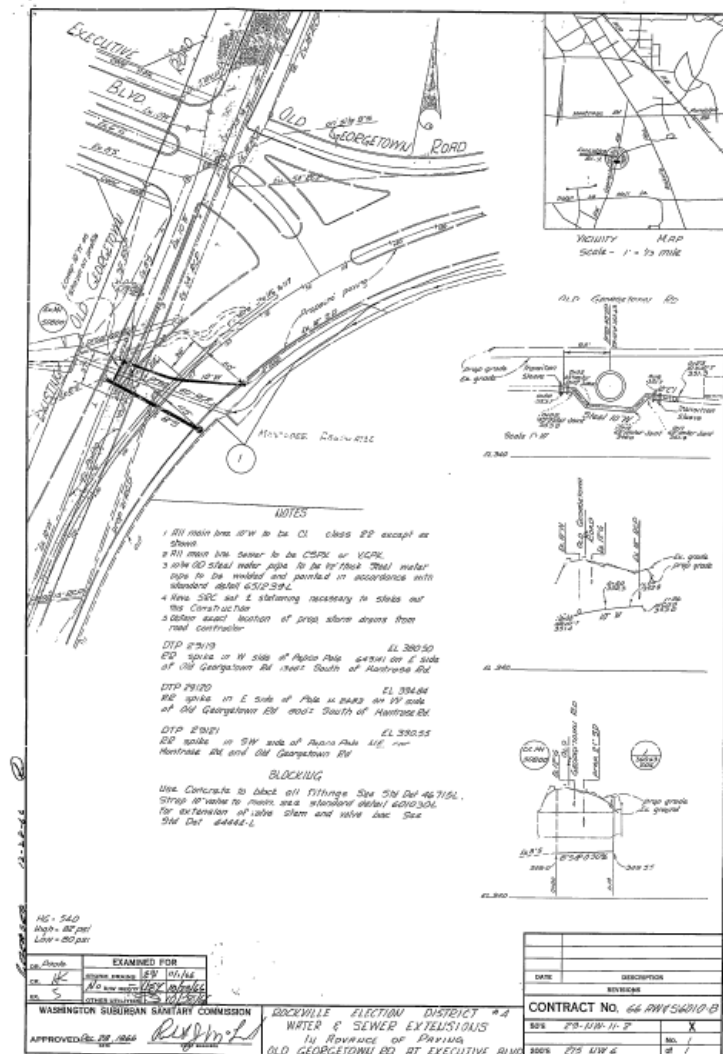
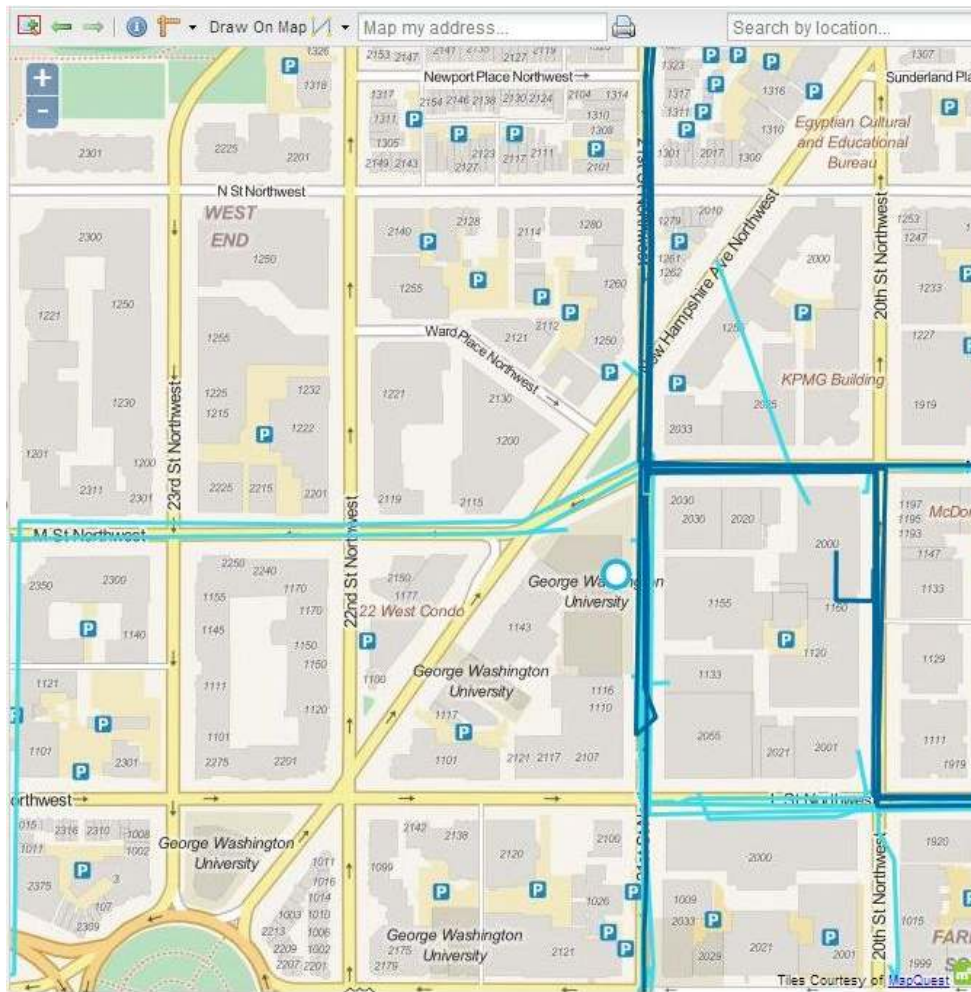
Created by:
GIS Services
10-15-08

RECORD TYPES

FROM ONE EXTREME TO THE OTHER

A TELECOM PROVIDER

WSSC



FIELD EQUIPMENT

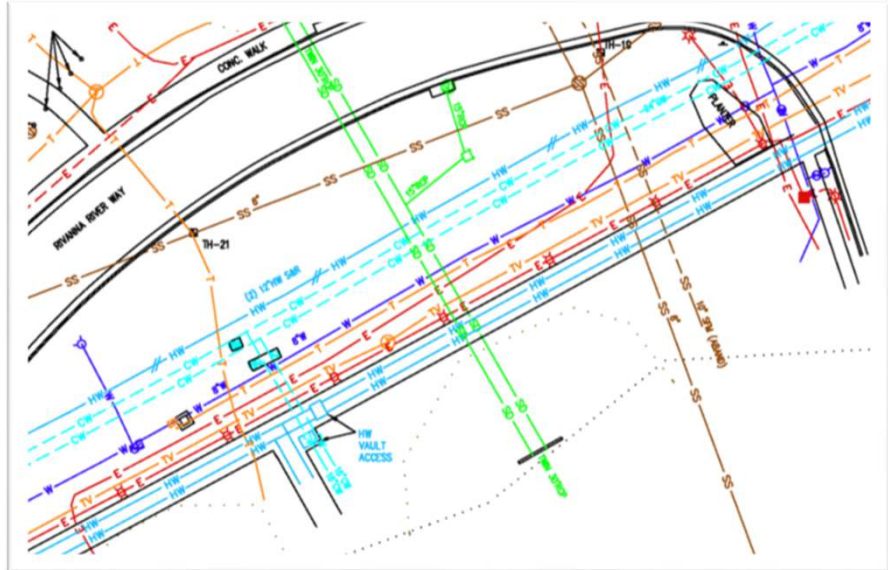
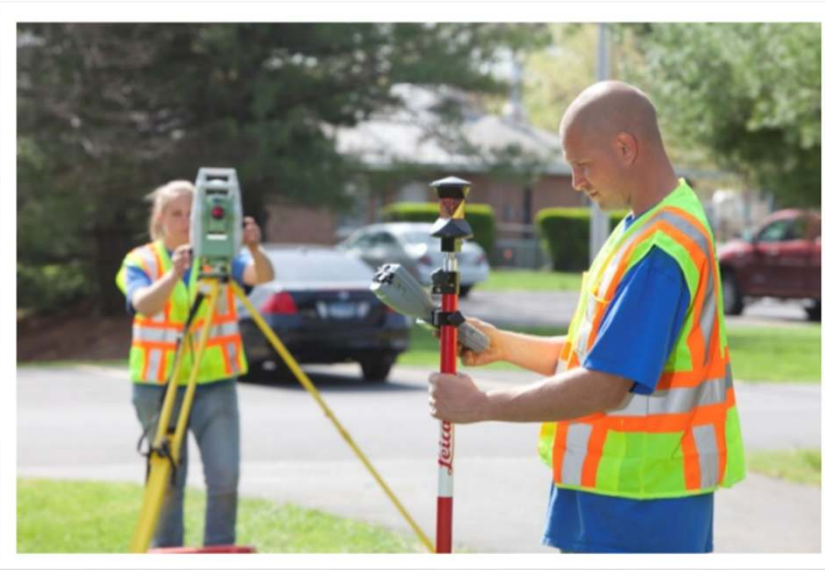
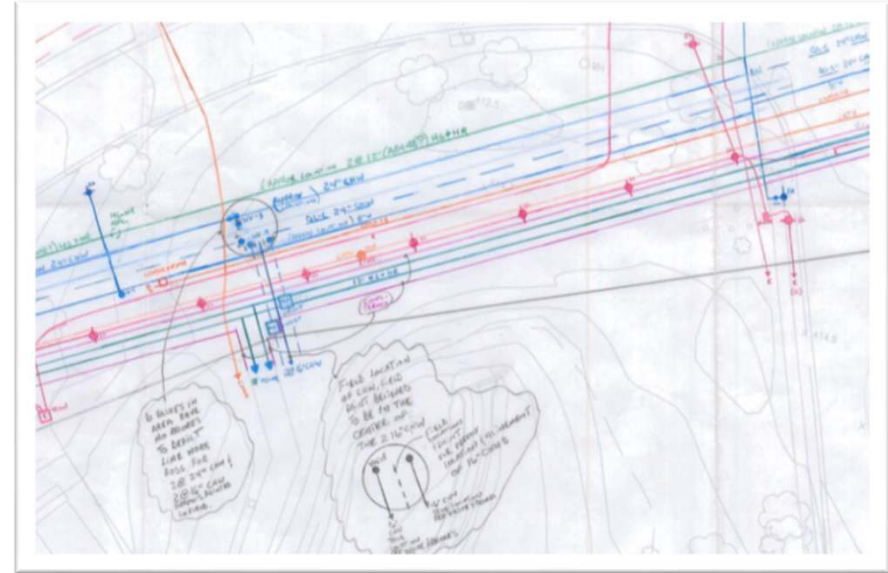
A VARIETY OF EQUIPMENT TO COVER A WIDE RANGE OF UTILITY LOCATING SCENARIOS



UTILITY DESIGNATION: MARKINGS CAREFULLY PLACED

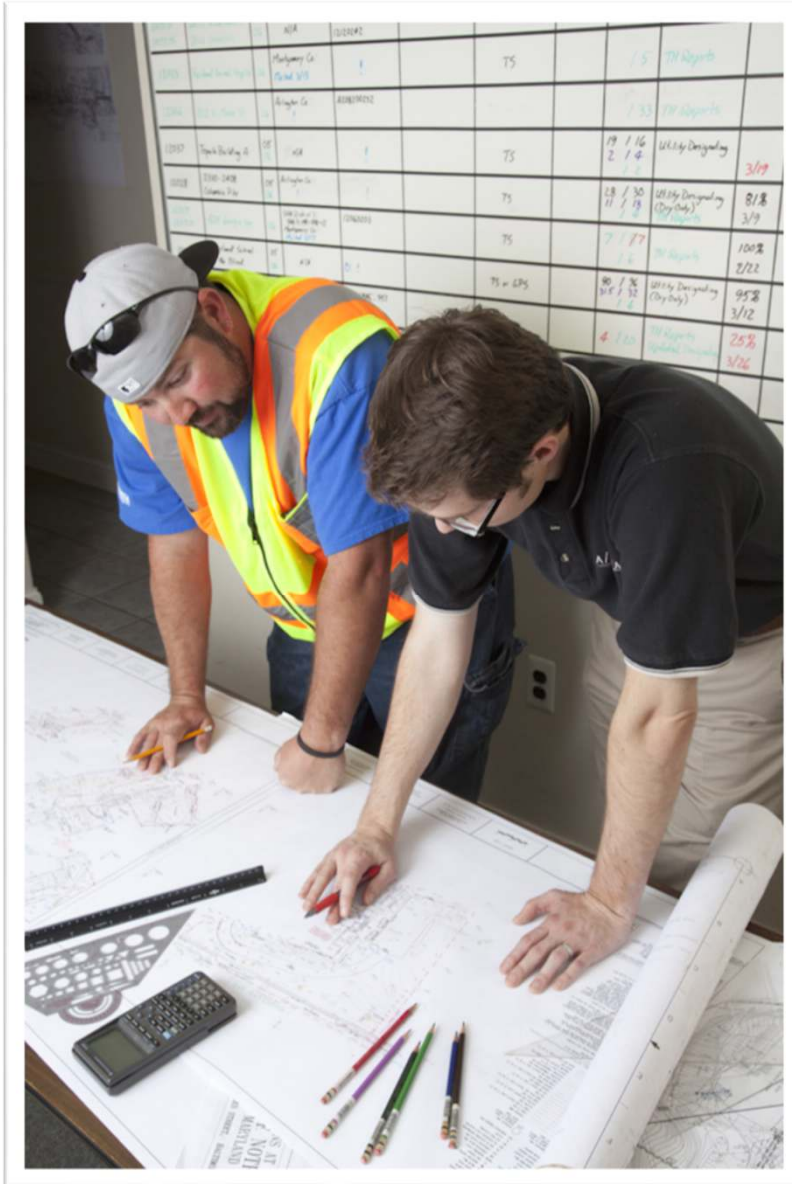


FIELD SKETCHING, SURVEY & CAD PROCESSING



FIELD/ OFFICE COLLABORATION

- **Debrief field crew for unique site issues and problems**
 - QL D search efforts
 - Troubleshoot difficult detection scenarios
- **Compare field sketch to CAD results**
- **Compare CAD to records**
- **Correlate field data with records**
- **Assign QL to utility depictions (QL-B is the goal with QL-C or D as needed)**
- **Provide mapping in AutoCAD or MicroStation**



UTILITY DESIGNATING NOTES

- UTILITY DEPICTIONS CONFORM TO CI/ ASCE STANDARD 38-02.
- UTILITY QUALITY LEVELS DEFINED AS FOLLOWS"

QUALITY LEVEL "D" (QL-D)
INFORMATION COMES SOLELY FROM EXISTING UTILITY RECORDS.

QUALITY LEVEL "C" (QL-C)
INVOLVES SURVEYING VISIBLE ABOVEGROUND UTILITY FACILITIES, SUCH AS MANHOLES, VALVE BOXES, POSTS, ETC., AND CORRELATING THIS INFORMATION WITH EXISTING UTILITY RECORDS.

QUALITY LEVEL "B" (QL-B) - DESIGNATING
INVOLVES THE USE OF SURFACE GEOPHYSICAL TECHNIQUES TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF UNDERGROUND UTILITIES.

QUALITY LEVEL "A" (QL-A) - LOCATING
INVOLVES THE USE OF NONDESTRUCTIVE DIGGING EQUIPMENT AT CRITICAL POINTS TO DETERMINE THE PRECISE HORIZONTAL AND VERTICAL POSITION OF UNDERGROUND UTILITIES, AS WELL AS THE TYPE, SIZE, CONDITION, MATERIAL, AND OTHER CHARACTERISTICS.

- THE SUBSURFACE UTILITIES DEPICTED HEREON AT QUALITY LEVEL "B" REPRESENT THE REMOTELY SENSED INDICATION OF THE SUBSURFACE UTILITY. UTILITY PIPE SIZES AND CONFIGURATIONS HAVE BEEN TAKEN FROM RECORD DRAWINGS AND ACCESSIBLE FIELD EVIDENCE. THE ACTUAL LOCATION, SIZE AND EXTENT OF ALL SUBSURFACE UTILITIES MUST BE DETERMINED THROUGH TEST HOLE OR OTHER QUALITY LEVEL "A" INVESTIGATION METHODS.
- AN EFFORT HAS BEEN MADE TO DEPICT UTILITIES AT QL "B". SOME UTILITIES ARE SHOWN AT QL "C" OR QL "D" AS NECESSARY.
- GRAVITY DEPENDENT UTILITY SYSTEMS (STORM AND SANITARY SEWERS) WERE NOT INCLUDED IN THE SCOPE OF THIS UTILITY MAPPING EFFORT.
- UTILITY SURFACE FEATURES, E.G. VALVES, MANHOLES AND VAULTS, ARE SHOWN SYMBOLICALLY AND THEIR SIZE AND SHAPE ARE SCHEMATIC AND NOT TO SCALE. EXCEPT AS SPECIFICALLY STATED HEREON, SUBSURFACE CONDITIONS SUCH AS SIZE AND ORIENTATION OF ANY ASSOCIATED STRUCTURE HAVE NOT BEEN DETERMINED. ACTUAL DIMENSIONS AND POSITIONS MUST BE DETERMINED THROUGH ADDITIONAL SUBSURFACE UTILITY INVESTIGATION.
- THE UNDERGROUND UTILITY LOCATIONS SHOWN HEREON REPRESENT A PROFESSIONAL OPINION AND INTERPRETATION BASED ON RECORD INDICATIONS AND FIELD EVIDENCE INCLUDING THE USE OF ELECTRONIC UTILITY DETECTION EQUIPMENT. THE RESULTS OF THIS UTILITY INVESTIGATION MAY BE AFFECTED BY THE AVAILABILITY OF UTILITY RECORD INFORMATION AND A VARIETY OF EXISTING SITE CONDITIONS. SITE CONDITIONS THAT MAY AFFECT THE RELIABILITY OF DETECTED UTILITY LOCATIONS INCLUDE SOIL CONTENT, DEPTH OF UTILITY, DENSITY OF UTILITY CLUSTERS, AND ELECTROMAGNETIC CHARACTERISTICS OF THE TARGET UTILITIES.
- AUTOCAD REFERENCE FILES USED IN THIS DRAWING:
"Moore Prop-Base - 2011.dwg" PROVIDED BY DEVELOPMENT FACILITATORS, INC. FOR BASE MAP/ PLANIMETRIC FEATURES.

— TV —	CABLE TV LINE (QL-B)
— TV —	CABLE TV LINE (QL-C OR QL-D)
— E —	ELECTRIC LINE (QL-B)
— E —	ELECTRIC LINE (QL-C OR QL-D)
— FO —	FIBER OPTIC LINE (QL-B)
— FO —	FIBER OPTIC LINE (QL-C OR QL-D)
— G —	GAS LINE (QL-B)
— G —	GAS LINE (QL-C OR QL-D)
— T —	TELECOMMUNICATIONS LINE (QL-B)
— T —	TELECOMMUNICATIONS LINE (QL-C OR QL-D)
— UK —	UNKNOWN DETECTED UTILITY/ CONDUCTOR (QL-B)
— W —	WATER LINE (QL-B)
— W —	WATER LINE (QL-C OR QL-D)

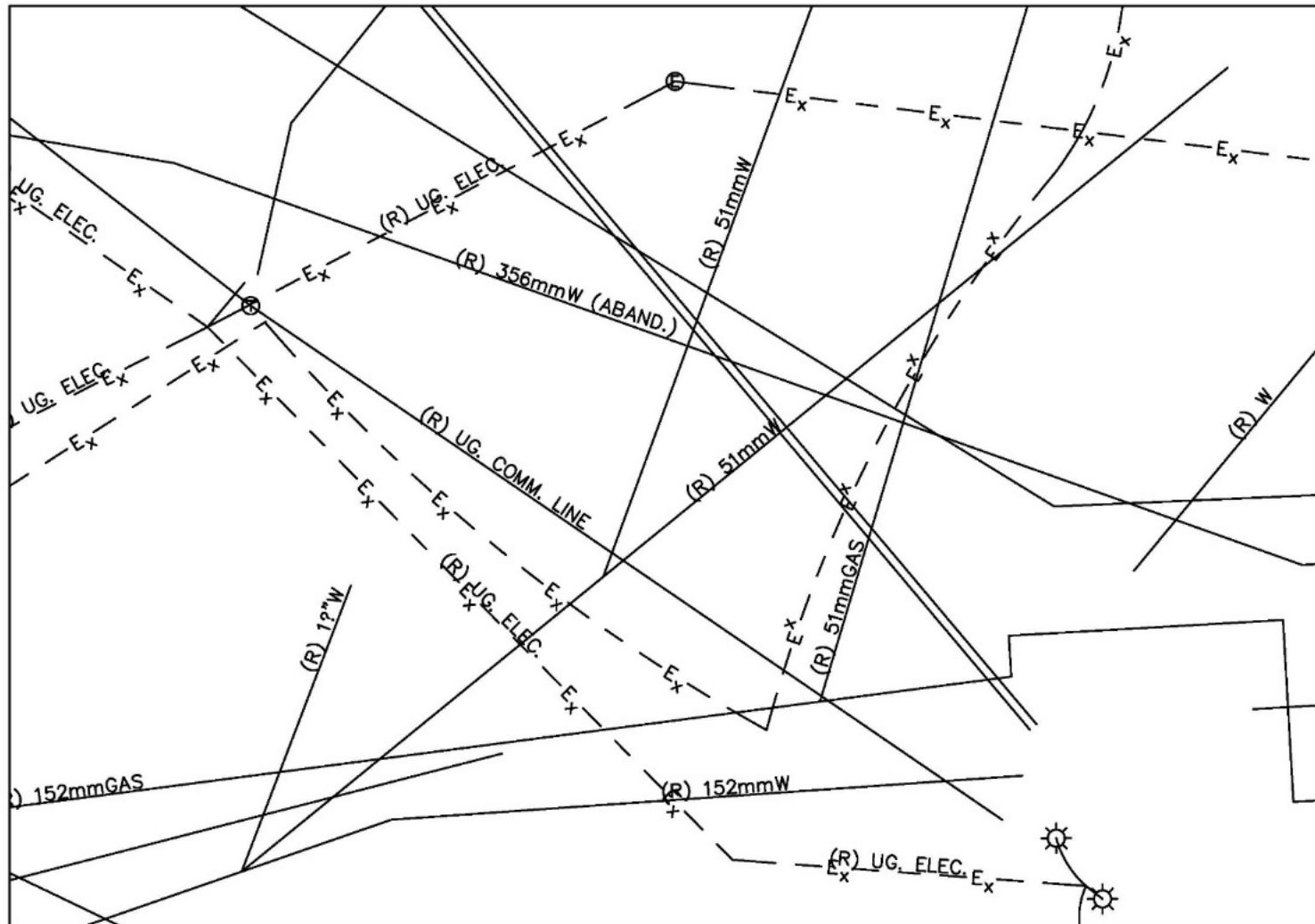
ALL HORIZONTAL SURVEY DATA CONTAINED IN UTILITY MAPPING FILE "13009-MooreProperty.dwg" ARE
REFERENCED TO TRAVERSE POINTS PROVIDED BY DEVELOPMENT FACILITATORS, INC., INCLUDING:

POINT#	NORTHING	EASTING	DESCRIPTION
801	540788.26	1389639.86	REBAR & CAP
802	540630.19	1389828.46	REBAR & CAP

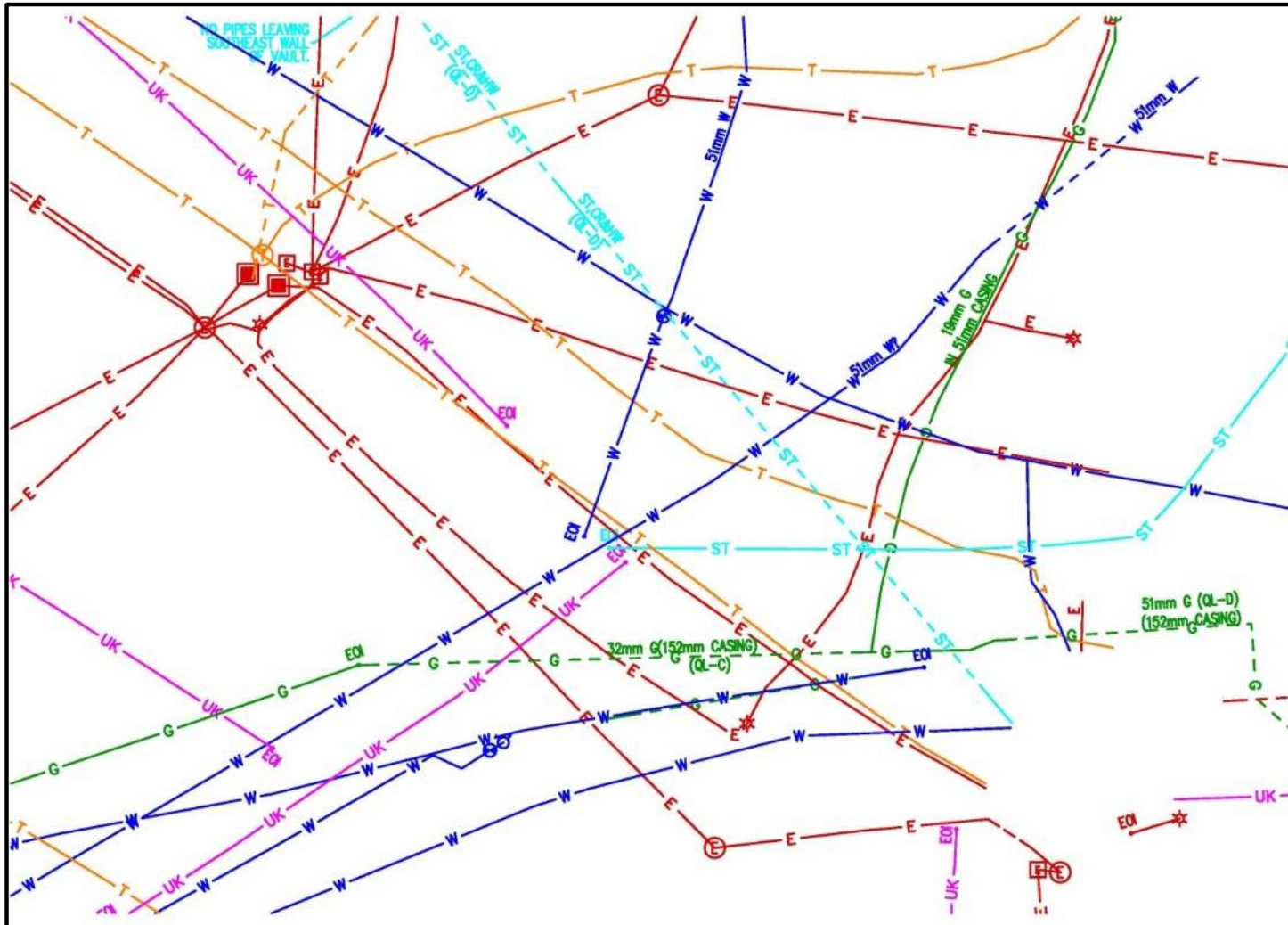
Category	Item	Value
Category 1	Item 1	Value 1
Category 1	Item 2	Value 2
Category 1	Item 3	Value 3
Category 1	Item 4	Value 4
Category 1	Item 5	Value 5
Category 1	Item 6	Value 6
Category 1	Item 7	Value 7
Category 1	Item 8	Value 8
Category 1	Item 9	Value 9
Category 1	Item 10	Value 10
Category 1	Item 11	Value 11
Category 1	Item 12	Value 12
Category 1	Item 13	Value 13
Category 1	Item 14	Value 14
Category 1	Item 15	Value 15
Category 1	Item 16	Value 16
Category 1	Item 17	Value 17
Category 1	Item 18	Value 18
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Category 1	Item 22	Value 22
Category 1	Item 23	Value 23
Category 1	Item 24	Value 24
Category 1	Item 25	Value 25
Category 1	Item 26	Value 26
Category 1	Item 27	Value 27
Category 1	Item 28	Value 28
Category 1	Item 29	Value 29
Category 1	Item 30	Value 30
Category 1	Item 31	Value 31
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Category 1	Item 93	Value 93
Category 1	Item 94	Value 94
Category 1	Item 95	Value 95
Category 1	Item 96	Value 96
Category 1	Item 97	Value 97
Category 1	Item 98	Value 98
Category 1	Item 99	Value 99
Category 1	Item 100	Value 100

MAPPING FROM RECORDS

UTILITY INFORMATION ONLY AS GOOD AS ORIGINAL
SOURCE MATERIAL AND ONLY IF CORRECTLY FITTED TO
CURRENT CONDITIONS.

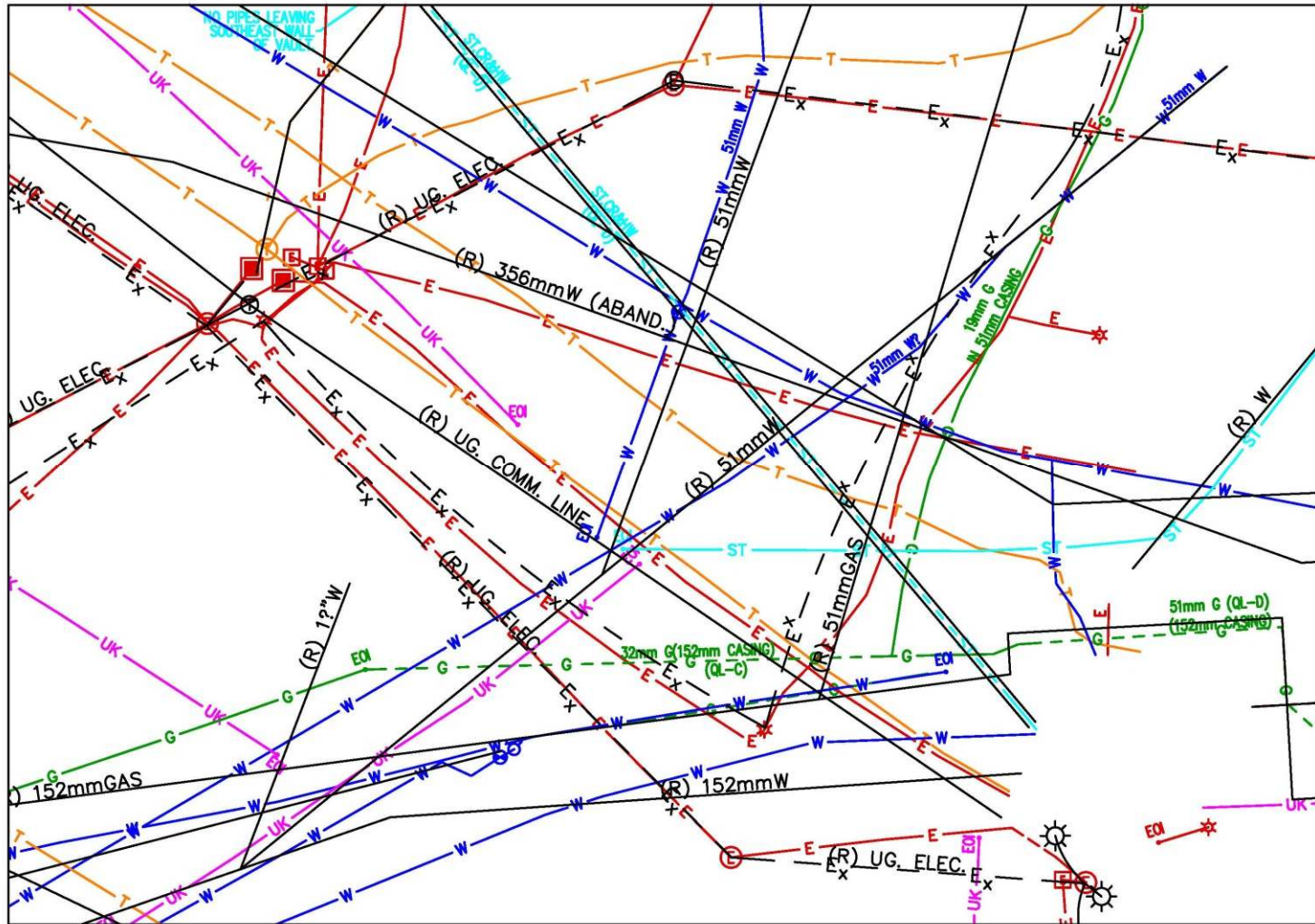


UTILITIES DESIGNATED, SURVEYED AND MAPPED

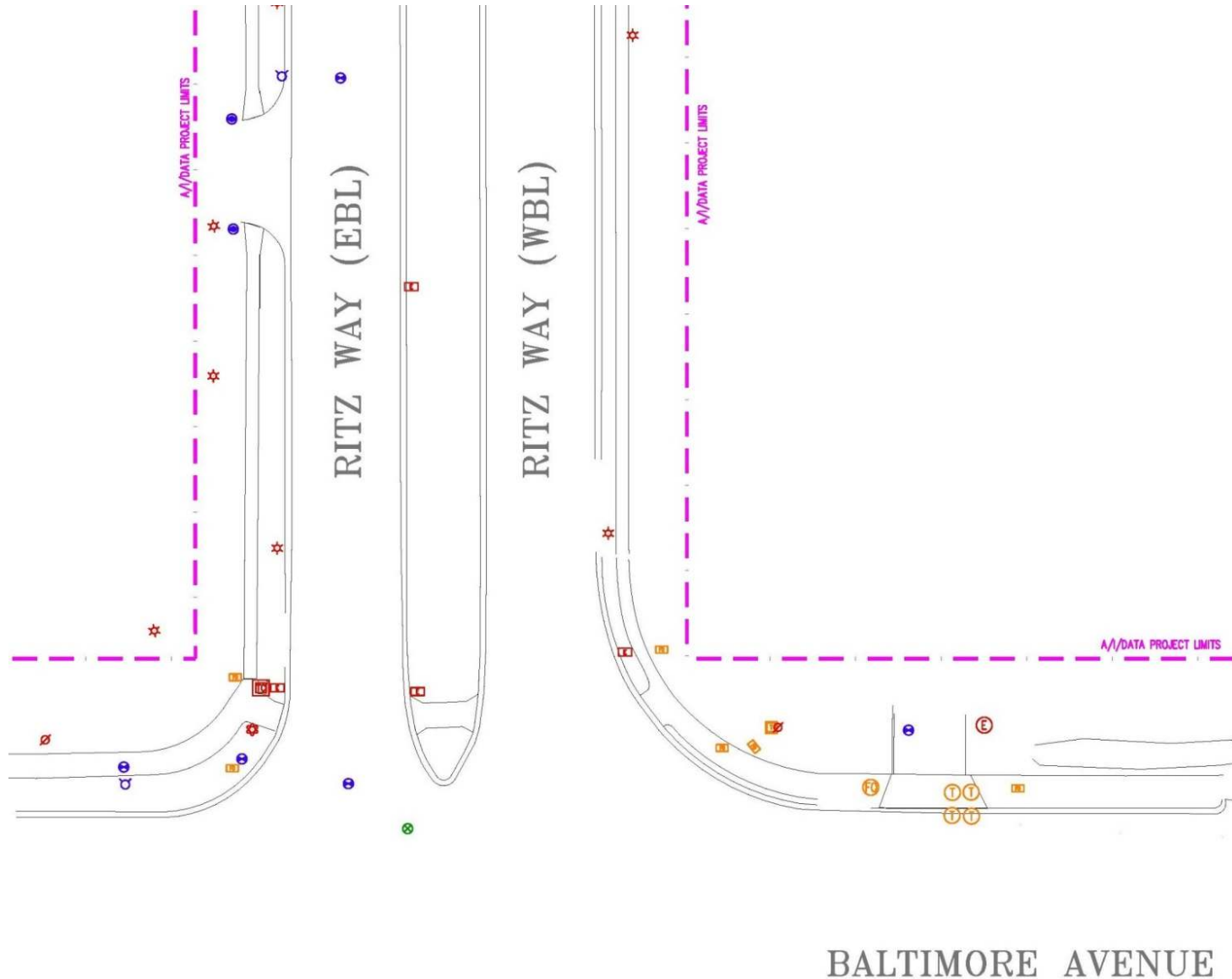


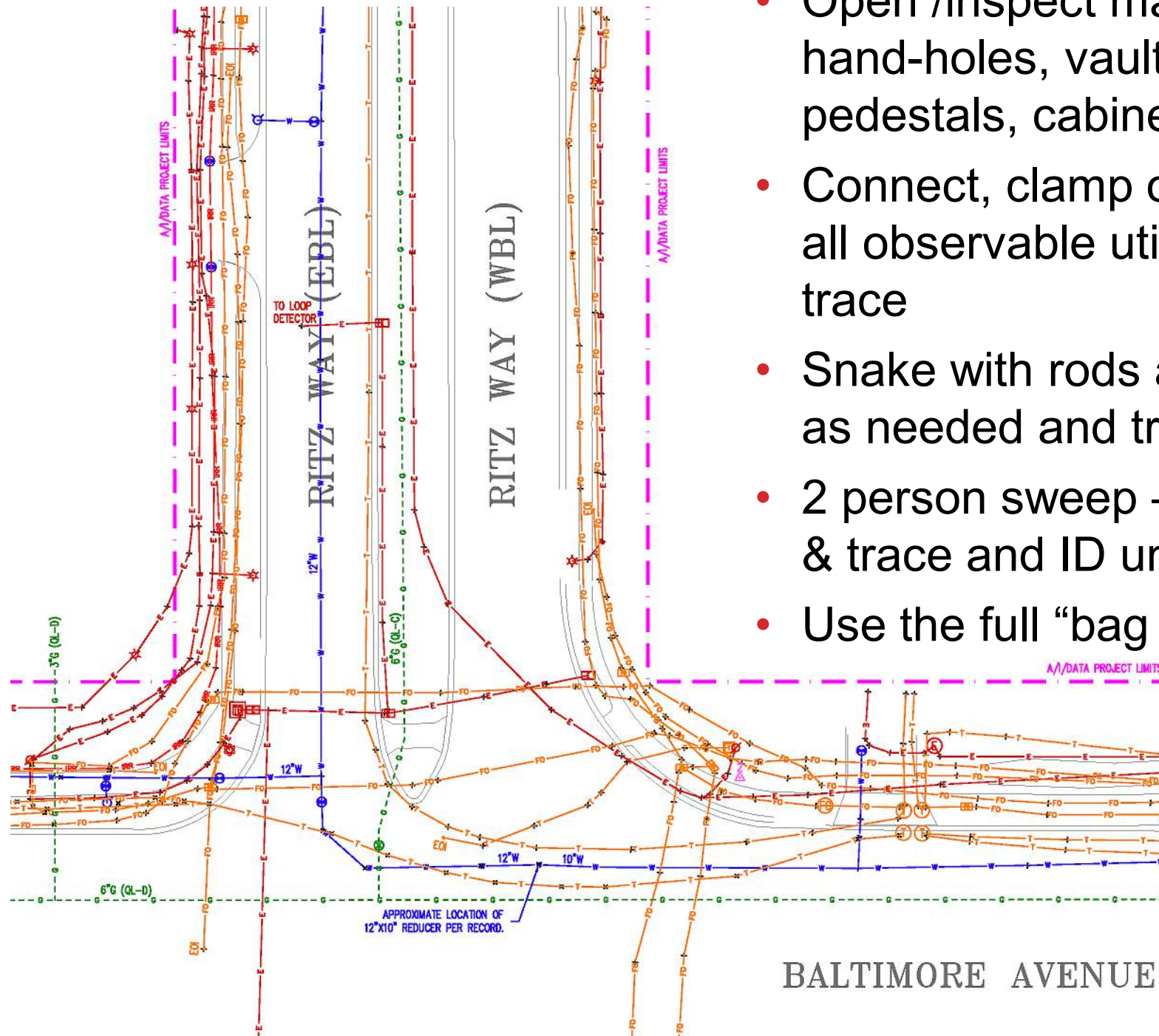
OVERLAY

SOME ORIGINAL LOCATIONS GOOD/ SOME NOT



SURFACE FEATURES DON'T TELL THE WHOLE STORY!





- Open /inspect manholes, hand-holes, vaults, pedestals, cabinets
- Connect, clamp or induce on all observable utilities and trace
- Snake with rods and sondes as needed and trace
- 2 person sweep – seek out & trace and ID unknowns
- Use the full “bag of tricks”

BALTIMORE AVENUE

SUMMARY – QL “B”

A Standardized Procedure

Records Research

Field Investigation

- Direct Connect
- Clamp
- Induce (Sweep)

Field Marking

Field Sketch

Data Collection (Total Station, RTK GPS)

Map & Correlate With Records

Review & Edit

Deliver In AutoCAD Or MicroStation

LOCATING – QL“A”

AIR/ VACUUM TEST HOLES

THE BASIC STEPS

- Perform test hole setup at the site.
 - Test hole plan based on QL B info?
 - QL C or QL D info?
- Notify the one call utility notification center.
- Plan traffic control.
- Apply for an excavation permit.
- Coordinate with utility inspectors.
- Schedule the rig, test hole crew and survey crew.
- Compile results and report to client / engineer

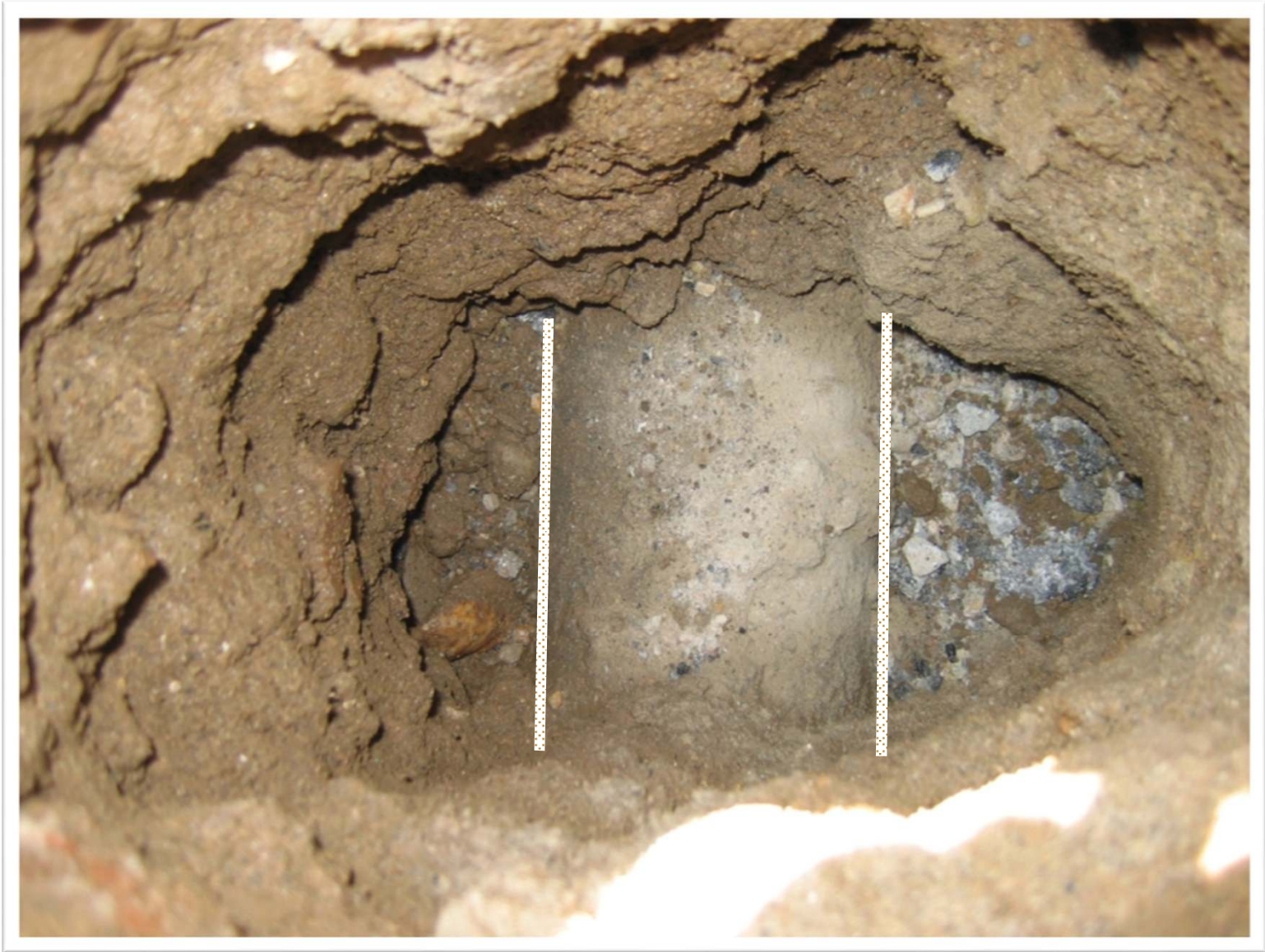
VACUUM EXCAVATION



VACUUM EXCAVATION

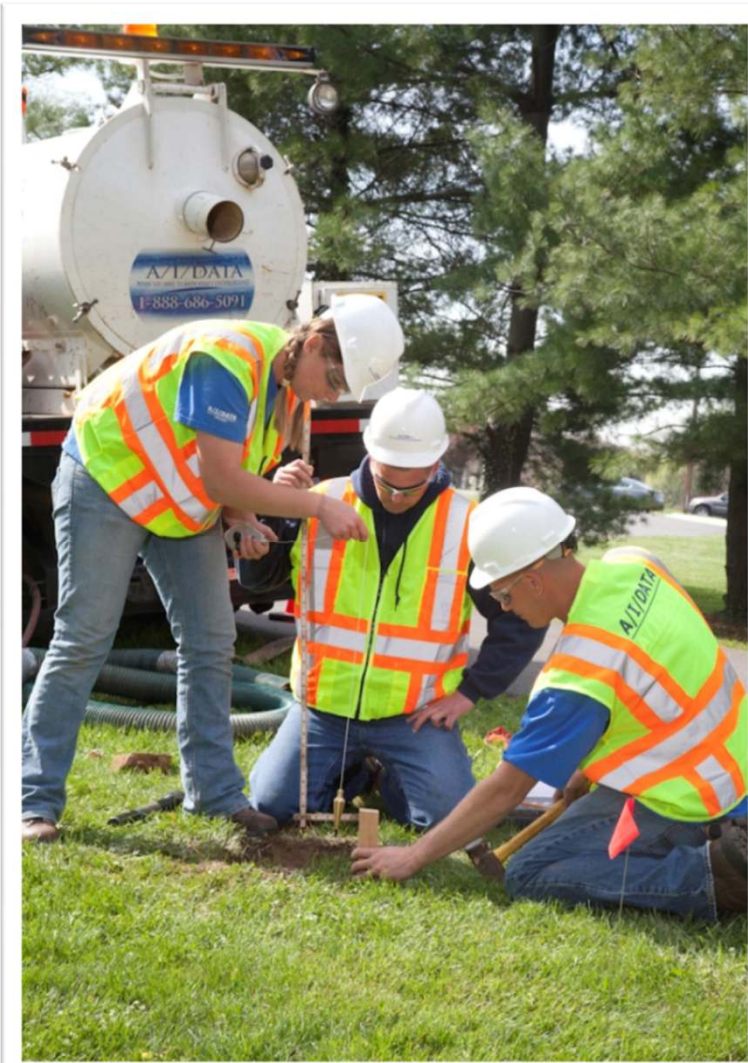


DOWN-HOLE VIEW



TEST HOLE OPERATIONS

SET MARKER/ MEASURE



BACKFILL / COMPACT



CLOSE & RESTORE

- **Original Material Reused**
- **Compacted in lifts**
- **Seasonal cold-patch**
- **Turf restored**
- **Permit closed**



WHY AIR/ VACUUM EXCAVATION? COMPARED TO MECHANICAL/ BACKHOE ETC.

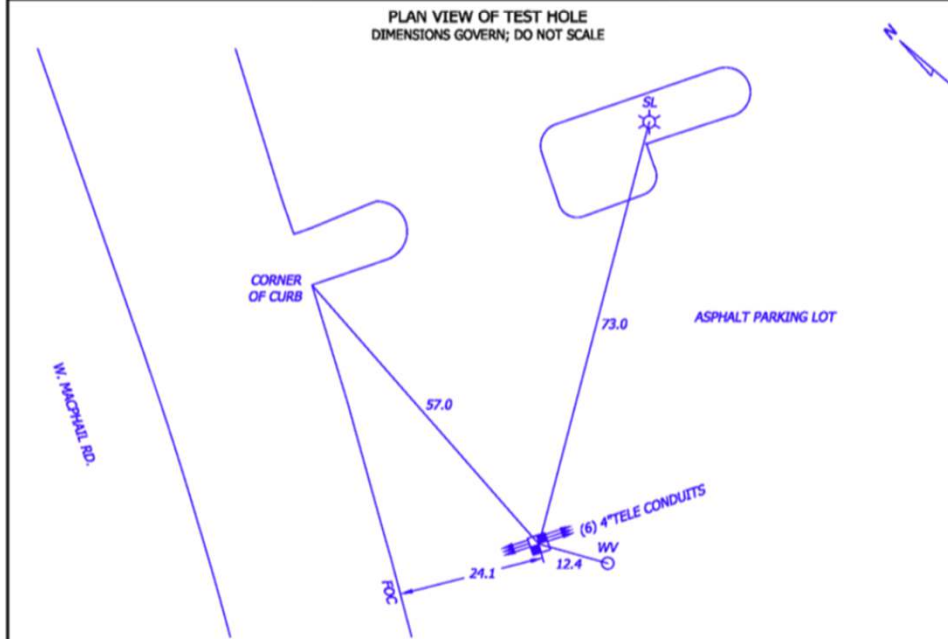
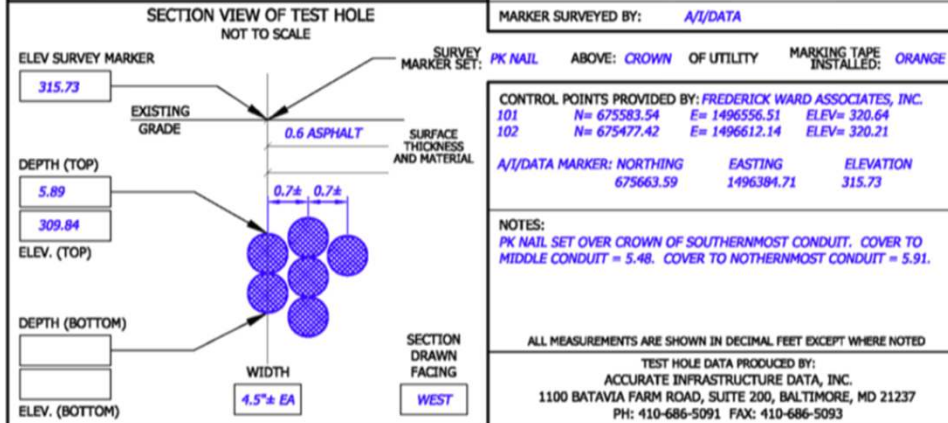
- Less impact to utilities
 - A bit safer than hand digging
 - A lot safer than mechanical digging
- Less impact to property and public
 - Small hole – “test hole” not “test pit”
 - Relatively small work footprint
 - Relatively neat work area (soils contained)
 - Short duration occupancy (9 to 3 restrictions)
- Low cost (particularly in paved roadways)
- Effective for majority of utility measurement needs

TEST HOLE DATA SHEET

A/I/DATA - TEST HOLE DATA SHEET

JOB #: 11004.1 TEST HOLE #: 2

PROJECT NAME:	UPPER CHESAPEAKE MEDICAL CENTER	EXCAVATION BY:	A/I/DATA	DATE DUG:	03/28/11
PROJECT LOCATION:	HARFORD COUNTY, MARYLAND	FORM BY:	TDM	ASSISTED BY:	MLJ, GMC
CLIENT NAME:	FREDERICK WARD ASSOCIATES, INC.	CHECKED BY:	SEW	PAVING CONDITION:	GOOD
UTILITY REQUESTED:	TELEPHONE	GENERAL SOIL CONDITIONS:	SOFT DRY SAND	UTILITY CONDITION:	GOOD
UTILITY FOUND:	(6) 4" PLASTIC TELEPHONE CONDUITS	MARKER SURVEYED BY:	A/I/DATA		



DATA VIEW

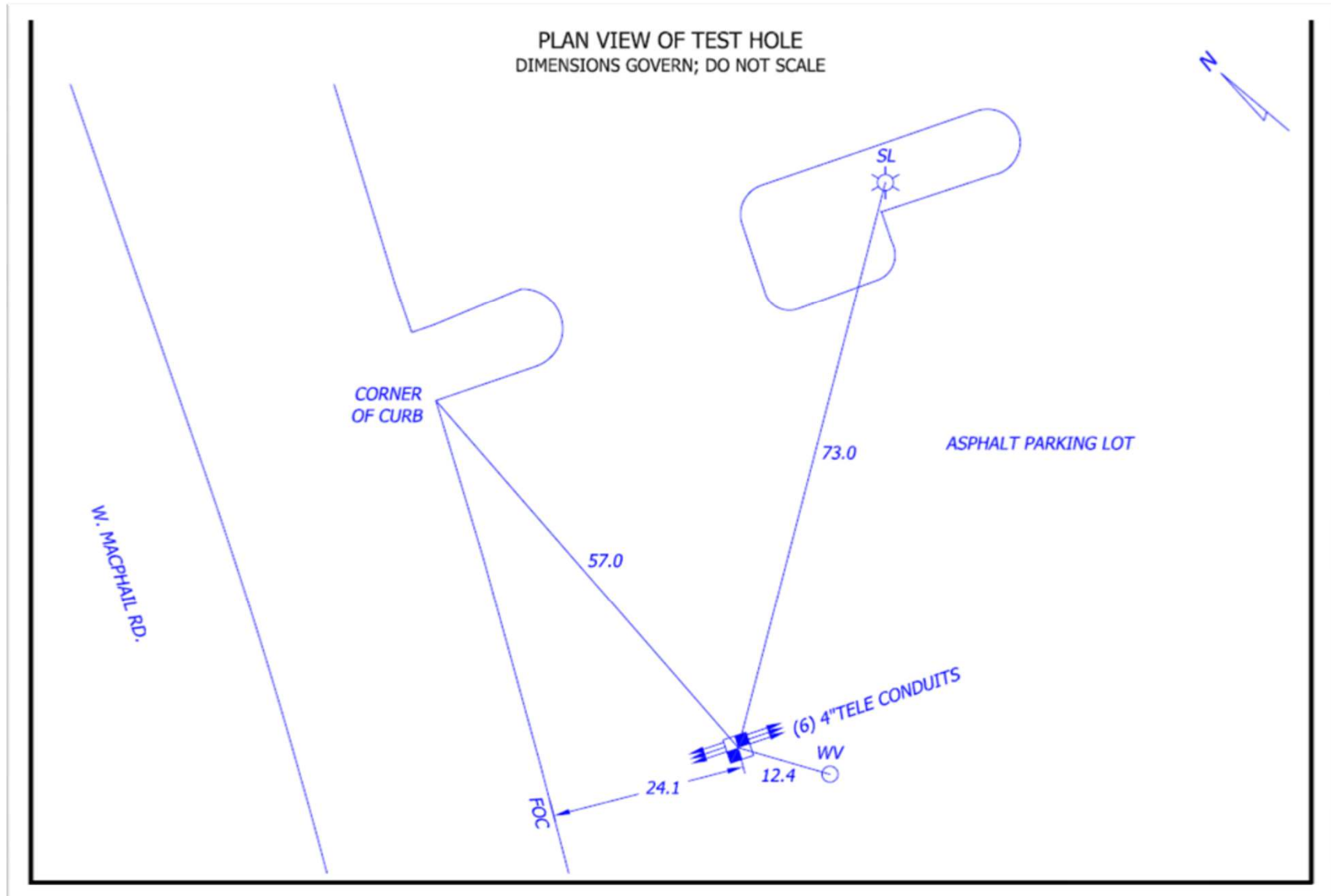
A / I / DATA - TEST HOLE DATA SHEET

JOB #: 11004.1 TEST HOLE # : 2

PROJECT NAME: UPPER CHESAPEAKE MEDICAL CENTER	EXCAVATION BY: A/I/DATA	DATE DUG: 03/28/11
PROJECT LOCATION: HARFORD COUNTY, MARYLAND	FORM BY: TDM	ASSISTED BY: MLJ, GMC
CLIENT NAME: FREDERICK WARD ASSOCIATES, INC.	PAVING CONDITION: GOOD	CHECKED BY: SEW
UTILITY REQUESTED: TELEPHONE	GENERAL SOIL CONDITIONS: SOFT DRY SAND	
UTILITY FOUND: (6) 4" PLASTIC TELEPHONE CONDUITS	UTILITY CONDITION: GOOD	
SECTION VIEW OF TEST HOLE NOT TO SCALE		MARKER SURVEYED BY: A/I/DATA

ELEV SURVEY MARKER 315.73		CONTROL POINTS PROVIDED BY: FREDERICK WARD ASSOCIATES, INC.
EXISTING GRADE		101 N= 675583.54 E= 1496556.51 ELEV= 320.64
DEPTH (TOP) 5.89		102 N= 675477.42 E= 1496612.14 ELEV= 320.21
ELEV. (TOP) 309.84		A/I/DATA MARKER: NORTHING EASTING ELEVATION 675663.59 1496384.71 315.73
DEPTH (BOTTOM)		NOTES: PK NAIL SET OVER CROWN OF SOUTHERNMOST CONDUIT. COVER TO MIDDLE CONDUIT = 5.48. COVER TO NOTHERNMOST CONDUIT = 5.91.
ELEV. (BOTTOM)		ALL MEASUREMENTS ARE SHOWN IN DECIMAL FEET EXCEPT WHERE NOTED
		TEST HOLE DATA PRODUCED BY: ACCURATE INFRASTRUCTURE DATA, INC. 1100 BATAVIA FARM ROAD, SUITE 200, BALTIMORE, MD 21237 PH: 410-686-5091 FAX: 410-686-5093

PLAN VIEW SKETCH



TEST HOLE RESULTS ARE TIED BY SURVEY
METHODS TO PROJECT CONTROL AS NEEDED.

PIPES VS DUCTS OR OTHER STRUCTURES

A/I|DATA TEST HOLE DATA SHEET

PROJECT NAME: *TOWNPLACE SUITES*

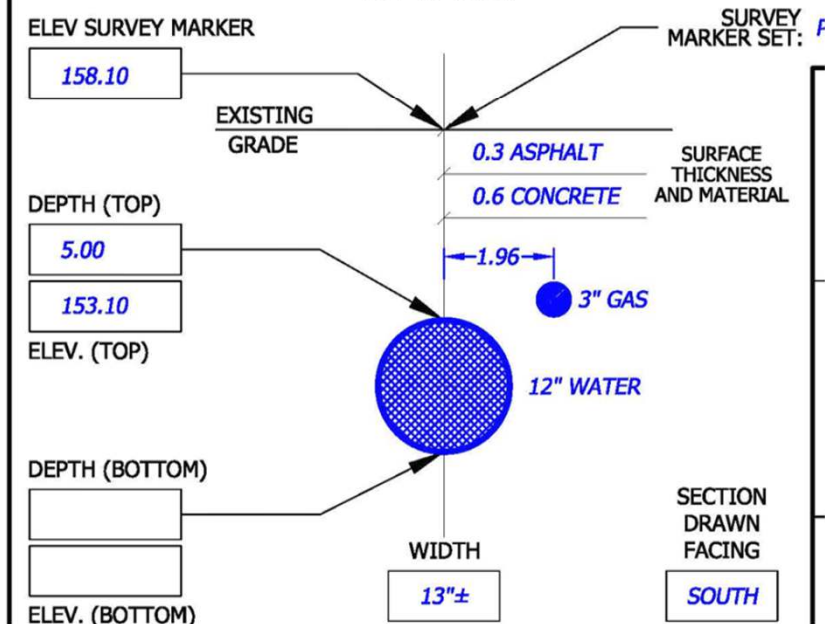
PROJECT LOCATION: *PRINCE GEORGE'S COUNTY, MARYLAND*

CLIENT NAME: *BOHLER ENGINEERING, P.C.*

UTILITY REQUESTED: *12" WATER*

UTILITY FOUND: *12" CAST IRON WATER & 3" METAL GAS (SEE NOTES)*

SECTION VIEW OF TEST HOLE NOT TO SCALE



A/I|DATA TEST HOLE DATA SHEET

PROJECT NAME: *NAVY FEDERAL CREDIT UNION - BESTGATE ROAD*

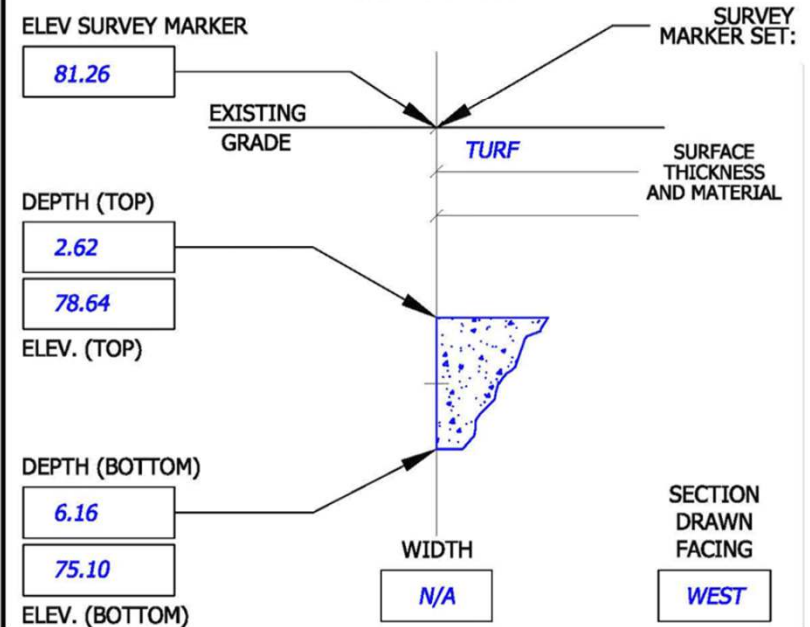
PROJECT LOCATION: *ANNE ARUNDEL COUNTY, MARYLAND*

CLIENT NAME: *BOHLER ENGINEERING*

UTILITY REQUESTED: *ELECTRIC*

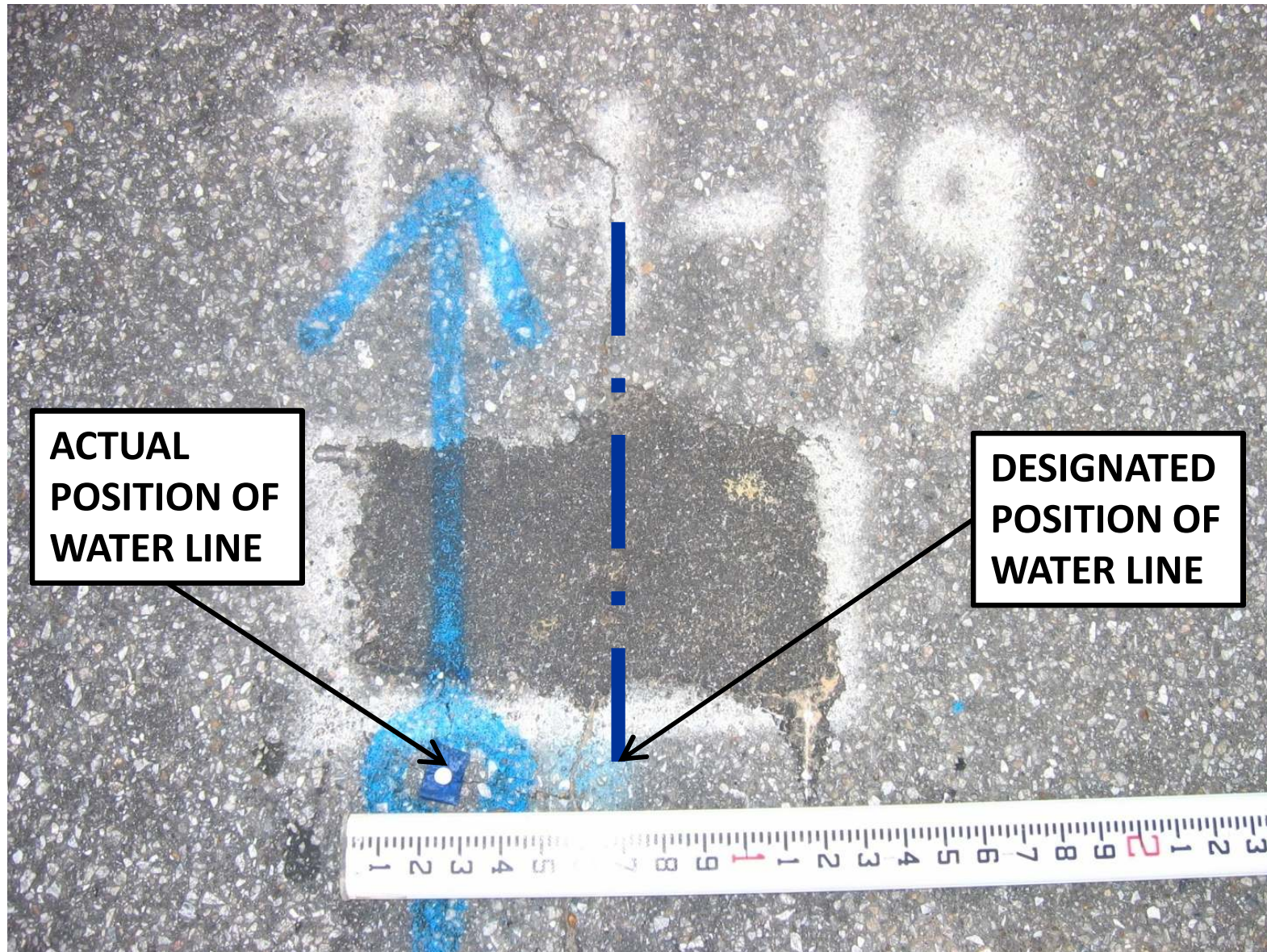
UTILITY FOUND: *CONCRETE ELECTRIC DUCT*

SECTION VIEW OF TEST HOLE NOT TO SCALE



DETECTION ACCURACY

0.4' +/- OFFSET FROM DESIGNATED POSITION



SUMMARY – QL “A”

Engineering / Survey Grade Data

Most Reliable Determination Of Utility Data however...

- Point Specific Results
- May not accurately predict utility characteristics beyond test hole location. QL B may still be needed.

Minimizes Risk Of Damage To Exposed Utilities

May Be Used For A Variety Of Structure Types

Most often used when precision is needed for conflict identification and resolution

SUE IMPLEMENTATION

Possible Surveyor's/Engineer's Note

- *Subsurface utilities are depicted by their Quality Levels in accordance with ASCE 38-02 based on professional designating services provided by A/I/DATA on January 14, 2014. Contractors shall validate subsurface utility data to their own satisfaction.*
 - “designating and locating...” if test holes performed as part of services provided.

Show 38-02 Quality Level definitions in drawing legend.

Use 38-02 labeling conventions in plan view.

- These steps help distinguish “paint on the ground” from professional services rendered
- Design excellence is built on quality base data

SUE APPLICATIONS

Location And Depth Of Subsurface Facilities

- Design Development
- Conflict Identification And Resolution
- Risk Reduction Service
 - Avoid Change Orders
 - Avoid Extra Work Orders
 - Avoid Project Delays
- Meet Standard Of Professional Care

Manhole Blowdown & Documentation Services

Enhanced Topographic Services

As Built Survey Requirements

GIS Data Population For Utility Network Management

Pre-construction “Existing Conditions” Marking

QUESTIONS?

FHWA -

<http://www.fhwa.dot.gov/programadmin/sueindex.cfm>

ASCE - <http://www.asce.org/codes-standards/list/>

COMMON GROUND ALLIANCE

<http://www.commongroundalliance.com/>

UNDERGROUND CONSTRUCTION

<http://www.undergroundconstructionmagazine.com/>

UNDERGROUND FOCUS

http://www.underspace.com/ufm_magazine.php

A/I/DATA

ACCURATE INFRASTRUCTURE DATA, INC.

1100 Batavia Farm Road, Suite 200

Baltimore, MD 21237

888-686-5091 (TOLL FREE)

410-686-5091 (PHONE)

410-686-5093 (FAX)

mmaguire@aidatainc.com

jberrettini@aidatainc.com

THE END?

