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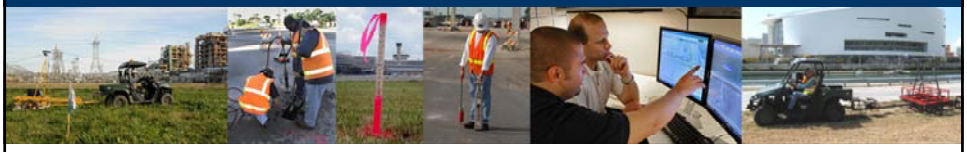

Subsurface Utility Engineering:

A Proven Solution

XXIV FIG International Congress 2010

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The Problem:
Unreliable Utility Information

Change Orders $$$$

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Unreliable Utility Information Affects Project Planning / Design

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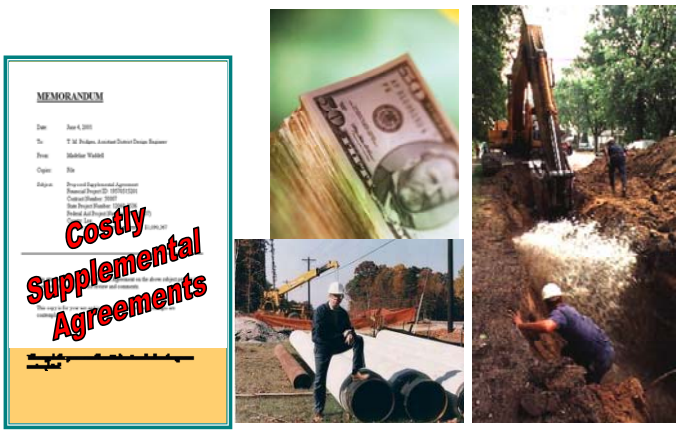
Unreliable Utility Information Affects Project Funding and Construction Cost



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Unreliable Utility Information Affects Road Reserve Acquisition

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Unreliable Utility Information Affects Utility Damage and Construction Delays

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Unreliable Utility Information Affects Health & Safety Risks

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A Proven Solution: Subsurface Utility Engineering (SUE)

- Civil Engineering
- Geophysics
- Survey
- Cadd and/or GIS

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American Society of Civil Engineering (ASCE)

SUE: 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.

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SUE is important because it has been proven to:

- Reduce damages
- Resolve conflicts prior to construction
- Avoid unnecessary utility relocations
- Save Lives
- Saves Money

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SUE: The Process

Currently, the popular view of SUE includes three major phases:

- Designating
- Locating
- Data Management

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SUE: The Process

Designating:

The process of using surface geophysical methods to interpret the presence of a subsurface utility and to mark its ***approximate*** horizontal position (its *designation*) on the ground surface. (Note: Utility owners and contractors often call this process "locating.")

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SUE: The Process

Locating:

The process of exposing and recording the precise vertical and horizontal location of a utility, through the use of vacuum excavation. It is non-destructive and typically more time and cost efficient than other conventional digging methods.

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SUE: The Process

Data Management: The use of the surveyed utility information obtained by designating and locating and typically that data is incorporated into CAD or GIS.

Activities include:

- updating existing utility drawings
- Depiction on design plans
- Creation of "composite" utility maps
- Conflict analysis and resolution

What is SUE's History?

- 1982 -- Traditional ways not working -- SUE "invented"
- 1985 -- First statewide contract with Virginia DOT

What is SUE's History?

- 1991 -- FHWA began promoting SUE

U.S. Department of Transportation
Federal Highway Administration

- 2002 – Standard Guideline was adopted by American Society of Civil Engineers

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Industry Standards and Guidelines

- Federal Highway Administration (FHWA)
- American Association of State Highway and Transportation Officials (AASHTO)
- American Society of Civil Engineers (ASCE)
- American Public Works Association (APWA)
- National Transportation Safety Board (NTSB)
- Federal Aviation Authority (FAA)
- State DOT's, Cities, Counties and Utility Owners

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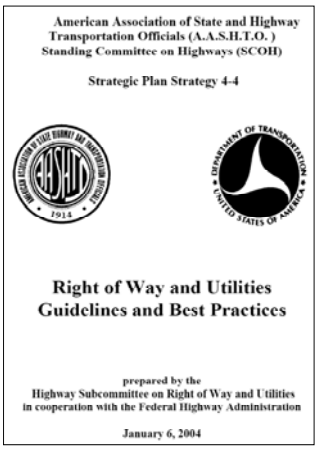
SUE: A Proven Solution


American Association of State and Highway Transportation Officials (A.A.S.H.T.O.)
Standing Committee on Highways (SCOH)

Strategic Plan Strategy 4-4

Right of Way and Utilities
Guidelines and Best Practices

prepared by the
Highway Subcommittee on Right of Way and Utilities
in cooperation with the Federal Highway Administration

January 6, 2004

AASHTO
Subcommittee on
Right-of-Way and Utilities

http://rightofway.transportation.org

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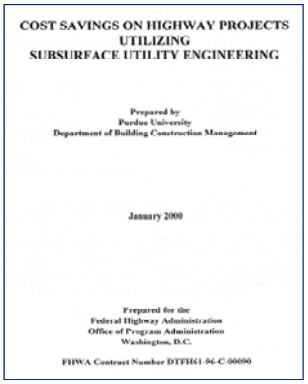
SUE: A Proven Solution

FHWA-Purdue study
$4.62 Saved Per $1.00 Spent


COST SAVINGS ON HIGHWAY PROJECTS
UTILIZING
SUBSURFACE UTILITY ENGINEERING

Prepared by
Purdue University
Department of Building Construction Management

January 2000

Prepared for the
Federal Highway Administration
Office of Program Administration
Washington, D.C.

FHWA Contract Number DTFH61-96-C-00090

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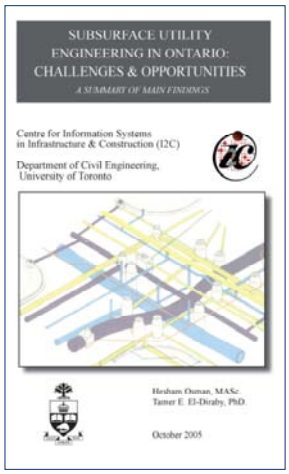
SUE: A Proven Solution

- University of Toronto
- Commissioned by Ontario Sewer and Watermain Contractors Assoc.
- $3.41 Return on $1.00 Investment


SUBSURFACE UTILITY ENGINEERING IN ONTARIO: CHALLENGES & OPPORTUNITIES

A SUMMARY OF MAIN FINDINGS

Centre for Information Systems in Infrastructure & Construction (I2C)

Department of Civil Engineering, University of Toronto

Hesham Osman, M.A.Sc.
Tamer E. El-Diraby, Ph.D.

October 2005

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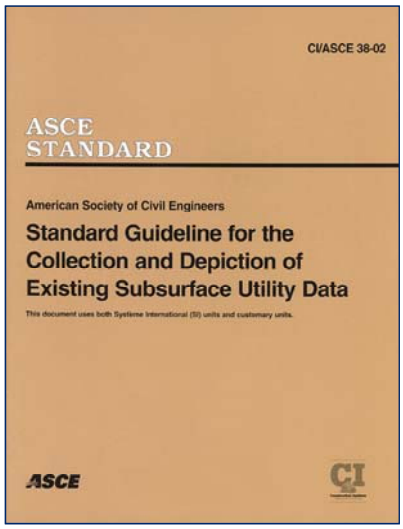

CI/ASCE 38-02

Four "Quality Levels" defined

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ASCE Standard
SUE Quality Levels D, C, B, A

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ASCE Quality Level D – "Records Research"

Information comes solely from:

- Existing utility records,
- Individual recollections
- Dial Before You Dig tickets
- Field review
- Public Service Commission
- Governmental Permitting Agencies
- Web base Search

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ASCE Quality Level C – "Field Research"

- Involves surveying visible above ground utility facilities, i.e. manholes, valve boxes, etc.
- Correlates survey data with existing utility records plans

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ASCE Quality Level B – "Designating"

Using surface geophysical techniques to determine the existence and approximate horizontal position of underground utilities

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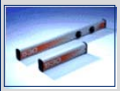
Quality Level B Designating Instruments

Radiodetection 400
Multi-Frequency
512Hz 8KHz 33Khz 65KHz
Low Medium

3M Dynatel 2250
Multi-Frequency
5772Hz 8Khz 33KHz 133Khz
Low Medium High

Metrotech 810
Single Frequency
83KHz
High



Metrotech 530
Single Frequency
332KHz
High

Subsite 950
Multi-Frequency
512Hz 1Khz 8KHz 29Khz 80KHz
Low Medium High

Rycom 8876
Dual Frequency
815Hz 82KHz
Low High

Metrotech 9890xt
Multi-Frequency
982Hz 9.8KHz 82KHz
Low High

Pipehorn
Single Frequency
480 KHz
Very High

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2D and 3D Radar Tomography

Safe, non-invasive geophysical investigation method used to detect metallic, non-metallic, natural and manmade underground objects

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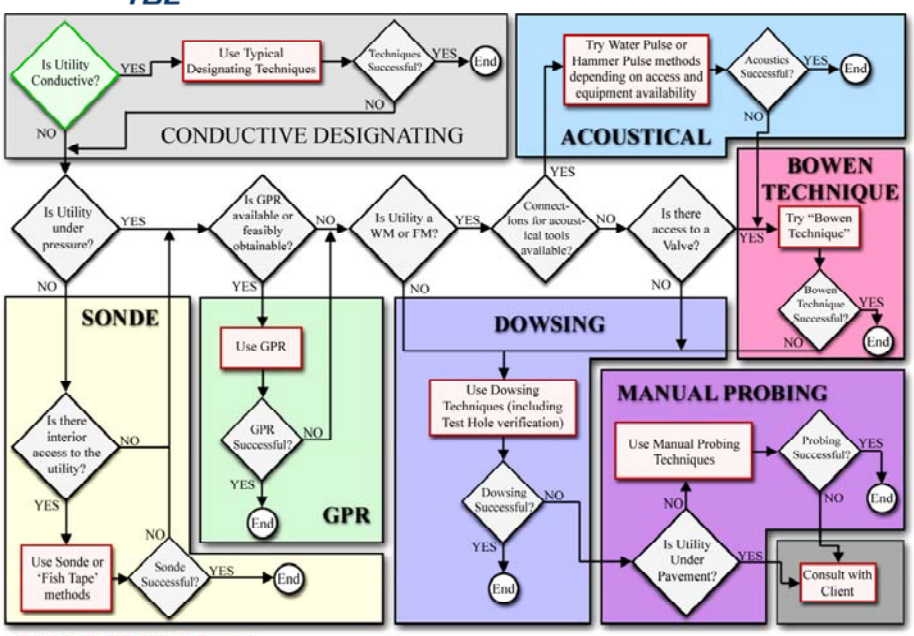
Approach to Designating Conductive / Nonconductive Utilities



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ASCE Quality Level A – "Locating"

Using non-destructive excavating equipment at critical points to determine the precise horizontal and vertical position, type, size, condition, material and other characteristics of underground utilities

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ASCE Quality Level A – Locating Equipment

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ASCE Quality Level A – Locating Equipment

Record Utility Information

Visually Verify Utility

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Dial Before You Dig vs. SUE- ASCE Quality Level B

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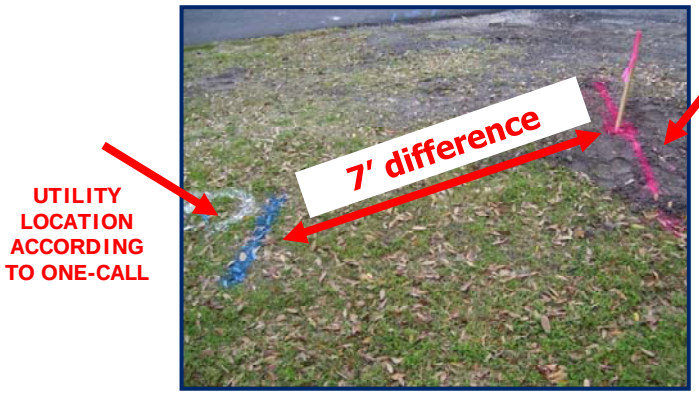
One-Call vs. ASCE Quality Level B



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One-Call vs. ASCE Quality Level B

Oregon Demo Project

Utility	Utility Mark (m)	SUE QL-B (m)
Gas	7,272	8,373
Power	400	587
Telephone	3,085	4,455
Water	4,921	7,180
Sewer	4,250	4,250
Unknown	0	268

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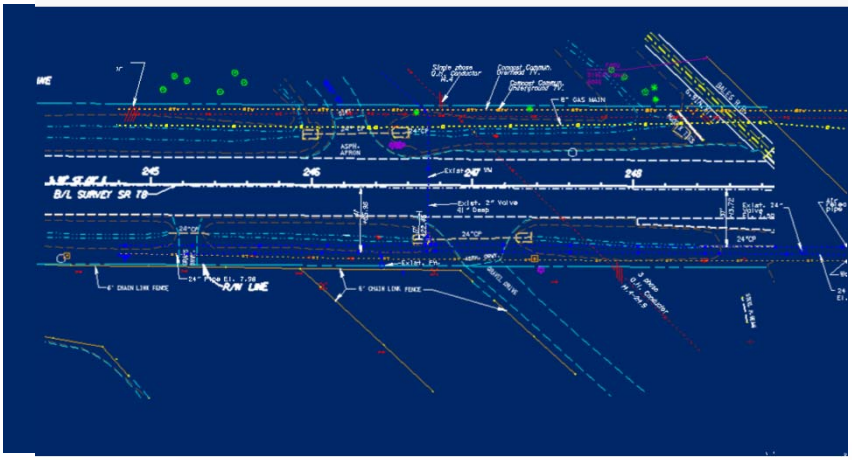
Example Application of SUE – Highway Project

Start with the Topography

Add Existing Road Reserve limits Add Existing Utilities (Quality Level B)



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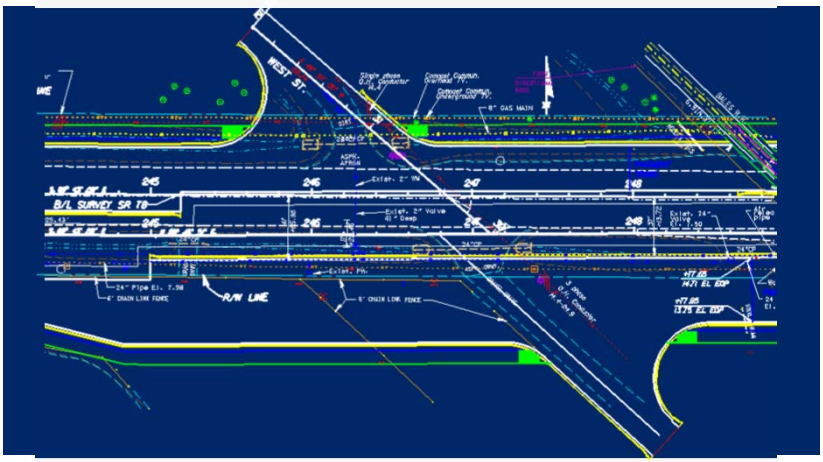
Example Application of SUE – Highway Project

Add Preliminary Roadway Design



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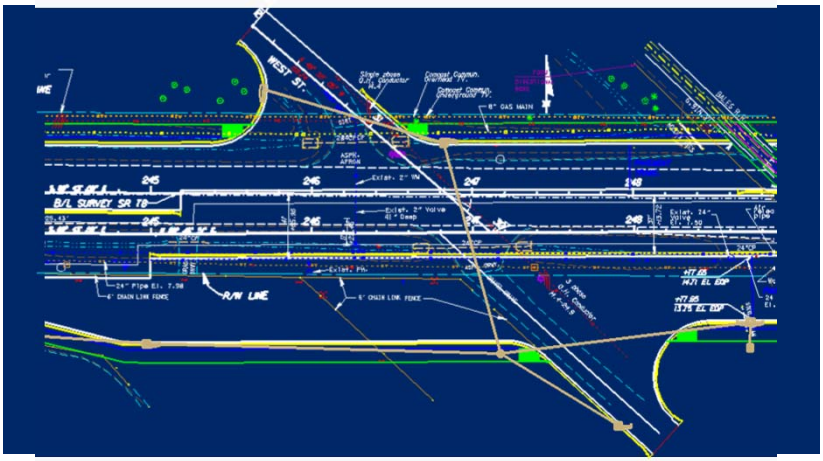
Example Application of SUE – Highway Project

Add Preliminary Drainage Design



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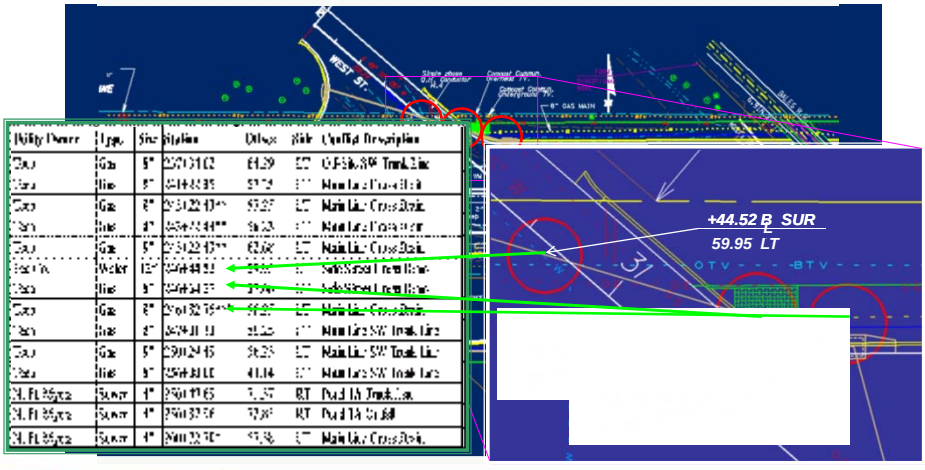
Example Application of SUE – Highway Project

Analyze Conflicts

Identify Locations

Build Conflict Matrix



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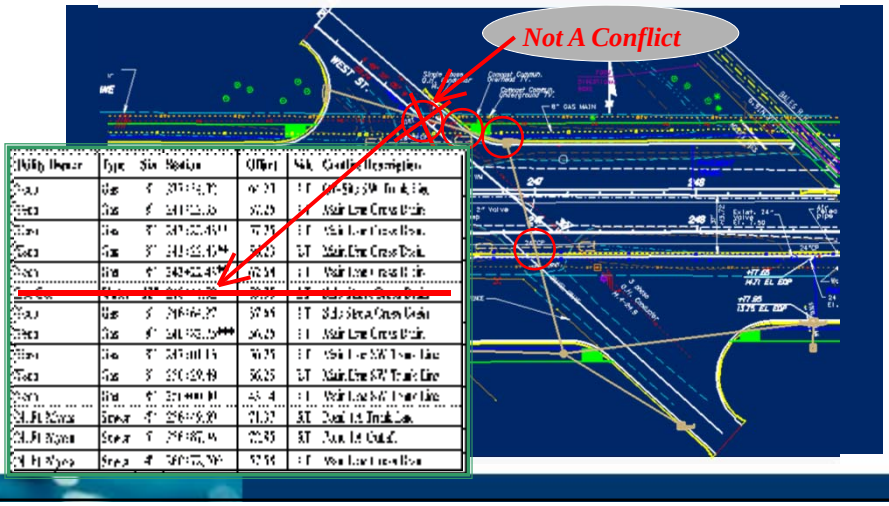
Example Application of SUE – Highway Project

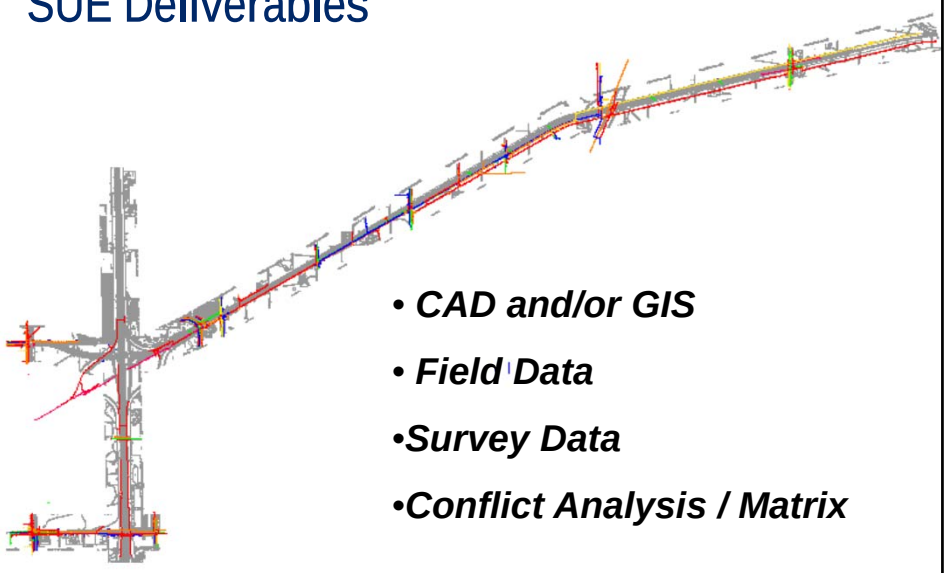
Identify Actual Conflicts Through QL A

Analyze SUE Data

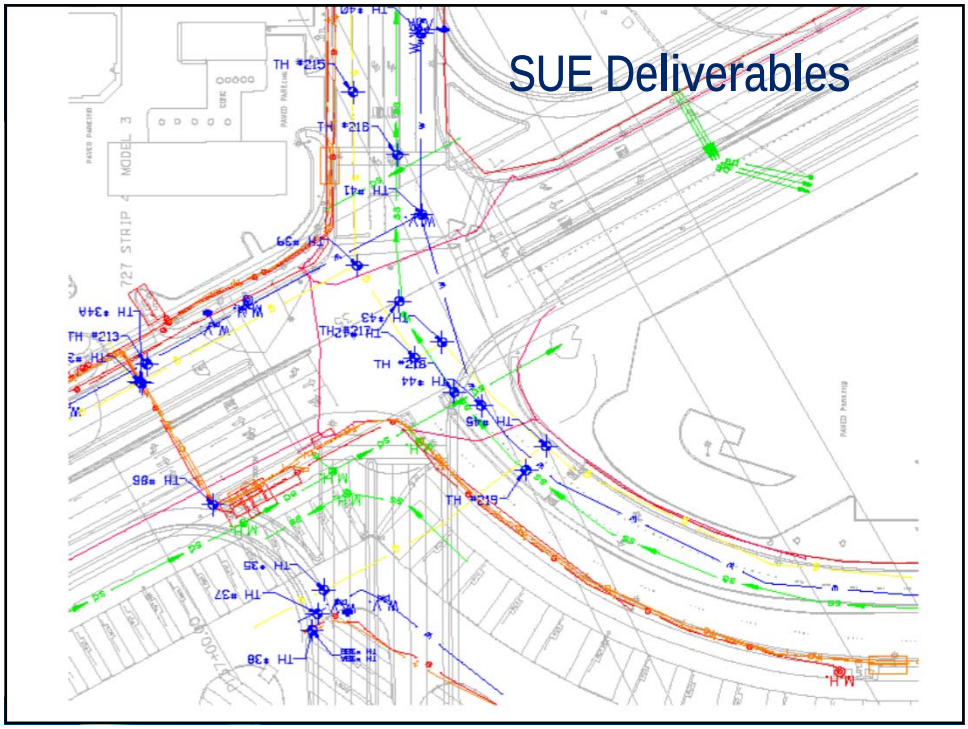
Update Conflict Matrix

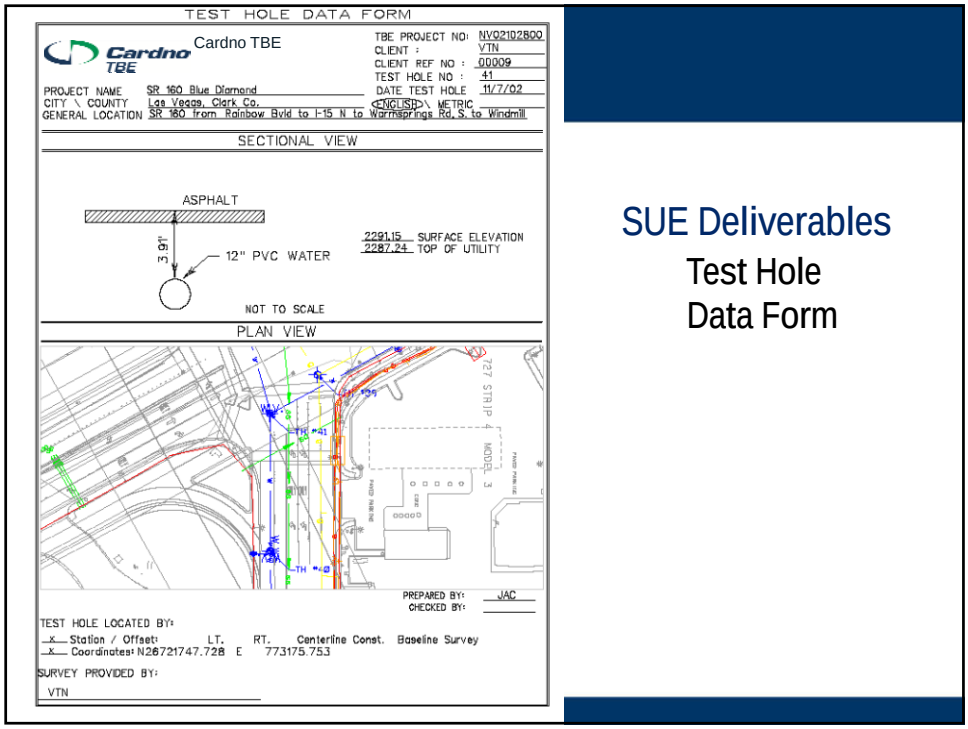


SUE Deliverables



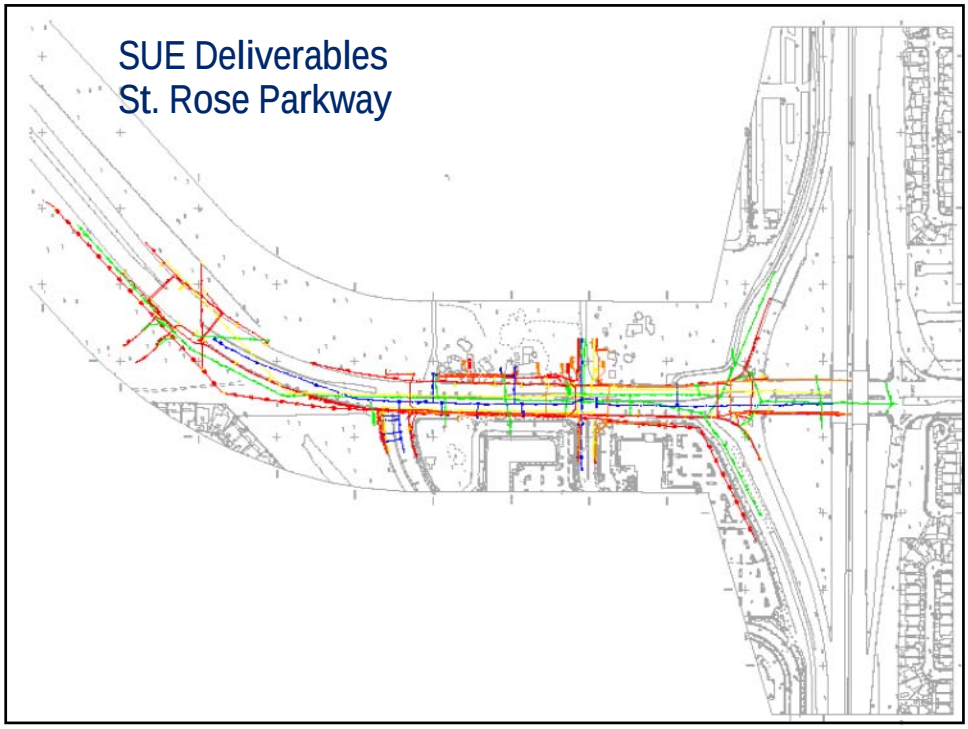
- ***CAD and/or GIS***
- ***Field Data***
- ***Survey Data***
- ***Conflict Analysis / Matrix***





SUE Deliverables

Test Hole
Data Form



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2505	8142820	243568	656.2	TS-20-14
2506	8142820	243568	656.2	TS-20-14
2507	8142820	243568.1	656.18	TS-20-15
2508	8142820	243568.6	656.15	TS-20-16
2509	8142820	243569.9	656.31	TS-22-1
2510	8142819	243569	656.32	TV-9-58
2511	8142820	243570	656.31	TS BOX
2512	8142820	243570	656.3	TS BOX
2513	8142820	243569.2	656.28	TS BOX
2514	8142820	243569.2	656.3	TS BOX
2515	8142821	243570	656.3	FO BOX
2516	8142821	243569.1	656.28	FO BOX
2517	8142822	243569.1	656.25	FO BOX
2518	8142822	243570	656.26	FO BOX
2519	8142822	243571	656.52	TS-21-1
2520	8142823	243570.6	656.29	TS-21-2
2521	8142826	243570.7	656.23	TS-21-3
2522	8142827	243570.2	656.19	E-21-2
2523	8142827	243569.6	656.17	TV-9-59
2524	8142837	243569.8	655.98	TV-9-60
2525	8142837	243570.1	655.99	TS-21-4
2526	8142837	243570.3	655.99	E-21-1
2527	8142815	243570.5	656.47	TS-2-2
2528	8142815	243570.9	656.66	E-22-3

SUE Deliverables
St. Rose Parkway
2528 Survey Shots

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SUE Deliverables

US-95 Searchlight, Nevada Phase III

Level=1	UG TELEPHONE	61,944.38
Level=10	GAS	94,632.65
Level=30	CATV	409.64
Level=35	STORM DRAIN	5,475.23
Level=40	WATER	804.62
Level=24	TRAFFIC ELECTRIC	3,780.82
Level=50	UG ELECTRIC	3,079.87
Level=60	FIBER OPTIC	101,582.96
Level=51	OH ELECTRIC	4,259.66
	TOTAL	**271,710.17**

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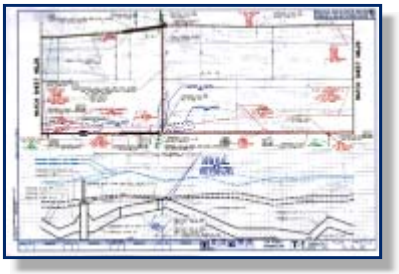
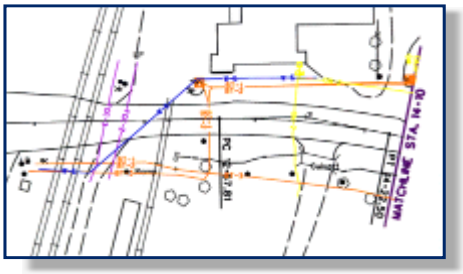
Conflict Matrix

- Utilizes 38-02 data
- Identifies all potential conflicts
- Recommends where to use Quality Level A





Conflict Matrix

Conflic	Station and Offset	Utility	Identified Conflict	Testhole Needed	Utility Impact with Cost ("As-designed")	Recommended Resolution	*Benefit of Resolution
C1	100+05, 21'L 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO	No	Relocate 1150LF of BFO-DUCT ($91,000)	Relocate proposed storm drainage into street. Use DI's that drain toward roadway.	Save Cost to Relocate BFO-DUCT ($91,000)
C2	100+66, 21'L 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO	No	See C1		
C3	100+38, 24'R 14th St Constr. BL	UNK@Tee	Proposed 18" storm and unknown utility tee	TH 1	Relocate unknown type and function utility	TH to identify utility and conflict	Eliminate possible delay during construction
C4	100+56, 25'R 14th St Constr. BL	8"W	Proposed 18" storm and existing 8"W	TH 2	Relocate 8"W ($7,500)	TH on 8"W, adjust depth of proposed storm drainage	Save Cost to Relocate 8"W ($6,000)
C5	100+61, 25'R 14th St Constr. BL	8"W	Proposed 18" storm and existing 8"W	TH 3	Relocate 8"W ($7,500)	TH on 8"W, adjust depth of proposed storm drainage	Save Cost to Relocate 8"W ($6,000)
C6	100+82, 28R 14th St Constr. BL	4"G	Proposed storm structure and existing 4"G	TH 4	Relocate 20 LF of 4"G ($6,000)	TH on 4"G, adjust depth of proposed storm structure	Save Cost to Relocate 4"G ($4,500)
C7	101+22 27'R 14th St Constr. BL	4"G	Proposed 18" storm and existing 4"x2" gas tee	TH 5	Relocate 2"G & 4"G Tee ($12,500)	TH on G lines, adjust depth of proposed storm structure	Save Cost to Relocate G lines ($11,000)
C8	101+01 28'L 14th St Constr. BL	16"G	Proposed 18" storm and existing 16"G	TH 6	Relocate 16"G ($10,000)	TH on 16"G, adjust depth of proposed storm structure	Save Cost to Relocate 16"G ($8,500)
C9	101+25 41'L 14th St Constr. BL	BT-DUCT 2"G	Proposed storm structure and two BT-ducts	TH 7	Relocate BT-DUCT & 2"G ($11,000)	TH on BT-DUCT & 2"G, adjust depth of proposed storm structure	Save Cost to Relocate BT-DUCT & 2"G ($10,500)
C10	101+37, 41'L 14th St Constr. BL	6"W	Proposed 18" storm and existing 6"W	TH 8	Relocate 6"W ($5,000)	TH on 6"W, adjust depth of proposed storm drainage	Save Cost to Relocate 6"W ($3,500)
C11	101+57, 27'L 14th St Constr. BL	16"G	Proposed 18" storm and existing 16"G	TH 9	Relocate 16"G ($10,000)	TH on 16"G, adjust depth of proposed storm structure	Save Cost to Relocate 16"G ($8,500)
C12	101+58, 22'L 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO	No	See C1		
C13	101+90, 22'L 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO	No	See C1		
C14	102+20, 27'R 14th St Constr. BL	4"G	Proposed storm structure and existing 4"G	No	Relocate 4"G ($4,500)	Relocate 4"G	Elimnate conflict with proposed DI
C15	102+36, 24'L 14th St Constr. BL	AGL-BFO	Proposed storm structure and existing BFO	No	See C1		

*Please include all benefits incurred including time, costs, and safety improvements.

Key:

AC - Asbestos Concrete
BF - Buried Electric
BFO - Buried Fiber Optic
BT - Buried Telephone
G - Gas
L - Left
MES - Mitered End Section
OE - Overhead Electric
OT - Overhead Telephone
R - Right
RCP - Reinforce Concrete Pipe
W - Water
WM - Water Main
TH - Test Hole, verify vert. and horiz
UNK - Unknown Type
SAN - Sanitary Sewer

Utility Owner:

AGL Atlanta Gas Light
BE Georgia Power
BT Bell South
L3 Level 3 Communications
MFN Metromedia Fiber Network
SAN Fulton County Public Works
W City of Atlanta
UNK Unknown Owner

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Why Use SUE?
To Avoid Unreliable Underground Utility Information

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When & Where to Use SUE

- Not Just for Highways!
  - Public Works
  - Power Plants
  - Utility Facilities
  - Oil and Gas Transmission
  - Airports
    - FAA just completed a promotional video
  - Military bases
  - Railroad / rapid transit
  - Asset Management
  - Seaports
  - Other Industries:
    - health, education, manufacturing, pharmaceutical, etc.

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Why use SUE?

- More Efficient & Reliable Design
- Reduce Unnecessary Utility Relocations
- Avoid Costly Conflicts & Delays
- Reduce Utility Damage & Loss of Service
- Lower Construction Bids
- Safety
- Cost-Effective ($4.62 return per $1.00 spent)
- Standard of Care (ASCE 38-02)

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SUE Video

Subsurface Utility Engineering
A Proven Solution

U.S. Department of Transportation
Federal Highway Administration
1995

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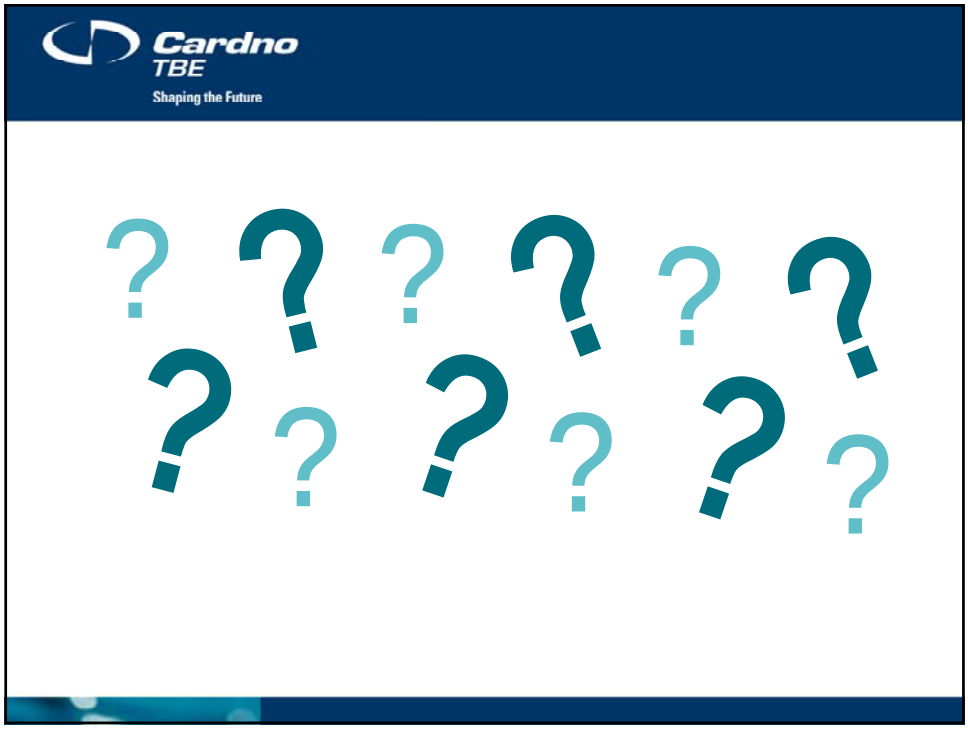
SUE Web Sites

- FHWA: http://www.fhwa.dot.gov/programadmin/sueindex.cfm
- Cardno: http://www.subsurfaceutilityengineering.com/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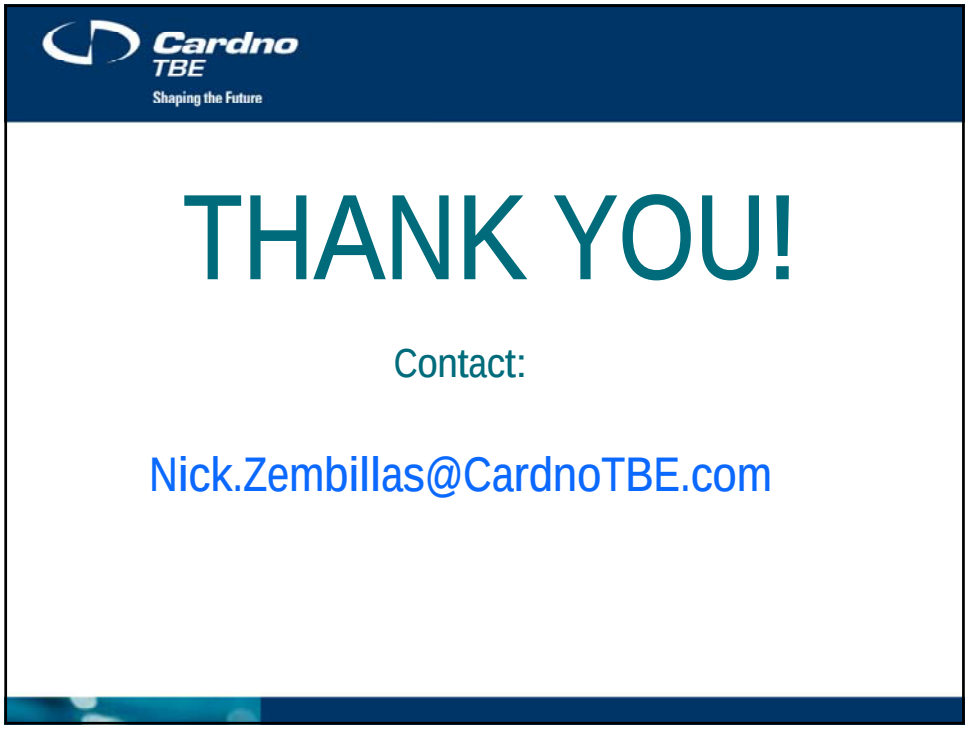
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THANK YOU!
Contact:
Nick.Zembillas@CardnoTBE.com