Who is Cardno?

- **Professional Infrastructure and Environmental Services Company**
- Global Reach, Local Knowledge
- Over 6,000 Employees, 3,500+ in US
- Projects in over 100 Countries
- #44 ENR Top 500 Design Firms, 2017
- #10 Trenchless Technology, 2016
- Head Office in Brisbane, Australia
- Providing SUE services in Texas since 1996, Formerly TBE Group, Inc.
- 32 Designating Crews & 26 Vacuum Truck Crews in the Region
- Additional resources from national SUE pool
What is the number one problem on most civil projects?

Utilities!
Unreliable *Utility* Information
Unreliable Utility Information Affects:

Project Planning and Design
Unreliable Utility Information Affects:

Project Funding and Construction Cost

MEMORANDUM

Date: June 4, 2001
To: T.M. Pridges, Assistant District Design Engineer
From: Madeline Waddell
Copies: Fic
Subject: Project Number: 50967

State Project Number: 000-000-0000
Federal AID Supplemental Agreement

The attached proposed Supplemental Agreement on the above subject project is forwarded to your office for review and comments.

This copy is for your use and is not to be returned unless changes are contemplated.
Unreliable Utility Information Affects:

Right of Way Acquisition
Unreliable Utility Information Affects:

Utility Damage and Construction Delays
Unreliable Utility Information Affects:

Project Schedules

![Image of joint water commission transmission line encroachment survey schedule]
Unreliable Utility Information Affects:

Contractor Safety
Unreliable Utility Information Affects:

Public Safety
There Is a Proven Solution!

Subsurface Utility Engineering (SUE)

A sub-discipline of civil engineering, that combines technologies and design methodologies to deal with the problems of underground utilities on civil, environmental and other related construction projects.
History of Subsurface Utility Engineering

- Early 1980’s Two New Technologies Emerge: Pipe/Cable Locators and Vacuum Excavation
- Subsurface Utility Engineering
  Began in the 1980’s
- 1984 Virginia Department of Transportation (DOT) Began Using SUE on Their Projects
- 1989 SUE Was Introduced at the First National Highway Conference
- Late 80’s and Early 90’s, the FHWA Introduced SUE to all State DOTs
- 1997, The National Transportation Safety Board (NTSB) Promotes the Use of Subsurface Utility Engineering Amongst Its Members
History of Subsurface Utility Engineering

January 2000 FHWA/Purdue Case Studies

A total of 71 projects from Virginia, North Carolina, Texas and Ohio were studied. The total construction costs of these projects were in excess of one billion dollars.

“The total savings on a typical project may range from 10% to 15% compared with costs from a project not supported by professional SUE.”

$4.62 to $1.00
History of Subsurface Utility Engineering

In 2003 the ASCE Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data was approved.

At Cardno, we wrote the book…literally.

> All subsurface utility engineering services compliant with ASCE 38
> Cardno Associates were part of original and ongoing ASCE 38 Committee:
  – Jim Anspach, PG, F.ASCE
    – Cardno Utility Markets & Practice Development
    – Chair of committee since 1996
> Paul Scott, PE – Cardno USA Utility Liaison
> Lawrence Arcand, P.Eng – UES Practice Lead
History of Subsurface Utility Engineering

**Case Study: 2005 University of Toronto**

- Commissioned by the Ontario Sewer and Watermain Contractors Association
- $3.41 Return on $1.00 Investment

**Case Study: 2008 Penn State University**

- Commissioned by PENNDOT
- $21.00 Return on $1.00 Investment
Who Promotes Subsurface Utility Engineering?

- Federal Highway Administration (FHWA)
- American Society of Civil Engineers (ASCE)
- American Public Works Association (APWA)
- American Association of State Highway and Transportation Officials (AASHTO)
- Federal Aviation Administration (FAA)
- National Transportation Safety Board (NTSB)
- Canadian Standards Association (CSA)
- Common Ground Alliance (CGA) (CARCGA)
- State DOTs, Cities, Counties and Utility Owners
- Colorado passed legislation requiring SUE on any development project funded with taxpayer dollars.
ASCE Standard 38-02: Quality Levels

- Quality Level D
- Quality Level C
- Quality Level B
- Quality Level A
ASCE Standard 38-02: Quality Level D

- As-Built Records
- Utility System Drawings
- Oral Recollections
- Permitting Agency Records
- DOT Utility Offices
- One-Call Centers
- Project Site Visits
ASCE Standard 38-02: Quality Level C

> Surveying visible, above ground, surface features such as:
  – Valves
  – Fire hydrants
  – Pull boxes
  – Manholes
  – Telephone pedestals

> Reconciled to ASCE Quality Level D records
ASCE Standard 38-02: Quality Level B

**Designating:** Surface geophysical methods to designate, or mark, the *approximate* horizontal position of subsurface utilities
Is One-Call Locating the Same as ASCE Quality Level B?
No!  ... Why not?

- One-Call is not conducted in accordance with CI/ASCE Standard 38-02
- Not depicted on plans and signed by a licensed professional engineer - backed-up by errors and omissions insurance
- Not provided by engineers and trained subsurface utility engineering technicians using optimum equipment and extended process
- “Get in – get out”
One-Call vs. ASCE Quality Level B
One-Call vs. ASCE Quality Level B

Utility Location According to One-Call

Found by Cardno TBE

7’ difference

Location where the “as-built” drawing said they should be

37’ difference

Found by Cardno
Primary Geophysical Methods – Designating Equipment

Pipe and cable locators:

- Multi-frequency units: Range of frequencies for complexity and congestion of telecom systems.
- Single Frequency units: Higher frequencies for specific scenarios or difficult situations.

Nonconductive Utilities
- Poor Soil Conditions
- Utility Congestion: “bleed over”
- Excessive Utility Depths
Primary Geophysical Methods – Designating Equipment

**Ground Penetrating Radar**
- Safe, non-invasive method
- Can detect metallic, non-metallic, natural and manmade underground objects
- Success rate limited by conductive soils
- Becoming standard industry equipment
GPR is NOT X-Ray Vision
Ground Penetrating Radar
Secondary Geophysical Methods – Designating Equipment

Acoustic (Elastic Wave): designate nonconductive waterline pipe by producing sound wave thru water column

Gradiometer (Magnetic): Metal pipe, valve covers and boxes, manhole lids, wellheads, or shallow buried metal debris

Detectable fiberglass duct rodders
Beacons / Sondes and Camera Systems for non-tonable, accessible utilities: sewer, storm, empty conduits
ASCE Standard 38-02: 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. Only use when vertical info is vital.
Quality Level A Locating Equipment

Vacmasters 4000 vs Tellus Units

Coring Asphalt and Concrete Pavement

Airlance and backfill with existing spoils

Hydrovac vs Air Vac Only

Where does “pot holing” come from?
Quality Level A Locating Equipment

Record Utility Information

Visually Verify Utility
Concrete Imaging Radar

- High-Frequency Radar Concrete Imaging System
- Provides real-time, in-the-box data acquisition, analysis and display (2D and 3D)
3D Underground Imaging

- 14-Channel 3D Ground Penetrating Radar system (Stream)
- Accurate data positioning using integrated GPS antennas
- Towable arrays allow for rapid data collection
Confined Space Investigation

- Performed in accordance with OSHA
- Laser Scanning (LiDAR)
- CCTV
Subsurface Utility Engineering Deliverables

Plan Sheets
Subsurface Utility Engineering Deliverables

- Breaks in Quality Levels
- Inverts on Manholes
Subsurface Utility Engineering Deliverables
Subsurface Utility Engineering Deliverables
Subsurface Utility Engineering Deliverables

- 3D Utility Model
- 3D Deliverable Video
- Subsurface Utility Model
Subsurface Utility Engineering/GIS Deliverables

- SUE/Survey Data of Utilities
- Process SUE/Survey in CAD/MicroStation
- Convert to GIS
Where to Use Subsurface Utility Engineering

- Transportation (highways, roads, rail)
- Public Works
- Utility Facilities
- Oil and Gas Transmission
- Private Property
- Sewer/Power Plants
- Airports/Seaports
- Military
- Health Care Facilities
- Educational Facilities
- Industrial Manufacturing
- Asset Management/GIS
- Archeological
Why use Subsurface Utility Engineering

> #1 Reason – To Reduce Risk on Your Projects

**Why use Subsurface Utility Engineering**

- **Without SUE**:
  - **Total Risk**: Total Engineering Risk Pool
  - **Undefined Quality Level**

- **With SUE**:
  - **Total Risk**: Allocation of Risk within Engineering Pool
  - **Defined Quality Level**
  - **Risk Eliminated**
  - **SUE Engineer**
  - **Design Engineer**
Why use Subsurface Utility Engineering

- Make Informed Design Decisions
- Reduce Unnecessary Utility Relocations
- Reduce Unexpected Utility Conflicts
- Reduce Construction Delays and Claims
- Reduce Utility Damage and Loss of Service
- Receive Lower Construction Bids
- Reduce Right of Way Acquisitions
- Public Safety
Questions and Answers

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Learn More About Subsurface Utility Engineering
www.SubsurfaceUtilityEngineering.com