UDOT Subsurface Utility Engineering Course
This Subsurface Utility Engineering (SUE) Course will address the following:

- What is SUE?
- ASCE Standard 38
- Return on Investment
- SUE Process
- SUE Scoping
- Using SUE Deliverables
- Best Practices / Limitations
- Qualifications for SUE providers

This SUE Course is designed to help the student know when, where, why and how to use SUE on a project.
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

- Scope
- Standard of Care
- Quality Levels
  D, C, B, A
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

Engineer Responsibilities

• Utility Conflicts
• Quality Levels / Costs
• Recommend a Scope
• Discuss deliverables
• Acquiring Data
• Prepare drawing
• Review
• Additional Information
• Conflict Analysis
• Call 811
• Accuracy
• Accommodation / Relocation
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

Owner Responsibilities

- Discuss deliverable
- Utility Owner’s - Cooperation
- SUE quality levels - description
- Discrepancies
- Construction utility marking
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02 - Quality Levels

- Quality Level D - Records Research
- Quality Level C - Above Ground Features
- Quality Level B - Designating
- Quality Level A - Test Holes
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02 - Quality Levels

Quality Level D - Records Research

- Contact Utility Owners for record information
- Sources for this information may also include:
  - Public agencies
  - Blue Stakes of Utah
  - County Clerk’s Office
  - Landowner
  - Internet Search
  - Visual Site Inspection
  - Utility Owner
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

Quality Level C

- Survey of visible, above ground surface features including:
  - Valves
  - Hydrants
  - Pull Boxes
  - Manholes
  - Telephone pedestals

Information collected is used to connect between the surface features. This information is then reconciled with quality level D information.
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

Quality Level B - Using geophysical methods to designate existing subsurface utilities.

• Equipment
• Ground markings
• Survey
• Depiction / Reproducible
• Reconcile
• Additional information
Designating Vignette
What is Subsurface Utility Engineering (SUE)?

ASCE Standard 38-02

Quality Level A - Using nondestructive excavation methods to expose and determine the precise location, horizontally and vertically of existing subsurface utilities.

• Elevation
• Additional information
• Survey
• Resolution
Test Hole Vignette
The Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data (ASCE 38-02):

da. defines quality levels of utility information

b. is a standard of care

c. defines project owner and engineer responsibilities

d. all of the above
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a. defines quality levels of utility information

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Quality Level B:

a. is typically a specific point on a utility line

b. is the precise horizontal and vertical location of utilities

c. is using surface geophysical techniques to determine the existence and approximate horizontal position of subsurface utilities

d. both a and b
Quality Level B:

a. is typically a specific point on a utility line

b. is the precise horizontal and vertical location of utilities

c. is using surface geophysical techniques to determine the existence and approximate horizontal position of subsurface utilities

d. both a and b
Quality Level A:

a. is typically at a specific point on a utility line

b. is the precise horizontal and vertical location of utilities obtained by actual exposure

c. typically describes the highest quality level to be collected for the entire length of a utility line

d. both a and b
Quality Level A:

a. is typically at a specific point on a utility line

b. is the precise horizontal and vertical location of utilities obtained by actual exposure

c. typically describes the highest quality level to be collected for the entire length of a utility line

d. both a and b
Quality Level D:

a. is the most reliable of the quality levels
b. is not needed to complete a quality level B investigation
c. involves the collection of utility records
d. both a and b
Quality Level D:

a. is the most reliable of the quality levels
b. is not needed to complete a quality level B investigation
c. involves the collection of utility records
d. both a and b
Why Use Subsurface Utility Engineering?

Manage Risk

- Limit construction delays / claims due to utilities
- Avoid costly relocations
- Unknown / undocumented utilities
- Provide more utility information to Design Build contractors
Why Use Subsurface Utility Engineering?

ASCE Standard 38-02

• Standard of Care
• SUE is a Best Practice
• Quality Levels
• Best Available Technologies, Equipment, and Methodologies
• QA/QC Procedures
• Ties Directly to Other Best Practices
Why Use Subsurface Utility Engineering?

Return on Investment

- Purdue Study
- University of Toronto
- Building relationships
Subsurface Utility Engineering:

a. provides utility mapping at appropriate quality levels
b. is a risk management tool
c. both a and b
d. neither a and b
Subsurface Utility Engineering:

a. provides utility mapping at appropriate quality levels
b. is a risk management tool
c. both a and b
d. neither a and b
Which of the Following Statements are True:

a. Delays in construction due to utility issues rarely occur.

b. Risks of utility issues occurring during construction can be mitigated by performing SUE in design.

c. Having accurate utility information is even more critical on projects with expedited delivery.

d. Both b and c
Which of the Following Statements are True:

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Return on Investment on SUE:

a. has been shown to be about break even in two separate studies conducted.

b. has been studied by Purdue University sampling 4 projects in 71 states

c. includes both direct financial benefits to the immediate project at hand as well as longer term relationship building between UDOT and utility companies

d. has only been studied in Canada and not in the United States
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Subsurface Utility Engineering Process

The order of occurrence of SUE activities generally follows the order of the ASCE 38-02 quality levels.
Subsurface Utility Engineering Process

- 2U1 - Utility (and Railroad) Identification
- Quality Level D - Records Research
- Quality Level C - Above Ground Features
- Quality Level B - Designating
Subsurface Utility Engineering Process

- 3U1 - Identify Potential Utility Conflicts
- 3U2 - Initial Design Utility Coordination
- Quality Level A - Test Holes
- 3U3 - Identify Utility Depth (SUE Quality Level A)
Subsurface Utility Engineering Process

- Management of Data
- Signed and Sealed Deliverables
- Professional Judgement
- Expert Resource for Project Team
How to Scope a Subsurface Utility Engineering Project

- Limits of Investigation
- Quality Levels
- Risk Management Decision
How to Scope a Subsurface Utility Engineering Project

Questions for Determining Scope

• What are the project utility impacts?
• Reliability of information provided by utility owner?
• Are there unknown utilities?
• Are there facilities present where depth may critical?
• What is the importance of the project?
• What is the risk?
How to Scope a Subsurface Utility Engineering Project

Example Applications

- Full SUE Investigation
- Varying Scope Within a Project
- Significant Utility Facilities
- Isolated Elevation Conflict
- Best Practice
How to Scope a Subsurface Utility Engineering Project

Project Delivery Method

- Design Bid Build
- Design-Build (Best Value)
- CMGC (Construction Management General Contractor)
- Pavement Preservation and Pavement Rehabilitation
The use of Subsurface Utility Engineering:

a. should always involve a complete mapping of utility lines to quality level B throughout the entire project limits

b. should always involve the collection of quality level A locations throughout the entire project limits

c. should fit the needs of the project

d. both a and b
The use of Subsurface Utility Engineering:

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b. should always involve the collection of quality level A locations throughout the entire project limits

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d. both a and b
Subsurface Utility Engineering
Scopes:

a. should define the limits of investigation

b. should not include quality levels

c. should be the same on every project

d. should reference ASCE Standard 38-02 only if quality level A will be included
Subsurface Utility Engineering

Scopes:

a. should define the limits of investigation

b. should not include quality levels

c. should be the same on every project

d. should reference ASCE Standard 38-02 only if quality level A will be included
The Subsurface Utility Engineering Process:

a. generally follows the quality levels beginning with quality level A activities and ending with quality level D activities.

b. never involves working on more than one quality level at a time.

c. should be the same on every project.

d. generally follows the quality levels beginning with quality level D activities and ending with quality level A activities noting that some activities may happen concurrently.
The Subsurface Utility Engineering Process:

a. generally follows the quality levels beginning with quality level A activities and ending with quality level D activities.

b. never involves working on more than one quality level at a time.

c. should be the same on every project.

d. generally follows the quality levels beginning with quality level D activities and ending with quality level A activities noting that some activities may happen concurrently.
Quality Level B work is typically completed:

a. just prior to the PS&E Stage.

b. after test hole locations are decided.

c. during the Scoping Stage.

d. after utility meetings are conducted during the Plan-in-Hand stage.
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Quality Level A work:

a. is completed only during the Plan-in-Hand stage.

b. is typically completed during Plan-in-Hand stage.

c. may be completed during the Geometry stage if significant utility conflicts are identified at that time.

d. at times noted in both b and c above.
Quality Level A work:

a. is completed only during the Plan-in-Hand stage.

b. is typically completed during Plan-in-Hand stage.

c. may be completed during the Geometry stage if significant utility conflicts are identified at that time.

d. at times noted in both b and c above.
Activity
Using Subsurface Utility Engineering Information

- Quality Levels
- Exutil File and .csv file
- Conflict Matrix
- Test hole information
- Utility Owner Design & Estimate
Limitations

• Equipment Limitations
  Non-conductive utilities
  Utility Congestion
  Excessive Utility Depths

• Site Conditions
  Water Table
  Poor Soil Conditions
  Accessibility
  Concrete Pavement
  Traffic Control
Qualifications / Experience for a Subsurface Utility Engineering Provider

ASCE recommendations & UDOT Requirements
Services - The Consultant shall be qualified and have the resources to provide Subsurface Utility Engineering services for various projects:

1. Designating Services - Designating means to indicate, by qualified personnel, the horizontal location of underground utilities through the application and professional interpretation of appropriate non-destructive surface geophysical techniques and to reference the location to established survey control, in accordance with ASCE Standard Guideline 38 (current edition). Must be able to certify horizontal accuracy to within +/- 1-foot tolerance. Designating also includes determining the approximate vertical location of underground utilities when geophysical equipment readings appear valid. Approximate vertical location data should be labeled as such.

2. Locate (Test Hole) Services - Locate means to obtain precise horizontal and vertical position, material type, condition, size and other data about the utility facility and its surrounding environment through exposure, inspection and survey. Excavation methods used to expose the utility shall be minimally intrusive and non-destructive, ensure the integrity of the utility and highway facilities, and be performed by qualified personnel in accordance with ASCE Standard Guideline 38 (current edition). Must be able to certify both vertical and horizontal accuracies to within +/- 0.1-foot tolerance.
Qualifications / Experience for a Subsurface Utility Engineering Provider

UDOT requirements

3. Data Management and Submittals - All SUE submittals shall be signed and sealed by a professional engineer licensed in the State of Utah. All work shall be processed and output submitted in the current UDOT drafting standards and current versions of MICROSTATION and BENTLEY CADD programs, unless otherwise approved by UDOT’s Project Manager. All SUE utility location data shall be submitted in UDOT’s current 3D as-built database format (CSV file). A final SUE report shall be submitted at the completion of each work order in a Microsoft Excel file.
Qualifications / Experience for a Subsurface Utility Engineering Provider

UDOT requirements

Experience, Certifications and Personnel - All SUE work shall be performed by qualified professionals. All years of experience listed below mean continuous work at the specific task or function rather than years of experience performing a wide variety of tasks of which some include the specific task or function:

1. Registered Professional Engineer - The Consultant shall have at least one (1) Professional Engineer licensed in the State of Utah with demonstrated training and project experience in:
   • Utility infrastructure mapping scope development
   • Utility records research and interpretation
   • Utility configurations and installation practices
   • Utility detection geophysical theory, application, precision, and limitations
   • Quality assurance and quality control review of utility infrastructure mapping and report deliverables
   • Survey, data collection, and CADD
   • Knowledge and application of ASCE Standard Guideline 38 (current edition)
   • Utility reports
   • At least three (3) years of experience in delivering Utility infrastructure mapping in accordance with ASCE Standard Guideline 38 (current edition) under the direct supervision of a qualified professional meeting the above criteria

2. Utility Designator - The Consultant shall have at least one (1) Utility Designator with three (3) years of direct experience working under the responsible charge of a registered professional engineer, with demonstrated training and project experience in:
   • Providing utility infrastructure designating services of all common utility systems using the applicable geophysical equipment as listed in the Equipment-Geophysical Section below
   • Utility construction practices including installation and layouts
   • Utility records interpretation
   • Utility detection geophysical applications, precisions and limitations
Qualifications / Experience for a Subsurface Utility Engineering Provider

UDOT requirements

3. Locator - The Consultant shall have at least one (1) Locator with one (1) year experience in utility exposure and visual identification of all observable common utility systems attributes using means and methods to safely and minimally expose underground utilities (e.g. vacuum systems).

4. Survey Party Chief - The Consultant shall have at least one (1) Survey Party Chief with two (2) years’ experience in surveying utility designating marks and identifying the function of visible utility appurtenances.

5. CAD Technician - The Consultant shall have at least one (1) CAD Technician with one (1) year of experience in reducing survey work and one (1) year of experience in depicting utilities in UDOT’s current versions of MICROSTATION and BENTLEY CADD programs, and in the current UDOT drafting standards.

6. Consultant Firm - In addition to the required experience of individual personnel, the Consultant shall demonstrate not less than four (4) years’ experience performing SUE. The four (4) years means continuous SUE work rather than years of experience performing a wide variety of work of which some include SUE.
Qualifications / Experience for a Subsurface Utility Engineering Provider

UDOT requirements

Equipment - The Consultant shall have access to a range of utility detection (geophysical) equipment. The equipment is not necessary to be owned. However, it is necessary to have equipment readily available and have in-house personnel specifically experienced in its use. All personnel using equipment must be under the direct responsible charge of a registered professional engineer who will seal the ASCE Utility Quality Levels. Not every project will require every piece of equipment:

Geophysical and related equipment:

- Pipe and cable locator(s) (PCL) covering the frequency range of 1kHZ-480kHZ, with specific frequencies broadly centered around 1kHZ, 8kHZ, 33kHZ, 83kHZ, 250kHZ, and 480kHZ
- Inductive clamp for PCL
- Di-electric extender pole for clamp
- Submersible antennas for underwater mapping
- 200 foot minimum length detectable push rod or CCTV for empty non-metallic ducts
- PCL with passive 60Hz and “Radio-Mode” coverage
- Non-metallic water pipe acoustic locator
- Magnetic gradiometer
- Manhole cover lifter
- Confined space entry equipment and OSHA certifications
- 200 foot minimum wire for remote grounding

Survey Equipment:

- Equipment capable of achieving 0.2 foot accuracy for x, y (Quality levels B, C, and D)
- Equipment capable of achieving 0.1 foot accuracy for x, y, and 0.05 foot for z referenced to local benchmarks (Quality Level A)
Qualifications / Experience for a Subsurface Utility Engineering Provider

UDOT requirements

**Excavation and Related Equipment:**

- Air-vacuum excavator capable of 16-foot minimum excavation (air mandatory; water jet optional, only for use in out of pavement areas with UDOT Project Manager’s approval)
- Asphalt/concrete removal tools
- Pneumatic/air tampers for backfill

**Computer and Software:**

- Engineering design and mapping software compatible with UDOT’s data management and delivery requirements

**General** - The Consultant must be able to perform Quality Level D, C, B, and A SUE work in conformance with ASCE Standard Guideline 38 (current edition). The ability to designate and locate must be able to be performed within the company. When outlining your experience as required in the RFQ with respect to SUE work, be specific on what role your company performed with respect to SUE - e.g. company did locating and Level A SUE, or company designated and performed Level B SUE, or company performed Level D SUE
Subsurface Utility Engineering Information:

a. should be set aside in a file drawer during design so it can be given to construction contractor to determine what utility conflicts will need to be addressed.

b. should be used in design to identify potential utility conflicts.

c. should only include quality levels of depiction when test holes are completed.

d. should exactly match utility records that have been collected.
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Which of the following is false?

a. Soil conditions can affect the ability to detect an underground utility.

b. Any utility that is less than 20 feet deep can be detected and visually verified.

c. Time of year may affect the ability to successfully complete a test hole.

d. There may be issues in obtaining an accurate quality level B positioning on an excessively deep utility facility.
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A Subsurface Utility Engineering provider for UDOT:

a. has to be pre-qualified.

b. has to meet certain personnel and equipment requirements.

c. need not have a Professional Engineer licensed in Utah.

d. Both a and b.
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