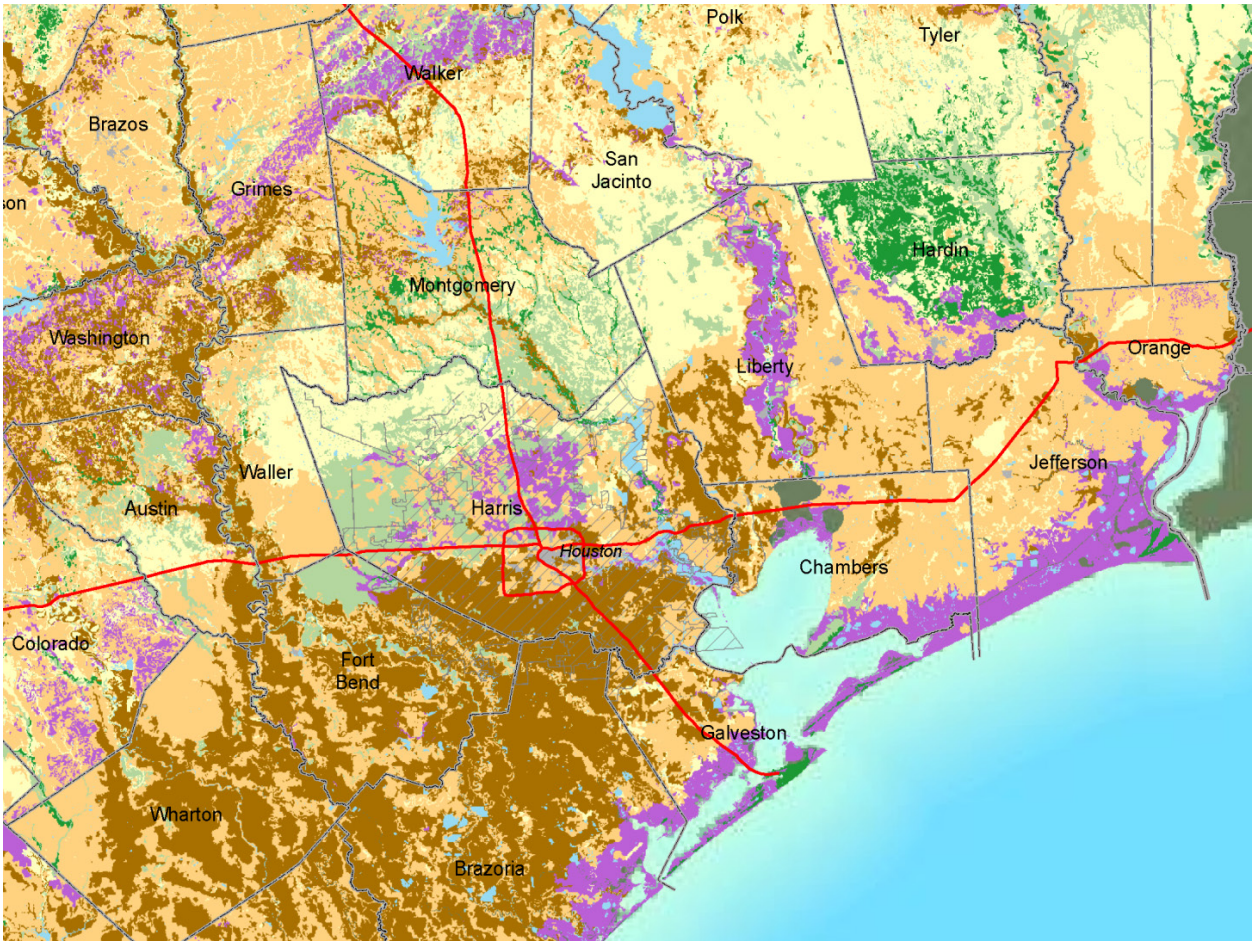
Introduction to SUE and Utility Impact Analysis

Workshop Materials



Research Project 0-6631: Best Practices for Utility Investigations in the TxDOT Project Development Process

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Introduction to SUE & Utility Impact Analysis Workshop

Best Practices in Utility Investigation in the TxDOT Project Development Process

Product: 0-6631-P1

Project: 0-6631

November 2012

INSTRUCTOR GUIDE

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Workshop Lesson Plan

Lesson	Time	Lesson Title	Instructional Method
1	8:00 AM – 8:30 AM	Introductions and Seminar Overview	Instructor(s) welcomes participants, introduces him/herself, and leads participants through introductions. Participants introduce themselves and provide a brief description of their role and experience with utility investigation in the project development processes and their expectation for the workshop. (20 min.) Instructor provides an overview of the workshop objectives, outcomes, agenda, and reference materials. (10 min.) Instructor discusses ground rules, sign-in sheet, feedback forms, and other housekeeping items as needed. (5 min.)
2	8:30 AM – 10:00 AM	Utility Investigation Concepts	Instructor provides an overview of SUE Quality levels, technology and terminology, including limitations. (30 min.) Instructor provides an overview of TxDOT project development process, including utility cooperative management process. Instructor discusses best practices for utility investigations tied to the project development process. (30 min.) Instructor provides an overview of contracting options and recommendations for QL B and QL A SUE, including funding mechanisms and deliverables. (20 min.) Activity 1: Questions and Answers (10 min.) "SUE Jeopardy."
	10:00 AM – 10:15 AM	Break	
3	10:15 AM – 11:45 AM	Utility Impact Analysis	Instructor provides an introduction into Utility Impact Analysis. (10 min) Activity 2: Instructor leads participants in completing the PennDOT utility impact form. This group exercise provides introduction for next activity. (20 min.) Activity 3: Participants are presented with an example project in a suburban setting and complete the GDOT UIA form. Participants share their results and the form is reviewed with the entire class. (30 min.) Activity 4: Participants are provided a much more complicated example section of Interstate through an urban setting. The class discusses challenges and issues with the example project. The purpose of the Interstate section is to share experiences and discuss strategies for SUE. (20 min.) Presentation of results and discussion. (10 min.)
4	11:45 AM – 12:00 PM	Wrap-Up	Activity 4: Instructor conducts a brief review of the workshop and assesses learning outcomes through question and answer session. Participants are given an opportunity to complete workshop/instructor evaluations. (15 min.)

Lesson Descriptions

Lesson 1: Introductions and Seminar Overview

Lesson Number:	**1**
Lesson Title:	**Introductions and Seminar Overview**
Learning Outcomes	At the end of lesson 1, the participant will be able to: Describe the workshop topics and agenda. Activity 1: The participant activities for this session include: • Each workshop participant will make self-introductions. The participant introduction should include their name, where they work, and what they do. • Each participant will also have an opportunity to express their expectations for the workshop.
Topics:	• Introductions (both instructor and participants). • Review of seminar objectives, outcomes, agenda, and reference materials. • Discussion of ground rules, sign-in-sheet, feedback forms, and other housekeeping items.
Instructional Method:	Interactive Lecture Instructor welcomes participants, introduces him/herself, and leads participants through introductions. Participants introduce themselves and provide a brief description of their role and experience with utility investigations, design, and other project development processes. Instructor provides an overview of the seminar learning objectives, agenda, and reference materials. Instructor discusses ground rules, sign-in sheet, feedback forms, and other housekeeping items as needed.
Instruction Day:	Day 1: 8:00 AM – 8:30 AM
Time Allocation:	• Participant Introductions 15 minutes • Workshop Review 10 minutes • Housekeeping 5 minutes • Total Lesson 1 30 minutes
Evaluation Plan:	• Instructor uses the instructor review form to take notes on the background, experience, and role of participants in utility investigations, design, or other project development processes.
References:	• Participant notebook. • Lesson 1 PowerPoint file and handouts. • TxDOT research project 0-6631 final report (http://tti.tamu.edu/documents/0-6631-1.pdf).

Lesson 2: Utility Investigations Concepts

Lesson Number:	**2**
Lesson Title:	**Utility Investigation Concepts**
Learning Outcomes:	At the end of this lesson, the participants should be able to: • Describe SUE and SUE quality levels (QL). • Identify when SUE occurs in the project development process. • Identify relevant contracting options for QL B and QL A SUE.
Instructional Method:	Instructor uses interactive lecture using question and answer methods with slides to introduce the following topics: • Utility investigation concepts and issues, including SUE technology and terminology, and limitations. • The typical TxDOT project development process. • A diagram describing when SUE occurs during the TxDOT project development process. • TxDOT contracting options for providing QL B and QL A SUE services. • Funding mechanisms for SUE services. <u>Activity 1:</u> Questions and answers: "SUE Jeopardy" • Instructor answers questions from participants. As needed, other participants participate in the discussion.
Instruction Day:	Day 1: 8:30 AM – 10:00 AM
Time Allocation:	• SUE technology and terminology. 30 minutes • Utility investigations in the project development process. 30 minutes • Best practices for contracting. 20 minutes • Lesson Review/questions and answers. 10 minutes • Total Lesson 2. 90 minutes
Evaluation Plan:	• Instructor will assess responses by participants evaluate learning. • Instructor uses the instructor review form to summarize the type of questions and comments from participants.
References:	• Lesson 2 PowerPoint file (slides) and Participant notebook.

Lesson 3: Utility Impact Analysis

Lesson Number:	**3**
Lesson Title:	**Utility Impact Analysis**
Learning Outcomes:	At the end of the lesson the participant will be able to: • Perform utility impact analysis (UIA). • Complete a Utility Impact Analysis form. • Describe when to conduct QL B and QL A SUE on TxDOT projects.
Instructional Method:	The instructor uses a combination of interactive lecture to explain the utility impact analysis process and introduces an example case study. The instructor should walk-through the first UIA example with the participants. Upon completion of the first example, the instructor should introduce a second example for the participants to complete as a small group exercise with the instructor closely monitoring the groups. Groups should report back on their experience completing a UIA form. Prior to activities the instructor should : • Describe Utility Impact Analysis form in other states. • Describe a real-life example using Utility Impact Analysis. • Describe the sample documents that workshop participants will use for the hands-on activity to perform a Utility Impact Analysis. <u>Activity 1:</u> Instructor leads participants, as a group, in completing the PennDOT UIA form. This group exercise provides introduction for next activity. <u>Activity 2:</u> Participants are presented with an example project in a suburban setting (FM 546 in Collin County) and complete the GDOT UIA form. Participants share their results and the form is reviewed with the entire class. <u>Activity 3:</u> Participants are provided a much more complicated example section of Interstate through an urban setting. The class discusses challenges and issues with the example project. The purpose of the Interstate section is to share experiences and discuss strategies for SUE. • Perform a Utility Impact Analysis on a TxDOT project. • Discuss analysis results within the group, and select a group representative to present results. • Direct participants during exercise and answer questions as needed. • Share findings and experiences with the class. • Lead a discussion with participants about the use of the utility impact analysis tool.
Instruction Day:	Day 1: 10:15 AM – 11:45 AM
Time Allocation:	• Utility impact background and lecture. 20 minutes • Activity 1: Group UIA walk-through. 20 minutes • Activity 2: Complete example UIA for actual project. 30 minutes • Activity 3: Discuss example utility analysis urban section. 20 minutes • Total Lesson 3. 90 minutes

Evaluation Plan:	• Instructor uses question and answer to assess learning outcomes. • Instructor reviews results of UIA activities to asses learning outcomes. • Participants use the participant feedback form to rate the effectiveness of the presentation.
References:	• Lesson 3 PowerPoint file and handouts. • Sample TxDOT project printouts and plan sheets. • Handouts that include blank UIA forms and example project information.

Lesson 4: Wrap-Up

Lesson Number:	**4**
Lesson Title:	**Wrap-Up**
Topics:	• Instructor provides summary and review of workshop. • Instructor reviews learning objectives. • Instructor collects feedback forms.
Instructional Method:	Activity 1: Instructor summarizes the activities of the seminar, addresses any final questions of seminar participants, and provides some closing remarks. Participants fill out the feedback forms. The instructor then collects the feedback forms provided by the seminar participants.
Instruction Day:	Day 1: 11:45 AM – 12:00 PM
Time Allocation:	• Activity 1: Final questions, closing remarks, and feedback. 15 minutes • Total Lesson 4. 15 minutes
References:	• Participant feedback form.

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Presenter Notes

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Introduction to SUE and Utility Impact Analysis

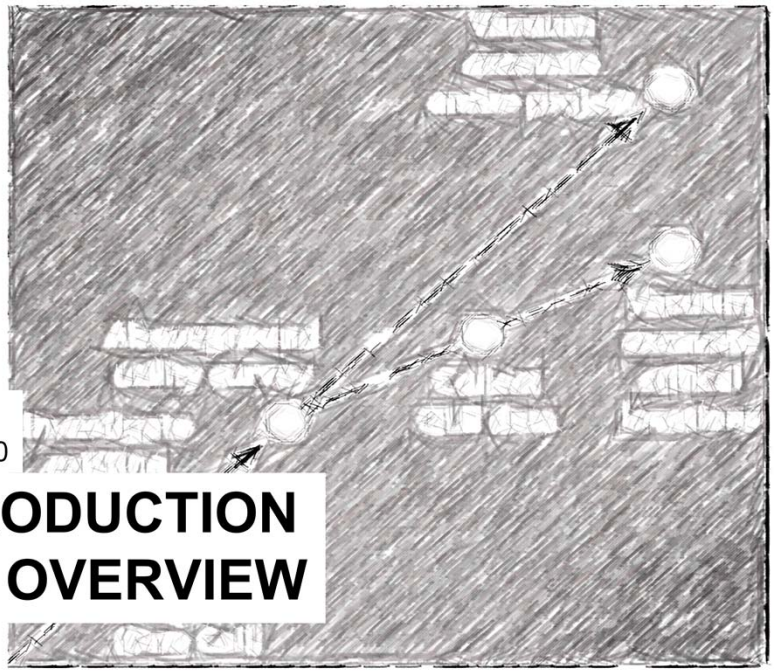
Research Project 0-6631

"Best Practices for Utility Investigations in the TxDOT Project Development Process"

Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 1-1



Lesson 1
8:00 – 8:30

INTRODUCTION AND OVERVIEW

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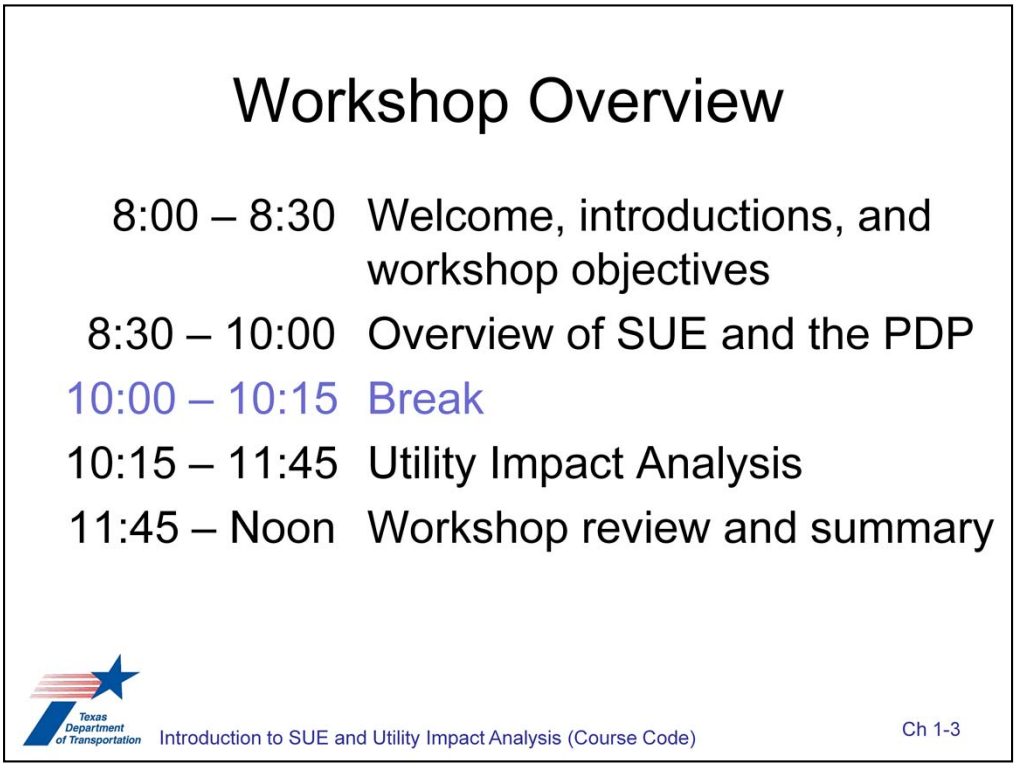
Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 1-2



Instructor Notes

Introduce instructor(s). It is important that the instructor(s) describe their experience, background, and qualifications as instructor(s). For example: “My name is John Overman, I have been a researcher with TTI for 15 years. I was a researcher on this project that examined best practices in utility investigation. I am also a certified National Highway Institute instructor and teach transportation planning. I have been involved in the TxDOT project development processes, including utility issues for many years. I have BS in Geology from A&M and a Masters in planning from UTA.”

Explain the agenda for the workshop.

Introduction & Overview

Introductions

Review learning objectives

Workshop materials

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Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 1-4

Instructor Notes

Read out the items that will be covered in the this lesson.

Self Introductions

What is your name?

What is your position/role in design, utility investigations, etc.?

Do you have SUE experience?

What do you expect from this workshop?

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Instructor Notes

Read out the following questions that each workshop participant should answer. If more than 20 people attend the workshop remind participants to be brief. Then let each participant answer the above questions.

Workshop Learning Objectives

At the end of this workshop you should be able to:

- Describe SUE concepts and data quality levels
- Identify when SUE should occur in the project development process
- Perform a utility impact analysis

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Instructor Notes

Explain the learning objectives for the workshop (read slide).

Housekeeping

Participant workbook
- Slides
- Utility impact data & forms
- Examples

Sign-in sheet

Participant feedback form

Miscellaneous

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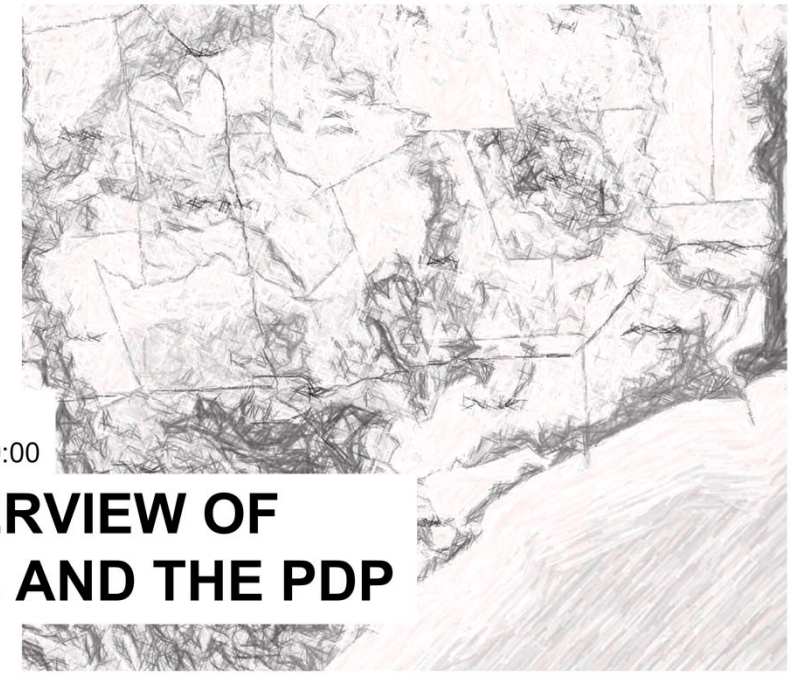
Instructor Notes

Describe the participant workbook, sign-in sheet, and the feedback form that participants should fill out at the end of the workshop. Provide additional information about miscellaneous items such as coffee, bathrooms, etc.



Lesson 2
8:30 – 10:00

OVERVIEW OF SUE AND THE PDP

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Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 2-1

Lesson 2 - Overview

Overview of Subsurface Utility Engineering (SUE) concepts and technologies

SUE in the project development process

Lesson review

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Instructor Notes

Lesson 2 will cover the three sections listed on this slide.

Learning Objectives

At the end of this lesson you should be able to:

- Describe what SUE is
- Describe what SUE quality levels are
- Describe how best to use SUE in the project development process
- Identify contracting options for QLB and QLA

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Instructor Notes

Describe the learning objectives of Lesson 2.

Overview of SUE Concepts and Technologies

2.1

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Ch 2-4

What, Why, and When

What is SUE?
- What are common SUE technologies?
- Limitations, benefits, and best uses

Why conduct SUE?

SUE best practices

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Instructor Notes

Describe the main focus areas of section 2.1. Ask Participants what is SUE and why is it used.

What is SUE

A branch of engineering practice that involves **managing certain risks** associated with utility

- Mapping at appropriate **quality levels**
- Coordination, relocation design, and condition assessment
- Communication of utility data to concerned parties
- Relocation cost estimates
- Implementation of utility accommodation policies

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Instructor Notes

Utility investigations characterize subsurface and above ground utility installations at different quality levels. The following definition comes from the ASCE/CI standard 38-02, which provides descriptions of :

- Engineer and owner tasks
- Actions necessary to achieve specific quality levels
- Formatting of deliverables
- Relative costs and benefits of various quality levels

What Is a SUE Quality Level

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

- QLD (lowest reliability)
- QLC
- QLB
- QLA (highest reliability)

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Instructor Notes

Review slide contents. Point out that it is reliability that distinguishes quality levels.

Characteristics of Quality Level D (QLD) Data

Existing records or oral recollections

- Utility owner records (not signed and sealed)
- Visual site inspections
- One-call notification centers ground markings

Product/deliverable: Composite drawing depicting utility facilities at QLD

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Instructor Notes

Examples of QLD are:

- Utility owner records (marked up drawings, cable records, service records, as-builts), GIS databases, oral histories, one call markings, field notes
- Information sources (utility owners, county clerk's office, visual site inspections, one-call notification centers, public service commissions, land owners, and database searches)
- One-call is also considered QLD

Instructor should ask why one-call is considered QLD. Answer: there is no vertical or horizontal reliable information.

According to the ASCE standard, QLD records must also be signed and sealed by a professional engineer. In practice, that may not always be the case.

Quality Level D – True/False

1. QLD is expensive and the information hard to find, I'll need to hire a contractor.

2. I've got my one-call markings, I won't need any additional information.

3. QLD is not needed because I'll end up relocating or needing QLA anyway.

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Instructor Notes

Instructor should ask the true/false questions and have participants explain responses.

1. QLD is expensive and the information hard to find, I'll need to hire a contractor. FALSE, there is usually plenty of QLD data TXDOT already has. It is also easy to obtain through site visits and in-house files.
2. I've got my one-call markings, I won't need any additional information. FALSE, one call does not provide accurate vertical and horizontal position in many cases. But it is a good start.
3. QLD is a waste of time because I'll end up needing QL A anyway. FALSE, QLD should always be collected as a starting point for other types of utility data.

Limitations and Uses of QLD Data

Limitations

- Information can be unreliable
- Horizontal and vertical locations are not measured/surveyed

Uses

- Useful for early planning, route selection, preliminary design
- QLD can provide starting point for additional data collection

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Instructor Notes

Request input from audience before showing the answers.

Knowing that certain types of utilities (e.g., a gas line) are within project limits can give planners and preliminary designers a heads-up in the early design process and avoid costly relocations later.

- QLD does not require a contractor. For the most part it is freely available data. Use in-house resources.
- QLD is the most abundant and least expensive type of utility data.
- Includes aboveground utilities
- QLD provides information needed to decide whether QLC,QLB, and QLA are needed.

Characteristics of Quality Level C (QLC) Data

Surveying visible utility features and inferences about underground utilities connected by visible appurtenances:

- Valve covers, junction boxes, manhole covers, aboveground utility lines

Data collection:

- Surveying of utility features and appurtenances
- Correlating utility records to surveyed features
- Resolving discrepancies

Product/deliverable: composite drawing (QLC and QLD)

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Instructor Notes

QLC utility investigations survey and plot visible utility appurtenances and make inferences about underground linear utility facilities that connect those appurtenances. An example of a QLC line may be a water line that was discovered by climbing into a manhole.

Limitations and Uses of QLC Data

Limitations
- Most underground utilities unknown
- Most vertical underground locations unknown
- Unresolved discrepancies with records

Uses
- Most useful before start of detailed design
- QLC can support QLB data collection

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Instructor Notes

Request input from audience before showing the answers.

Problems with records interpretations still exist: e.g., many underground utilities may still be unknown, vertical locations of underground utilities are unknown, and known underground utilities may not be straight between appurtenances.

- You can use in-house surveyors to conduct QLC SUE.
- QLC helps you decide whether QLB or QL A are needed.

Characteristics of Quality Level B (QLB) Data

Surface geophysical methods to determine the approximate horizontal position of subsurface utilities

Data collection:

- Geophysical survey (mark indications of utilities on ground surface, survey markings)
- Correlating utility records to surveyed features
- Resolving discrepancies

Product/deliverable: composite drawing (QLB, QLC, QLD)

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Instructor Notes

Positional inaccuracies in QLD data can range from several feet to several hundred feet. To avoid these problems, QLB utility investigations use a variety of noninvasive surface geophysical methods, including electromagnetic and radar techniques, to determine the approximate horizontal position of subsurface utilities. QLB utility investigations are characterized by the following:

- Mark indications of utilities on the ground surface (accuracy depends on geophysical method, soil conditions).
- Survey markings using project datum and specifications (no vertical positions are measured).
- Correlate utility records to surveyed features.
- Resolve discrepancies.

Deliverables are composite drawings including QLB, QLC, and QLD data.

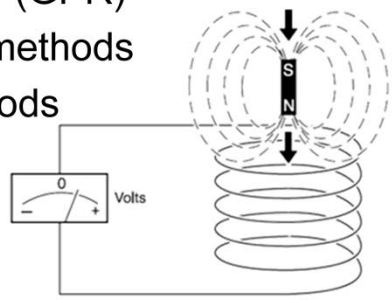
- QLB supports need for QLA

Ask participants: What does “approximate horizontal position” mean. Is it 6 inches, or 1 foot ? What should you expect from a QL B deliverable?

QLB Techniques and Technologies

Methods based on electromagnetic induction (EMI)

- Pipe and cable locators
- Ground Penetrating Radar (GPR)
- Terrain conductivity (TC) methods
- Capacitive resistivity methods
- Infrared thermography (rarely used)



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Introduction to SUE and Utility Impact Analysis (Course Code)

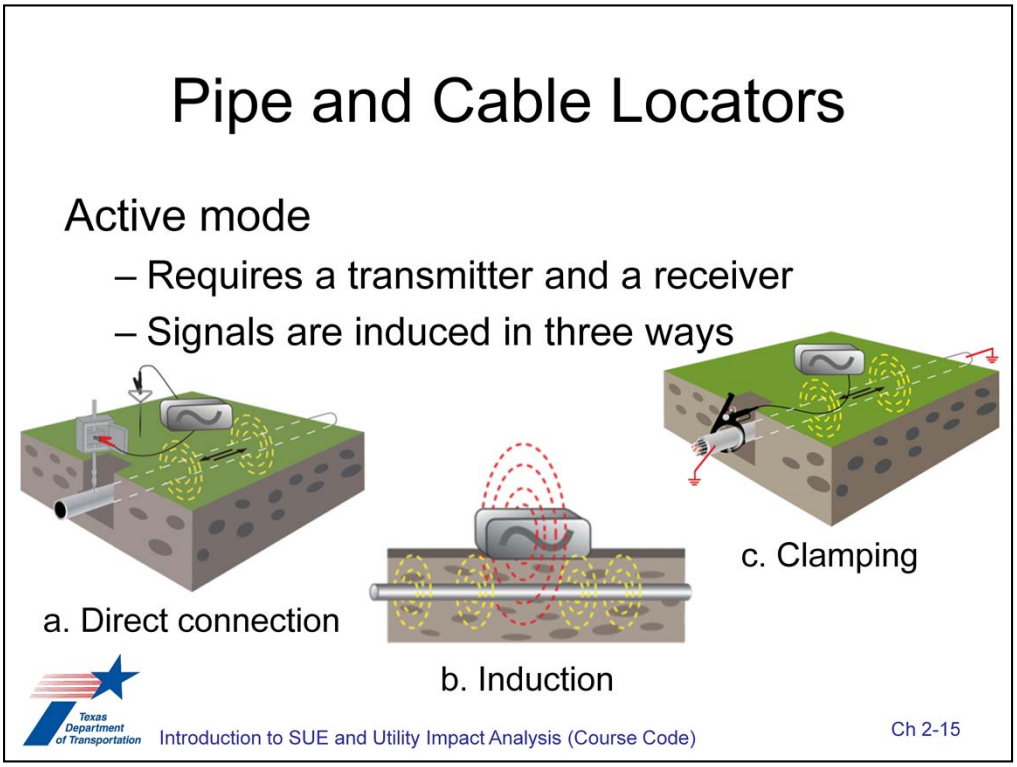
Ch 2-14

Instructor Notes

It is the fundamental principle of electromagnetic induction that changes of magnetic flux through a surface bounded by a closed circuit will induce a voltage in it. Electromagnetic induction can also be defined as the phenomenon by which an electric current is produced across a conductor that moves through a magnetic field.

EMI allows the detection of signals from buried utilities that are metallic or have a tracer wire. Detection methods vary by the signal frequency or frequencies used for detection.

There a two main modes, active and passive. The active mode impose a signal onto the buried utility, while the passive mode detect a magnetic signal using a detector.



Instructor Notes

There are several methods to induce AC into a buried utility line:

Direct connection. A grounded AC source is directly connected to the pipe or cable to be detected through an access point such as a valve, meter, or an end of the line. This method may also trigger signals on any lines in the vicinity that share a common ground point.

Induction. This method uses a rectangular coil in an AC circuit. The coil generates a magnetic field that then triggers an AC on the buried lines underneath it. Coils positioned vertically will generate a localized magnetic field and therefore are suitable for detecting single lines while coils positioned horizontally generate a more spread magnetic field that is useful for signal application on multiple parallel lines simultaneously. In general, a frequency of 8 kHz or higher is suitable for induction, but a higher frequency may cause other adjacent lines to be induced. Induction sometimes is the only way of applying an active signal, but it is not as effective as direct connection or clamping.

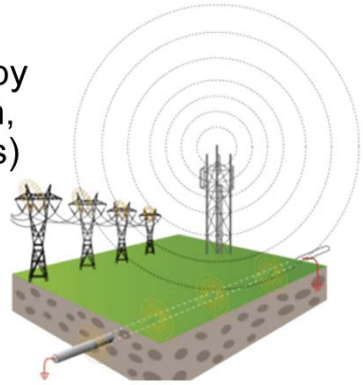
Clamping. The output from a transmitter is coupled to a buried utility line by clamping around it with a split toroidal magnetic core. Clamping has the advantage of direct connection but enables the clamped utility line to be the one with the strongest signal.

Ask participants: What are examples of facilities that cannot be detected with this technology? Example: you cannot “tone-detect” PVC pipe.

Pipe and Cable Locators

Passive mode

- Detects naturally occurring current in buried utilities
- Only requires a receiver
- But: current can be triggered by other sources (current in earth, long-wave radio transmissions)
- Not reliable, subject to change anytime, easily interfered by surrounding EM noises



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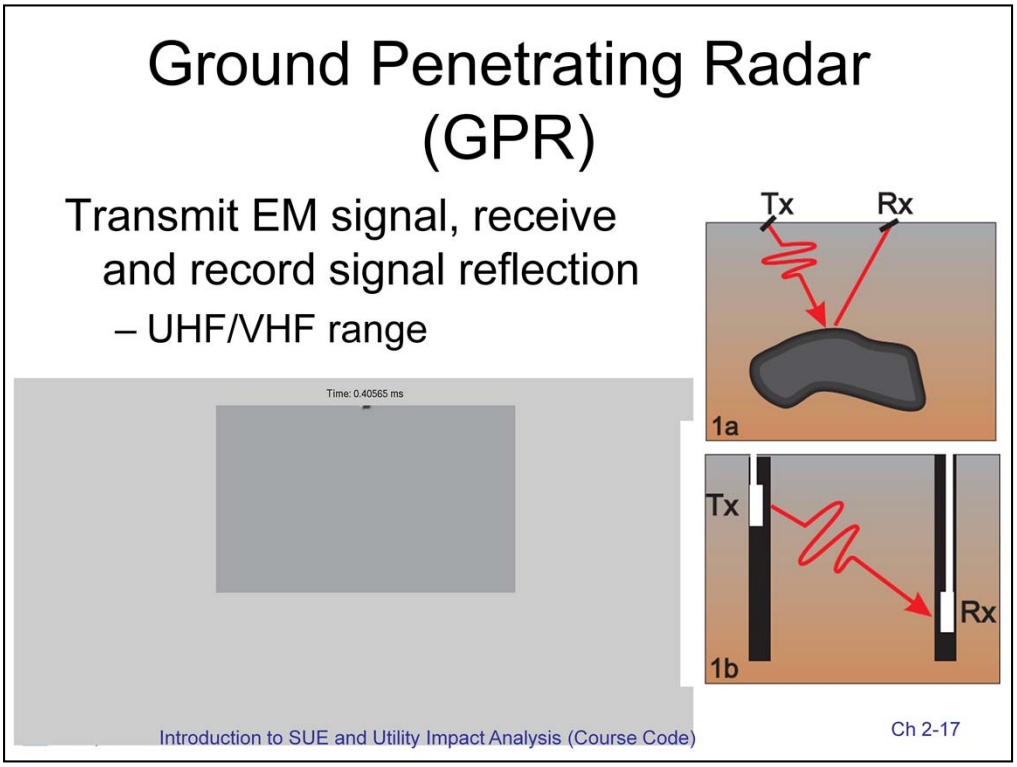
Instructor Notes

Describe the difference between “active” mode on previous slide and “passive” mode on this slide.



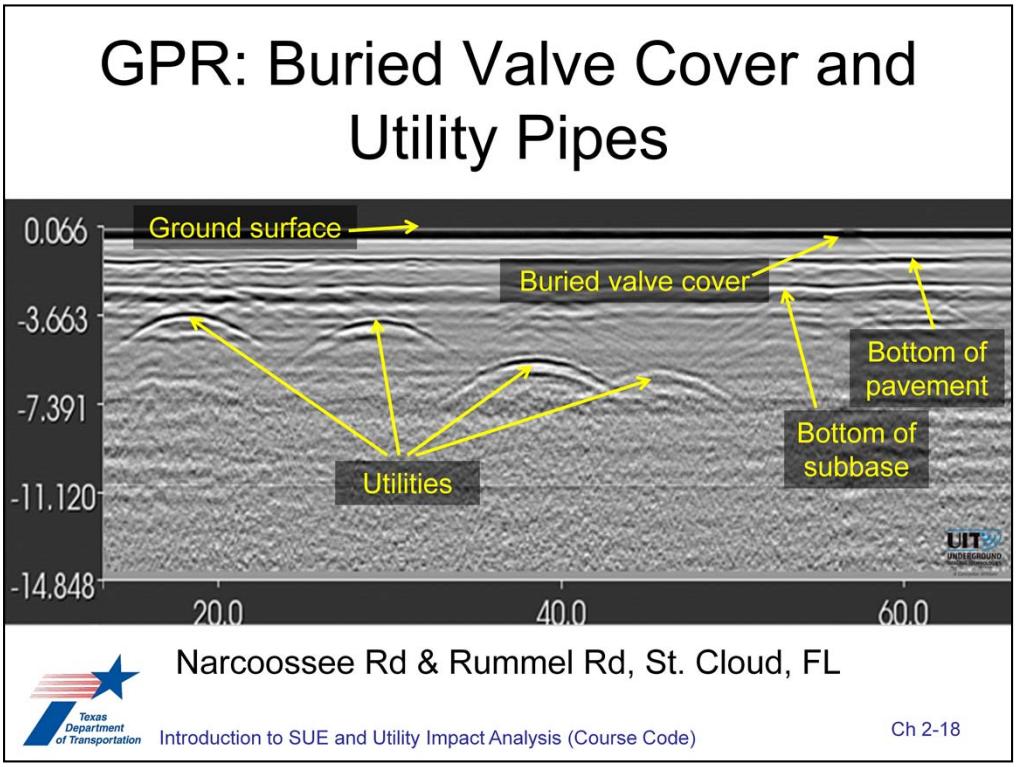
Instructor Notes

In general, essential to a GPR system are a transmitter, a receiver, and a timing unit. Antennas are connected to transmitter and receiver to convert between electromagnetic field and electric signal. In a simple GPR system, a timing unit initiates a signal to the transmitter electronics, which then sends out a short direct current (DC) pulse to the transmitting antenna. The antenna translates the excitation voltage into a predictable, temporally and spatially distributed electromagnetic signal. Some of this signal transmits through boundaries under the ground while the rest is reflected back. The receiving antenna detects the temporal variation of the returning electromagnetic field and translates it into a recordable signal for analysis and display.

VFH is about 30-300 Mhz, UHF is about 300-1000 Mhz.

Start the movie by clicking after explaining the basics of GPR.

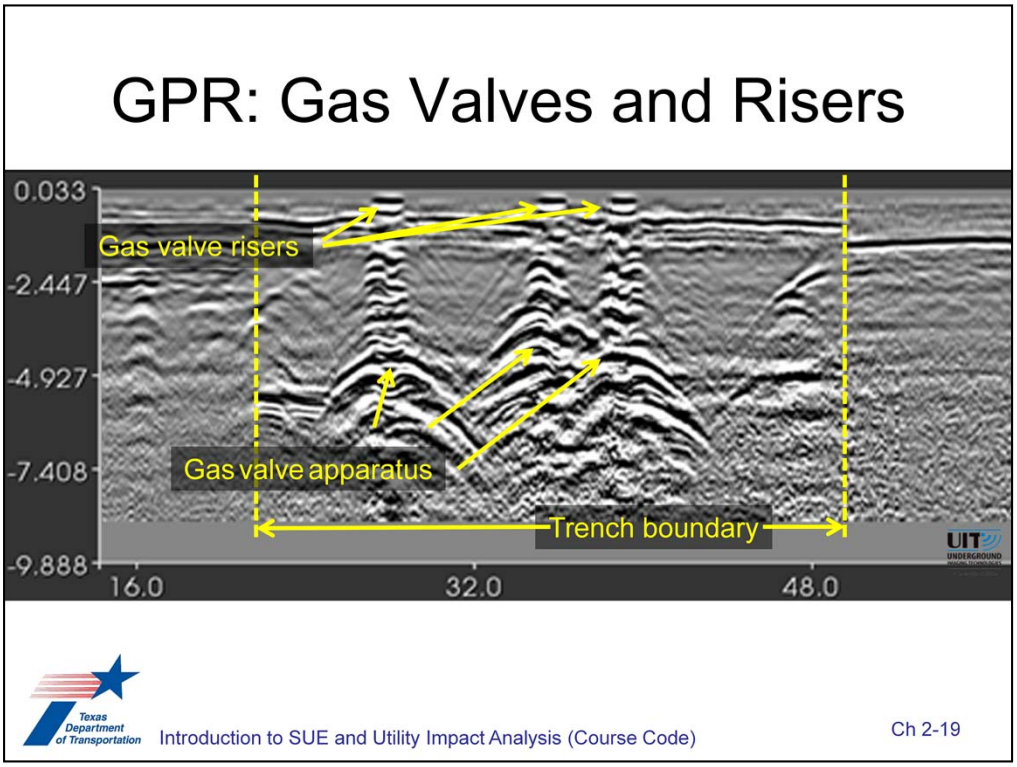
Ask the audience where the 12 inch pipe is located in the movie.



Instructor Notes

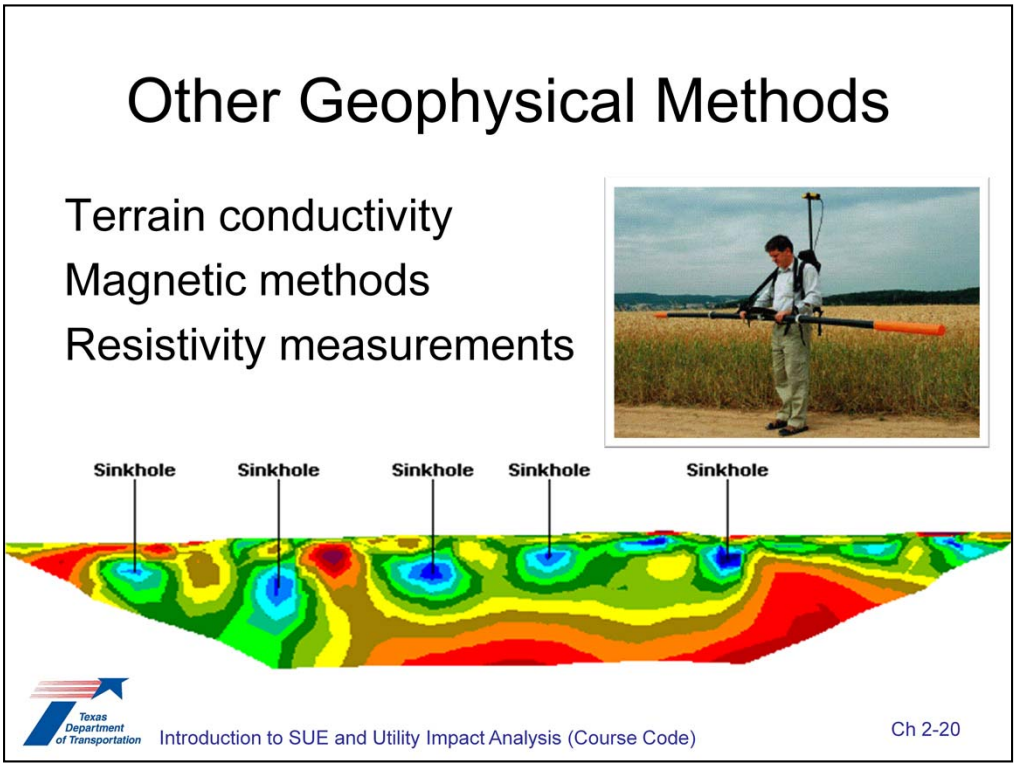
The purpose of this slide is to give the audience an idea of the need to professionally interpret GPR data. This process can be compared to a doctor who needs experience to interpret an X-ray image.

Ask the audience how many utilities are shown in this picture, then advance to provide the solution.



Instructor Notes

Another example of a GPR image. Ask the audience to identify gas valve apparatus, gas valve risers, and the boundary of the trench, then advance the slide.



Instructor Notes

This image shows terrain conductivity measurement and 2D visualization. These methods may be useful depending on specific project situations.

Terrain Conductivity Method: Calculates ground conductivity from a ratio of secondary to primary magnetic field. The transmitter generates and emits a time-varying electromagnetic signal in the ground underneath the coil, which then induces very small circular electrical currents in the earth below the coil. These currents in turn generate a secondary magnetic field, which is detected together with the primary field by the receiver coil.

Magnetic Methods: Measures variations in earth's magnetic field. This is useful for a utility search over large areas for large ferrous objects (e.g., valve boxes, steel drums, iron markers, and manhole lids), and may also be used to detect magnetized non-metallic fiber optic cables or cast iron pipes. Depth estimation and reliability is limited.

Resistivity Measurements: Injects a direct current into the ground using electrodes, then measures the resultant voltage difference at receiving electrodes. Data collection and interpretation efforts are limited and driving electrodes into the ground can be costly.

Other Geophysical Methods (Less Commonly Used)

Methods based on mechanical waves
- Acoustic location
- Seismic location

Other techniques
- Infrared thermography
- Micro-gravitational methods
- Chemical methods

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Instructor Notes

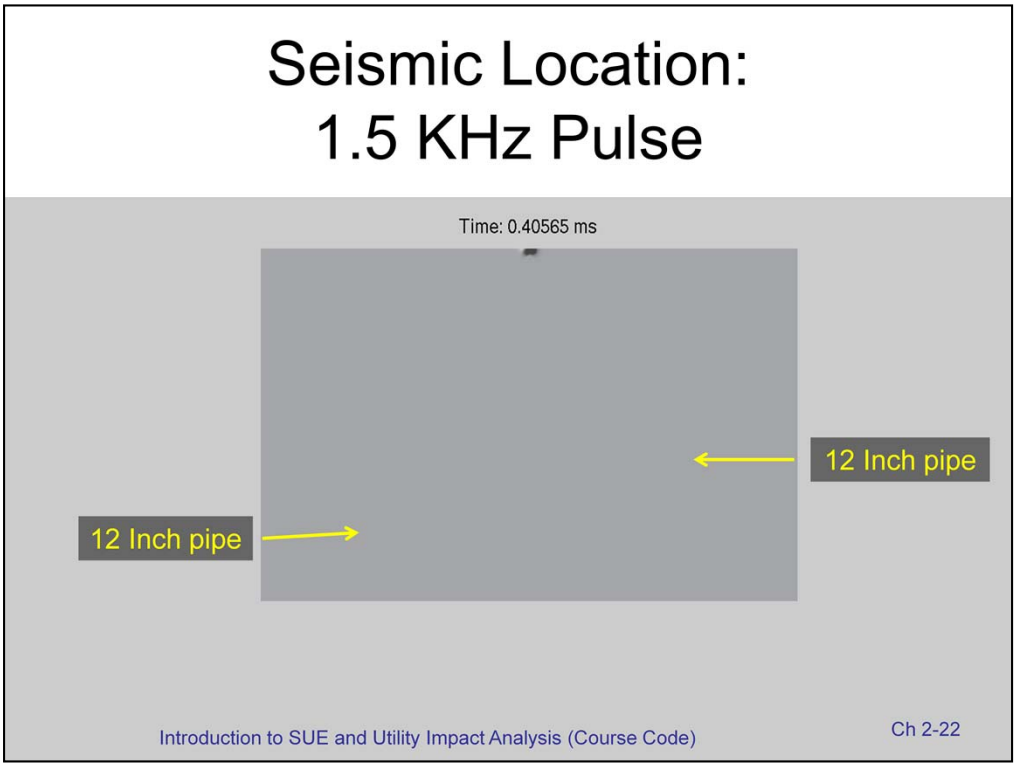
Acoustic Location: Detects acoustic emissions from underground utilities using special sensors such as geophones or accelerometers. This can be used for utility tracing. Acoustic location is prone to interference from background noises, requires access to or prior knowledge about utilities, and is not capable of depth estimation.

Seismic location: This is typically used in geological surveys to determine site geology, stratigraphy, or rock quality. Currently has only limited applications in underground utility investigation.

Infrared Thermography: Identifies variations in ground temperature, and can be used for utility searching.

Micro-Gravitational Techniques: Identifies variations in gravitational force caused by large underground objects.

Chemical Techniques: Finds utilities by detecting chemicals conveyed in pipelines, left around pipes due to leaks, or outgassed from plastic pipes. Method is often used for pipe leak detection.



Instructor Notes

This video shows a low-frequency seismic location pulse to detect underground utilities.

Ask participants to identify two 12-inch buried pipes.

Advance the slide to show location of the pipes.

Limitations and Uses of Quality Level B (QLB)

Limitations

- Requires professional experience, specialized equipment
- Field time intensive
  - Operator experience critical for good results
  - Limited next day delivery of results
- Depths unreliable, no elevations possible
- No guarantee all utilities will be detected
- Accuracy depends on method, soil conditions

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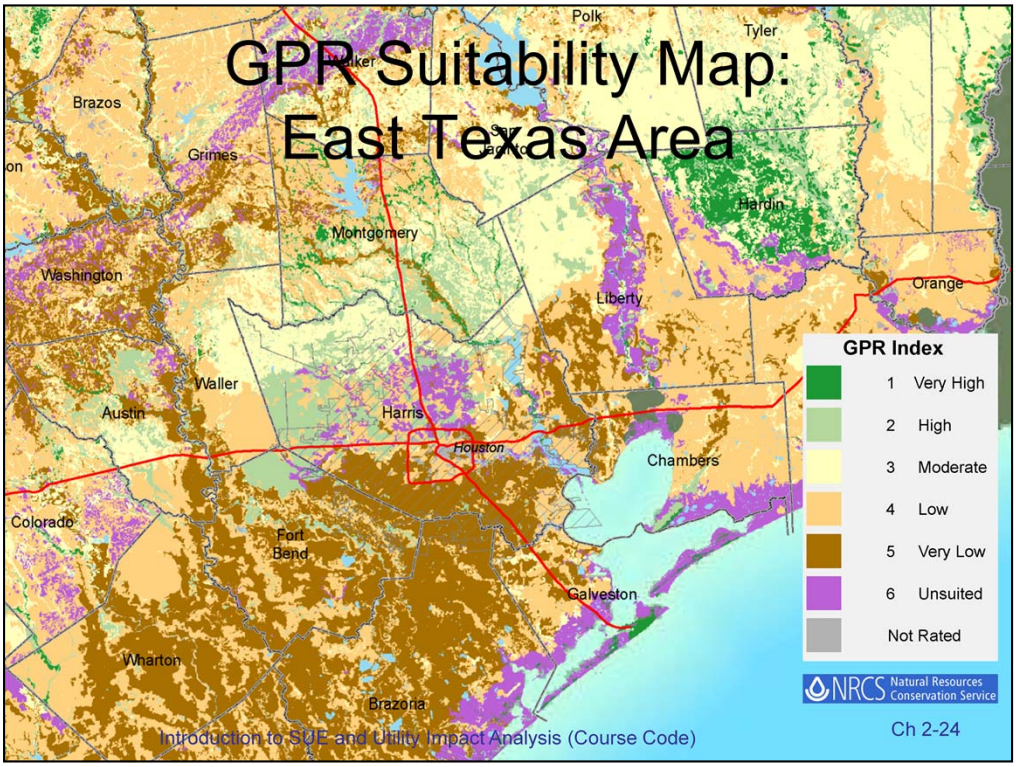
Instructor Notes

Request input from audience before showing the answers.

Discuss responses, then transition into the GPR suitability maps. Note that a second slide with limitations follows.

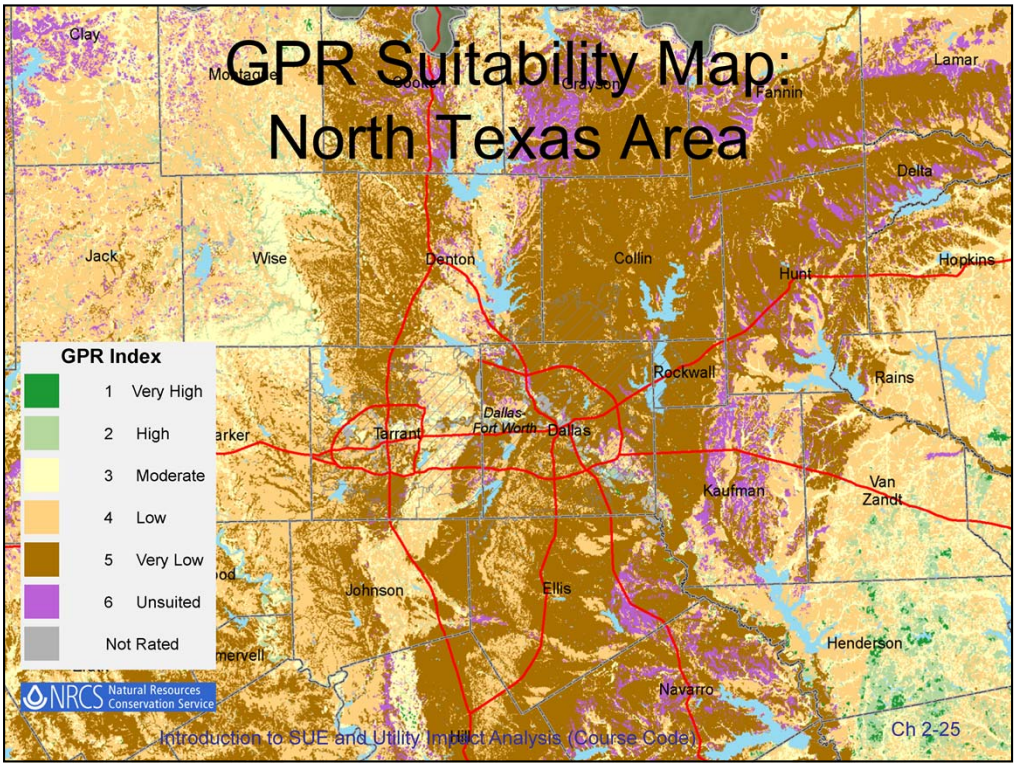


Instructor Notes

As an example, this map shows the relative suitability of using GPR to detect subsurface utilities in Texas. The GPR suitability map was developed by the Natural Resources Conservation Service, part of the United States Department of Agriculture. The penetration depth of GPR is mostly determined by the frequency of the antenna and the electrical conductivity of the soil. The higher the conductivity, the lesser the effectiveness of GPR, in general.

The map takes many factors into consideration such as clay content, salinity, and sodicity. More information is available at http://soils.usda.gov/survey/geography/maps/GPR/methodology.html.

The image shows the resulting map of general GPR suitability for the East Texas region.



Instructor Notes

The image shows the resulting map of general GPR suitability for the North Texas region.

Limitations and Uses of Quality Level B (QLB) (Ctd.)

Other Limitations

- Difficult to sweep in every direction
- Need separate survey to reference paint marks
- Can be expensive

Uses

- Most useful during detailed design phase
- QLB supports determination for test holes (QLA)

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-26

Instructor Notes

Request input from audience before showing the answers.

Characteristics of Quality Level A (QLA) Data

Accurate horizontal and vertical utility location by exposing the utility at certain locations

Test hole (pothole) excavation

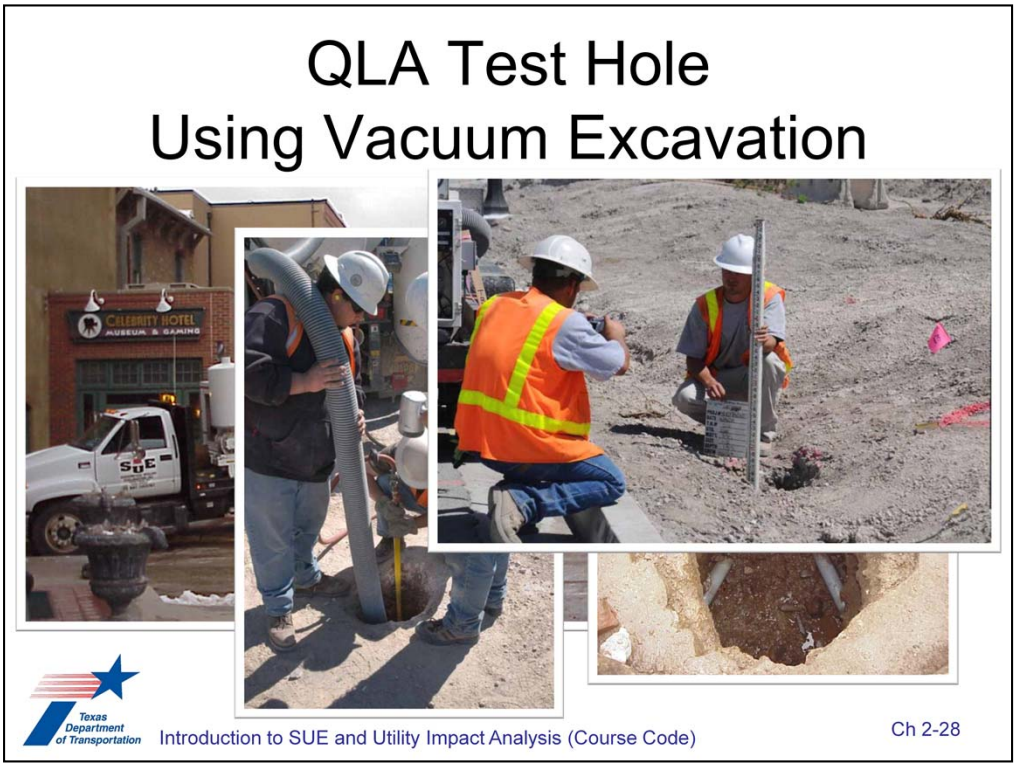
- Survey exposed facilities using project datum
- Resolve discrepancies

Product/deliverable: composite drawing (QLA, QLB, QLC, QLD), test hole reports

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-27

Instructor Notes

The two common types of excavation are air/vacuum excavation and water/vacuum excavation. Many utility owners do not allow water vacuum excavation.



Instructor Notes

Describe photographs depicting QL A investigation. Note that the utility is exposed and the horizontal and vertical position is surveyed.

Limitations and Uses of QLA Data

Limitations
- Field time intensive
- (Minimally) invasive
- Provides only a single location per test hole
- Needs separate survey to reference location
- Relatively costly

Uses
- Most useful during detailed design phase
- Useful to verify potential utility conflicts

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-29

Instructor Notes

Request input from audience before showing the answers.

SUE in the Project Development Process

2.2

Why Use SUE?

SUE can save project funds, avoid project delays

SUE can avoid or minimize utility impacts

- Avoid unnecessary utility relocations
- Evaluate design alternatives
- Facilitate utility conflict analysis

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-31

Instructor Notes

Ask the participants to describe why SUE is used.

Project Delays: TxDOT Perspective

Shortened timeframe for project development

Design changes

Environmental process

Inefficient utility coordination

- Inaccurate location and marking
- Utility conflicts late in the design phase
- Unexpected utility relocation costs

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-32

Instructor Notes

Inefficiencies in the utility coordination process are frequently blamed for delays in the project development process. The slide shows examples of situations that produce utility coordination inefficiencies. The list is not exhaustive.

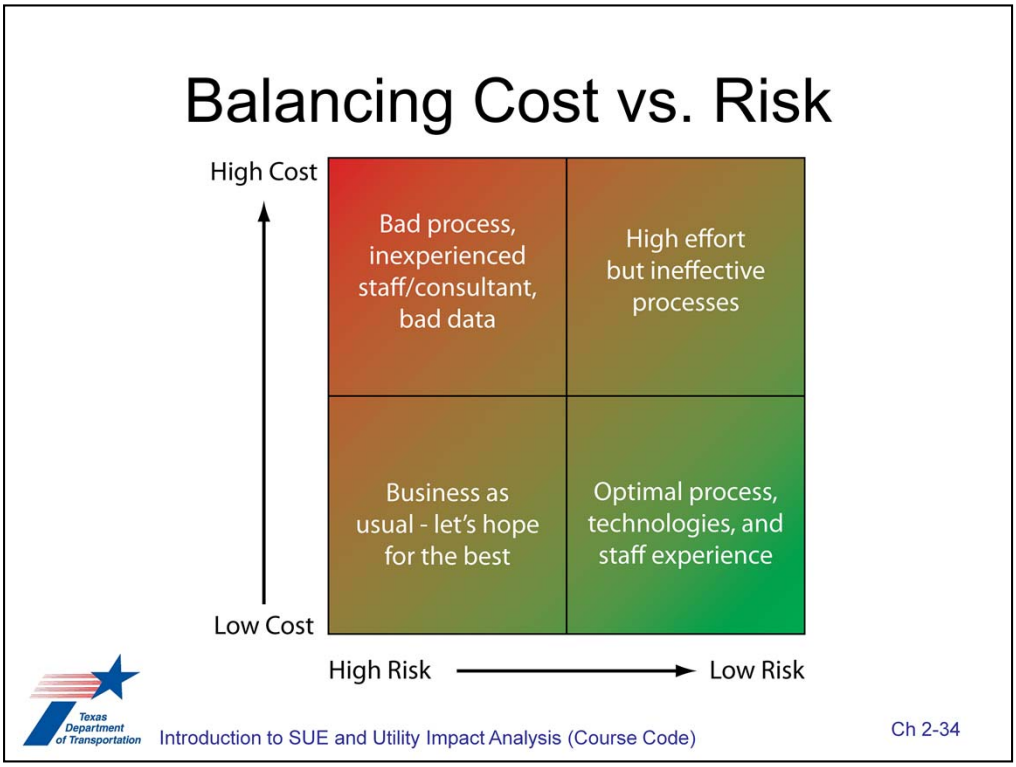
Project Delays: Utility Owner Perspective

- Limited resources (financial and personnel)
- TxDOT project uncertainties
  - Changes in design and schedules
- Unrealistic utility relocation schedule
  - Utility owner's project development process requirements
- Coordination with other stakeholders

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-33

Instructor Notes

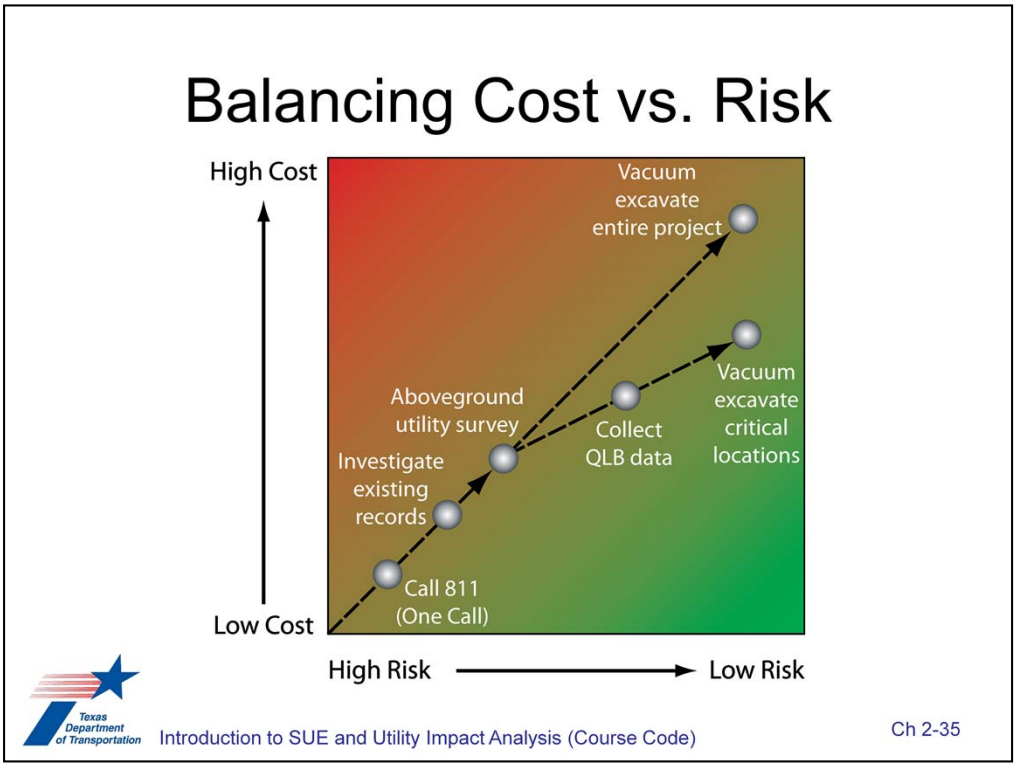
State DOTs are not the only party affected by inefficiencies. This problem also affects other stakeholders, e.g., utility companies. Utility companies have a host of challenges of their own, including operating under tight financial conditions (frequently, utility relocation is a low priority to utilities since it is not a revenue generating activity). They also have their own plans and schedules and need to accommodate requests from a third party (i.e., the DOT). In addition, there are issues related to the coordination with the DOT.



Instructor Notes

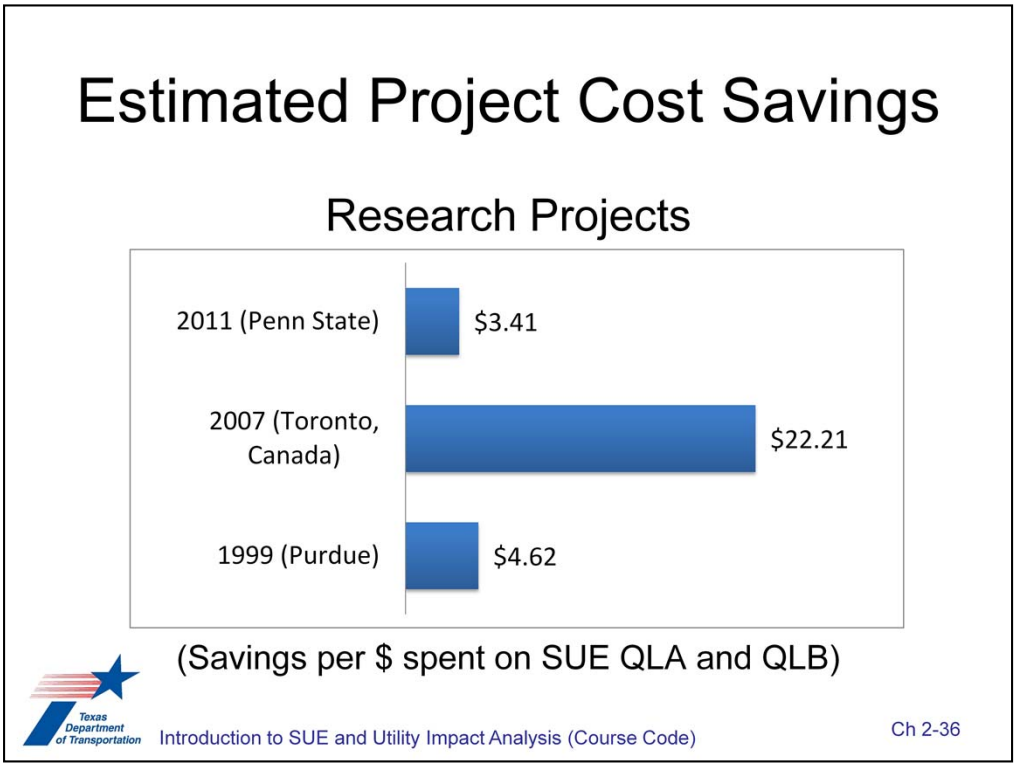
The graph represents the balance between the cost of conducting SUE and the risk of not having the needed utility information. The instructor should advance the slide, review the quadrants, and describe the differences.

As seen in the graph, low cost approaches also have higher risk. High cost SUE/ utility investigations may not be a best use of resources.



Instructor Notes

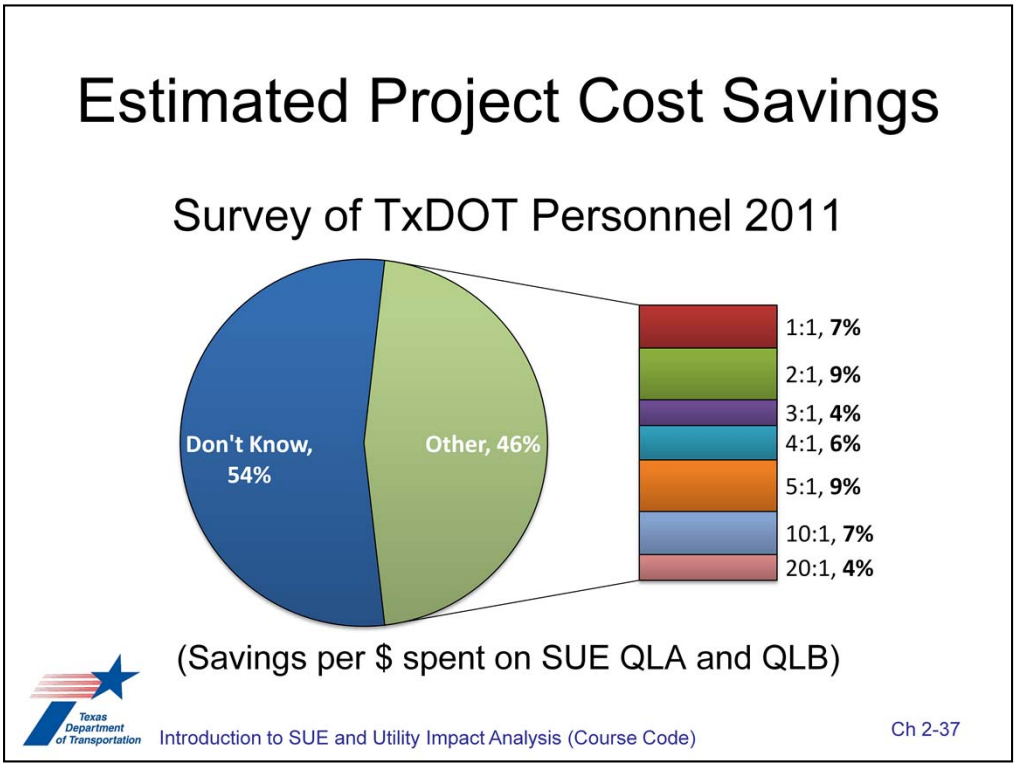
The instructor should use the chart to demonstrate the balance between cost and risk. The instructor should walk-through the example dots explaining cost and risk. Note that QLB data has a potential to reduce overall cost at a low level of risk.



Instructor Notes

Three recent studies estimated the cost savings of using SUE QLB and QLA data on projects. The research came back with different numbers, but overall all research projects identified a positive benefit.

For more information about the research projects refer to the 0-6631 research report.



Instructor Notes

A 2011 survey of about 250 TxDOT personnel in design and right of way were asked to indicate the estimated benefit of SUE QLB and QLA, based on their experience. For example, a rating of 2:1 would indicate twice the amount of benefit for the amount invested in SUE. The majority of respondents (54%) indicated they were not able to quantify the benefit. However, only 7% of respondents indicated no net benefit on average (a ratio of 1:1). The large majority of those surveyed that could quantify a benefit indicated a positive benefit.

Benefits and Uses of Quality Level B (QLB)

Benefits

- Locate known and unknown utilities with high horizontal accuracy
- Risk reduction
- Non-invasive field operations
- Documented positive return on investment
- Reduced number of test holes

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-38

Instructor Notes

Request input from audience before showing the answers.

Benefits and Uses of Quality Level A (QLA)

Benefits

- Locate utilities with high horizontal and vertical accuracy
- Risk reduction

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-39

Instructor Notes

Request input from audience before showing the answers.

When Should SUE Be Conducted?

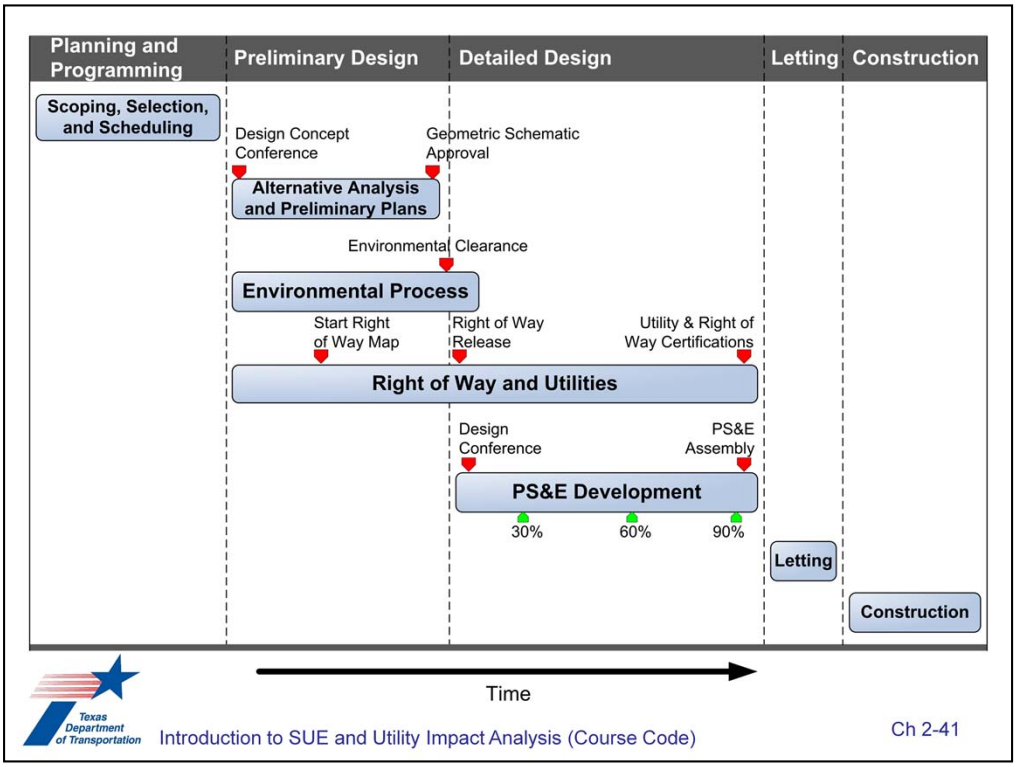
Can you provide an example of when you have used SUE?

Can you provide an example of when you used QLA during the PDP?

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-40

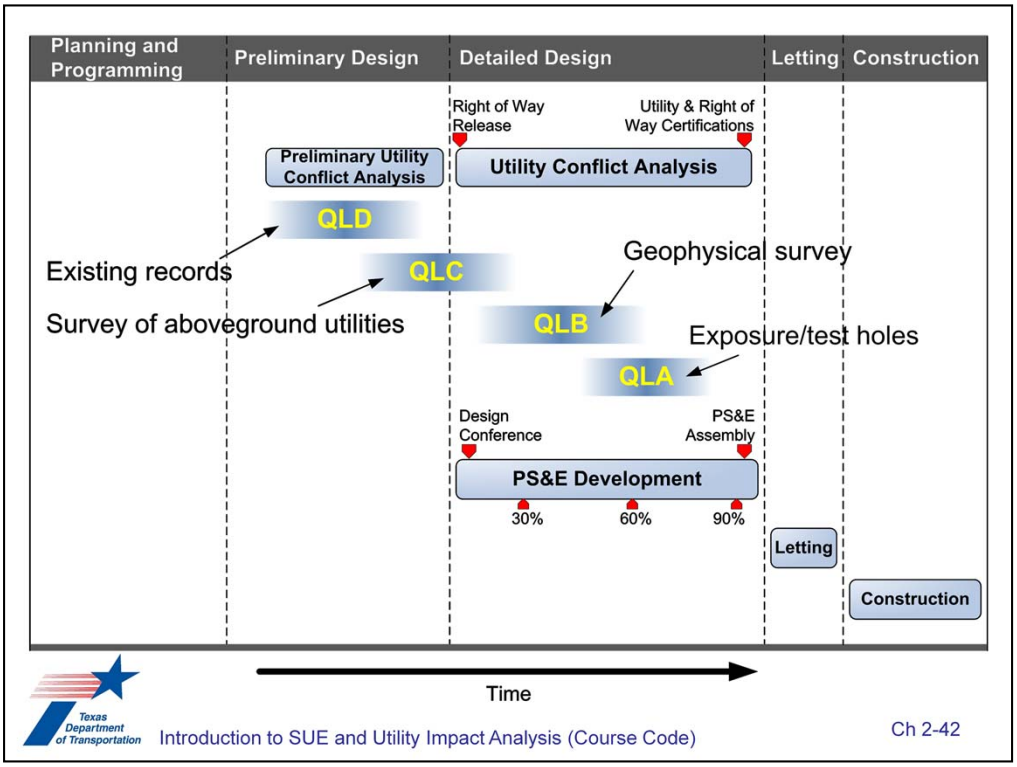
Instructor Notes

Ask the questions of the workshop participants. Allow time for answers. Show the next slide.



Instructor Notes

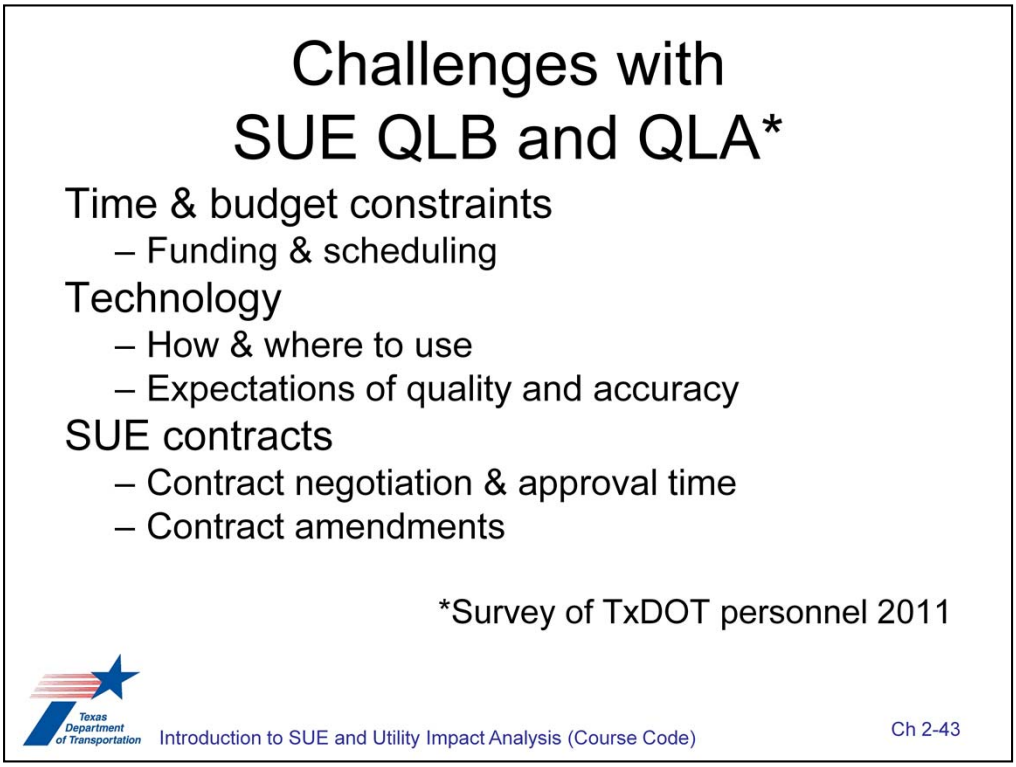
This slide shows the typical TxDOT project development process for projects that involve lengthy environmental review. The purpose is to set the stage for a discussion on when during the project development process SUE data collection should occur. Ask participants for concurrence and/or questions about the diagram, then advance to the next slide.



Instructor Notes

This slide focuses on a portion of the project development process, the utility coordination process, which may span the entire project development process from planning to post-construction. Utility conflict resolution is a portion of the utility coordination process that typically occurs at the end of preliminary design and should complete before the begin of construction.

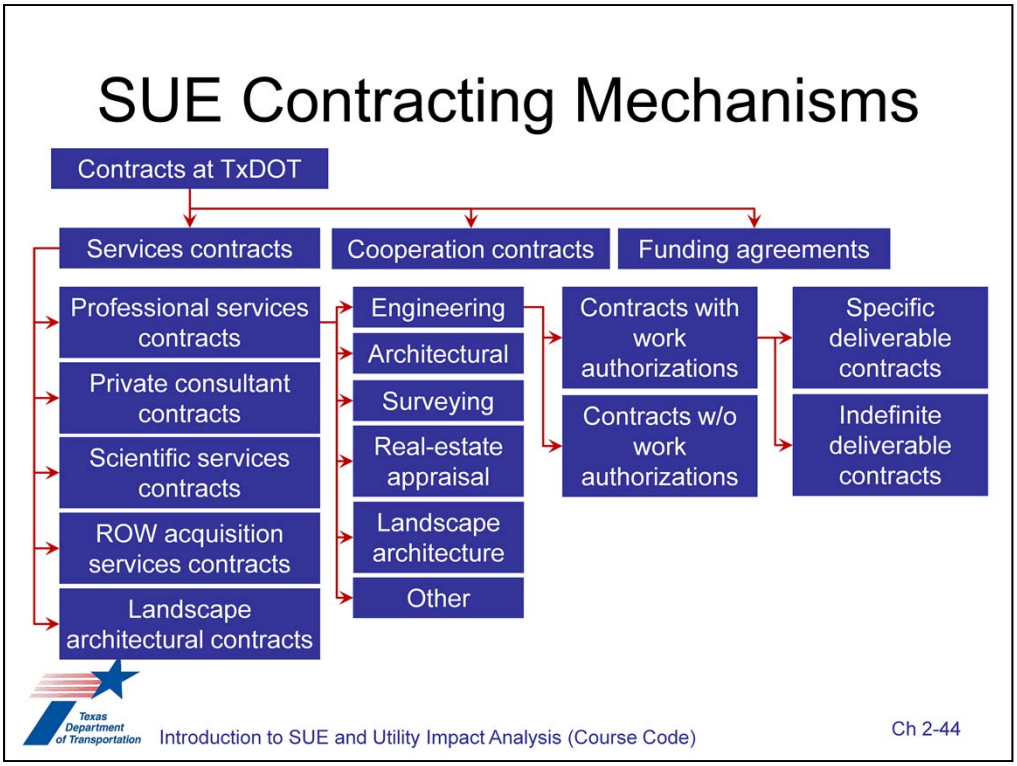
To function properly, the utility coordination process needs utility data input, which occurs at different times of the process. Typically, as time progresses, the utility information becomes more detailed and precise. Although any type of utility data can be collected at any time of the project development process, it is typical to collect QLD and QLC data during preliminary design, and QLB and QLA data during the detailed design phase.



Instructor Notes

A survey of TxDOT officials about challenges with SUE QLB and QLA provided the following sample responses:

- Negotiating hours and linear feet of utilities because of the unknowns.
- Time to get SUE work authorization or contract approved by division.
- Holding SUE providers accountable for work as errors are normally discovered years after contract has expired.
- Making sure the contract outlines specific tasks the consultant is to perform but still having the ability to add to or amend the contract.
- Quality and completeness of survey. Information provided is not always accurate.
- Questionable data if we receive anything less than QLA.
- I have observed quality from excellent to poor on SUE contracts.
- Getting the SUE information in a timely manner due to short project schedules.
- Identifying the locations you need verified in the field based off of inaccurate information.



Instructor Notes

Highlighted categories are those that SUE contracts can belong to.

Contracts with Work Authorizations

Specific deliverable

Explicitly identified scope of work

Flexible on dollar and time limits

Ideal for projects that may take a long time or require additional funding

Indefinite deliverable

General scope of services

Work assignments with little delay

Ideal for limited projects that fit in applicable time/dollar limits

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-45

Instructor Notes

Specific deliverable contracts

- Contain an explicitly identified scope of work
- Flexible on dollar and time limits
- Ideal for projects that may take a long time or require additional funding

Indefinite deliverable contracts

- Contain a general scope of services
- Allow work assignments with little delay
- Ideal for limited projects that fit in applicable time/dollar limits

SUE Contract Payment Methods

- Lump sum basis
  - A single dollar amount paid for deliverables
- Cost plus fixed fee basis
  - Direct/indirect costs plus a portion of the total estimated costs
- Unit cost basis (less used)
  - Dollar amount for a unit of production
- Specified rate basis (less used)
  - Overall hourly rate including all cost elements

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-46

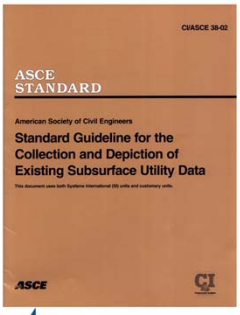
Instructor Notes

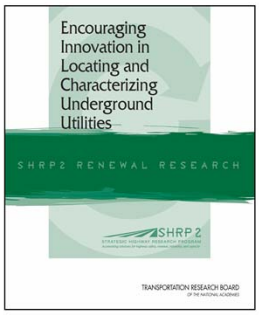
Convey information about different types of SUE contract payment methods provided on the slide.

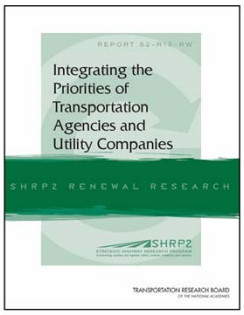
SUE Guidelines and Further Reading

ASCE/CI 38-02: Guideline for the Collection and Depiction of Existing Subsurface Utility Data

SHRP2 (Strategic Highway Research Program 2)







Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 2-47

Instructor Notes

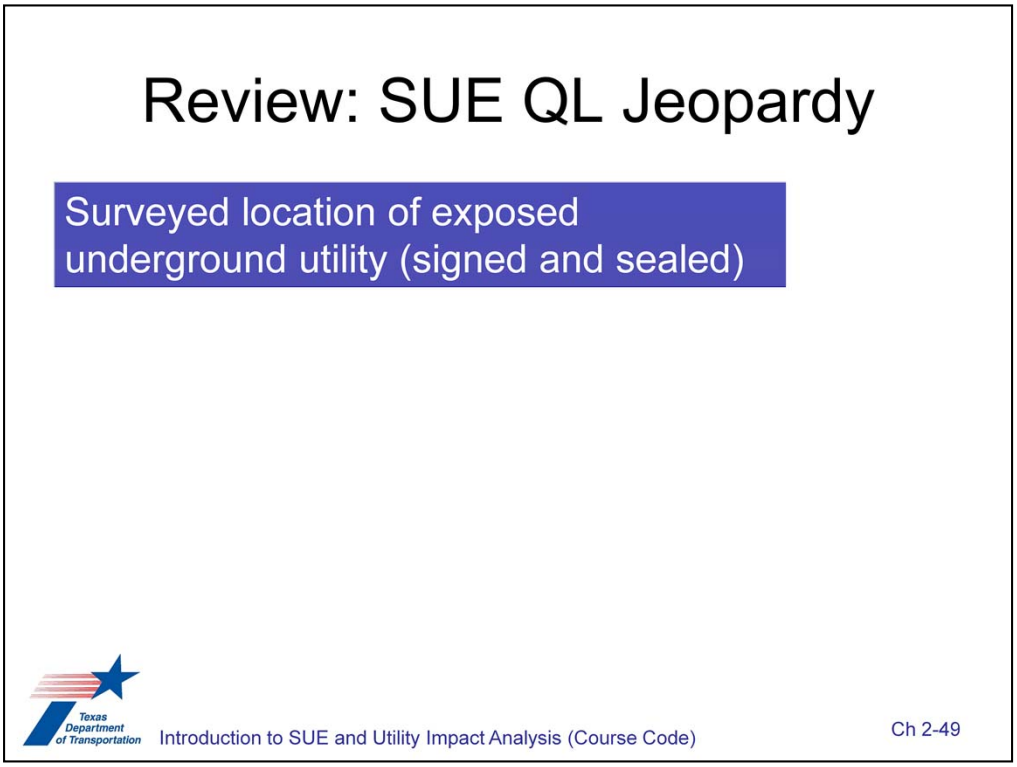
These are three valuable resources for further reading regarding SUE and utility investigations.

The SHRP 2 reports are available at the SHRP2 website:

http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx

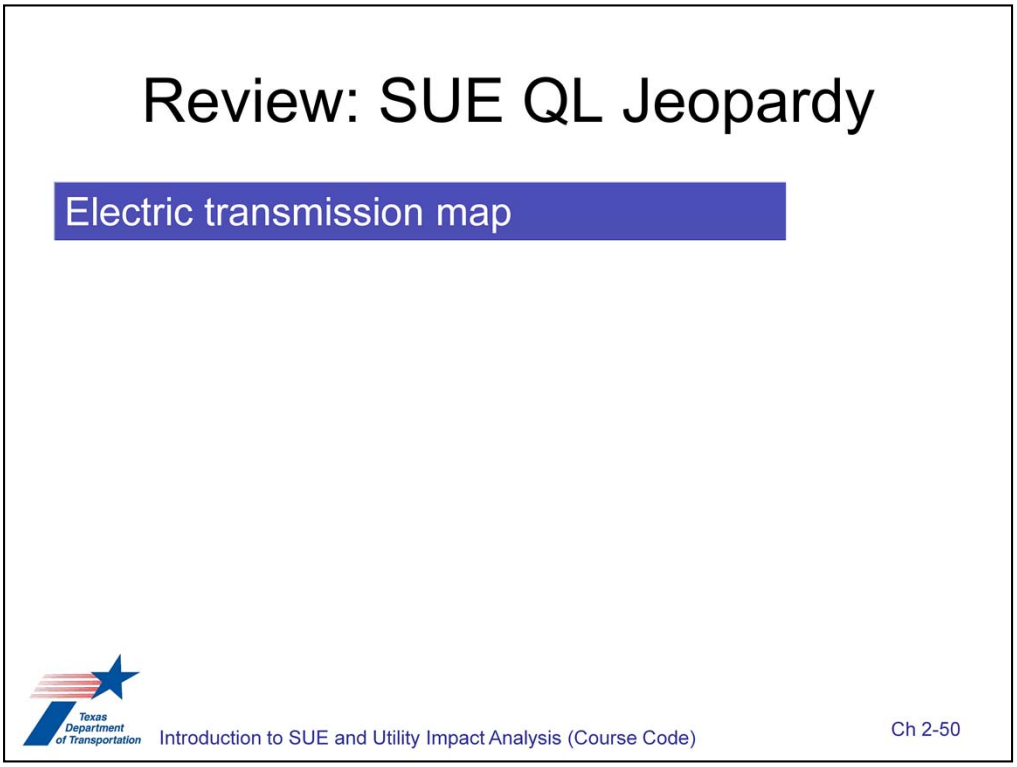
Lesson Review

2.3



Instructor Notes

Give a definition of a type of quality level, and solicit responses from the class. Then reveal the question and proceed to the next answer.



Instructor Notes

Continue with SUE jeopardy.

Review: SUE Benefits

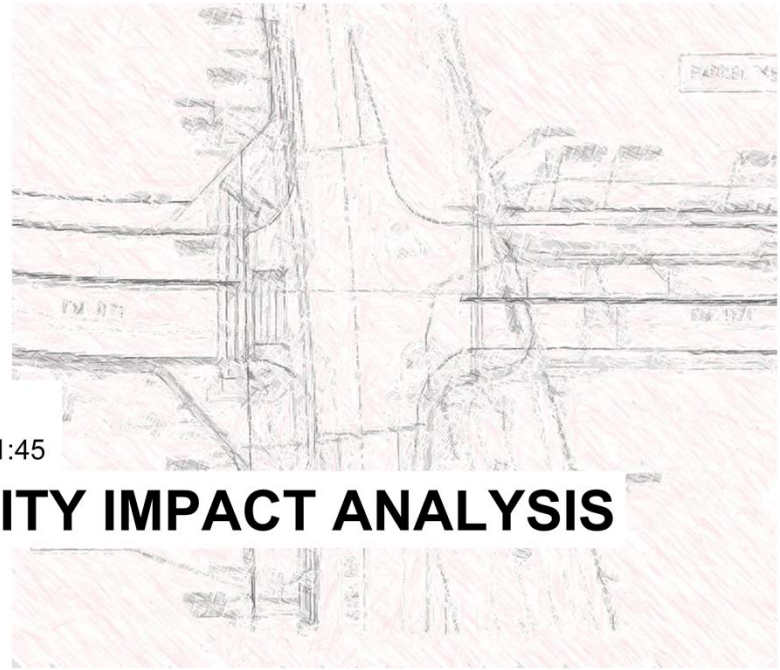
Give some examples of SUE benefits

Explain when to conduct what type of SUE

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 2-51

Instructor Notes

Solicit responses from the class based on the presentation given so far. One example is to let each person pick one benefit or one type of SUE data collection during the project development process.



Lesson 3
10:45 – 11:45

UTILITY IMPACT ANALYSIS

Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 3-1

Learning Objectives

At the end of this lesson you should be able to:

- Perform utility impact analysis
- Complete a utility impact form
- Describe example of when to use QLA

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-2

Instructor Notes

Read the learning objectives

Utility Impact Analysis

Look in your handouts. Find:

- Handout #1 *PennDOT UIA form*
- Handout #2 *GDOT UIA form*
- Handout #3 *FM 546 Example*
- Handout #4 *IH 35E Example*

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-3

Instructor Notes

Have the participants locate the handouts

Example Best Practices

PennDOT SUE impact form

- 3-step screening process
- Utility impact score and SUE QL recommendation
- Mandatory use of SUE QLB or QLA on all excavation/demolition projects over $400k

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-4

Instructor Notes

Utility impact analysis has been conducted by many state DOTs. PennDOT began using UIA in the mid 1990s. This impact form uses a 3-step screening process to reach a utility impact score and provide a recommendation. The instructor should walk-through the form noting the major features.

PennDOT UIA Demonstration Utility Impact Form (Excel)

Click to open PennDOT UIA

SUE UTILITY IMPACT FORM-STEP 2

Steps 1&2 are screening processes and Step 3 is an evaluation of the project passing Steps 1&2.

MPMS Number/Title:	
County/SR/Section:	

No.	QUESTIONS	Column 1		Column 2	
1	What is the depth of project excavation? Note: This includes any TCE or other easements.	○	≤ 18"	○	> 18"
2	What is the confidence level that the utility owners in the project area will be able to accommodate the project's schedule in regard to depicting their utility facilities on PennDOT plans?	○	Confident	○	Doubtful
3	What is the likelihood that project will have impact on the existing subsurface utilities?	○	No Impact	○	Impact
4	Do the utility owners in the project area have accurate utility information?	○	Yes	○	No

- If there are no boxes checked in Column 2, then it is generally not practicable to perform a SUE quality levels A and B investigation.
- If any boxes in Column 2 are checked, please proceed to STEP 3 to calculate utility impact score and determine the appropriate SUE quality levels.

SUE UTILITY IMPACT FORM – STEP 3 SUMMARY ANALYSIS

STEP 3 determines which SUE quality level should be selected for a project/section/location.
**NOTE-step 3 analysis can be conducted at the project level, or for a specific location within the project (e.g., intersection, utility crossing, etc.). Conduct Step 3 detailed analysis as necessary for each potential impact location.*

MPMS Number/Title:	
County/SR/Section:	
SUE Impact Location*:	
Description & Scope: *(leave blank when using step 3 for overall project level impact analysis)*	

STEP 3 UTILITY IMPACT SCORE RESULTS

Utility Impact Score:	Recommended SUE Quality Level:	Relative Cost Factor:

UTILITY IMPACT SCORE CALCULATION DESCRIPTION

1: Total Box Checked	Sum of Column 1	Sum of Column 2	Sum of Column 3
2: Utility Impact Score	[(1 x Sum of Column 1) + (2 x Sum of Column 2) + (3 x Sum of Column 3)] / n		

This Table demonstrates the process for calculating the utility impact score based on response.
n = number of the complexity factors considered/checked

UTILITY IMPACT SCORING LEVELS AND FACTORS

This table demonstrates the project complexity level, recommended SUE level to be used and relative cost of using SUE quality level, and project risk level based on the utility impact score.

Utility Impact Score	1.01-1.67	1.68-2.33	2.34-3.00
Recommended Minimum SUE Quality Levels	QLB	QLB/A	QLA
Relative Cost Factors	16.67	33.33	66.67

SUE UTILITY IMPACT FORM – STEP 3 DETAILED ANALYSIS

-Check the utility impact rating to the right that best fits your opinion of the issue. If the answer for the complexity factor is unknown, always check Column 3.
-Refer to page 9 for a detailed description of the complexity factors.
-When using an electronic version for the Step 3 analysis, place cursor over the cell on the named sheet for a detailed description of the complexity factor.

No.	Complexity Factors	Column 1		Column 2		Column 3	
1	Density of Utilities (number)	○	Low	○	Medium	○	High
2	Type of Utilities	○	Less Critical	○	Sub Critical	○	Critical
3	Pattern of Utilities (number)	○	Simple	○	Medium	○	Complex
4	Material of Utilities	○	Rigid	○	Flexible	○	Brittle
5	Access to Utilities	○	Easy	○	Medium	○	Restricted
6	Age of Utilities (year)	○	New	○	Medium	○	Old
7	Estimated Utility Relocation Costs (% of total project cost)	○	Low	○	Medium	○	High
8	Estimated Project Traffic Volume (ADT per lane)	○	Low	○	Moderate	○	High
9	Project Time Sensitivity	○	Low	○	Medium	○	High
10	Project Area Description	○	Rural	○	Suburban	○	Urban
11	Type of Project/Section/Location	○	Simple	○	Moderate	○	Complicated
	Quality of Utility Record	○	Good	○	Fair	○	Poor

Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 3-5

Instructor Notes

Have participants locate the form in their handouts. Then open the Excel file and walk users through the 3-step process.

Example Best Practice

Formalized GDOT utility impact avoidance process

- SUE request process
- Utility impact rating and score
- Utility impact analysis
- SUE deliverables review process

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-6

Instructor Notes

Describe the Georgia DOT UIA form. Explain that it is similar to the PennDOT form. The GDOT from was based on the PennDOT form, GDOT just modified it. The form is part of the GDOT process for procuring SUE services. It provides a way to document the need and justification for procuring SUE.

GDOT Utility Impact Rating

GDOT utility impact rating form

- Determines estimated utility impact for project
- Minimally, moderately, or severely
- Excel macro
- Used to determine need for QLB or QLA

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-7

Instructor Notes

Describe the purpose of the GDOT impact rating form.

Question	Rating		
1. How many utilities are expected to be encountered on this project?	**Low** ☐ 0-2	**Med** ☐ 3-4	**High** ☐ >4
2. Generally, for the type of work proposed, what is the probability for utility conflicts to be encountered on construction for this project?	**Low** ☐	**Med** ☐	**High** ☐
3. Which best describes the traffic volume (ADT) on this route?	**Low** ☐ ≤ 1500	**Med** ☐ > 1500 and ≤ 6000	**High** ☐ > 6000
4. How can the area where this project is proposed best be described?	**Low** ☐ Rural	**Med** ☐ Rural but Urbanizing	**High** ☐ Urban
5. How would the number of parcels affected by this project, relative to the total project length, best be characterized?	**Low** ☐ Few	**Med** ☐ Average	**High** ☐ Numerous
6. How often have the utility owners in this area provided timely/accurate information regarding their facilities on previous projects?	**Low** ☐ Almost Always	**Med** ☐ Occasionally	**High** ☐ Seldom

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-8

Instructor Notes

Have participants locate the form in the handout and identify the various criteria. The instructor should walk through the form and note the major features and questions.

Give an example explanation of a criteria. For example, have a participant read the description for utility density.

What Projects Are Good Candidates for SUE QLB and QLA?

High level of utility congestion

High probability for utility conflicts

Urban/suburban settings

High utility relocation costs

High probability existing facility can be saved

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-9

Instructor Notes

Based on the criteria used in the PennDOT and GDOT forms, ask what are the type of projects that make good SUE candidates. Then reveal the responses by advancing the slide.

Utility Impact Analysis Exercise #1

Use handout #3

- Review the project description
- Complete the GDOT UIA form
- Report back

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-10

Instructor Notes

Describe activity 1. Then describe the project and its setting using the following slides.

Exercise #1 FM 546

- Suburban Setting
- Reconstructing existing seven lane into four-lane divided urban highway
- Adding turn-lanes and medians
- Adding sidewalks
- No new right of way

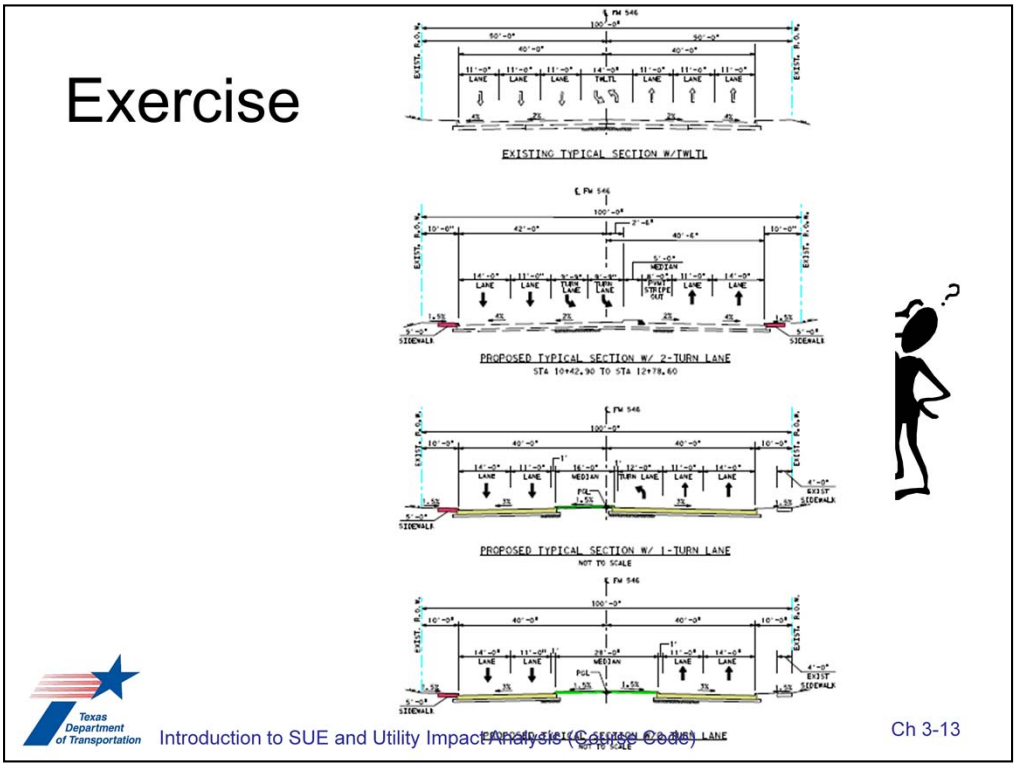
Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-11

Instructor Notes

Describe project limits and land use.

Instructor Notes

Use pointer to point out key features on aerial photo: cemetery, driveways, industrial park, adjacent land use.

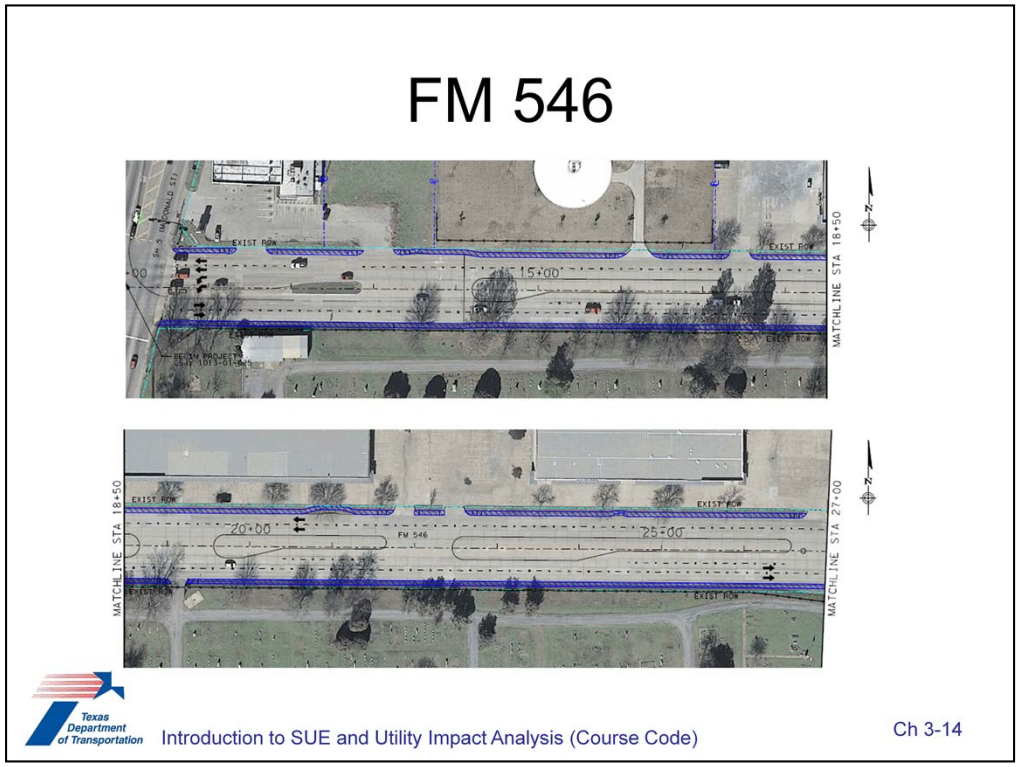


Instructor Notes

Ask participants for benefits and challenges, then provide or supplement from below.

Describe the typical sections. Ask participants if utilities will be impacted based on these typical sections.

Please note the right of way limits and how right of way is affected by the project.



Instructor Notes

Point out key features such as sidewalk locations, medians, and driveways.

Complete form together

Question	Rating		
1. How many utilities are expected to be encountered on this project?	**Low** ☐ 0-2	**Med** ☐ 3-4	**High** ☐ >4
2. Generally, for the type of work proposed, what is the probability for utility conflicts to be encountered on construction for this project?	**Low** ☐	**Med** ☐	**High** ☐
3. Which best describes the traffic volume (ADT) on this route?	**Low** ☐ ≤ 1500	**Med** ☐ > 1500 and ≤ 6000	**High** ☐ > 6000
4. How can the area where this project is proposed best be described?	**Low** ☐ Rural	**Med** ☐ Rural but Urbanizing	**High** ☐ Urban
5. How would the number of parcels affected by this project, relative to the total project length, best be characterized?	**Low** ☐ Few	**Med** ☐ Average	**High** ☐ Numerous
6. How often have the utility owners in this area provided timely/accurate information regarding their facilities on previous projects?	**Low** ☐ Almost Always	**Med** ☐ Occasionally	**High** ☐ Seldom

Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 3-15

Instructor Notes

Have participants in groups or as entire class walk-through and answer each question. Do not answer for the participants but have them discuss each question and agree on an answer.

After completing the list, total the scores and explain the results.

It Is always helpful to recruit a participant to lead this exercise and total scores.

Exercise #2 IH-35

Go to handout #4 – IH 35E

Review plan sheet

Work in groups to complete GDOT UIA form

Report your findings

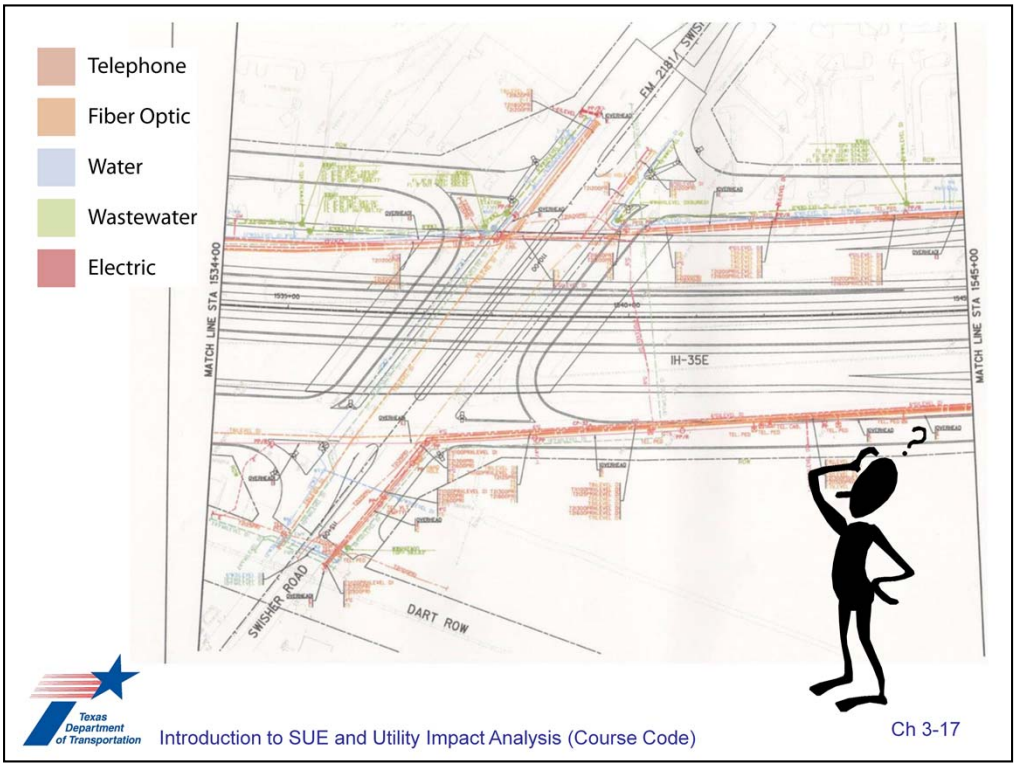
Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 3-16

Instructor Notes

The instructor should ask the participants to examine the existing utility layout for a section of IH 35 in Denton County.

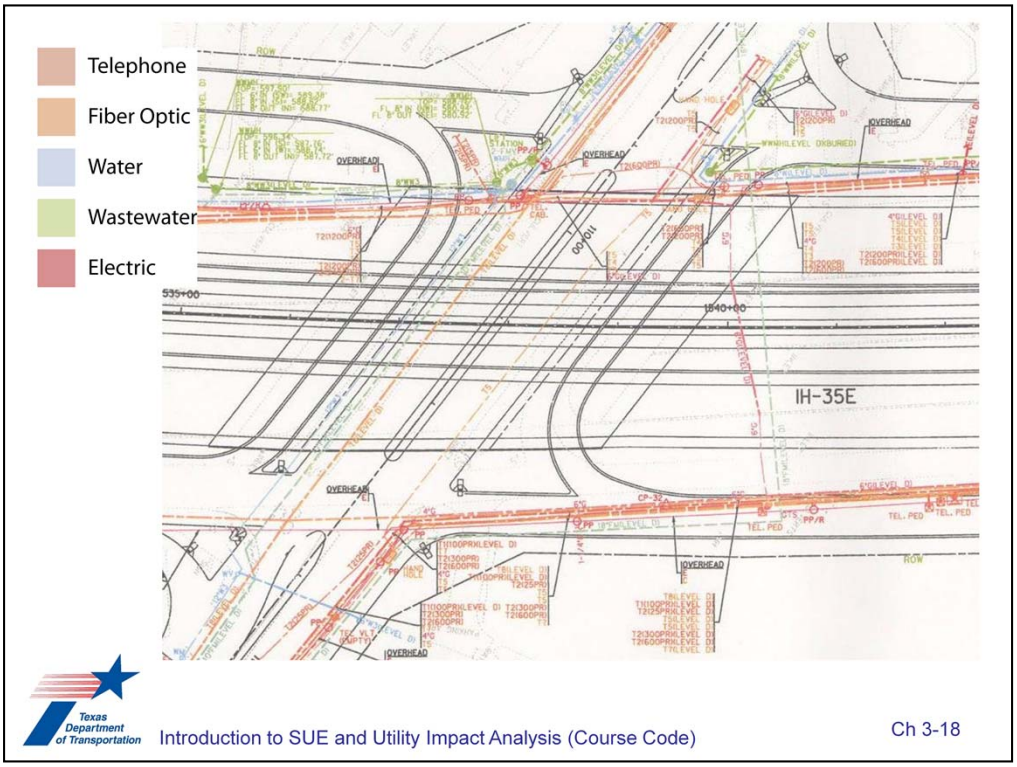
Explain the legend for the utilities – e.g., yellow and red are communications, blue are water lines.

Ask the participants to come up with a plan, or an approach to rebuild a section of this roadway. What would you do? Would you use the UIA?



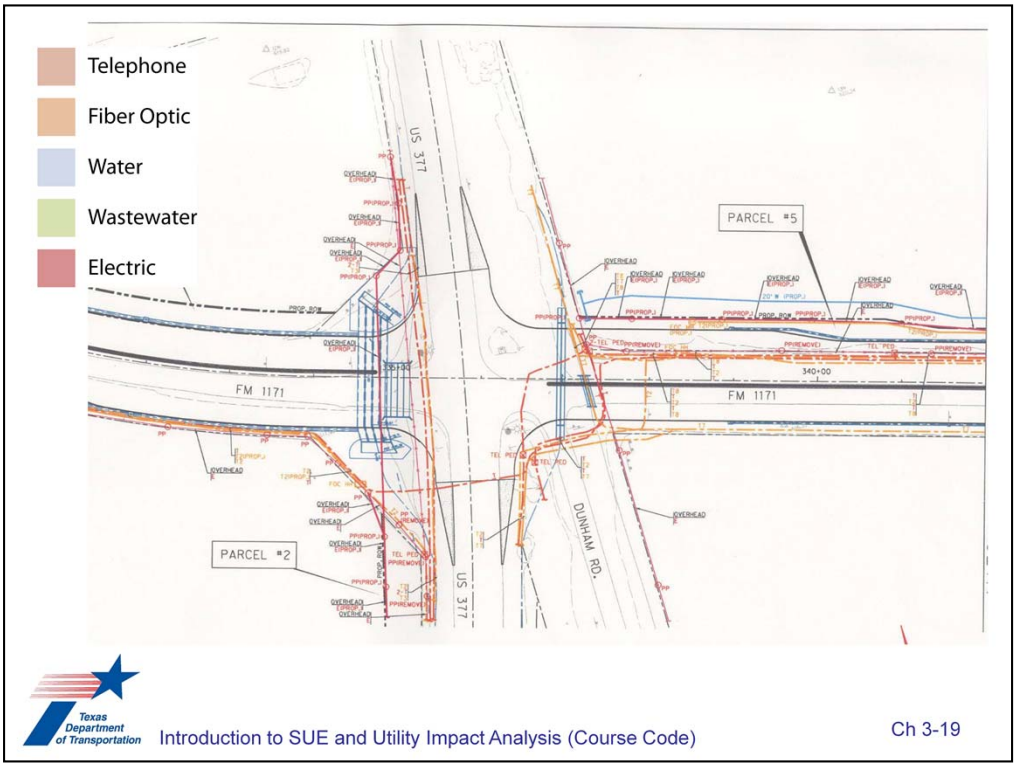
Instructor Notes

See previous slide instructor notes. Although this looks complicated, there are simpler ways to look at it. The participant should begin to identify utility conflicts. Using a utility conflict matrix is a useful tool that will be taught in an advanced class.



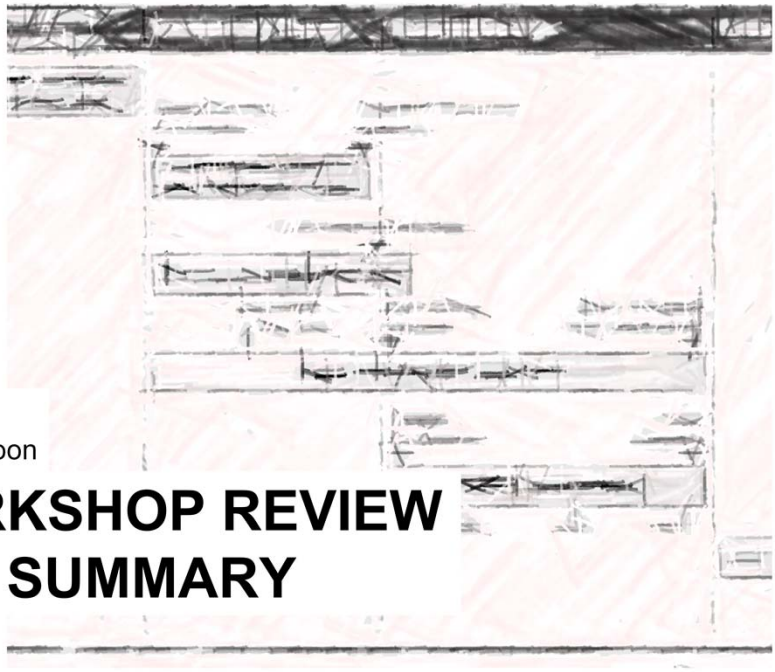
Instructor Notes

Zoom-in of previous slide.



Instructor Notes

Additional information for utility impact analysis.



Lesson 4
11:45 – Noon

WORKSHOP REVIEW AND SUMMARY

Texas Department of Transportation

Introduction to SUE and Utility Impact Analysis (Course Code)

Ch 4-1

Workshop Objectives

Describe SUE concepts and Quality Levels

Identify when SUE occurs in the project development process

Perform a utility impact analysis

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 4-2

Instructor Notes

Review learning objectives. Ask participants if they can:

- Describe SUE quality levels.
- Identify when SUE occurs in the project development process.
- Perform a UIA.

Workshop Review

Why do we conduct SUE?

How and why does SUE save money?

When do you conduct SUE QLD?

When do you conduct SUE QLA?

What are some limitations of SUE?

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 4-3

Instructor Notes

Ask review questions.

Workshop Evaluation

Please fill out feedback form

What will you do with the information when you return to your office?

Texas Department of Transportation Introduction to SUE and Utility Impact Analysis (Course Code) Ch 4-4

Instructor Notes

Thank You!

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