

# 2022 MIDWEST DAMAGE PREVENTION TRAINING CONFERENCE

## Subsurface Utility Engineering: State-of-the-Practice

By: Tom Iseley



Construction Engineering  
and Management



# AUDIOVISUAL SERVICES PROVIDED BY



metronet<sup>TM</sup>

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## Purdue CEM UIT



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Chair, BAMI-I Board of Director**



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# Overview

- What is SUE?
- Why Use SUE?
- How Does SUE Work?
- What Is The Value of SUE?
- How Is SUE Data Used?
- Examples

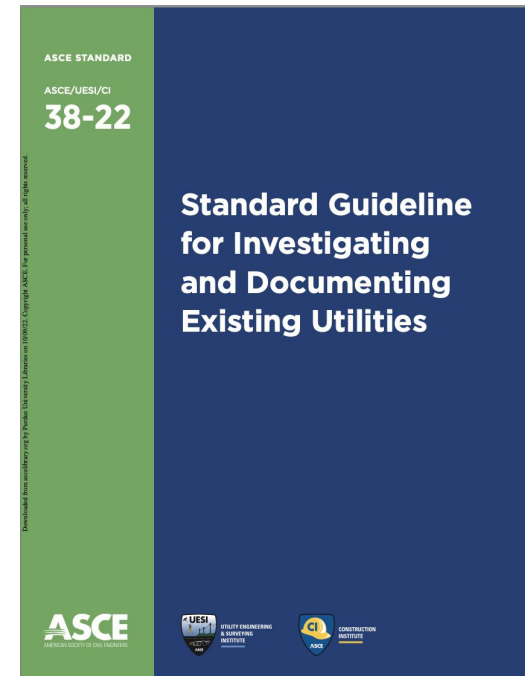
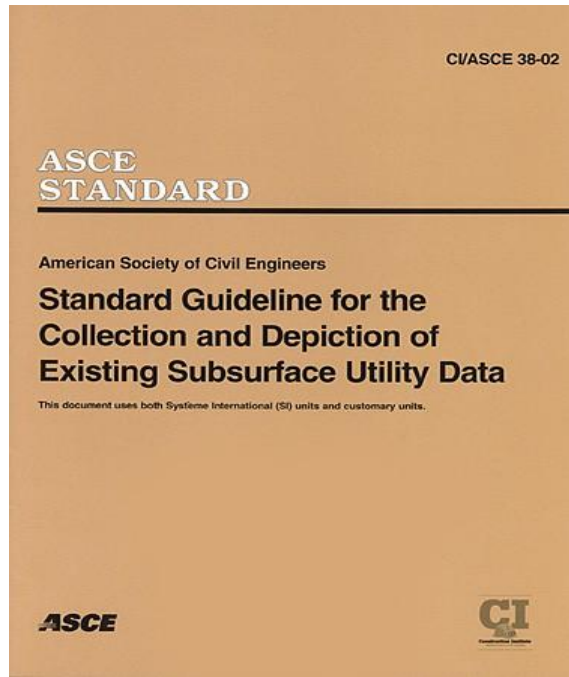




# What is SUE?



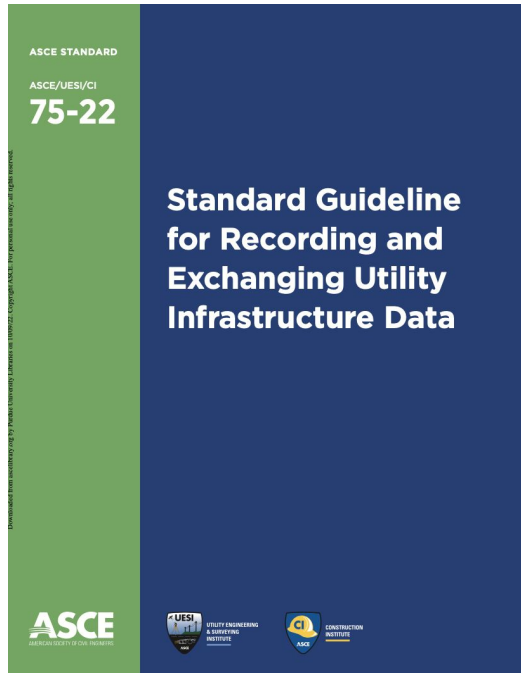
# What is SUE?



- ASCE Standard 38-02 & 38-22 •
  - Contains:
    - Definition of SUE,
    - Quality Levels,
    - Details, and
    - Examples.
- Standard Guideline for Investigating and Documenting Existing Utilities, ASCE/UESI/CI 38-22 and its companion standard, Standard Guideline for Recording and Exchanging Utility Infrastructure Data, ASCE/UESI/CI 75-22, are the ASCE's solution to reducing redesign, unnecessary utility relocations, and differing site conditions and associated costs..*



# ASCE 75-22



This standard specifies essential elements for documenting the location and other attributes of underground and aboveground utility infrastructure, with a particular focus on the documentation of newly installed or exposed infrastructure. It was developed to complement, CI/ASCE 38-02, hereinafter referred to as ASCE 38, Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data, and the corresponding 2022 revision ASCE/UESI/CI 38-22, Standard Guideline for Investigating and Documenting Existing Utilities.





# Subsurface Utility Engineering (SUE):

2002

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

**NOTE:** This is consistent with ASCE's position that project **risk should be identified and managed by the appropriate professional most qualified to be responsible and held accountable for the risk.**

2022

The specialty practice of Civil Engineering's Utility Engineering branch that includes the investigation, analysis, judgment, and depiction of existing utility networks.



# S.U.E. Combines Traditional Engineering Practices, such as .....



*Utility Records Research*



*Relocation Cost Estimates*



*Utility Design/Relocation Design*



*Plotting of Utilities from Records*



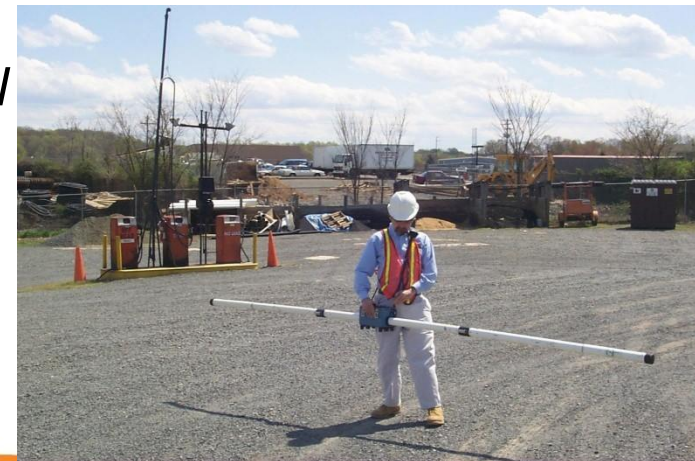


# With New Technologies



*Utility Designating*  
via  
*Surface Geophysical*  
*Methods*

*Detecting*  
*Frequencies*







## *Utility Locating Via Non-Destructive Vacuum Exposure*





# Why Use SUE?



# Why Use SUE?

• We keep adding and changing utilities

We don't keep good records



- Expansion
- Modernization
- Changing Utility Technology
- Changing Facility Missions

- ✓ Referenced to changed topo features
- ✓ No centralized records storage
- ✓ No standard format
- ✓ No responsibility





# Why Use SUE?

We don't know  
where most  
utilities are.



# What Are The Risks?

- Project delays
- Damage to utilities
- Safety of workers
- Safety of public
- Redesign costs
- Higher bids
- Change orders
- Extra work orders
- Construction claims
- Higher insurance costs
- Higher financing costs
- Detours
- Bad publicity

Construction Business is all about “Risk Management”





# How Does SUE Work?



# How Does SUE Work?

- SUE doesn't follow any set pattern.
- Rather it is tailored to individual projects.
- It essentially involves:
  - systematically identifying the quality of utility information needed to design a project, and
  - acquiring and managing that level of information.



# How Does SUE Work?

Four Quality Levels are defined in the ASCE Standard

- Utility Quality Level A
- Utility Quality Level B
- Utility Quality Level C
- Utility Quality Level D

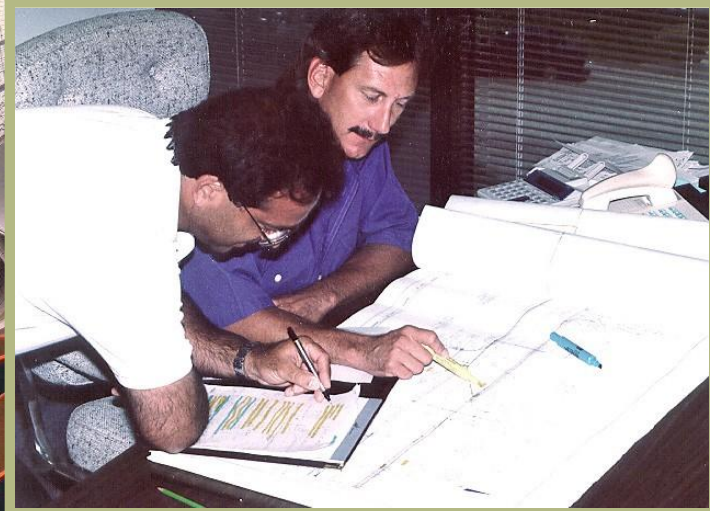
*Level of  
Details  
(Quality)  
increases*



# Utility Quality Level D

Information derived from existing records or oral recollections.

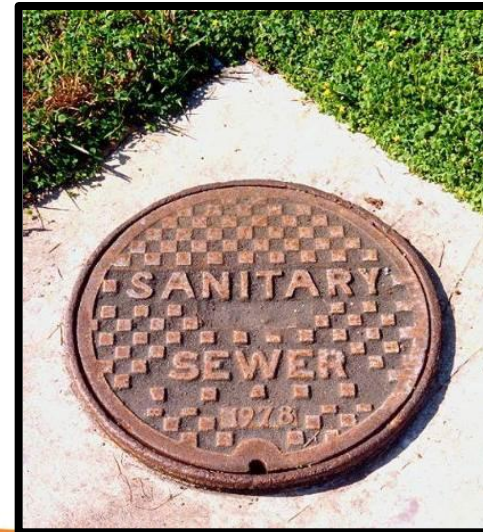
- **Records Research**
- Recollections
- Design Tickets





# Utility Quality Level C

- Information obtained by **surveying and plotting visible above-ground utility features** and by using professional judgment in correlating this information to quality level D information.

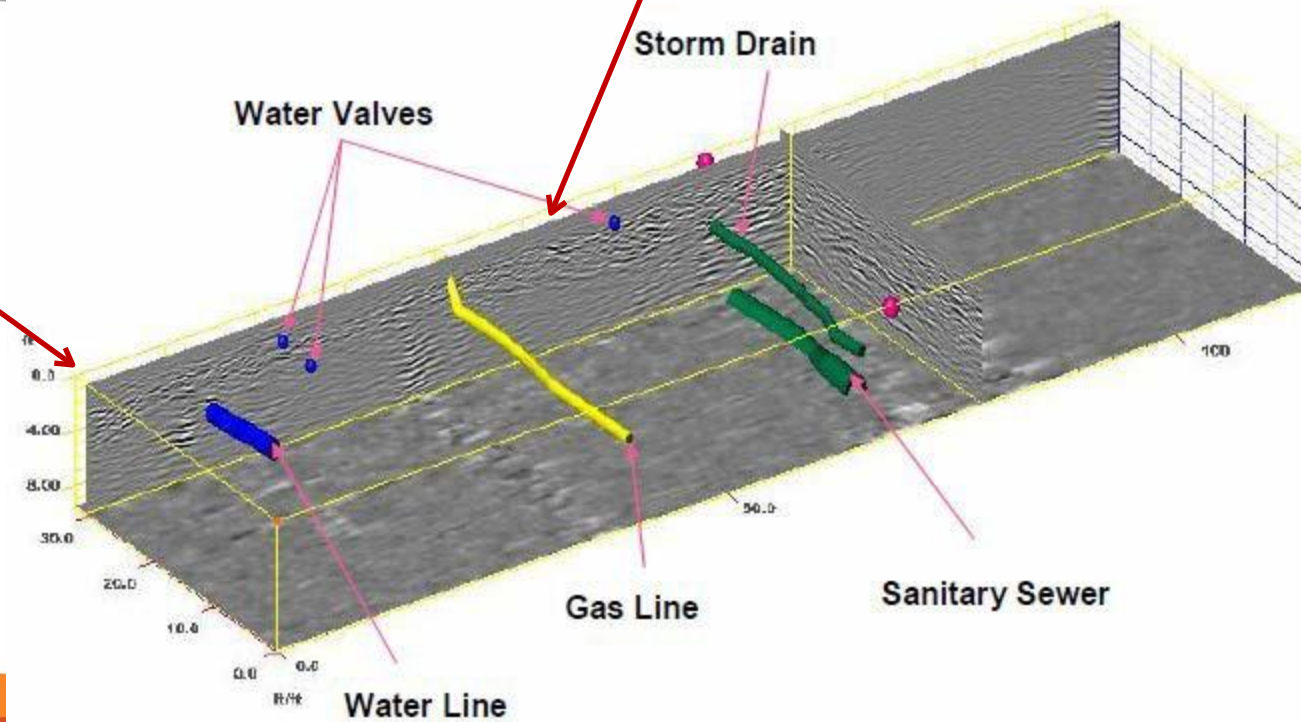
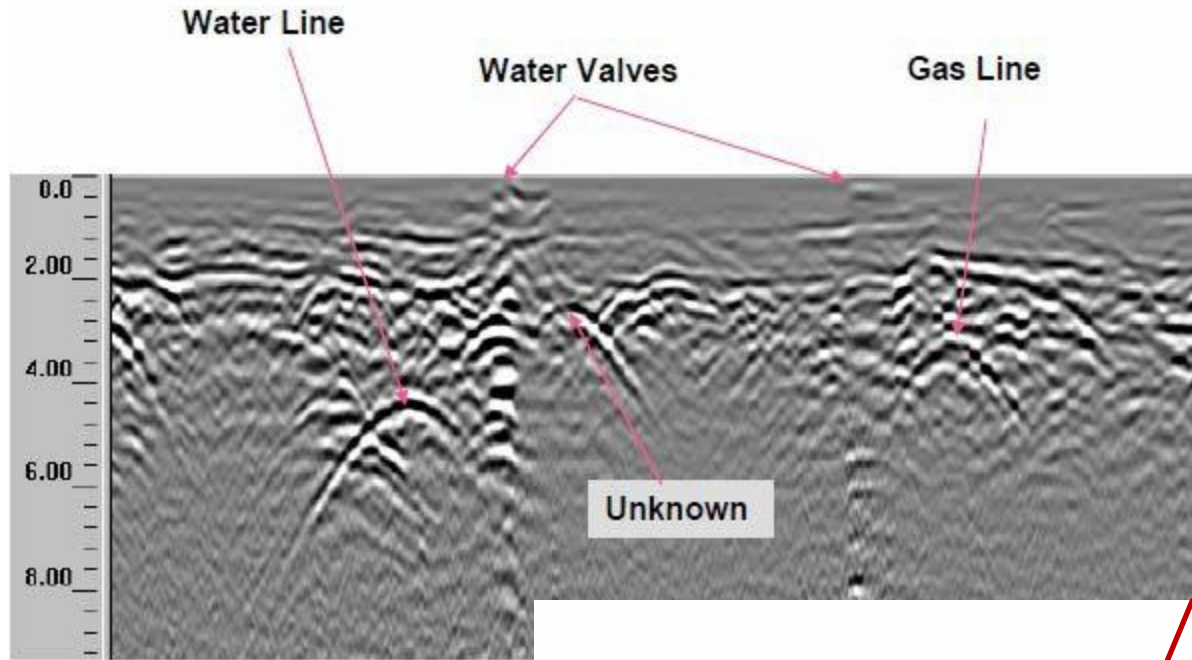


# Utility Quality Level B

- Information obtained through the application of appropriate **surface geophysical methods** to determine the existence and approximate horizontal position of subsurface utilities.



# Utility Quality Level B





All Utilities depicted at Quality Level B(QI B) eKcept:

1. All Sanitary Sewers are Quality Level C (QL C)
2. 6 Gas - 25 feet RT of Centerline Station 260 23 to 27 feet RT of Centerline Station 266 11 is Quality Level D (QL D).
3. There are no Quality Level A (QL A) data.

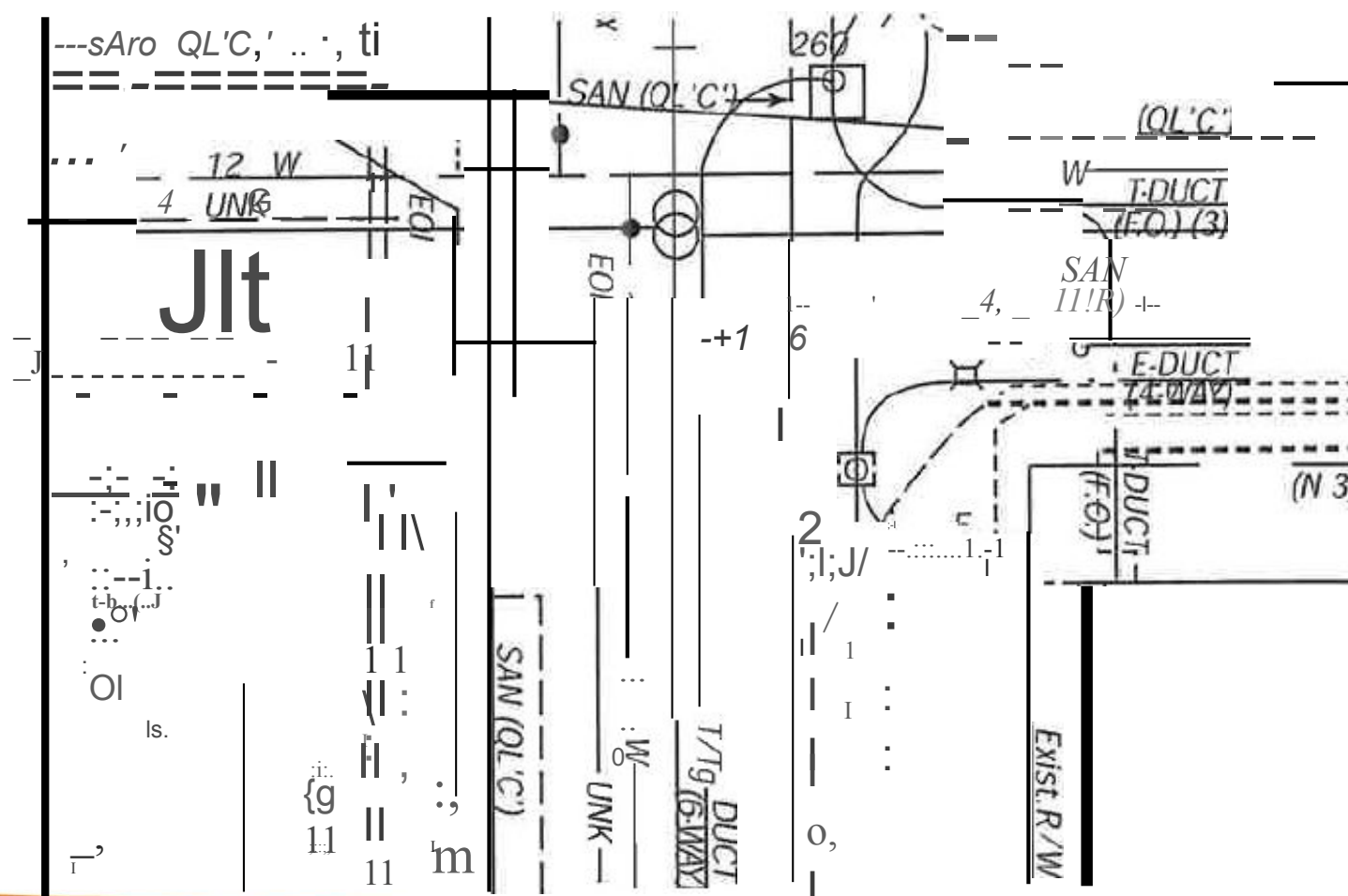


FIGURE 6-3: An Example of Quality Level Delineation by Notes.





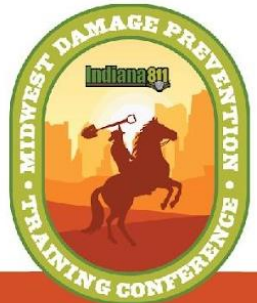
# Utility Quality Level A

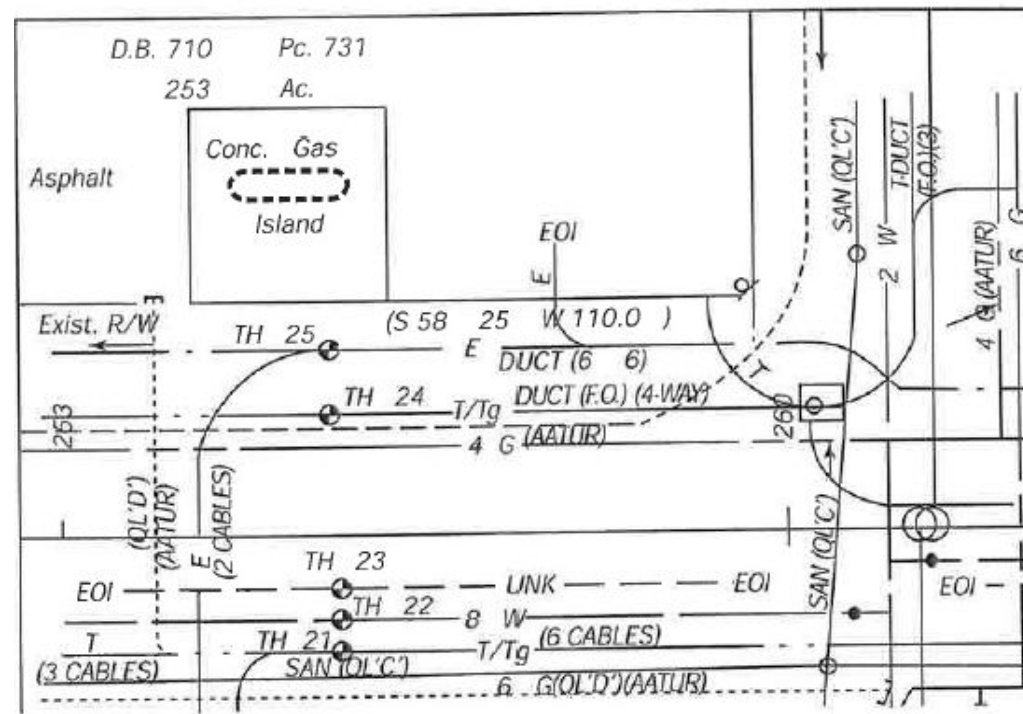
- Precise horizontal and vertical location of utilities obtained by the **actual exposure** (or verification of previously exposed and surveyed utilities) and subsequent measurement of subsurface utilities, usually at a specific point. Minimally intrusive excavation equipment is typically used to minimize the potential for utility damage
- Determine precise **vertical and horizontal** locations
  - Conventional accuracies shall be 0.1 ft (30 mm) vertical and to 0.2 ft (60 mm) horizontal for the measurements of the outside limits of the Utility Feature or Utility Segment that is exposed



# Utility Quality Level A

## Vacuum excavation pothole excavation for locating





All Utilities depicted QL B unless otherwise noted.

QL A Data Summary (see QL A Supplemental Data Sheets for additional information):

TH 21: 6 non-encased telephone cables

elevation top of cable configuration: 188.15  
 elevation bottom of configuration: 183.43  
 Coords: N 441987.8011  
 E 3640280.1310

TH 23: 6 3/4 unknown function steel pipe  
 elevation top of pipe: 181.12  
 Coords: N 441997.3489  
 E 3640280.8993

TH 25: concrete encased electric duct  
 elevation top of duct: 186.87  
 elevation bottom duct: 183.55  
 width of duct: 4.66  
 Coords: N 442032.1007  
 E 3640281.2239

TH 22: 8 3/4 C.I. water

elevation top of water line: 184.67  
 Coords: N 441992.7925  
 E 3640280.0092

TH 24: Fiber Optic concrete telephone duct  
 elevation top of duct: 184.41  
 elevation bottom duct: 182.22  
 width of duct: 2.62  
 Coords: N 442022.7934  
 E 3640281.0571

## QL A Summary

FIGURE 6-2. An Example of Line Code, Labeling, Symbol Embedding, and Notes.





City, County, State ACME CHEMICAL CO. CANYON, AZ  
Gen. Loc. SOUTHEAST OF BUILDING #10  
Recorded Size/Material/Type 18-WAY ELECTRIC DUCT / 8 UNKNOWN TYPE GAS  
Foreman/Truck#/Form By G. RANDOLPH / 216 / G. MAYER

Condition of paving prior to work  
ASPHALT LOT IN GOOD CONDITION

Control # ASC1234  
Test Hole # 33  
Plan Scale 1" = 2'  
Sheet # 1A  
Proposed BUILDING #10 ADDITION  
Date JANUARY 1, 1999

B.M. 1 Elev. = 3044.19  
is GIVEN

Description: (USGS MONUMENT #274489) BRASS DISK FOUND  
77 S. OF SE CORNER OF BUILDING #10

B.M. 2 Elev. = 3047.55  
is CALCULATED

Description: CHISELED "X" SET IN TOP RIM OF SAN. HH.  
54 SE OF SW CORNER OF BUILDING #15

Benchmark check BY 0.02  
Elevations are referenced to

B.M. #1

Recorded Size/Type of utility WAS FOUND.

There WERE NOT additional utilities in the test hole.

The utility WAS NOT in good condition. SEE REMARKS

Paving Thickness and type 8 ASPHALT OVER 6 CONC.

Color of ribbon installed RED / YELLOW

Soil Type SATURATED BROWN CLAY

Field Condition HEAVY ROAD TRAFFIC

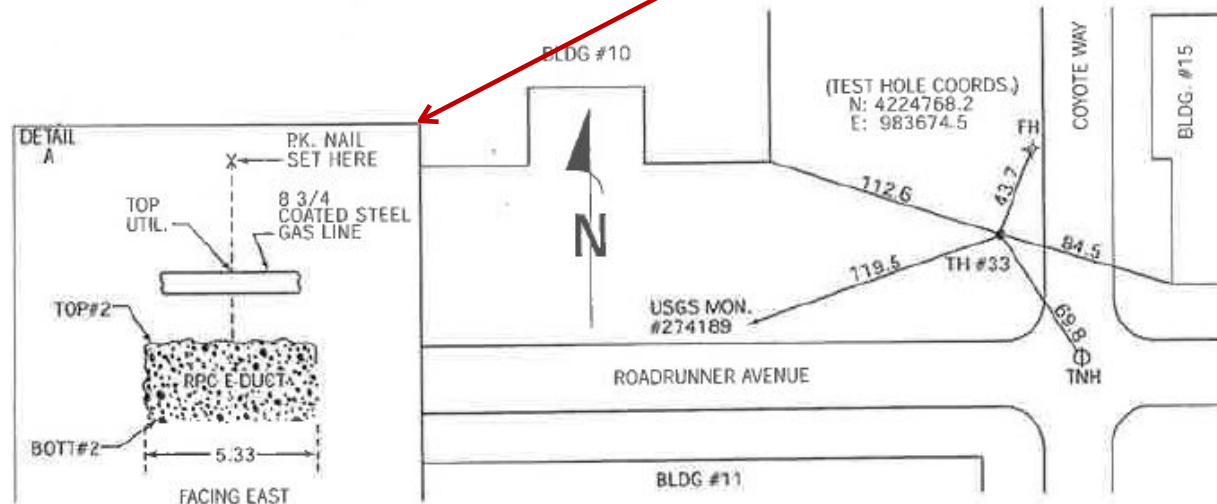
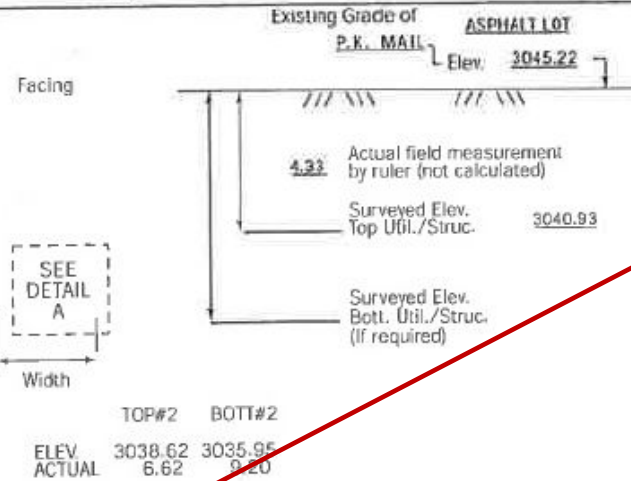
T.H. lied to P.K. MAIL

2.67 H 5.33 W RPC E-DUCT/\*8 3/4 COATED STL GAS

Size/Material/Type  
Portion of pipe exposed  
for O.D. measurement:

FULL

REMARKS: \*CREW FOUND THE GAS LINE HEAVILY CORRODED AT THIS LOCATION.



Summary of Field note  
- Supplementary Info.

See Detail

FIGURE 6-4. An Example of Quality Level A Supplemental Data.



# Is One-Call Locating QL-B?

## Not Exactly QL-B

- Not developed in accordance with ASCE Standard (QL-D, QL-C, QL-B)
- Not depicted on plans and signed by Engineer
- Not backed up by Errors & Omissions Insurance

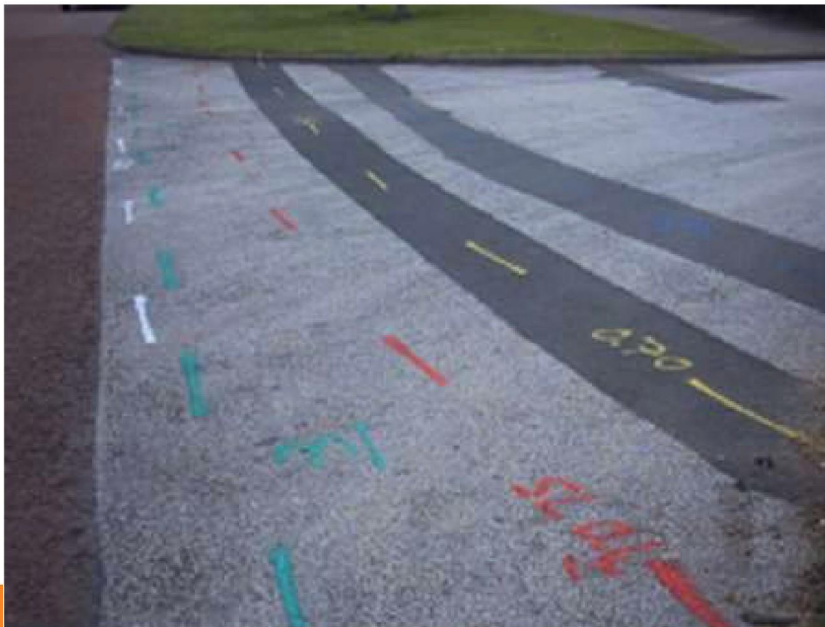
# Is One-Call Locating As Good As QL-B?







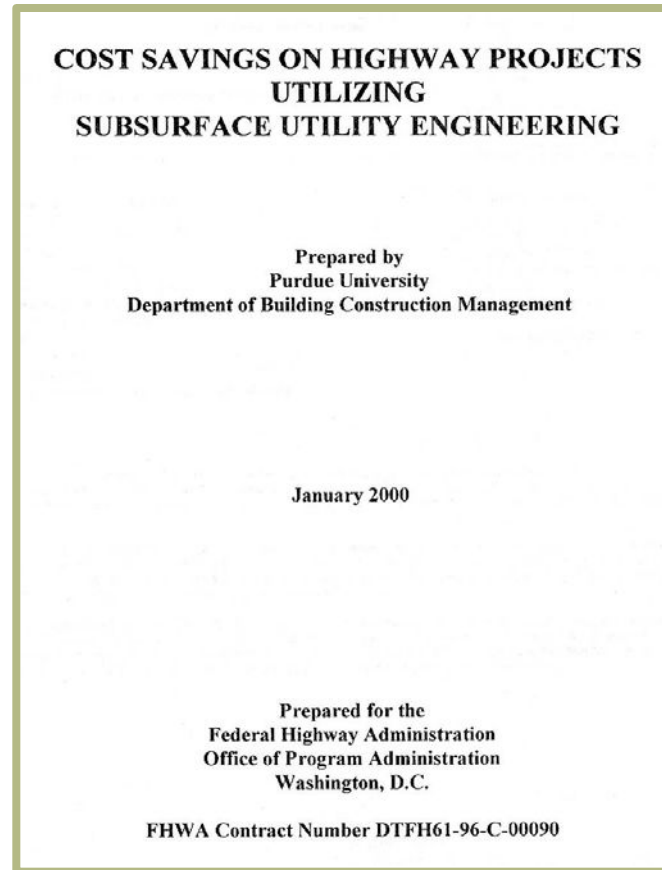
| UTILITY  | COLOR      |
|--|------------|
| PIPOPOS:EO EJi:C Pi.Mai ION                                  | WHITE      |
| ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES    | RED        |
| POTABLE WATER  | BLUE       |
| STEAM, CONDENSATE, GAS OR OIL COMPRESSED AIR                 | YELLOW     |
| TELECOMMUNICATIONS, ALARM OR SIGNAL LINES, CABLES OR CONDUIT | ORANGE     |
| TEMPORARY SURVEY MARKINGS                                    | PINK       |
| SEWER AND STORM DRAINS                                       | GREEN      |
| CHILLED WATER, RECLAIMED WATER, IRRIGATION AND SLURRY LINES  | PURPLE     |
| OTHER  | LIGHT BLUE |



# Value of SUE

## FHWA Study

- 4.62:1 Savings
- Savings from:
  - Relocation Avoided
  - Fewer Delay

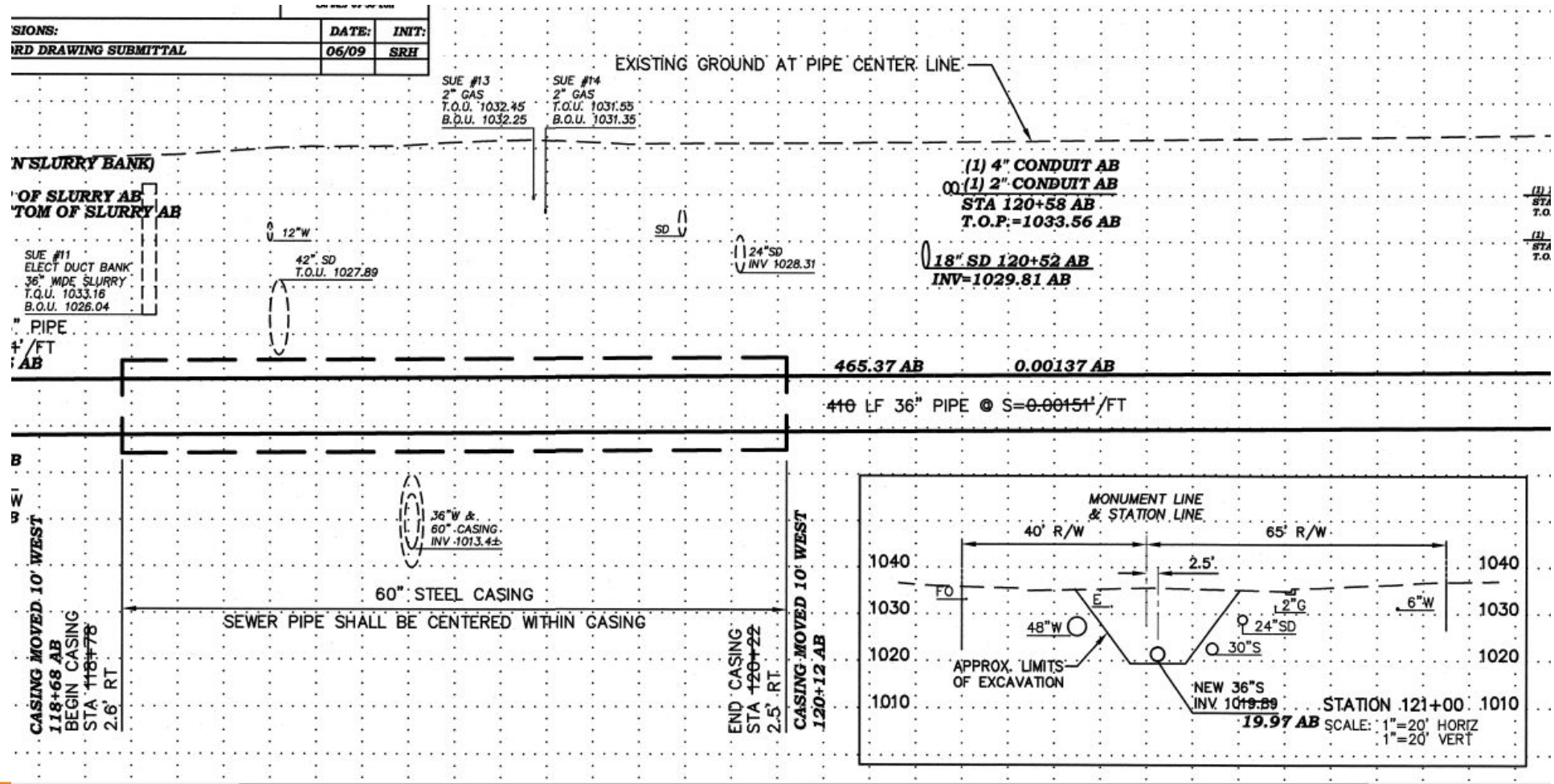








# Avoid potential conflicts

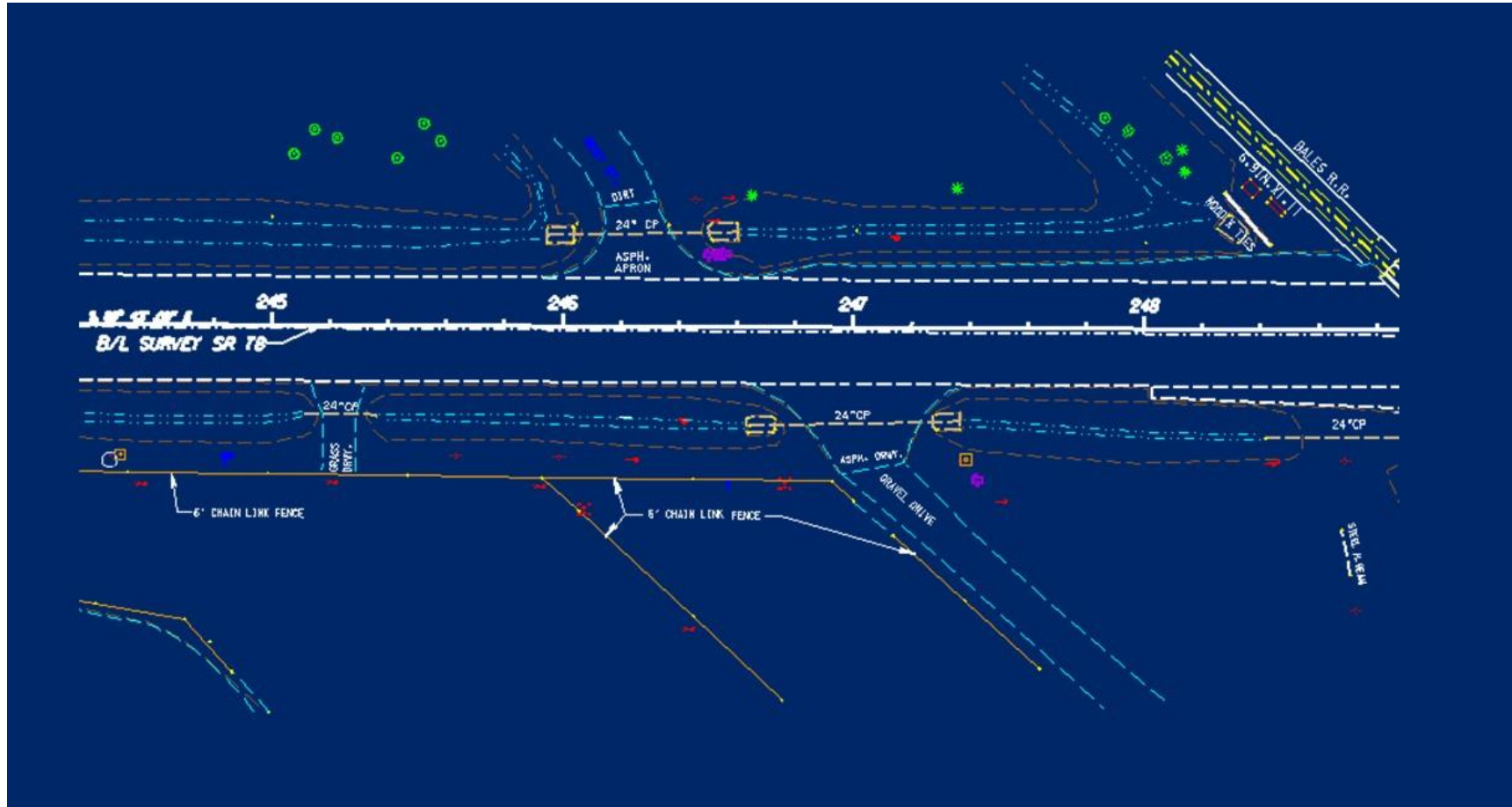


# SUE Example II

- Storm drain Pipeline across the proposed roadway design and construction
- Use multiple layers of design plan
- Determine level of SUE

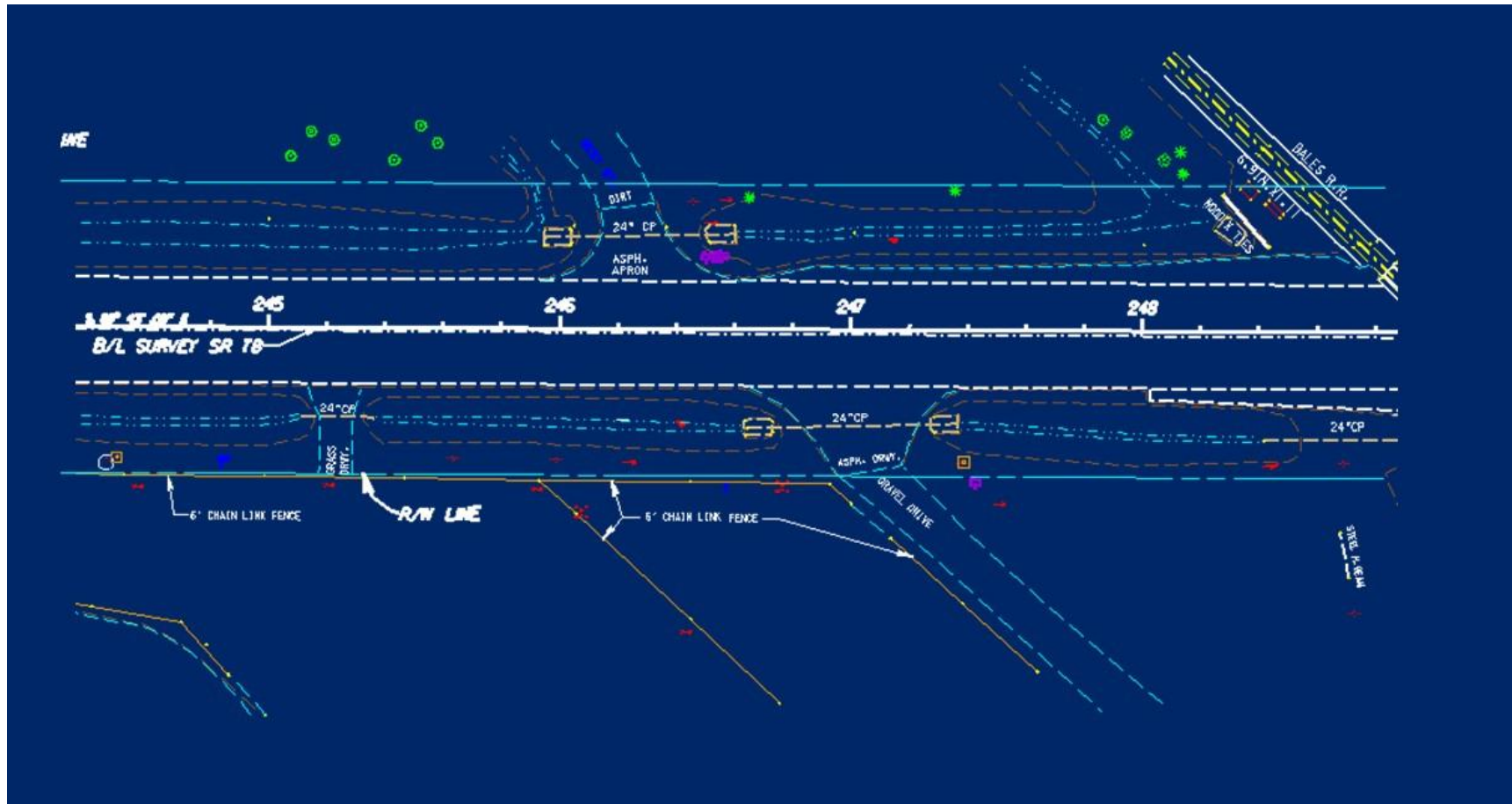


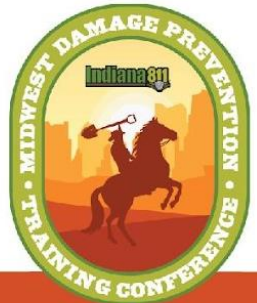
# Existing Topo and Plan



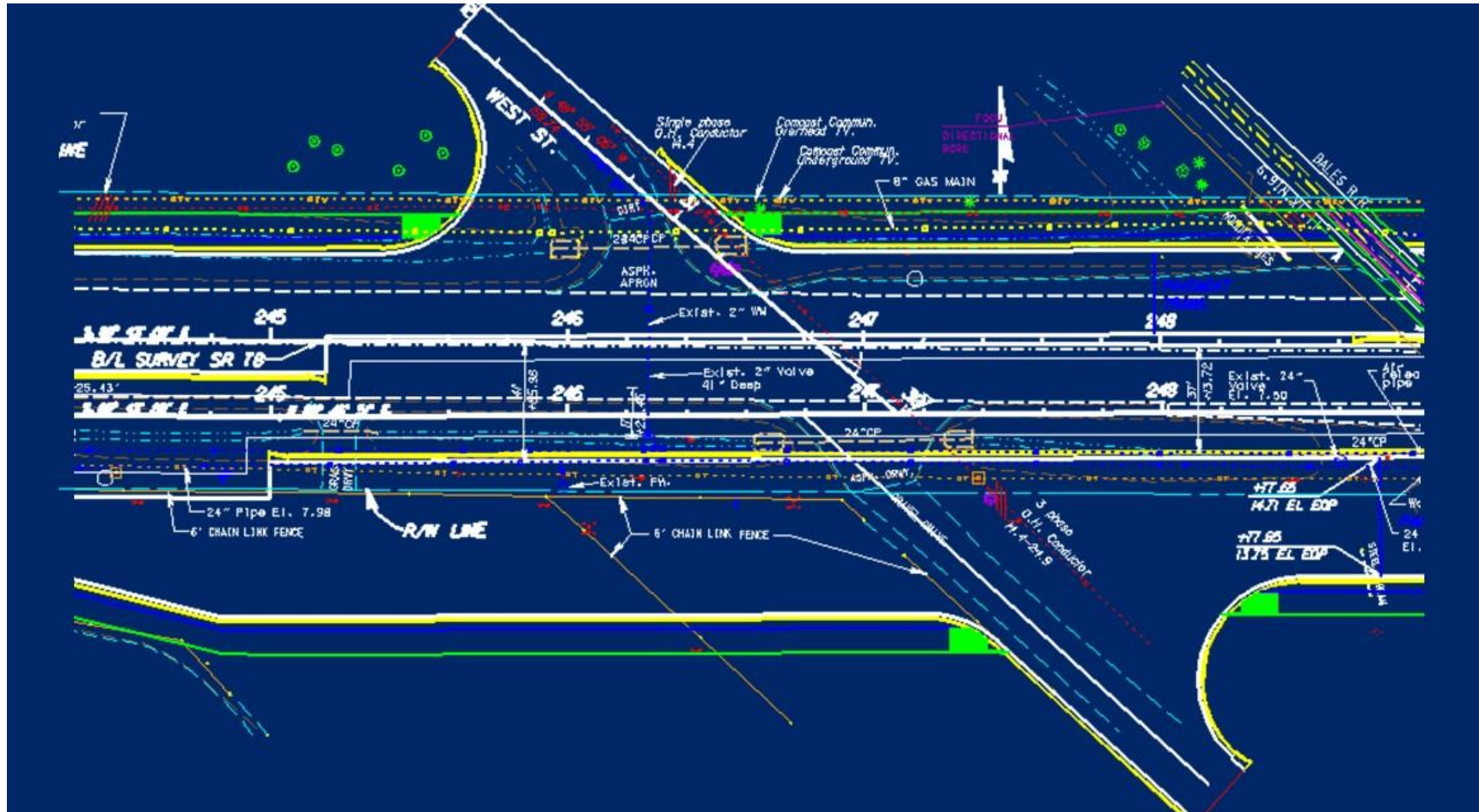


# Add Right of Way



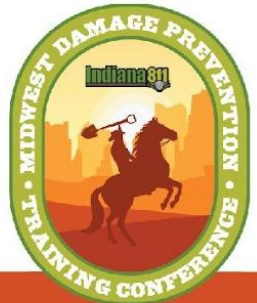
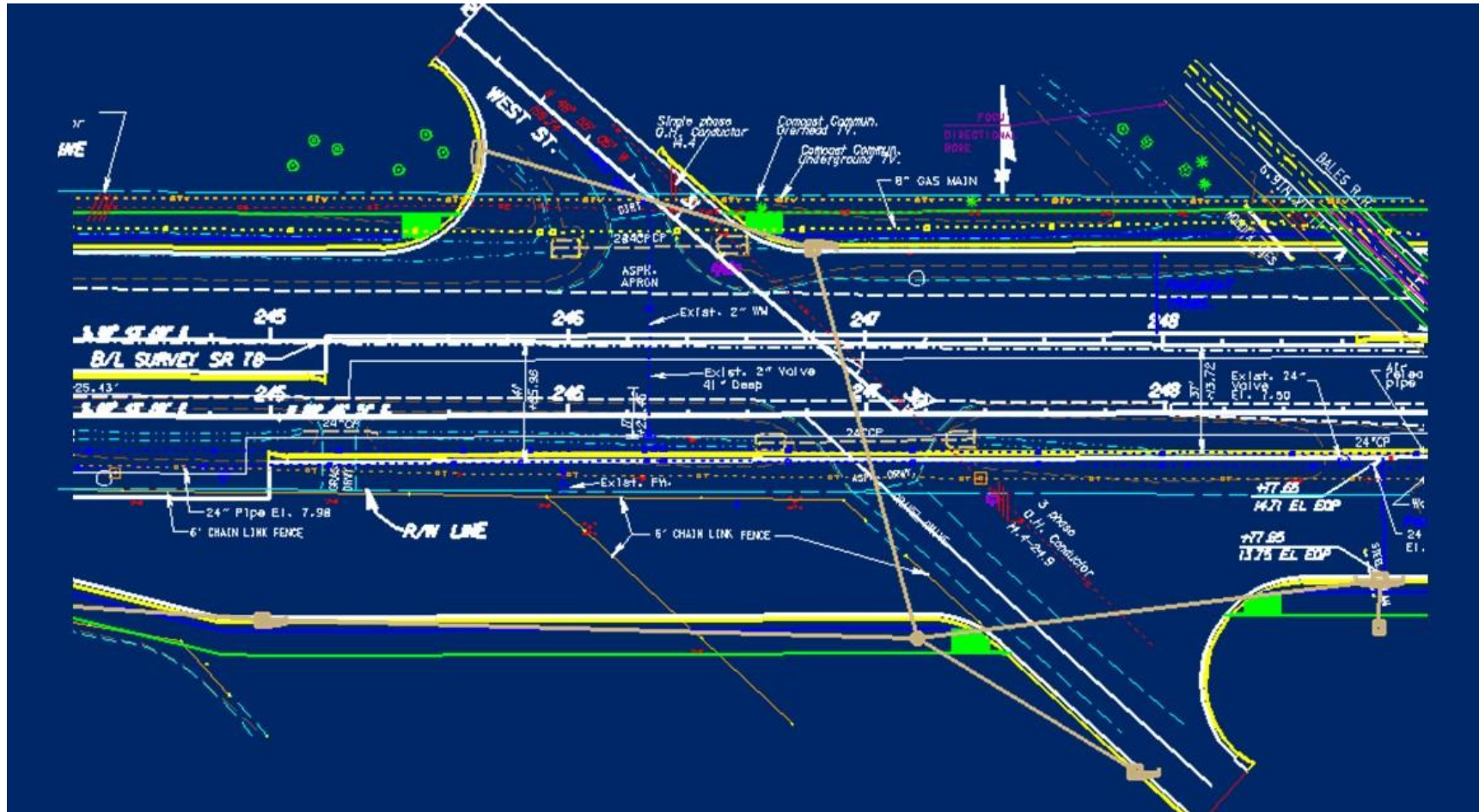


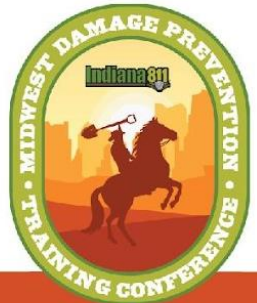
# Add Preliminary Road Design





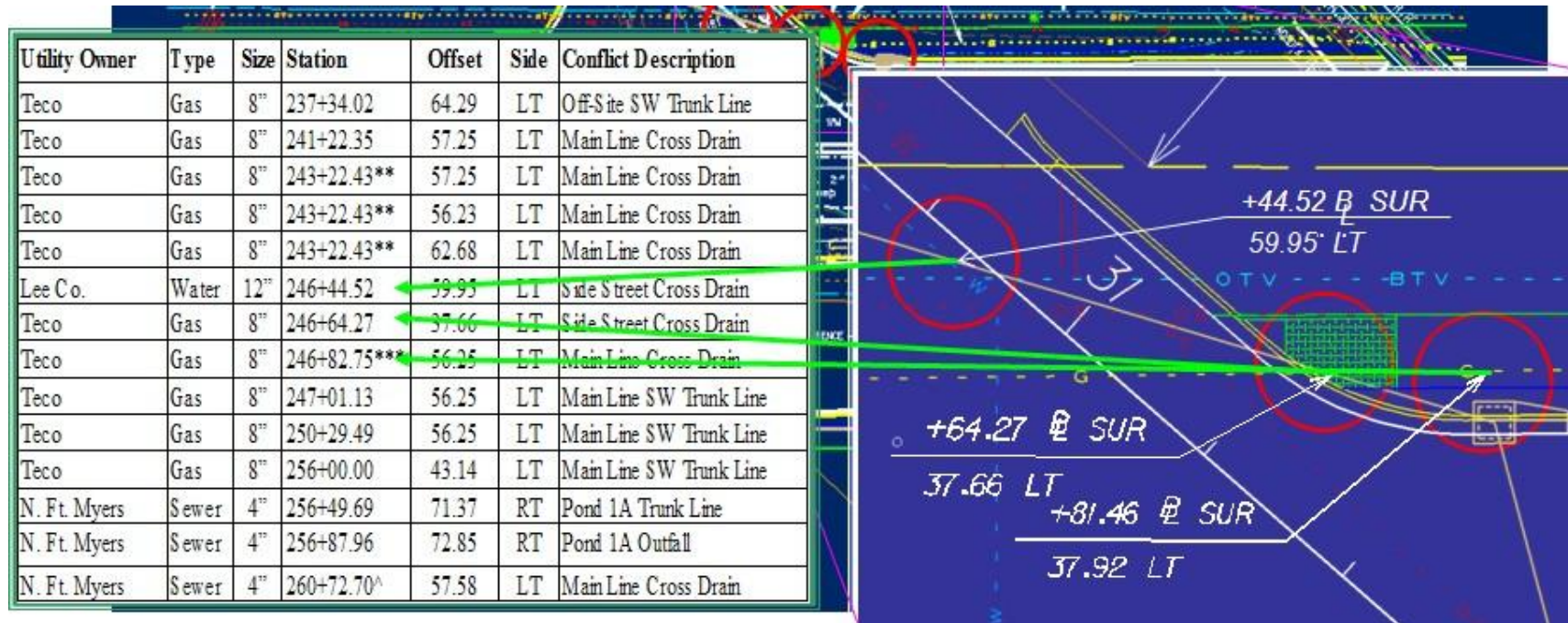
# Add Preliminary Drainage Design







# Identify Locations and Build Metrics





# SUE Design Applications

- Geometric and Alignments
  - Change grade
  - Move alignment
  - Widen only one side of highway
  - Move ramps
- Drainage, Ditch, Culvert, Inlet & Curb
  - Use alternative type inlets & storm drain
  - Move storm drains
  - Change ditch grade
  - Add curb & gutter
- Slope, Retaining Wall & Barrier
  - Change slope of embankment
  - Add retaining walls or change types
- Structure, Bridge & Footing
  - Move bridge bents and pilings
  - Change footer designs
  - Provide alternative foundations
- One Call Center
- Utility Company
- Contractor
- Asset Management Data Base
- Other Uses



| COLOR                             | CODE  | SYMBOL                    |
|-----------------------------------|---|---------------------------|
| <del>IL/NE</del>                  | <del>S</del>                                | <del>S</del>              |
| <del>J.e.</del>                   | <del>0</del>                                | <del>MANHOLE</del>        |
| <del>PROTECTION</del>             | <del>(I)</del>                              | <del>OROP INLET</del>     |
| <del>CW</del>                     | <del>C!J</del>                              | <del>UTILITY POLE</del>   |
| <del>JiA,S</del>                  | <del>(!)</del>                              | <del>LI GHTPOLE</del>     |
| <del>WATER GAS</del>              | <del>X</del>                                | <del>VALVE</del>          |
| <del>PROPAN</del>                 | <del>*</del>                                | <del>FIRE HYDRANT</del>   |
| <del>CONDENSATERETUR</del>        |   |                           |
| <del>TEAM</del>                   |   |                           |
| <del>COMPRESSED AIR</del>         | <del>POINT</del>                            | <del>UTILITY ENO</del>    |
| <del>NITROGE</del>                | <del>POINT</del>                            | <del>POINT</del>          |
| <del>N</del>                      | <del>0:(</del>                              | <del>RISER</del>          |
| <del>OXYGEN</del>                 | <del>●</del>                                | <del>HA NDHOLE, BOX</del> |
| <del>CARBON</del>                 | <del>■</del>                                | <del>PEDESTAL,</del>      |
| <del>DIOXIDE</del>                | <del>TRANSFORME</del>                       | <del>R</del>              |
| <del>TELEPHONE</del>              | <del>□</del>                                | <del>BOLLARD</del>        |
| <del>Util</del>                   |   | <del>SIGN</del>           |
| <del>ELECTRIC</del>               |   | <del>HOUSE TRAP</del>     |
| <del>CHEMICAL SEWER</del>         |   | <del>"QUALITY LEVEL</del> |
| <del>UNKNOWN FOR QLC OR QLO</del> |   | <del>A" DATA POINT</del>  |
| <del>INFORMATION</del>            |   |                           |
| <del>STORM</del>                  |   |                           |
| <del>ABBREVIATIONS</del>          |   |                           |
| F.O.                              | FIBEROPTIC                                  |                           |
| EOI                               | ENO OF SURFACE GEOPHYSICAL                  |                           |
| EORI                              | INFORMATION END OF RECORD                   |                           |
| AATU                              | INFORMATION                                 |                           |
| R                                 | UTILITY ABANDONED ACCORDING TO UTILITY R    |                           |
| AATFI                             | ECORDS UTILITY ABANDONED ACCORDING TO FIELD |                           |
| EATU                              | INSPECTION                                  |                           |
| R                                 |   |                           |
| NAP                               | EMPTY ACCORDING TO UTILITY RECORDS          |                           |
| NAC                               | NO ASSOCIATED PIPI NG FOUND FROM            |                           |
|                                   | STRUCTURE NO ASSOCIATED CABLES FOUND        |                           |
|                                   | FROM STRUCTUER                              |                           |





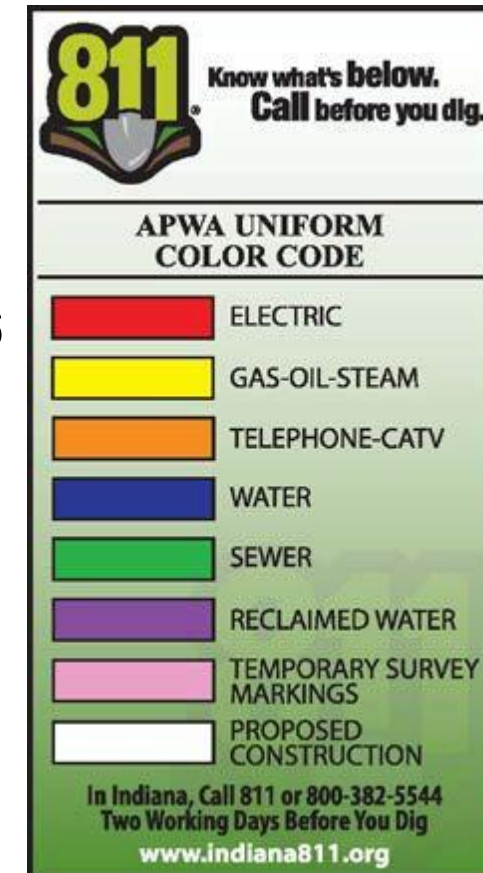
- Use single Call “Before You Dig #811” before 2– full working days.
- Including residential property
  - (limited information)
- Not all underground utilities included (IC 8–1–26 –22 requires all utility owners participation)
- If incorrect marking, call immediately 811 and request remarking
- If you damage, immediately notify the utility operator and Indiana 811.
- Limitation of damage (Indemnification clauses)

## Indiana

Indiana 811

1-800-382-5544

[www.indiana811.org](http://www.indiana811.org)





# 811 vs. Contractors

Based on a conversation with a Utility Contractor in Indiana

- 811 is most likely **indemnified** by those who created it and for whom 811 works, the various utility owners.
- The locating firms are also hired by the utility companies.
- It is the utility company that is obligated by the law to mark its' facilities.
- 1] We have been told the excavator **cannot seek reimbursement** from the utility.
- 2] The excavator may so advise the IURC's Advisory Panel, which may elect to fine the utility up to \$1,000.00. [This panel is empowered to fine excavators up to \$10, 000.]
- The law does not require utilities to either mark, or keep track of, the depth of its' facilities or any still remaining in place but abandoned facilities.
- The contractors' perspective, the system is very unfair.
- This favoritism leads utilities to do less of a job than they could and should, which leads to the likelihood of increased levels of accidents, injuries, and death.



# Industries' Response to This Global Challenges

- Late 1980's the ground work was established to create a new professional practice in Civil Engineering call:
  - ❑ SUE: Subsurface Utility Engineering
- During the early 1990's, I served a 5-year term on the EXCOM of Construction Division of ASCE (now CI)
  - ❑ Liaison to ASCE Codes & Standards Council
- Established committee to develop ASCE 38-02



# ***ASCE 38 Concepts Conceived in 1994 as a performance standard***

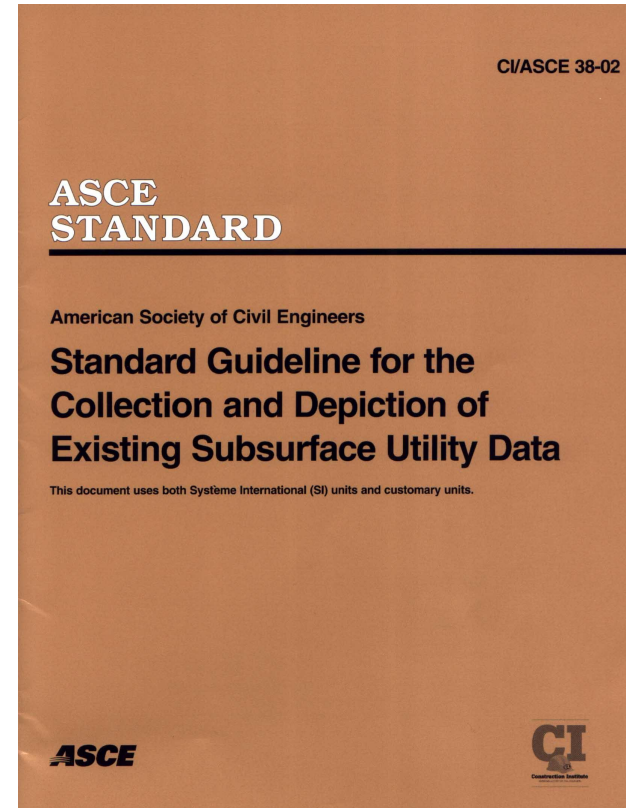
How can a project be designed so as to have minimal utility issues during the project development process?

How can engineers be protected against utility-related claims during the project development process?

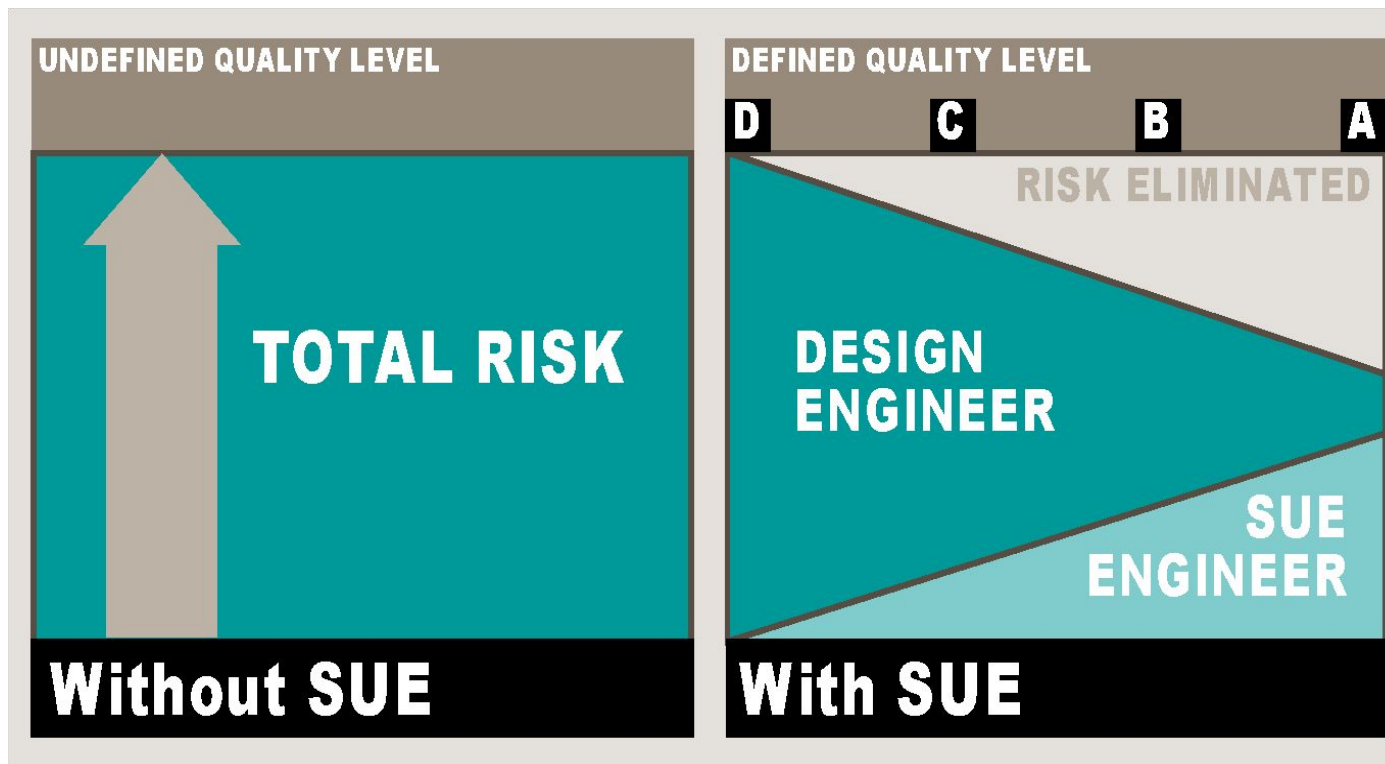
Standard Development Process:

- ASCE Codes & Standards Council approves request,
- ASCE announces invitation for committee members,
- Balanced committee formed (Users, Producers, General Public),
- Committee control group established,
- Draft document developed,
- Reviewed,
- Committee balloting,
- Institute balloting, and
- General public balloting

**NOTE:** All comments must be addressed and all negative votes must be satisfied.







TOTAL ENGINEERING RISK POOL

ALLOCATION OF RISK WITHIN ENGINEERING POOL



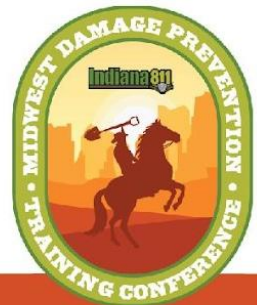
# Why Use SUE?

- ♦ For every \$1 spent on SUE, a project could see a minimum quantifiable savings of \$4.62

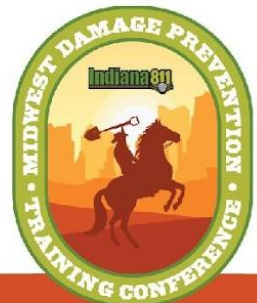
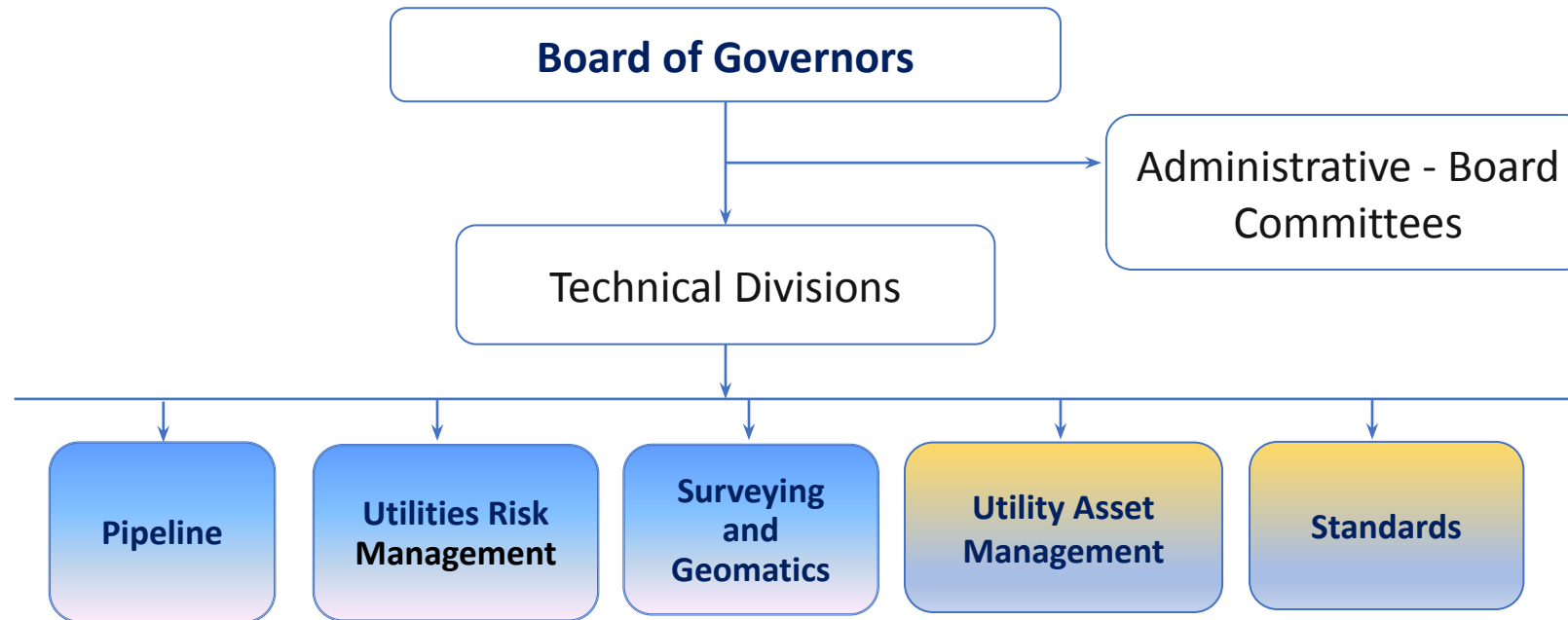
*"Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering," Purdue University*



- UESI is the newest Institute, starting in October 2015
- The Institute focuses on two separate but related aspects of civil engineering practice: Utility Engineering and Surveying
- We have defined Utility Engineering and Engineering Surveying and placed these definitions in the Strategic Plan and on the UESI website.
- The Survey aspect of the Institute is not limited to utilities. It is focused on all aspects of Engineering Survey and Geomatics practice.







## PIPELINE DIVISION

- Pipeline Infrastructure Committee
- Lateral Rehabilitation Task Committee
- Pipeline Location & Installation Committee
- Pipeline Planning & Design Committee
- Trenchless Installation of Pipelines Committee

## UTILITY ASSET MANAGEMENT DIVISION

- Campus Asset Management & Utility Mapping Committee
- Energy Infrastructure Asset Management Committee
- Water Infrastructure Asset Management Committee
- Condition Assessment of Gravity Sanitary Sewers

## SURVEYING AND GEOMATICS DIVISION

- SGD Education Committee
- Spatial Data Applications Committee
- Surveying Committee
- Underwater Technologies Committee

## UTILITY RISK MANAGEMENT DIVISION

- Subsurface Utility Engineering & Investigations Committee
- Utility Risk Division Data Management & Security Committee
- Utility Coordination Committee
- Utility Risk Research And Education Council

## STANDARDS DIVISION

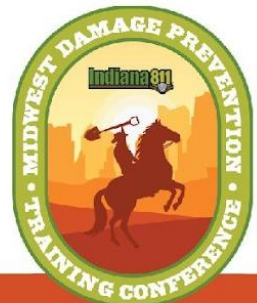
- Direct Design of Buried Concrete Pipe Box Sections Standards
- Utility Data Collection Standards (ASCE 38)



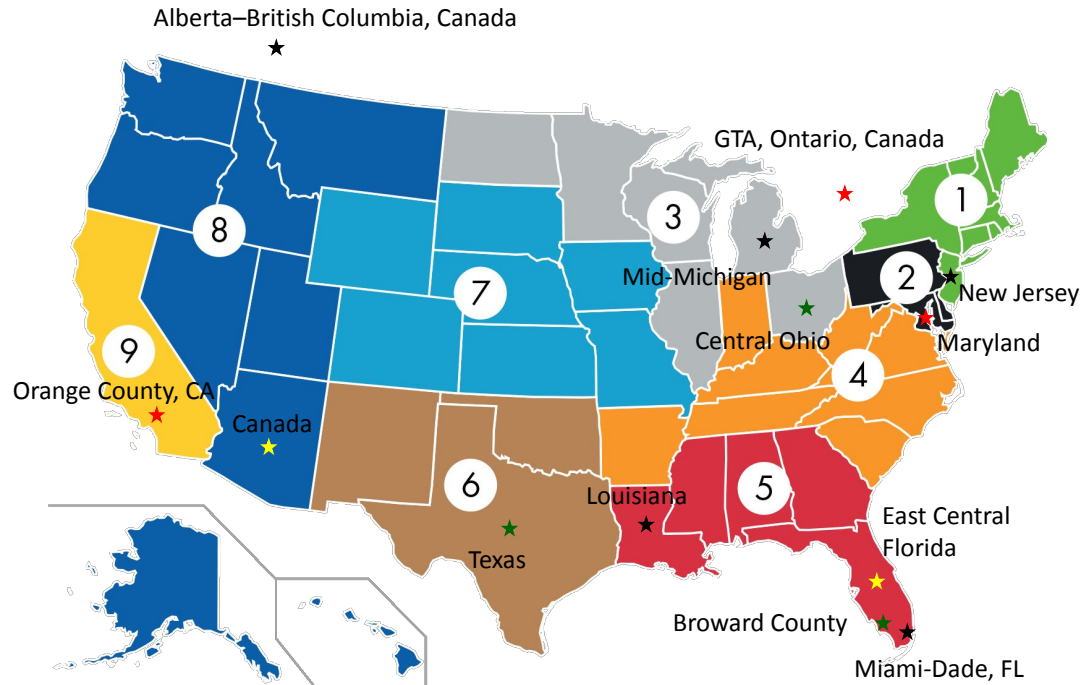


## UESI Pipelines 2023 Conference

San Antonio, Texas | August 12–16, 2023







## Region 2

- ☐ Maryland
- ☐ New Jersey

## Region 3

- ☐ Central Ohio
- ☐ Greater Toronto Area, Ontario, Canada
- ☐ Mid-Michigan (Jackson/Lansing)

## Region 5

- ☐ Broward County, FL
- ☐ East Central Florida
- ☐ Miami-Dade, FL
- ☐ Louisiana

## Region 6

- ☐ Texas

## Region 9

- ☐ Orange County, CA

## Region 8

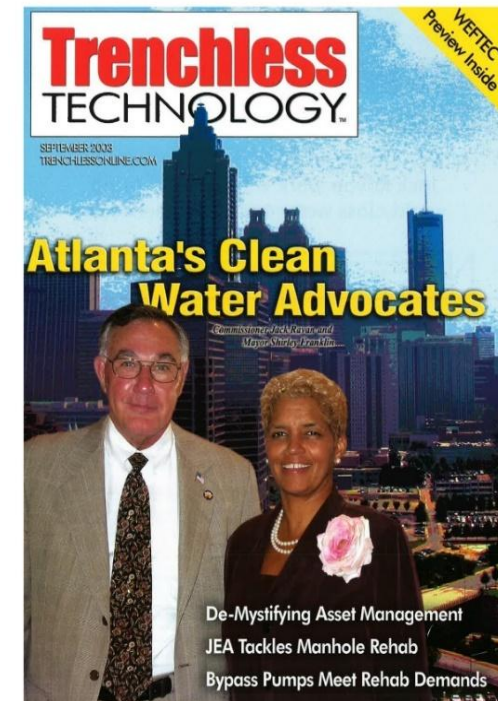
- ☐ Alberta-British Columbia, Canada
- ☐ Arizona, AZ





In 2003, formed in Atlanta's Department of Watershed Management as a result of inspiration & leadership by Mayor Shirley Franklin & Commissioner Jack Ravan.

In June 2004, formed as non-profit organization. Serves to provide a center of excellence for owners of underground water infrastructure to join with industry and researchers:



# ***BAMI-I Operation Committees***

- **Pipeline Condition Assessment (PCA)**
- **Utility Investigation (UI)**

**SCOPE:** Establishing a risk-based utility locating program utilizing ASCE 38-22 to develop an accurate inventory and mapping system to comply with an asset management plan

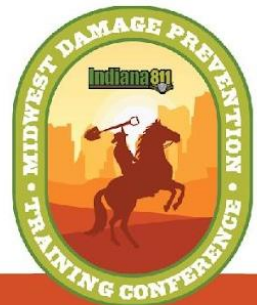
- **Financial Management (FM)**
- **Trenchless Technology (TT)**
- **Education and Research (R&E)**
- **TT- Renewable Energy Infrastructure (TT-REI)**
- **Oil and Gas(O&G)**





# *13th BAMI-I/UESI/Caltrans Utility Investigation School (UIS)*

## *– San Diego, CA.*



# *The 13<sup>th</sup> BAMI-I/UESI Utility Investigation School*

*September 19-23, 2022*

*San Diego, CA*

Platinum Sponsors:



***The 14<sup>th</sup> BAMI-I/UESI Utility Investigation School***  
***14-18, 2022***  
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## ***The 14<sup>th</sup> Utility Investigations School (UIS)***

**November 14-18, 2022, Sacramento, California**

## ***The 15<sup>th</sup> Utility Investigations School (UIS)***

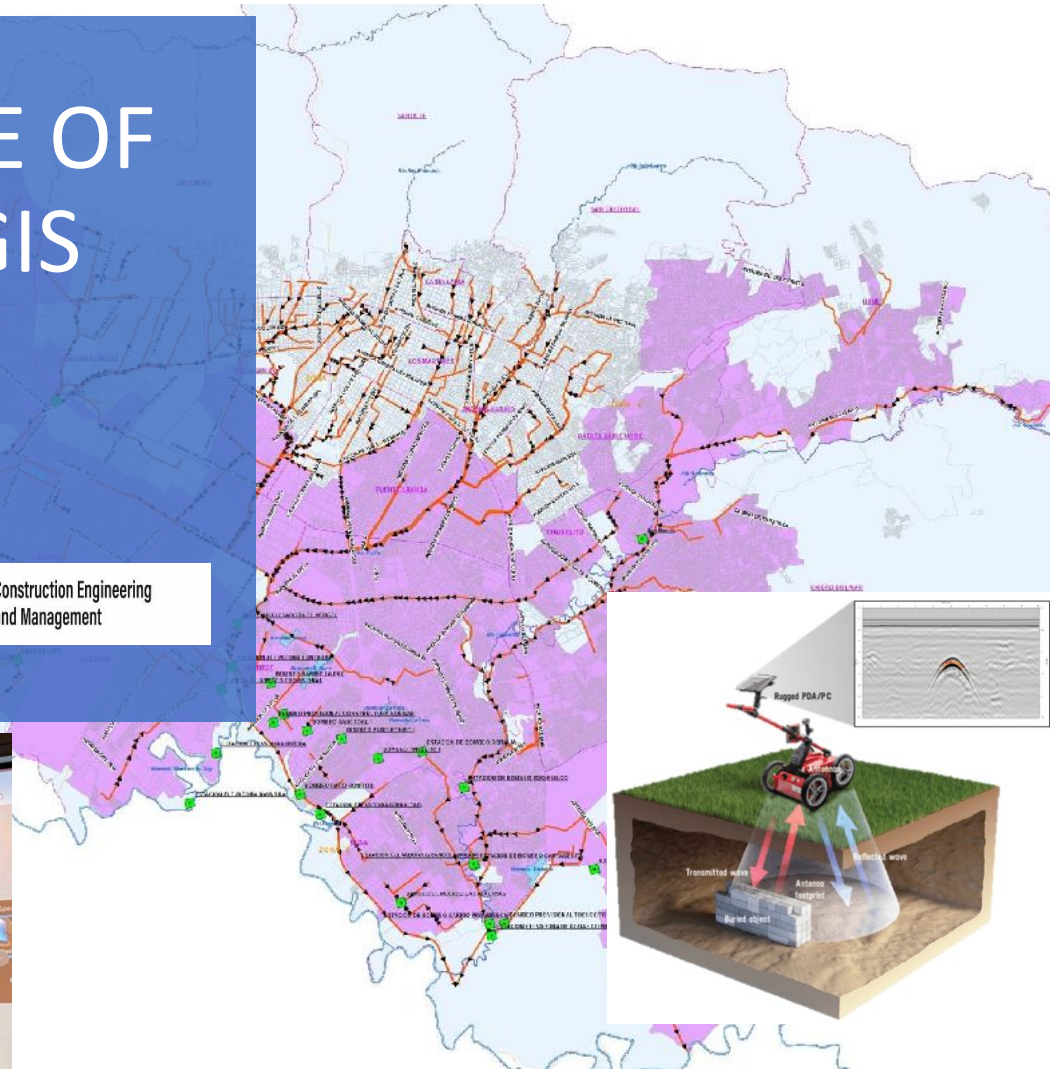
**DEC 12-15, 2021, Colorado School of Mine**



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Thanks for your attention!

Questions?



**Contact information**

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## CEU & SCHOLARSHIP ATTENDEES:

Attendees who would like to receive CEU credit or who are scholarship recipients, please scan the QR code OR visit the link below and fill out the online form.

<https://www.midwest811conference.com/dr-tom-iseley>

