MAPPING THE INVISIBLE: A JOURNEY THROUGH SUE

June 2025

CEC®

SUBSURFACE UTILITY ENGINEERING (SUE)

- What is SUE?
- Why SUE is different than One-Call?
- SUE in design
- Cost/benefits
- Deliverables

SUE SPECIFICATIONS

ASCE 38-22 defines Subsurface Utility Engineering (SUE) as a branch of civil engineering that includes the investigation, analysis, judgment, and documentation of existing Utility networks.

QUALITY LEVEL-D

Utility Records Research

- Derived from as-built's & existing utility records
- Provides overall feel for the congestion of utilities
- Limited in terms of accuracy and comprehensiveness
- Useful in planning and route selection
- Lowest level of accuracy
- Highest degree of risk

QUALITY LEVEL-C

Surface Evident Utility Appurtenance Survey

- Survey of visible above-ground utility features / appurtenances i.e. manholes, valve boxes, water valves, fire hydrants
- Correlates available utility records to surveyed features
- Identifies discrepancies between utility records & surveyed features for further investigation
- Moderate degree of risk

QUALITY LEVEL-B

Utility Designation, Survey, & Mapping

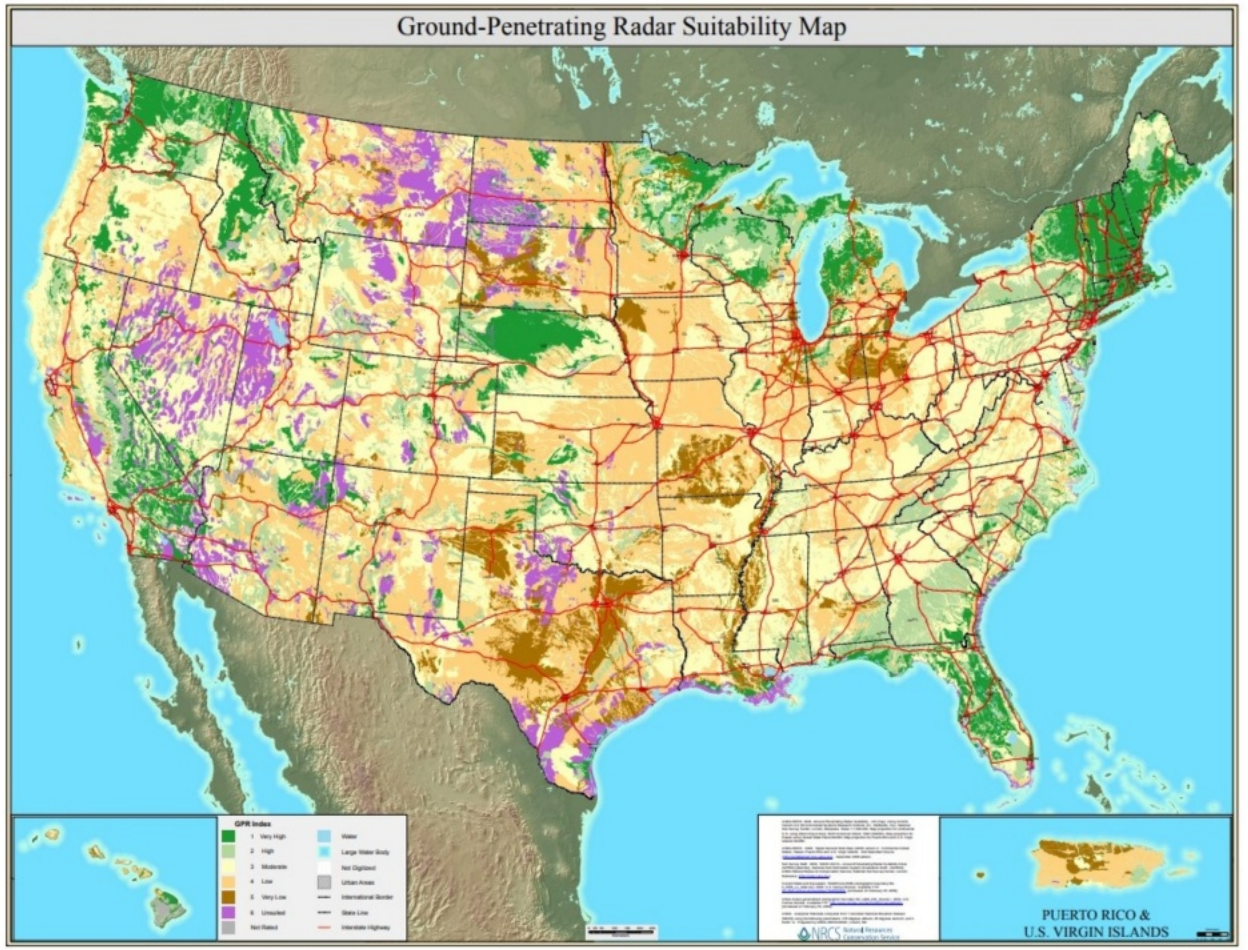
- Horizontal location of Utility is designated, surveyed & mapped
- Electronic (approximate) depth information
- QL-B Data used to rectify QL-C/D efforts
- Allows designers to adjust early in design process to avoid conflicts with existing utilities
- Most used
- Lower degree of risk

QUALITY LEVEL-B: METHODS

Primary method is electromagnetic location

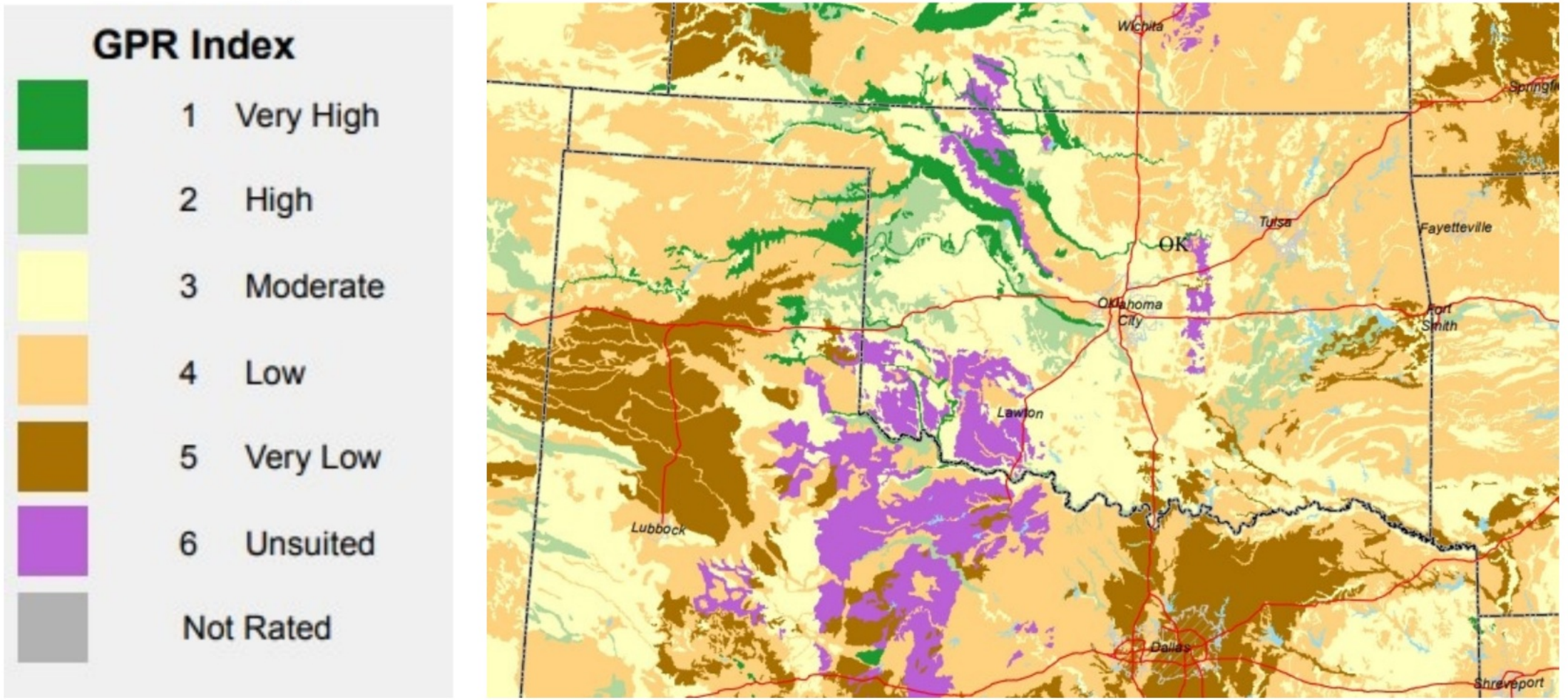
QUALITY LEVEL-B: METHODS

Ground penetrating radar



QUALITY LEVEL-B: METHODS

Ground penetrating radar



QUALITY LEVEL-B: LIMITATIONS

- Water
  - Lines often not conductive
- Tracer wires
  - May not be present/intact

QUALITY LEVEL-A

Utility Test Hole Excavation

- Vacuum excavation methods provide non-destructive exposure of any utilities in question
- Provides precise horizontal and vertical location for plan and profile mapping
- Documents size, material composition, and condition of the facility
- Lowest degree of risk
- Highest level of accuracy

WHY IS SUE DIFFERENT THAN ONE-CALL?

ONE-CALL

- Not a professional service
  - Limited training & oversight
  - Marks placed by low-bid contractor
- Only member utilities respond
- Loose tolerances

VS

SUE

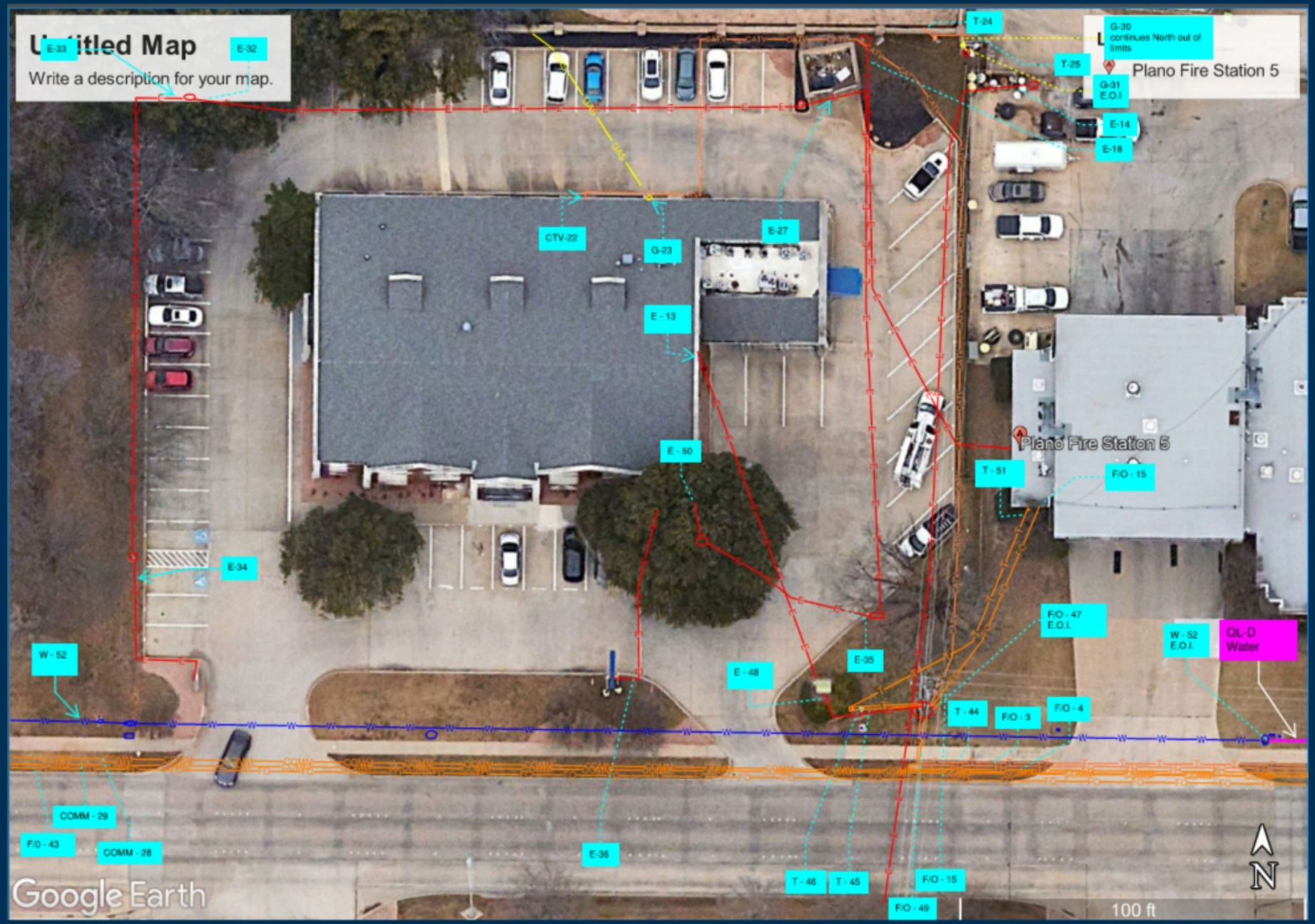
- Professional services
  - P.E. oversight
  - Incentivized to provide best product
- All utilities located
  - Private utilities included
  - Can search for unknowns
- Tighter tolerances
- Marks surveyed

DAMAGE PREVENTION

- Orlando, FL – April 12, 2016
- Construction crew rips through 30-in waterline
- 50 customers affected
- Everyone at all 14 downtown Orange County facilities — including judges, lawyers and felons at the courthouse — to stop drinking tap water

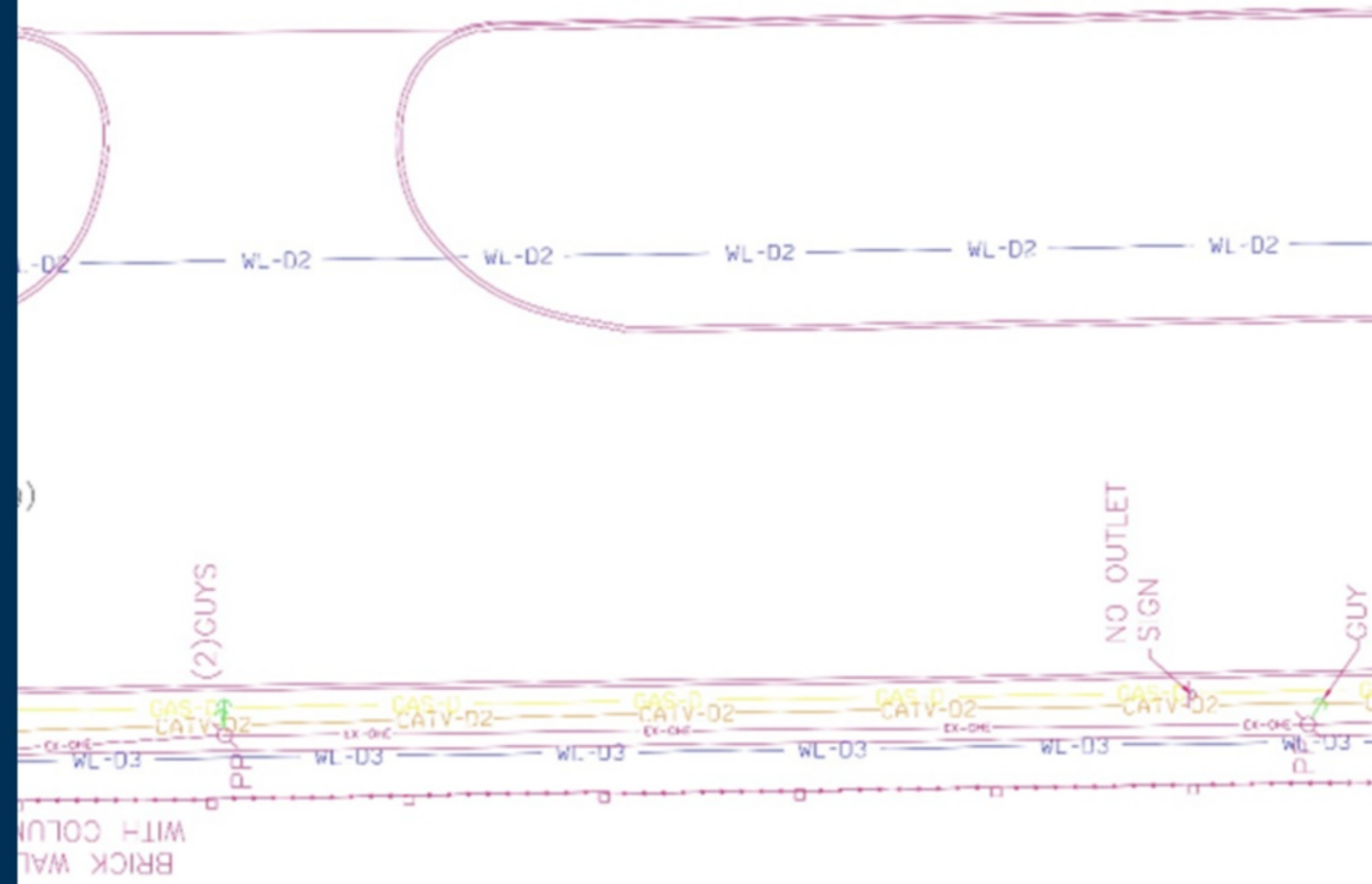
DAMAGE PREVENTION: CLOSER TO HOME

- Street & Sidewalk improvements in front of the former Vanessa House Brewery in OKC
- OKC instructed designers to use their record information for water lines known to be approx 4 ft. deep
- Water lines encountered closer to 4 in. deep during excavation, just below sidewalk
- Project delayed during redesign process
- VHB sued OKC for lost income due to delay, CEC participated
- Actually a very small lawsuit, but 2 test holes could have been dug to verify line for <10% of the settlement


Untitled Map
Write a description for your map.
E-33
E-32
T-24
G-30 continues North out of limits
T-25
Plano Fire Station 5
G-31 E.O.I
E-14
E-18
CTV-22
G-23
E-27
E - 13
E - 50
Plano Fire Station 5
T - 51
F/O - 15
E-34
F/O - 47 E.O.I.
W - 52 E.O.I.
QL-D Water
W - 52
E - 48
E-35
T - 44
F/O - 3
F/O - 4
COMM - 29
F/O - 43
COMM - 28
E-36
T - 46
T - 45
F/O - 15
F/O - 49
Google Earth
100 ft
N

HOW TO BEST UTILIZE SUE

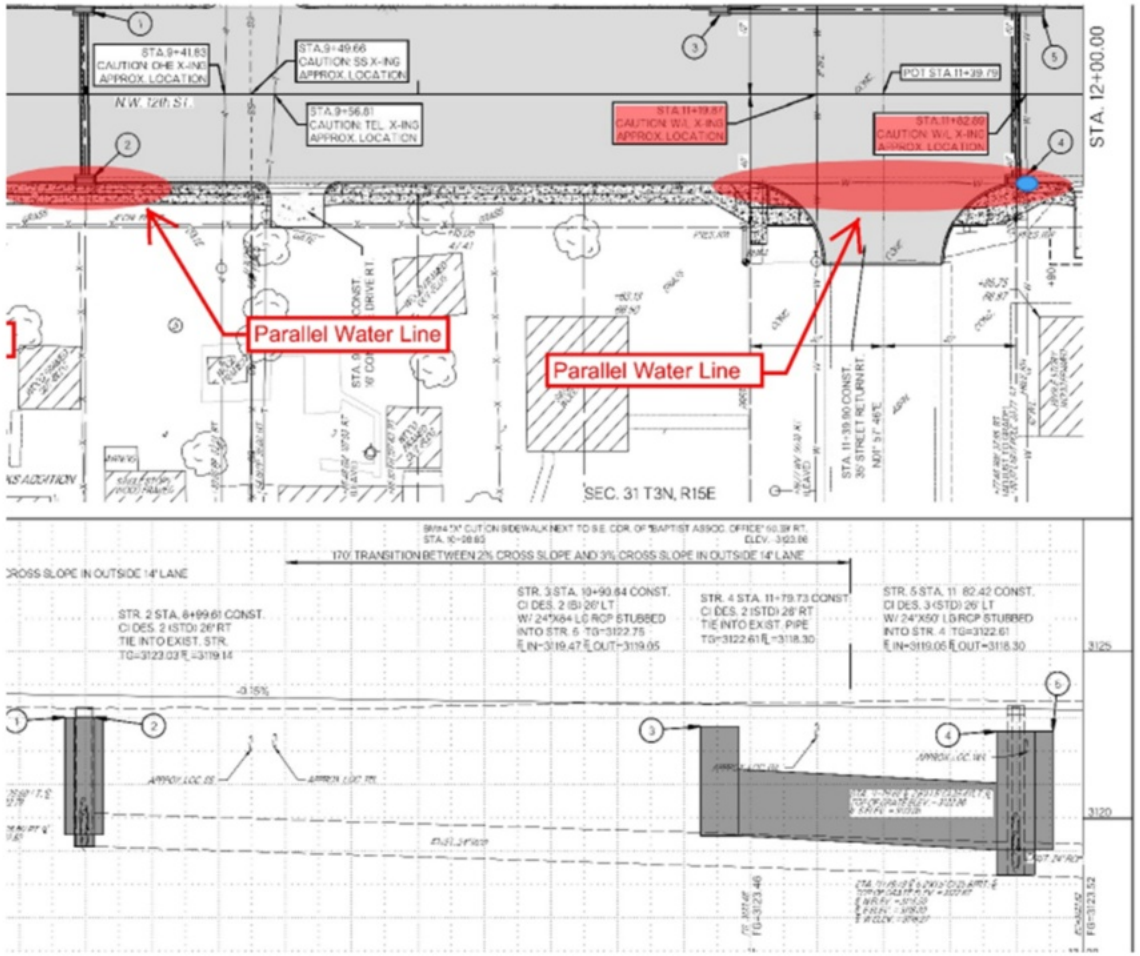
- Preliminary design
  - Route studies
  - Planning
- PS&E design
  - 30 – 60 – 90
- Information to avoid utilities & revise design



HOW TO BEST UTILIZE SUE

Reducing Costs

- Only perform SUE at critical locations
- Utilize QL D/QL C for route evaluation
- Use test holes to investigate conflict points

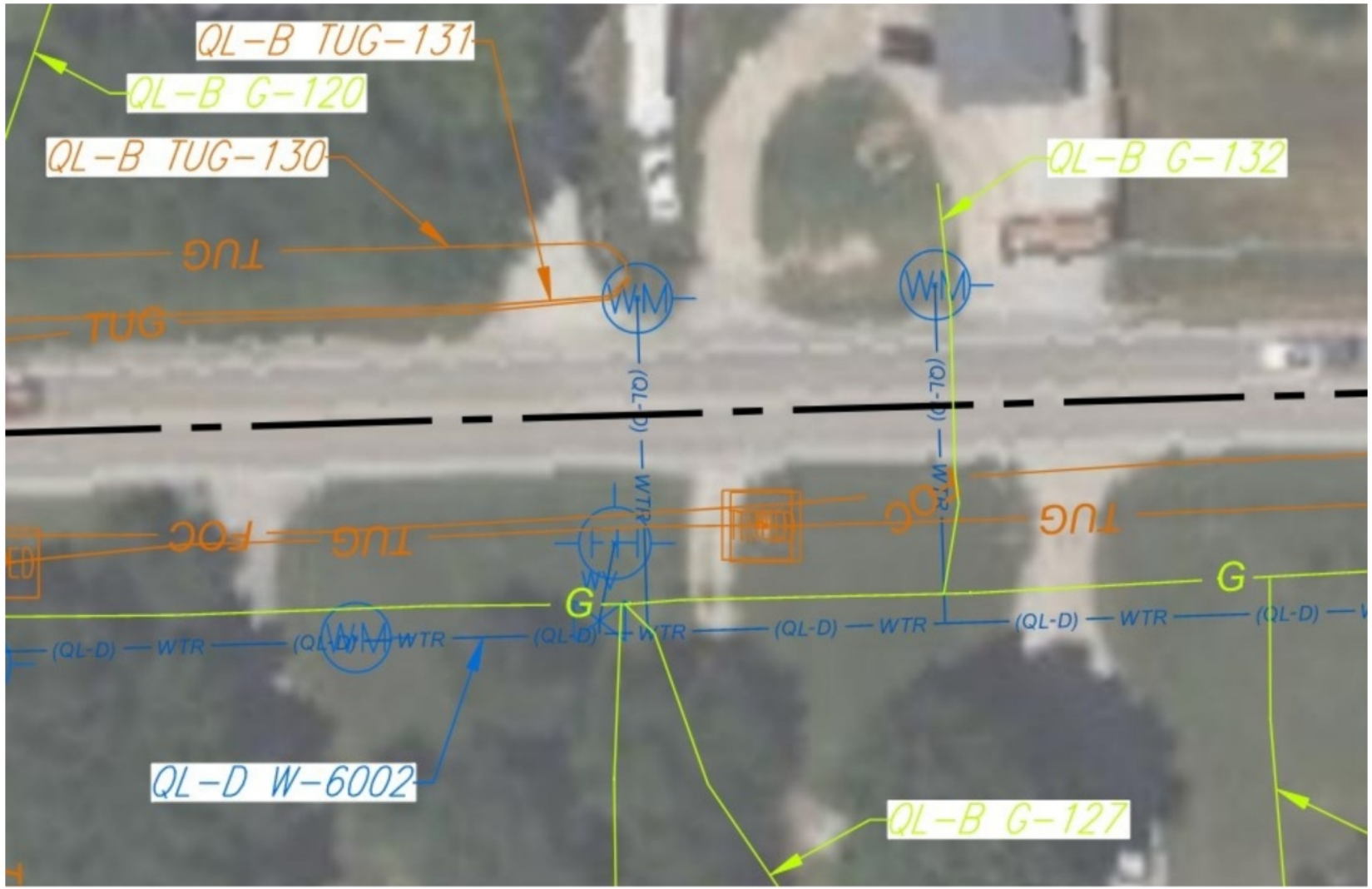


COST / BENEFIT

- 1999 study performed at Purdue University for FHWA
  - Studied 71 projects of various types across 4 states
- Cost savings is historically 5x the cost to perform SUE services
- Cost savings greater today?
- Think like a program manager, not a project manager

QLB DELIVERABLES

QLB DELIVERABLES

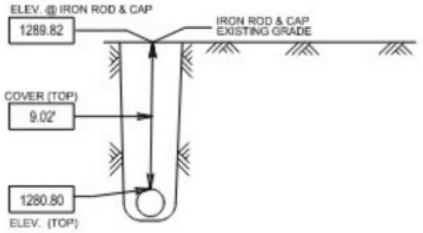


QLA DELIVERABLES

PRE-DIG TH #25

BACK FILL TH #25

ADDITIONAL TEST HOLE PHOTOS



UTILITY CROSS-SECTION VIEW
NTS

COMMENTS

LEGEND

UTILITY DESCRIPTION

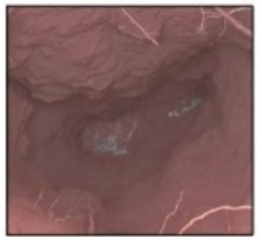
UTILITY LOCATION

UTILITY PROFILE

PROJECT CONTROL:

CONTROL POINTS

CP #1	N:703291.41	E:2050952.10	ELV:1315.28
CP #2	N:706520.56	E:2050935.55	ELV:1307.34
CP #3	N:698885.90	E:2050894.15	ELV:1311.76
CP #4	N:696919.00	E:2050971.30	ELV:1311.83



DOWN HOLE PHOTO OF UTILITY
DATE: 04-03-2024

PHOTO OF DEPTH INFORMATION
DATE: 04-03-2024

LOCATION MAP
NOT TO SCALE

LOCATION: SH-4
GRADY, OKLAHOMA

UTILITY STATION/OFFSET:	N/A
HORIZONTAL DATUM:	OK83-SF
SURFACE ADJUSTMENT FACTOR:	N/A
VERTICAL DATUM:	N/A
TEST HOLE NO.: 25	POINT NUMBER: 150008
NORTHING: 706951.82	EASTING: 2050877.13
GROUND ELEVATION: 1289.82	DEPTH OF UTILITY: 9.02
FIELD MANAGER:	PALMER/POLLOCK
DATE OF WORK:	04-03-2024
VACUUM TYPE:	AIR EXCAVATION
DESCRIPTION:	16" STEEL GAS LINE - ONEOK
UTILITY OWNER:	ONEOK
UTILITY TYPE:	GAS
UTILITY SIZE: 16"	T.O.U. 1280.80
UTILITY MATERIAL:	STEEL
UTILITY CONDITION:	GOOD
SURFACE MATERIAL:	NATURAL GROUND
PAVEMENT TYPE/DEPTH:	N/A

CEC
4555 W. MEMORIAL RD.
OKC, OK 73142
TX FIRM #13735

LICENSED PROFESSIONAL ENGINEER
AARON FINLEY
24264
OKLAHOMA

05/15/2024

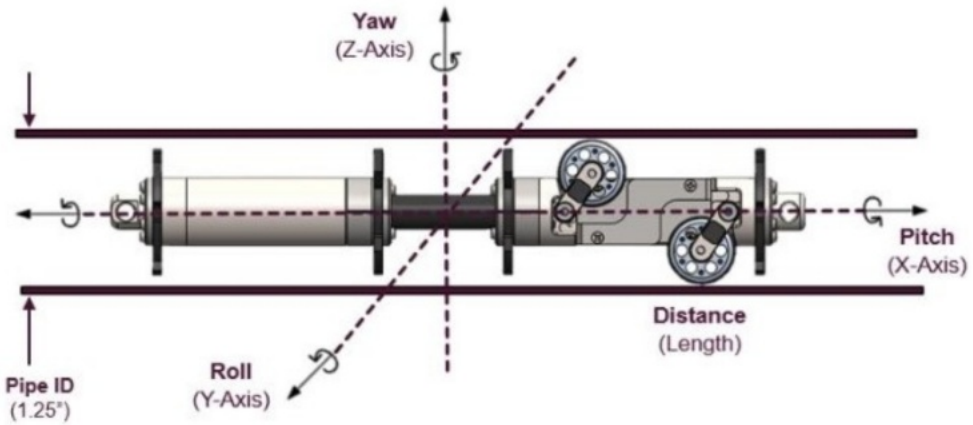
TEST HOLE DATA FORM
SUE: QUALITY LEVEL - A
PROJECT: ODOT - GRADY
SH-4 QL-A: RIGHT-OF-WAY TESTHOLES

PROJECT MANAGER	STATE	DISTRICT	COUNTY	SHEET NO
AARON FINLEY, PE	OKLAHOMA		GRADY	19

EMERGING TECHNOLOGY

TECHNOLOGY OVERVIEW – INERTIAL MEASURING UNIT

- IMUs measures angular acceleration/rate of change in position of an object, relative to a local inertial reference frame
- IMUs determine an object's orientation within 3D space about three axes:
  - Pitch (X-axis),
  - Roll (Y-axis),
  - Yaw (Z-axis)
- Ultra-high accurate and precision IMUs provide low drift and low bias instability



* IMUs with sampling rate 1000 Hz (1 kHz) provides a higher resolution for detecting rapid changes in motion

EMERGING TECHNOLOGY

IMU GYRO MAPPING - BENEFITS

Any Pipeline Material

- Metallic
- Non-Metallic

Electrical Power
Conduits

Telecom & Fiber
Ducts

Natural Gas & Oil
Pipelines

Sewer & Drain
Segments

Drinking Water
Main lines

Any Utility

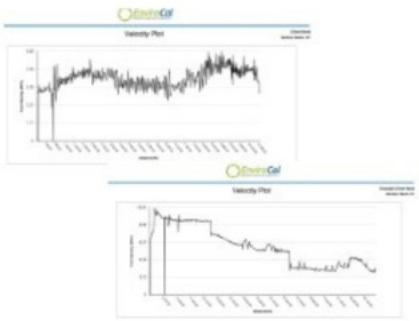
- Underground Utilities (All)

Any Depth

- 100' & below
- River Crossings

No Tracing Required

- No Electromagnetic Noise
- No Traffic Disruptions
- No Satellite reception
- No Impact of Soli Conditions



High Frequency Data

- High Sample Rate
- Autonomous Tool

EnviroCal Pipeline Inspection Solutions GEOCal Utility Mapping Services

QUESTIONS?

Aaron Finley, P.E.
SUE Department Manager
aaron.finley@connectcec.com
405.753.4200