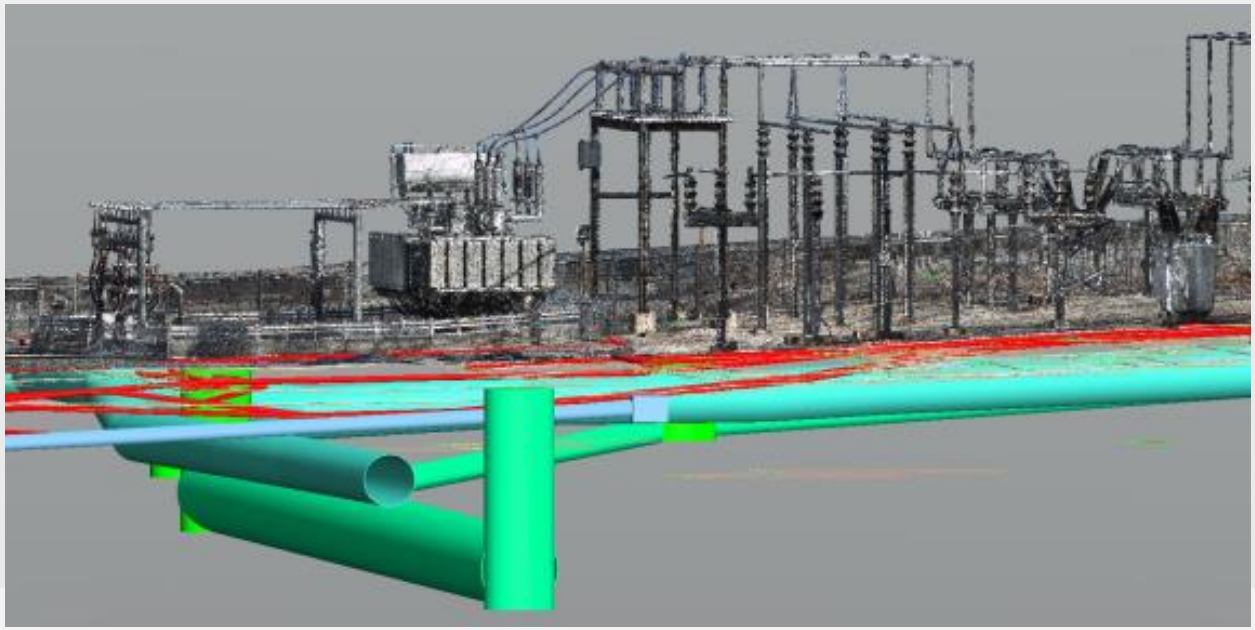
Utility Engineering Best Practices Using ASCE 38

Andrew Sylvest
Utility Engineering Operations Manager
SAM Family of Companies
May 18, 2018



Ever have a utility problem?

Underground Utilities

- 50+ million miles of underground utilities exist in the U.S.
- Existing utilities are at varied depths, in varied soils, made of different materials, are varied sizes and have varied access.
- More utilities are being installed daily, deeper and with less detectable materials.
- No one entity in control; hodgepodge of laws, policies, attitudes

Underground Utilities

- Oil/Gas Pipeline
- Water
- Sanitary Sewer
- Storm Drain (normally not considered a utility)
- Telephone
- Fiber Optic Cable
- Electric Transmission
- Electric Distribution
- Gas Distribution
- Cable TV
- ITS Systems
- Traffic Control
- Others

It’s Easy If You Can See The Lines

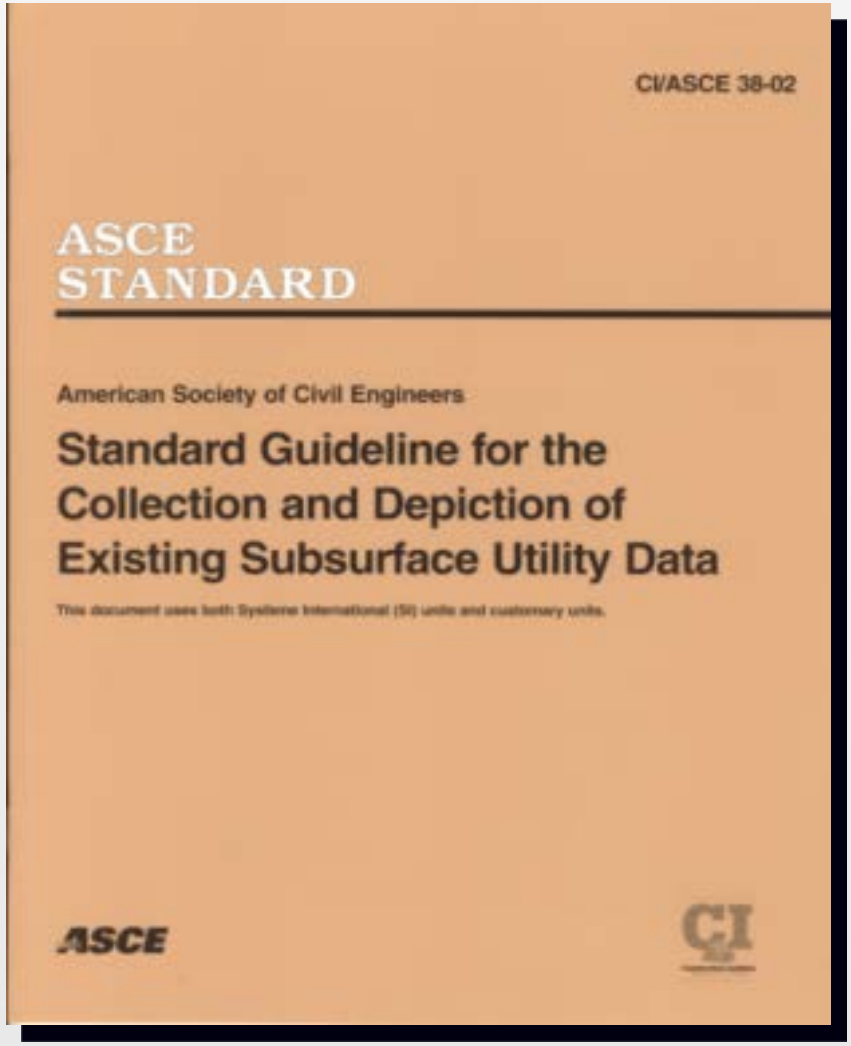
How do people map utilities?

- Record Data
  - Incorrect, Missing, Never Made
- One Call/ Private Locating Contractors
  - Incorrectly Marked, Do Not Participate, Abandoned Utilities Not Marked
- Exploratory Potholing
  - Nothing In The Hole, Where Does It Go Between Holes?
- Survey What You Can See
  - How Does It Connect Below Ground?

National Standard

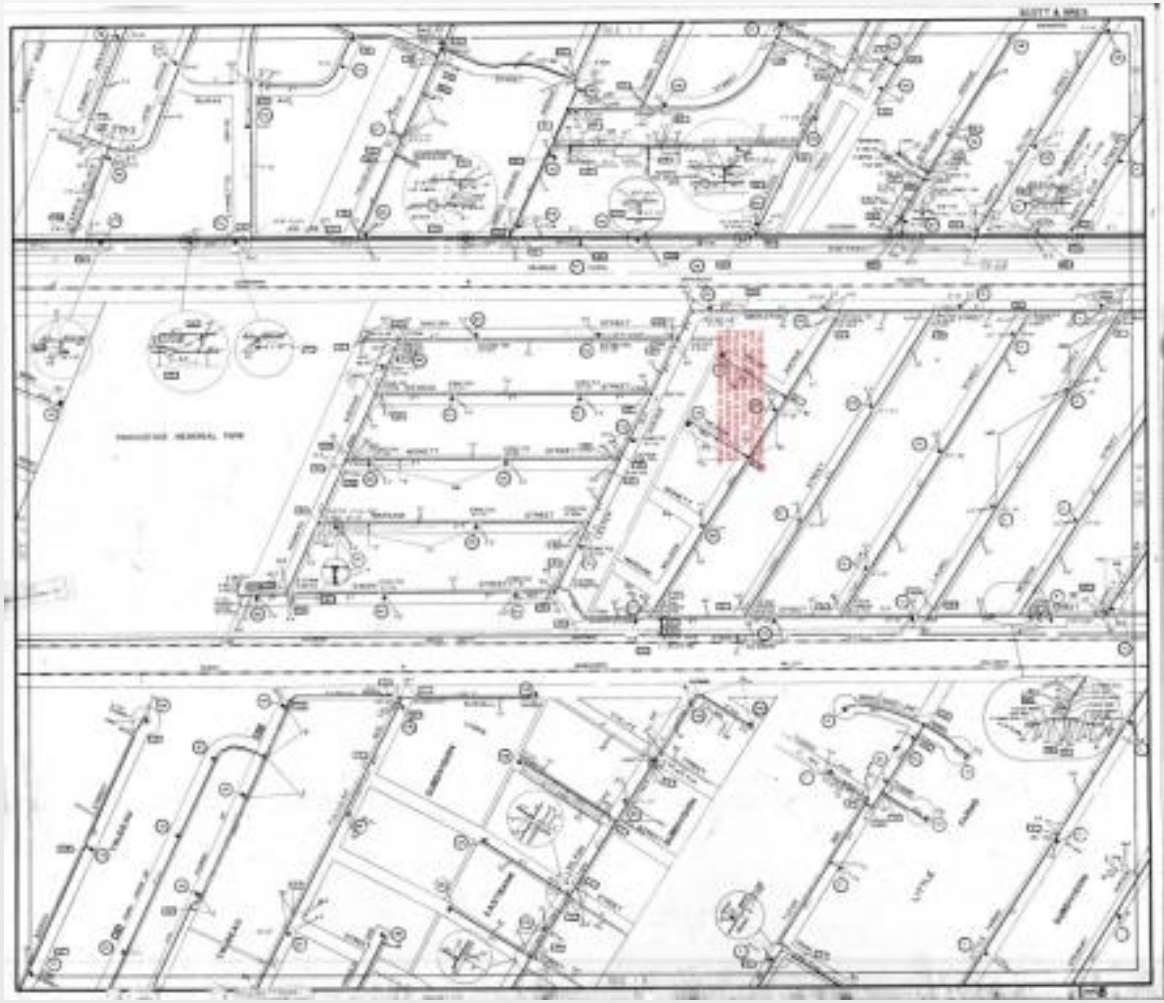
D, C, B, A

Least Accurate → **Most Accurate**

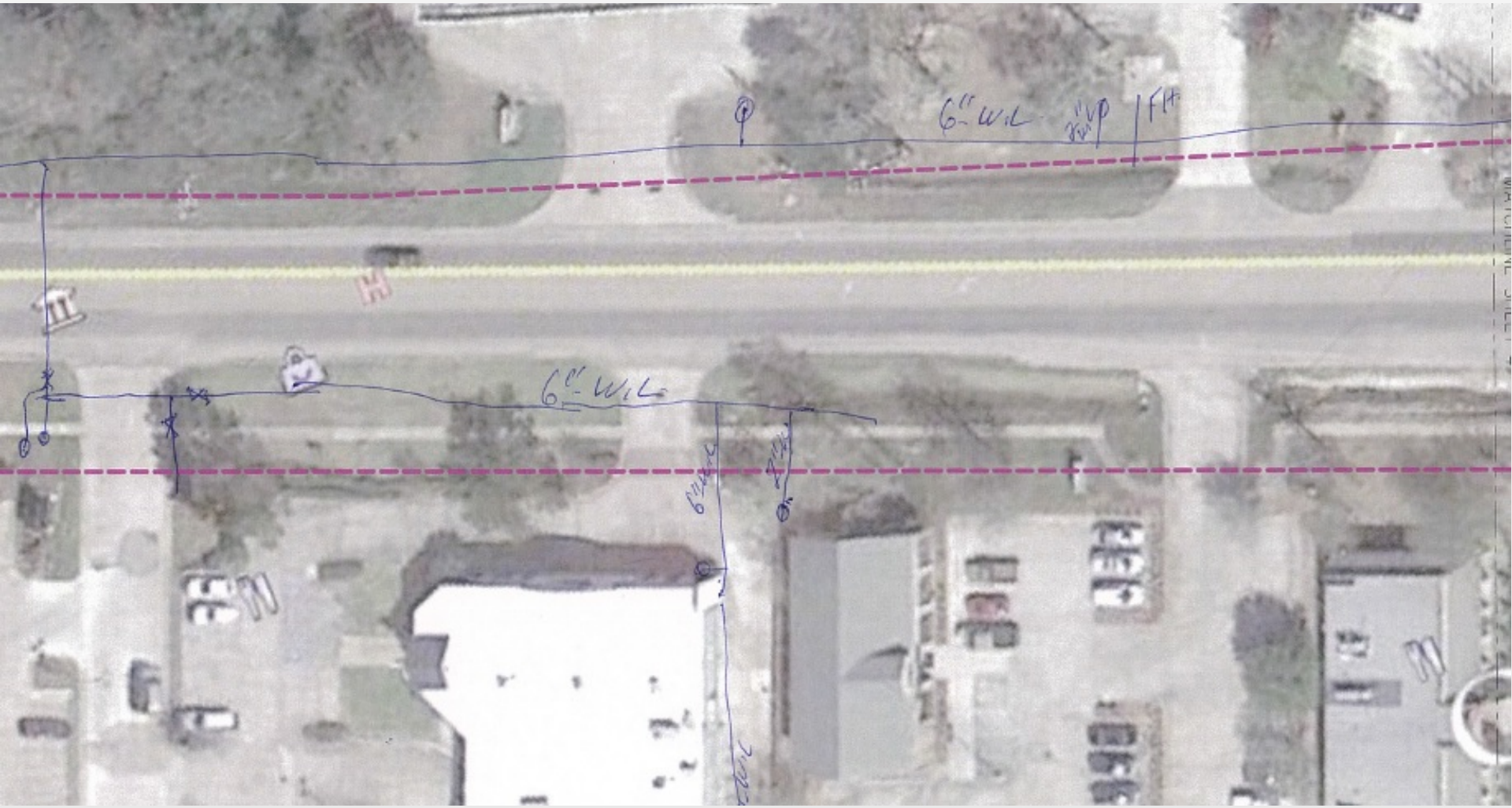


ASCE Standard 38-02 Quality Level “D”

- As-Built records
- Utility system drawings
- One-Call Marks
- Oral recollections



ASCE Quality Level D – “Record Research”



ASCE Standard 38-02 Quality Level “C”

Surveying visible, above ground, surface features such as:

- Valves
- Fire hydrants
- Pull boxes
- Manholes
- Telephone pedestals

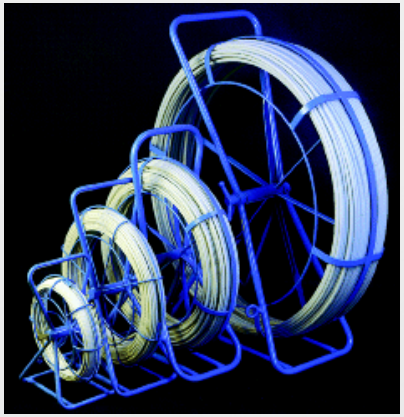
Reconciled to ASCE Quality Level D records

ASCE Standard 38-02 Quality Level “B”

Surface geophysical methods to designate, or mark, the ***approximate*** horizontal position of subsurface utilities, with subsequent survey, professional judgment, and depiction

Surface Geophysical Equipment

- Electromagnetic Methods
- Rodders & Sondes
- Elastic Wave/Acoustic
- CCTV
- Laser Scanning (LiDAR)
- Ground Penetrating Radar (GPR)
- Advanced Geophysics
  - Multi channel GPR (STREAM)
  - EM 31/61



One Call vs. Quality Level B

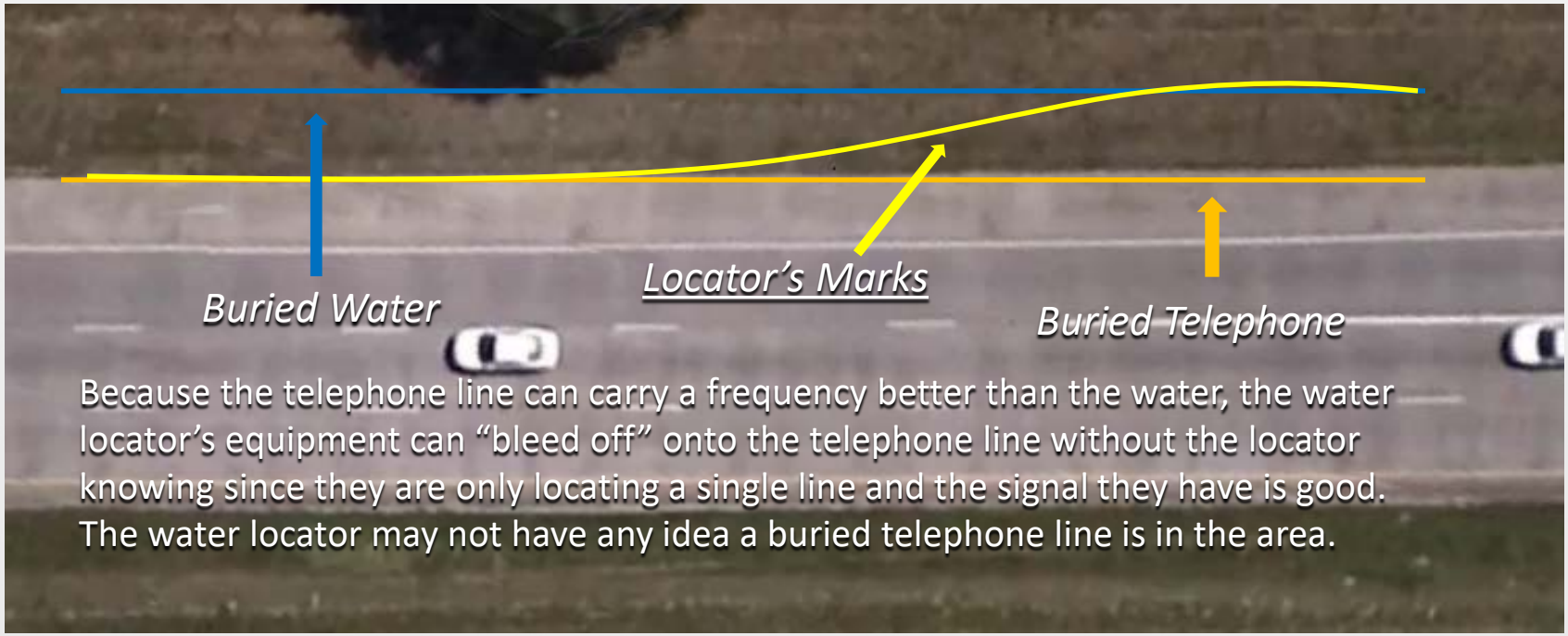
NCHRP SYNTHESIS 405

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

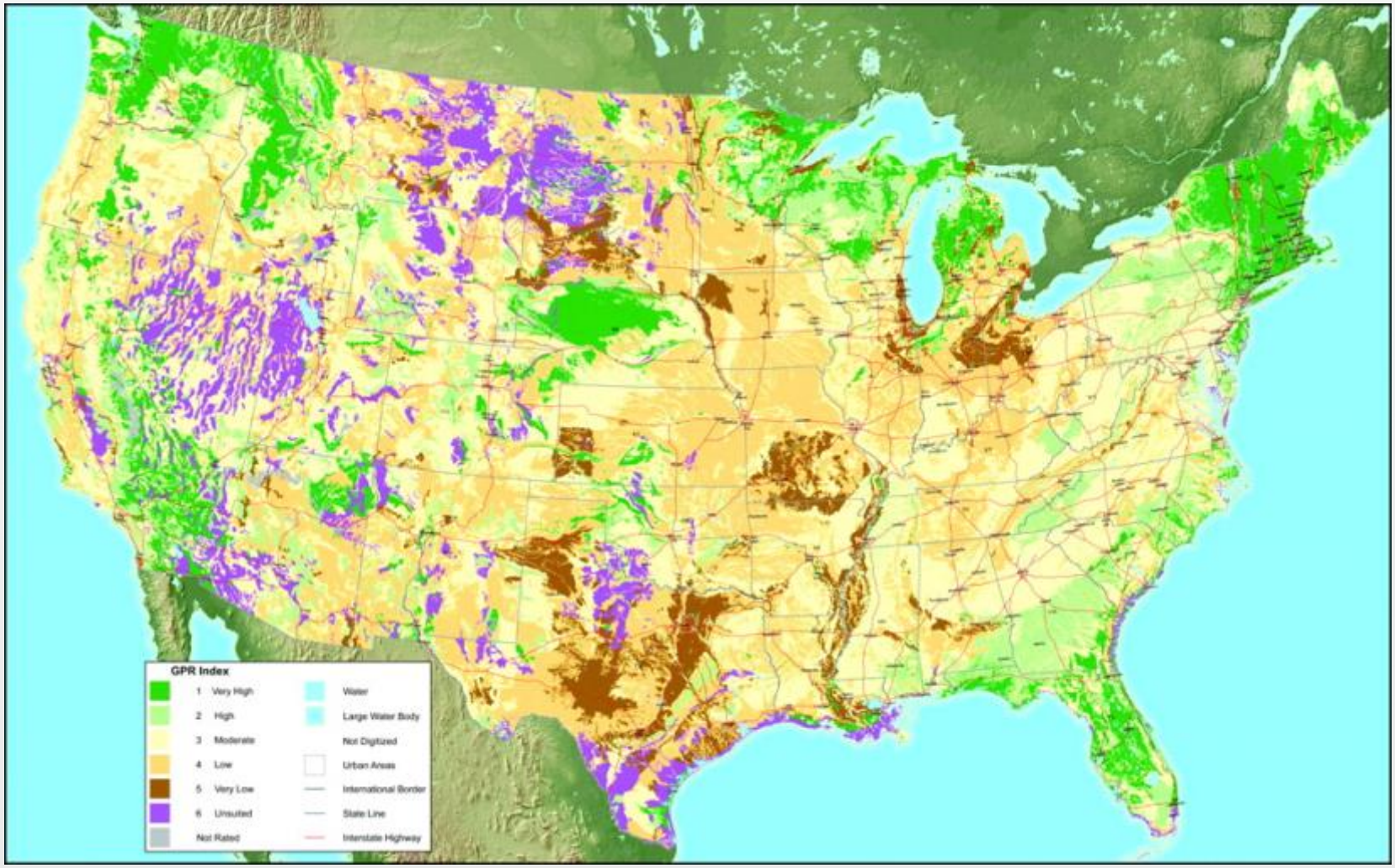
- Designator: Possesses or at least has requested all available utility owners' records
- Locator: Possess only those records for the utility owner for which he/she is under contract
- Designator: Finds and marks all utilities capable of being found
- Locator: Only marks some utilities – doesn't have advantage of seeing all parts of the puzzle. For instance, abandoned utilities, unknown utilities, multiple non-encased wires, etc. cause identification confusion

- Designator: Has many pieces of equipment on-site or readily available
- Locator: Has limited equipment available
- Designator: Maps a large area, allowing better familiarization with utilities at a site
- Locator: Usually only responsible for a very small area, making it difficult to see the large picture
- Designator: Has a realistic time frame for finding and marking utilities
- Locator: Is under severe time constraints for getting utilities marked

What happens when you are only marking one specific Utility?



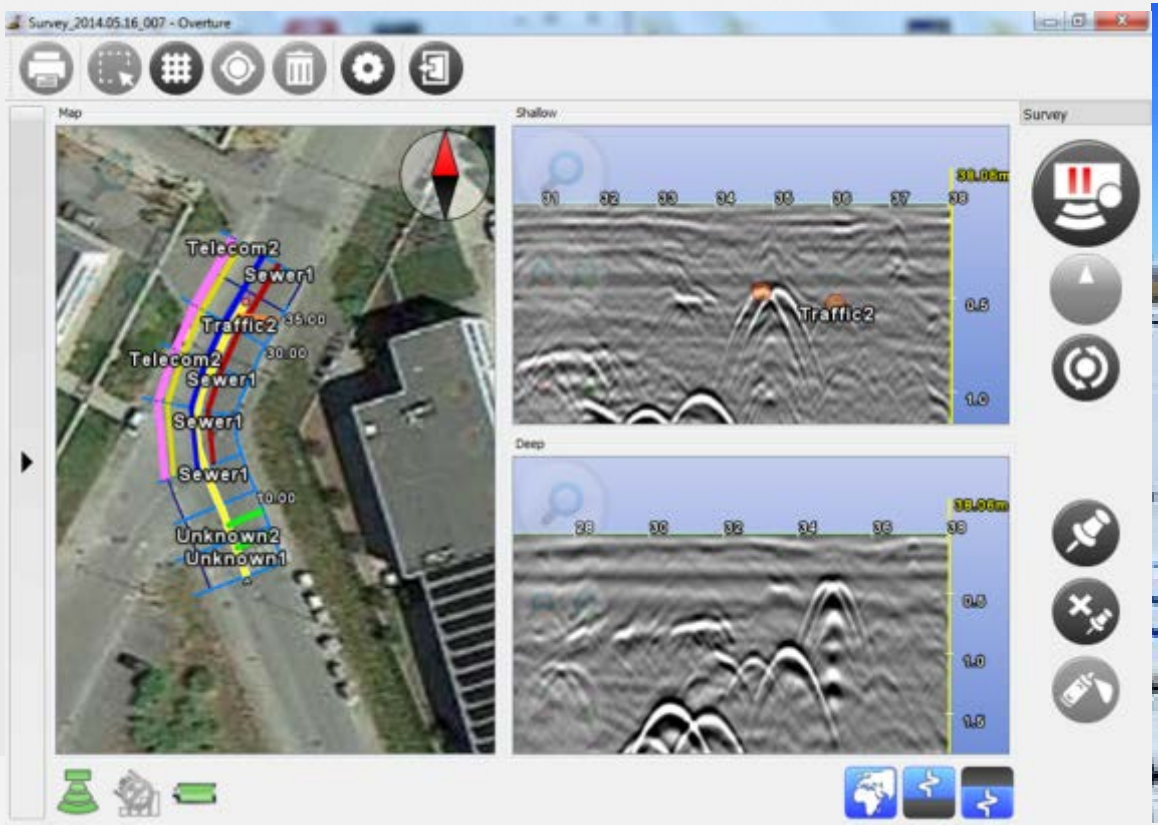
Does GPR Work?



Missouri GPR Soil Suitability

Ground Penetrating Radar (GPR)

- NAS R-01: Using only GPR would be considered negligent in most cases
- FDOT: 45% of utilities imaged with GPR (great soils)



ASCE Standard 38-02
Quality Level "A" Locating (Test Hole)

Using non-destructive excavating equipment at critical points to determine the ***precise*** horizontal and vertical position, type, size, condition, material and other characteristics of underground utilities

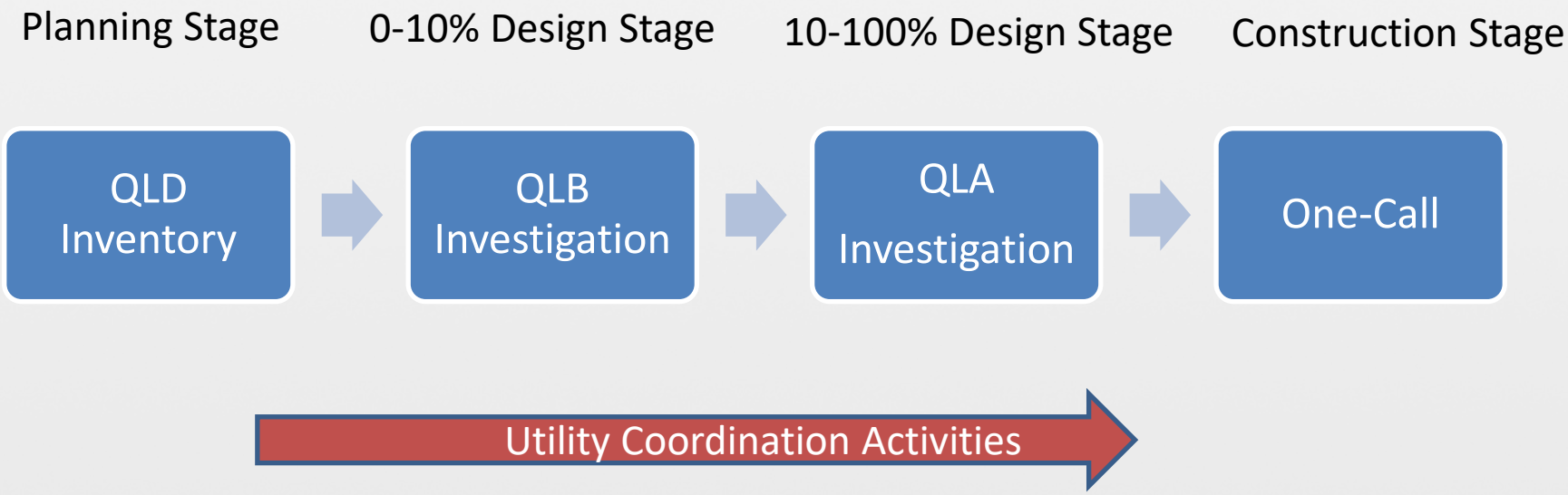
Quality Level "A" Documentation

Utility Type:	Utility Material:	Owners:	Identified By:
E-Electrical G-Gas Line BT- Buried Telephone FOC-Fiber Optic Cable W- Water SAN-Sanitary Sewer STM-Storm Sewer CATV-Cable TV FM-Force Main RW-Redaimed Water SL-Street Light TS-Traffic Signal CWR-Chilled Water FL-Fuel Line UNK-Unknown Utility	1- Steel 2- PVC (Polyvinyl Chloride) 3- DIP (Ductile Iron Pipe) 4- VCP (Vitrified Clay Pipe) 5- PE (Polyethylene Pipe) 6- AC (Transite) 7- CI (Cast Iron) 8- DBC(Direct Buried Cable) 9- Concrete Pipe 10- Corrugated Metal Pipe 11- Duct 12- Concrete Duct Bank 13- Fiberglass 14- Rubber Flex 15- PCCP (Prestressed Concrete Cylinder Pipe)	SJP-St. John The Baptist Parish SHELL - Shell ATT - AT&T UNK - Unknown **Surface Type:** A- Asphalt C- Concrete NG- Natural Ground	20- Sleeve 21- Hub/Lath 22- Nail/Disk* 23- "X" in Concrete 24- SIRC 5/8"** * Note: 22=Set Nail and Disk Stamped TEST HOLE" ** Note: 24=Set Iron Rod & Cap Stamped" TEST HOLE" 25- _____ 26- _____

Test Hole Date	Test Hole #	Utility Type	Utility Material	Utility Size (Diam.) in. ☒ mm. ☐	Approx Station	Northing	Easting	Elevation of Hub Placed for Survey	Manual Depth (Top) ft. ☒ m. ☐	Elevation at top of utility	Cross Sectional View	Utility Direction	ID'd By	Surface Type	Pavement Thickness	Site Condition	Owner
12/08/14	1	SAN	2	8	107+20	573749.8756	3544091.4408	11.62	4.98	6.64	◯	↕	24	NG	N/A		SJP
12/08/14	2	SAN	2	8	108+70	573884.6428	3544041.7894	11.28	5.22	6.06	◯	↕	24	NG	N/A		SJP
12/08/14	3	W	6	12	103+70	573423.2021	3544188.7692	13.77	5.50	8.27	◯	↕	24	NG	N/A		SJP
12/08/14	4	FM	1	16	103+70	573425.0327	3544172.2570	12.91	1.72	11.19	◯	↕	24	NG	N/A		SJP
12/09/14	5	W	6	12	111+60	574187.9960	3543989.4601	11.27	2.54	8.73	◯	↕	24	NG	N/A		SJP
12/09/14	6	FM	1	16	111+60	574181.6271	3543972.8359	10.51	1.98	8.53	◯	↕	24	NG	N/A		SJP
12/09/14	7	PL	1	12	108+60	573899.7208	3544136.7401	10.74	5.30	5.44	◯	↕	23	C	12"		SHELL
12/09/14	8	W	6	12	115+40	574550.1075	3543904.9963	9.89	3.52	6.37	◯	↕	24	NG	N/A		SJP
12/09/14	9	FM	1	12	115+40	574544.7729	3543888.5856	9.63	1.86	7.77	◯	↕	24	NG	N/A		SJP
12/10/14	10	W	6	12	119+80	574993.7460	3543803.0729	10.08	5.38	4.70	◯	↕	24	NG	N/A		SJP
12/10/14	11	FM	1	12	119+80	574983.3796	3543795.9670	10.05	5.00	5.05	◯	↕	24	C	5"		SJP
12/10/14	12	FOC	8	1	119+86	574994.3167	3543805.2699	9.97	1.83	8.14	◯	↔	24	NG	N/A		ATT
12/11/14	13	SAN	1	12	113+66	574390.2245	3543983.9648	9.50	4.86	4.64	◯	↗	24	NG	N/A		SJP

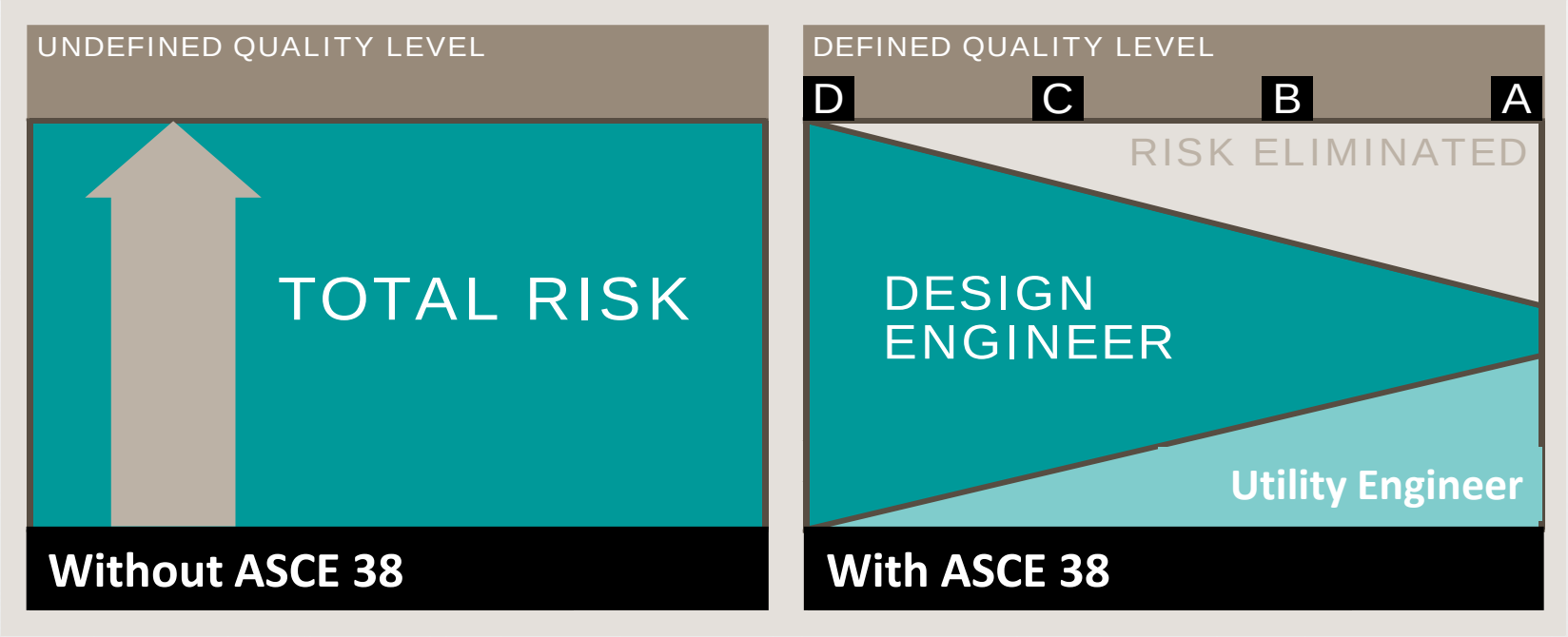
Desired Project Utility Investigation Process

(for "horizontal" projects requiring the design services of a civil engineer)



Project Risk

With and Without ASCE 38

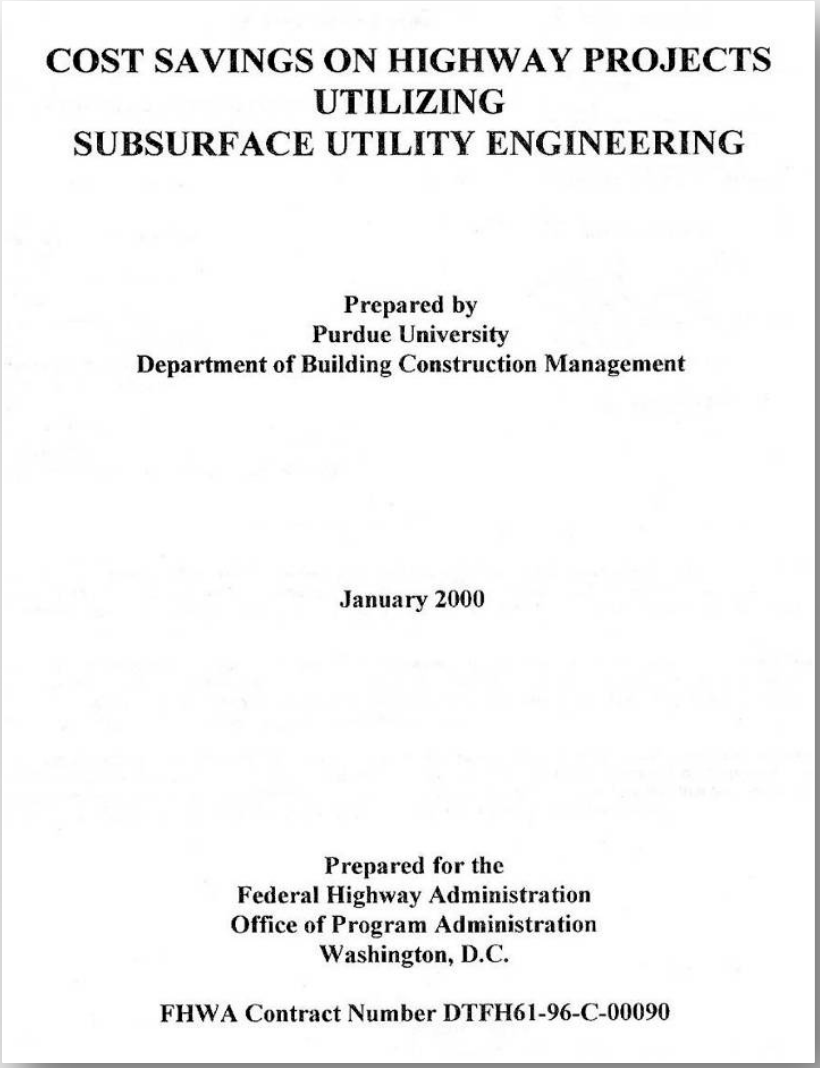


TOTAL ENGINEERING RISK POOL

ALLOCATION OF RISK WITHIN ENGINEERING POOL

Section 7.0 Relative Costs and Benefits

- Cost/Benefit Studies:
  - Purdue University- $4.62 saved per $1 spent
  - University of Toronto- $3.41
  - Penn State- $22.21
- Biggest Savings:
  - Relocations avoided
  - Fewer delay claims
- Best Practice:
  - FHWA
  - AASHTO
  - FAA
  - 39 State DOT's
  - State Law in Colorado and Pennsylvania



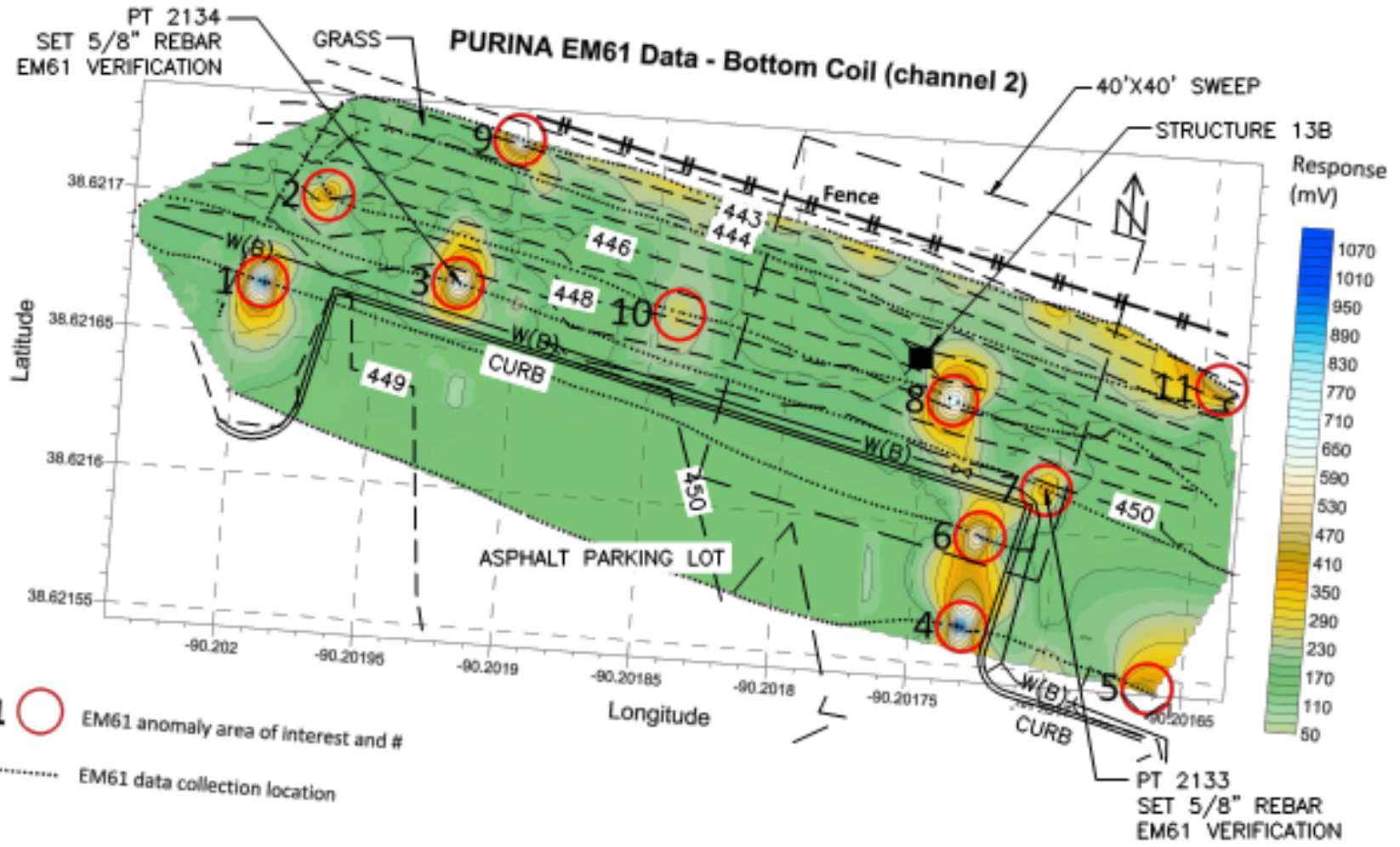
COST SAVINGS ON HIGHWAY PROJECTS
UTILIZING
SUBSURFACE UTILITY ENGINEERING

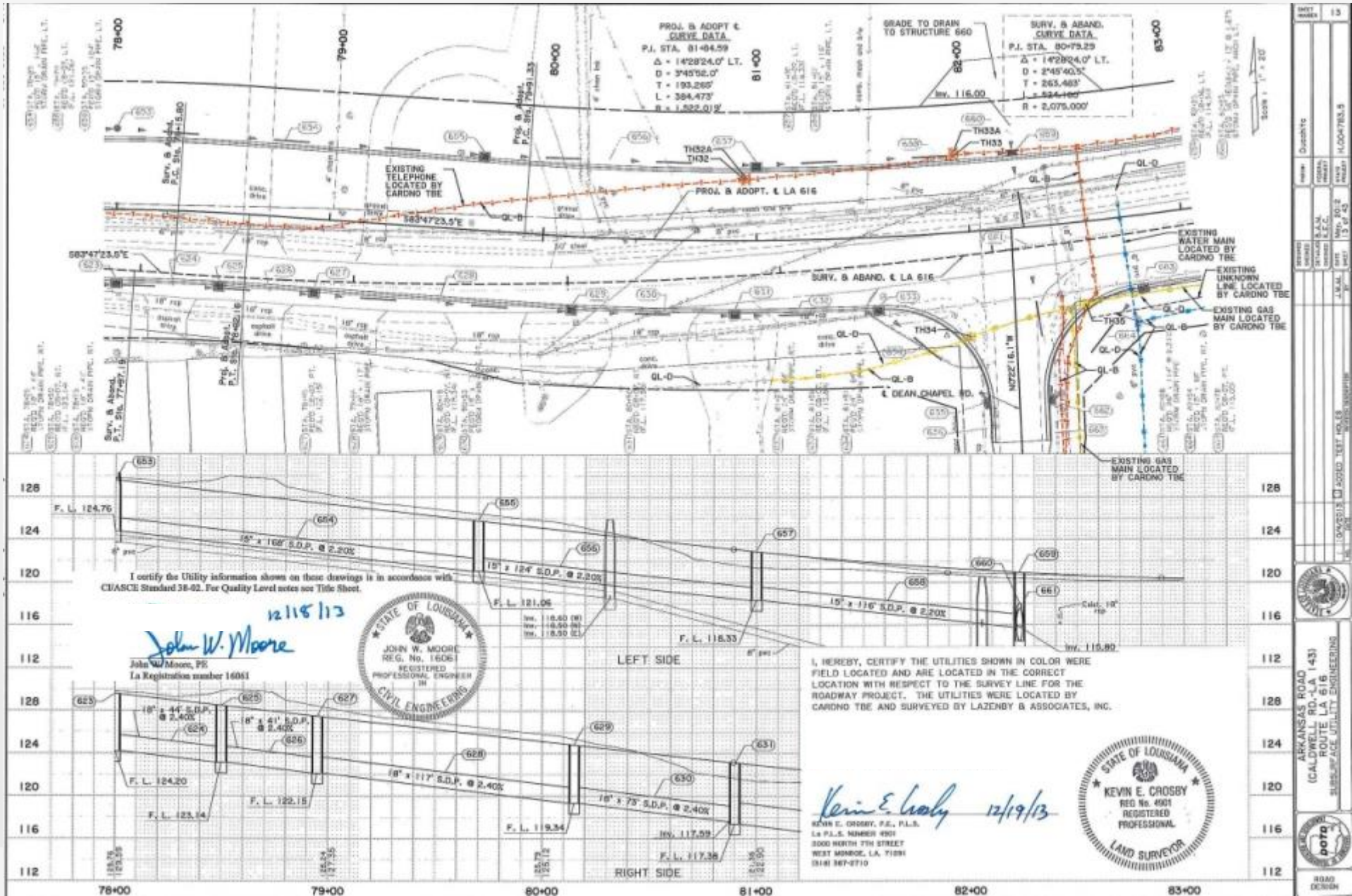
Prepared by
Purdue University
Department of Building Construction Management

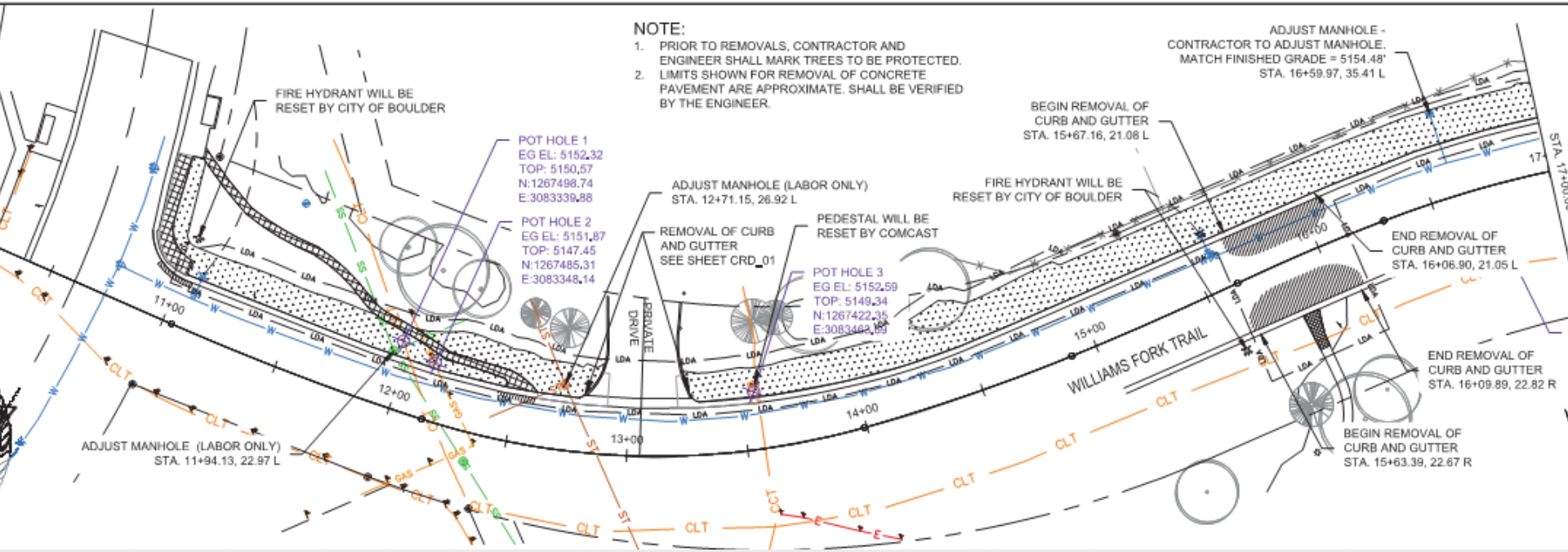
January 2000

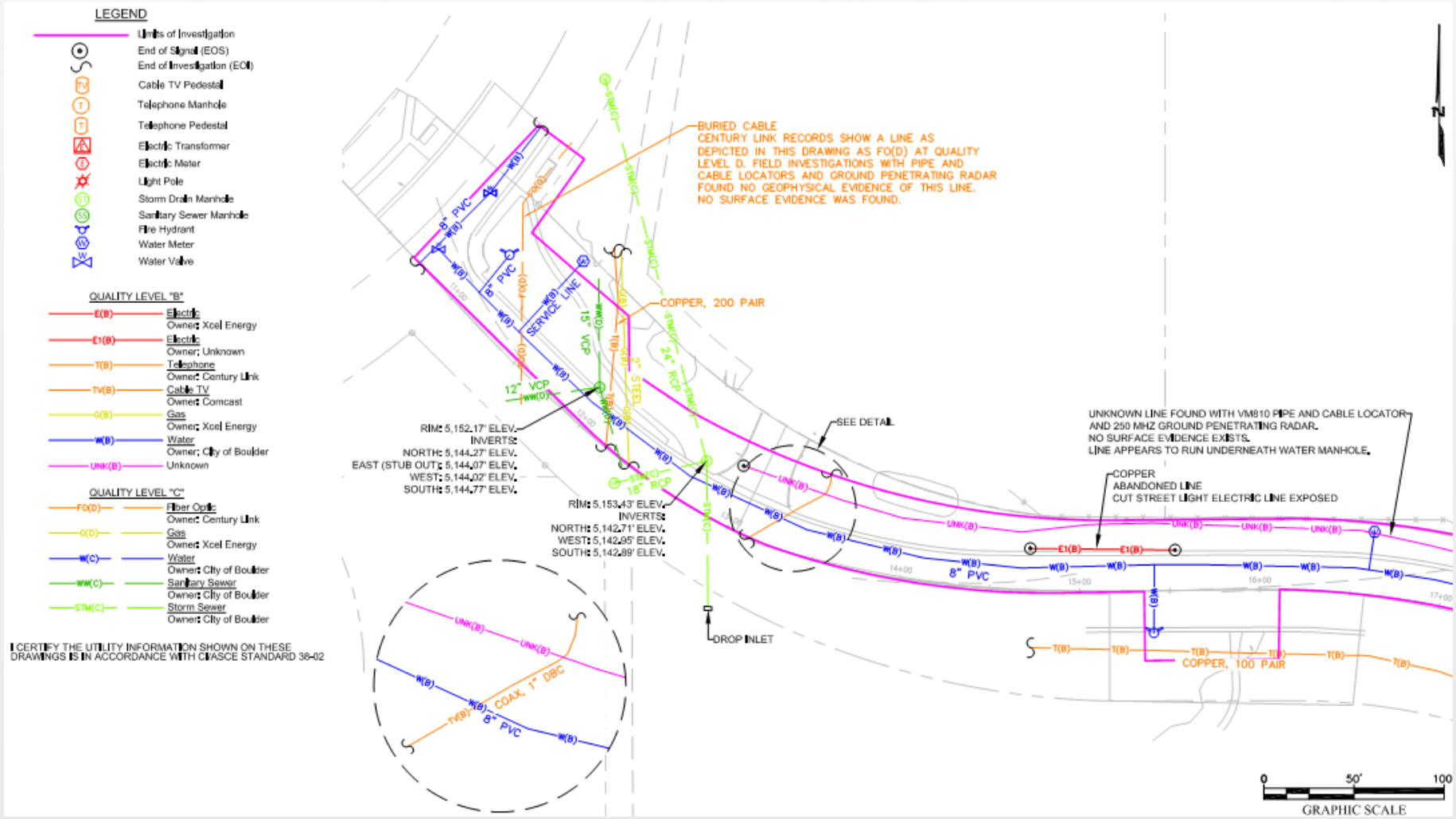
Prepared for the
Federal Highway Administration
Office of Program Administration
Washington, D.C.

FHWA Contract Number DTFH61-96-C-00090

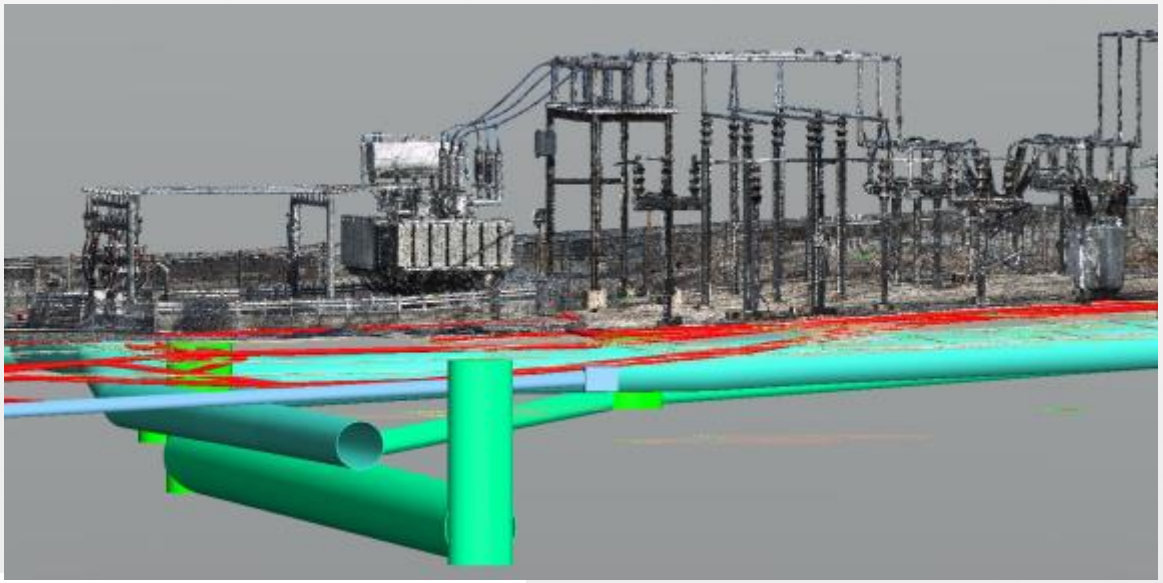

PT 2134
SET 5/8" REBAR
EM61 VERIFICATION
GRASS
PURINA EM61 Data - Bottom Coil (channel 2)
40'X40' SWEEP
STRUCTURE 13B
Response (mV)
1070
1010
950
890
830
770
710
650
590
530
470
410
350
290
230
170
110
50
Fence
443
444
446
448
449
450
W(B)
CURB
ASPHALT PARKING LOT
Latitude
38.6217
38.62165
38.6216
38.62155
Longitude
-90.202
-90.20195
-90.2019
-90.20185
-90.2018
-90.20175
-90.20165
1
2
3
4
5
6
7
8
9
10
11
1 EM61 anomaly area of interest and #
EM61 data collection location
PT 2133
SET 5/8" REBAR
EM61 VERIFICATION

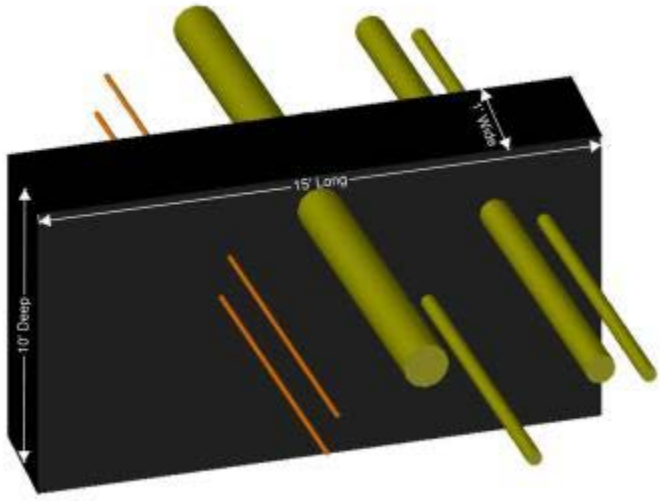

PROJ. & ADOPT. ℄ CURVE DATA
P.I. STA. 81+84.59
Δ = 14°28'24.0" LT.
D = 3°45'52.0"
T = 193.265'
L = 384.473'
R = 1,522.01'
GRADE TO DRAIN TO STRUCTURE 660
SURV. & ABAND. CURVE DATA
P.I. STA. 80+79.29
Δ = 14°28'24.0" LT.
D = 2°45'40.5"
T = 265.463'
L = 524.180'
R = 2,075.000'
Inv. 116.00
TH33A
TH33
TH32A
TH32
EXISTING TELEPHONE LOCATED BY CARDNO TBE
PROJ. & ADOPT. ℄ LA 616
S83°47'23.5"E
QL-D
QL-B
EXISTING WATER MAIN LOCATED BY CARDNO TBE
SURV. & ABAND. ℄ LA 616
EXISTING UNKNOWN LINE LOCATED BY CARDNO TBE
EXISTING GAS MAIN LOCATED BY CARDNO TBE
TH35
TH34
℄ DEAN CHAPEL RD.
N72°16.1'W
EXISTING GAS MAIN LOCATED BY CARDNO TBE
78+00
79+00
80+00
81+00
82+00
83+00
F. L. 124.76
15" x 108' S.D.P. @ 2.20%
15" x 124' S.D.P. @ 2.20%
15" x 116' S.D.P. @ 2.20%
F. L. 121.06
F. L. 118.33
Inv. 116.80
LEFT SIDE
18" x 44' S.D.P. @ 2.40%
18" x 41' S.D.P. @ 2.40%
18" x 117' S.D.P. @ 2.40%
18" x 73' S.D.P. @ 2.40%
F. L. 124.20
F. L. 123.14
F. L. 122.15
F. L. 119.34
Inv. 117.59
F. L. 117.38
RIGHT SIDE
I certify the Utility information shown on these drawings is in accordance with CI/ASCE Standard 38-02. For Quality Level notes see Title Sheet.
12/18/13
John W. Moore
John W. Moore, PE
La Registration number 16061
STATE OF LOUISIANA
JOHN W. MOORE
REG. No. 16061
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING
I, HEREBY, CERTIFY THE UTILITIES SHOWN IN COLOR WERE FIELD LOCATED AND ARE LOCATED IN THE CORRECT LOCATION WITH RESPECT TO THE SURVEY LINE FOR THE ROADWAY PROJECT. THE UTILITIES WERE LOCATED BY CARDNO TBE AND SURVEYED BY LAZENBY & ASSOCIATES, INC.
Kevin E. Crosby 12/19/13
KEVIN E. CROSBY, P.E., P.L.S.
La P.L.S. NUMBER 4901
3000 NORTH 7TH STREET
WEST MONROE, LA. 71291
(318) 387-2710
STATE OF LOUISIANA
KEVIN E. CROSBY
REG No. 4901
REGISTERED PROFESSIONAL LAND SURVEYOR
ARKANSAS ROAD
(CALDWELL RD.-LA 143)
ROUTE LA 616
SURFACE UTILITY ENGINEERING
ROAD DESIGN

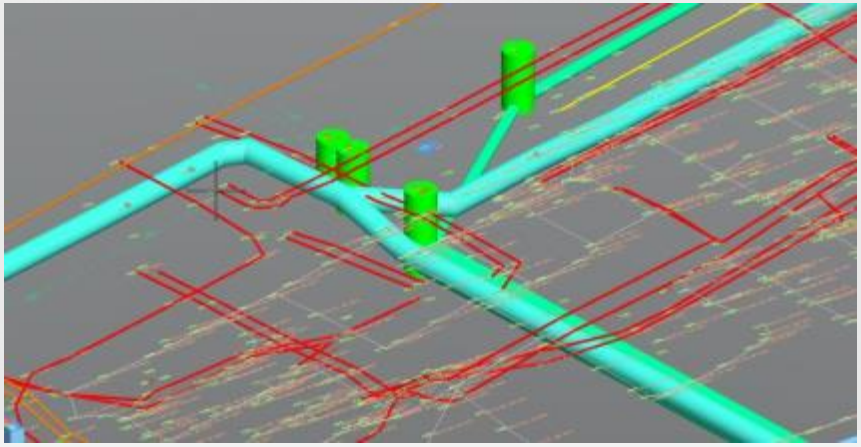

NOTE:
1. PRIOR TO REMOVALS, CONTRACTOR AND ENGINEER SHALL MARK TREES TO BE PROTECTED.
2. LIMITS SHOWN FOR REMOVAL OF CONCRETE PAVEMENT ARE APPROXIMATE. SHALL BE VERIFIED BY THE ENGINEER.
FIRE HYDRANT WILL BE RESET BY CITY OF BOULDER
POT HOLE 1
EG EL: 5152.32
TOP: 5150.57
N:1267498.74
E:3083339.88
POT HOLE 2
EG EL: 5151.87
TOP: 5147.45
N:1267485.31
E:3083348.14
ADJUST MANHOLE (LABOR ONLY)
STA. 12+71.15, 26.92 L
REMOVAL OF CURB AND GUTTER
SEE SHEET CRD_01
PEDESTAL WILL BE RESET BY COMCAST
POT HOLE 3
EG EL: 5152.59
TOP: 5149.34
N:1267422.35
E:3083463.89
PRIVATE DRIVE
ADJUST MANHOLE (LABOR ONLY)
STA. 11+94.13, 22.97 L
ADJUST MANHOLE -
CONTRACTOR TO ADJUST MANHOLE.
MATCH FINISHED GRADE = 5154.48'
STA. 16+59.97, 35.41 L
BEGIN REMOVAL OF CURB AND GUTTER
STA. 15+67.16, 21.08 L
FIRE HYDRANT WILL BE RESET BY CITY OF BOULDER
END REMOVAL OF CURB AND GUTTER
STA. 16+06.90, 21.05 L
END REMOVAL OF CURB AND GUTTER
STA. 16+09.89, 22.82 R
BEGIN REMOVAL OF CURB AND GUTTER
STA. 15+63.39, 22.67 R
WILLIAMS FORK TRAIL
11+00
12+00
13+00
14+00
15+00
16+00
CLT
LDA
W
SS
CO
GAS
SW
ST
E


LEGEND
Limits of Investigation
End of Signal (EOS)
End of Investigation (EOI)
Cable TV Pedestal
Telephone Manhole
Telephone Pedestal
Electric Transformer
Electric Meter
Light Pole
Storm Drain Manhole
Sanitary Sewer Manhole
Fire Hydrant
Water Meter
Water Valve
QUALITY LEVEL "B"
E(B) Electric Owner: Xcel Energy
E1(B) Electric Owner: Unknown
T(B) Telephone Owner: Century Link
TV(B) Cable TV Owner: Comcast
G(B) Gas Owner: Xcel Energy
W(B) Water Owner: City of Boulder
UNK(B) Unknown
QUALITY LEVEL "C"
FO(D) Fiber Optic Owner: Century Link
G(D) Gas Owner: Xcel Energy
W(C) Water Owner: City of Boulder
WW(C) Sanitary Sewer Owner: City of Boulder
STM(C) Storm Sewer Owner: City of Boulder
I CERTIFY THE UTILITY INFORMATION SHOWN ON THESE DRAWINGS IS IN ACCORDANCE WITH CI/ASCE STANDARD 38-02
BURIED CABLE
CENTURY LINK RECORDS SHOW A LINE AS DEPICTED IN THIS DRAWING AS FO(D) AT QUALITY LEVEL D. FIELD INVESTIGATIONS WITH PIPE AND CABLE LOCATORS AND GROUND PENETRATING RADAR FOUND NO GEOPHYSICAL EVIDENCE OF THIS LINE. NO SURFACE EVIDENCE WAS FOUND.
COPPER, 200 PAIR
SERVICE LINE
8" PVC
15" VCP
12" VCP
24" RCP
18" RCP
2" STEEL CONDUIT
RIM: 5,152.17' ELEV.
INVERTS:
NORTH: 5,144.27' ELEV.
EAST (STUB OUT): 5,144.07' ELEV.
WEST: 5,144.02' ELEV.
SOUTH: 5,144.77' ELEV.
RIM: 5,153.43' ELEV.
INVERTS:
NORTH: 5,142.71' ELEV.
WEST: 5,142.95' ELEV.
SOUTH: 5,142.89' ELEV.
SEE DETAIL
DROP INLET
UNKNOWN LINE FOUND WITH VM810 PIPE AND CABLE LOCATOR AND 250 MHZ GROUND PENETRATING RADAR.
NO SURFACE EVIDENCE EXISTS.
LINE APPEARS TO RUN UNDERNEATH WATER MANHOLE.
COPPER
ABANDONED LINE
CUT STREET LIGHT ELECTRIC LINE EXPOSED
COPPER, 100 PAIR
COAX, 1" DBC
N
0
50'
100
GRAPHIC SCALE

3D Utility Models







Questions?

Andrew Sylvest
720-891-6047
andrew.sylvest@sam.biz