Cleanup by 70-foot-deep LDA Vertical Excavation:

Design, Methods, and Safety, plus Vapor Ignition Control, Contaminant Monitoring, and Fast-tracked Data Evaluation for Dig Limit Refinements

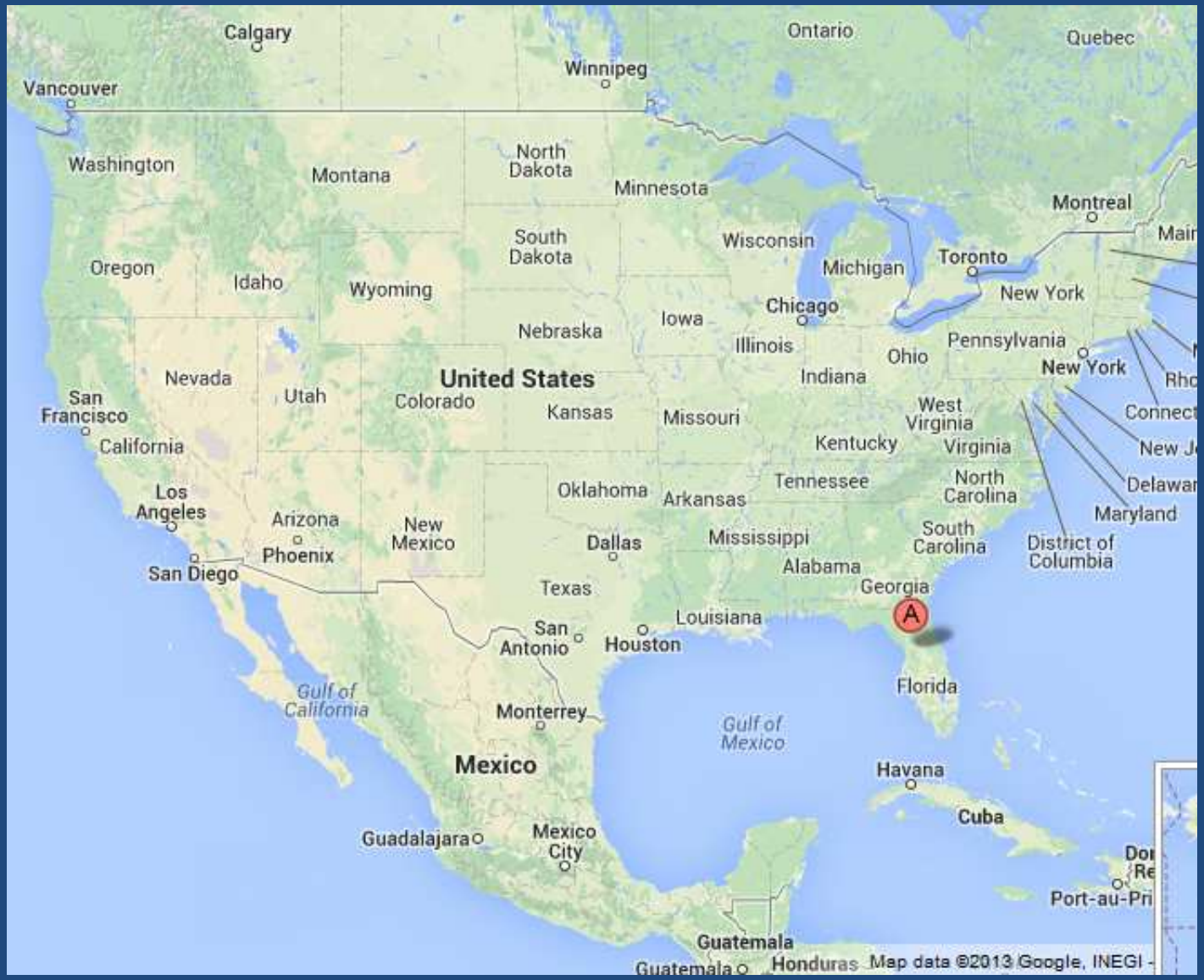
- Paco Amram, P.E., LEED AP
- Environmental Consulting & Technology, Inc. (ECT)
- 1408 North Westshore Boulevard., Suite 115
- Tampa, Florida 33607
- 813-289-9338, cell 813-503-6319
- pamram@ectinc.com

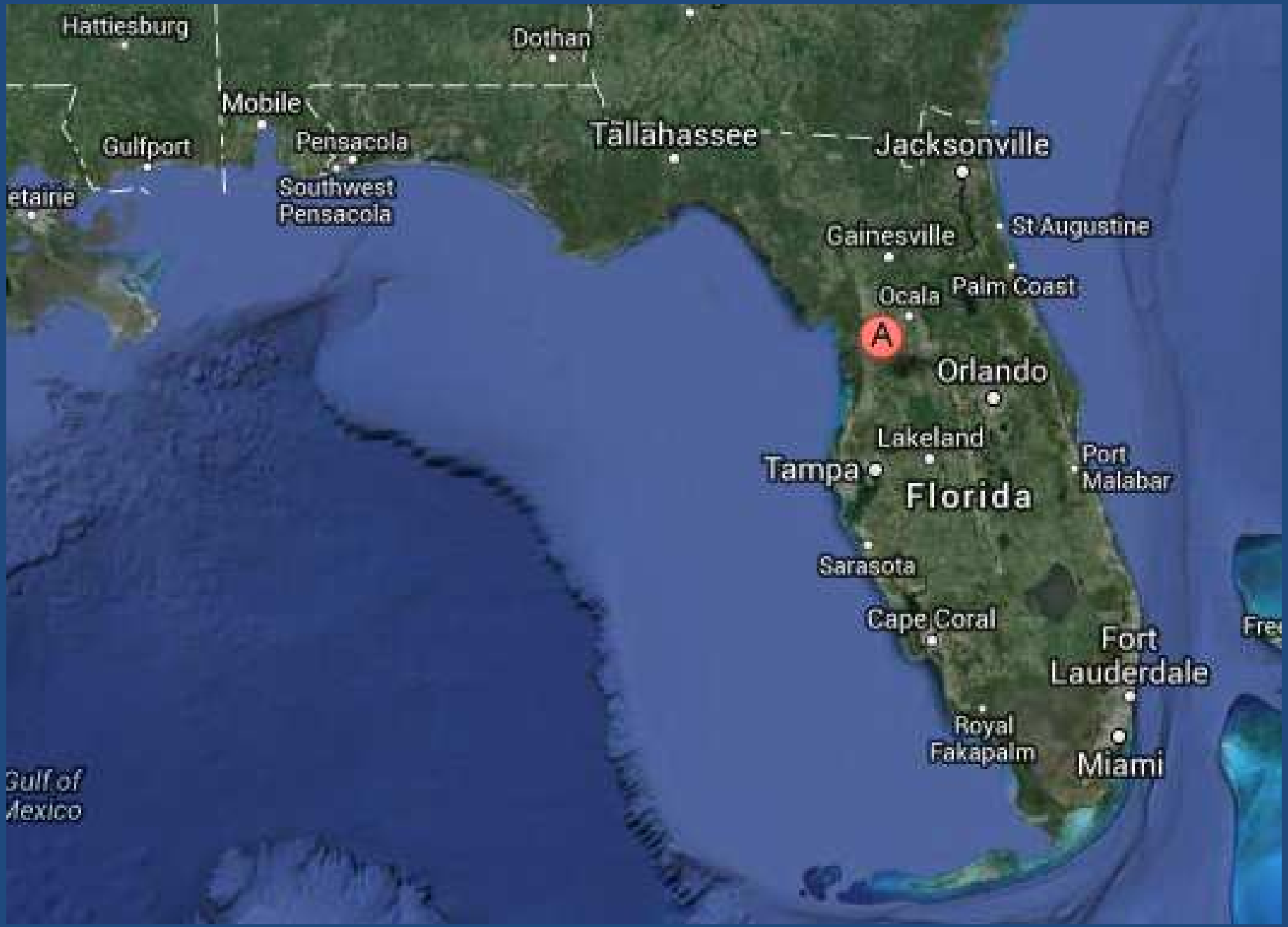
ECT Environmental Consulting & Technology, Inc.

LDA Excavation Cleanup

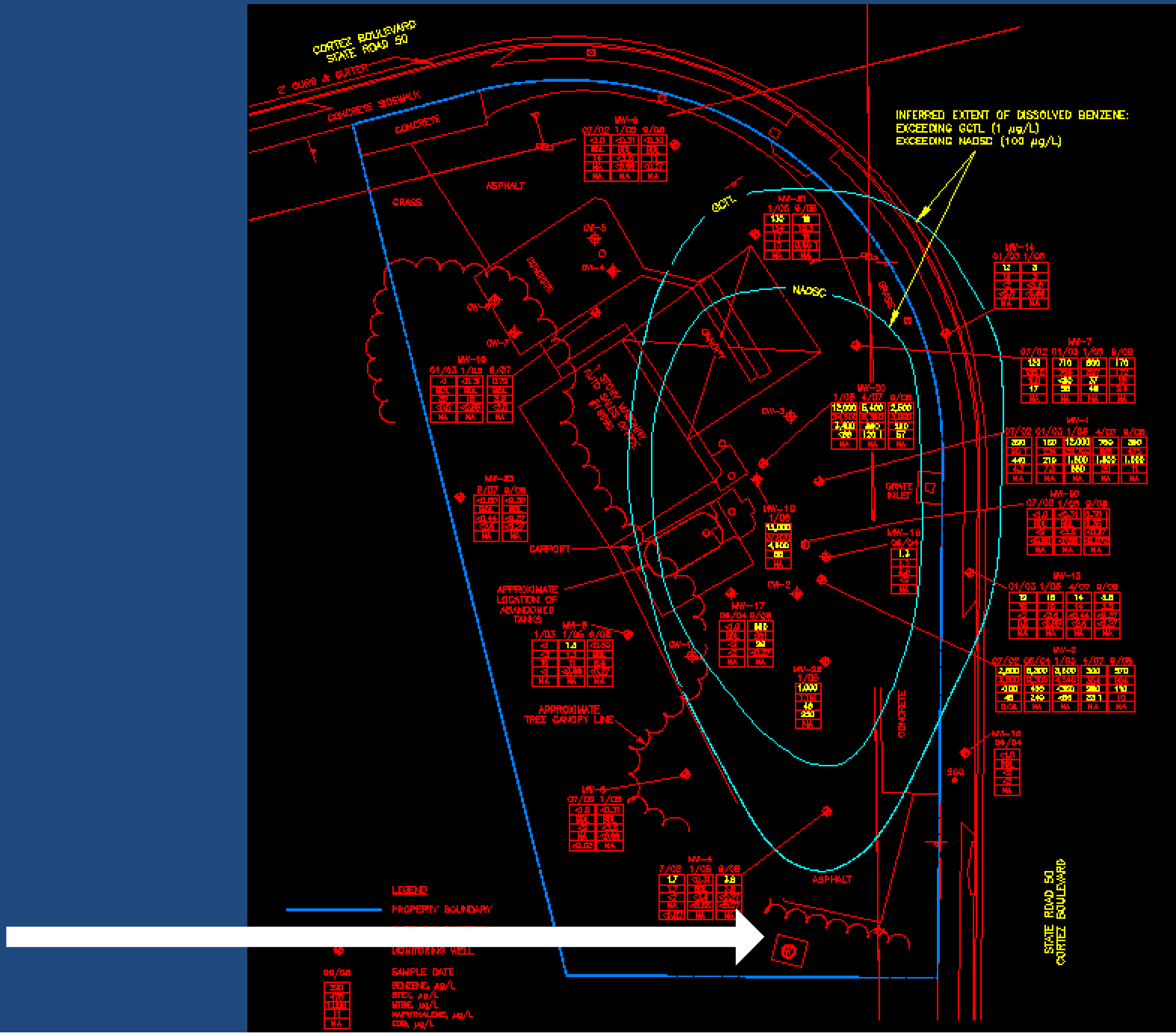
1. Problem Site
2. LDA Drilling?
3. Set Up
4. Design, Options
5. Specs, Methods
6. Safety
7. ***Fire in the Hole!***
8. Work Plan
9. Monitoring, Quick Evaluations, Reporting

Presto 17 Site

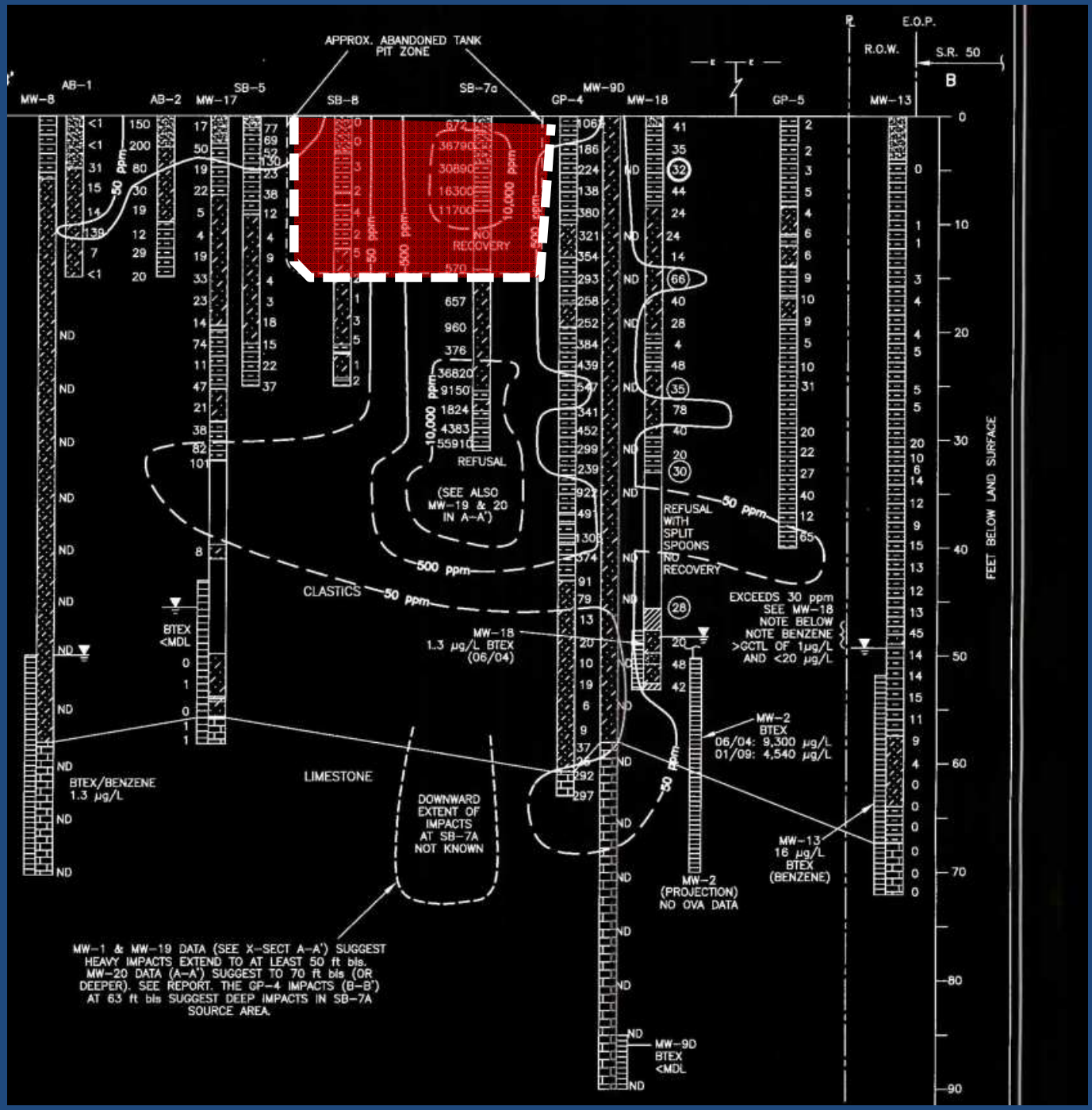



Hattiesburg
Dothan
Mobile
Gulfport
Pensacola
Tallahassee
Jacksonville
etairie
Southwest
Pensacola
Gainesville
St Augustine
Ocala
Palm Coast
A
Orlando
Lakeland
Tampa
Port
Malabar
Florida
Sarasota
Cape Coral
Fort
Lauderdale
Royal
Fakapalm
Miami
Gulf of
Mexico

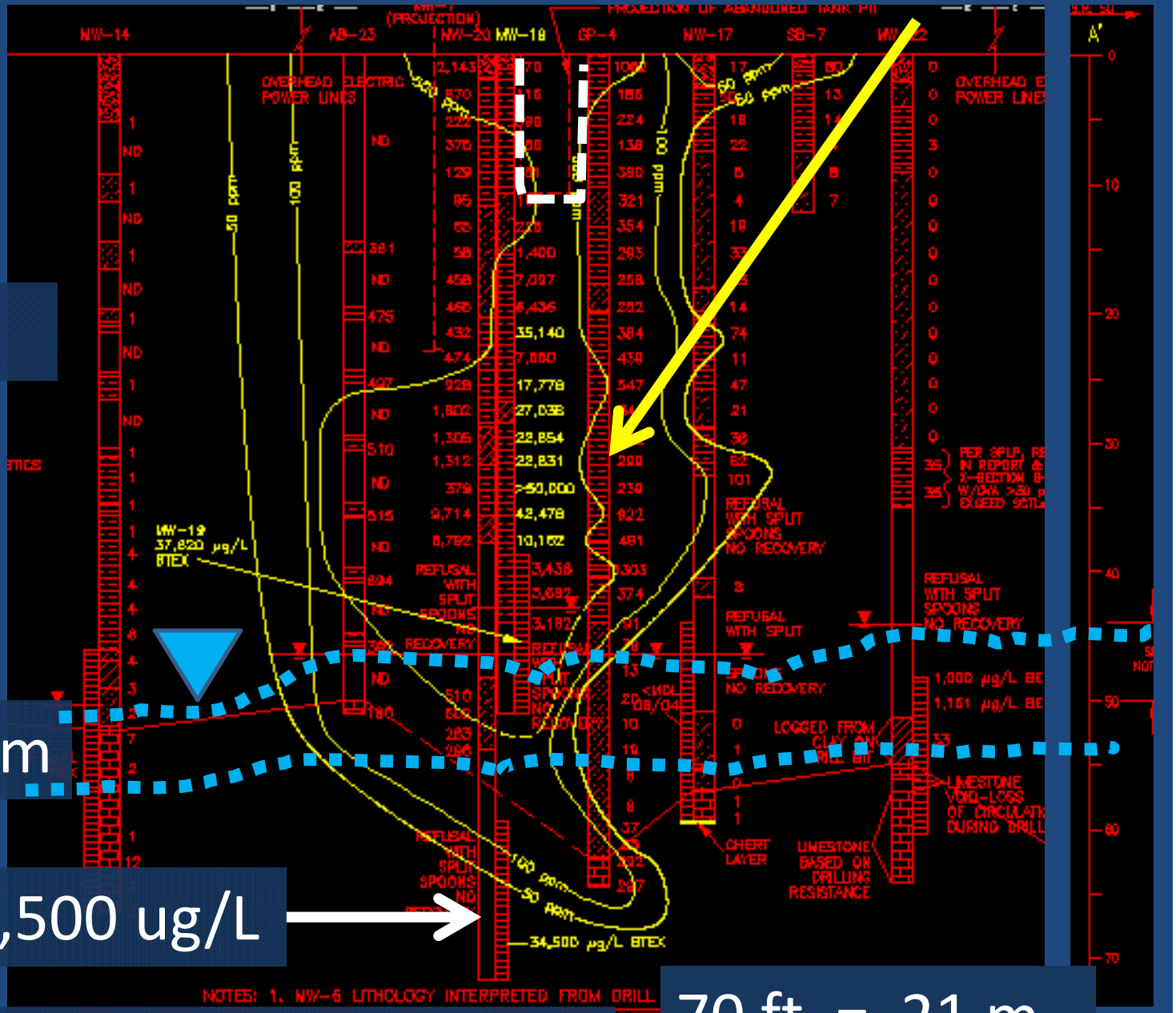
- State Cleanup Funds
- *“Imminent Threat”*



CORTEZ BOULEVARD
STATE ROAD 50
2' CURB & GUTTER
CONCRETE SIDEWALK
CONCRETE
ASPHALT
GRASS
INFERRED EXTENT OF DISSOLVED BENZENE:
EXCEEDING GCTL (1 µg/L)
EXCEEDING NADSC (100 µg/L)
GCTL
NADSC
CARPORT
APPROXIMATE LOCATION OF ABANDONED TANKS
APPROXIMATE TREE CANOPY LINE
GRATE INLET
CONCRETE
ASPHALT
LEGEND
PROPERTY BOUNDARY
MONITORING WELL
SAMPLE DATE
BENZENE, µg/L
BTEX, µg/L
MTBE, µg/L
NAPHTHALENE, µg/L
EDB, µg/L
STATE ROAD 50
CORTEZ BOULEVARD


APPROX. ABANDONED TANK PIT ZONE
AB-1
MW-8
AB-2
MW-17
SB-5
SB-8
SB-7a
MW-9D
GP-4
MW-18
GP-5
MW-13
R.O.W.
E.O.P.
S.R. 50
B
50 ppm
500 ppm
10,000 ppm
NO RECOVERY
REFUSAL
(SEE ALSO MW-19 & 20 IN A-A')
REFUSAL WITH SPLIT SPOONS NO RECOVERY
CLASTICS
BTEX <MDL
MW-18 1.3 µg/L BTEX (06/04)
EXCEEDS 30 ppm SEE MW-18 NOTE BELOW NOTE BENZENE >GCTL OF 1µg/L AND <20 µg/L
MW-2 BTEX 06/04: 9,300 µg/L 01/09: 4,540 µg/L
BTEX/BENZENE 1.3 µg/L
LIMESTONE
DOWNWARD EXTENT OF IMPACTS AT SB-7A NOT KNOWN
MW-13 16 µg/L BTEX (BENZENE)
MW-2 (PROJECTION) NO OVA DATA
MW-1 & MW-19 DATA (SEE X-SECT A-A') SUGGEST HEAVY IMPACTS EXTEND TO AT LEAST 50 ft bls. MW-20 DATA (A-A') SUGGEST TO 70 ft bls (OR DEEPER). SEE REPORT. THE GP-4 IMPACTS (B-B') AT 63 ft bls SUGGEST DEEP IMPACTS IN SB-7A SOURCE AREA.
MW-9D BTEX <MDL
FEET BELOW LAND SURFACE

Soils



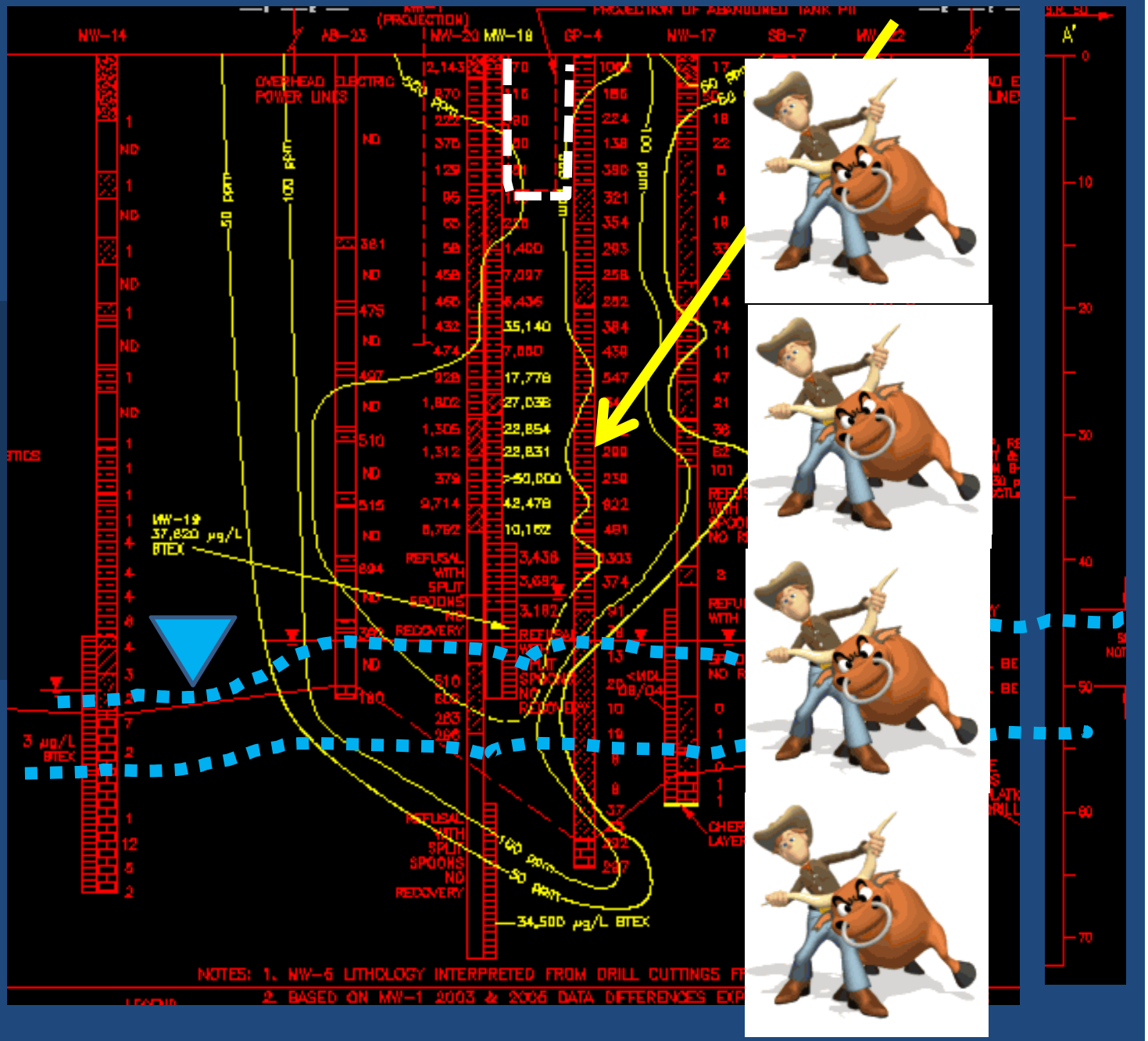
50 ft = 15 m

BTEX 34,500 ug/L

70 ft = 21 m

In situ Cleanup challenges ←

10 Texans Tall



“Can we dig it?”

“Yes, we can!”,

***Bob the Builder*, 2003**

Large-diameter Auger (LDA)

1 to 10-feet diameter (3 m)

>200 feet deep (> 60 m)

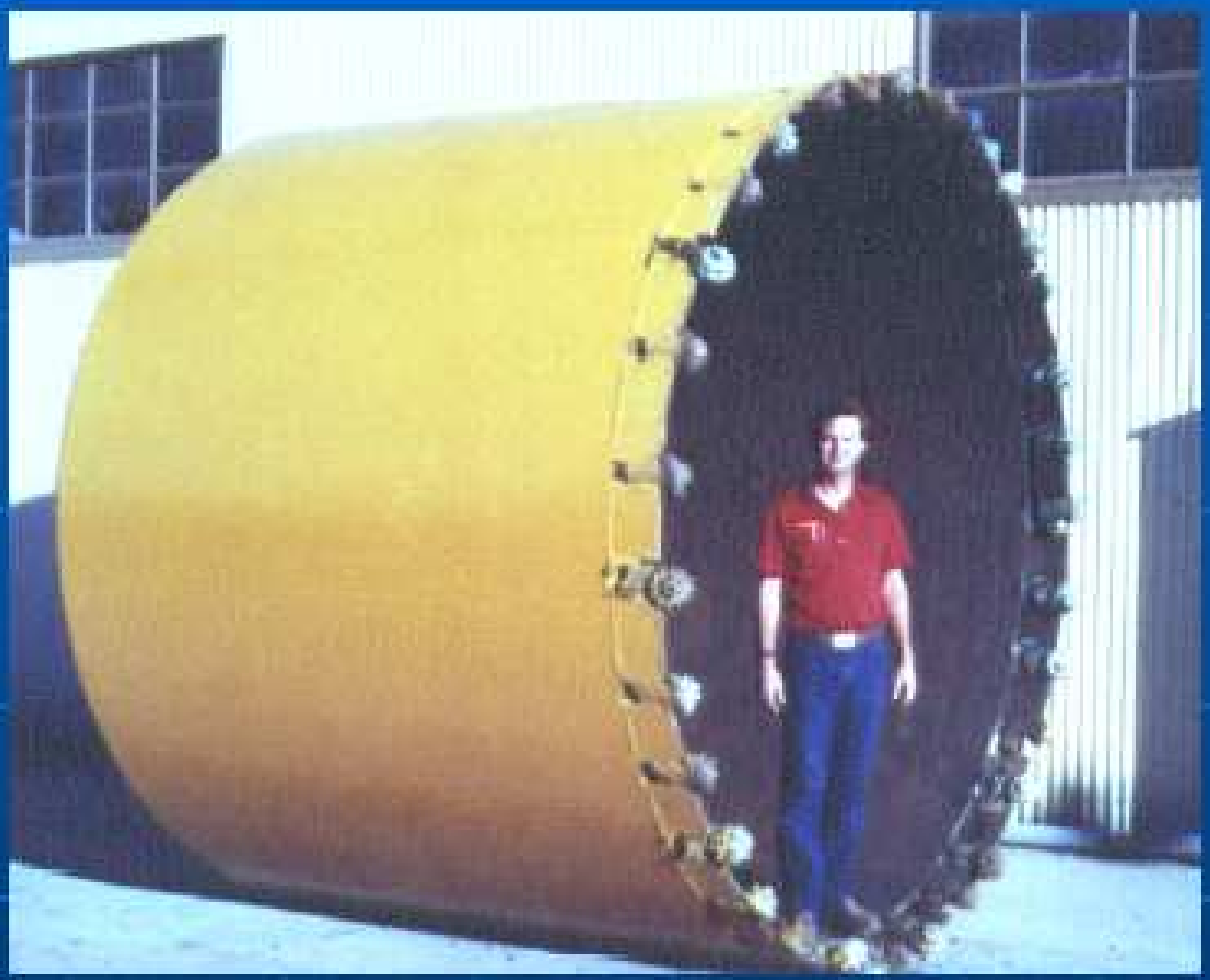
THOMPSON
brothers drilling inc

http://www.thompsonbrothersdrilling.com/auger.html

Tooling

Soil Auger ***Rock Auger*** ***Drilling Bucket***

Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html



Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html

http://www.rwharrisinc.com/tfoundation.html

Tremmie concrete

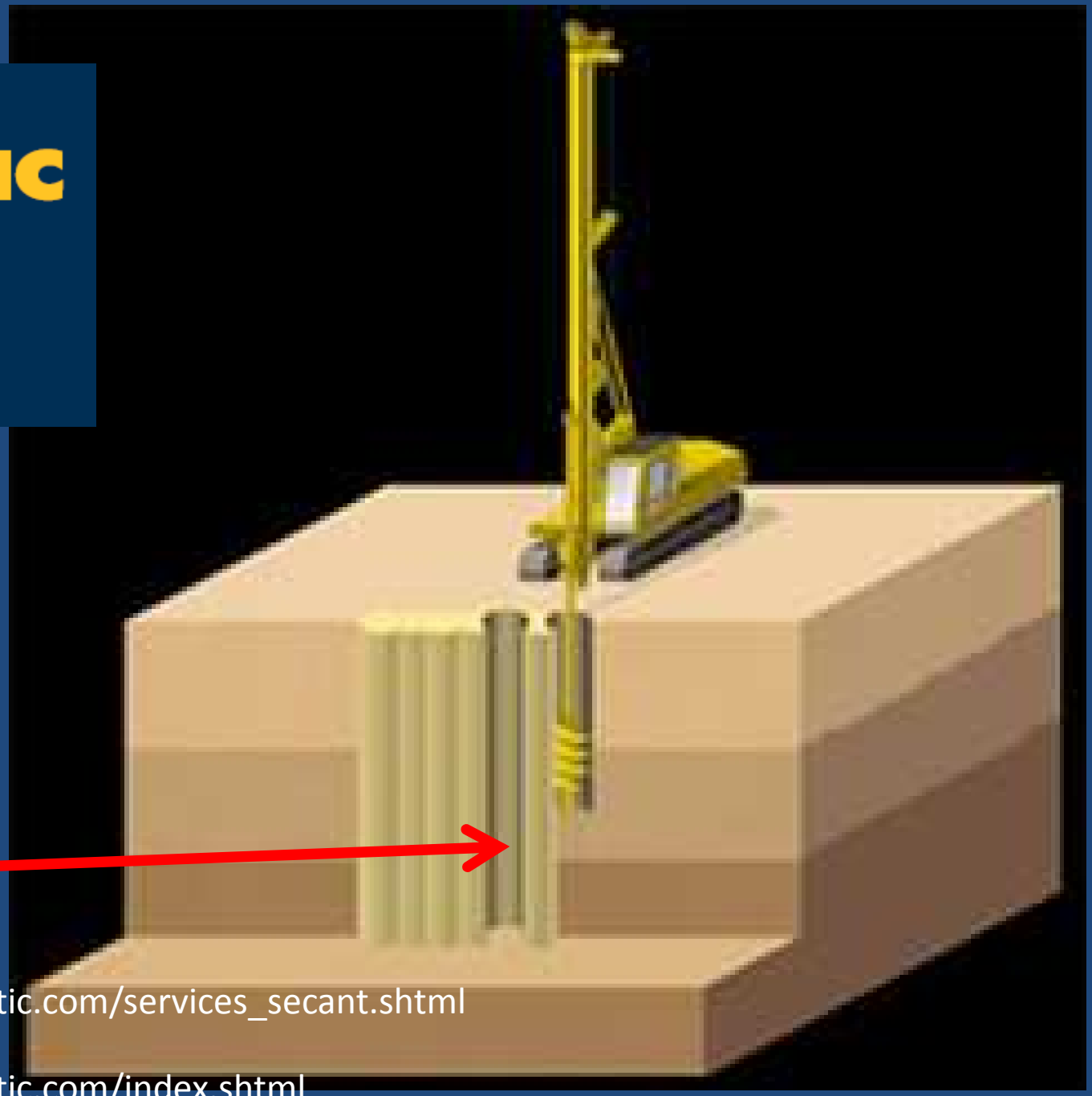
http://www.rwharrisinc.com/tfoundation.html

http://www.rwharrisinc.com/tfoundation.html

CASE ATLANTIC
A Keller Company

KELLER

Secant Pile Walls



http://www.caseatlantic.com/services_secant.shtml

http://www.caseatlantic.com/index.shtml

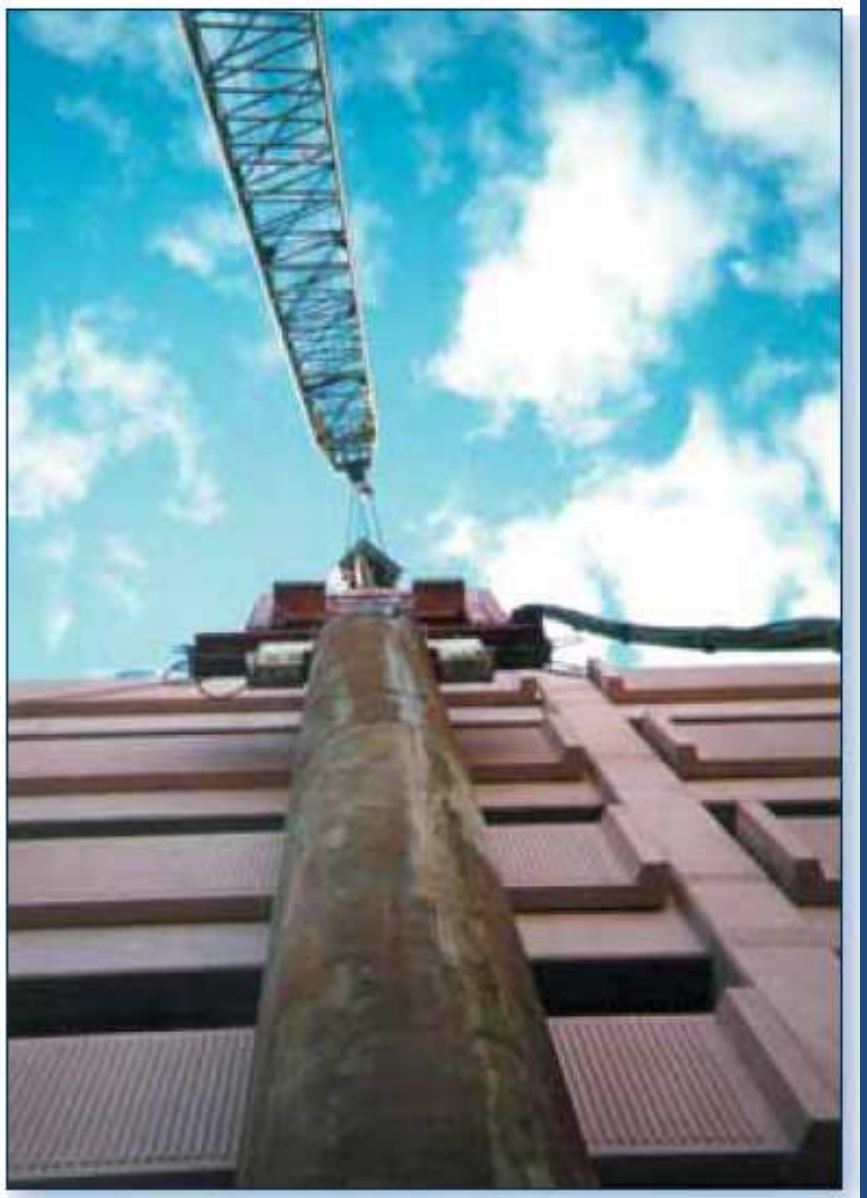
CASE ATLANTIC
A Keller Company

KELLER

http://www.caseatlantic.com/Downloads/CASE%20ATL%20Drilled%20Shaft%20Broch%20R1-8-09.pdf

7

Cumberland Street Parking



BAUER FOUNDATION

CFA –

http://www.bauerfoundations.com/en/index.html

http://www.bauerfoundations.com/shared/_content/bst/broschueren_flippingbook/en/Imagebrochure/index.html

BAUER FOUNDATION

Multi-rig production

http://www.bauerfoundations.com/en/index.html

BAUER FOUNDATION

Cleanup AND / or Build water-tight stuff

Accurate and water-tight: For a large-scale sewage treatment plant between the Buda and Pest districts of the city of Budapest, Bauer Spezialtiefbau constructed four water-tight circular shafts as the start and end locations for tunnel bore machines.

http://www.bauerfoundations.com/en/index.html

http://www.rwharrisinc.com/tfoundation.html

Open Excavation:

Large, at only 15-ft deep

Dewatering, Treatment

Open Pit hazards

Exposed soil Emissions

→PPE, $$$

→neighbors

Access for incremental additions challenging

Building stability

LDA

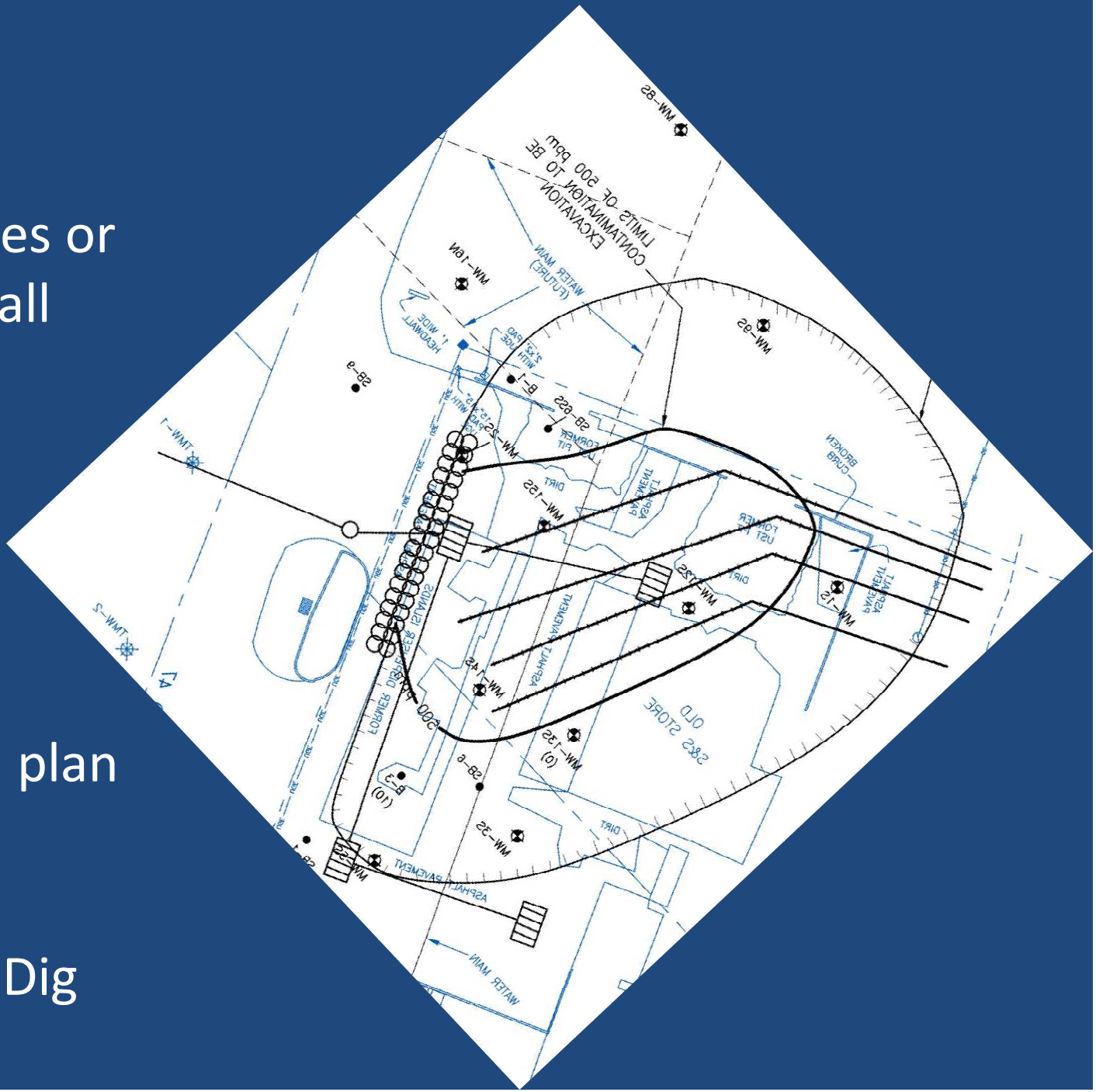
- Controlled dig: 1 Small*, securable borehole
- Less Emissions! ← Cuttings pile
- Low-vibration piling for structures
- Containment ~= Slurry Wall
- Varied Depths
- Scalable and “increment-able”

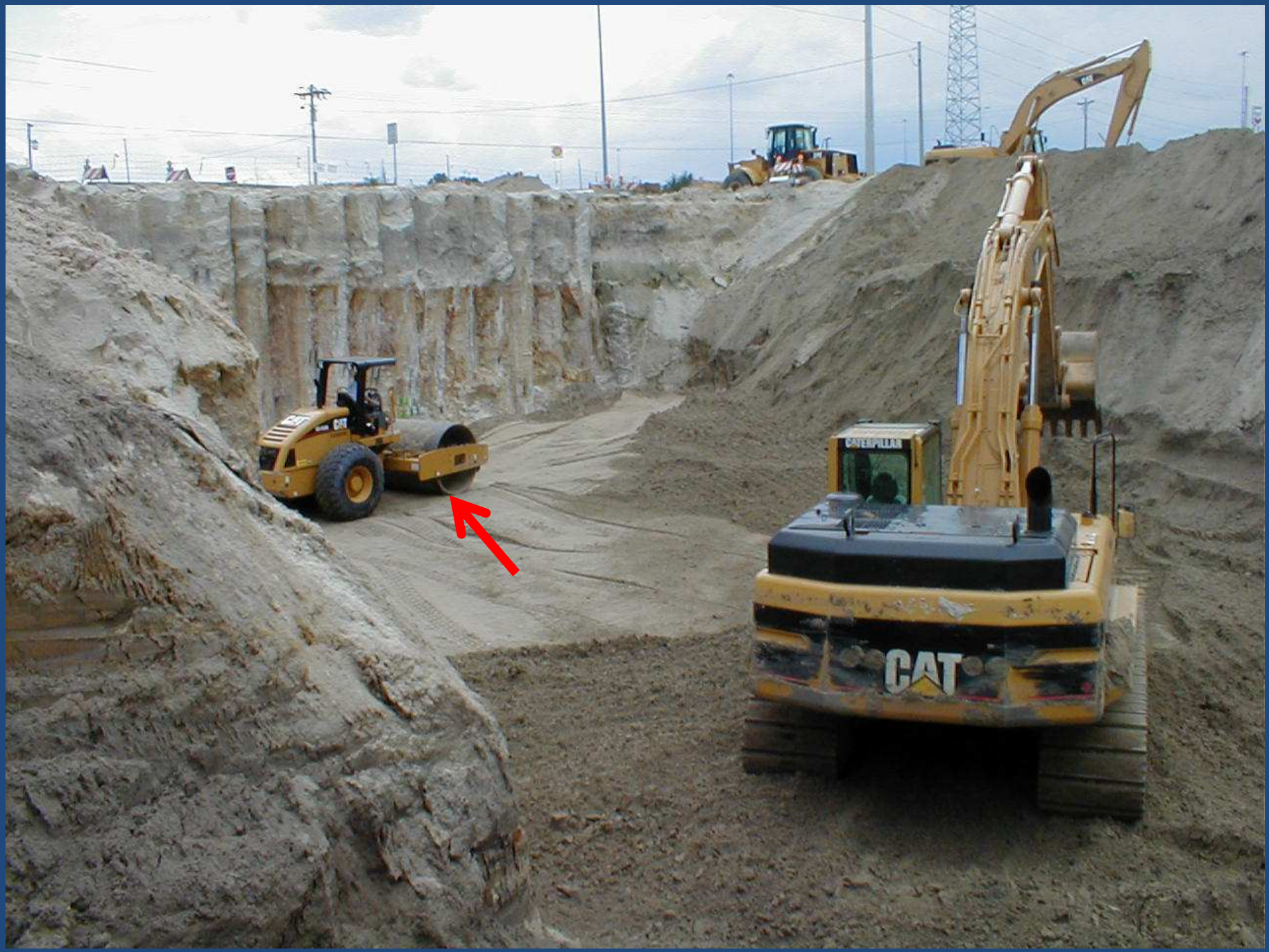
* small, but deep and also dangerous

LDA
Auger-cast piles or
Secant Pile Wall
by highway

Structural P.E. plan

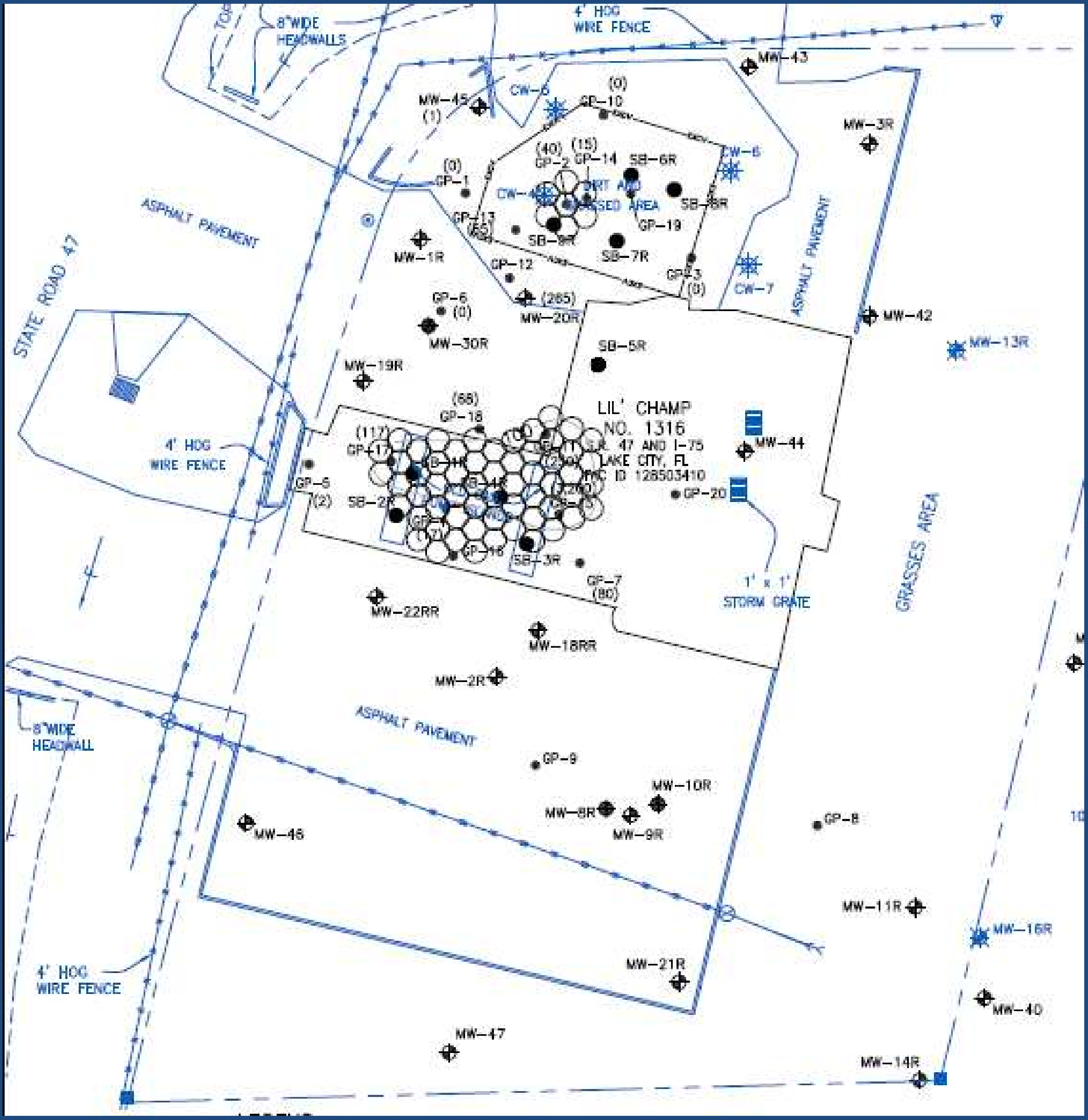
Conventional Dig




CATERPILLAR
CAT

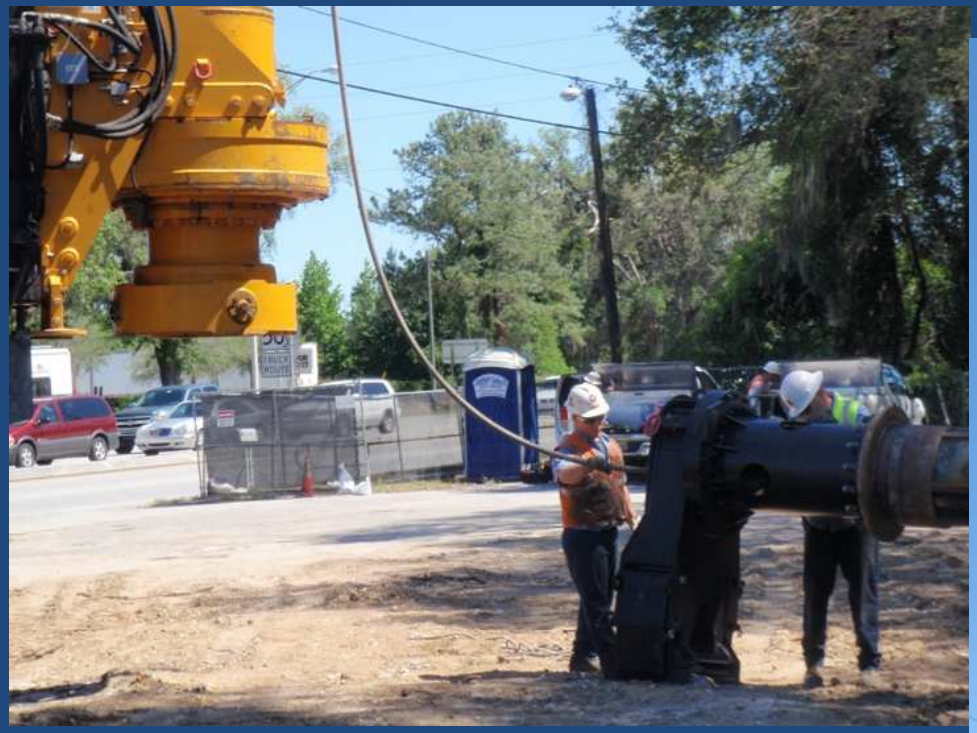
…

LDA-only Dig


LIL' CHAMP
NO. 1316
STATE ROAD 47
ASPHALT PAVEMENT
GRASSES AREA
4' HOG WIRE FENCE
8" WIDE HEADWALLS
8" WIDE HEADWALL
1' x 1' STORM GRATE
MW-43
MW-45
MW-3R
MW-1R
MW-42
MW-13R
MW-20R
MW-30R
MW-19R
MW-44
MW-22RR
MW-18RR
MW-2R
MW-10R
MW-8R
MW-9R
MW-46
MW-11R
MW-16R
MW-21R
MW-40
MW-47
MW-14R
CW-6
CW-4
CW-7
GP-10
GP-2
GP-14
GP-1
GP-13
GP-19
GP-12
GP-3
GP-6
GP-18
GP-17
GP-5
GP-20
GP-7
GP-9
GP-8
SB-6R
SB-8R
SB-9R
SB-7R
SB-5R
SB-2R
SB-3R

Where's the Pit?!

Presto 17 Site – Set Up




DELMAG
RH28


DELMAG
RH28

Drilling 1st hole,

Rotating 90 degrees, Spinning off soils.

Rotating 90 degrees,


DELMAG
RH28


DELMAG


Hertz
DEERE

Presto 17 Site - DESIGN

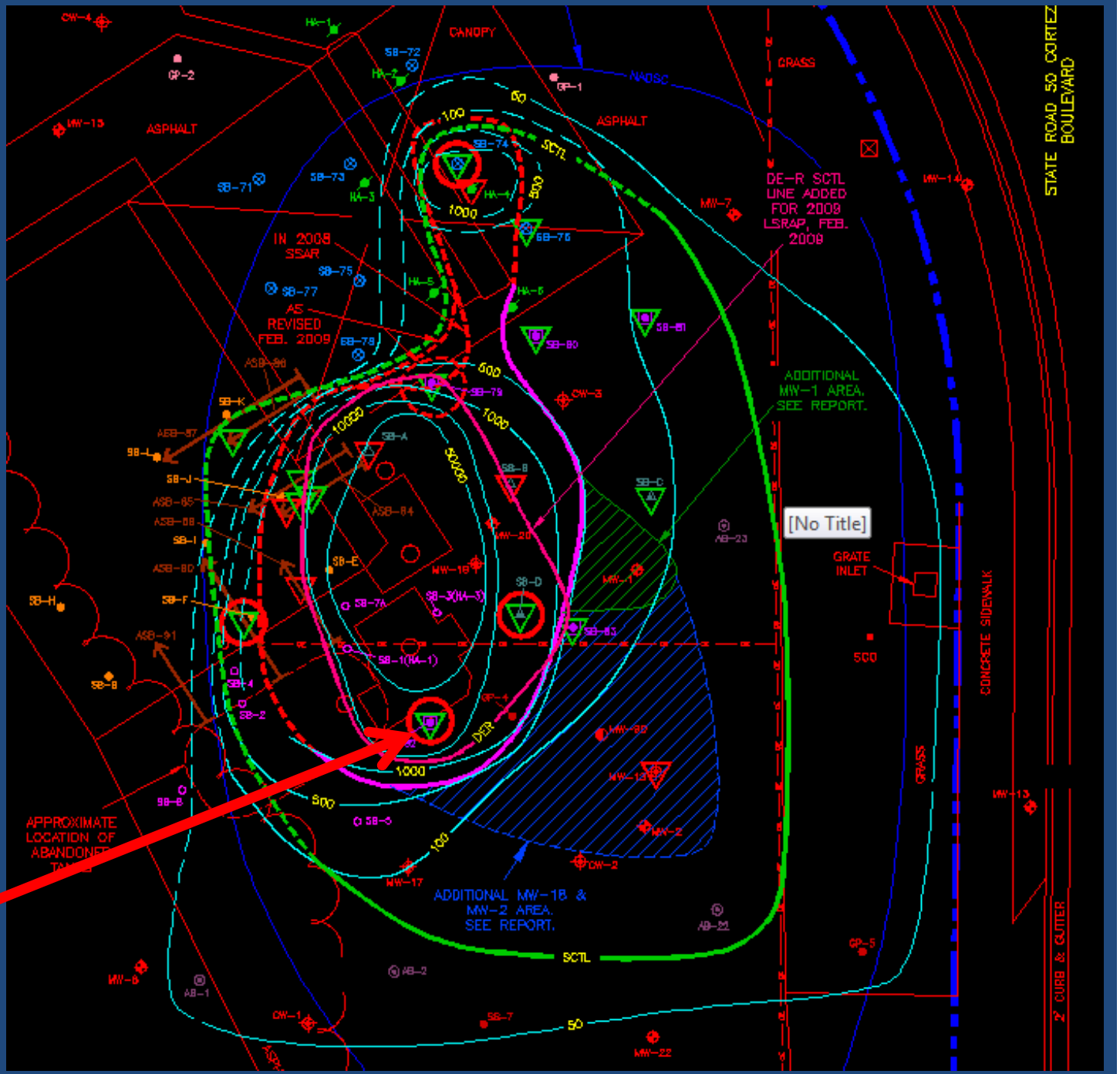
1. Assessment, Cleanup Goals, Extents
2. Prelim. Design
3. $$$

4. Subsurface → Iterations → $$$ Accuracy

SSAR

Spatial Variability

Data Compilation & Evaluation Map



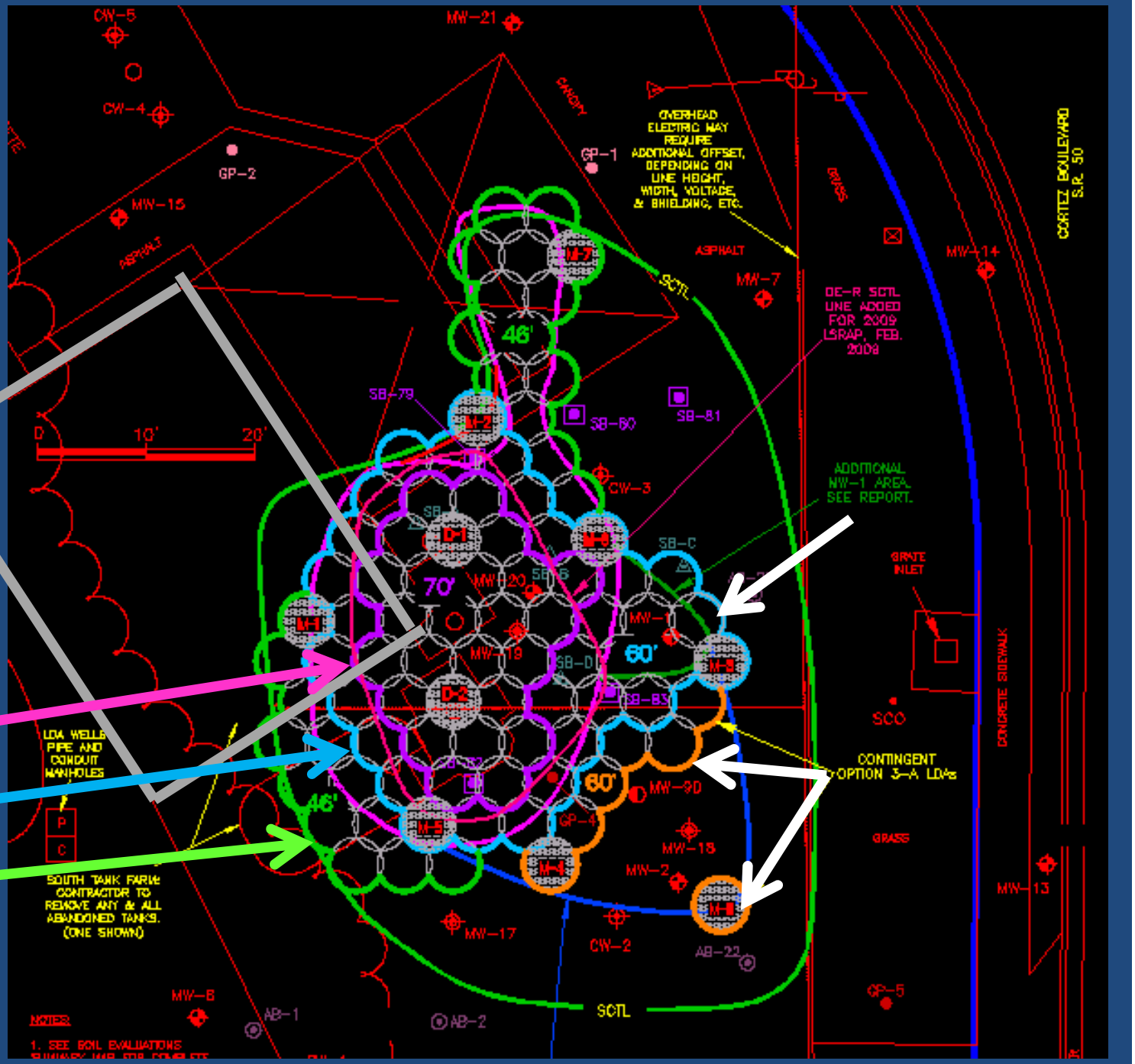
LDA Option 3-A

91 LDAs

70’

60’

46’

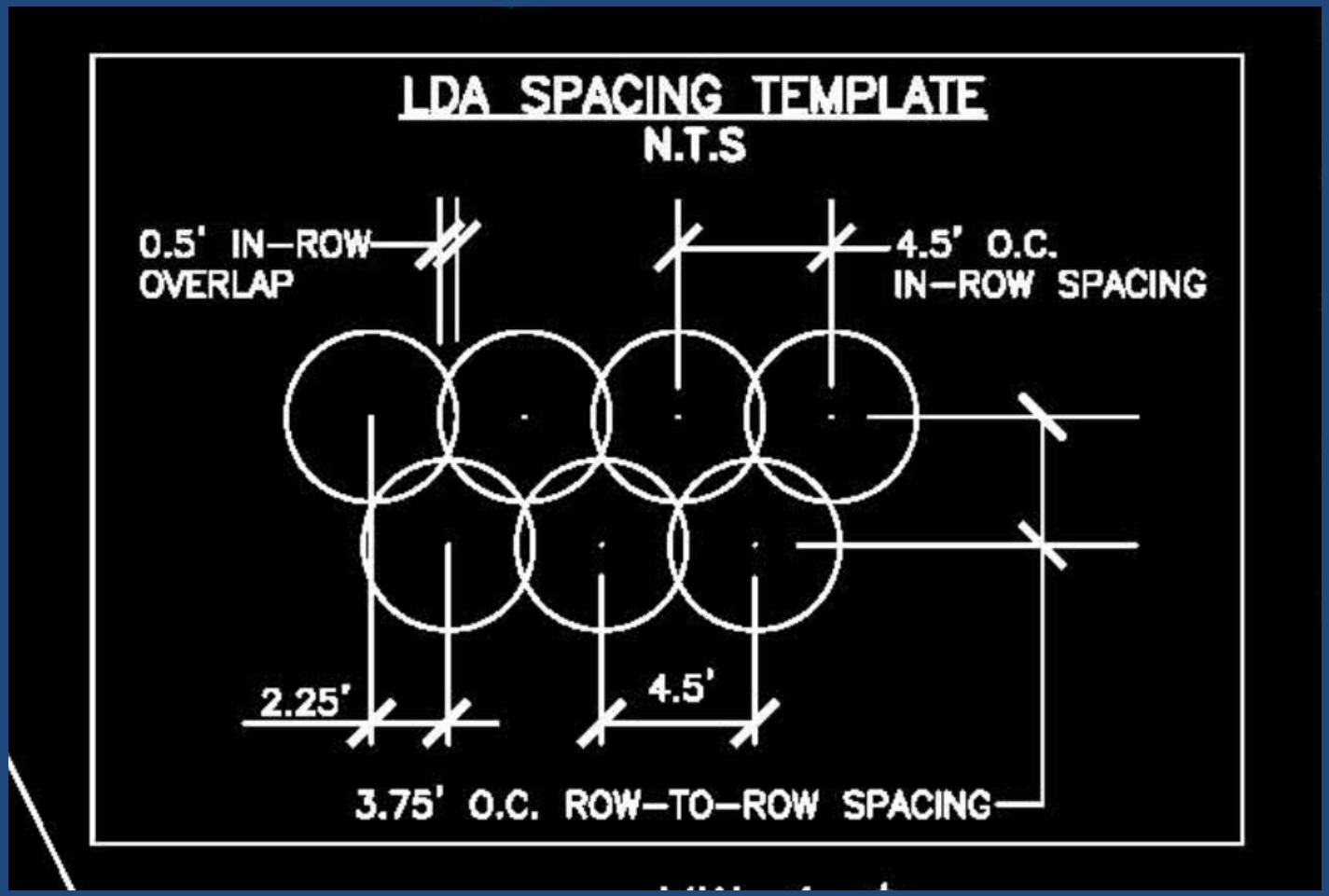


***RAP 2* - LDA Option:**	**3-A**	**4**
LDAs	91	105
Soil T&D, **CY**	4,627	5,452
Soil T&D,**Tons**	6,940	8,178
Capital Cost	$1.8 M	$2.1 M
Cost / CY (estimated)	$391	$381
Cost / Ton (estimimated)	$261	$254
Reliability, Effectiveness	Medium	High
Recommendation	Minimum +	Recommended
Capital Cost Vs. RAP 2 Option 3:	6%	21%

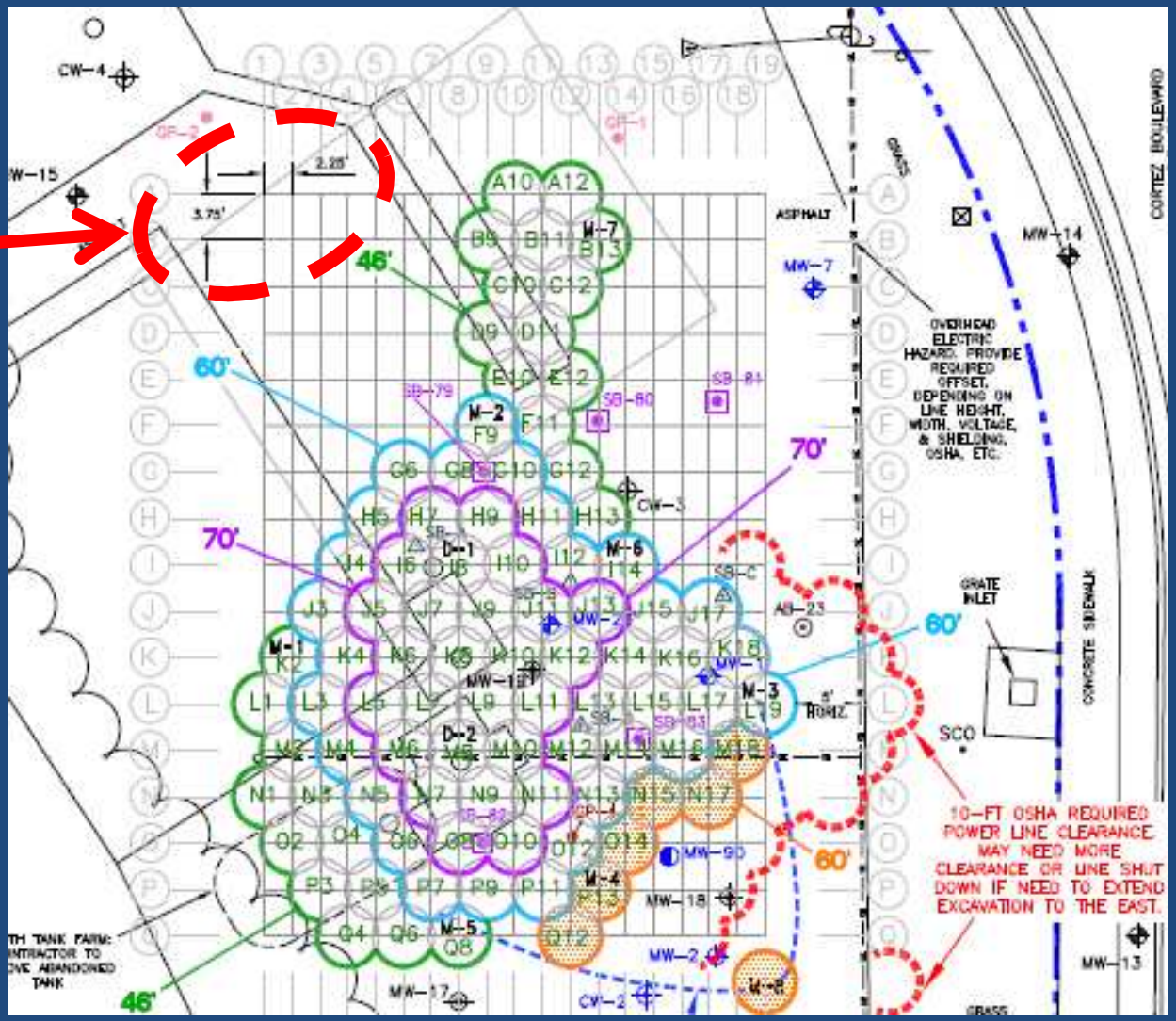
Design: Systematic GRID

→ Coverage!

without Overage $$$



→ Surveyor Grid



Check!

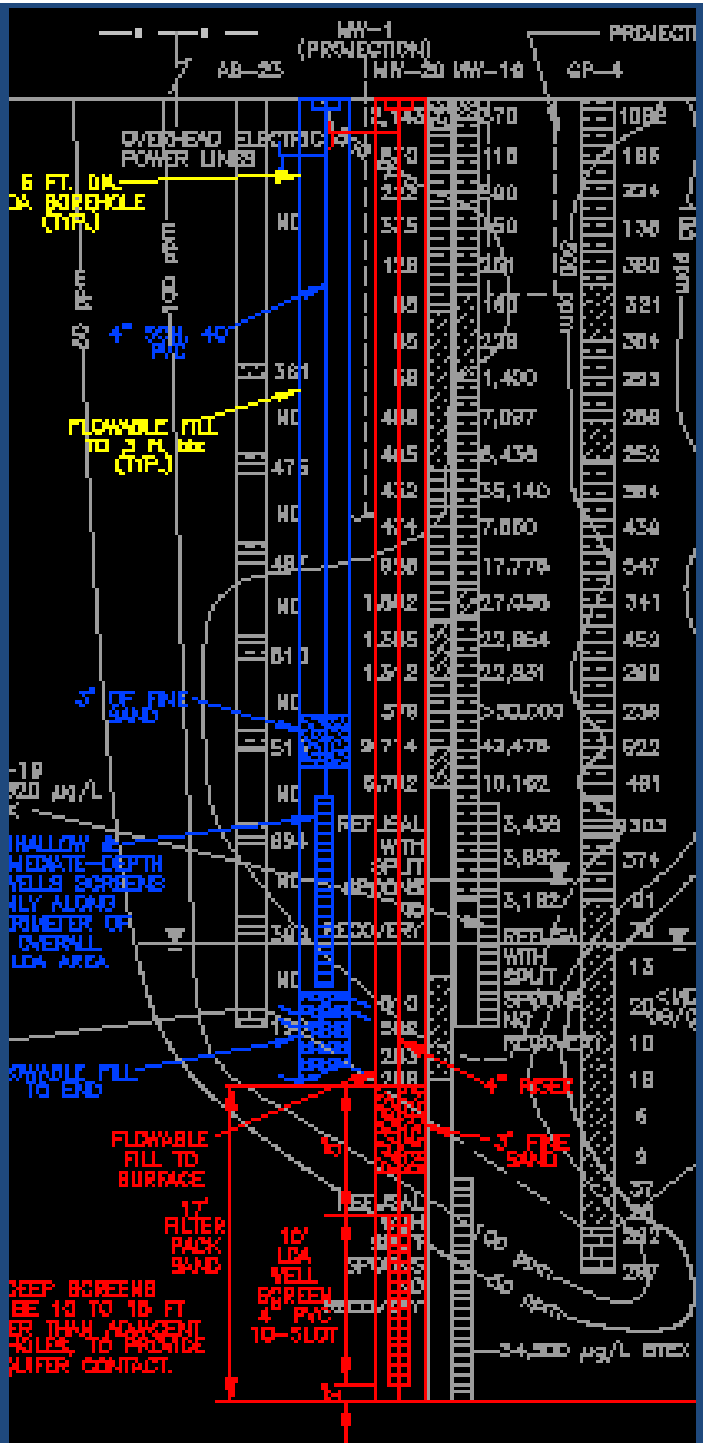
Staked out → Dig Control

- Measure Twice! Cut Once.

→ Prevented Tracking Nightmares

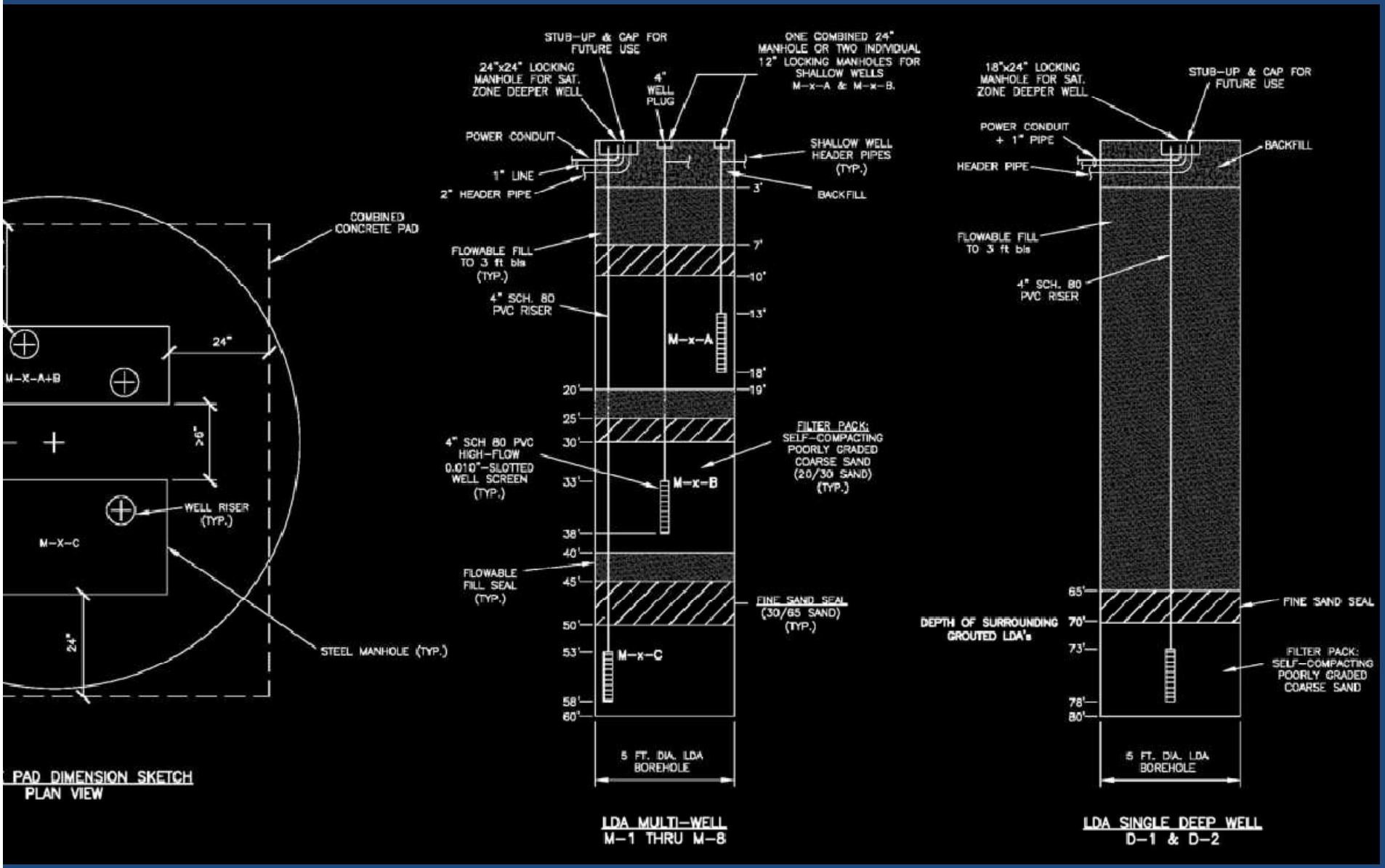
Design Option:

LDA Wells



(Drillers: "Not typical." So state chose NOT to fund that for this site.

Multi-level or Deep Wells



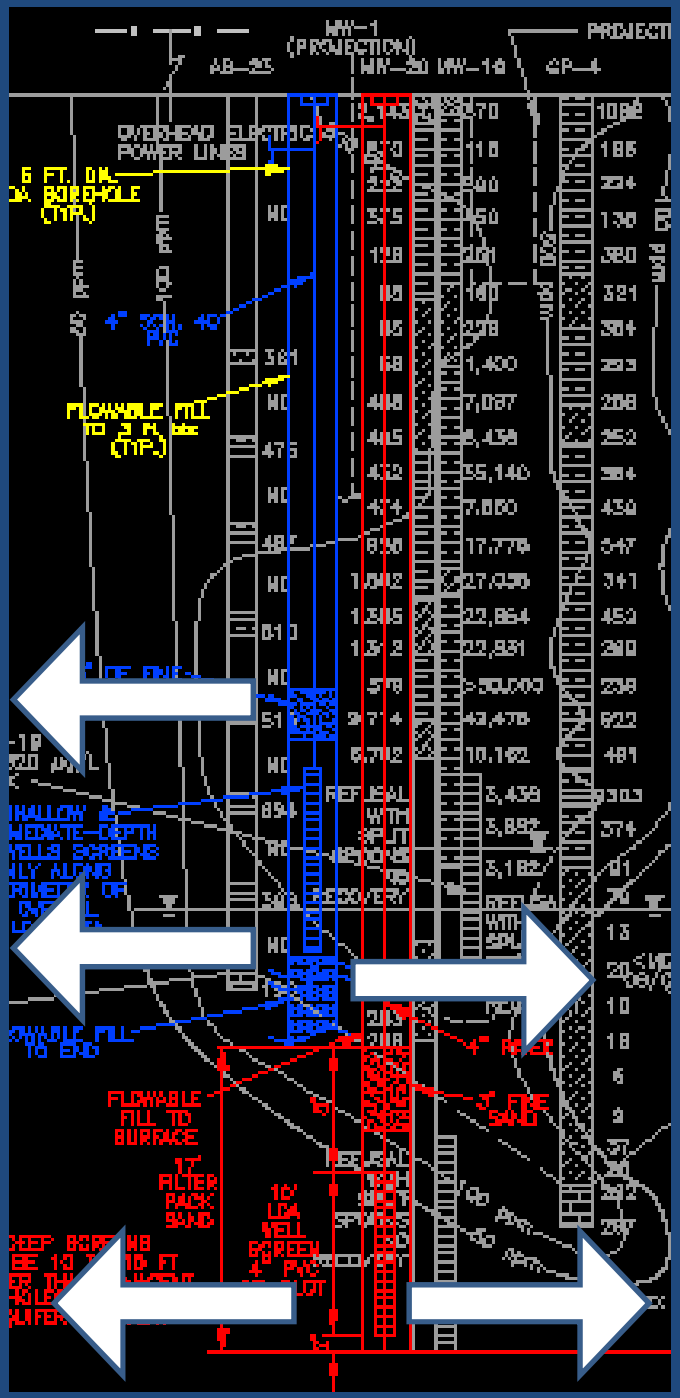
Design Option:

Downhole Treatments:

Chemical or Biological

Aquifer Contact!

(State chose NOT to fund that for this site)



Design:

Backfill
&
COMPACTION

Flowable Fill®

- Self compacting!
- Excavatable Concrete
- 75 - 175 psi vs. 3,500 psi
- Specs.
- Accelerators
- CMT - Flow cone test, etc.

On-site Concrete Batch Plant


7SL
EnviroTek


Hertz
DEERE
JOHN DEERE

Onsite Concrete Truck

Flowable Fill®

Flowable Fill®

“Drill ‘n Fill“

Design → Specs

- RAP + Addenda = "TMI" → Plans / Specs
- *Geotech Engr*: casing, mud
- *Structural PE:* LDA Walls or Pilings
- ACI 336.1-01 "Drilled Piers"
- Flowable Fill® specs – FDOT and NRMCA

ACI 336.1-01

Specification for the Construction of Drilled Piers

Section 3—Execution, p. 336.1-5

3.1—Tolerances
3.2—Dry method
3.3—Steel casing and liner
3.4—Reinforcing steel
3.5—Concrete
3.6—Casing withdrawal
3.7—Slurry displacement method
3.8—Placement of anchorage embedments

Specs: Standards of Practice

Civil Eng'r & Construction Industry

Versus

Environmental

Industry practice =

"Casing, Mud, Tremmie, …"

or

"Numerous LDA digs without"

→ *Terzaghi's "Observational Method"*

- LDA
- Design
- Safety
- Work Plans
- Data Plans

HAZARDS

- Traffic, Power Lines, Utilities
- Workers, truckers/visitors
- Cement dust

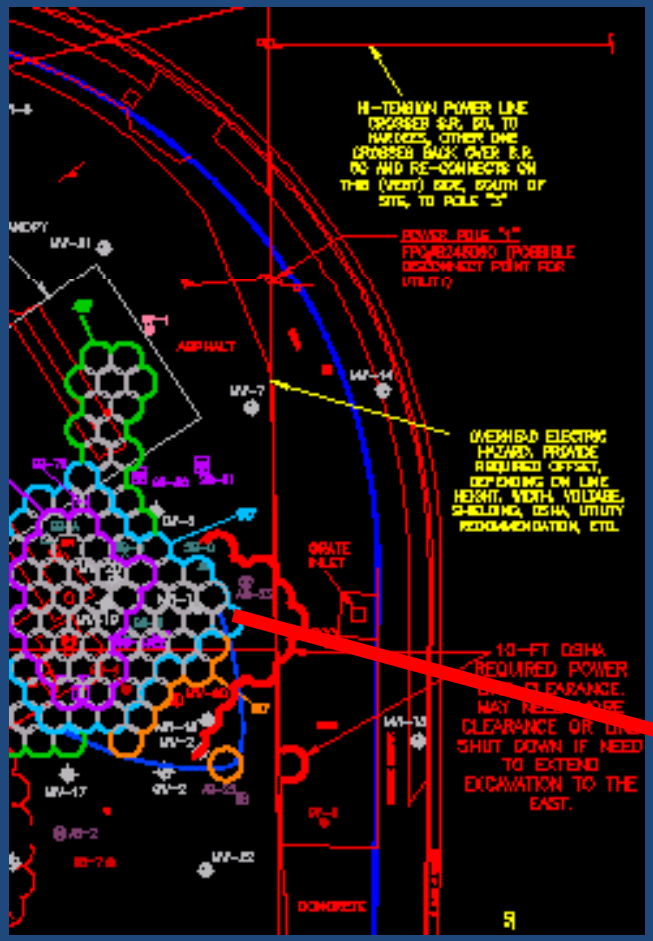
- Downhole fall, low O_2
- Collapse
- Sinkhole
- Rig topple
- Vapor Ignition

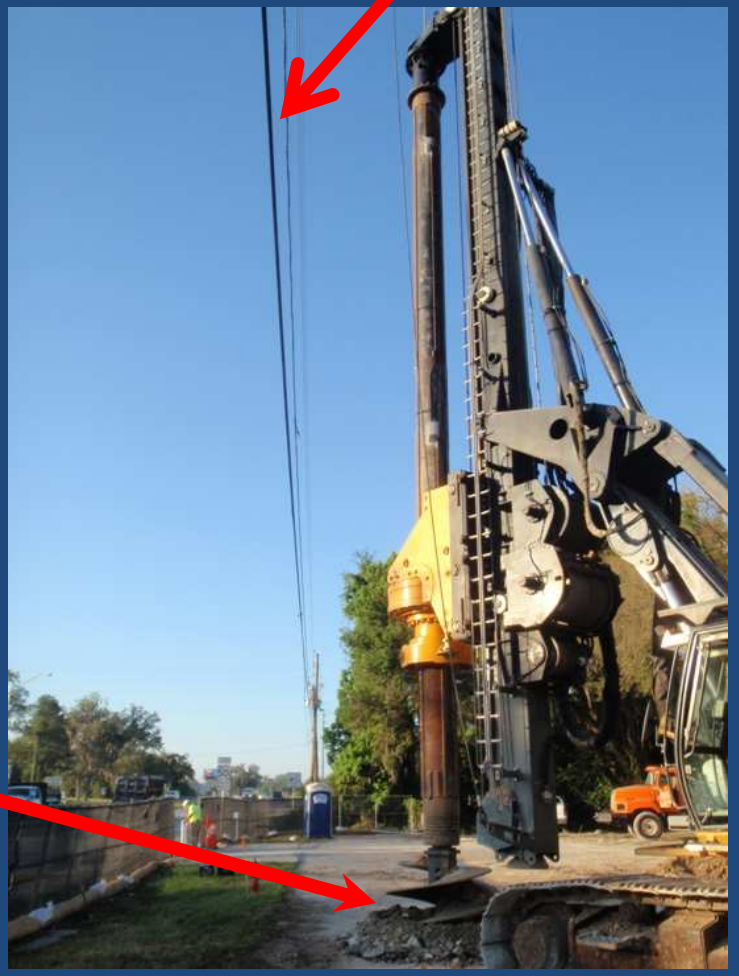
Safety Plan Summary -
1-page outline topics

- **See Safety Map with Hole Clearances**
- **NO OPEN BOREHOLE without the mesh, except *actively* DRILLING**.
- Measure depths: Run Tape over long pipe across hole.
- Screen soils from Spoil Pile zone, away from Hole.
- Screen ambient air - OVA, LEL, Dreagger Tubes
- If need Respirators
- …

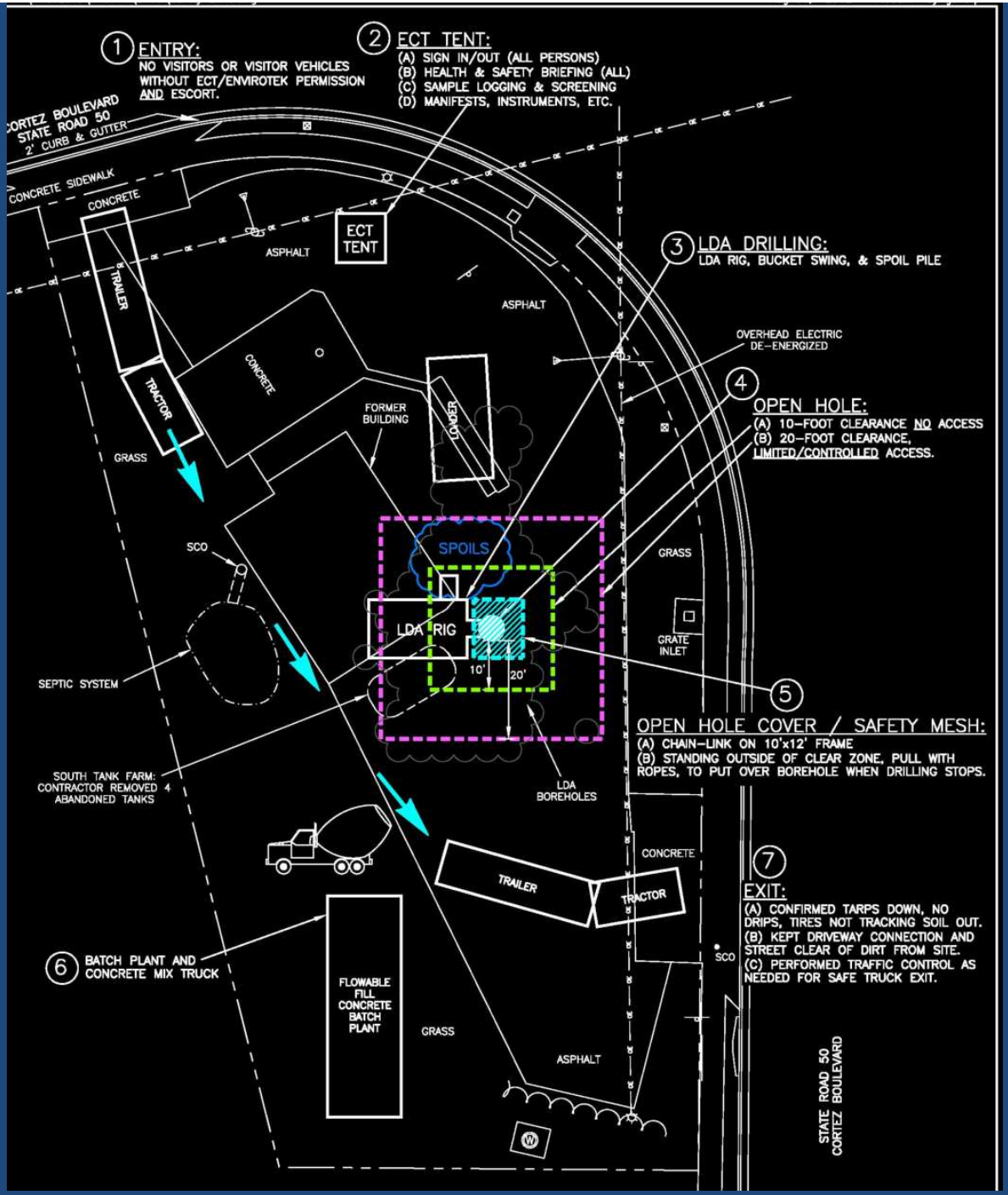
Power Line Clearance or → de-energized!

(not yet summer ☺)





Safety Zones & Work Flow




352-593-SIGN (7446)
FAMILY OWNED
&
OPERATED
QUALITY PRE-OWNED VEHICLES

Traffic Flow

Borehole Cover …

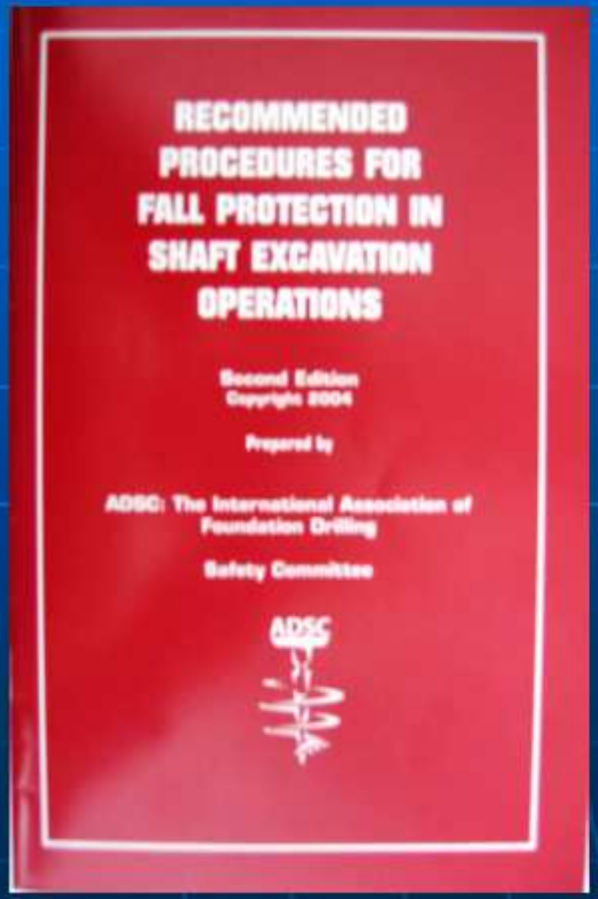
…& Clearance!


ECT
DEERE

Safety References

Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html

Methods of Fall Protection



The ADSC has procedures in place to minimize fall hazards on a drilled shaft project

These procedures compliment the OSHA standards found in CFR1926 Subpart M

Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html

Methods of Fall Protection

Personal Fall Protection

Guardrail System

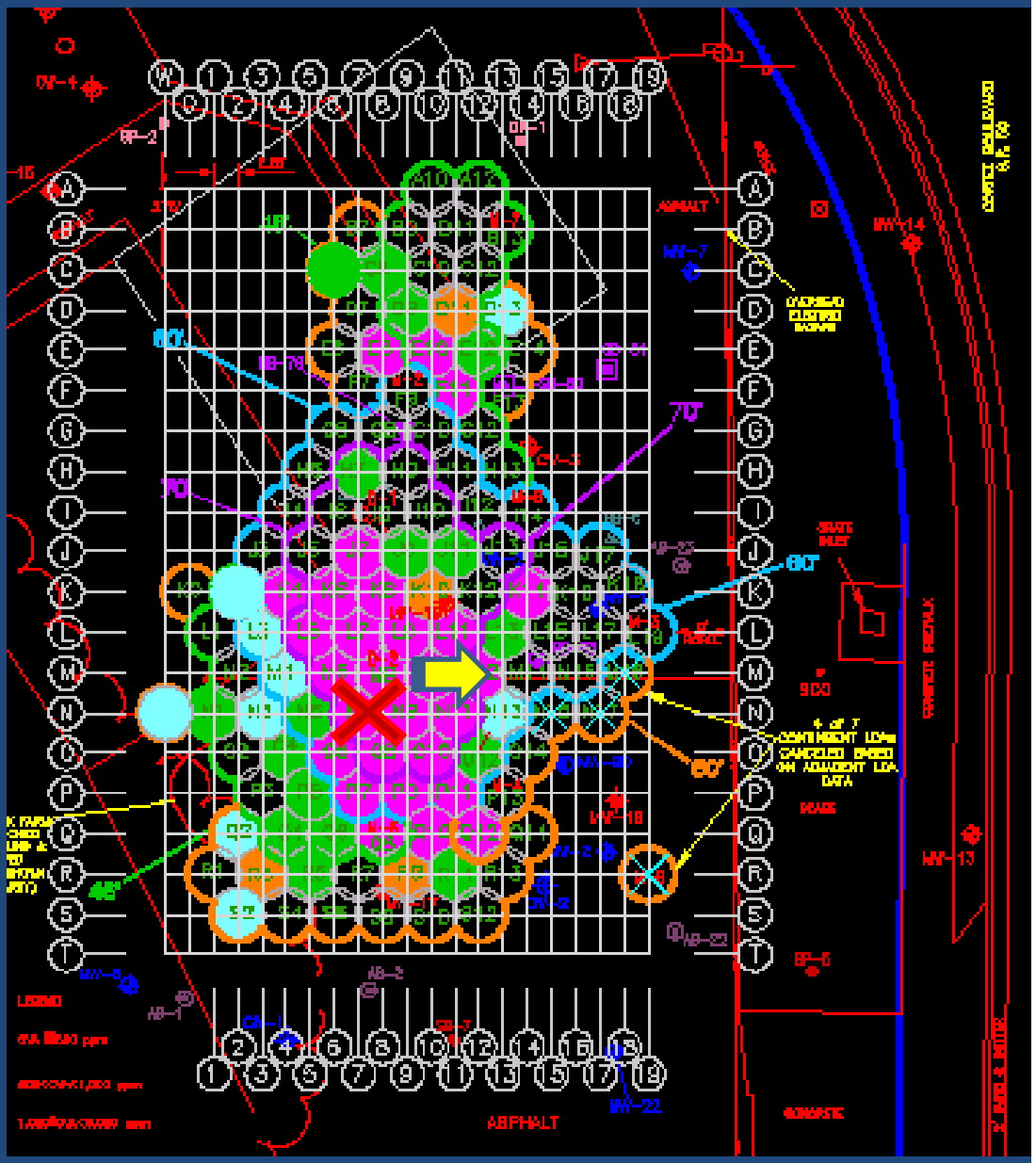
Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html

Fill

Go to:
www.osha.gov/dcsp/alliances/adsc/adsc_20050222_final.html

Measuring: Push long pipe across hole

Fire in the hole!



Downhole Vapor Ignition Options:

- Avoid Hot Zone
- Foams
- Inerting: Liquid Nitrogen, CO_2 (dry ice)
- Over-the-borehole ventilation
- Downhole Ventilation
- Sequence Holes

Vapor Control – basic science:

2.4 MIXTURES—DILUTION VENTILATION FOR HEALTH

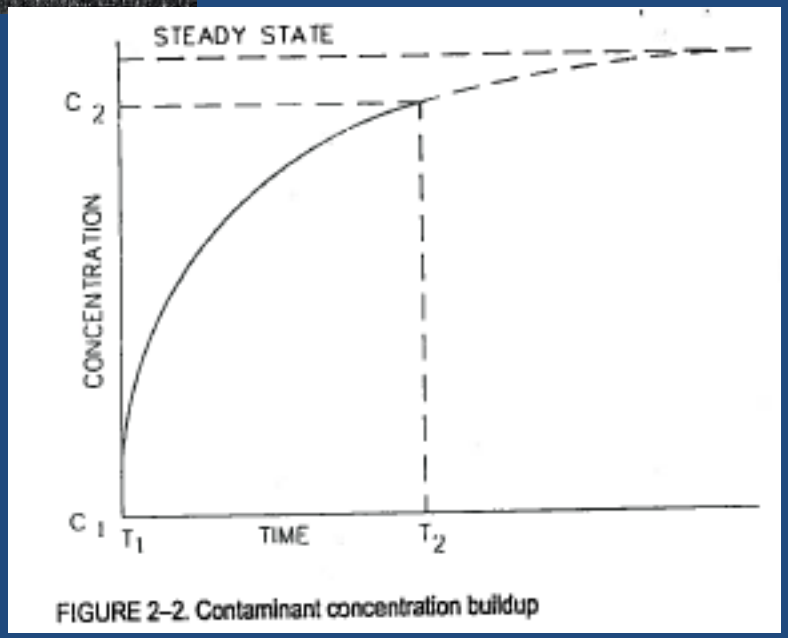


FIGURE 2–2. Contaminant concentration buildup

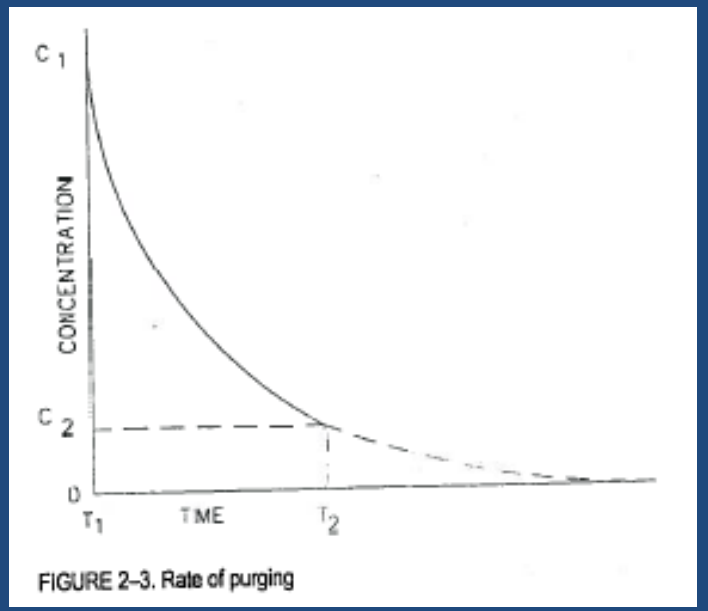
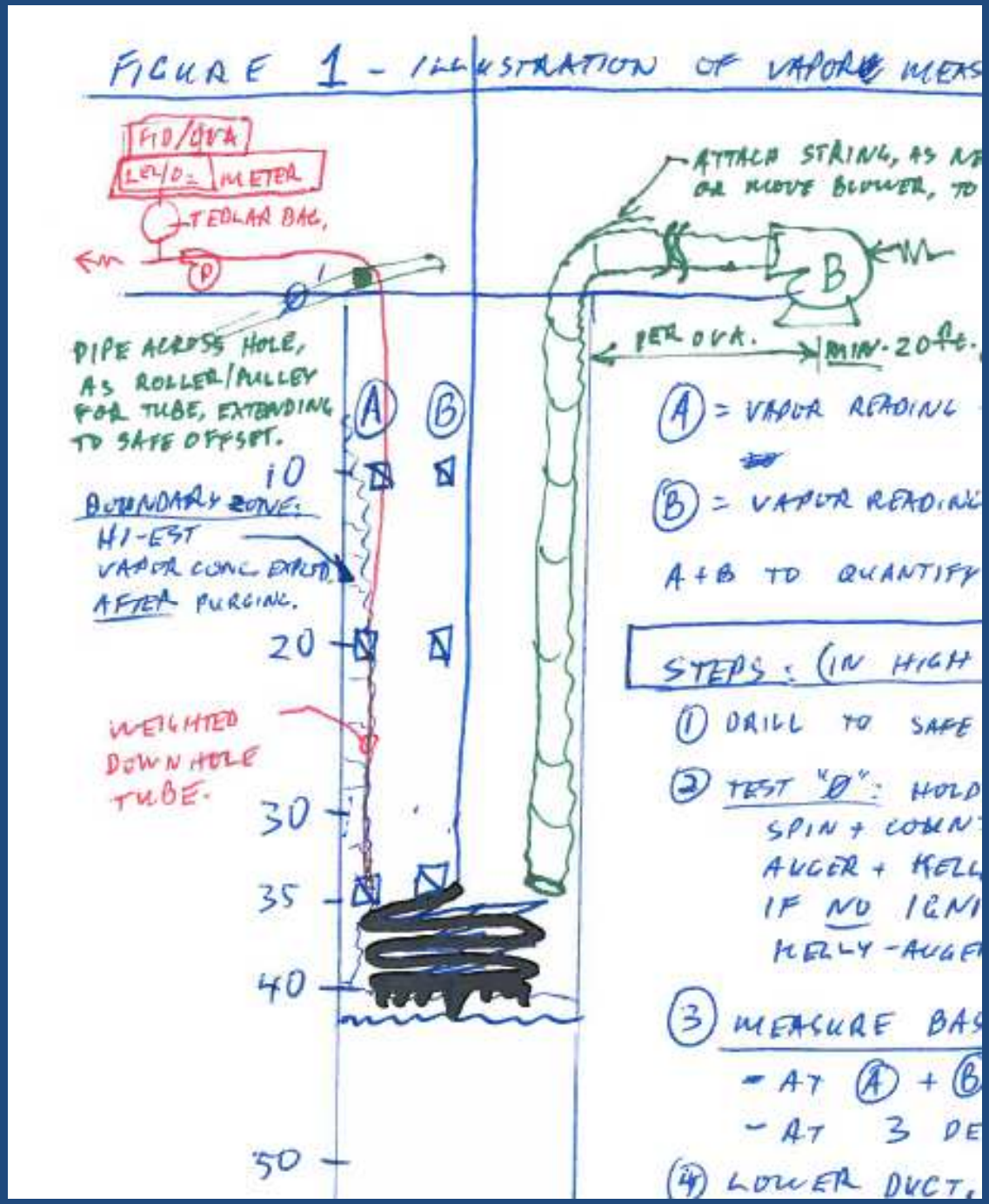


FIGURE 2–3. Rate of purging

Vapor
Measurement
&
Purging

Setup
&
Procedure



Flex Duct:
Not Suitable

Stiff HPDE Drain Tube

Weighted Vapor
Sampling Tube

Instrument & Blower & Duct

LDA Vapor Measurement and Purging

LDA Purging Results: Worked fast!

BORING NO.	TIME	AIR SAMPLE DEPTH (feet)	LEL %	O2 %	OPEN HOLE OVA (ppm)	SOIL OVA (ppm)	COMMENTS
M-8	10:30	10	**39%**	19.2%	F.O.	>50,000	**Pre-Purge**
		20	**0%**	20.9%	99	>50,000	Downhole Air
		30	**100%**	19.2%	72	>50,000	and auger soil samples
		45	**100%**	17.8%	65	508	
	11:00						**Deploy Vent Ducting, Start Blower**
	11:02	45	**44%**	20.0%	5,600		
	11:04	45	**14%**	20.4%	1,922		
	11:07	45	**40%**	20.9%	445		
	11:09	45	**0%**	20.9%	468		
	11:10	45					**Stop Blower**
	11:12	45	**23%**	20.9%	7,346		
	11:14	45	**45%**	20.9%	42,386		
	11:16	45	**51%**	20.8%	34,770		
	11:18	45					**Start Blower**
	11:22	45	**1%**	20.9%	421		
	11:24	45	**2%**	20.9%	344		
	11:26	45	**0%**	20.9%	223		
	11:28					**Stop Blower**	**Pull Air Sample Tubing**
	11:32						Pull Vent Ducting, Restart LDA
	11:39	50	**39%**	20.9%	10,140	626	

- Design
- Safety
- Work Plans
- Data Plans

"What you Expect:

Spec…

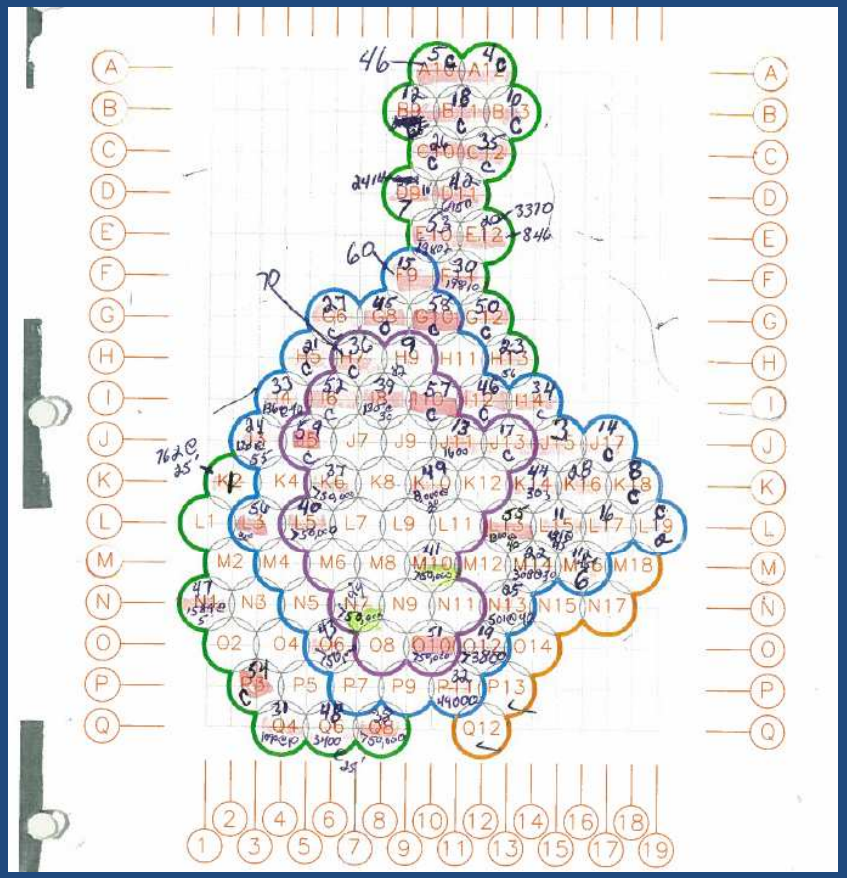
and Inspect!"

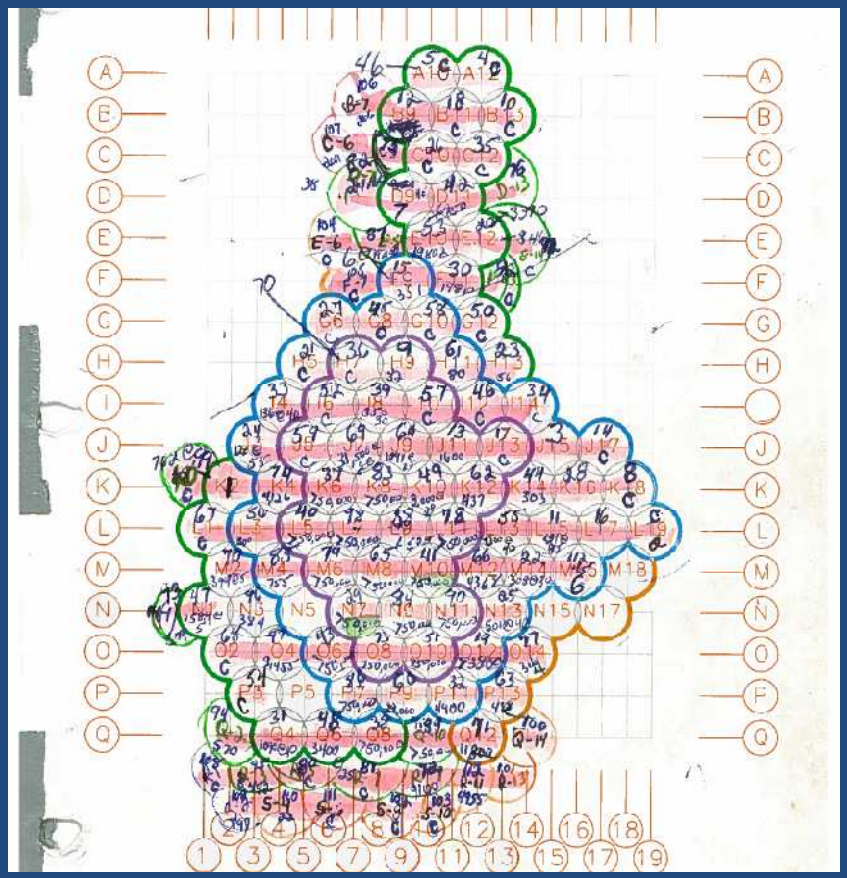
Work Plan Summary -

- RAP, Specs → 2-page outline
- Goals & Scope → **"same page"**
- Map, Monitor, Track…
- **Repeat!** → ***Systematize!***
- End of Day: Closeout & Summary

- Design
- Safety
- Work Plans
- Data Mgt., Eval., Reporting

LDA Progress Map



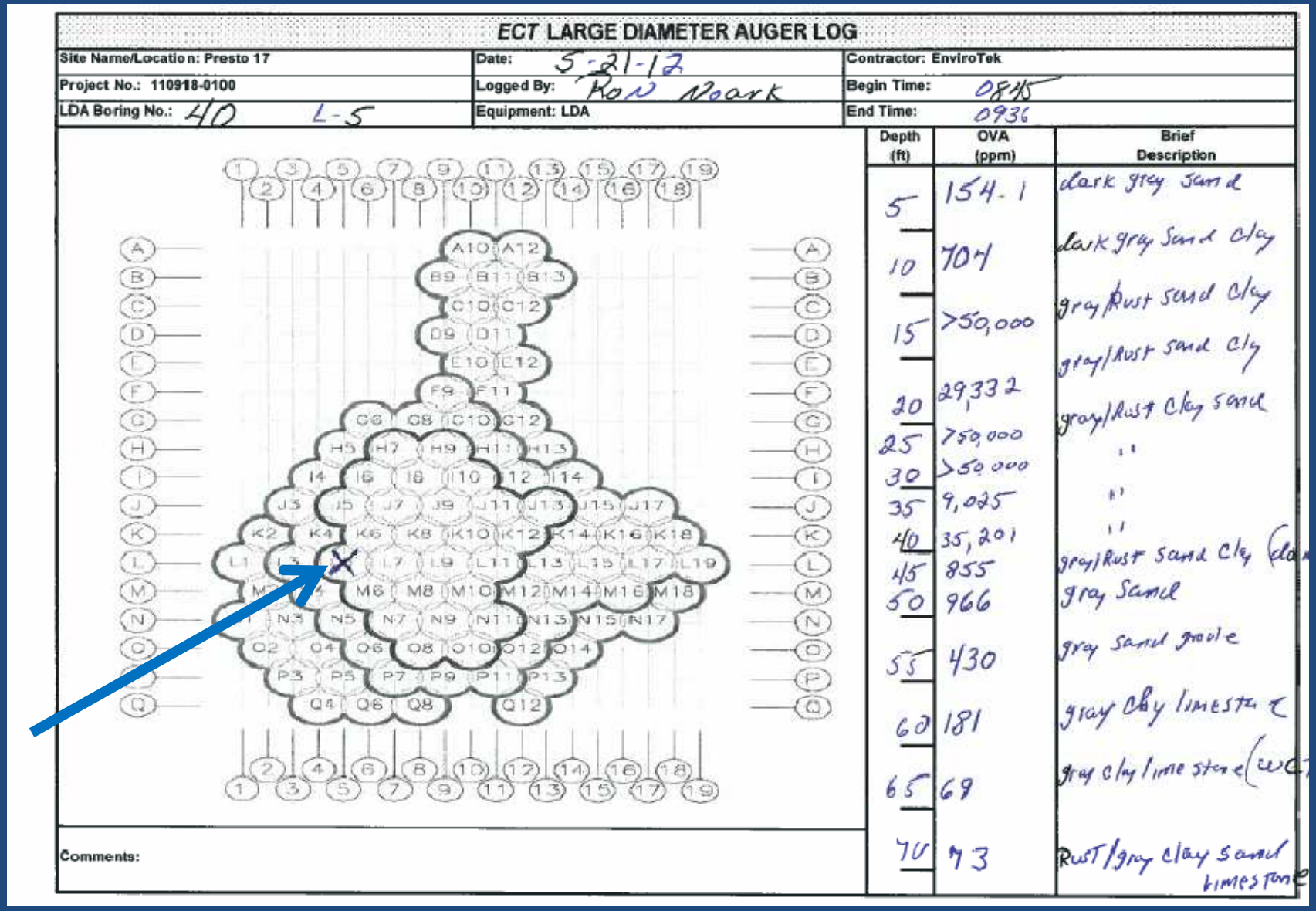


Fill Log

CONCRETE BATCHING LOG

HOLE ID	HOLE DIA/LENGTH	BATCH ID#	YDS	TIME	DATE	VERIFICATION ECT	VERIFICATION ENVIROTEK
H9	66"/70'	1		1226	5-1		
		2		1354			
		3	6 1/2	1436			
		4		1516			
		5		1601			

LDA Log Form



ECT LARGE DIAMETER AUGER LOG

Site Name/Location: Presto 17	Date: 5-21-12	Contractor: EnviroTek
Project No.: 110918-0100	Logged By: Ron Noark	Begin Time: 0845
LDA Boring No.: 40 L-5	Equipment: LDA	End Time: 0936

Depth (ft)	OVA (ppm)	Brief Description
5	154.1	dark gray Sand
10	704	dark gray Sand Clay
15	>50,000	gray/Rust Sand Clay
		gray/Rust Sand Clay
20	29,332	gray/Rust Clay Sand
25	750,000	"
30	>50,000	"
35	9,025	"
40	35,201	"
45	855	gray/Rust Sand Clay (cla
50	966	gray Sand
55	430	gray Sand gravle
60	181	gray Clay limestone
65	69	gray clay limestone (we
70	73	Rust/gray Clay Sand limestone

Comments:

Daily Status Report

(with emphasis added)

Status Report for : Friday, May 25, 2012

URGENT Needs: None

General Needs or Recommendations:
Contaminant extent (added drilling) and vapor mitigation issues.

Daily Production Summary:

			Subtotals
LDA's Completed:	**46-fters:**		**0**
	60-fters:	G-10	**1**
	70-fters:	O-10, J-5	**2**

Totals =

3	**LDA's**
176	**CY, est.**

All Filled by day's end? **No**

If not, which open? J-5

Secured? Yes

Contaminated Soil Loaded/Hauled out:

10	Truckloads
290	Approximated Tons

Safety Problems / Issues:

Vapor mitigation measures attempted. Downhole ducting failed to perform and was unworkable. PA and RC devised alternate and submitted VCO to implement. Preparing/attempting next week.

Shutdowns:

At 07:05, the excavator was leaking. Excavator shut down for 3 1/2 two hours. Flowable fill batching and LDA continued, and excavator was repaired and functional before noon.

Day Summary:

Started O-10 on Wednesday, May 23rd and could only go to 40 ft bls. Completed O-10 today to 70 ft bls. At J-5, sloughing between 65 to 70 ft bls. Took multiple trips to get to 70 ft bls. Completed LDA at 69.5 ft bls.

Contamination Extent Issues / Lab Sampling:

ECT engineers and FDEP case mgr to review and authorize added borings needed.

Additional Details:

Fourteen loads of sand were delivered.

Soil Screening -- Typical per-Borehole table

BORING NO.	DATE COLLECTED	DEPTH TO WATER	SAMPLE DEPTH (feet)	BKG (ppm)	TOTAL READING (ppm)	CARBON FILTERED (ppm)	NET READING (ppm)	COMMENTS
N-7	05/15/12		**5**		**>3,857**		**>3857**	
			10				**Flame out**	
			15		10,750		10,750	
			20		17,050		17,050	
			25				**Flame out**	
			30		19,190		19,190	
			35				**Flame out**	
			40		16,725		16,725	
			45		**>50,000**		**>50,000**	
			50		3,348		3,348	
			55				**Flame out**	**Downhole ignition. Fill from M-8 flowed via void to M-12**
			60		1,925		1,925	
			65					No sample, too wet
			70					No sample, too wet

Soil Vapor Data X-Section w/ Recos.

NORTHWEST OUTER LIMIT

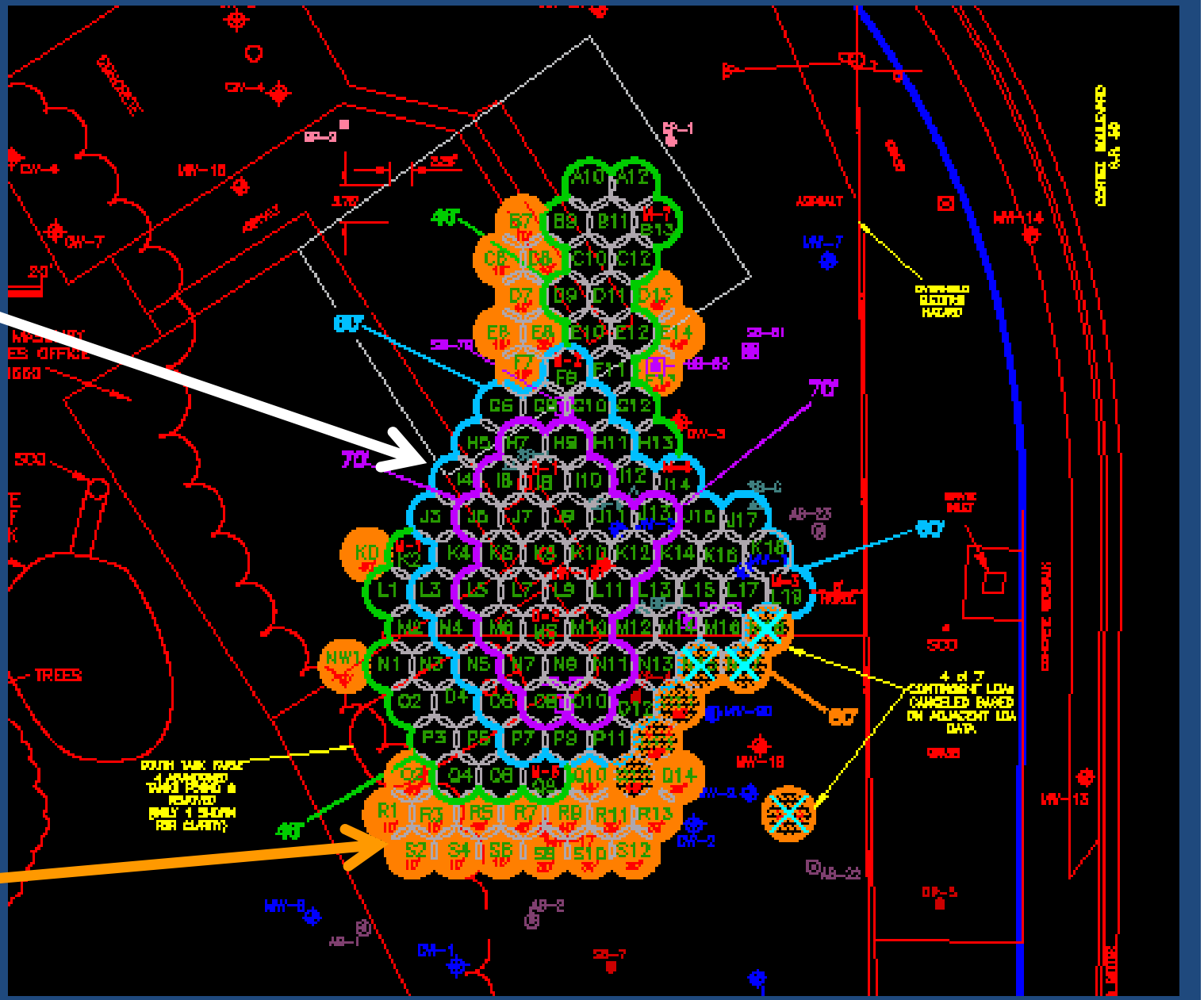
Outer Limit:		No	CO 3	CO 4	CO 4	CO 3	No	CO 3	CO 4	CO 4	Yes	
SAMPLE	E-W ?	West	West	West	West	West	West	West	West	West	West	
DEPTH	N - S ?	North	North	North	North	North	North	North	North	North	North	
(feet)	LDA #	C-10	C-8	B-7	C-6	D-7	E-10	E-8	E-6	F-7	F-9	
5		2	2,860	206	2,011	23	19,802	18,950	28	19	61	
10		2	226	34	121	23	3,856	4,187	19	19	351	
15		7	83			19	8,506	518	22	18	114	
20		5	32		managed to	24	3,377	266			149	
25		7	28		get west wall	18	5,274	846			271	
30		10	28		sample:	16	737	74			42	
35		6	39		38 ppm.	26	100	24			44	
40		7	24		so good.	26	46				37	
45		13					30				38	
50											5	
55					some data						3	
60					pending						37	
65												
70												Subtotal
Recommended DEPTH				10	10				30	15		65

Results / Reporting

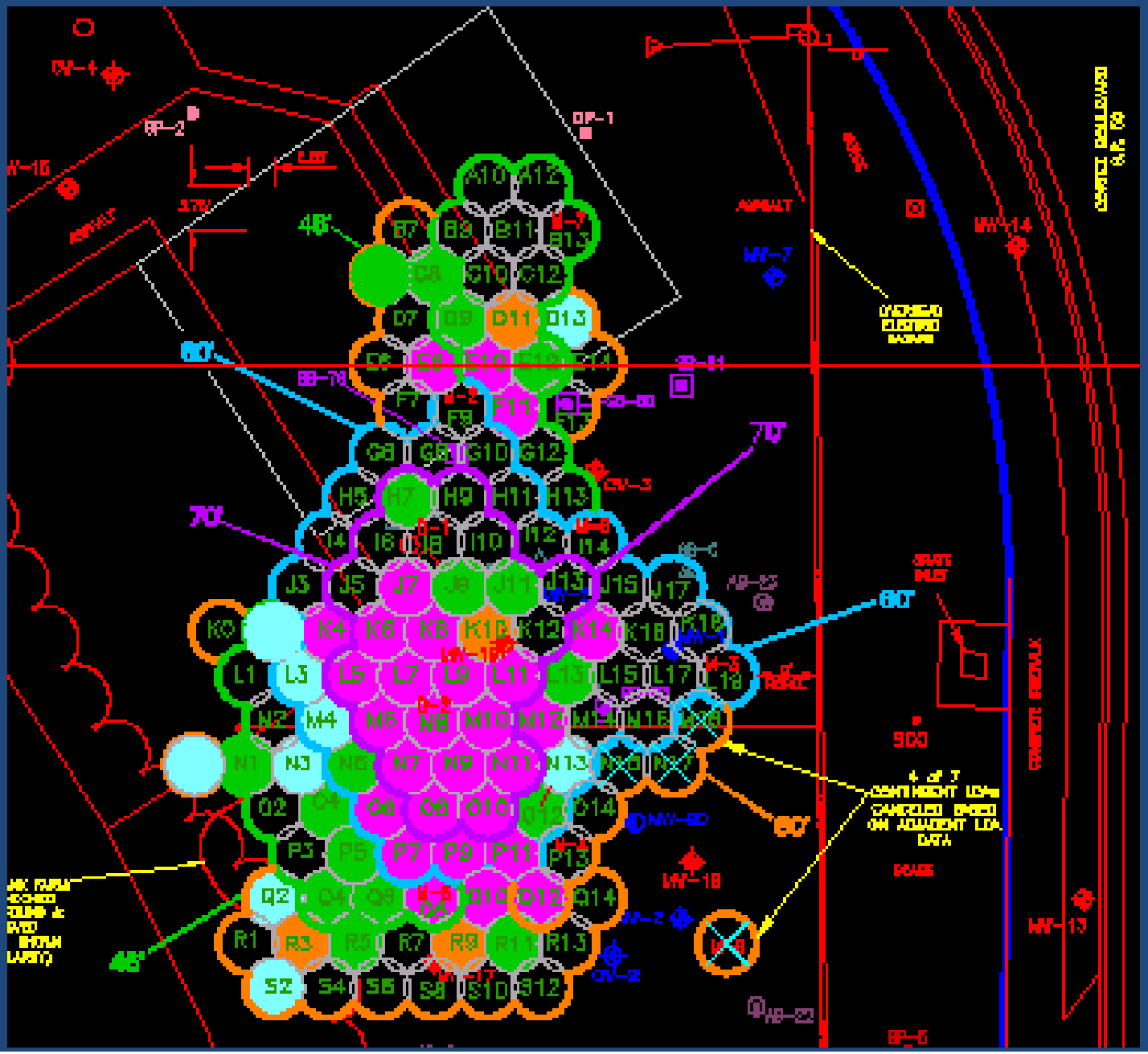
Completed Extent

Original Approval

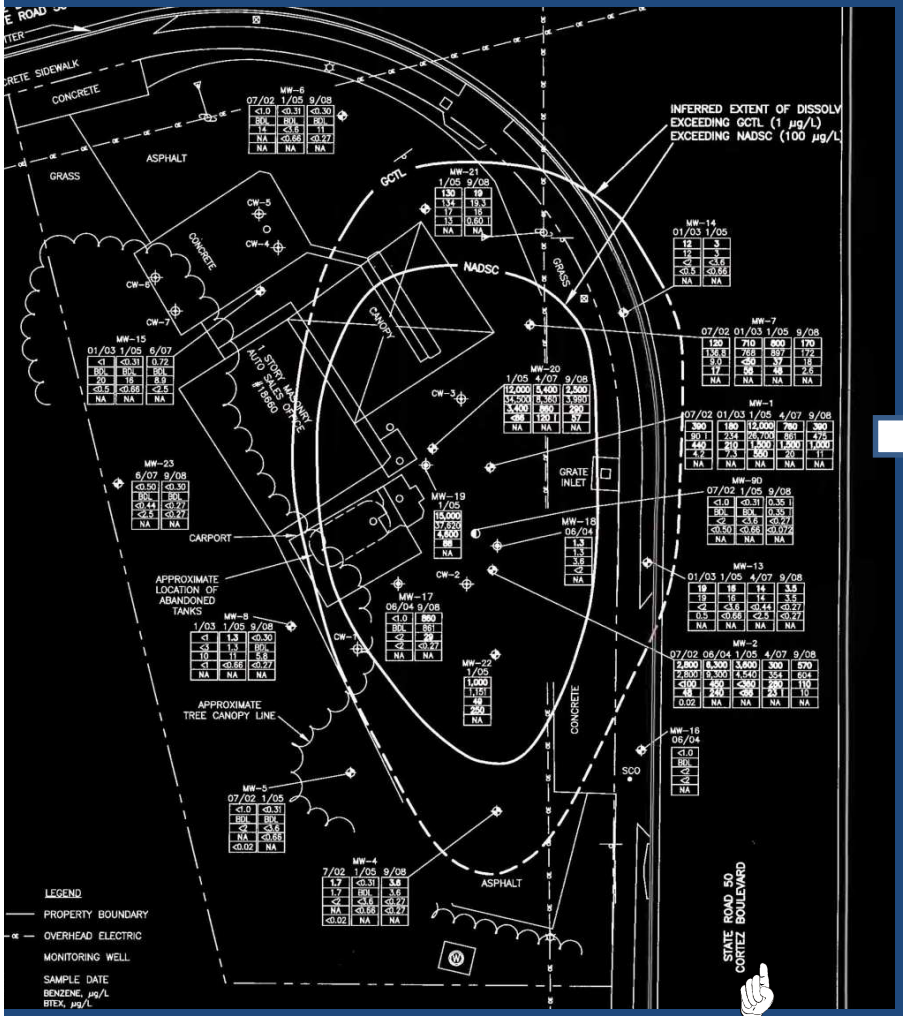
Final Additions As-built

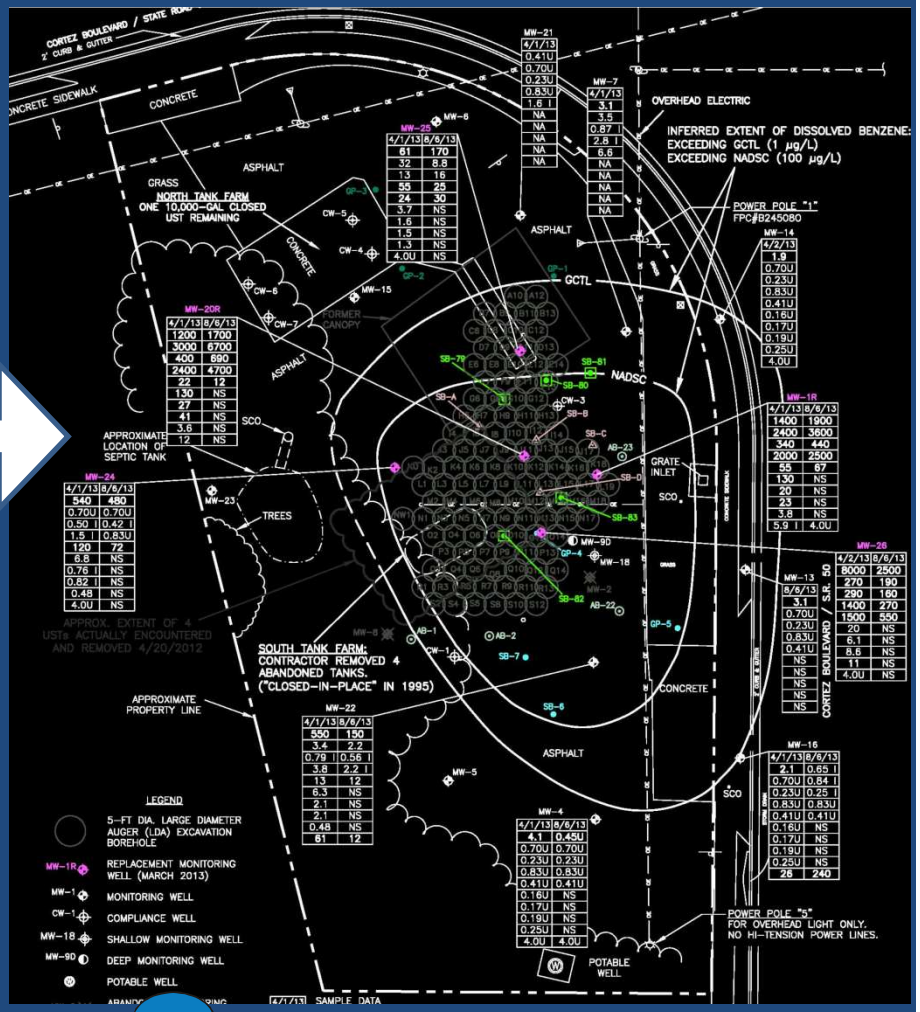


Vapor Data Summary Map



Pre-Dig vs. Post-Dig GW





Smaller plume,

Still high BTEX area.

→ Downhole Treatments

Cleanup by 70-foot-deep LDA Vertical Excavation:

Design, Methods, and Safety, plus Vapor Ignition Control, Contaminant Monitoring, and Fast-tracked Data Evaluation for Dig Limit Refinements

- Paco Amram, P.E., LEED AP
- Environmental Consulting & Technology, Inc. (ECT)
- 1408 North Westshore Blvd., Suite 115
- Tampa, Florida 33607
- 813-289-9338, cell 813-503-6319
- pamram@ectinc.com

ECT Environmental Consulting & Technology, Inc.