



# TOP OF CASING (TOC) ELEVATION SURVEY

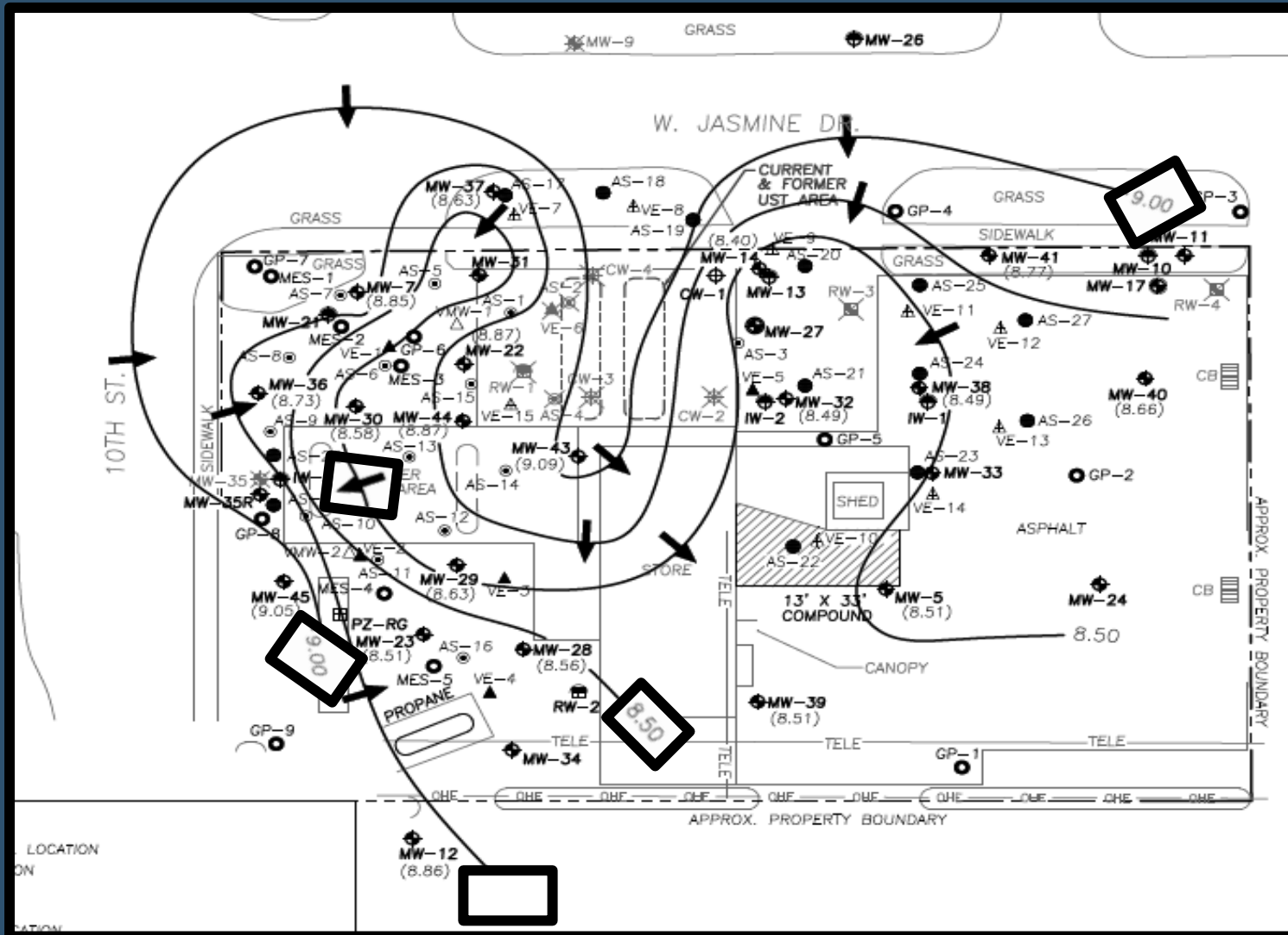
**Jennifer L. Rogers, P.E.**

Division of Waste Management / Petroleum Restoration Program  
Florida Department of Environmental Protection

Tallahassee, FL | Feb. 21, 2024



# TOC ELEVATION SURVEY



## Agenda:

### Top of Casing (TOC) Elevation Survey

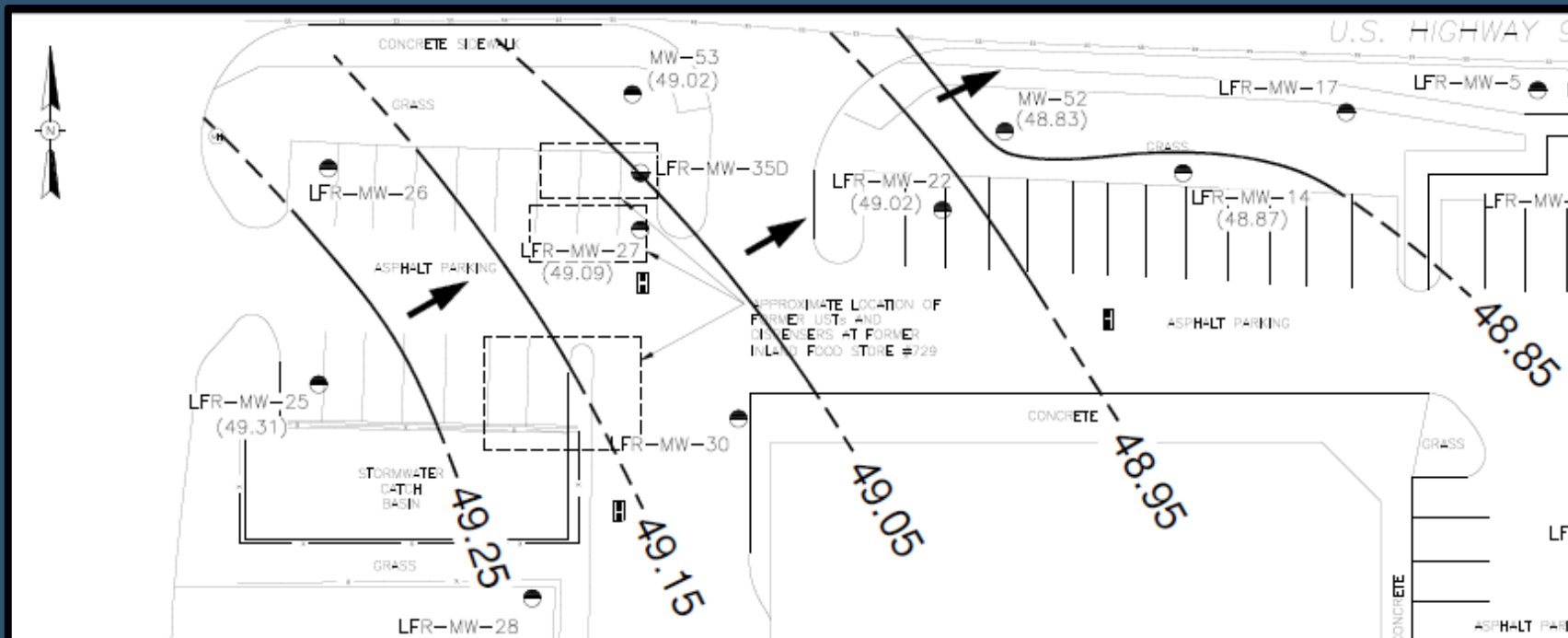
- Why review TOC elevation surveys?
- Agency Term Contract (ATC) Requirements.
- Terminology.
- ATC Contractor Documentation.
- Reviewing Documentation.
- Calculations.



# TOC ELEVATION SURVEY

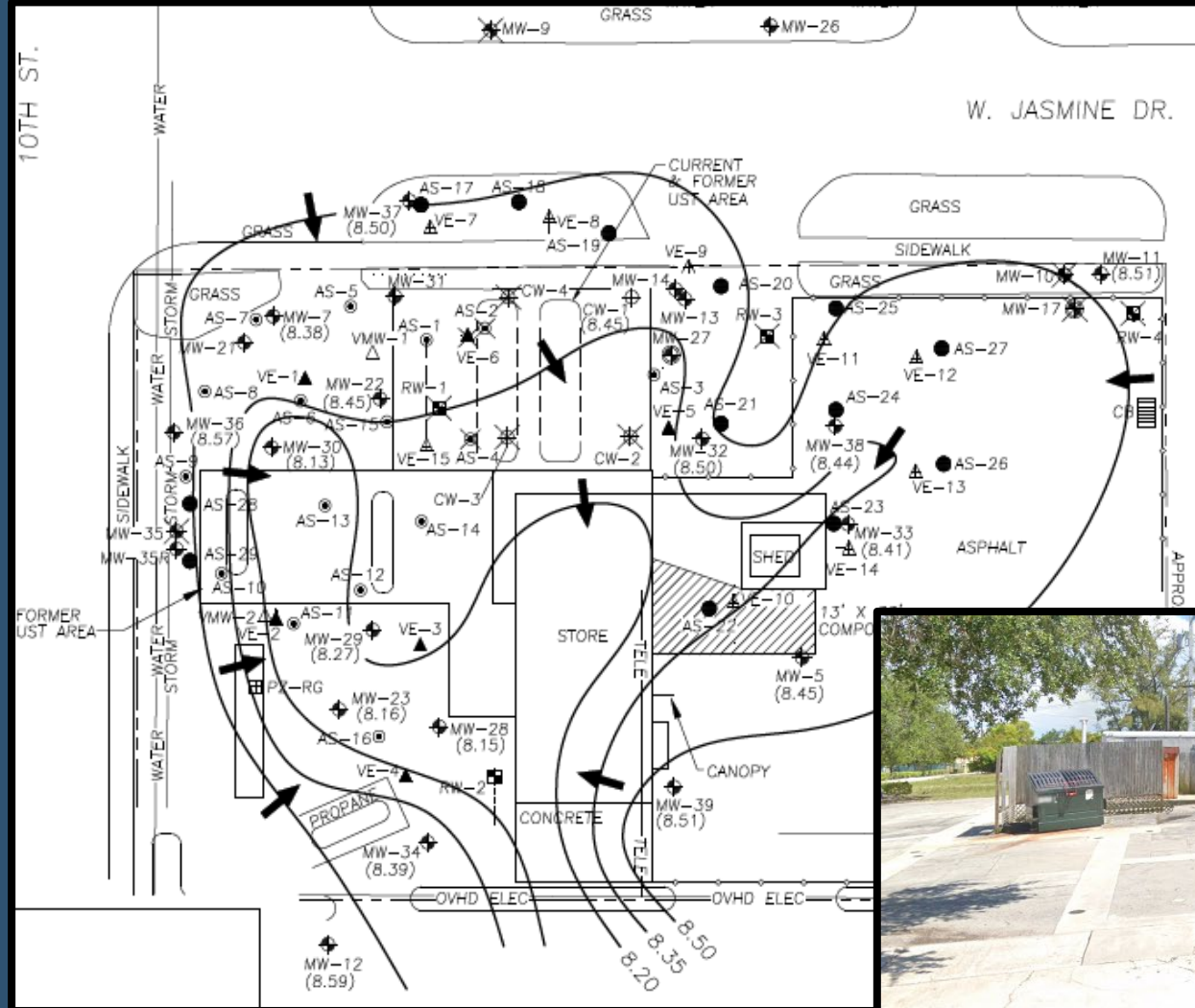
## Why Review TOC Elevation Surveys?

- Groundwater elevation is based on TOC elevation.
  - $GW \text{ Elevation} = TOC \text{ Elevation} - \text{Depth To Water (DTW) measurement}$ .
- Groundwater Elevation Maps.
  - Used to determine upgradient, side-gradient, downgradient wells, etc.



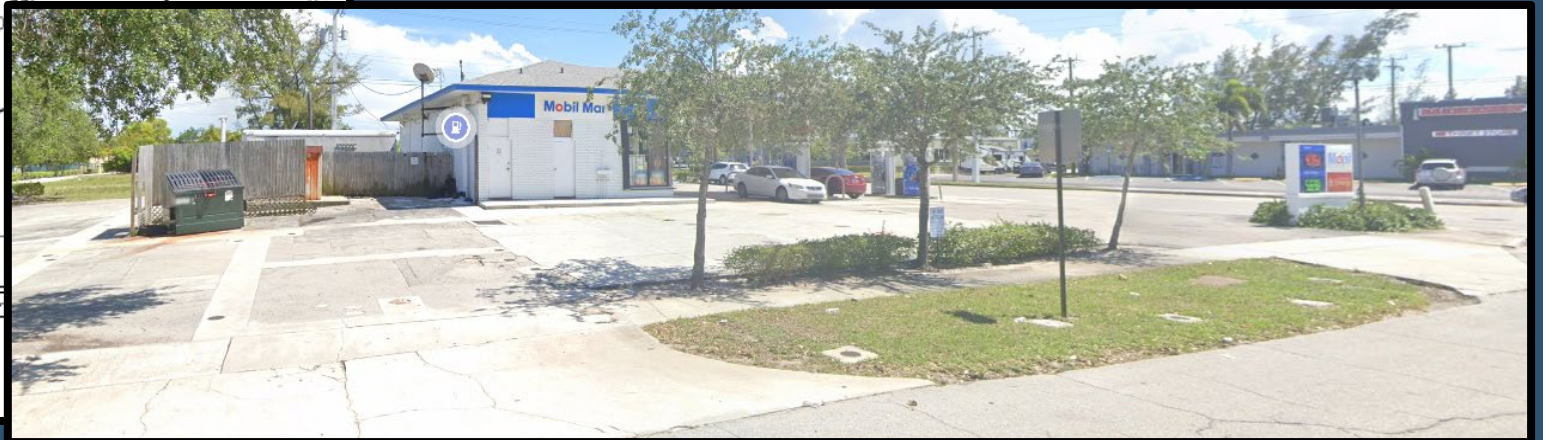


# TOC ELEVATION SURVEY



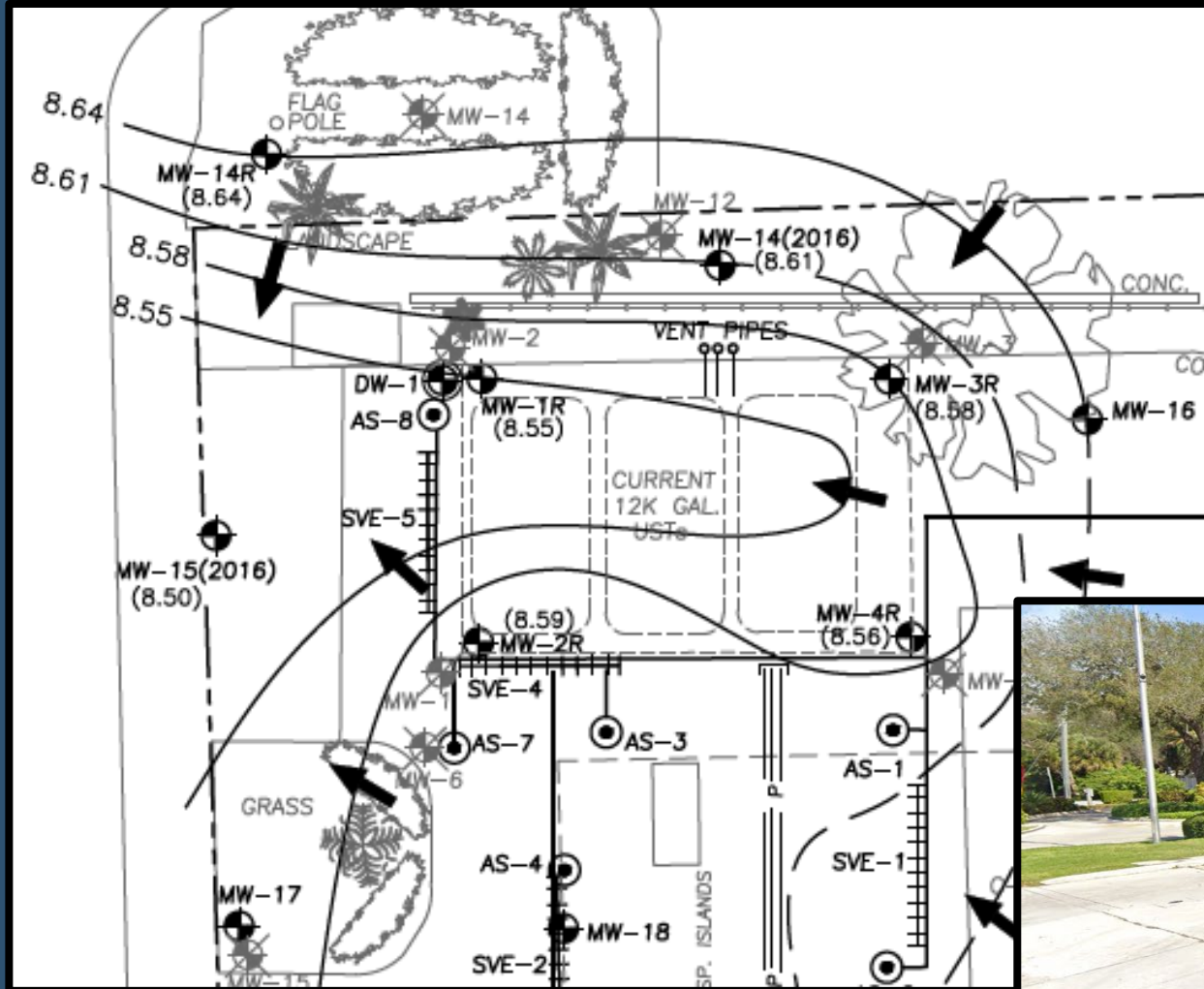
## Why Review TOC Elevation Surveys?

- Groundwater Elevation Maps.
- Example:
  - Plausible contours?
  - Across the site, the groundwater elevation varies by:
    - 0.36 ft. (4.3 in.).
  - Upgradient, Downgradient wells?



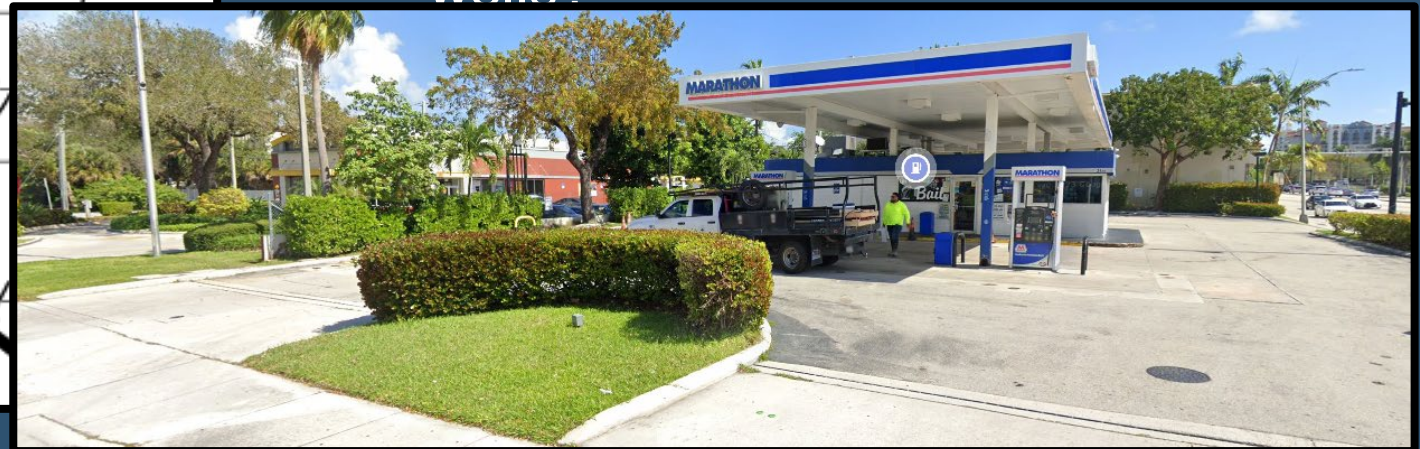


# TOC ELEVATION SURVEY



## Why Review TOC Elevation Surveys?

- Groundwater Elevation Maps.
- Example:
  - Plausible contours?
  - Across the site, the groundwater elevation varies by:
    - 0.14 ft. (1.7 in.).
  - Upgradient, Downgradient wells? wells?



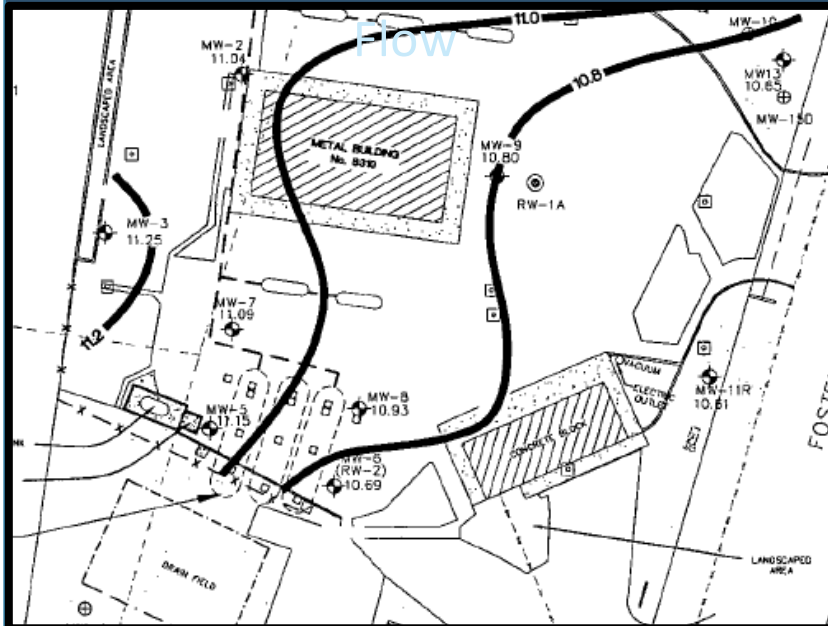


# TOC ELEVATION SURVEY

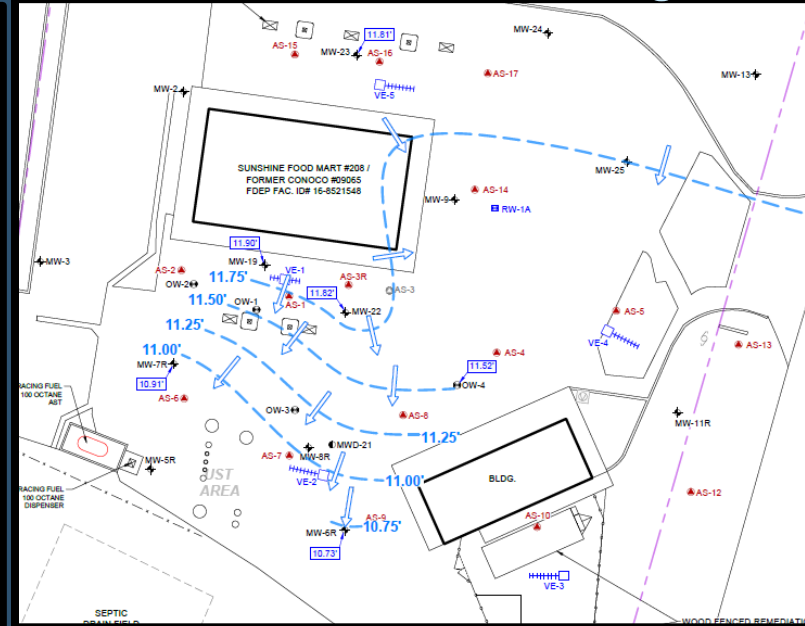
## Why Review TOC Elevation Surveys?

- Groundwater Elevation Maps.
- Example:
  - Changes over time as wells added (beyond seasonal fluctuations)?
  - Upgradient, Side-gradient, Downgradient well location(s)?

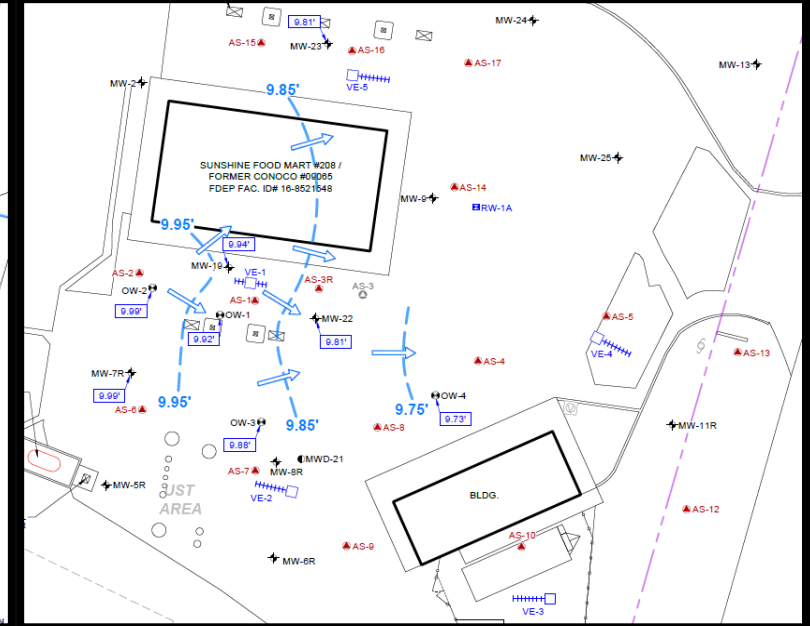
### Historical Groundwater



### Groundwater Flow Changed

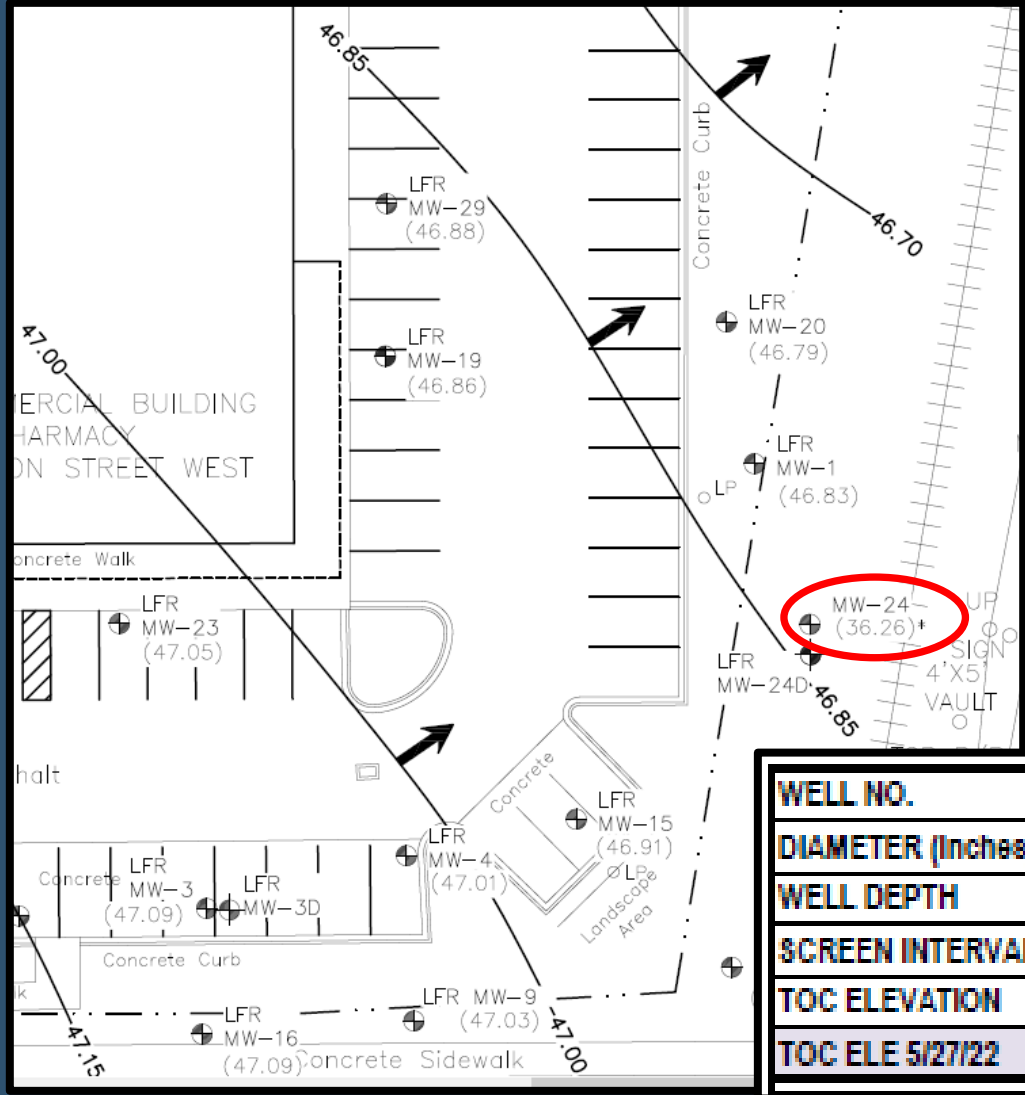


### Groundwater Flow After Resurvey





# TOC ELEVATION SURVEY



## Why Review TOC Elevation Surveys?

- Groundwater Elevation Maps.
- Example:
  - Groundwater Elevation data for select well(s) **not used** for contouring?
  - MW-24 groundwater elevation documented consistently as approximately 10 ft. higher than nearby wells.
    - TOC elevation of MW-24 indicated as approximately 11 ft. lower than directly adjacent well.

WELL NO.	MW-22	MW-24	LFR-MW-24D
DIAMETER (Inches)	2.0	2.0	2.0
WELL DEPTH	62.49	62.20	75.00
SCREEN INTERVAL	47.49 - 62.49	47.20 - 62.20	70-75
TOC ELEVATION	95.19	88.54	99.42
TOC ELE 5/27/22		99.44	



# TOC ELEVATION SURVEY

## Agency Term Contract (ATC) Requirements:

- Well Installation INCLUDES:
  - TOC Elevation Survey.
  - Precision 0.01 ft.

6. **WELL INSTALLATION:** The following pay items will be used to **CONVERT** a soil boring into a well. These pay item costs do **NOT** include the cost of drilling of the borehole which is covered under the Drilling and Boring pay items. All wells will be authorized by the DEP and shall be constructed in accordance with the Petroleum Restoration Program procedure PCS-006, Design, Installation, and Placement of Monitoring Wells and other applicable guidance.

Unless otherwise specified, the following pay items **INCLUDE**:

- g. Field measurement of top-of-casing elevation to a precision of 0.01-foot vertical relative to a common datum or benchmark within 1,000 feet.





# TOC ELEVATION SURVEY

## Terminology

### Backsight (BS)

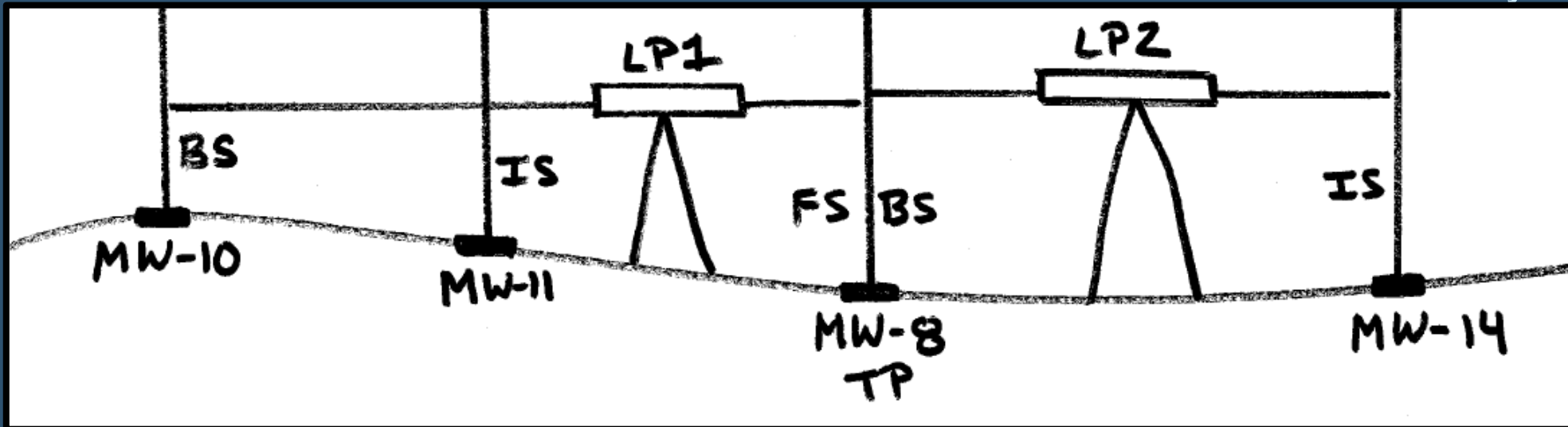
- Start Survey.
- To Existing Location:
  - Monitoring Well.
  - Benchmark.
- Known Elevation.
- Arbitrary Elevation.

### Level Position (LP)

- Location of Level/  
Survey Equipment.
- Small sites, typically one LP.
- Changed using a  
Turning Point.

### Height of Instrument (HI)

- Based on one BS to  
known or arbitrary  
elevation point.
  - **Not an average.**
- Same for each LP.
- $HI = \text{Known Elev.} + BS$
- $HI = \text{Arbitrary Elev.} + BS$





# TOC ELEVATION SURVEY

## Terminology

### Intermediate Site (IS)

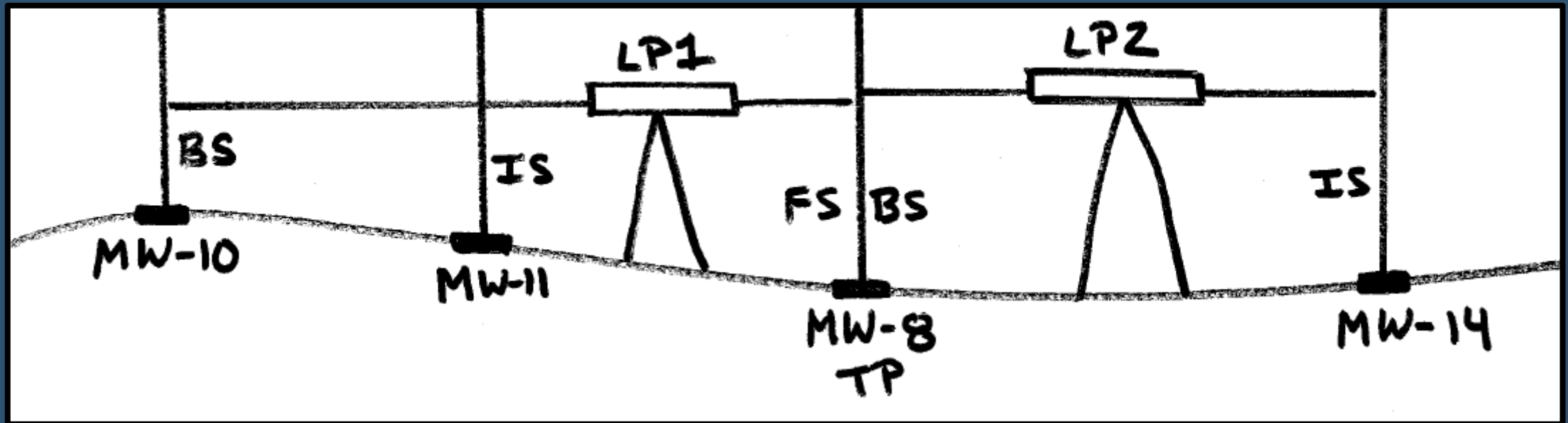
- To New Location(s).
- Unknown Elevation(s).
  - New Well(s).
- May be used to verify existing data.

### Foresight (FS)

- To close survey.
  - Known elevation.
  - Existing Well.
- To Turning Point:
  - Unknown elevation.
  - New Well.

### Turning Point (TP)

- Used to change LP.
- Arbitrary Point.
- Visual from LP 1 and LP 2.
- Un/Known Elevation.
  - New/Existing Well.





# TOC ELEVATION SURVEY

## Intermediate Sights

## Backsight

Survey Point #1

MW-61 = 5.82
MW-16I = 5.50
MW-49 = 5.74
MW-115 = 5.58
FMW-11 = 5.79
MW-62 = 5.84
IMW-05R = 6.58
MW-50R = 6.86
MW-17I = 8.46
MW-48R = 8.56
IMW-03 = 4.05

Survey Point #2

MW-18I = 5.78
MW-64 = 6.08
FMW-07 = 5.71
MW-25R = 5.85
MW-2PR = 5.88
MW-26R = 4.98
MW-15I = 4.75
MW-60 = 4.72
MW-30 = 8.12
MW-65 = 4.67

Survey Point #3

MW-65 = 6.01
MW-52 = 4.02
MW-10 = 5.43
IMW-03 = 5.41
MW-66 = 6.33
IMW-07 = 5.83

6-21-22 Mobil Lake Park Cont  
Survey Data

NEW MW	Survey	OLD MW	Survey
40-	8.15	30	5.96
41-	7.02	32-	5.08
IW1-	5.94	36-	4.76
IW2-	4.32	35R	4.78 TB
43-	3.67	21-	4.86
44-	4.32	15-	3.98
45-	4.66		
IW3-	4.74		
46-	4.80		

- All samples on ice  
- Packed up equipment  
- All wells are sense  
1500-offsite

## ATC Contractor Documentation

- Field notes.
  - Preferably includes calculations conducted in the field to verify:
    - Accuracy of survey.
    - Existing TOC Elevations. Prior to demobilization!
- Examples:
  - Typically, only backsight and intermediate sights provided.
  - Calculations not completed in field.



# TOC ELEVATION SURVEY

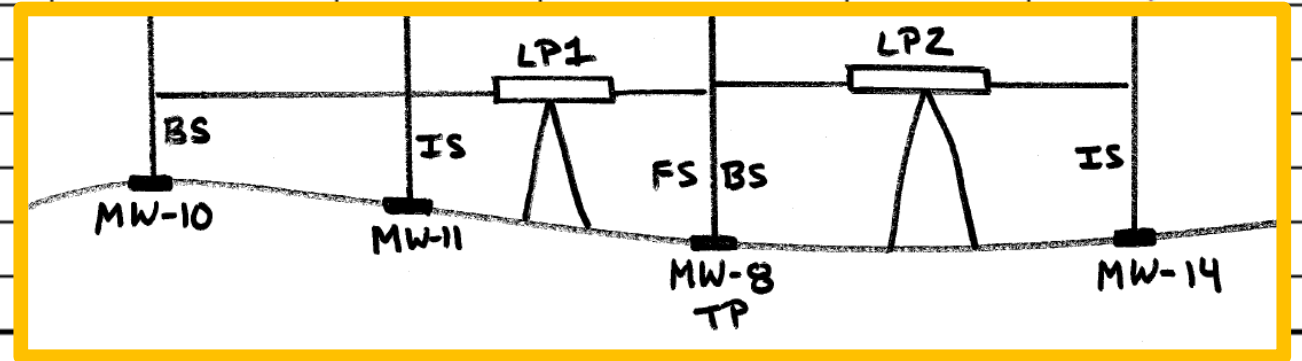
## TOC Elevation Calculations

Project Site/FacID:

TOC Elevation Check by:

Example: Known TOC Elevation for Backsight.

Location ID	New or Existing	Back Site (BS)	Intermediate Site (IS)	Fore Sight (FS)	Height of Instrument (HI)	Reduced Level*	Remarks	Level Position	If backcheck, matches prior?
MW-10	Existing	4.51			108.76	104.25	Reference Point	LP 1	
MW-11	New		5.21		108.76	103.55		LP 1	NA
MW-12	New		5.32		108.76	103.44		LP 1	NA
MW-13	New		5.01		108.76	103.75		LP 1	NA
MW-5	Existing		4.89		108.76	103.87		LP 1	check rpt table
MW-8	Existing			4.95					
MW-8	Existing	5.32							
MW-14	New		5.56						
MW-15	New		5.48						
MW-8	Existing			5.32					



\* Reduced Level = TOC Elevation

HI = Reduced Level + BS

\*\* Benchmark may be arbitrary

HI = 104.25 + 4.51 = 108.76



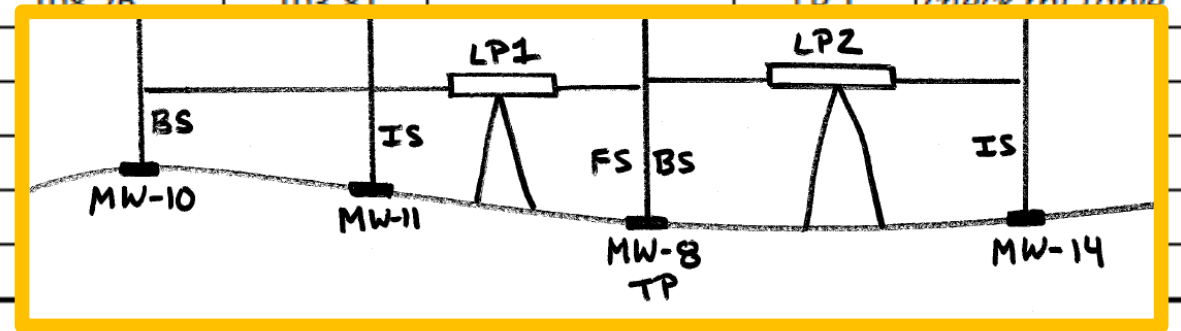
# TOC ELEVATION SURVEY

## TOC Elevation Calculations

Project Site/FacID:

TOC Elevation Check by:

Location ID	New or Existing	Back Site (BS)	Intermediate Site (IS)	Fore Sight (FS)	Height of Instrument (HI)	Reduced Level*	Remarks	Level Postion	If backcheck, matches prior?
MW-10	Existing	4.51			108.76	104.25	Reference Point	LP 1	
MW-11	New		5.21		108.76	103.55		LP 1	NA
MW-12	New		5.32		108.76	103.44		LP 1	NA
MW-13	New		5.01		108.76	103.75		LP 1	NA
MW-5	Existing		4.89		108.76	103.87		LP 1	check rpt table
MW-8	Existing			4.95	108.76	103.81		LP 1	check rpt table
MW-8	Existing	5.32							
MW-14	New		5.56						
MW-15	New		5.48						
MW-8	Existing			5.32					



\* Reduced Level = TOC Elevation

Reduced Level = TOC Elevation New Well = HI - IS

\*\* Benchmark may be arbitrary

Reduced Level = TOC Elevation New Well = 108.76 - 5.21 = 103.55



# TOC ELEVATION SURVEY

## TOC Elevation Calculations

Project Site/FacID:

TOC Elevation Check by: Example: MW-8 used as Turning Point (TP).

Location ID	New or Existing	Back Site (BS)	Intermediate Site (IS)	Fore Sight (FS)	Height of Instrument (HI)	Reduced Level*	Remarks	Level Position	If backcheck, matches prior?
MW-10	Existing	4.51			108.76				
MW-11	New		5.21		108.76				
MW-12	New		5.32		108.76				
MW-13	New		5.01		108.76				
MW-5	Existing		4.89		108.76				
MW-8	Existing			4.95	108.76	103.81		LP 1	check rpt table
MW-8	Existing	5.32			109.13	103.81		LP 2	
MW-14	New		5.56		109.13	103.57		LP 2	
MW-15	New		5.48		109.13	103.65		LP 2	
MW-8	Existing			5.32	109.13	103.81			

\* Reduced Level = TOC Elevation (LP 1) TOC Elevation MW-8 =  $108.76 - 4.95 = 103.81$

\*\* Benchmark may be arbitrary (LP 2) HI =  $103.81 + 5.32 = 109.13$



# TOC ELEVATION SURVEY

## TOC Elevation Calculations

Example: Arbitrary TOC Elevation for Backsight.

Location ID	New or Existing	Back Site (BS)	Intermediate Site (IS)	Fore Sight (FS)	Height of Instrument (HI)	Reduced Level*	Remarks	Level Postion	If backcheck, matches prior?
MW-1R	New	4.51			104.51	100.00	Reference Point	LP 1	
MW-2R	New		5.21		104.51	99.30		LP 1	NA
MW-3R	New		5.32		104.51	99.19		LP 1	NA
MW-4R	New		5.01		104.51	99.50		LP 1	NA
MW-5R	New		4.89		104.51	99.62		LP 1	NA

\* Reduced Level = TOC Elevation

\*\* Benchmark may be arbitrary

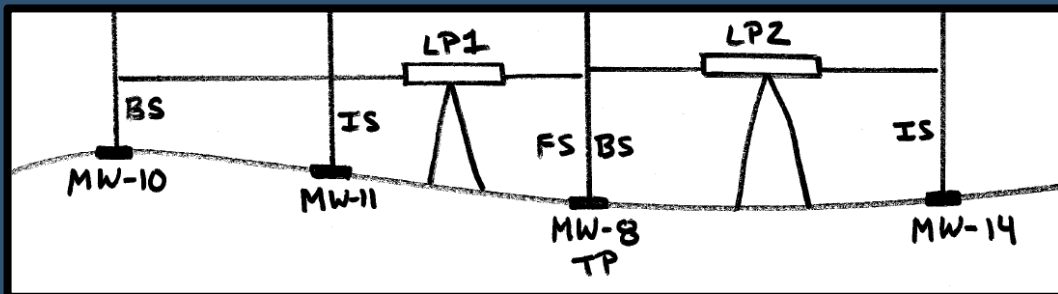
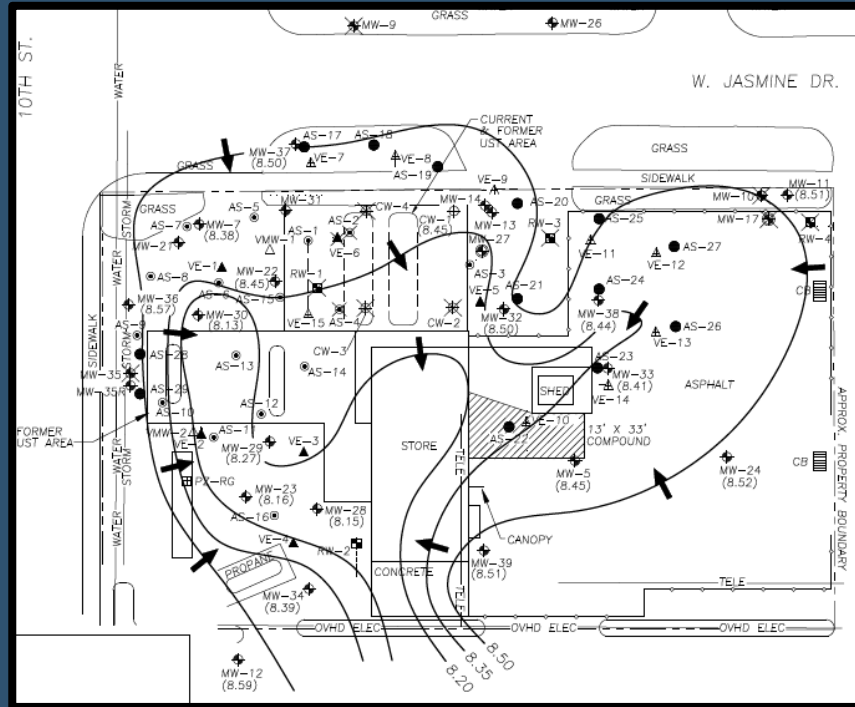
$$HI = \text{Reduced Level} + BS$$

$$HI = 100.00 + 4.51 = 104.51$$

\*\*\* The TOC Elevation is the arbitrary elevation (e.g., 100 ft.); the Height of Instrument is not arbitrary.



# TOC ELEVATION SURVEY



## Summary:

- Why Review TOC Elevation Surveys?
  - Groundwater Elevation Contours.
  - Upgradient, Downgradient wells.
- ATC Requirements.
- Terminology.
- ATC Documentation.
- Reviewing Documentation.
- Calculations.





**QUESTIONS?**



# THANK YOU

**Jennifer L. Rogers, P.E.**

Division of Waste Management / Petroleum  
Restoration Program  
Florida Department of Environmental Protection

Contact Information:

850-245-8919

[Jennifer.L.Rogers@floridadep.gov](mailto:Jennifer.L.Rogers@floridadep.gov)