



Later Stage Remedial Design Refinement Based on Depositional Environmental and Stratigraphic Evaluation

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Introduction and Outline

This project was conducted on behalf of the U.S. Army Corps of Engineers as part of the Formerly Used Defense Sites (FUDS) Program, in consultation with the Maryland Department of the Environment.

Presentation Outline:

- **Background**
- **Timeline**
- **Overview of Groundwater Impacts**
- **Initial Groundwater Injection**
- **Performance Monitoring**
- **Conceptual Site Model Refinement**
- **Remedial Design Refinement**
- **Conclusions**



W-44 Background

Waldorf Nike Missile Battery W-44

- Located in Waldorf, Maryland
- One of 13 Nike Missile sites ringing Washington D.C.
- Land acquired between 1955 and 1960
- Launch area
 - ◆ Two underground missile magazines
 - ◆ Missile assembly building
 - ◆ Generator building
 - ◆ Acid fueling area
 - ◆ Maintenance garage
 - ◆ Barracks
- Sold to Charles County in 1986



W-44 Missile Battery Timeline



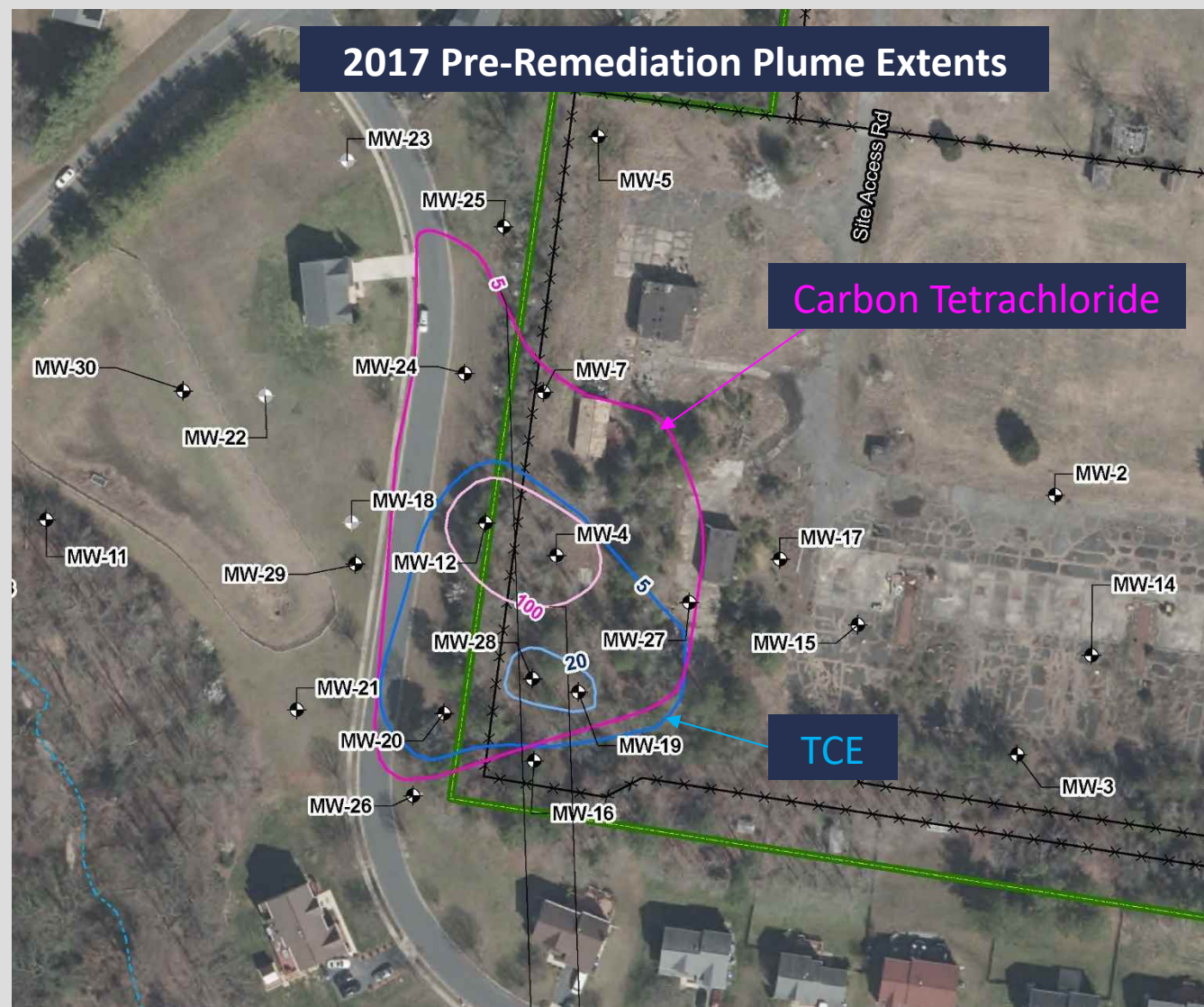
Overview of Groundwater Impacts

Carbon Tetrachloride

- Plume core centered around MW-4/MW-12
- Highest historical concentration = 350 ug/L at MW-4 in 2008

Trichloroethylene (TCE)

- Plume core centered around MW-19/MW-28
- Highest historical concentration = 23 ug/L at MW-19 in 2018



Initial Remedy Implementation

2021 Full-Scale Injection Event

- Chosen remedy = In-situ chemical reduction (ISCR) using zero valent iron
 - ◆ 48,500 pounds of Provect-IR®
 - ◆ 48,500 pounds of sodium bicarbonate
- Injections completed at 194 borings
 - ◆ Three injection intervals per boring
- Completed October-November 2021



Performance Evaluation – Groundwater Monitoring

Post-Injection Performance Groundwater Monitoring

- Conducted quarterly first year post-injection
- Biannual after first year
- Analysis includes:
 - ◆ Volatile organic compounds
 - ◆ Total iron and manganese
 - ◆ Total organic carbon
 - ◆ Methane, ethane, ethene
 - ◆ General chemistry parameters
- Remedial goals achieved within injection area
- May 2023 results indicated remedial goal exceedances for carbon tetrachloride at MW-7, MW-12, MW-20, and MW-24



Performance Evaluation – Soil Borings

Post-Injection Soil Borings

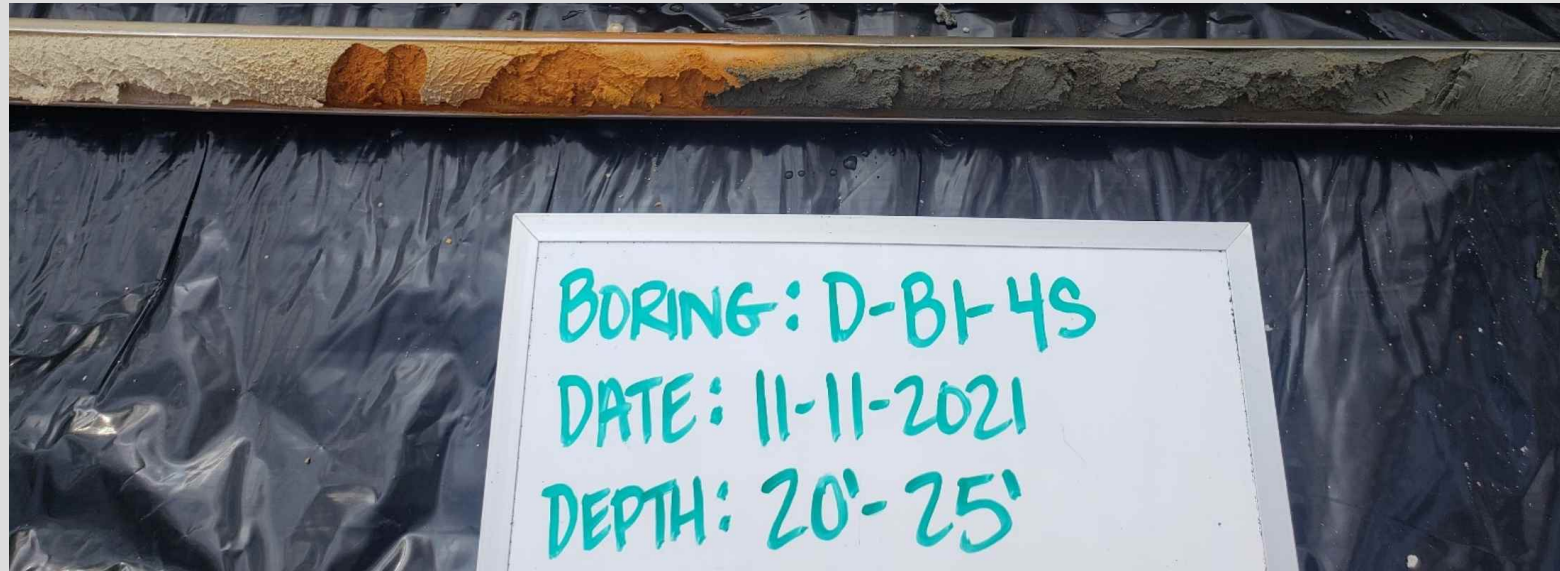
- 20 soil borings advanced in injection areas to assess distribution of injection material
- Additional detailed stratigraphic data

Identification of distinct unit overlying Calvert Formation

- Bright orange, fine sand/silts

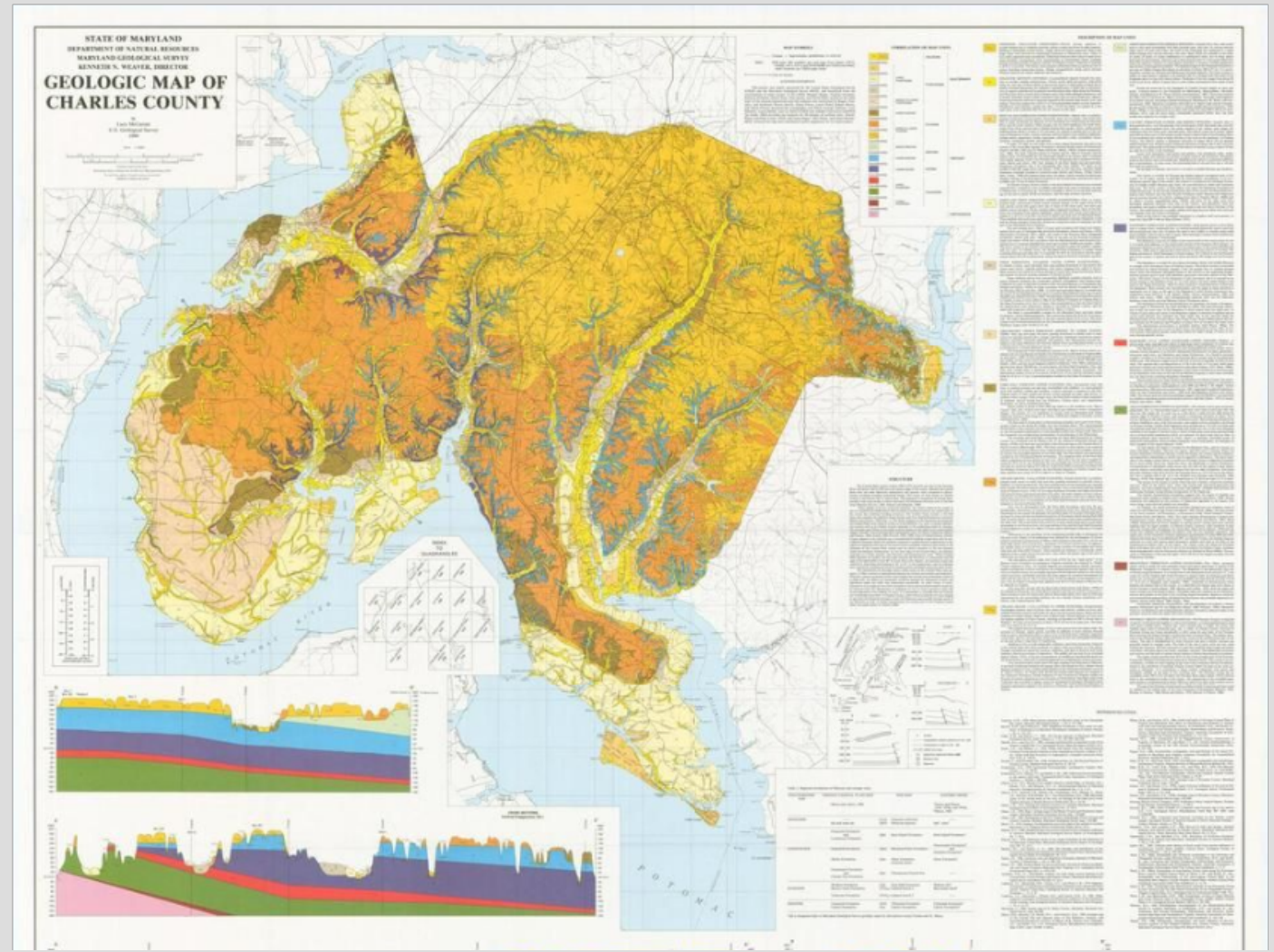
Data used to refine CSM

- Depth to confining units
- North Keys Sands equivalent

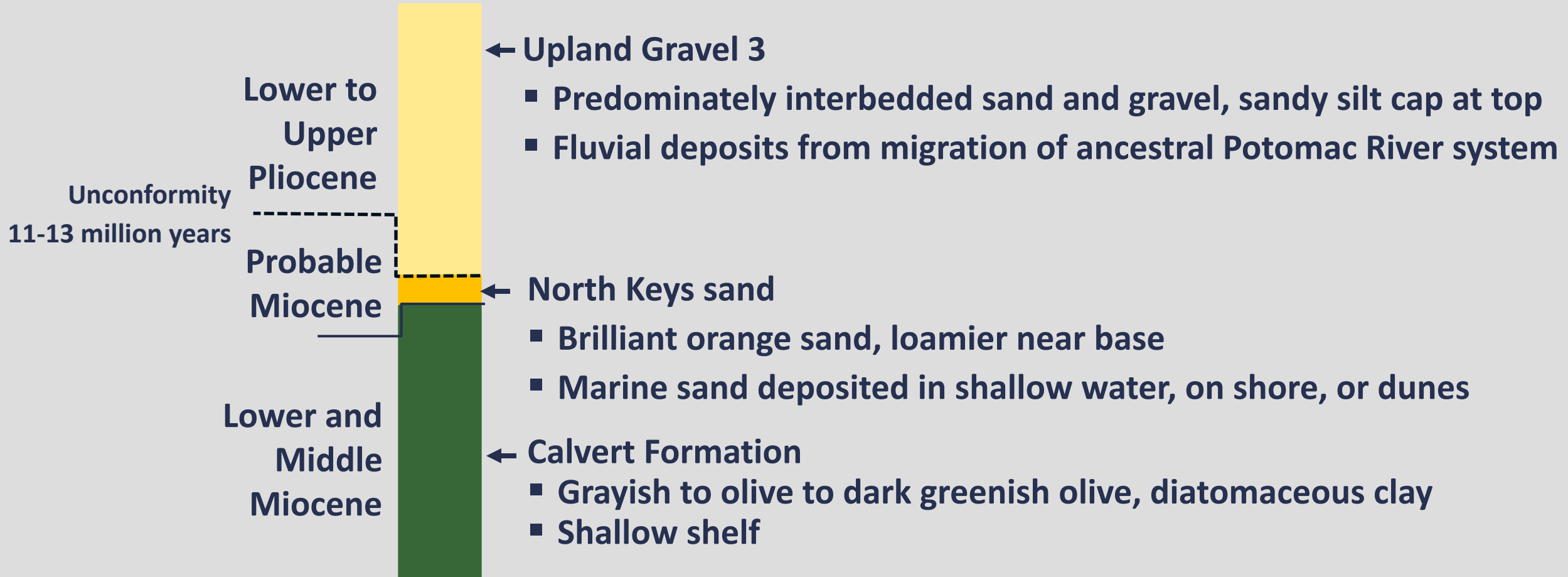


Conceptual Site Model Refinement

- Research publications
 - ◆ Geologic mapping
 - Develop expected stratigraphy
 - Depositional environments and depositional sequence
 - ◆ Hydrogeology studies
- Review previous site reports
- Examine available boring logs
 - ◆ Detail and overall quality
 - ◆ Compare to photographs
 - ◆ Rough out cross-sections



Expected Geological Sequence



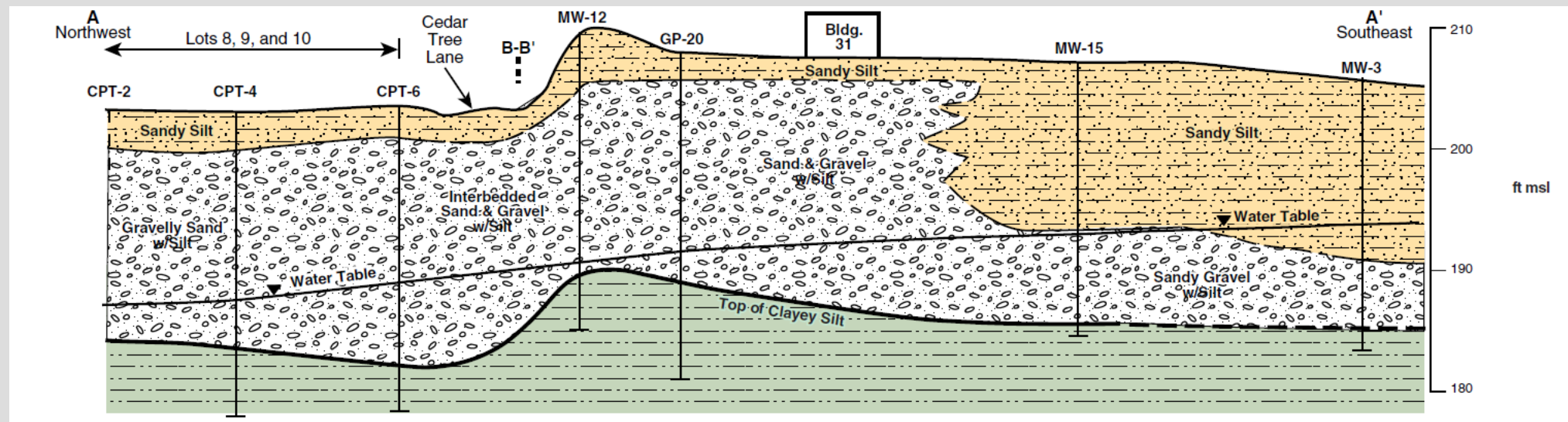
Conceptual Site Model Refinement - Geology

Remedial Investigation – Remedial Design Site Geology Descriptions

■ Upland Deposits

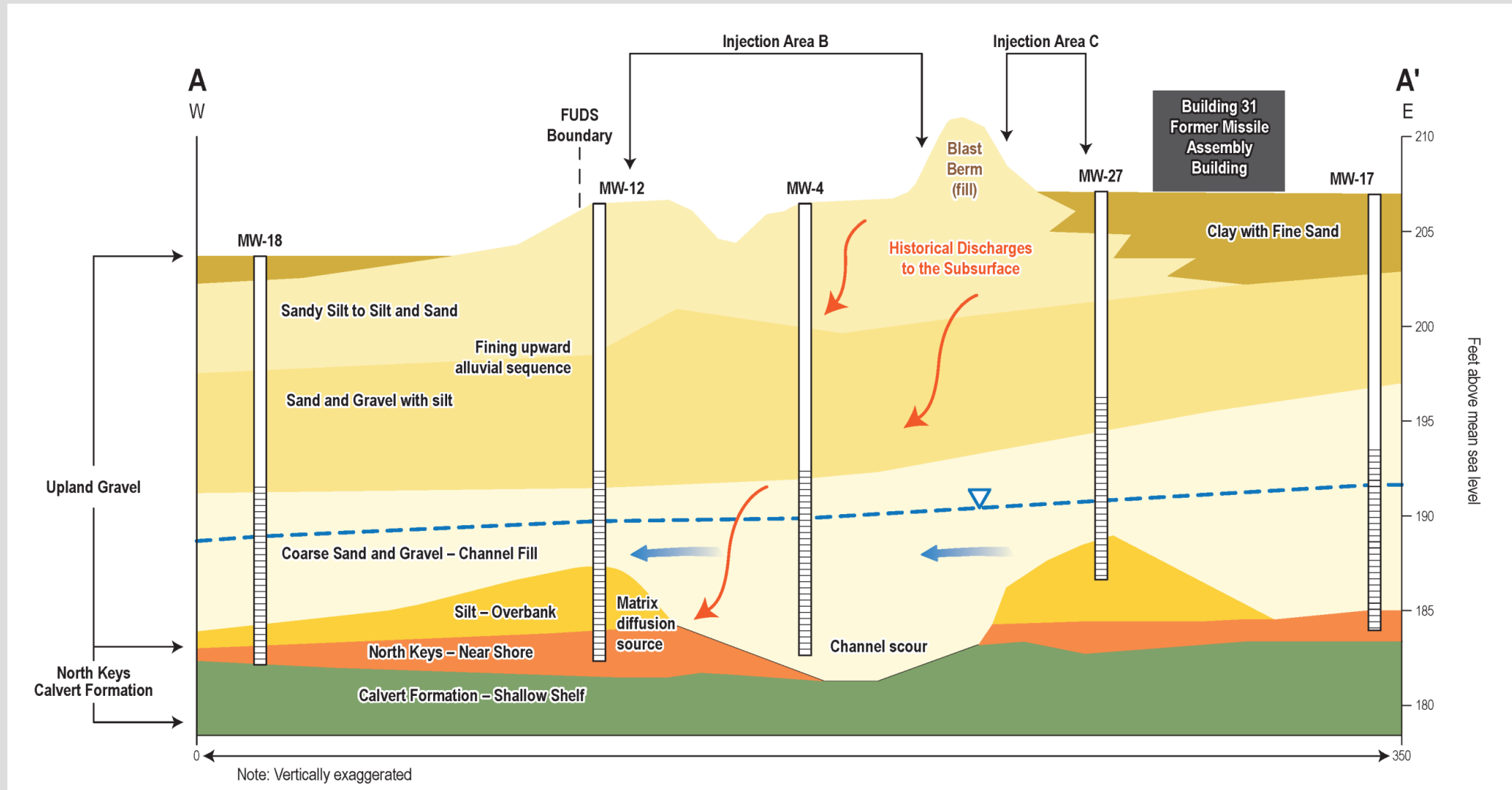
- ◆ 0-5 ft medium – dark brown sandy silt and clay
- ◆ 5-20 ft- alternating bands of brownish gray sand and gravel
- ◆ 20-35+ft – clayey silt with very fine sand

■ Lower confining unit greater than 16 ft thick

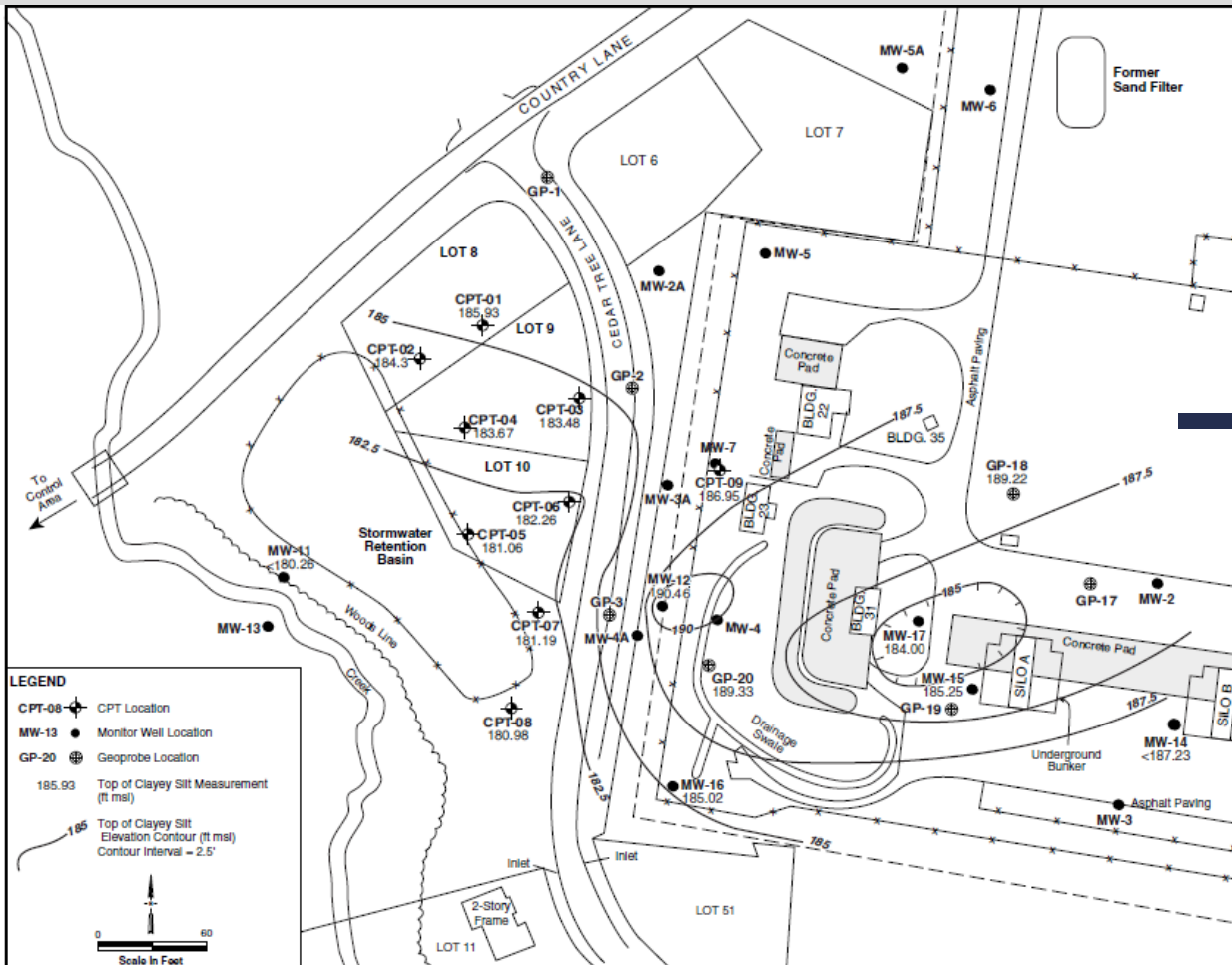


Source: 2005 Remedial Investigation

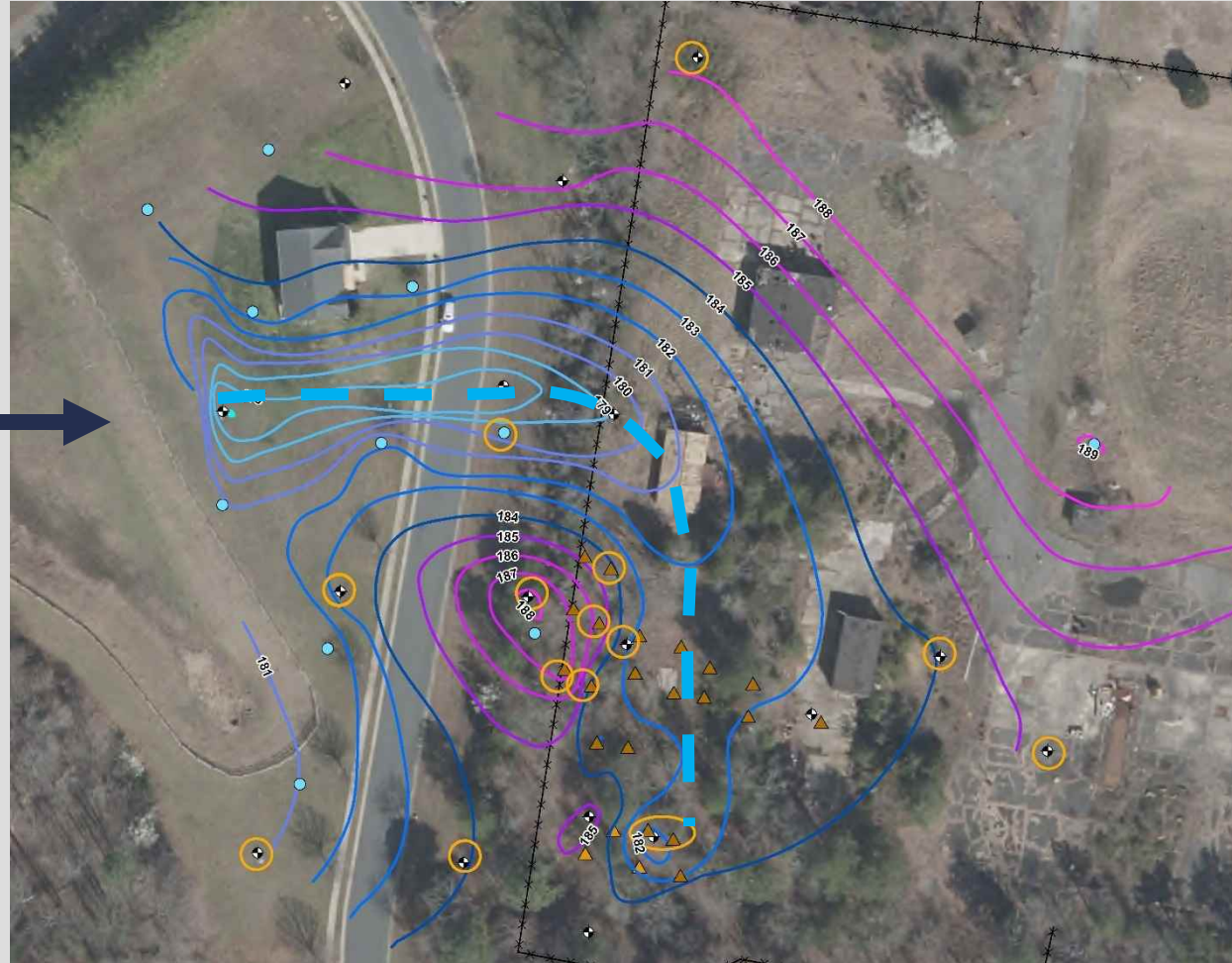
Conceptual Site Model Refinement - Geology



Depth to Confining Layer



2005 Remedial Investigation

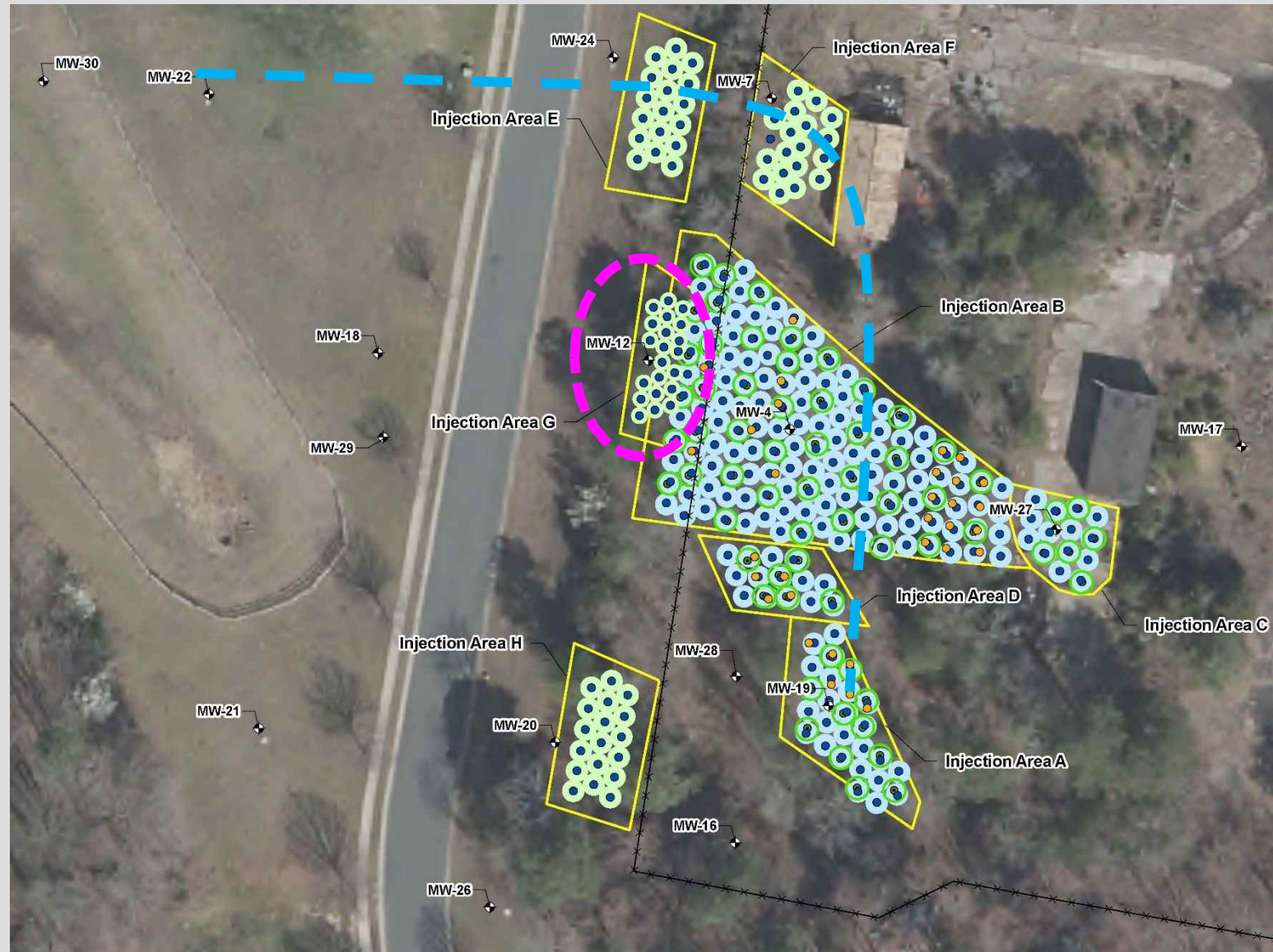


2023 Remedial Design Re-Evaluation

Remedial Design Refinement

ESS Principle Applications:

- Location of paleochannel orientation and deeper channel scour at MW-7 and MW-24
- Targeting of finer grained interval at MW-12 as source of matrix diffusion
- MW-20 – groundwater mounding issue, potential for matrix diffusion



Remedial Implementation

November 2023

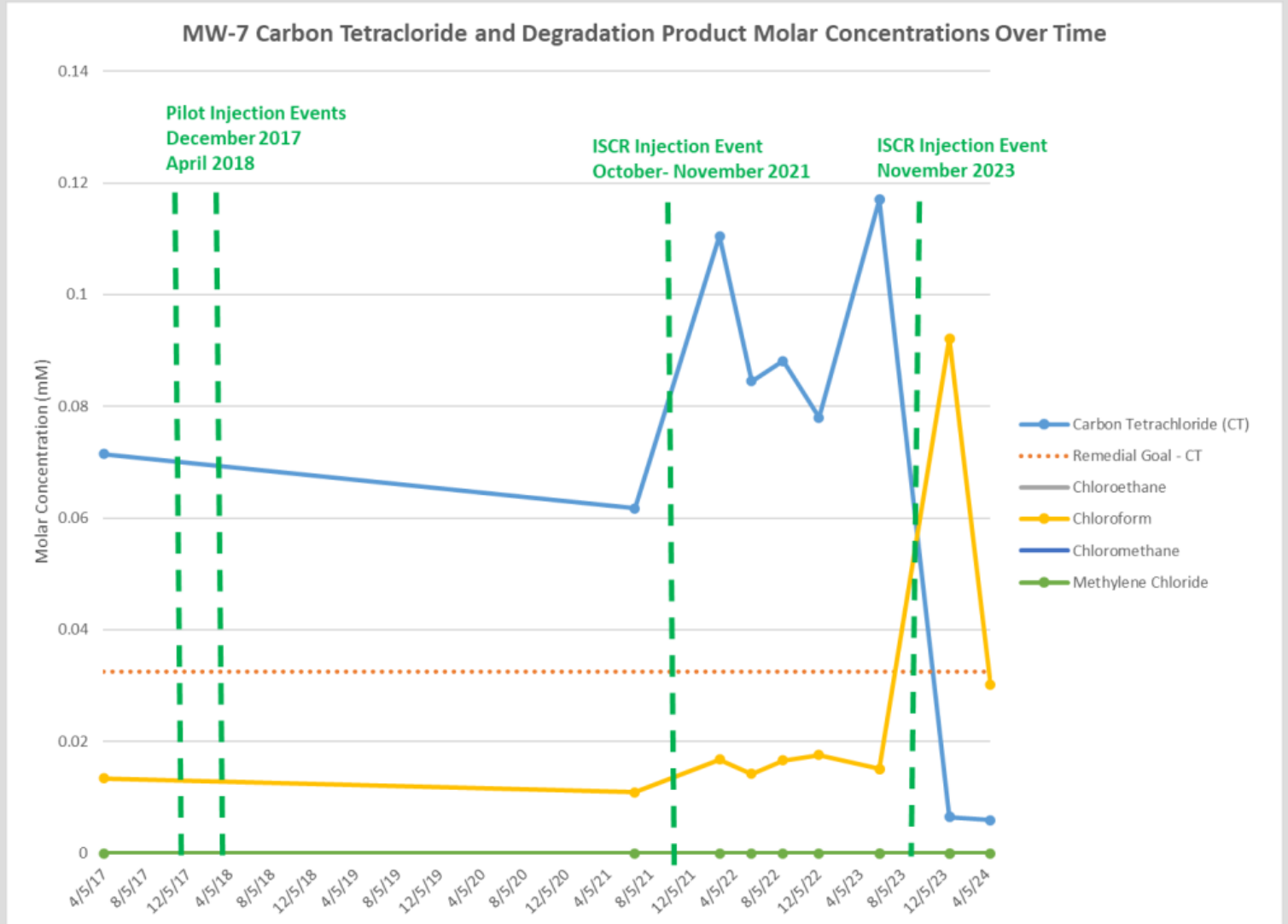
- Injections associated with MW-7, MW-12, MW-20 and MW-24
- 21,000 pounds of Provect-IR®
- Injections completed at 75 borings



MW-7

Post-2023 Injection

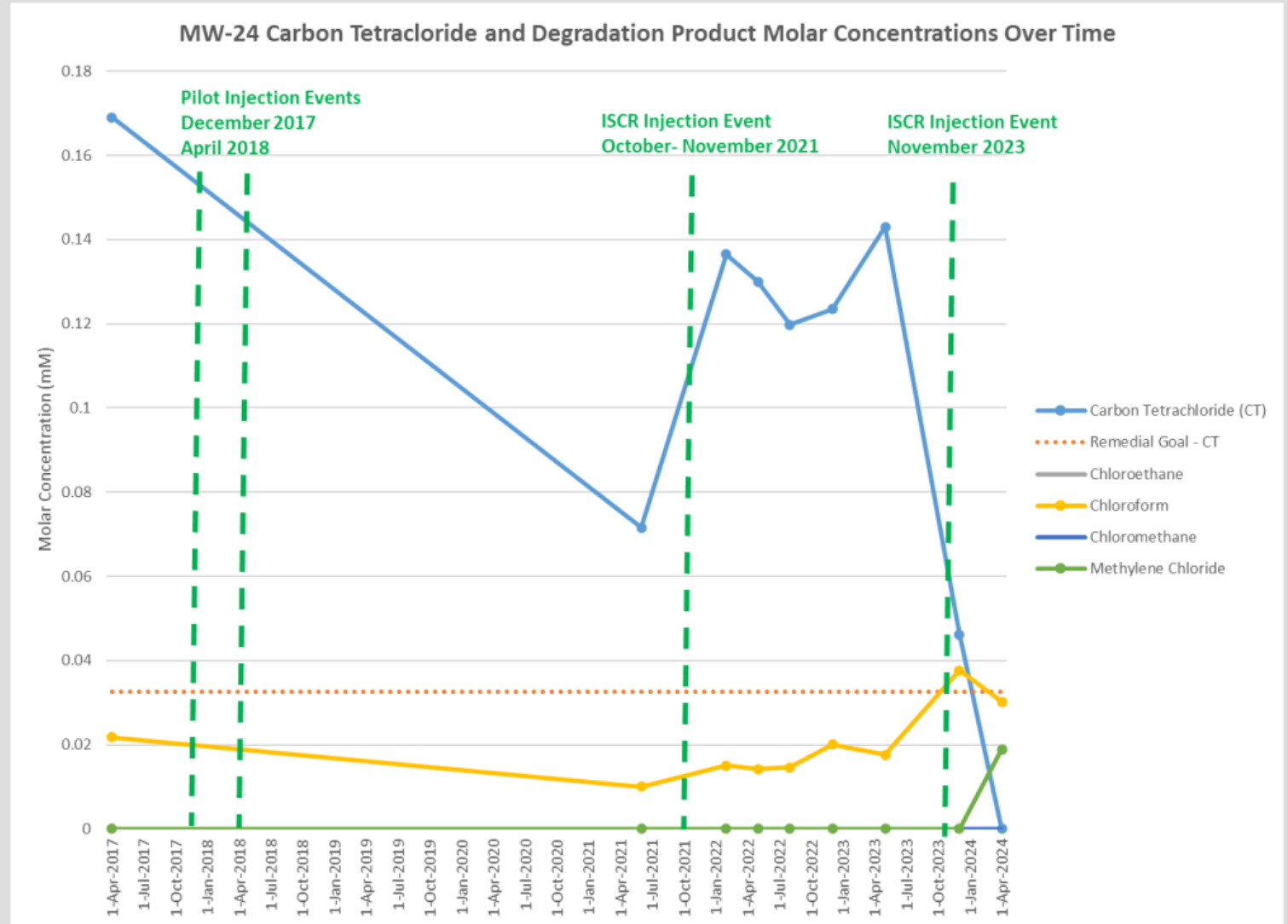
- ◆ Carbon tetrachloride below remedial goal as of April 2024
- ◆ Initially appears successful, performance monitoring will continue



MW-24

Post-2023 Injection

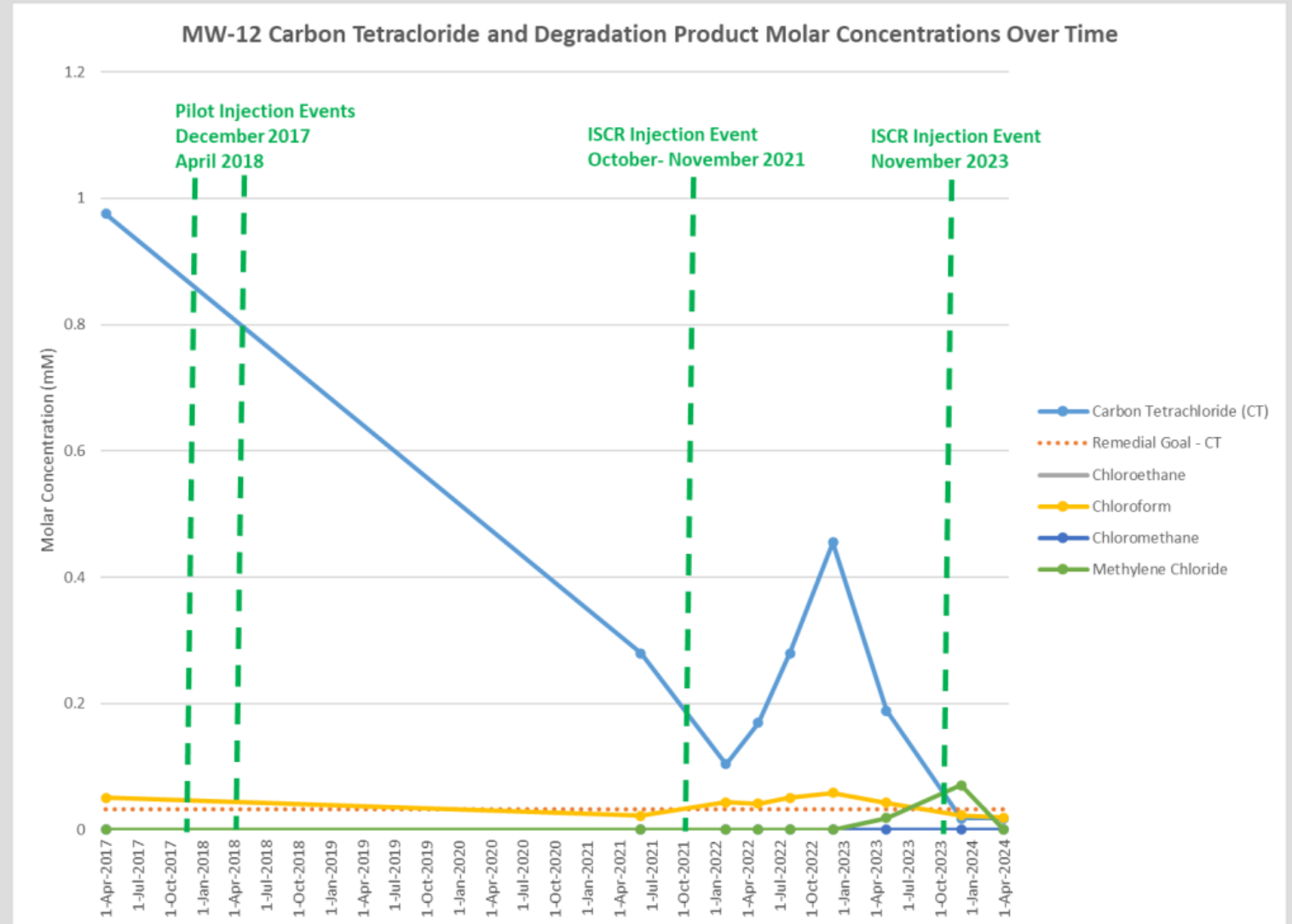
- ◆ Carbon tetrachloride below remedial goal as of April 2024
- ◆ Initially appears successful, performance monitoring will continue



MW-12

Post-2023 Injection

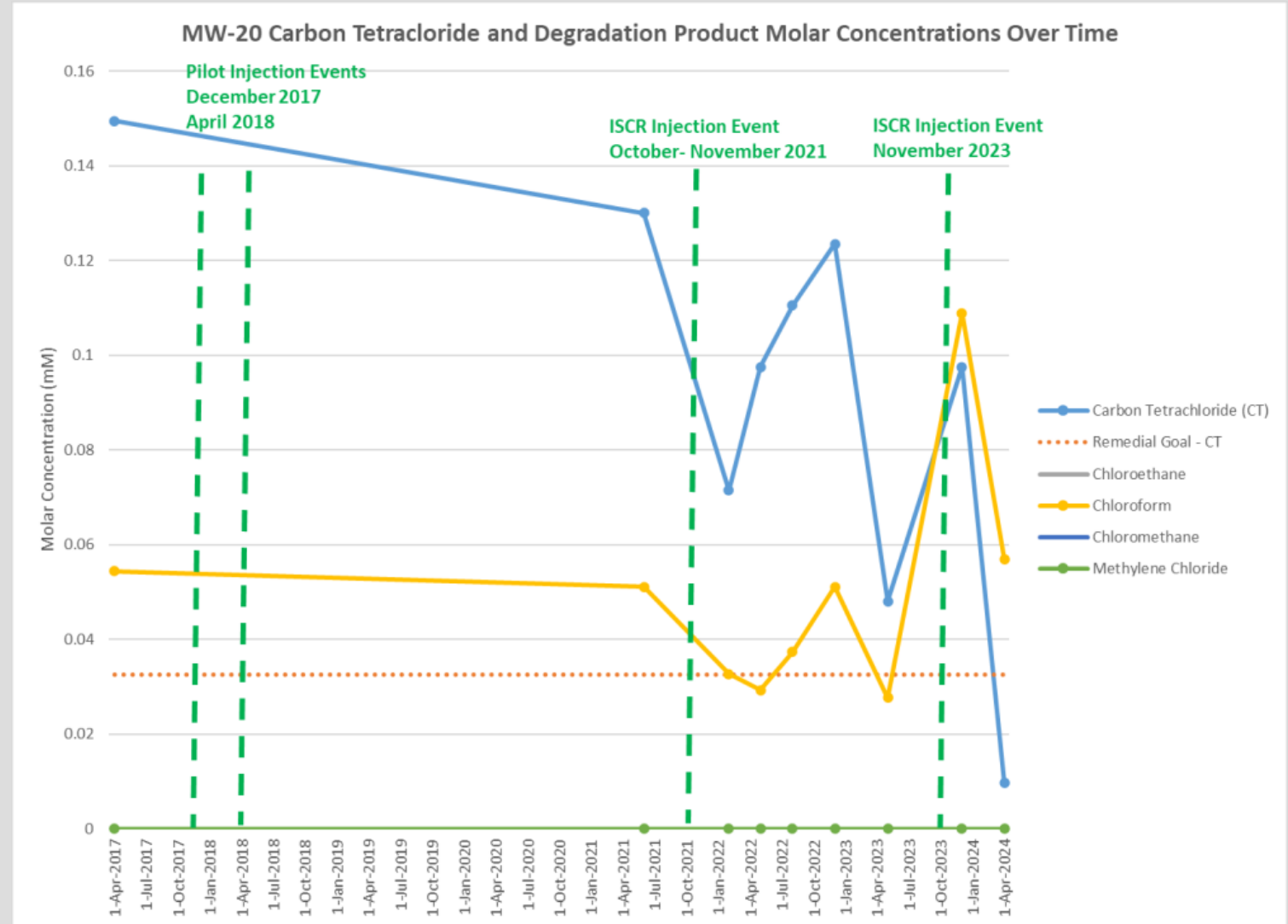
- ◆ Carbon tetrachloride and TCE below remedial goals as of April 2024
- ◆ Initially appears successful, however matrix diffusion potential exists



MW-20

Post-2023 Injection

- ◆ Initial post-injection increase in carbon tetrachloride and TCE
- ◆ Injection likely pushed impacted groundwater towards groundwater mound
- ◆ Currently below remedial goals for carbon tetrachloride and TCE as of April 2024



Conclusions

- ✓ Remedial design refinement later in the CERCLA process is achievable
- ✓ Assess what should be expected based on a review of available publications/research
- ✓ Work with historical data to fill in the gaps
 - ◆ If quality isn't great focus on big picture (e.g. color and general sediment type differences)
- ✓ As you acquire more site-specific data revisit and refine the CSM
- ✓ Refinement of remedial efforts can result in optimization/reduce costs

Thank You!

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