

Treatability Study to Evaluate In Situ Soil Mixing of EVO and ZVI to Reduce Munitions Constituents in Saturated and Vadose Zones

Presented by

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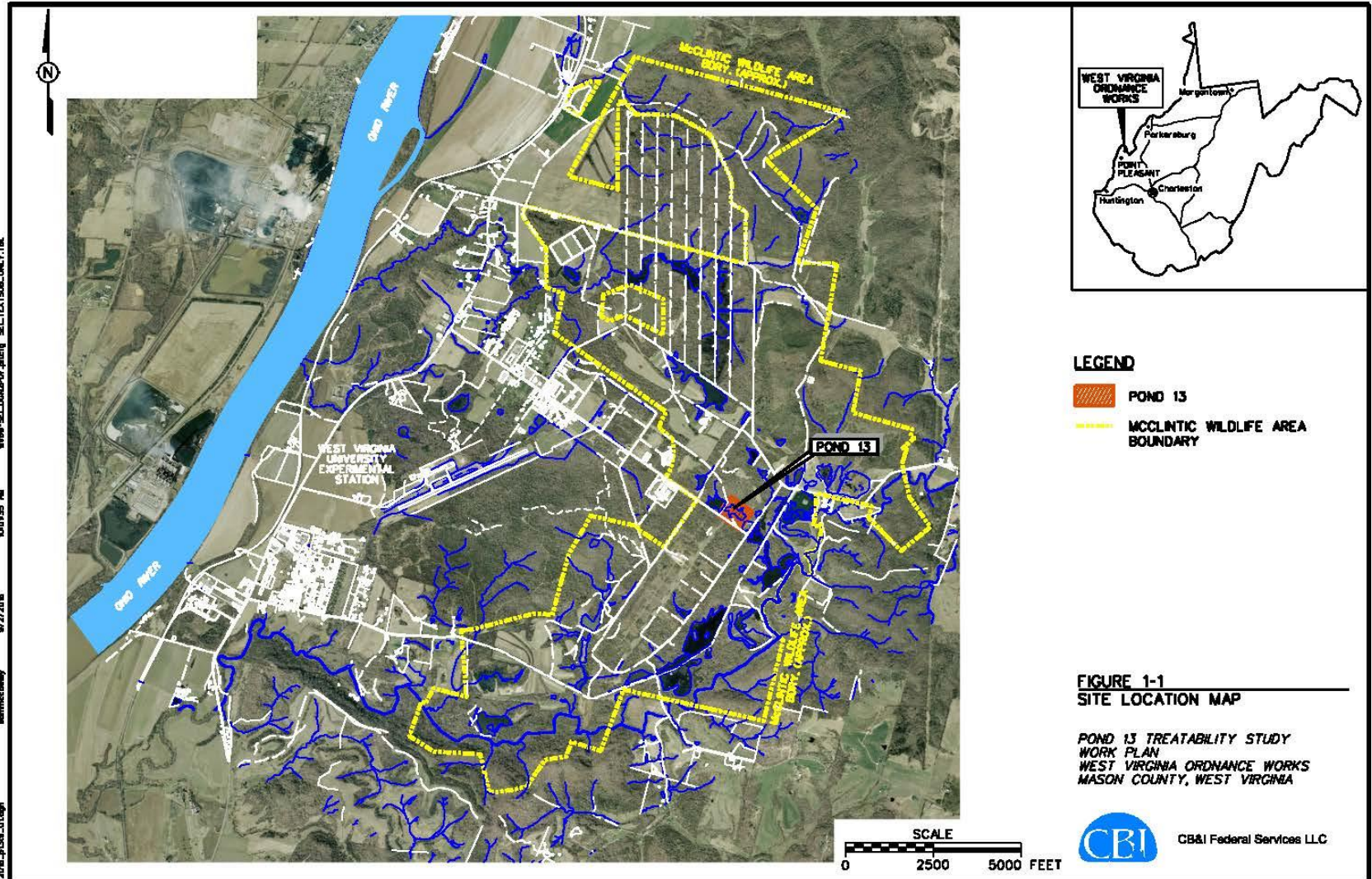
Outline

- ▶ Introduction
- ▶ Objectives
- ▶ Study Area
- ▶ Previous Study
- ▶ Additional Investigations
- ▶ Soil Mixing Treatability Study

Introduction

- ▶ West Virginia Ordnance Works (WVOW) was a TNT manufacturing facility from 1942-1945
- ▶ The WVOW site is located on the east bank of the Ohio River, six miles north of Point Pleasant, WV
- ▶ WVOW included 12 TNT production lines
- ▶ TNT production resulted in soil and groundwater contamination
- ▶ Although the TNT was not completely remediated, portions of the facility were transferred to the state of West Virginia for use as a wildlife management reserve
- ▶ This site is now the McClintic Wildlife Management Area

WVOW Location



Introduction (continued)

- ▶ The WVOW site is listed on the EPA National Priorities List
- ▶ A Record of Decision (ROD) is in place that covers the Yellow Water Reservoir, Red Water Reservoir and Pond 13 Wet Well Area
- ▶ This ROD requires extraction and treatment of groundwater until such time as contaminants are below ROD action levels
- ▶ A groundwater extraction and treatment system has been operating at the Pond 13 Wet Well Area since 1997
- ▶ Extraction and treatment is achieving capture; however, nitroaromatic levels have essentially remained constant

Historic View of WVOW

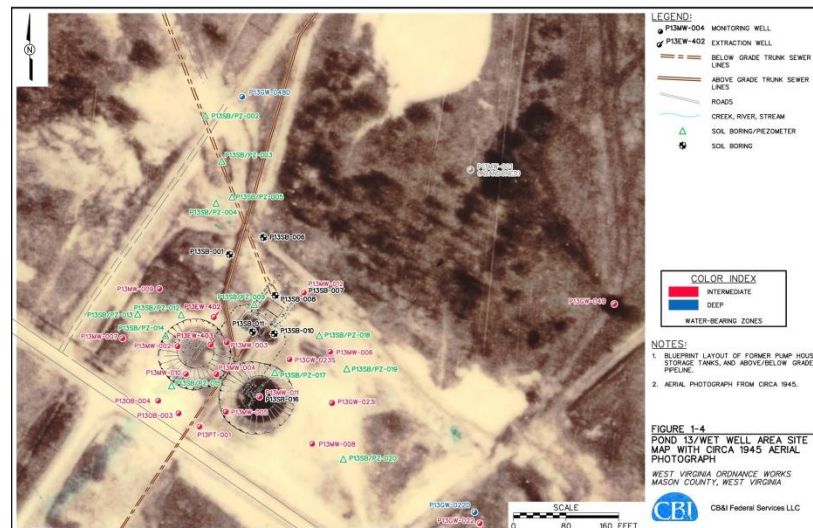


Study Objectives

- ▶ A previous treatability study using in situ enhanced bioremediation (ISEB) was conducted 2008-2010
 - ▶ Study was effective in reducing contaminants, but levels rebounded once carbon source was exhausted
 - ▶ Appears contaminant source still exists
- ▶ Preparing to conduct an additional study in the Pond 13 Area utilizing soil mixing to distribute EVO into the subsurface
- ▶ The objectives of this study are:
 - ▶ Evaluate effectiveness of soil mixing to distribute treatment amendments in soil (saturated and vadose zones)
 - ▶ Determine time required to achieve remedial objectives
 - ▶ Evaluate cost vs. benefit of adding ZVI to the amendment used
 - ▶ Determine design characteristics for large scale remediation

Pond 13 Wet Well Area

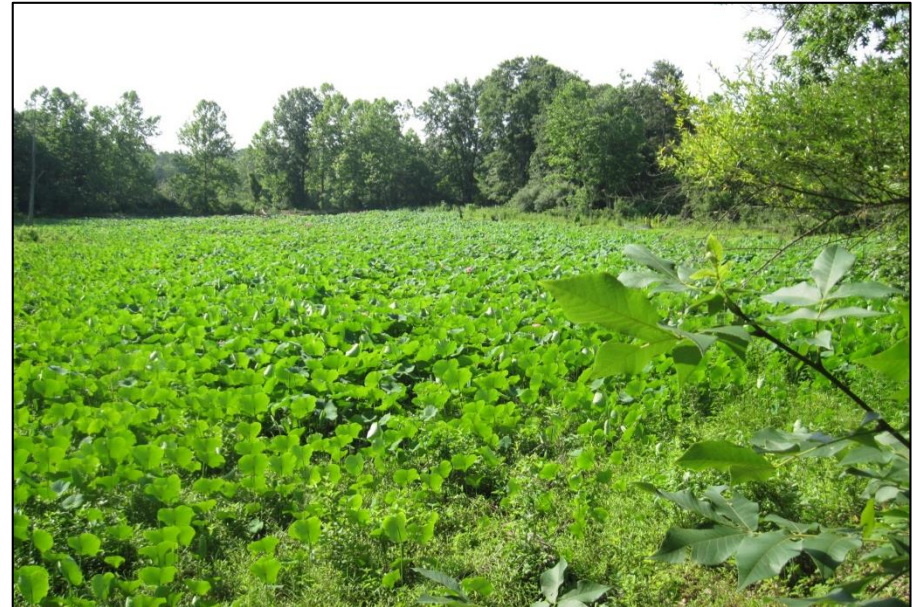
- ▶ Area was a wastewater handling system
- ▶ Includes two earthen wet wells to handle red and yellow wastewater
- ▶ Primary contaminants include 2,4,6-TNT, 2,4-DNT, and 2,6-DNT



- ▶ Existing Extraction and monitoring wells



- ▶ View of Pond 13 in the spring



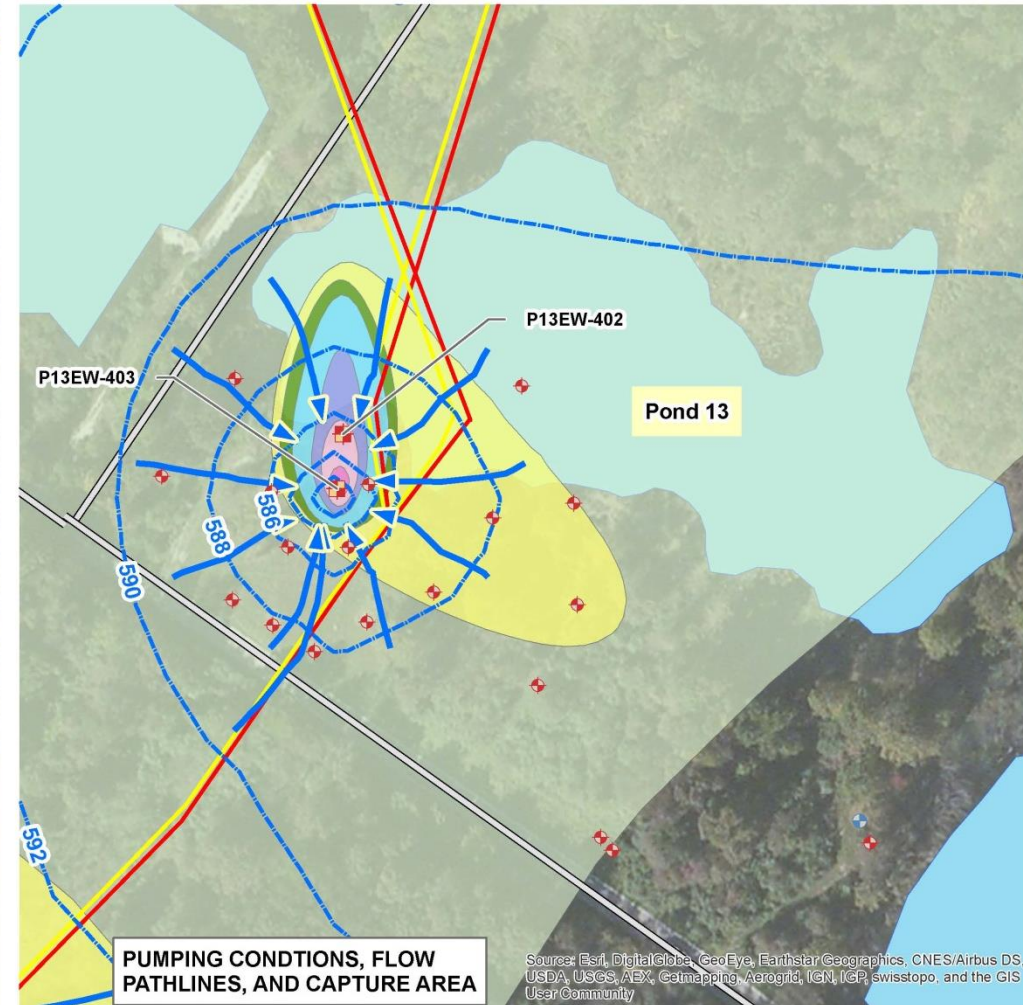
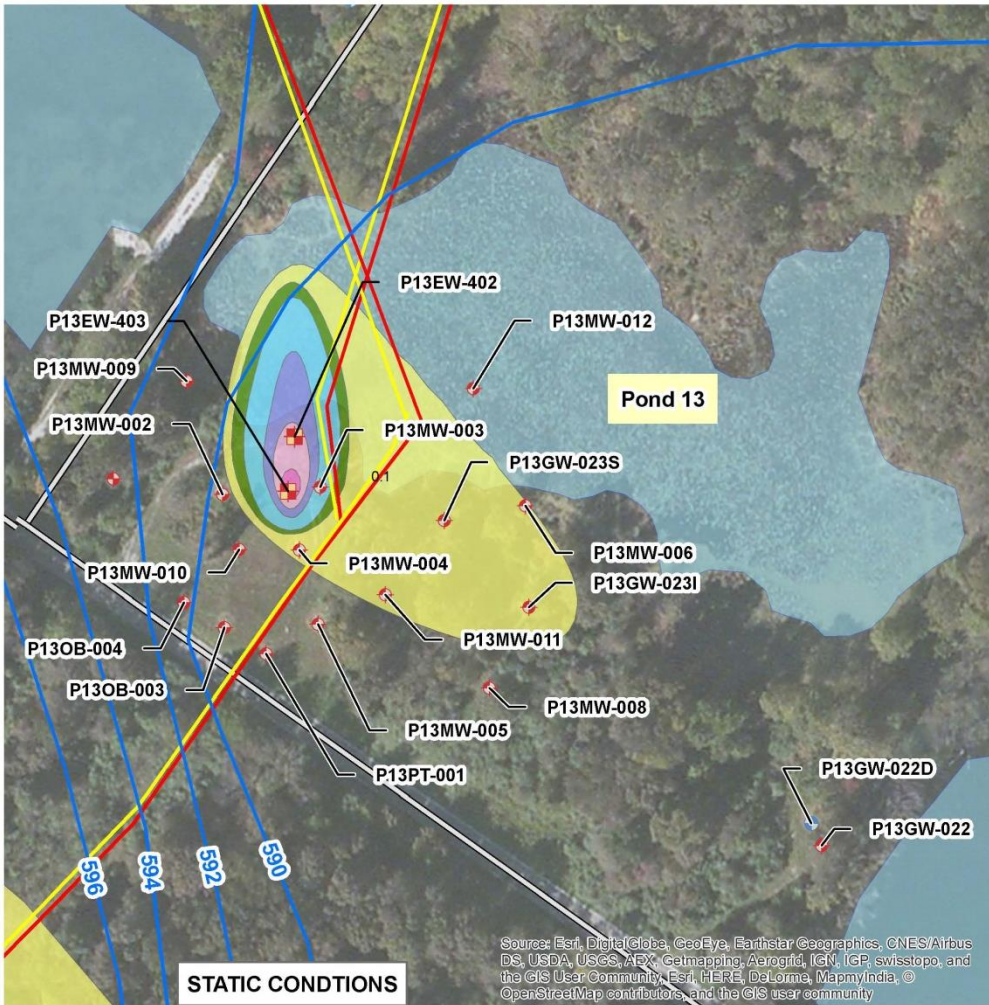


FIGURE B-5
POND 13 AREA CAPTURE ANALYSIS

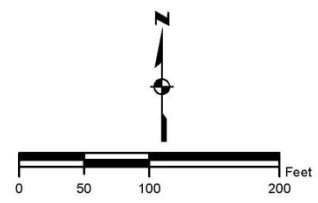
REMEDIAL SYSTEM OPTIMIZATION EVALUATION
WEST VIRGINIA ORDNANCE WORKS
MASON COUNTY, WEST VIRGINIA



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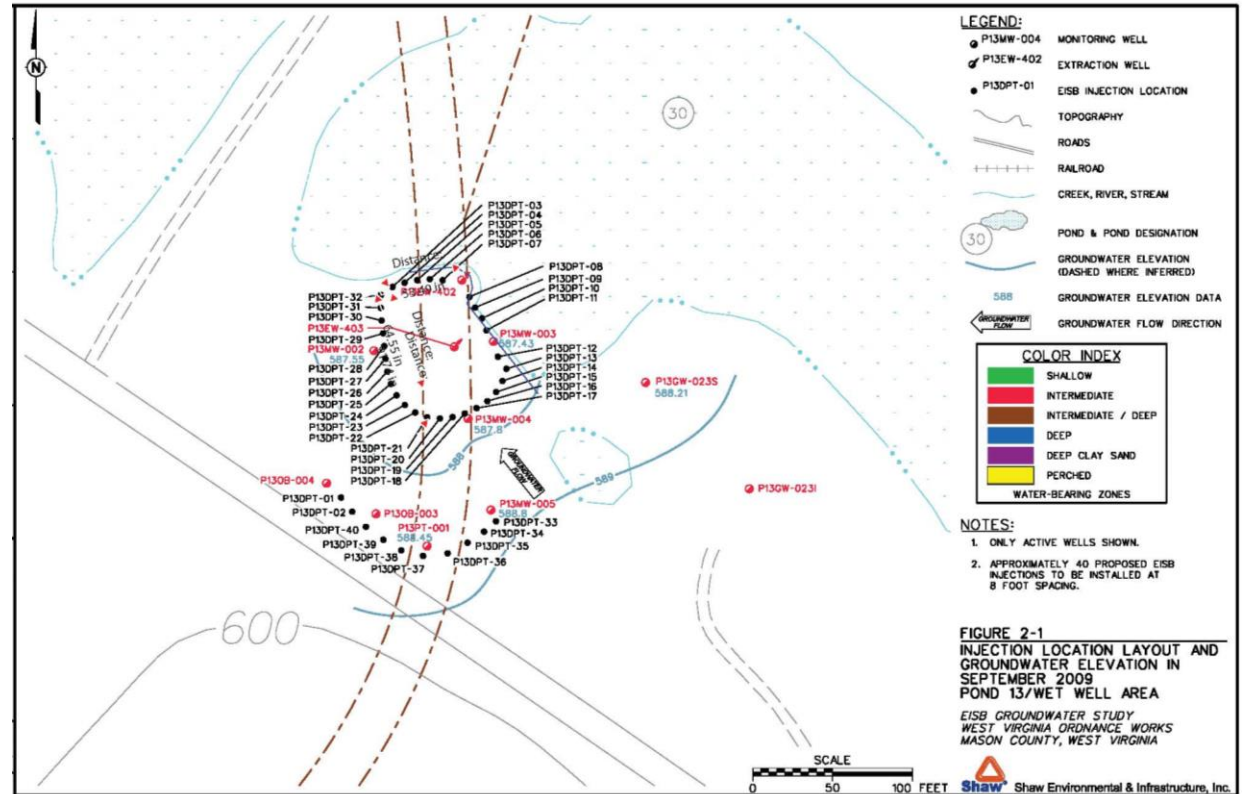
Legend

- | | | | | |
|-------------------------|-----------------------------------|----------------|--------------------------------|-------------------------|
| Shallow Monitoring | Groundwater Flow Path | Discharge Line | TNT Process Sewer Lines | 2,4,6-TNT (µg/L) |
| Intermediate Monitoring | Model Pumping Groundwater Surface | Yellow Water | 0.1 - 1 | 1 - 4 |
| Deep Monitoring | Static Groundwater Surface | Red Water | 4 - 10 | 10 - 50 |
| Extraction Well | Streams | Roads | 50 - 100 | 100 - 1000 |
| | Ponds | | 1000 - 5000 | |



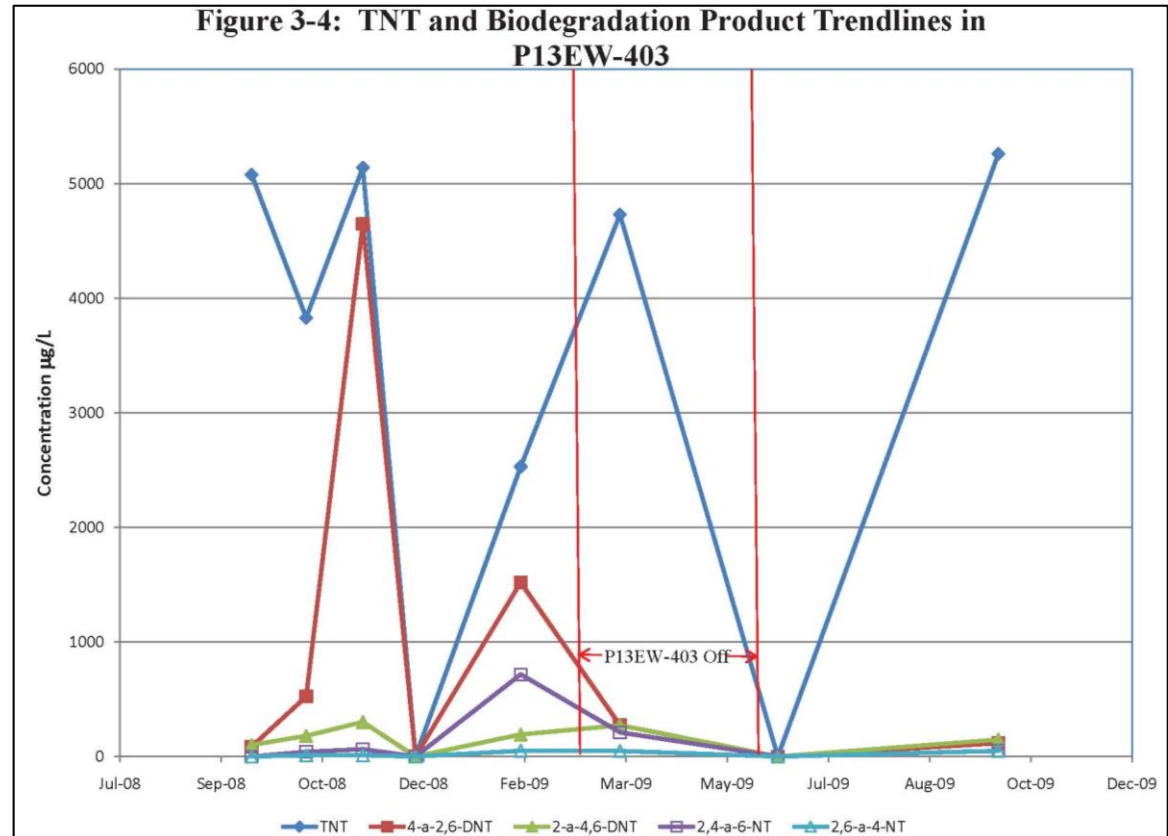
Previous Study at Pond 13 Area

- ▶ ISEB study 2008-2010 utilized injection of EVO into the shallow groundwater around two extraction wells
- ▶ Extraction wells were shut down for approx. 2 months



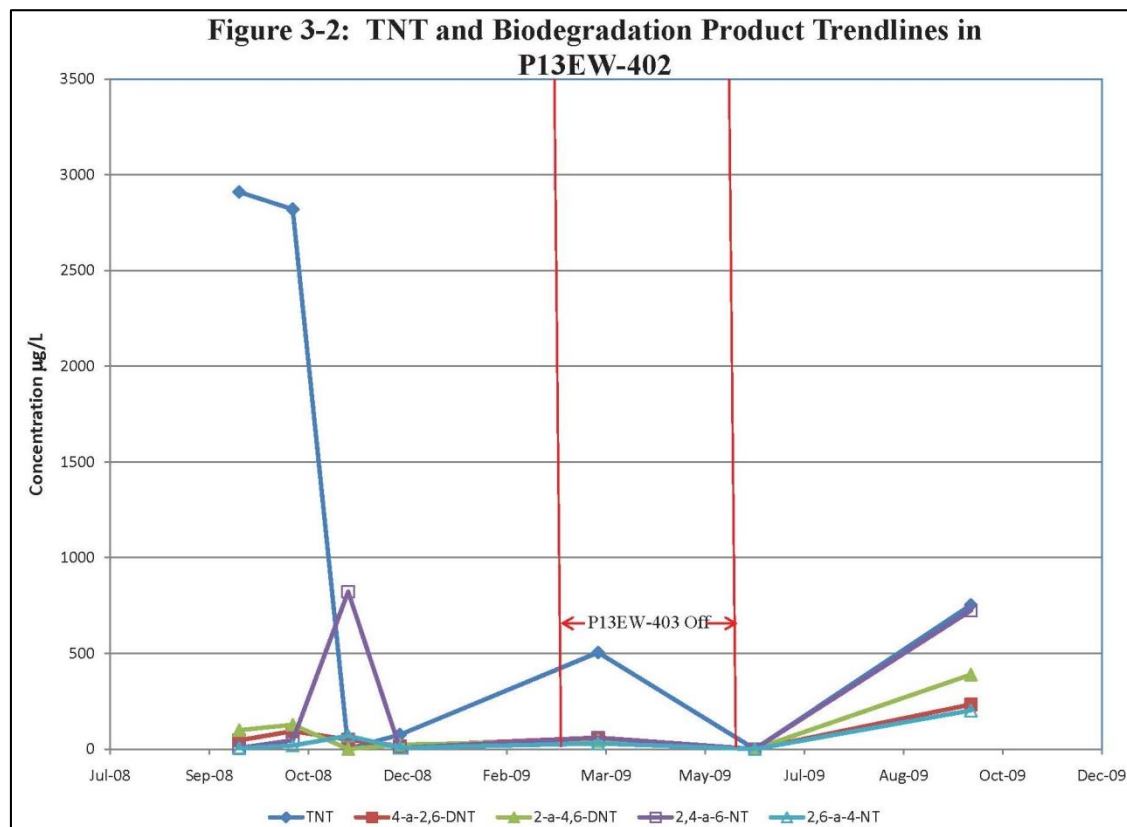
Previous Study at Pond 13 Area

- ▶ Concentrations of TNT in P13EW-403 dropped from over 5,000 ug/l to near non-detect
- ▶ Once pumping resumed, contaminant concentrations rebounded



Previous Study at Pond 13 Area

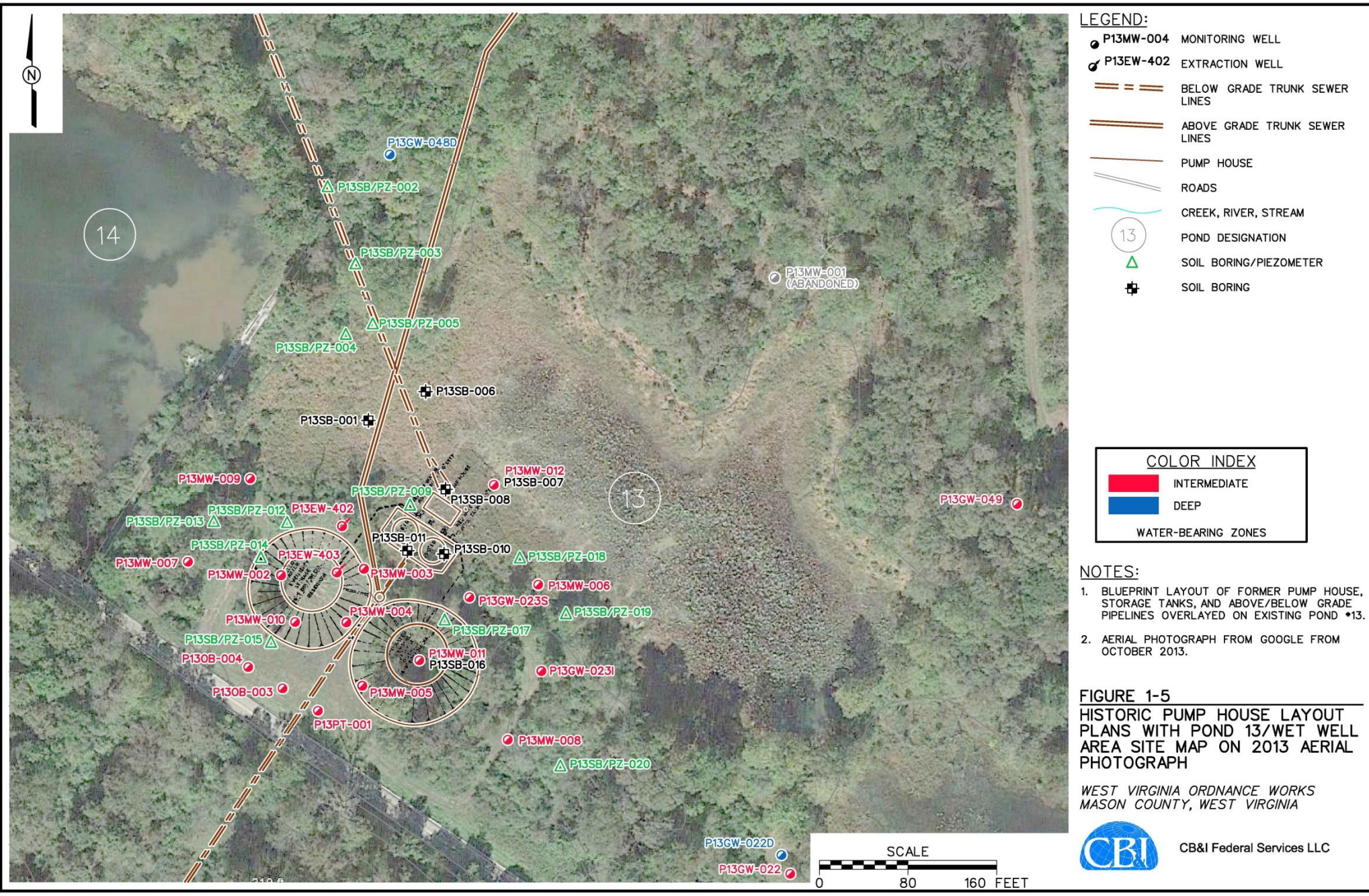
- ▶ Concentrations of TNT in P13EW-402 dropped from nearly 3,000 ug/l to near non-detect
- ▶ Once pumping resumed, contaminant concentrations rebounded



Additional Investigations

- ▶ Additional soil and groundwater samples were collected January 2014
- ▶ Further sampling was conducted in June 2016 to establish vertical delineation
- ▶ Higher concentrations were observed at the former wet well locations





LEGEND:

- P13MW-004 MONITORING WELL
- P13EW-402 EXTRACTION WELL
- BELOW GRADE TRUNK SEWER LINES
- ABOVE GRADE TRUNK SEWER LINES
- PUMP HOUSE
- ROADS
- CREEK, RIVER, STREAM
- POND DESIGNATION
- SOIL BORING/PIEZOMETER
- SOIL BORING

COLOR INDEX

	INTERMEDIATE
	DEEP

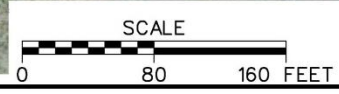
WATER-BEARING ZONES

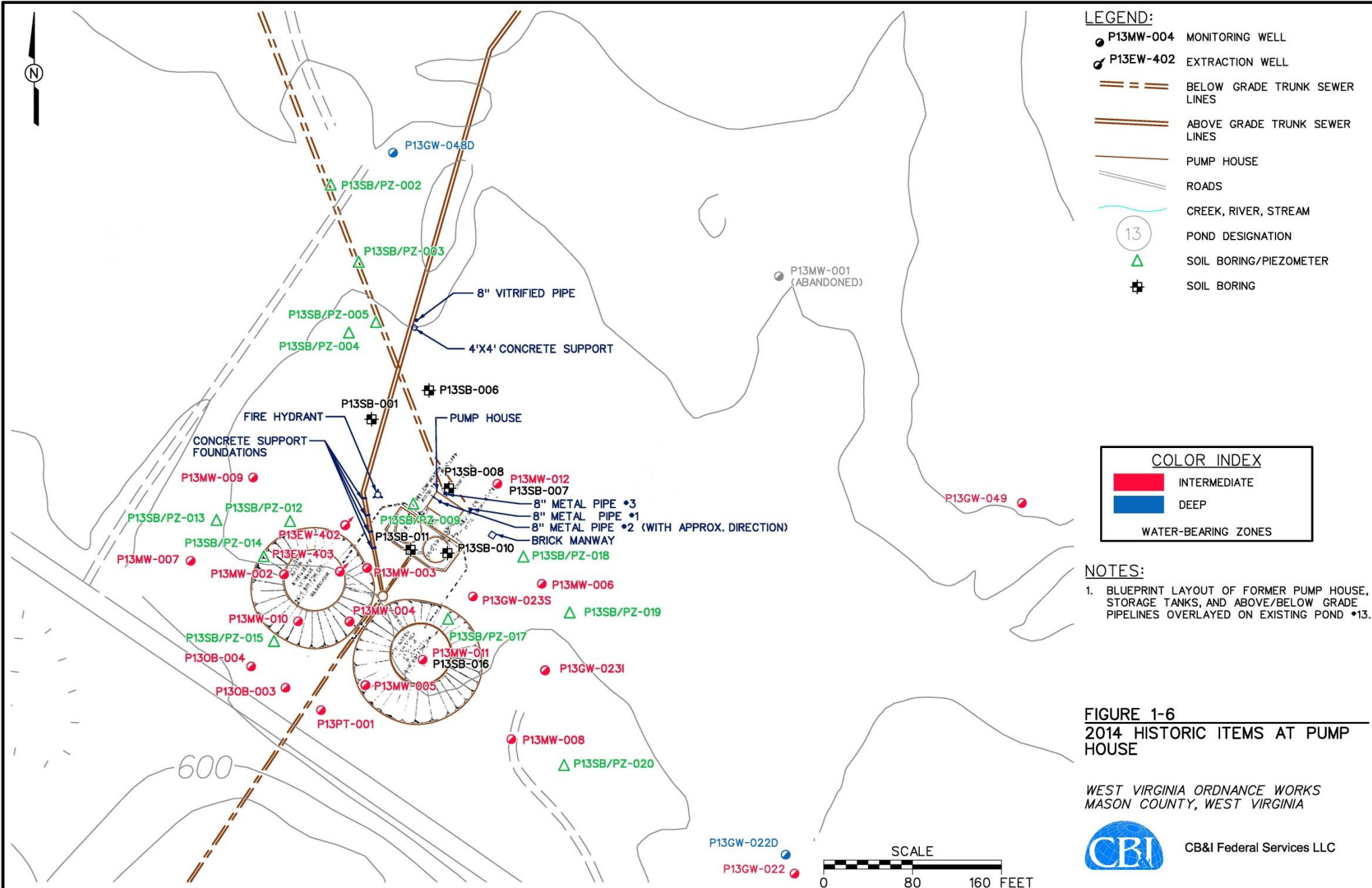
NOTES:

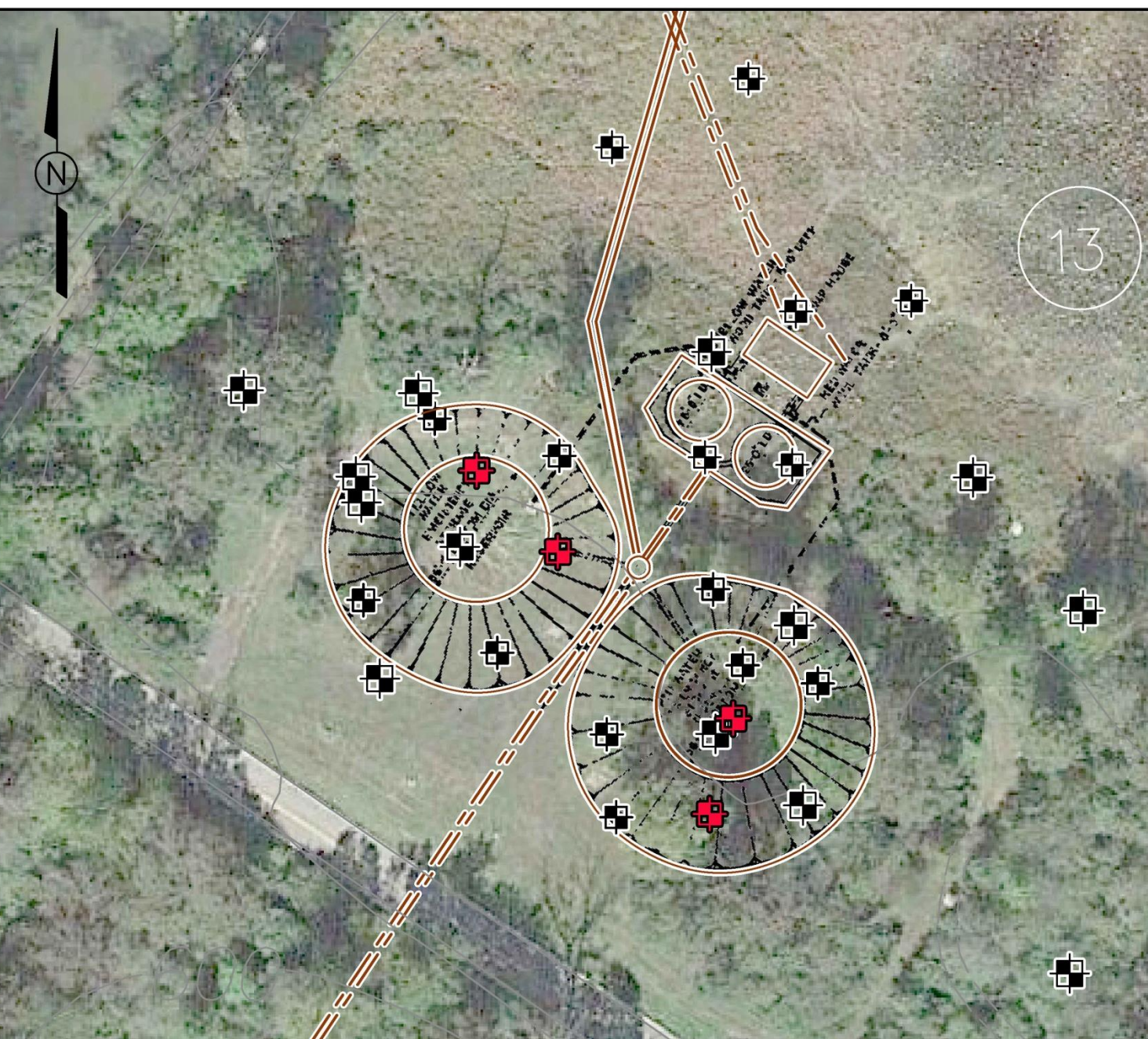
1. BLUEPRINT LAYOUT OF FORMER PUMP HOUSE, STORAGE TANKS, AND ABOVE/BELOW GRADE PIPELINES OVERLAYED ON EXISTING POND *13.
2. AERIAL PHOTOGRAPH FROM GOOGLE FROM OCTOBER 2013.

FIGURE 1-5
HISTORIC PUMP HOUSE LAYOUT PLANS WITH POND 13/WET WELL AREA SITE MAP ON 2013 AERIAL PHOTOGRAPH

WEST VIRGINIA ORDNANCE WORKS
 MASON COUNTY, WEST VIRGINIA







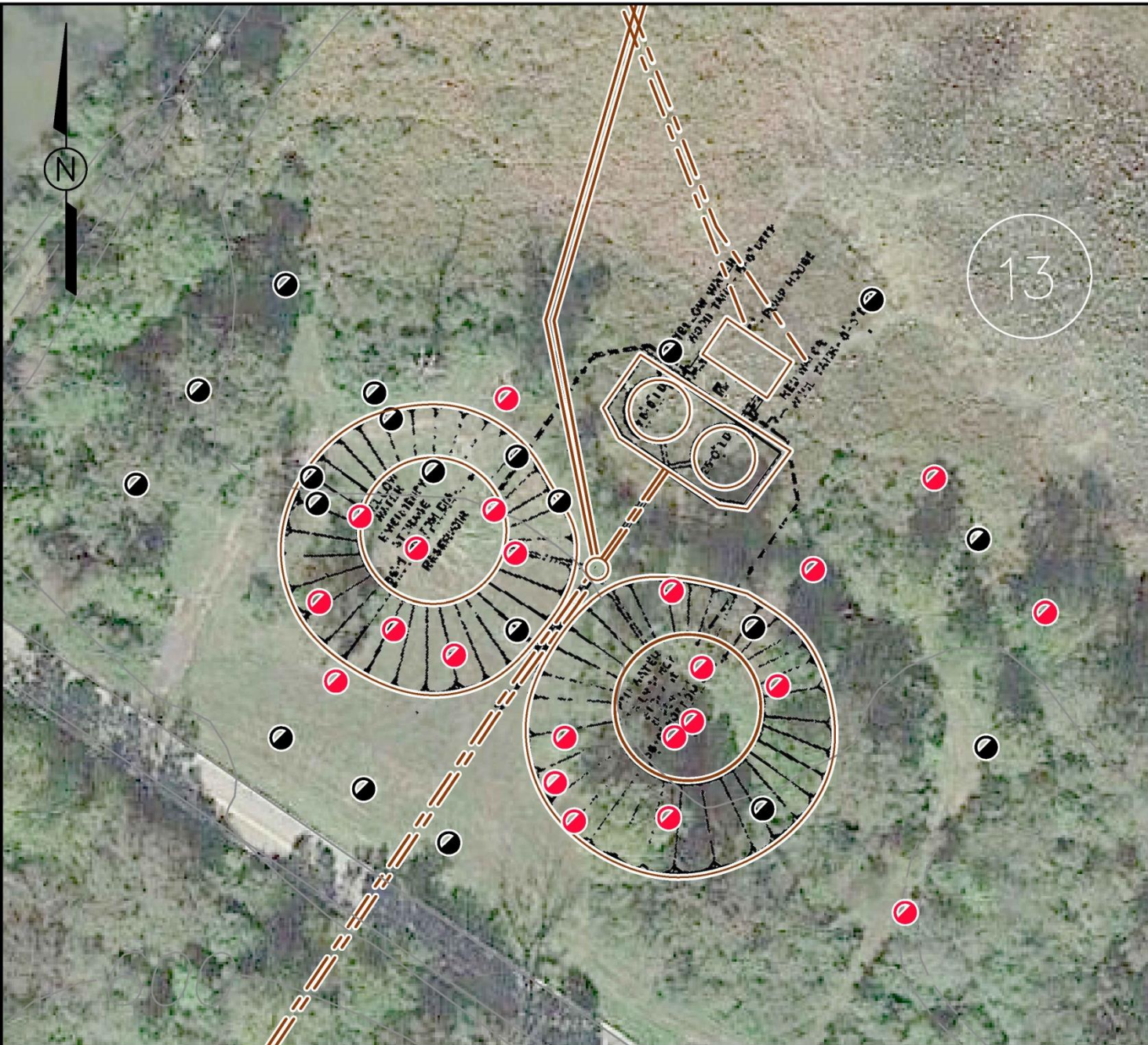
SURFACE AND
SUBSURFACE SOIL
LEGEND:





RED INDICATES RBSC EXCEEDANCES



BLACK INDICATES NO RBSC EXCEEDANCE



GROUNDWATER LEGEND:

-  RED INDICATES RBSC EXCEEDANCES
-  BLACK INDICATES NO RBSC EXCEEDANCE

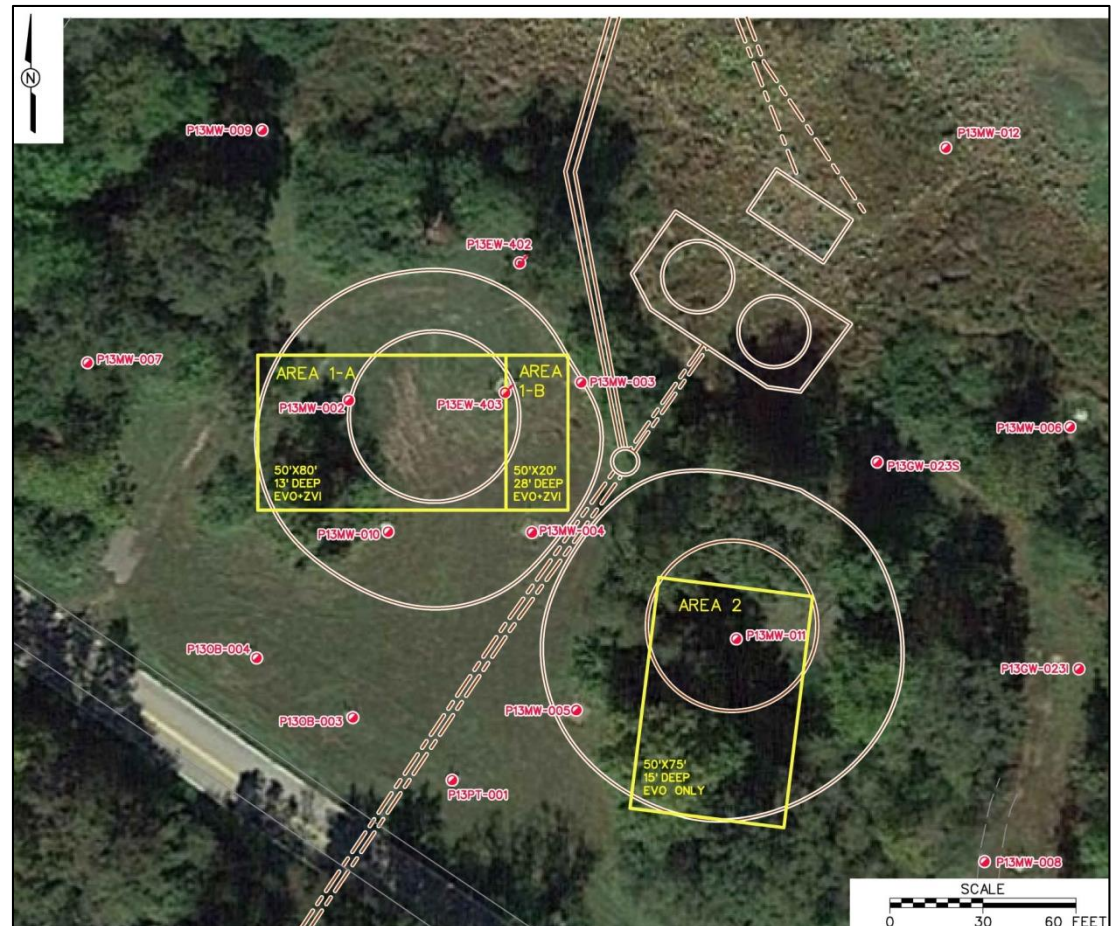
Pre Soil Mixing Activities

- ▶ Remove pump, motor, piping, and electrical from extraction well P13EW-403
- ▶ Perform site clearing
- ▶ Abandon wells P13MW-002, P13MW-011, P13EW-403
- ▶ Install P13MW-013, P13MW-014 and P13MW-015
- ▶ Collect baseline groundwater samples



Amendments will be mixed using a soil blender into the saturated and vadose zone

- ▶ EVO and ZVI Area
 - ▶ Area 1-A: 13' deep over the western 50' X 80'
 - ▶ Area 1-B: 28' deep over the eastern 50' X 20'
- ▶ EVO only Area
 - ▶ Area 2: 15' deep 50' X 75'



Amendments will mixed using a soil blender



Performance Monitoring of Groundwater

- ▶ Collect performance groundwater samples
 - ▶ 3 months
- ▶ Install P13MW-016 and P13MW-017
- ▶ Collect performance groundwater samples
 - ▶ 6 months
 - ▶ 9 months
 - ▶ 12 months
 - ▶ 15 months
 - ▶ 18 months

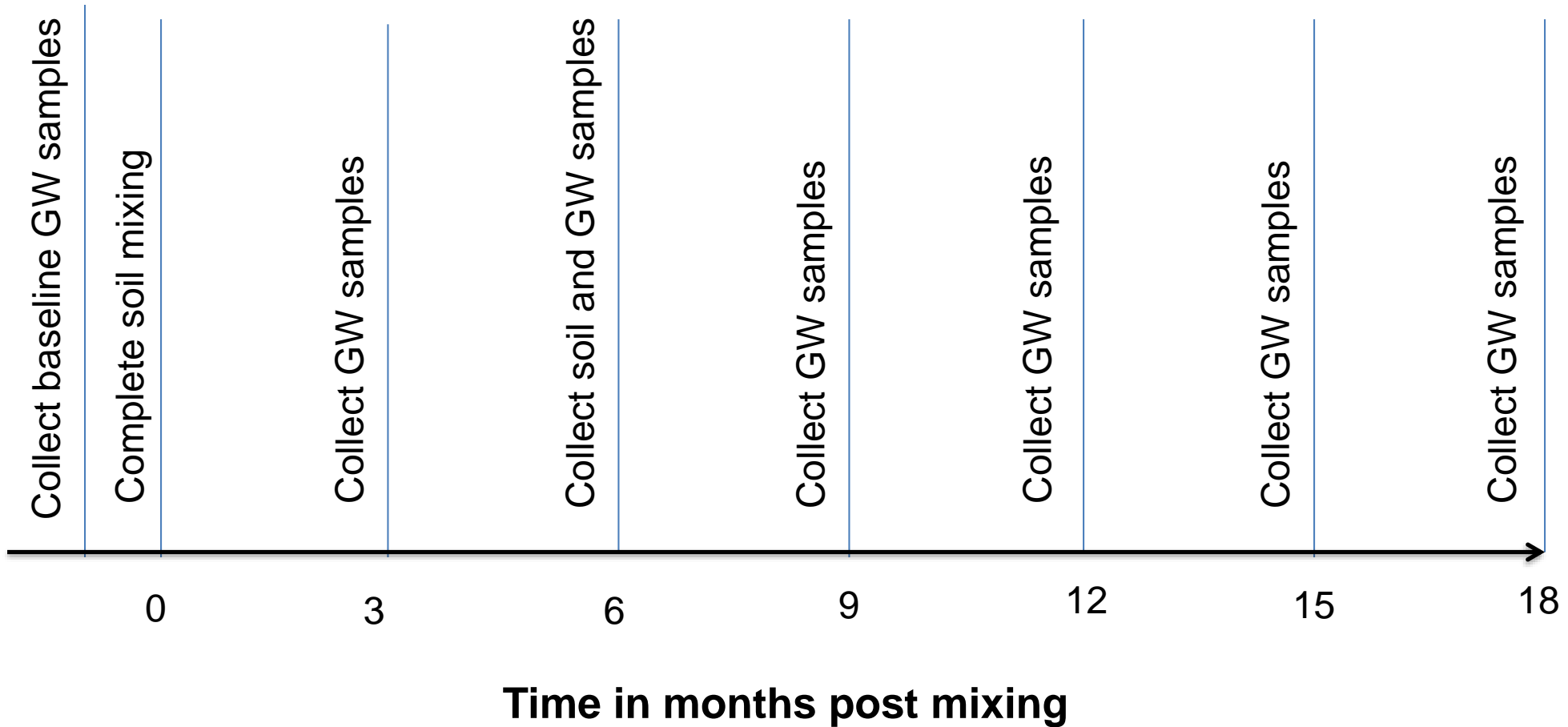


Amendment Distribution Monitoring of Saturated Soil

- ▶ Collect soil samples at 6 months; and analyze for Fe and TOC



Sequence of Sampling Events





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