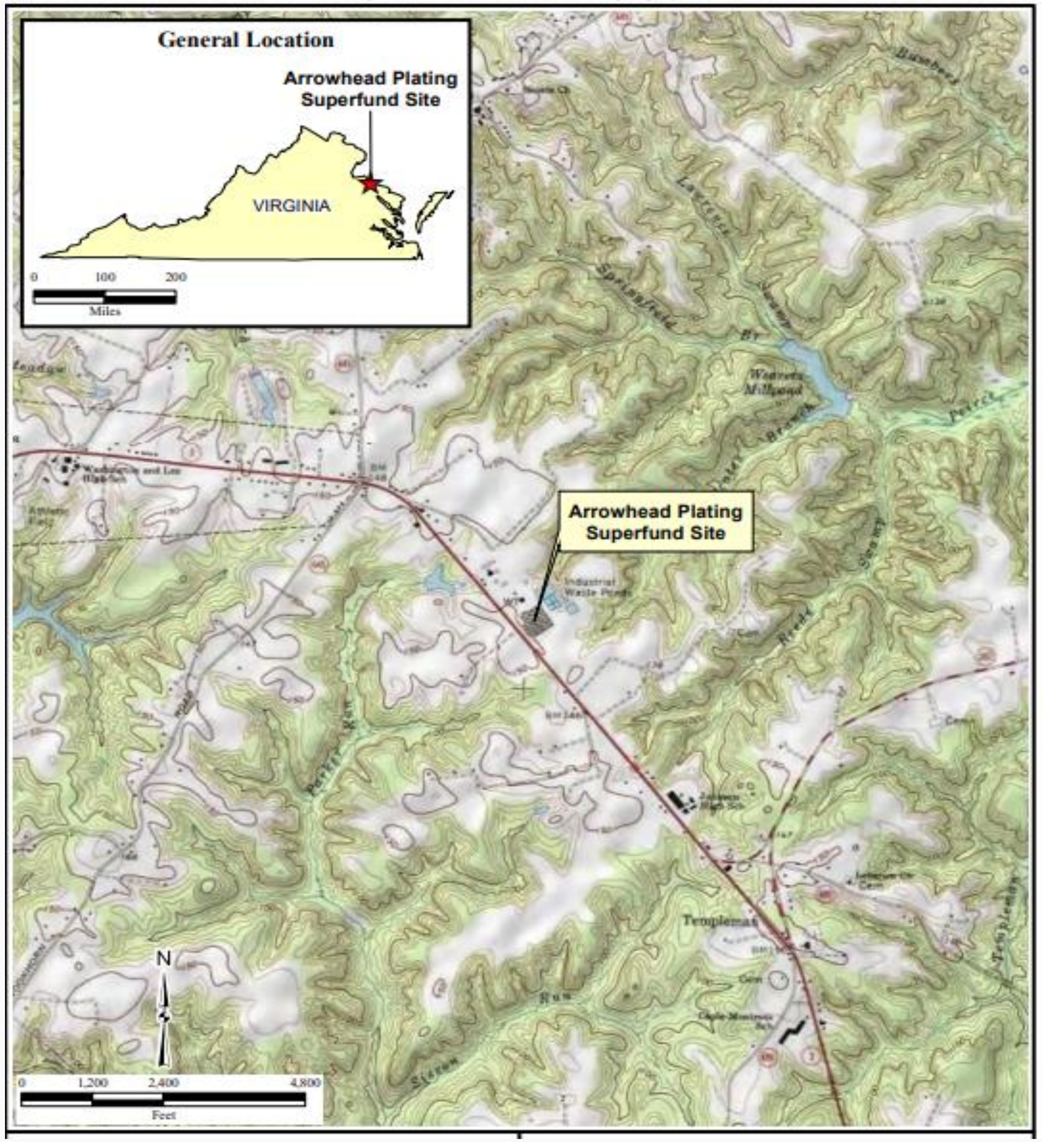


Arrowhead Associates, Inc. Superfund Site 18047 Kings Highway, Montross, VA 22520

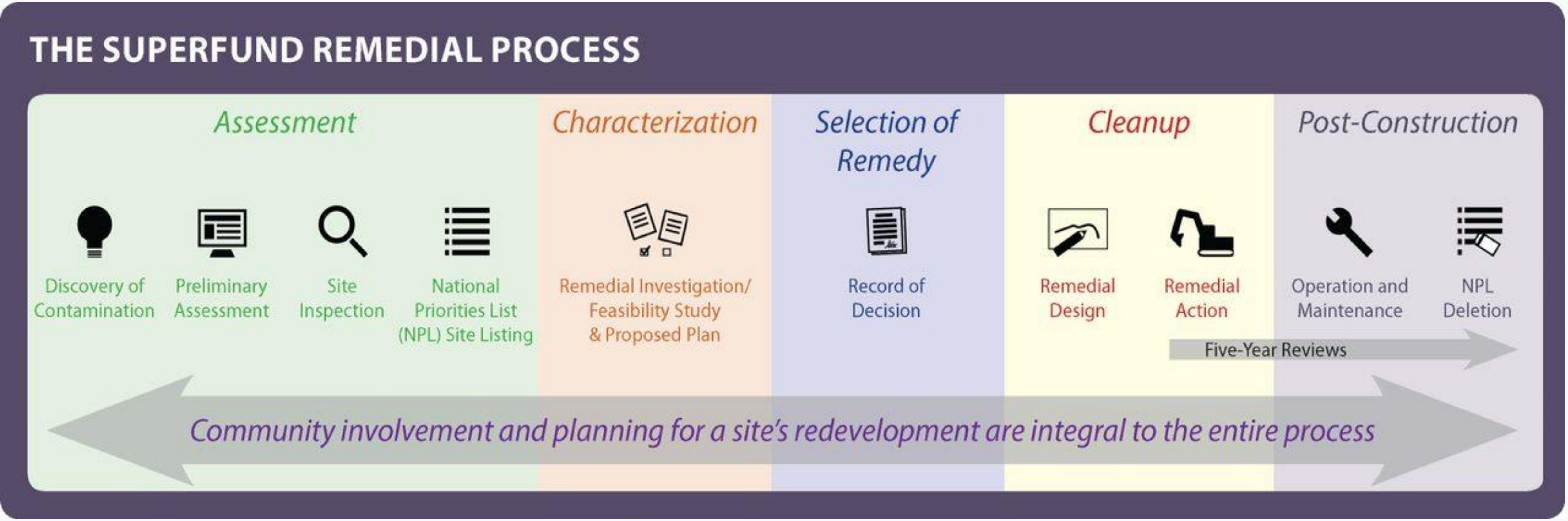
Proposed Cleanup Plan
October 17, 2019

Chris Vallone, RPM
Cathleen Kennedy, CIC
Chris Corbett, Senior RPM

Agenda

- Superfund Process
- Site History
- Previous Cleanup Activities
- EPA’s Proposed Cleanup Plan
- Next Steps

Superfund Process



Site History

- 1966 – 1979: Facility Manufactured Cosmetic Cases
  - Electroplating, Lacquering & Enameling Processes
  - Chlorinated solvents were used to degrease cases

- 1986 – Removal of Drums and Contaminated Soil

- 1990 – National Priorities List (Superfund)

Figure 2
Site Layout Map
Arrowhead Plating
Superfund Site

Legend

- Monitoring Well
- Surface Water Sampling Location
- Seep Sampling Location
- Wastewater Distribution Network
- PRB Location
- Stream
- Property Line
- Fence
- Former Acid AST
- Approximate Location of Oil-Stained Soils
- Former Drum Storage Area
- Former Sewage Lagoon
- Former Pond Area
- Former Solvent Tank Area
- Approximate Limits of Existing Cap

Notes:
AST=above ground storage tank
PRB=permeable reactive barrier

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(1-02)SiteLayout.mxd
8/28/2018 JG
Source: HGL,
ArcGIS Online Imagery

Contaminants of Concern

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- 1,4 – Dioxane

Cleanup Overview

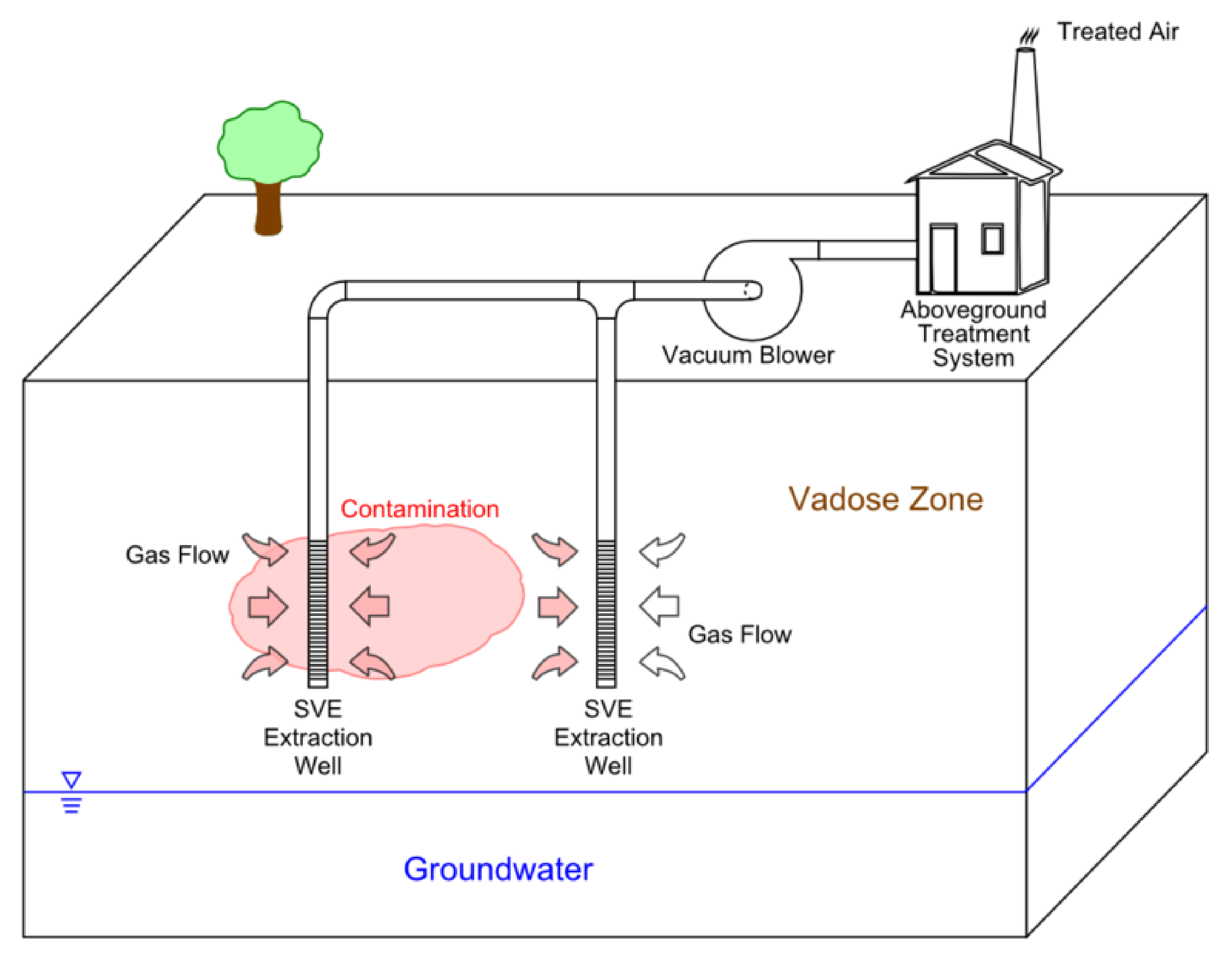
- **1991 Record of Decision:** Pump & Treat and Soil Vapor Extraction

- **1998 Explanation of Significant Differences:** Permeable Reactive Barrier

- **2001 Record of Decision Amendment:** Install Surface Cap

Cleanup Action

- 2002 - PRB/Cap Installed
- 2001-2003 – Soil Vapor Extraction Operation



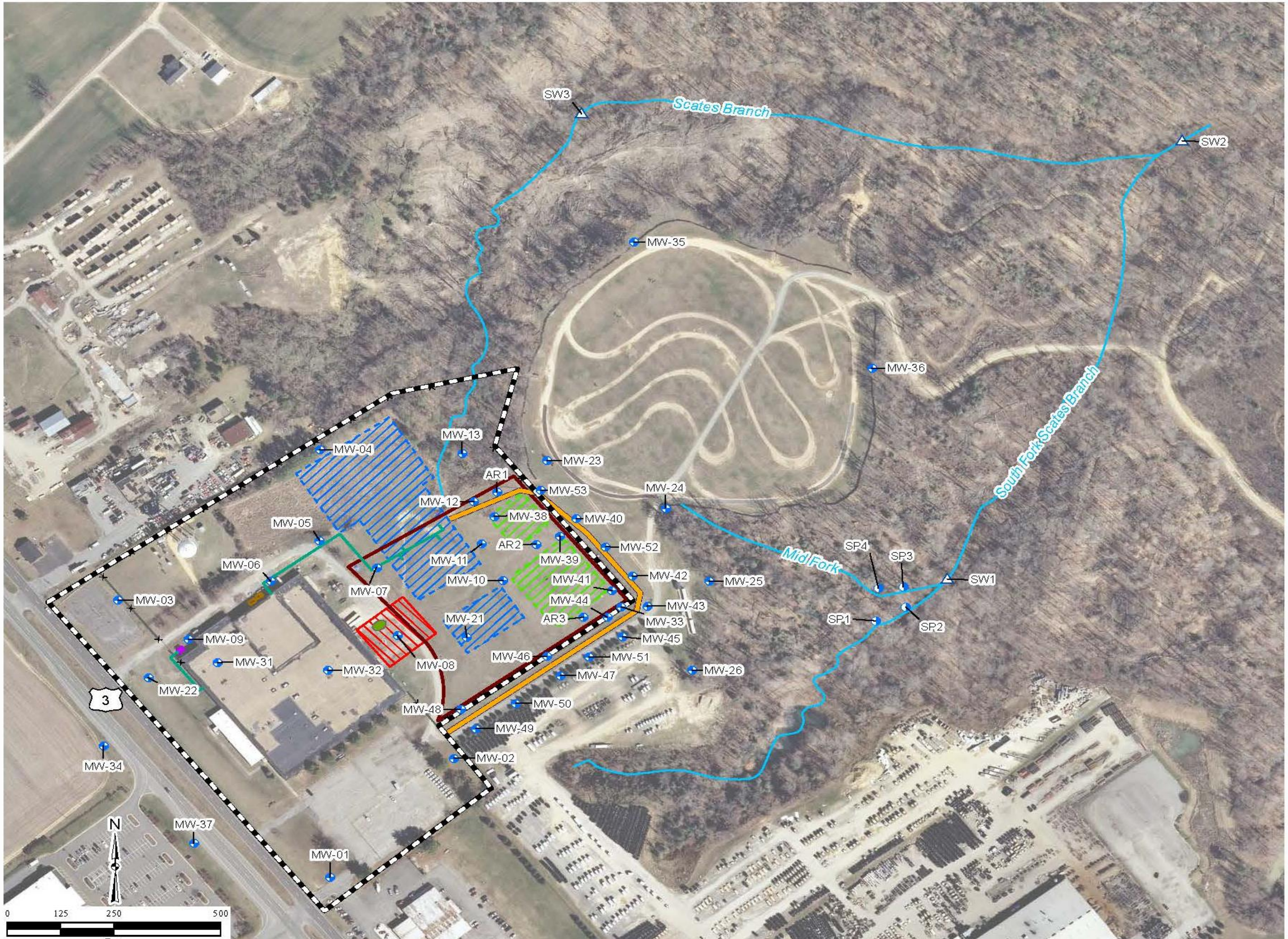


Figure 2
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Superfund Site

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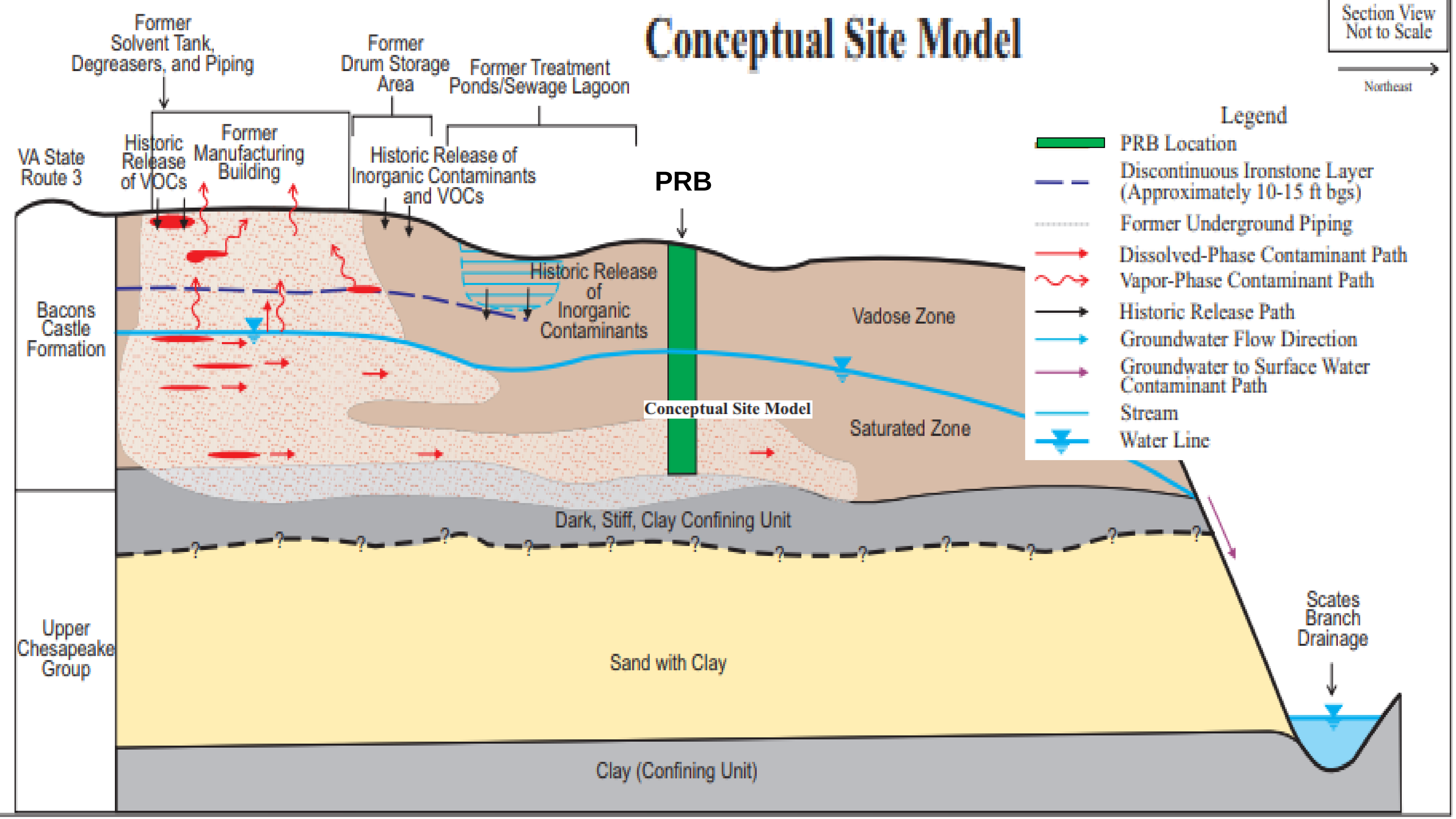
8/28/2018 JG
Source: HGL, ArcGIS Online Imagery



Conceptual Site Model
Section View Not to Scale
Northeast
Former Solvent Tank, Degreasers, and Piping
Former Drum Storage Area
Former Treatment Ponds/Sewage Lagoon
VA State Route 3
Historic Release of VOCs
Former Manufacturing Building
Historic Release of Inorganic Contaminants and VOCs
PRB
Historic Release of Inorganic Contaminants
Vadose Zone
Saturated Zone
Conceptual Site Model
Bacons Castle Formation
Dark, Stiff, Clay Confining Unit
Upper Chesapeake Group
Sand with Clay
Clay (Confining Unit)
Scates Branch Drainage
Legend
PRB Location
Discontinuous Ironstone Layer (Approximately 10-15 ft bgs)
Former Underground Piping
Dissolved-Phase Contaminant Path
Vapor-Phase Contaminant Path
Historic Release Path
Groundwater Flow Direction
Groundwater to Surface Water Contaminant Path
Stream
Water Line

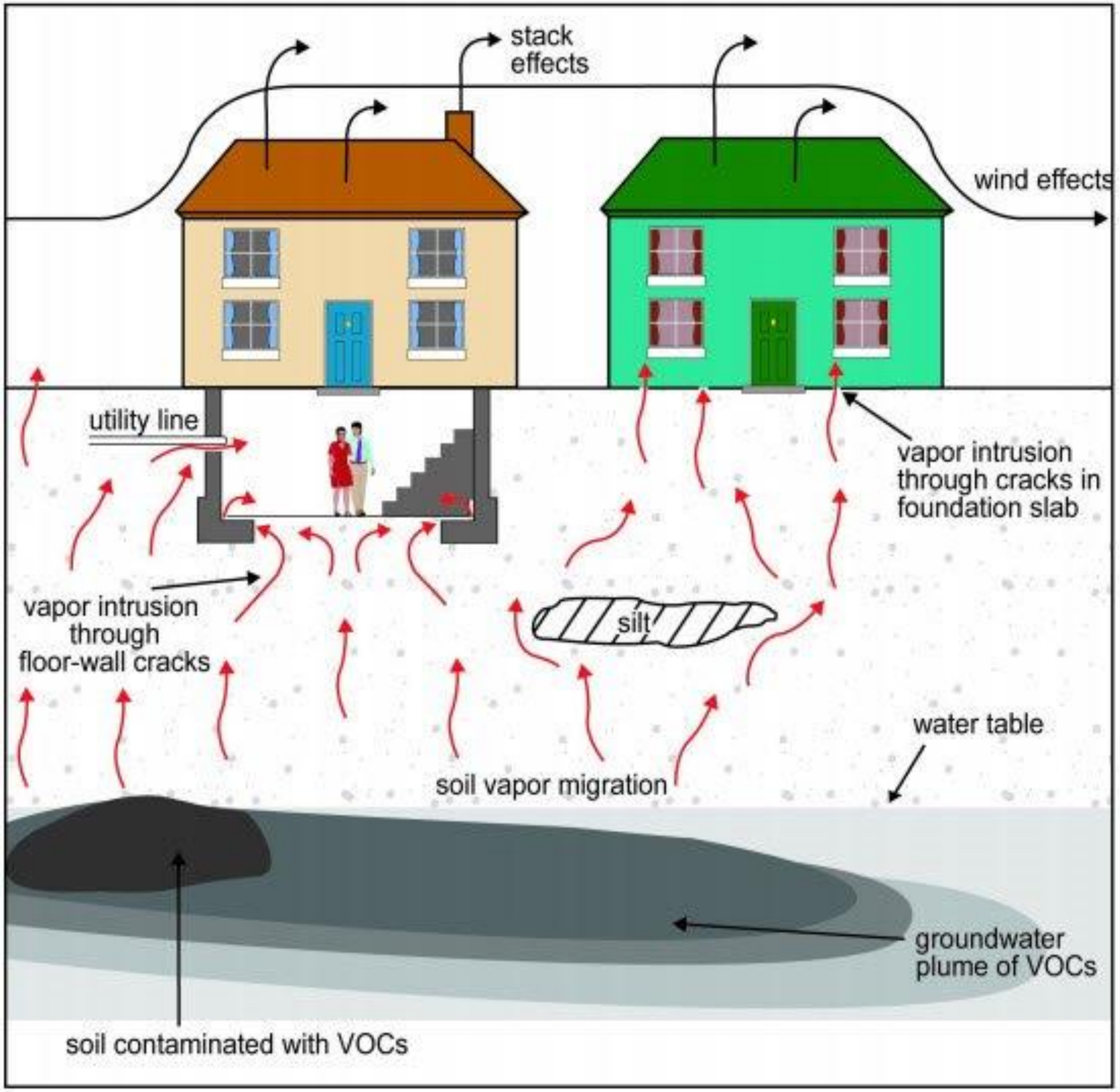
Cleanup Overview Continued

- 2010: Five Year Review - Assessment to determine the effectiveness of the cleanup

- 2012: EPA found 1,4 - Dioxane and other Volatile Organic Compounds (VOCs)
  - EPA collected samples of the groundwater and soil


Legend
Monitoring Well
MIP Location
Well or MIP Identification
PRB Location
Stream
Property Line
Fence
Former Drum Storage Area
Former Sewage Lagoon
Former Pond Area
Former Solvent Tank Area

Vapor Intrusion



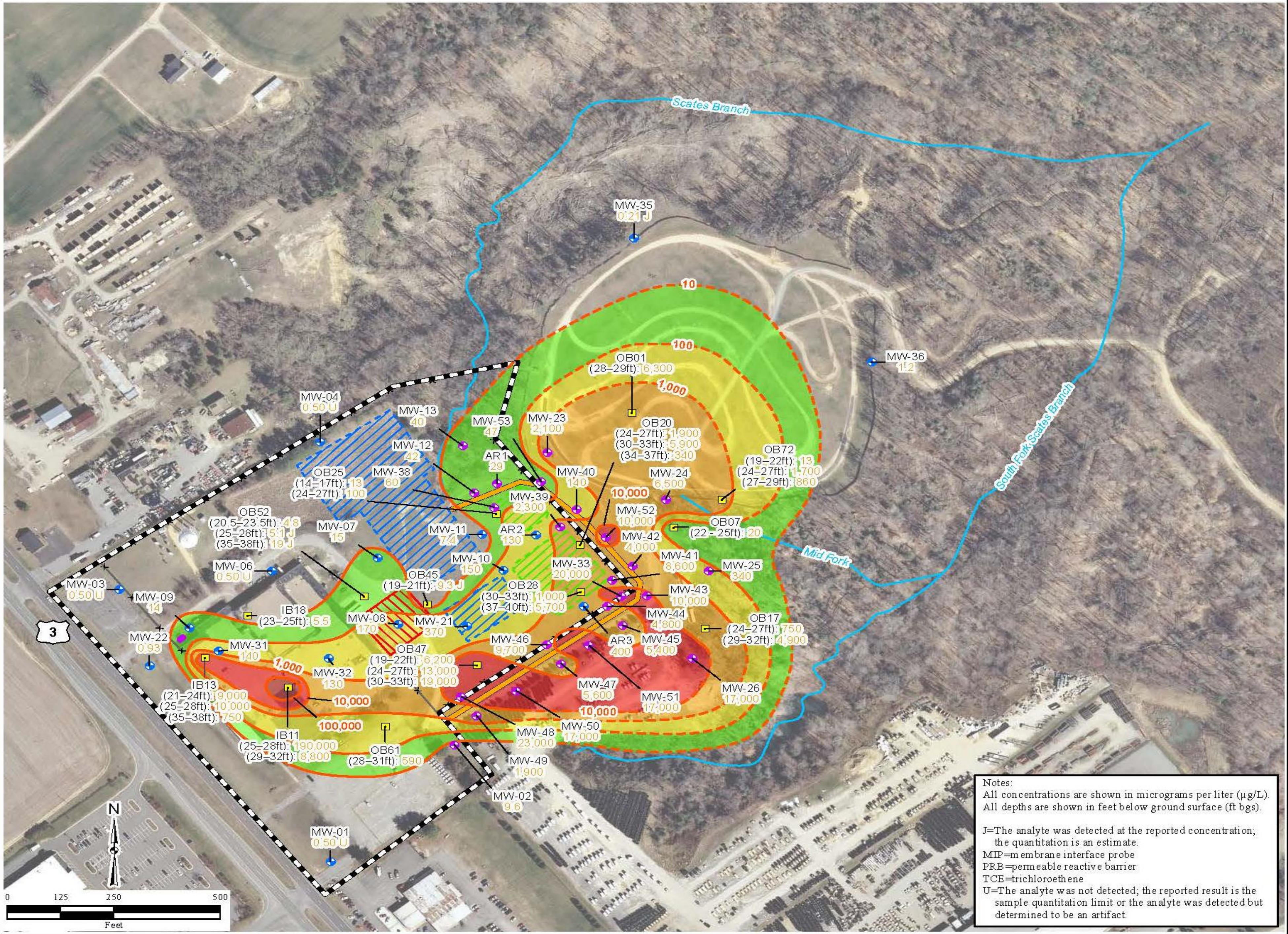
Conclusions Supplemental RI

- Source Areas Identified
  - Former Solvent Tank Area
  - Former Drum Storage Area

- Highest VOCs above confining clay (32 - 40 feet deep)

- Low levels of VOCs detected in sediments & surface water

Figure 3
TCE in Groundwater October 2012/January 2015 Arrowhead Plating Superfund Site



Notes:
All concentrations are shown in micrograms per liter (µg/L).
All depths are shown in feet below ground surface (ft bgs).

J=The analyte was detected at the reported concentration; the quantitation is an estimate.
MIP=membrane interface probe
PRB=permeable reactive barrier
TCE=trichloroethene
U=The analyte was not detected; the reported result is the sample quantitation limit or the analyte was detected but determined to be an artifact.

Legend

- Monitoring Well Sampled in January 2015
- Monitoring Well Sampled in October 2012
- MIP Location
- OB72 (19–22ft): 13 (24–27ft): 1,700 (27–29ft): 860 — Well or MIP Identification, TCE, First Depth, TCE, Second Depth, TCE, Third Depth
- 10 — TCE Contour (dashed where inferred)
- PRB Location
- Stream
- Property Line
- Fence
- Former Drum Storage Area
- Former Sewage Lagoon
- Former Pond Area
- Former Solvent Tank Area

TCE Concentration:

- 10–100
- 101–1,000
- 1,001–10,000
- 10,001–100,000
- >100,000

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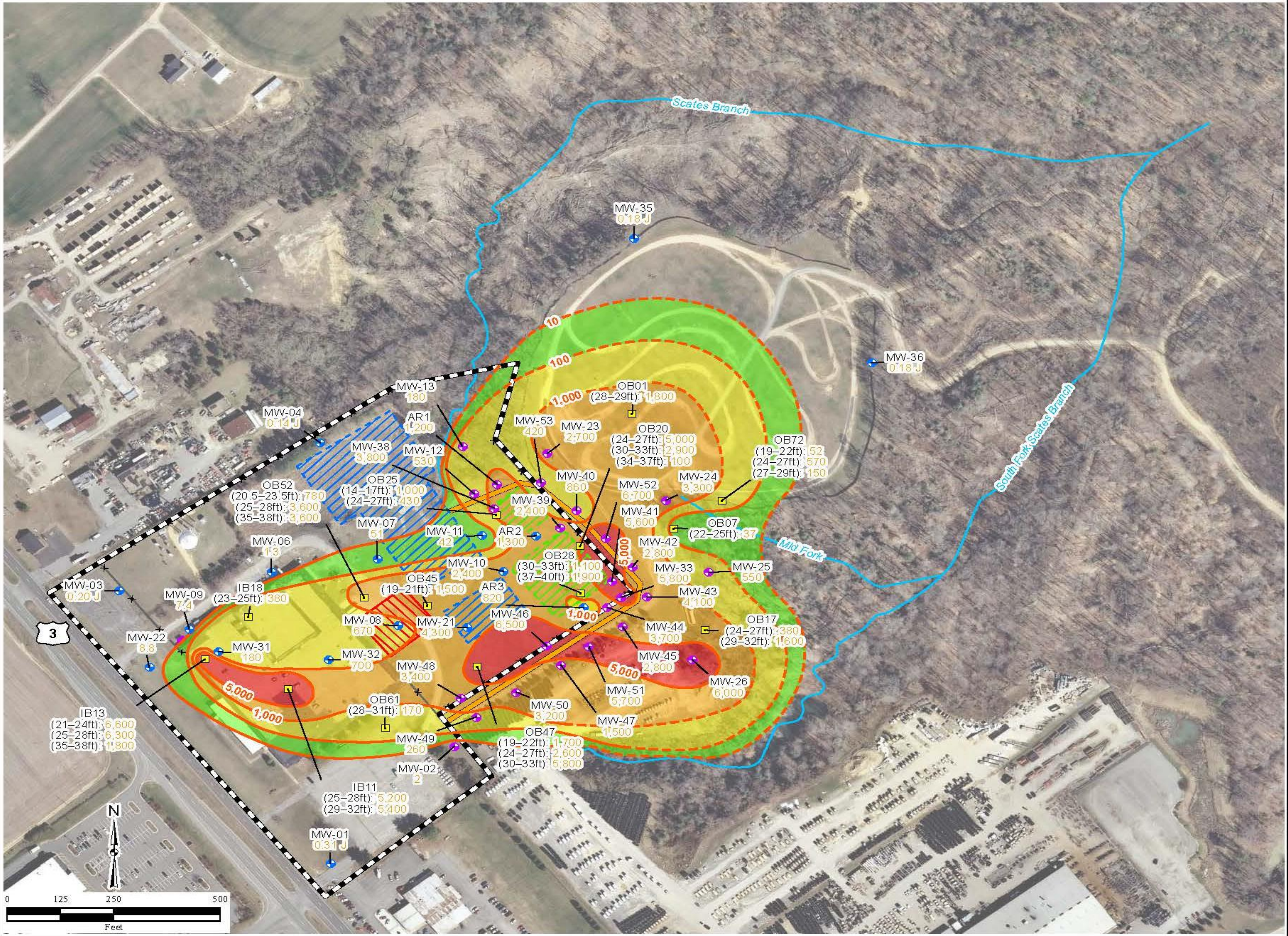
5/9/2018 JG
Source: HGL,
ArcGIS Online Imagery

Figure 4
PCE in Groundwater
October 2012/January 2015
Arrowhead Plating
Superfund Site



Legend

- Monitoring Well Sampled in January 2015
- Monitoring Well Sampled in October 2012
- MIP Location
- OB72 — Well or MIP Identification
- (19–22ft): 52 — PCE, First Depth
- (24–27ft): 570 — PCE, Second Depth
- (27–29ft): 150 — PCE, Third Depth
- 10 — PCE Contour (dashed where inferred)
- PRB Location
- Stream
- Property Line
- Fence
- Former Drum Storage Area
- Former Sewage Lagoon
- Former Pond Area
- Former Solvent Tank Area

PCE Concentration:

- 100–999
- 1,000–4,999
- ≥5,000

Notes:
All concentrations are shown in micrograms per liter (µg/L).
All depths are shown in feet below ground surface (ft bgs).

J=The analyte was detected at the reported concentration; the quantitation is an estimate.
MIP=membrane interface probe
PCE=tetrachloroethene
PRB=permeable reactive barrier

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5/9/2018 JG
Source: HGL, ArcGIS Online Imagery

HydroGeoLogic, Inc

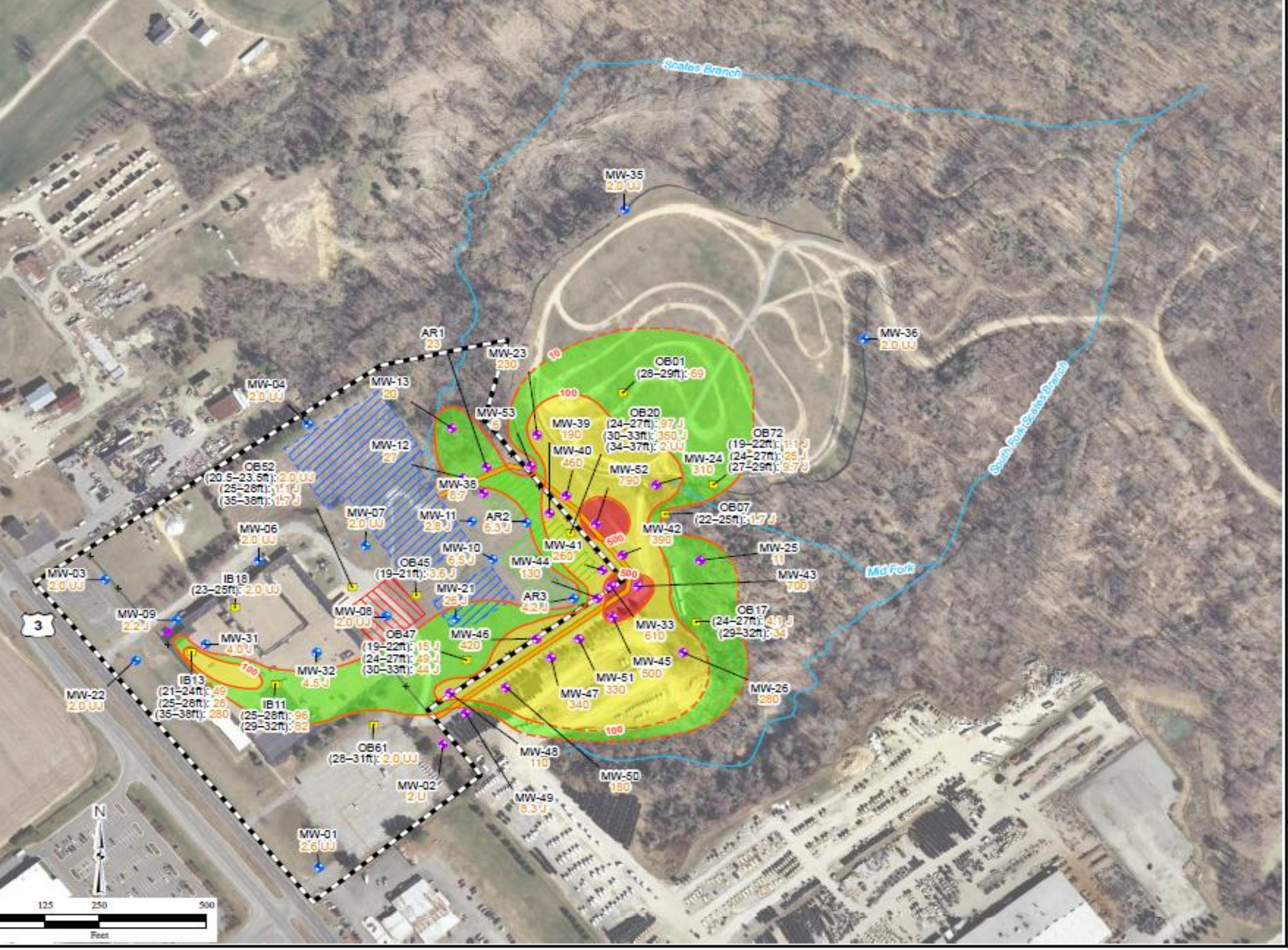

Figure 1.18
1,4-Dioxane in Groundwater
October 2012/January 2015
Arrowhead Superfund Site

Legend

- Monitoring Well Sampled in January 2015
- Monitoring Well Sampled in October 2012
- MIP Location
- OB72 — Well or MIP Identification
- (19–22ft): 1.1 J — 1,4-Dioxane, First Depth
- (24–27ft): 25 J — 1,4-Dioxane, Second Depth
- (27–29ft): 9.7 J — 1,4-Dioxane, Third Depth
- —10— 1,4-Dioxane Contour (dashed where inferred)
- PRB Location
- Stream
- Property Line
- Fence
- Former Drum Storage Area
- Former Sewage Lagoon
- Former Pond Area
- Former Solvent Tank Area

1,4-Dioxane Concentration:

- 10-99
- 100–499
- ≥500

Notes:
All concentrations are shown in micrograms per liter (µg/L).
All depths are shown in feet below ground surface (ft bgs).

J=The analyte was detected at the reported concentration; the quantitation is an estimate.
MIP=membrane interface probe
PRB=permeable reactive barrier
U=The analyte was not detected; the reported result is the sample quantitation limit or the analyte was detected but determined to be an artifact.

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5/9/2018 JG
Source: HGL, ArcGIS Online Imagery

HGL

Overview of Current Activities

- 2019 Feasibility Study
- 2019 Proposed Remedial Action Plan (Cleanup Plan)
- 2020 Record Of Decision Amendment
  - Remedial Design
  - Remedial Action (Cleanup)

Nine Criteria

1) Overall Protectiveness of Human Health and the Environment
2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
3) Long-term Effectiveness
4) Reduction of Toxicity, Mobility, or Volume through Treatment
5) Short-Term Effectiveness
6) Implementability
7) Cost
8) State Acceptance
9) Community Acceptance

Remedial Action Objectives

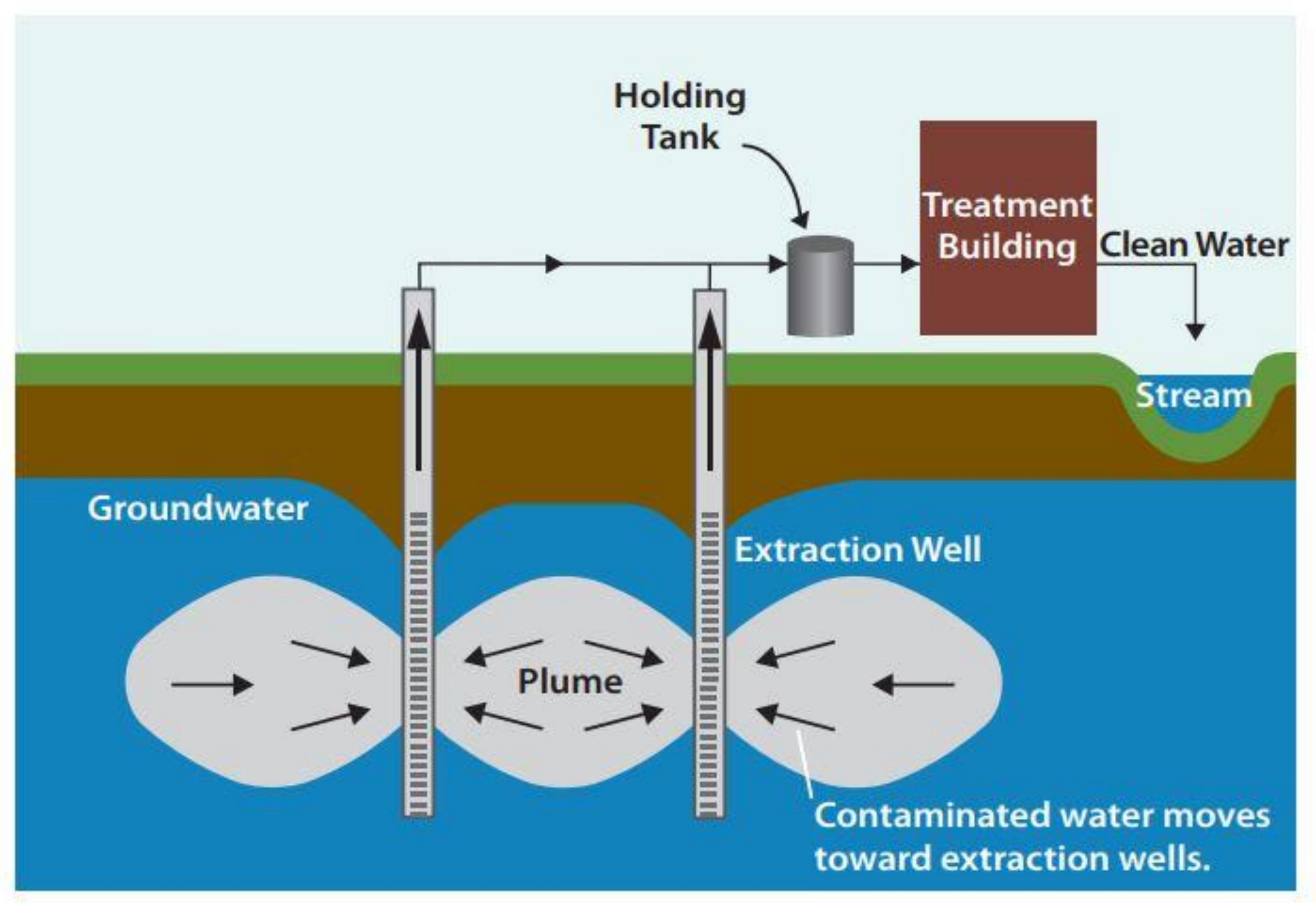
- Reduce VOCs in soil, air and groundwater
- Restore groundwater to beneficial use
- Protect human health from contamination
- Eliminate contaminated vapors in the building
- Restrict use of groundwater until cleanup goals are achieved

Cleanup Technologies Evaluated

- Electrical Resistance Heating (ERH)
- Pump & Treat Groundwater
- Air Sparge & Soil Vapor Extraction
- In-Situ Chemical Oxidation (ISCO)
- Enhanced Reductive Dechlorination (ERD)
- Excavation & Off-site Disposal

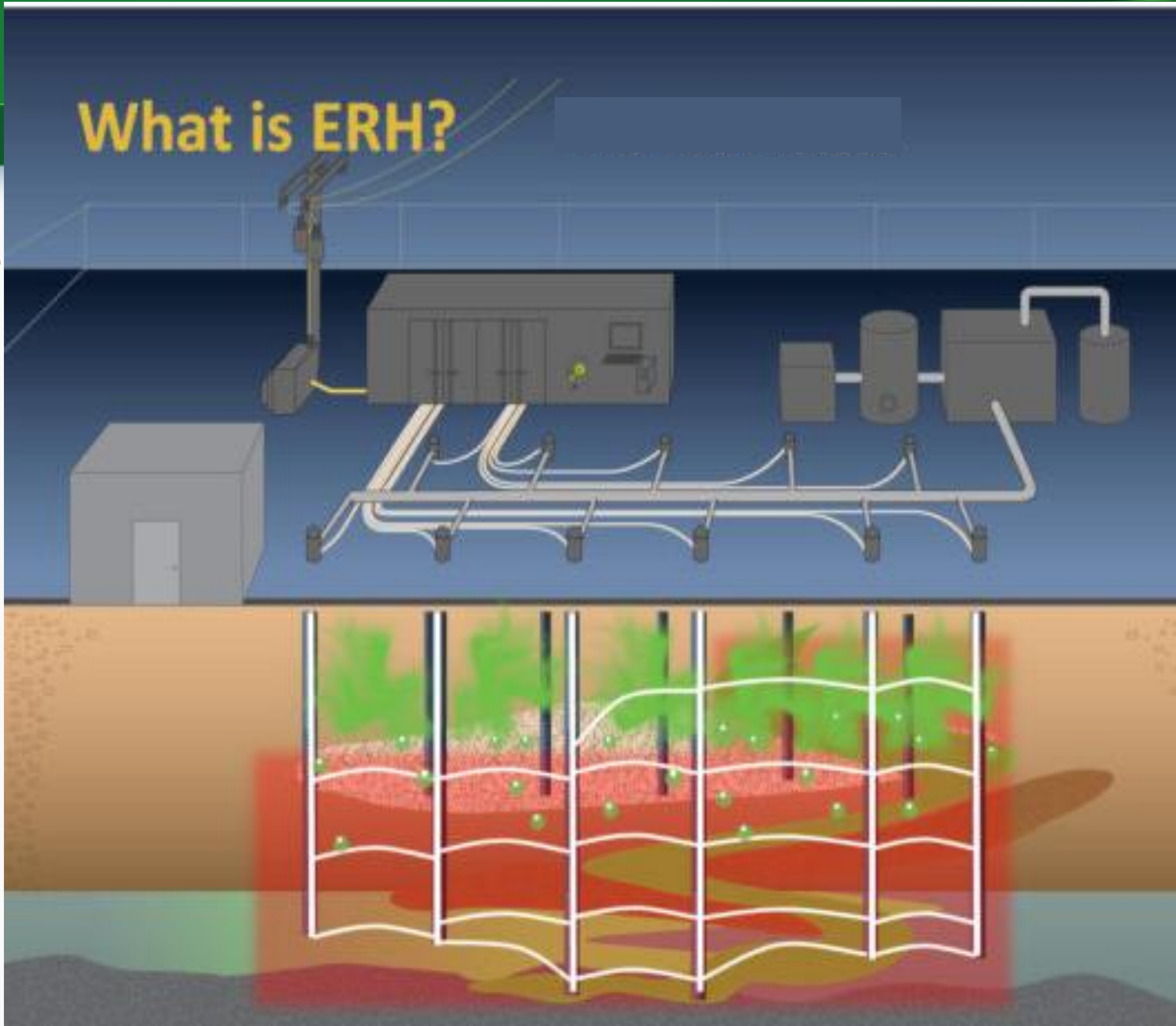
Pump & Treat

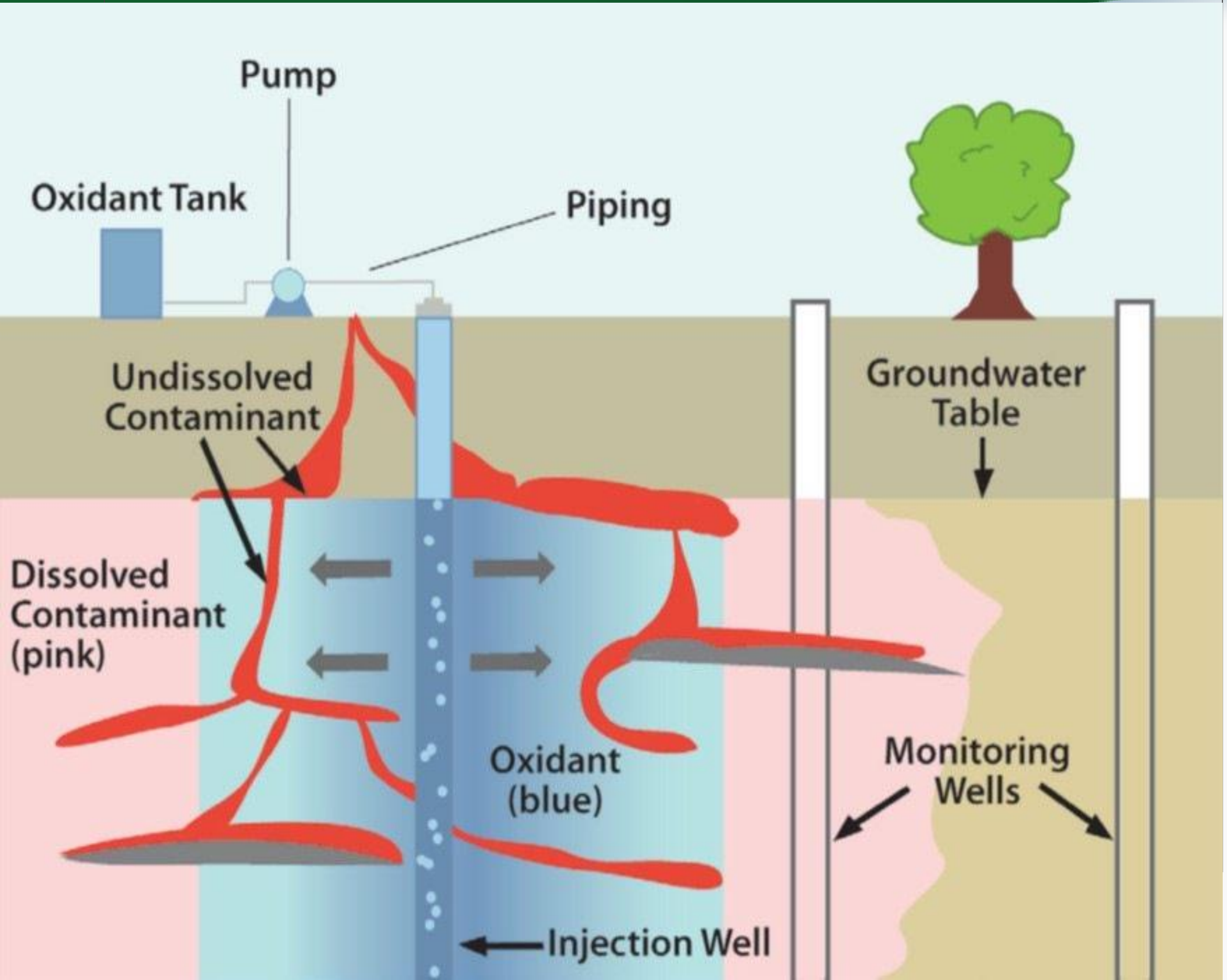
- Extraction wells pump groundwater
- Treat groundwater
- Discharge for future use



Electrical Resistance Heating (ERH) (Thermal)

- Heats soil and groundwater
- Extracts the vapors
- Permanently removes all contaminates

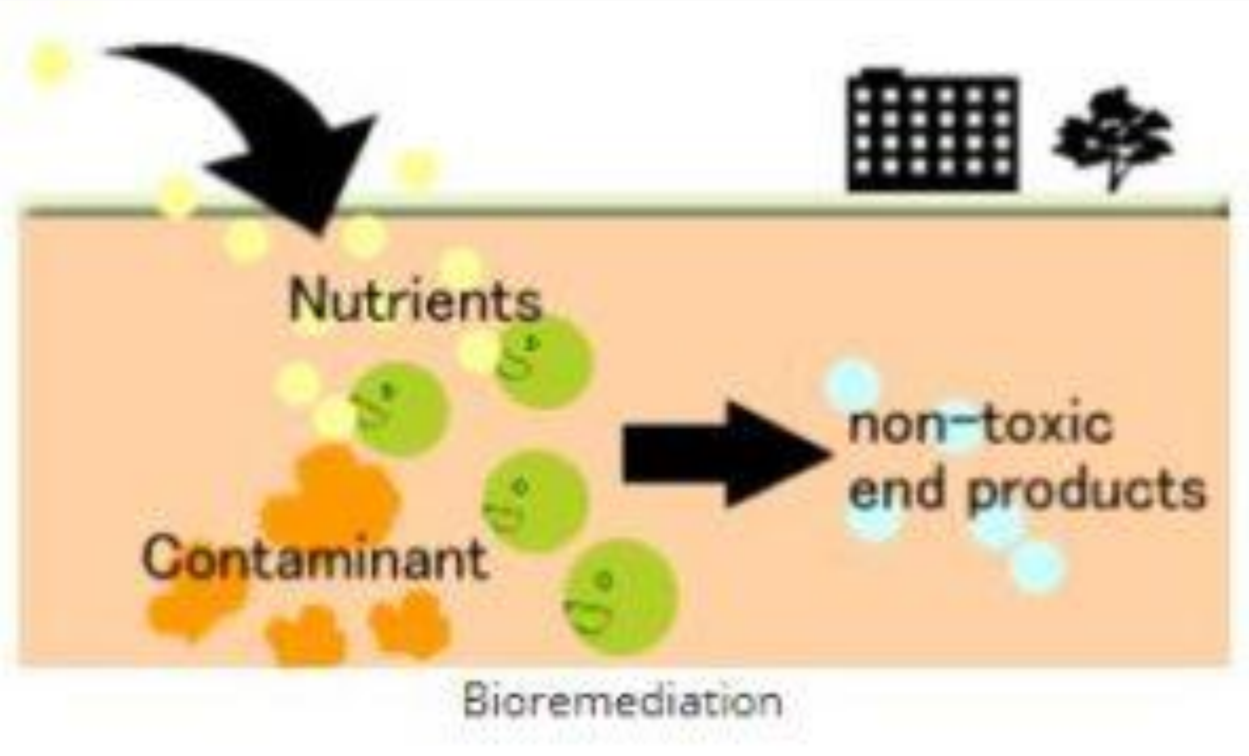




In-Situ Chemical Oxidation (ISCO)

- Chemical oxidizer is injected or mixed into soil and/or groundwater
- Chemical reaction converts hazardous compounds to nonhazardous compounds

Enhanced Reductive Dechlorination (ERD)



2 Step Phase:

- 1st Step: Electron Donor
  - Creates an environment for 2nd step

- 2nd Step: Bioremediation
  - Any process that uses microorganisms to return the natural environment changed by contaminants to its original condition.

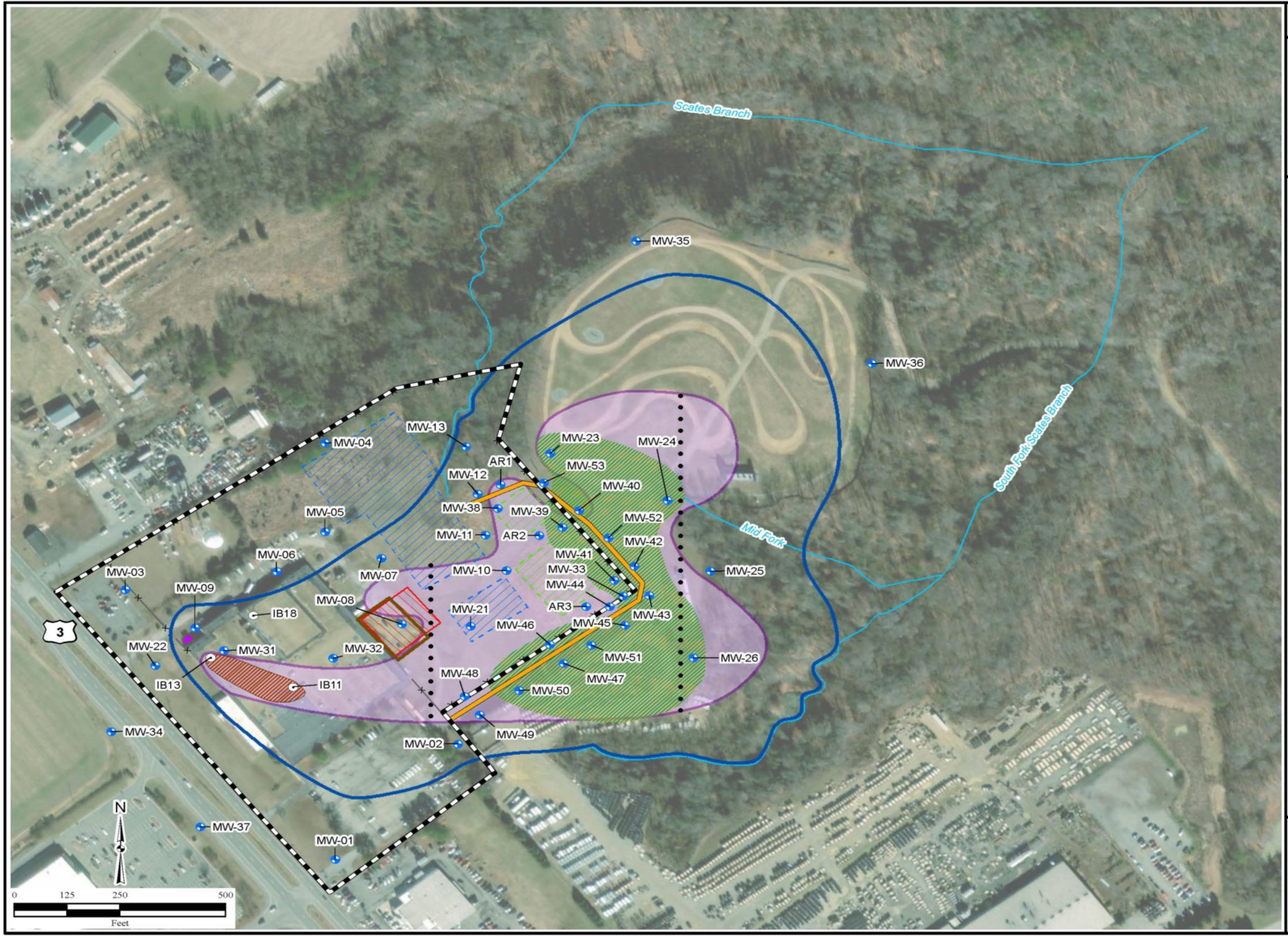
Alternatives Developed

	ERH	Groundwater Extraction and Treatment	ERD	ISCO	Soil excavation with off-site disposal	Soil Vapor Extraction	Vapor Intrusion (VI) mitigation	Cost
Alternative #1	No action*							N/A
Alternative #2	✓	✓	·	·	·	✓	✓	$42 M
Alternative #3	✓		✓	·	✓	·	✓	$14 M
Alternative #4				✓	·	·	✓	$36 M
Alternative #5	✓		✓		✓	·	✓	$17 M
Alternative #6	✓			✓	✓		✓	$31 M
Alternative #7	✓	-	✓	✓	✓	-	✓	$18 M

Alternative 7: ERH, ISCO, ERD, Excavation/Disposal

- ERH used under the building
- ISCO to treat 1,4-dioxane outside building
- ERD used to treat remaining VOCs
- Soil excavation of Former Drum Storage Area

Figure 12
Alternative 7 Remedial Components
Arrowhead Superfund Site



Legend

- Monitoring Well
- Soil Sample
- MW-01 Well or Soil Sample Identification
- PRB Location
- Proposed ERD Injection Locations
- Stream
- Property Line
- Fence
- Former Drum Storage Area
- Former Sewage Lagoon
- Former Pond Area
- Former Solvent Tank Area
- Composite PCE/TCE >1,000 μg/L Groundwater Area
- Approximate Groundwater Area Exceeding RGs
- Soil Excavation Area
- ERH Treatment Area
- ISCO Injection Treatment Area (1,4-Dioxane Concentration, 150 μg/L)

Notes:
μg/L=micrograms per liter
ERD=enhanced reductive dechlorination
ERH=electrical resistance heating
ISCO=in situ chemical oxidation
PRB=permeable reactive barrier
RG=remedial goal

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7/2/2019 TH
Source: HGL,
ArcGIS Online Imagery

HGL
HydroGeoLogic, Inc

Why is Alternative 7 the Best?

- Protective of Human Health and the Environment
- Meets all Regulations – Federal & State
- Effectively Treats all Contamination
- Cost Effective

Next Steps

- Public comment period is from now until to October 28, 2019 to submit comments

- Record of Decision and Responsiveness Summary is scheduled for May 2020
  - Includes answers to the questions received during the public comment period

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  Community Involvement Coordinator

  Environmental Protection Agency

  Region III

  1650 Arch Street (3RA22)

  Philadelphia, PA 19103

  215-814-2746

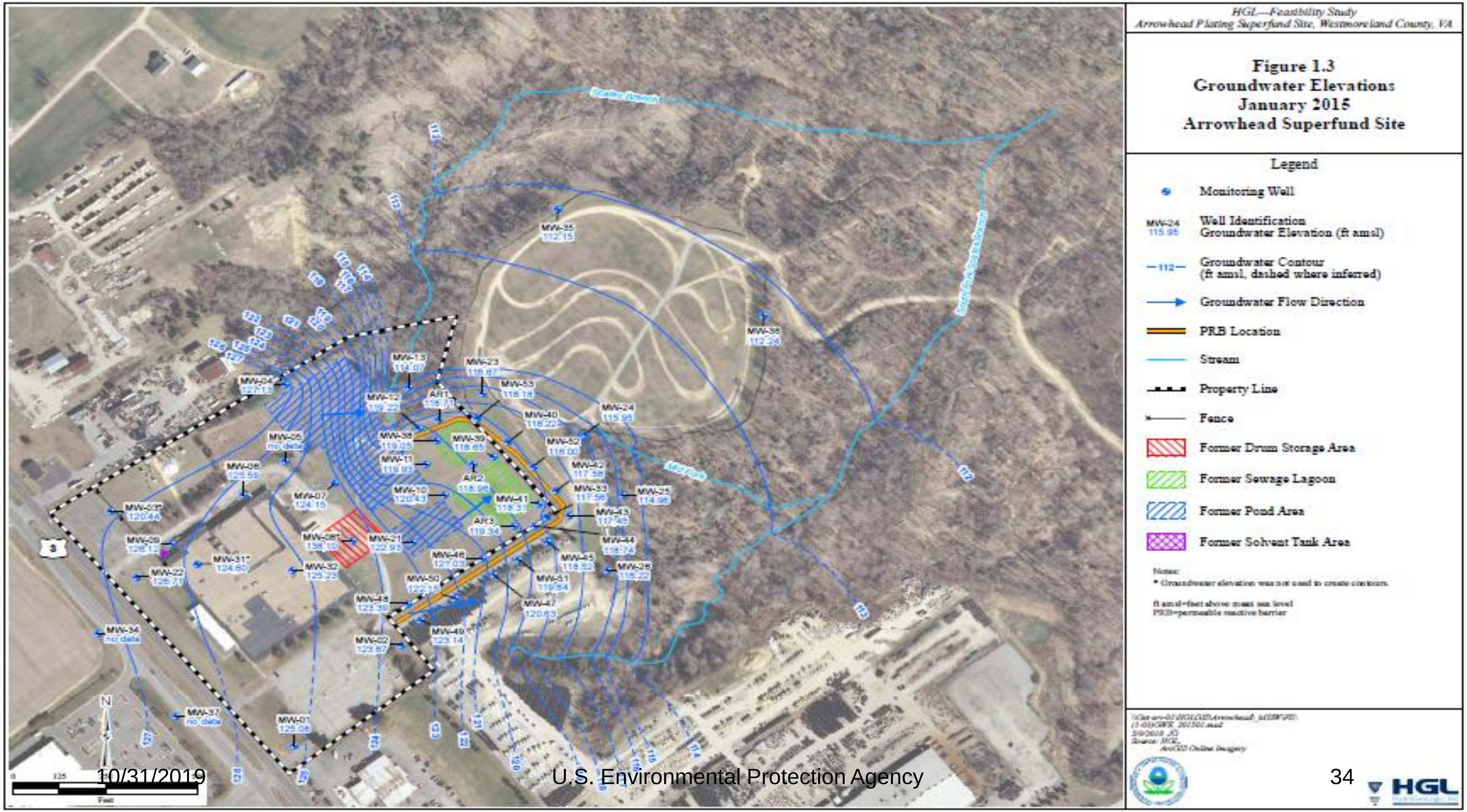
  Kennedy.Cathleen@epa.gov

Contaminants of Concern Groundwater Remedial Goals

Contaminant	Remedial Goal (µg/L)	Source
1,1,1-Trichloroethane	200	ROD
1,1,2-Trichloroethane	5	ROD
1,1-Dichloroethane *	28	EPA tap water RSL, $1X10^{-5}$ risk
1,1-Dichloroethene	7	ROD
1,2-Dichloroethene (total)	70	ROD
1,4-Dioxane *	23	Risk-based, site-specific
Tetrachloroethene	5	ROD
Trichloroethene	5	ROD
Vinyl chloride	2	ROD
Cadmium	10	ROD
Copper	1,300	ROD
Iron	14,000	EPA tap water RSL
Manganese	480	EPA tap water RSL
Nickel	100	ROD
Zinc	5,000	ROD

Contaminants of Concern
Soil Remedial Goals

Contaminant	Remedial Goal (mg/kg)
Tetrachloroethene	0.058
Trichloroethene	0.057
cis-1,2-Dichloroethene	0.4
Vinyl Chloride	0.013
1,1,2-Trichloroethene	0.031


HGL—Feasibility Study
Arrowhead Plating Superfund Site, Westmoreland County, VA
Figure 1.3
Groundwater Elevations
January 2015
Arrowhead Superfund Site
Legend
Monitoring Well
MW-24 115.95
Well Identification
Groundwater Elevation (ft amsl)
—112—
Groundwater Contour
(ft amsl, dashed where inferred)
Groundwater Flow Direction
PRB Location
Stream
Property Line
Fence
Former Drum Storage Area
Former Sewage Lagoon
Former Pond Area
Former Solvent Tank Area
Notes:
* Groundwater elevation was not used to create contours.
ft amsl=feet above mean sea level
PRB=permeable reactive barrier
Scates Branch
Mill Fork
MW-35 112.15
MW-36 112.24
MW-24 115.95
MW-13 114.07
MW-23 118.87
MW-04 127.13
MW-05 no data
MW-34 no data
MW-37 no data
MW-01 125.08
N
Feet
HGL

Applicable or Relevant & Appropriate Req

- Safe Drinking Water Act (MCLs)/VA Groundwater Standards
- Clean Water Act (NPDES)/VA Pollutant Discharge Elimination
- Migratory Bird Treaty/Endangered Species Act
- Underground Injection (Federal) - substrate injections
- Monitoring Well Installation & Abandonment Act (VA)
- Stormwater Mgt./Erosion & Sediment Control (VA)
- VA Waste Management Act - manage/dispose wastes
- Clean Air Act section 112(d) – emissions from remediation
- Air Pollution Control Board (particulates/emissions)
- TBDs - Screening Tables, GW Guidance, USF&WS (bald eagles)

Comparative analysis of alternatives

- Alt 2: P&T expensive ($41.4M)
- Alt 3: ERD not effective for 1,4-dioxane under building & vadose zone ($12.9M)
- Alt 4: Not effective on vadose zone & expensive ($36.2M)
- Alt 5: ERD not effective for 1,4-dioxane ($16.3M)
- Alt 6: ISCO – Expensive & multiple injections ($30.2M)
- Alt 7: Treats 1,4-dioxane, significant portion of VOC plume & cost effective ($18.2M)