



Green  
Infrastructure  
Partners



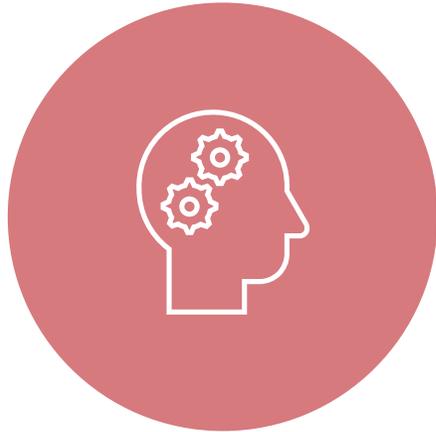
# PRBs and Innovative Boundary Control to Support Redevelopment of a Hazardous PCB Brownfield

Devin Rosnak – Green Infrastructure Partners Inc.

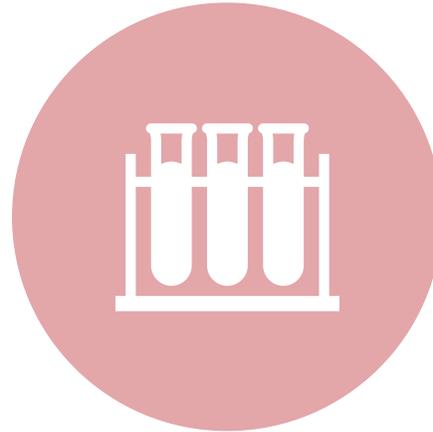
Samuel Lingwood – Pinchin Ltd.



# AGENDA



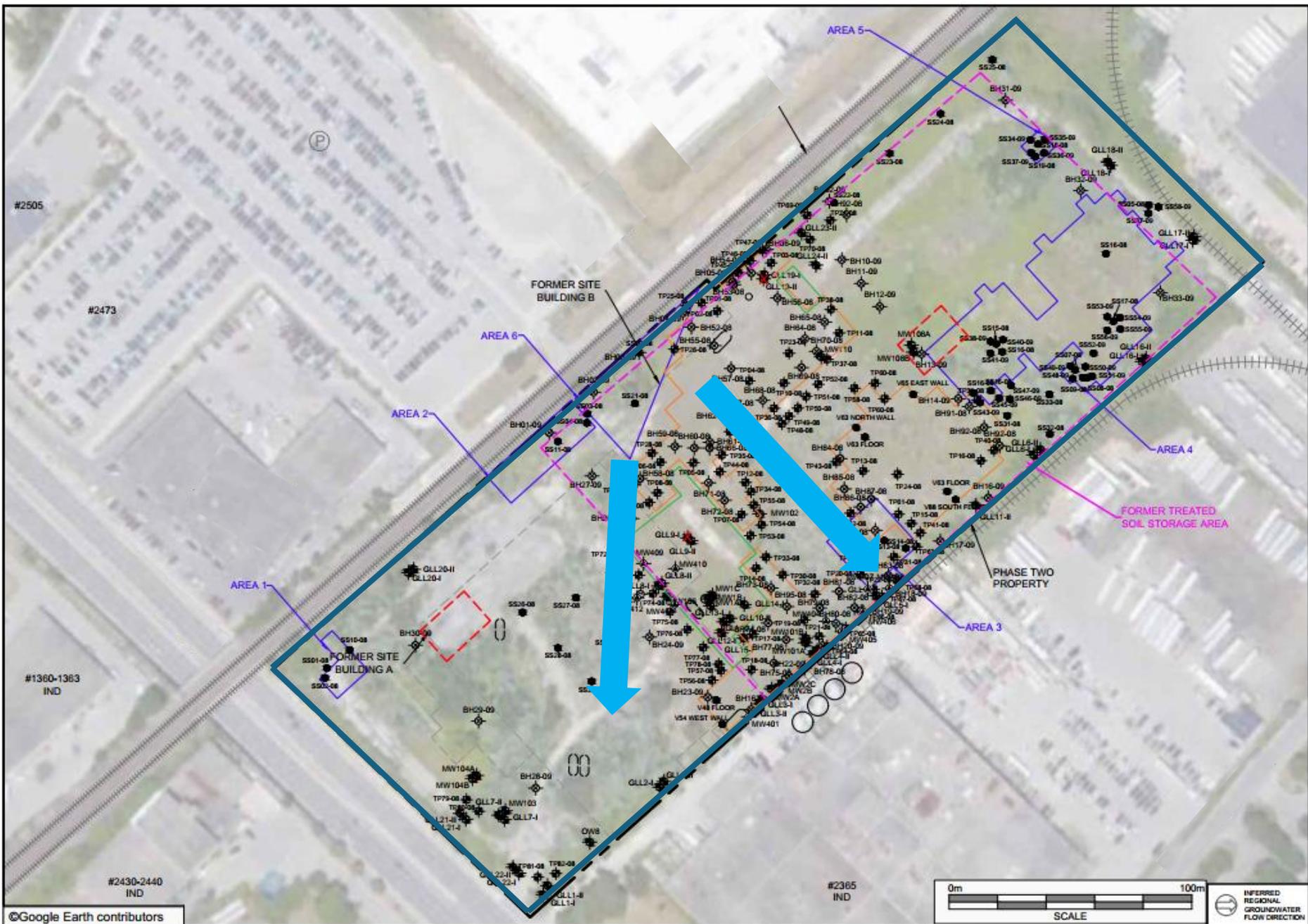
FRAMING THE PROBLEM



DESIGN AND BENCH SCALE  
TESTS



INSTALLATION /  
IMPLEMENTATION



### Groundwater Maximums

TCE: 290 ppb

Cis-1,2-DCE: 1,100 ppb

VC: 210 ppb

PCBs: 1,200,000 ppb

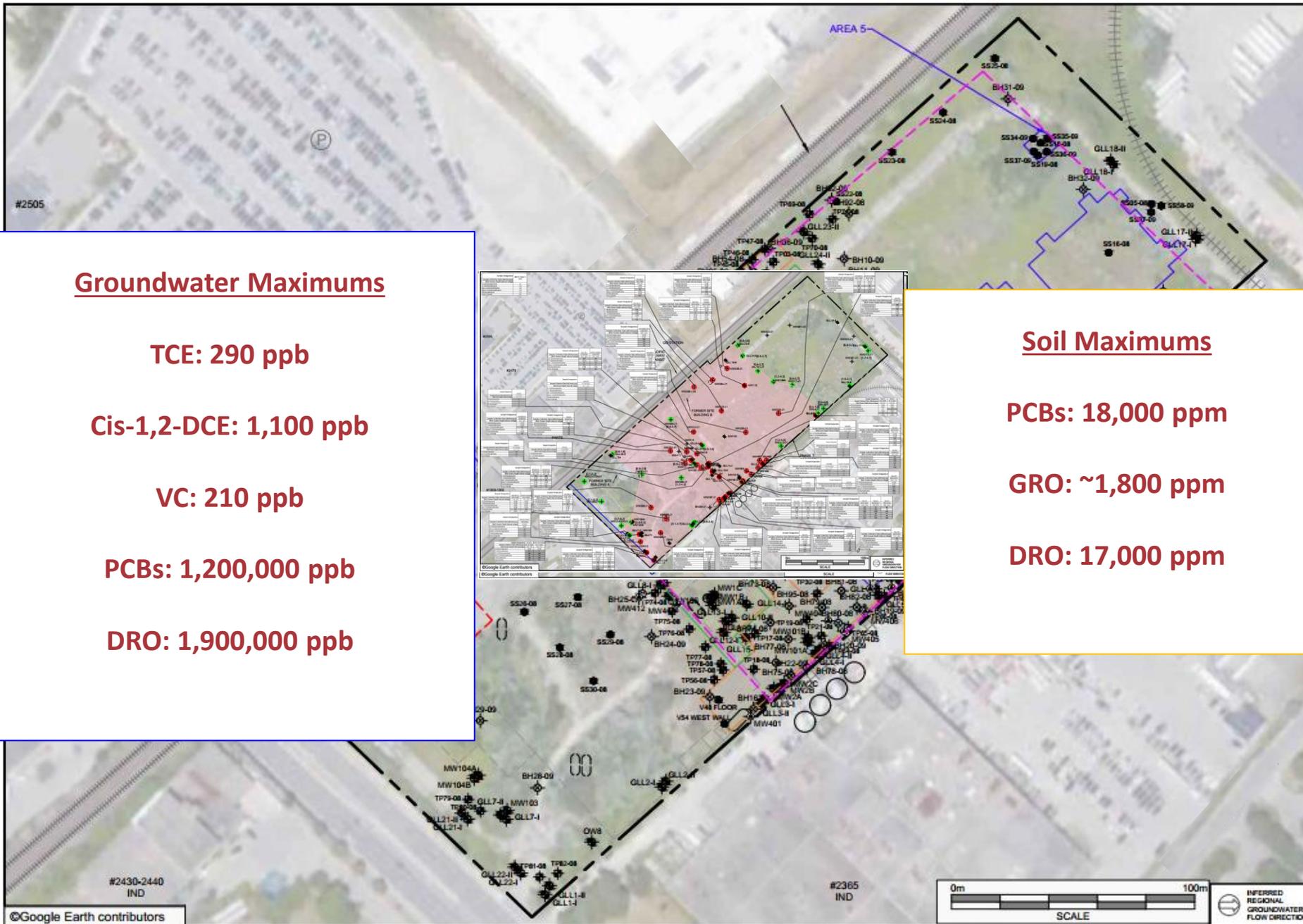
DRO: 1,900,000 ppb

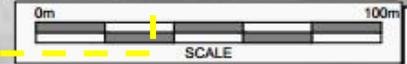
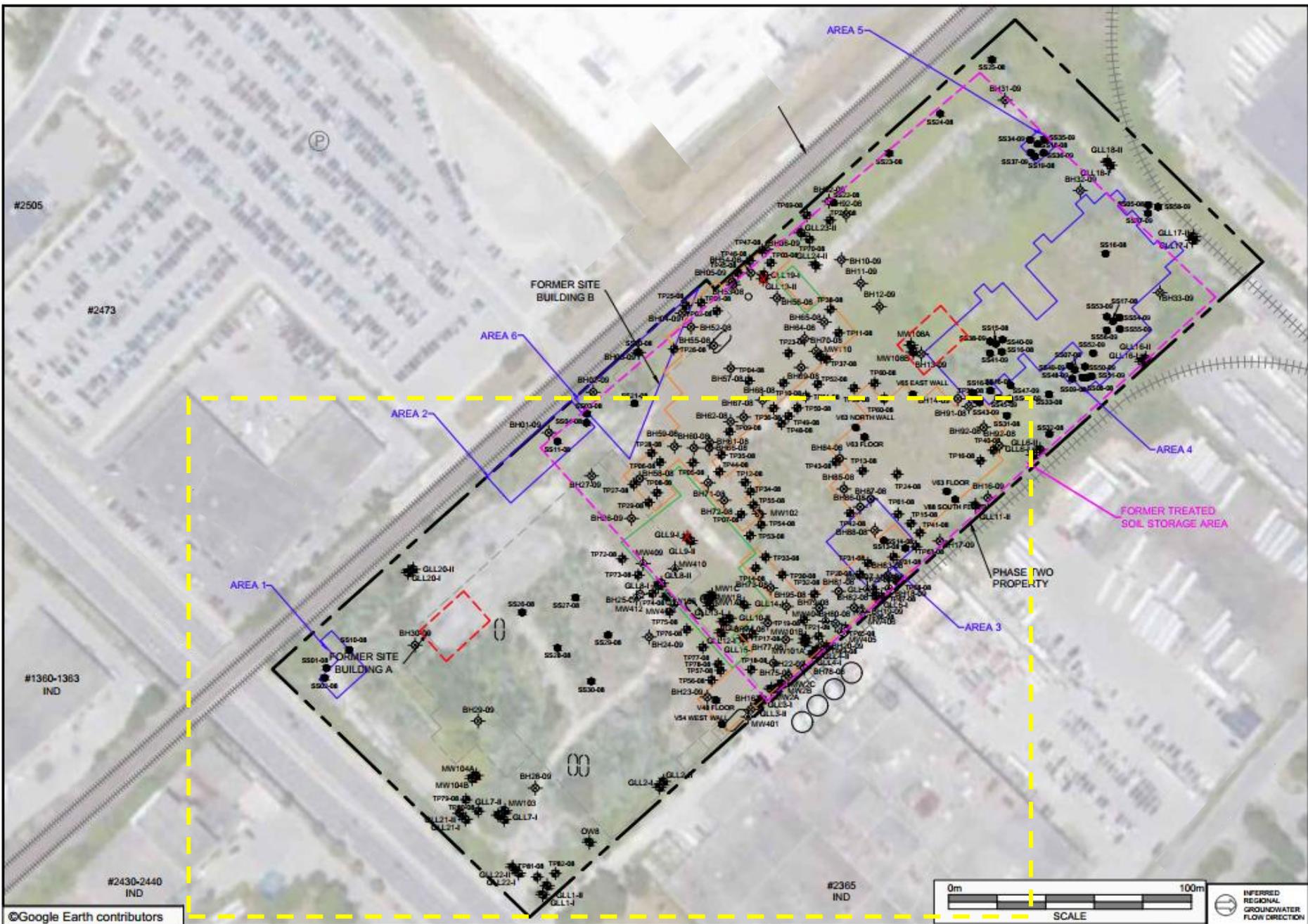
### Soil Maximums

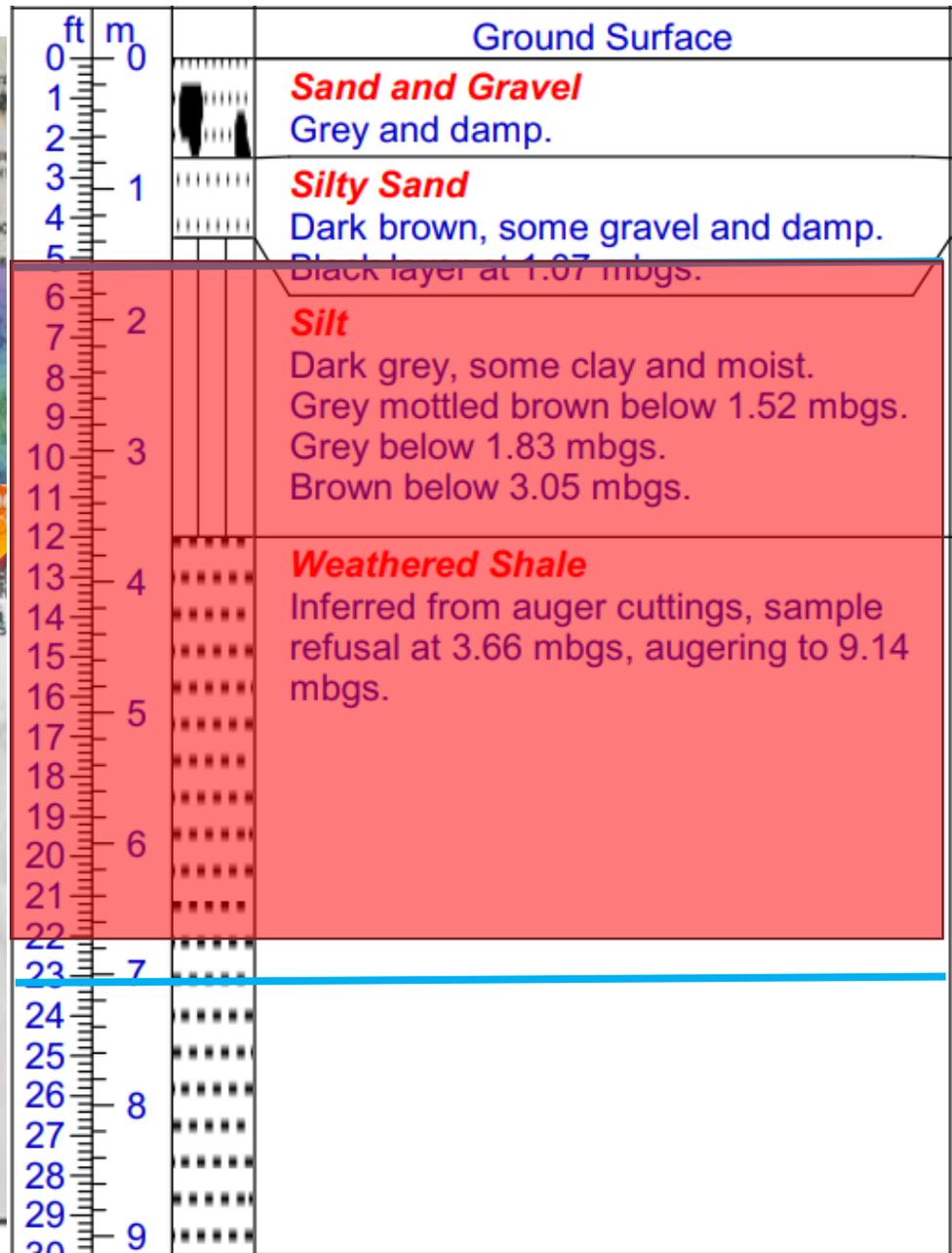
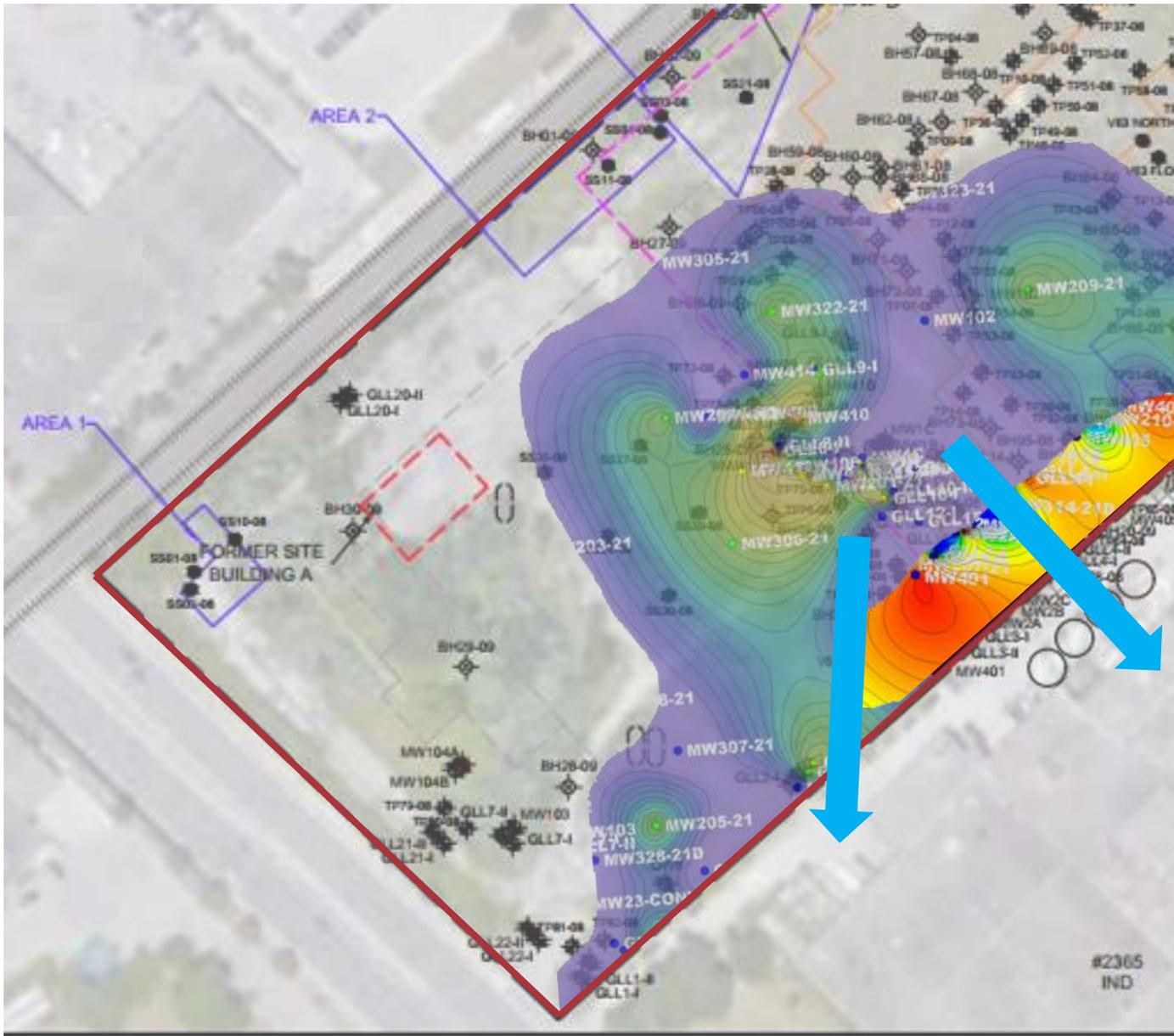
PCBs: 18,000 ppm

GRO: ~1,800 ppm

DRO: 17,000 ppm







- Full Remediation **>\$100 Million!**



Treat and Manage



# RISK ASSESSMENT AND RMMS

## Risks:

- Indoor Vapour Intrusion
- Ingestion/Contact
- Offsite Migration

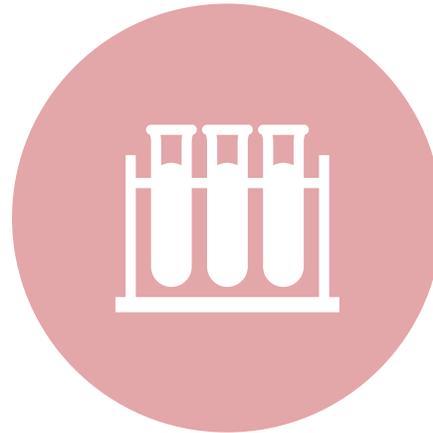
## Management:

- SSDS
- Hard-capping/HASP
- Boundary Control

# AGENDA



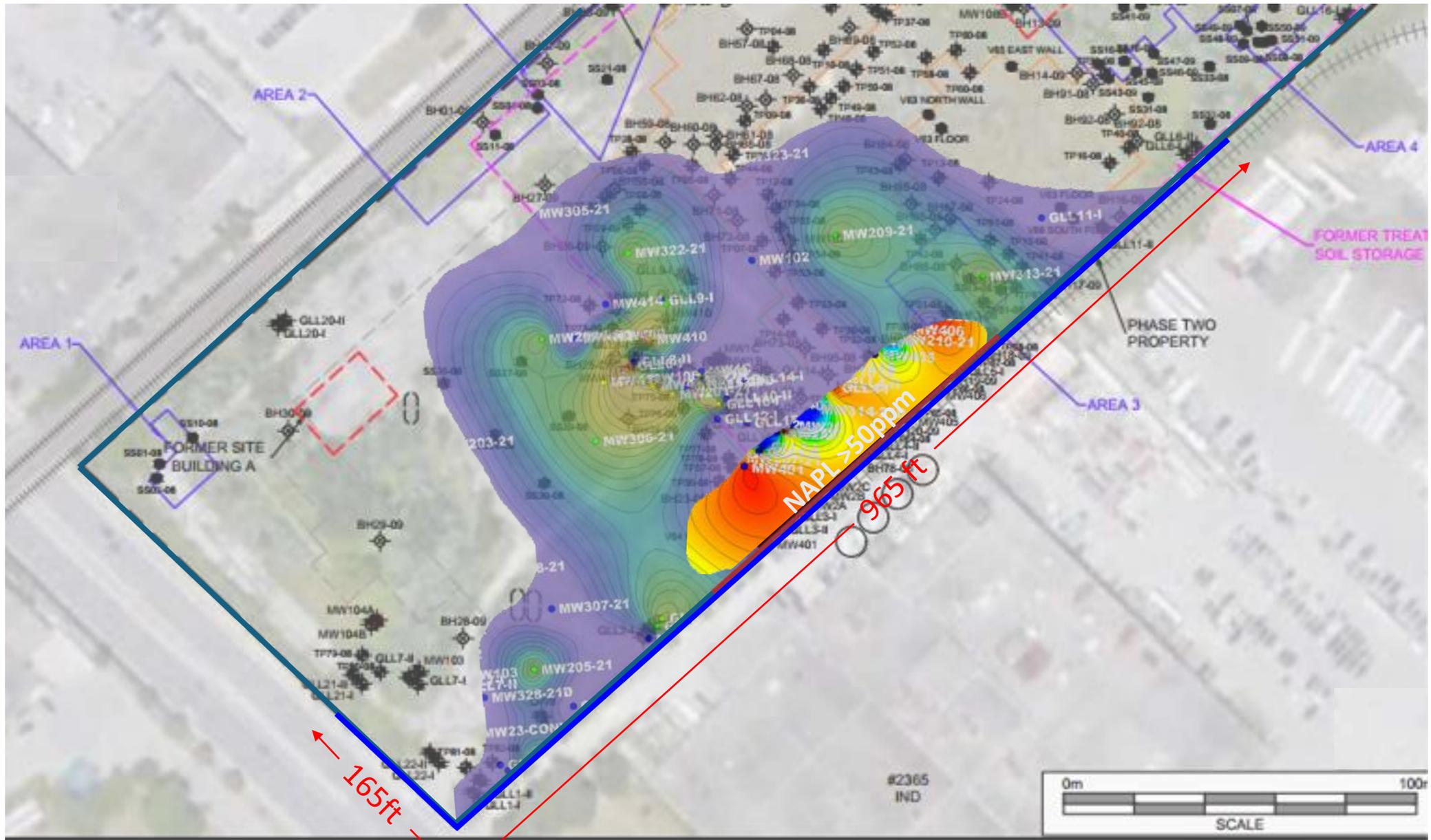
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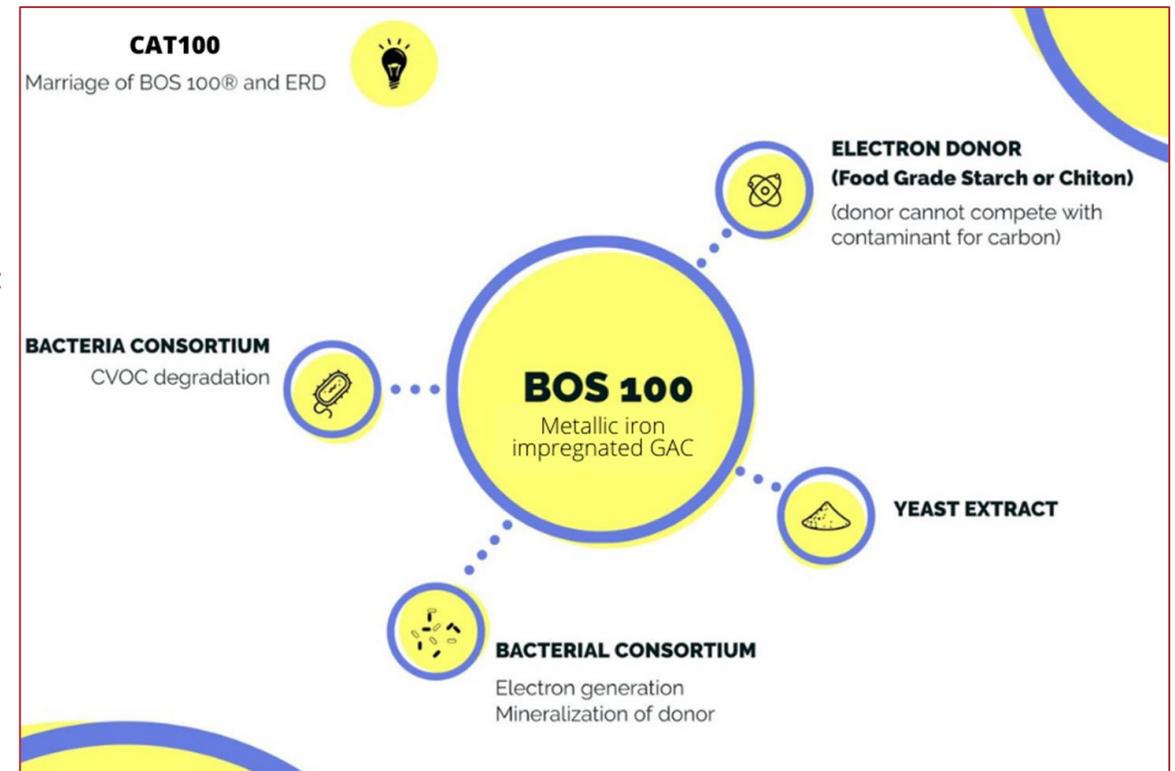
INSTALLATION /  
IMPLEMENTATION



# CAT100

## Key Elements

- Activated Carbon Impregnated with Metallic Iron (BOS 100®)
- Complex Carbohydrate – Food Grade Starch
- One Set of Microorganisms Designed to Degrade CVOCs
- Second Set of Microorganisms Designed to break down the Carbohydrate (e.g. acetate)
- Yeast extract (nutrients)

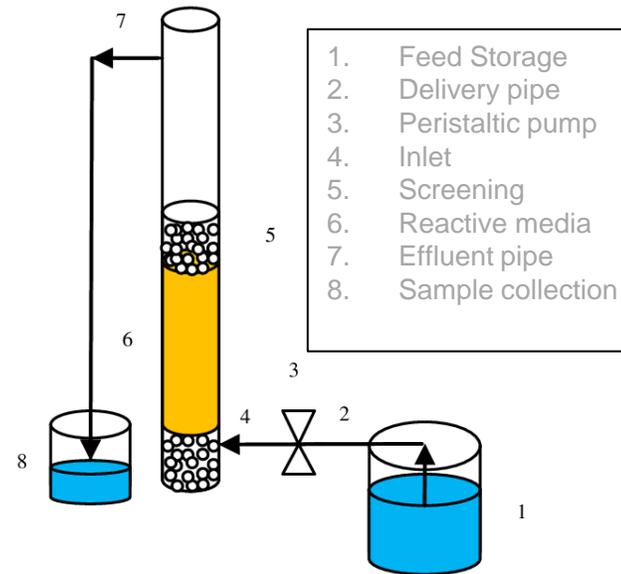


# BENCH SCALE TREATABILITY STUDIES

## Column Study – Test Set-up

- Designed to model a discrete section of PRB and assess effectiveness of chosen reactive media to degrade contaminant over a given residence time

- Two different tests were run:
  - Model Average Concentration Areas
    - Control column – silica sand
    - Reactive column – 1% BOS100
  - Model High Concentration Areas
    - Control column – silica sand
    - Reactive column – 1% BOS100 combined with gypsum and Petro-Clear



# BENCH SCALE TREATABILITY STUDIES

## Column Study – Results

Analyte:	“High” Spiked (µg/L)	“Average” Spiked (µg/L)
TCE	504	161
cis-1,2-DCE	2,660	143
VC	242	70.4
*PHC F1	119	61
*PCBs	1,180	352
**PHC F2	310	100
**PHC F3	580	250

“High”

Parameter	TCE	Cis-1,2-DCE	VC	PCBs
Half-Life (Days)	0.43	0.34	0.47	

“Average”

Parameter	TCE	Cis-1,2-DCE	VC	PCBs
Half-Life (Days)	0.57		0.43	0.21

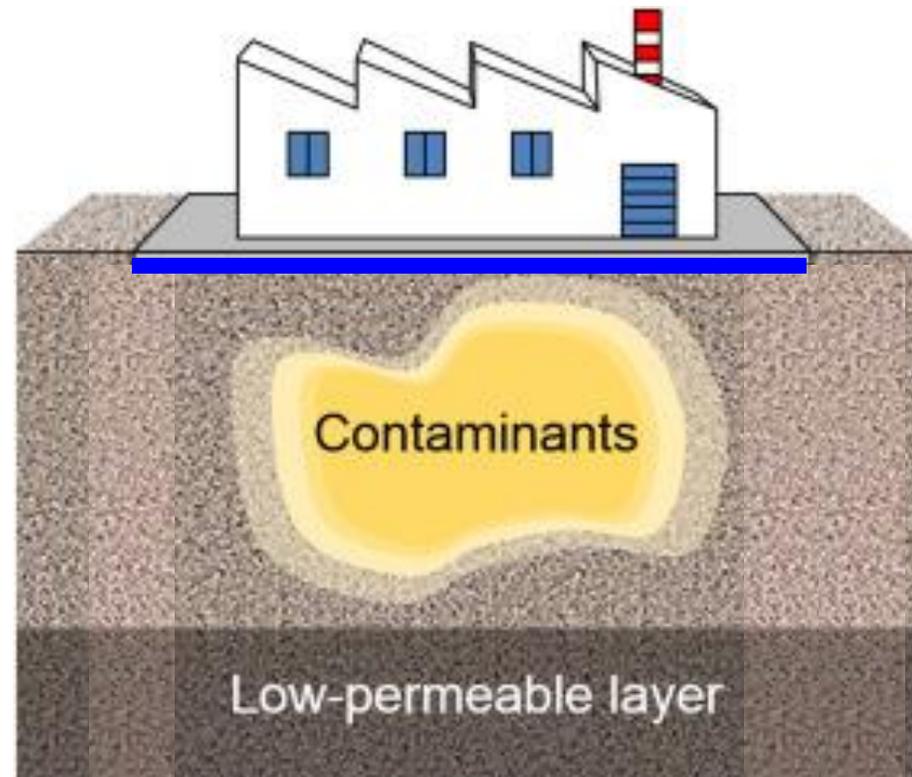
\*Influent values not spiked prior to commencement of Column Test

\*\* concentrations used for the modelling and PRB design |

<b>BOS 100® and Gypsum Demand Loading Rates</b>				
<b>Amendment Required (wt./wt.)</b>	<b>Average Area</b>		<b>High Area</b>	
	<b>Bedrock</b>	<b>Overburden</b>	<b>Bedrock</b>	<b>Overburden</b>
<b>BOS 100®</b>	1.00%	1.00%	4.00%	2.50%
<b>Gypsum</b>	1.00%	0.50%	5.00%	2.00%

k values measured on site from: 1.2 x 10<sup>-6</sup> m/s to 7.6 x 10<sup>-7</sup>m/s      2.3 x 10<sup>-6</sup> m/s to 1.6 x 10<sup>-7</sup>m/s





# BENCH SCALE TREATABILITY STUDIES

## Permeability Study

- Designed to determine ideal mixing ratio to achieve in-situ impermeability (ASTM D5048 Hydraulic Conductivity of Porous Saturated Materials)
- Multiple tests were run with different percentages of bentonite with target permeability of  $10^{-7}$  cm/s

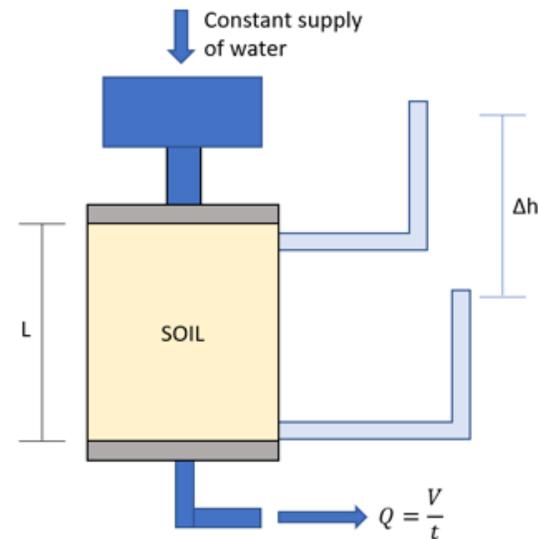


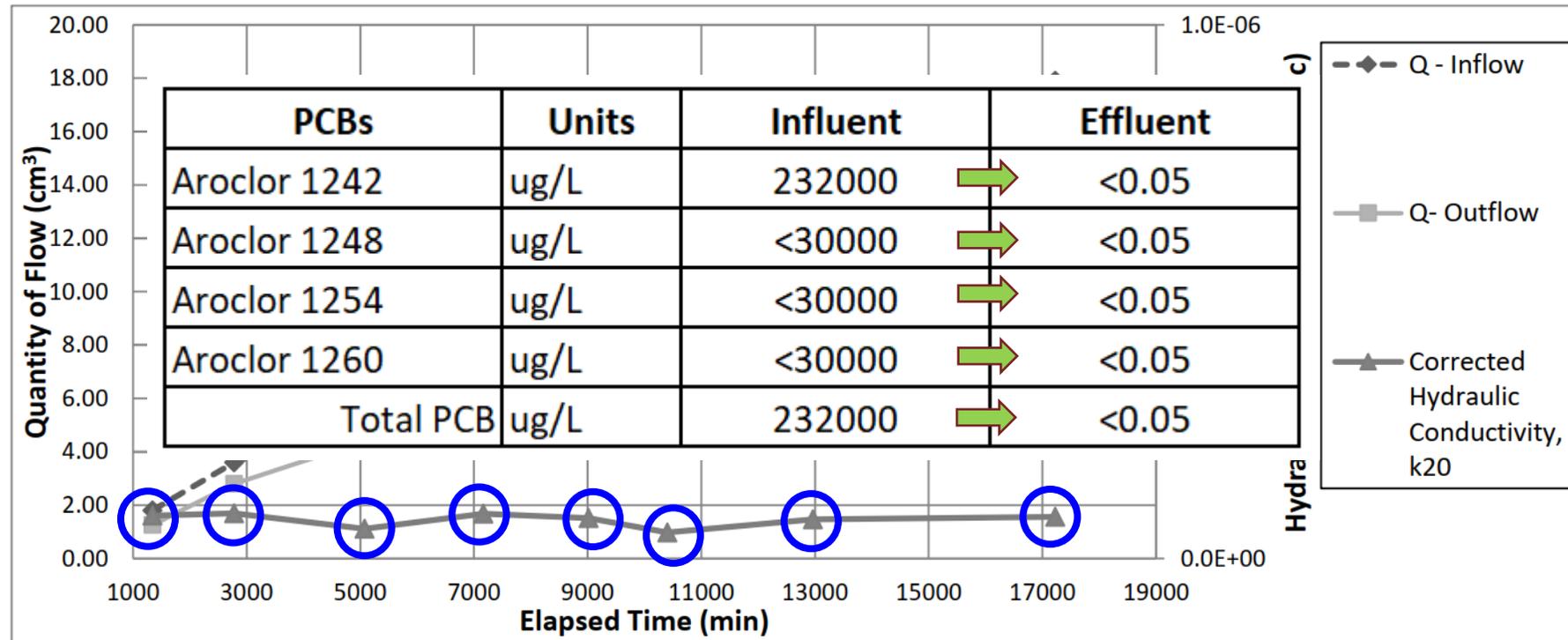
Figure 1: Schematic representation for Constant head Permeability test



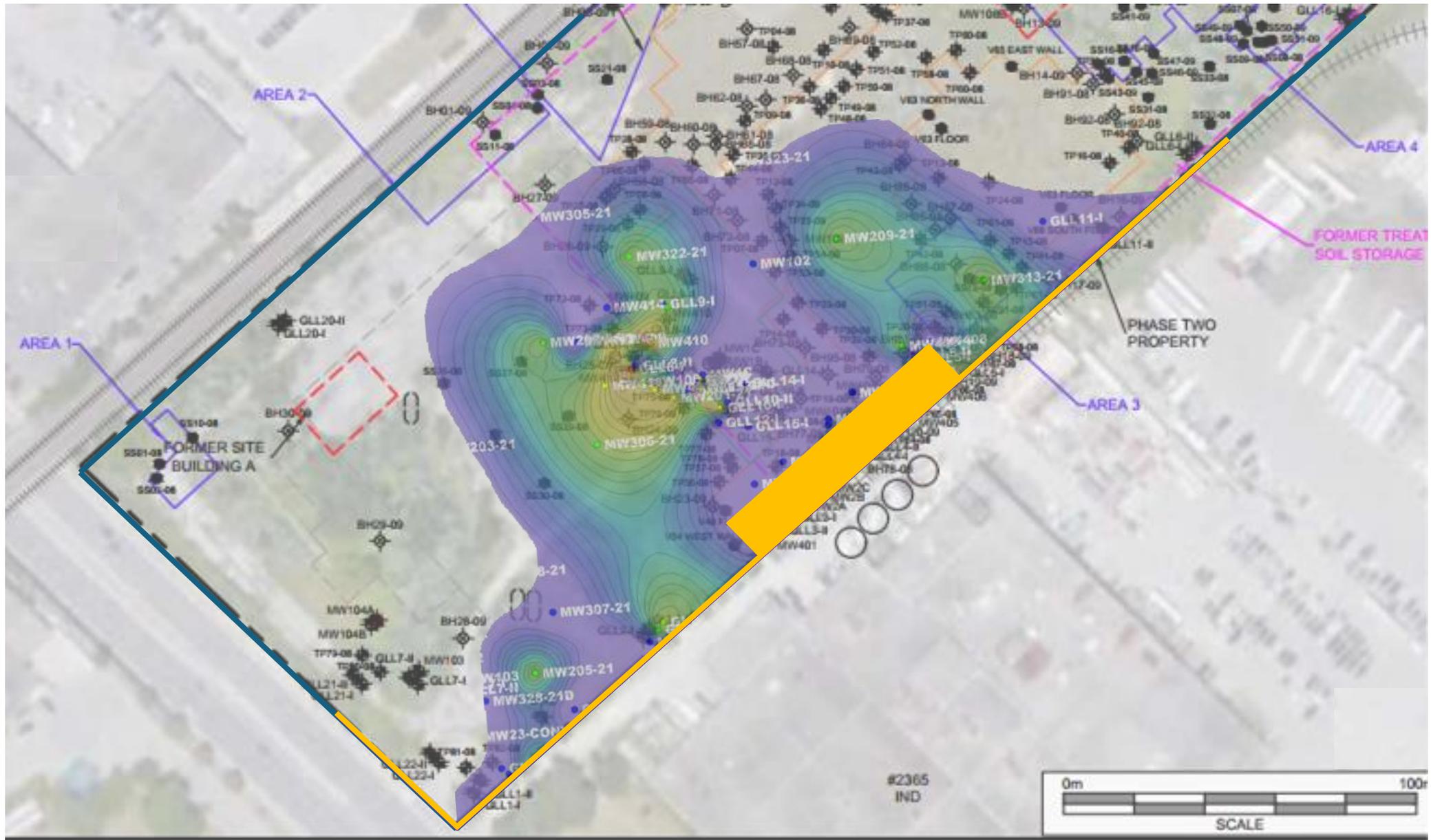
# BENCH SCALE TREATABILITY STUDIES

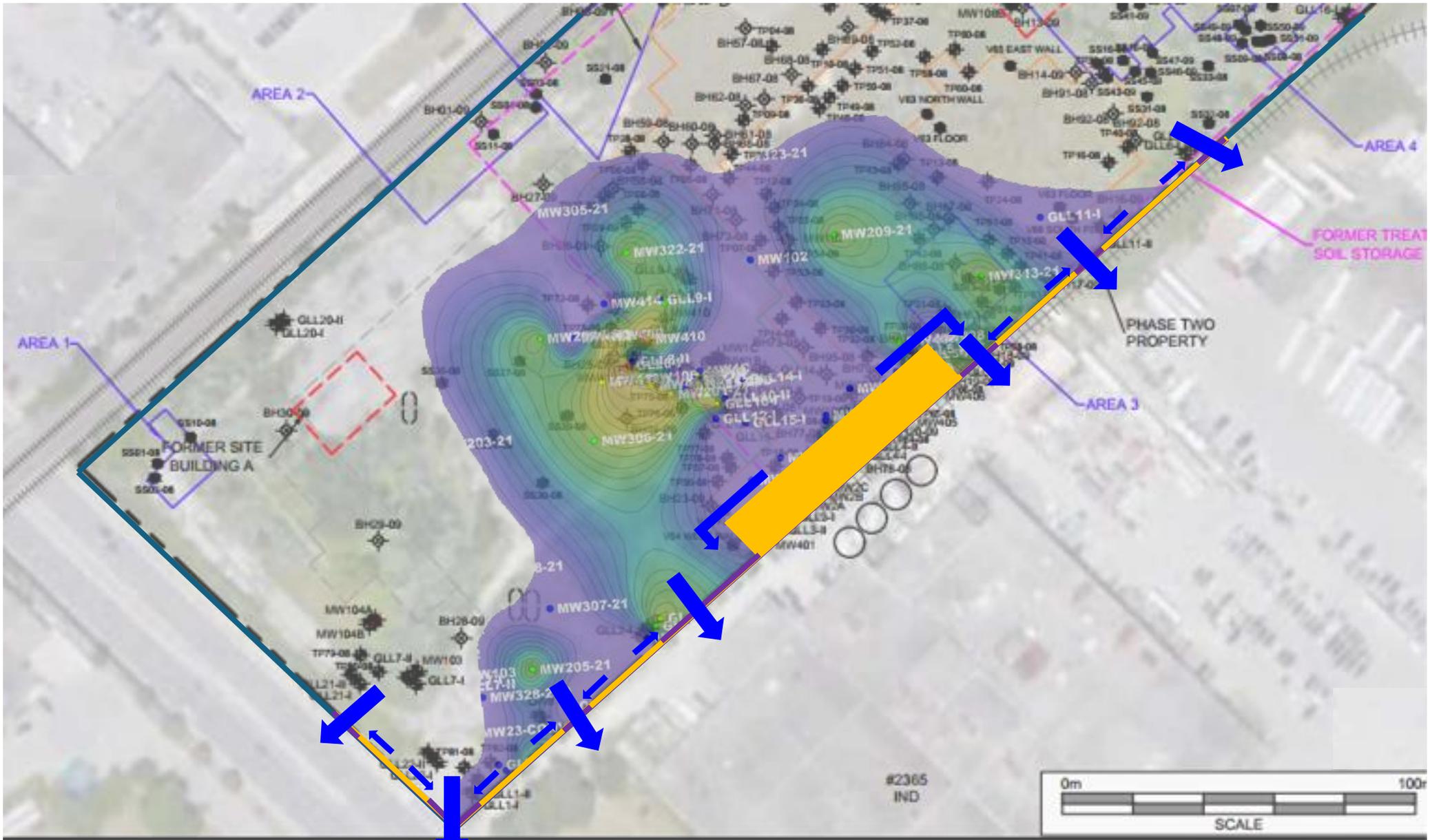
## PCB Permeability Study

- Designed to assess PCB permeability through Slurry Wall Design

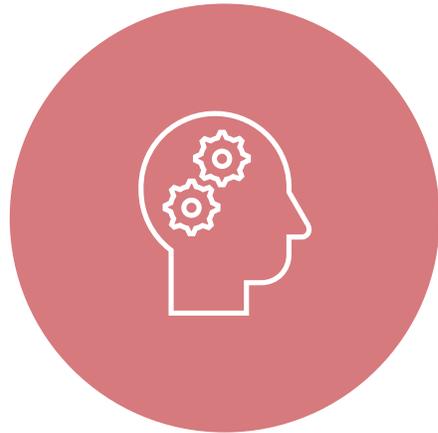


Hydraulic Conductivity, $k_{20}$ , cm/sec	<b>6.7E-08</b>
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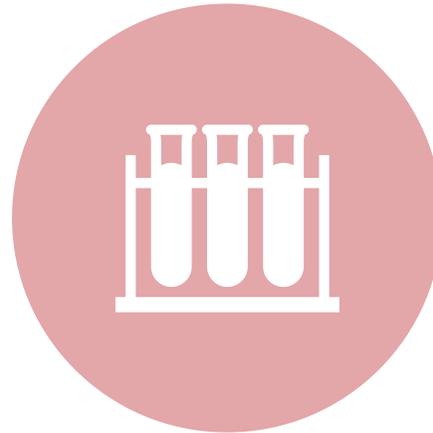




# AGENDA



FRAMING THE PROBLEM



DESIGN AND BENCH SCALE  
TESTS



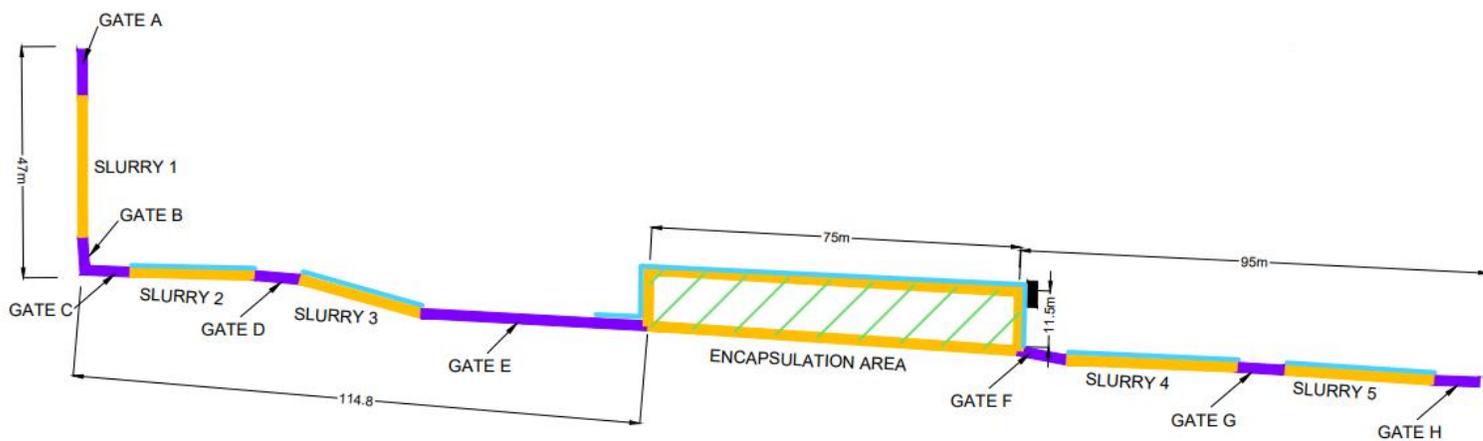
INSTALLATION /  
IMPLEMENTATION



# SITE SPECIFIC HEALTH & SAFETY

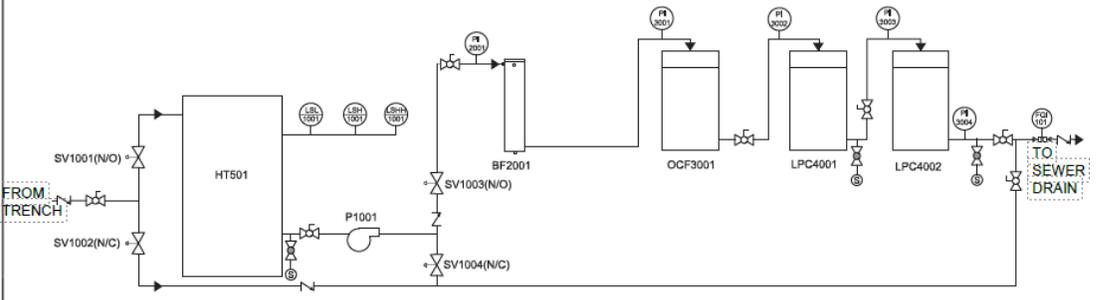
- Specialized PPE and procedures
- Personal PID monitors due to elevated CVOC
- Setup of exclusion zones
- Decontamination/contaminant reduction zones
- Donning & Doffing PPE procedures
- Monitoring to prevent track-out and cross contamination on & off site





**SYSTEM POSITION DESIGNATION**  
 500 - HOLDING TANK  
 1000 - CENTRIFUGAL PUMP  
 2000 - POLYLINE BAG FILTER  
 3000 - ORGANIC CLAY  
 4000 - CARBON FILTER

**EQUIPMENT**  
 BF - BAG FILTER  
 LPC - LIQUID - PHASE CARBON FILTER  
 OCF - ORGANIC CLAY FILTER  
 HT - HOLDING TANK ON PALLET  
 P - CENTRIFUGAL PUMP



- LEGEND**
- LSL1001 LEVEL SWITCH LOW PUMP 1001
  - LSH1001 LEVEL SWITCH HIGH PUMP 1001
  - LSHH1001 LEVEL SWITCH HIGH HIGH PUMP 1001
  - SV1001 SOLENOID VALVE #1
  - SV1002 SOLENOID VALVE #2
  - SV1003 SOLENOID VALVE #3
  - SV1004 SOLENOID VALVE #4
  - ⊕ SAMPLE PORT
  - ⊕ BALL VALVE NORMAL OPEN
  - ⊖ BALL VALVE NORMAL CLOSE
  - ⊕ FLOW METER
  - ⊕ PRESSURE GAUGE
  - ⊕ CHECK VALVE
  - N/O NORMALLY OPEN
  - N/C NORMALLY CLOSED



PROJECT NAME  
 Proposed WTS Schematic

CLIENT NAME

PROJECT LOCATION

FIGURE NAME  
 SUMP WATER TREATMENT SYSTEM PROCESS AND INSTRUMENT DIAGRAM

APPROXIMATE SCALE PROJECT NO.  
 NTS

DATE FIGURE NO.  
 1



# CHALLENGES

- Soil / Bentonite slurry didn't have sufficient geotechnical stability for future re-use:
  - In the encapsulation area, the surface cap was modified to a GCL anchored into the slurry wall trench
  - Along the property line (PL), geogrid / geotextile combo was used to improve strength (slurry was brought up to 1mbgs)
  - Along the PL along the encapsulation area, we completed the slurry to surface (from GCL up) with Portland added to the mixture – this solidified sufficiently for redevelopment
- Mix design & bench scale testing took longer than anticipated, forcing schedule to creep into winter months
- Winter conditions had to be considered during slurry mixture and only completed above freezing temperatures.



# FINDING EFFICIENCIES & COST SAVINGS

- Design specified 1m wide trench for slurry wall and PRB, however the trench boxes initially supplied on site were 1.5m wide. This significantly increased amount of soil to be disposed, as well as well as backfill and amendments
- GIP engaged with internal shoring/engineering and civil team to construct a custom 1m wide trench box to reduce cost and consumables on site.
- Trench box has sliding panels to adapt to depth and elevation of bedrock – reduces amount of groundwater infiltration as well.





- Established tiered costing for disposal of various levels of PCB contamination
  - <50ppm (Non-Haz)
  - 50ppm -> 400ppm (Low-level haz concentrations)
  - >400ppm (High-level haz concentrations)
- Determined that cost for double handling and segregating soil based on concentration ranges still outweighed a blended or elevated cost to cover all levels of PCB concentration



## CONCLUSIONS

- Full scale clean up to generic values not necessary
  - Contaminant Management supported rehabilitation of urban environments possible
- Final cost ~\$10 million vs. original estimate of full remediation at >\$100 million
- Completed in a fraction of the time
- Non-conventional remediation is absolutely viable but requires a non-convention team dynamic.





Questions?

Presented By:

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