



Phased Pre-Design Investigation Approach in Support of CSM Refinement and Effective Injection Design

Session H1

In-Situ Technologies:
Lessons Learned

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Acknowledgements

Project Partners



Woodard & Curran



- ▶ Emulsified ZVI Supplier



- ▶ Injection Services

RioTinto

- ▶ ZVI Supplier – Phase 1

Höganäs

- ▶ ZVI Supplier – Phase 2

Background Information

- **History/AOC**
- **Previous Remedial Actions**
- **Site Setting/Geology**

Site Background

History/AOC

- ▶ Historic manufacturing operations created ongoing sitewide liability with subsurface soils and groundwater
- ▶ One AOC is the focus of the activity covered in this presentation

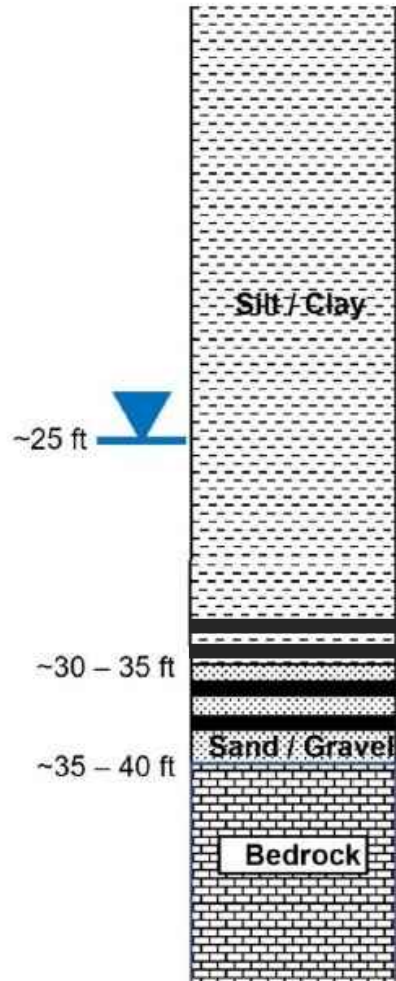
COCs

- ▶ PCE
- ▶ TCE
- ▶ *cis*-1,2-DCE
- ▶ *trans*-1,2-DCE
- ▶ Vinyl chloride

Previous RAs

- ▶ Soil excavation and backfill completed within the AOC
- ▶ Excavation, waste removal, and GW remedial injections completed at other areas of the site

Site Background



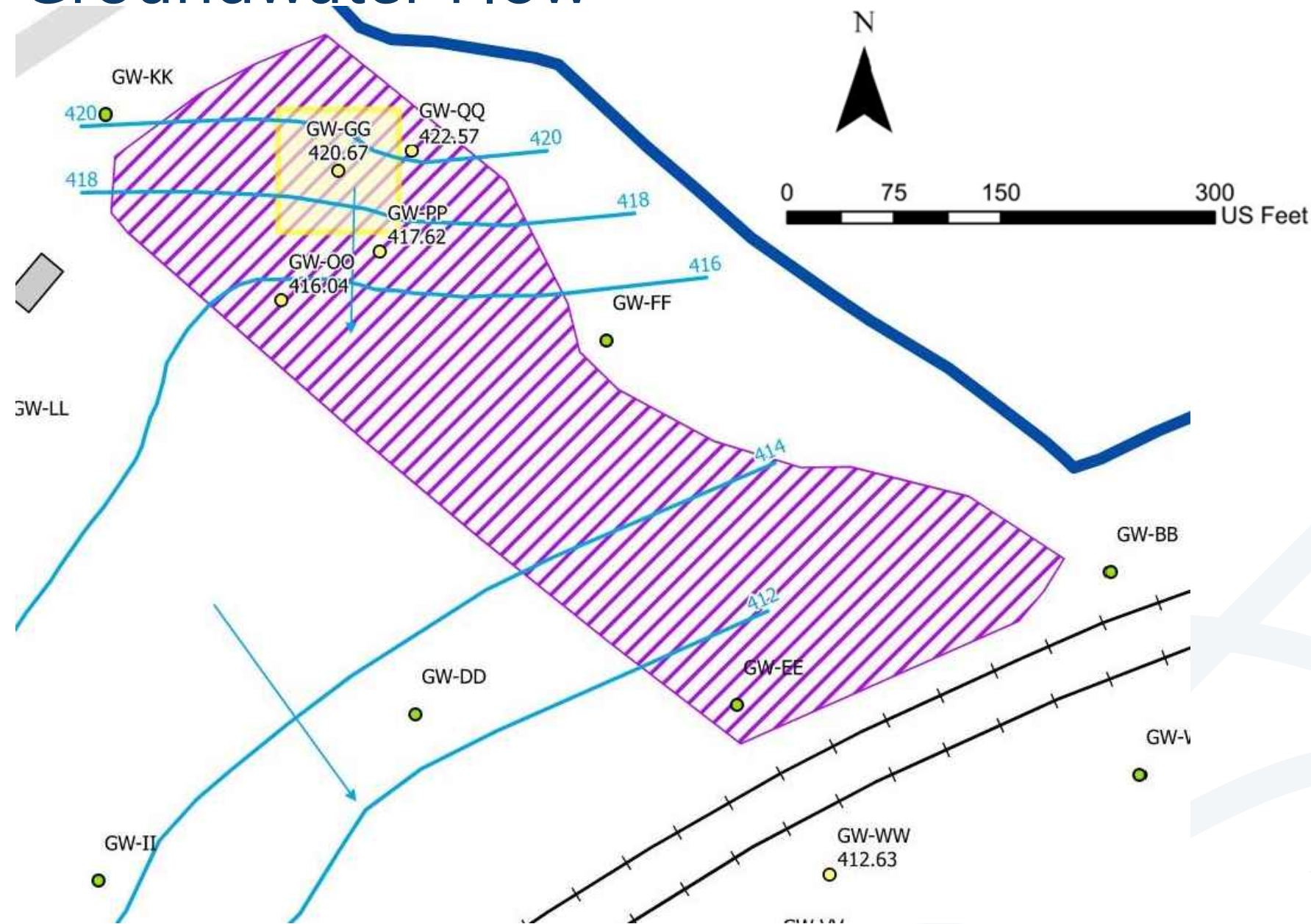
Underlying Geology

- ▶ Alluvial silt and clay to ~30 or 35 ft. bgs
- ▶ Sand and gravel ~30 to 40 ft. bgs
- ▶ Bedrock at ~35 or 40 ft. bgs

Site Setting

- ▶ Flat topography
- ▶ Residents and farmland surrounding the site

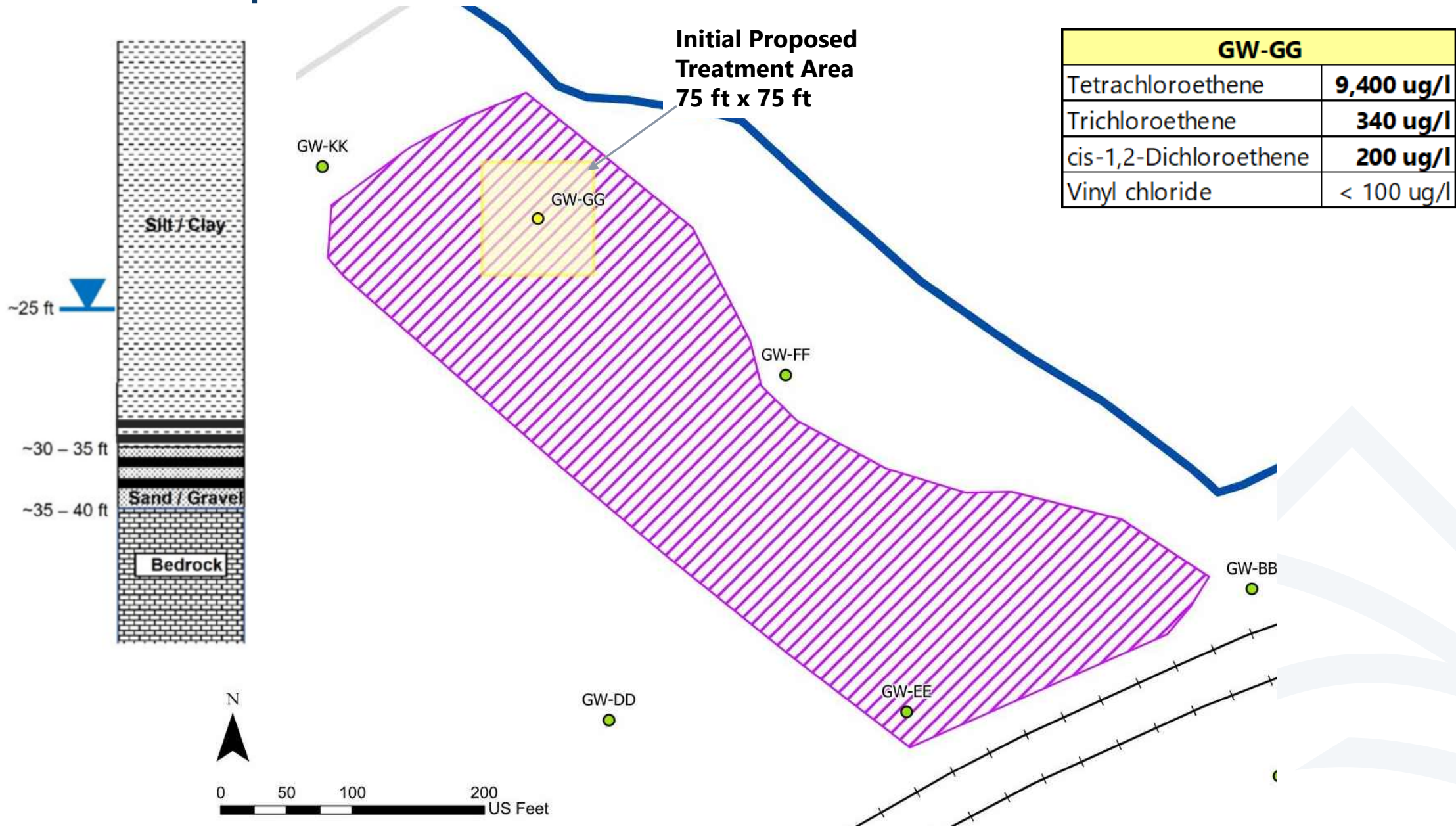
Local Groundwater Flow



Objectives

- Mitigate ongoing sources of dissolved-phase cVOCs
- Mitigate the flux of cVOCs in groundwater migrating downgradient from primary source area
- Support/evaluate ISCR pilot study, transitioning to MNA, as the final site remedy for groundwater

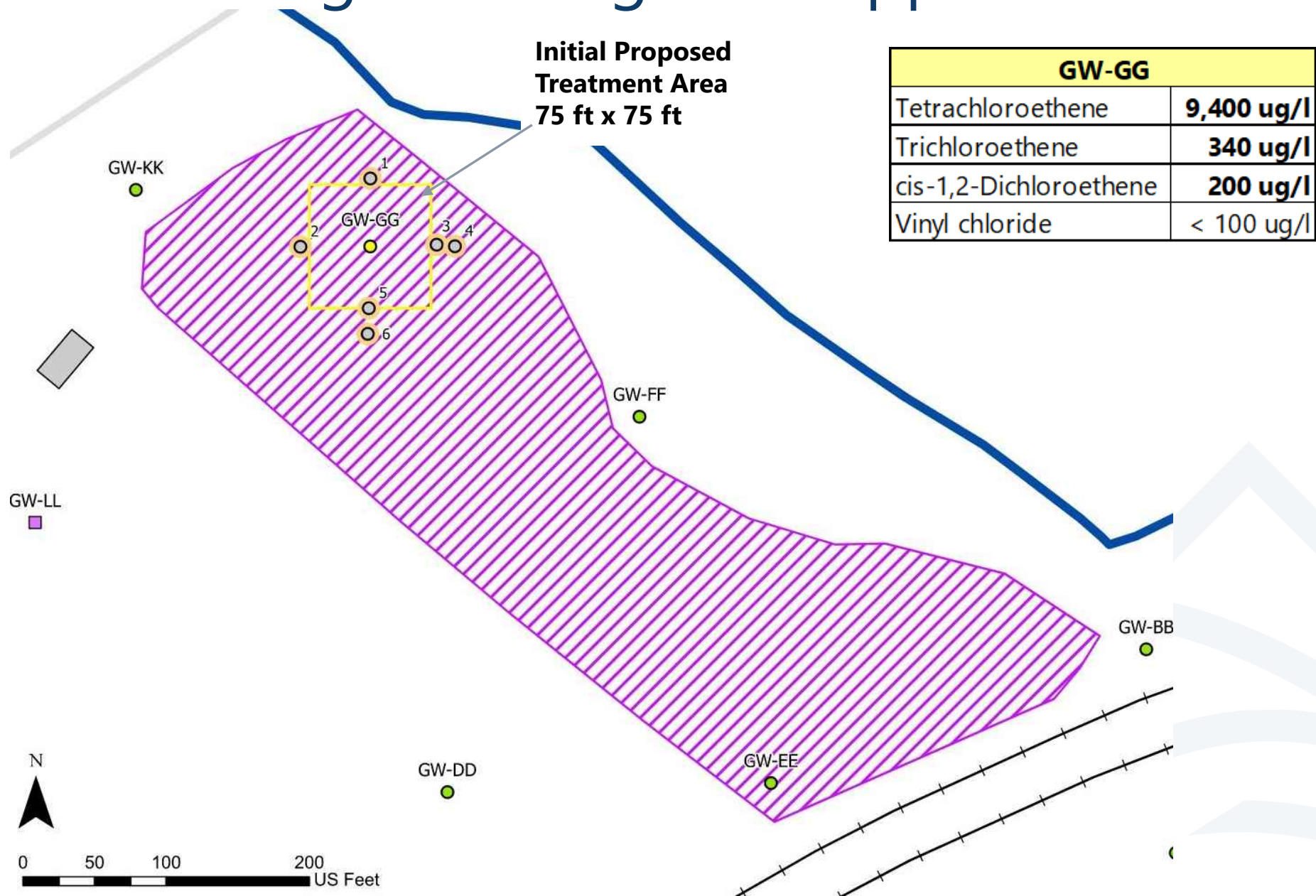
Initial Proposed Treatment Area



Approach

- **Pre-Remedial Design Investigation**
- **Refine dimensions of source area**
- **Expanded understanding of source area extent**

Pre-Remedial Design Investigation Approach



Results

- **Understanding source area – concentrations and footprint**
- **Injection scope nearly doubled**
- **Phased remedial activities**

Pre-Remedial Design Investigation Results – Phase I

TW-2	
Tetrachloroethene	27,000 ug/l
Trichloroethene	870 ug/l
cis-1,2-Dichloroethene	1,700 ug/l
Vinyl chloride	< 200 ug/l

TW-5	
Tetrachloroethene	4,700 ug/l
Trichloroethene	2,200 ug/l
cis-1,2-Dichloroethene	1,500 ug/l
Vinyl chloride	180 ug/l

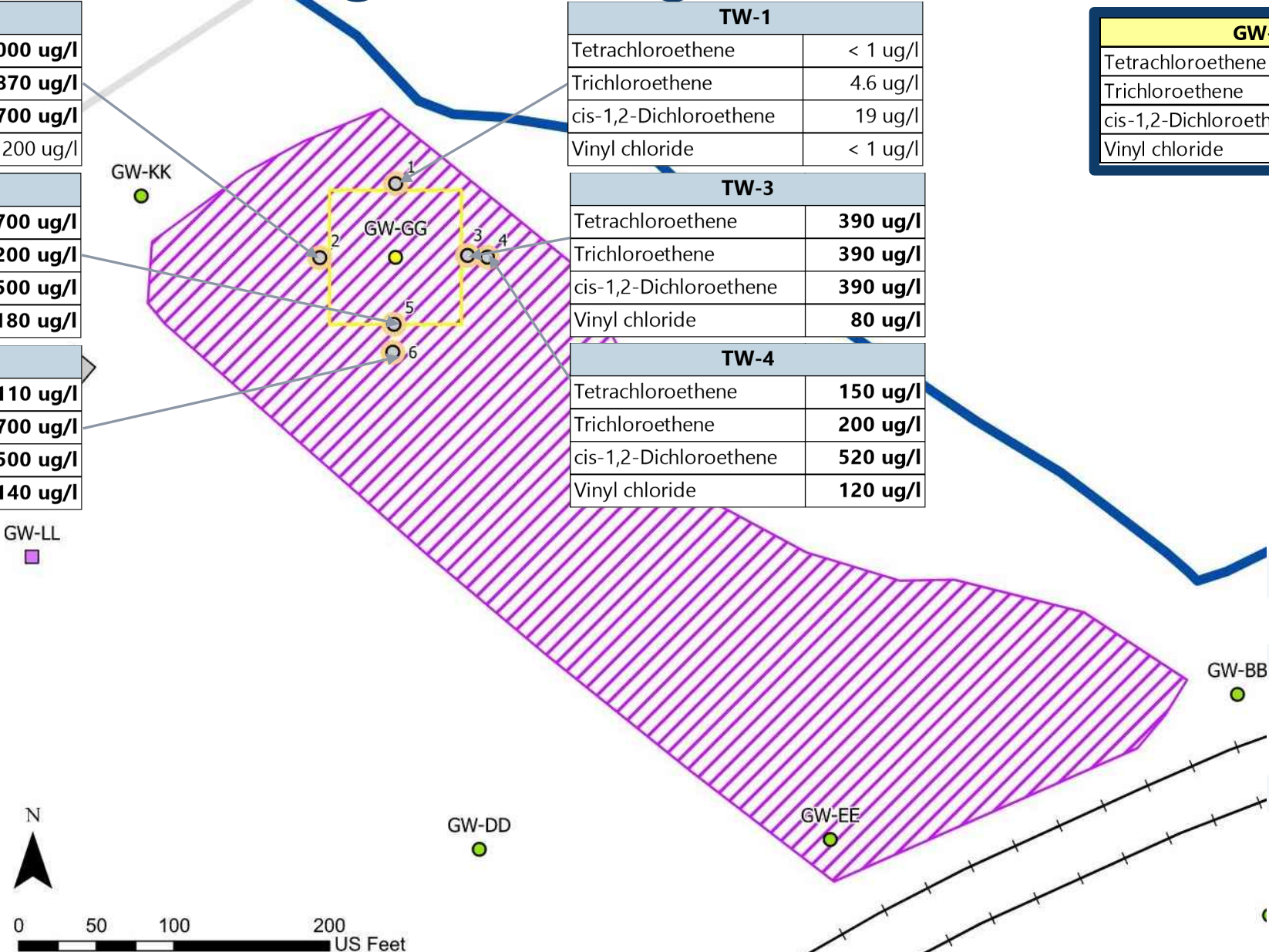
TW-6	
Tetrachloroethene	110 ug/l
Trichloroethene	700 ug/l
cis-1,2-Dichloroethene	2,500 ug/l
Vinyl chloride	140 ug/l

TW-1	
Tetrachloroethene	< 1 ug/l
Trichloroethene	4.6 ug/l
cis-1,2-Dichloroethene	19 ug/l
Vinyl chloride	< 1 ug/l

TW-3	
Tetrachloroethene	390 ug/l
Trichloroethene	390 ug/l
cis-1,2-Dichloroethene	390 ug/l
Vinyl chloride	80 ug/l

TW-4	
Tetrachloroethene	150 ug/l
Trichloroethene	200 ug/l
cis-1,2-Dichloroethene	520 ug/l
Vinyl chloride	120 ug/l

GW-GG	
Tetrachloroethene	9,400 ug/l
Trichloroethene	340 ug/l
cis-1,2-Dichloroethene	200 ug/l
Vinyl chloride	< 100 ug/l



Pre-Remedial Design Investigation Results – Phase 2

TW-20	
Tetrachloroethene	14 ug/l
Trichloroethene	6.8 ug/l
cis-1,2-Dichloroethene	5.8 ug/l
Vinyl chloride	< 1 ug/l

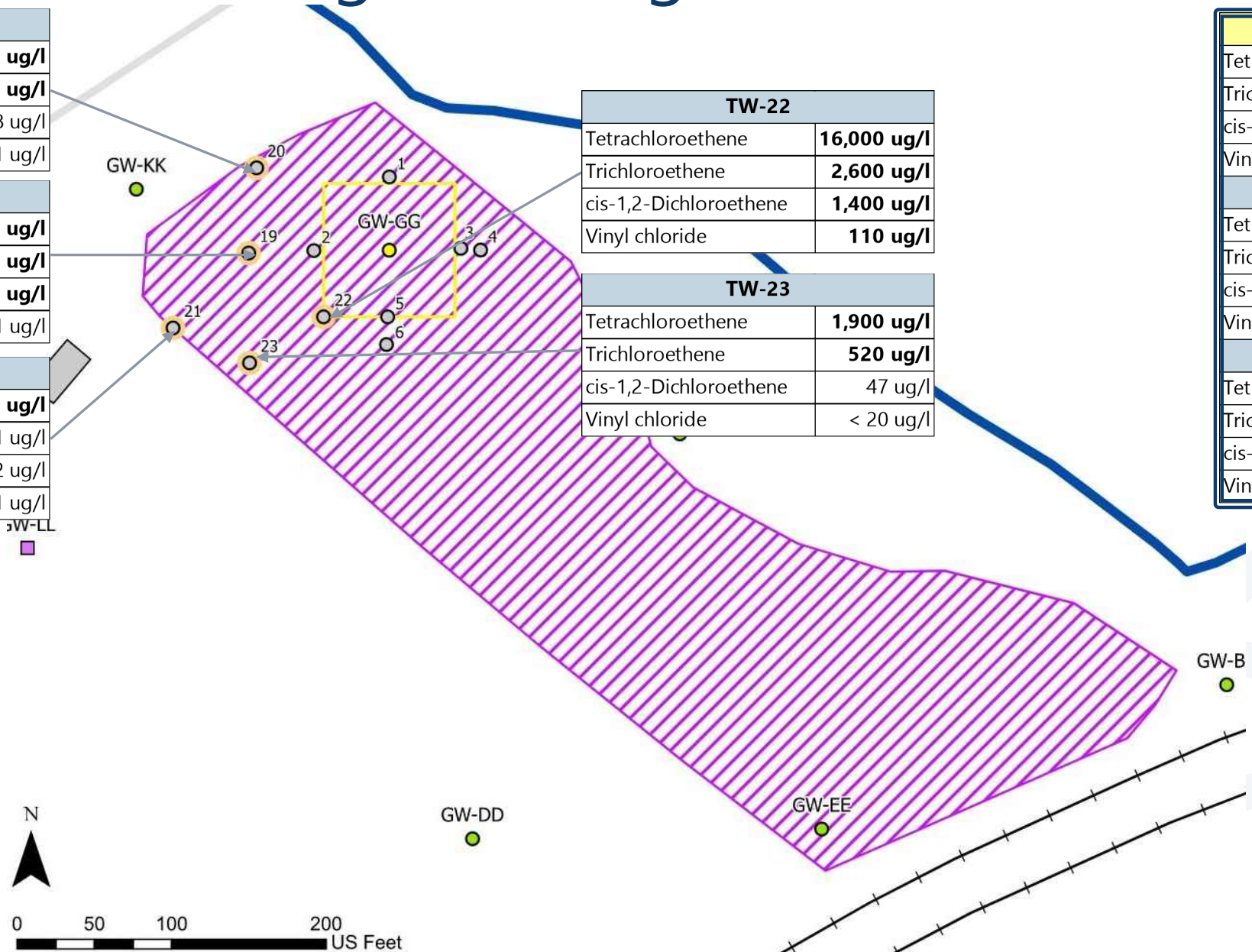
TW-19	
Tetrachloroethene	170 ug/l
Trichloroethene	8.1 ug/l
cis-1,2-Dichloroethene	75 ug/l
Vinyl chloride	1.1 ug/l

TW-21	
Tetrachloroethene	5.4 ug/l
Trichloroethene	1.1 ug/l
cis-1,2-Dichloroethene	1.2 ug/l
Vinyl chloride	< 1 ug/l

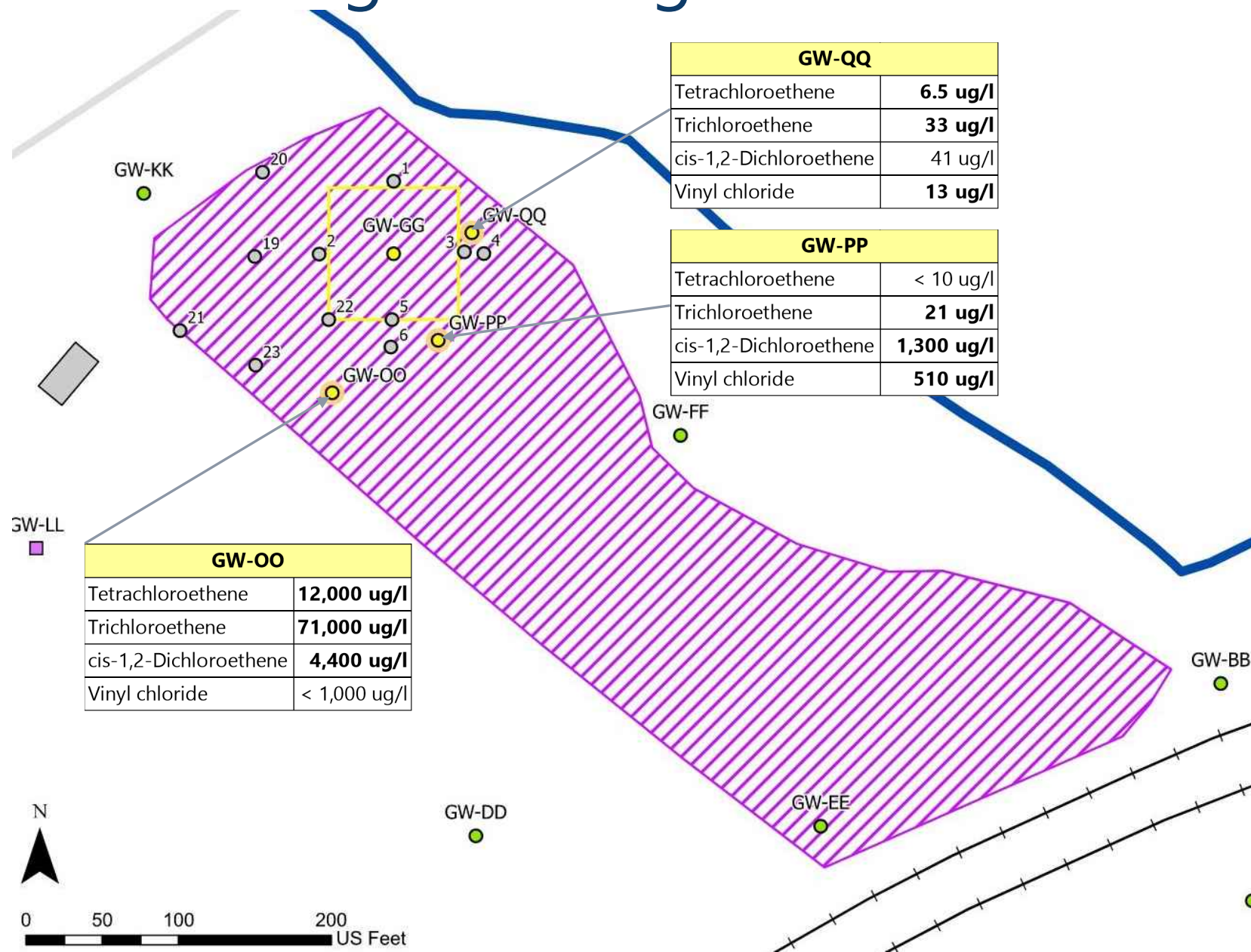
TW-22	
Tetrachloroethene	16,000 ug/l
Trichloroethene	2,600 ug/l
cis-1,2-Dichloroethene	1,400 ug/l
Vinyl chloride	110 ug/l

TW-23	
Tetrachloroethene	1,900 ug/l
Trichloroethene	520 ug/l
cis-1,2-Dichloroethene	47 ug/l
Vinyl chloride	< 20 ug/l

GW-GG	
Tetrachloroethene	9,400 ug/l
Trichloroethene	340 ug/l
cis-1,2-Dichloroethene	200 ug/l
Vinyl chloride	< 100 ug/l
TW-2	
Tetrachloroethene	27,000 ug/l
Trichloroethene	870 ug/l
cis-1,2-Dichloroethene	1,700 ug/l
Vinyl chloride	< 200 ug/l
TW-5	
Tetrachloroethene	4,700 ug/l
Trichloroethene	2,200 ug/l
cis-1,2-Dichloroethene	1,500 ug/l
Vinyl chloride	180 ug/l



Pre-Remedial Design Investigation Results – Phase 2a

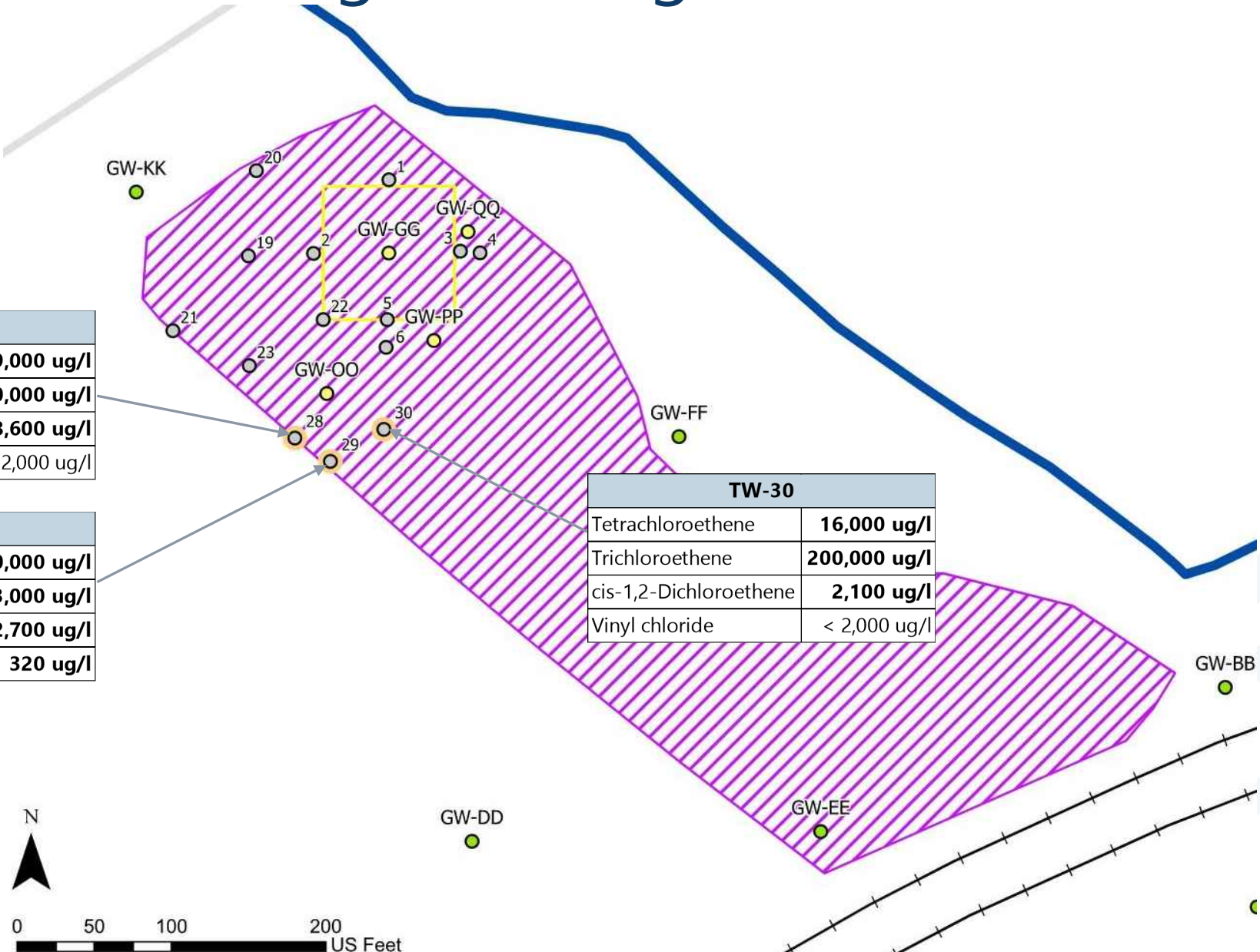


Pre-Remedial Design Investigation Results – Phase 3

TW-28	
Tetrachloroethene	29,000 ug/l
Trichloroethene	190,000 ug/l
cis-1,2-Dichloroethene	8,600 ug/l
Vinyl chloride	< 2,000 ug/l

TW-29	
Tetrachloroethene	10,000 ug/l
Trichloroethene	53,000 ug/l
cis-1,2-Dichloroethene	2,700 ug/l
Vinyl chloride	320 ug/l

TW-30	
Tetrachloroethene	16,000 ug/l
Trichloroethene	200,000 ug/l
cis-1,2-Dichloroethene	2,100 ug/l
Vinyl chloride	< 2,000 ug/l



Pre-Remedial Design Investigation Results – Phase 4

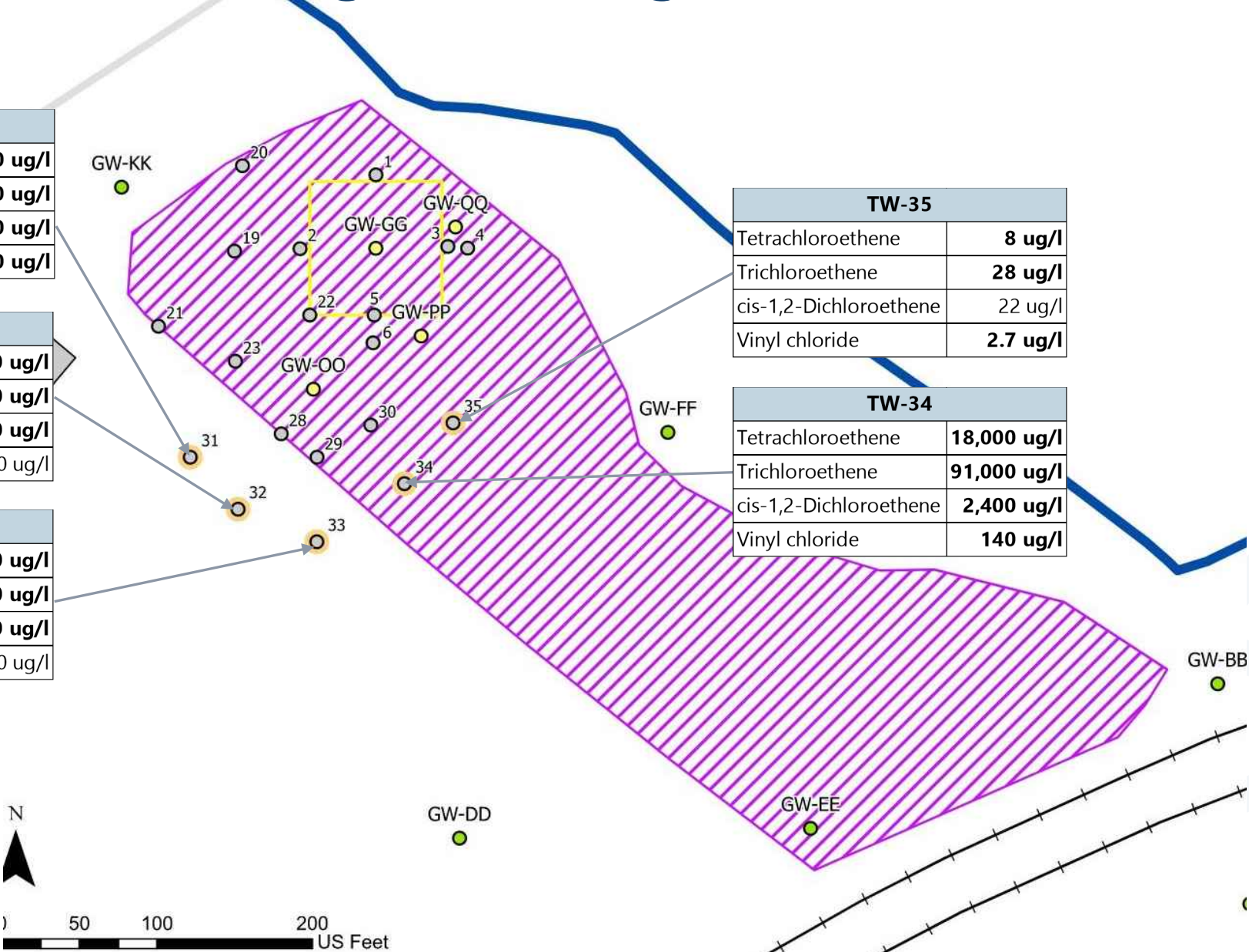
TW-31	
Tetrachloroethene	2,300 ug/l
Trichloroethene	25,000 ug/l
cis-1,2-Dichloroethene	22,000 ug/l
Vinyl chloride	2,100 ug/l

TW-32	
Tetrachloroethene	32,000 ug/l
Trichloroethene	75,000 ug/l
cis-1,2-Dichloroethene	5,000 ug/l
Vinyl chloride	< 2,000 ug/l

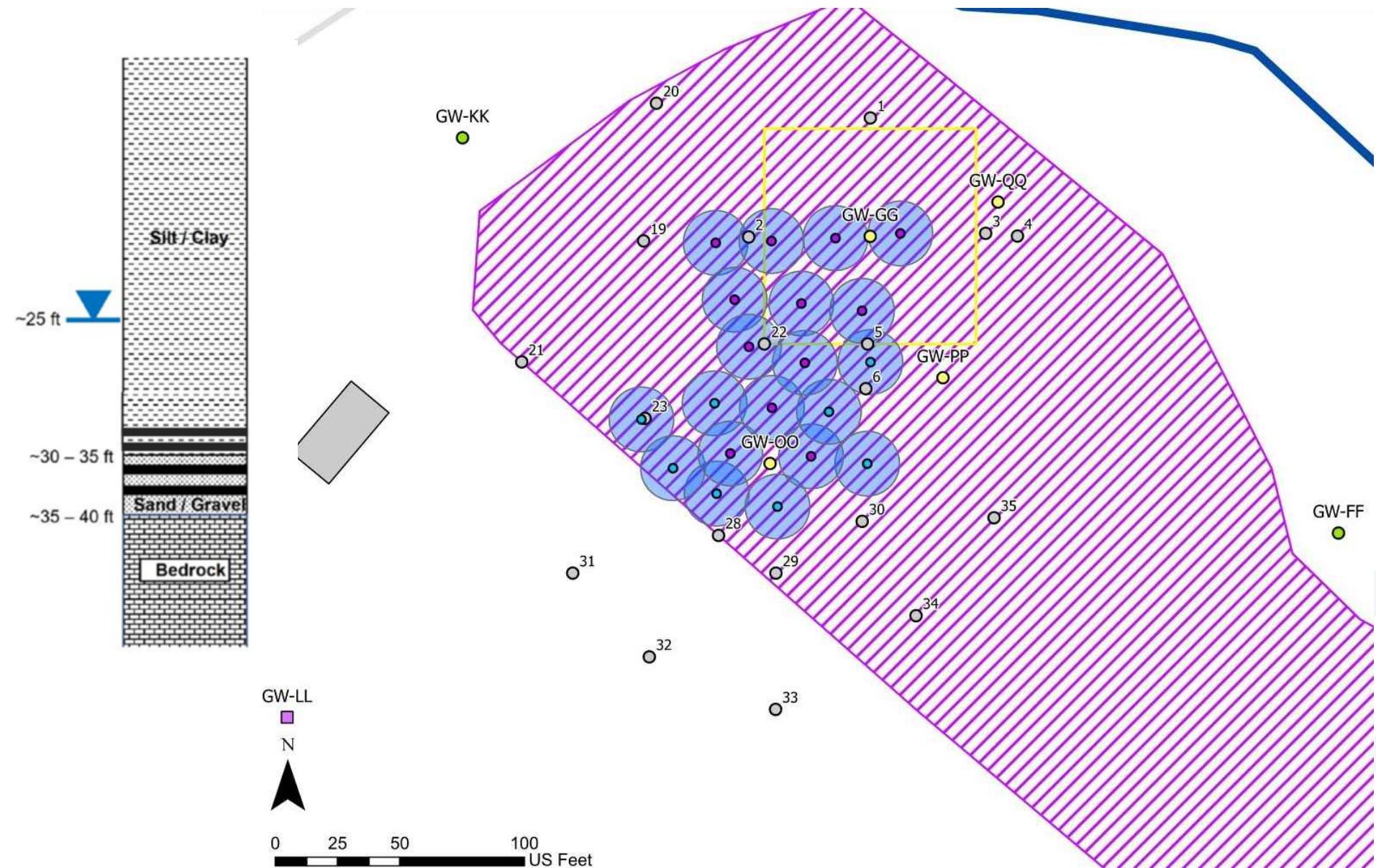
TW-33	
Tetrachloroethene	14,000 ug/l
Trichloroethene	67,000 ug/l
cis-1,2-Dichloroethene	5,200 ug/l
Vinyl chloride	< 2,000 ug/l

TW-35	
Tetrachloroethene	8 ug/l
Trichloroethene	28 ug/l
cis-1,2-Dichloroethene	22 ug/l
Vinyl chloride	2.7 ug/l

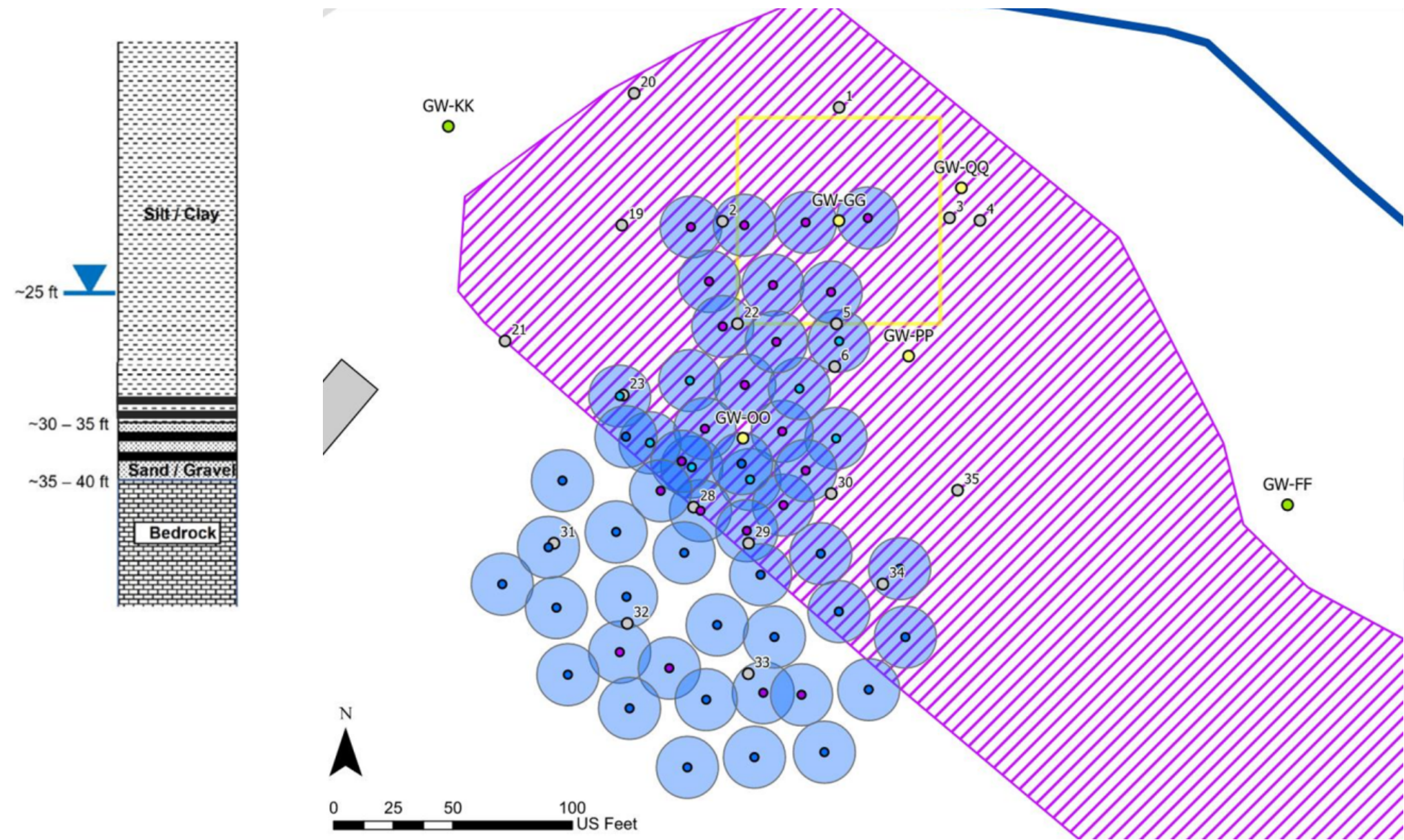
TW-34	
Tetrachloroethene	18,000 ug/l
Trichloroethene	91,000 ug/l
cis-1,2-Dichloroethene	2,400 ug/l
Vinyl chloride	140 ug/l



Phase I Injection Location

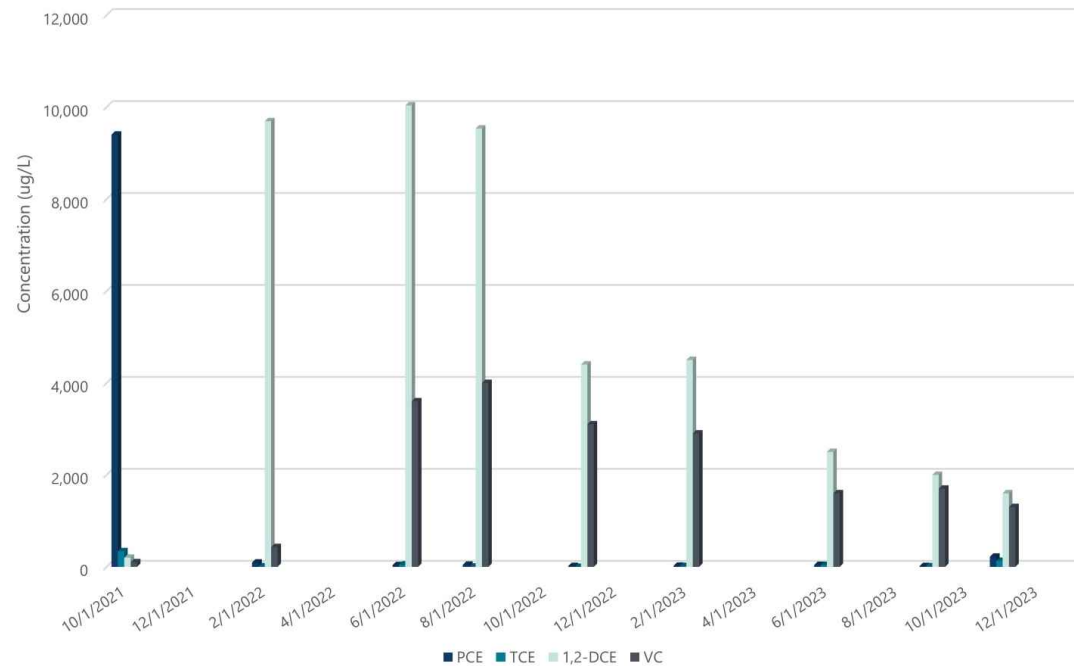


Phase II Injection Location

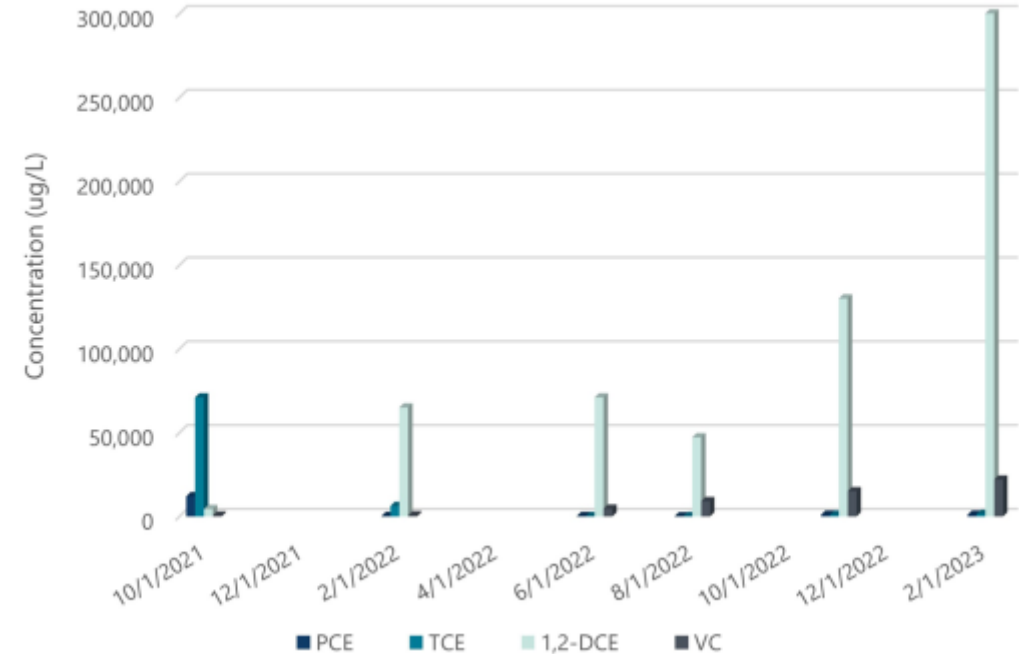


Injection Area Results

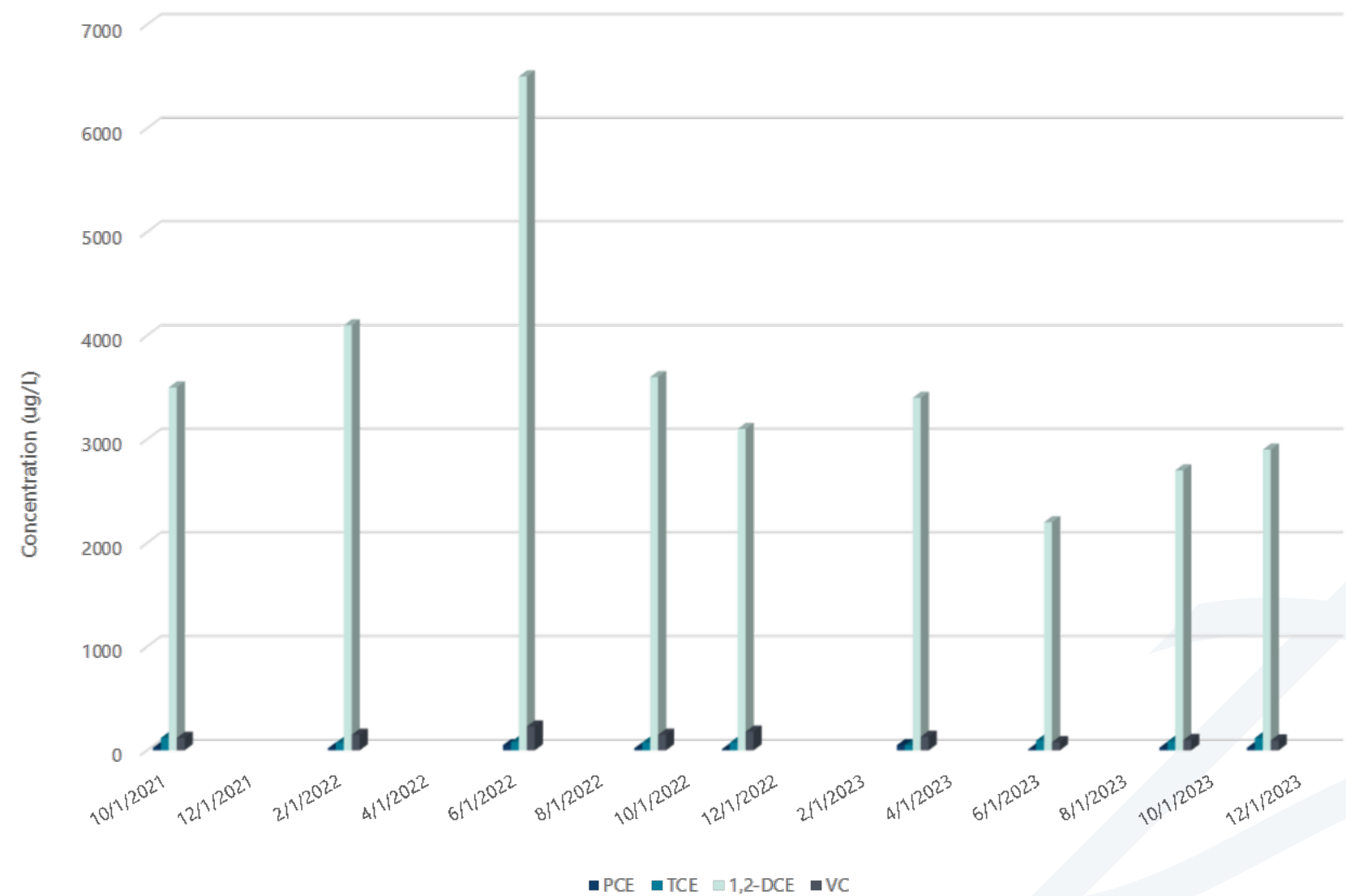
GW-GG Results



GW-OO Results



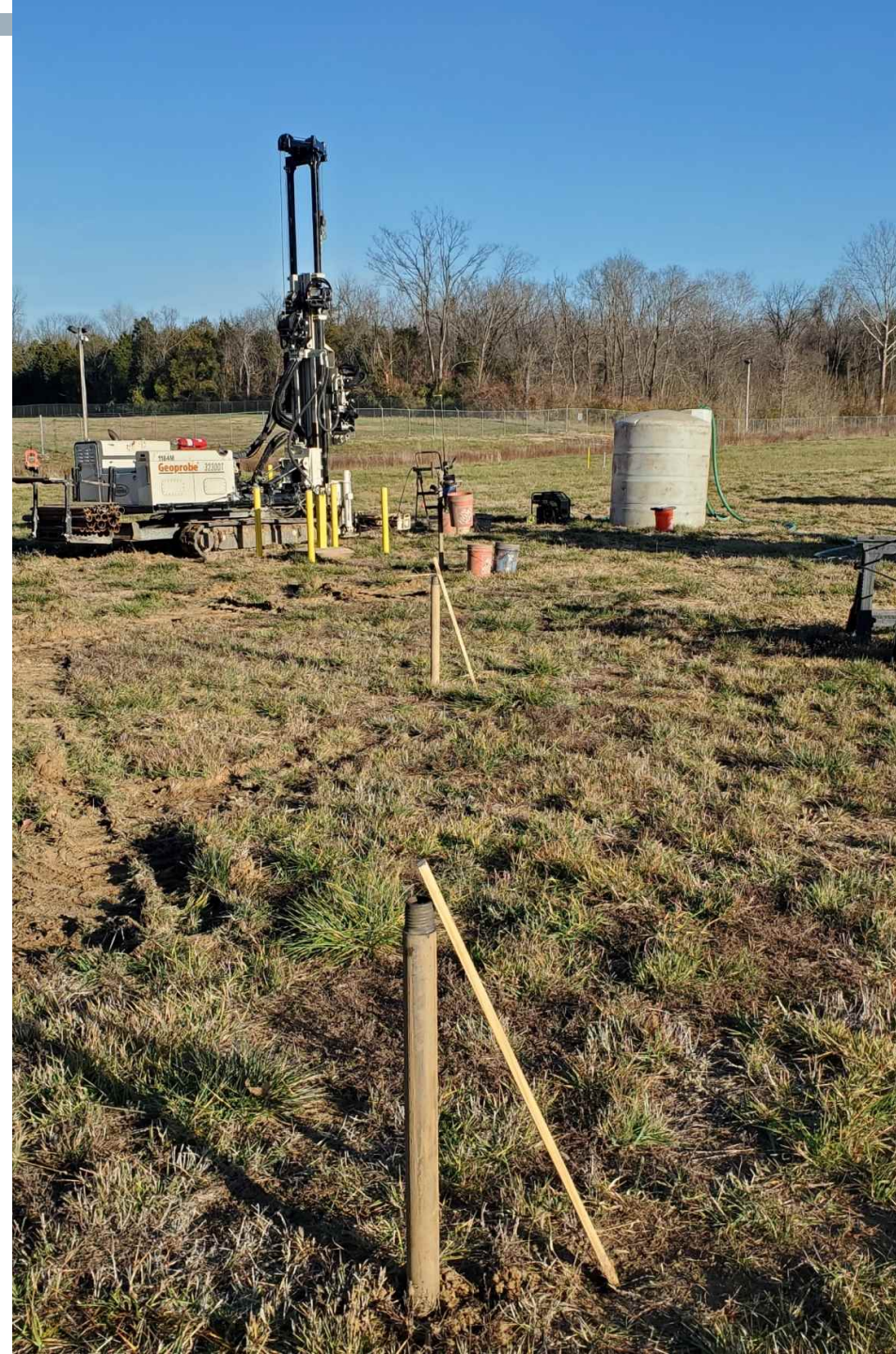
Downgradient Results (GW-DD)



Lessons Learned

- **Schedule – based on client fiscal timeline**
- **Timeline – several weeks between phases**
- **Groundwater remediation activities – completed in two phases**

Questions?



Thank you!

