

Phased Amendment Delivery at Urban Brownfield to Address Mixed Plume

Presenter: Joseph Good, PE, LEED AP

Jason Hayes, PE, LEED AP

Lingke Zeng

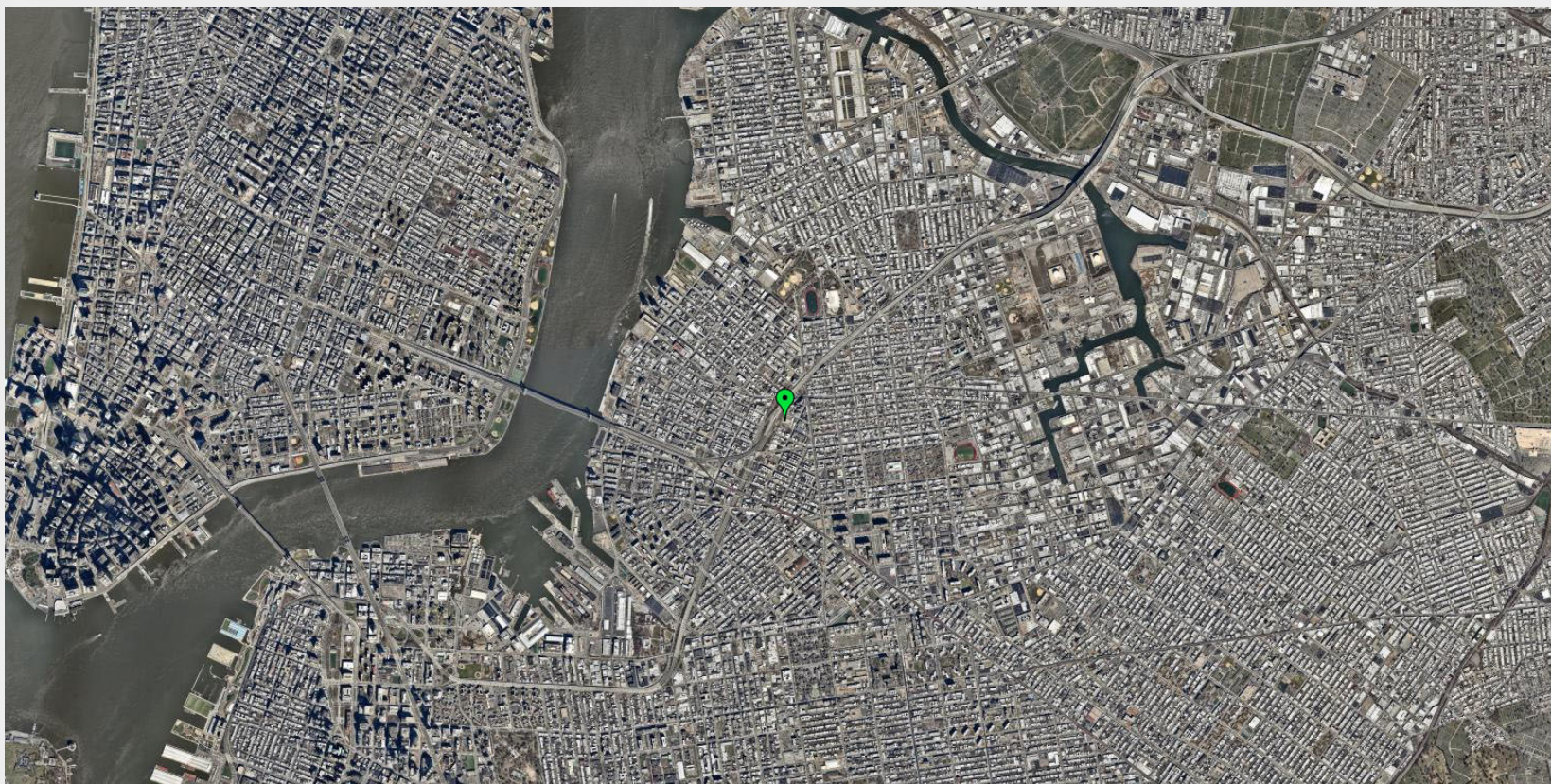
Stew Abrams, PE

Alana Miller- Regenesis®

PRESENTATION OVERVIEW

- Project Background
- Remedial Approach/ Treatability Study
- Phased Remediation
- Implementation
- Results
- Conclusions/ Lessons Learned

SITE LOCATION



BACKGROUND

- 27,000-square-foot brownfield in Brooklyn, New York
- Petroleum contamination and chlorinated volatile organic compounds in soil, groundwater, soil vapor
- Historical releases associated with the former auto repair facilities and historical underground storage tanks (UST)
- Entered New York State Brownfield Cleanup Program

BACKGROUND- SOIL/FILL

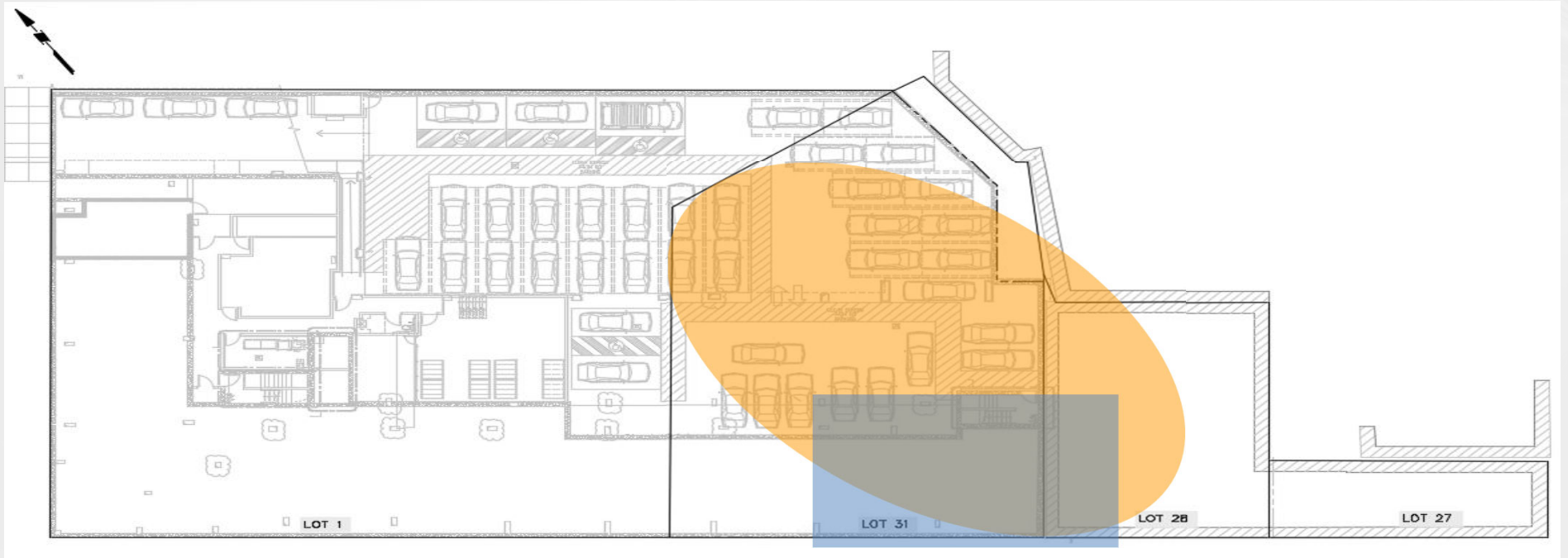
- Historic fill to depths of about 4 to 11 feet
- SVOCs, metals, and pesticides detected within the fill horizon above regulatory cleanup levels
- Native soil (silty sand) horizon beneath the fill was encountered
- VOCs identified within both the fill and native horizons


BACKGROUND- GROUNDWATER


- Groundwater CVOCs above standards in groundwater samples
 - Total CVOCs- 8,110 µg/L
 - PCE- 1,000 µg/L
 - TCE- 260 µg/L
 - DCE- 6,500 µg/L
 - VC-330 µg/L
- Petroleum impacts identified in the central and southern portion of the site around areas of historical auto repair and gasoline USTs.
 - BTEX: 11,860 µg/L
- Deep samples orders of magnitude less than the shallow results

BACKGROUND- SOIL VAPOR

- Total CVOC concentrations in soil vapor samples were detected across the site up to 221,985 $\mu\text{g}/\text{m}^3$
- Attributable to historical releases associated with the former auto repair facilities and historical underground storage tanks



 CVOC groundwater plume

 Petroleum contamination

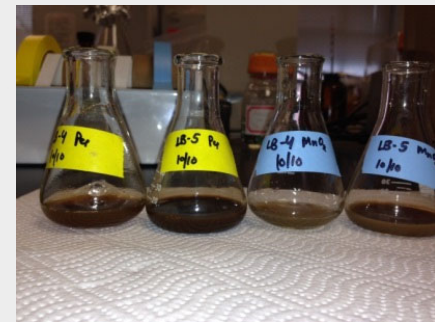
TREATABILITY STUDY

- Bench-scale study at the Langan Treatability Facility at the New Jersey Institute of Technology (NJIT)
- Evaluation of ISCO via sodium permanganate and alkaline-activated persulfate
- Determine design parameters for an in-situ remedy implementation.



TREATABILITY STUDY

- Soil Oxidant Demand (SOD)- 9 g/kg
- Mixed Plume Removal Efficiency
 - Permanganate
 - Total VOCs- 45%
 - Persulfate
 - Total VOCs- >70%



COMBINED TREATMENT TRAIN

SOURCE
REMOVAL

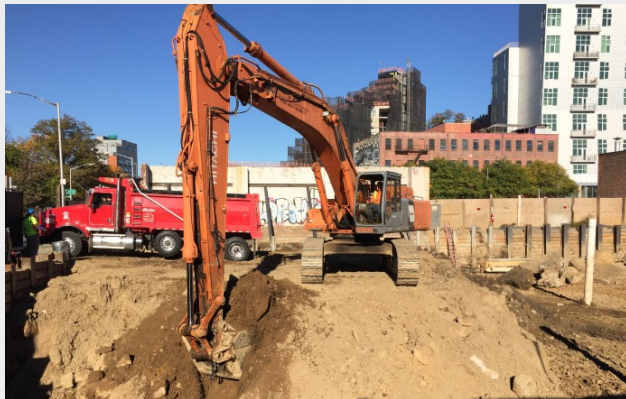
BASE-ACTIVATED
SODIUM PERSULFATE
INJECTIONS

PLUMESTOP®
INJECTIONS

PLUME STOP
Liquid Activated Carbon

SOURCE REMOVAL

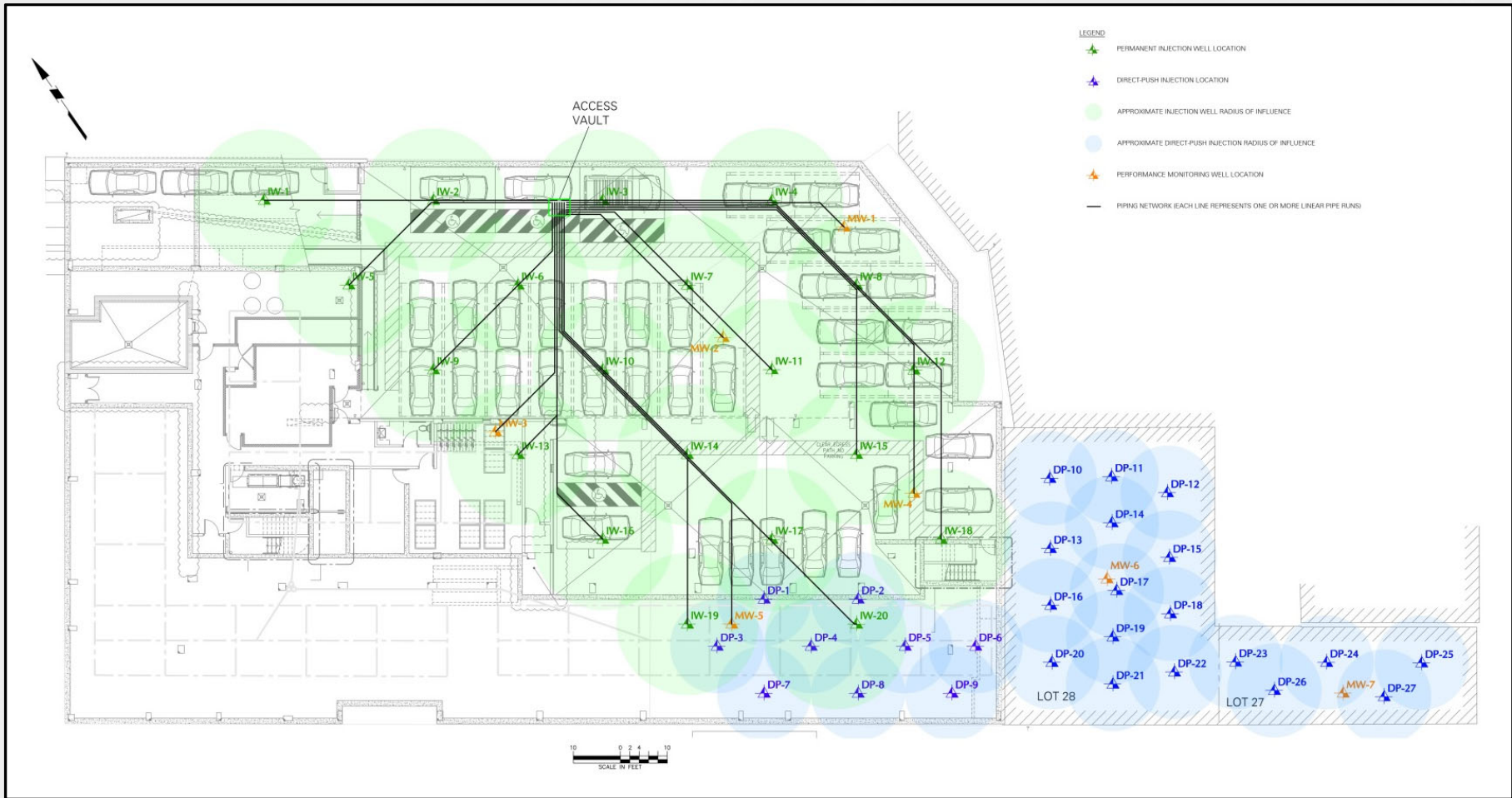
- Decommissioning/removal of two 275-gallon ASTs and four 550-gallon USTs
- Excavation of impacted soil to about 10 feet below grade surface
 - 2,437 tons of historic fill
 - 14,023 tons of petroleum contaminated fill



BASE-ACTIVATED SODIUM PERSULFATE INJECTIONS

- Direct-injection of a base-activated persulfate to pretreat mixed petroleum/CVOC groundwater contamination
 - 11,800 lbs sodium persulfate
 - 20,520 lbs sodium hydroxide





PlumeStop® Injections

- Injection of PlumeStop® for residual petroleum and CVOCs
 - 56,400 pounds via well network
 - 15,600 pounds via direct push





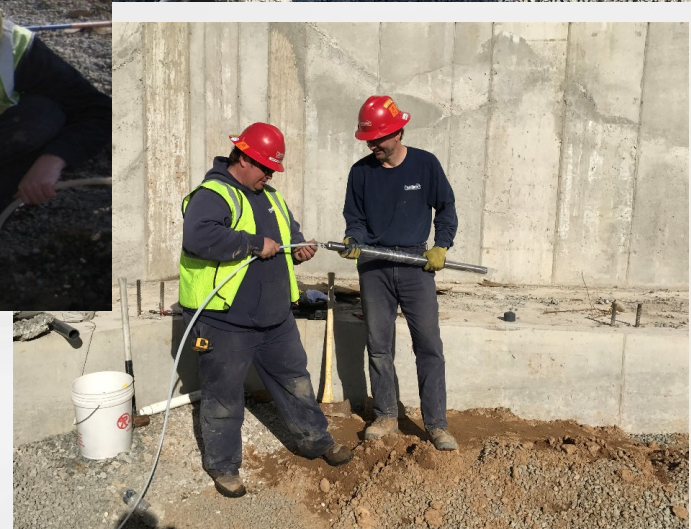






LANGAN

Battelle | Bioremediation and Sustainable Environmental Technologies 2019



LANGAN

Battelle | Bioremediation and Sustainable Environmental Technologies 2019







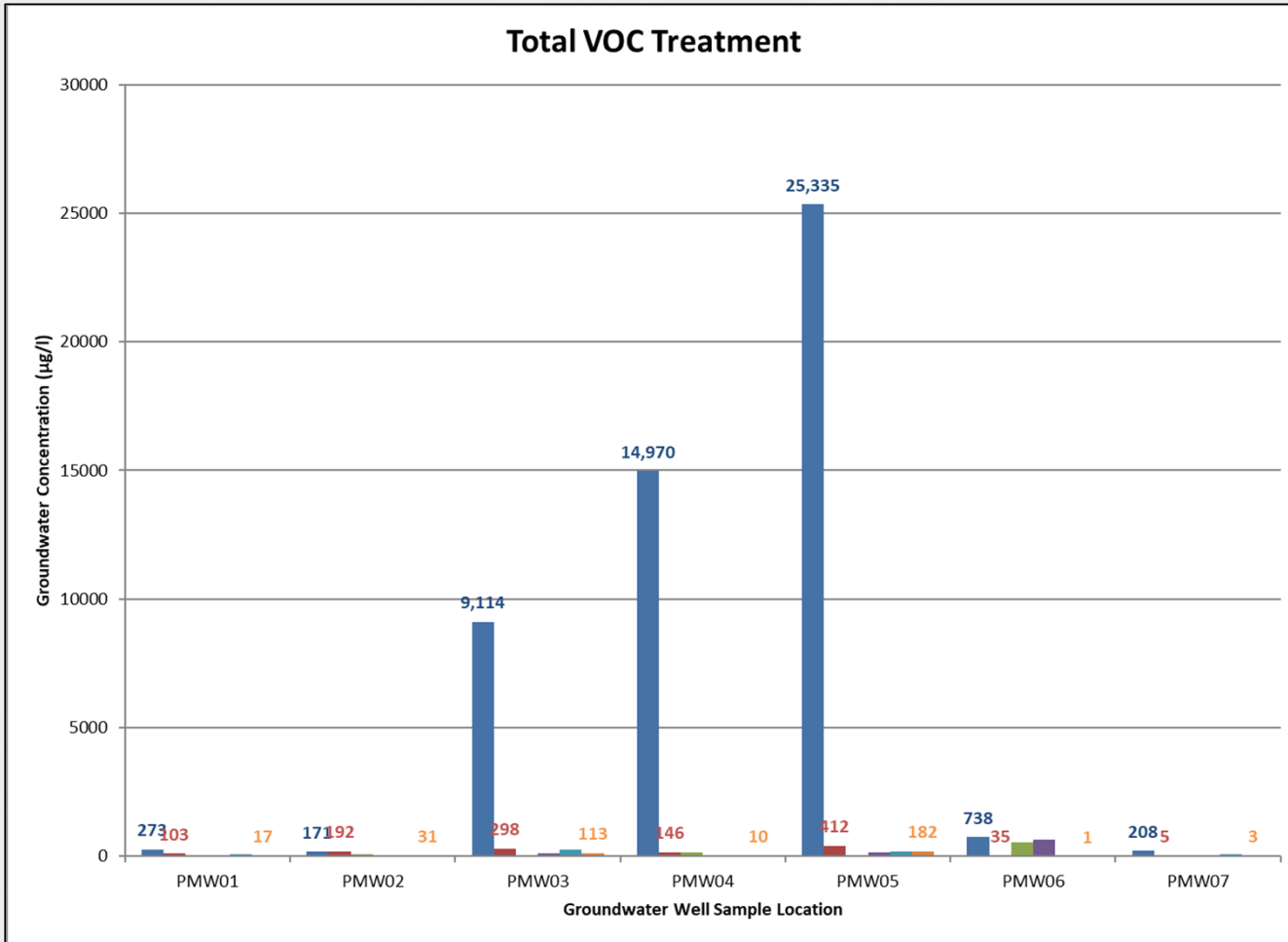




RESULTS

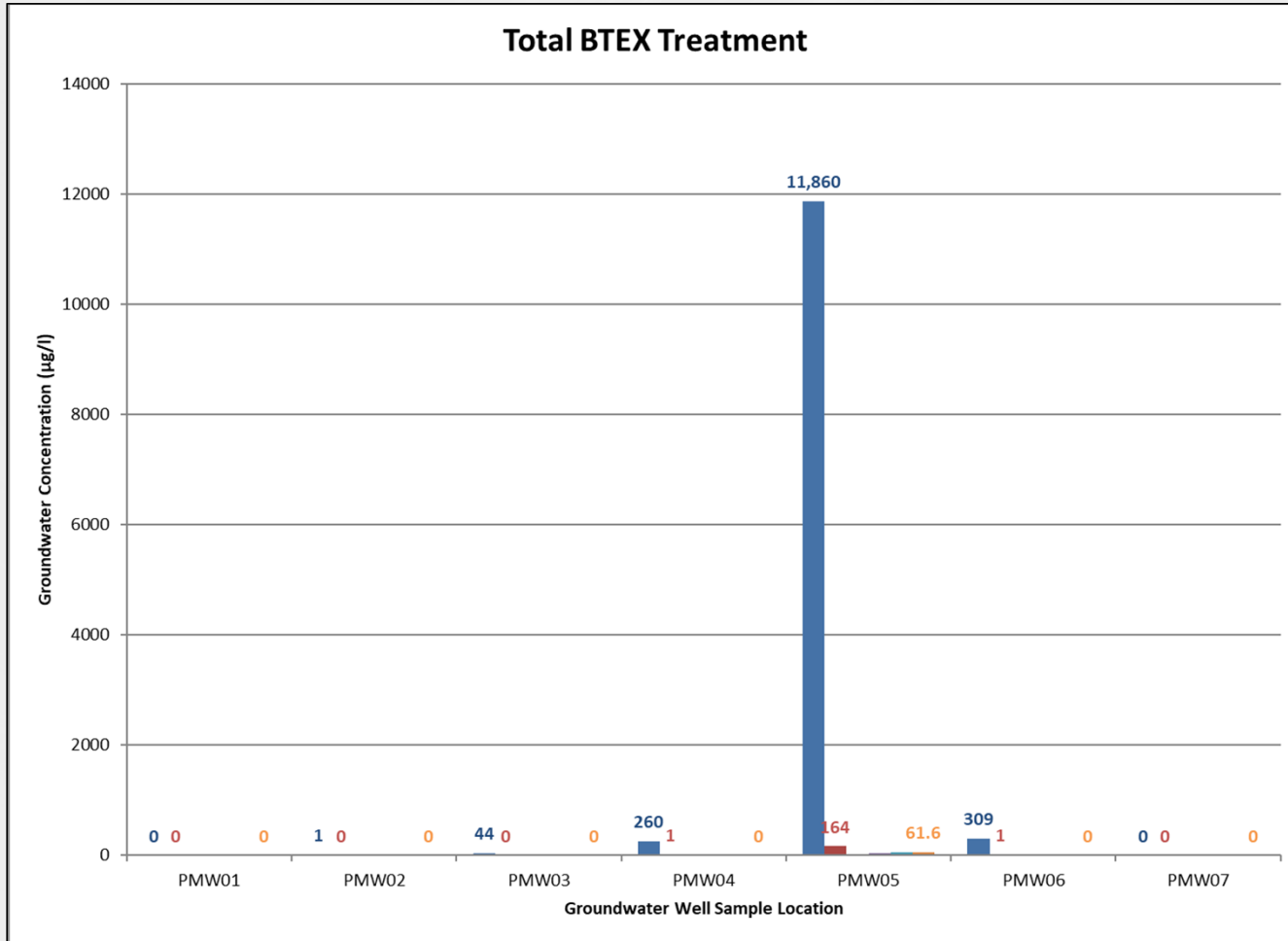
- ISCO field implementation was completed in March 2017
 - Results show up to two orders of magnitude reduction in total VOCs as compared with pre-treatment concentrations
- PlumeStop[®] injections were completed in November 2017
 - Results show an additional order of magnitude reduction (across four quarterly sampling events- March 2018- December 2018)

Total VOC Treatment



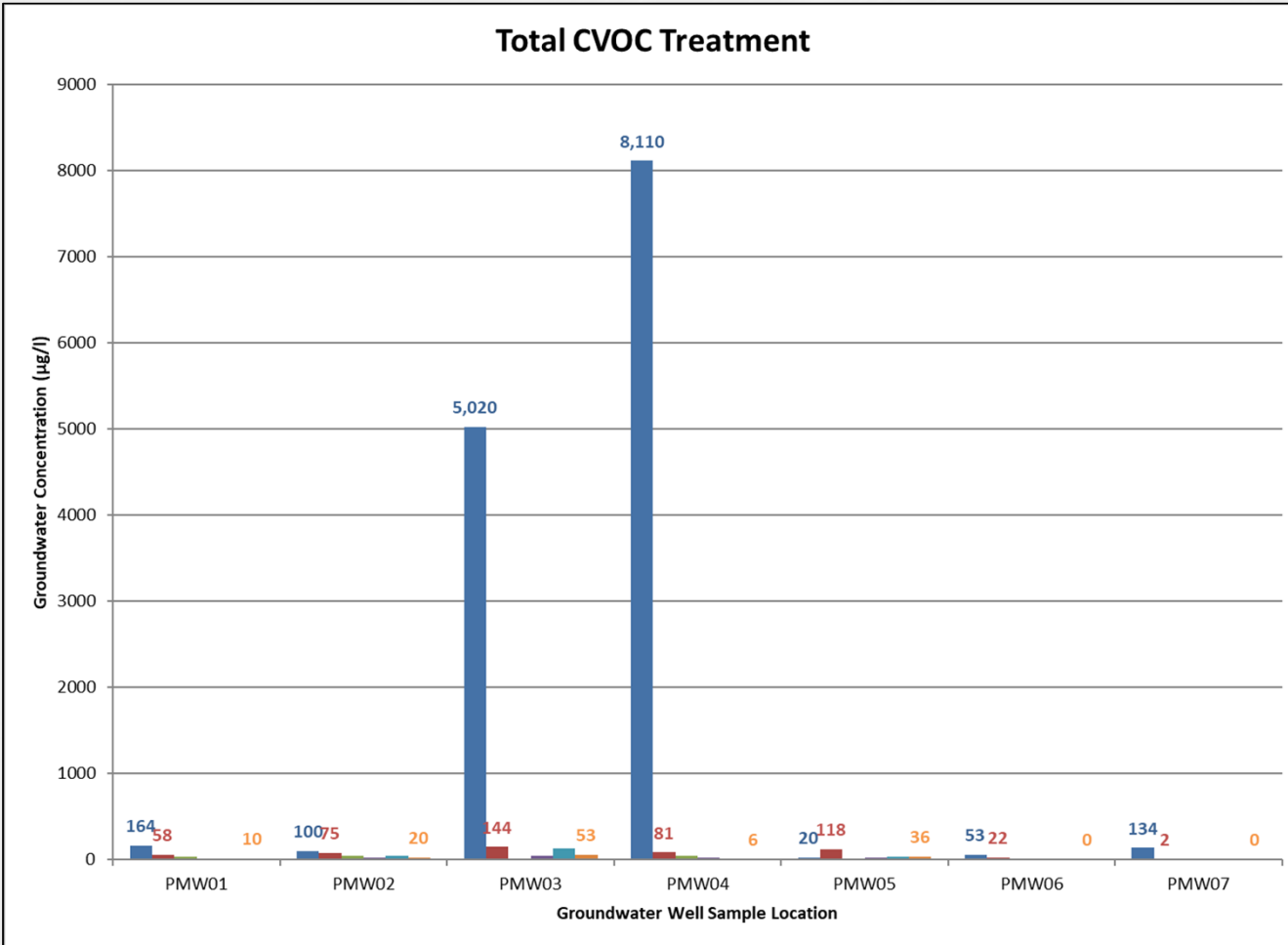
■ Baseline
 ■ Post Source Removal/Persulfate
 ■ Post PlumeStop- Q1
 ■ Post PlumeStop- Q2
 ■ Post PlumeStop- Q3
 ■ Post PlumeStop- Q4

Total BTEX Treatment



■ Baseline
 ■ Post Source Removal/Persulfate
 ■ Post PlumeStop- Q1
 ■ Post PlumeStop- Q2
 ■ Post PlumeStop- Q3
 ■ Post PlumeStop- Q4

Total CVOC Treatment



■ Baseline
 ■ Post Source Removal/Persulfate
 ■ Post PlumeStop- Q1
 ■ Post PlumeStop- Q2
 ■ Post PlumeStop- Q3
 ■ Post PlumeStop- Q4

Contaminant Removal Efficiency

	Post-Source Removal/Persulfate Injection		Post PlumeStop® Injection- Q1		Post PlumeStop® Injection- Q2		Post PlumeStop® Injection- Q3		Post PlumeStop® Injection- Q4	
	<i>mean</i>	<i>median</i>	<i>mean</i>	<i>median</i>	<i>mean</i>	<i>median</i>	<i>mean</i>	<i>median</i>	<i>mean</i>	<i>median</i>
Total VOCs	77%	97%	81%	98%	82%	98%	84%	97%	96%	99%
CVOCs	-7%	65%	90%	99%	80%	99%	72%	97%	71%	99%
BTEX	86%	99%	100%	100%	100%	100%	100%	100%	100%	100%

ADDITIONAL PROTECTIVE MEASURES

- Installation of depressurization system to address potential SVI
- Installation of waterproofing/vapor barrier



CONCLUSIONS/LESSONS LEARNED

Key findings from the project include:

- A phased remedial approach (ISCO and PlumeStop®) proved effective at degrading commingled contamination at a brownfield site below applicable standards.
- An in-situ well network, constructed below the newly constructed building with a vault integrated into the building superstructure, allowed a phased remedial approach that prevented major delays and associated cost impacts to the project and provided confidence in the remedial approach should rebound be identified.

SPECIAL THANKS TO



An aerial photograph of a dense city skyline, likely New York City, taken from a high vantage point. The sky is a mix of orange, yellow, and blue, suggesting sunset or dusk. The city lights are beginning to glow, and the buildings are packed closely together. The word "QUESTIONS?" is written in large, white, sans-serif capital letters across the upper middle part of the image.

QUESTIONS?

LANGAN

Battelle | Bioremediation and Sustainable Environmental Technologies 2019