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REMTECH 2018

Remediation of a Former Chemical Blending Facility Utilizing Multiple Methods Including in situ Chemical Oxidation and Soil Treatment

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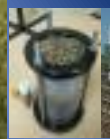
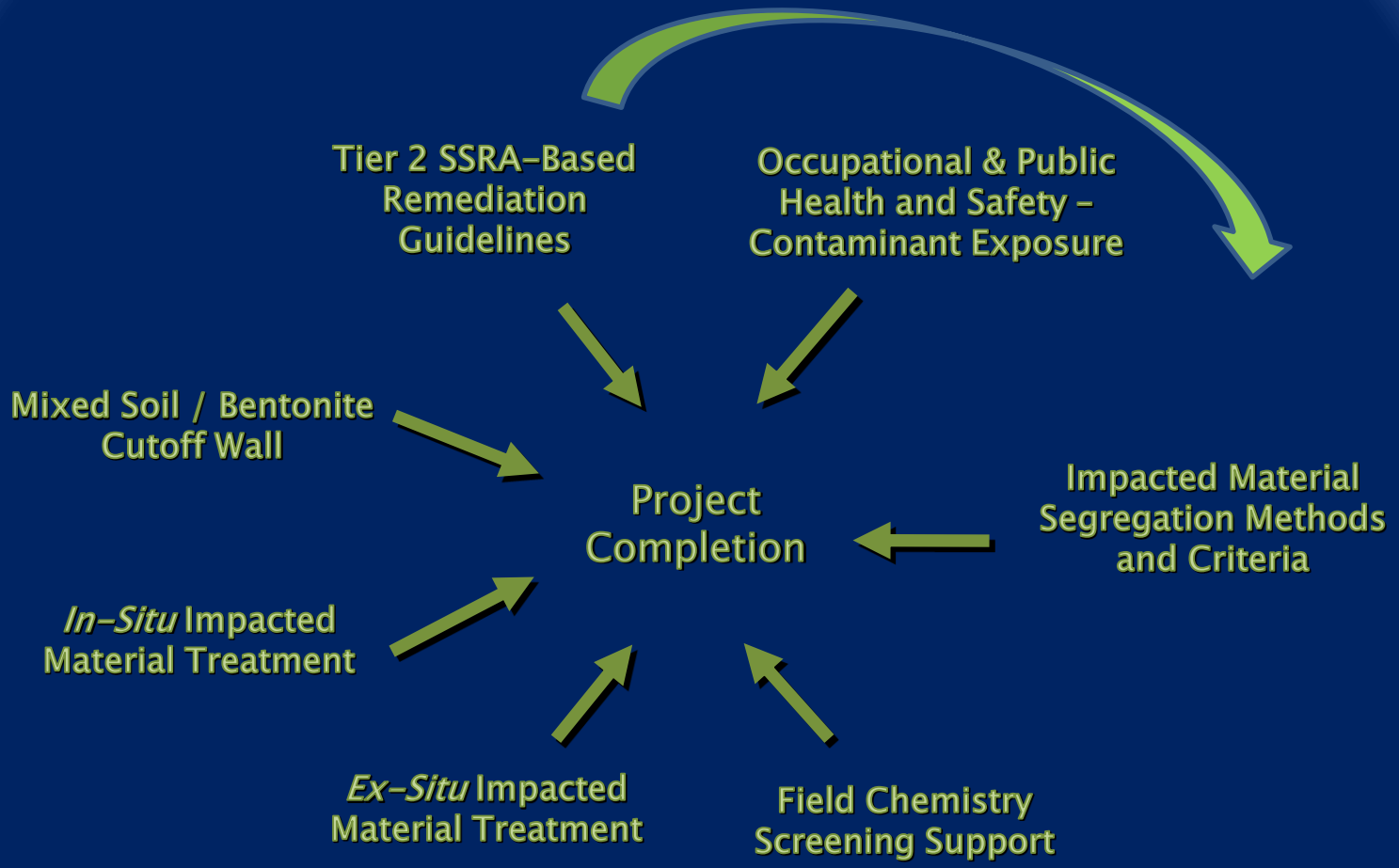







Activities Contributing Project Value



Site History

- former chemical blending facility from 1975 to 1998
- chemicals included proprietary defoamers, surfactants, scale and corrosion inhibitors, demulsifiers, and copolymers, hydrocarbons
- former facility structures:
  - Underground Storage Tanks
  - Pump house
  - Above ground storage tanks and storage berms
  - Building/warehouse
    - laboratory, office area, blending room, storage areas
    - Blending room contained two kettles and a trench in the concrete floor for collection and drainage of wash water and chemical spills
- remediation area constrained by building foundation, neighboring properties, and railway line
- SSRA completed in 2006
- Remediation completed in 2017

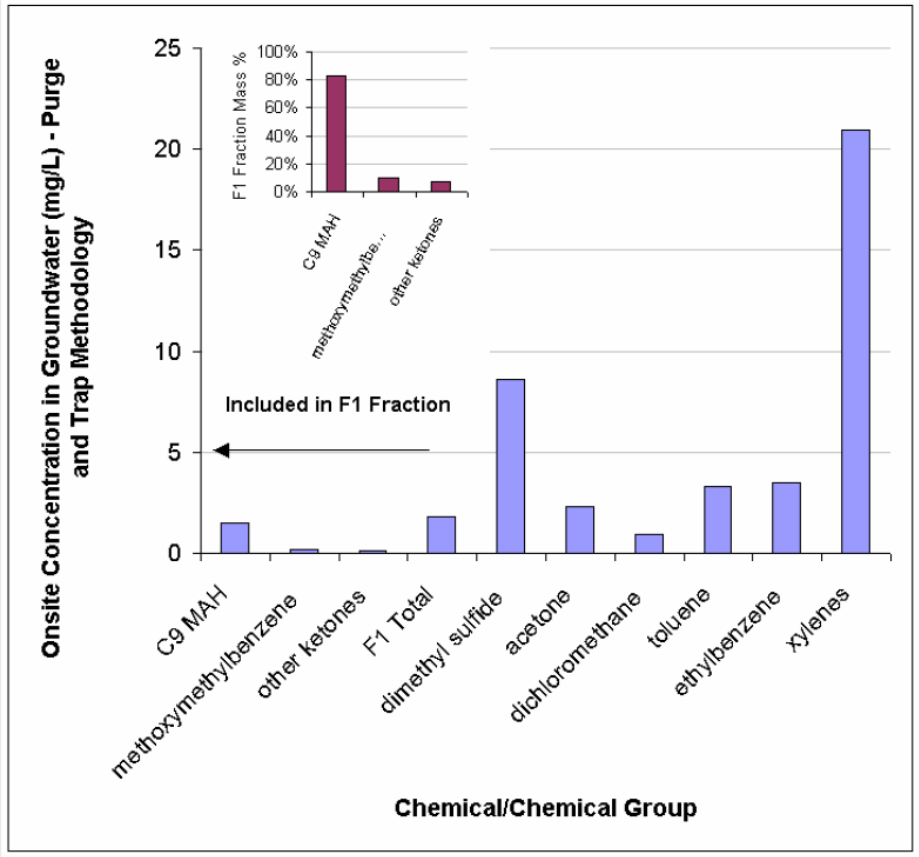
SSRA

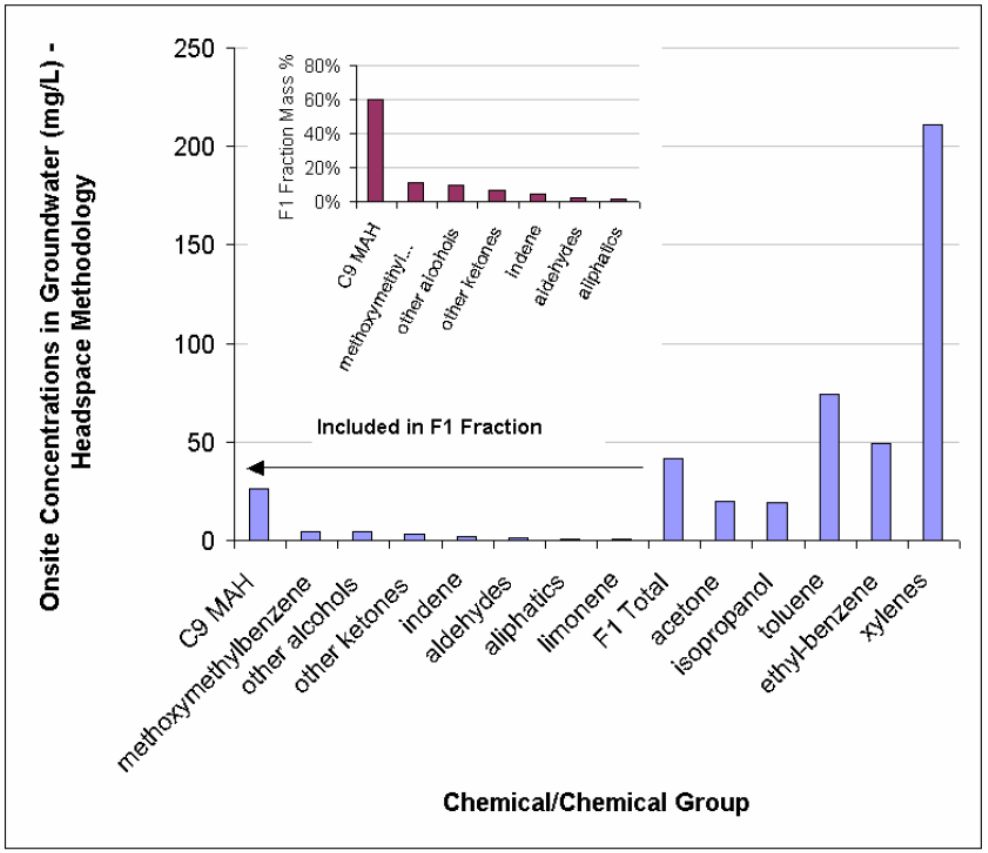
SSRA Contaminants of Potential Concern (CoPCs)

- Challenging SSRA
- Analyses on source, soil, water, soil vapour
- Petroleum Hydrocarbons
  - BTEX, F1 to F4
  - Polycyclic Aromatic Hydrocarbons
  - Monocyclic aromatic hydrocarbons, alkanes and alkenes
- Exotics
  - compounds lacking Tier 1 guidelines
    - phenolic hydrocarbons (methylated and dimethylated)
    - ketones and aldehydes
    - acids and alcohols
    - ethers and terpenes
    - chlorinated alkanes, alkenes, and benzenes
    - Chlorofluorocarbons, mercaptans and sulfides
- Work was completed prior to release of Oct 20, 2017 AEP guidance for selecting toxicity reference values – very useful

Tier 2 SSRA

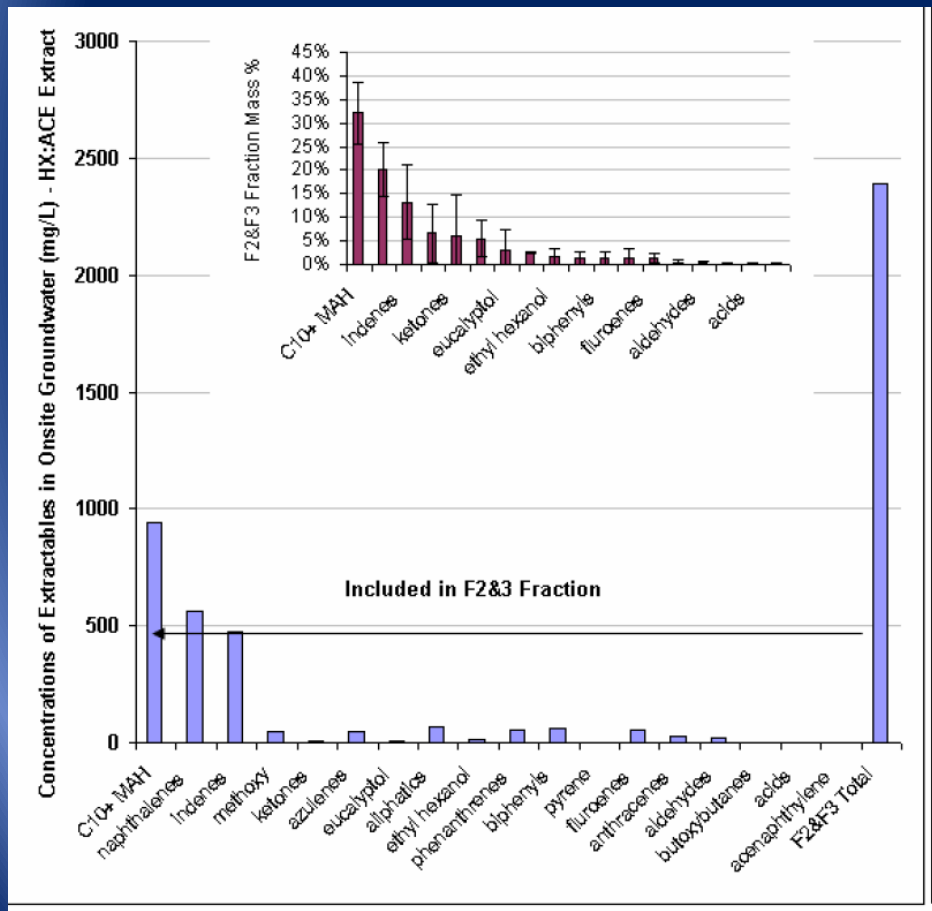
- If just ran BTEX/F1 to F4, would only think PHC impacts
- Variety of analytical and extraction techniques to maximum recovery rate of atypical CoPC
- Purge and trap vs headspace for volatiles produce different suites of CoPC in varying proportions
  - differences in phys/chem properties relative to extraction method

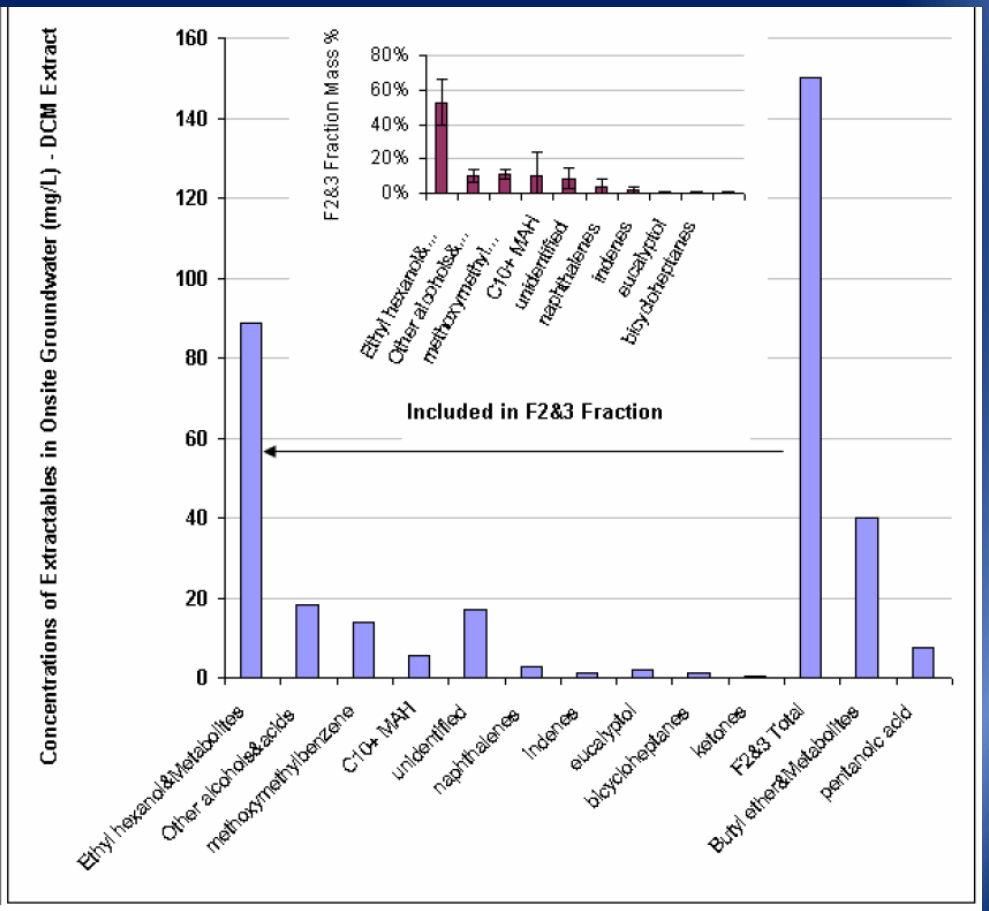




Tier 2 SSRA

- Hexane:acetone solvent extraction vs dichloromethane solvent extraction – differences due to variability in phys/chem properties
- Due to uncertainties with exotics, remediation objective was to minimize their presence and aim for non-detect, and address any residuals <u>if necessary</u> via SSRA





OCCUPATIONAL AND PUBLIC HEALTH SAFETY

Occupational Health and Safety

- Deep excavation (8–9m) 'sandwiched' between railroad tracks and building (Tervita)
- Excavation methods included:
  - Shoring cells along railroad tracks, open cut excavation in center, and slot cutting along the building
  - Impacts directly adjacent to tracks & building foundation
  - Require pilot drilling before sheet piling install – LELs in drill holes were within LEL range – required ventilation
  - Required workers and machinery to go into the excavation to get materials along piling walls – positive air and pit air exhaust used to protect workers


Sheet piling and cross bracing in a shoring box

Open Cut Excavation

Slot Cut Excavation

Occupational and Public Health and Safety

- Chemical exposure was monitored with personal PID detectors set to alarm at specified levels
  - Calibrated against lab data
  - Half masks – VOC and particulate filters provided to workers
  - Supplied air breathing apparatus (SABA) used by workers below ground in excavation
  - Full face masks, different cartridges replaced daily, PPE for chemical exposure during Chemox treatment, full chem suits, etc.


Photo Ionization Detectors

Occupational and Public Health Safety

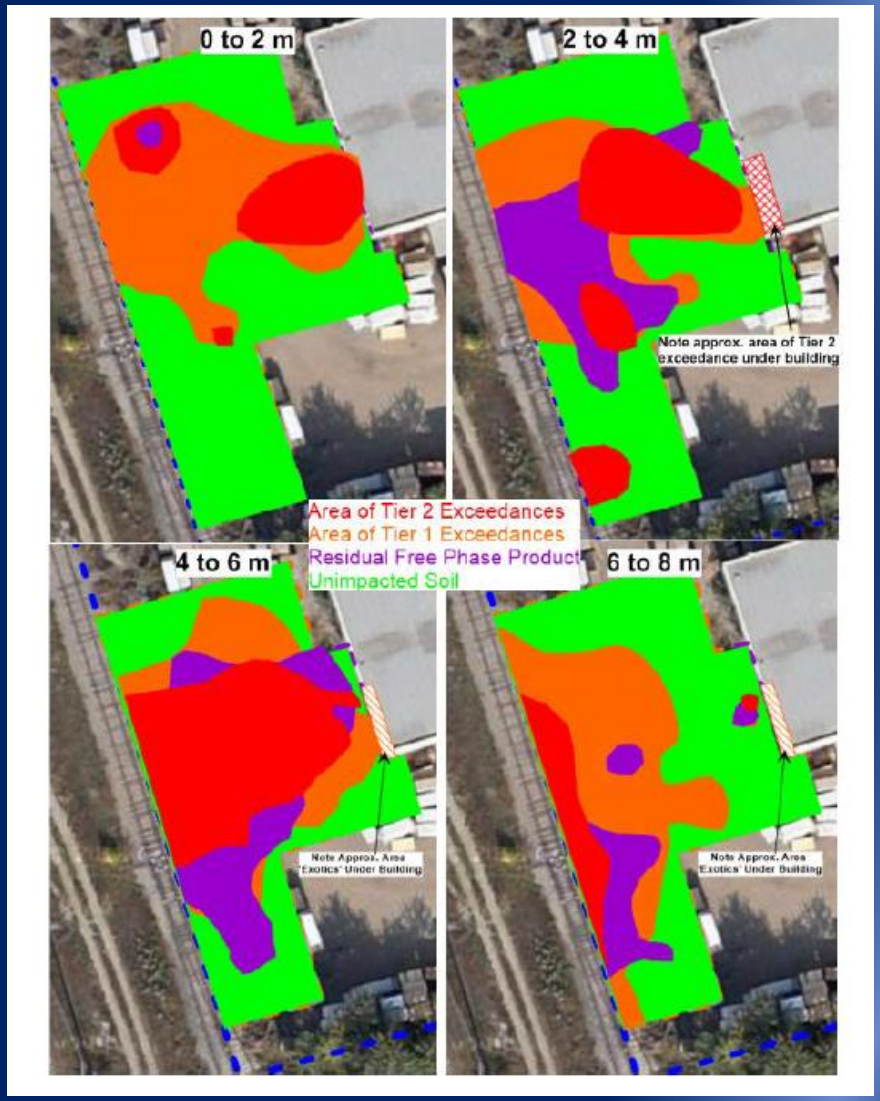
- Building was occupied – continuous indoor air sampling and analysis via GC/MS
  - Was necessary to sample during and excluding excavation activities as wood products produce various emissions including certain BTEX parameters
- Fenceline monitoring on all sides to address potential public concerns regarding health risks
- SUMA canisters used as well as portable hand held PIDs (using different eV bulb) for combined screening data and quantitative results

IMPACTED MATERIAL SEGREGATION & *EX-SITU* TREATMENT

Impacted Material Segregation

- Pre-excavation analysis
- Target areas/depths for materials segregation
- Accomplished using three techniques
  - hand held PID
  - Onsite GC FID/PID producing full range chromatographs
  - Onsite flash point tester etc.
  - Create an exotic standards suite
  - Back by cross-checking with an accredited laboratory

- Five groupings of impacted material:
  - Clearly Class I Landfill
  - Treatable Class I to Class II
  - Clearly Class II
  - Treatable low level Class II impacts (exotics to non-detect and BTEX / F1 to F4 < Tier 2)
  - Clean Backfill



Class I to Class II Treated Soils

- Significant cost savings
- Only certain soils were treatable to the target level
- Confirmed through rigorous and extensive on-site GC/FID/PID testing as well as confirmation from an accredited lab
- Treated ex-*Situ* using Fenton's Reaction
    - Iron catalyst (VTX Chemco) combined with 50% hydrogen peroxide (Chemco)
- reduce parameters (including exotics etc.) to below Class II criteria
    - Some exotics are included in the Class II analytical package and relative risk ranking based on toxicity values indicates other exotic chemicals would represent a relatively lesser risk

Field Screening

- Extensive field screening used to determine the final depth of excavation in each area and confirmed through analysis by accredited lab (Exova)
- on-site field screening lab provided minimal wait time for confirmatory sampling (approx. 20-30 minutes, vs 24-48 hours using off-site lab)
- Off-site backfill was continuously tested in the field lab and occasional official samples were sent to Exova to ensure backfill was appropriate


Field Lab


Flash Point Tester

Accredited Lab Open Scans

- Samples were assessed for volatile and semi-volatile compounds by GC/MS by Exova
- Extracted and run through a capillary gas chromatography mass detector
- Compared to a 200,000+ compound spectral library
- 30 largest peaks identified were reported in descending order of peak area (generally proportional to concentration)
- A number of exotic compounds were identified including (but not limited to):

Acetonitrile
Acetone
Alpha-pinene
Acridine
Butanol
Butanal
Camphene
Cymene
Dibemethine
Ethylhexanoate
Hexanoic Acid
Heptanol
Heptanal
Heptanone
Methacrolein
Methoxymethyl-
Benzene
Nonanol
Pentanol
Pentanal
Propanol

IN SITU IMPACTED MATERIAL TREATMENT

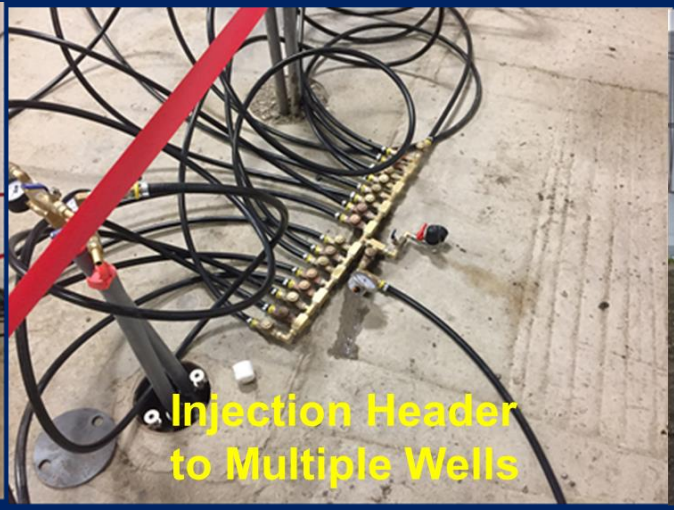
In situ Soil Treatment

- Injection wells install through building foundation and in certain areas where impacts extended > 9 m that were inaccessible in the sheet piling cells
- Iron catalyst injected (& diluted) and distribute throughout the impact area for 2 weeks prior to injection with peroxide
- Vapour monitoring conducted at regular intervals for:
  - Injection wells
  - Vapor recovery wells installed at the top and bottom of the building foundation
  - Continuously within the airspace of the building
- Chemical injections conducted regular intervals for 16 weeks
  - 15% peroxide (non-TDG) then dropped to 6 to 8% peroxide
  - Over this time elevated PID (9.8 eV) readings went from 70 ppm to <5 ppm at injection wells
- Post injection confirmatory sampling
  - soil concentrations below Tier 2 SRGs and all but one below Tier 1
  - Exotic compounds reduced to non-detect levels except for two components addressed via SSRA

In situ Soil Treatment

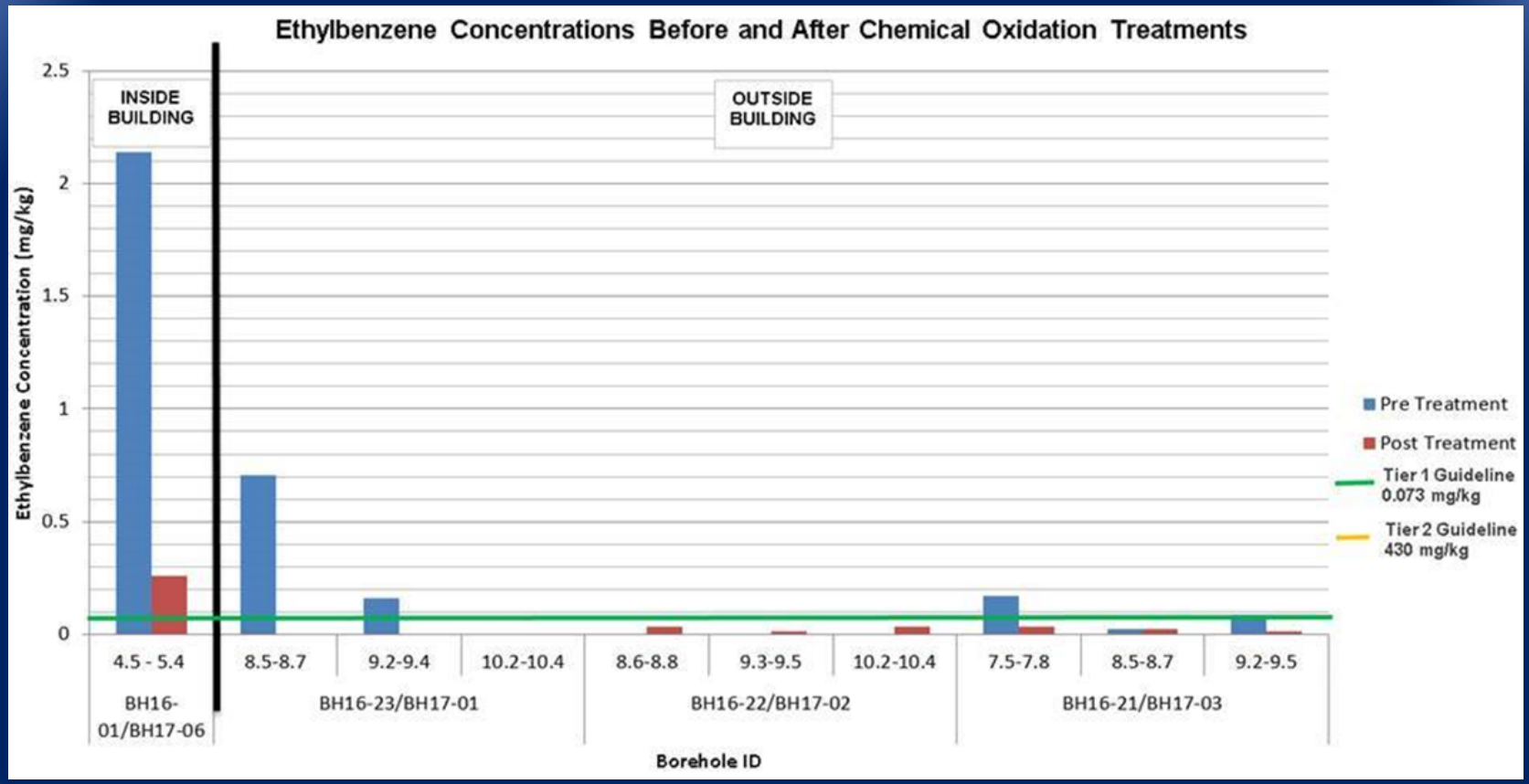
- Watch out for crumbled asphalt – can confound surface chemistry data – not the best choice of surface dressing
- Venting on injection wells – pressures can compromise grout (with Portland) annulus – pulsed injections


Sub-Slab Injection Wells

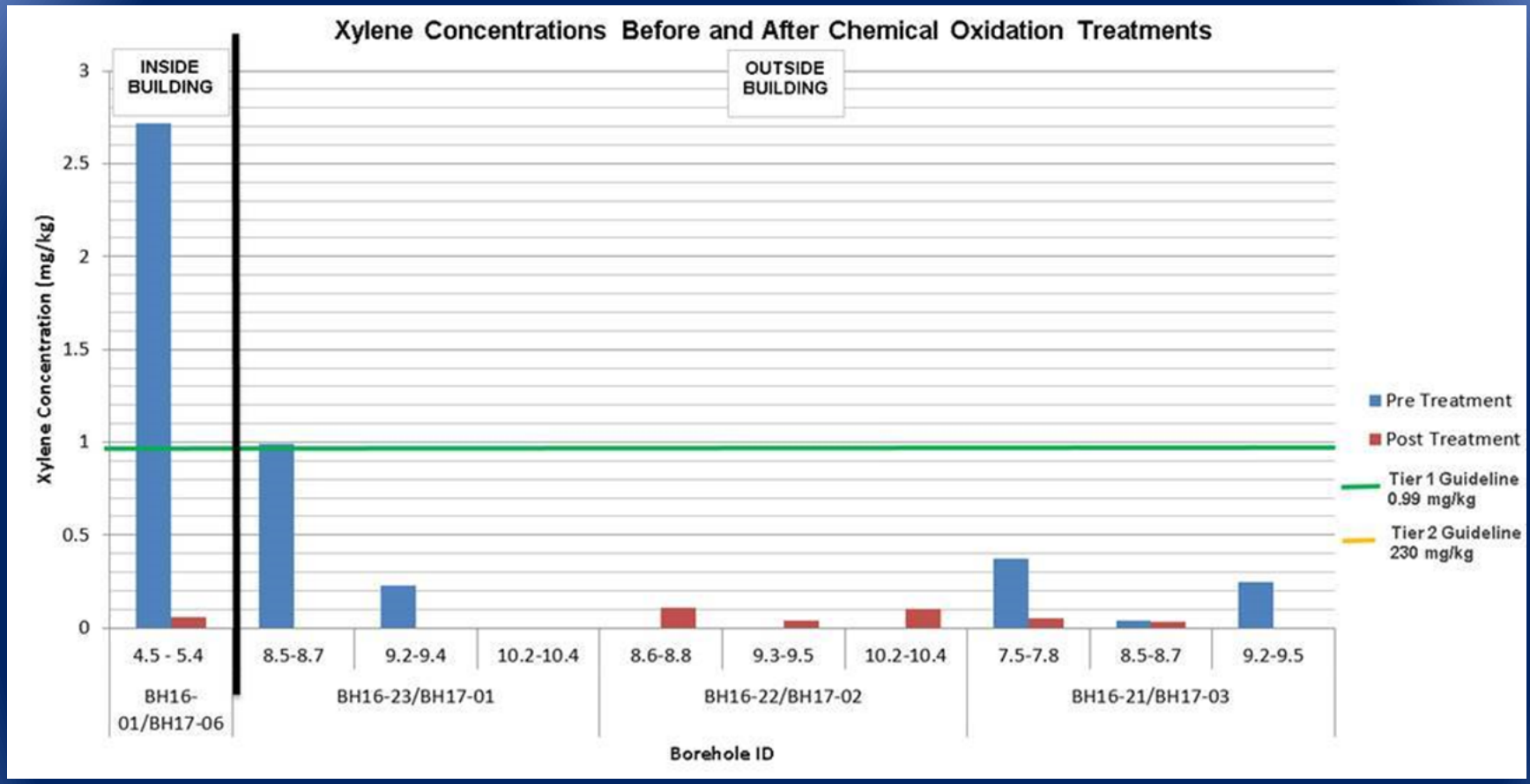

Injection Header to Multiple Wells


Injection Chemical Storage

In-Situ Soil Treatment



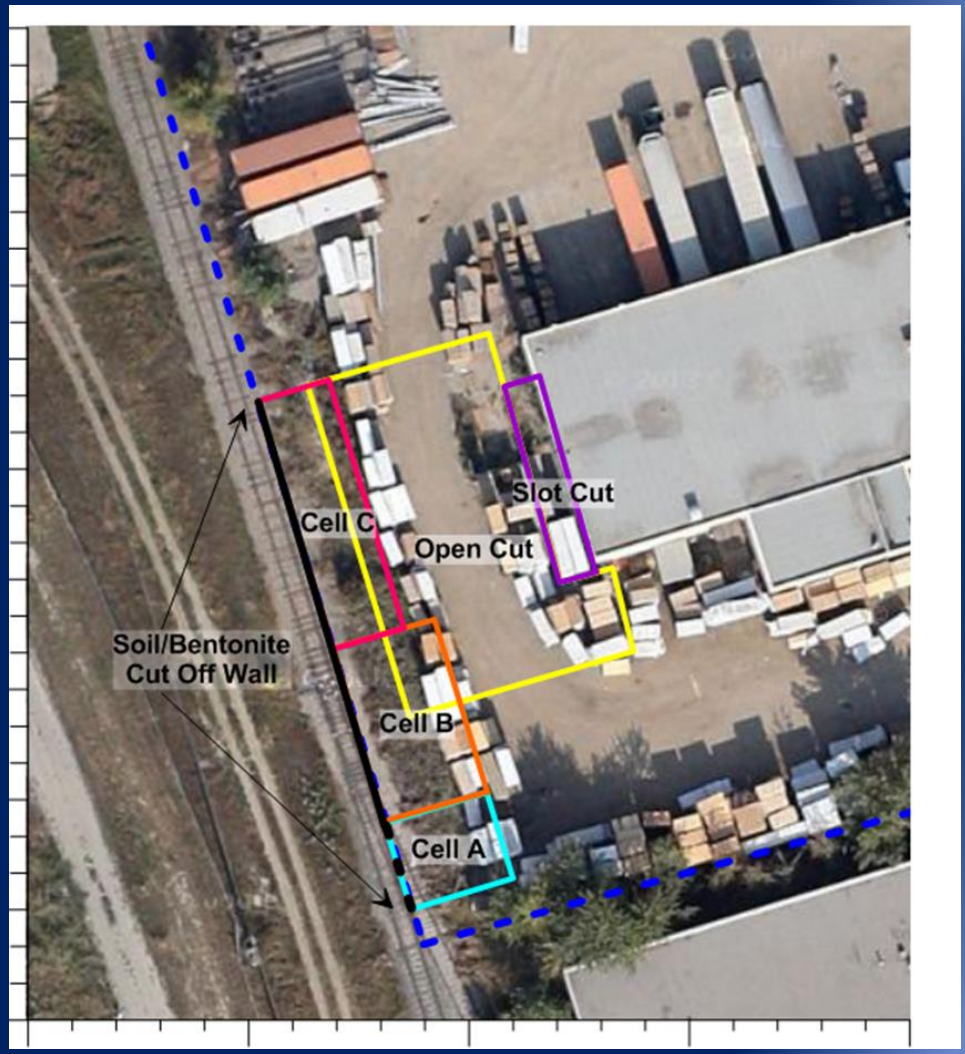
In-Situ Soil Treatment



MIXED SOIL / BENTONITE CUTOFF WALL

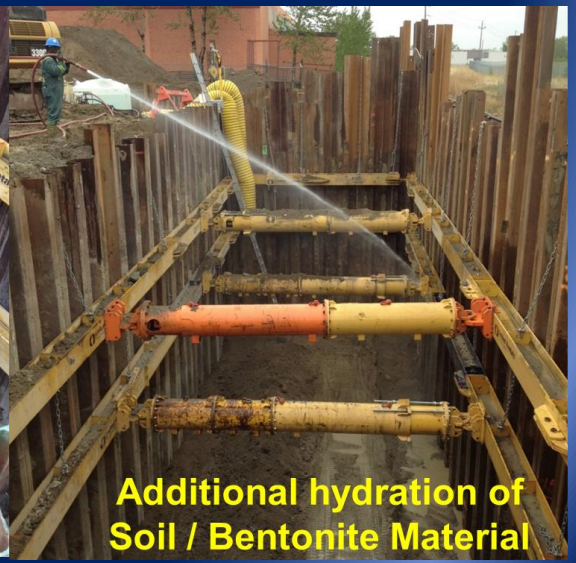
Soil / Bentonite Cut Off Wall

- soil / bentonite cut off wall installed during backfilling
- prevent transport of chemicals back onto the Site at concentrations above guidelines
- Bentonite mixed with low level impacted excavated soils via allu bucket for improved long term chemical reactivity
- Leaching column studies determined the hydraulic conductivity of the cut off wall
- Ranged from 4.95 x 10^{-11} to 6.5 x 10^{-11} m/s
- Also Leached with acetone solution (to represent potential contaminants at the Site) to test chemical reactivity – did not affect hydraulic conductivity



Soil / Bentonite Cut Off Wall

- Wall was installed from 3 m to 8 m below ground surface against the sheet piling on the excavation boundary/property line
- Material was pre-hydrated and mixed prior to installation
- The soil / bentonite cut off wall was a cost effective method to prevent the back migration of impacts west of the property line
- Water bearing zone at approximately 5 to 7 m
  - Appears to have been anthropogenically created (leaking culvert)



Questions?