• Part III – Darin Payne













- Reactive Soil Mixing of CVOCs
 - Client: Private client
 - Dates: 2015
 - Volume improved: 10,300 CYs
 - Depth: 45 ft.
 - Soil mixing performed with large diameter single auger setup
 - Target addition rates of 1.25% ZVI and 1% bentonite by weight



<u>Background</u>: Previous site activities resulted in soil and groundwater being <u>contaminated with chlorinated solvents</u>, primarily TCE and PCE.

<u>GSI Scope</u>: Use soil mixing to add <u>zero valent iron / bentonite</u>. The ZVI was to <u>promote *in situ* chemical reduction</u>. The bentonite was to reduce the contaminated zone permeability to force flow around the contamination and also to facilitate the reduction reaction.













<u>Background</u>: Site on an <u>active military facility</u> (proving ground). Various activities (munitions disposal included) resulted in site soil and groundwater being <u>contaminated</u> <u>with TeCA</u>.

<u>GSI Scope</u>: Use soil mixing to add <u>zero valent iron, soda ash,</u> <u>and emulsified vegetable oil (EVO)</u> to <u>promote</u> *in situ* <u>reduction and biodegradation</u>.





- Reactive Soil Mixing & Enhanced Biodegradation
 - Client: US Government
 - Dates: 2016
 - Volume improved: 9,800 CYs
 - Depth: 22 ft.
 - Soil mixing performed with large diameter single auger setup
 - Target addition rates of 0.5% ZVI by weight, 16 lbs. soda ash / CY, 7 lbs. EVO / CY















<u>Background</u>: Former manufactured gas plant (MGP). <u>Numerous subsurface structures</u>, e.g. foundations, coal tar holders, etc. Subsurface <u>contaminated with coal tar: BTEX</u>, <u>DNAPL</u>

<u>GSI Scope</u>: Use soil mixing to add <u>Portland cement</u> to the contaminated soil to <u>stabilize and/or solidify the</u> <u>contaminants</u>. GSI also performed structure demolition, a test program, site preparation & restoration, waste handling & removal.





Case Study 3

ISS of former MGP

- Client: Utility / Natural Resource Technology
- Dates: 2013 2014
- Volume improved: 300,000 CYs
- Depth: 13 to 27 ft.
- Soil mixing performed with large diameter single auger setups -> 2 rigs
- Targets: strength > 50 psi, perm < 1x10⁻⁶ cm/s







Waste loading

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Crane mounted auger mixing

LALL ...

Aerial of soil mixing

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<u>Background</u>: Previous site activities resulted in soil being <u>contaminated with chlorinated solvents</u>, primarily TCE and PCE.

<u>GSI Scope</u>: Soil mixing with steam injection to reduce TCE concentrations prior to soil mixing with a <u>zero valent iron /</u> <u>bentonite mixture</u> to complete the contaminant reduction. The ZVI was injected to promote *in situ* chemical reduction.

TCE contamination was reduced from as high as 1,900 ppm down to below 10 ppm, so that soils could be excavated and disposed of at a local non-hazardous landfill.

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- Steam Stripping and ZVI Reduction of TCE contamination in soils
 - Client: Private client
 - Date: 2018
 - Volume improved: 2,300 CYs
 - Depth: Up to 18 feet
 - Soil mixing performed with large diameter single auger with steel shroud
 - ZVI addition rates between 1% and 2% depending on TCE levels



Additional Project Highlights:

- Excavate and dispose of 17,000 tons of non-hazardous soils from depths up to 18 feet.
- Clean and refurbish site storm water system.
- Install footer beam to support adjacent building.
- All site restoration activities including gravel surface, seeding and fence installation.



- Original site use:
 - Glassware manufacturing facility
- Contaminant of Concern
 - TCE and related byproducts
- Performance Schedule
 - Bench Scale Study: Fall 2009
 - Site Prep Work: Spring 2010
 - Soil Mixing: Spring Summer 2010
- Treated Volume Dimensions
 - 6,800 CYs treated twice (13,600 CYs total)
 - Up to 20' BGS
- Reagents
 - Potassium Permanganate @ 17.5 lbs / CY
- Portland Cement @ 202 lbs / CY (applied 3 days post
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- 242 nine foot diameter columns installed
- Quality Control
 - Post construction groundwater monitoring showed 99% reduction in TCE concentration
 - Wet grab samples were collected from recently mixed columns
 - Average UCS = ~270 psi @ 28 days
 - Average Permeability = 4.1 x 10-7 cm/s @ 28 days

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- Original site use:
 - Chemical manufacturing
- Contaminant of Concern
 - Acetone
- Performance Schedule
 - Soil Mixing: Winter Spring 2012
- Treated Volume Dimensions
 - 19,500 CYs
 - Up to 30' BGS
- Reagents Post hot air mixing
 - Ammonium Sulfate @ 0.5 lbs / CY
 - Potassium Chloride @ 0.25 lbs / CY
 - Phosphoric Acid @ 18 lbs / CY
 - Calcium Peroxide @ 21.5 lbs / CY

Case Study 6

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- 324 nine foot diameter columns installed
- Quality Control
 - Process controls were utilized to ensure the proper amounts of reagents were added to and mixed with the soils
- Post construction sampling to be conducted
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Questions?

Thank you for your time!

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