Recent ISS Activities for the Treatment of Organics

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Note: Not all jobs depicted were completed by Envirocon – Dr. Lear brings experience from previous employers

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PRESENTATION OUTLINE

- Technology Description
- Stabilization of Organics (Theory and Practice)
- Leaching Criterion
- Full-Scale Examples of ISS of Chlorinated Solvents
- Conclusion

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TECHNOLOGY DESCRIPTION

- "In situ Stabilization/Solidification (ISS) is the mixing of impacted soils with reagents (such as Portland cement and/or slag) to reduce the leachability of contaminants while decreasing the permeability of the stabilized materials."
- ISS can be applied using "auger-based" and "excavator-based" soil mixing approaches.
- "Auger-based" ISS mixing has been practiced for many years, primarily in the geotechnical and deep foundations arenas.
- "Excavator-based" ISS mixing has been practiced for many years, primarily at waste impoundments and sites with subsurface obstructions

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STABILIZATION OF ORGANICS - THEORY

- Reactions which can alter the organic contaminant in a stabilized matrix
  - Hydrolysis
  - Oxidation
  - Reduction
  - Compound Formation

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STABILIZATION OF ORGANICS - THEORY

- Physical processes which immobilize the organic contaminant in a stabilized matrix
  - Adsorption
  - Encapsulation

- Typically both the chemical and physical processes occur simultaneous, though the relative effect of each may vary with the contaminant
  - The more recalcitrant the organic contaminant, the more prevalent the physical processes

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REAGENTS FOR STABILIZATION OF ORGANICS -

- Sorbents
  - Activated carbon
  - Organoclays/Bentonite
  - Rice hull ash
  - High carbon fly ash
- Reactants
  - Persulfate
  - Permanganate
  - Calcium peroxide
  - Zero valent iron (with and without bentonite)
- Used alone or in conjunction with traditional alkaline S/S reagents

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STABILIZATION OF ORGANICS - RANGE

Project Name	Contaminants	Project Name	Contaminants
Umatilla Army Depot	Explosives, metals	Hercules Brunswick	Toxaphene
Camp Pendleton	Pesticides, PCBs, dioxins, metals	Orkin Dettlebach	Chlordane
American Creosote	PAHs, dioxins, metals	Geiger Oil	Benzene, TPH, metals
Roma Street	PAHs	Sunflower AAP	Explosives, propellants, metals
X-31, Portsmouth GDP	TCE, radionuclides	Docklands Development Site	PAHs
Selma Wood	PAHs, PCP, metals	GM Fisher Guide	Organometalics

Note: Many of the emerging contaminants should be amenable to stabilization treatment

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LEACHING CRITERIA FOR ISS OF ORGANICS

- No regulatory leaching criteria are typically available for the organic contaminants of concerns
  - PAHs
  - BTEX
  - CVOCs
- How do you develop these?
  - ITRC Guidance
  - Risk-Based Site Clean-up Approach

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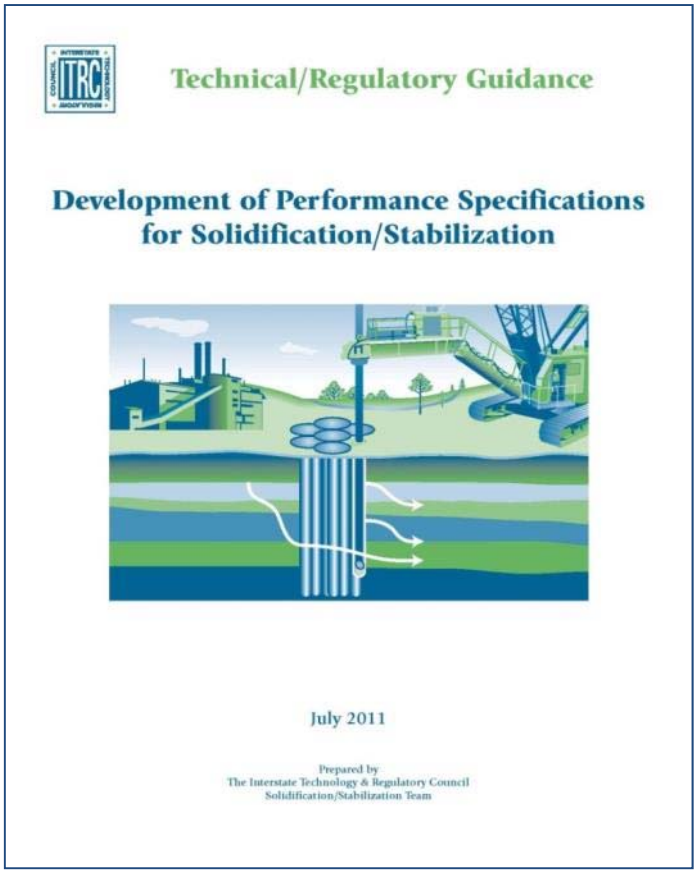
ITRC GUIDANCE

- The Interstate Technology Regulatory Council (ITRC) issued “Development of Performance Specification for Solidification /Stabilization” in July of 2011

Available at
http://www.itrcweb.org/Guidance



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ITRC - LEACHABILITY AT SOURCE VS POC

- Leaching tests provide an estimate at the source of contamination
- Leaching test results should not be
  - Considered to directly represent POC value unless source is at the POC
  - Compared directly to water quality standards for purposes other than screening
- A Dilution-Attenuation Factor (DAF) relates concentration at source to that at POC
  - "Use and Measurement of Mass Flux and Mass Discharge" (ITRC 2010)

RISK-BASED APPROACH TO SITE REMEDIATION

- The EPA and many states utilize a risk-based approach to calculate standards for site remediation
- The Risk-based Impact to Groundwater Standards establish a Leachate Criterion
  - The quantity of a contaminant that the soil can leach and still be protective of human health and the environment at the POC

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RISK-BASED LEACHATE CRITERION CALCULATION

- Site–Specific Leachate Criterion
  - The higher of the health-based water quality standard x site-specific dilution attenuation factor or the aqueous practical quantitation level (PQL) for the analyte
- Default Leachate Criterion
  - Higher of health-based water quality standard x a default dilution attenuation factor (13 to 20) or aqueous PQL

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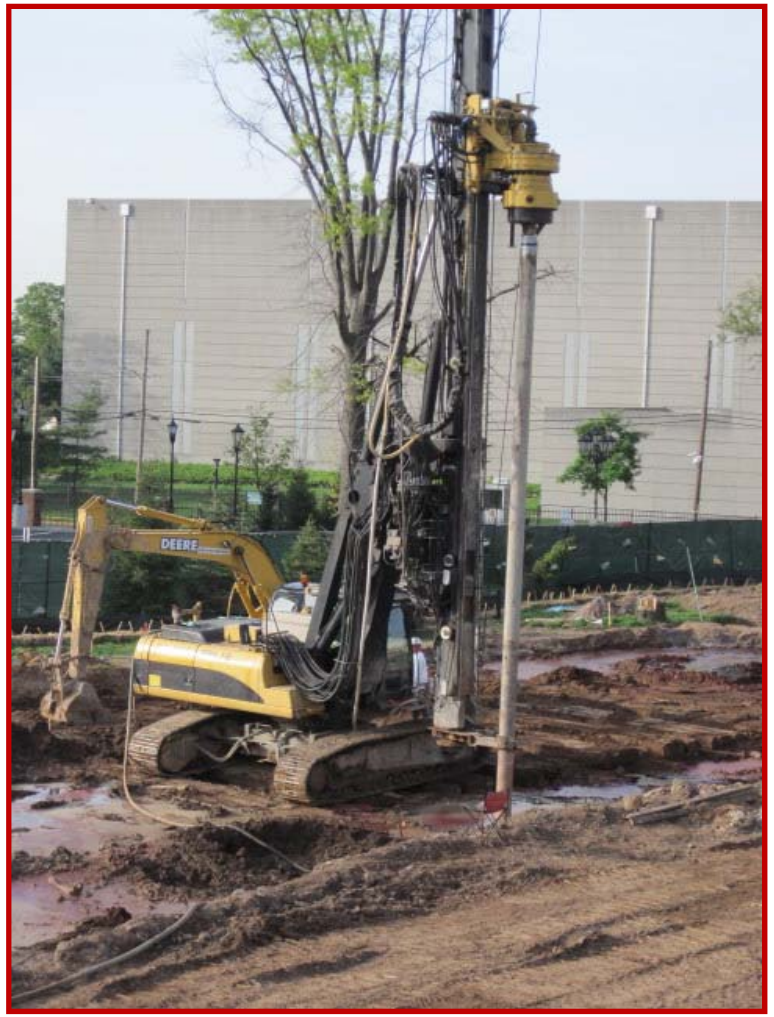
ISS LEACHING CRITERION

- Can be set at water quality standard multiplied by an appropriate DAF
  - Represent how much of a contaminant the ISS treated material can leach to groundwater and still be protective of human health and the environment
- Should not be set below the aqueous PQL
  - Laboratories typically will not quantify below the PQLs



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ISS LEACHING CRITERION RATIONALE

- Consistent with both
  - The ITRC guidance, and
  - the existing use of Leaching Criterion for calculating site-specific Impact to Groundwater Remediation Standards
- Protective of human health and the environment

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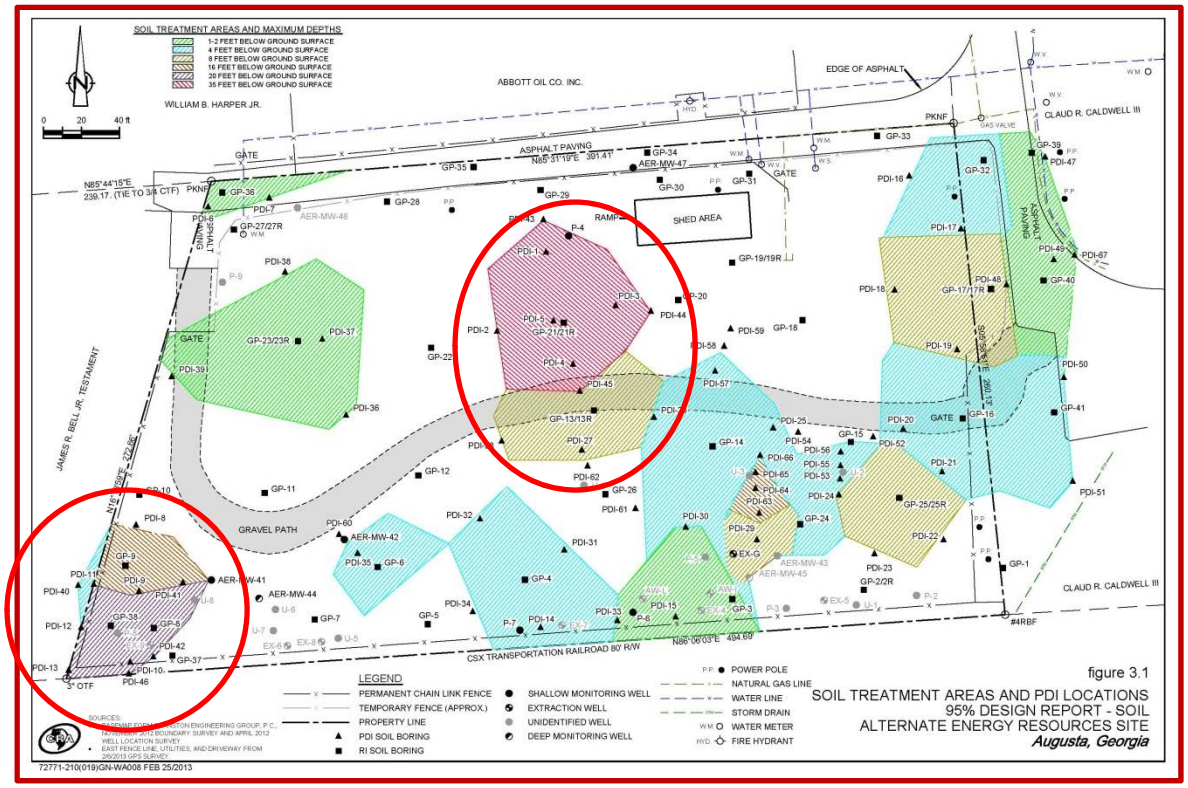
FULL-SCALE ISS TREATMENT

AER Superfund Site, Augusta, GA

- Solvent recycling operations results in chlorinated solvent contamination
- ISS treatment depths ranged from 4 to 35 feet bgs



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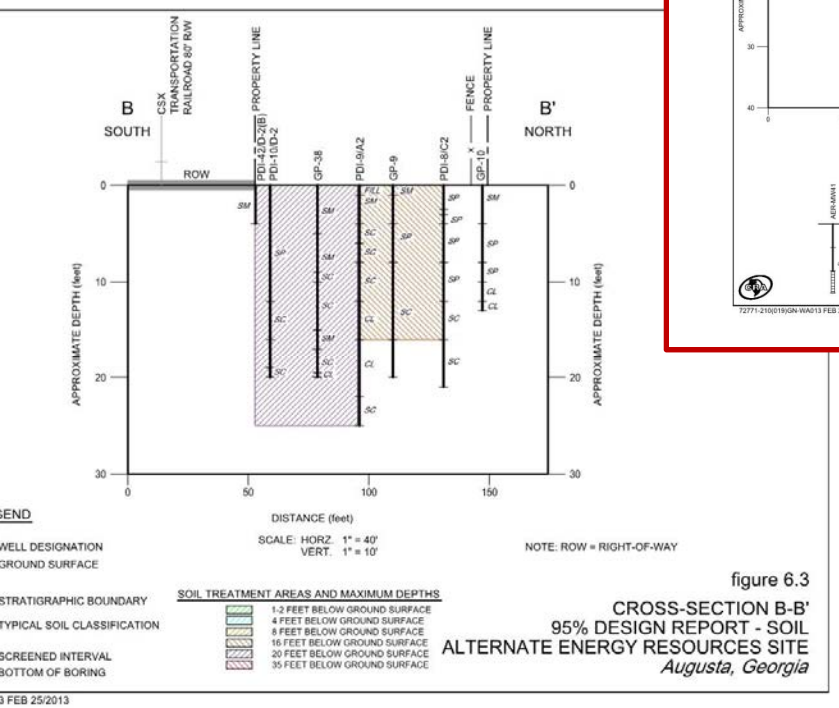
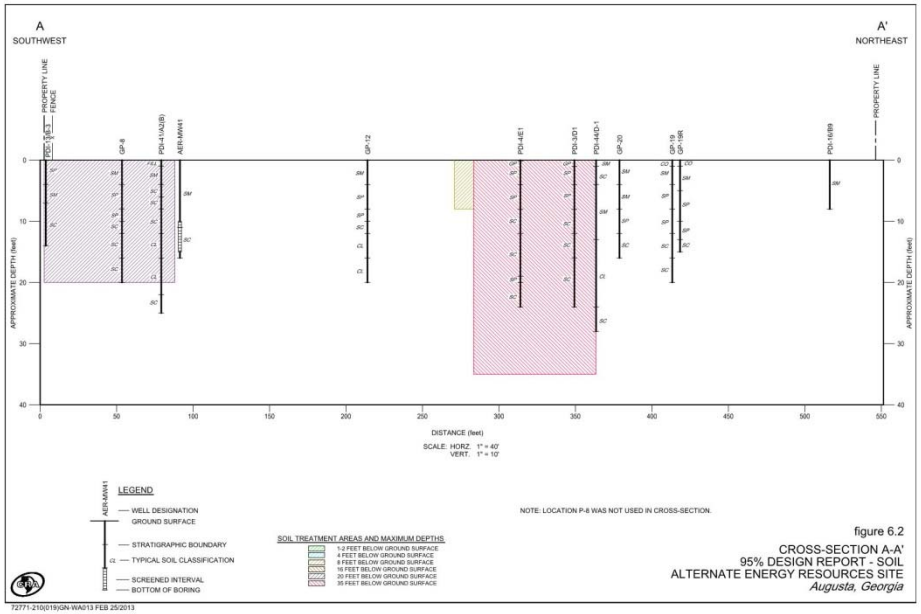
FULL-SCALE ISS TREATMENT

ISS Cross Sections





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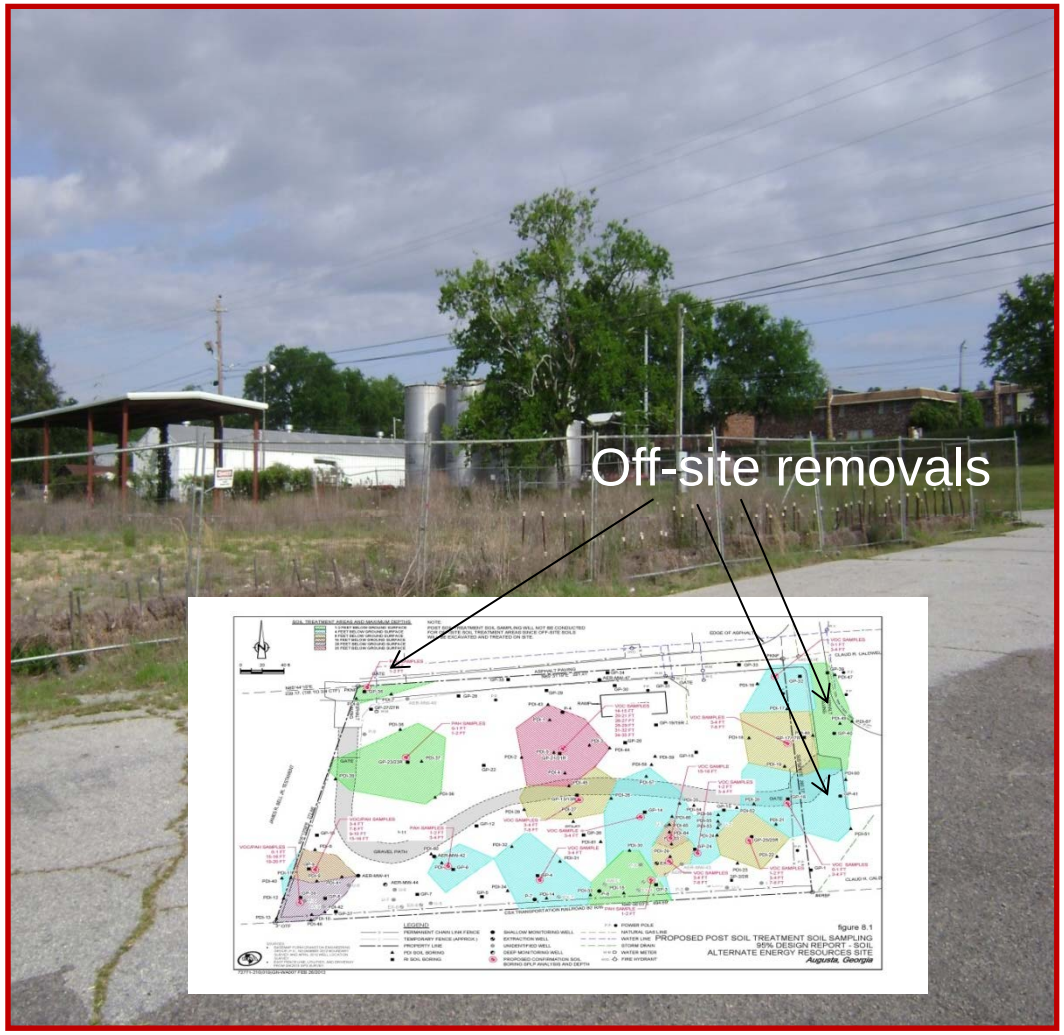
RELOCATION OF IMPACTED SOILS

Excavated and Placed in Soil Treatment Area GP-14 for ISS Treatment



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Auger ISS treatment

- Treatment depth greater than 16 feet bgs
- Daily production areas pre-excavated to accommodate swell
- Cement grout added to 10% by weight of soil
- Carbon added to grout where auger reached highly contaminated treatment zones (1% by soil weight)
- Total of 3 mixing passes were required

cavator ISS treatment

- Treatment depth less than 16 feet bgs
- Treatment cells (400 cy) bermed to accommodate swell
- Cement grout added to 10% by weight of soil
- Mixed until visibly homogeneous (no “bigger than fisted-sized” lumps)

S Performance iteria

- Risk-based SPLP Leachate Criteria
- Calculated by MCL or groundwater quality standard times a site-specific DAF
- Approved by GA EPD and USEPA Region IV

Parameters	*SPLP Extract Criterion d.1*
	mg/L
VOCs	
1,1,1-Trichloroethane	17.82
1,1-Dichloroethene	0.68
Benzene	0.05
cis-1,2-Dichloroethene	0.46
Methylene Chloride	0.49
Tetrachloroethene	0.12
trans-1,2-Dichloroethene	0.66
Trichloroethene	0.03
Vinyl Chloride	0.01
Xylenes (Total)	65.5
SVOCs	
Benzo(a)anthracene	0.07
Benzo(a)pyrene	0.07
Benzo(b)fluoranthene	0.07

AER SUPERFUND SITE

rformance Verification

- Sampled every 500 cy for each mixing method
- Sampling location determined by de maximis (Oversight Engineer)
- 3rd party analytical lab

sults

- All samples met the leachate criteria
- Most in 7 days after treatment, but all in 35 days
- Mixing method irrelevant to performance

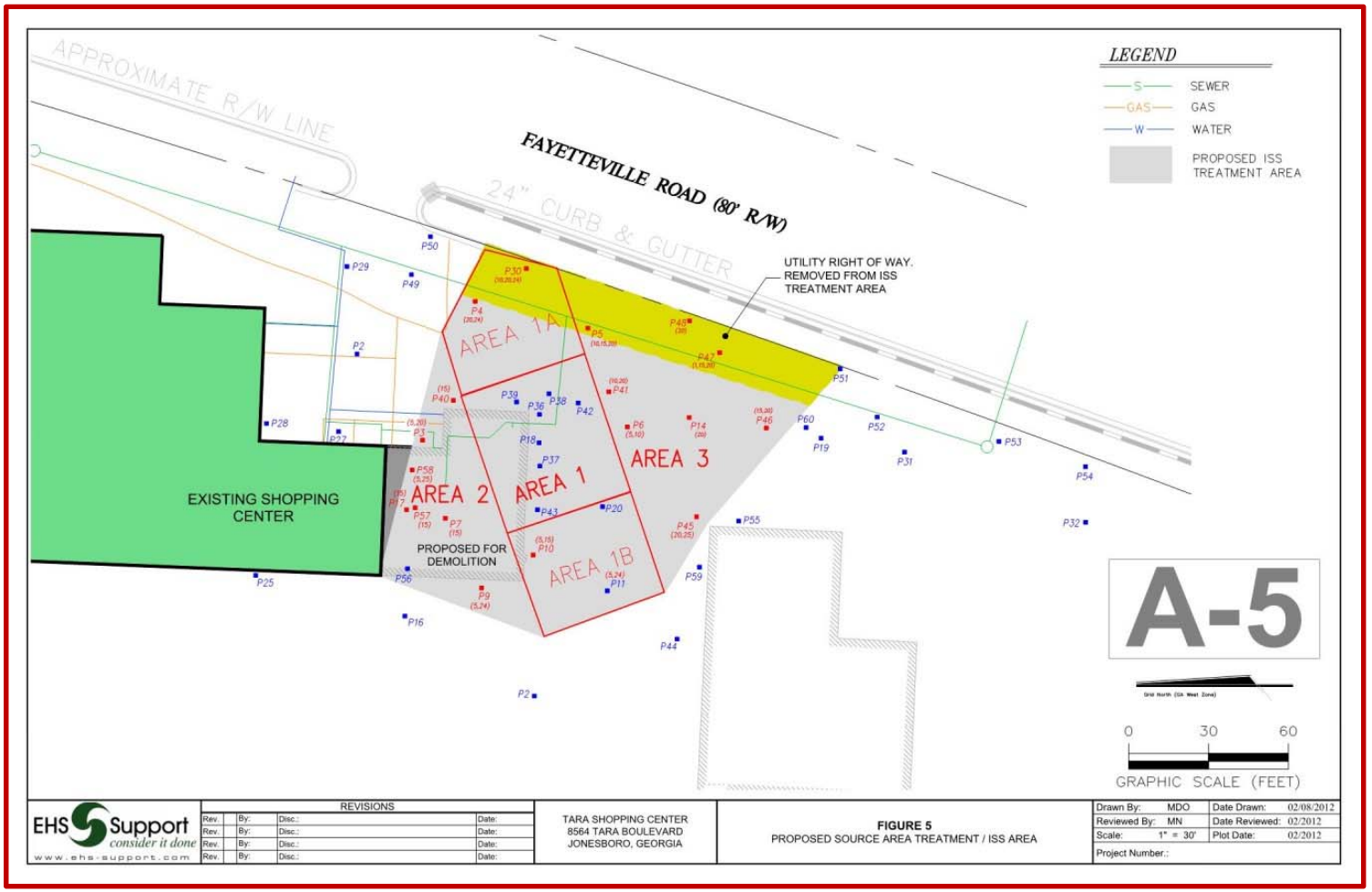
FULL-SCALE ISS TREATMENT

ara Shopping Center, onesborough, GA

- Dry cleaner disposed of solvents in a dry well, resulting in chlorinated solvent contamination in soil and groundwater
- Impacts to groundwater detected off-site
- Voluntary site cleanup to facilitate redevelopment

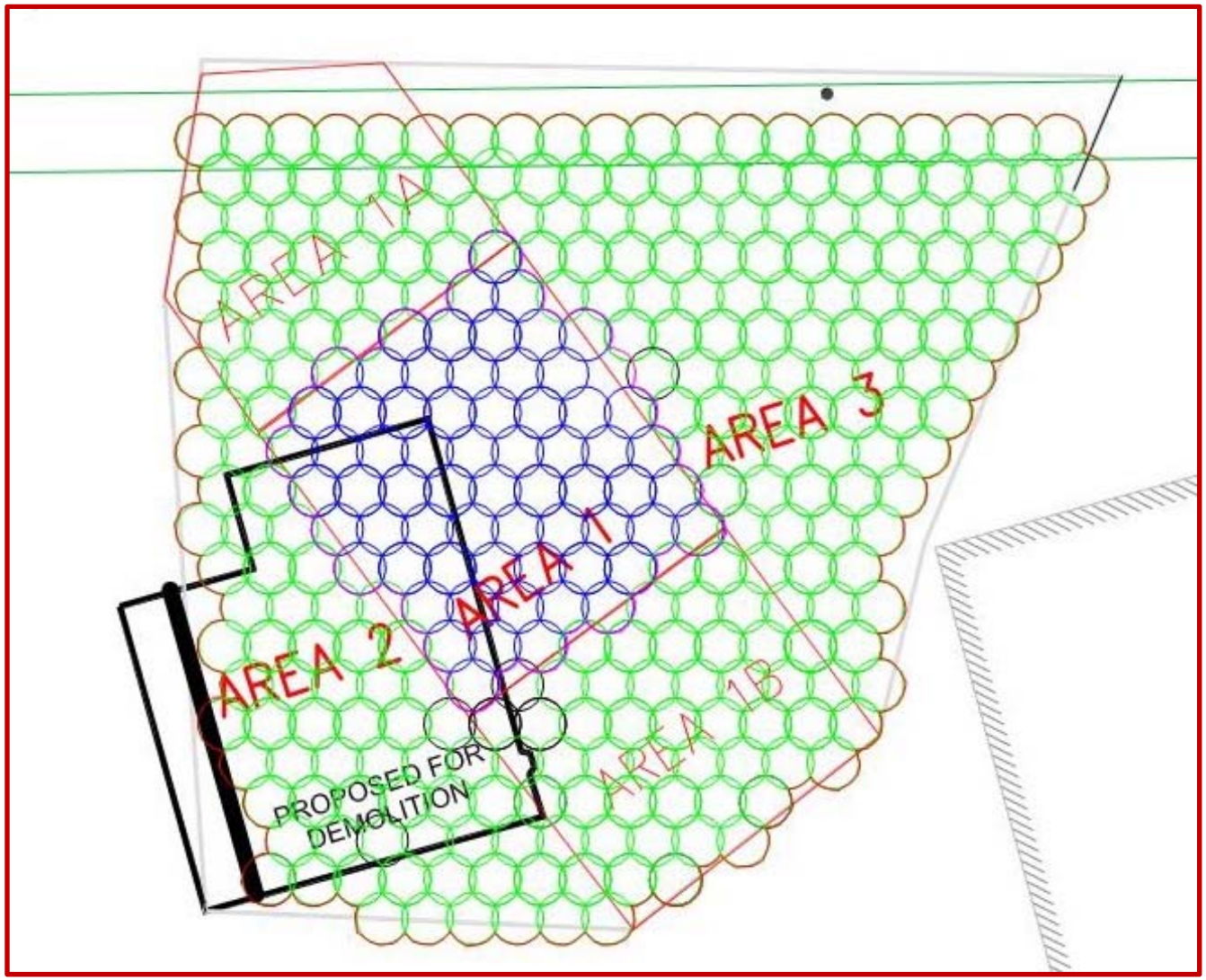
TARA SITE

S treatment depths ranged from 25 to 45 feet bgs



TARA SITE

uger ISS
Layout



TARA SITE

uger ISS treatment

- Daily production areas pre-excavated to accommodate swell
- Area 1 – 1.9% cement + 5.6% slag + 1% carbon added to the soil as a grout
- Other Areas (1A, 1B, 2, and 3) – 1.9% cement + 5.6% slag added to the soil as a grout
- Total of 3 mixing passes were required for each column

Performance Criteria

rameter	Method	Criteria		Tolerance
S	ASTM D1633	50 psi		No less than 40 psi
rmeability	ASTM D5084	5x10-7 cm/s		No more than 8x10-7 cm/s
LP Leachability	SW846 Method 1312	PCE TCE Cis 1,2DCE Vinyl Chloride	5 µg/L 5 µg/L 70 µg/L 2 µg/L	None

Note: Leachate criteria = MCL

rformance Verification

- Sampled every 250 cy
- Sampling location determined by ESH (Oversight Engineer)
- Sample material placed into 3’x6” molds
- 3rd party analytical and geotechnical lab testing

sults

- All samples met the ISS performance criteria

CONCLUSIONS

S can be applied to soils and diments contaminated with ganics

- Including many emerging contaminants

aching performance criterion sked-based SPLP leachate terion) can be calculated

- MCL or groundwater quality standard times a default or site-specific DAF

QUESTIONS OR COMMENTS?

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