Innovations in Stabilization Treatment of Dredged Material Placement Areas

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What is S/S Treatment?

Involves mixing a binding agent into contaminated media such as soil, sediment, sludge or industrial waste.

S/S treatment protects human health and the environment by immobilizing hazardous constituents within treated material.

Geotechnical improvement of treated material

Physical (solidification) and chemical (stabilization) changes to the treated material.

Mobility Reduction Terms: Stabilisation (UK), Inertage (France), Immobilization (EU).

STABILISATION APPLICATIONS

Geotechnical applications

Environmental applications

MASS STABILISATION OF SOFT SOILS

Clay, mud, peat…

MASS STABILISATION OF DREDGED SEDIMENTS

Soft sediments, clean /contaminated

MASS STABILISATION OF CONTAMINATED SOILS

Application areas:

ROADS, STREETS, RAILROADS, PIPELINES, PARKING AREAS, SPORT FIELDS, COMMERCIAL AREAS, RESIDENTIAL AREAS, INDUSTRIAL AREAS, HARBOURS, STORAGE AREAS, RIVER EMBANKMENTS, SOIL SOLIDIFICATION AND REMEDIATION

EPA-542-R-07-012

Technology	Total number of projects[a]	Polycyclic aromatic hydrocarbons (PAHs)	Other nonhalogenated semivolatile organic compounds[b]	Benzene-toluene-ethylbenzene-xylene (BTEX)	Other nonhalogenated volatile organic compounds[c]	Organic pesticides and herbicides	Other halogenated semivolatile organic compounds[d]	Halogenated volatile organic compounds	Polychlorinated biphenyls	Metals and metalloids
Bioremediation	113	37	51	33	33	24	17	22	2	5
Chemical Treatment	29	1	2	3	4	1	4	12	4	13
Multi-Phase Extraction	46	9	3	11	6	4	8	18	1	1
Electrical Separation	1	0	0	0	0	0	0	1	0	0
Flushing	17	3	5	5	5	1	3	11	0	5
Incineration	147	27	41	33	23	36	34	52	36	6
Mechanical Soil Aeration	7	0	0	3	1	0	1	7	0	0
Neutralization	15	2	0	0	0	0	0	0	0	6
Open Burn/ Open Detonation	4	0	1	0	0	0	0	0	0	0
Physical Separation	21	4	2	1	0	3	0	0	4	5
Phytoremediation	7	1	2	2	2	1	1	4	0	4
Soil Vapor Extraction	255	15	31	107	51	3	33	217	1	0
Soil Washing	6	1	1	0	0	2	0	0	1	2
Solidification/ Stabilization	**217**	**17**	**18**	**13**	**13**	**16**	**7**	**20**	**35**	**180**
Solvent Extraction	4	2	1	0	1	1	0	2	2	1
Thermal Desorption	71	21	17	24	15	8	12	33	16	0
In Situ Thermal Treatment	14	5	0	2	0	3	3	8	0	0
Vitrification	3	0	0	1	1	0	1	3	2	1
Total Projects	**977**	**145**	**175**	**238**	**155**	**103**	**124**	**410**	**104**	**229**

Types of Sites Applied

- Wood Preserving Sites
- Herbicide and Pesticide Sites
- Oil Refinery Sludge Lagoons
- Manufactured Gas Plants
- Sediment including PCB
- Metal Refining, Smelting, Plating, Recycling
- Residual Ash

S/S Agents

Portland cement, Cement kiln dust

Fly ash e.g. Class F and C (pozzolanic fly ashes)

Lime e.g. quicklime, hydrated lime, lime kiln dust

Slag e.g. ground granulated blast furnace slag

Organoclay®

EnviroBlend®

Bentonite clay

Activated carbon

Cement-based proprietary mixtures

Silicate, phosphate, and sulfate

e.g. triple super phosphate

Binding Agent Pricing

- Priced by transportation costs:
  - Industrial waste/byproducts, finely divided materials available on site, e.g. spent fullers earth, ash
- Priced per ton:
  - Common construction materials:
    - portland cement, blended cements, Class C or F fly ash, GGBFS, lime.
- Priced per pound:
  - Specialized materials, sorptive, reactive, or compounding
    - Carbons, organophilic clays, oxidizers, reducers

Laboratory Formulation

Large scale laboratory mixing in drum

Solidified samples prepared for strength and permeability testing

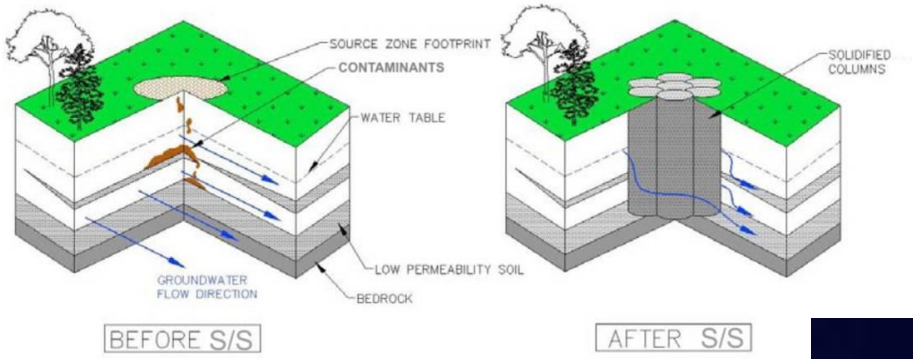
Thoroughness of Mixing = Efficiencies

VS.

MIXING ENERGY and SHEAR

SPOON: FOLDING ACTION

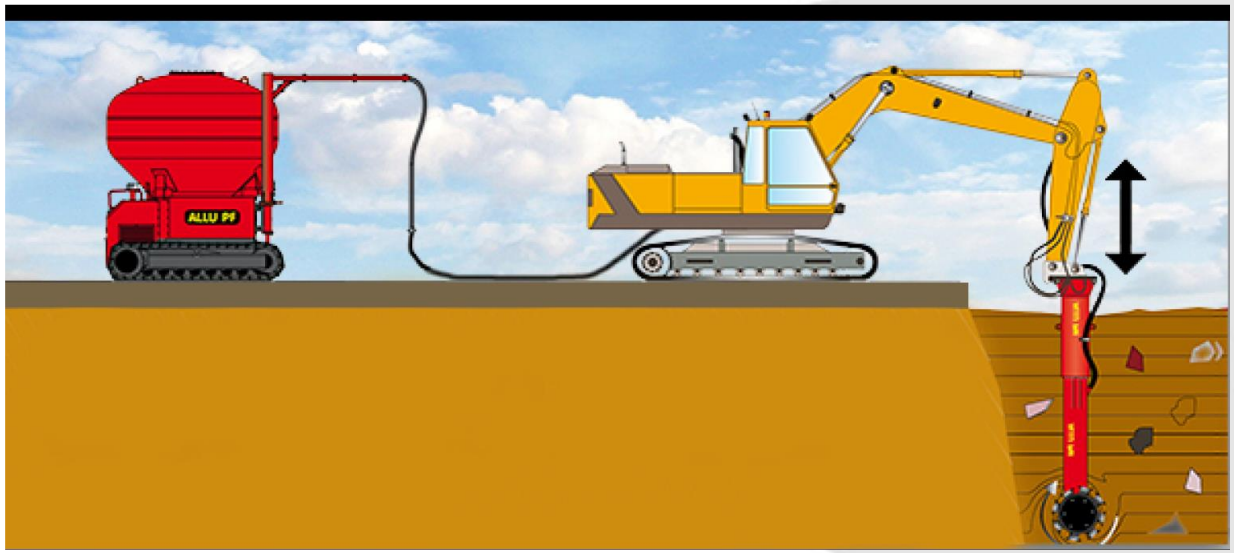
Auger Mixing



Road Reclaimer

Excavator-Based

Horizontal Axis Insitu Mixers

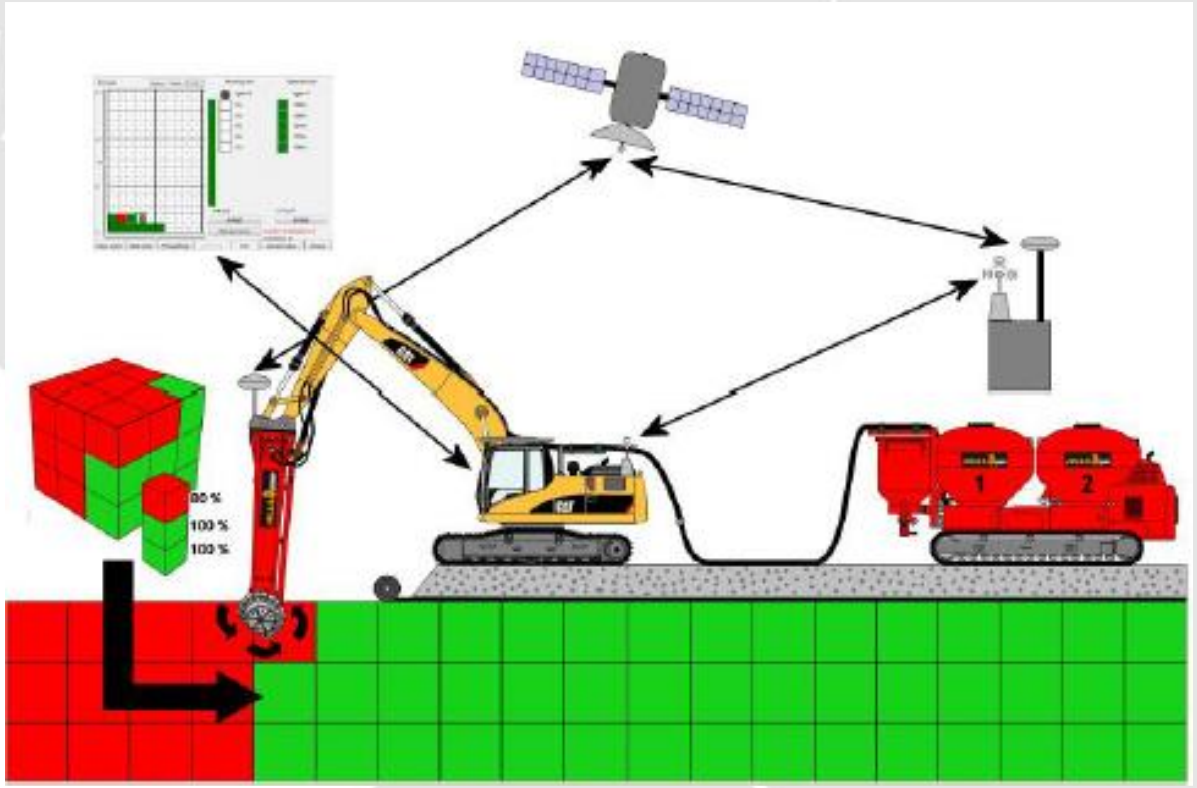


Efficient Use of Binders Matters

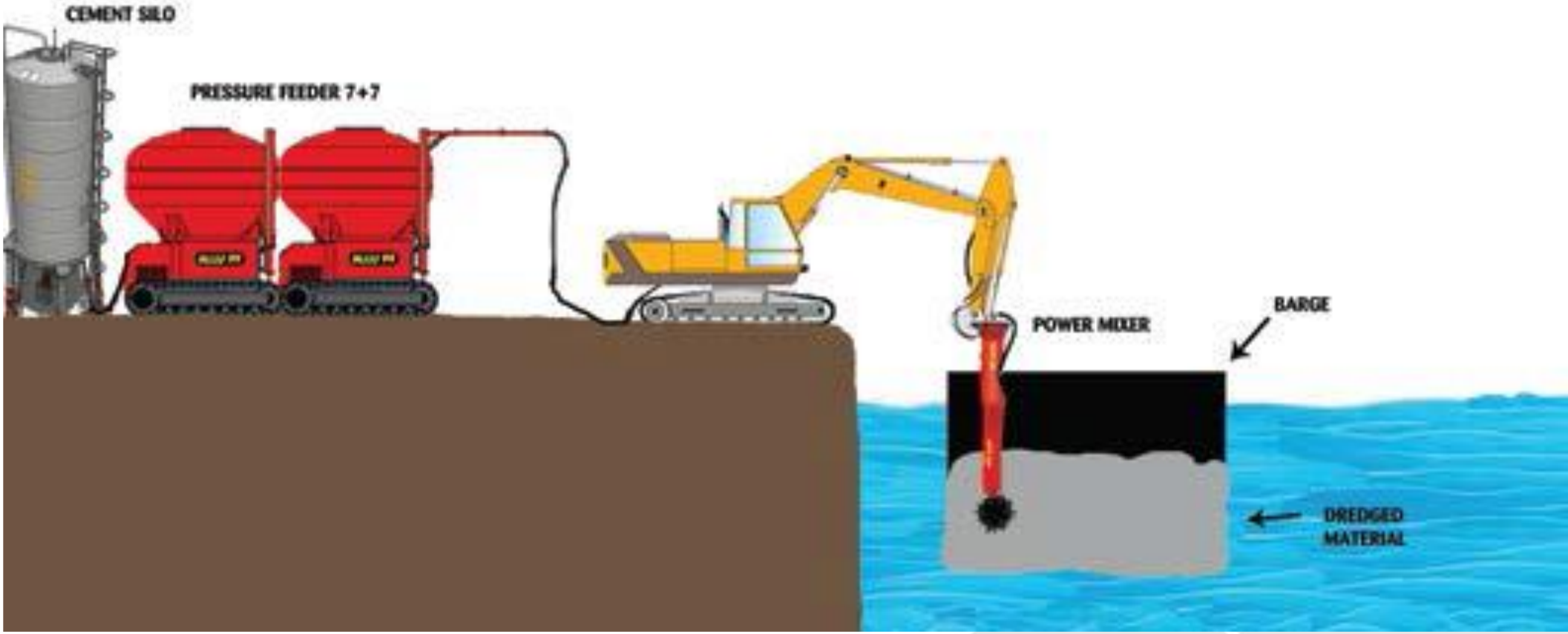
Most of the cost in a mass stabilization project comes from the binder, which represents about ***50-70 % of the total project cost.***

Efficiencies (Cost Savings) are **improved** by:

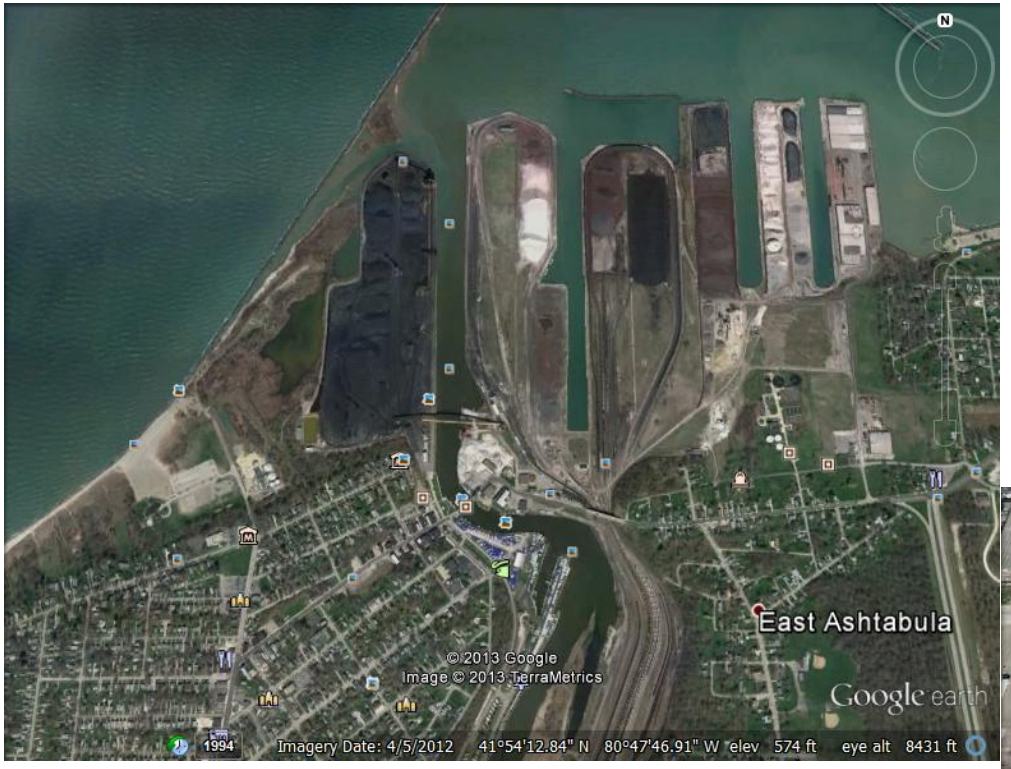
- Thorough mixing (mixing shear & energy) resulting in intimate contact of binder and subject material***.***
- Introduction of binder at mixing point.
- Locating and metering of binder to avoid under-dose and overdose.
- Use of dry binders in wet materials to conserve drying capacity of binders.



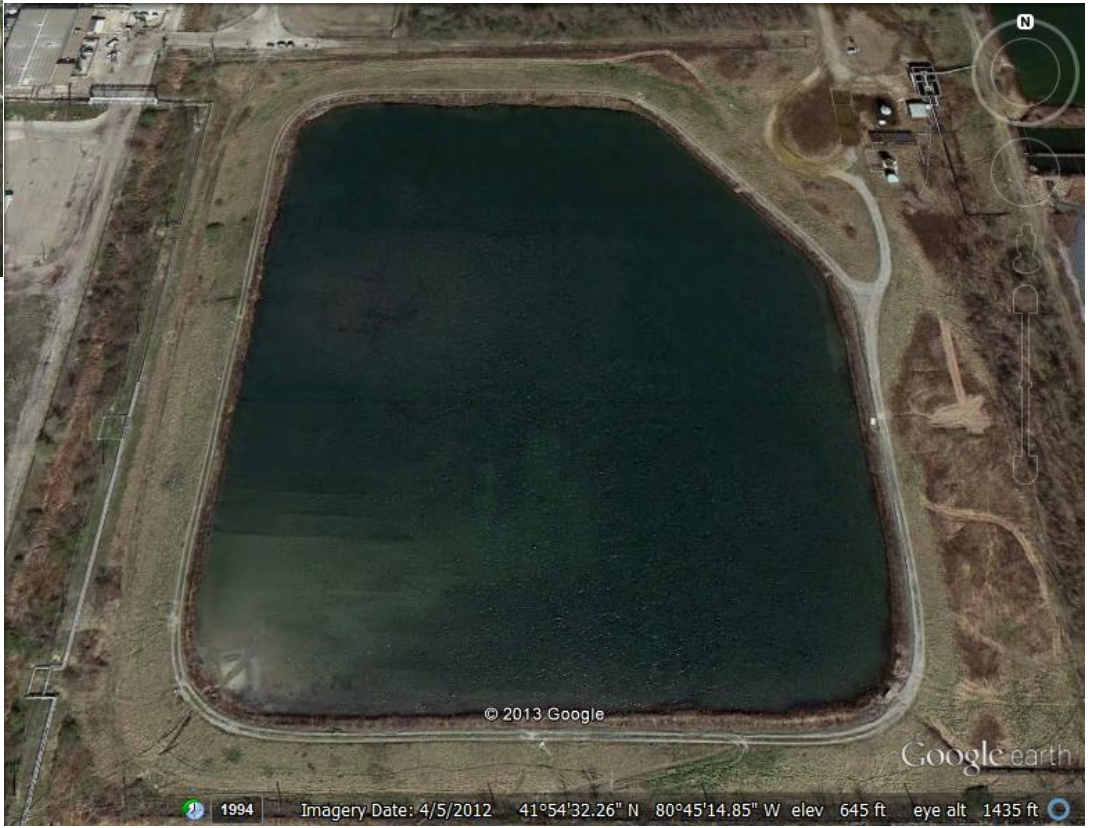
Dock side Treatment



Ashtabula Harbor, Ohio



Dredge and S/S treat 120,000 cy (92,000 m^3) of contaminated sediment.



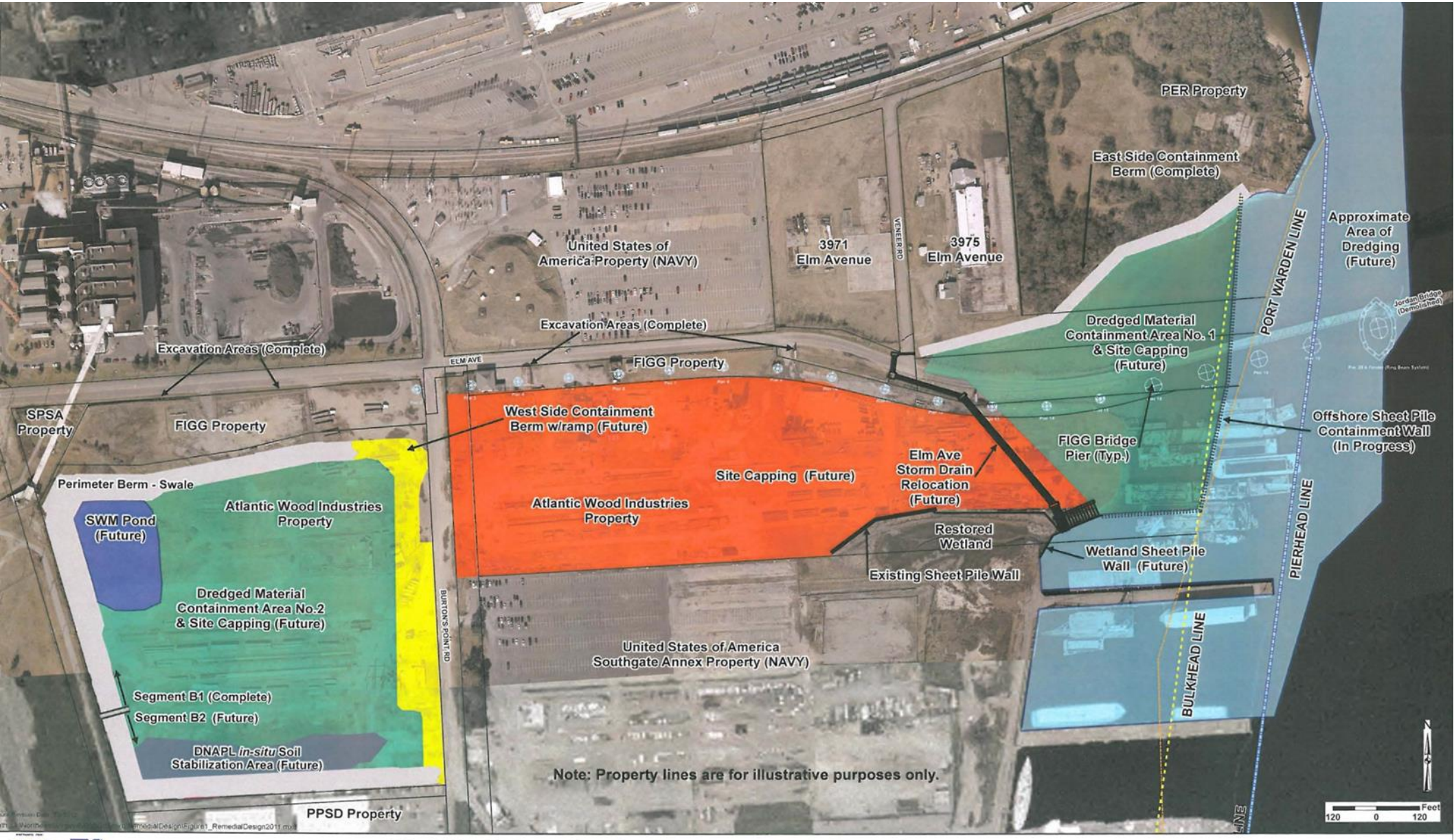
Placement of S/S treated dredge into Elkem 5C Pond, a 9-acre former settling pond. Additional material needed to facilitate closure of pond

Solidification of Elkem 5C Pond

Binder added dry 20% by weight. UCS goals range from 1,000 psf to 1,500 psf (0.05 to 0.07 MPa.
Unconsolidated shear strength goal of 1,250 psf (0.08 Mpa)
Mixing depths variable - 5 - 20 ft.

- Solidification of existing contents 153,000 m^3

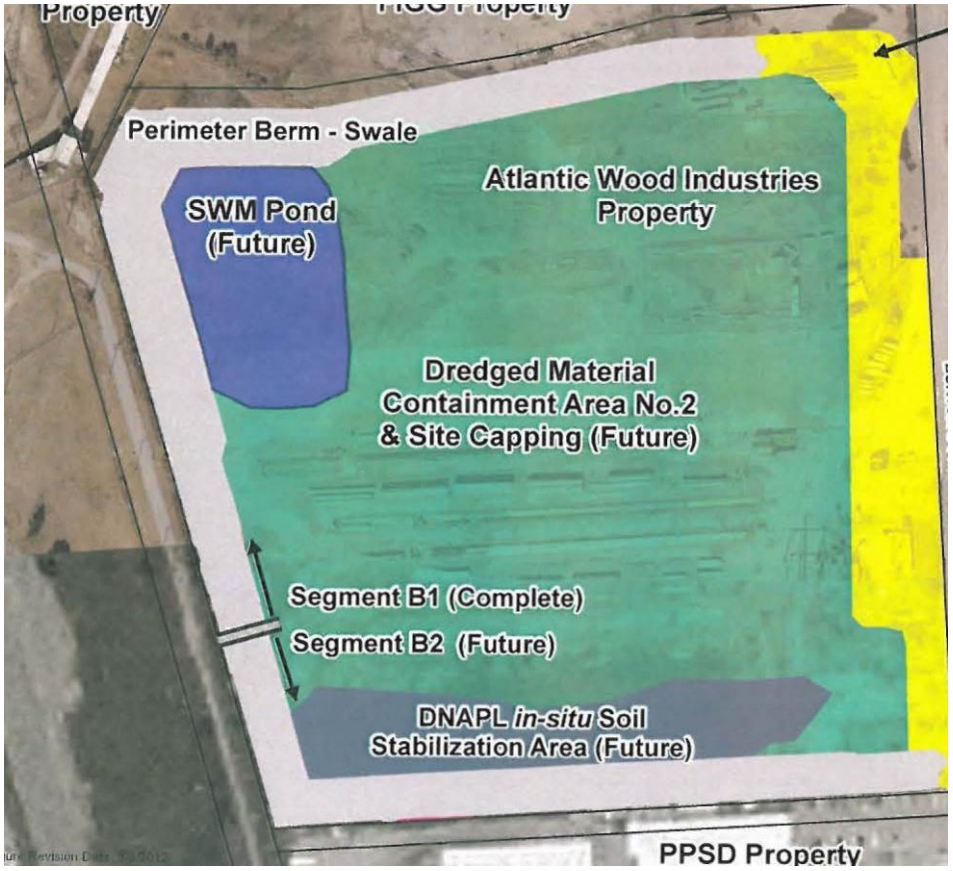
Atlantic Wood Industries



Atlantic Wood Industries Superfund Site - Remedy Elements (May 2012)
Portsmouth, Virginia

AWI Project

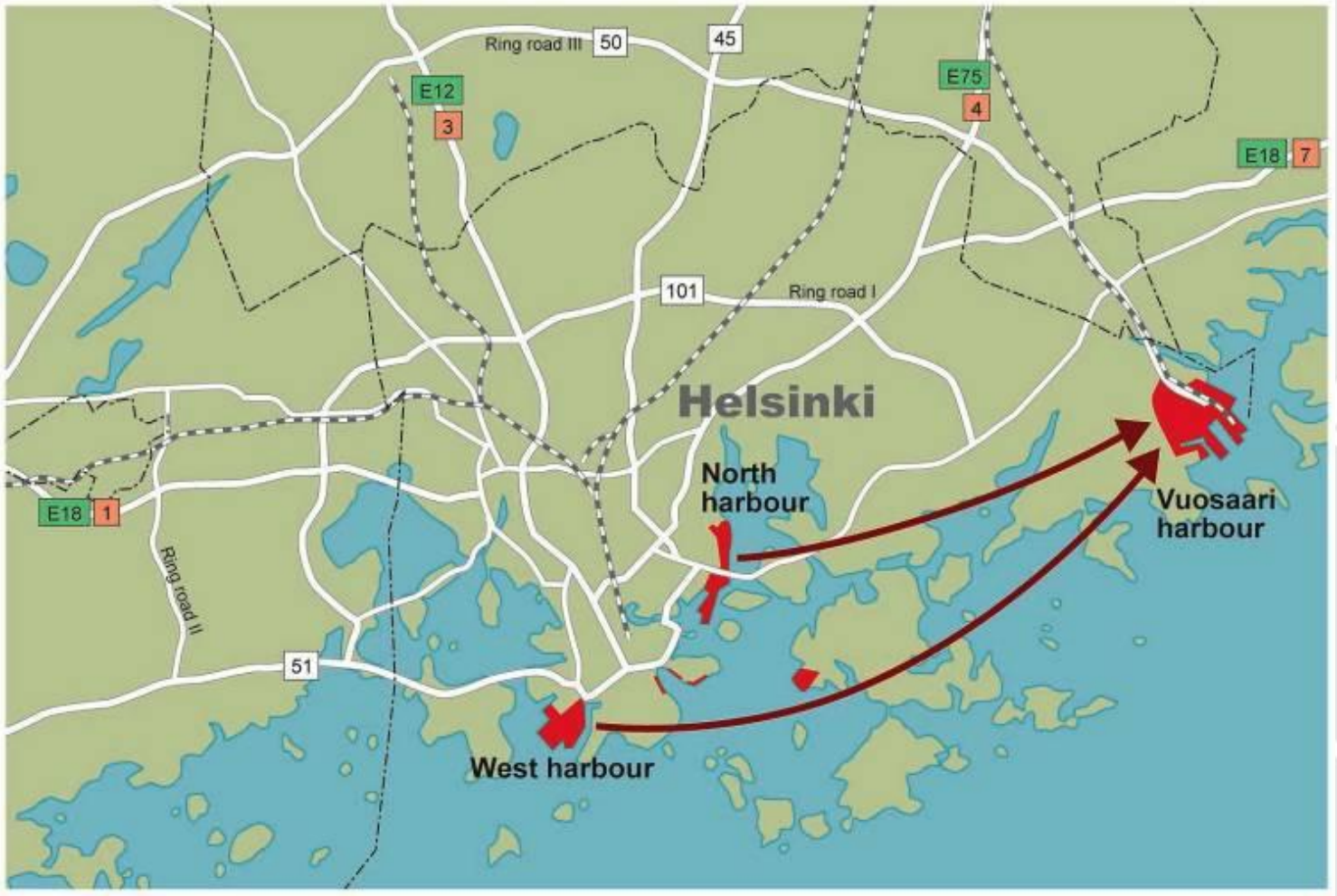
- Insitu S/S of 47,000 cu yd creosote- and pentachlorophenol-impacted soils
- Treatment depths ranging from 8 to 27 feet.
- Performance standard
  - ≥50 psi UCS
  - <4 X 10^{-6} cm/sec



Soft Marine Sludge Treatment in Harbour Construction

Vuosaari, Finland

All cargo operations have been moved to the new Vuosaari harbour from the city centre



Building the TBT safety wall, forming the TBT-lagoons and transporting mud to the lagoons.

MASS STABILISATION OF DREDGED SEDIMENTS

Stabilising the lagoons.

Vuosaari, Finland

- Mass stabilisation was used as a method for processing TBT-contaminated dredged mud to be a part of new harbour structures.

- Environmental:
  - TBT-contaminated dredged mud
- Site facts:
  - Area: 11 ha
  - Depth max. 6 m
  - Volume: 500.000 m^3

- Project for three ALLU stabilization systems

Valencia harbour, Spain

- Project to extend freight container storage area
- Project for two ALLU stabilisation systems

Valencia harbour, Spain

- Environmental:
  - Dredged mud
  - 1…1,5 m dry crust

- Site facts:
  - Area: 5 ha
  - Depth max. 5 m
  - Vol: 250.000 m^3

Coal harbour, Australia

- Dredged Marine Sludge :
  - 2 to 5 meters depth
- Site facts:
  - Storage area for coal
  - 140 kg/m^3 binder
  - Depth max. 5 m
  - Vol: 300.000 m^3
- Project for two ALLU stabilisation systems

MASS STABILISATION OF DREDGED SEDIMENTS

Kokkola harbour, Finland

- Dredged contaminated silt
- Total 12.500 m³
- Binder 30 kg cement + 100 kg fly ash/m³

MASS STABILISATION OF DREDGED SEDIMENTS

Harbour construction, Brasil

- Marine Sludge
- Max. depth 6-18m
- Mass stabilisation depth 3-6 m
- Binder cement 120kg/m³
- Area 50x120m

MASS STABILISATION OF DREDGED SEDIMENTS

Solidifying dredged mud, Italy

MASS STABILISATION OF DREDGED SEDIMENTS

Processing dredged mud in a basin, Italy

Soil stabilization needed to support planned infrastructure of LNG facility expansion in Louisiana

Soil subject to treatment. Soil has no bearing capacity. Wooden mat “roads” needed to move heavy equipment around on site

Example of cleared and grubbed area in foreground prior to stabilization treatment.

Closer view of cleared & grubbed soil before stabilization treatment.

Plumbing and mounting of ALLU PMX-300 Power Mixer onto

Cat 349 Excavator at local equipment yard

ALLU PMX Power Mixer and PF-7 Pressure Feeder at project site

Staking out the test plot. Note:

- Proximity to active waterway,
- Puddles caused by recent rain on “tight” clay/silty soil, and
- Cracking of clay/silt due to wetting & drying.

Testing consistency of soil subject to treatment. PMX operated without binder. Note high clay & silt content”

Testing consistency of soil subject to treatment. PMX operated without binder. Note high clay & silt content evidenced by soil “smear

Two binder addition methods tested:

- Spreader
- Pressure Feed

Test plot using “spreader” method of binder addition

PMX mixing of “spread” binder.

Test plot binder addition by ALLU PF-7 Pressure Feeder

Completed PMX-mixed area prior to compaction.

Test area after binder addition, PMX mixing, and compaction. Flagged for sampling and testing.

Contact

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