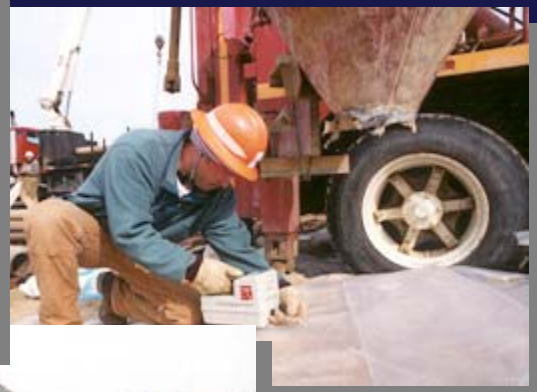
Comparison of Innovative Technologies for Soil Cleanup at Camp Edwards Massachusetts Military Reservation

Tri-Service Symposium

June 19, 2001



Presented by:

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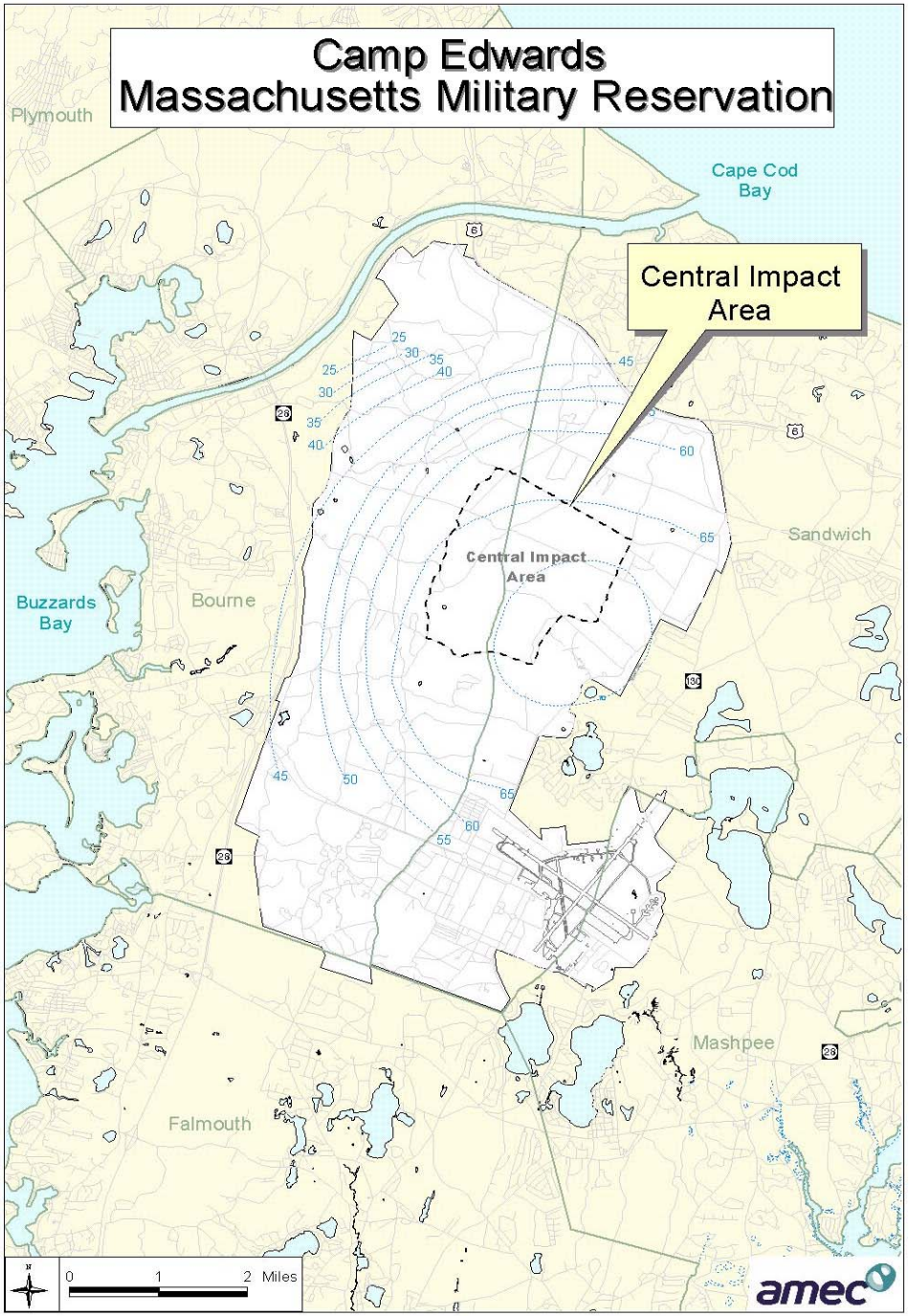
Massachusetts Military Reservation (MMR)

- Located on Cape Cod
- Central Impact Area, training ranges used for target practice, range training
- Covers 15,000 acres
- Surface soils
  - Glacial end moraine
  - Fine sand - boulders, little clay
  - pH 5.5 to 6.0
  - Thin layer of organics



Explosives Residues in Soils at MMR

- Explosives deposition attributes
  - Particulates
  - Low concentrations
  - Variability in duplicate soil samples
- Soil Cleanup Goals are low to support drinking water requirements

Innovative Technology Evaluation (ITE) Who's on the ITE Team ?

- Army National Guard (ARNG)
- AMEC Earth and Environmental
- Army Environmental Center
- Army Corps of Engineers - New England District

What is the ITE Doing ?

- Select innovative soil and groundwater remediation technologies to address explosives contamination at MMR
- Laboratory bench scale studies
- Field scale demonstrations

Why is ITE Being Done ?

- Support responses to EPA Administrative Orders to protect groundwater at MMR
- Future applications at other DoD/ARNG training installations

How Were Technologies Selected ?

- Selection criteria include
  - Media treated - soils
  - Experience with explosives
  - Clean-up levels achieved
  - Time frame to complete clean up
- Vendors chosen based on competitive bid proposals

Technologies Selected for ITE Studies

- Physical Processes
  - Soil Washing
  - Low Temperature Thermal Destruction
- Biological Processes
  - Composting
  - Solid Phase Bioremediation
  - Bioslurry
- Chemical Processes
  - Chemical Oxidation
  - Chemical Reduction

Physical Process - Soil Washing Brice, Inc.

- Isolates metal particulates and soil containing most of the contaminants
- Demonstrated at MMR, reducing soils requiring further remediation by 74%
- Washed soils included in ITE studies

Soil Washing at MMR

Photo courtesy of Brice, Inc.

Physical Process - Low Temperature Thermal Destruction - TerraTherm

- Thermally degrades contaminants by slow heating
- TerraTherm heated soil to 200°, 250°, and 300°C
- Washed and untreated soil

Thermal Destruction in the field

Photo courtesy of TerraTherm, Inc.

Biological Process - Composting BSI

- Uses local nutrients (manure, cranberry mash) and bulking agents (wood chips)
- 70% additives mixed with 30% soil
- Washed and untreated soils

Composting in the field

Photo courtesy of BSI, Inc.

Biological Process - Solid Phase Bioremediation - Grace Canada

- Uses DARAMEND® made from plant fibers
- 2% DARAMEND® added to soil
- 0.2% iron added to control redox potential
- Washed, untreated soils

Solid Phase Bioremediation in the field

Photo courtesy of Grace Canada, Inc.

Biological Process - Bioslurry Envirogen

- Adds a nutrient to a slurry (>70% water)
- 0.3% molasses added to soil
- Study is not complete

Molasses added to bioslurry

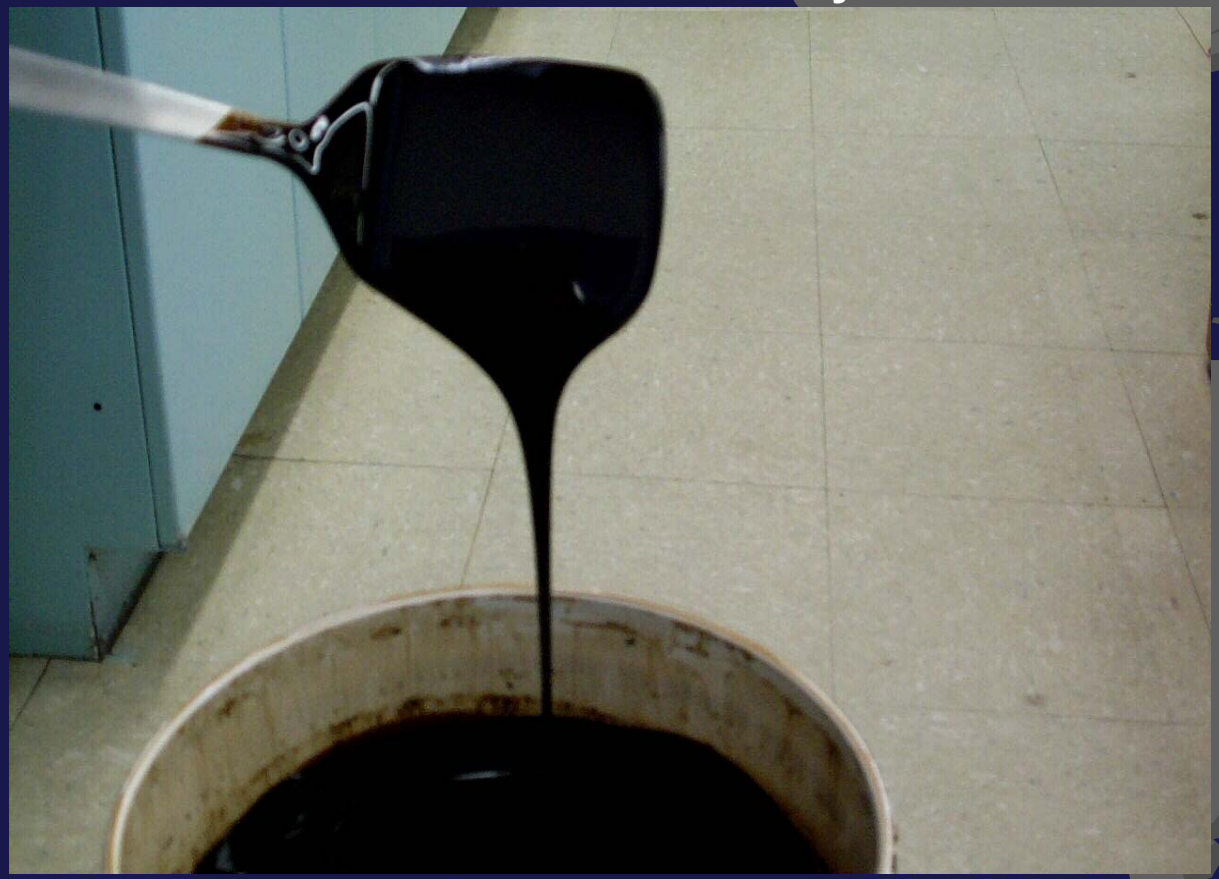


Photo courtesy of Envirogen, Inc.

Chemical Process - Oxidation Brice/UNL

- Destroys contaminants with oxidizing agents
- 1% - 4% hydrogen peroxide and 80 - 320 mg iron sulfate added to soil
- Washed soil only

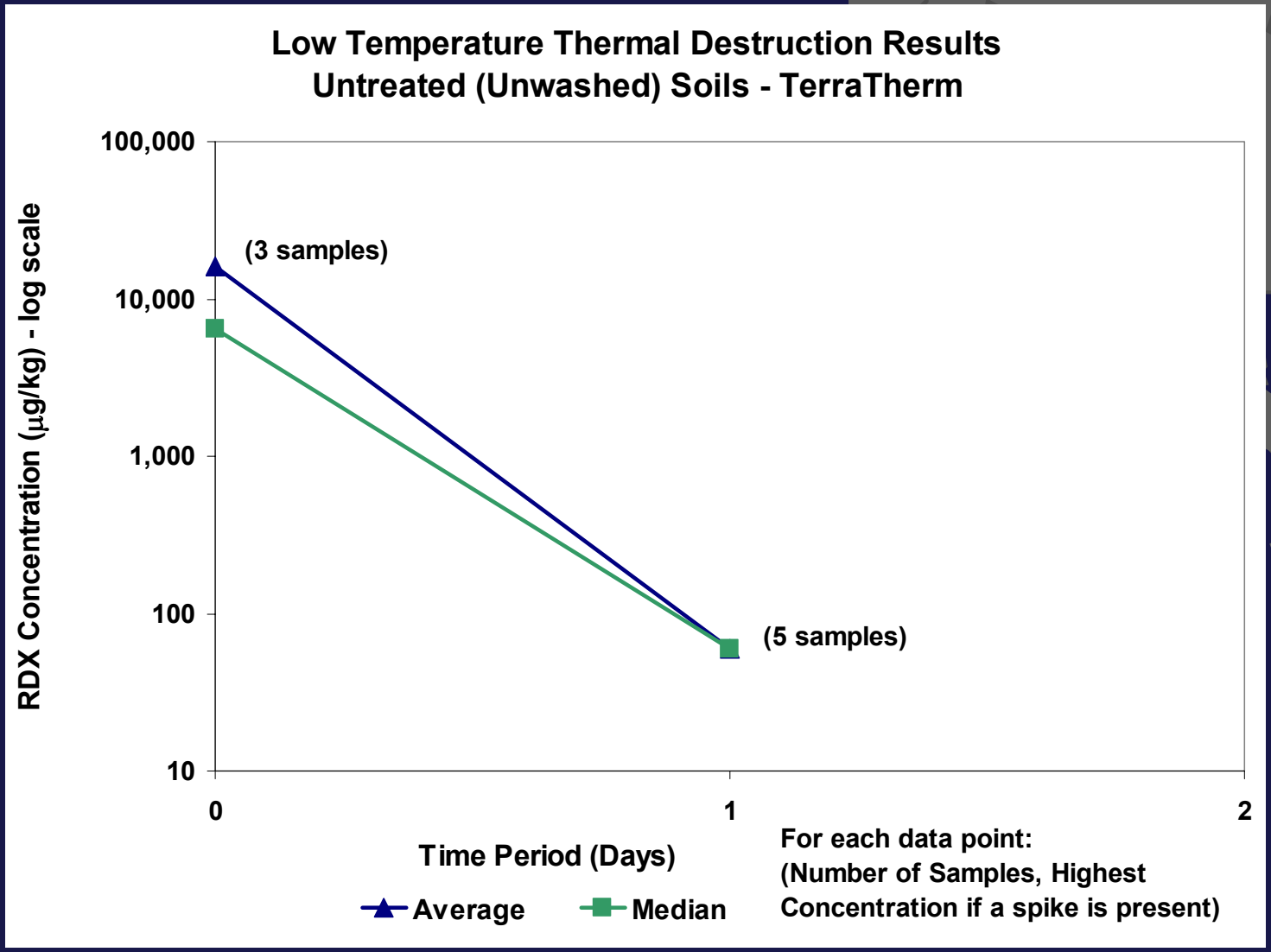
Chemical Process - Reduction Brice/UNL

- Destroys contaminants with reducing agents
- 5% iron, acetic acid, aluminum sulfate added to wet soil
- Washed soils only

Chemical Reduction in the Field

Photo courtesy of Brice, Inc. and University of Nebraska, Lincoln

ITE Study Results



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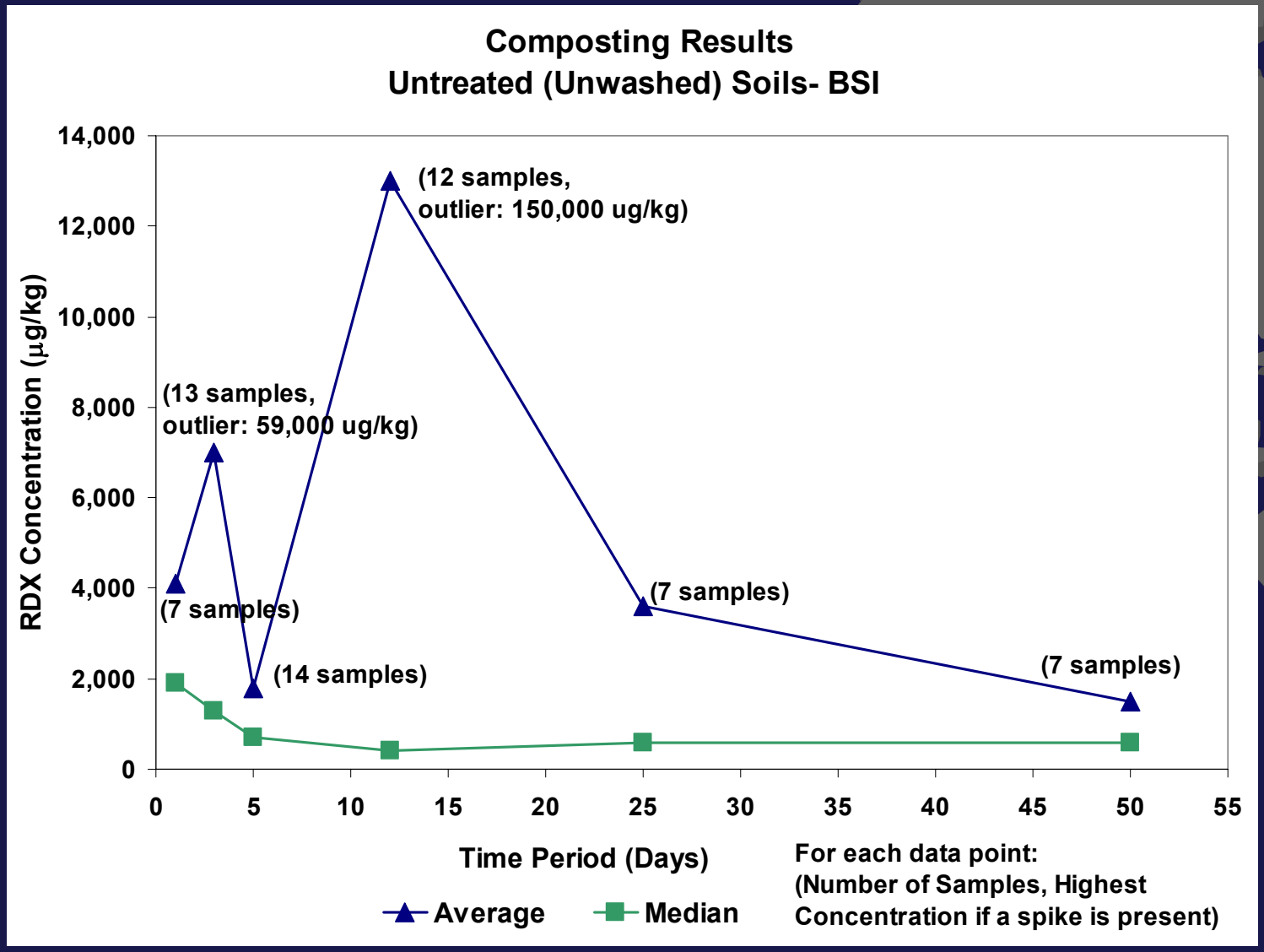

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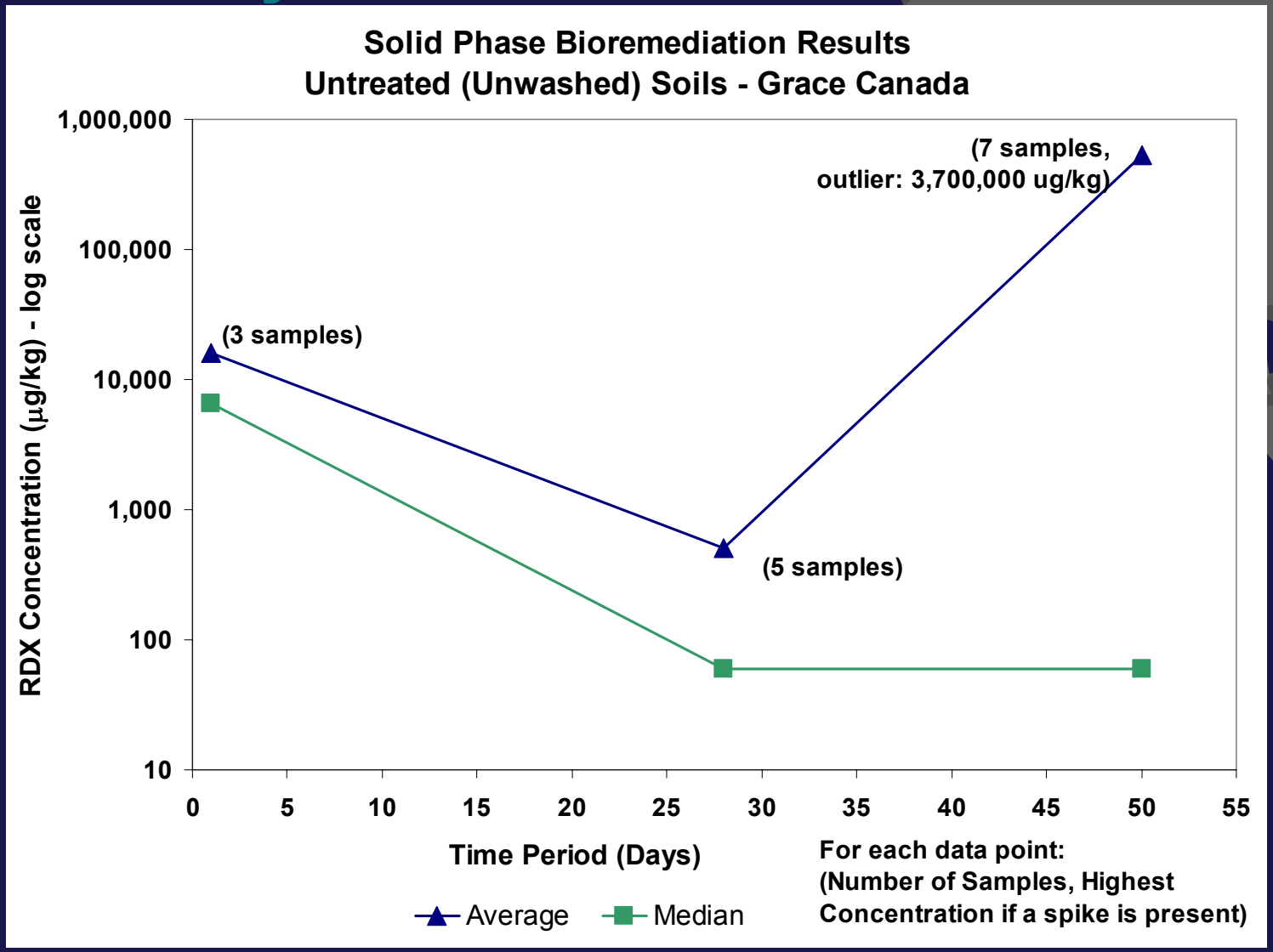

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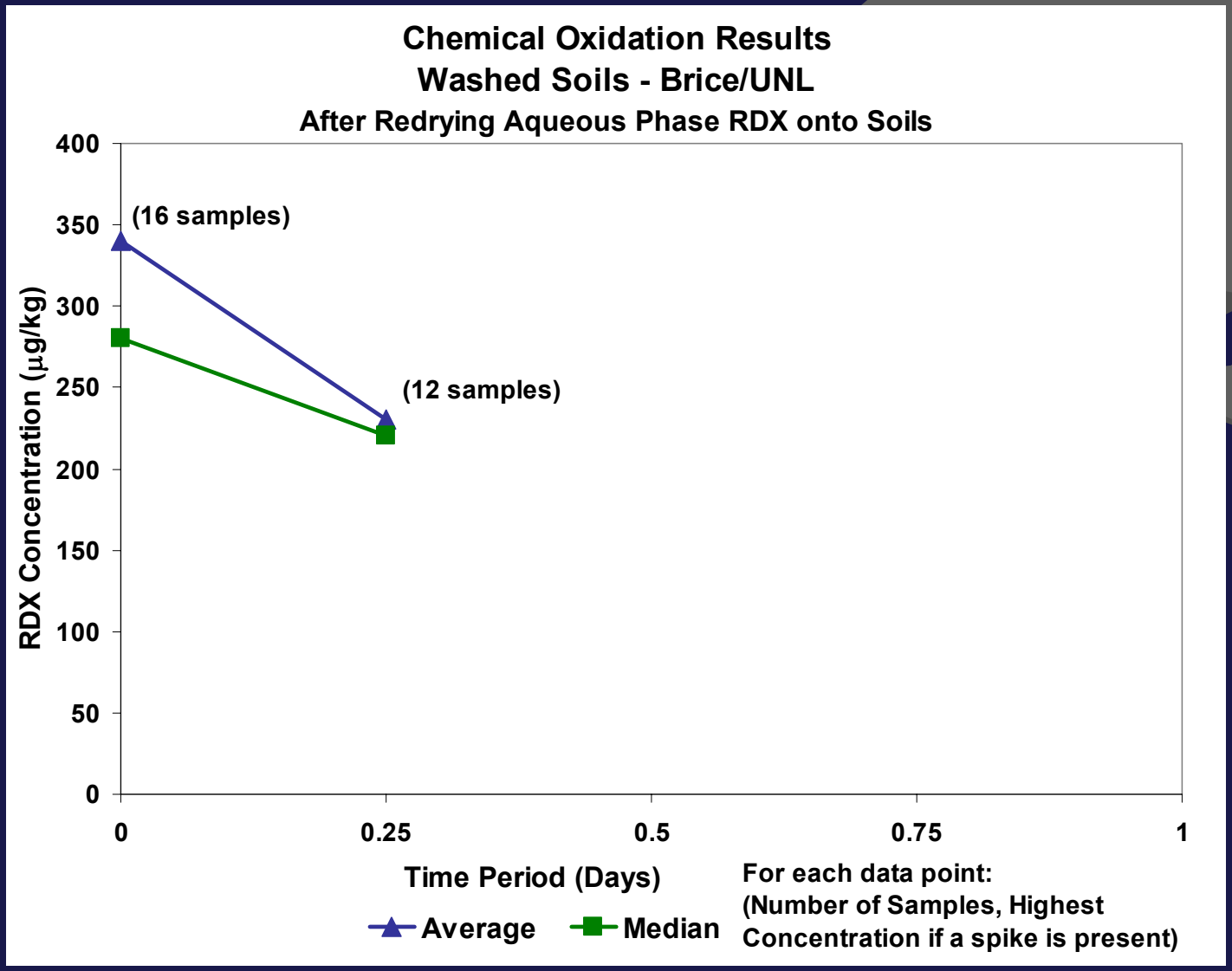
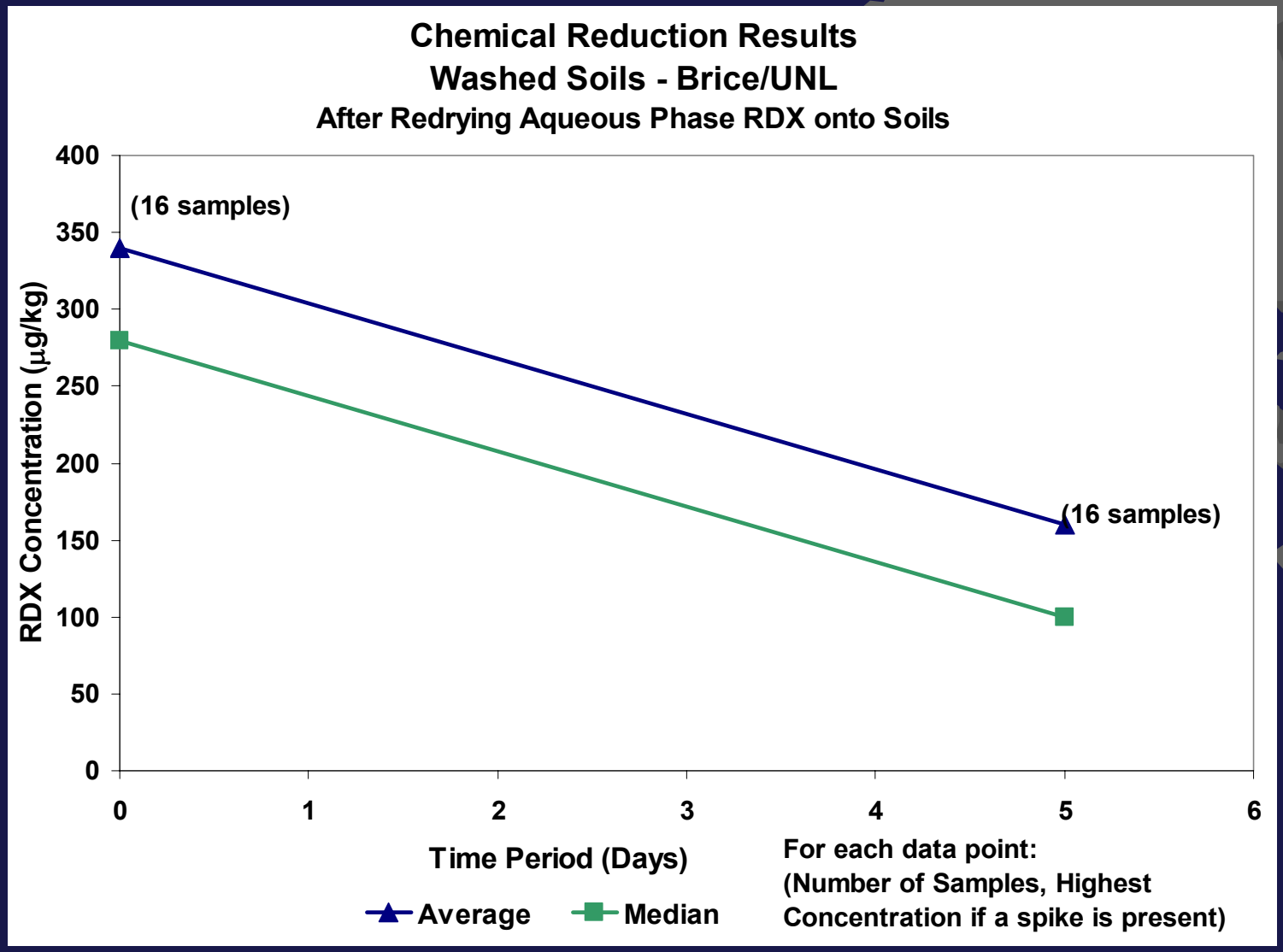


ITE Study Results



ITE Study Results - DRAFT

Low Temperature Thermal Destruction

- For - Worked on washed soils, remediates unwashed soils at higher temperatures (250° and 300°C)
- Against - Not clear whether proven or disproven for HMX at 200°C
- Safety issues need to be addressed - historic DoD rejection of thermal technologies

ITE Study Results - DRAFT

Composting, Solid Phase Bioremediation

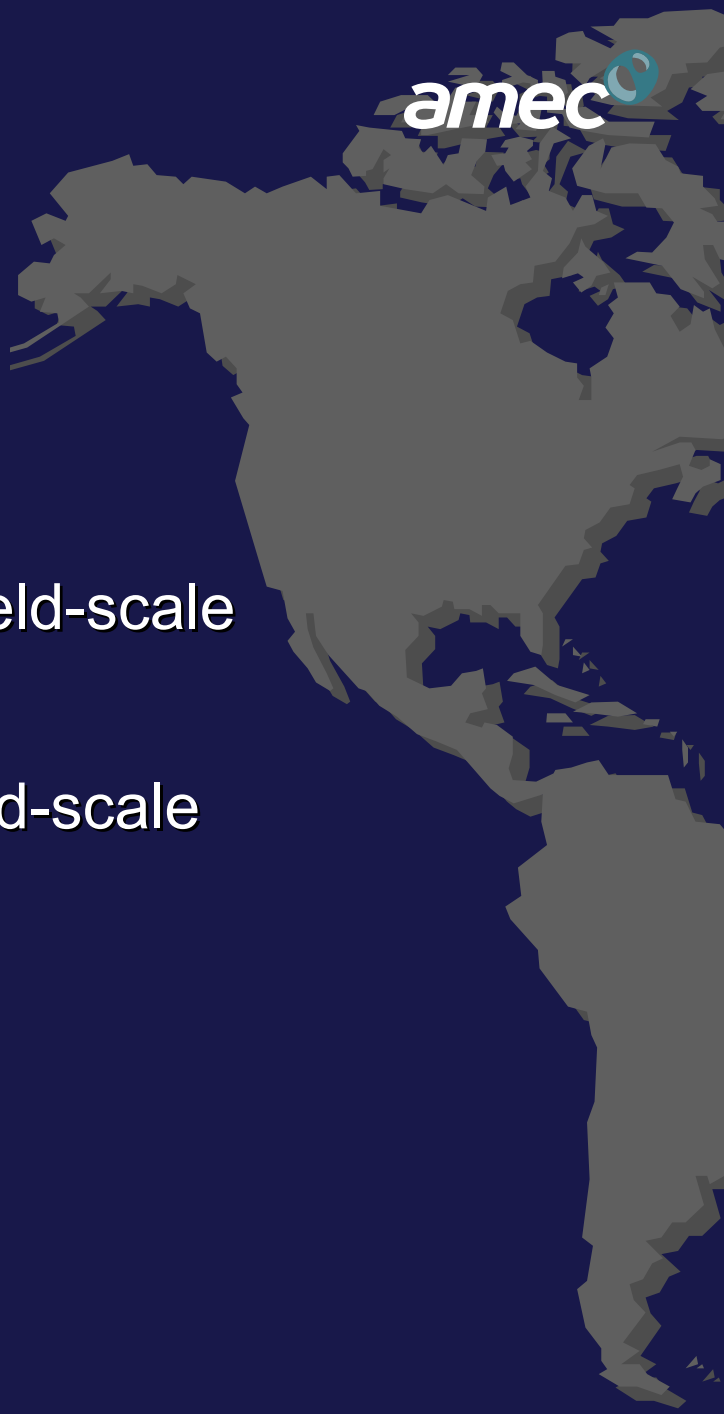
- For - Worked on washed soils - Composting has historically worked well at many munitions manufacturing and assembly sites
- Against - Difficult to prove success in unwashed soils, due to outliers

ITE Study Results - DRAFT

Chemical Reduction and Oxidation

- For - Reduction worked well on washed soils
- Against - Question of re-drying dissolved RDX onto soils for the study
- Oxidation not successful in washed soils

ITE Study - Next Steps



- Finalize conclusions
- Review conceptual designs for field-scale demonstration
- Recommend technologies for field-scale demonstrations