

# **Bioremediation Using Soil Amendments**

**DARAMEND™**

**Atlantic Division  
Naval Facilities Engineering Command**

**W. R. GRACE & Co.**

# Bioremediation Using Soil Amendments

- *Technology*
- Site Information
- Contracting Approach
- Technology Application
- Revelations

# Technology Information

## ■ Bioremediation

- The use of microorganisms (microbes, bacteria, bugs) to breakdown toxic compounds into non-toxic end products
- The microorganisms use the contaminant as a food source

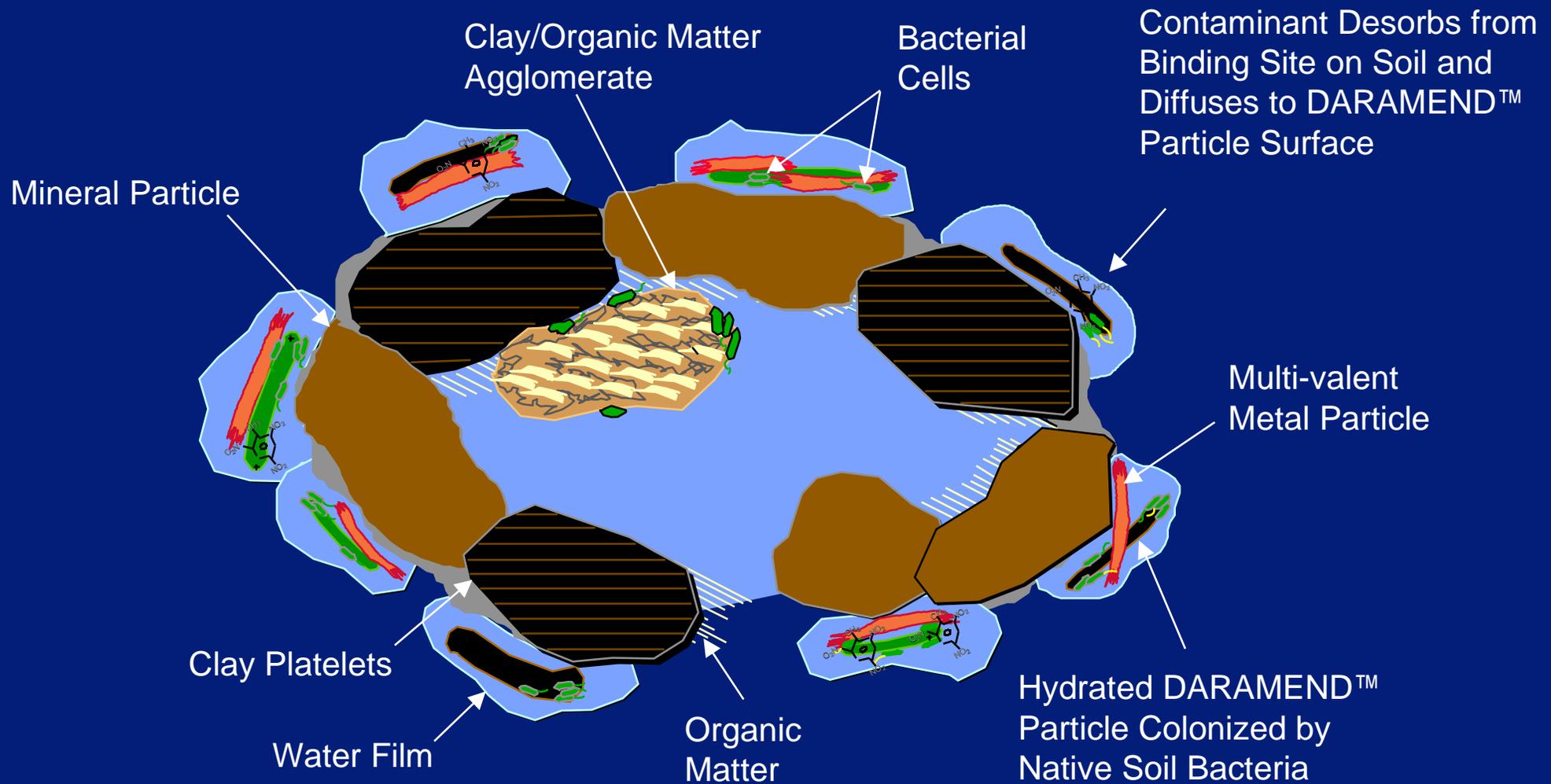
## ■ Bioremediation using soil amendments

- Remediate contaminated soil utilizing non-hazardous soil amendments to enhance the activity of indigenous microorganisms
- Degrades persistent organic compounds
- Utilizes aerobic and anerobic conditions to optimize treatment times

# DARAMEND™

- **Bioremediation process**
- **Soil amendment**
  - Solid-phase organic amendment
  - Applicable in situ and ex situ
- **Treats soils contaminated with:**
  - Polynuclear aromatic hydrocarbons (PAHs)
  - Chlorinated phenols (CPs) including pentachlorophenol (PCP)
  - Organic explosives (TNT, RDX, HMX)
  - Chlorinated solvents (TCE, PCE)

# DARAMEND™ Bioremediation



# DARAMEND™ Organic Amendment Particle in Contact with Soil During Treatment



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# Yorktown Naval Weapons Station Site 6



**Site  
Information**

# Yorktown Naval Weapons Station

## Site 6

### Site History

- Explosives washout/reclaiming operation since 1941
- Wastewater discharged to tidal saltwater marsh
- TNT, RDX, HMX
- Volatile organic compounds
  - TCE



Site 6 facing north



# Contaminants

Initial concentrations of organic explosive compounds in soil from Yorktown Naval Weapons Station Site 6.

<u>Compound</u>	<u>Concentration (mg/kg)</u>					
<u>Replicate No.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>mean</u>
1,3,5-trinitrobenzene	4.84	BDL	6.40	13	BDL	4.85
2,4,6-trinitrotoluene	18.9	62.7	50.3	1,320	25.7	295
2-amino-2,6-dinitrotoluene	61.4	33.1	59.2	95.6	55.0	60.9
HMX	98.5	74.7	67.8	84.7	67.4	78.6
RDX	195	319	147	198	120	196
total organic explosives	379	490	331	1,711	268	636

# Bioremediation Treatment Goals

## ■ Industrial and Commercial Land Use

### – Organic Explosives

- RDX 5 mg/kg
- TNT 15 mg/kg
- HMX

### – Total VOCs

- 700 mg/kg

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# Contracting Approach

## ■ Fixed price contract

- Phase 1: Treatability Investigation
  - 20 weeks
  - \$28K
  - GRACE / Navy 50% = \$14K
  
- Phase 2: Field-scale Implementation
  - 1,000 tons of soil
  - Soil treatment in EBC = 12 weeks
  - \$316K
  - 50% = \$158K

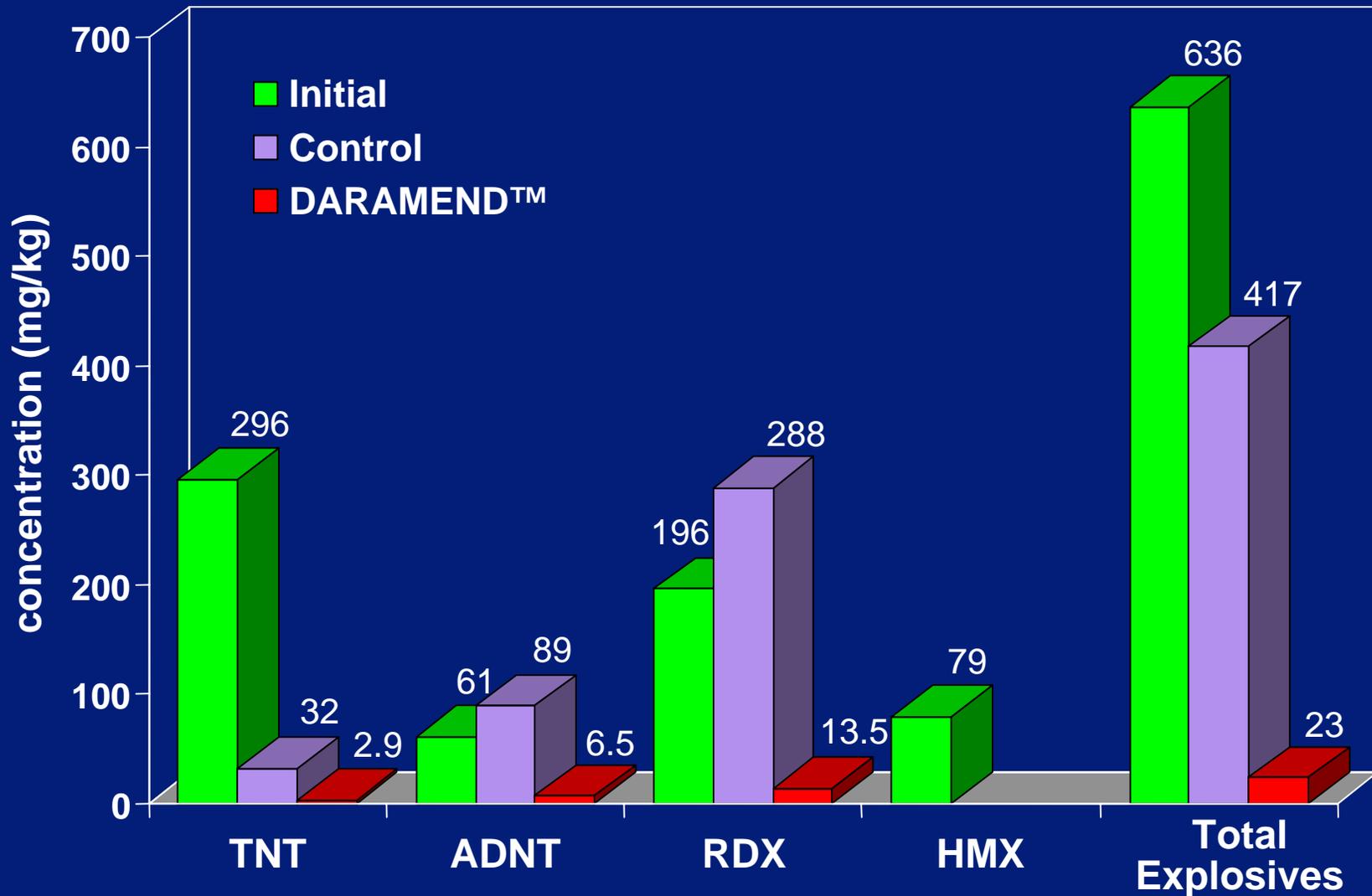
# Bioremediation Using Soil Amendments

- Technology
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- Contracting Approach
- ***Technology Application***
- Revelations

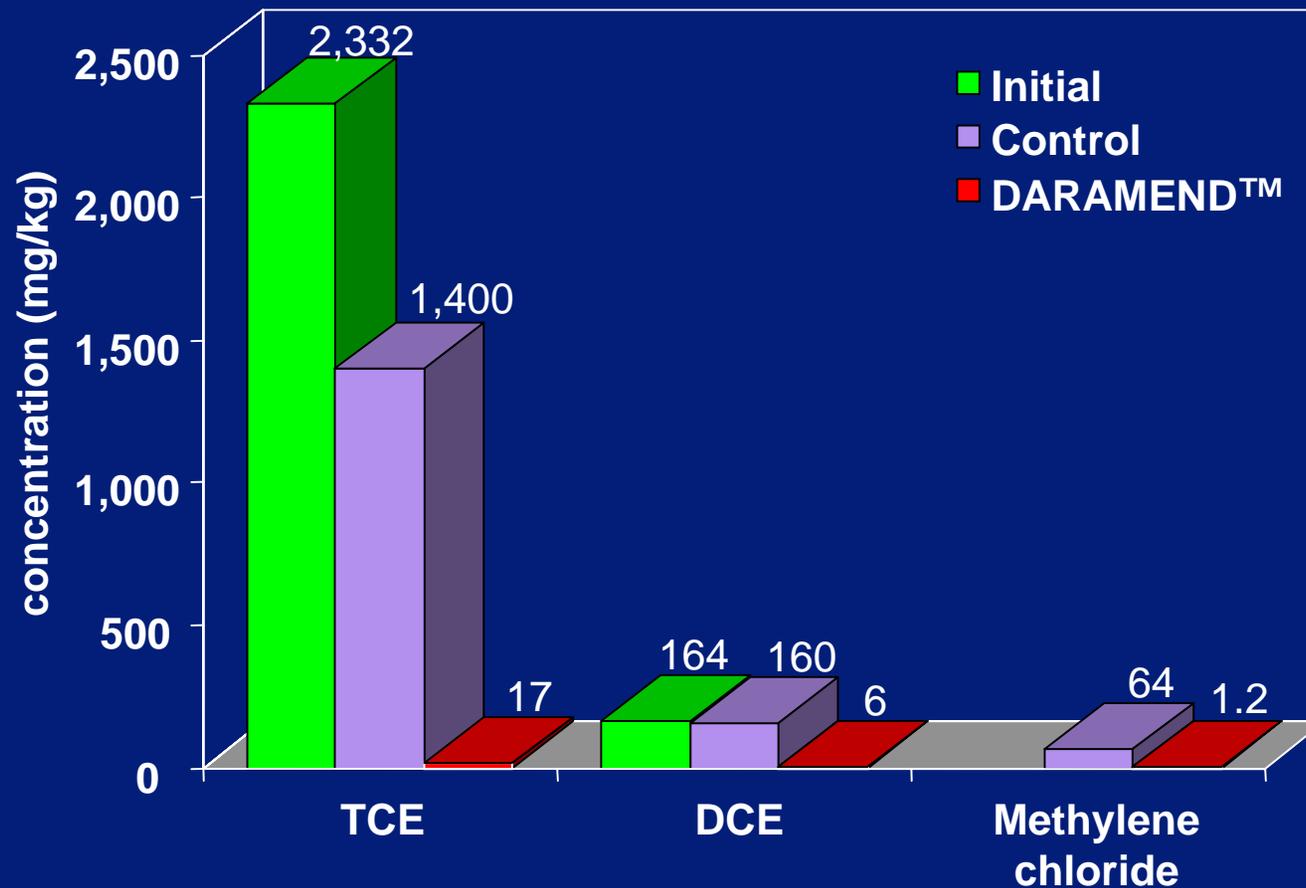
# **Technology Application**

## **Treatability Investigation Results**

# Influence of DARAMEND™ Technology on Concentrations of Organic Explosives in Soil Following 41 Days of Treatment (Yorktown NWS)



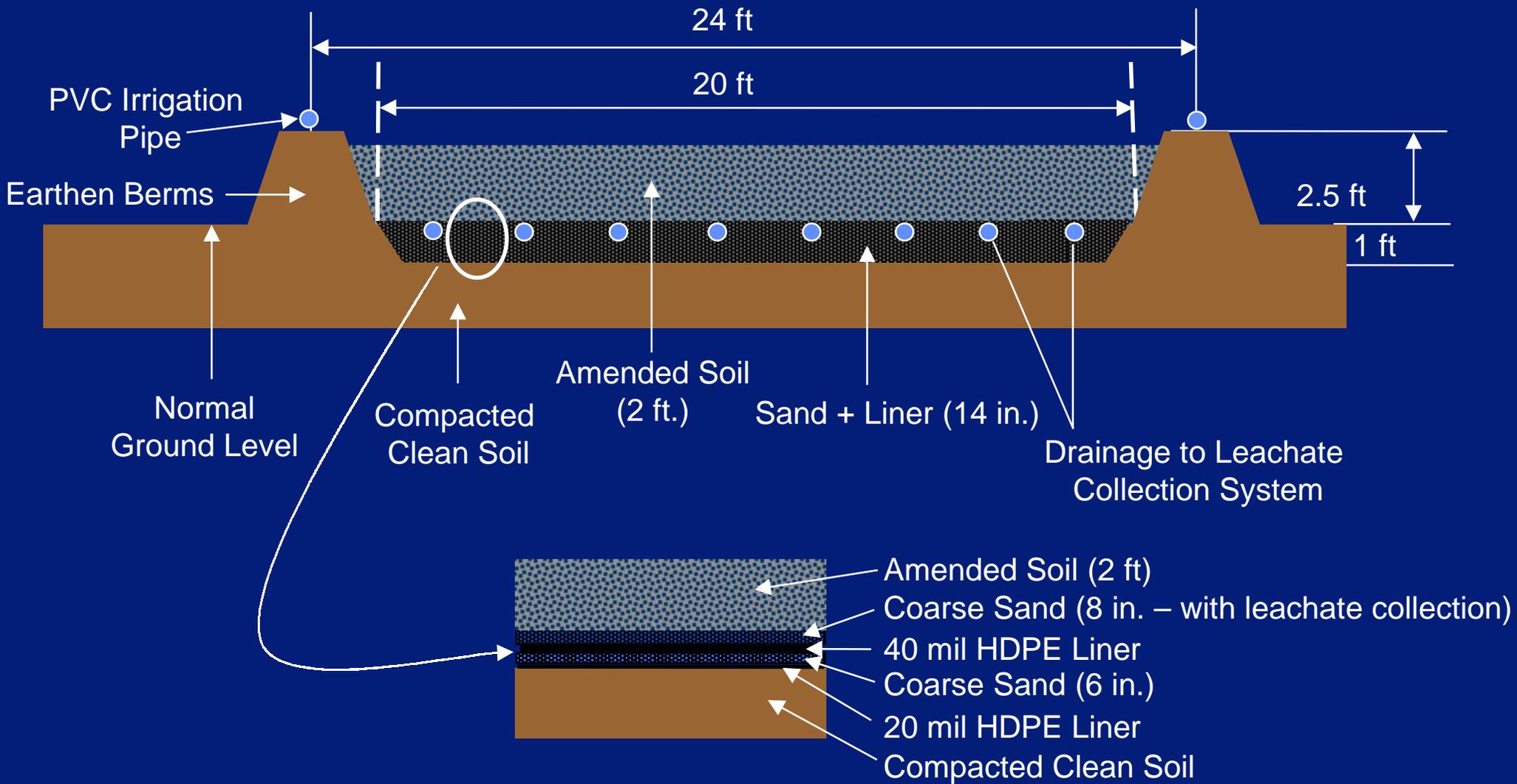
## Influence of DARAMEND™ Technology on Concentrations of Chlorinated Solvents in Soil Following 41 Days of Treatment (Yorktown NWS)



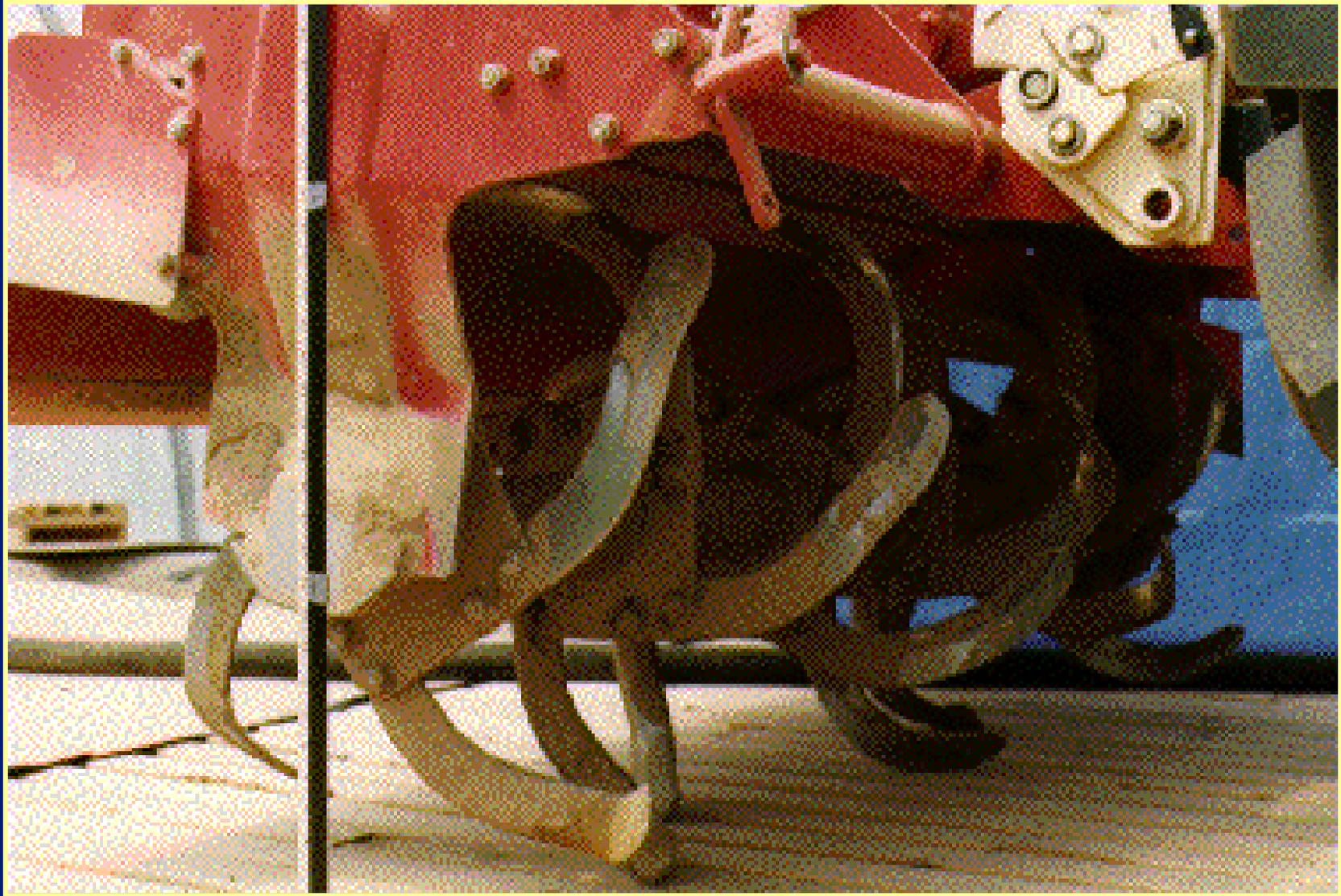
# *Engineered Biotreatment Cell*

## *Design Considerations*









# Bioremediation Using Soil Amendments

- Technology
- Site Information
- Contracting Approach
- Technology Application
- *Revelations*

# Revelations

## ■ Advantages

- Cost-effective
- Provides final solution
- Public acceptance

## ■ Disadvantages

- Inhibitors to the DARAMEND™ process
  - Soil debris
  - Acidic soils (pH >2)
  - Elevated heavy metal concentrations in soil

# Revelations

- **Regulatory Issues**

- Partnerships

- **Lessons Learned**

- Benefits
- Partnerships

# Yorktown Partnership

- YORKTOWN NWS
- LANTDIV
- NFESC
- VADEQ
- USEPA
- GRACE
- CANADIAN DEPT. OF NATIONAL DEFENSE

United States  
Environmental Protection  
Agency

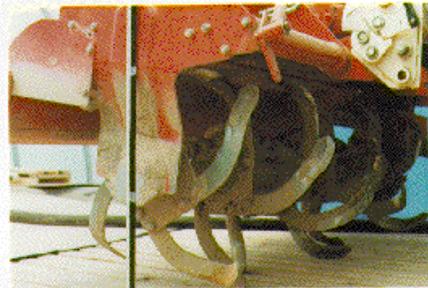
Office of Research and  
Development  
Washington DC 20460

EPA/540/R-95/538  
July 1996



# GRACE Bioremediation Technologies Daramend™ Bioremediation Technology

## Innovative Technology Evaluation Report



**SITE**  
SUPERFUND INNOVATIVE  
TECHNOLOGY EVALUATION

# Lessons Learned

- **Treatability Investigation**
- **Contract in phased approach to ensure success**
- **How you can apply this technology**
  - EPA Innovative Technology Evaluation Report
    - Wood Preserving Facility
      - PAHs, CPs, PCP
  - Demonstrated In Situ at a US Army site

# Points of Contact

## ■ Remedial Project Manager

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## ■ Contracting Officer's Technical Representative

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