NY/NJ Harbor Sediment Decontamination Program

E.A. Stern
U.S. Environmental Protection Agency
Region 2
New York, New York

Healthy Communities, Clean River Workshop
June 3, 2006
Portland, Oregon
Eric A. Stern

- Regional Contaminated Sediment Program Manager
- U.S. Environmental Protection Agency
  - Region 2
  - 290 Broadway
  - New York, New York USA 10007
  - Stern.eric@epa.gov
  - Tel. 212.637.3806
Sediments are Complicated as a Media

- Pathways
- Assessment
  - Testing (Biological/Chemical)
  - Risk Assessment
- Sediment Flux Modeling
- Sediment Management
- Public Perception / Political
- Agency Cross-Program
  - Dredged Material / Contaminated Sediments
  - Remediation – Superfund, Urban Rivers
- Beneficial Use
Integrated Approach
Contaminated Sediment Management
Remediation/Restoration

**Multi complex contaminants**
(TCDD, PAHs, Pb, Hg, Cr)

- Materials Handling
  - dewatering, pumping, drying
- Environmental Precision Dredging +
- Capping + Reactive CAPS
- Stabilization/Solidification + (ox)
- In-Situ Stabilization
• CDFs/CAD Management
  – Storage, immobilization

➢ Innovative Sediment Decontamination Technologies
  ➢ Thermal/non-thermals
  ➢ Treatment Train/Systems Approach

• In-Situ Bioremediation
  – Mudflats

• Monitored Natural Attenuation
  – CADs / hot spots – is it bioavailable?
  – Leave in place?
• Develop Long-term Self Sustaining Enterprises in the Environmental Management/Manufacturing of Beneficial Use Products from Contaminated Sediments
  – It’s a business....... 

– Sediments are a Resource
– Beneficial Use Applications
Dredging in NY/NJ Harbor

- Naturally 6m deep. Authorized to 15m MLW in many areas.
- Dredge approximately 3-5 million m³ per year. 385 km of channels.
- Historically most dredged material ocean disposed. This changed as more current science was considered and new testing was implemented.
- Dredged material mostly fine-grained containing PCB, DDT, PAHs, and dioxins.
Dredging & Placement Costs

Environmental Regulation
- 1991 Green Book Update
- 1993 Regional Implementation Plan
- 1996 Magnusen Stevens Act
- 1997 Mud Dump site closed

- 1998 More stringent permit requirements imposed
- 1999 NMFS institutes EFH and Fish Windows
- 2001 Air conformity concerns
New York/New Jersey Sediment Decontamination Technologies Demonstration Program

- Program initiated in 1992 under the Water Resources Development Act
- Partners: US EPA Region 2, Brookhaven National Laboratory, and New Jersey (NJ) Department of Transportation Office of Maritime Resources
- Develop and demonstrate technologies from bench-, pilot-, to full-commercial scale
  - Meet desired treatment efficiencies
  - Cost-effective compared to other placement options (S/S)
    - (~$35-70/yard$^3$)
    - Process or store 1500 yard$^3$/d and achieve commercial-scale capacity of 500,000 yard$^3$/yr
    - Saleable beneficial use product from post-treated material
- In 1998, NJ provided further funding to the program ($20M)
- $42 million in Federal and State resources, combined with private investment
EPA/NJDOT Program

- **Logistical - Economic**
  - Moderate to high capacity 500Kcy/yr
  - Accept 3-6000 cy/day
    - Storage
  - Produce a value added product ($35-40 cy)
  - Practically unlimited market for product

- **Environmental**
  - Final product meets applicable criteria for proposed end use
  - Destroy or capture and account for all COC’s
  - Safe for human health and the environment
  - Able to be sited or permitted in a location suitable for processing harbor material (PPF)

Common goals to both EPA and NJDOT dcon programs
Collaborations

- EPA Region 2
- EPA SITE Program
  - TetraTech
- EPA ORD ERL-N
  - TIE’s
  - USGS Columbia, MO
- USACE NYD
- WES
- Port Authority NY/NJ
- NJDOT/OMR
- NJDEP
- GLNPO
- Michigan DEQ
- NJIT, Stevens, RPI, Rutgers, MSU, UNH
- Port of Baltimore
- Department of Ecology - WA
  - MUDS
- USACE Seattle District
- EPA Region 10
- USACE New England
- CTDEP
- Hart Crowser
- Weston Solutions
- Montgomery Watson Harza
- Malcolm Pirnie
- Battelle
- Port Authority of Venice, Italy
- EU SedNet
• Developed a program:
  – USACE, Brookhaven National Laboratory, Stevens Institute, NJIT, RPI, Rutgers (public outreach)
  – **RFP Process (BNL)**
    • Complete treatment train
    • Proof of concept – Bench – Pilot – Full scale – Commercial.
    • RFP Process (all in one contract modification)
    • Dcon techniques need not to be pre-proven in terms of likely success (wrda)
General Components of the Program

- Program / Project Management (EPA)
- BNL-DoE Procurement
  - RFP development/award
    - Move from bench-commercial in performance stages
    - Treatment train (materials handling / black box / beneficial use)
    - Environmental
    - Basic – Applied Research (ego’s)
    - Economics
    - Beneficial use
      - Permitting
      - Siting
      - Public outreach
      - Analytical testing program
      - EPA SITE Program

Innovative Technology Development

TECHNOLOGY
BLACK BOX
Over-commitment
Start-up time

Basic vs Applied Research
Proof of Concept

Bench
Pilot
Full-scale
Commercial

FRONT END MATERIALS HANDLING

POST TREATED BENEFICIAL USE

START OVER-commitment

START over-commitment

START Over-commitment

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time

START Start-up time
Stimulate innovation to more efficient treatment technologies:

- To date treatment technologies are too costly
  - Large amounts of sediments
  - Dredging and processing rates can’t keep up
- **Technology itself is not the problem**
  - Diversity of technologies are available
    - It’s everything else…
NY/NJ Harbor Sediment Treatment Technologies (full/commercial scale) with Beneficial Use

- **Gas Technology Institute/Endesco**
  - Thermo-chemical rotary kiln *(cement and co-gen)*

- **BioGenesis Enterprises**
  - Sediment washing *(soils, bricks, polymer coating)*

- **BayCycle Aggregates**
  - Rotary kiln *(light-weight aggregate)*

- **Harbor Resource Environmental Group, Inc**
  - Solidification/stabilization/oxidation *(structural fill)*

- **Westinghouse/The Solena Group**
  - Plasma-arc vitrification *(co-generation)*
• Work with many technology development firms outside of the sediment decontamination program
Moved From Bench-scale to Pilot-scale (1994-2003) to presently in 2005-2006 Full/Commercial Scale Demonstrations
BioGenesis Bench-Scale
1994
BioGenesis Sediment Washing Pilot Demonstration – Kearny, NJ 1999
BioGenesis
Pilot Demonstration
Venice, Italy Port Authority
January 2004
Genesis - February 14, 2006
Commercial-scale Demonstration
Isbey, New Jersey
Pilot-Scale Unit - GTI Cement-Lock
2005 - 2006

EPA/NJDOT Integrated Full-Scale Decontamination Demonstrations
BioGenesis / Endesco Cement-Lock
NJ Treatment Test Processing Facility Keasby, NJ

It’s a business learning curve for both
NY/NJ Sediment Decontamination Program
Cross-Program Demonstration 2006

• (1) **Navigational / Dredged Material**
  – BioGenesis Sediment Washing Process
  – Bayshore Recycling Slip Dredging
  – US Army Corps of Engineers
  – Federal Navigational Deepening
    • Arthur Kill

• **Unloading From Scow to Ship Hold**
  – Gross screen / .06cm screen
  – Direct pumping from hold to BioGenesis facility
NY/NJ Sediment Decontamination Cross-Program Demonstration

- (2) **Contaminated Sediments - Superfund**
- Passaic River, NJ Superfund Restoration Study
  - **BioGenesis** –

  - **Gas Technology Institute / Endesco**
    - Belt-filter press dewatering
    - Transport off site to Endesco processing facility
    - IMTT / Bayonne, NJ
Passaic River Superfund D
December 2006

5,000 cy dredged for BioG
Endesco Cement-Lock De

Cable Arm
ARRIER
PUMPED TO SHIP
GER SHIP
Final mooring at Bayshore
Toyo Pumps for pumping sediment from the bottom of the ship hold
Bayshore landside house sediment demonstrations. Sediment will be facility.
Beneficial Use Products and Markets

Potential Uses of Modified Final Product

- Top Soil/Potting Soil
- Compost
- Finish Grading Material for Construction
- Cap or cover materials for landfills
- Restoration Material
New York / New Jersey Harbor Sediment Decontamination & Beneficial Use Demonstration Project

Cement-Lock® Technology

Sponsored By:
• Gas Research Institute
• U.S. Environmental Protection Agency Region 2
• U.S. Department of Energy
  Brookhaven National Laboratory
• U.S. Army Corps of Engineers
  (New York District)
  – funding from the federal
    Water Resources Development Act (WRDA)
• New Jersey Office of Maritime Resources
  – funding from NJ Environmental Bond Issue

Technology Developer:
Gas Technology Institute

Site Host:
International-Matex Tank Terminal – Bayonne

General Contractor:
RPMS Consulting Engineers

Equipment Manufacturer:
Andersen 2000 Inc.

Technology Licensor:
Cement-Lock Group, L.L.C.
Cement-Lock® Technology

- A Patented technology (Ecomelt) – not kiln
- An advanced thermo-chemical manufacturing process for decontaminating sediments and other wastes
- Organic contaminants are destroyed with DREs > 99%
- Heavy metals are immobilized in the cement matrix exceeding TCLP and MEP requirements
- Vitrified sediment (EcoMelt) is transformed into construction-grade cement
- Waste heat is transformed into power
Cement Lock Demo Plant
IMTT - Bayonne, NJ - 2005
Pulverized EcoMelt
Beneficial Use
Construction Grade Cement/Concrete
Interior View of Kiln – 1345 °C

- Natural Gas Flame
- Molten Sediment
- Sediment Feed

Interior View of Kiln - 1345 °C
BARGE-MOUNTED CEMENT-LOCK® PLANT

Starboard View

(Brown) Waste Feed System
(Green) Modifier Feed System
(Red) Rotary Kiln, Drop-Out Box and Granulator
(Orange) Ecomelt Product Processing and Storage
(Blue) Air Pollution Control & Flue Gas Treatment System

30,000 ton Plant
(225' x 100' Barge)
Business Development
Where are we going?

- Develop **Long-term Self Sustaining Enterprises in the Environmental Management/Manufacturing** of Beneficial Use Products from Contaminated Sediments
  - It’s a business....... Venture capital interest

- Sediments are a Resource
- Beneficial Use Applications
Uncertainties in Developing Long-Term Enterprises

- Unpredictable dredging volume estimates
- Unpredictable dredging cycles
  - Fish migratory windows
- Superfund Construction Schedules
- Litigation
- Long-Term Contracts
- Government Risk Sharing

- Is this a good business?
Technology Financing Reality

Facts of Life

- Lowest Price
- Long Term Commitment
- Larger Investment
- Bottom Line
- Environmental Compliance
- Largest Scale Facility

Greater Financing
The Future of Sediment Management

• Public Education / Outreach

Without an adequate technical basis for decision making, the special interests that are always present will tend to dominate the process.

There is never enough information or data to answer all questions - hence decision making in the presence of uncertainty.
The Future of Sediment Management

• **Policy**
  - Consistent cross-agency, authorities
  - Dirt is Dirt

• **Administrations come and go**
  - Policy decisions are made that will have future implications
  - Political short term fix vs. long-term strategy
  - Need structures in place to succeed in the long-term.
The Future of Sediment Management

• Policy (continued)

• Throwing $$ at problem w/o implementing policy changes that will at least give a program a chance to succeed is wasting $$

• Changes in legislation and regulatory requirements
Environmental Sustainability
Contaminated Sediments
They’re making people every day, but they ain’t making any more dirt – Will Rodgers

- Topsoil is being depleted avg/yr 18X faster than what is being built up in nature
  - Takes 2000 yrs to build up 1in of topsoil

- US/California
  - CA agriculture depleting as much as 1in TS every 25 years. 80x faster than nature

- Developing Nations – 36x

- China – 54x

- National Resources Inventory. Soil Conservation Service. USDA, Washington, DC (1992)
• Environmental Sustainability of Sediments
  – Environmental, Economic and Social
• Environmental Manufacturing
  – *Beneficial Use*
    • Environmental Restoration
    • Economic Revitalization
    • Social Consciousness
      – Shrinking Natural (Un-renew) Resources
      – Short vs. Long-term vision
• Finite capacity, difficulty of siting, changes in public perception
  – Consistent with SedNet
Positioning for the Future

- **Life Cycle Assessment**
  - What is the cost associated (long-term)?
    - Environmental, economic, social
  - Of not (environmental sustainability)
    - Diminishing natural resources
    - Waste minimization
    - Landfill Closures
    - Lack of real-estate (CAD/CDF)
      - Loss of Benthic Habitat / wetlands

- Application of Innovative Decontamination Technologies with Beneficial Use
Barriers to Innovative Technology Implementation
Impediment to Innovative Technology Development

TECHNOLOGY BLACK BOX

Basic vs Applied Research
Proof of Concept

FRONT END MATERIALS HANDLING

Bench Pilot Full-scale Commercial

POST TREATED BENEFICIAL USE
The Future of Sediment Management

• Program Integration
  - Sediments are cross-program
    • Dredged Material (Navigation)
    • Superfund (Remediation)
    • Aquatic Brownfields (Superfund)
    • Solid Waste Industrial Sites
    • Remediation/Clean-up
      - Run for the Hills……
      “dirt is dirt” (tech. def.)
There is NO ONE WINNER in Technologies

There is NO SILVER BULLET

- Explore from a technology integration and multiple beneficial use perspective
- Technology Campus
  - Multiple contaminant, cross-program

Make an informed decision that at some time, treatment will be a component or part of a tool box for dredged material / contaminated sediments management strategies
Overcoming Barriers to Innovative Technology Development – 2 Workshops

- **International Navigation Association (PIANC)**
  - Brussels, Belgium
- **U.S. Army Corps of Engineers – Waterways Experiment Station**
  - Oakland, California
  - May 2000
- **Maryland Port Authority**
  - Annapolis, Maryland - USA
  - November 2004
  - [http://www.mpasafepassage.org/forumpresents/index.htm](http://www.mpasafepassage.org/forumpresents/index.htm)
- Norman Francingues
Overcoming the Barriers to Technology Implementation
U.S.PIANC Special Workshop
2 May 2000

• Long-term forecasting of dredging requirements and likelihood of funding

• Public funding of centralized dredged sediment storage and management facilities

• Use of other waste streams to insure continuous feed stream to process
Overcoming the Barriers to Technology Implementation
U.S. PIANC Specialty Workshop
2 May 2000

• Mandate the use of treated sediment products in public work projects
  – Federal – state – municipal government

• Provide education on the benefits of using treated sediment products as beneficial use
  – Sustainability
    • Un-renewable resources
Observations – 4 Major Areas

- Long-term supplies
- Permitting process
- Long-term contracting
- Siting
• Primary challenges to produce marketable products:
  – Cost
  – Product Acceptance
  – Permitting / Regulatory
  – Safety
• **Recommendations**
  
  – Provide regional storage sites to ensure a steady source of sediments for potential innovative re-use options
    
    • *Dredging > than processing rates*
    
  – Support market studies and development of intermediate and end use products including regulatory policy and incentives
Establish how much RISK the Government, Port Authorities etc. is willing to assume to implement technologies and beneficial use options.

Present a realistic timeframe and schedule to implement re-use based upon potential business models.

Incorporate the continued use of public outreach programs.
Sunset over Bayonne, NJ
GTI Cement-Lock Rotary Kiln