

Sustainable Urban and Environmental Management Restoration Applications Using Sediment Treatment Systems with Beneficial Use

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Urban Sediment Management and Port Redevelopment

Sediment in River Basin Management Plans

5th International SedNet Conference

28 May 2008

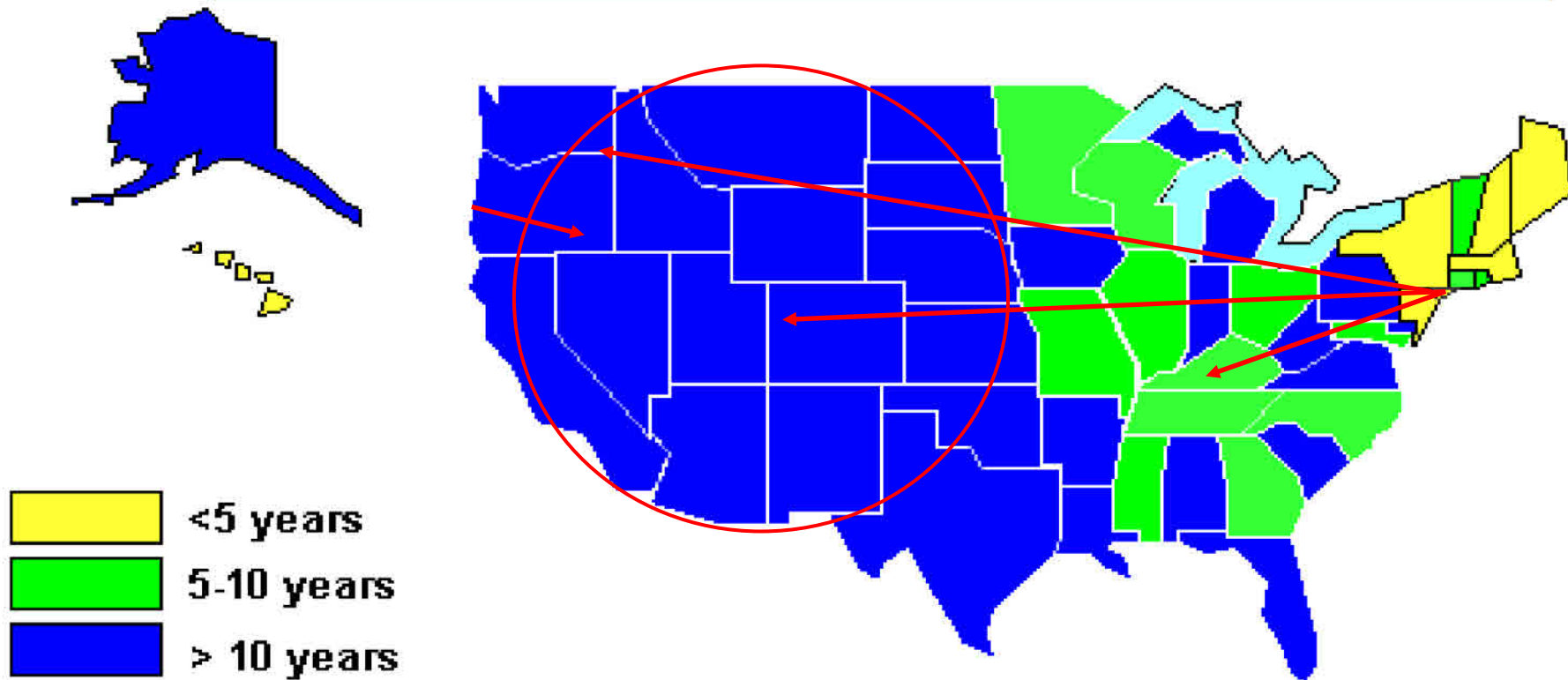


Urban Environmental Management

- **Sustainability (long-term)** ←
 - **Ecopsychology (Urban Sed. Mgmt.)**
 - Behavioral understanding of moving forward
 - Urban – City / Port Environment
 - Leadership
 - Education (K-12) / Outreach
 - Different brain wiring (political)
 - **Integrated Sediment Management**
 - Hybrids – Holistic – Treatment Train Approaches
 - **Multi Contaminants / Media**
 - Regional Sediment Management (watersheds/basins)
 - **Beneficial Use** ←
 - Un-renewable resources
- 

LANDFILL CAPACITY WILL BECOME CRITICAL IN THE NORTHEAST U.S

YEARS OF REMAINING LANDFILL CAPACITY



Source: Directory and Atlas of Solid Waste Disposal Facilities, 1996

US < than 20 years of disposal capacity

Integrated Urban Contaminated Sediment Management

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

- **Materials Handling**
 - dewatering, pumping, geo-tubes
- **Environmental Precision Dredging**
 - Cable Arm, Hydraulic
 - Geophysical – debris fields
- **Capping**
 - Active/Reactive Core Mats
- **Stabilization/Solidification (portland cement) + (oxidation)**
 - H_2O_2 , KMNO_4 , NaS_2O_8

- **CDFs (upland & nearshore)**
- **CADs (aquatic)**
 - **Siting is becoming a challenge / aquatic real estate**
- **Ex-situ / In-Situ Innovative Sediment Technologies**
 - **Thermal**
 - **Non-thermals**
 - **In-Situ Stabilization (cement injection) / caps**
- **In-Situ Bioremediation**
 - **Mudflats**
- **Monitored Natural Attenuation**

INTEGRATE PHYSICAL
INFRASTRUCTURE IN ALL
ALTERNATIVES

Urban Environmental Sustainability



National Sediment Management Programs

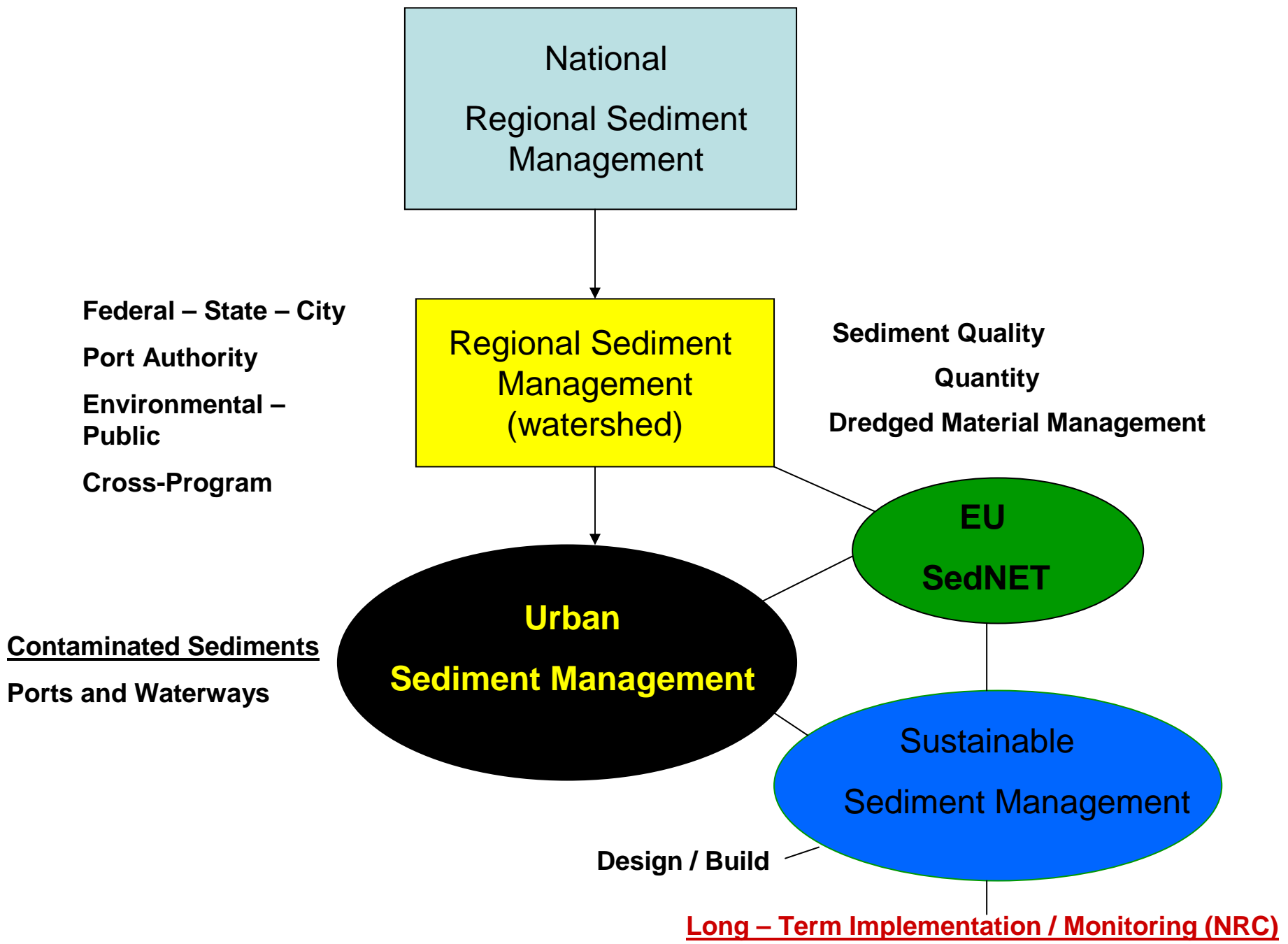
- **USEPA Contaminated Sediment Management Strategy (1998)**
 - Superfund focus
- **EU Sediment Research Network (SedNet) (2000-2006)**
 - Multi-national River Basins
 - **2008 SedNet Conference / Oslo**
- **Clean and Rich Oceans (2002)**
 - Norwegian Parliamentary Bill 12
- **USACE Regional Sediment Management (RSM) (2004)**
 - Coastal Processes



Regional Sediment Management

- **System-based (*watershed*) approach** that seeks to solve sediment-related problems by designing solutions that fit within the context of a ***regional strategy*** and sediment system
 - Recognizes sediments as a **resource**
 - Sediment processes (coastal/estuarine)
 - Integral to environmental / economic vitality
 - Engage Stakeholders
 - Achieve **long-term balance** and **sustainable solutions**

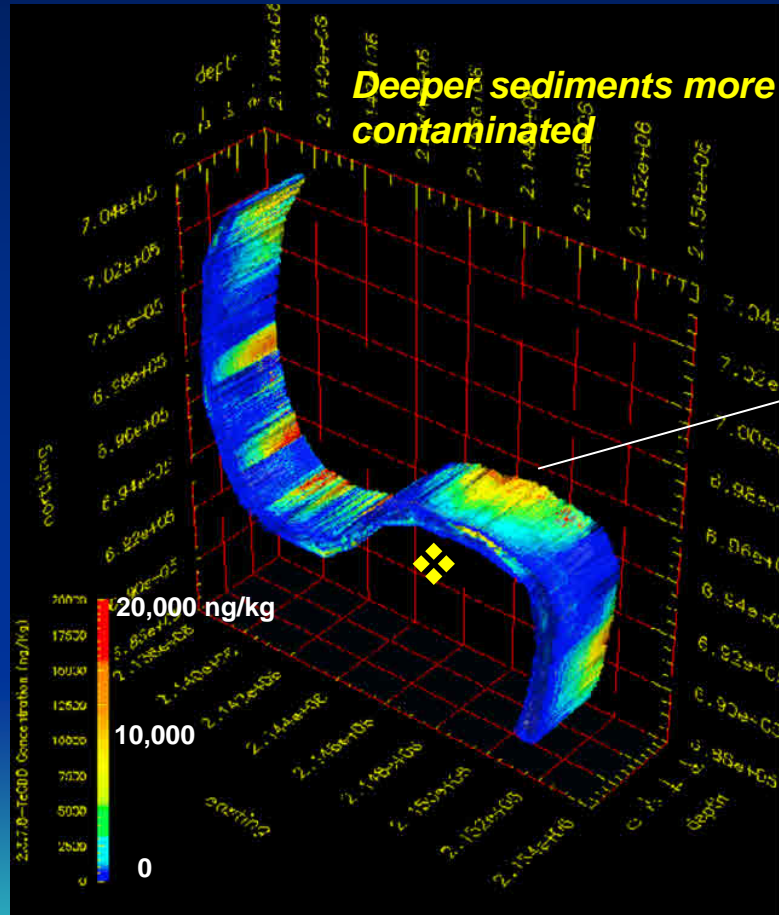




Urban / Port Impacts

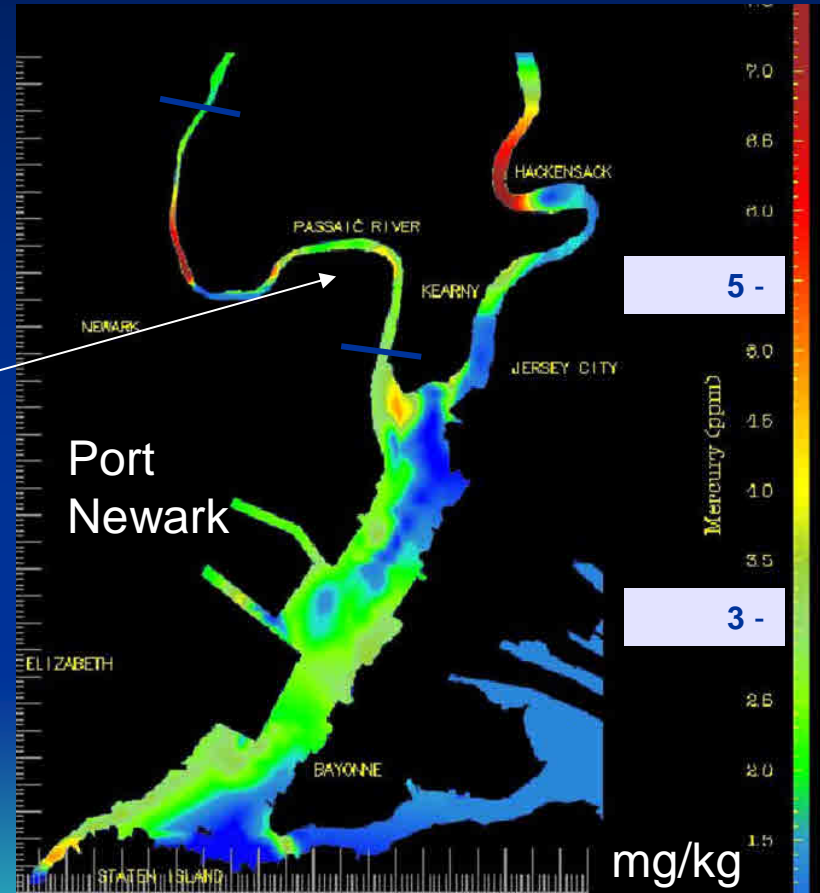
- ***Contaminants in sediment:***
 - Pose an ecological and human health risk in the river and contributes to risk harbor-wide;
 - Contribute to contaminant loading in the harbor (on-going sources)
 - **Regional Sediment Management (Watersheds)**
 - **Impact dredged material and port management**
 - **Impact future waterfront development opportunities (weak link)**

Passaic River, NJ – Port Newark Downstream 2,3,7,8-TCDD / Mercury Contamination



Passaic River (3D)

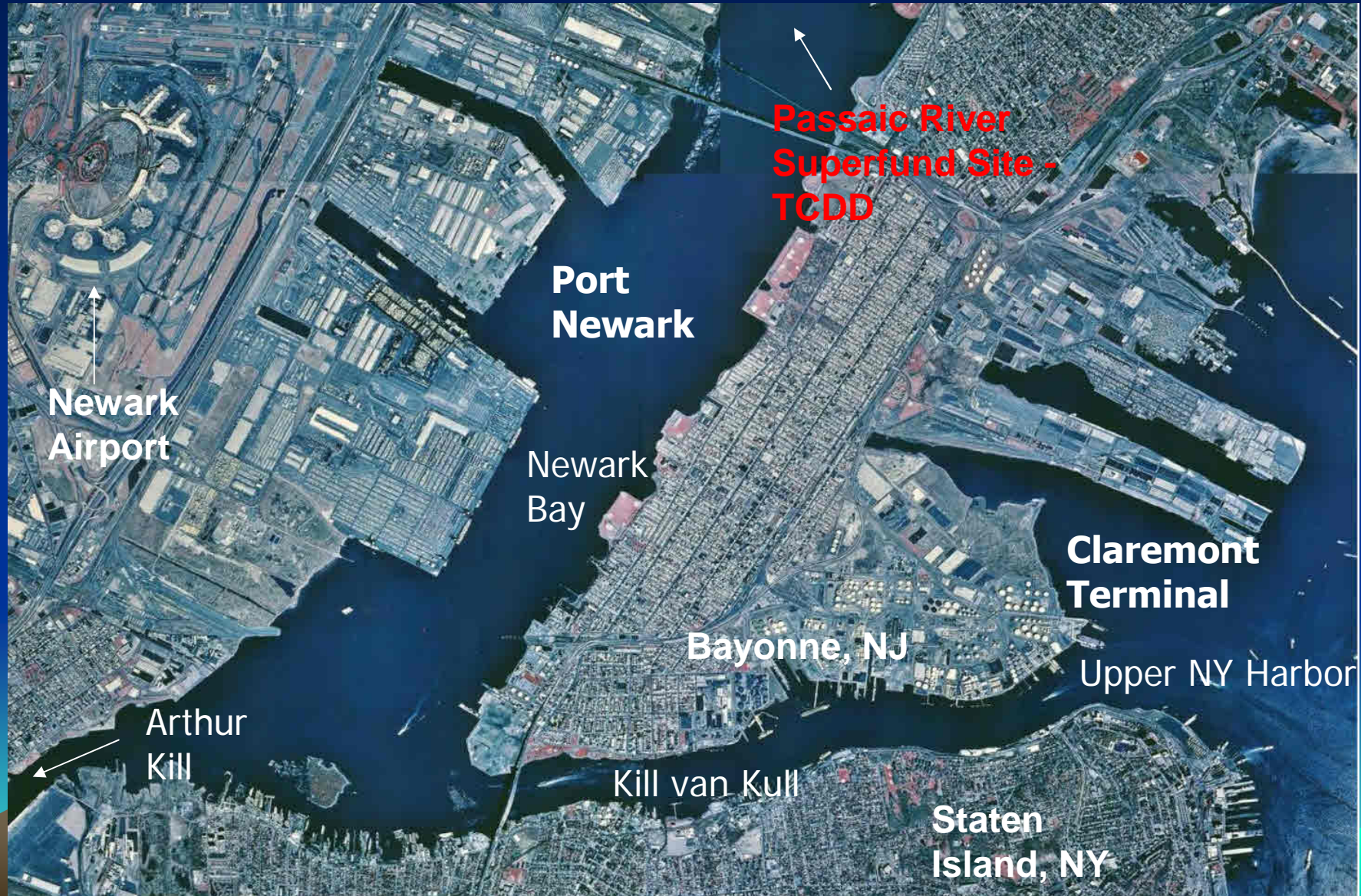
TCDD



Passaic River / Newark Bay

Mercury

Port of NY & NJ - Navigation



Use of Innovative Technologies

Positioning for the Future

Environmental Sustainability

Environmental Manufacturing

Beneficial Use



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 for most contaminated sediments
 - Lack of real-estate (CAD's/CDF's)
 - Loss of Benthic Habitat / wetlands / channel configuration
 - **Short vs. long-term vision**
 - ✓ **Application of Innovative Decontamination Technologies with Beneficial Use**



3rd International SedNet Conference
25-26 November, 2004 – Venice, Italy
Contaminated Sediments - European River Basin
Final Recommendations

- Stimulate innovation to more efficient treatment technologies:
 - sustainability
- To date treatment technologies are too costly
 - (THIS IS CHANGING – 2008)
 - Large amounts of sediments
 - Dredging and processing rates can't keep up
 - (REGIONAL STORAGE FACILITIES PPF / CDF/CAD– 2008)
- Technology itself is not the problem
 - Diversity of technologies are available



**Moved From Bench-scale to
Pilot-scale (1994-2003) to presently in
2005-2007
Full/Commercial Scale
Demonstrations**



Ex-Situ Treatment Technologies Tested USEPA/NJDOT Decontamination Programs (1994-present)

- **Sediment Washing ***
- **Thermo-Chemical Rotary Kiln ***
- Plasma-Arc Vitrification (EPA)
- Base-Catalyzed Decomposition (EPA)
- **Rotary Kiln -Thermal Desorption**
- Solvent Extraction (EPA)
- **Solidification/Stabilization with Oxidation ***
- Fluidized Bed Reactor (EPA)

* Full Scale

Technologies with Beneficial Use

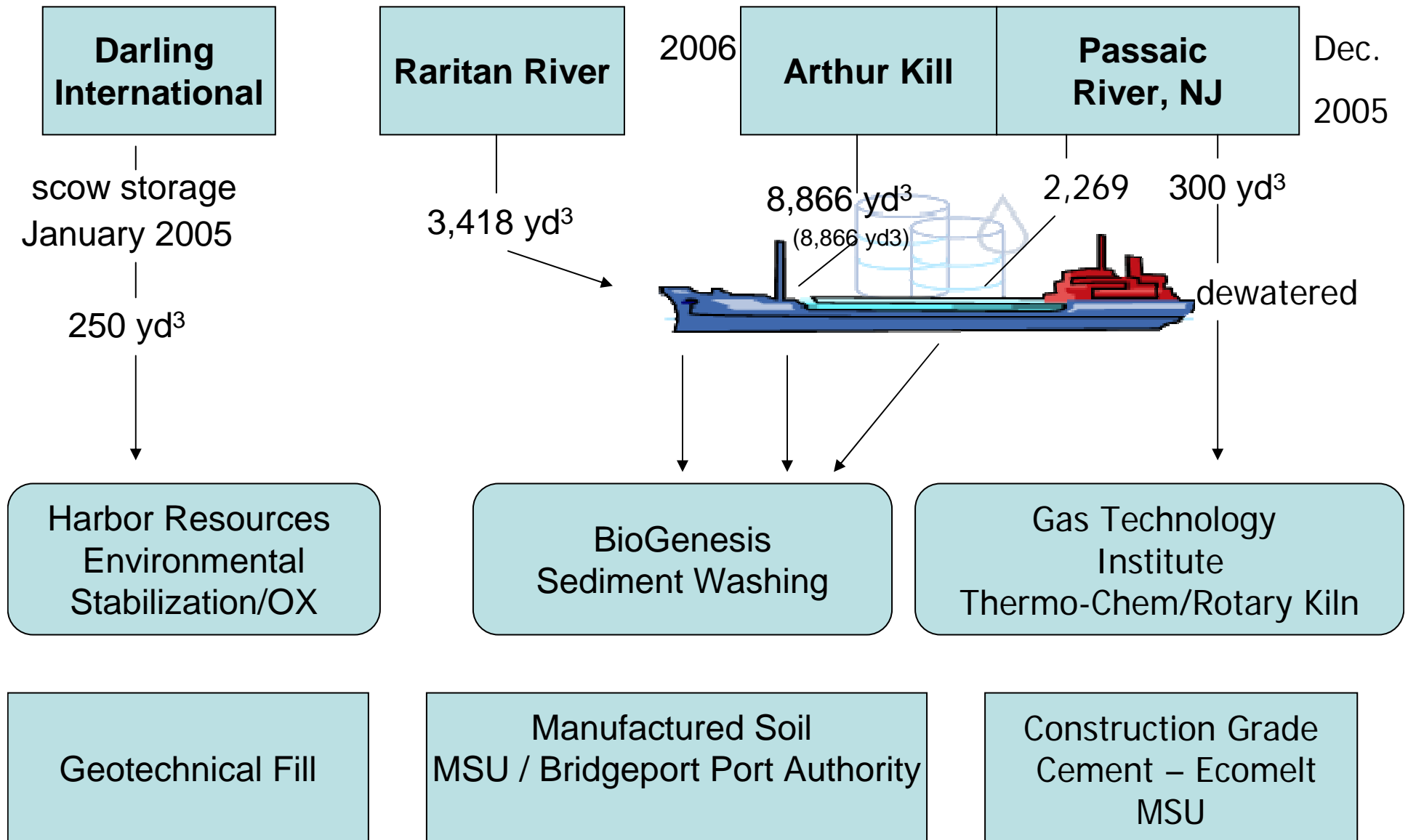
- ***Gas Technology Institute/Endesco***
 - Thermo-chemical rotary kiln (**cement and co-gen**)
- ***BioGenesis Enterprises***
 - Sediment washing (**soils, bricks, polymer coating**)
- **Upcycle / BayCycle Aggregates**
 - Rotary kiln (**light-weight aggregate**)
- **Harbor Resource Environmental Group, Inc**
 - Solidification/stabilization/oxidation (**structural fill**)
- **Westinghouse/The Solena Group**
 - Plasma-arc vitrification (**glass tiles / co-generation**)



NY/NJ Harbor Sediment Decontamination Program Demonstrations : 2005-2007
Bayshore Recycling Processing Facility – Keasbey, NJ (Raritan River)

Navigational Dredged Material

Superfund Contaminated Sediments



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



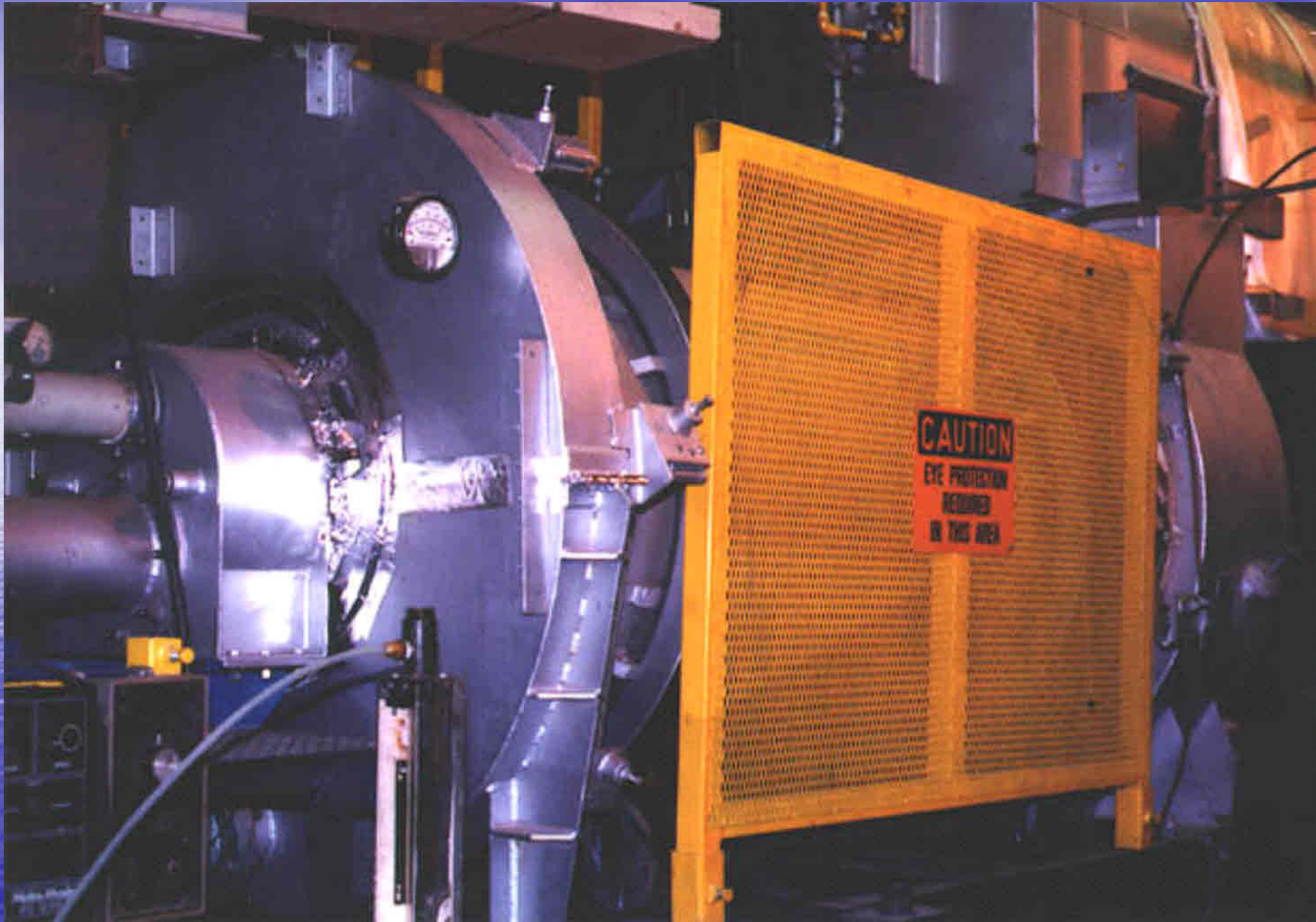
Equipment Manufacturer:

Andersen 2000 Inc.



Technology Licensor:

Cement-Lock Group, L.L.C.



Pilot-Scale Unit - GTI Cement-Lock 1996

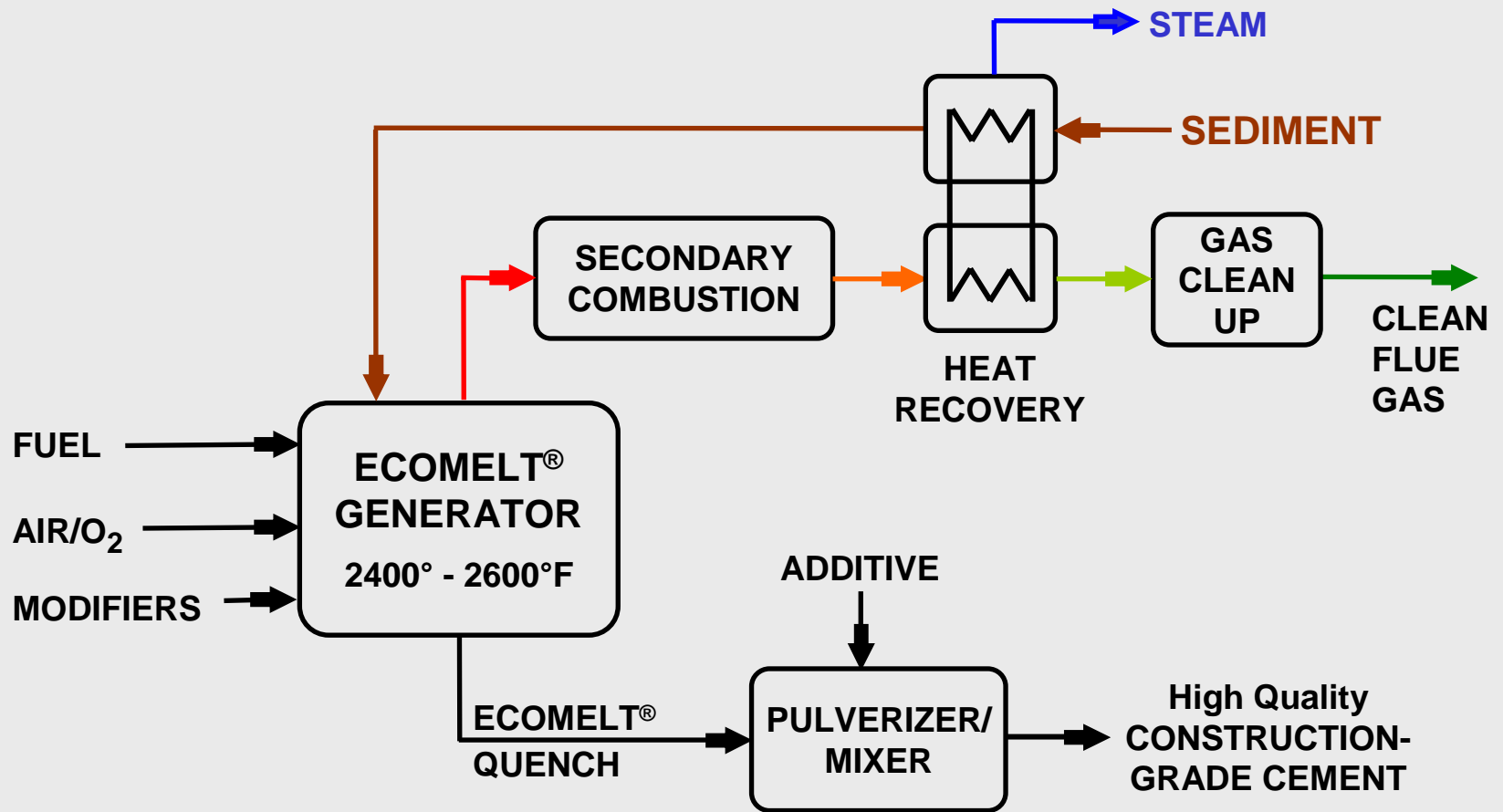
Cement Lock Demo Plant
IMTT - Bayonne, NJ / 2005-2007



Cement-Lock Demo Plant IMTT, Bayonne, NJ



Cement-Lock Technology

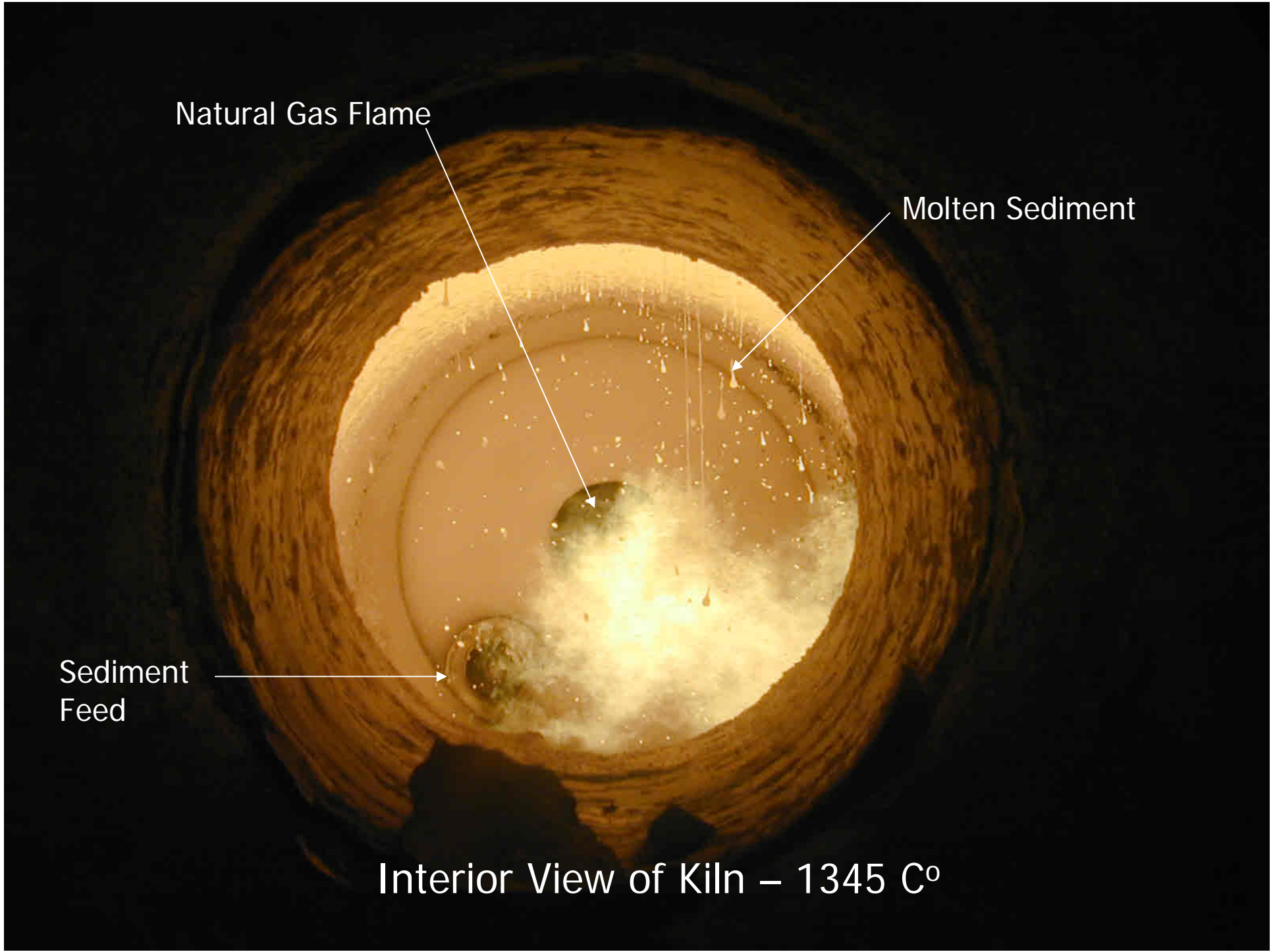


Natural Gas Flame

Molten Sediment

Sediment
Feed

Interior View of Kiln – 1345 C°





EcoMelt

Beneficial Use

0 INCHES

1

2

3

4

5

6

0 CM

1

2

3

4

5

6

7

8

9

10

12

13

14

15



TIMER

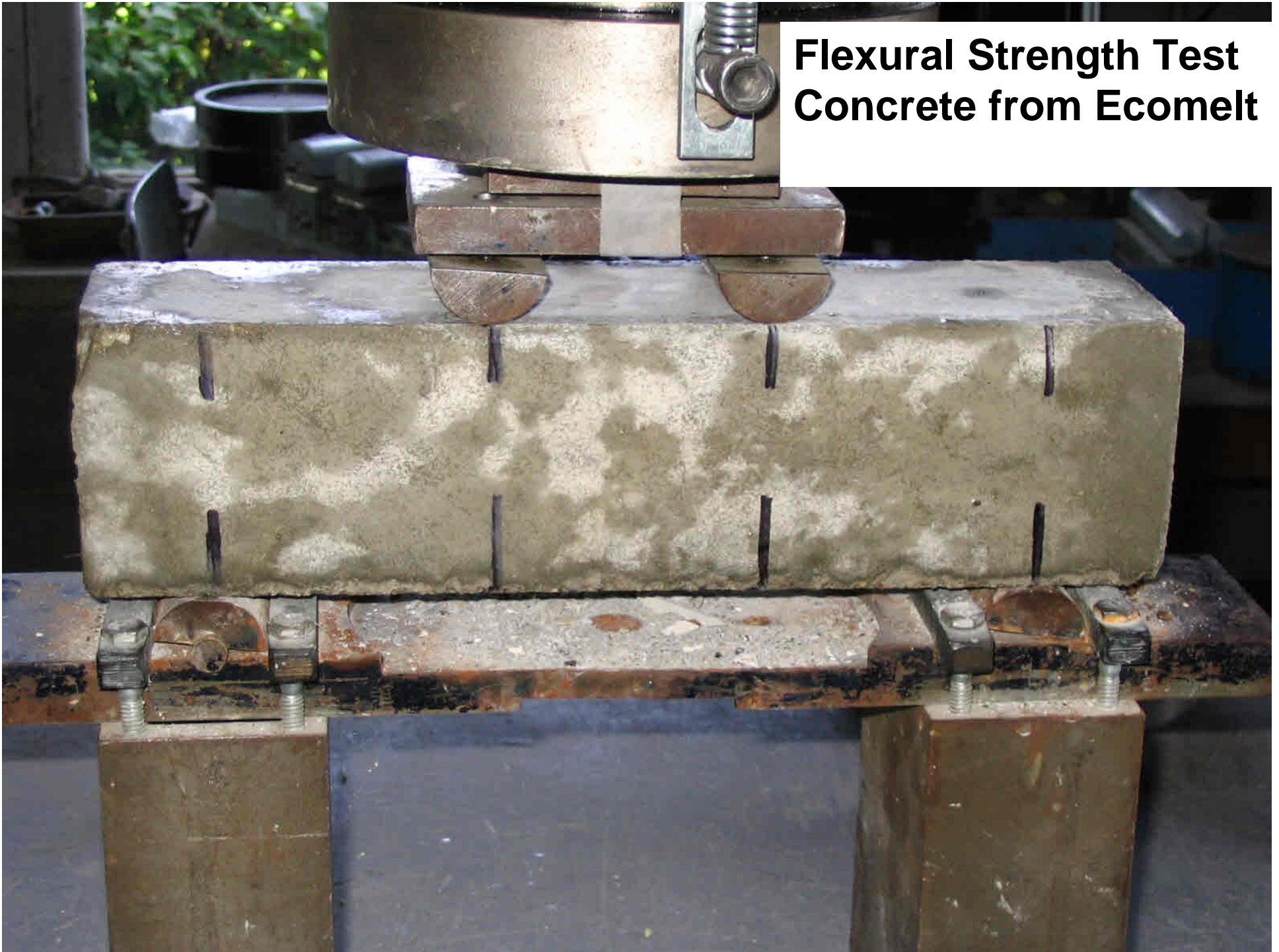
about you

Beneficial Use

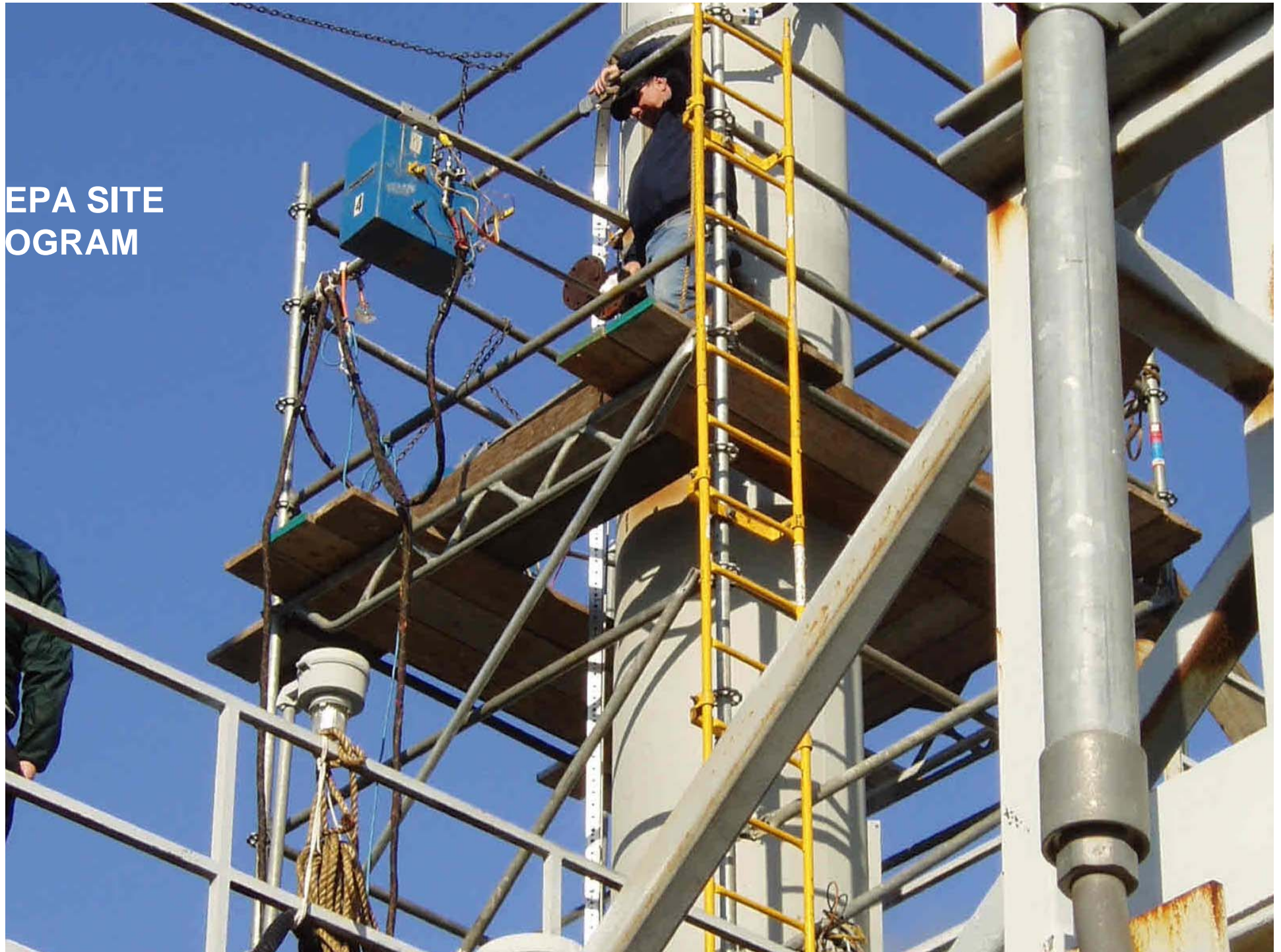
Construction Grade Cement/Concrete



**Flexural Strength Test
Concrete from Ecomelt**



EPA SITE
PROGRAM



Phase II Demo Project – Results DRAFT

Extended Duration Test – December 2006 (NEWARK BAY)

- > Dioxin/furans in flue gas was 1.3e-10 lb TEQ/hr or 58.8 ng TEQ/hr
- > Dioxin/furans DRE was 99.9994%
- > PCBs in flue gas was 1.2e-4 lb/hr
- > PCBs DRE was 97.0%
- > Mercury capture efficiency of AC bed was 86.7%

Extended Duration Test – May 2007 (PASSAIC RIVER)

- > Dioxin/furans in flue gas was 3.3e-12 lb TEQ/hr or 1.5 ng TEQ/hour
- > Dioxin/furans DRE was 99.999986%
- > PCBs in flue gas 1.2e-6 lb/hr
- > PCBs DRE was 99.957%
- > Mercury capture efficiency of AC bed was 97.8%

ECH

gti[®]

BioGenesis Sediment Washing Bench- Scale - 1994



BioGenesis Sediment Washing Pilot Demonstration – Kearny, NJ 1999



BioGenesis Pilot Demonstration Venice, Italy Port Authority



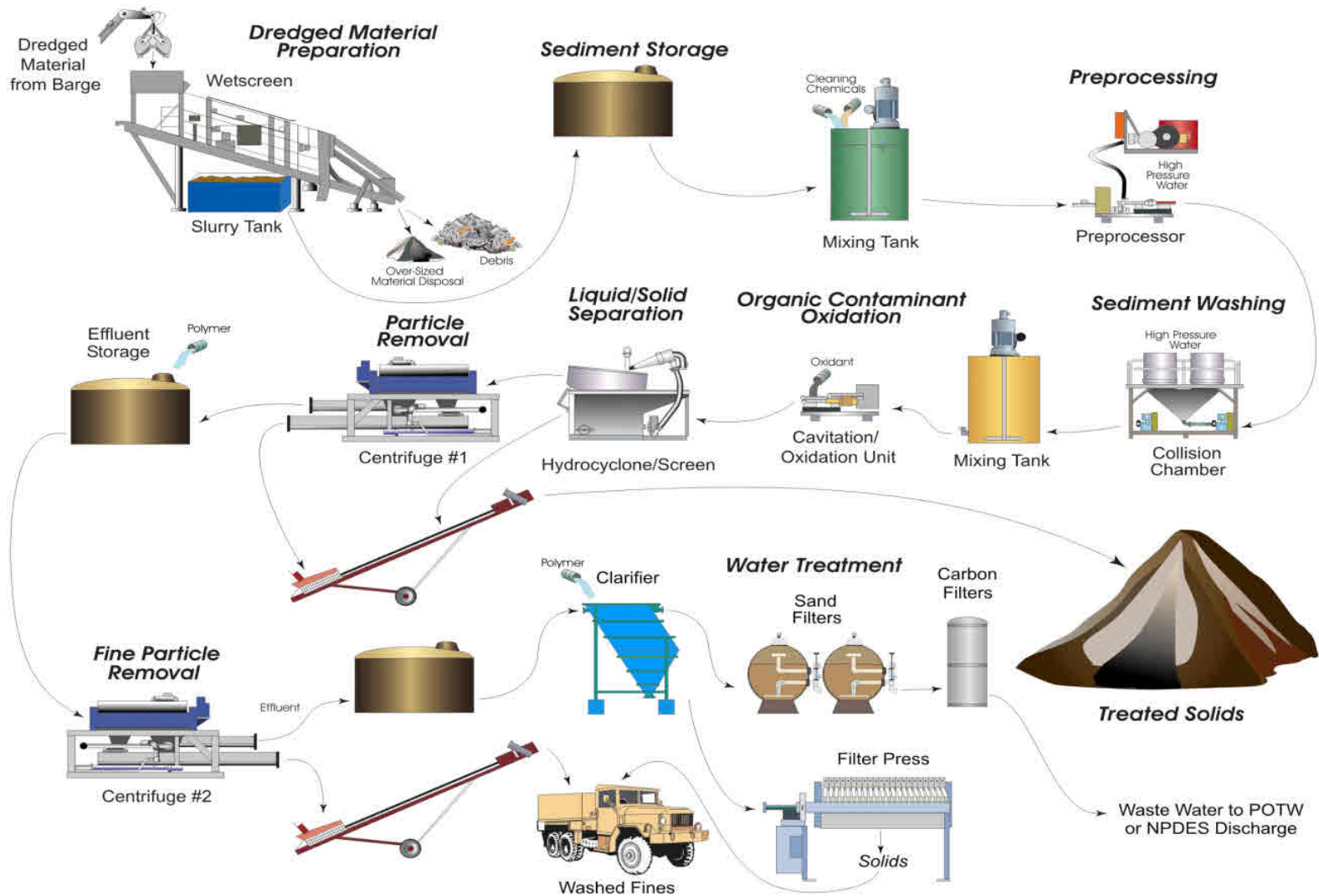
January 2004

Autorità Portuale di Venezia



Process Flow Diagram

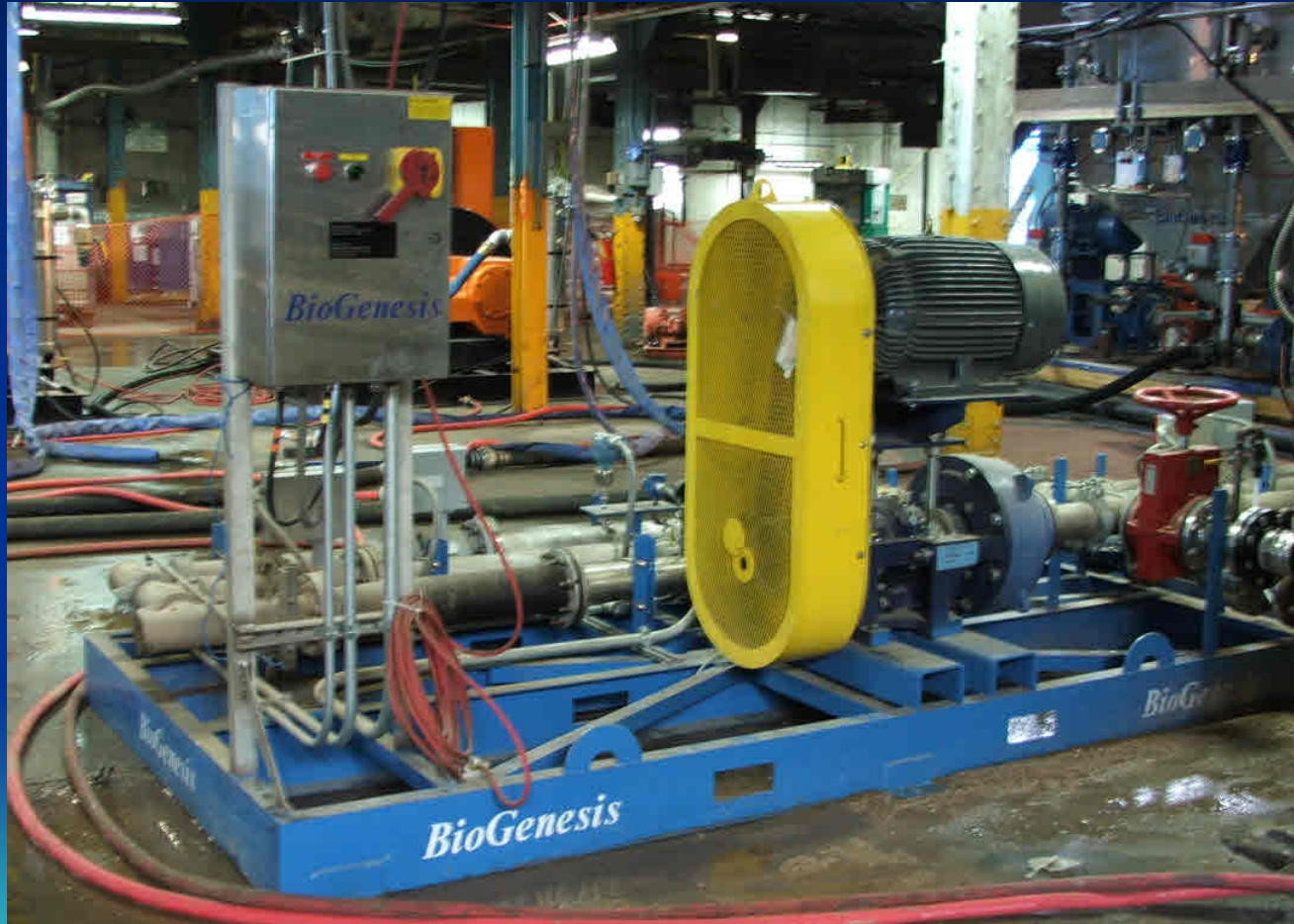
BioGenesisSM Sediment Washing Technology



2006 Full-Scale Demonstration



Organic Contaminant Oxidation



Liquid/Solid Separation - hydrocyclones



Liquid/Solid Separation - Centrifuges



Beneficial Use – Manufactured Soil

- Decontaminated sediment blend with sand and organic material (mulch) to create a high end topsoil



Pre-Processor

Collision Chamber

Oxidation

Hydrocyclone / Centrifuge

Treated Sediment

**1st centrifuge and
hydrocyclone**

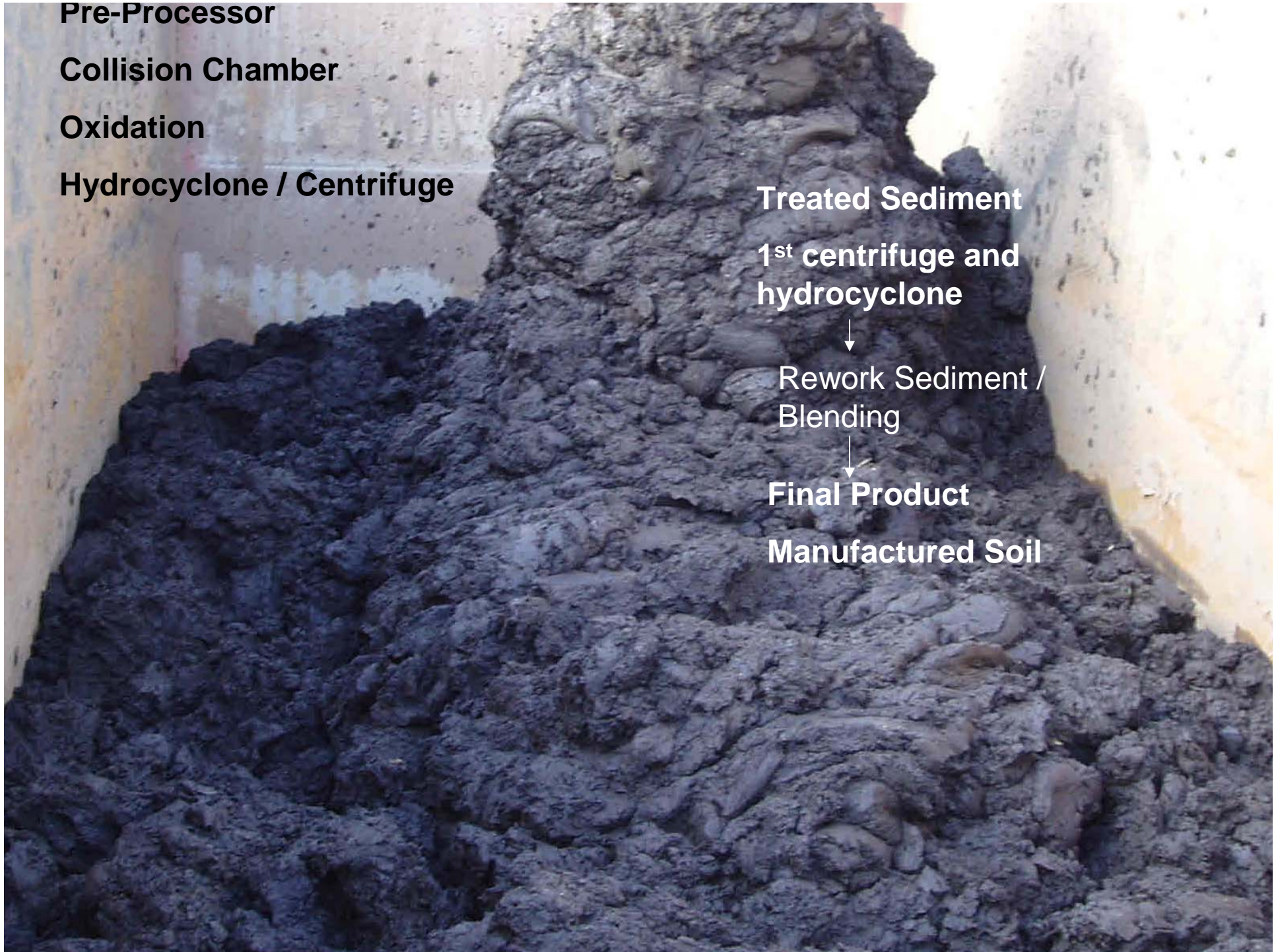


**Rework Sediment /
Blending**



Final Product

Manufactured Soil



Is this a Good Business?



DREDGED ESTUARINE SEDIMENT

Uncertainties in Developing Long -Term Business Models

- Unpredictable dredging volume estimates
- Unpredictable dredging cycles
 - Fish migratory windows
- Superfund Construction Schedules
 - Remedial Investigation Process (years)
- Litigation (lawyers)
- **Long-Term Contracts**
- Government Risk Sharing
- Siting / Permitting



The Future of Urban Sediment Management

- Develop Long-term Self Sustaining Enterprises in the Environmental Management of Sediments
 - *Sediments and other mixed media*
 - *Urban centers / waste priorities*



Environmental Manufacturing

- **Multiple Feeds of:**
 - Dredged Material (Navigation)
 - **Contaminated Sediments (Superfund)**
 - Contaminated Soils
 - Coal Ash
 - Construction / Debris
 - **Electronic waste**
 - Sewage sludge
 - Medical Waste
 - Tires
 - Auto Fluff
 - **Food Waste**
 - Municipal Solid Waste
- Keeps system economics by supplying constant feed of material
- Diversity of Beneficial Use Products

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

– C.J. Barrow. Land Degradation, Cambridge U. Press. (1981)

– National Resources Inventory. Soil Conservation Service. USDA, Washington, DC (1992)

Beneficial Use – Manufactured Soil

- Decontaminated sediment blend with sand and organic material (mulch) to create a high end topsoil



Large-Scale Food Composting Montclair State University

- Aerobic Composter
 - Process 2 yd³ / food residue day
 - \$3/day
- 130° F
 - Rotated 4x/hr / 4x/day – add wood chips
 - 3 days to process
- Upgrade to large composter for entire MSU
- **Combine with decontaminated sediment washed sediment for manufactured soil blending**
 - June 2008
- Principal Investigator: Dr. Nicholas Smith-Sebasto





Buckets of Food from MSU Dining Hall for Composting



Bio-Mixer: Food Residue and Wood Chips

Compost ready
to be mixed with
decontaminated
sediment and
placed on
campus



Case Study Waste to Energy High Temperature System



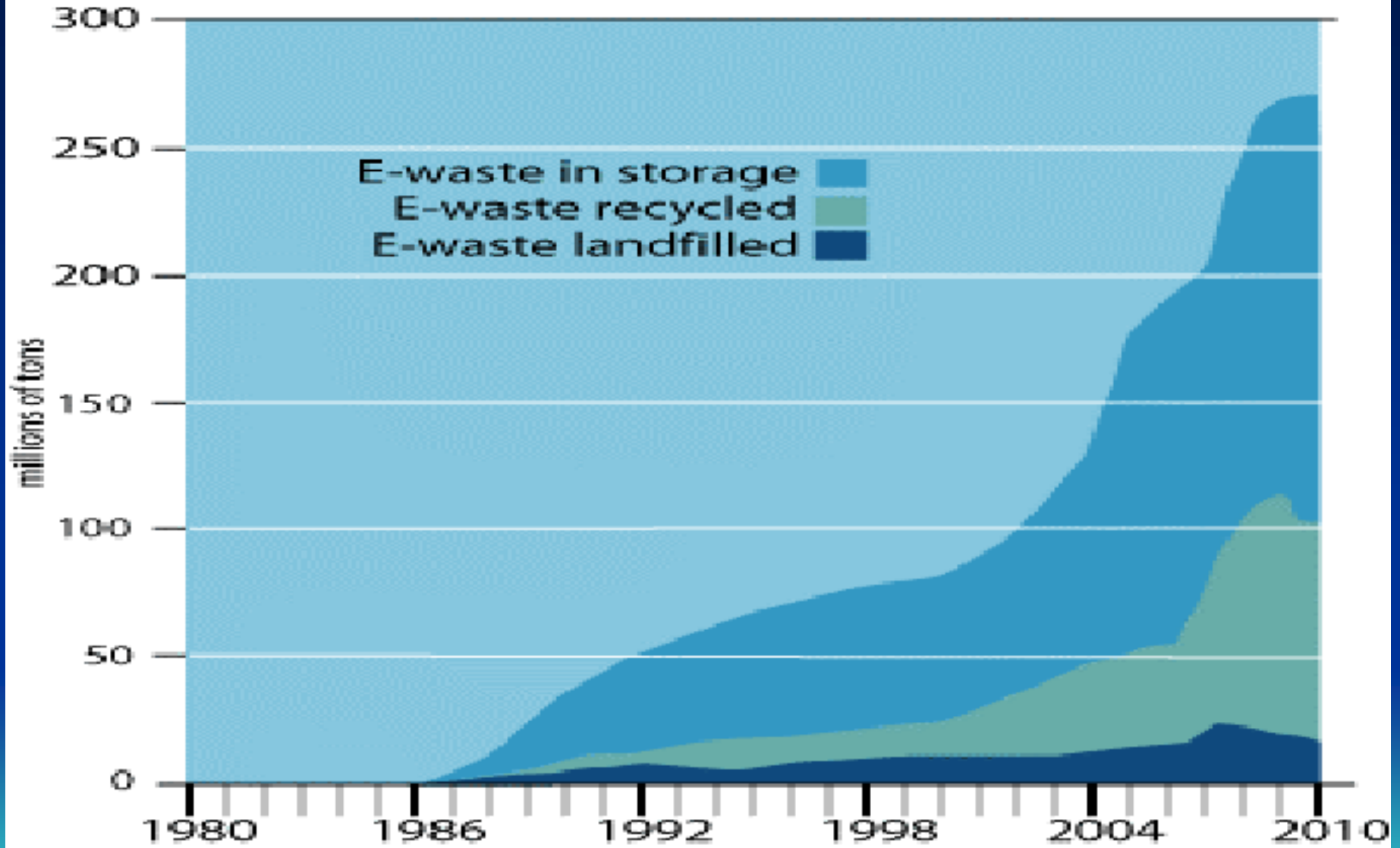
Electronic Waste(E Waste) as a sustainable co-generation fuel source.

US E-Waste Market

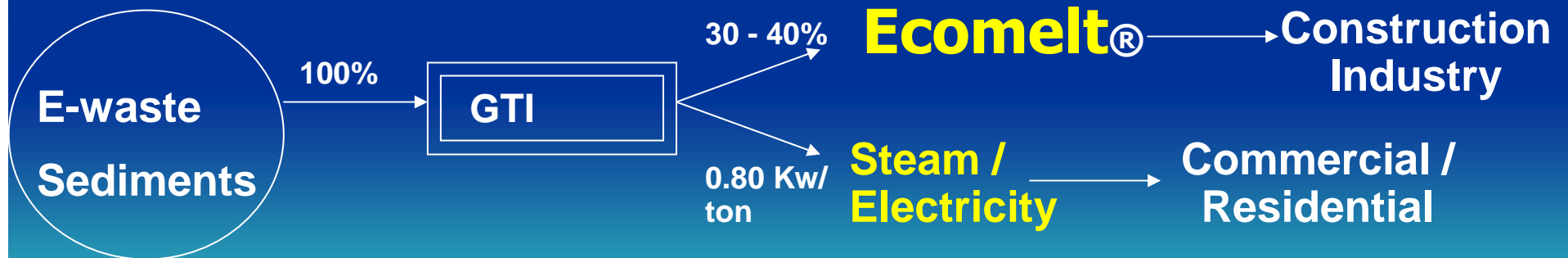
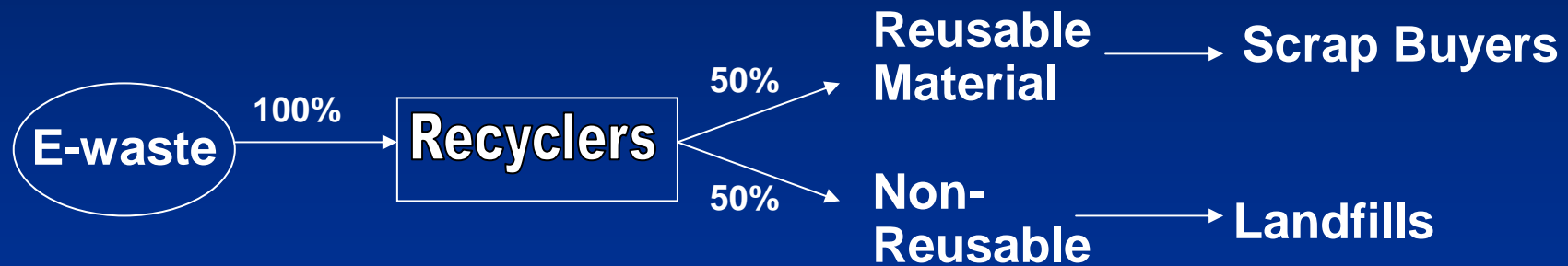
- Total Estimated US Annual E Waste = 3.2 million tons
- Estimated E Waste disposal cost = >\$1000 / ton
- Potential US E Waste market = >\$2.5 billion
- Estimated toxic materials generated:
 - plastic = 4.0 billion pounds (2million tons)
 - Lead = 1.2 billion pounds (600 million lbs.)
 - Mercury = 400,000 pounds (200 tons)
- Est. annual E Waste recycled = 750,000 tons / year (25% of Total)
- Est. E Waste recycling efficiency = 45 %
- Market researcher Gartner Group forecasts Americans will replace or retire 133,000 PCs per day.

*Note: Information obtained from IAER Report 5/2004

E-waste Tsunami

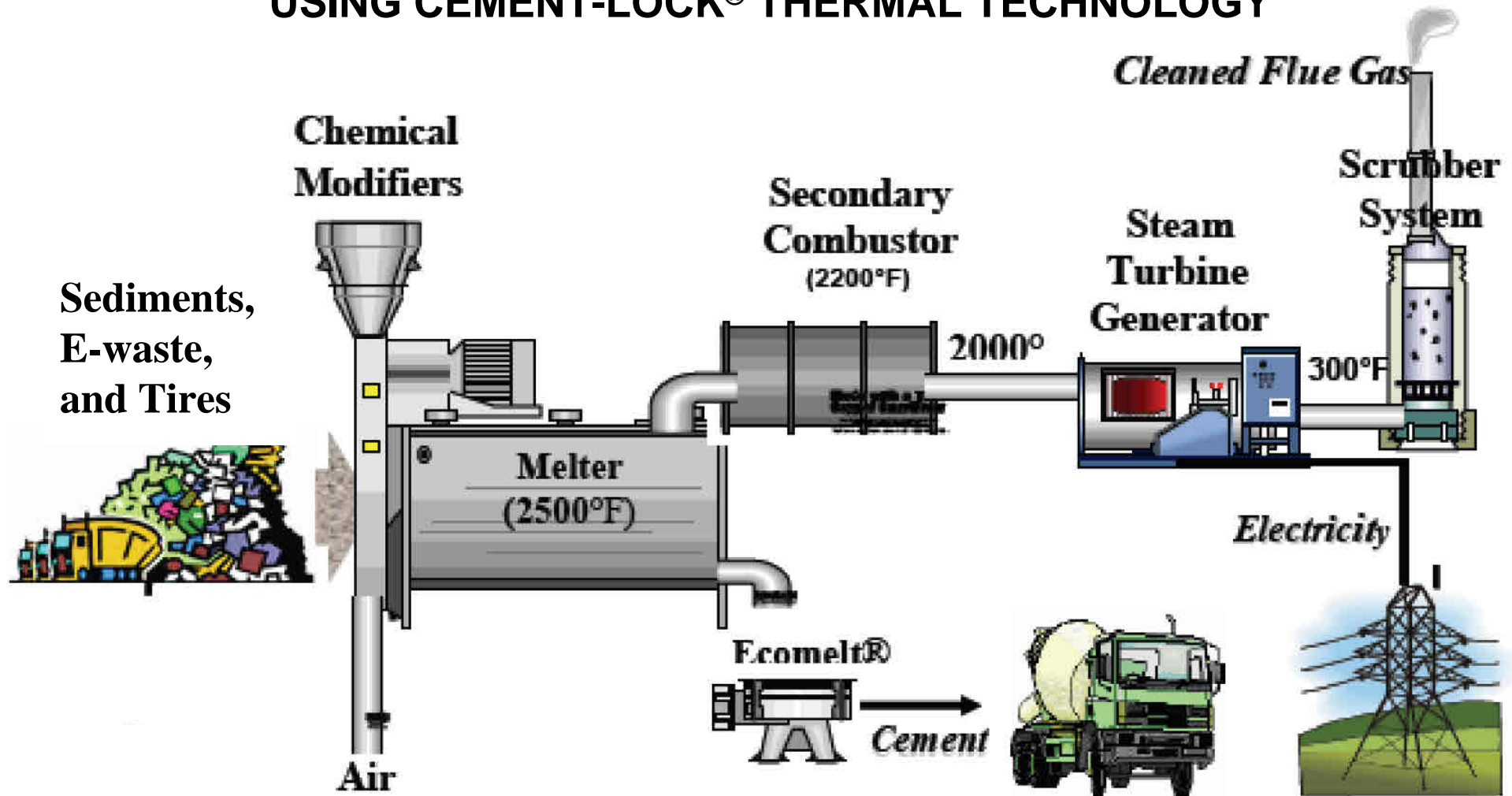


Sediments / E-Waste Model



**Ecomelt – GTI Cement-Lock Rotary Kiln
for contaminated sediments**

VOLCANO WTE SUSTAINABILITY APPROACH USING CEMENT-LOCK® THERMAL TECHNOLOGY





US Army Corps
of Engineers



Urban Rivers Restoration

February 2003

USEPA / USACE Pilots

➤ **Gowanus Canal, NY**

➤ **Passaic River, NJ**



**Gowanus Canal, NY
Urban Sediment
Restoration**



Public Library
Collection



cc Andrew Kloppe
www.heroshima.info

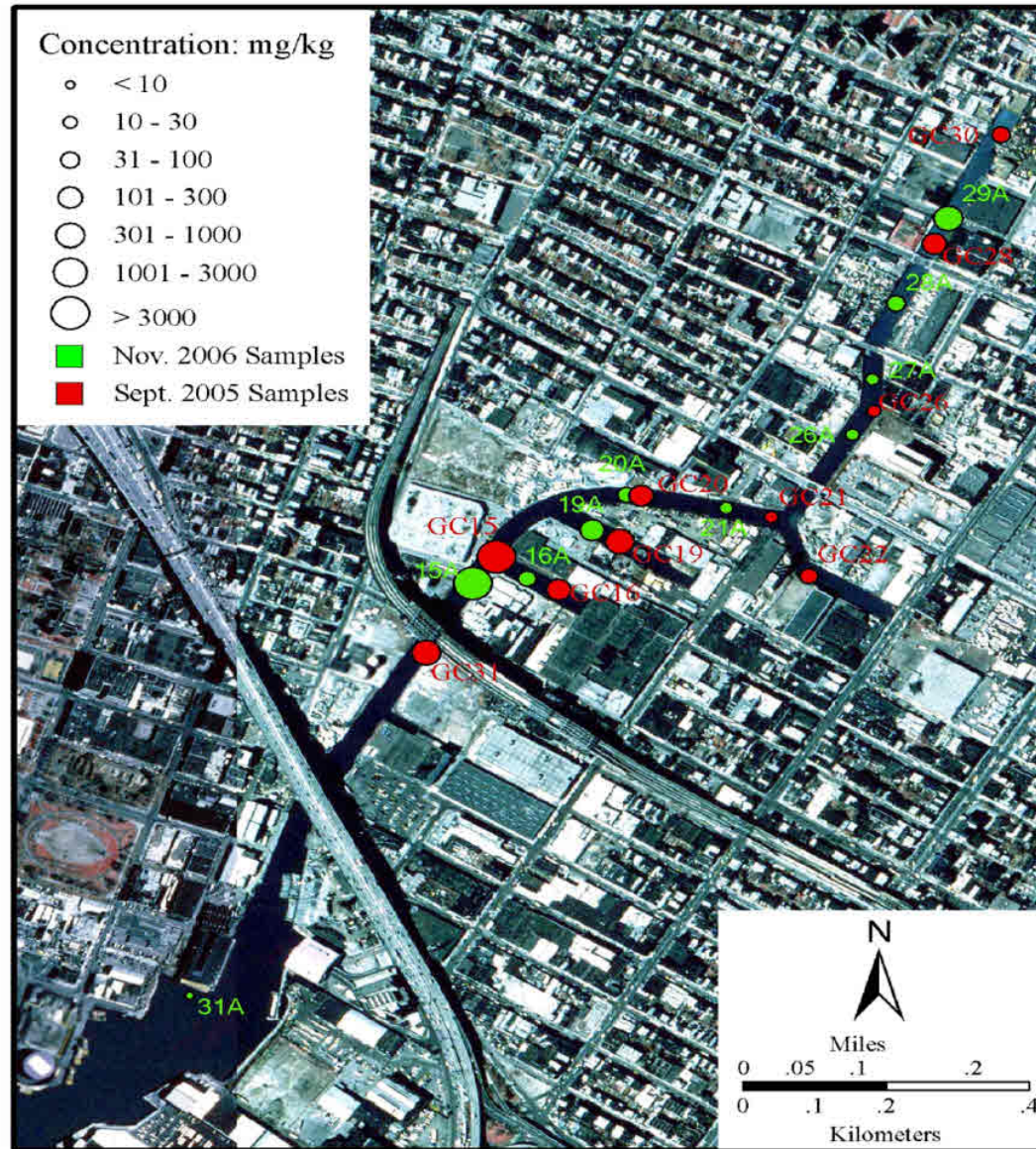


Development Adjacent to the Gowanus Canal





Gowanus Canal Surficial Sediment Chemistry (Total Priority PAH Concentrations)



2005 samples: STL Laboratory, Edison, NJ
 2006 samples: Ft. Monmouth Environmental Testing Laboratory

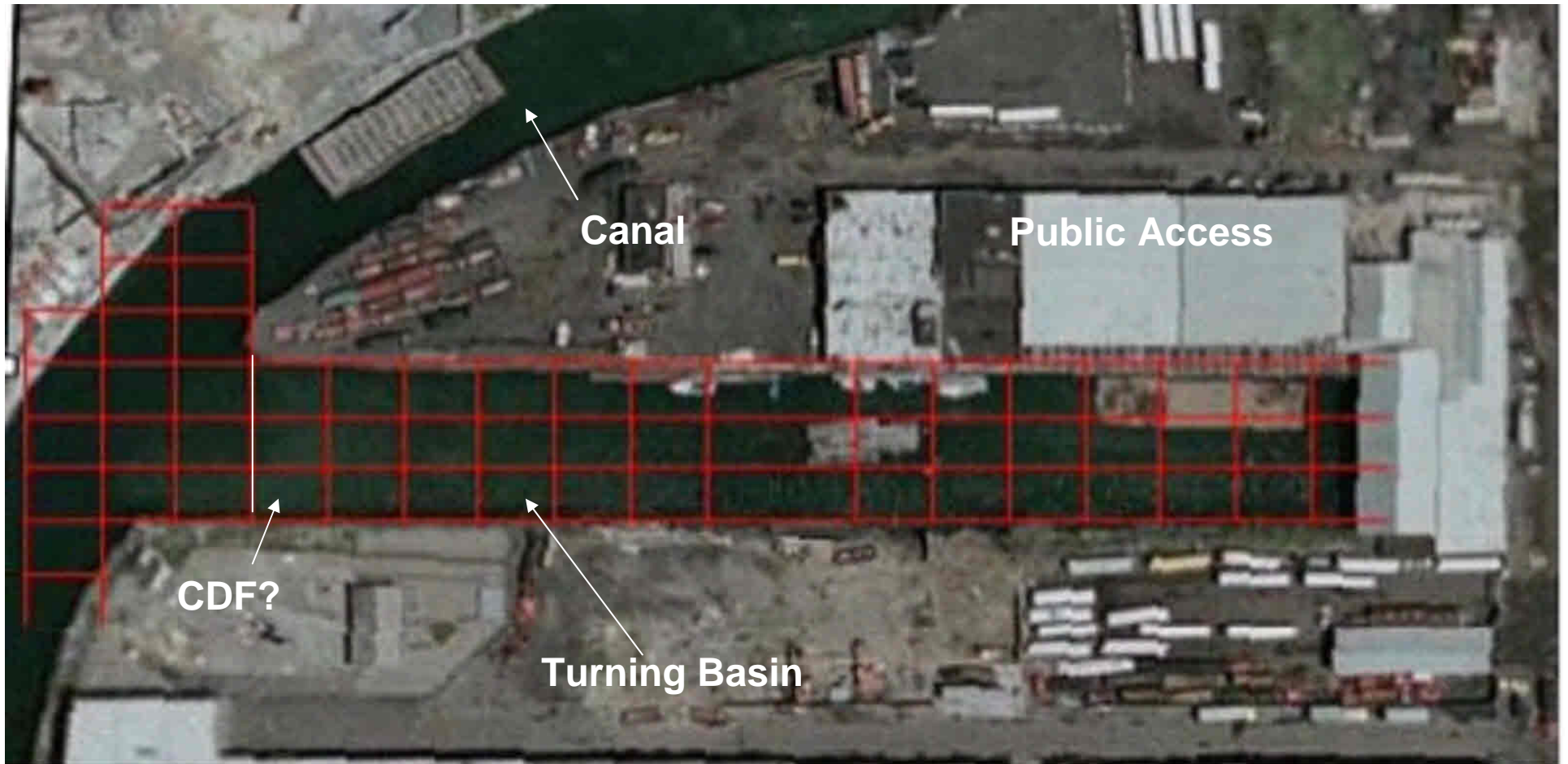
Montclair State University
 Passaic River Institute
 Gowanus Canal Research Team
 Montclair, NJ, 07043, USA

Pilot Demonstration

- Conduct a pilot-scale demonstration in parallel to the USACE Feasibility Study
- Similar to an Interim Remedial Measure
 - Quick to implement
 - Collect data – monitor effect for long-term action. Integrate with final remedy
 - **Public Access / Community Support**



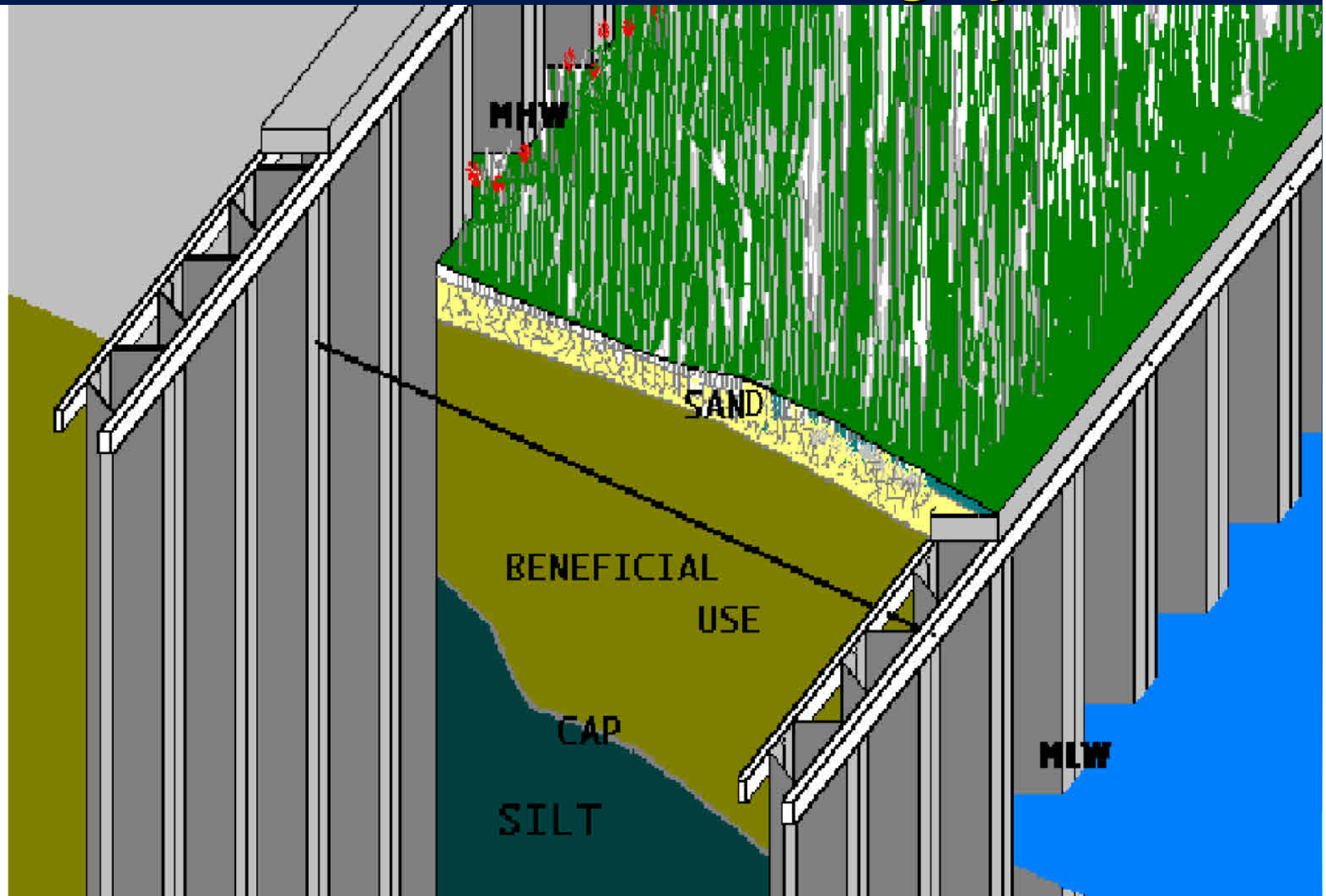
Pilot Demonstration



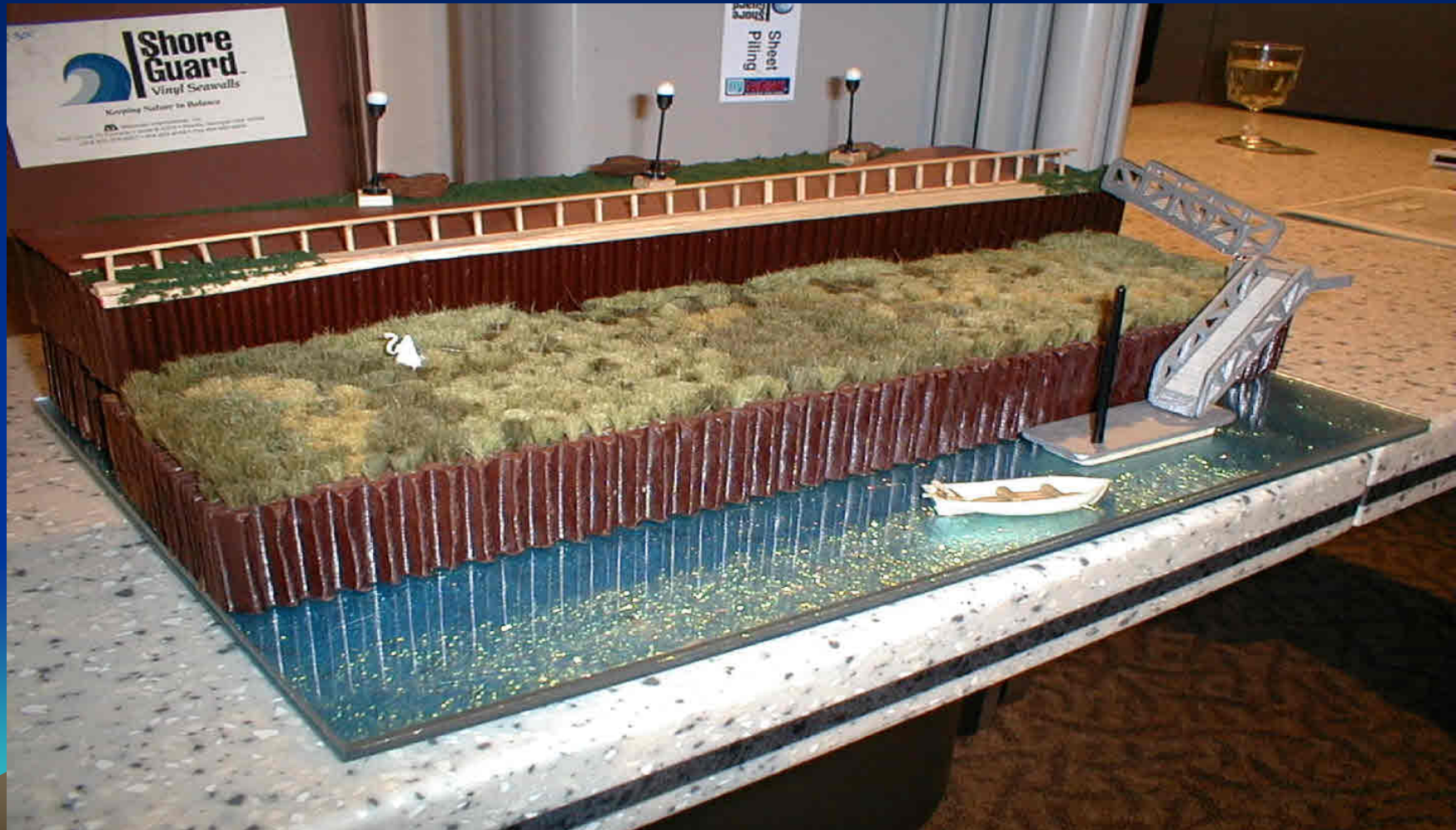
AquaBlok Capping

**Bulk and Tiering Wetland
Restoration**

Bionautics Bulk and Tiering System



Bionautics Bulk and Tiering System



Gowanus Canal



Summary

- **It's a business..... Venture capital interest**
- **Regional Multi-Media Processing Facilities**
 - **Treatment Train**
- **Innovative [ALL] Integrated Technology Driven**
- ✓ **Sediments are a Resource**
- ✓ **Beneficial Use Applications**
- ✓ **Long-term linear generational view of Sustainability – it's a social property / right**



Sediment Based Products

Polymer/Composite Research

BASF Corporation

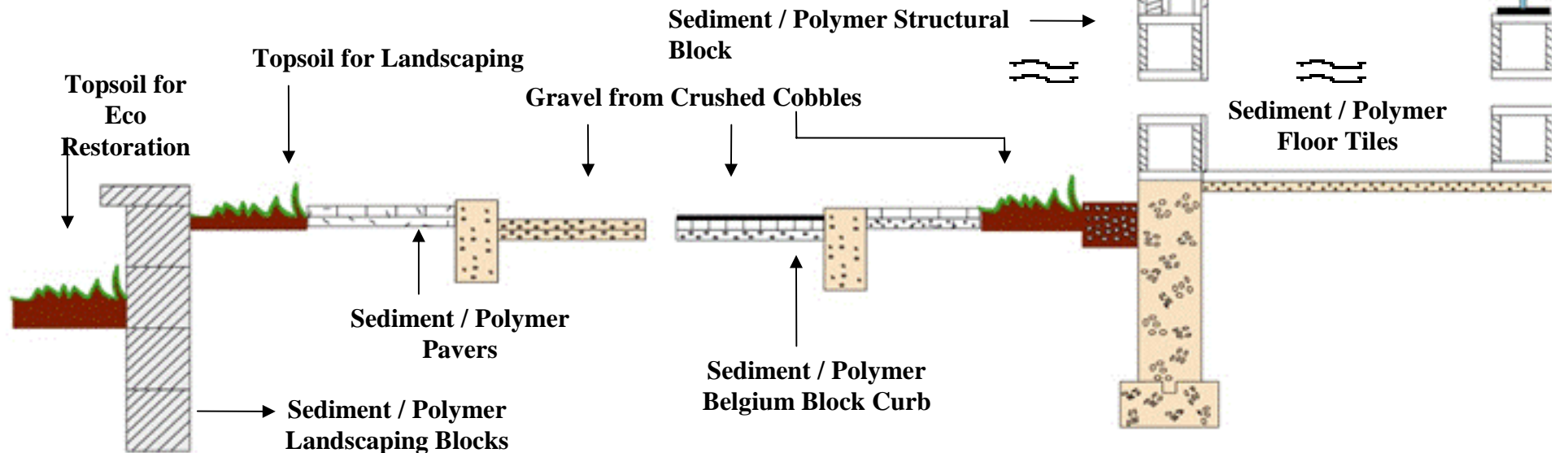
SUNY Stony Brook

Brookhaven National

Laboratory

USEPA Region 2/ORD

(after Stern, 2005)



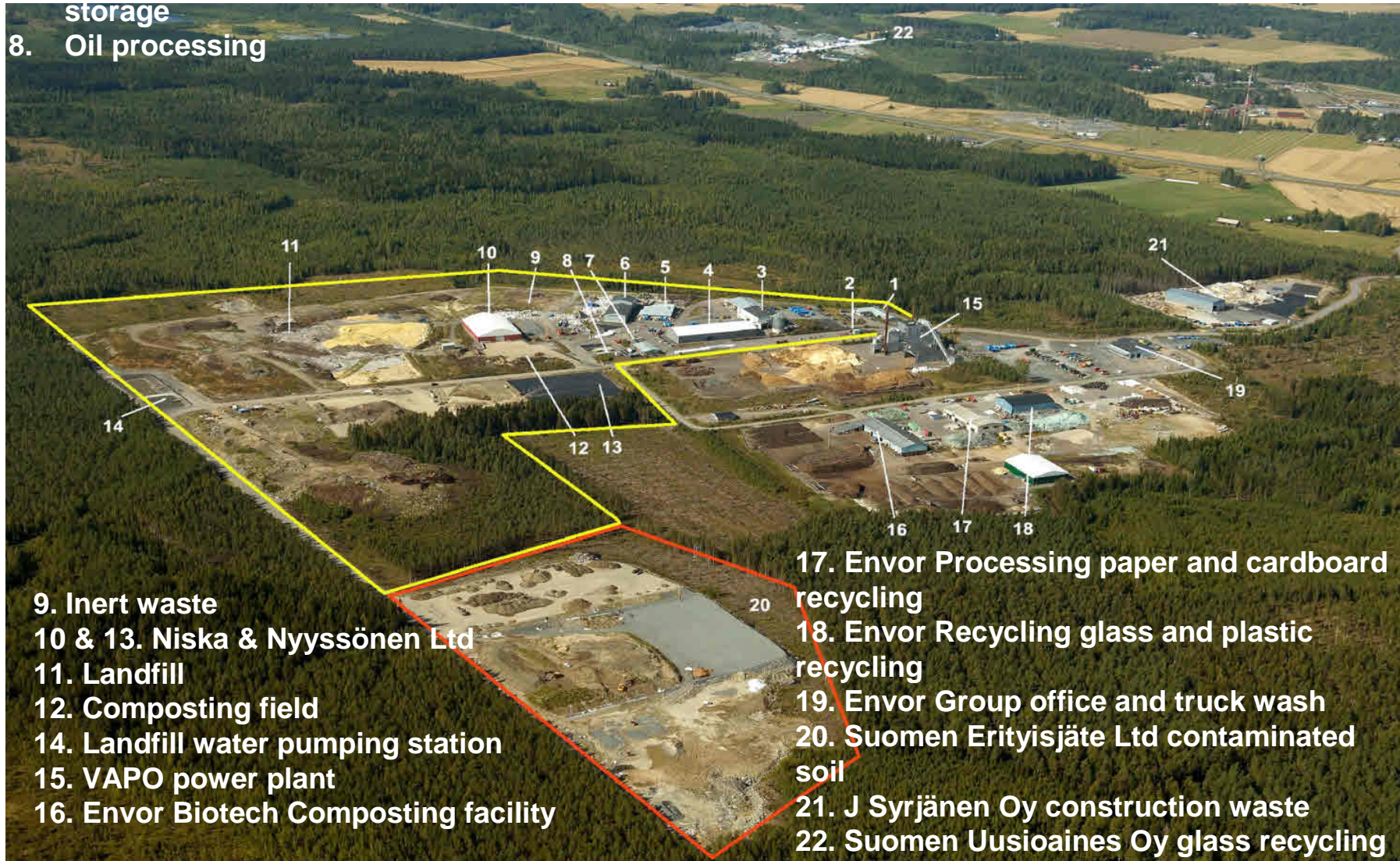
1. LHJ office
2. Weighing station
3. REF-facility
4. REF Storage
5. CRT-Finland Ltd
6. Cool-Finland Ltd
7. Hazardous waste



-A department store for Environmental Services

www.envitech.fi

8. Oil processing storage



9. Inert waste
- 10 & 13. Niska & Nyssönen Ltd
11. Landfill
12. Composting field
14. Landfill water pumping station
15. VAPO power plant
16. Envor Biotech Composting facility

17. Envor Processing paper and cardboard recycling
18. Envor Recycling glass and plastic recycling
19. Envor Group office and truck wash
20. Suomen Erityisjäte Ltd contaminated soil
21. J Syrjänen Oy construction waste
22. Suomen Uusioaines Oy glass recycling



**A Clever Person (or
Solves the Problem
Wise Person Avoids**