



# **Sediment Management Using Light Weight Aggregate (LWA) Manufacturing**

## **An Effective Solution for the Susquehanna River**

**Presentation to the Lower Susquehanna River Watershed  
Assessment Working Group**

**September 24, 2012**

**HarborRock**

# Presentation Content

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- 1. Summary of Susquehanna River Sediment Situation**
- 2. HarborRock Overview**
- 3. LWA Sediment Management for the Susquehanna River**
- 4. Summary of the HarborRock Innovative Reuse Demonstration for the Maryland Port Administration**
- 5. LWA Overview**
- 6. Photographs**



# Summary of Need

## Hurricane Irene and tropical storm Lee bruise the Chesapeake Bay



Over 160 million tons of sediments are currently stored behind the Conowingo Dam.

There is essentially no sediment retention capacity remaining behind the Conowingo Dam;

Consequently, 3 million tons per year of sediment will flow unchecked into the Chesapeake Bay and;

The nation's largest estuary and national treasure plus the region's economic vitality are in jeopardy

Unless immediate action is taken to stop sediments from reaching the Bay;

LWA Manufacturing is the most timely, practical and cost effective Sediment Management tool for this job.

### Muddy waters

When deluges produced by Tropical Storm Lee forced officials to open the gates of the Conowingo Hydroelectric Dam, 4 million tons of built-up sediment gushed into the Chesapeake Bay, coloring the upper half brown, as seen in this satellite image taken Sept. 12.



**HarborRock began R & D in 1996 to develop projects to convert dredged sediments into lightweight aggregate**



# HarborRock History with Sediment Reuse

Since 1996, HarborRock has Manufactured and Tested Structural Grade LWA Made from Dredged Materials at:



# Technology and Business Plan Verification

Recommended by NJDEP's consultant, Louis Berger Inc., for disposal of materials dredged from **Passaic River, NJ**

Business model was validated in \$500,000 Test Program funded in part by NJ Commission on Science & Technology using **Delaware River** dredged materials

"Best Alternative and Most Viable Business" for disposal of sediments from the **Puget Sound, WA** State Department of Natural Resources

Selected by Shaw Environmental Inc. as the preferred solution for the long term disposal of dredged material at **Naval Station Mayport, Florida**

Executed \$400,000 contract with **Maryland Port Administration** to prove reuse is a viable long term sediment management solution.



# Technology and Business Partners

*HarborRock has the resources needed to get the job done*

**ARCADIS U.S., Inc. ([www.arcadis.com](http://www.arcadis.com))** Role: **Development, Permitting, Engineering, Operations.**

ARCADIS is an international company with 16,000 people worldwide and \$2.7 billion in revenues and globally ranks among the top 10 management and engineering firms and top 3 in the environmental market.

**Duane Morris, LLP ([www.duanemorris.com](http://www.duanemorris.com))** Role: **Legal Advisor**

Duane Morris LLP, a full-service law firm with more than 700 attorneys in the United States and around the world.

**FLSmidth ([www.flsmidth.com](http://www.flsmidth.com))** Role: **Process , Equipment Supplier and Process Efficacy Guarantor**

FL Smidth is the leading supplier of equipment and services to the global cement and minerals industry. They employ over 10,000 people and have the largest installed base of kilns (over 3,000) of any company in the world.

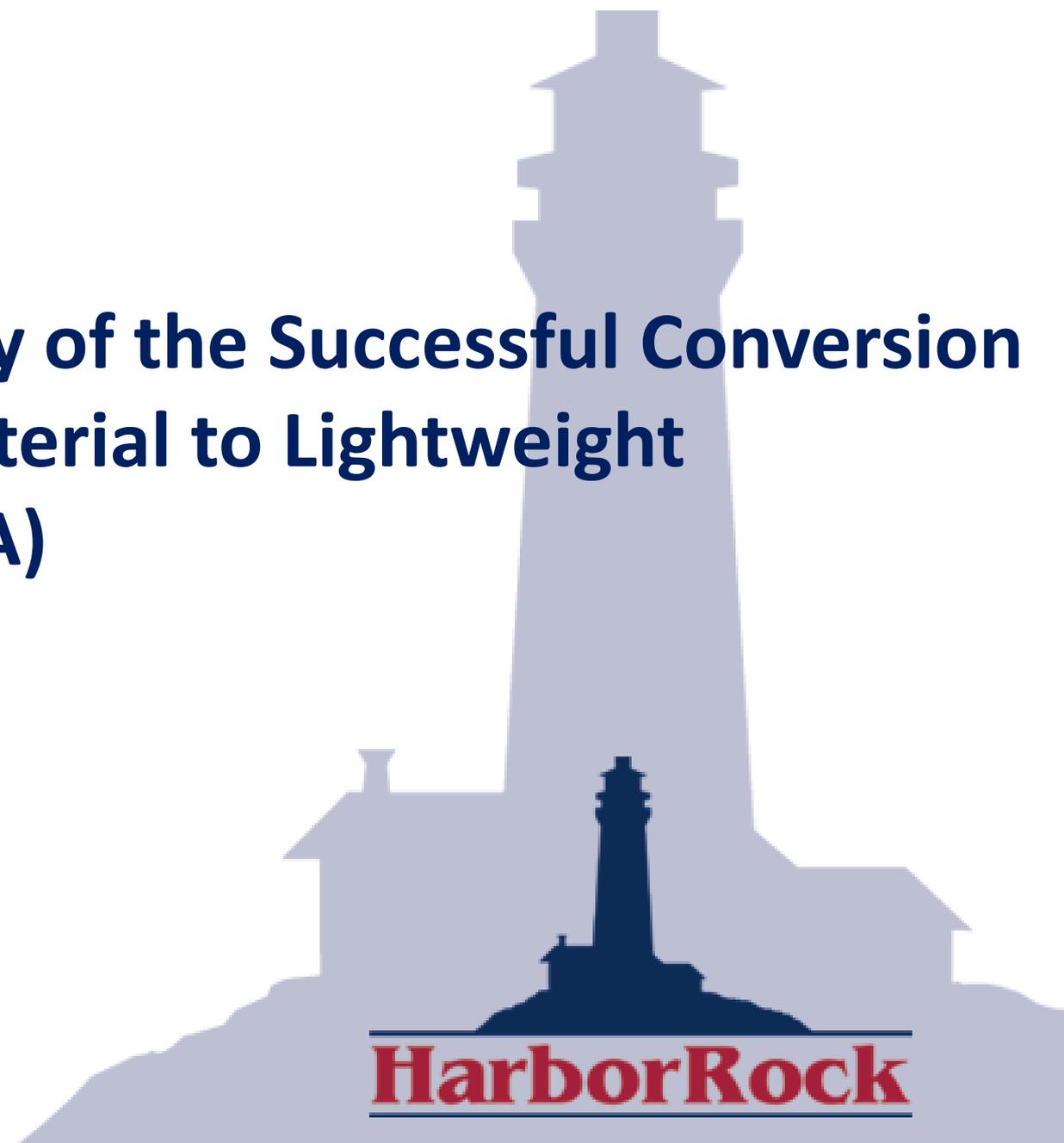
**Roberts & Schaefer Co. ([www.r-s.com](http://www.r-s.com))** Role: **Engineering, Procurement and Construction**

R&S provides mechanical, civil, electrical, and process engineering services for mineral and energy industries globally. R&S is a **KBK ([www.kbr.com](http://www.kbr.com))** company. KBR has 35,000 employees and over \$9 billion in revenues.

**Scully Capital Services Inc. ([www.scullycapital.com](http://www.scullycapital.com))** Role: **Financial Advisor**

Provide investment banking and advisory services in the environmental and infrastructure industries.



A large, light blue silhouette of a lighthouse tower with a lantern room at the top, situated on a rocky island. The base of the lighthouse includes a smaller tower and several buildings. The background is white.

# **Video Summary of the Successful Conversion of Dredged Material to Lightweight Aggregate (LWA)**

**HarborRock**

A large, light blue silhouette of a lighthouse tower stands on a rocky island. At the base of the tower, there is a smaller, dark blue silhouette of the lighthouse's lantern room and a building with a chimney. The background is white.

# **Why & How Sediment Management Using LWA Manufacturing is an Effective Solution for the Susquehanna River**

**HarborRock**

# LWA Sediment Management Qualifiers

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- 1. All Equipment and Methods Being Proposed are Commercially Available, Currently In Use, or Have Already Been Performed**
- 2. HarborRock's Technology and Business Model have been Tested and Validated for Over a Decade**
- 3. There are Guarantees Available for all Construction Costs and Process Inputs and Outputs**
- 4. It Will Take 4-5 Years To Permit & Build a Susquehanna LWA Sediment Management Facility**



# LWA Sediment Management Concept Summary

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*Use Sediments as the Raw Material to Make Aggregate that is Sold and the Revenue Earned is Used to Offset Costs*

- 1. Install Hydraulic Dredge in Conowingo Reservoir**
- 2. Extract 3 Million Tons/Year of Sediments from the River and Transport Material Via Pipeline to LWA Manufacturing Plant**
- 3. Produce 2.7 Million Tons/Year of LWA Using 3 Gas Fired Kilns**
- 4. Return Water to the River Through Electricity Producing Turbines**
- 5. Employ 160 Full Time in the LWA Facility**
- 6. Transport LWA via Truck, Rail and Barge**



# LWA Market Considerations

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**2.7 million tons of LWA will be produced per annum**

**The LWA will be marketed & priced to:**

- 1. Demonstrate LWA's enhanced performance over dense aggregates**
- 2. Compete with dense aggregate in multiple market sectors: structural concrete, asphalt chip seal, etc.**
- 3. Grow demand for LWA in developing applications (e.g. green roofs, horticulture)**
- 4. Allow for freight costs to distant markets**



# LWA Sediment Management Economics

*The typical business model for a HarborRock LWA Sediment Management Facility consists of 2 Expenses and 2 Revenue Sources. Revenues must balance Expenses.*

**Expenses:**

- 1) Operating Costs (fuel, labor, profit etc.)
- 2) Capital Repayment (debt)

1. Operating Costs are generally stable and predictable
2. Capital Repayment is dependent on how the project is structured & ownership. Generally public funds/ownership are less expensive than private funds

**Revenue :**

- 1) LWA Sales
- 2) Sediment Management Fee (\$/ton)

1. LWA Sales revenue is generally stable and predictable
2. The Sediment Management Fee makes up any revenue needs, If Necessary

**A conservative estimate of the Sediment Management Fee for the Susquehanna River is \$20/ton - \$25/ton.**



# Comparative Economic Analysis

*“Haul Away & Dump” is the only alternative to LWA Sediment Management as a 100% solution for management of the Susquehanna River sediments*

*“Haul Away & Dump” requires the addition of a “Binding Agent” to solidify the sediments for transport*

Sediments requiring removal – 3.0 millions tons/year

Binding Agent @ 50% – 1.5 million tons/year

Total Disposal Amount - 4.5 million tons/year

Estimated All In “Haul Away & Dump” Cost - \$100 per ton

Total Annual Cost for “Haul Away & Dump”- **\$450 million/yr**

LWA Sediment Management Fee - \$20 -\$25/ton

Sediments removed– 3.0 millions tons/year

Total Annual Cost for LWA Sediment Management **\$60 - 75 million/yr**

**Over \$1 Million/Day Savings Plus the Benefits of Jobs and Long-Term Capital Investment**



# Potential Siting Area

*Area available for facility sites is limited only by the hydraulic pumping distance*

5 miles

Nominal Area for Sites  
125 square miles – per side

15 miles

10 miles

Holtwood

Conowingo

Harford

Cecil

Havre De Grace

Image U.S. Geological Survey  
© 2012 Google

Image PA Department of Conservation and Natural Resources-PAMAP/USGS

Imagery Date: 10/7/2011

39°40'44.47" N 76°06'21.81" W elev 339 ft



# Next Steps to Develop Susquehanna LWA

*Immediate Actions, On Parallel Fronts, are Needed to Address The Critical Issue Upon Us or We Will Be Overtaken by Inevitable Events that have Catastrophic Consequences*

1. Form a Decision Making Committee to engage with HarborRock to establish budget, plan & source funds for project implementation
2. Undertake a comprehensive Demonstration Program comparable to the one HarborRock performed for the Maryland Port to:
  - a) Obtain permitting data
  - b) Determine aggregate quality
3. Begin identification of suitable sites
  - a) >50 acres
  - b) Access to roads, rail, barging, infrastructure etc.



A large, light blue silhouette of a lighthouse tower with a multi-tiered top, standing on a rocky island. In the foreground, a smaller, dark blue silhouette of the lighthouse's base and a small building is visible. The background is plain white.

# Summary of the Innovative Reuse Demonstration Program for the Maryland Port Administration

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# Advantages to the MPA from Using LWA Manufacturing for Sediment Management

## Fully Permitted, Renewable Capacity Disposal Site Inside the Harbor

- 1) Eliminates expense & risk securing other disposal sites
- 2) Reduces dredged material haul costs
- 3) Requires small footprint – nominally 15 acres

## Operational Year Round with Scale Up Potential

- 1) 365 days per year operation, rain or shine
- 2) Initial System Capacity of 500,000 CY/yr or more
- 3) Rapid scale up to >1.0 million CY/yr. without increases in site acreage

## Handles Clean or Contaminated Materials

- 1) Material segregation not required
- 2) Verifiable contaminate destruction > 99.99 % effective
- 3) No Mixing or Blending with other products
- 4) No waste products



# Advantages to the MPA from Using LWA Manufacturing for Sediment Management

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## Financial

- 1) Innovative Reuse cost is competitive & predictable
- 2) Enables long-term budgeting & forecasting
- 3) Pay for IR only as the dredged material is processed – no capital outlay

## Job Creation

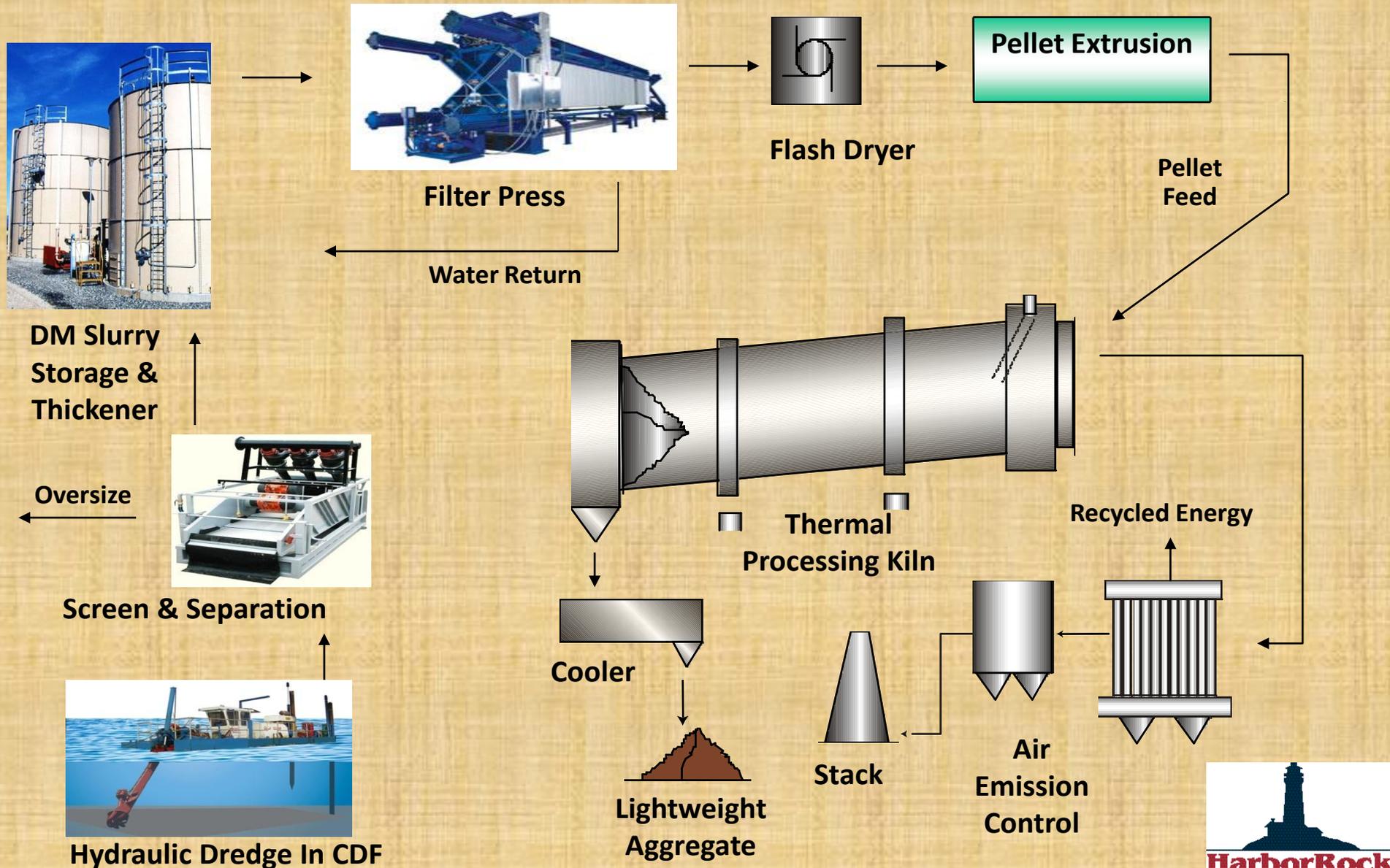
- 1) 200 man-years of construction employment
- 2) 65 ongoing family wage jobs in operations
- 3) 50 ongoing transportation related jobs
- 4) 345 indirect jobs @ 3:1 multiplier

## Capital Investment & Taxes

- 1) Over \$75 million manufacturing facility constructed



# HarborRock - Simplified Process Flowsheet



# Scope of Innovative Reuse Demonstration

*All key aspects of the HarborRock LWA process were tested and demonstrated*

- 1) **Chemical & Physical Analysis of DM, Cox Creek Water, Effluent & LWA**
- 2) **Effectiveness of Dredged Material Dewatering with Filter Presses**
- 3) **Dredged Material Drying Operation (natural gas )**
  - a) Mass & Energy Balance, b) Emissions Testing
- 4) **Pilot Scale LWA Production (approx. 5 tons )**
  - a) Mass & Energy Balance, b) Emissions Testing
- 5) **LWA and Concrete Masonry Block Testing per ASTM standards**
- 6) **Engineering**
  - a) Equipment Configuration, b) Air Pollution Control Design,
  - c) Mass & Energy Balance, d) Capital & Operating Costs



# Overview of Demonstration Study Results

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## Hydraulic Dredge Performance Verified (Ellicott Dredges, LLC)

- ✓ Enabled sizing of tanks, plant flow rates, solids content

## Screen & Separation Efficiency Determined (DEL Tank/Krebs Engineers)

- ✓ Enabled equipment sizing, reject rates, CAPEX and OPEX

## Filter Presses & Thickener (FLSmidth – Dorr Oliver Emico)

- ✓ Enabled sizing, flocculant dose, sizing, CAPEX, OPEX and return water testing

## Extrusion Testing (J.C. Steele & Sons, Inc. and FLSmidth)

- ✓ Verified small extrusions produce quality LWA - less final crushing needed

## Air Emissions Data Obtained (Peregrine Technical Services, LLC)

- ✓ Enabled air pollution control system design for permitting



# Overview of Demonstration Study Results

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## Chemical & Physical Data Obtained (Fredericktowne Labs Inc.)

- ✓ Below detection limits for all organics and metals in solids
- ✓ Minor variations in metals concentrations from basin water input and return water from thickener – data currently under analysis by FLSmith

## Aggregate Quality Confirmed (Construction Technology Laboratories, Inc.)

- ✓ Meets and exceeds all ASTM C330 and C331 requirements

## Block Testing (National Concrete and Masonry Association & Ernest Maier, Co)

- ✓ NCMA, in conjunction with Ernest Maier, Co., confirms masonry blocks made using only 25% HarborRock LWA meet and exceed ASTM C90 requirements

## Engineering and Cost Evaluations Completed (FLSmith & Scully Capital)

- ✓ Pollution control system design for permitting
- ✓ Full Scale plant Capital & Operating Expenses developed



# Overview of Lightweight Aggregate

A large, light blue silhouette of a lighthouse and several buildings on a hill, serving as a background for the slide. The lighthouse is the tallest structure, with a smaller one in front of it. The buildings are clustered at the base of the lighthouse.

**HarborRock**

# What is Lightweight Aggregate?

1. Volcanic stone - pumice, lava rock;
2. Shale, slate or clay (dredged material) expanded in rotary kilns that operate at temperatures over 2,000°F.



# LWA provides more than twice the volume for the same weight as conventional aggregates



1 lb. Soil

1 lb. Lightweight  
Aggregate

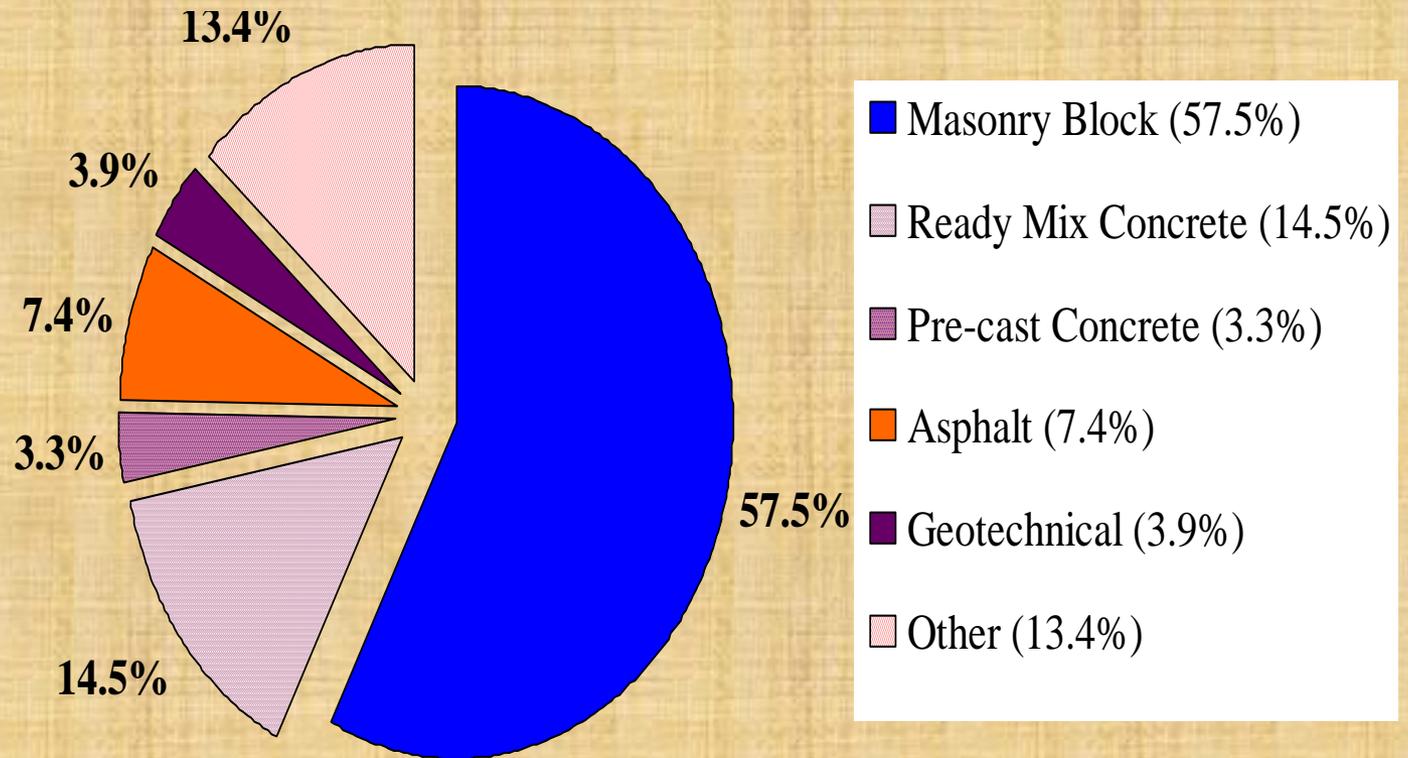
1 lb. Sand

1 lb. Gravel

1 lb.  
Limestone



# LWA Market Segments



# Advantages of HarborRock's LWA

## 1. Is Extruded & Highly Engineered:

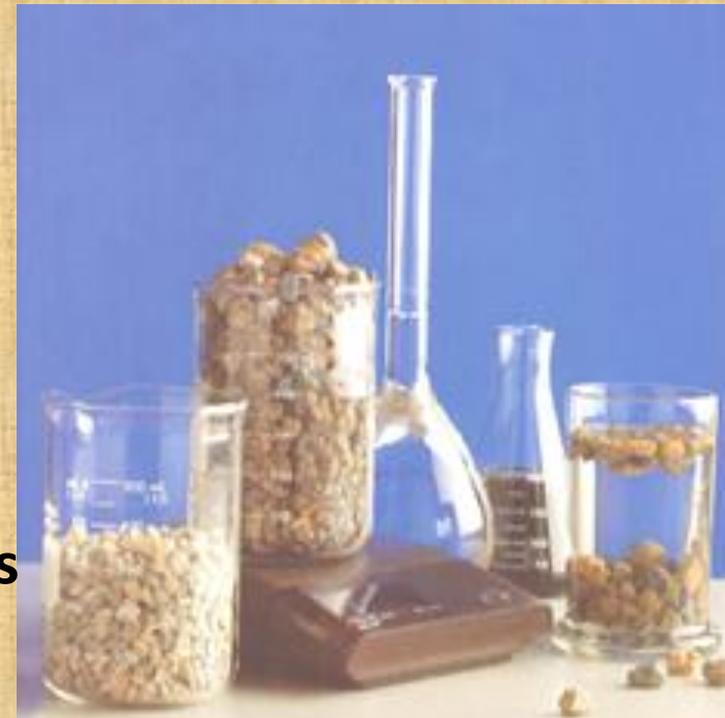
- Uniform and consistent properties

## 2. Meets ASTM standards

- C330 LWA for Structural Concrete
- C331 LWA for Concrete Masonry Units
- C90 for Concrete Masonry Units

## 3. Is Inert & Highly Marketable:

- Complete destruction of organic contaminants
- Metals immobilized magnitudes below RCRA TCLP limits
- Not blended or mixed with other products
- Eligible for LEED Certification



# Photographs

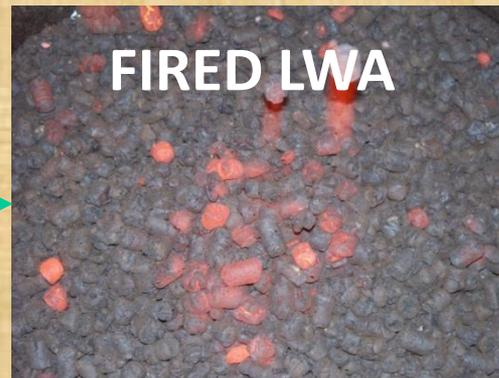
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The following are photographs taken of various aspects of the HarborRock process including:

- kiln test equipment;
- LWA samples;
- the Maryland Port Administration's Cox Creek Dredged Material
- Containment facility
- hydraulic dredging.



# LWA TEST SAMPLES



# SMALL DIAMETER EXTRUSION WORK

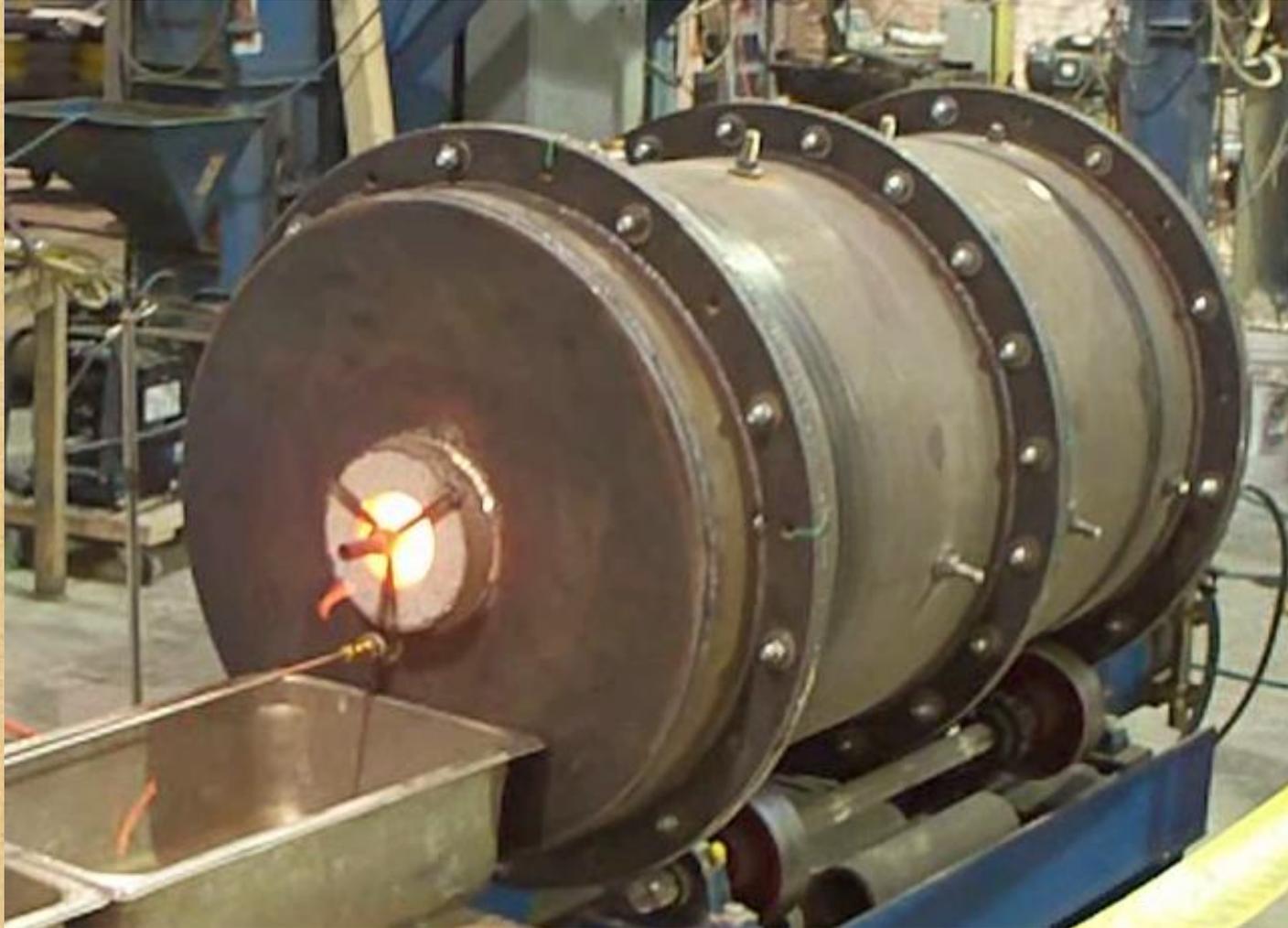
## EXTRUDER OPERATION



## FURNACE TEST SAMPLES



# BATCH KILN TEST UNIT



# PILOT ROTARY KILN (3' x 50')



# Greater Port of Baltimore

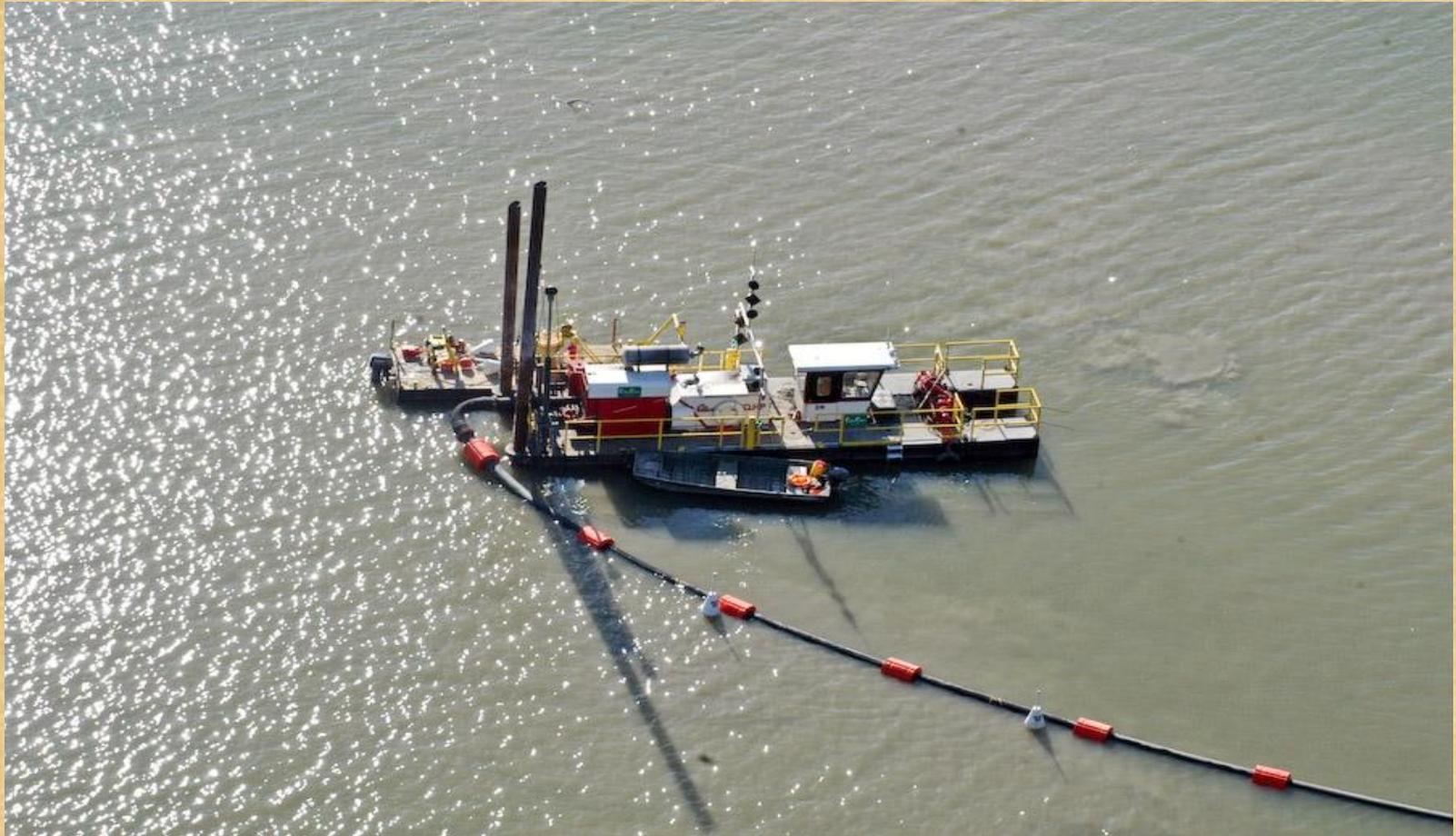


**HarborRock**

# The MPA's Cox Creek Dredged Material Containment Facility (DMCF)



# Hydraulic Dredging



Over 125 years design/build experience in hydraulic dredges; two manufacturing plants in North America – one in Baltimore, MD



Jeffrey B. Otto, P.E.

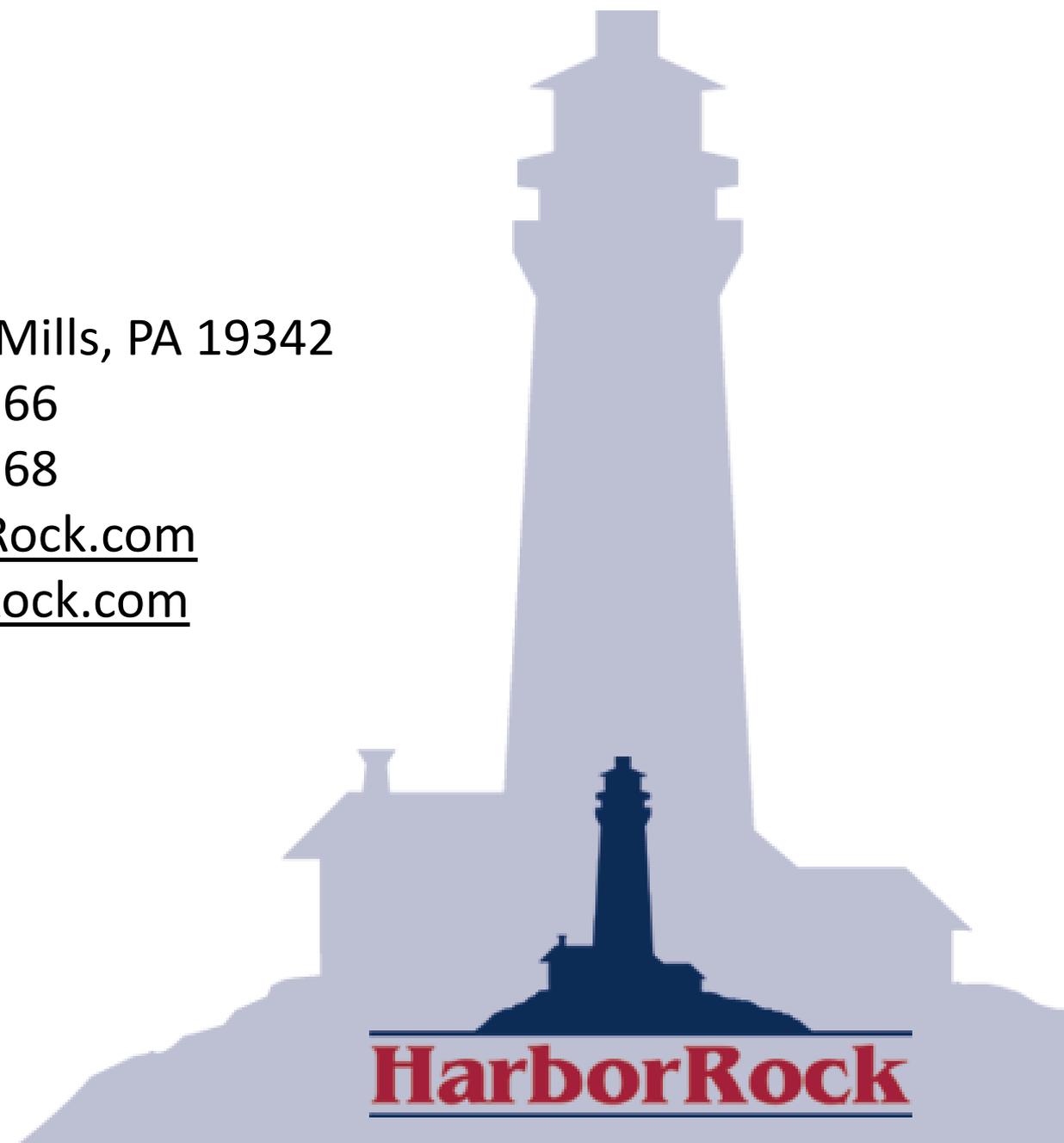
411 S. Ivy Lane, Glen Mills, PA 19342

Phone: 610 - 358 – 9366

FAX: 610 - 358 – 9368

Email: [Info@HarborRock.com](mailto:Info@HarborRock.com)

Web: [www.HarborRock.com](http://www.HarborRock.com)

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