CONOWINGO SEDIMENTS AS A RESOURCE

Results from the Pilot Project and Next Steps for Commercialization

March 29, 2023

BATTELLE

ICR23
Innovations in Climate Resilience

northgate
environmental management, inc.

CONTRIBUTORS AND TEAM STRUCTURE

Today's Presentation:

Deni Chambers, Principal-in-Charge - Northgate
Steve Bedosky, Project Manager - Northgate
Ana Demorest, Lead Engineer - Northgate
Sam Merrill ***(Presenter)****, Economic Analysis* - Northgate

Overall Project:

Extensive involvement and contributions from over a dozen industry, academic, and government partners.

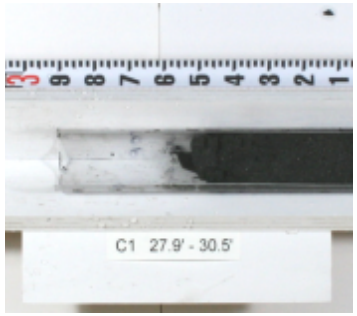
SESSION AGENDA

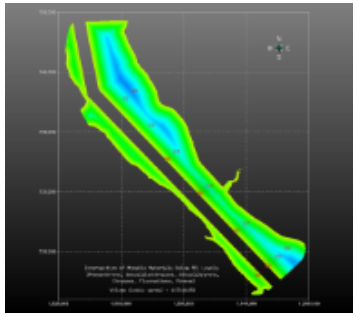
1	Project Background
2	Sediment Characterization Study Results
3	Bench Scale Testing
4	Water Quality Impact Evaluations
5	Economic Evaluations
6	Conclusions and Next Steps

PROJECT COMPONENT #1

Sediment Characterization Study

- Characterize thickness and volume of sediment wedge
- Characterize physical and chemical properties of sediment wedge
- Assess potential implications of chemical characteristics on potential sediment reuse
- Assess abundance and distribution of known coal layers
- Provide data to support nutrient and sediment transport models





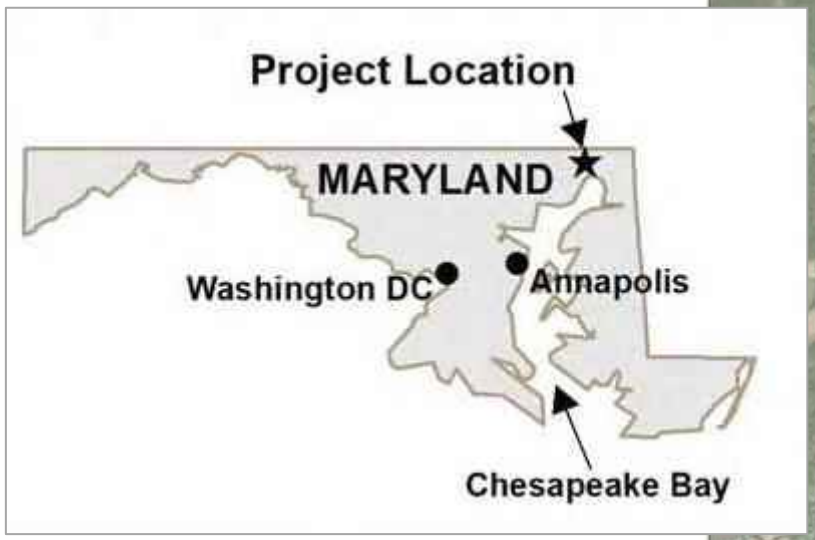
PROJECT COMPONENT #2

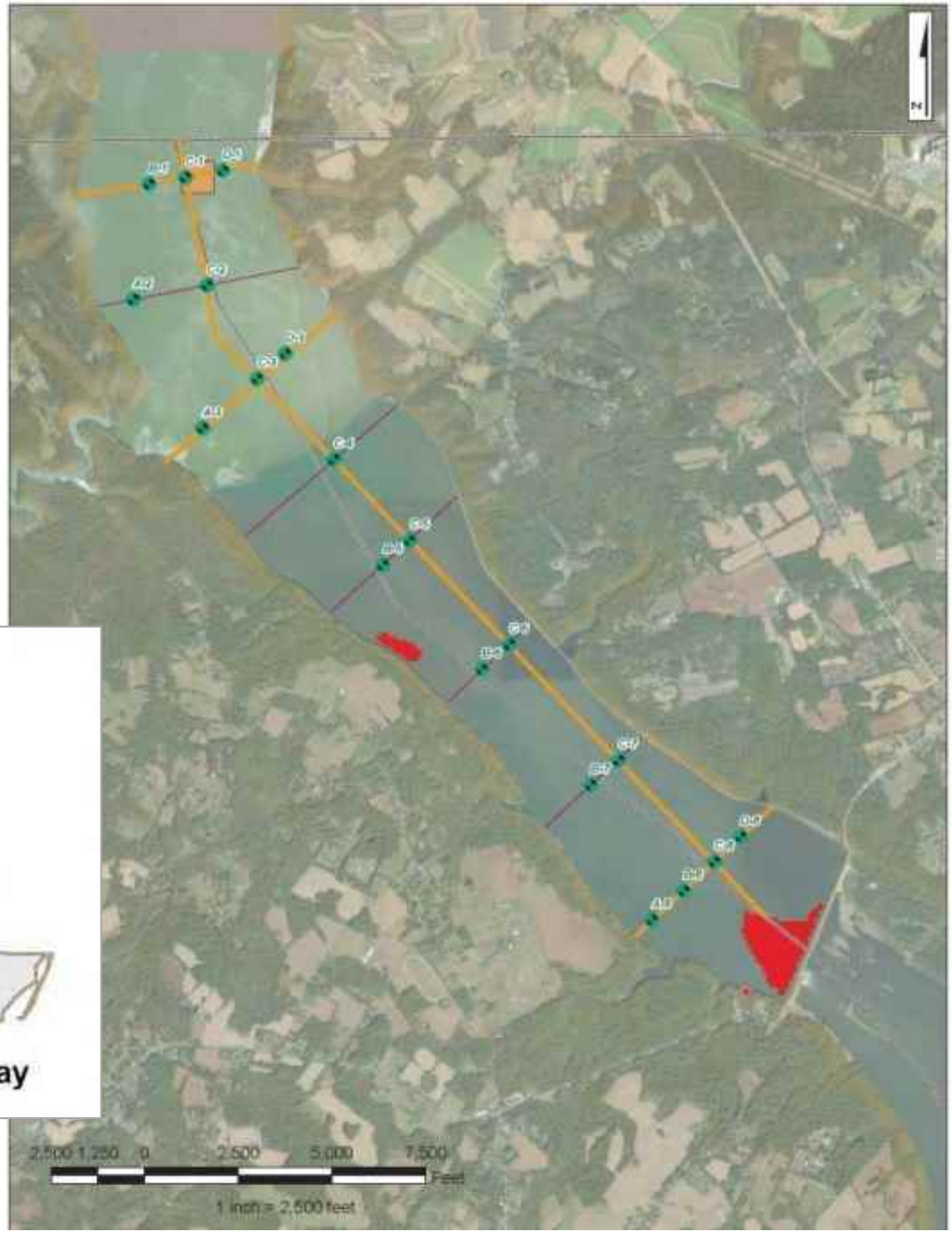
Innovative Reuse Demonstration

- Dredge 1,000 CY from designated dredging area
- Conduct bench scale tests to assess suitability of material for potential end uses
- Demonstrate suitability of material in manufactured products
- Evaluate changes in nutrient and sediment flux caused by increased storage capacity
- Conduct economic analysis of incorporating dredge material into suitable products

DRAINAGE BASIN

CORE LOCATIONS



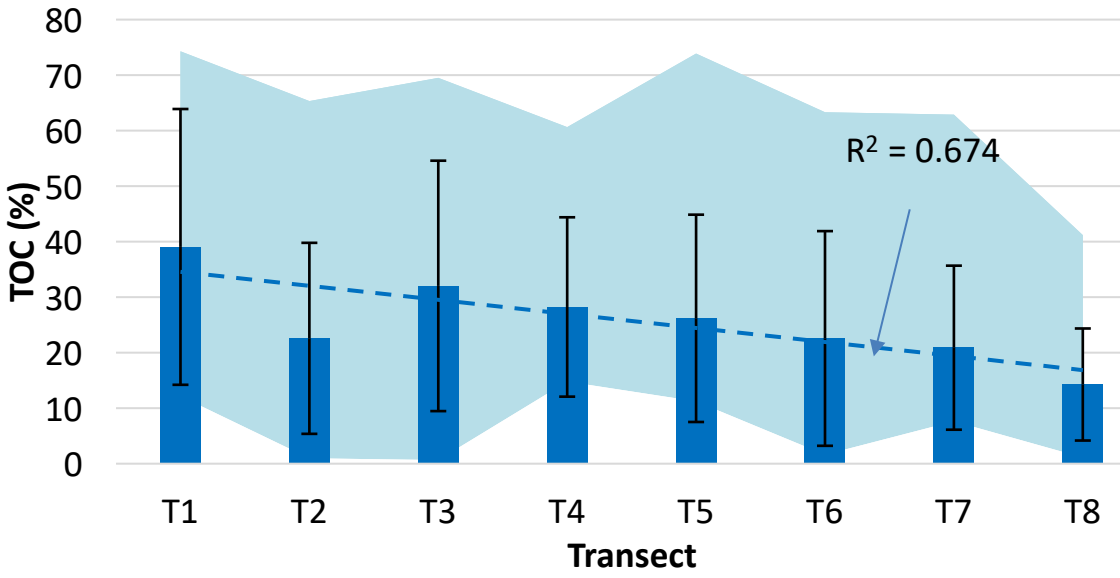


FIELD ACTIVITIES

- Over 150 core intervals characterized
- All samples analyzed for grain size, metals, organic carbon (coal), and percent moisture
- 32 samples analyzed for Maryland IR/BU Guidance parameters
- 1,000 cy of sediment dredged and dewatered for end use demonstration

PHYSICAL RESULTS

- Approximately 250 million cy of sediment
- The material is predominantly interbedded silt and clay with sand lenses
- Sand/granular coal deposits near State line; predominantly silty clay near Dam
- Granular coal and coal dust observed throughout



SEDIMENT CHARACTERIZATION INSIGHTS

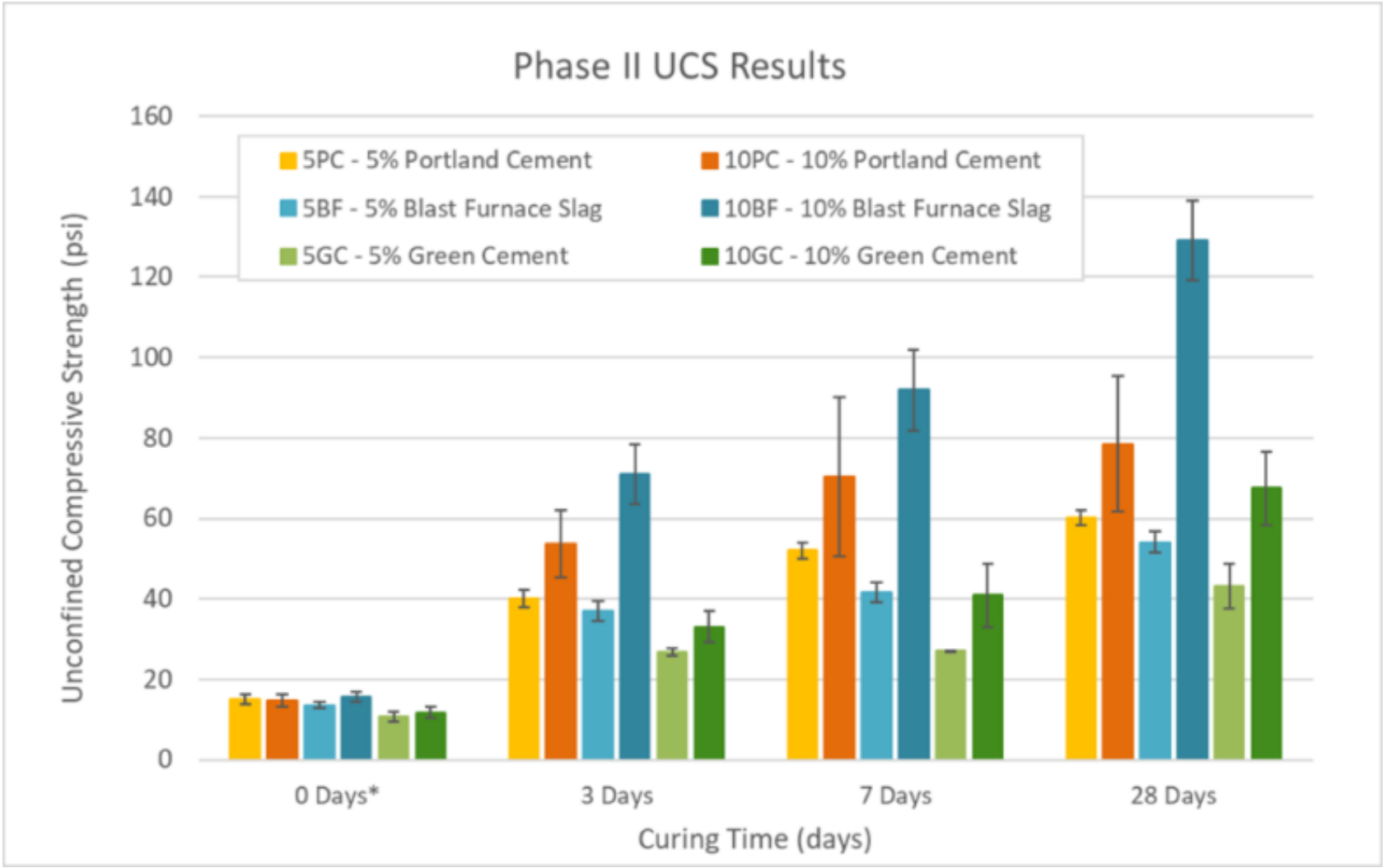
- ✓ **New Distribution Data –** Distribution of sand, silt, and clay throughout the reservoir was previously unknown. Data will be useful in fine tuning predictive models and help guide decisions about potential sediment removal.
- ✓ **Coal –** Granular coal and coal dust were observed throughout the Reservoir at concentrations above those observed in prior investigations. This will influence sediment reuse evaluations and may require material processing before reuse.
- ✓ **Metals and PAHs –** Chemical analysis indicated presence of select metals (Arsenic, Manganese, and Thallium) at concentrations consistent with regional background levels; PAHs observed are likely associated with coal in the matrix.
- ✓ **End Use Implications –** Some metals and PAHs may influence suitability of the material for some end uses while not affecting others. Additional coal leachability tests are required to assess bioavailability.

BENCH SCALE TESTING RESULTS

- Concrete/Asphalt
- Cement Clinker
- Supplementary Cementitious Materials
- Solidification/Stabilization
- Soil Blending
- Soil Fertility Testing

CONOWINGO TREATABILITY RESULTS – PHASE II

Summary of Bench Scale Solidification/Stabilization Laboratory Testing



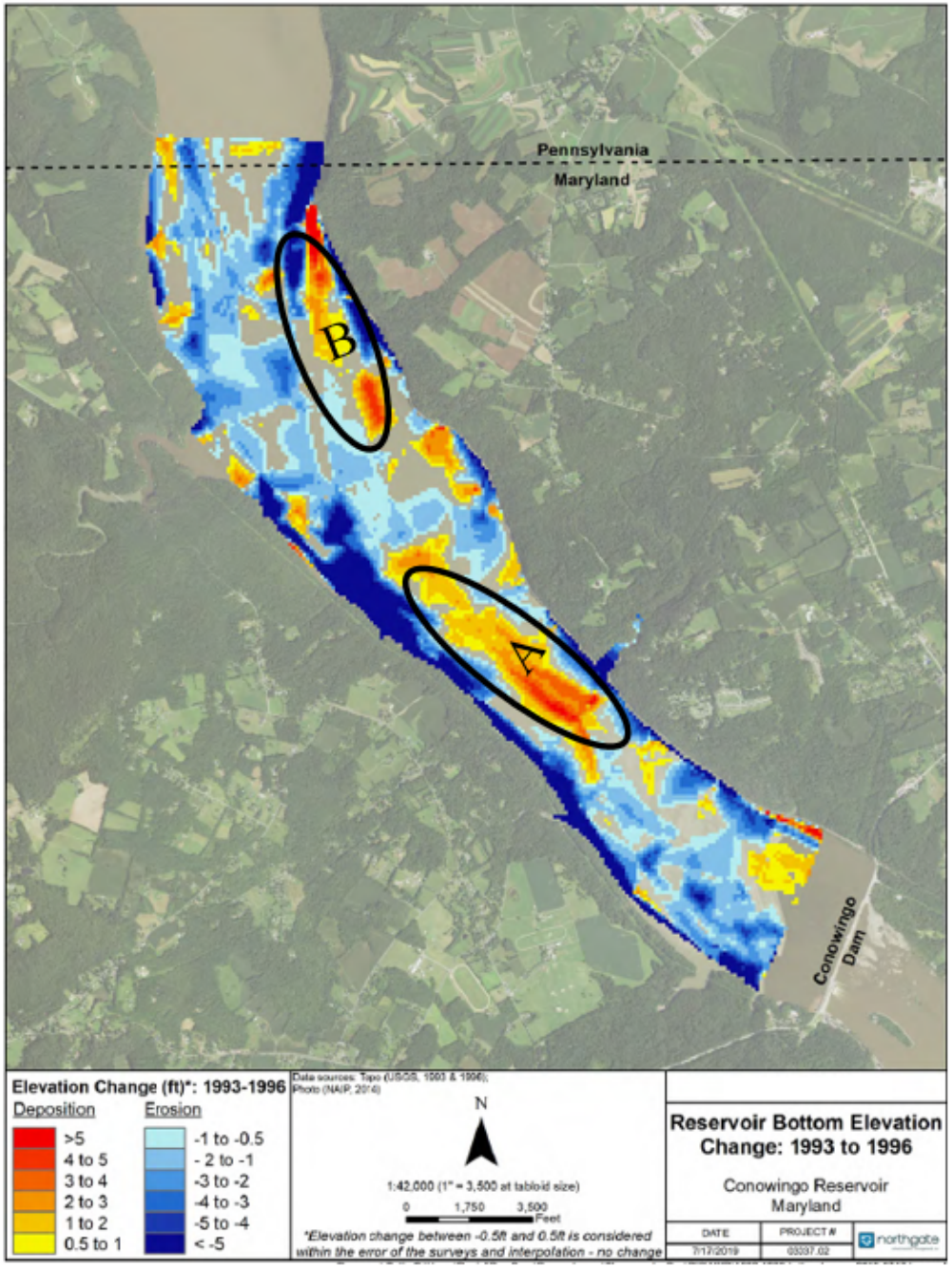
CEMENT CLINKER - BENCH SCALE TESTING

Fine-grained sediment samples were compared to shale from Hagerstown, an existing clay mineral source for industrial scale clinker production

	Conowingo Sediment	Hagerstown Shale
% Moisture	46.14	9.0
LOI, %	17.06	8.5
SiO2, %	59.14	60.23
Al2O3, %	14.79	15.6
Fe2O3, %	7.53	8.67
CaO, %	0.59	1.29
MgO, %	1.04	1.21
Na2O, %	0.17	0.11
K2O, %	2.79	3.34
SO3, %	0.77	0.07
TiO2, %	0.91	0.87
P2O5, %	0.3	0.18
Mn2O3, %	0.38	0.07

WATER QUALITY IMPACT EVALUATION

- **Data Evaluation and Synthesis** – review of historical chemical and physical data, modeling results, and implications on nitrogen and phosphorous flux to the upper Chesapeake Bay.
- **Water Quality Impact Calculator** – a planning level screening tool was developed to approximate the effect of different sediment removal quantities on sediment and nutrient loading.
- **Strategic Dredging Plan** – dredging scenarios were developed with characteristics that will increase trapping capacity to reduce pollutant transport considering logistical constraints such as wildlife restrictions and other regulatory requirements.


Pennsylvania
Maryland
B
A
Conowingo Dam
Elevation Change (ft)*: 1993-1996
Deposition
>5
4 to 5
3 to 4
2 to 3
1 to 2
0.5 to 1
Erosion
-1 to -0.5
- 2 to -1
-3 to -2
-4 to -3
-5 to -4
< -5
Data sources: Topo (USGS, 1993 & 1994); Photo (NAIP, 2014)
N
1:42,000 (1" = 3,500 at tabloid size)
0 1,750 3,500
Feet
*Elevation change between -0.5ft and 0.5ft is considered within the error of the surveys and interpolation - no change
Reservoir Bottom Elevation Change: 1993 to 1996
Conowingo Reservoir
Maryland
DATE
7/17/2019
PROJECT #
03037.02
northgate

ECONIMIC EVALUATIONS

- Conducted **market evaluations** for each product
- Used **three dredging scenarios** (1, 3, 5 MCY plus sediment transport, dewatering, and separation costs) to evaluate the extent to which the State could offset costs of dredging, dewatering, and separation through sale of IR/BU products
- Conducted a **Willingness-to-Pay analysis** to gauge public appetite to support these activities

  >> Public WTP was calculated as $20.3 million per year

ECONIMIC EVALUATIONS

- In combination, the IR/BUs evaluated represent **a means for the State to find end destinations for all dredged material.**
- Cost efficiency of evaluated scenarios (the portion of State costs that can be recovered through product sales) ranged from 12 – 15% when trucking is the transportation mode from separation site to vendor site, and 65 – 137% with barging.
- Results also depended on:

  >> Volume scenario and transportation mode

  >> Degree to which the State is responsible for costs of dredging, pumping, dewatering, and separating sediment

LESSONS LEARNED

- Infrastructure needs for a project of this scale are significant, to address 3 MCY of pumping, dewatering, and separation of sediment fractions – plus bringing them to market.
- Land-intensive operation with significant permitting and public acceptance strategy development needs – in addition to public-private finance partnerships. – But it's what's needed to solve the environmental problem.

2011, Tropical Storm Lee

CONCLUSIONS

- **Economic evaluation** indicates that local markets for IR/BU products are robust. Demand for concrete, asphalt, and cement clinker is greater than the supply while supply is greater than demand for blended soil and stabilized sediment
- **Additional bioavailability testing** will be required when considering "in-water applications"
- **Dredging of the reservoir** above the rate of depositional inflow is expected to reduce downstream sediment and nutrient loading
- ***Conowingo sediment should be considered a resource; under some scenarios it can be harvested cost-efficiently while improving downstream water quality.***

NEXT STEPS

1. Conduct additional screening level modeling to support development of a larger scale dredging project.

2. Conduct industrial scale testing for potential for manufacturing of cement clinker and SCM.

3. Continue to refine the policy environment so water quality credits are a viable finance mechanism

QUESTIONS/DISCUSSION

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