

# Interim Action Evaluation (IAE): Preliminary Detailed Analysis

May 24, 2006

Remedial Options Workgroup

Lower Passaic River Restoration Project

# Agenda

- Overview and Recap of February 1, 2006 Remedial Options Workgroup
- Detailed Analyses – Feasibility Evaluations
  - Dredging
  - Capping
  - Capping w/ pre-dredging
  - Combinations
- Cost Estimates Revisited
- Data Analysis – Next Steps
- Comments, Discussion, and Wrap Up

# Overview of IAE Approach

- Objectives
  - Mass remediation
  - Prioritization of areas of actual/potential erosion (sediment stability consideration)
  - Consistent with overall project goals
- Alternative Development and Evaluation
  - Order of magnitude resolution
    - 50,000 – 100,000 cy (Small)
    - 500,000 – 1,000,000 cy (Medium)
    - 5,000,000 – 10,000,000 cy (Large)
- Alternative Development, Screening, and Detailed Analysis
- Target Area Selection
- Interim Action Selection

# Alternatives for Detailed Analysis

| Alternative # | Description  |
|---------------|--|
| 1             | Dredging 50,000-100,000 CY *   |
| 2             | Dredging 500,000-1,000,000 CY *  |
| 3             | Capping 50,000-100,000 CY  |
| 4             | Capping 500,000 - 1,000,000 CY   |
| 5             | Capping 5,000,000 - 10,000,000 CY  |
| 6             | Capping w/ predredging 50,000-100,000 CY *   |
| 7             | Capping w/ predredging 500,000 - 1,000,000 CY *                                      |
| 8             | Capping w/ predredging in shoals 5,000,000 - 10,000,000 CY *                         |
| 9             | Dredge "hot" area (500,000 - 1,000,000 CY), Cap remaining 4,000,000 - 9,500,000 CY * |

•All dredging alternatives include reconstruction of disturbed mudflats and backfill placed in dredged areas to restore original grade.

# Additional Options for Consideration

- In Situ Stabilization
- > 1,000,000 CY Dredging Option(s)
- Navigationally Constrained Capping Option(s) (e.g. 30', 25', 20', or 15' depth channels)

**DREDGING**

# Detailed Analysis: Dredging

- Major Feasibility Considerations
  - Accuracy
  - Productivity
  - Resuspension
  - Residuals
  - Dredged Material Management
    - Processing Facility Siting
    - Throughput

# Dredging Accuracy

- Dredging Pilot: Production Cut

| +/- | Minimum | Maximum | Accuracy |
|-----|---------|---------|----------|
| 6"  | 66%     | 72%     | 12"      |
| 9"  | 82%     | 89%     | 18"      |
| 12" | 92%     | 94%     | 24"      |

- Functioning sensors achieve an improvement in dredging accuracy (increase of 7%)
- Conclusion: Assume 1' overdredging



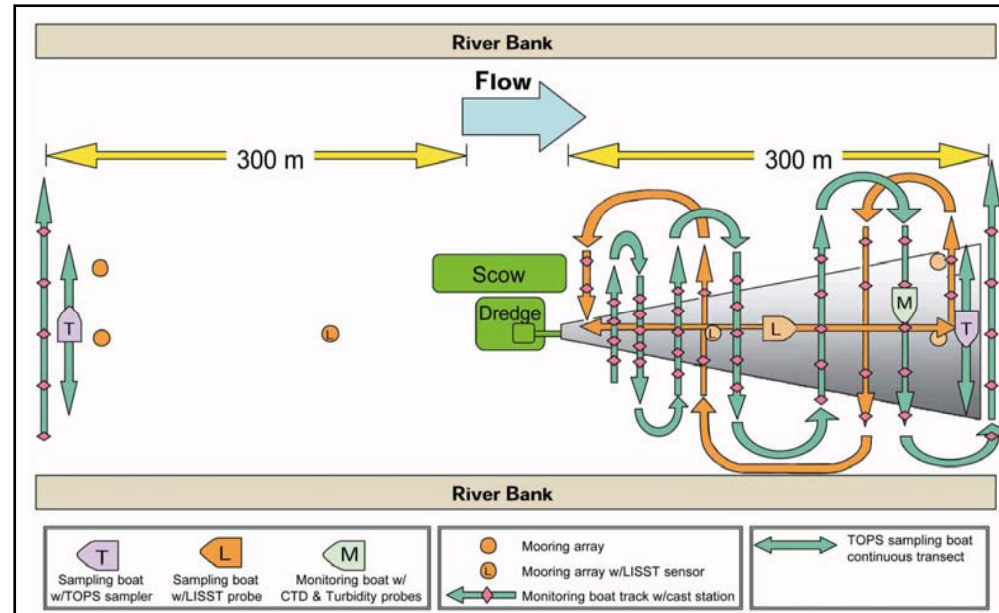
# Dredging Productivity

- Productivity
  - Dredge Pilot
    - Average Hourly Rate ~100 cy/hr
    - Average Daily Rate ~ 830 cy/day
    - ~10 hours per day
  - Case Study: Head of Hylebos:
    - Production Cut: 2140 cy/day
    - Cleanup Pass: 1630 cy/day
  - Dredging represented 64% of working time during pilot
  - Production rate may be controlled by dredged material management options
- Conclusion: Production rate of 2000 yards per dredge per 24 hour day is achievable.



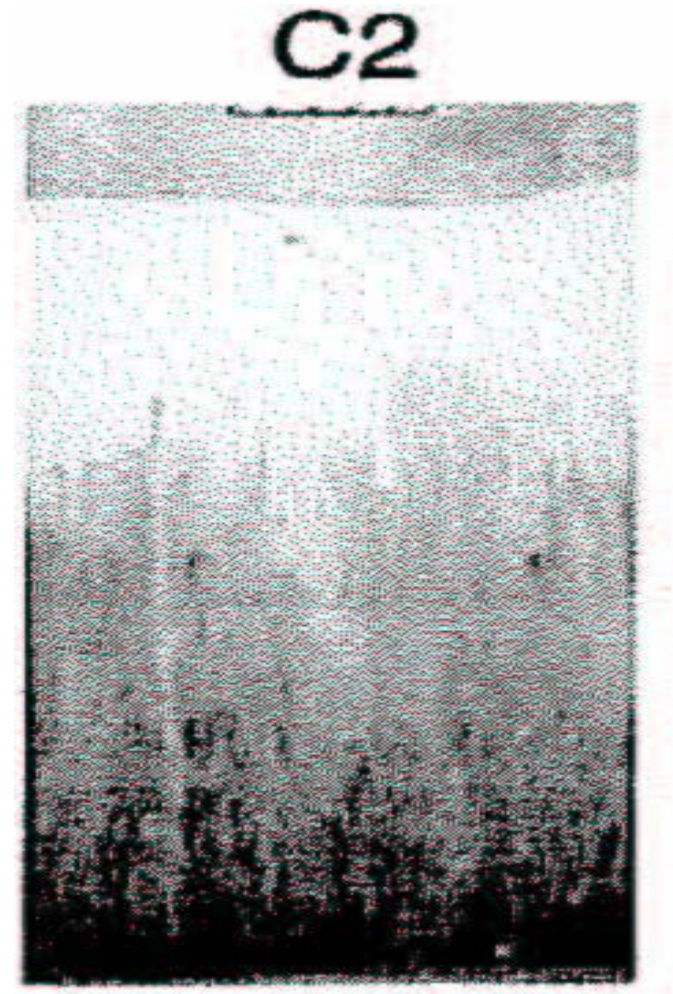
# Dredging Resuspension

- Dredge pilot TSS data indicates that it may be difficult to discern dredging effects at farfield boundary (300 m)
  - Typical TSS ~40 mg/L
- TSS load dominated by tidal influence
- Plans for analyses:
  - Background comparison
  - Analysis of chemistry data
  - Analysis of near field hydrodynamic data
  - Flux Calculations (?)
- Determination of acceptable loss rate will control selection of containment and drive costing assumptions
  - Cost estimates assume that dredging operations in “hot” areas will require containment by sheeting



# Dredging Residuals

- Assume average of 2 passes
  - Initial pass to achieve lines and grades
  - Second pass to clean up
- Small and medium dredging alternatives include the placement of backfill to restore original grade
- Sediment Profile Imagery (SPI)



# Dredged Material Management

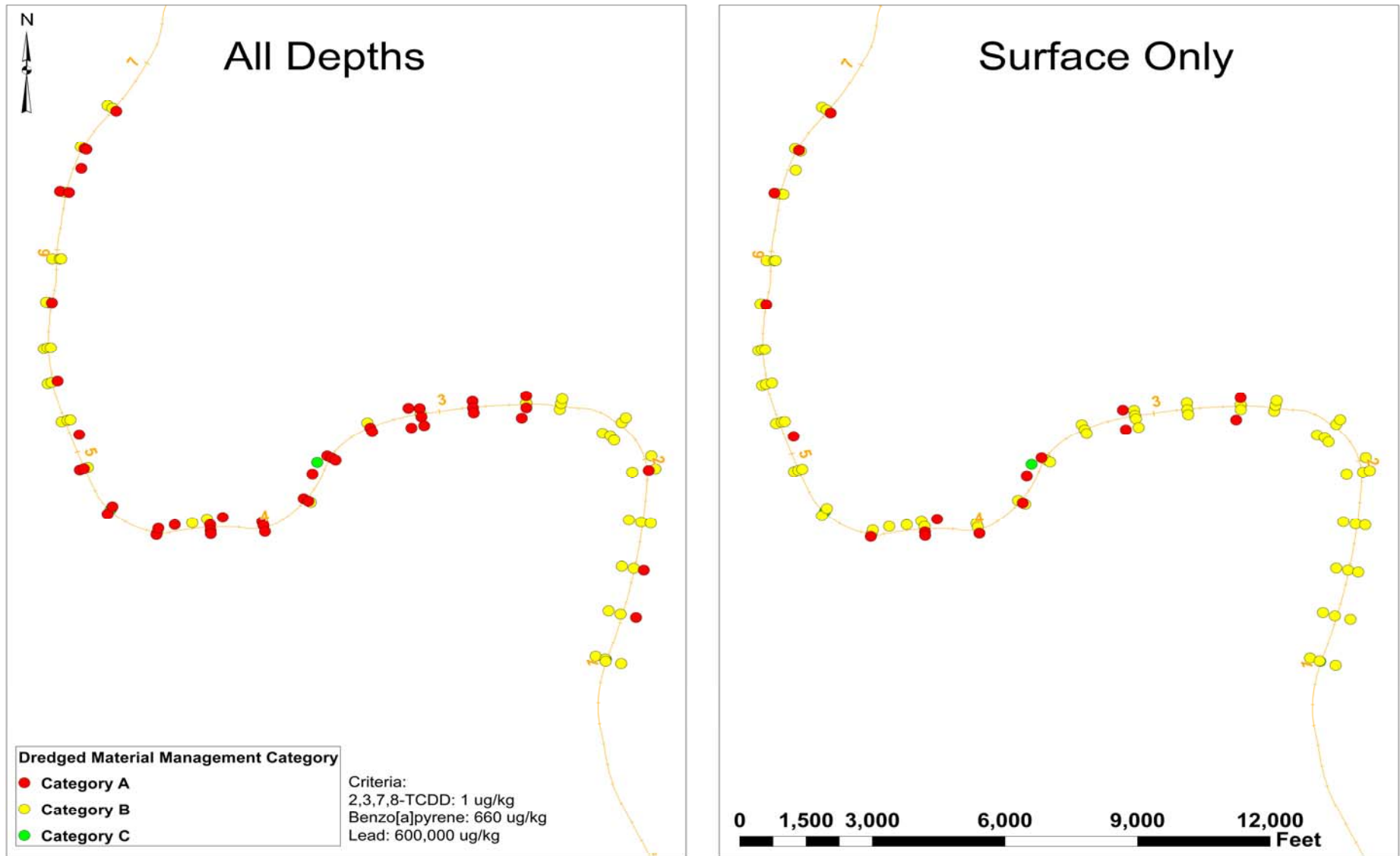
- Options Considered

| Material Category | Description  | Options for Management   |
|-------------------|--|--|
| A                 | Many orders of magnitude above NJ non-residential Criteria/UTS | <ul style="list-style-type: none"><li>Newly constructed thermal plant<ul style="list-style-type: none"><li>–Assume general cost for land, permitting, construction</li></ul></li><li>•Transport to Texas (250 ton/day), Utah, Nebraska? Canada?<ul style="list-style-type: none"><li>–Project schedule likely controlled by thermal treatment plant throughput or storage capacity</li></ul></li></ul> |
| B                 | ~One order of magnitude above NJ non-residential Criteria/UTS  | <ul style="list-style-type: none"><li>•Onsite sediment washing</li><li>•Conventional Landfill</li></ul>  |
| C                 | Below NJ non-residential Criteria/UTS                          | <ul style="list-style-type: none"><li>•Disposal at beneficial use placement site</li><li>•CAD Cell disposal</li></ul>  |

# Dredged Material Management: Criteria Comparison

- Evaluate if sediment can be segregated by concentration for different treatment options
- Tierra Solutions 1995 data set compared to NJ non-residential soil cleanup criteria or Universal Treatment Standard (if no NJ criteria)
  - 1704 samples (at 97 core locations)
  - BAP: Most common parameter to exceed NJ Criteria (~80%)
  - Dioxin: 40% of samples exceed (~20% of surficial samples)
- Plotted locations of exceeding samples – randomly distributed
- May be difficult to segregate sediment for multiple dredged material management options

# Criteria Comparison Map



Comparison to Criteria: 2,3,7,8-TCDD; Benzo[a]pyrene; Lead  
River Mile 0 - 7  
Interim Action Evaluation (IAE)  
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# Dredged Material Management: Options

| Option Considered   | Applicability                                 | Costing Assumptions          |                                 |                       |
|---|---|------------------------------|---------------------------------|-----------------------|
|   |   | 50,000 – 100,000 CY Dredging | 500,000 – 1,000,000 CY Dredging | Predredging of Shoals |
| Newly constructed local thermal/vitrification facility  | Could treat all material (Category A)         |                              |                                 |                       |
| Transport to existing hazardous waste incinerator (e.g., Clean Harbors in Deer Park, TX; Onyx in Port Arthur, TX) | Could treat all material (Category A)         | ✓                            | ✓                               |                       |
| Sediment washing (local facility)   | Moderately contaminated material (Category B) |                              | ✓                               | ✓                     |
| Local beneficial use or landfill (e.g., ENCAP facility)   | Material below NJ criteria (Category C)       |                              |                                 | ✓                     |
| Confined Aquatic Disposal (CAD) cell in river or in Newark Bay  | Varies  |                              |                                 | ✓                     |

# Dredging Advantages/Limitations (per USEPA Guidance)

| Advantages                                       | Limitations  |
|--|--|
| Lower uncertainty for long-term effectiveness*   | More logistically complex and costly                         |
| Flexibility for future use                       | Treatment technologies still in scale-up mode; may be costly |
| Institutional controls more limited              | Disposal facilities / options may be limited                 |
| Less time to achieve RAOs than MNR*              | Uncertainty in estimating residuals                          |
| Allows for treatment/beneficial use of sediments | Concerns over resuspension and/or volatilization             |
|  | Temporary disruption of aquatic community and habitat        |

\* Where cleanup levels achieved

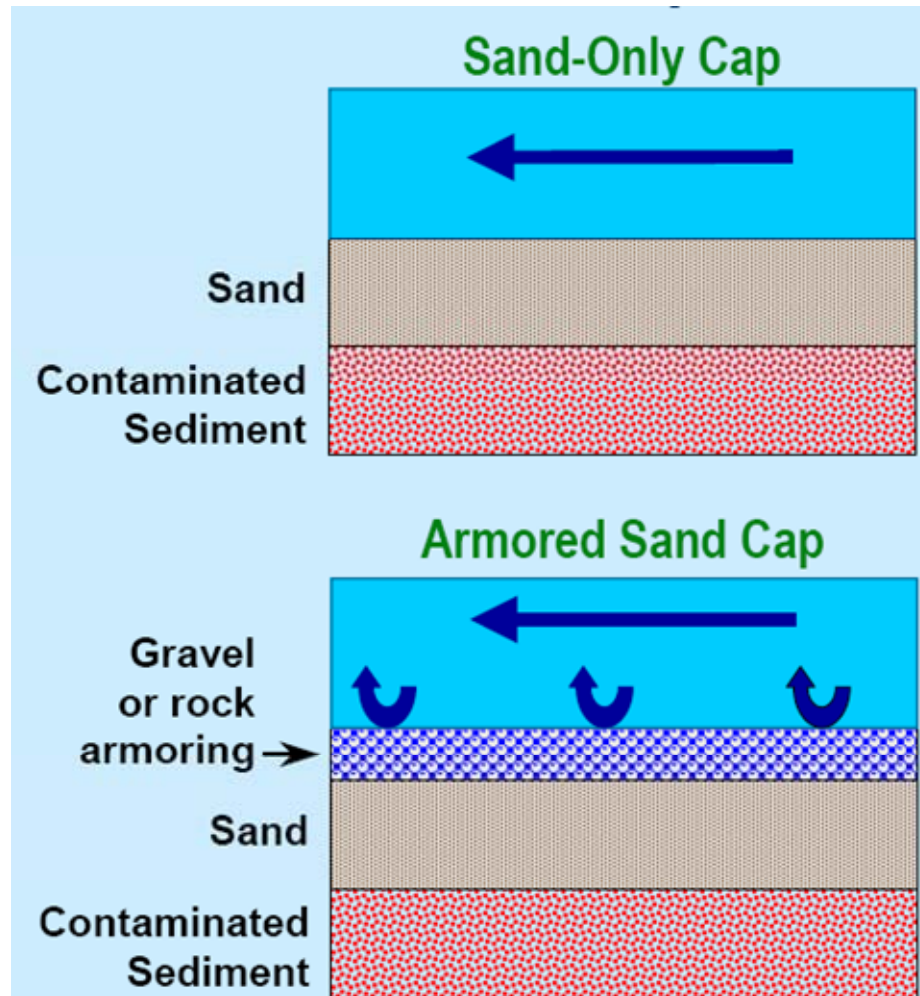


CAPPING

# Detailed Analysis: Capping

- Major Feasibility Considerations
  - Flooding issues
  - Sand cap erosion/armor layer
  - Settlement
  - Consolidation
  - Porewater fluxes
  - Navigation

# Conceptual Cap Design



# Capping – Flooding Analyses

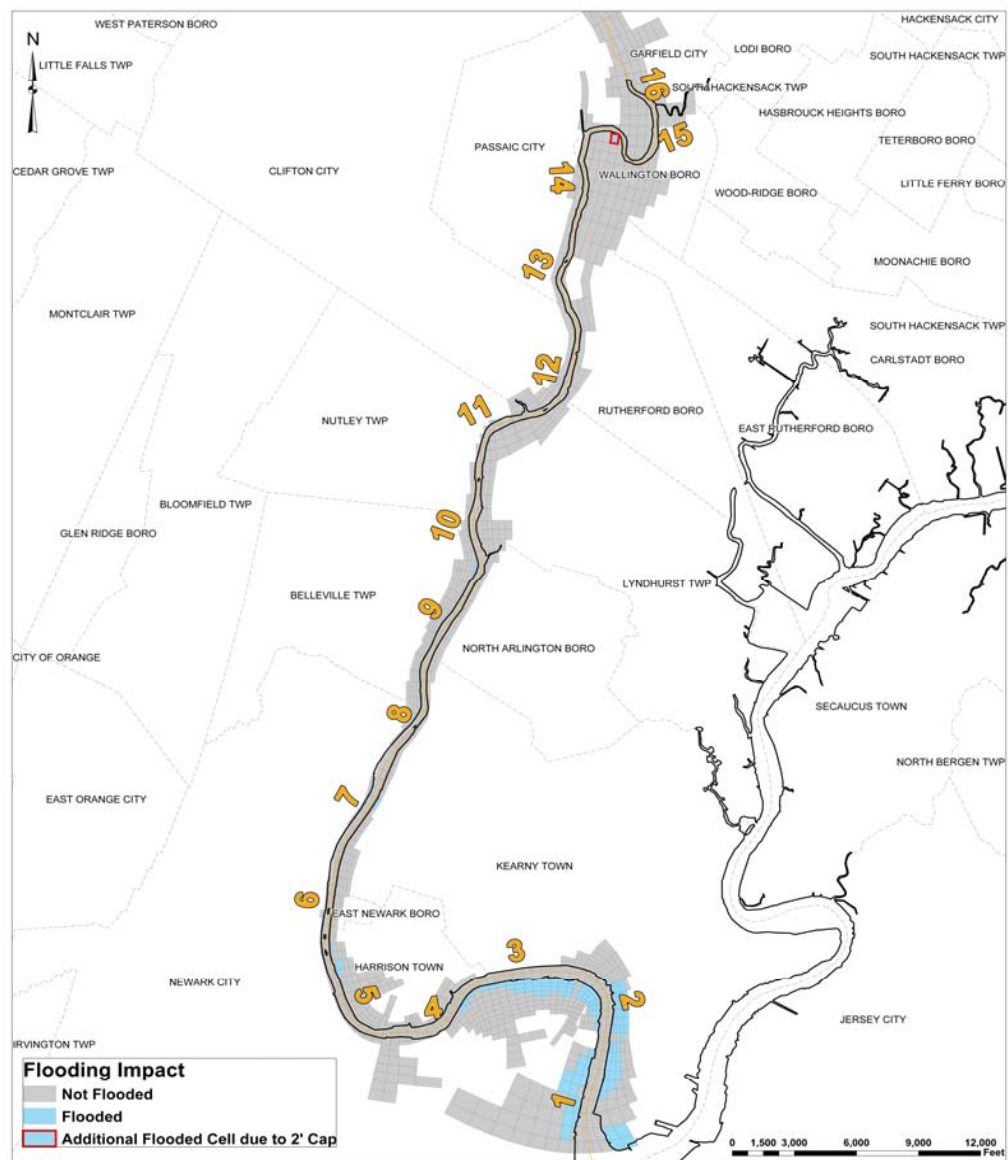
- Flood Design
  - HQI grid augmented to incorporate FEMA floodplain
  - Lack of correlation between surge and flow – “Perfect Storm” design unrealistic
  - 500 Year Flow Events
    - 500 year flow at Little Falls (26,000 cfs) augmented to include drainage basin
    - Hydrograph assumed to follow distribution of major storm (1984)
  - 500 Year Surge Event
    - 500 year storm surge at Bergen Point (1.97 m) assumed to represent extreme water elevation

# Capping – Flooding Impacts

- Hydrologic modeling of 500 year storm events for cap alternatives

| Scenario  | 500 Yr Flow Event –<br>Acreage Flooded | 500 Yr Surge Event –<br>Acreage Flooded | Maximum<br>Percentage<br>Increase over<br>Baseline |
|---|--|---|--|
| Baseline  | 4                                      | 329                                     | N/A  |
| Cap over 1,000,000 CY<br>of inventory                             | 4                                      | 333                                     | 1.2%   |
| Cap over 7 miles, bank<br>to bank (10,000,000 CY<br>of inventory) | 4                                      | 333                                     | 1.2%   |

# 500 Year Storm Surge Flooding Impact Map



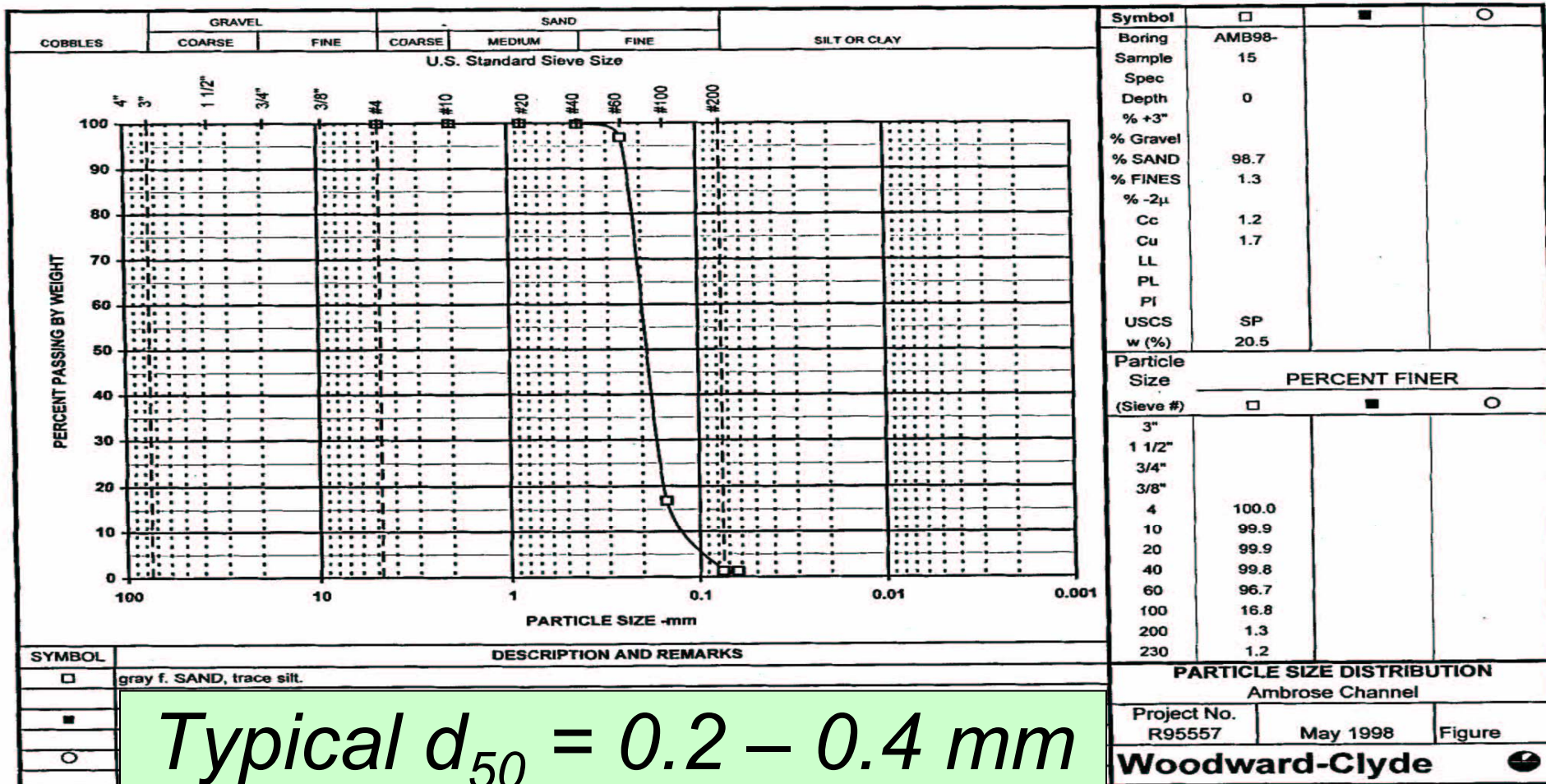
Flood Impact: 500 Year Storm Surge Event  
River Mile 0 - 17  
Interim Action Evaluation (IAE)  
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# Sand Cap Erosion

- Bed load transport estimated using Meyer-Peter equation
- Inputs:
  - Cap material  $d_{50} = 0.2$  mm (similar to Ambrose sand)
  - 100 year flow event modeled velocity distributions
  - River geometry
- Conservative assumptions used to estimate “worst case” expected annual erosion for each grid cell
- Areas of erosive concern correlate well with distribution of maximum modeled velocities
- Costs developed to maintain cap based on volume, area, and frequency of maintenance

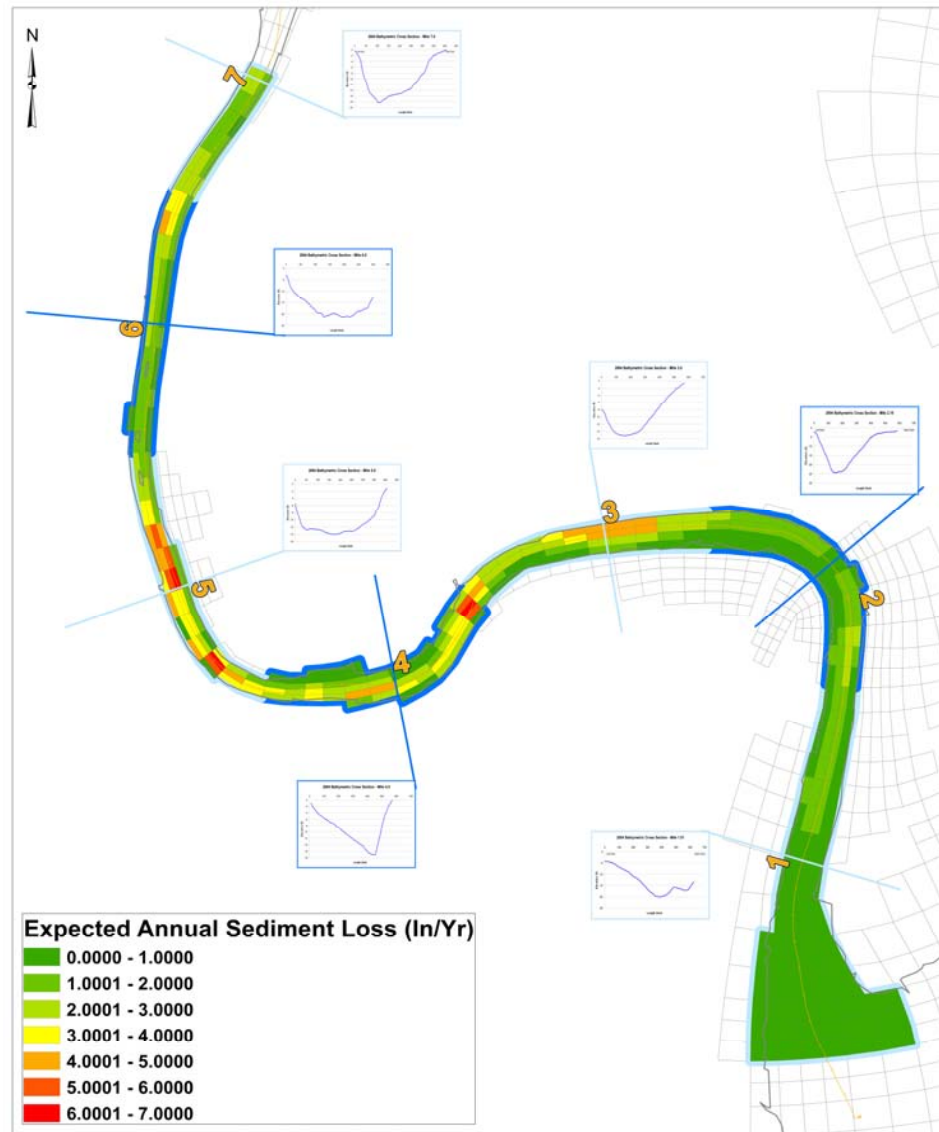
# Grain Size Analysis – Typical NY Harbor Sand



Source: USACE NY District



# Sand Cap Erosion Map



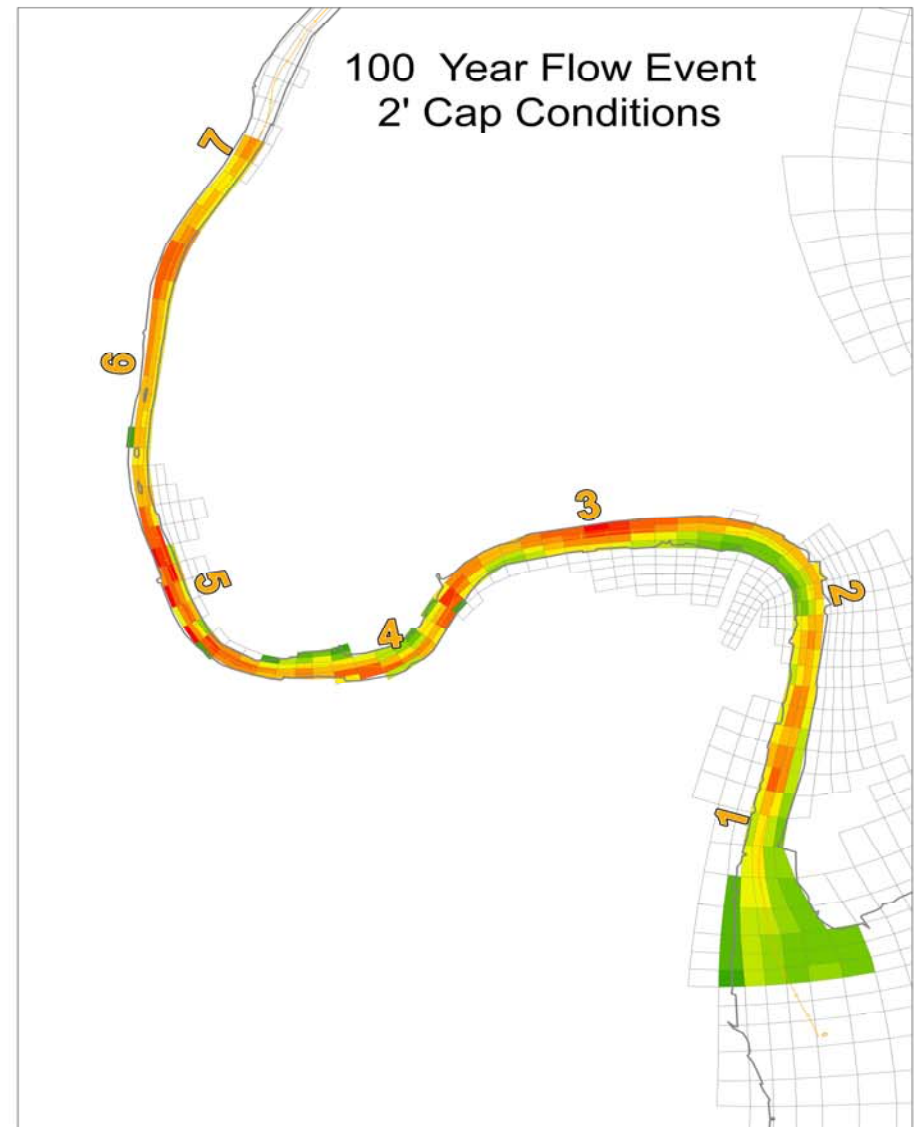
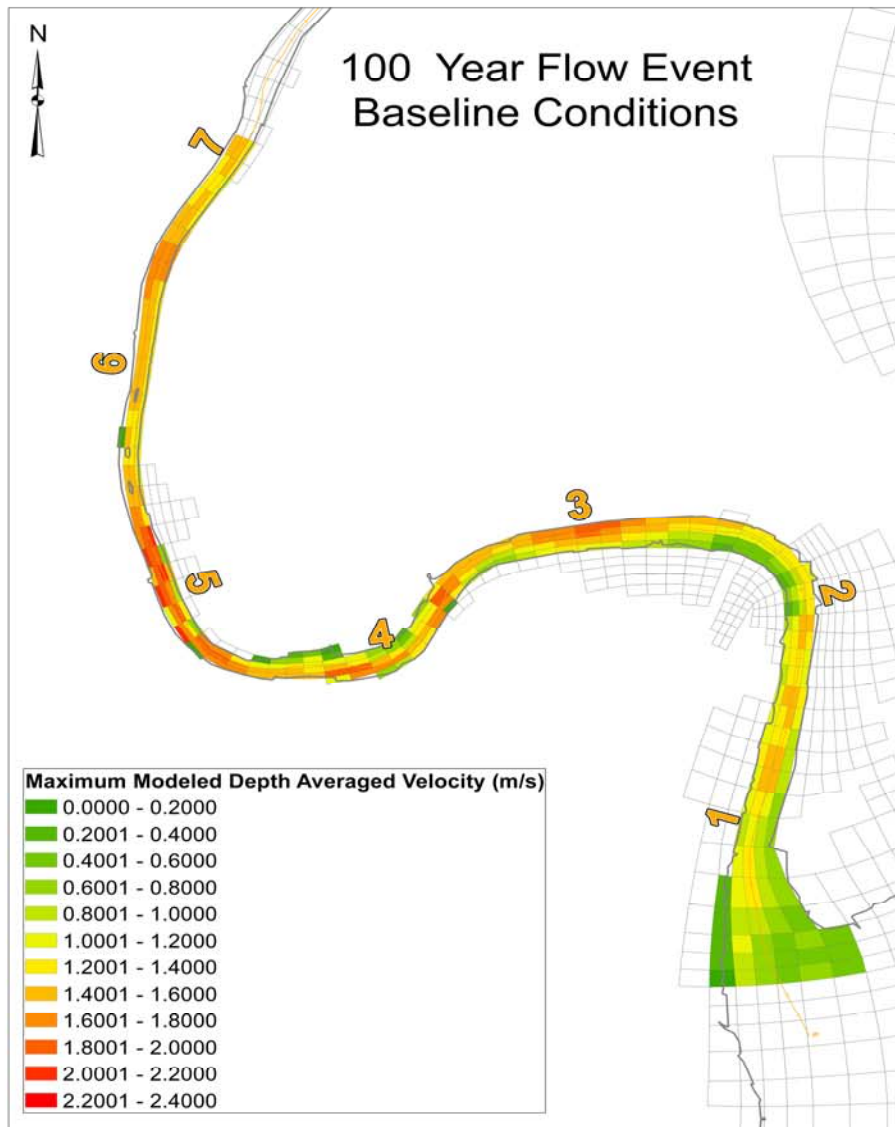
Cap Erosion: Expected Annual Sediment Loss (in/yr)  
River Mile 0 - 7  
Interim Action Evaluation (IAE)  
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# Cap Armor Layer

- 100 year flow event used for design criteria
- Statistical analysis of modeled velocities used to determine area requiring armor
- Stone sizes of  $d_{50} = 2''$  to  $6''$  required to withstand maximum velocity at selected grid cells
- Armor Layer Thickness =  $3 \text{ to } 4 \times d_{50}$

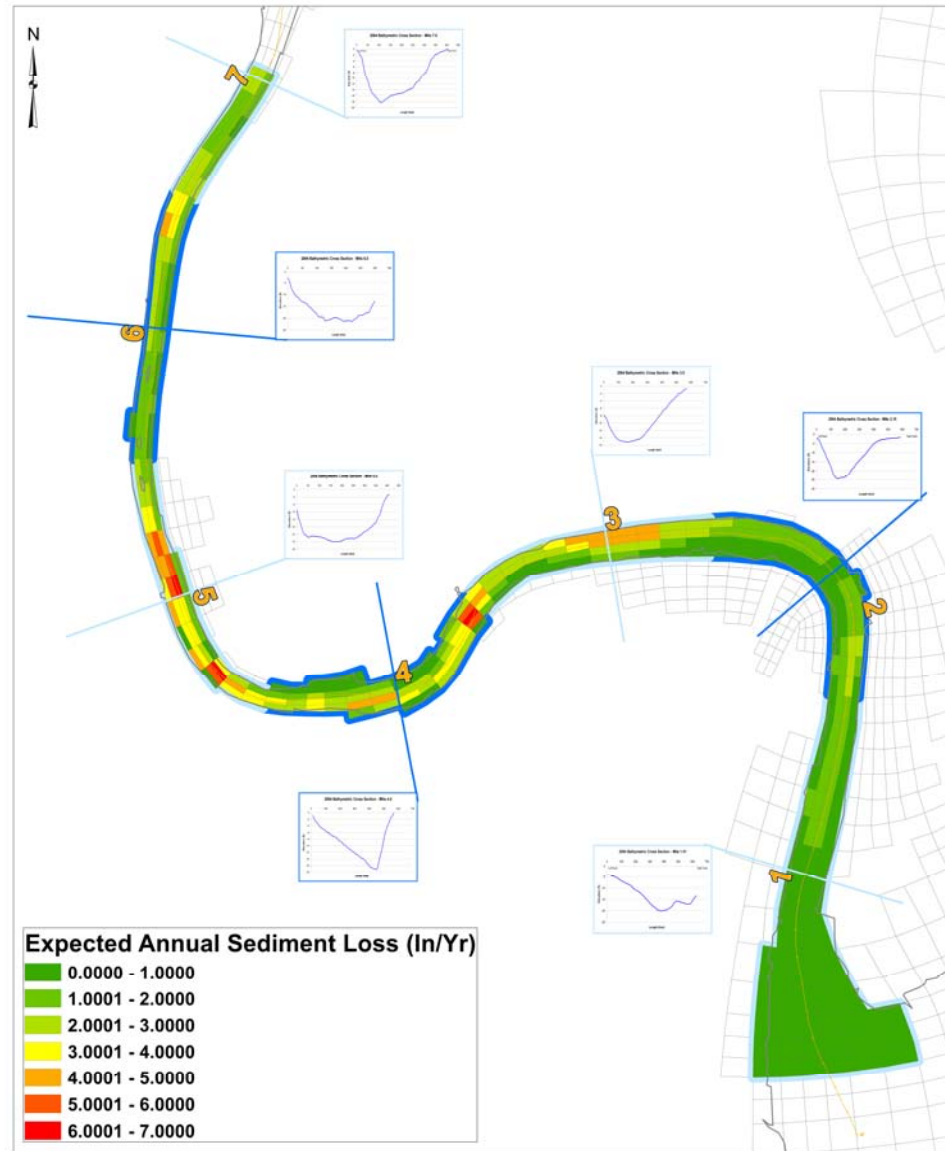
# Model Output – Maximum Velocity



Maximum Modeled Depth Averaged Velocity (m/s): 100 Year Flow Event  
River Mile 0 - 7  
Interim Action Evaluation (IAE)  
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# Armored Areas



Cap Erosion: Expected Annual Sediment Loss (in/yr)  
River Mile 0 - 7  
Interim Action Evaluation (IAE)  
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# Capping Advantages/Limitations (per USEPA Guidance)

| Advantages   | Limitations  |
|--|--|
| Quickly reduce exposures   | Contaminated sediment remains – could be released if disturbed or break through            |
| Clean substrate for benthic re-colonization  | Possibility of sediment disruption during placement  |
| May enhance habitat  | Shallow water may require inconvenient institutional controls (e.g., boating restrictions) |
| Less infrastructure for material handling  | Cap may alter hydrologic regime  |
| Less potential for resuspension  | Cap materials may alter biological community   |
| Avoids risks associated with material treatment or disposal                          | Long-term monitoring and maintenance   |
| Usually lower cost and less disruption than dredging and sediment treatment/disposal |  |

# Detailed Analysis: Capping with Pre-Dredging

- Major Feasibility Considerations
  - Pre-dredging necessary from a flooding standpoint?
- Cap causes insignificant change in modeled water surface elevation over baseline conditions.
- Insignificant additional flooding during 500 year events.
- Eliminate capping with pre-dredging, except capping with pre-dredging in shoals.

# Further Screening of Alternatives

- Remove capping with predredging alternatives
  - Cap causes insignificant change in modeled water surface elevation over baseline conditions
- Retain capping with predredging in shoals to maintain river geometry

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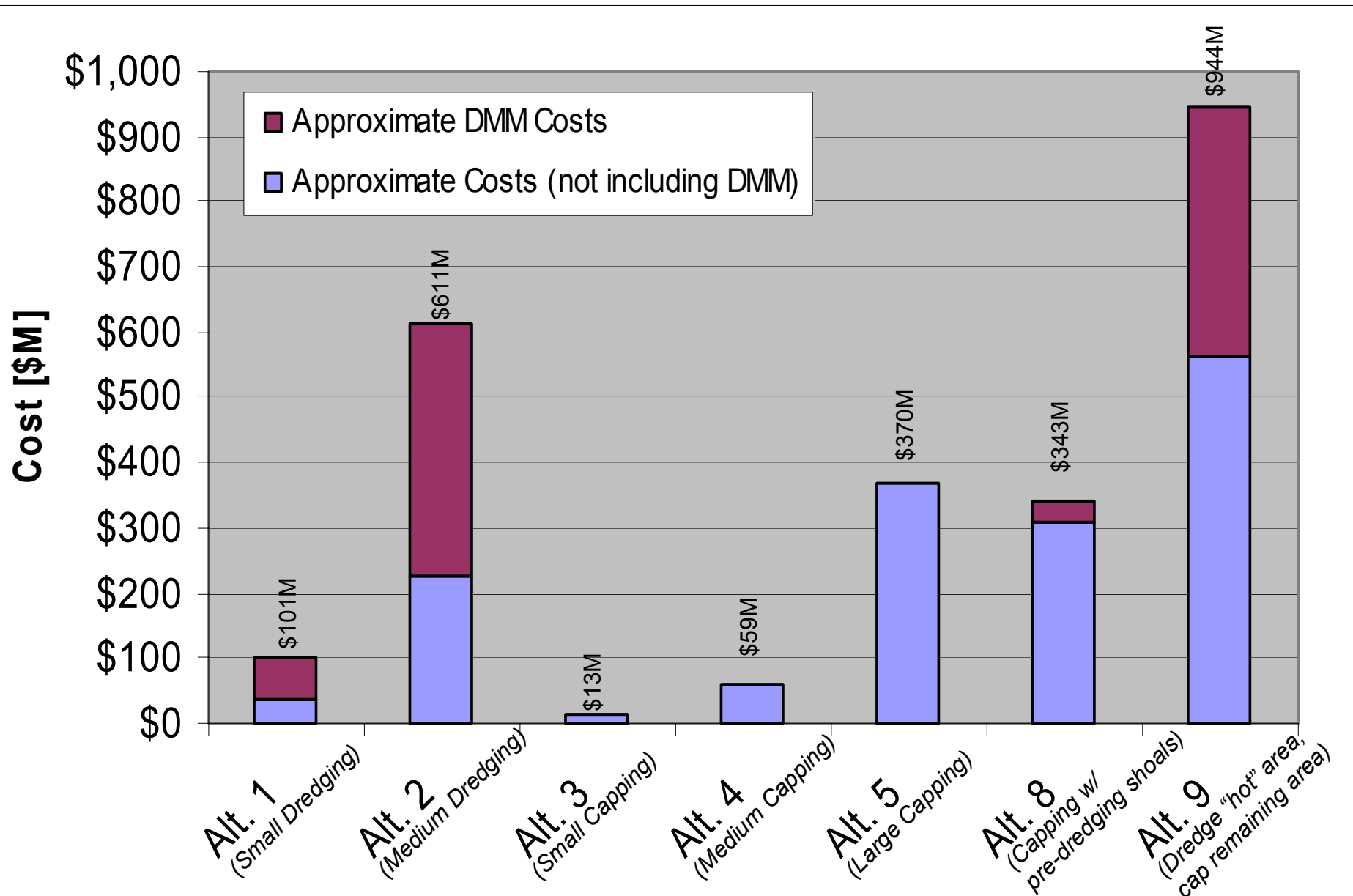
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# To Be Determined

- In Situ Stabilization, Larger Dredging, and/or Navigationally Constrained Capping Alternatives

# Cost Estimates Revisited



# Data Analysis – Next Steps

- Receipt of validated lo-res data
- Calculation of MPA for dioxin, PCB, Hg using lo-res data
- Refinement extrapolation basis for inventory analysis based on lo-res downcore profiles of major contaminants
- Selection of target areas
- Selection of target depths
- Refinement of volume estimates
- Refinement of cost estimates

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Remedial  
Options  
Workgroup  
Recommended

# Comments

- Objectives of IAE
- In Situ Stabilization Questions
- Silt Trap Evaluation
- Selection of Contaminants
- Restoration

# In Situ Stabilization Questions

- Discuss remediation experience demonstrating that costs of implementation can be estimated with a degree of accuracy consistent with a conceptual level of design in the context of the Lower Passaic River Restoration Project.
- What limitations exist in extrapolating the findings of land-based implementation of this remediation technology to a marine environment? For example, more heterogenous material (silt, sand, etc) and the presence of large amounts of debris and associated potential voids?
- What are the hydraulic impacts associated with implementation of this technology in the LPR including (a) potential for increased flooding, and (b) groundwater upwelling or artesian conditions under a low permeability cement cap?
- What data exist to demonstrate the effectiveness of this remediation technology in destroying or sequestering contaminants?
- On what basis can predictions be made regarding the long term chemical and geotechnical fate of sediments remediated using this technology?
- What limitations exist regarding equipment availability for implementing this technology in a marine environment?

# In Situ Stabilization Questions (cont'd)

- If selected for implementation as an interim action, what inconsistencies or conflict might this technology create with a final remedy?
- How can this technology be implemented as an ancillary technology to another, primary technology?
- Based on work to date, what opportunities for optimization exist such that costs might be lowered?
- Can this technology be used to address the complete suite of contaminants present?
- What basis could be used to develop production rates for full-scale implementation of this technology in a marine environment to remediate contaminated sediments?
- Describe any technology-specific factors that may exist to limit production rate.
- What limitations exist in consistency and coverage? How has success been demonstrated for the application of injection technology in areas of heterogeneity and large amounts of debris? Is it possible to know that expansion will not destabilize adjacent sediment laterally, creating unpredictable results?
- How might certain factors affect the contaminants present? For example, might thermal elevation or volume expansion lead to potential releases of contaminants?

# Acknowledgements

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