Monitoring

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Dr. Michael R. Palermo
Mike@mikepalermo.com

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Training Objectives

• Learn general monitoring principles and considerations and monitoring components for environmental dredging,
• Become familiar with monitoring tools and techniques commonly used,
• Identify components of a monitoring and management plan

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ED Monitoring Outline

• Monitoring Principles /General Considerations
• Monitoring Objectives for ED
• Tools and Techniques
• Monitoring and Management Plans

Why Monitor?

• To measure success
  – Remedy Effectiveness (cleanup levels)
  – Risk Reduction
• To determine compliance with ARARs
  – Water quality standards (resuspension, release)
  – Air quality concerns (release)
• To learn something (as with a pilot)
What do we monitor?

• Removal
• Resuspension
• Release
• Residual

General Monitoring Considerations

• Compatibility with Guidance
  – EPA Monitoring Guidance (OSWER) Directive 9355.4-28
  – EPA Monitoring Fact Sheets (underway)
  – Six-Step Process
• QA/QC via approved SOW/Quality Assurance Plan process
ED Monitoring Objectives

• Confirm that contaminated material is removed
• Determine compliance with CULs
• Determine compliance with ARARs regarding resuspension/releases

ED Monitoring Tools/Techniques

• Bathymetry/Volume Measurements
• Plume dimensions via ADCP and similar tools
• Turbidity/TSS and WC Chemistry sampling
• Sediment chemistry in post-dredging samples for undredged inventory and residuals
  (Note that these partially overlap with site and sediment characterization)
Monitoring Plans - Six-Step Process

1. Identify monitoring plan objectives;
2. Develop monitoring plan hypotheses;
3. Formulate monitoring decision rules;
4. Design the monitoring plan;
5. Conduct monitoring analyses and characterize results; and,
6. Establish the management decision.

Success = Meeting Goals

- All cleanup decisions should be RISK-BASED
- There is a hierarchy of goals: RAOs>RGs>CULs
- Remedial Action Objectives (RAOs)
  - e.g., reduction in cancer risk to fish consumers
- Remediation Goals (RGs)
  - e.g., achieve a specified fish tissue level
- Cleanup Levels (CULs)
  - Chemical specific cleanup levels
  - Consider uncertainty, exposure, remedy feasibility
  - Should be tied to risk reduction and are considered a surrogate for RGs and RAOs.
Success = Meeting Goals

More on the hierarchy of RAOs/RGs/CULs:

- Depend on one another
- Represent a continuum from scoping to remedy selection
- CULs should be tied to risk management goals
- Meeting CULs is more direct (easier) than meeting RGs and RAOs
- CULs are met short term; RGs and RAOs are met in the long term
- If properly structured, meeting CULs will result in meeting RGs and RAOs

Levels of Remediation Success

- Remedy Effectiveness Success
  - If CULs are met and maintained, the remedy is effective
  - Depends on viability of design, operations, and construction (engineering)
- Risk Reduction Success
  - If RGs and RAOs are met, the desired risk reduction is achieved
  - Depends on validity of food chain modeling, toxicity data, species diversity data, etc. (biological/toxicological)
- Monitoring can be categorized in a similar fashion
  - Remedy Effectiveness Monitoring (specific to the remedy approach, e.g., dredging vs. capping)
  - Risk Reduction Monitoring (this is similar for all remedy approaches)
ED Monitoring Categories

- Production and Project Duration
- Resuspension, Transport, and Release
- Dredging Effectiveness (Residuals)

Production (Removal) Monitoring Approaches

- Determine if intended sediment volume is removed
- Determine if goals for production rates and duration of project are met
Production (Removal) - Monitoring Tools/Techniques

- Bathymetric surveys
  - Compare pre and post dredging surveys
  - Determine progress over time

Production (Removal) - Management Actions

- Multiple dredges
- Larger dredges
  (Note that this may conflict with other objectives)
Resuspension/Release Monitoring Approaches

- Water Column
  - Near Field vs. Far Field (differing points of compliance)
  - Impact of dredging alone and effectiveness of controls
  - Stationary or towed instruments for real-time feedback
  - Water Column sampling for compliance
  - “Upstream” and “downstream” stations for comparison to background and WC standards

(Cont’d)

- Air
  - Focus on near field exposures
  - Comparison with air-quality limits
  - Stationary instruments for real-time feedback
Resuspension/ Release -
Monitoring Tools/ Techniques

- Measure turbidity (real time feedback)
- Turbidity a surrogate for TSS (site specific)
- Measure WC TSS and chemistry (analytical requires time)
- Dissolved and Total concentrations of COCs
- Direct measurements of air quality

Figure 3: Monitoring Mooring Arrangement
with Monitoring Boat Track (Plan View) Uni-Directional Flow
Resuspension/Release - Monitoring Tools/Techniques

**Figure 2:** Monitoring Mooring Arrangement (3D View) - One Side of Operation


Resuspension/Release - Monitoring Tools/Techniques

**Figure 1:** Monitoring Mooring Arrangement with Monitoring Boat Track (Plan View) during Bi-Directional Flow

Resuspension/ Release - Management Actions

- Increase monitoring
- Implement operational controls
  - Temporary work stoppage
  - Slow down the operation
  - Use smaller dredge
- Implement engineered controls
  - Containment (curtains, etc)
  - Volatile controls (foams, etc.)

Dredging Effectiveness Monitoring Approaches

- Sampling of post-dredging surficial sediments for comparison to CULs
  - Undredged inventory
  - Residual sediments
- Sampling of surficial sediments in non-dredged areas
  - Residuals due to resettlement of resuspended sediments
More on Cleanup Levels

• Most likely form of CUL is limiting concentration of COC in surficial sediment
• CUL should be tied to a surficial thickness and method for confirmation
• CUL may be tied to Surface Area, e.g. SWAC approaches
• Design Standards based on CULs should therefore consider processes affecting surficial sediment concentrations with depth and time, considering mechanics of the remedy.

Pre-Dredging

Set Cut-line
**Post-Dredging – Short Term**

- Dissolved Release
- Resuspension
- Residual

**Volatilization**

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**Post-Dredging – Long Term**

- Oxidized and Mixed

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Compliance for Dredging Effectiveness

• Point of Compliance should be in the surficial sediments (considering residual), i.e., the biologically active zone.
• Time of Compliance – what is appropriate?

Dredging Effectiveness - Monitoring Tools/ Techniques

• Sediment cores
  – Upper sediment layers (~ 2 foot cores)
  – Analysis from top down
  – Separate analysis of surface “fluff” vs stiffer material
• Grab samples
• Sediment Profile Camera
Dredging Effectiveness - Monitoring Tools/ Techniques

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Dredging Effectiveness - Management Actions

• If residuals exceed CUL,
  – Additional cleanup passes,
  – Consider time period of mixing, or
  – Add residual cap
• If inventory remains,
  – Additional production passes,
  – Consider partial dredging with isolation cap
  – Same considerations as for capping remedy

ED Monitoring and Management Plans

Should be:
• A written plan agreed to by all parties
• Include detailed SOPs, etc. for all components
• Results tied to testable hypotheses
• Include pre-determined management actions
Environmental Dredging

General Conclusions

• Evaluate risks – Balance capabilities and limitations with environmental controls
• Suitable equipment is available
• Mass removal with acceptable precision is attainable
• Resuspension is minimal and can be controlled
• Release is a far field issue – evaluate risks accordingly
• Residual is a major issue for effectiveness and cost – limit cleanup passes and allow for residual cap
• Dredging/transport must be compatible with treatment/disposal
• Detailed/comprehensive guidance on environmental dredging is lacking but under development