Dredging Operations and the Potential Impacts of Underwater Sound

Bob Romagnoli, Philip Spadaro, and Kristi Maitland – The Intelligence Group
Paul Bluestein and Paul Brzozowski – Tierra Solutions, Inc.
Topics Covered

• Background on the issue of Underwater Sound (UWS) as related to dredging
• UWS case study – Passaic River Phase I Removal Action
• Lessons learned: applicability of UWS monitoring to environmental dredging programs
State of Affairs

• The complexity of in-water environmental remediation programs has increased
• These programs now require extensive monitoring and BMPs
• One such requirement may be underwater sound monitoring
Background

• Various organisms use sound for navigation, feeding, and communication
• Anthropogenic underwater sound can interfere with these behaviors
• Very intense sound can cause mortality and/or permanent damage to exposed organisms
• This intensity of sound is not associated with dredging operations but may be associated with pile driving
• Various studies conducted and published on the underwater sounds produced by dredges
Sound is Everywhere in the Underwater Environment

Figure 4. Noise levels and frequencies of anthropogenic and naturally occurring sound sources in the marine environment.
Dredging Sound

- Medium intensity
- Mainly below 1 kHz
Sound Sources

Backhoe Dredger

Engine & Mechanical Sound

Spud Carriage Sound

Spud Impact Sound

Digging Sound

Propeller Sound

Workboat or Tug

Dredger
In 2009, Tierra Solutions, Inc. (Tierra) initiated a sediment dredging program located within the Passaic River.

Program directed by the United States Environmental Protection Agency (USEPA) and involved removing approximately 40,000 cubic yards of contaminated sediments to a depth of 12 feet.
Project Overview

- Overall goal to reduce inventory and source of dioxins in the Passaic River by removing highest concentrations of 2,3,7,8-TCDD
- 40,000 cy sent for treatment/disposal
- Removal conducted via clamshell dredge within sheet pile enclosure
- Area backfilled and restored
Phase I UWS Monitoring Program

• As part of sheeting installation and dredging, NMFS requested underwater sound data
• To be used for information purposes only - no association with compliance
• Interested in understanding effects on local native fish species (however no specific target species were identified)
Phase I UWS Monitoring

- Focus was to collect underwater sound data:
  - During enclosure installation
  - During sediment removal operations
  - Ambient conditions measured before start of construction
Phase I UWS Monitoring

• Sound Monitoring Methodology
  – Hydrophone system measured frequencies between 20 Hz and 20,000 Hz
  – Data were obtained from 26 stations spaced at 200 ft intervals
  – Hydrophone placed in middle of water column
  – Each station was monitored six times at various phases of the tide over the 2-day survey window
Phase I UWS Monitoring

• Data were acquired at 13 locations along two transects for a total of 26 monitoring locations.
Phase I UWS Monitoring

• The monitoring campaign consisted of three phases:
  • August 2011 – Pre-construction background monitoring
  • November/December 2011 – Sheetpile installation
  • April/May 2012 – Dredging
• 468 individual sound data files
Background Peak SPL

- Spectrum data range from 90db to 130db
- Higher SPL values below 1000Hz

Figure 2. Peak SPL (RMS) Spectrum Data from Mappings 1-6 combined.
Sheetpile Peak SPL

- Spectrum data range from 110db to 155db
- Higher SPL values below 1000Hz

Figure 5. Peak SPL (RMS) Spectrum Data from Bulkhead Installation.
Dredging Peak SPL

- Spectrum data range from 90db to 165db
- Higher SPL values below 1000Hz

Figure 5. Peak SPL (RMS) spectrum data during dredging operations.
Comparison of Results with Other Studies

- Results generally consistent with those of Reine, Clarke, and Dickerson (Characterization of Underwater Sounds Produced by a Backhoe Dredge Excavating Rock and Gravel, December 2012)
Phase I Findings / Conclusions

- Sheetpile installation and dredging were associated with increased Peak Sound Pressure Level (SPL) spectrum relative to the ambient levels.
- Levels observed were not in the range expected to cause injury or mortality.
- Significant acoustic sources observed during all three testing stages were not related to underwater activity:
  - Overhead aircraft
  - Passing trains
  - Other nearby construction
Overall Conclusions and Recommendations

- Environmental dredging is of generally medium intensity but yet does constitute an elevation above ambient levels.
- As expected, sheetpile installation is of higher intensity than dredging.
- Target species must be identified to appropriately gauge anticipated effect.
- Environmental dredging is not likely to produce SPLs within the range that might lead to serious effects such as injury or mortality.
- Pile driving must be evaluated separately as the SPLs in the near field could cause harm.
- However, potential harm to individual organisms should not be overlooked in future programs.
- Long duration environmental dredging programs, such as those currently envisioned in the Passaic River or other locations should be scrutinized for potential adverse effects on fish behavior (existing environmental windows may mitigate this potential).
Guidance Published in 2013

• The process begins with identification of the risk
• Beware of monitoring for its own sake
Thank You!
References

- CEDA (Central Dredging Association), 2011. Underwater Sound in Relation to Dredging.
References


