Environmental Windows in the Great Lakes: Progress Toward a Balance Between Dredging Needs and Resource Protection

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Environmental Windows

- Are based on the Precautionary Principle
- Greatly complicate the conduct of dredging
  - both in terms of coordination and contracting
- Can inflate the cost of dredging
- Have no performance standards
- Are a management practice of first rather than last resort
- Can only be resolved by
  - science-based decisions
  - substantial investments in research and training of regulatory personnel
Chronology of Windows

• First appeared after passage of NEPA in 1969
• By 1980 > 80% of all Federal navigation projects complied with at least one window
• By 1996 > 90% of Federal projects were restricted, a majority by multiple windows
• The percentage of restricted projects continues rising to this day in response to new emphasis on environmentally driven mandates, such as the ESA and EFH

Frequency of Windows by Region (1987-96)
The Problem

Concerns Not Prioritized

<table>
<thead>
<tr>
<th>Life History Stage</th>
<th>Suspended Sediments</th>
<th>Turbidity</th>
<th>Entrainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>Moderate</td>
<td>NA</td>
<td>High</td>
</tr>
<tr>
<td>Larvae</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Juveniles</td>
<td>Moderate</td>
<td>High</td>
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</tr>
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<td>Adults</td>
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</tbody>
</table>
NRC Recommendations to Improve the Process

Take a Regional Approach

• Form regional study team
• Prioritize technical issues
• Identify data gaps
• Select appropriate dredging project(s)
• Make commitments
• Collaborate to plan and execute study
• Share and publish results

Great Lakes Dredging Team

• **Windows Advisory Team**
  – Great Lakes Commission
  – NY, OH, PA, IN, MI, WI, MN Resource Agencies
  – Buffalo, Detroit and Chicago Districts
  – Engineer R&D Center
  – EPA, USFWS, NOAA
**Major Technical Issues**

- **Dredging effects on walleye, pike, and bass spawning**
  1. Sedimentation
  2. Developmental effects

- **Dredging effects on salmon and trout**
  1. Spring downstream migrants, including hatchery releases
  2. Fall upstream migrants

**Determining Effects on Walleye Spawning Habitat**

- Degree of Exposure
- Sedimentation
- Plume Characterization
- Tolerance
- Threshold of detrimental effects
Research Task: *Sedimentation Effects*

- Persistent concerns
- Detection in the field exceedingly difficult at appropriate scales (i.e. mm, hours)
- No standardized lab protocols analogous to suspended sediment exposures exist
- Investigate suitable technologies
- Develop testing procedures for tolerance determinations

Oysters
Dredged Material
Natural Bottom

MAUMEE BAY

TOLEDO HARBOR
Effects of Sedimentation on Spawning Habitat

Measuring sediment deposition with Sediment Profiling Camera

2 mm layer
Plume Characterization

- Acoustic technologies
  - ADCP backscatter
  - Sediview backscatter to concentration conversion
- Optical Backscatter Sensors
  - Continuous data record

Field Studies

Wide Area Plume Characterizations

ADCP Transects

Dredge

Turbidity Sensors

Fixed Station Continuous Data
EXAMPLE ADCP PLUME TRANSECT
(35 Meters from Bucket Dredge in Chesapeake Bay)

Spatial decay of plume

EXAMPLE ADCP PLUME TRANSECT
(96 Meters from Bucket Dredge in Chesapeake Bay)
EXAMPLE ADCP PLUME TRANSECT
(157 Meters from Bucket Dredge in Chesapeake Bay)

Movement of residual plume over shoal

EXAMPLE ADCP PLUME TRANSECT
(217 Meters from Bucket Dredge in Chesapeake Bay)

Movement of residual plume over shoal
EXAMPLE ADCP PLUME TRANSECT
(278 Meters from Bucket Dredge in Chesapeake Bay)
If dispersion to spawning habitat occurs:

- Plume characterization results could be used to design appropriate experimental exposures of walleye eggs and larvae
- Experimental approaches could determine threshold effect levels
- Plume characterization results could then be used to determine effective protection measures, e.g., spatial “buffer” zones to avoid exceeding thresholds

### Juvenile Salmonids

![Graph showing concentration vs. duration for Behavioral, Sublethal, and Lethal effects]
Suspended/Deposited Sediment Exposure System

- Modular
- Computer controlled dose
- Continuous WQ monitoring

SUSPENDED/DEPOSITED SEDIMENT EXPOSURE SYSTEM

OBS SENSOR
Determining Effects on Salmon and Trout

- Migratory Blockage
  - Plume Characterization
  - Underwater Sound
  - Water Quality

Research Task: *Salmon Protection*

- Few definitive studies conducted on navigation dredging effects except for entrainment concerns
- Migration impairment remains a major concern
- Actual probabilities of species-specific exposures and thresholds of effects need to be determined
- Sublethal effects of exposure difficult to ascertain and evaluate
Monitoring Plume-Fish Interactions

ADCP Transducer (RDI Workhorse Series)
Fisheries Hydroacoustics Transducer
GPS Unit
Water Bottle
OBS Sensor

St. Joseph, MI
May 1, 1999
Intensive Survey D
Bottom Single Targets
Nighttime
Dredge Active

Fish per 100 cu. m.
- 0
- 50 - 90
- 90 - 190
- 190 - 290
- 290 - 500
- >500
DREDGE LOCATION

30 m

Increasing Distance from Dredge

CAFT 11

76.8 kHz

Combined Acoustic & Radio Transmitters

Coded Acoustic Transmitters
Research Task: *Modeling Tools for Environmental Windows Determination*

- Modeling tools can facilitate and optimize objectivity in windows determination
- Models must be verified
- Models must adapt, evolve through continual refinement (SMS)
- Link to DMM Focus Area
- Emphasize development, testing and application of tools that address environmental aspects (e.g., support risk assessment)

**Pitfalls in the Present System**

- Windows must be over-restrictive to ensure effectiveness
- Windows have no performance standards
- Multiple regulatory players involved
- Few resource agencies have staff dedicated to the dredging process
- Resource agencies have no funds for dredging research or training
- Little incentive exists to change the status quo
Recommendations

• Consider all best management practices on an equal basis with windows
• Accept windows as a potentially useful tool based on the merits of a given project and specific sources of risk
• Do not institutionalize windows
• Seek science-based, adaptive approaches
• Obtain commitments to resolve major concerns

WWW.WES.ARMY.MIL/DOTS