

POTENTIAL EFFECTS OF DREDGING ON AQUATIC RECEPTORS



Michael Kravitz
USEPA ORD/NCEA
Dennis Timberlake
USEPA ORD/NRMRL



US EPA Office of Research and Development

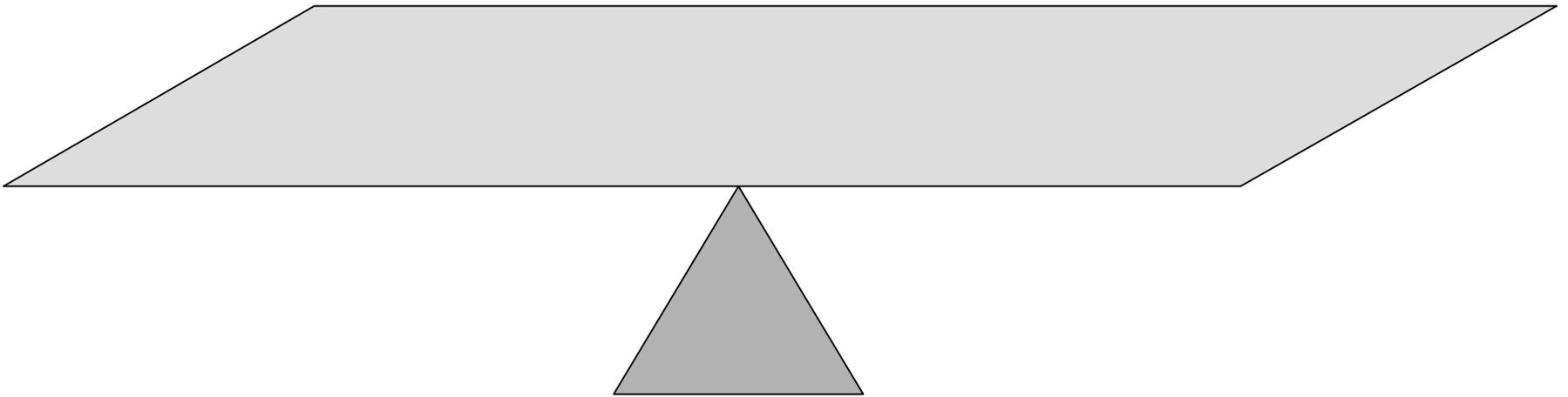
Outline

- Overview of the potential risks
- Factors affecting resuspension
- Toxicity risks/Phase Distribution of Contaminants
- Downstream transport of contaminants
- Habitat disruption and recovery time
- Points to bear in mind when evaluating risks
- Putting the risks into perspective

Weighing the Data

RISKS

BENEFITS



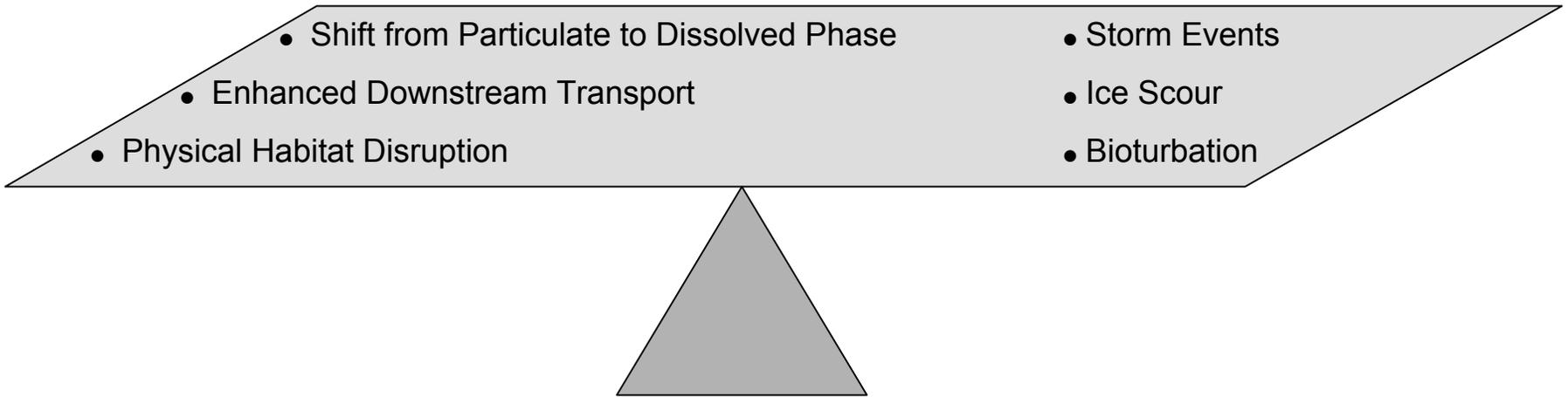
Dredging - Weighing the Data

Remediation Risks

- Shift from Particulate to Dissolved Phase
- Enhanced Downstream Transport
- Physical Habitat Disruption

“Natural” Risks

- Storm Events
- Ice Scour
- Bioturbation



Dredging Increases Resuspension

Nakai (1978):

Estimated releases of between 0.5% and 4.5% of sediments dredged using hydraulic dredges in silt & clay sediments.

Estimated releases of between 2.5% and 9% of sediments dredged using mechanical dredges in silt & clay sediments

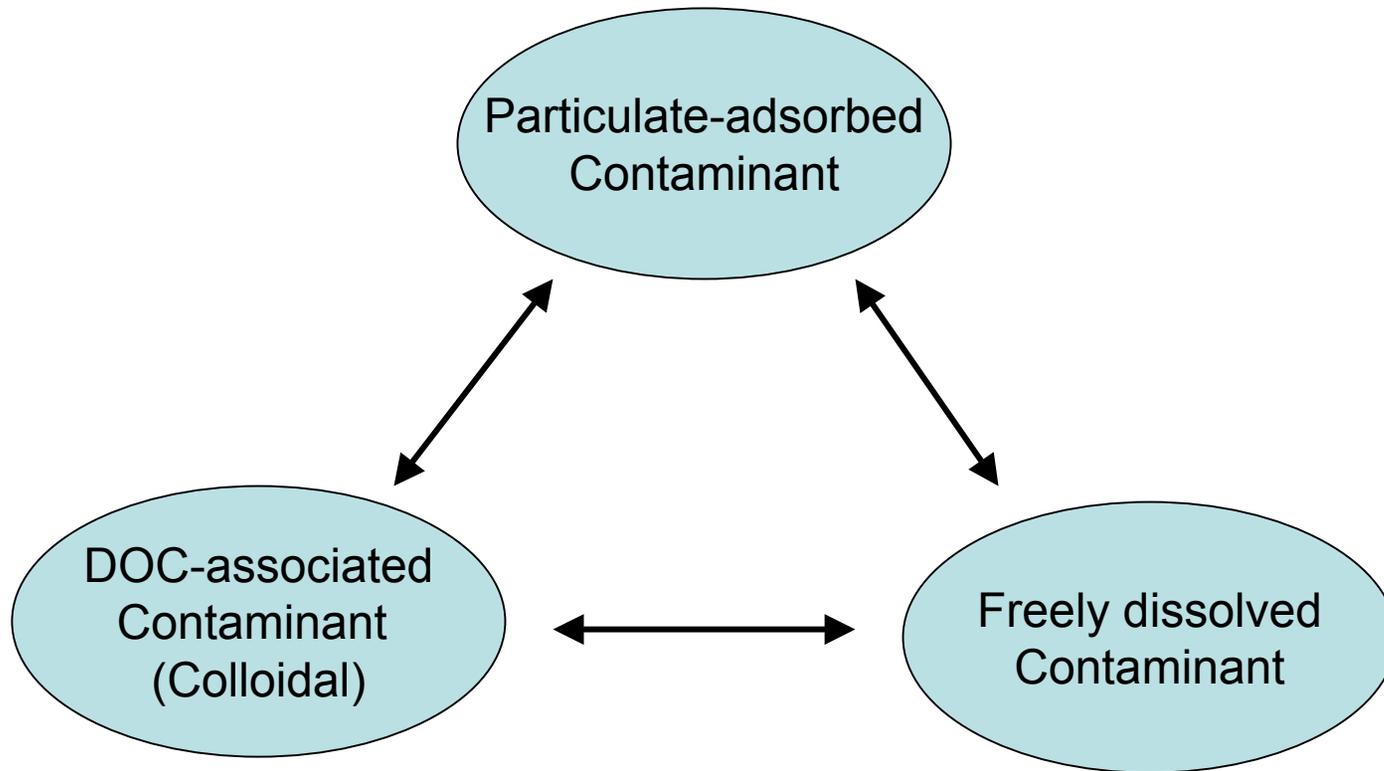
Some Factors Affecting Resuspension

- Dredge Type
- Operational practices (including use of silt curtains)
- Dredging plan
- Geological properties, including sediment type, water content, age of sediment
- Extent of biological activity
- Storm and weather events

Toxicity Risks

- Release of contaminants in the water column through resuspension can have a direct effect (e.g. on filter feeding organisms) or affect higher trophic levels through bioaccumulation
- Toxicity and bioaccumulation tests can be used to gauge potential effects. Decision criteria are important

Three Phase Aquatic System



Contaminant Distribution According to Equilibrium Partitioning

$$C_w = \frac{C_s W_s}{1 + C_s K_{sw}} \text{ (DiGiano et al. 1993)}$$

where,

C_w is the dissolved phase concentration in the water

C_s is the suspended solids concentration

W_s is the initial contaminant loading of the resuspended sediment, in mg/kg

K_{sw} is the sediment-water partition coefficient

$$(K_{sw} = K_{oc} \times f_{oc})$$

Estimate Freely-dissolved Chemical Concentration

Freely dissolved concentrations in the water can be estimated using a three-phase partitioning model:

$$F_{fd} = 1 / (1 + [POC]K_{POC} + [DOC]K_{DOC})$$

Where, f_{fd} is the fraction of chemical freely dissolved; $[POC]$ is the conc. of particulate OC; K_{POC} is the partition coeff. between particulate OC and freely dissolved chemical; $[DOC]$ is the conc. of the dissolved OC; K_{DOC} is the partition coeff. between dissolved OC and freely dissolved chemical.

Why is This Important?

Estimates of bioavailability that assume only two phases (i.e. particulate and dissolved) may be too high

Calculation of Source Strength

Sediment resuspension rate, or source strength, can feed into transport models

Source strength = sediment loss rate x sediment removed

Sediment loss rate, or Resuspension Factor, can be obtained from literature

Sediment removed can be calculated from dredge production rate and sediment density

Downstream Transport

- If concerns primarily associated with particulate phase, can estimate total contaminant concentration in water column at any point, and estimate the flux leaving the dredging area
- Does net cumulative transport downstream approach decision criteria?
- Turbidity can be used as a gauge of sediment resuspension, but doesn't tell the whole picture

Habitat Disruption and Recovery Time

Impacts to Aquatic Habitat Depend upon Nature and Extent of the Habitat

Coastal Systems:

- Recovery time of 6-8 months characteristic of estuarine muds
- Recovery time of 2-3 years more likely for sand and gravel communities

Lacustrine Systems:

- Recovery time can be > 2 yr if physical diversity of habitat is affected

Points To Bear in Mind when Evaluating Dredging Risks

- Magnitude of release and transport can be controlled by operational practices (including specially designed dredges)
- Most contaminants remain bound to sediment particles during dredging
- Estimates of bioavailability that assume only 2 phases may be too high

Put Potential Risks Into Perspective

Projected dredging-related increases in water-column contaminant loads should be compared to current and projected water column concentrations resulting from natural perturbations.

Dredging - Weighing the Data

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