Problem Formulation and Conceptual Model Development for Aquatic Placement

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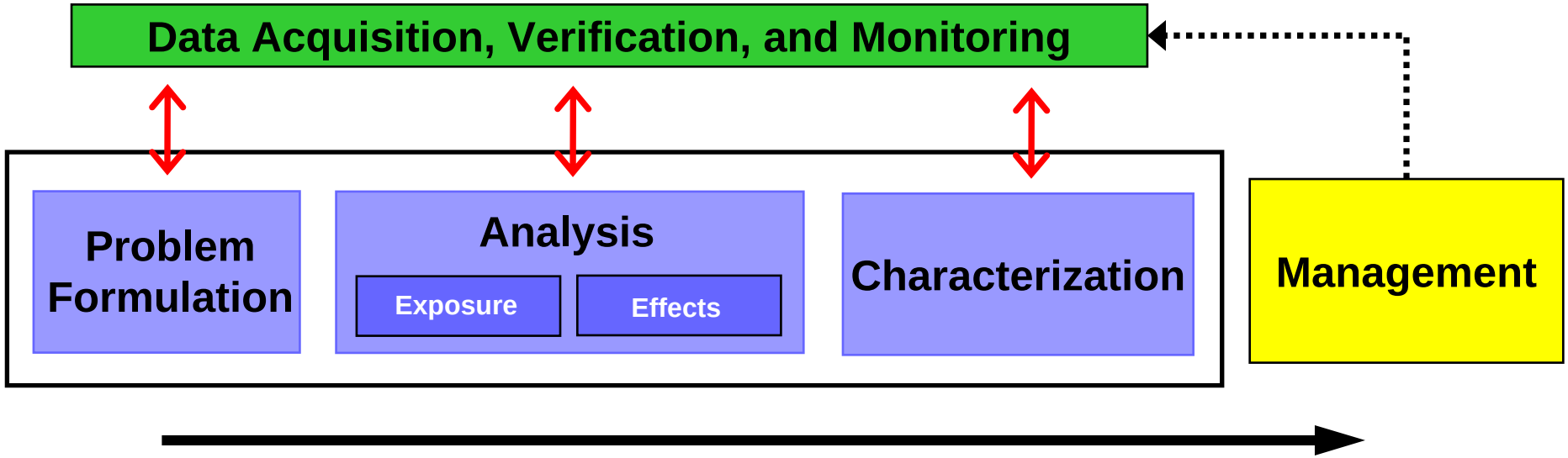
Objectives

- Overview of problem formulation
- Overview of conceptual site models

Risk Assessment Process



- **Process that evaluates the likelihood that adverse effects may occur or are occurring as a result of exposure to one or more stressors (USEPA 1997)**

Problem Formulation Goal

The goal is to define the ecological and human relationships to be evaluated, then plan how to evaluate them. Any deficiencies in problem formulation will compromise all subsequent work on the risk assessment.

Why do Problem Formulation?

Practicality

- **Documents basis for the evaluation**
- **How it will be done**
- **Why it will be done**
- **How decision will be made**

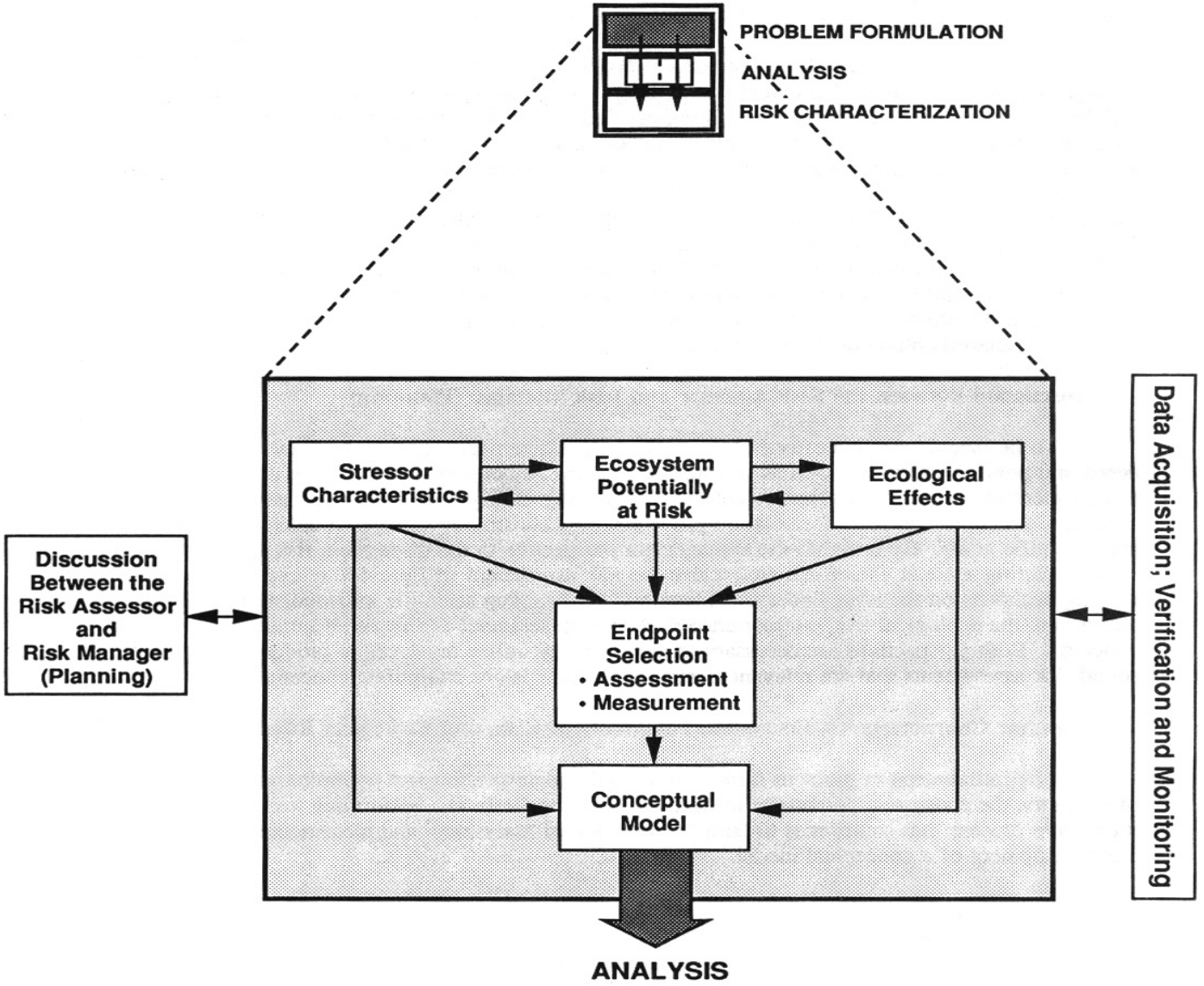
- **Is there a reason to believe there is a problem requiring further evaluation?**
- **What tests are needed?**

What is Problem Formulation?

Components (products):

- **Site characterization**
  - **Document current conditions**
  - **Determine nature and extent of contamination**
    - **in abiotic media (sources)**
    - **in biota (plants and animals)**
- **Identify receptors and endpoints**
- **Completed exposure pathways**
- **Conceptual site model**
- **Information sources include:**
  - **disposal site designation EISs**
  - **monitoring efforts**
  - **ecological literature of studies in the vicinity**

Problem Formulation Overview



Contaminants of Concern

- Metals
- Semi-volatile organic compounds
- Volatile organic compounds
- Polycyclic aromatic hydrocarbons (PAHs)
- Polychlorinated biphenyls (PCBs)
- Dioxins/furans
- Others

Endpoints

- **Assessment Endpoints**
- **Measurement Endpoints**

Assessment Endpoint

An explicit expression of the value that is to be protected, operationally defined by an ecological or human entity and its attributes (USEPA 1997)

- **Allows assessment of the risk to the receptor from placement of dredged material at the site**
- **Considers potential exposure pathways from the dredged material to the receptor**

Criteria for selecting Assessment Endpoints

- Ecological Relevance
- Societal Values
- Susceptibility to stressor
- Can contact dredged material

Why these receptors?

- Representative species of flora, fauna or sensitive human subpopulations
- Live in the project area (or surrogate species)
- Sensitive to the contaminants of concern
- Selecting test species for dredged material evaluations
  - Arthropods (e.g., daphnids)
  - Vertebrates (e.g., fish)
  - Molluscs (e.g., bivalves)
  - Echinoderms
- Characteristics of test species

Measurement Endpoint

A measurable ecological or human characteristic that is related to the valued characteristic chosen as the assessment endpoint (USEPA 1997)

Measurement endpoints are often expressed as the statistical or arithmetic summaries of the observations that comprise the measurement

Measurement Endpoints

Selection Criteria:

- **Relevancy to assessment endpoint**
- **Practical to quantify**
- **Sensitivity and responsiveness**

Examples:

- **Water quality criteria/guidelines**
- **Sediment quality criteria/guidelines**
- **Endpoints from acute and chronic bioassays**
- **Inputs to ecological models**
- **Population statistics**
- **Abundance of prey species**

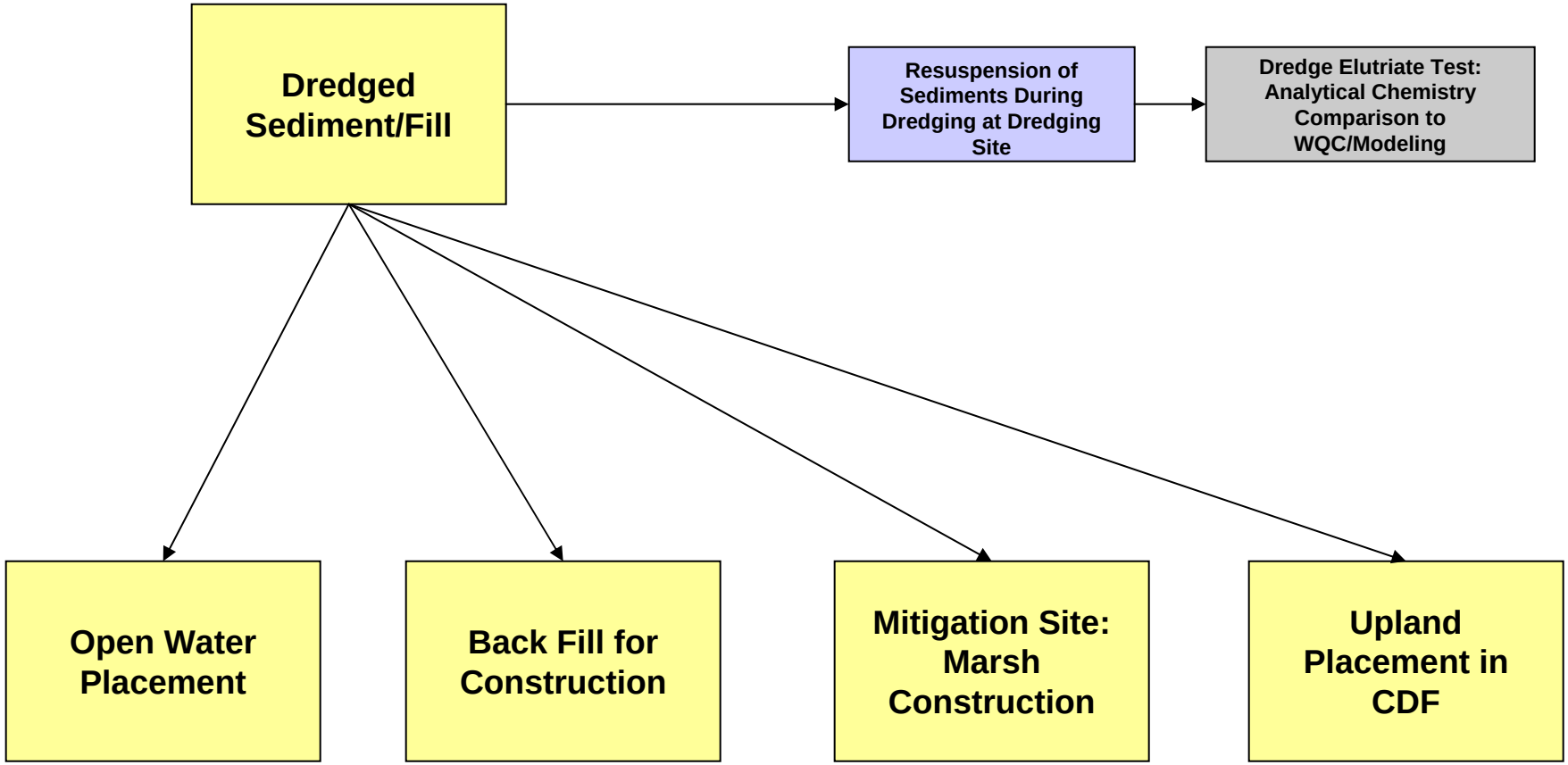
Conceptual Model

The conceptual model describes a series of working hypotheses of how the stressor(s) might affect ecological and human components (USEPA 1997)

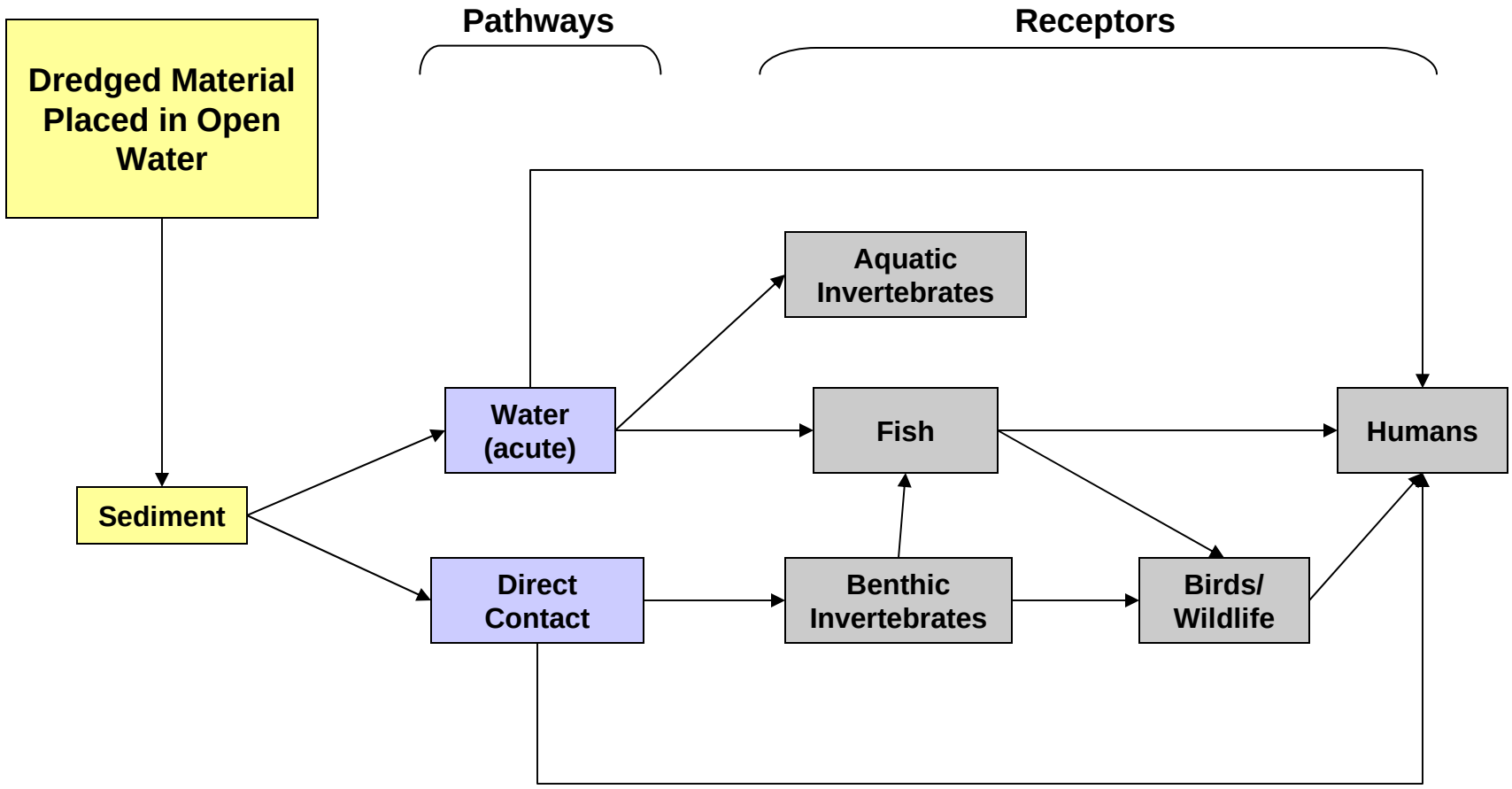
Conceptual Model

- **Written and visual representation of predicted relationships between ecological and human entities and the stressors to which they may be exposed**
- **Typically consist of:**
  - **Source(s) and nature of stressor (e.g., chemicals in dredged material)**
  - **Exposure pathways (direct contact, trophic transfer, reduction in prey availability)**
  - **Receptors (direct and indirect contact to dredged material)**

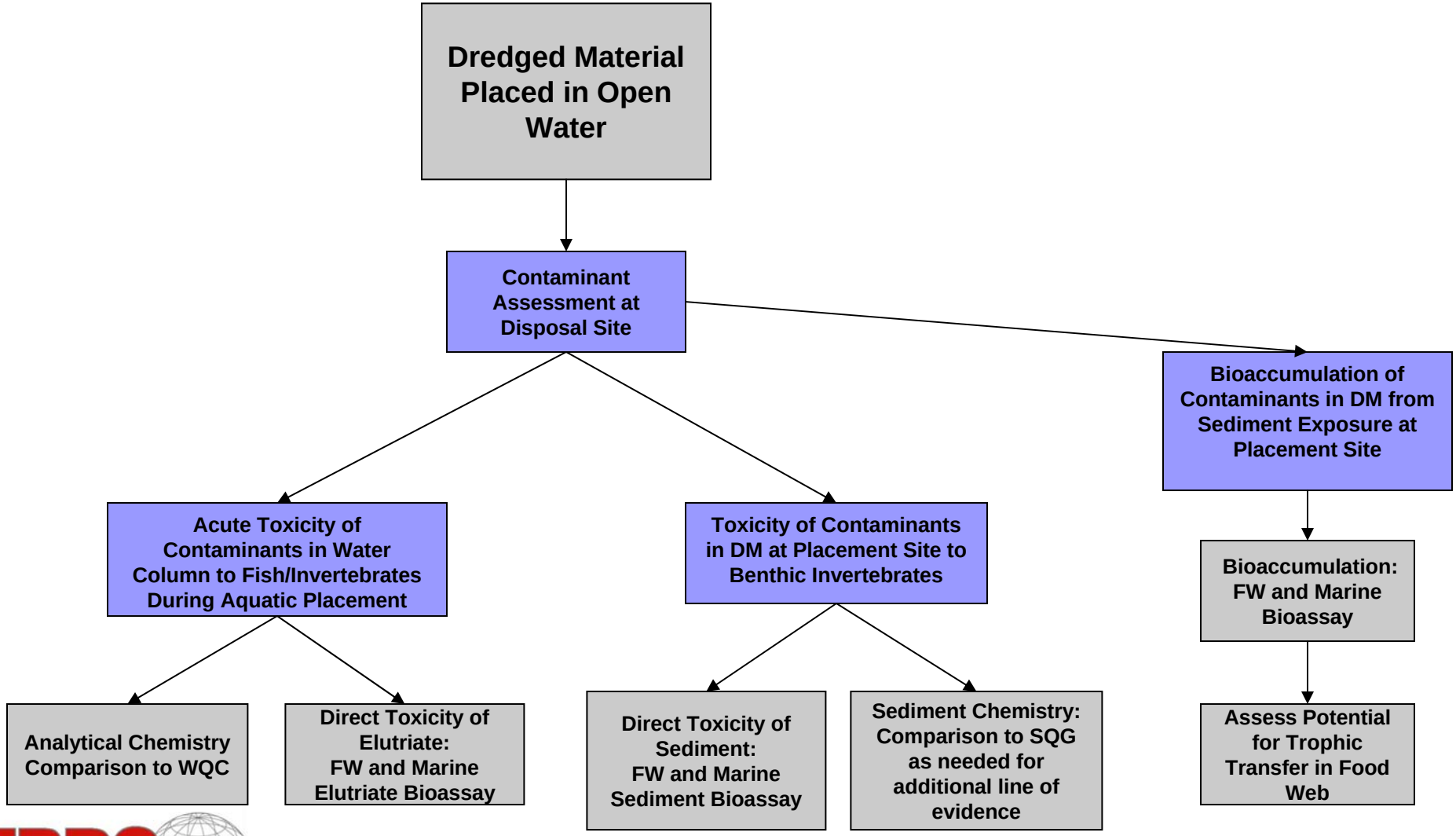
Conceptual Model Examples for Dredging Activities



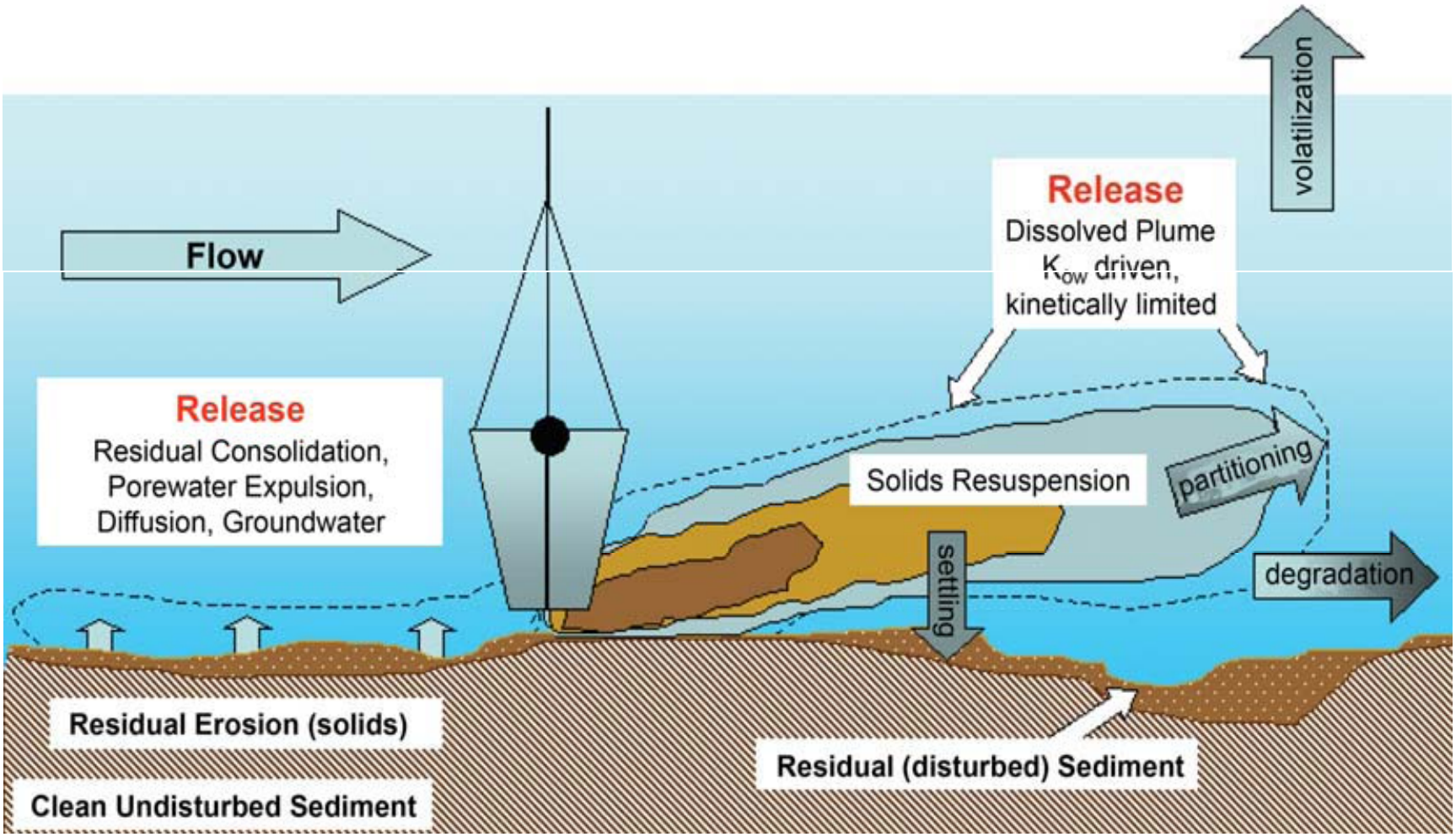
Conceptual Model for Aquatic Placement



Conceptual Model for Aquatic Placement



Conceptual Model Schematic of Contaminant Release Sources and Mechanisms



Strengths of RA Approach

- Provides a process for focusing on important issues
- Integrates ecological and societal concerns
- Can be used to integrate physical and chemical stressors in risk characterization
- Useful in decision-making

Take Home Message

After completing problem formulation, should have:

- **Plan documenting how dredged material evaluation will be conducted**
- **Plan documenting how decision will be made based on data generated**
- **Basis for developing shared understanding of why we are conducting the RA**
- **Methodology (road map) to proceed with evaluation**