SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR

28-30 NOVEMBER 2018

GALVESTON, TX

Pathway Assessment

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Upland placement alternatives

- Confined disposal
- Beneficial use
  - Habitat development
  - Beach nourishment
  - Parks & recreation
  - Agriculture, forestry, horticulture, aquaculture
  - Strip-mine reclamation/Solid waste management
  - Construction/Industrial development
  - Multipurpose


Buffalo Harbor CDF


Huron Harbor CDF


Saginaw


Poplar Island

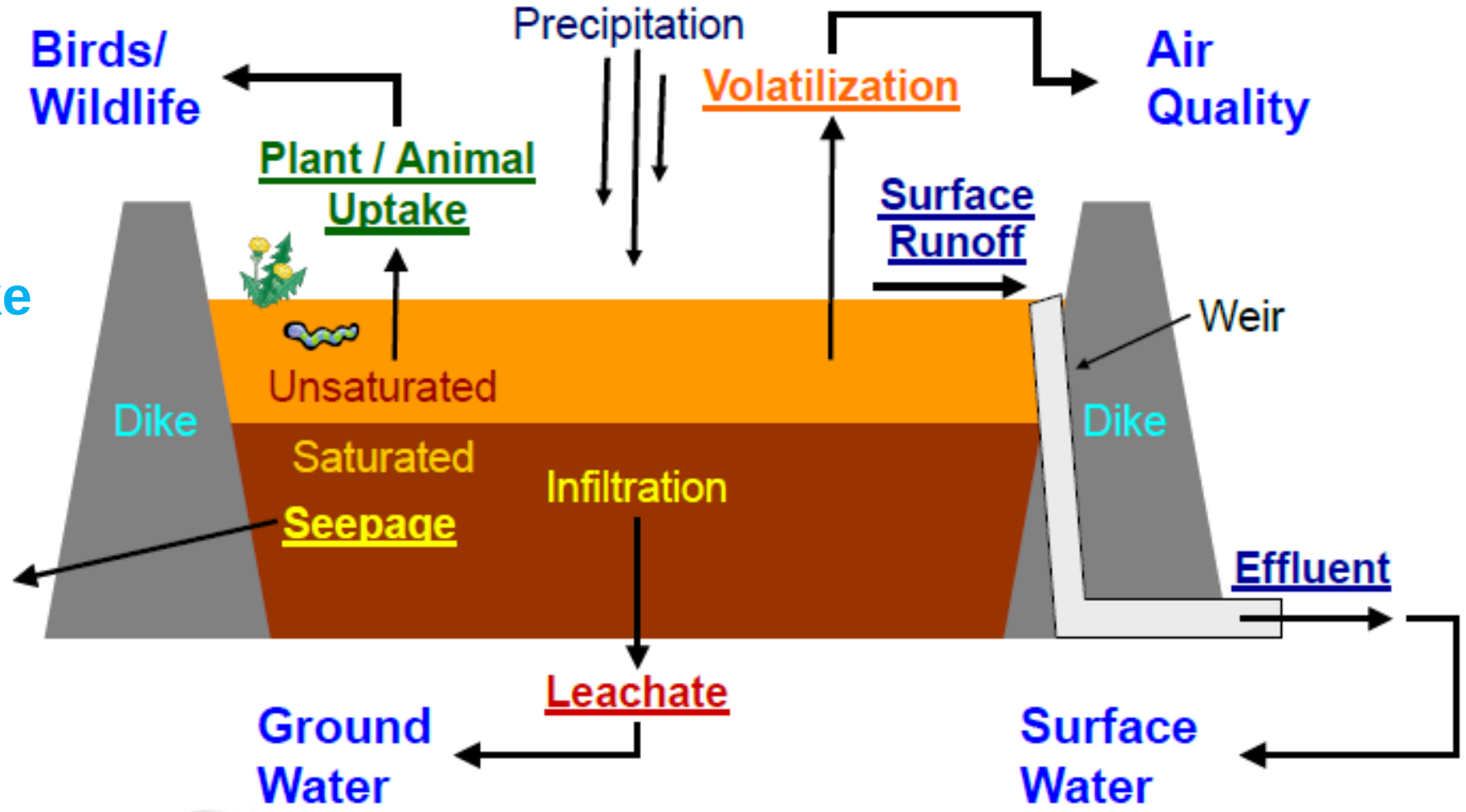
Regulatory concerns and available guidance

- Regulatory
  - CWA Section 404
- Guidance
  - USACE/EPA Technical Framework
  - Upland Testing Manual
  - Draft – Great Lakes Regional BU Manual

Upland pathways

- Effluent
- Runoff
- Volatilization
- Leachate
- Plant/Animal Uptake

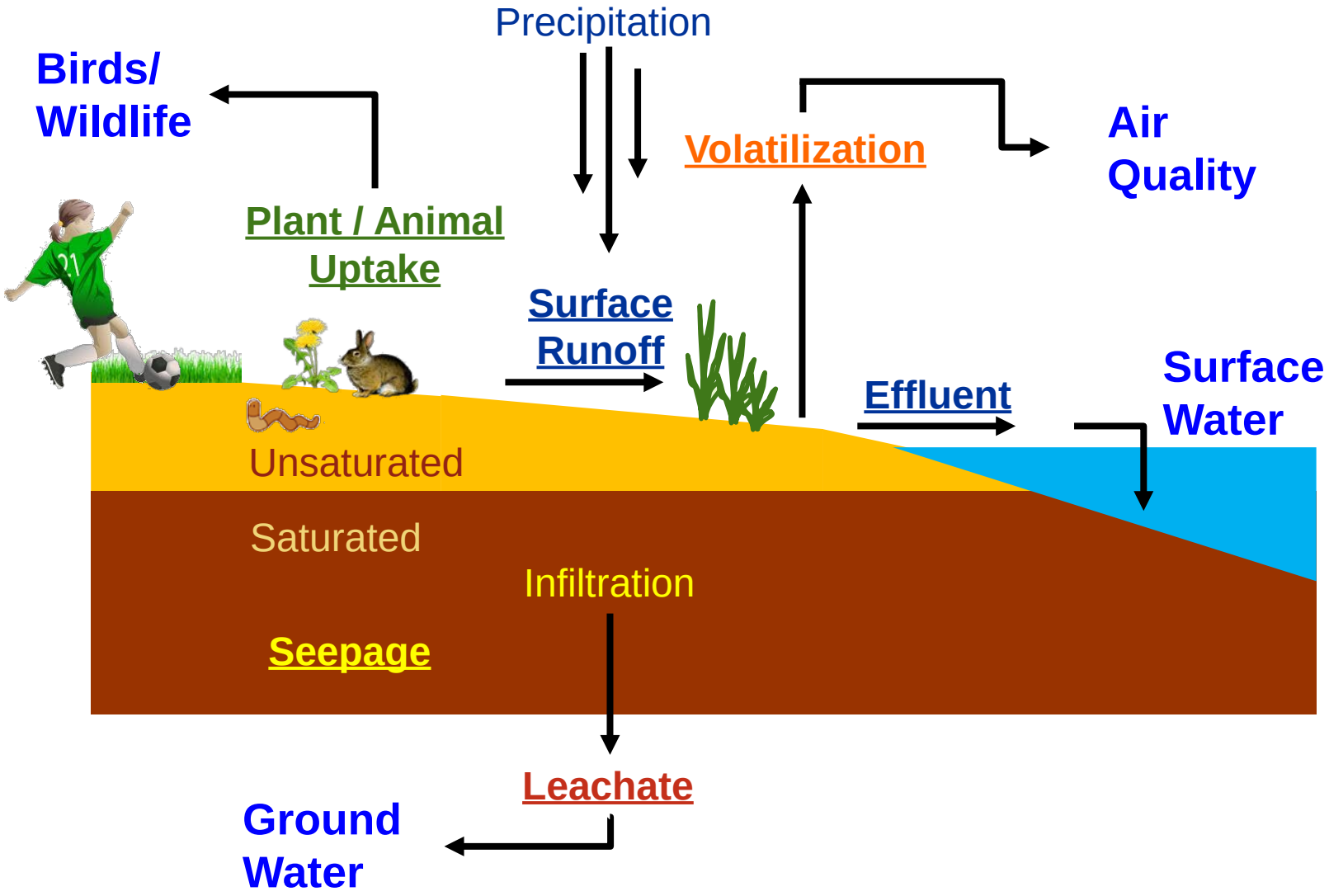
- Disposal vs. BU



Upland pathways – Unconfined / BU

- Effluent
- Runoff
- Volatilization
- Leachate
- Plant/Animal Uptake

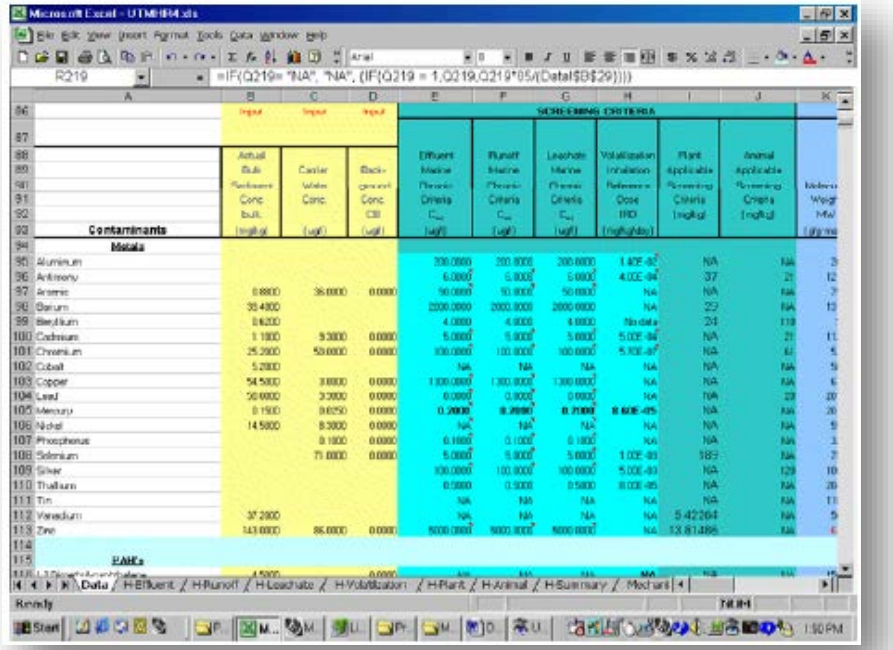
- Disposal vs. BU

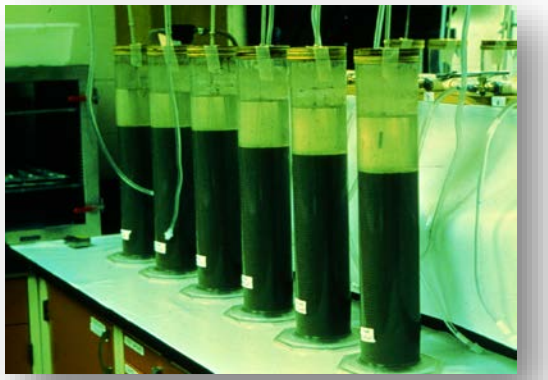


Pathway evaluation

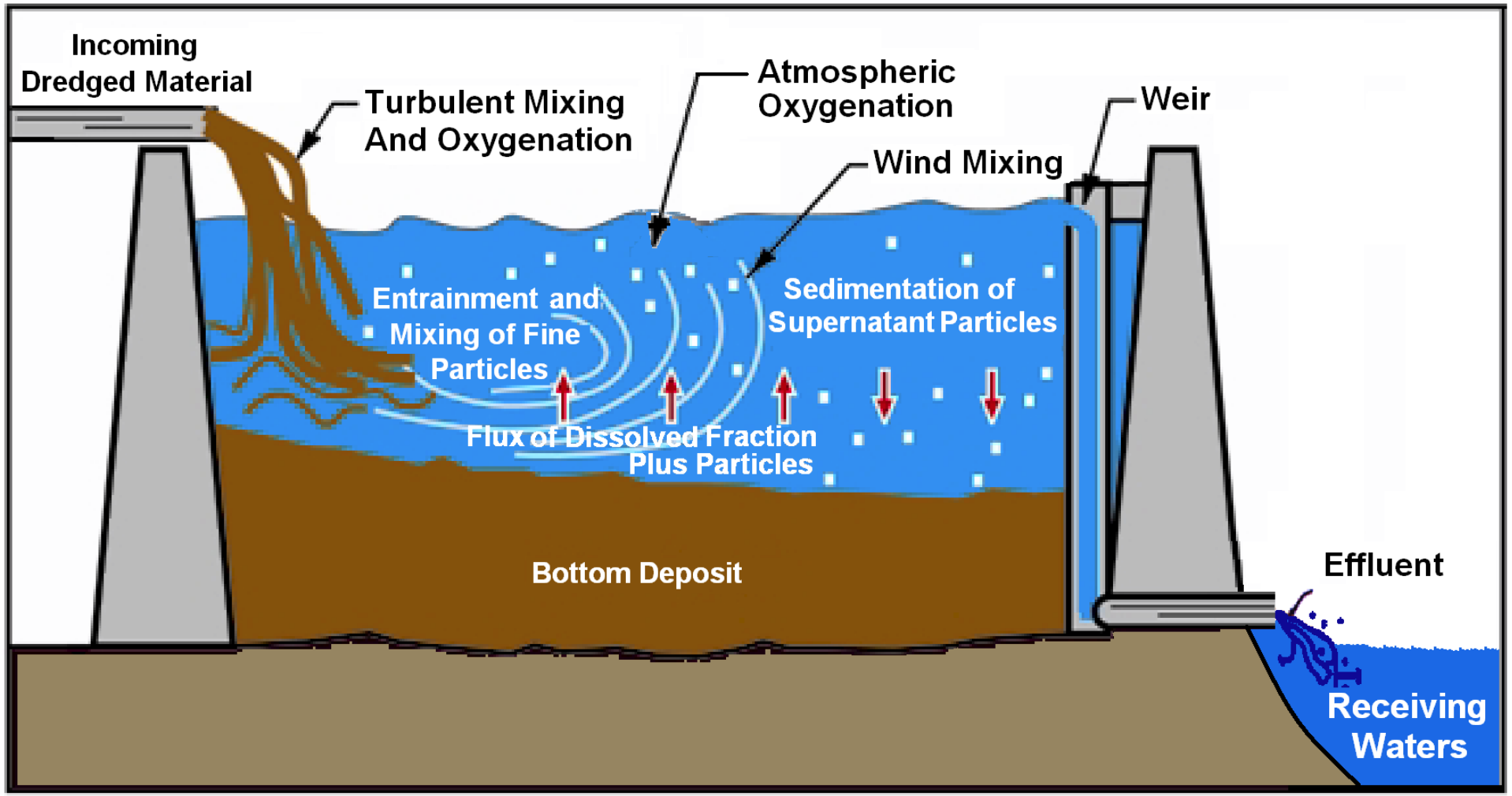
Complexity
Data/Effort Required
Cost

- Tier I – Existing info
- Tier II - Screening
  - calculate concentrations
    - ► conservative assumptions
    - ► bulk sediment concentrations
    - ► equilibrium partitioning
  - spreadsheet available
  - consider initial mixing/dilution
  - compare to appropriate criteria
- Tier III – Laboratory testing
  - used to generate pathway concentrations
- Tier IV – Case specific





Effluent



Receptors:

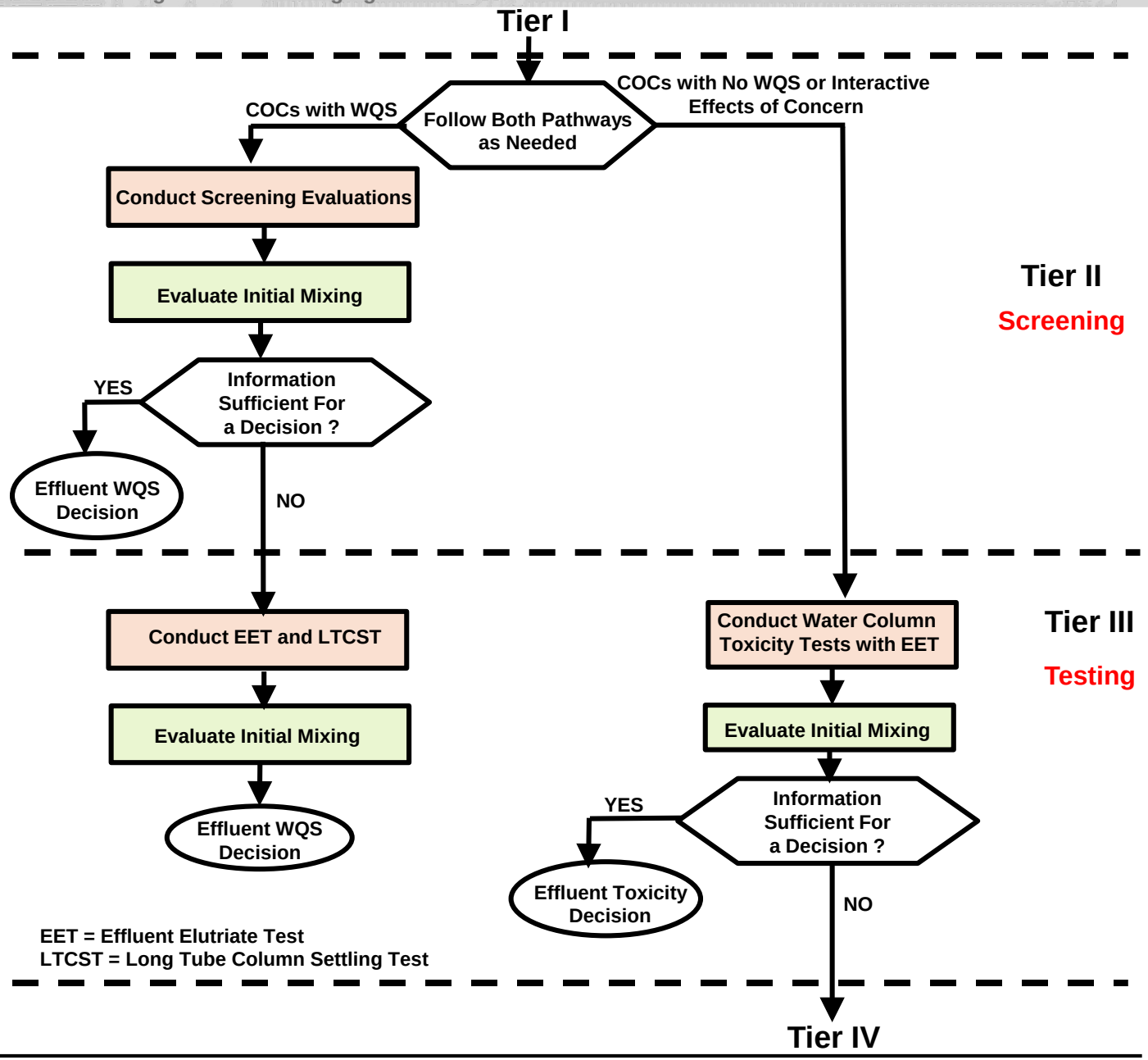
Aquatic species

Criteria:

State/Federal WQS/WQC

Effluent

- Compare predicted effluent concentration with WQC/WQS
- Consider initial mixing
- Tier II – Screening
  - Effluent concentration predicted based on equilibrium partitioning (K_d) and bulk sediment properties
- Tier III – Testing
  - Modified Elutriate Test
    - EFQUAL model
  - Column Settling
    - SETTLE model
  - Toxicity Evaluation (procedure in ITM)
    - LAT-E model (or EFFLUENT)



Effluent – Modified Elutriate Test

1. Mix sediment and water to expected influent concentration[1]

Water from dredging site

Sediment

2. Aerate in 4L cylinder for 1 hr

Air

3. Settle for expected mean field retention time up to 24 hr maximum

4. Extract sample and split

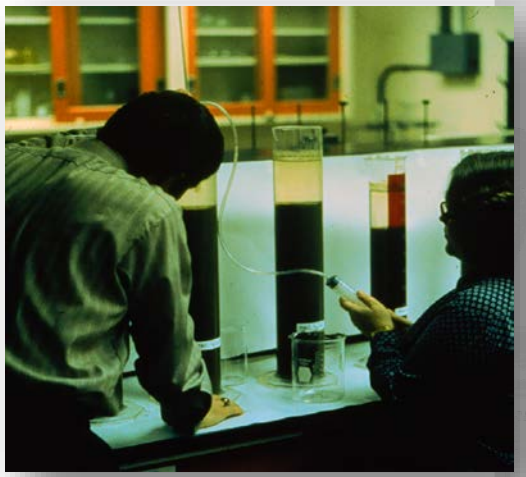
Suspended Solids Determination

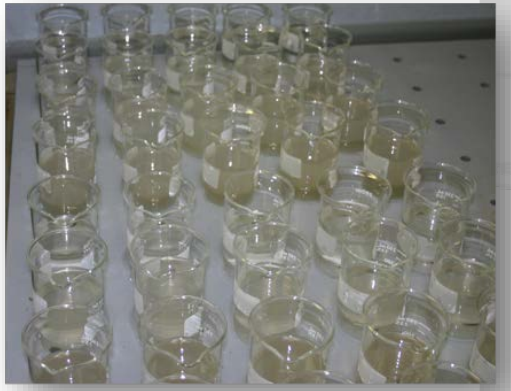
Chemical Analysis **Total** Concentration

5. Centrifugation or 0.45 µm filtration

Chemical Analysis **Dissolved** Concentration

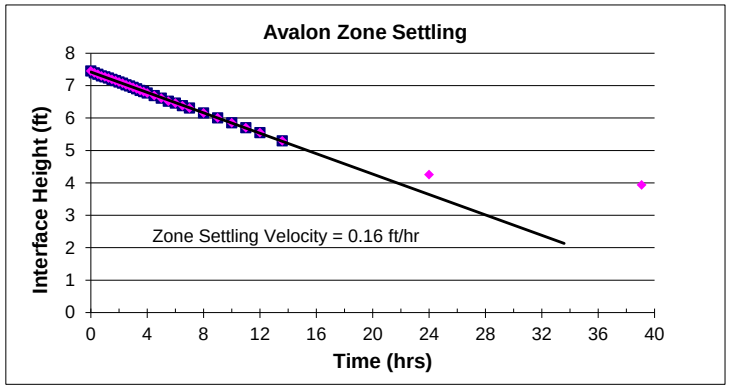
[1] *CsI = % Fines + 3 x % Coarse*

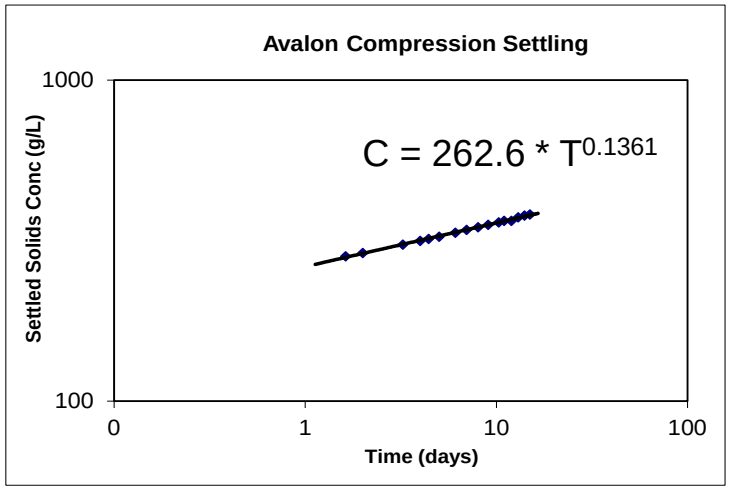


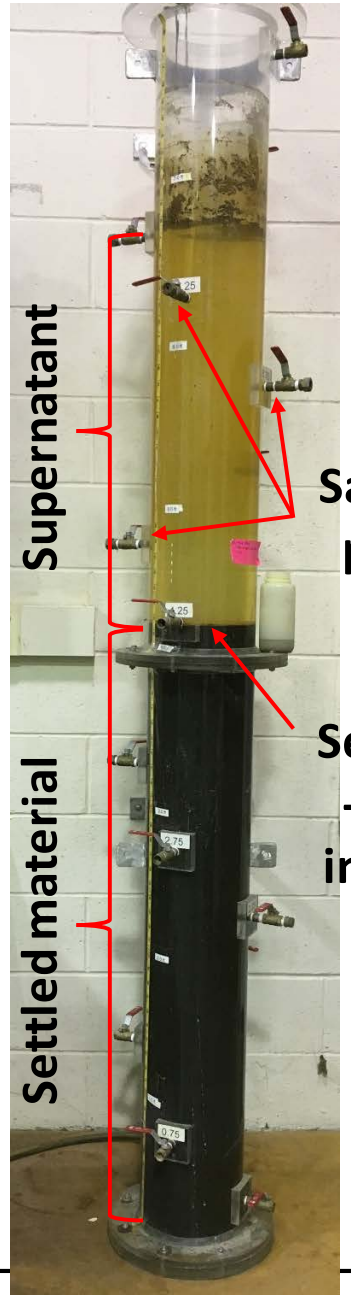


Effluent – Column Settling Test

- Column
  - 8-in diameter, > 6-ft tall
  - Ports every 6 in.
- Fill column with slurry at expected influent solids concentration
  - *CsI = % Fines + (3 x % Coarse)*
- 15 day test
  - Sample supernatant TSS
  - Record interface height
- Predict rate of settling and effluent TSS
  - SETTLE model



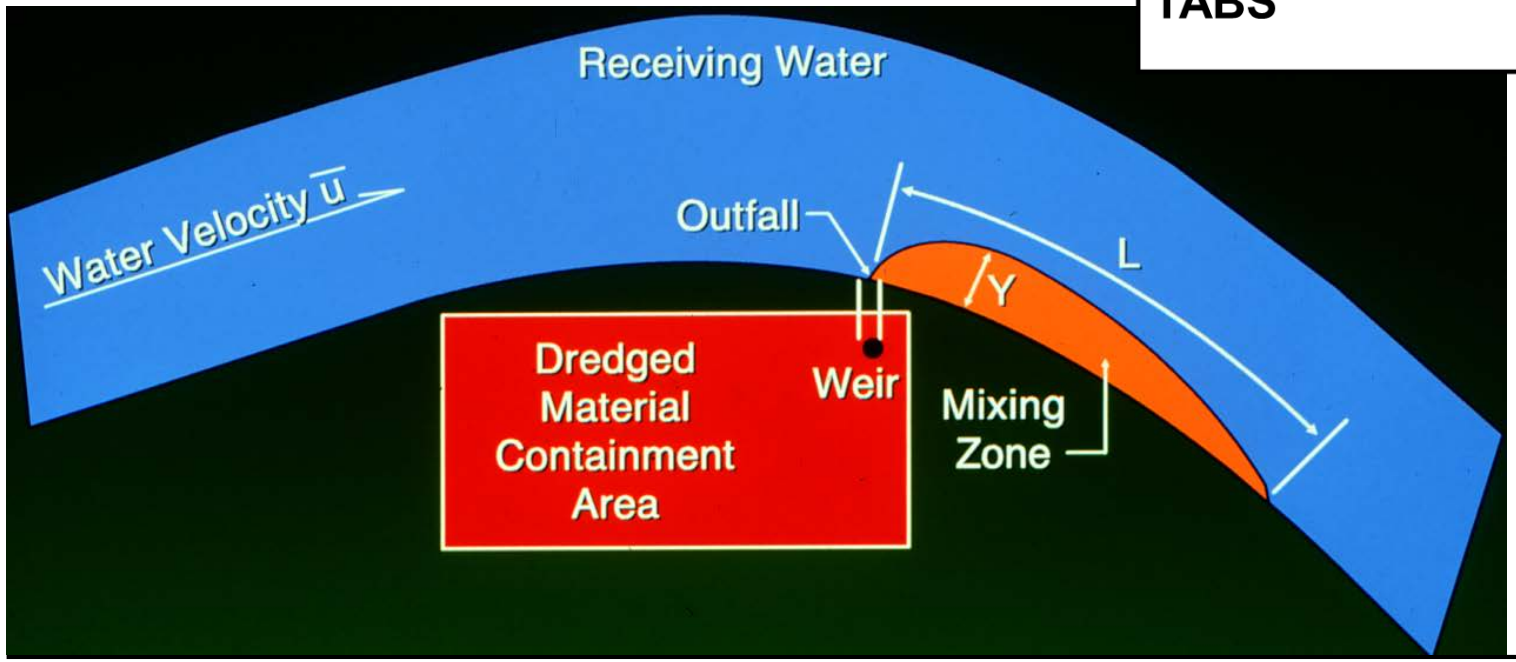




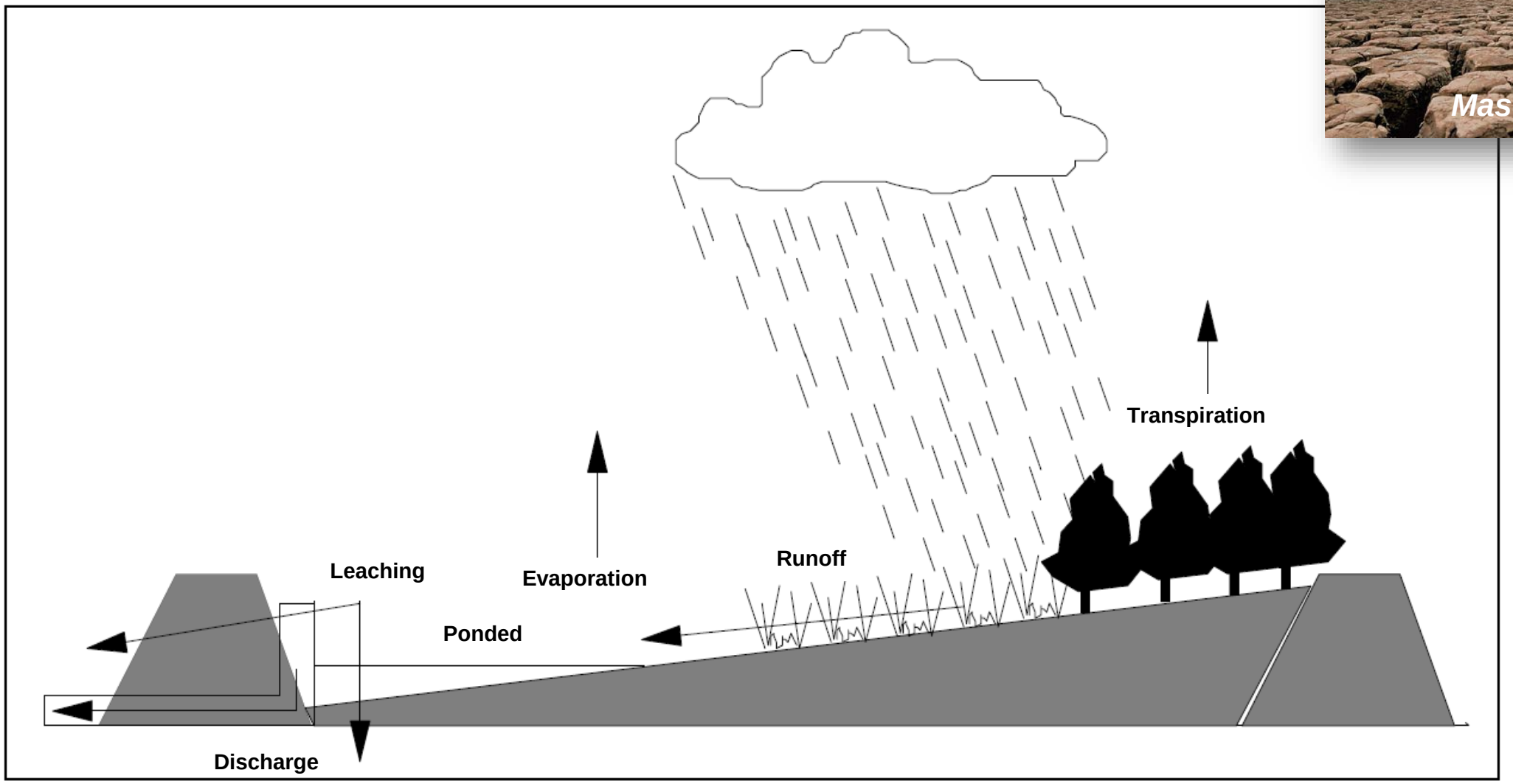
Initial Mixing

40 CFR § 230.3 (m) The term *mixing zone* means a limited volume of water serving as a zone of initial dilution in the immediate vicinity of a discharge point where receiving water quality may not meet quality standards or other requirements otherwise applicable to the receiving water.

Model/Technique	Hydrodynamics	Conditions
Dilution Volume	Steady Uniform	General
MacIntyre	Steady Uniform	Riverine
CDFATE (CORMIX)	Steady Uniform	
TABS	Unsteady Nonuniform	Tidally influenced Rivers & Estuaries



Runoff



Receptors:

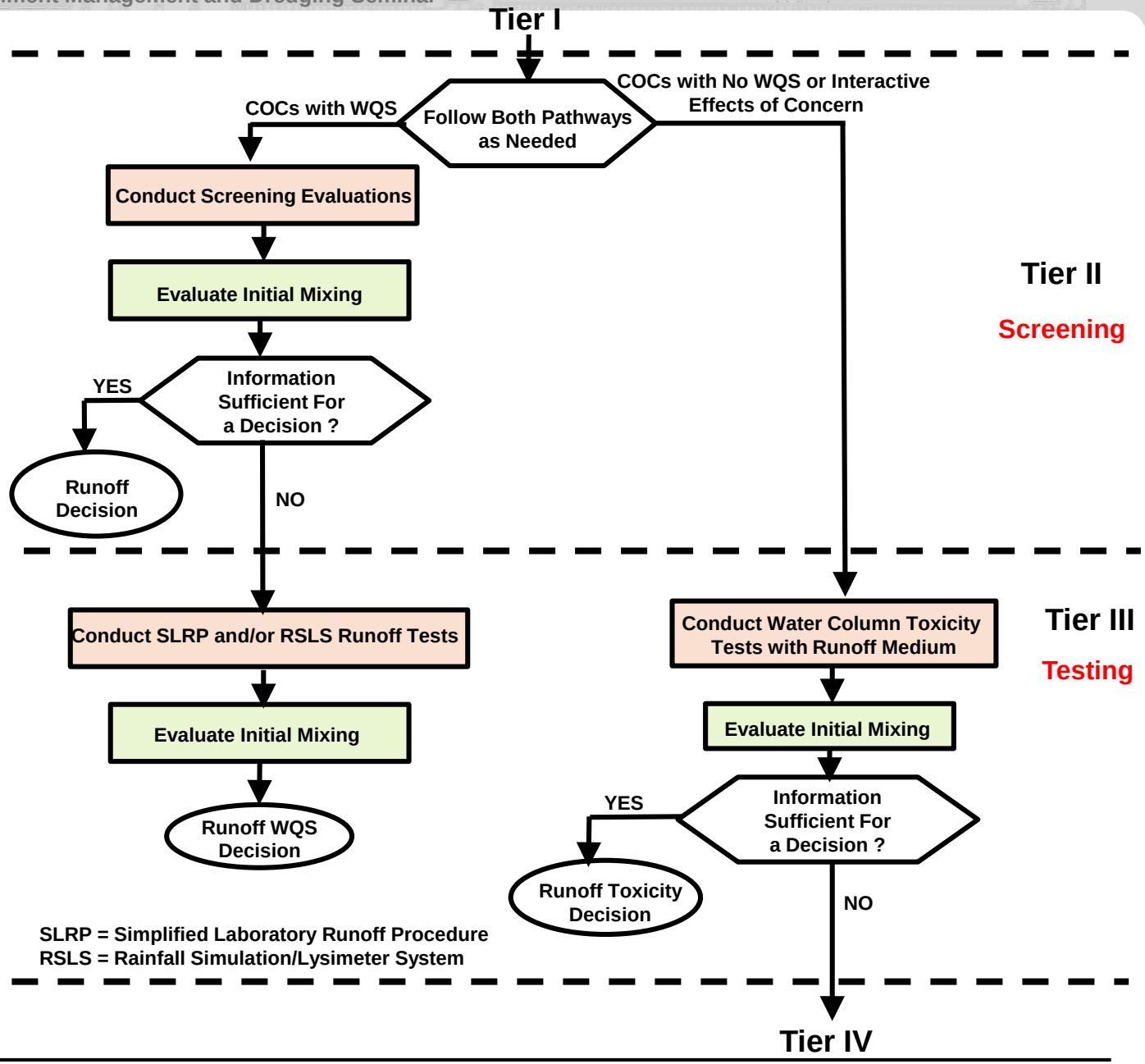
Aquatic species

Criteria:

State/Federal WQS/WQC

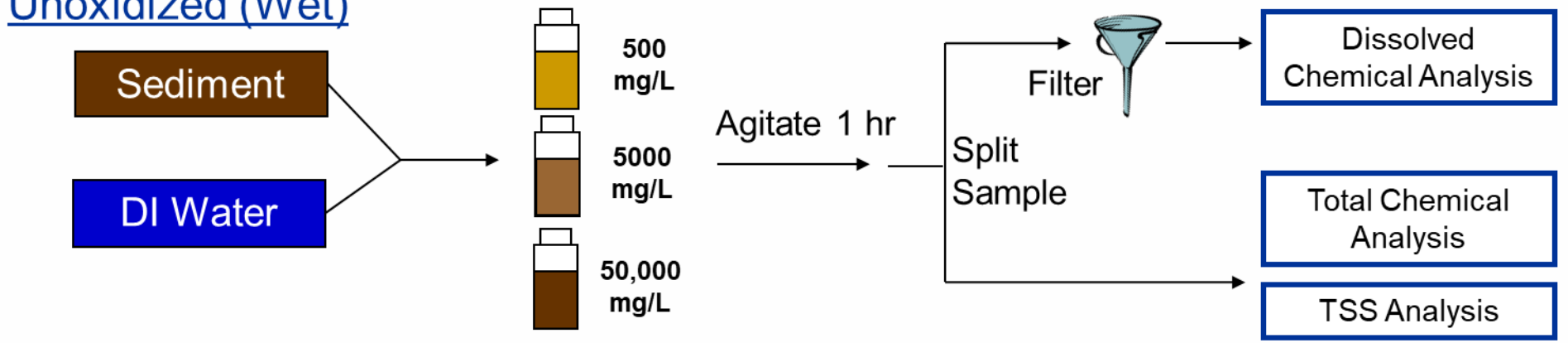
Runoff

- Compare predicted runoff concentration with WQC/WQS
- Consider initial mixing
- Tier II – Screening
  - Effluent concentration predicted based on equilibrium partitioning ($K_{d,\ ox}$ and $K_{d,\ unox}$) and bulk sediment properties
- Tier III – Testing
  - Simplified Laboratory Runoff Procedure (SLRP)
    - Wet (unoxidized) and Dry (oxidized)
  - Rainfall Simulator/Lysimeter System (RSLS)
    - RUNQUAL model
  - Toxicity Evaluation (procedure in ITM)
    - LAT-R model (or RUNOFF)

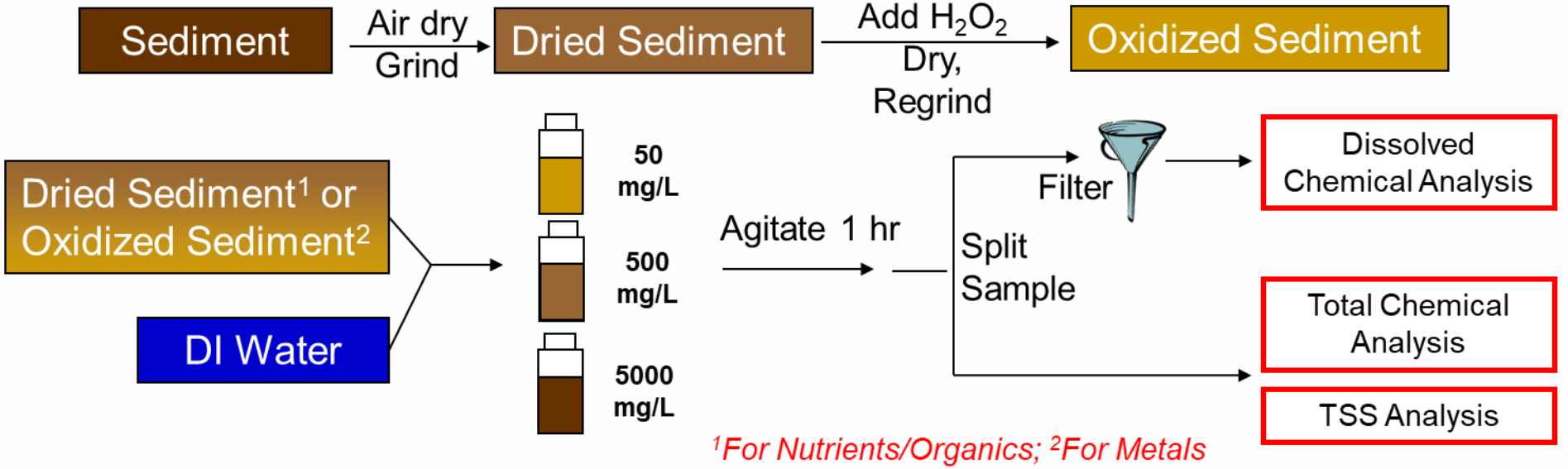


Runoff – SLRP Procedures

Unoxidized (Wet)

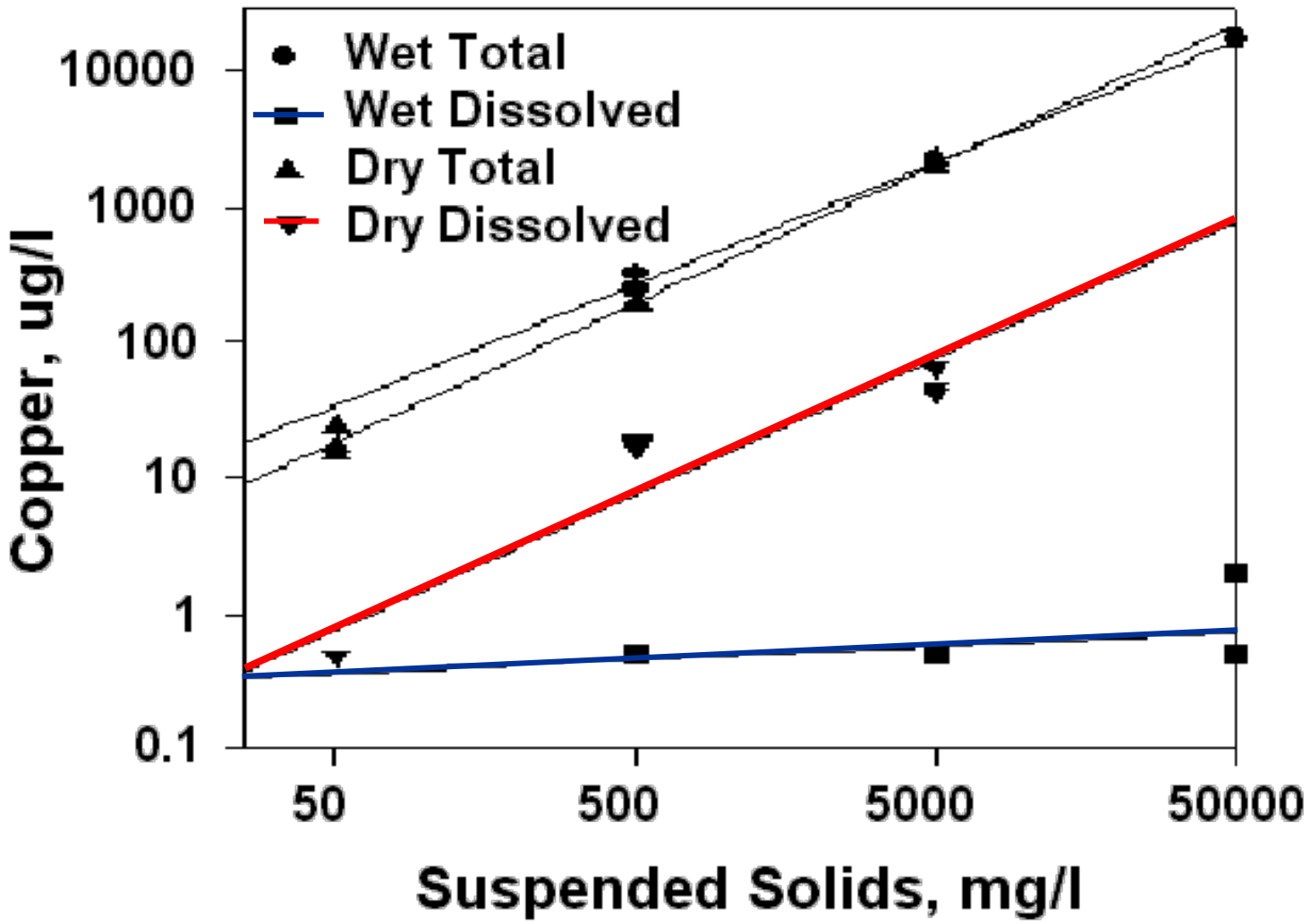


Oxidized (Dry)



[1]For Nutrients/Organics; [2]For Metals

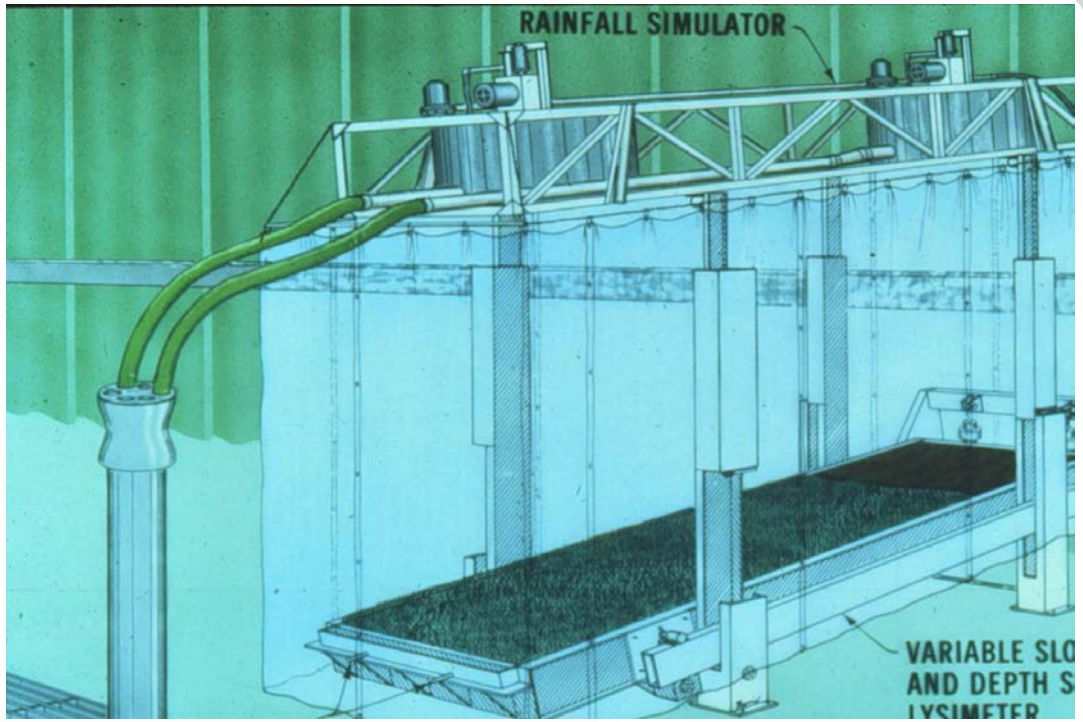
Runoff – SLRP predicted copper



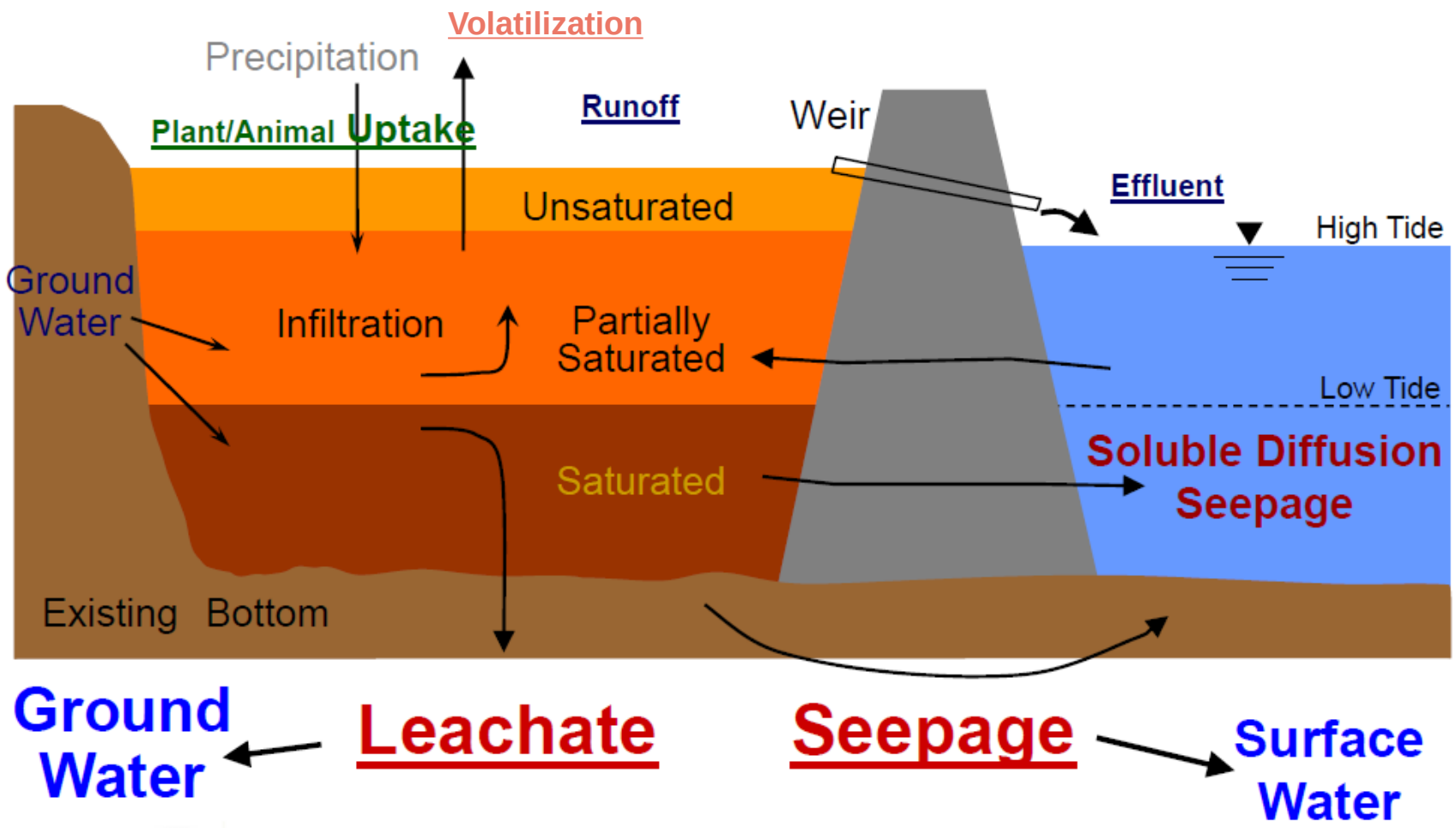
This is why we do both wet, and dry SLRP tests

Runoff – RSLS Procedure

- Specialized equipment
- 60 gal sediment
- Conduct on wet; allow to dry 6 months, repeat on oxidized sediment
- Test specifics
  - Rainfall
    - 2 in/hr, 30 min events, 3 events
  - Sample
    - Runoff rate – every minute
    - pH, TSS, EC
      - Every minute up to 15 min, then every 5
    - Chemical analysis
      - Composite of 5, 15, 25 minutes after runoff begins
      - Dissolved and total



Leachate



Receptors:

- GW supply (freshwater)
-Benthic zone receptors (marine)

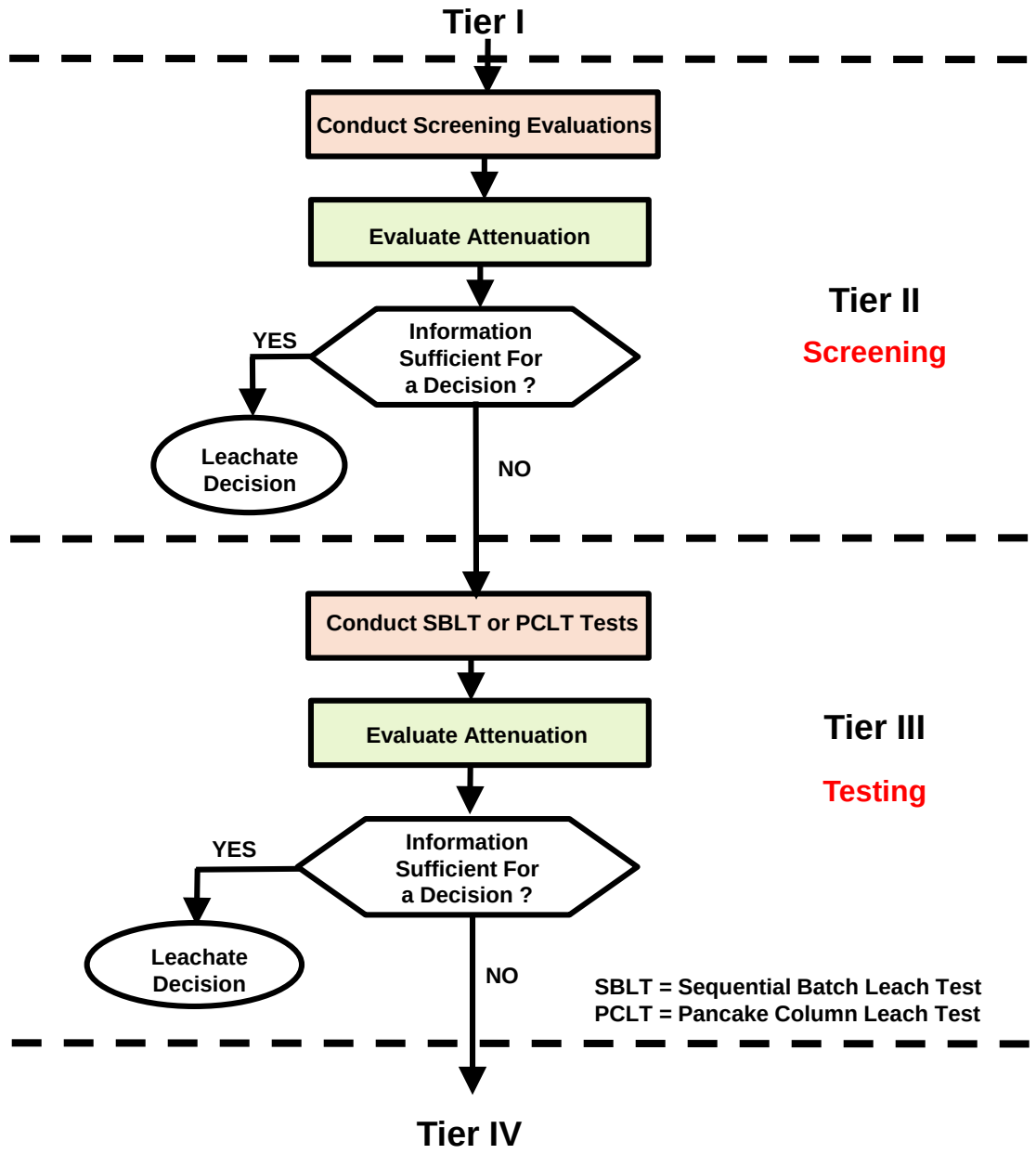
Criteria:

GW or surface water standards

Leachate

- Tier II – Screening
  - Equilibrium partitioning
    - ► Laboratory determination of sediment chemical properties
  - Attenuation
  - Compare to applicable GW or surface water standards

- Tier III – Testing
  - Freshwater sediments
    - ► Sequential Batch Leach Test (SBLT)
  - Marine (saline) sediments
    - ► Pancake Column Leach Test (PCLT)
  - Groundwater modeling
    - ► HELPQ
    - ► MultiMed/IWEM
    - ► GMS

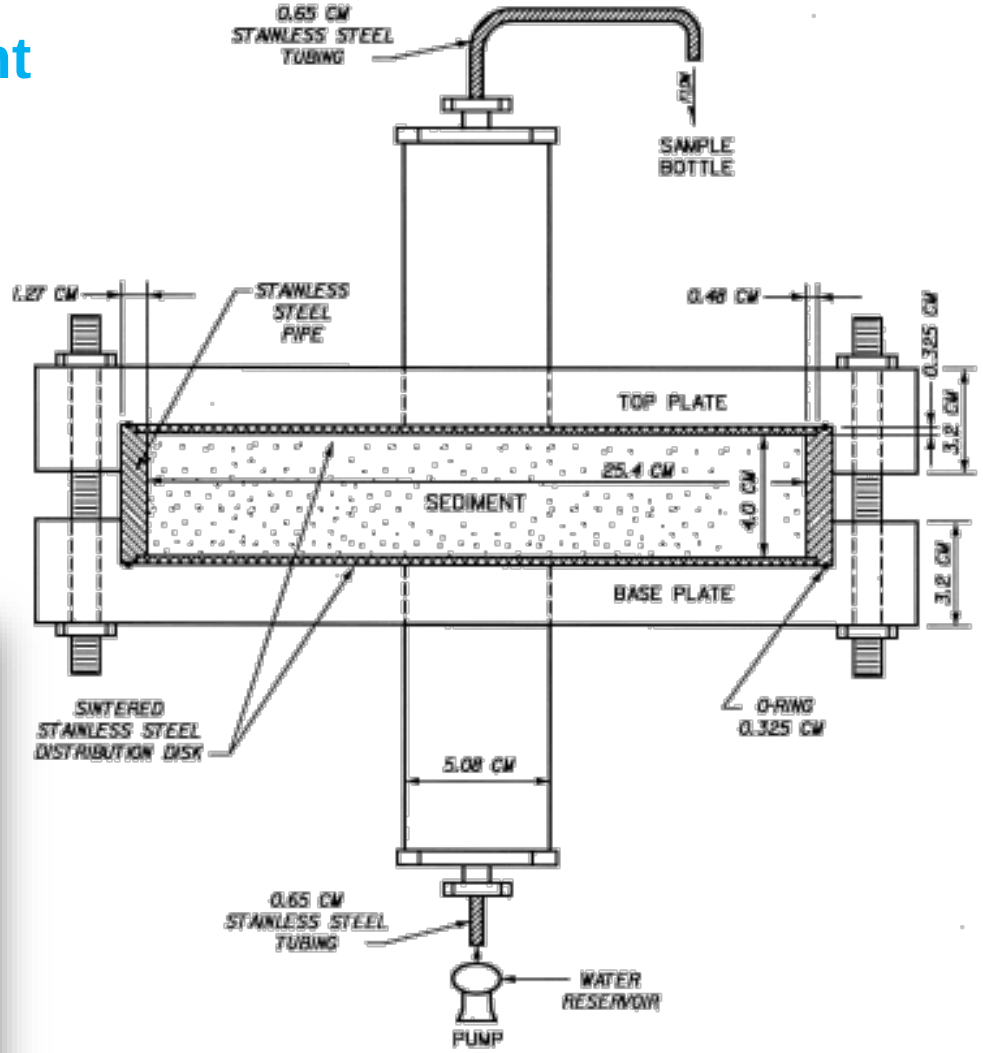


Leachate - Sequential Batch Leach Test (SBLT)

- Load sediment in a 4:1 water-to-sediment ratio under anaerobic (nitrogen atmosphere) conditions (for unoxidized dredged materials).
- Shake for 24 hours, centrifuge, and filter leachate.
- Add water to sediment to make up that removed. Repeat steps 1 and 2.
- Repeat procedure for at least four cycles.

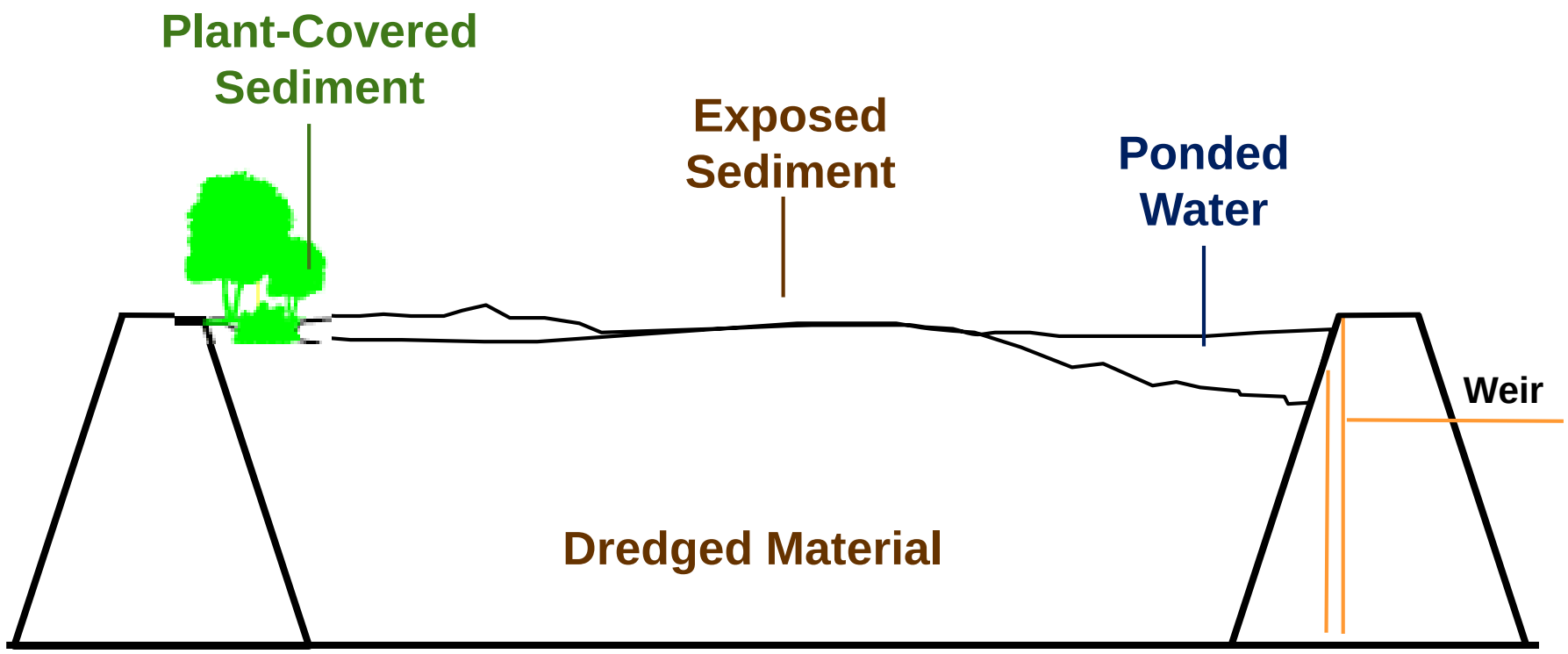
Leachate - Pancake Column Leach Test (PCLT)

- Laboratory-scale physical model of contaminant elution from dredged material
- Thin layer column to maximize the number of pore volumes eluted
- Testing conducted in up-flow mode
- Pore water velocity limited to 1×10^{-5} cm/sec
- Elution of 30 pore volumes recommended



Volatilization

- **Not regulated under Clean Air Act.**
  Evaluation designed to meet exposure standards under OSHA.



Receptors:

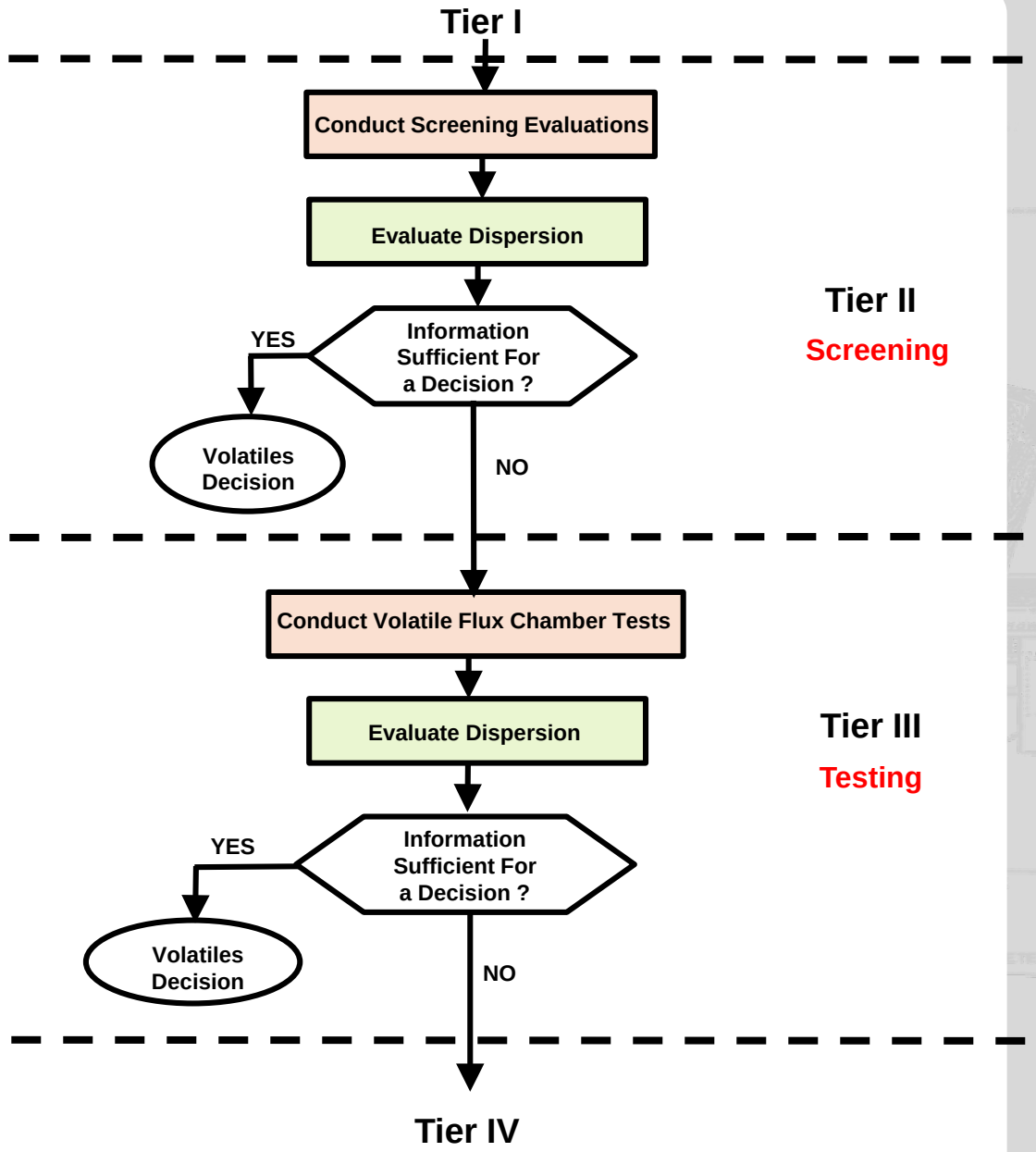
Humans working on site or adjacent

Criteria:

OSHA Human Exposure Standards

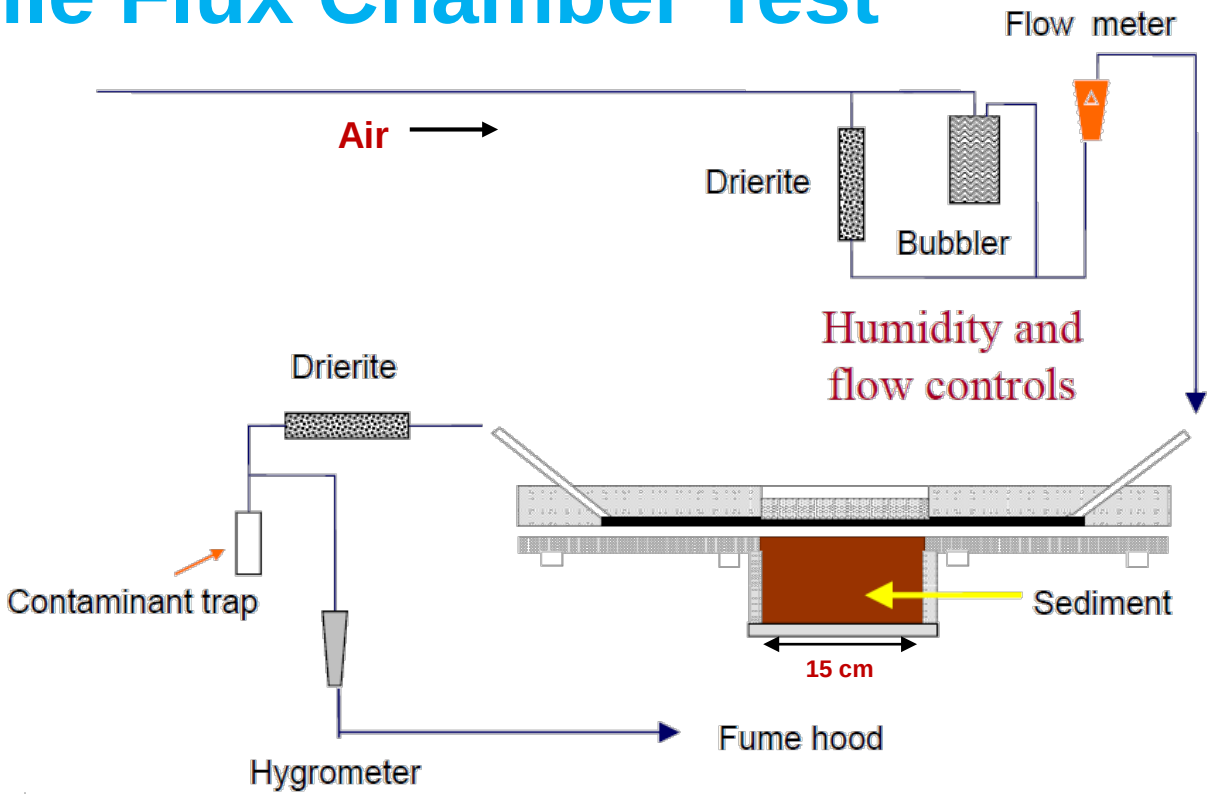
Volatilization

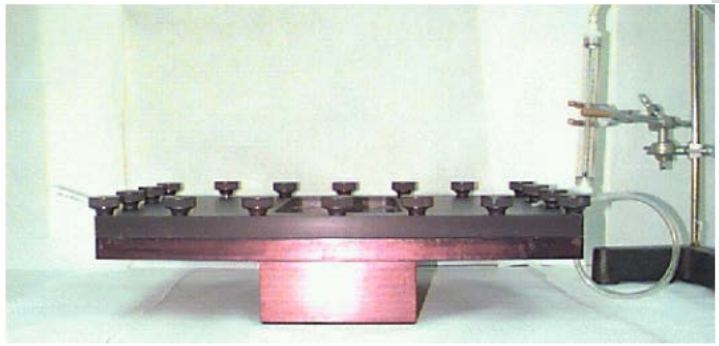
- Tier II – Screening
  - Equilibrium partitioning based on Henry's Law, bulk sediment properties
- Tier III – Testing
  - Laboratory and field procedures to quantify volatile losses
- Dispersion
  - Predictive models
    - ► Gaussian models
    - ► More sophisticated, e.g. AERMOD
      https://www.epa.gov/scram/air-quality-dispersion-modeling



Volatilization – Tier III – Volatile Flux Chamber Test

- Load dredged material into flux chamber
- Attach COC-specific air sampling tube (traps)
  - Arrange in series for multiple COCs
- Apply air - 1.7 L/min
  - "House" air, compressed gas, or vacuum pump
  - Flow meter at entrance, traps to remove contaminants
- Sample air passed over DM surface
  - Sampling intervals depends on concentration
  - E.g. 6, 24, 48, 72 hours, 5, 7, 10, and 14 days
- Flux determination: $N_A(t) = \Delta m / \Delta t / A_c$





Summary

- Upland placement
  - Disposal in CDFs
  - Beneficial use alternatives
- Tiered screening process
- Pathways
  - Effluent
  - Runoff
  - Leachate
  - Volatilization
  - Plant & Animal uptake

Tier	Effluent	Runoff	Leachate	Volatilization	Plant Uptake	Animal Uptake
Tier I	Exisiting Info	Exisiting Info	Exisiting Info	Exisiting Info	Exisiting Info, conceptual site model, complete exposure routes	Exisiting Info, conceptual site model, complete exposure routes
Tier II	Total release screen and/or Solubility partitioning screen	Solubility partitioning screen	Solubility partitioning screen	Volatility partitioning screen	DTPA Extract, COC elimination	TBP Calculation, COC elimination
Tier III	LTCST turbidity/TSS EET chemistry EET toxicity	SLRP and/or RSLS chemistry SLRP and/or RSLS toxicity	SBLT chemistry and/or PCLT chemistry	VFC chemistry	Plant bioaccumulation test	Animal bioaccumulation test
Tier IV	Case specific study or risk assessment					