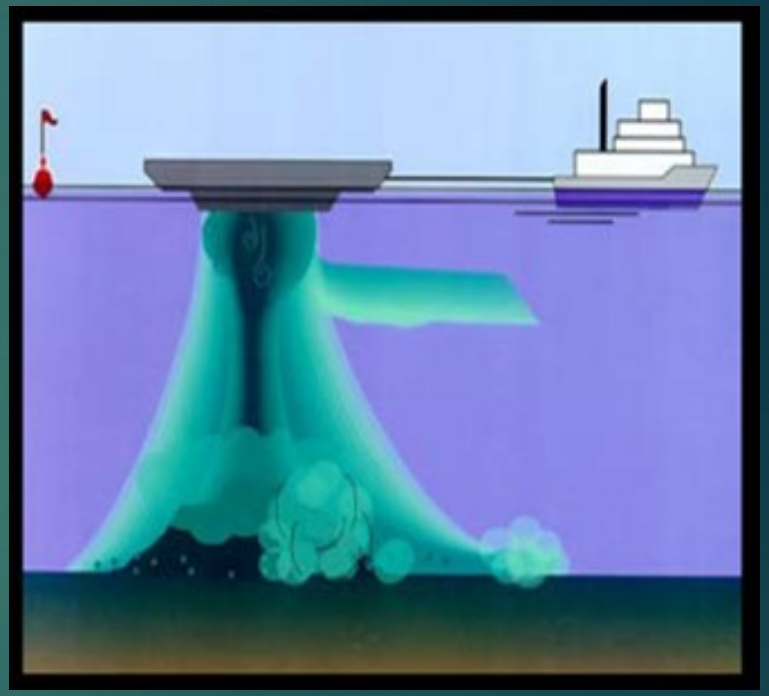
STFATE
(SHORT-TERM FATE OF DREDGED MATERIAL DISPOSAL IN OPEN WATER MODELS)



OPEN WATER DISPOSAL MODELS FOR PLUME DISPERSION AND INITIAL DEPOSITION FROM DUMP SCOWS AND HOPPER DREDGES

(DISCRETE, NON-CONTINUOUS DISCHARGES)

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MODELS FOR DREDGED MATERIAL DISPOSAL IN OPEN WATER

- DIFID – DISPOSAL FROM AN INSTANTANEOUS DISCHARGE
- DIFID – DISPOSAL FROM AN INSTANTANEOUS DISCHARGE
- DIFCD – DISPOSAL FROM A COUNTINUOUS DISCHARGE
- ORIGINAL MODELS DEVELOPED BY EPA (KOH AND CHANG 1973)
- MODIFIED AND REFINED BY WES (BRANDSMA AND DIVOKY 1976 AND JOHNSON 1990)
- VERIFIED BY DATA AT SEVERAL SITES (BOKUMIEWICZ 1078 AND JOHNSON 1978)

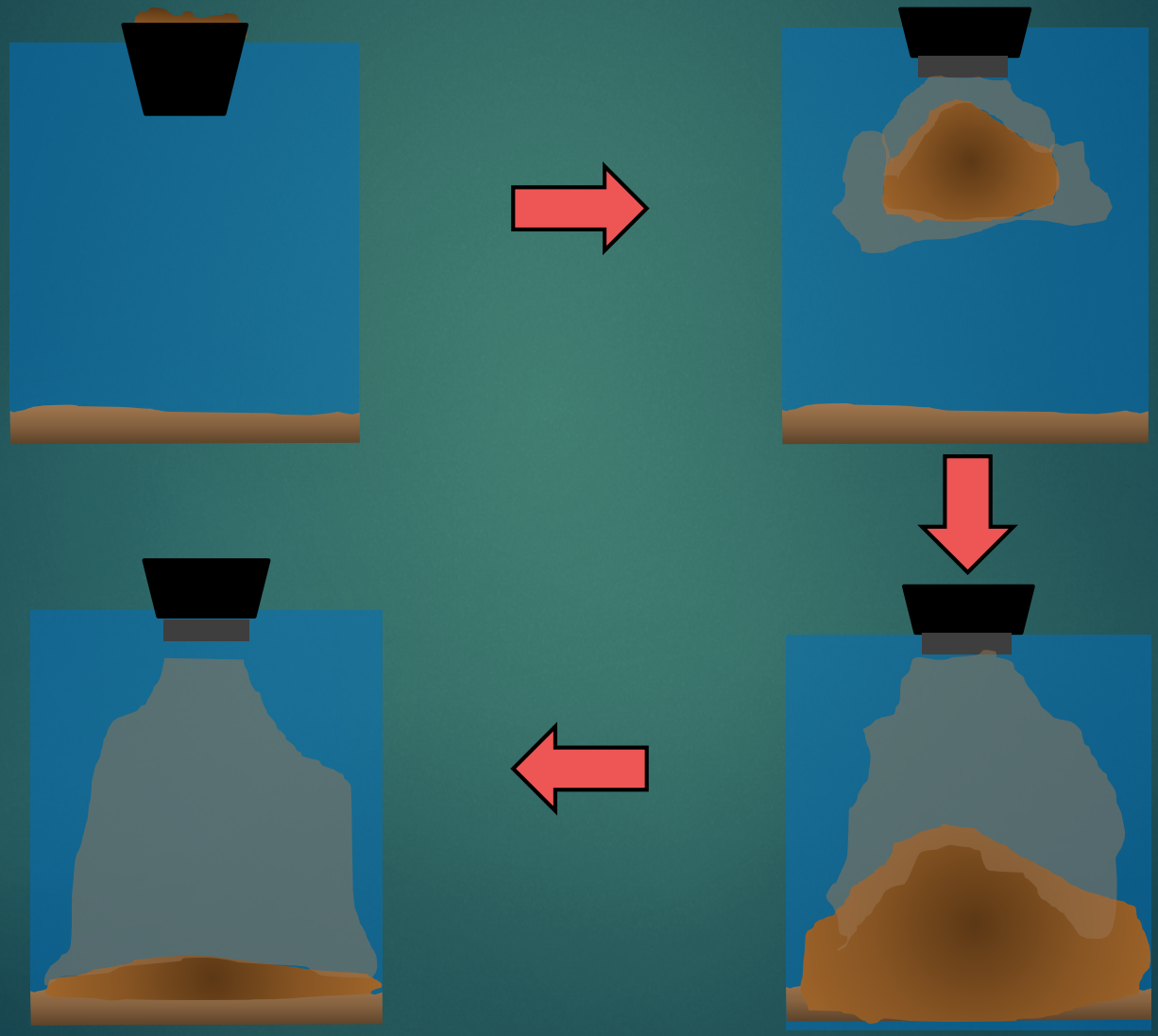
STFATE

CDFATE

PURPOSE

- Simulation of dredged material descent, collapse, and transport by advection and dispersion
- Prediction of water quality in water column considering the effects of initial mixing
- Comparison of contaminant concentration in water column with water quality standard at edge of disposal site
- Prediction of mixing zone required for open water disposal of dredged material
- Prediction of initial deposition of dredged material

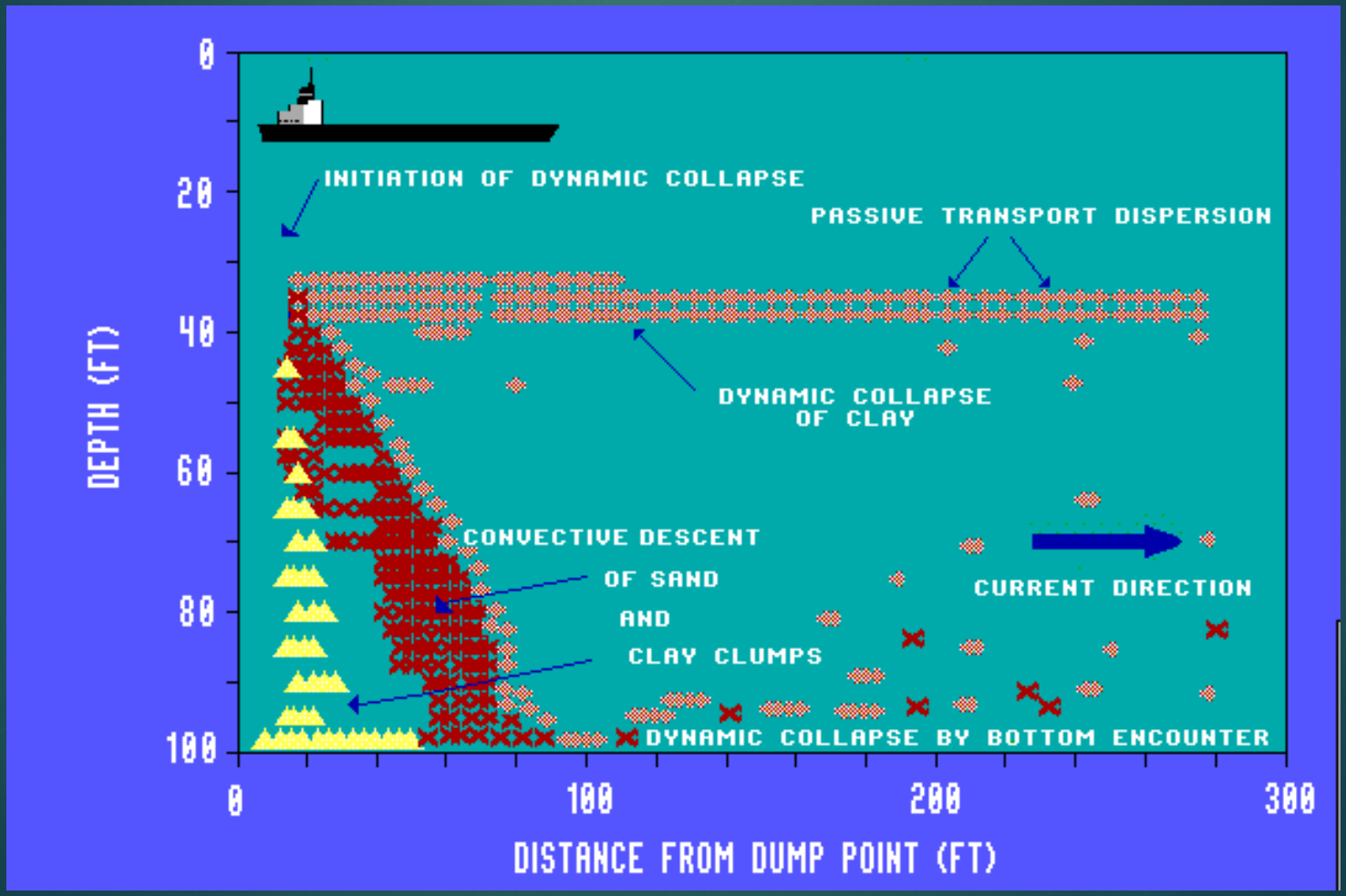
DISPOSAL SEQUENCE



PHASES MODELED

- Convective descent – controlled by gravity and momentum
- Dynamic collapse – bottom encounter, spreading dominates
- Passive transport dispersion – currents and turbulence dominate

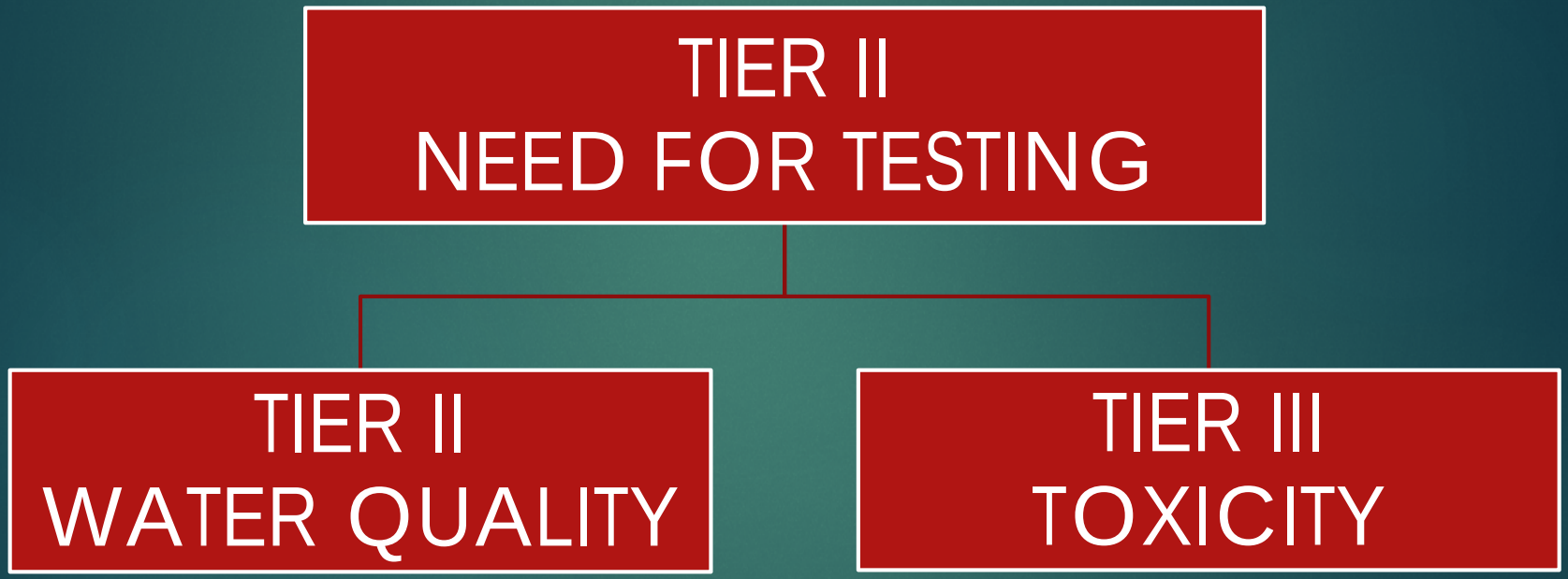
EXAMPLE PLUME GENERATION AND TRANSPORT



APPLICATIONS

- Regulatory evaluation under Section 103 of the Marine Protection Research and Sanctuary Act and Section 404(b)(1) of the Clean Water Act
- Evaluation of sediment mound development
- Plume generation and transport evaluations

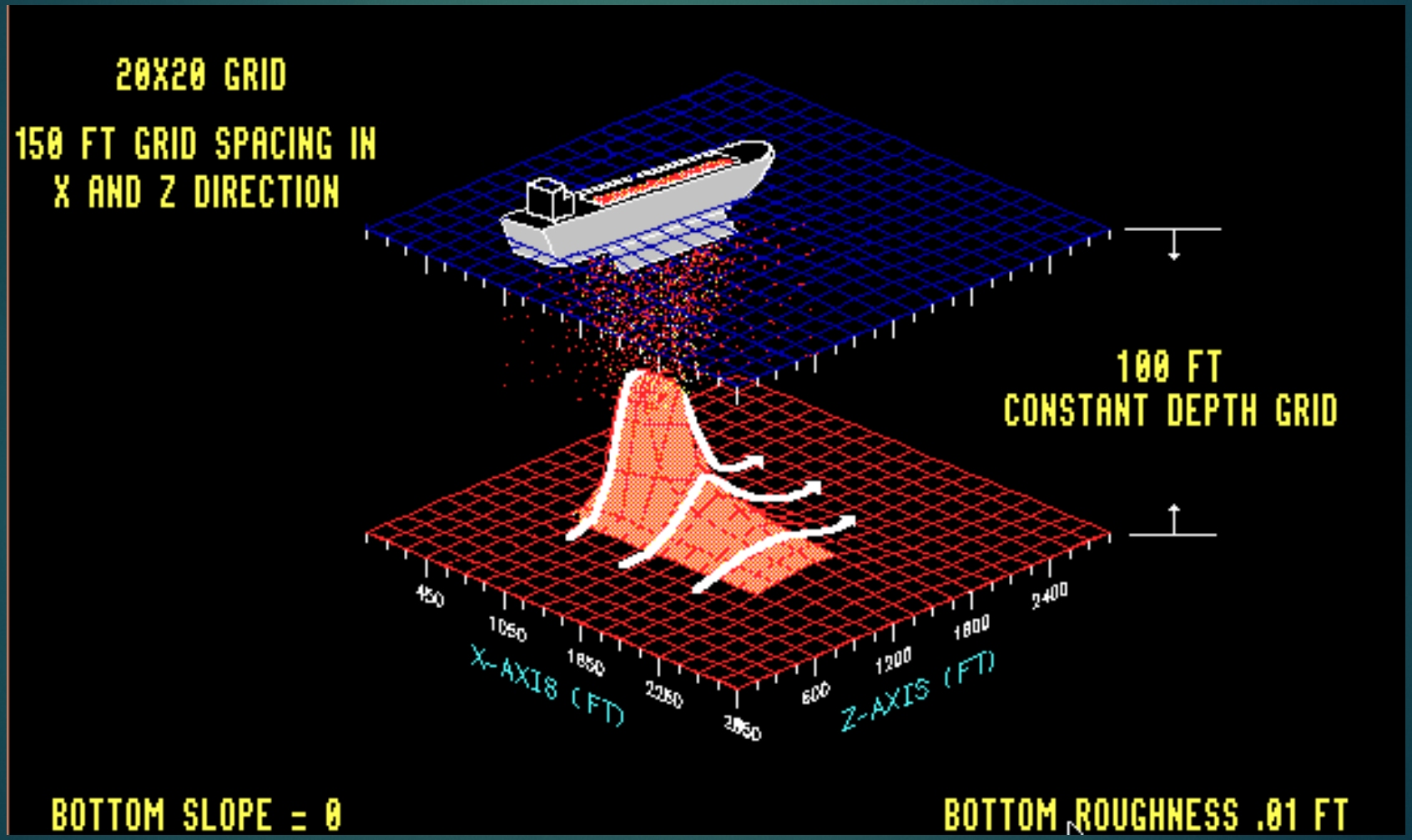
REGULATORY EVALUATION USES TIERED APPROACH



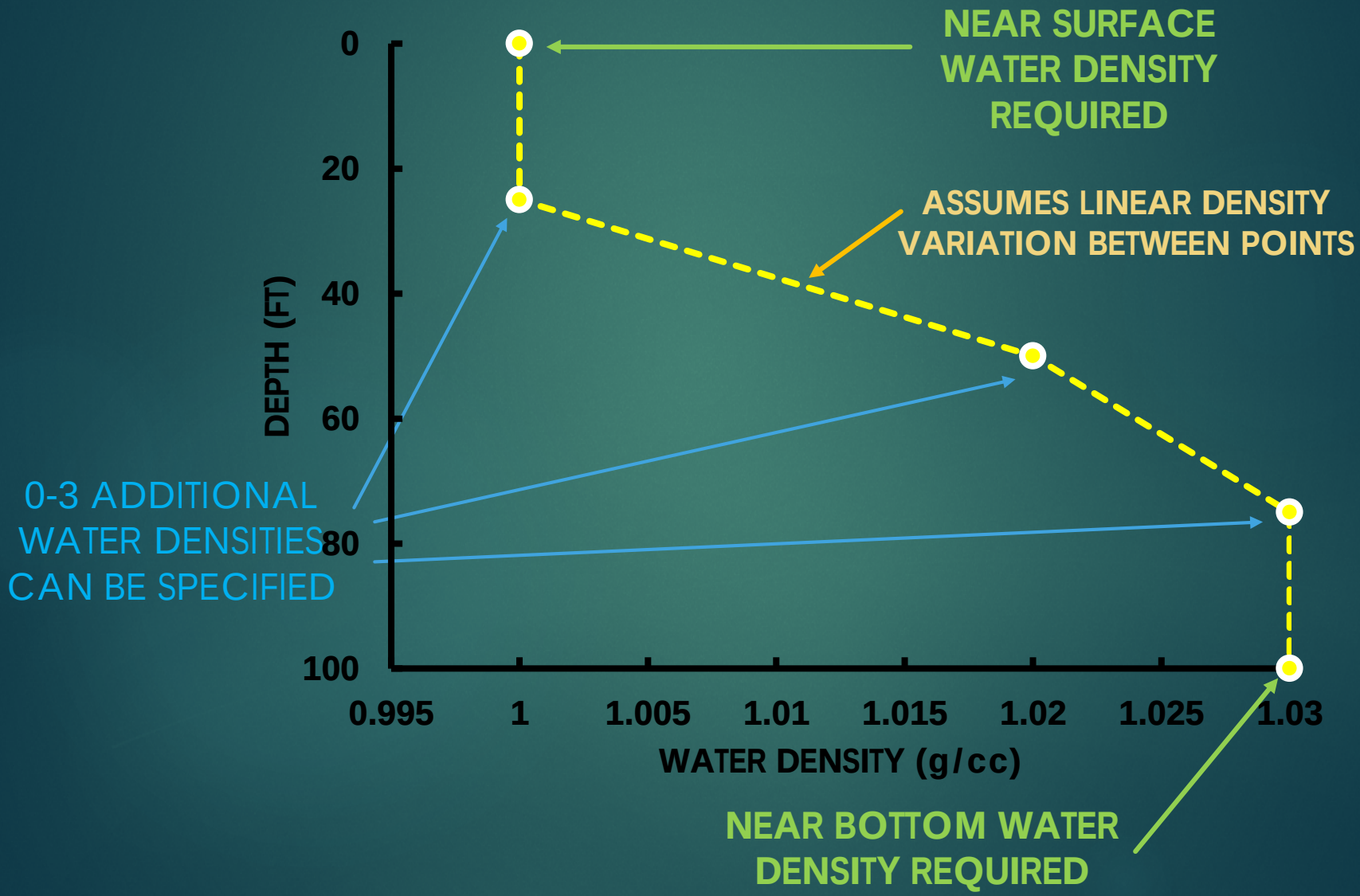
INPUT REQUIREMENTS

- DISPOSAL SITE DESCRIPTION
- VELOCITIES AT DISPOSAL SITE
- INPUT/OUTPUT/EXECUTION CONTROLS
- DREDGED MATERIAL DESCRIPTION
- DISPOSAL OPERATION
- MODEL COEFFICIENTS

DISPOSAL SITE DATA



WATER DENSITY PROFILE

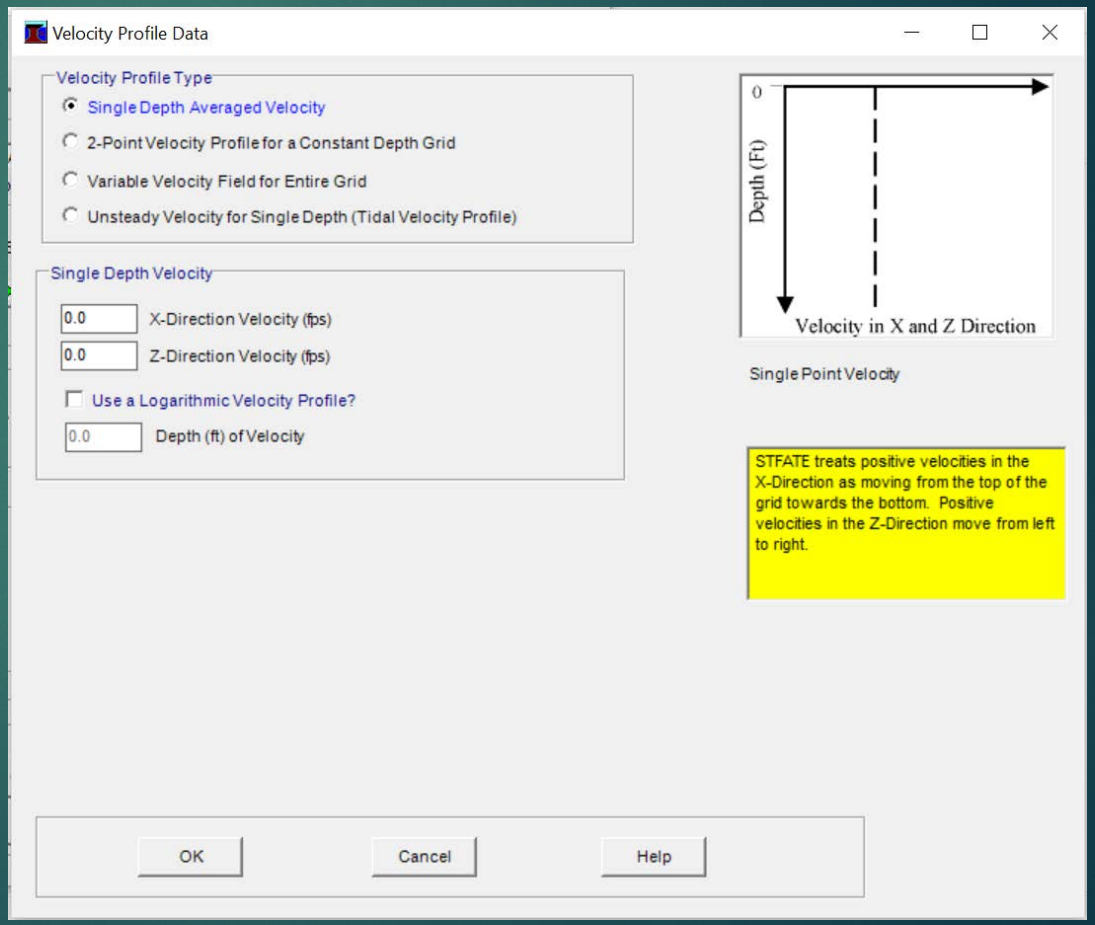


DISPOSAL SITE WATER VELOCITY OPTIONS

- SINGLE DEPTH-AVERAGED VELOCITY
  - Uniform velocity profile
  - Logarithmic velocity profile
- 2-POINT VELOCITY PROFILE
  (Constant Depth Grid Only)
- VARIABLE VELOCITY FIELD FOR ENTIRE GRID
- UNSTEADY VELOCITY FOR SINGLE DEPTH
  (Tidal Velocity Profile)

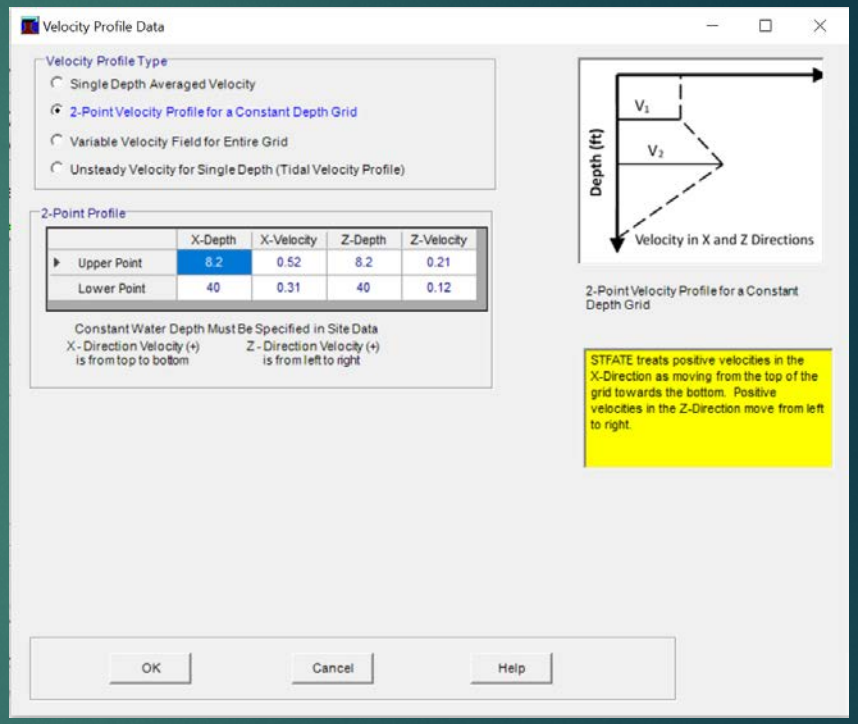
DEPTH AVERAGED VELOCITIES (SINGLE VALUE)

- UNIFORM VELOCITY PROFILE
- LOGARITHMIC VELOCITY PROFILE



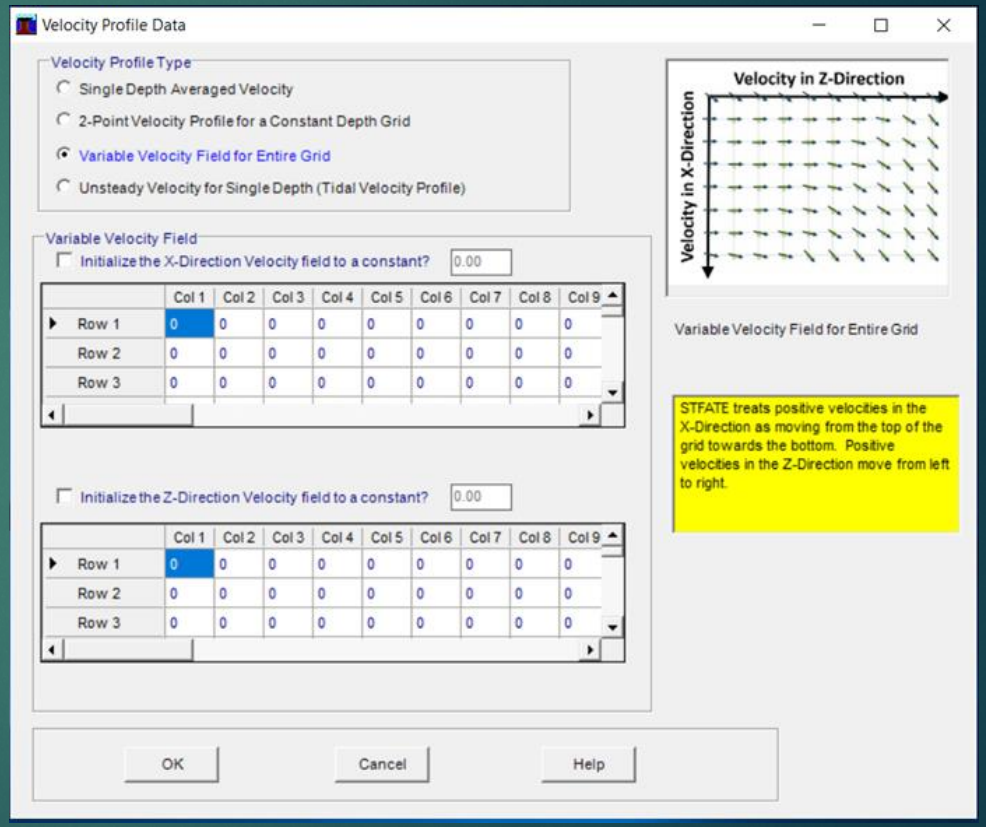
2-PT VELOCITY PROFILES

- User Enters X and Z Velocities at 2 Depths
- STFATE Extrapolates Velocity with Depth as:
  - Constant velocity between water surface and shallowest depth
  - Linear variation between shallowest and deepest depth
  - Linear variation between deepest depth and velocity = 0 at bottom
- Velocities Assumed Constant Throughout Simulation



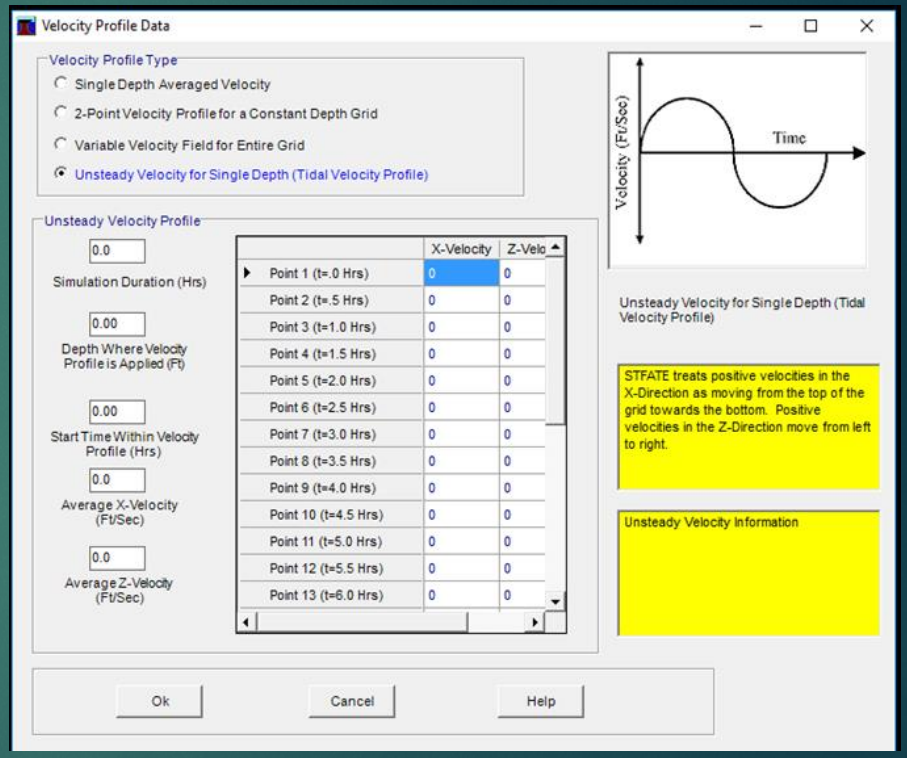
VARIABLE VELOCITY PROFILE

- User enters x and z velocity vectors for each cell
- Allows detailed flow field
- Typically derived from hydrodynamic model output
- Velocity assumed constant throughout simulation



UNSTEADY VELOCITY (SINGLE POINT, TIDAL VELOCITY)

- CONSTANT VELOCITY WITH DEPTH
- MAGNITUDE AND DIRECTION CHANGE OVER A FIXED PERIOD
- TIME PERIOD REPEATS DURING SIMULATION
- TYPICAL OF TIDAL CYCLES
- COULD BE USED FOR OTHER SIMULATIONS



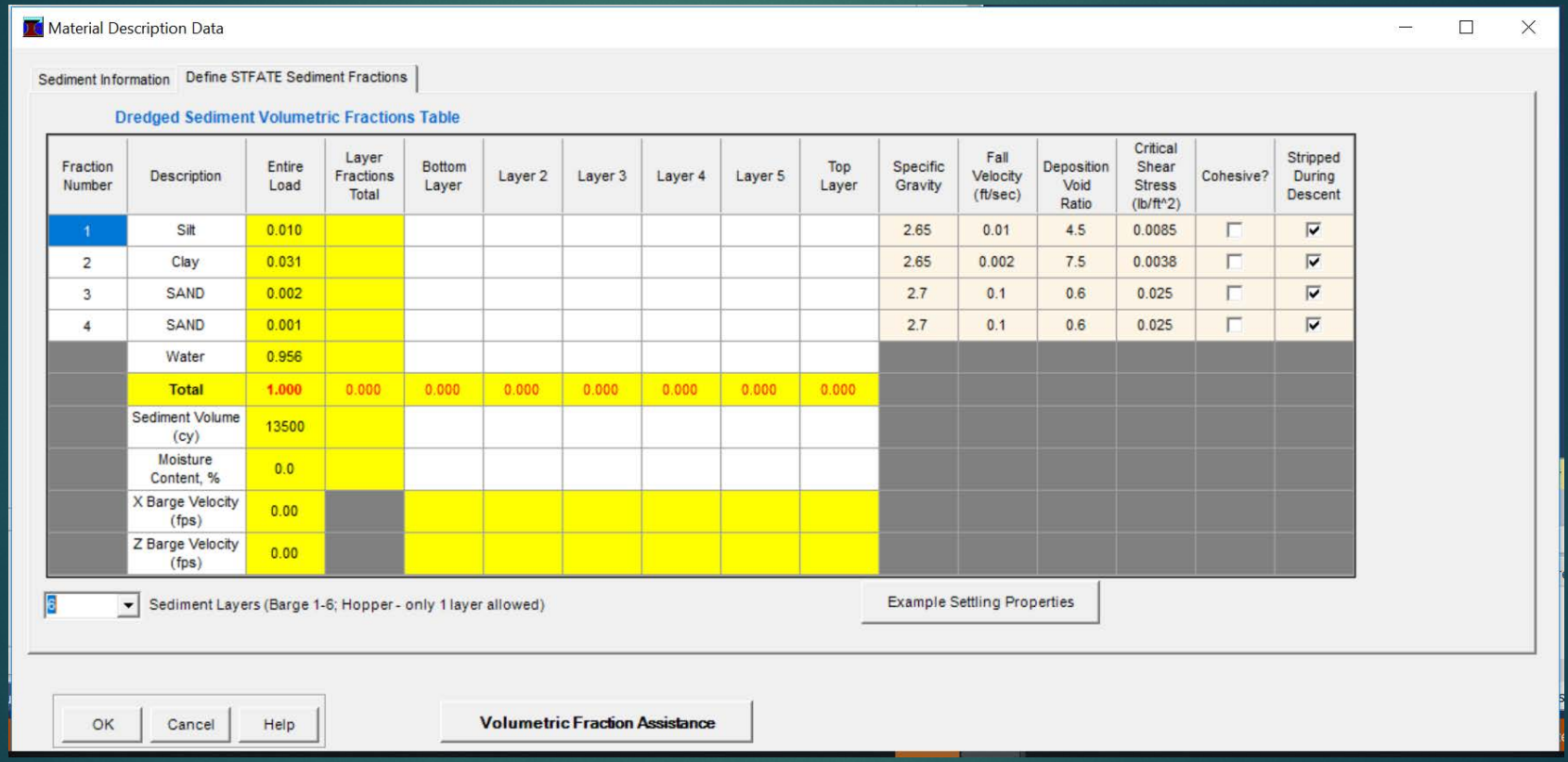
INPUT, EXECUTION, AND OUTPUT CONTROLS

- Phases To Be Modeled
- Level of Evaluation (Tier)
- Disposal Site/Mixing Zone Location
- Contaminant Description, Concentrations, and Criteria
- Depths Where Output Desired
- Duration of Simulation
- Size of Long-Term Time Step for Diffusion
- Selection of Output Types

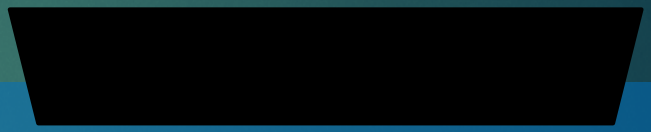
DREDGED MATERIAL DESCRIPTION

- NUMBER OF LAYERS (MAX 6) AND VOLUMES
- X & Z VELOCITY VECTORS OF BARGE/HOPPER
- NUMBER OF SOLID FRACTIONS (Max 4)
  - e.g. Clumps, Sand, Silt, Clay
- PROPERTIES OF SOLID FRACTIONS
  - Specific Gravity
  - Volumetric Concentration
  - Fall Velocity
  - Void Ratio
  - Critical Shear Stress
  - Cohesiveness
- DREDGING SITE WATER DENSITY

DREDGED MATERIAL DESCRIPTION



BARGE PARAMETERS AND DISPOSAL OPERATIONS DATA

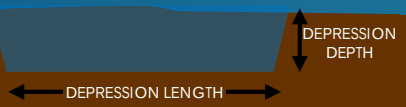


BARGE PARAMETERS:

- LENGTH
- WIDTH
- PREDISPOSAL (LOADED) DRAFT
- POST-DISPOSAL (UNLOADED) DRAFT

DISPOSAL OPERATIONS:

- DREDGED MATERIAL VOLUME
- TIME TO EMPTY
- DISCHARGE CONDITIONS
  - X-VELOCITY VECTOR
  - Z-VELOCITY VECTOR



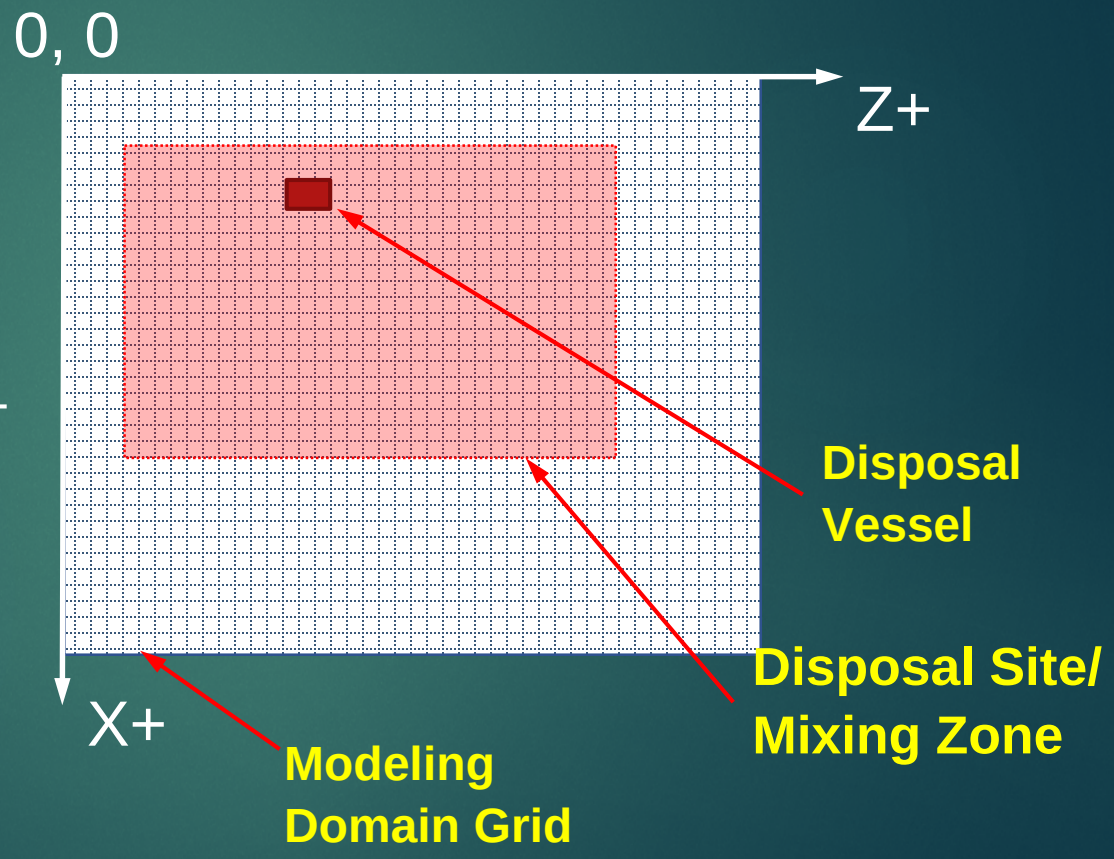
SITE PARAMETERS:

- SIZE OF ANY DEPRESSIONS
  - LENGTH
  - WIDTH
  - DEPTH

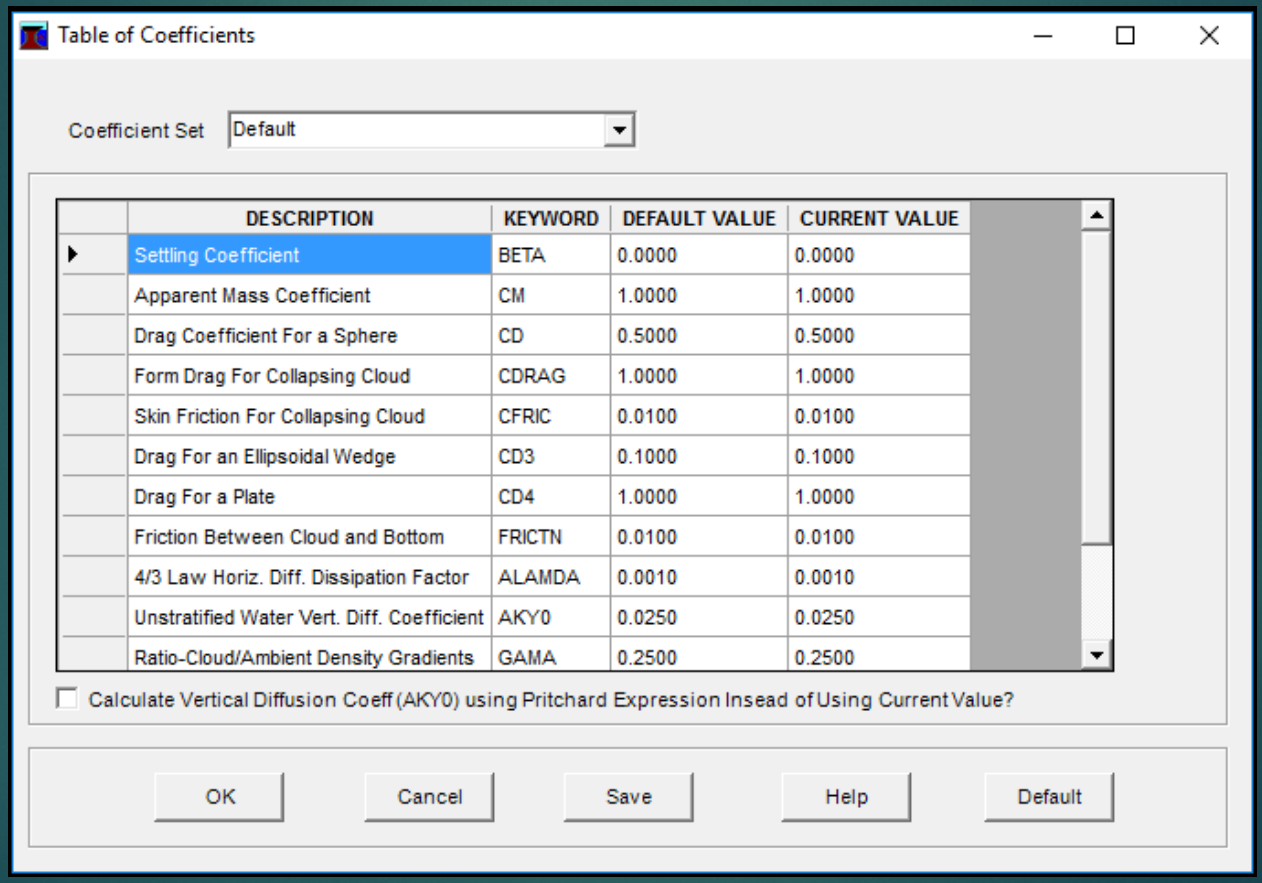
GRID SCHEMATIC

REQUIRED:

- DISPOSAL SITE/MIXING ZONE LOCATION
  - X,Z OF UPPER LEFT CORNER
  - X,Z OF LOWER RIGHT CORNER
- DISPOSAL LOCATION
  - X,Z OF VESSEL CENTER



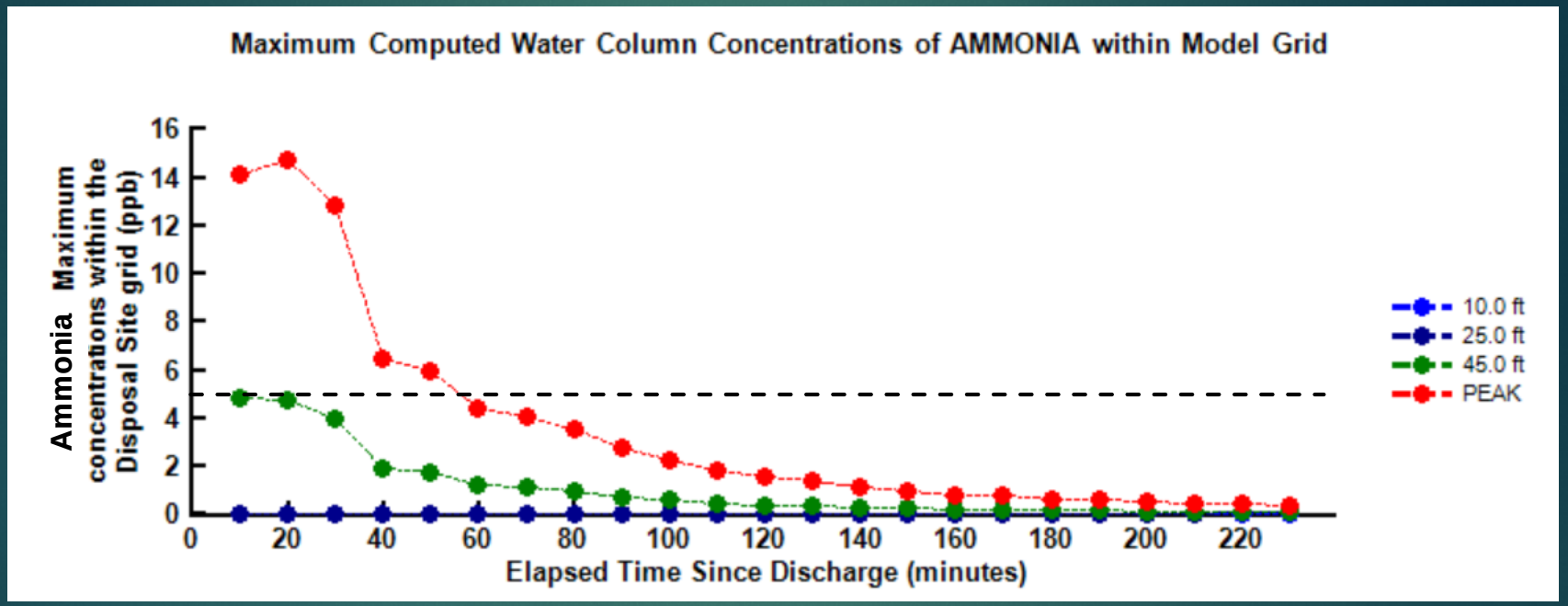
MODEL COEFFICIENTS WITH DEFAULTS



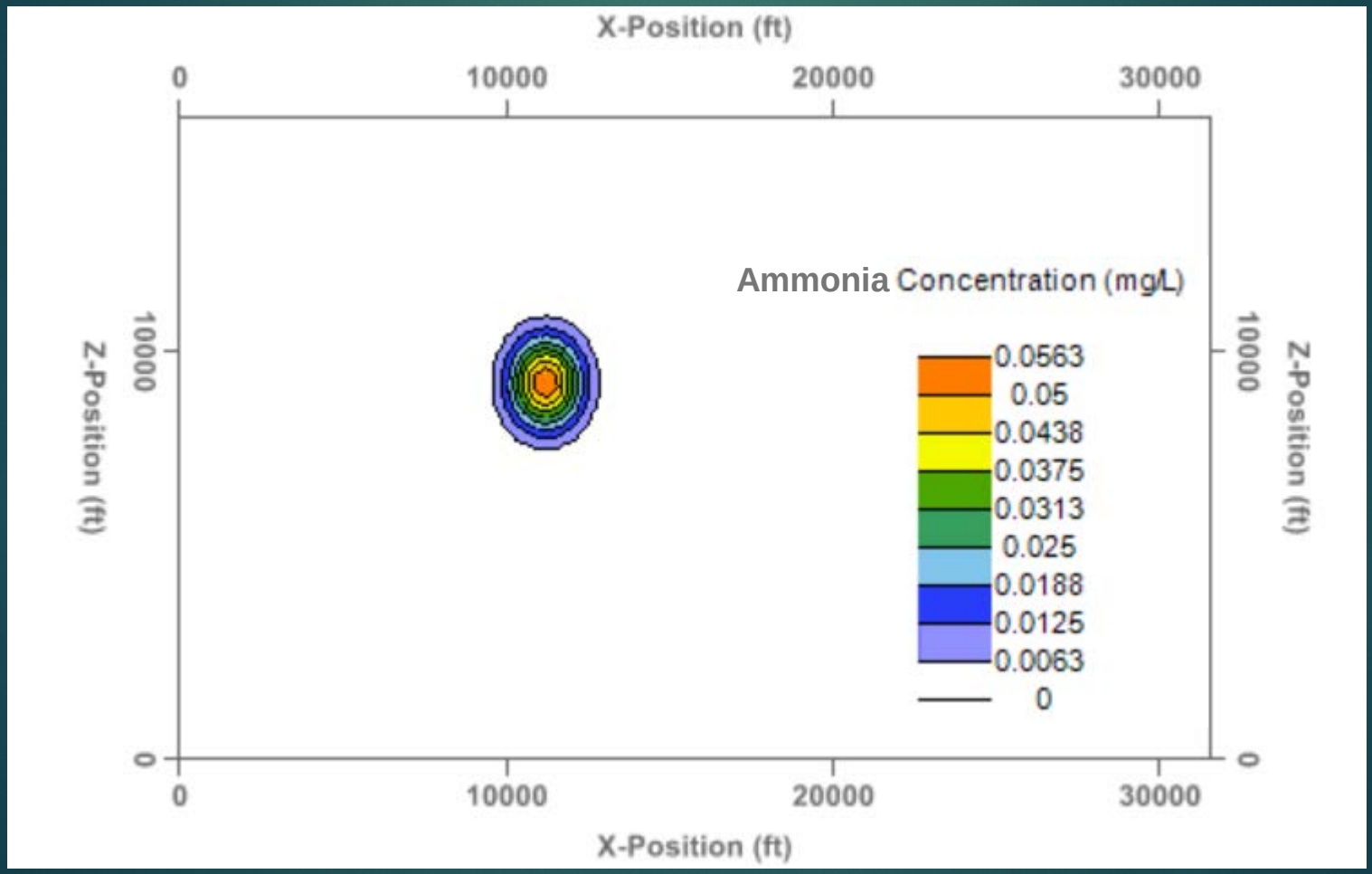
OUTPUT DATA

- Time History of Descent and Collapse Phase
- Plume Concentrations by Time/Depth
- Accumulation of Material on Bottom
- Maximum Concentrations

MAXIMUM WATER COLUMN CONCENTRATIONS



WATER COLUMN CONCENTRATIONS



DEPOSITION DEPTH WITHIN MODEL GRID