

A Shipyard Program for NPDES Compliance

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Shipyard NPDES Permitting

- **Problem:**

- » Shipyards are significantly affected by discharge limits and testing requirements set forth by regulators in their NPDES permits (National Pollutant Discharge Elimination System). These permits are periodically re-negotiated.

- **NSRP Project:**

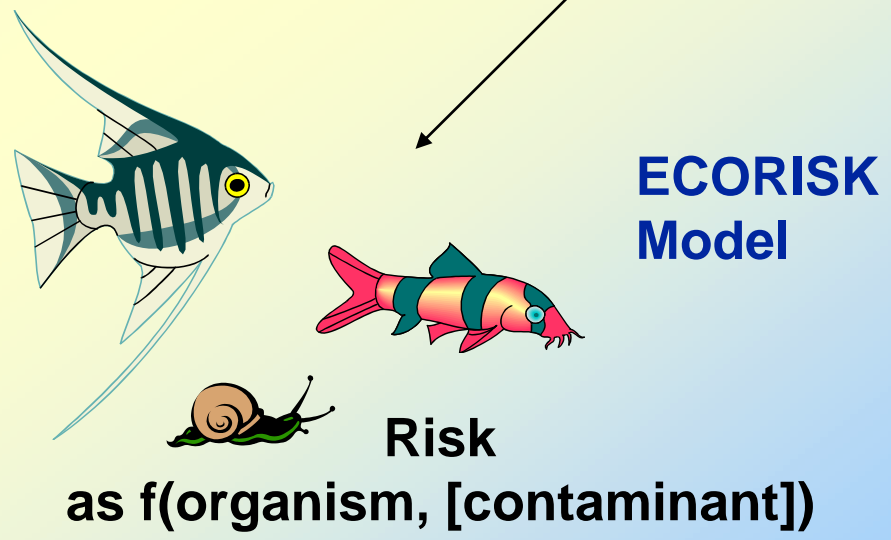
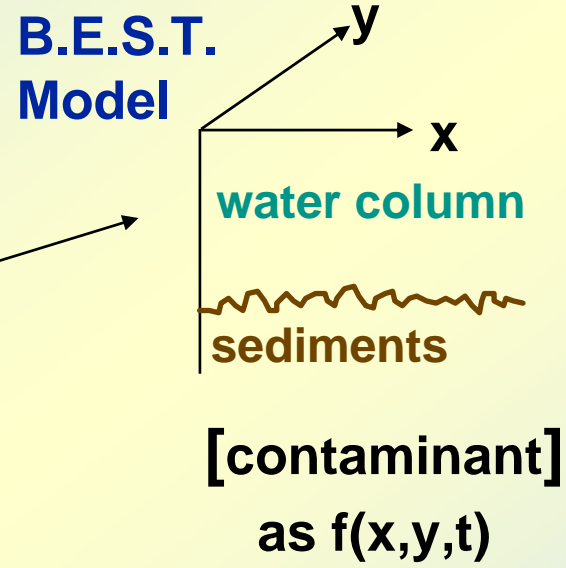
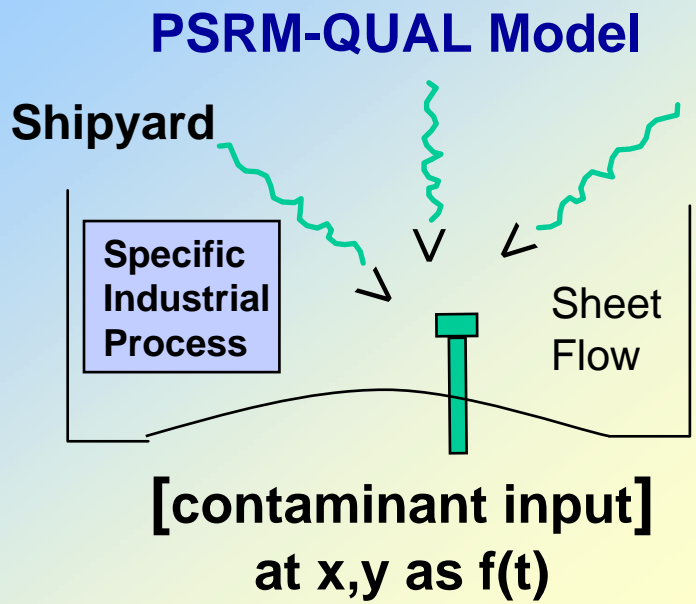
- » Develop a tool to assist the shipbuilding/repair industry with NPDES permitting and compliance, standard setting and risk management.
- » Scientific and unified shipyard approach for negotiating shipyard NPDES permits.

- **TEAM:**

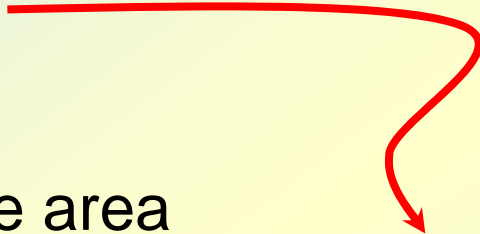
- ARL Penn State
- Penn State Environmental Engineering
- NASSCO Environmental Personnel

Test Case

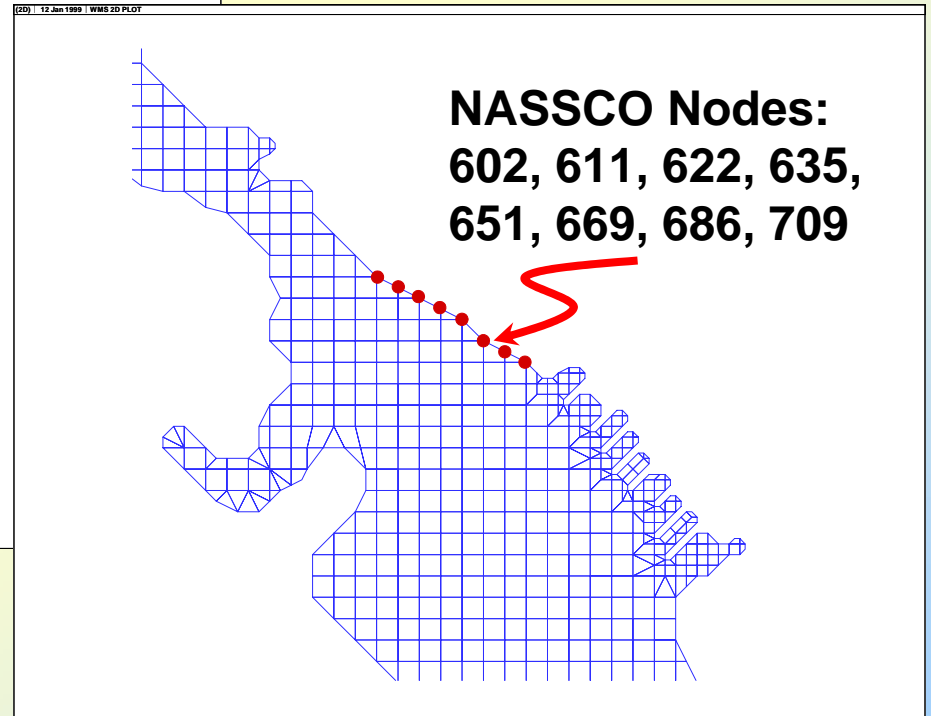
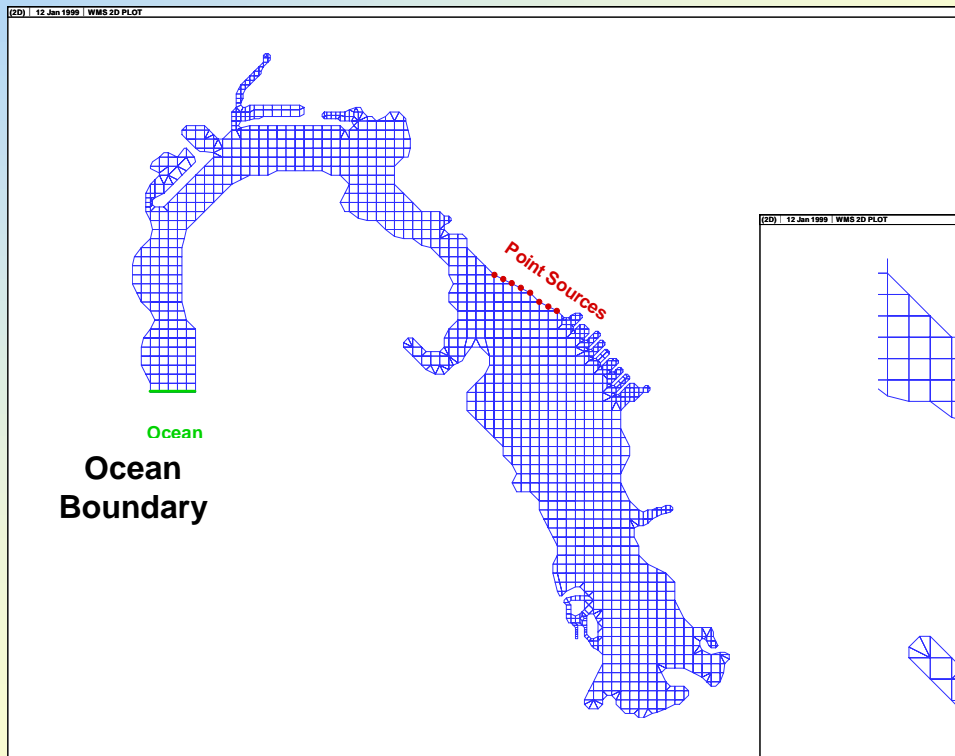
- San Diego Bay
 - » Bathymetry
 - » Tidal data
- NASSCO Shipyard
 - » Sediment load
 - » Copper loading
 - » Land uses
- Copper
 - » One of the most difficult pollutants



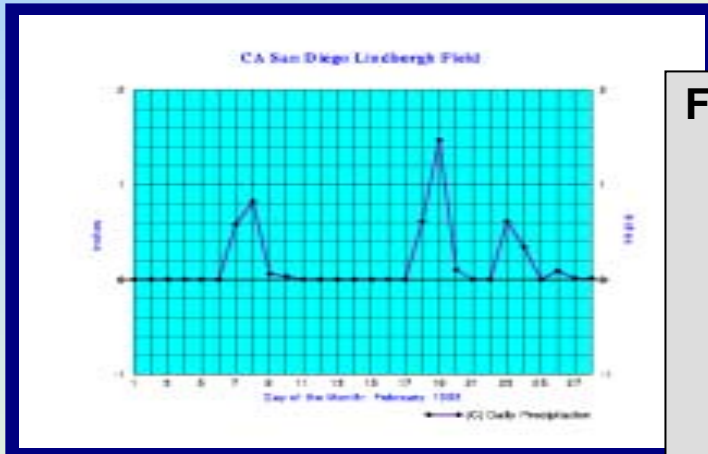
Shipyard Contaminant Transport Model

- Model Input:
 - » Storm data
 - » Land surface area
 - » Land slope
 - » Amount of sediment present at site
 - » Mass fraction relation between sediment and contaminant
 - Outputs
 - » Data files of shipyard pollutant data and water volumes over time, in a format suitable for running the bay/estuary model.
- 

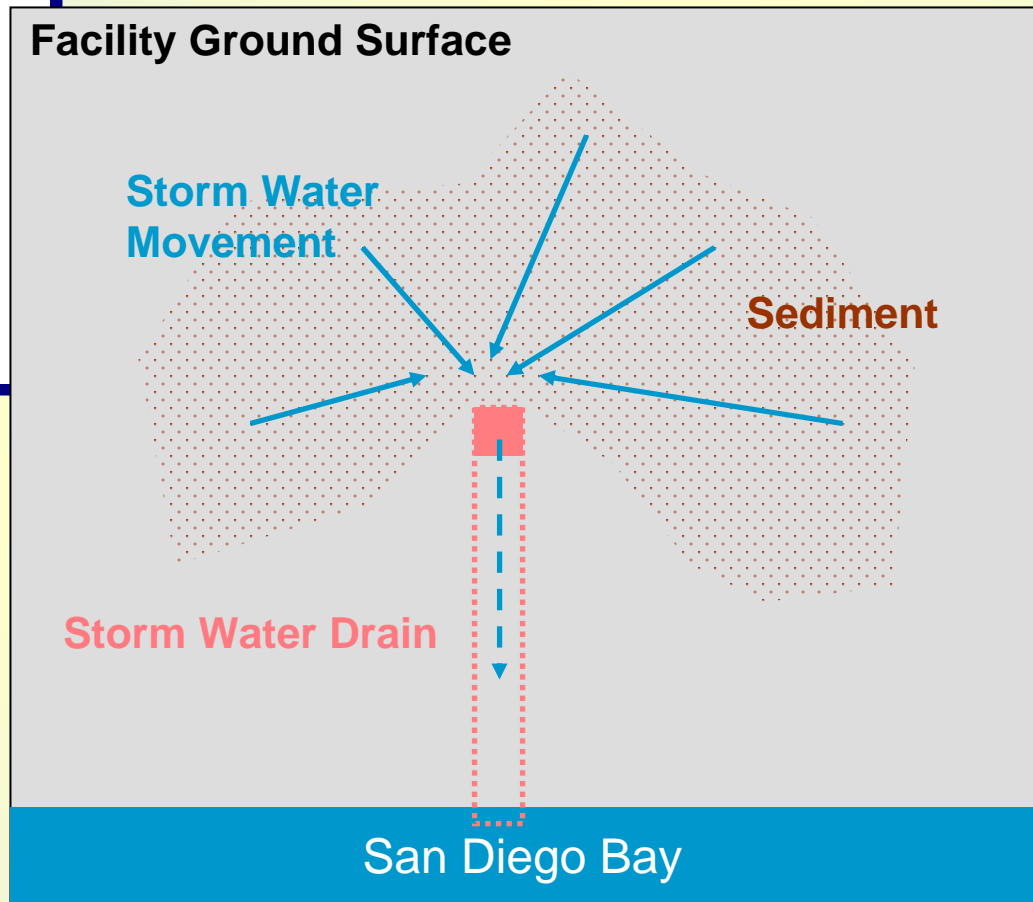
San Diego Bay Grid



Shipyards Contaminant Transport Model

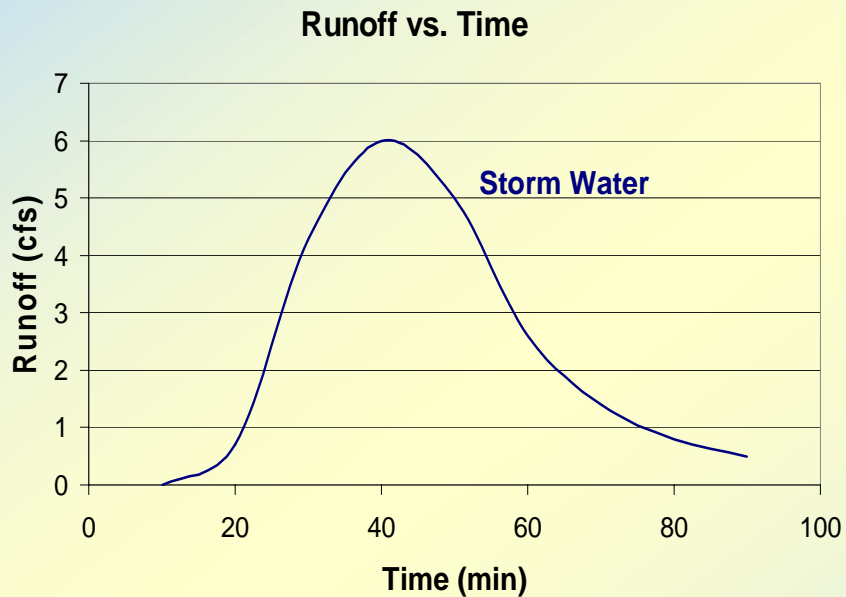


Rainfall Data From NOAA
February '93

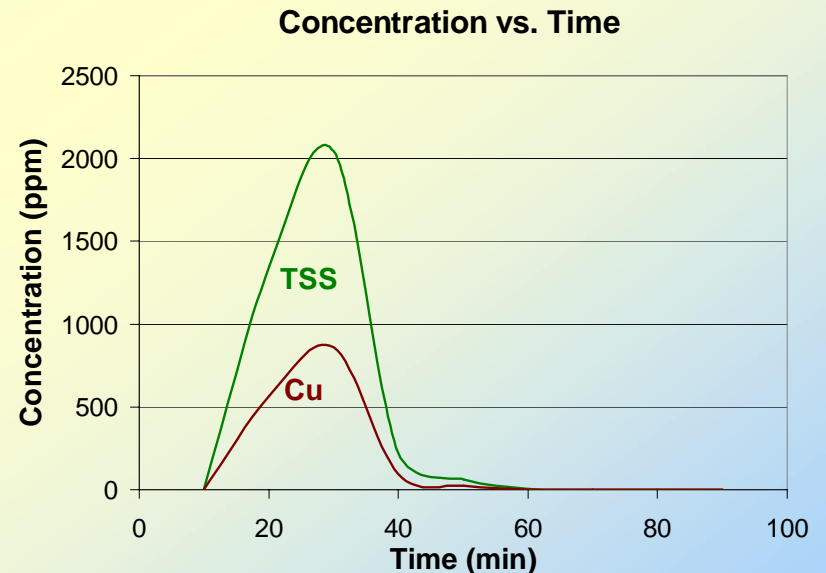


PSRM-QUAL Model Output

- Storm Water Hydrograph



- Contaminant Pollutograph



Bay/Estuary Model

- Inputs

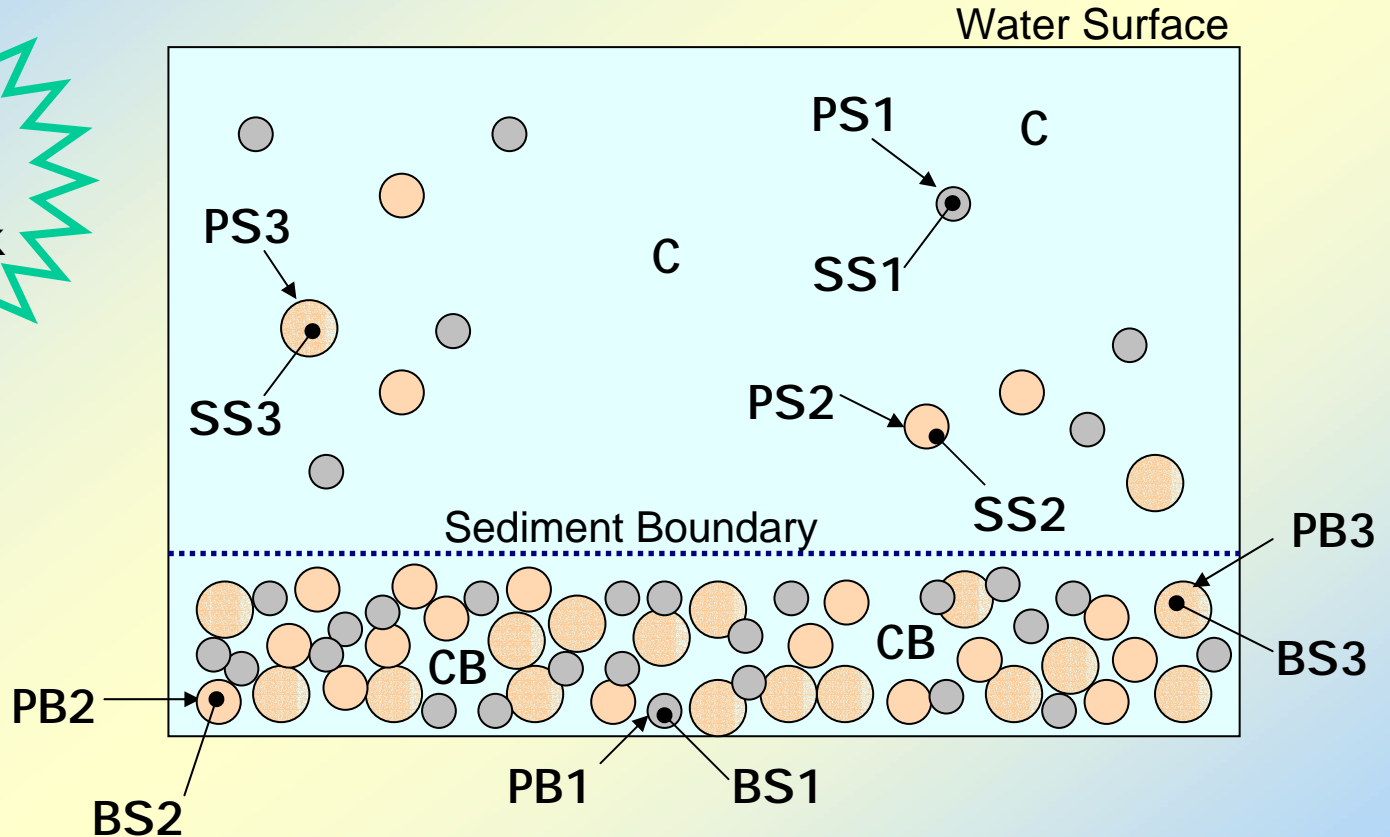
- » Water volume, sediment, and pollutant concentration data over time from PSRM-QUAL
- » Tidal data
- » Bay bathymetry data
- » Sediment/pollutant partition data

- Outputs

- » Data files of pollutant concentration in water column or sediment vs. time vs. location in bay, in two formats
 - TecPlot
 - Ecorisk

VARIABLES IN B.E.S.T. MODEL

C and CB
are key
to Ecorisk

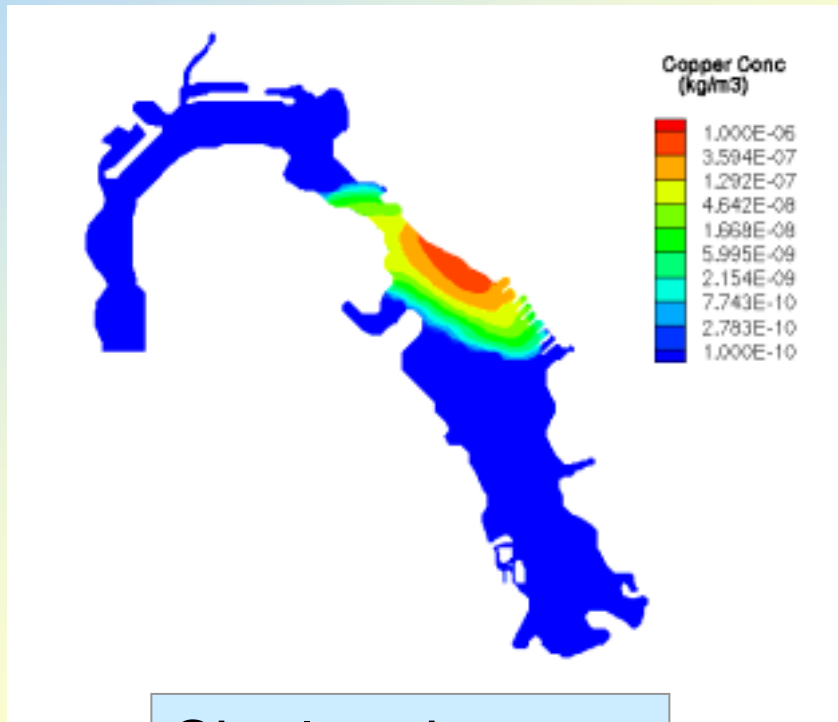


B = bed
S_ = suspended
S = sediment

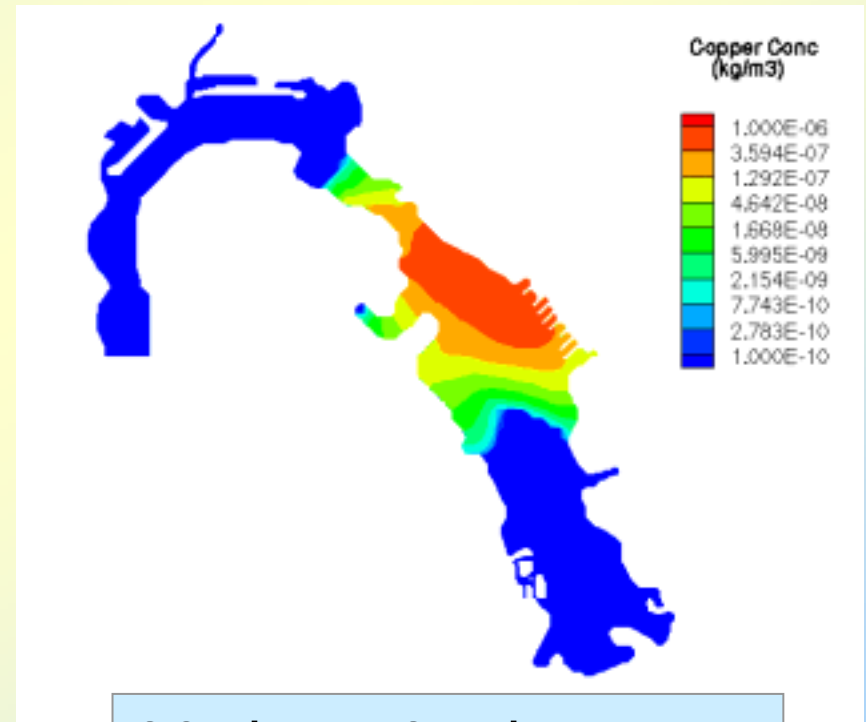
P = particulate (adsorbed)
C = concentration (dissolved)

1 = clay
2 = silt
3 = sand

TecPlot Visualization of B.E.S.T. Output



Single rain event



30-days, 3 rain events

Ecological Risk Assessment Model

- Inputs

- » Output from bay / estuary model
- » Species name
- » Species habitat
- » Species location in bay
- » Acute and chronic LC50

- Outputs

- » Estimate of the risk that given species will be exposed to concentrations above their acute or chronic LC50

ECORISK - Data Base



Add species

- name
- habitat
- location
- LC50

Edit species



Delete species

EcoRisk Sample Data Base - EcoRisk

File View Compute Species Help

- ♦ *Pleurobrachia pileus* - sea gooseberry
- ♦ *Neanthes arenacedentata* - worm
- ◆ *Crassostrea gigas* - Pacific oyster
- ♦ *Carcinus maenas* - Euro. shore crab
- ♦ *Mysidopsis bahia* - mysis shrimp
- ♦ *Echinometra mathaei* - sea urchin
- ◆ *Leiostomus xanthurus* - spot fish
- ◆ *Paralichthys dentatus* - flounder
- ♦ *Homarus americanus* - lobster
- ◆ *Nereus diversicolor* - clam worm
- ♦ *Artemia salina* - brine shrimp
- ♦ *Daphnia magna* - water flea
- ♦ *Balanus eburneus* - barnacle
- ♦ *Cragnon cragnon* - shrimp

Name:

Habitat

Water Sediment Used

Location

All area

Xmin: Xmax:

Ymin: Ymax:

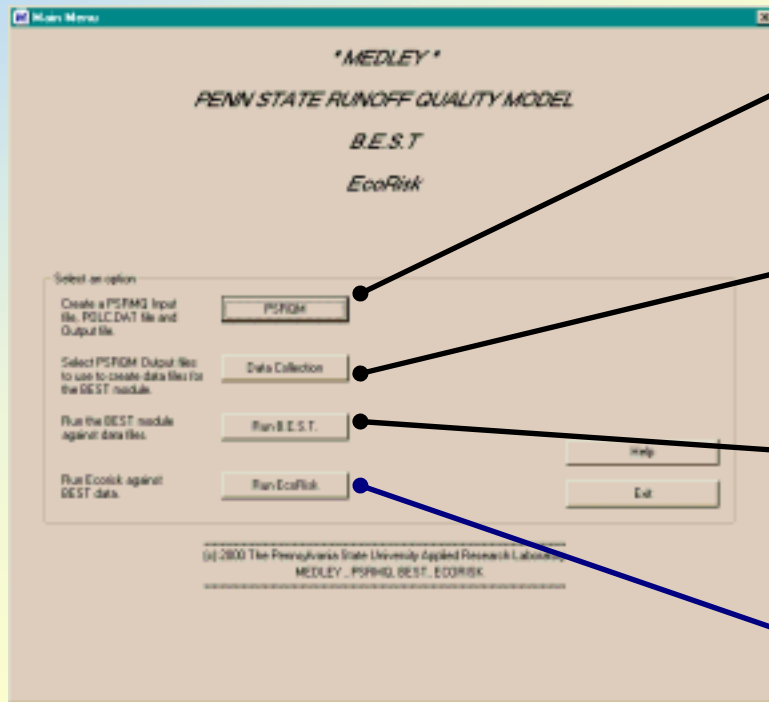
Copper Risk Criteria

Acute LC50 (mg/L)

Chronic LC50 (mg/L)

Ready

ECORISK



Shipyards Model - PSRQM

Data Collection

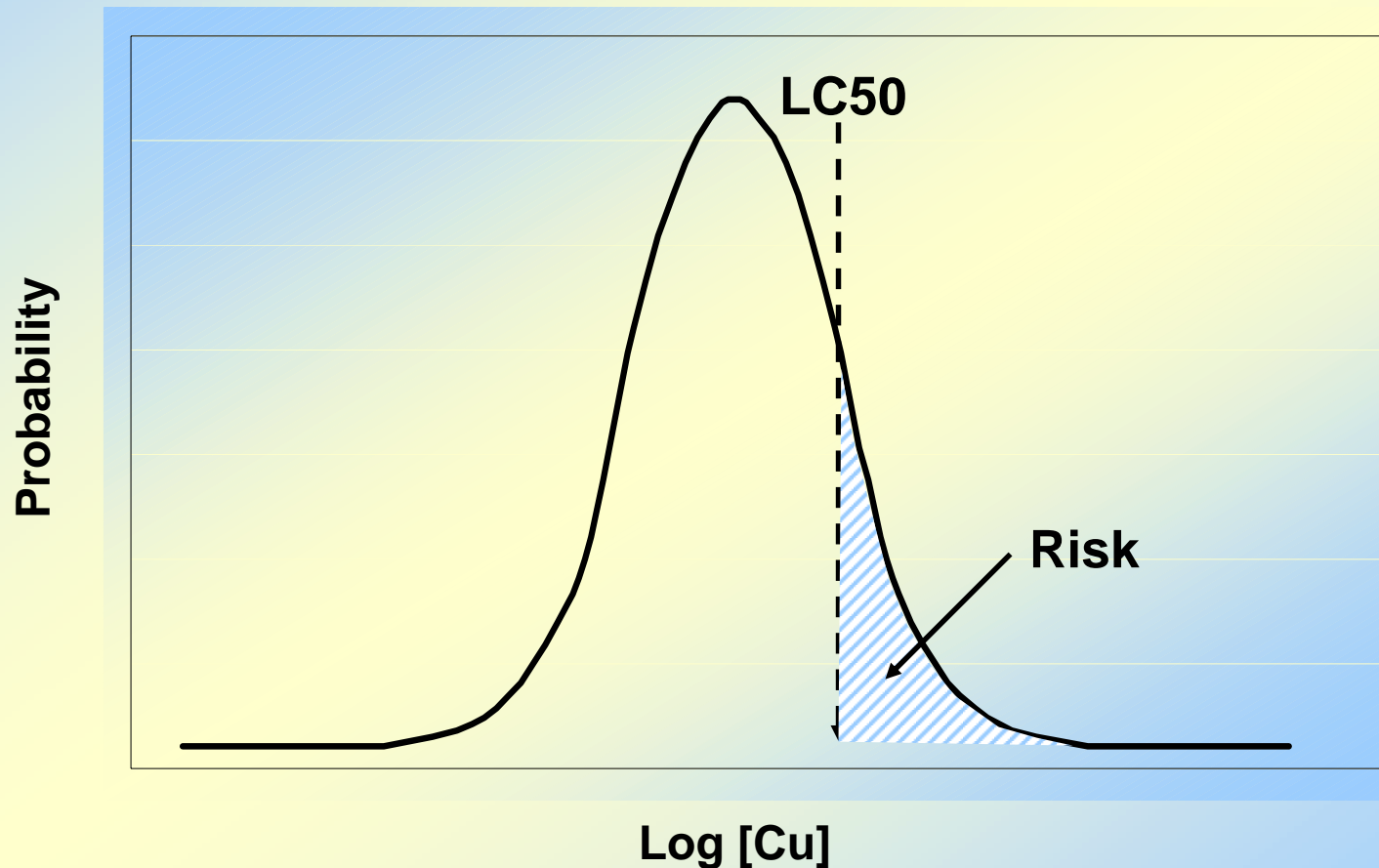
Bay/Estuary Model – B.E.S.T.

Ecological Risk Model – EcoRisk

Risk Assessment

Risk of exposure to contaminant concentrations above the LC50

*Based on Water Environment Research Foundation Multi-Tiered Approach



ECORISK - Compute



Compute toxicity

Compute Toxicity [X]

Toxicity Function
 Acute Chronic

Options
 Full model
 Time average
 Space average
 Overall average

OK
Cancel

Calculated Risks [X]

The following are estimated risks calculated using Chronic Overall Average, based on the LC50's for copper in this database.

Organism	Risk	LC50(mg/L)	log[Cu, kg/cu.m] ± s.d.
Crassostrea gigas - Pacific oyster	1 %	0.010000	-11.825468 ± 3.091921
Leiostomus xanthurus - spot fish	0 %	0.160000	-12.044200 ± 2.407607
Paralichthys dentatus - flounder	100 %	0.000000	-12.044200 ± 2.407607
Nereus diversicolor - clam worm	0 %	0.250000	-12.044200 ± 2.407607

OK

Summary

- PSRQM Runoff Model
 - » simulate water flows and contaminant transport of pollutants from shipyard activities into the bay
- B.E.S.T.
 - » dispersion of shipyard pollutants throughout the bay
- ECORISK
 - » compute ecological risk to bay organisms from the site-specific shipyard pollutants
- MEDLEY
 - » user-friendly interface for the three models.
 - » automatically sequence the data transfer from one model to another