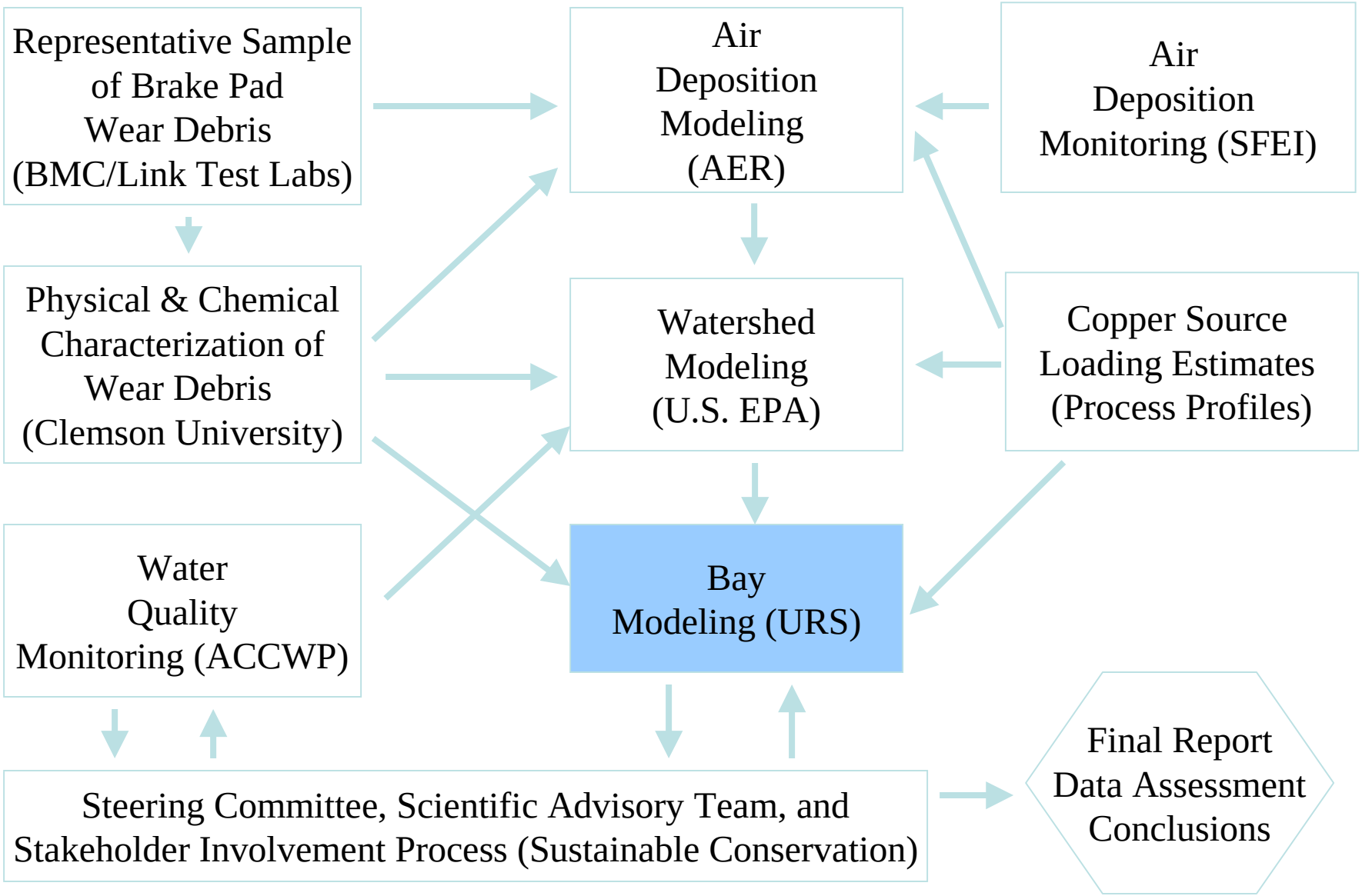
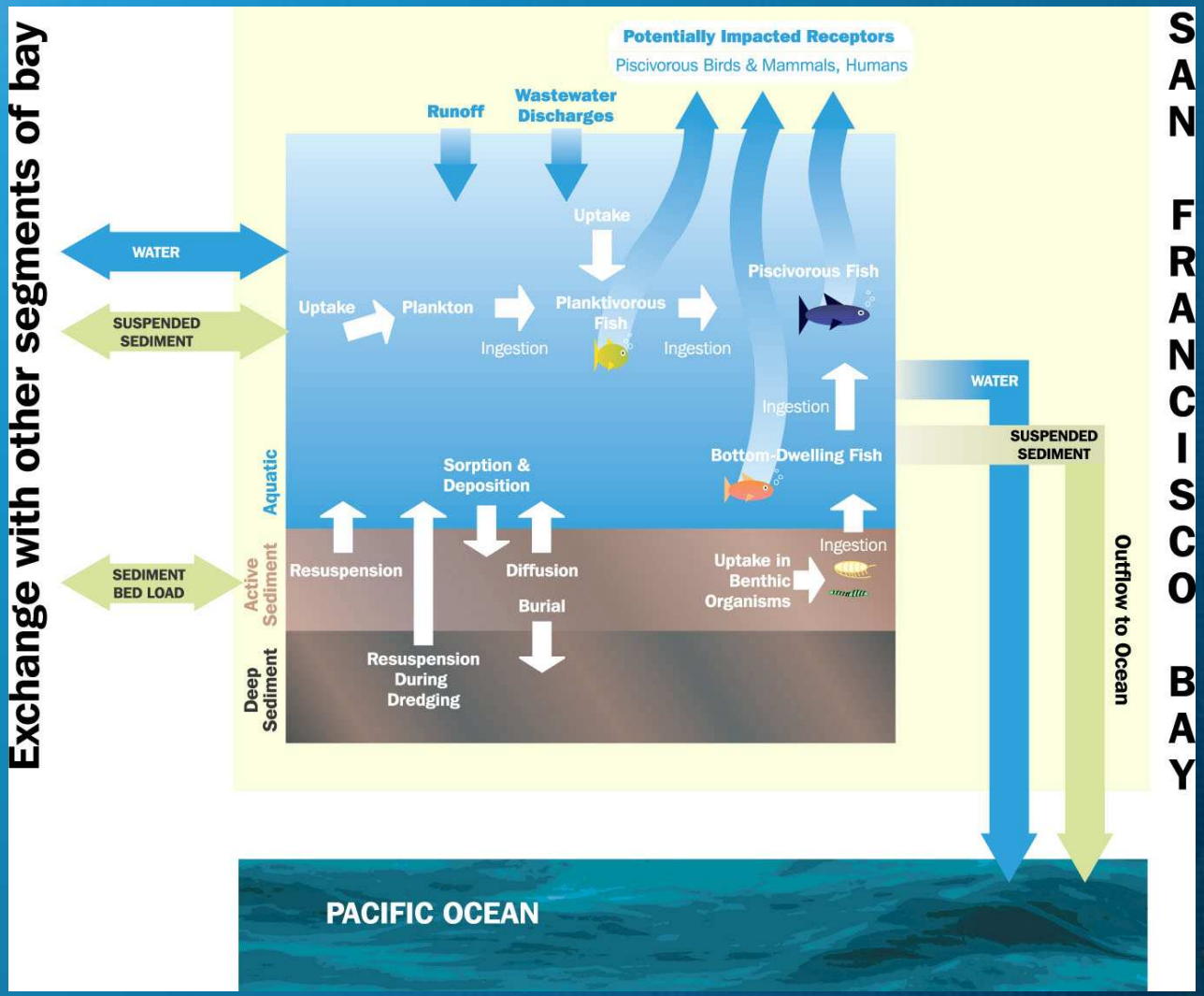
BPP Technical Studies



Bay Modeling
Model Description

URS

Conceptual Biogeochemical Model



URS

San Francisco Bay Water Quality Models

- MIKE 21 (DHI)
  - Tidal Time Scale Model
  - Two- Dimensional (Depth Averaged)
  - Hydrodynamic, Sediment, and Chemical submodels
- Box Model (EPA WASP, Lower Resolution MIKE 21 or SFEI multi-box model)
  - Daily/Monthly Time Scale
  - Fully Mixed
  - Long-term estimates
  - Fluxes and Benthic Concentrations driven by Tidal Model

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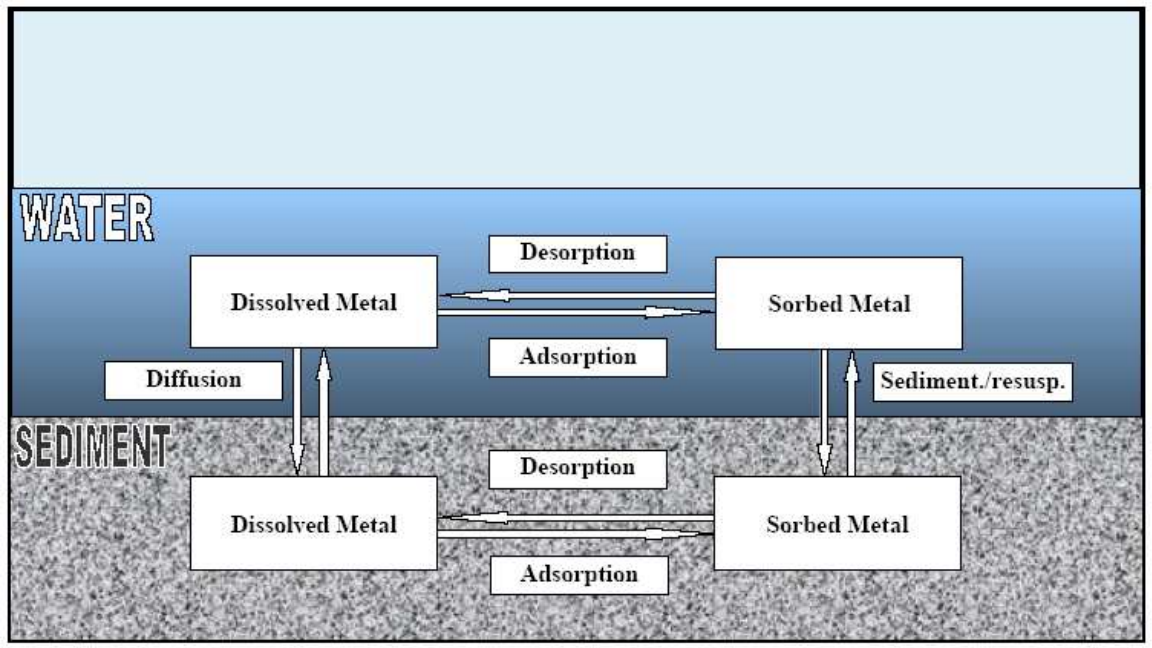
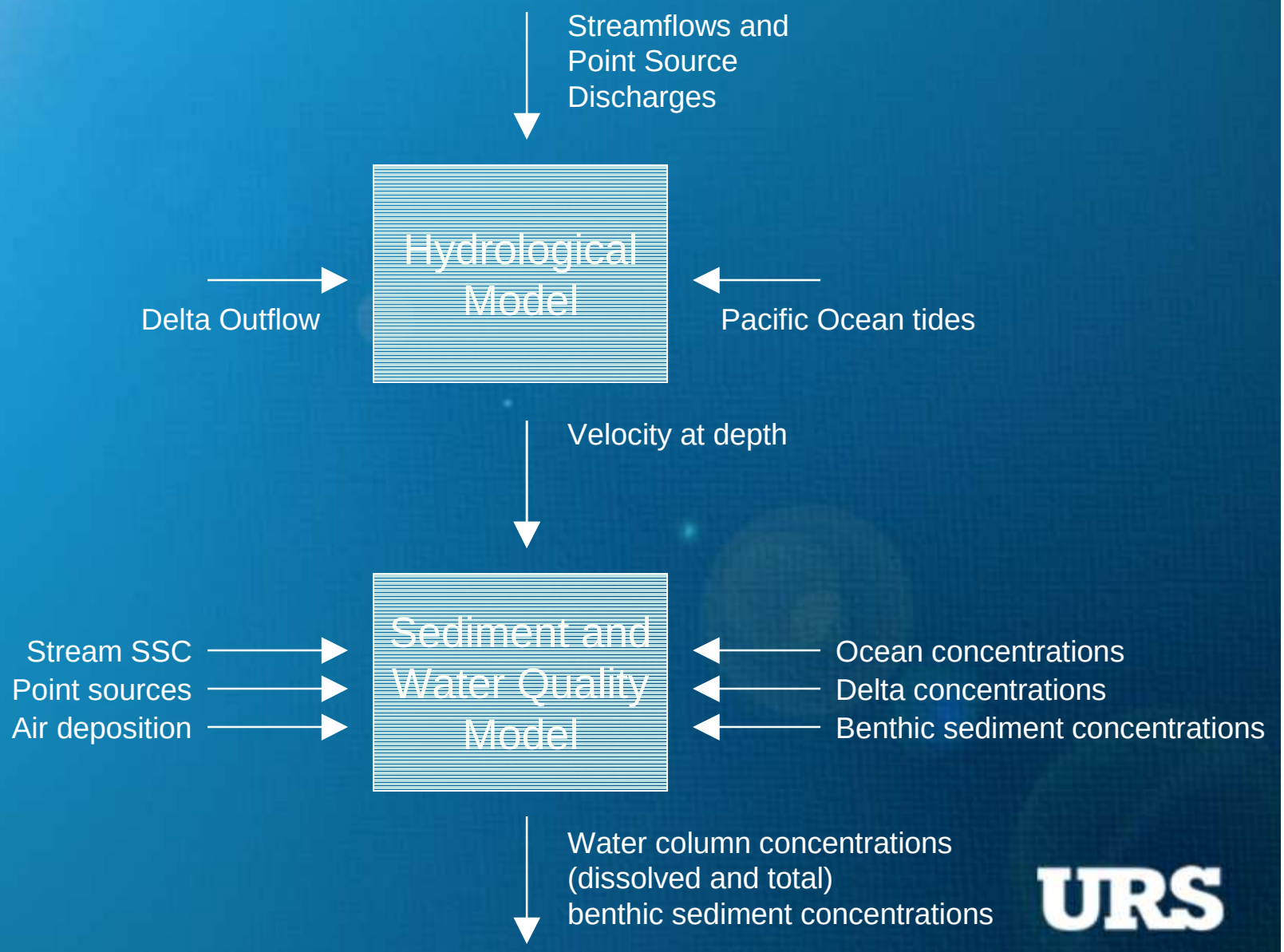
Processes/Sources included Bay Water Quality Model

- Processes
  - Water advection and diffusion (tides)
  - Sediment resuspension, deposition, and transport
  - Copper-sediment adsorption/desorption
  - Benthic sediment pore water exchange



URS

Schematic of Numerical Model



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Bay Modeling
Model Updates

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BPP Bay Model Update Progress

Input Direct Atmospheric Wet and Dry Deposition

Input HSPF Watershed Flows and Copper Concentrations

Input Marina Sources

Calibration Checks

Runtime Improvements

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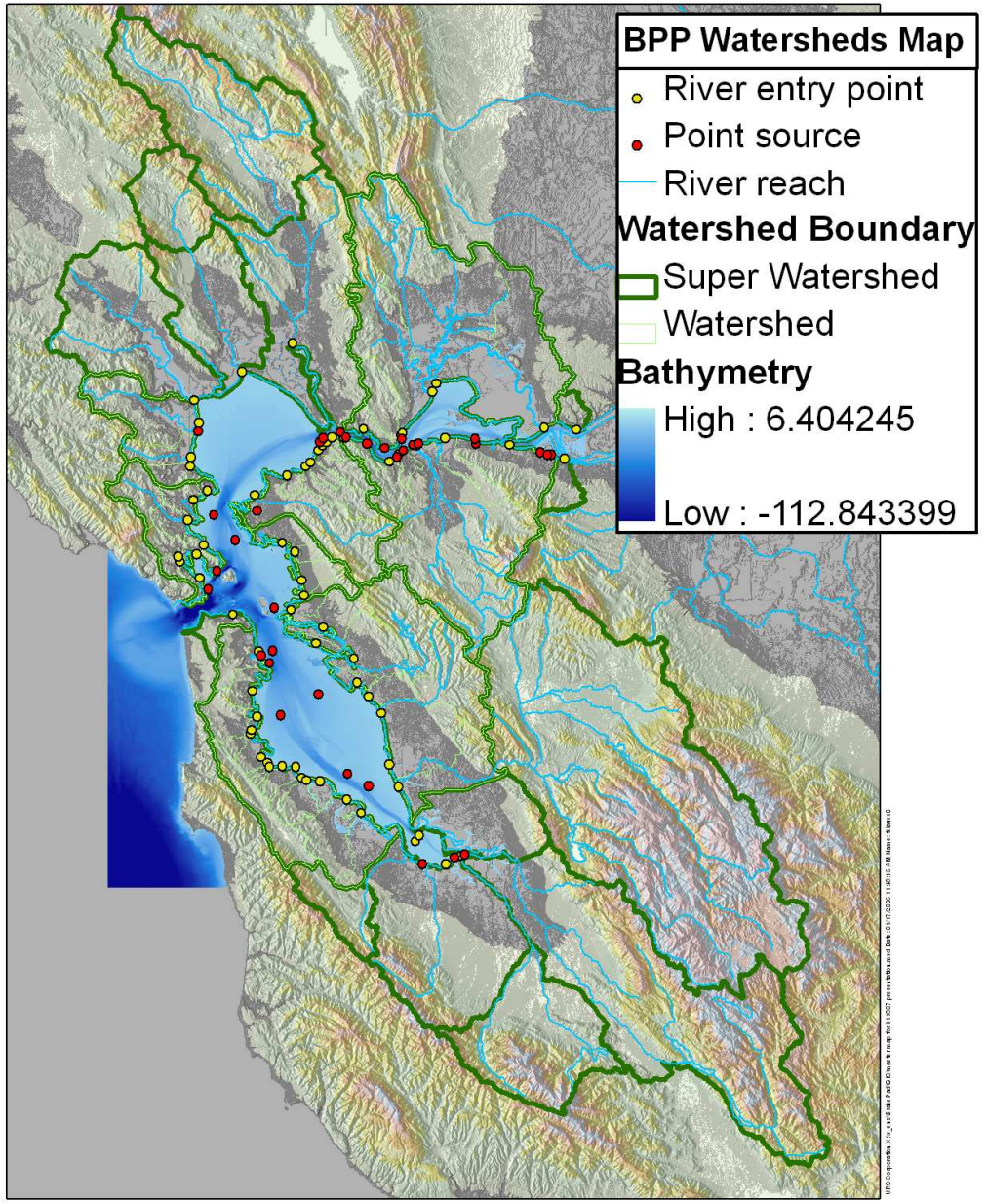
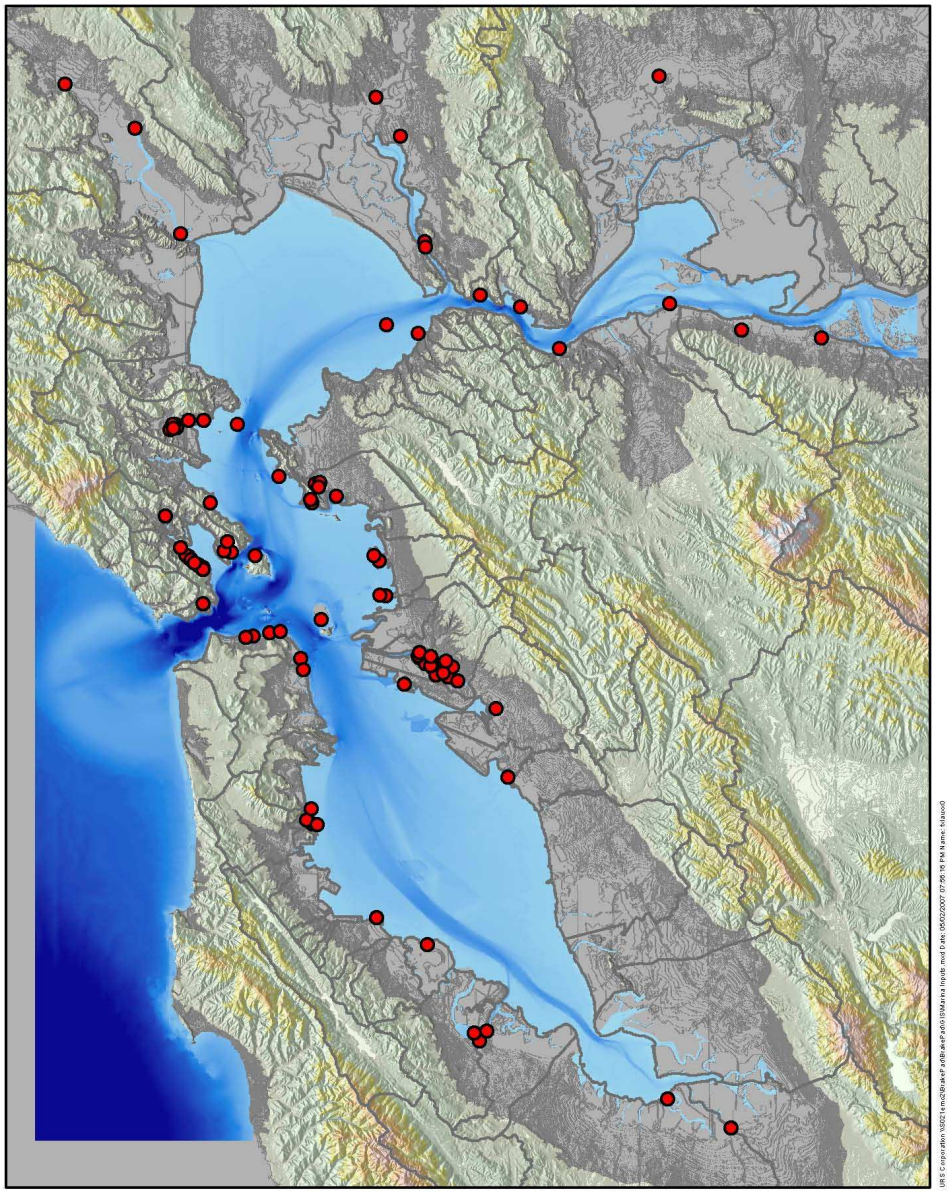

BPP Watersheds Map
River entry point
Point source
River reach
Watershed Boundary
Super Watershed
Watershed
Bathymetry
High : 6.404245
Low : -112.843399
Miles
0 5 10 20
N
URS
Brake Pad Partnership
26814617
BPP Watersheds

URS



URS	Brake Pad	Marina Inputs
	26814617	

URS

BPP Model Scenarios

- Baseline conditions
  - Representative WY Types (Wet, Dry, Normal)
- Scenarios - Reduce Watershed Loads To Reflect Phase Out of Copper in Brake Pads
  - Scenario 1 – Best Estimate BP Sources
  - Scenario 2 – Low BP Sources
  - Scenario 3 – High BP Sources

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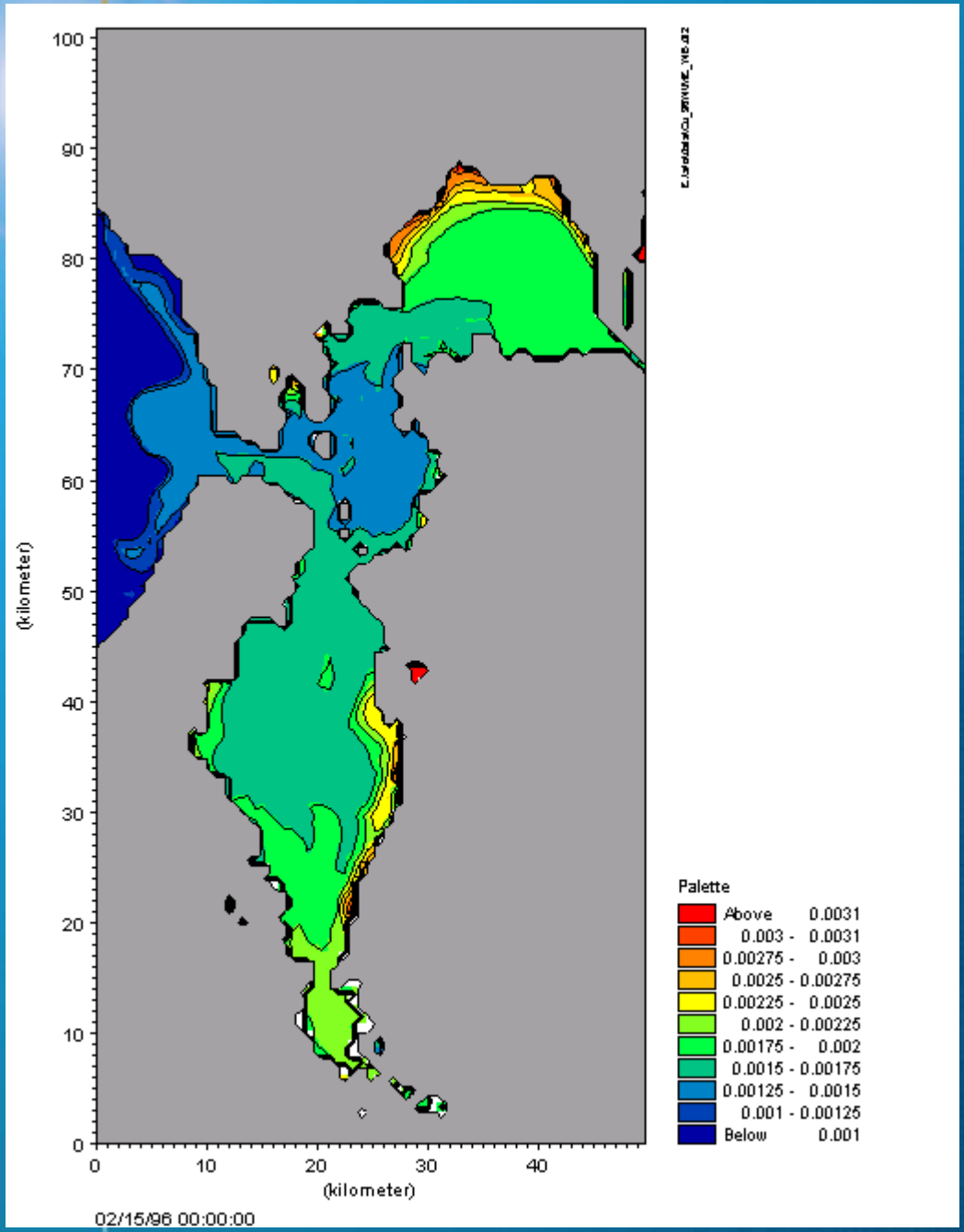
Previous Modeling Results

URS



Dissolved Copper Concentration - Storm Event (whole Bay movie)

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Previous Modeling Results

- Bay [Cu] Sensitive to Tributary Loads
- Modeled Residence Times

Matrix	South Bay	Lower South Bay
Water	35-80 days	8-20 days
Diss.Copper	100-300 days	30-100 days
Ads.Copper	6-9 years	1-4 years
Total Copper	6-7 years	1-2 years

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Implications for Future Results

- Changes in Tributary Loads Can Result in Changes in Copper Concentrations in Bay
- Timescales for Changes Depends on Bay Segment
- Lower South Bay 1-2 years
- South Bay 6-8 years

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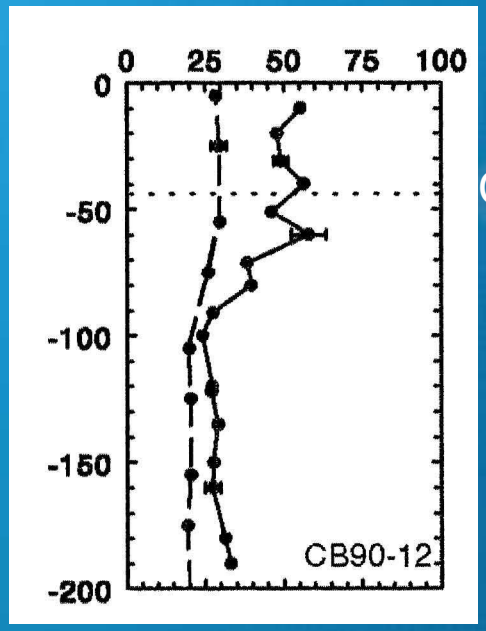
Downcore Sediment Copper (ug/g)

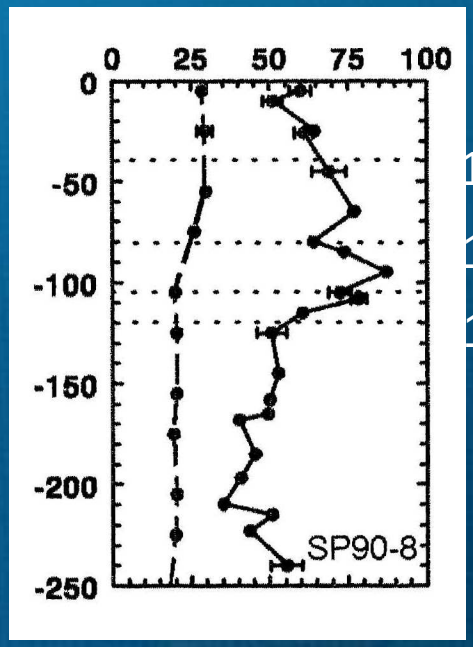
South Bay



cm

Cs 137

San Pablo Bay



1980

1970

1963

Pre-1952

From Hornberger, et al. Marine Chem 64 (1999) 39-55

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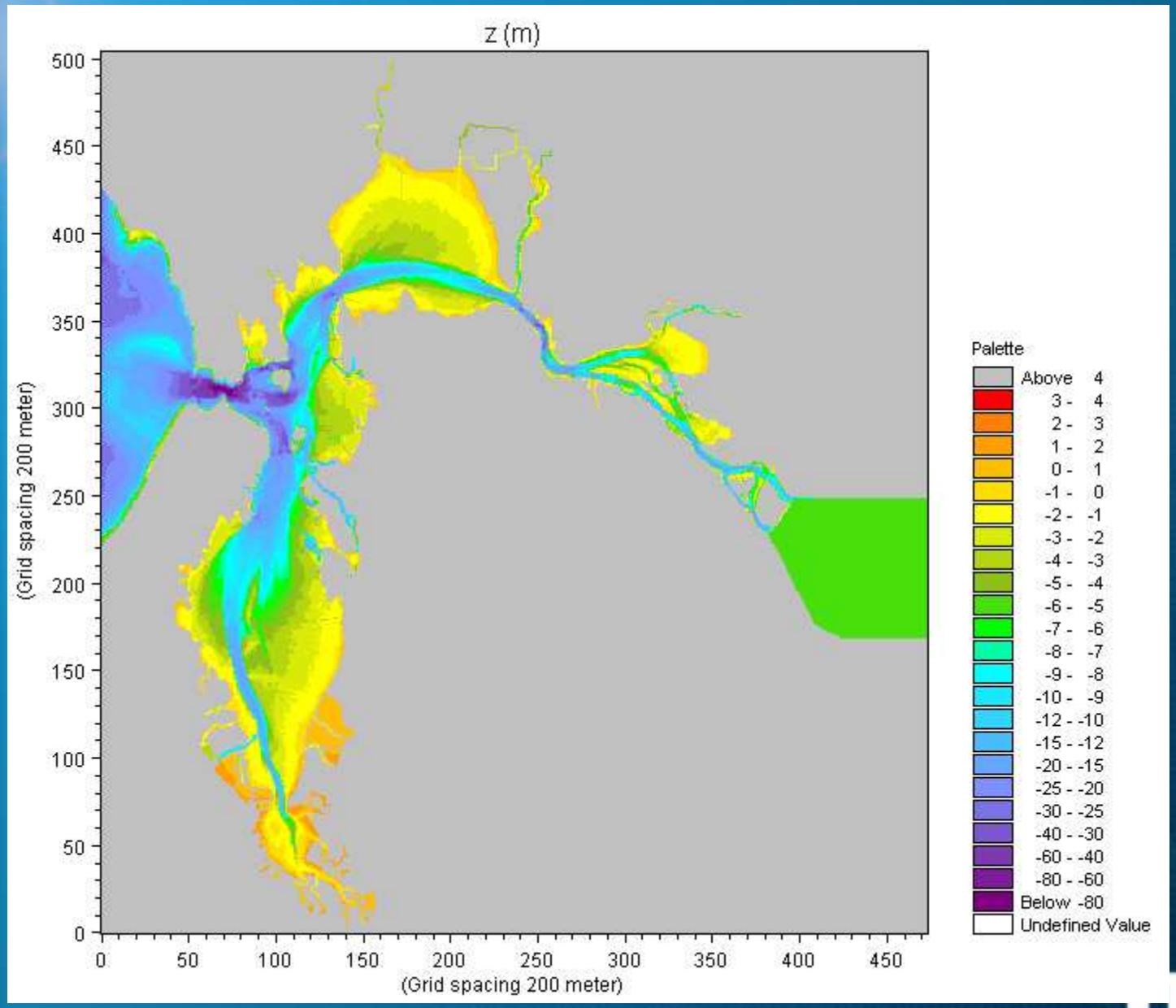
z (m)
(Grid spacing 200 meter)
(Grid spacing 200 meter)
0
50
100
150
200
250
300
350
400
450
500
Palette
Above 4
3 - 4
2 - 3
1 - 2
0 - 1
-1 - 0
-2 - -1
-3 - -2
-4 - -3
-5 - -4
-6 - -5
-7 - -6
-8 - -7
-9 - -8
-10 - -9
-12 - -10
-15 - -12
-20 - -15
-25 - -20
-30 - -25
-40 - -30
-60 - -40
-80 - -60
Below -80
Undefined Value

URS

Bay Modeling Calibration

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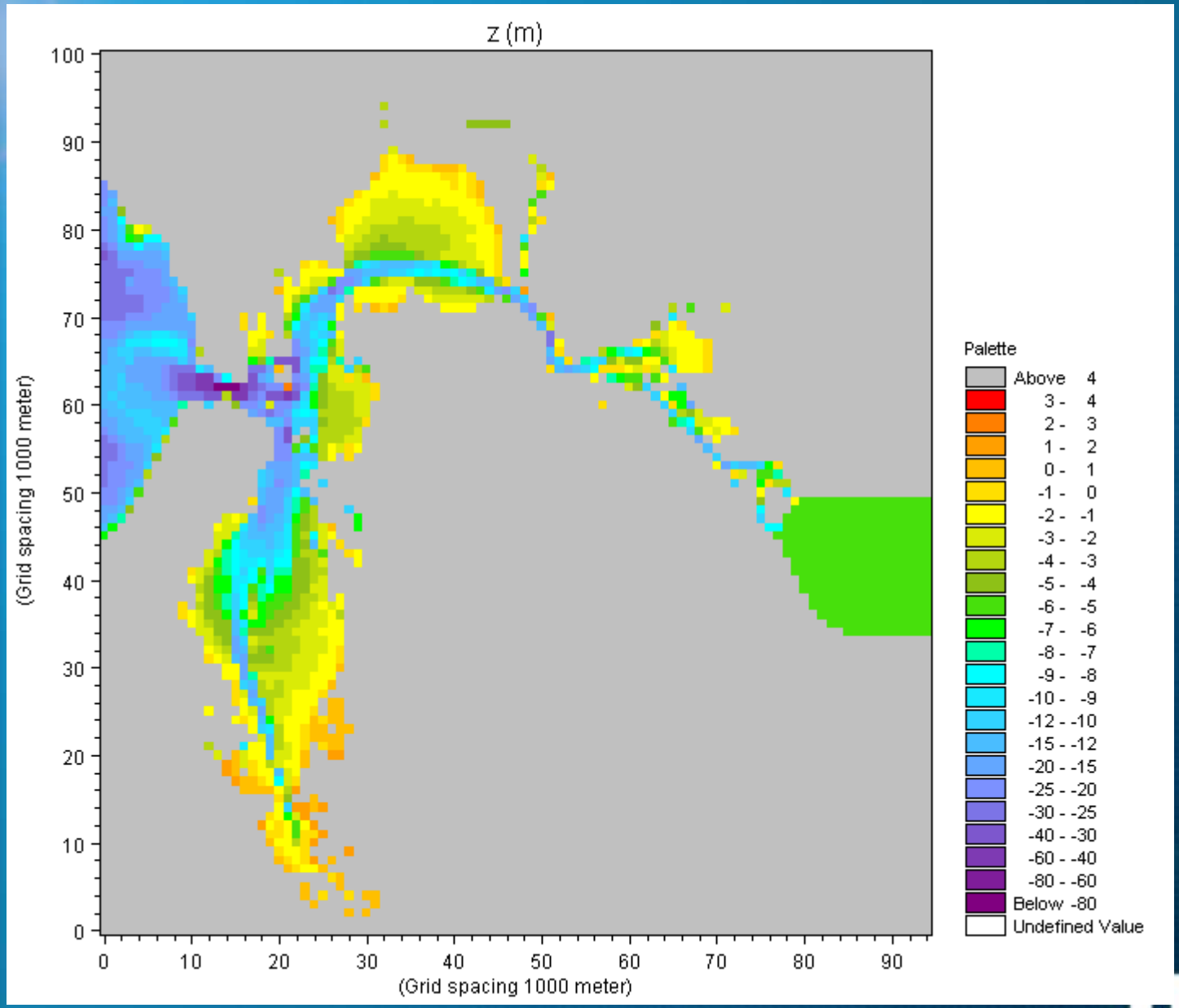
Dissolved Copper Mass Balance Update

		Copper Mass Flux Rates			BPP
		1996 Wet Season	1997 Dry Season	Annual	Avg. Annual
Bay Segment		(10^3 kg yr^{-1})	(10^3 kg yr^{-1})	(10^3 kg yr^{-1})	(10^3 kg yr^{-1})
Entire Bay					
	Sac San Joaquin Rivers	104	14	118	
	Local Tributary Inflow	39	0.9	39.9	56
	POTW Inflow	15.7	9.7	25.4	
	Direct deposistion				1.7
	Marinas				13.2
	Other Shoreline Releases				11
	Desorption	-5.5	1.1	-4.4	
	Diffusion	14.7	16	30.7	
	Net Pacific Ocean Exchange	-142	-37	-179	
	Net Change	25.9	4.7	30.6	
	Red are from BPP and not yet included in modeled estimates				


z (m)
(Grid spacing 1000 meter)
(Grid spacing 1000 meter)
0
10
20
30
40
50
60
70
80
90
100
Palette
Above 4
3 - 4
2 - 3
1 - 2
0 - 1
-1 - 0
-2 - -1
-3 - -2
-4 - -3
-5 - -4
-6 - -5
-7 - -6
-8 - -7
-9 - -8
-10 - -9
-12 - -10
-15 - -12
-20 - -15
-25 - -20
-30 - -25
-40 - -30
-60 - -40
-80 - -60
Below -80
Undefined Value

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BPP Copper Bay Models Timescales

Timescale

(computational timestep)

Tidal

(Seconds, minutes)

Average Fluxes

Average Benthic Concentrations

Annual

(days, months)

Output

Hourly, Daily Concentration

Decadal Trends

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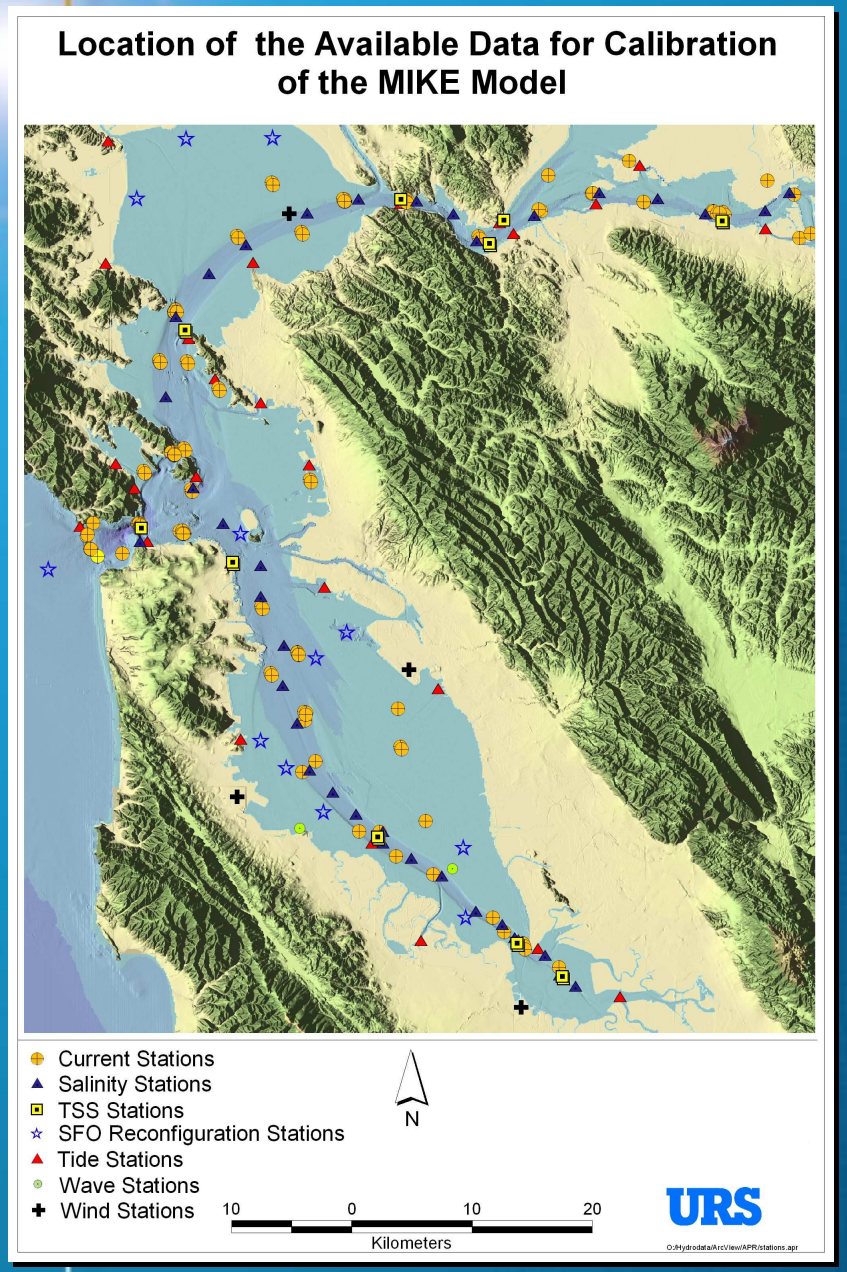
MIKE 21 Water Quality Model Calibration

- Existing Data
  - NOAA/USGS/RMP/RWQCB/City of San Jose/BP Wear Debris Leaching/Literature
- URS Additional Measurements:
  - Pore Water Concentrations
  - Copper Adsorption and Desorption Rates
  - Benthic Sediment Concentrations
- Calibrated to Water Column Concentrations
  - SSC, DCu

URS



Baseline Hydrologic Data Used to Develop Model

- USGS
- NOAA/NOS
- Stanford University
- NCDC
- NGDC
- DWR
- URS Data

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Bay Modeling
Data Presentation

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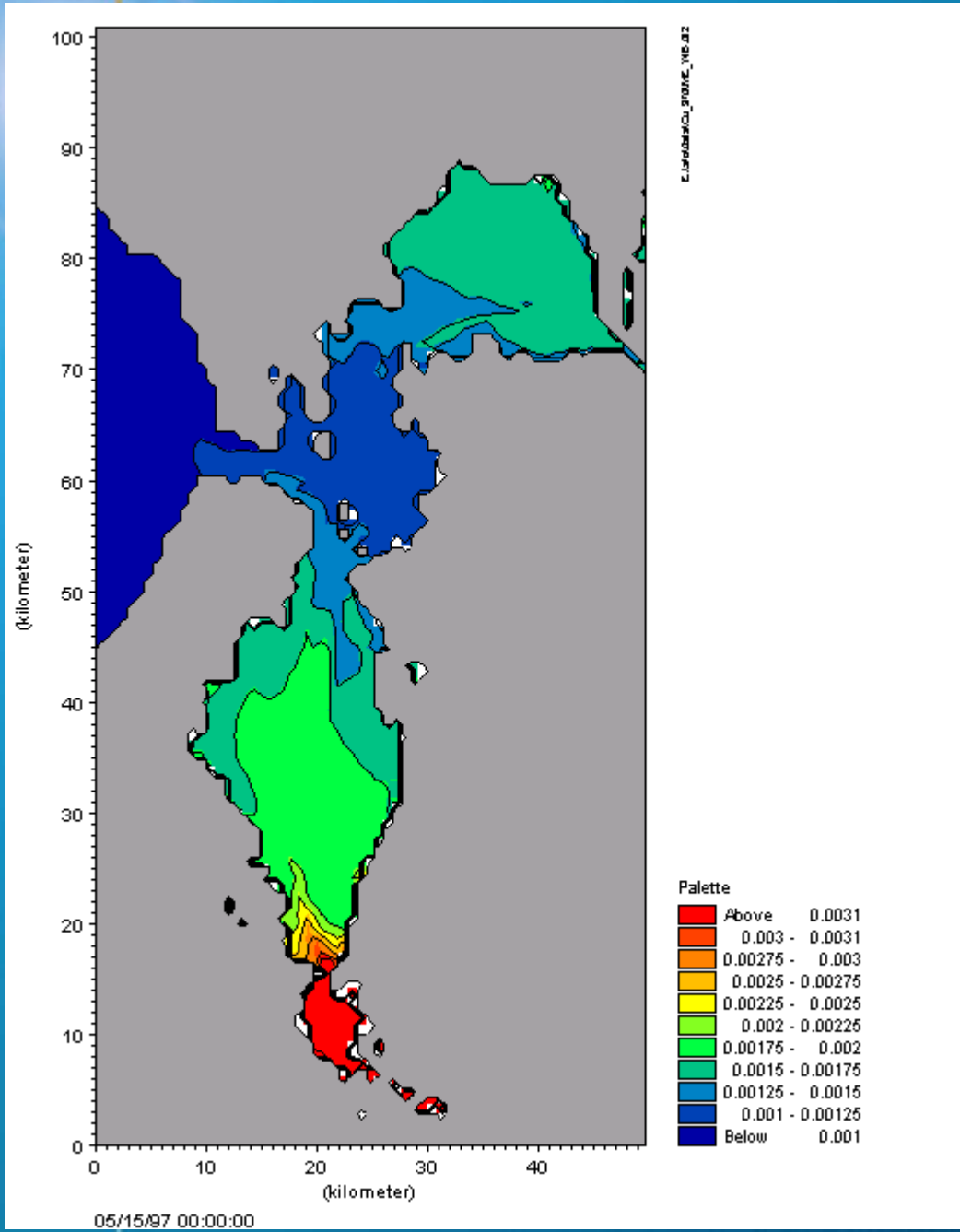
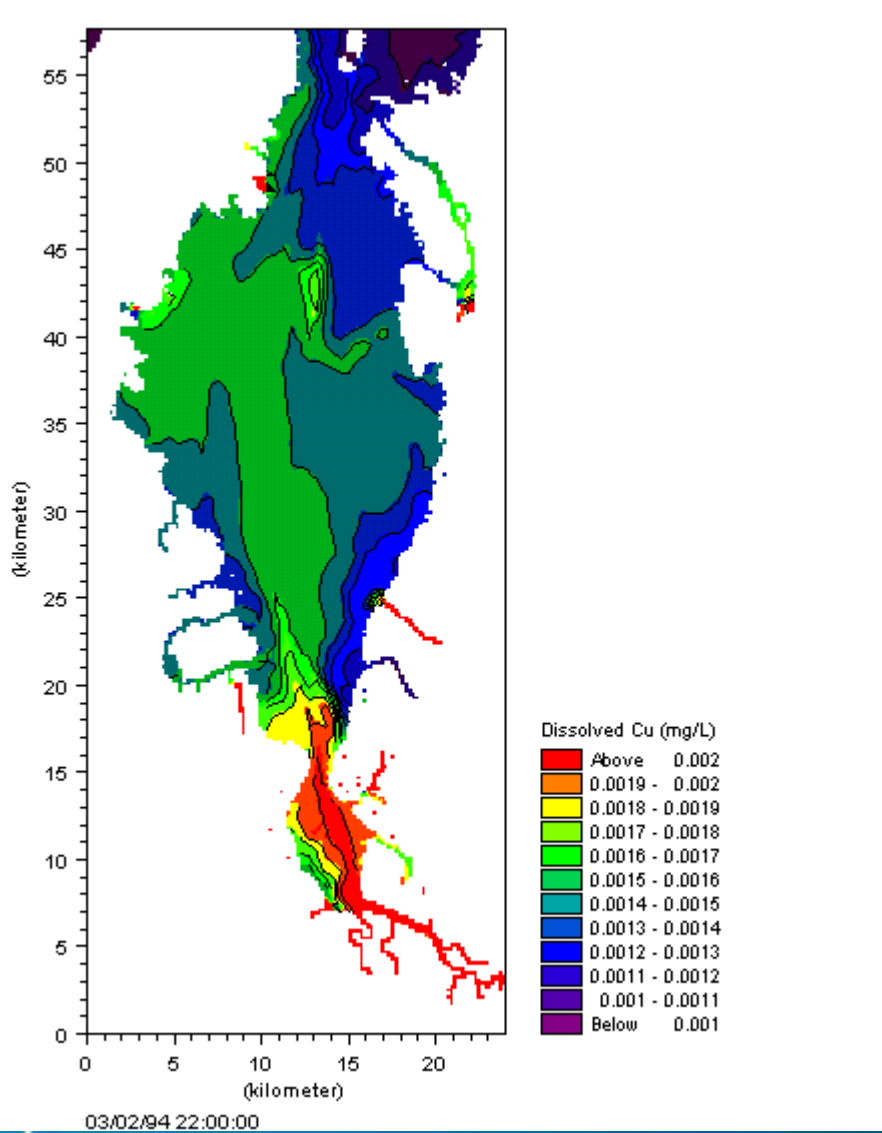


Dissolved Copper Concentration – Dry Season (whole Bay movie)

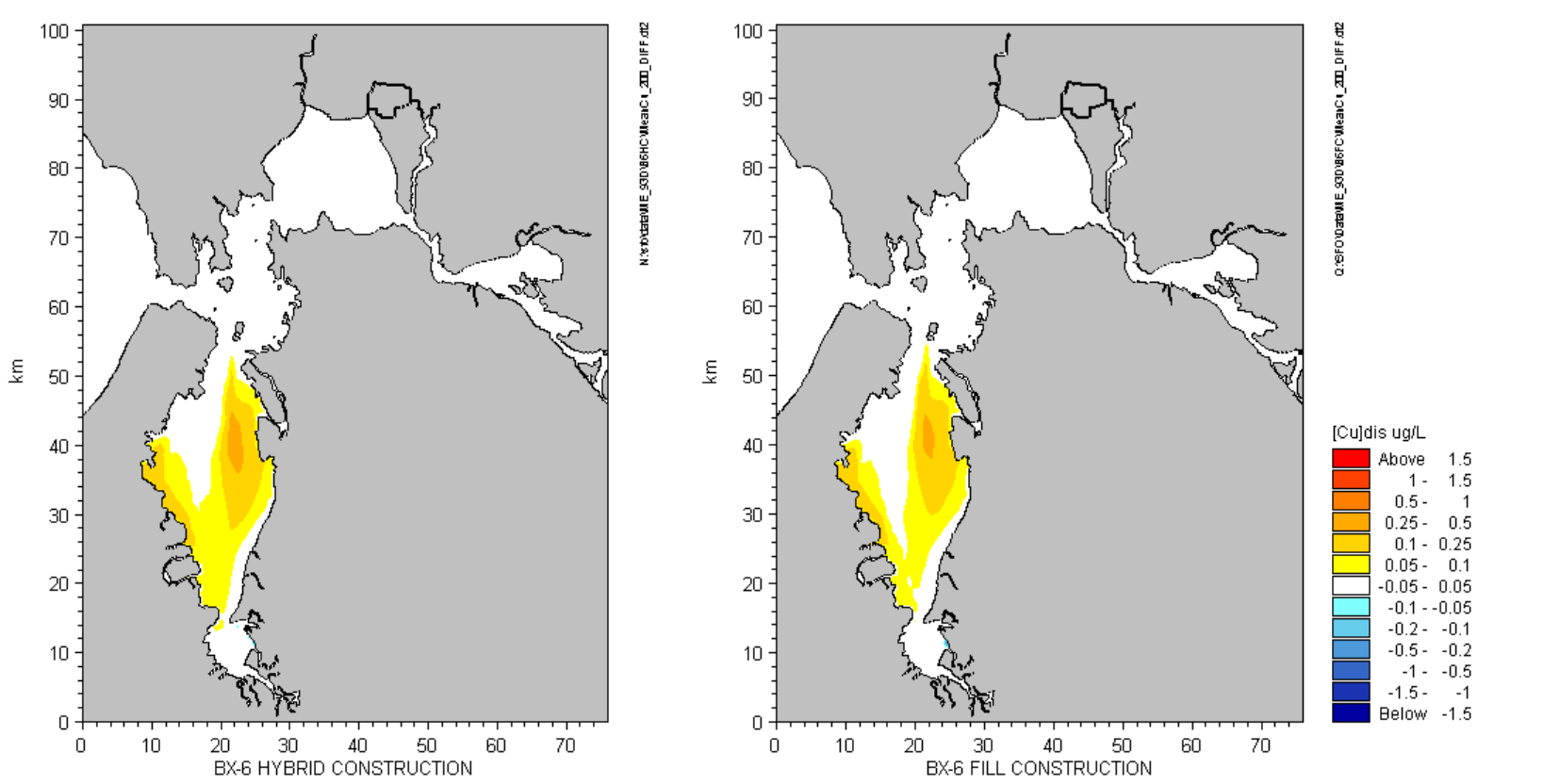
URS



Dissolved Copper in the South Bay

URS

Differences in Dissolved Copper Concentration between Baseline and Two Scenarios (4 day average)



Scenario 1

Scenario 2

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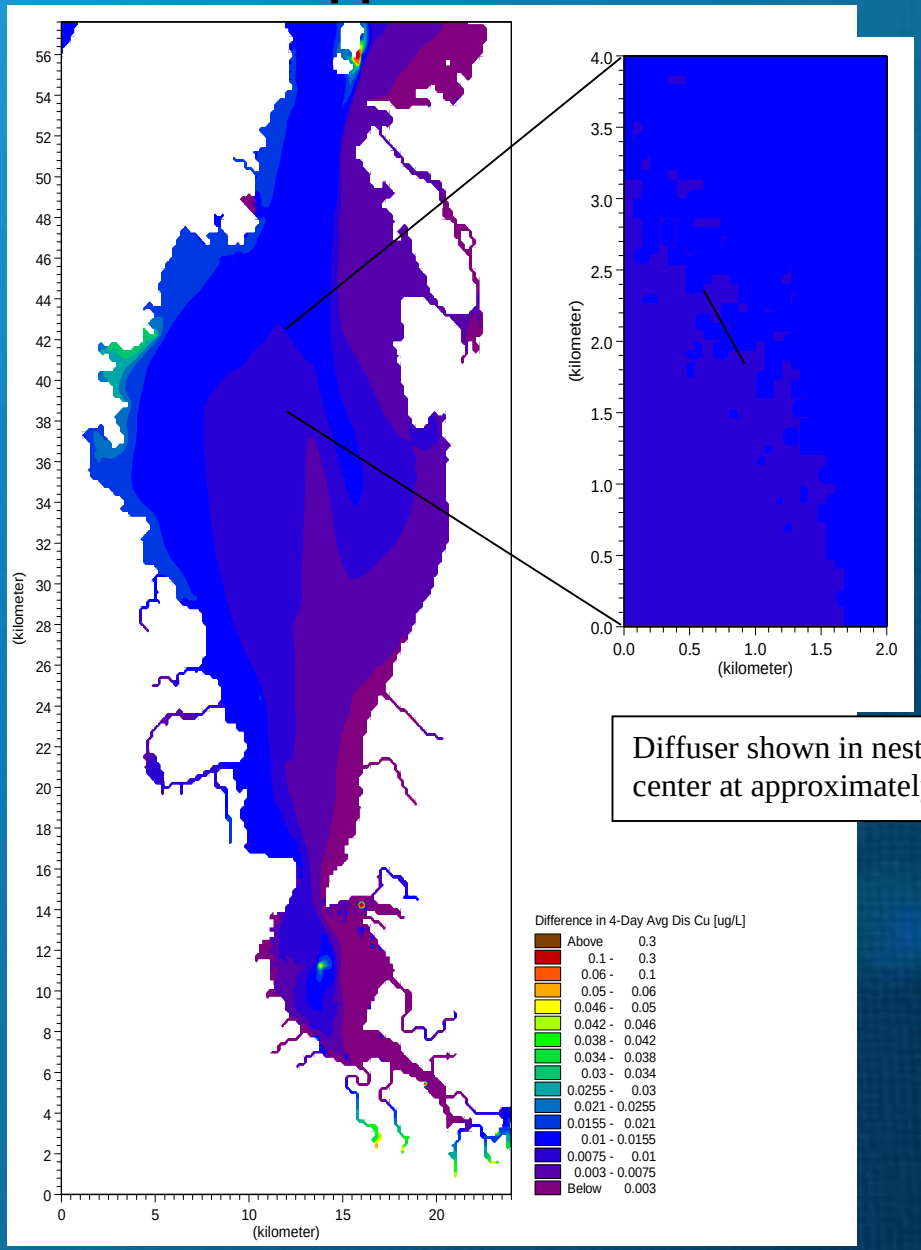
Difference in Dry Season Maximum 4-Day Average Dissolved Copper MIKE 21 Results



Diffuser shown in nested grid above, with center at approximately (0.8, 2.1).

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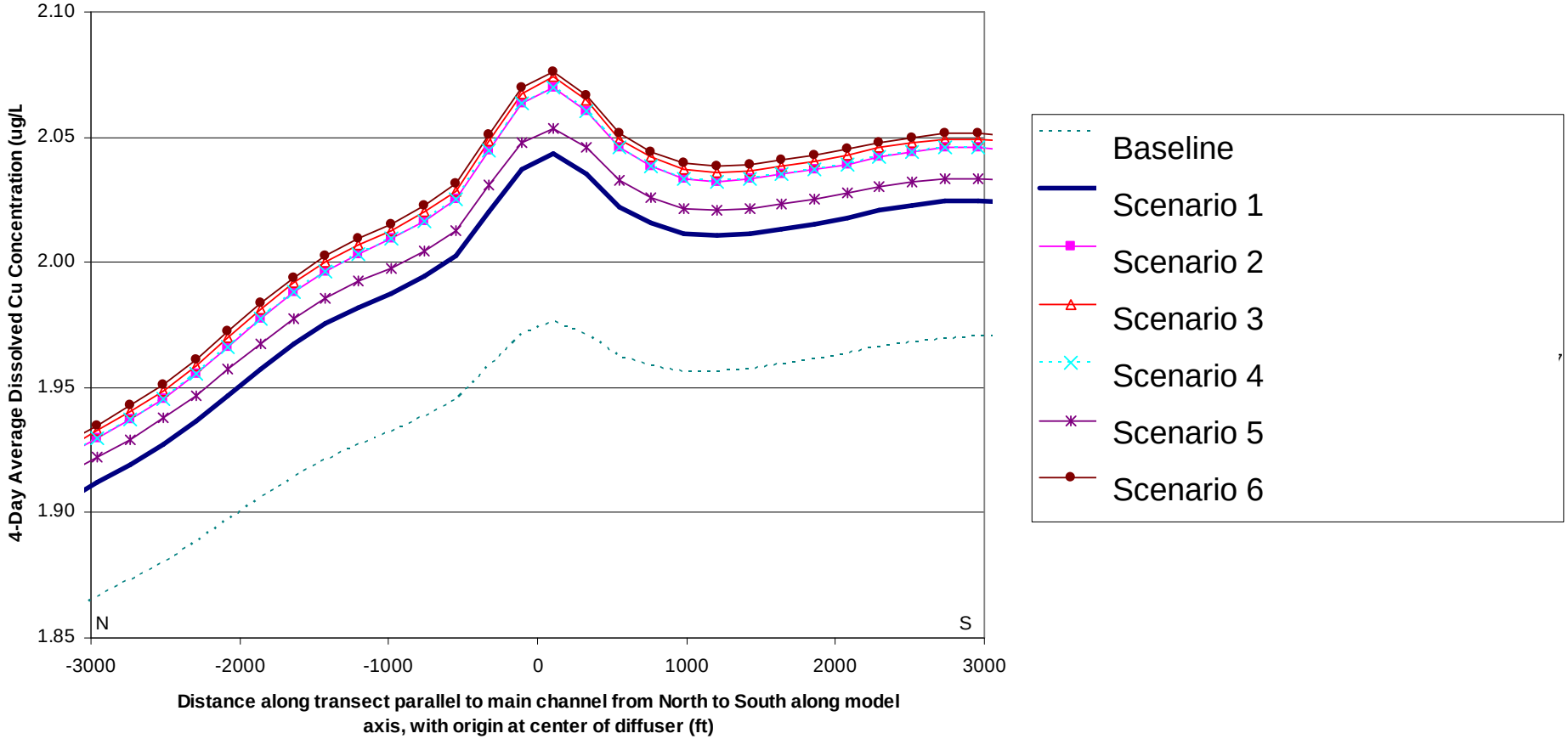
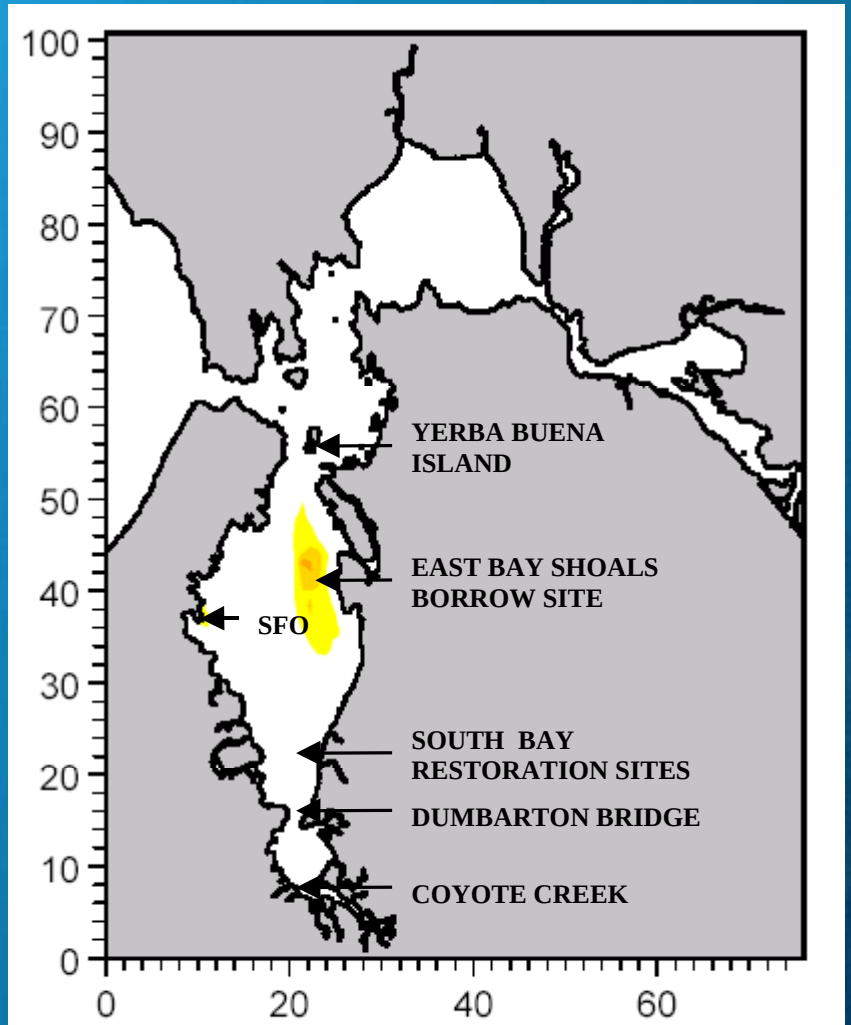
Dry Season Maximum 4-Day Average Dissolved Copper Concentration Along Transect Parallel to South Bay Main Channel for All Modeled Scenarios



Probability Extraction Locations - Construction



BX-R Fill Construction

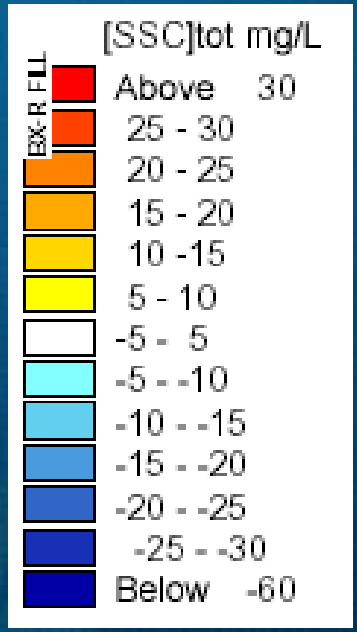


Fig. 5.3.2-19

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Dissolved Copper – Construction

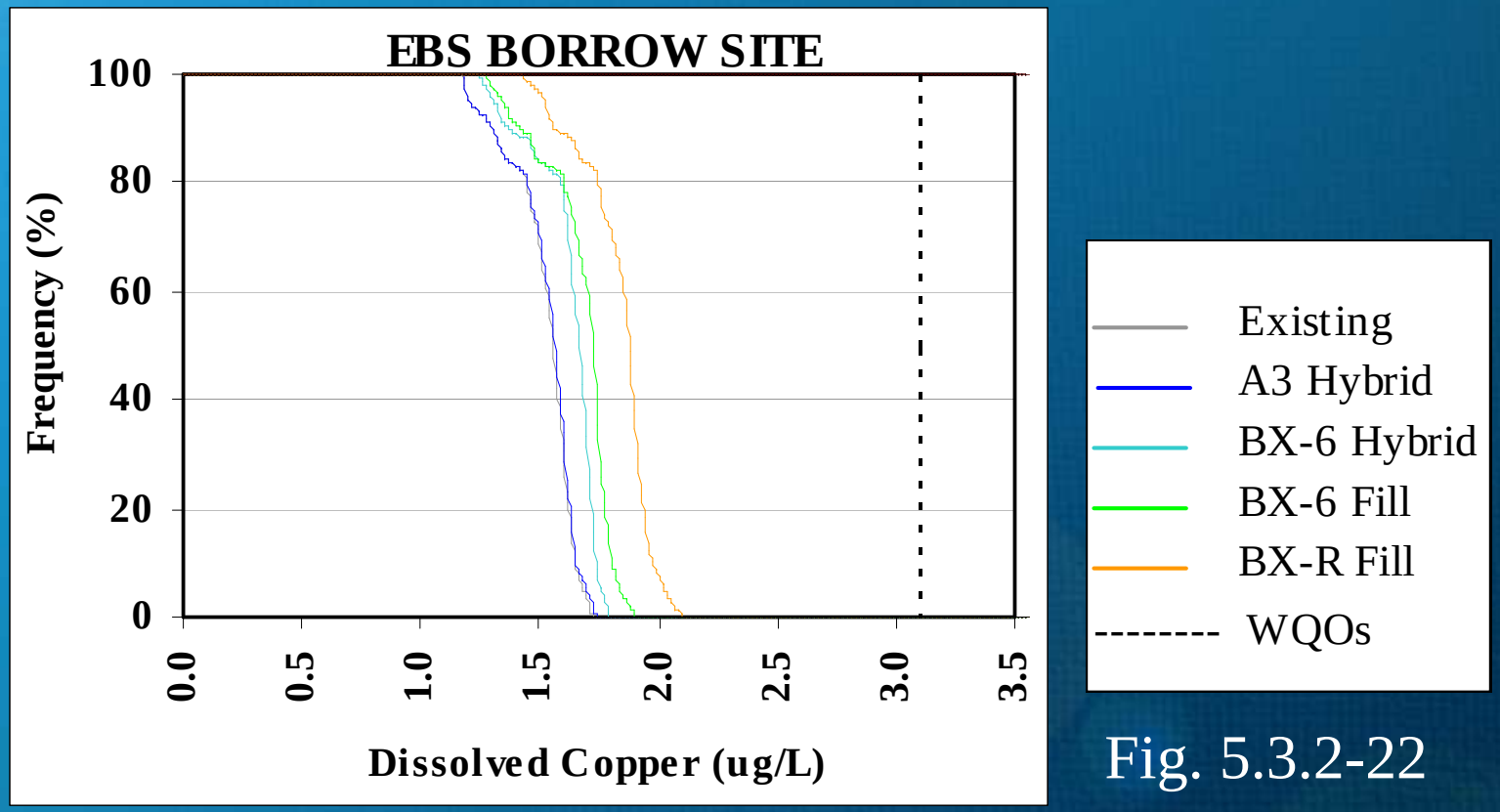

Fig. 5.3.2-22

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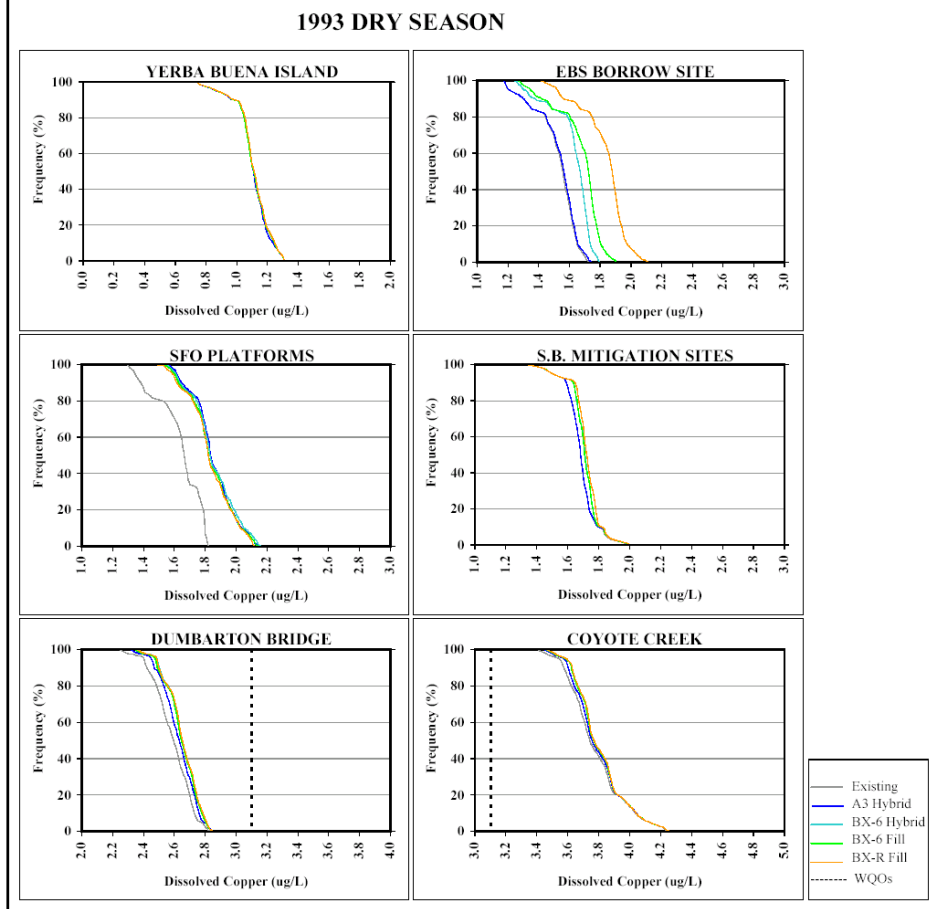
Dissolved Copper – Construction –all locations



	SFO Runway Reconfiguration Project	MIKE 21 PREDICTED FREQUENCY OF EXCEEDANCE OF 4-DAY AVERAGED DISSOLVED COPPER WQOs--CONSTRUCTION	FIGURE 5.3.2-21

URS

Bay Modeling Sensitivity

URS

Previous Sensitivity to Changes in Tributary Loads

- Tripled Tributary Loads
- Evaluated changes in average dissolved copper at one location over six months
- Dissolved Copper increased by up to 1.2 ug/L

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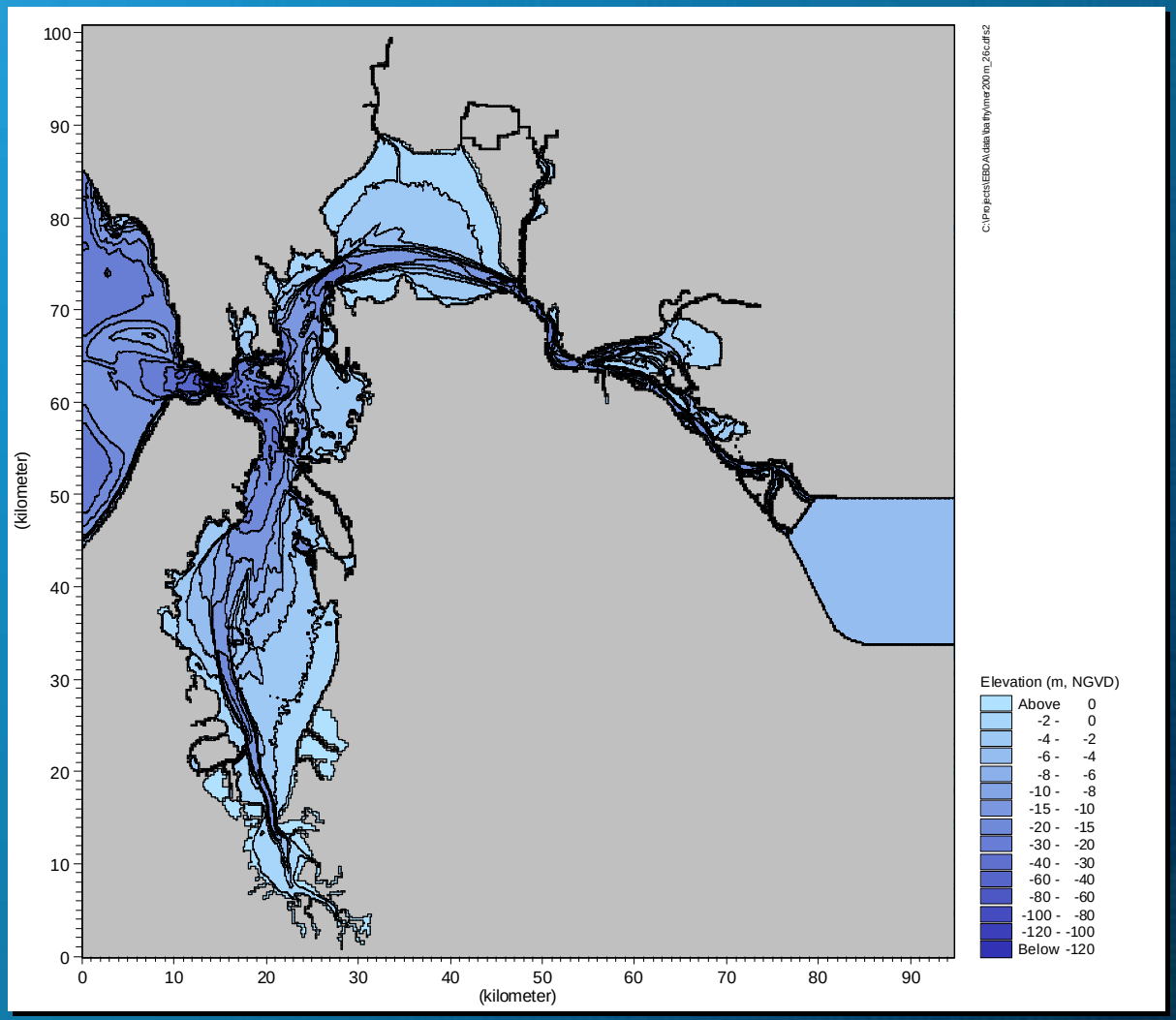
Bathymetry Used in Model
(200 meter grid)



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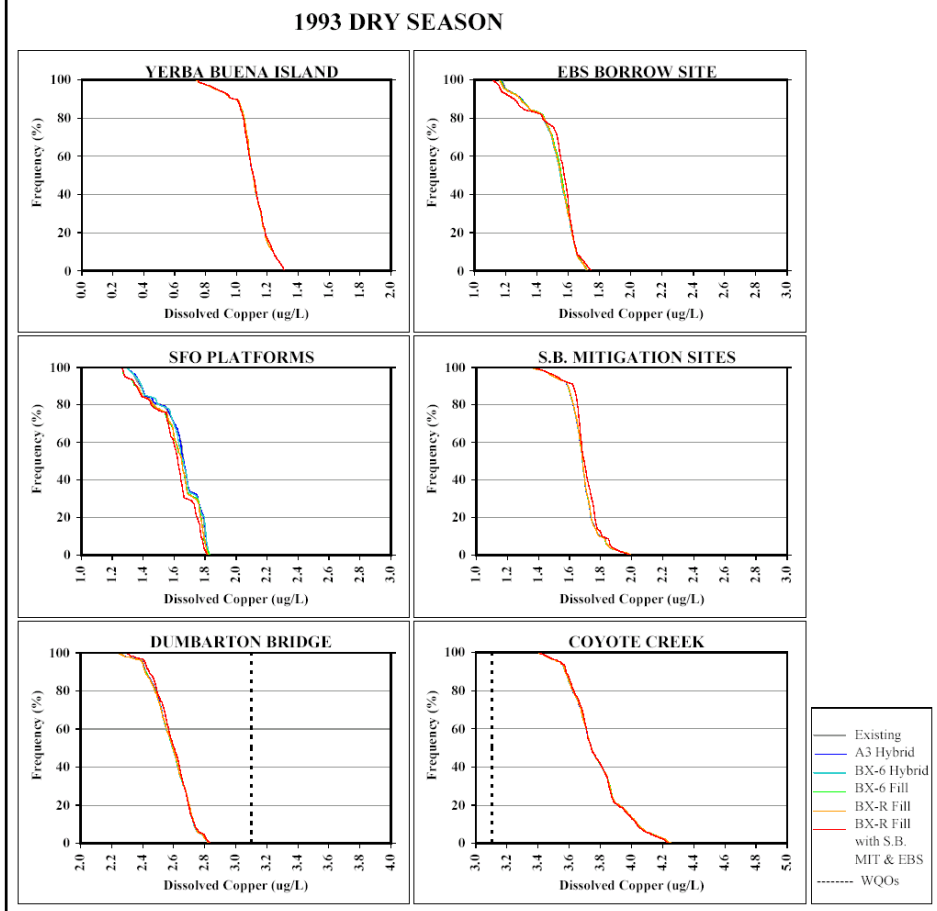
Dissolved Copper - Operation – all locations



	SFO Runway Reconfiguration Project	MIKE 21 PREDICTED FREQUENCY OF EXCEEDANCE OF 4-DAY AVERAGED DISSOLVED COPPER WQOs--SFO OPERATION	FIGURE 5.2.6-49

URS