Dominguez Channel and Los Angeles and Long Beach Harbors TMDLs

Nearshore Modeling Options

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Technical Advisory Committee Meeting
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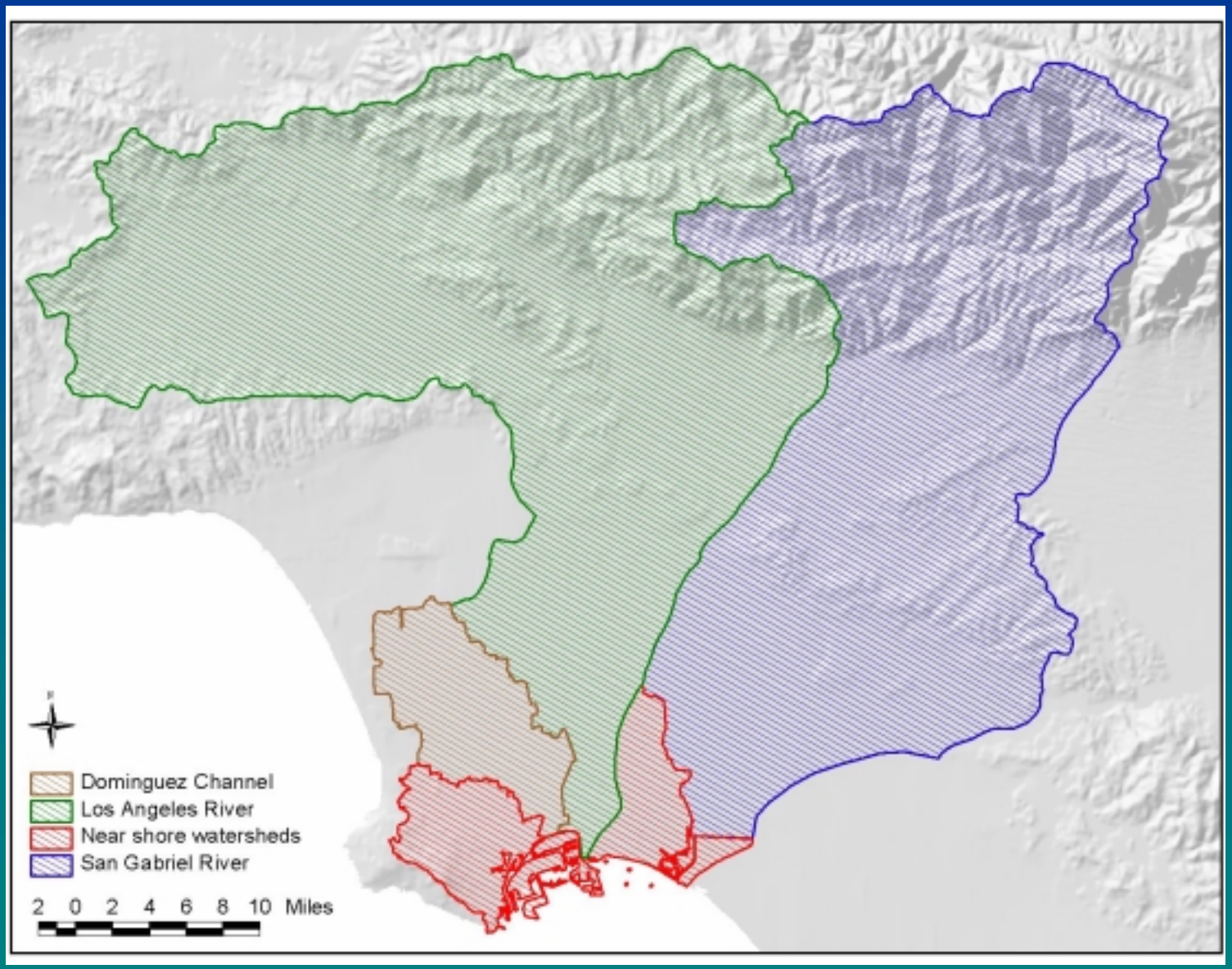
Watershed Model Development

- Models developed to provide estimates of historic (hourly/daily) pollutant loadings to receiving waters
- Pollutants addressed in TMDL and requiring model development
  - Metals (Cu, Pb, Zn)
  - PAHs
  - DDT
  - Chlordane
  - PCBs
- Separate approaches required for dry and wet weather
  - Sources and methods of transport vary
  - Availability of data characterizing water quality for each condition

Overview of Watersheds Addressed

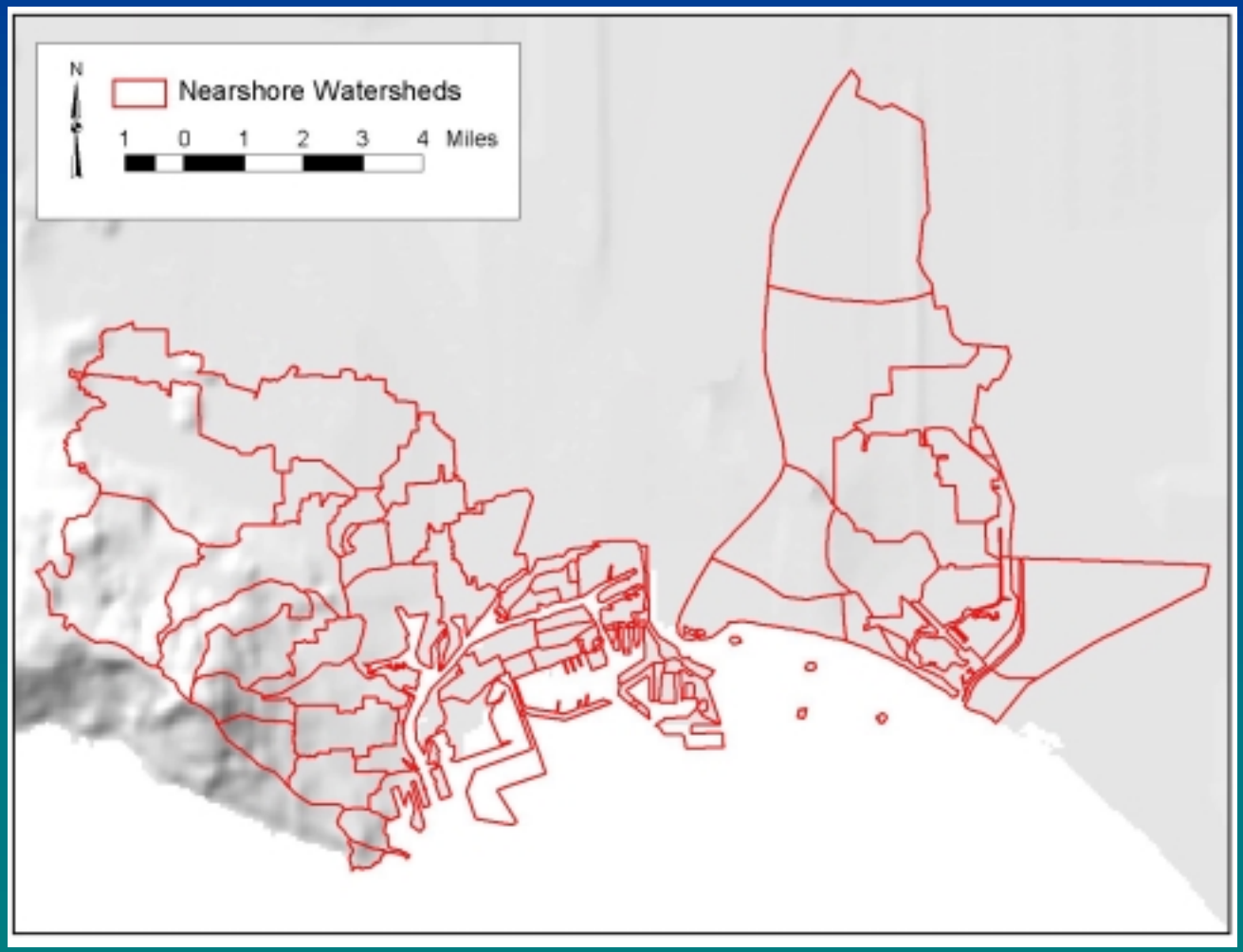


Wet-Weather Watershed Model Development

- LA River (LAR) and San Gabriel River (SGR)
  - Previous models developed by Tetra Tech to support watershed TMDLs
  - Models setup for hydrology, sediment, and metals (Cu, Pb, & Zn)
- Dominguez Channel (DC)
  - Model currently under development by SCCWRP
  - Models setup for hydrology, sediment, and metals (Cu, Pb, & Zn)
- Nearshore watersheds
  - Continuation of regional modeling approach used for LAR, SGR, and DC
  - Models currently under development by Tetra Tech
- New approaches required for modeling PAHs, DDT, chlordane, and PCBs

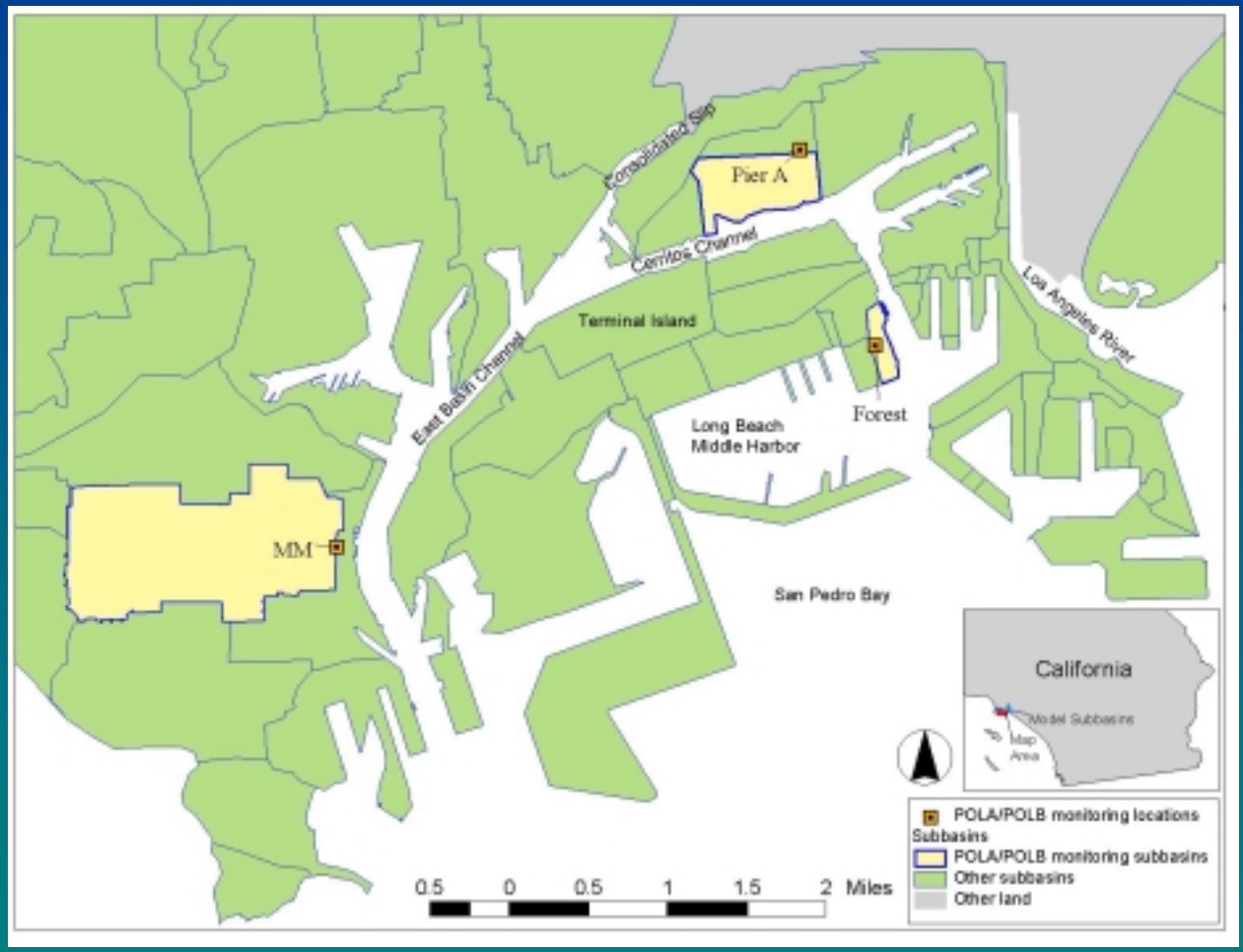
Model Development of Nearshore Areas

- **Delineations based on DEMs and data received from POLA and POLB**



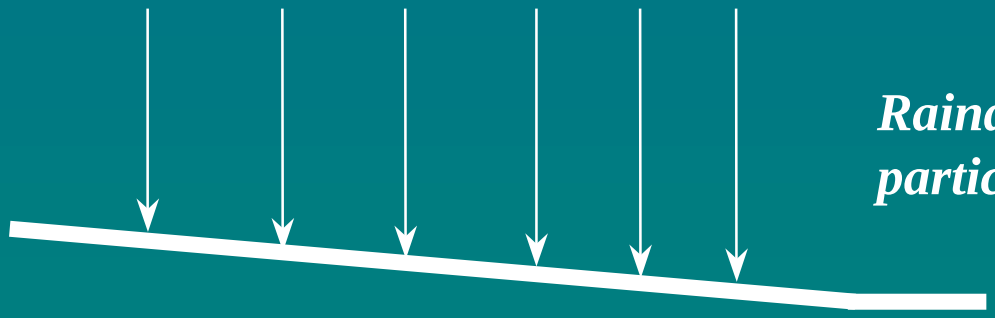
Consideration of Local Monitoring Stations

- Monitoring data collected by POLA and POLB
- Three sites in nearshore model domain
  - Maritime Museum (MM)
  - Pier A
  - Forest
- Pier A and Forest sites represent “Port Activities” based on SCAG land use data
- MM represents a mix of land uses



Regional Modeling Approach for Sediment and Metals

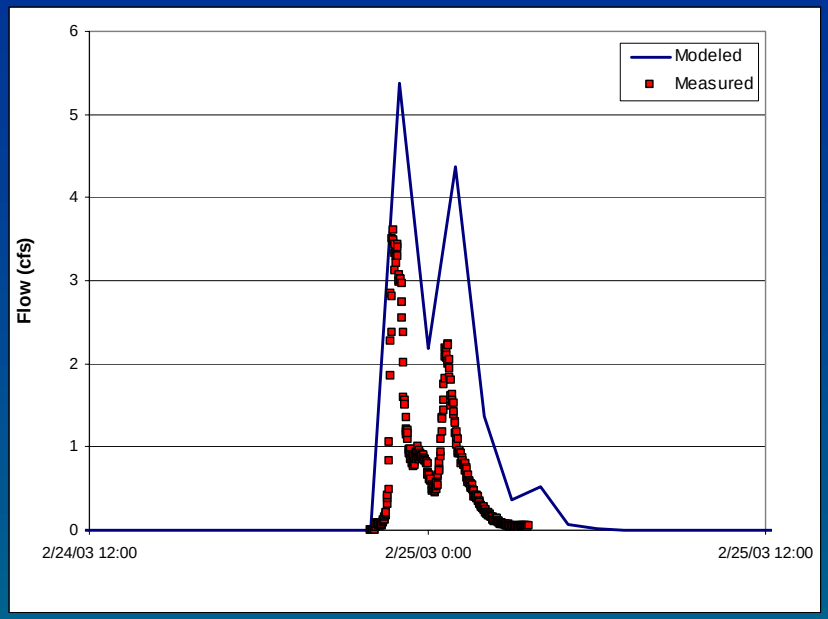
- Erosion is a function of land use activity, soil characteristics, slope, land cover, and precipitation
- Erosion occurs due to rainfall "energy"
  - Detachment of soil particles
  - Wash off of detached material
  - Use of potency factors to estimate associated metals
- Model parameters developed by SCCWRP for major land use categories
- Validated in separate watershed models
  - Ballona Creek HSPF model – SCCWRP
  - LAR and SGR LSPC models – Tetra Tech

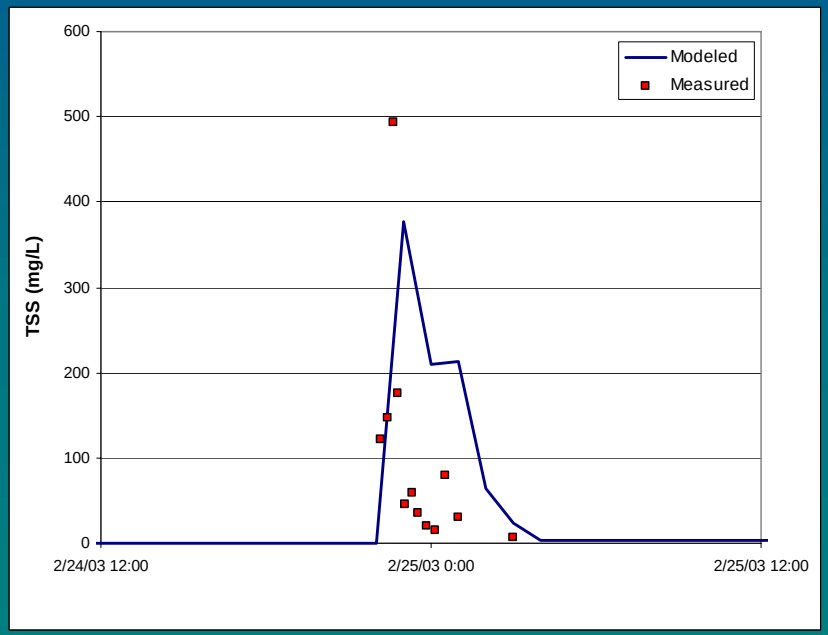


Raindrop impact detaches soil particles

Refinement of the Regional Modeling Approach

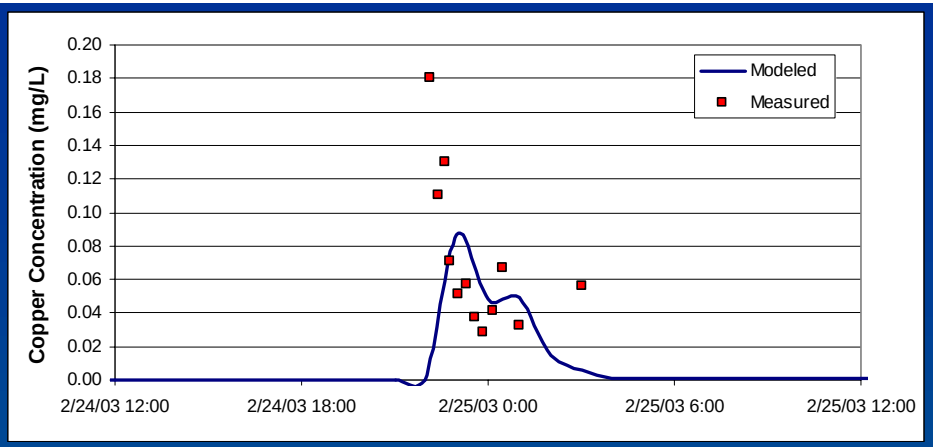
- Additional land use category added to model – Port Activities
- POLA and POLB data used for calibration of parameters specific to Port Activities
- Example: Forest site
  - Flow
  - Sediment

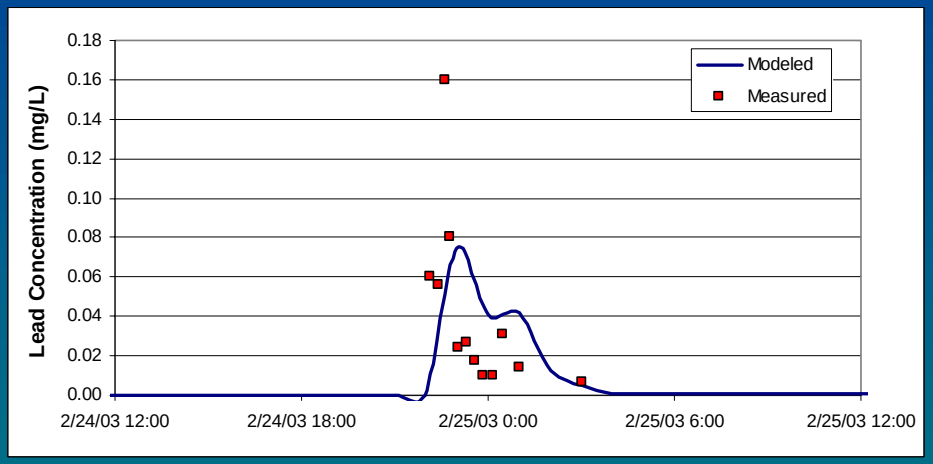


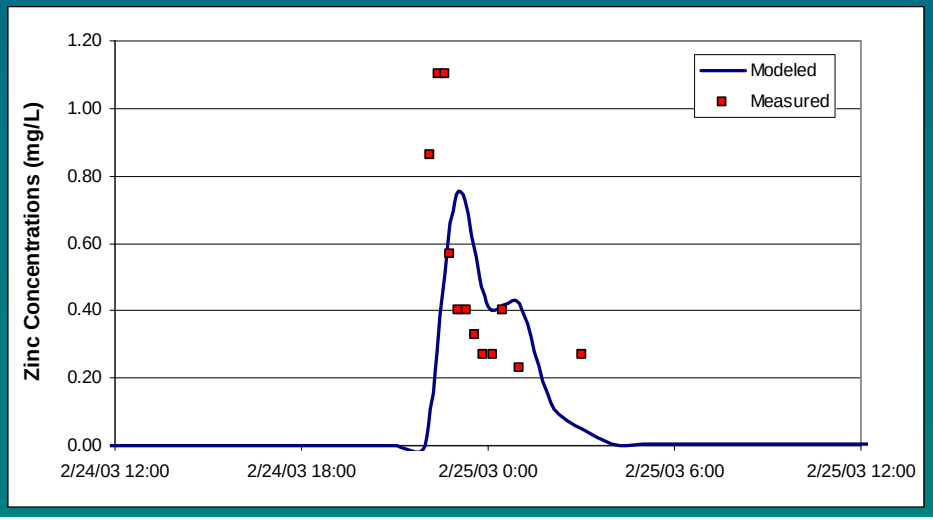


Refinement of the Regional Modeling Approach (cont'd)

- Following hydrology and sediment, metals modeling parameters were calibrated
- Figures show comparisons of observed and model-predicted concentrations for the Forest site

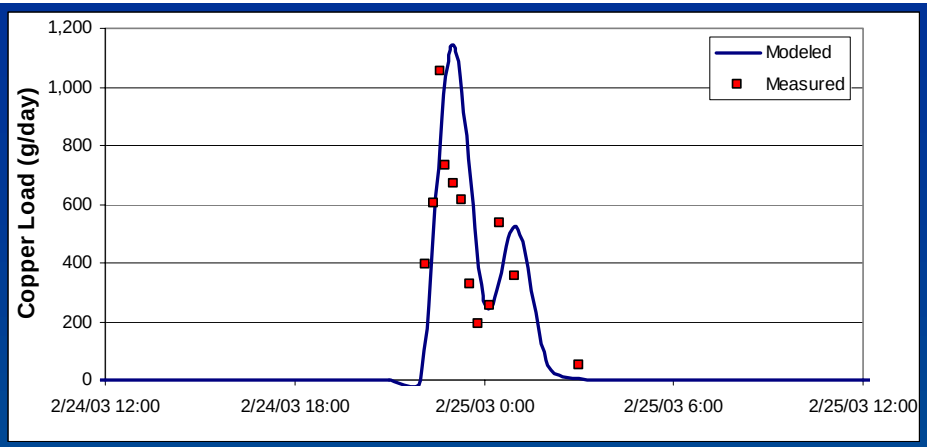


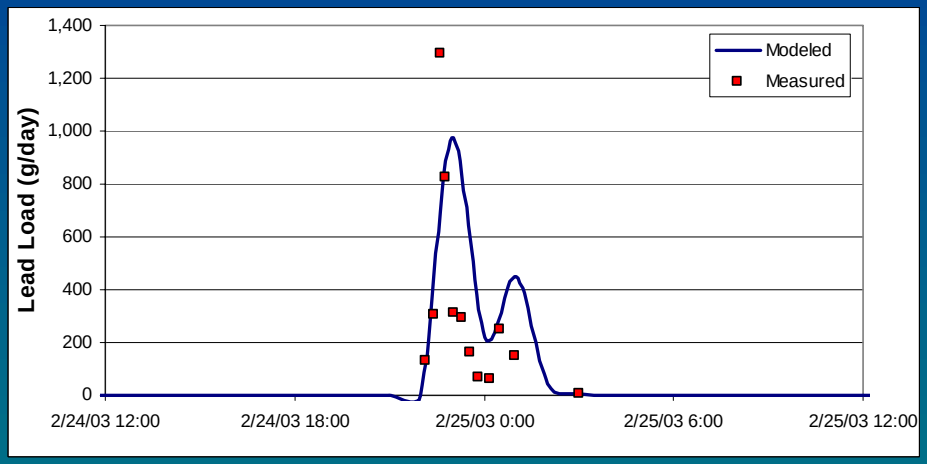


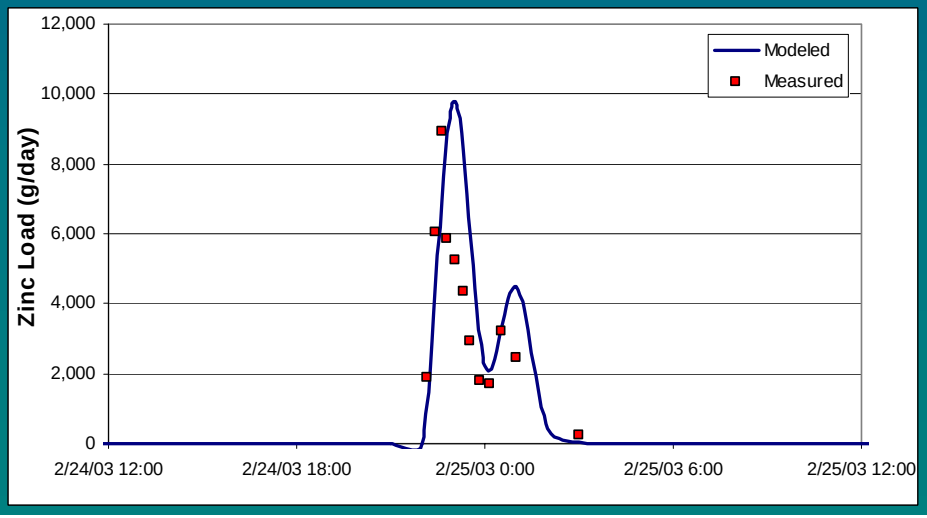


Refinement of the Regional Modeling Approach (cont'd)

- Figures show comparisons of observed and model-predicted loads for the Forest site







Wet-weather Modeling Approach for PAHs

- **EMCs for PAHs reported by SCCWRP for various land uses based on monitoring performed in the LA Region (Stein et al., 2005)**

Land Use	EMC (ng/L)	SD
Industrial	1.50E+03	8.60E+02
Commercial	1.20E+03	5.80E+02
Low-density residential	1.40E+03	6.00E+02
High-density residential	4.40E+03	2.60E+03
Agricultural	8.60E+02	1.00E+03
Open	1.38E+02	0.00E+00
Recreational	4.60E+02	3.00E+02
Transportation	4.80E+02	2.80E+02

Wet-weather Modeling Approach for PAHs

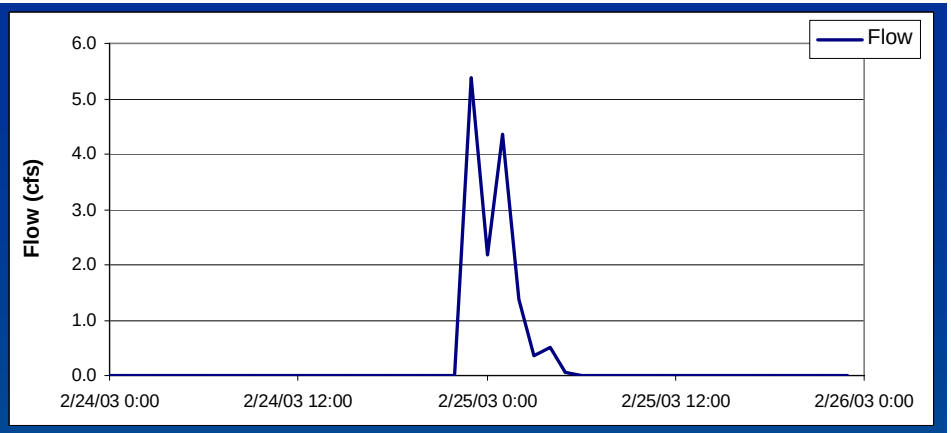
- **Total PAH concentrations for each model subwatershed predicted using weighted averages of land use EMCs based on area and runoff potential of each land use in each subwatershed**

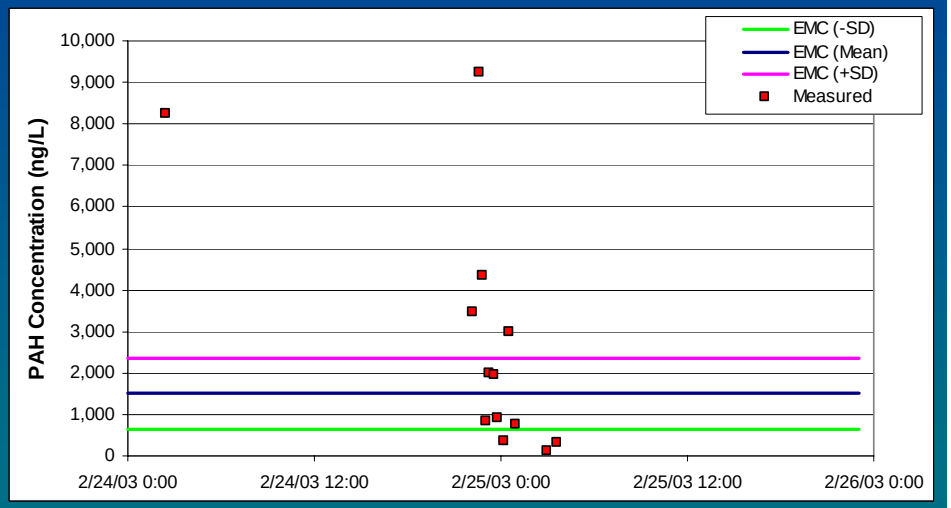
$$EMC_{avg} .= \frac{\sum_{i=LU} A_i C_i (EMC_i)}{\sum_{i=LU} A_i C_i}$$

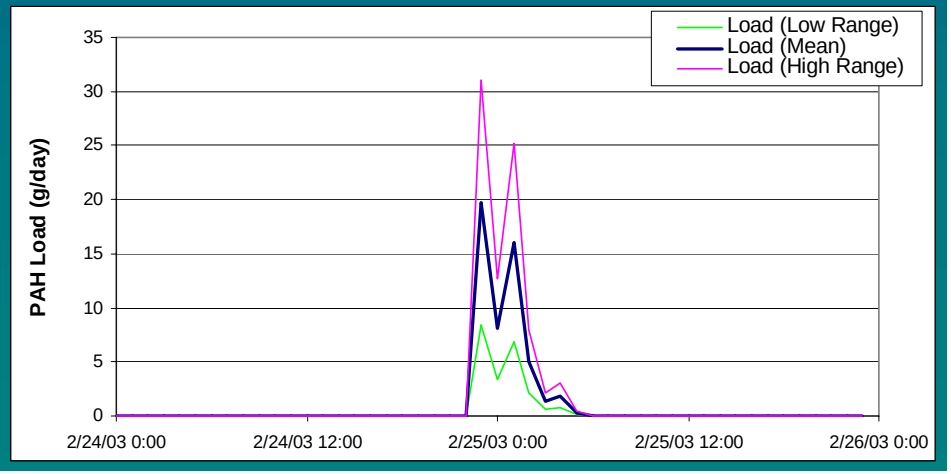
where, EMC_{avg} = average subwatershed EMC; *LU* = land use category; *A* = land use area; *C* = runoff coefficient

Example Results for PAHs – Forest Site

- Dynamic hydrology based on LSPC model
- Constant PAH concentration based on weighted EMCs
  - Predicted ranges consistent with observed
  - EMCs cannot account for first flush
- Resulting in dynamic loads due to variable flows







Wet-weather Monitoring Data for DDT, chlordane, and PCBs

- Limited data from LADPW watershed monitoring due to high detection limits (DL)
  - Few detectable levels of DDT (4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, each with a DL of 0.1 ug/L)
  - No detectable levels of PCBs (DL = 0.05 ug/L)
  - No detectable levels chlordane (DL = 0.5 ug/L)
- Additional monitoring at POLA/POLB sites at lower DLs (0.001 ug/L)
  - Representative of land uses surrounding the ports
  - Does not provide information for all land uses

Wet-weather Modeling Approach for DDT, chlordane, and PCBs

- Lack of water quality data to base watershed loading assumptions
- Sediment quality data can provide estimates of pollutants transported with sediment
  - Bight 03 data most representative of latest conditions
- Assumes that concentrations in bottom sediments are representative of sediment concentrations transported from watersheds during wet-weather

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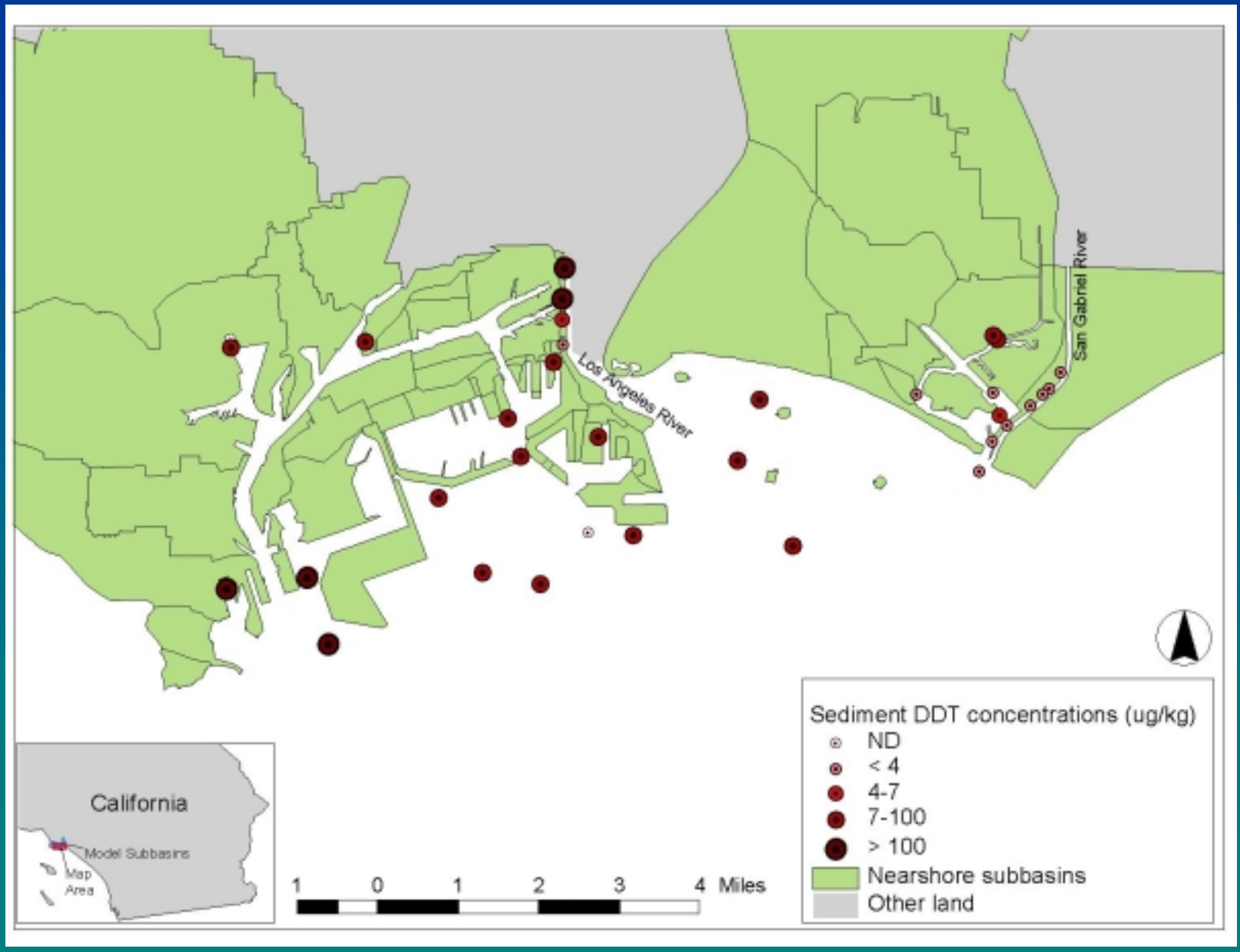
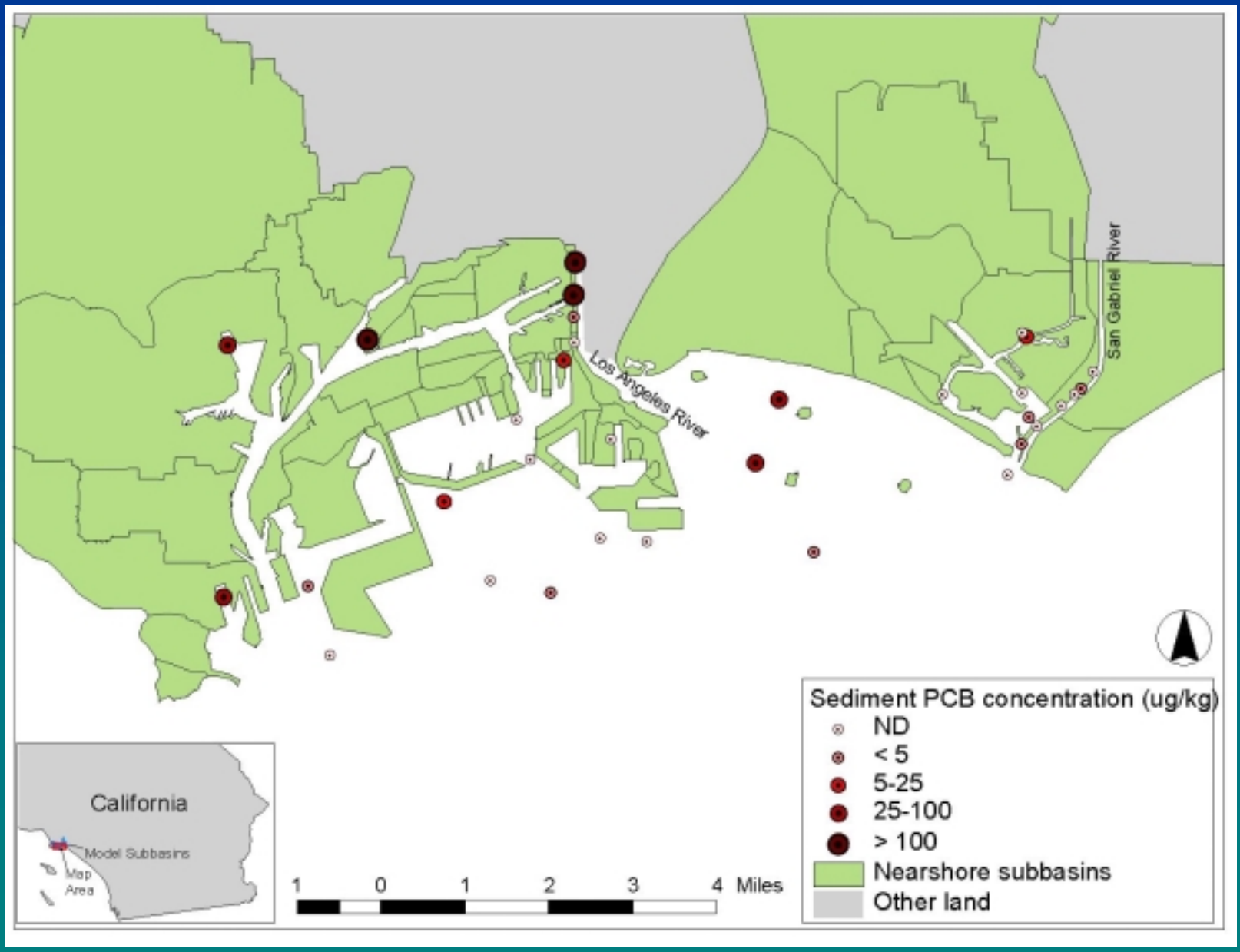
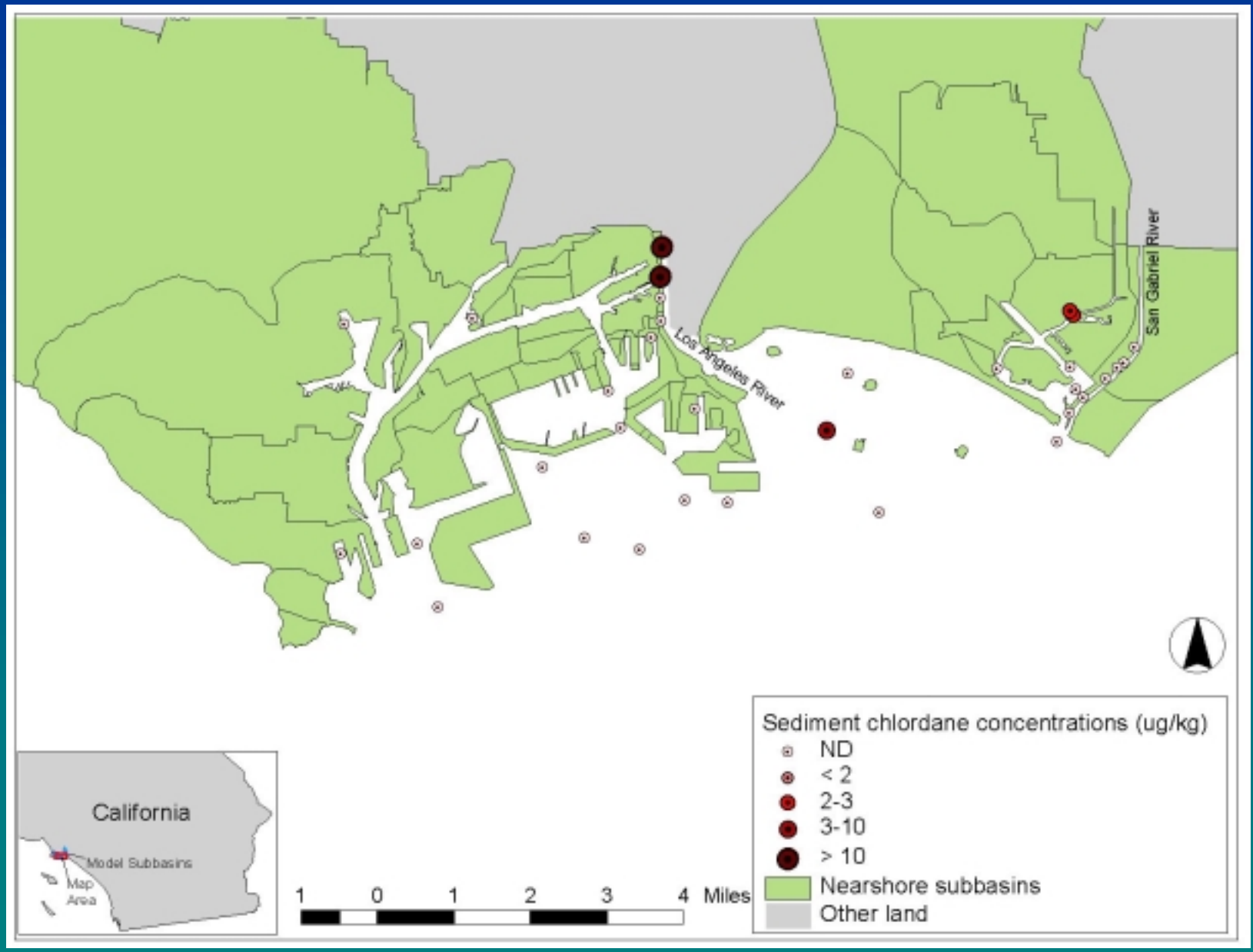
Bight 03 Sediment DDT Data



Bight 03 Sediment PCB Data



Bight 03 Sediment Chlordane Data

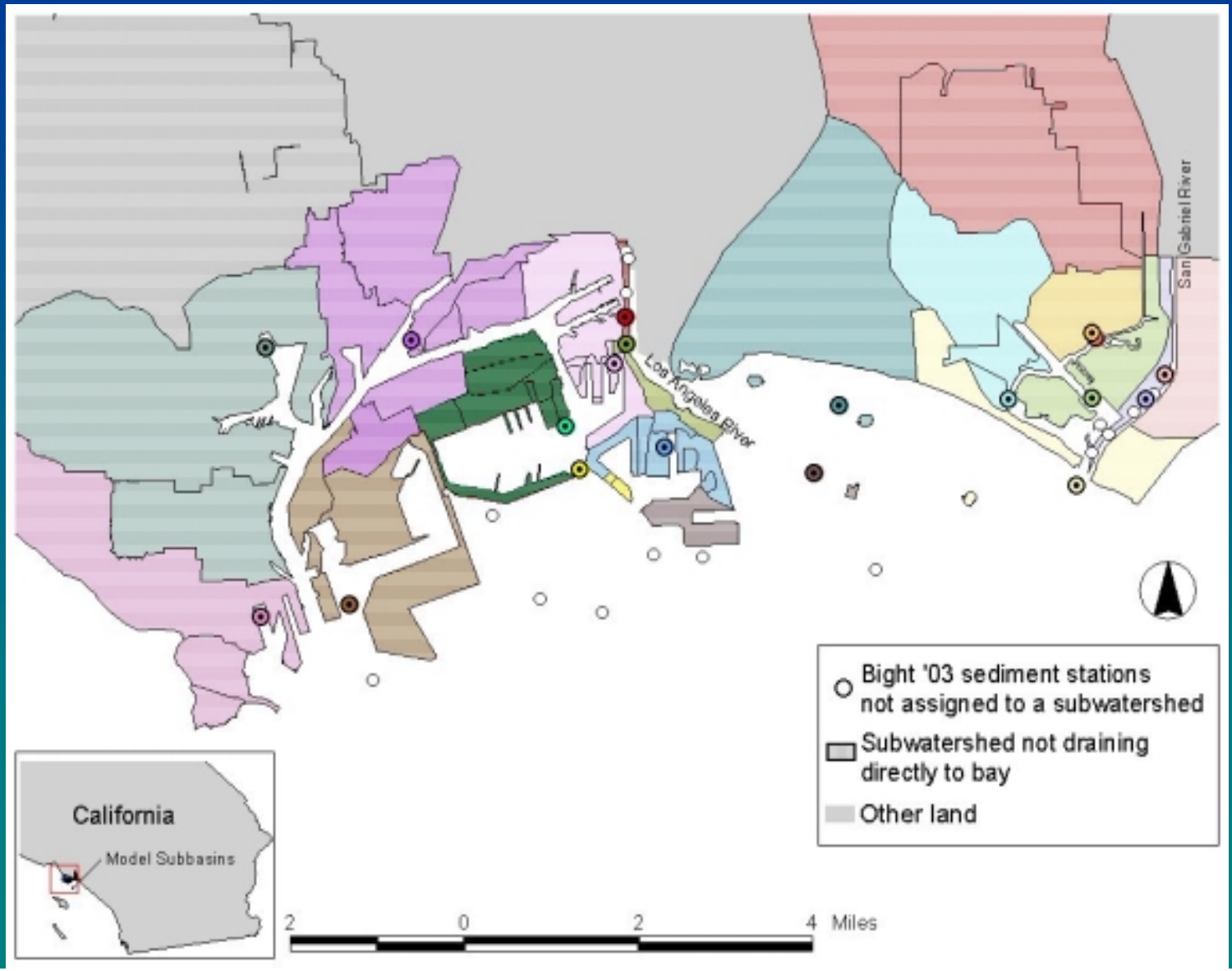


Wet-weather Modeling Approach for DDT, chlordane, and PCBs (cont'd)

- Sediment concentrations assigned to each subwatershed
  - Based on proximity to watershed discharge
- Sediment concentrations (ug/L) multiplied by hourly TSS concentrations (mg/L) predicted by watershed models
- Results in hourly prediction of pollutant concentration (ug/L) in runoff

Pollutant Conc. in Sediment (ug/kg)	x	Modeled Wet Weather TSS Concentration (mg/L)	x	Conversion factor	=	Water Quality Pollutant Concentration (ug/L)

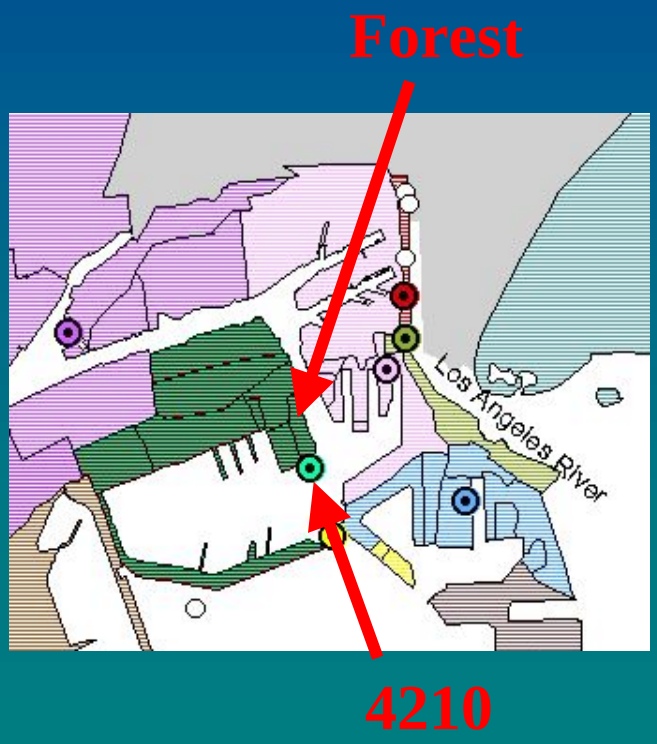
Assignment of Bight 03 Stations to Modeled Subwatersheds



Example –DDT, PCB, and Chlordane Loads from the Forest Site

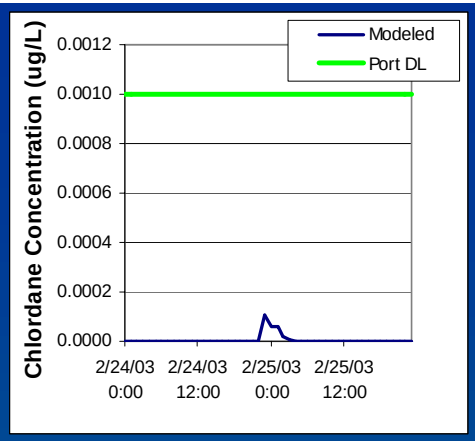
- **Sediment concentrations from Bight 03 Station 4210**

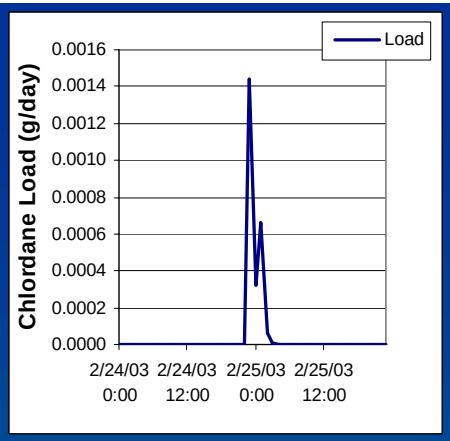
Pollutant	Concentration
DDT	24.41 (ug/kg)
PCBs	0.38 (ug/kg)
Chlordane	0.29 (ug/kg)

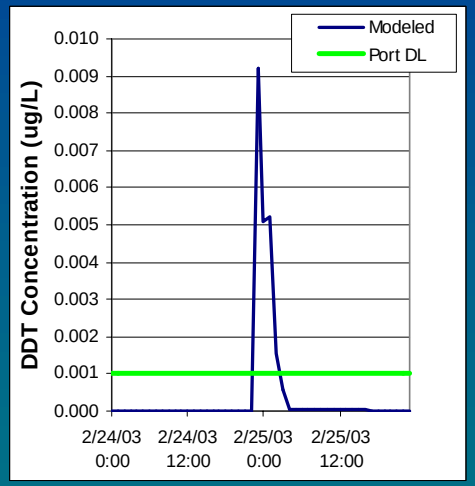


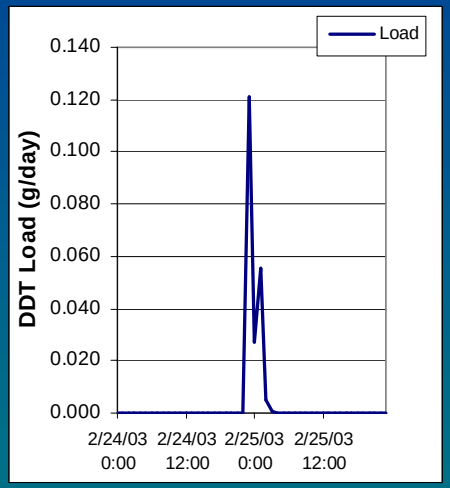
Example –DDT, PCB, and Chlordane Loads from the Forest Site (cont'd)

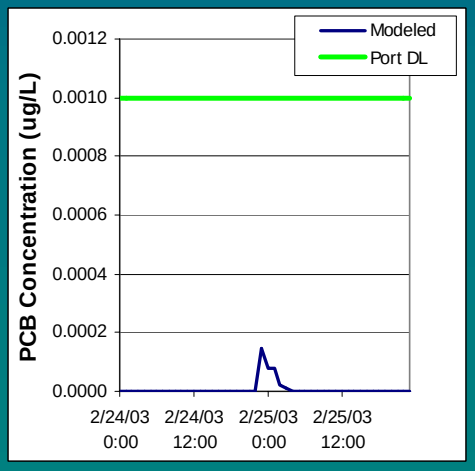
- All POLA/POLB monitoring data at Forest were non-detects
- Most resulting pollutant concentrations were also below DLs
- Although DDT exceeded, not by much
- Combined with model-predicted flows, resulted in hourly load predictions

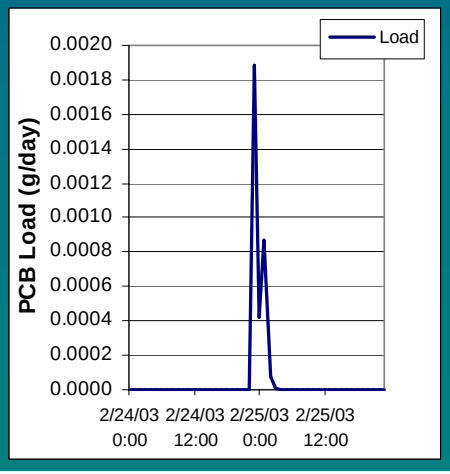












Dry-Weather Watershed Model Development

- LA River (LAR) and San Gabriel River (SGR)
  - Models developed to provide steady-state simulation of flows and metals
  - Based on detailed dry-weather monitoring data
- Dominguez Channel (DC)
  - Monitoring data collected by Everest – no model of DC
- Nearshore watersheds
  - Most watersheds do not have data
  - Requires new approach for prediction of flows and water quality based on data collected in the region

Estimation of Dry-Weather Runoff from Nearshore Areas

- Lack of flow monitoring at most nearshore subwatersheds
- Dry flows typically associated with urban land use
- SCCWRP reported average flows for six watersheds monitored in the LA area (Stein and Ackerman, in press)
- Relationship was established for prediction of dry flows based on total urban area ($R^2 = 0.96$)

$$Flow = 0.0024 \times (UrbanArea)$$

- Land use distributions in each model subwatersheds used to calculate dry flows

Estimation of Metals Concentrations from Dry-Weather Nearshore Runoff

- Average metals concentrations determined from LADPW dry-weather monitoring data at ME sites
- Non-detects impacted averages
- Different assumptions for non-detects tested to determine effect on averages

Metals Values	Value for Non-Detected Samples		
	0	1/2 Detection Limit	Detection Limit
Region-wide Concentrations			
Average Copper Concentration (ug/L)	19.92	20.33	20.74
Average Lead Concentration (ug/L)	1.92	3.31	4.70
Average Zinc Concentration (ug/L)	85.50	95.66	105.83

Dry-weather Modeling Approach for Metals

- Flows estimated for each model subwatershed
- Metals concentrations assigned based on regional averages

Example: Forest Site

Forest Subwatershed Loads			
Average Copper Load (g/day)	0.66	0.67	0.68
Average Lead Load (g/day)	0.06	0.11	0.16
Average Zinc Load (g/day)	2.82	3.15	3.49

Next Steps

Wet-Weather Modeling

- Refine calibration of metals modeling parameters based on data collected at Maritime Museum
- Application of the modeling approaches for PAHs, DDT, chlordane, and PCBs for all watersheds
  - Includes neashore areas, LAR, and SGR

Dry-Weather Modeling

- Selection of appropriate assumptions for metals DLs for calculation of regional averages
- Determination of average metals concentrations for LAR and SGR
  - Based on detailed dry-weather monitoring studies performed by SCCWRP
  - Consistent with TMDLs for the watersheds