

Item #6

Regional Spreadsheet Model & Land-Use Specific EMCs

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Presentation to the SPLWG
May 12, 2011

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Overview of timeline

Phase 1 Tasks	Time frame	Status
Compile GIS layers	Summer 2010	Completed
Develop base rainfall-runoff model	Fall 2010	Completed
Add in initial POCs (SS, Hg)	Winter 2010-11	Completed
Literature review on land-use specific EMCs & source characterization	Spring 2011	In progress
Report	June 2011	Upcoming

Phase 2 Tasks	Time frame	Status
Refine rainfall-runoff model	2011	Upcoming
Improve sediment model	2011	Upcoming
Incorporate results of lit. review (revise L.U. categories for POCs as data supports)	2011	Upcoming
Update Phase I Report	2011	Upcoming

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Objectives

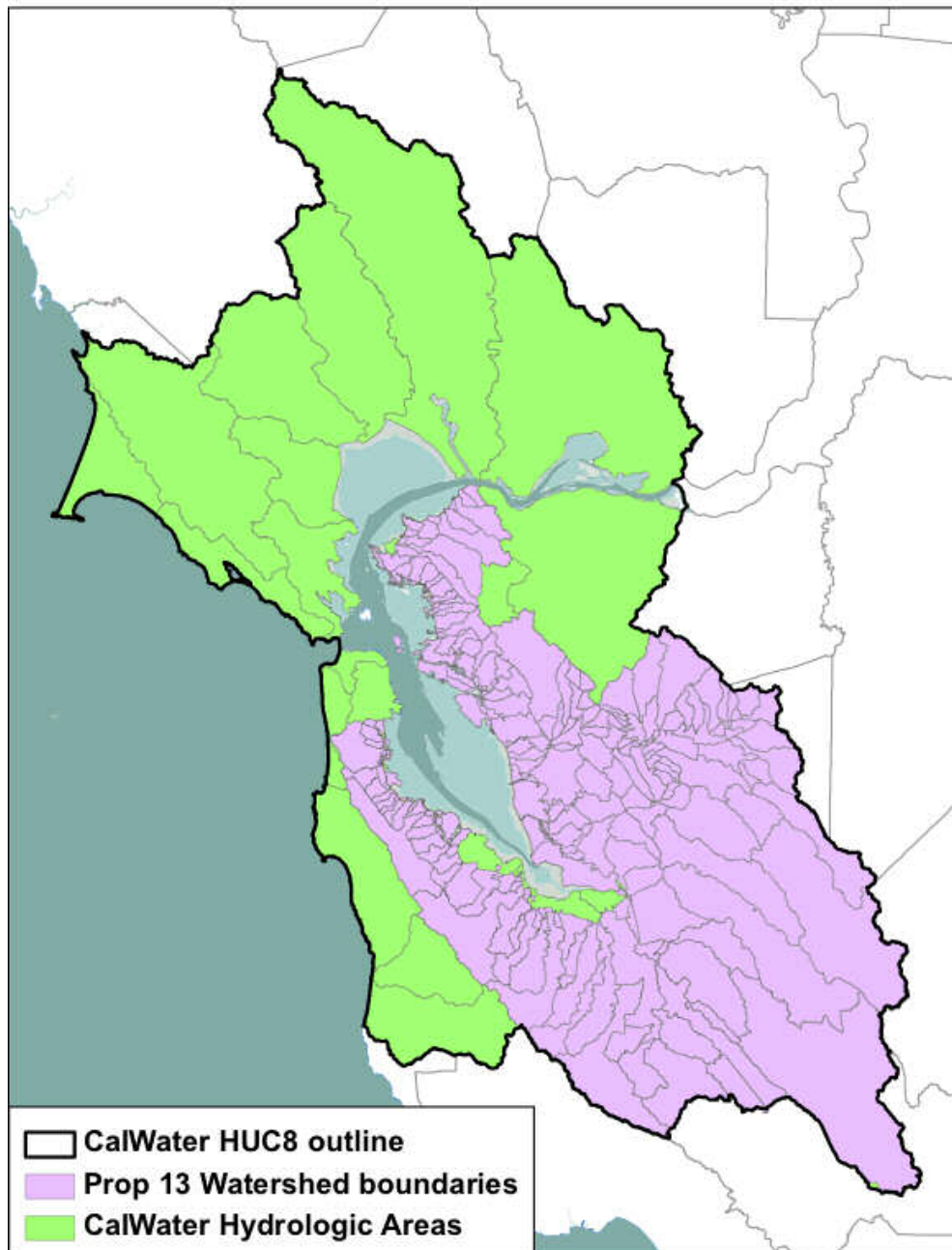
- Review land use/source specific EMC data
- For each watershed, generate average annual:
 - discharge volume
 - sediment load
 - POC loads

Methods

- Simple rainfall/runoff model
- Loads generation:

$$W = \sum_j EMC_j \cdot r_j \cdot i \cdot A_j$$

where j = land use categories



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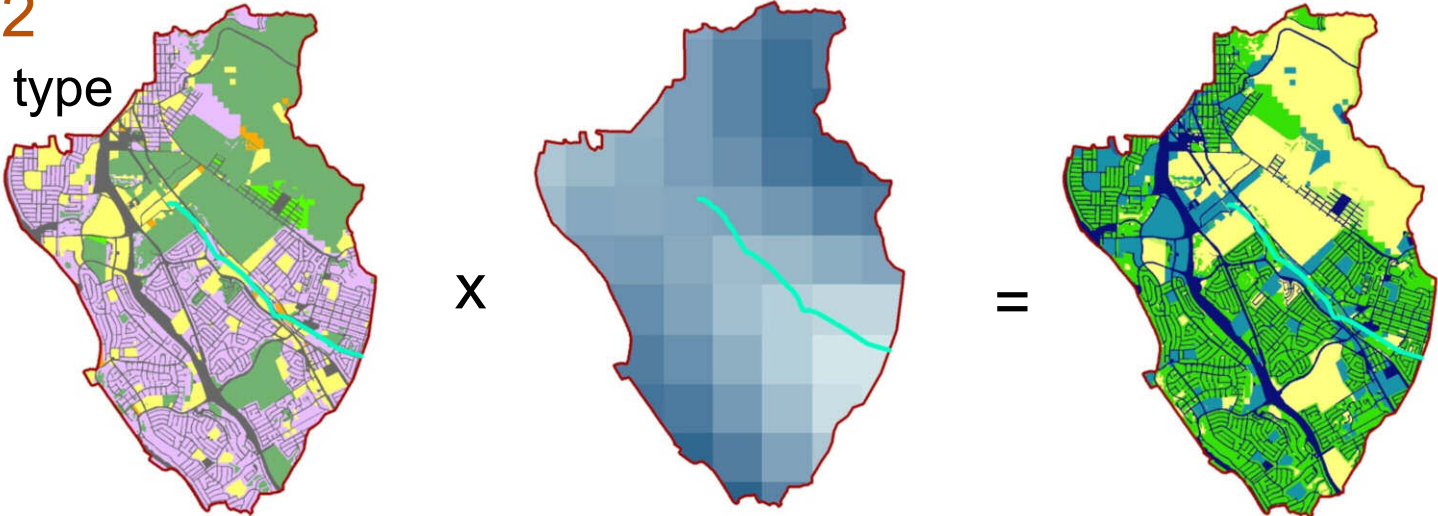
Base Hydrology Model

$$\text{Runoff Coefficient} \times \text{Rainfall} = \text{Runoff}$$

Approach 1
by % impervious



Approach 2
by land use type



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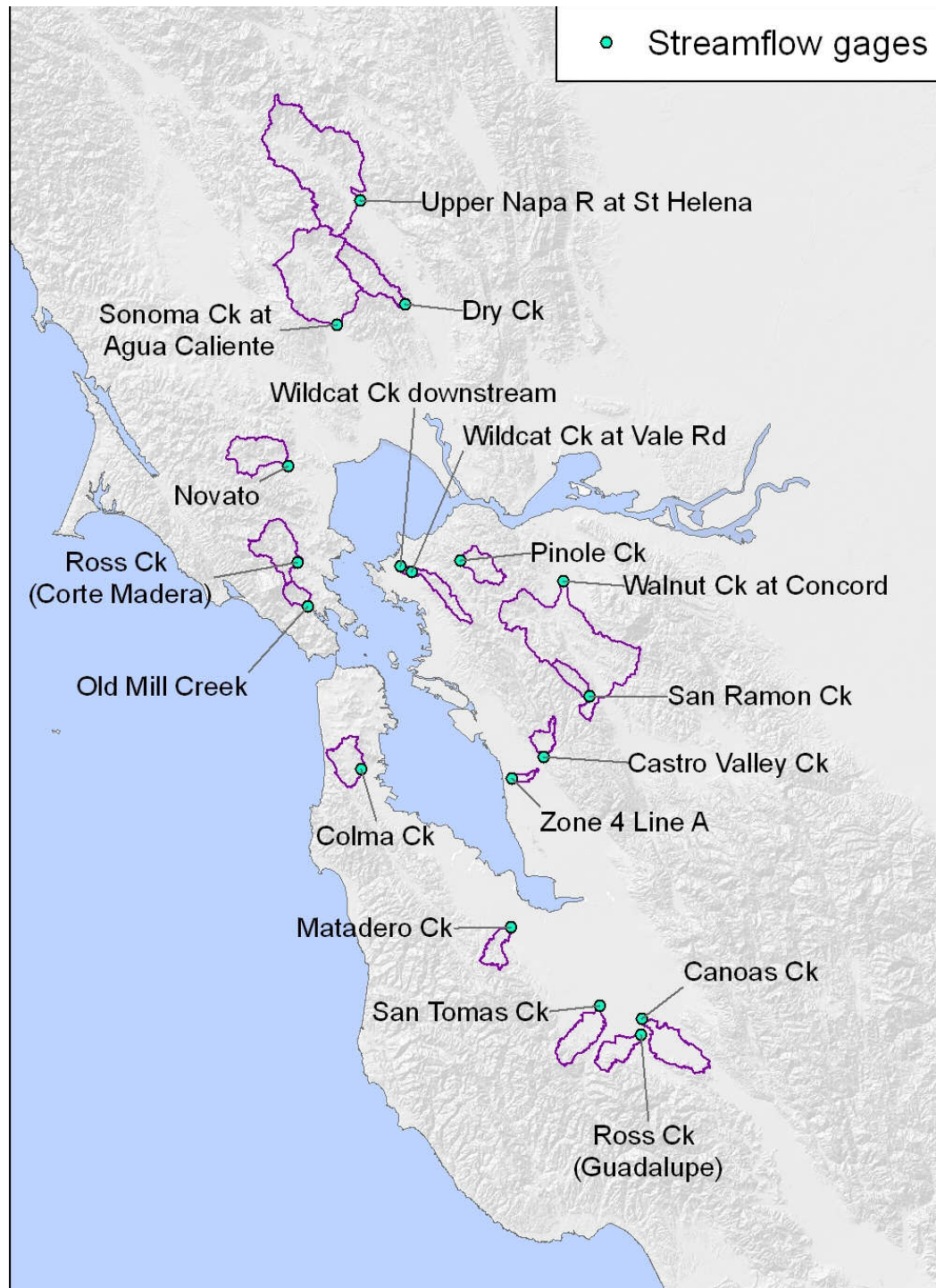
Runoff coefficients tested

Impervious-based

- Schueler, 2003
 - Developed for Chesapeake Bay area

Land use-based

- Rantz, 1971
 - Developed for Bay Area
- Browne, 1991
 - Split out by slope and soil group

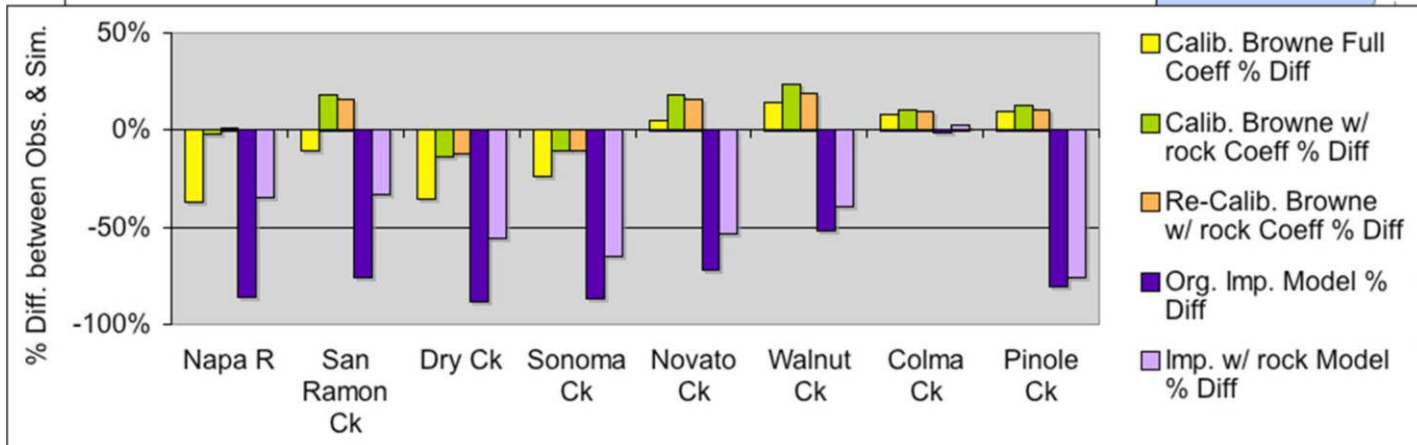
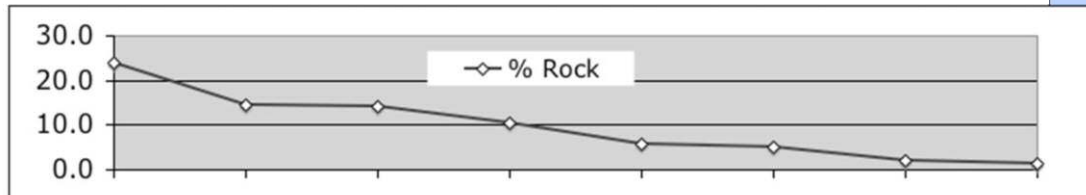
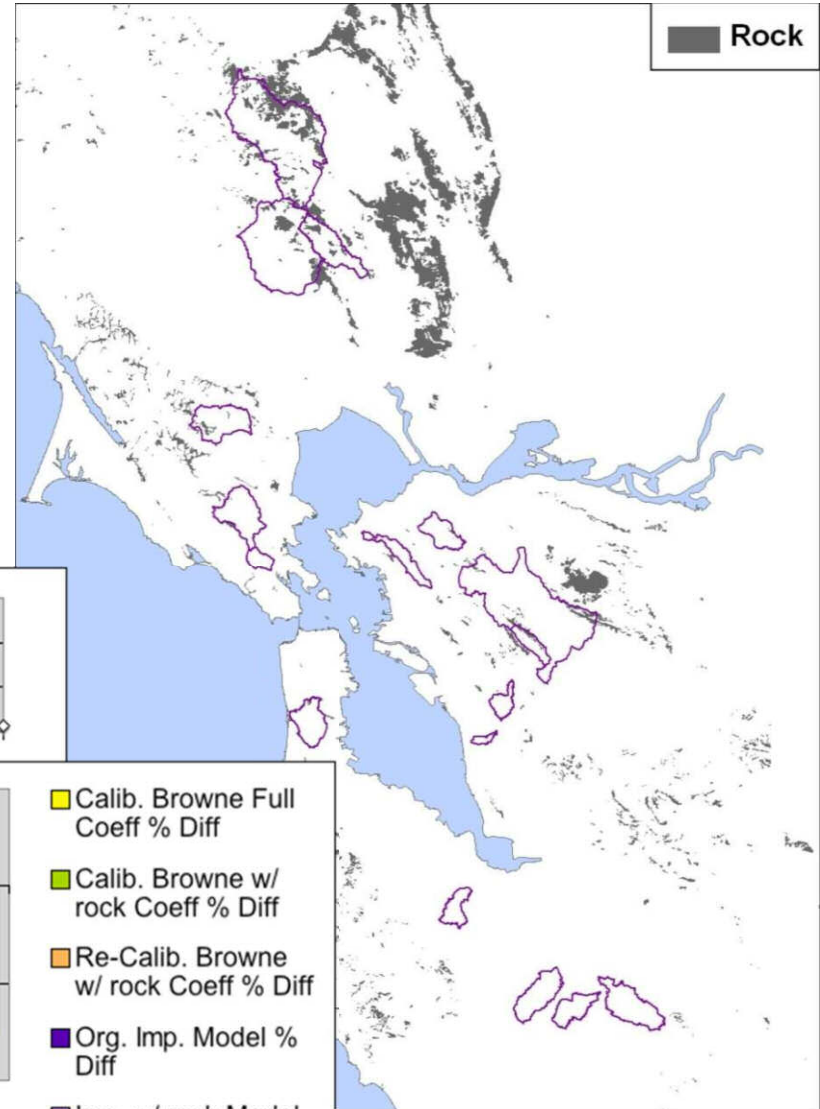


Calibration watersheds

- Range from 1.7 to 85 sq. miles
- <1 to 71% impervious surface
- 15 to 45 inches annual mean rainfall
- 2 to 32% slope

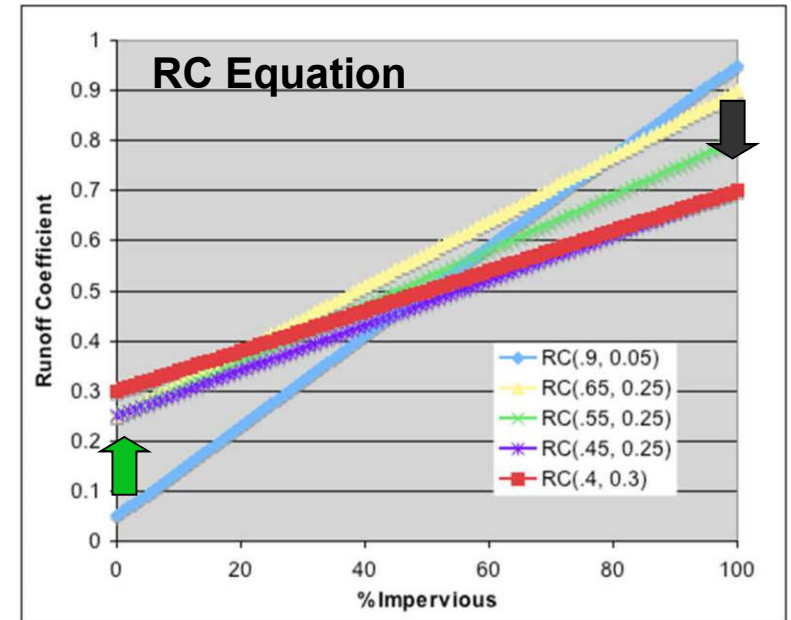
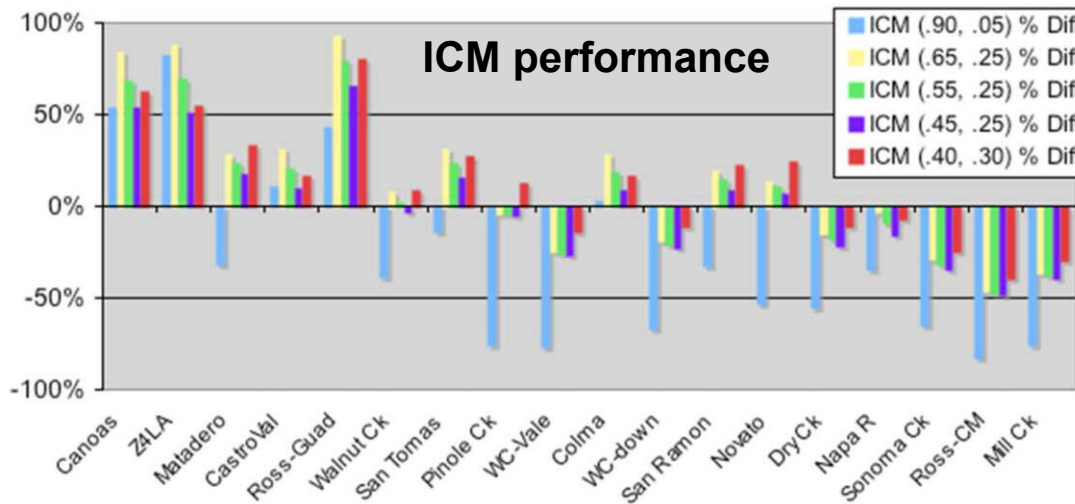
Item #6 Calibration process findings

Important to include rock as impervious surface



Item #6 Calibration process findings

National and East Coast runoff coefficients have to be adjusted for Bay Area

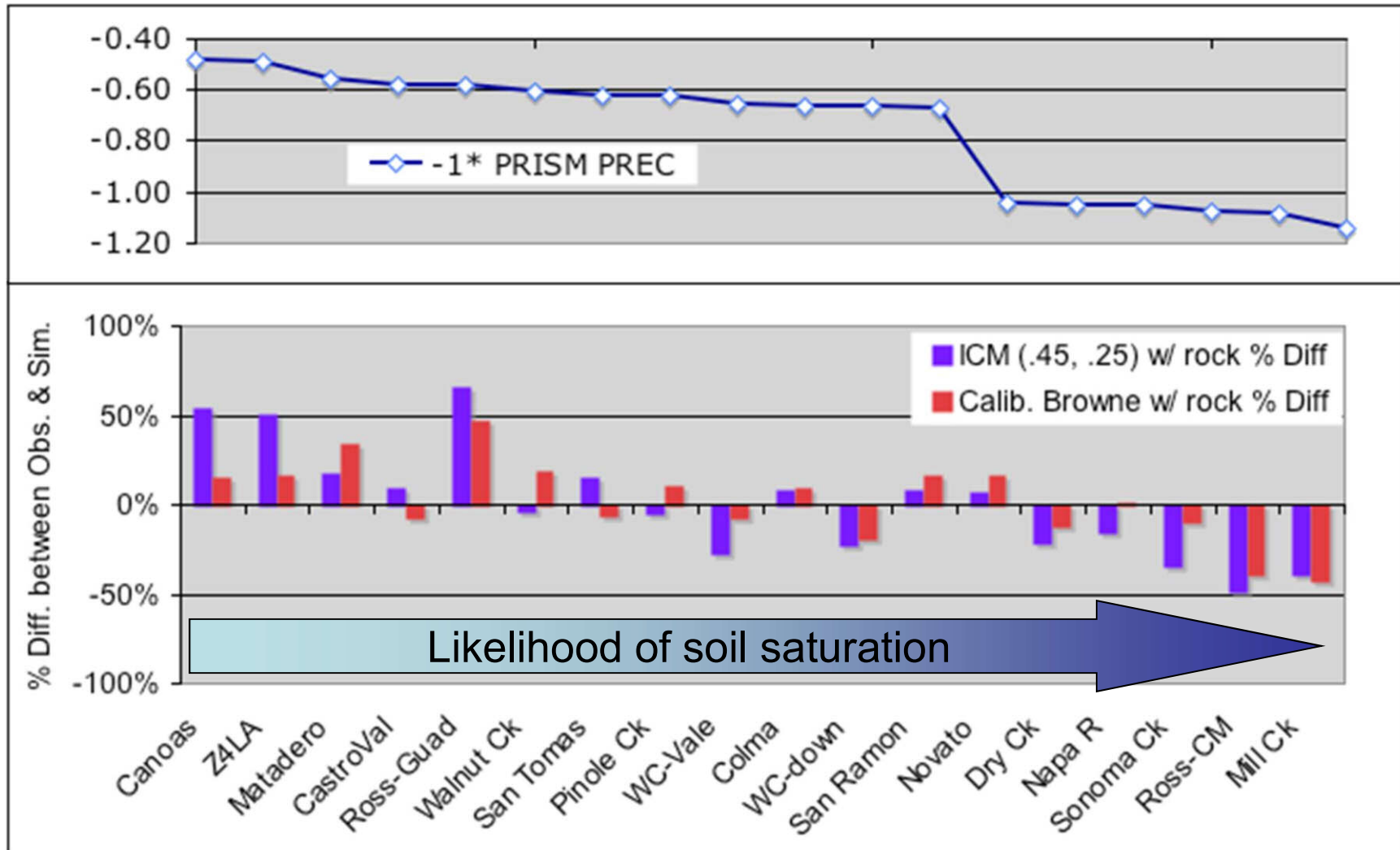


Land use	RC (Browne)	Calibrated RC
Open	0.07-0.29	0.09-0.34
Ag	0.10-0.41	0.12-0.46
Residential	0.20-0.39	0.20-0.39
Commercial	0.71-0.72	0.50-0.60
Industrial	0.67-0.70	0.50-0.60
Transportation	0.78-0.83	0.78-0.83



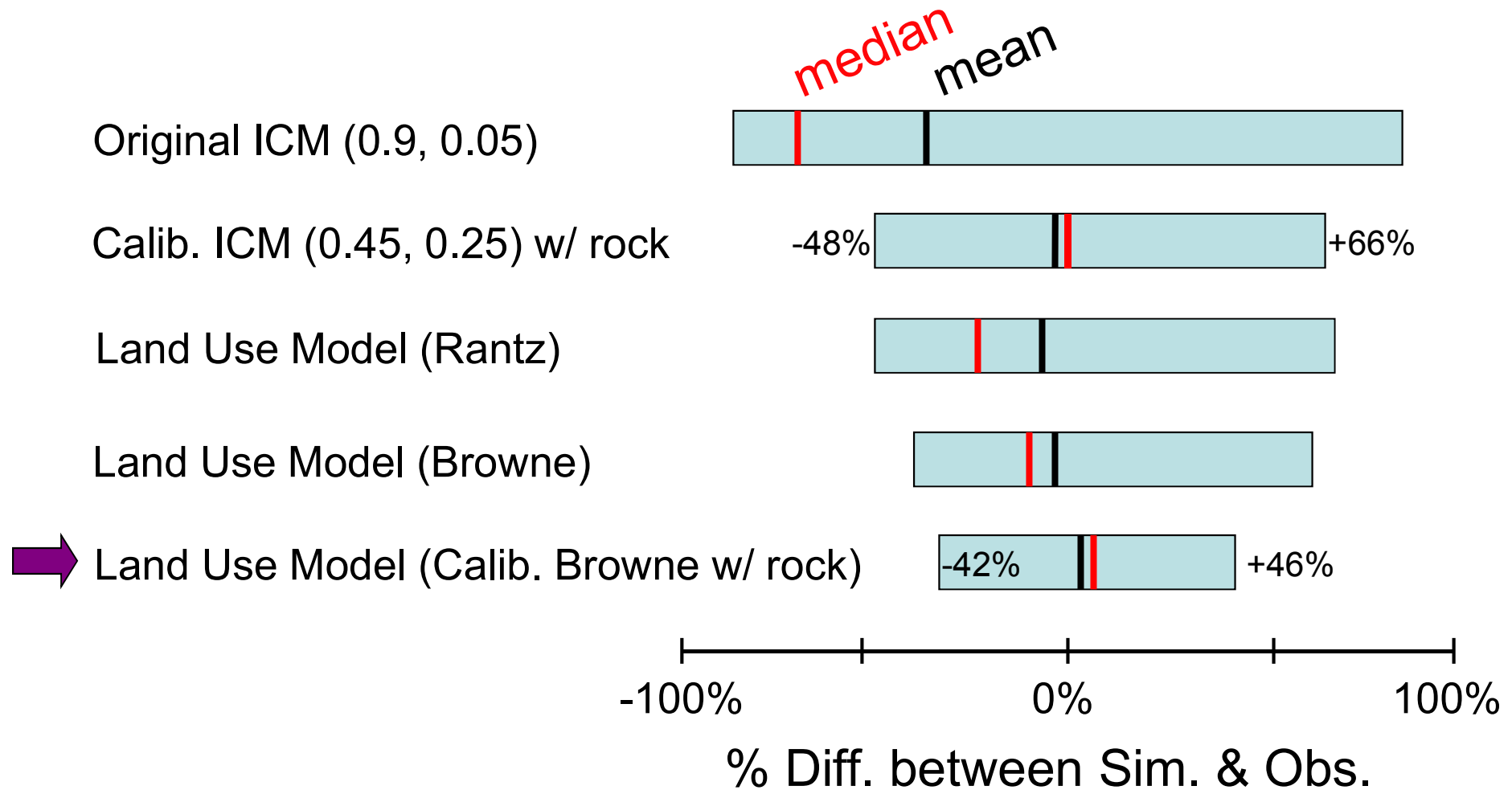
Item #6 Calibration process findings

Precipitation (soil saturation) trend in simulation results



Item #6 Hydrologic Results

Range of annual flow volume results shown for 18 watersheds



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EMC Model

Item #6 Computing loads

- Compile data on land-use specific pollutant concentrations
- Apply pollutant concentrations to generate loads:

Runoff volume

x

EMC

=

Load



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Pollutants of concern

MRP Category 1:

- Suspended Sediments
- Total Organic Carbon
- Copper
- Mercury
- PCBs
- Nitrate as N

MRP Category 2:

- Selenium
- Phosphorous
- PBDEs
- PAHs
- Pyrethroids
- OC Pesticides
 - Chlordane
 - DDTs
 - Dieldrin



Land use based concentration compilation for EMC development



Data hits (n) for EMCs, FWMCs, means, & ranges

POC	Open	Agri.	Residential	Commercial	Industrial	Transportation
SS	22	16	38	24	28	47
Hg	9	9	4	2	7	8
Cu	16	12	24	15	22	28
TOC	0	0	0	0	0	0
PCBs	2	2	1	0	0	1
Nitrate	4	2	6	2	6	13
Se	1	2	1	1	1	0
Total P	13	7	31	13	16	22
PBDEs	0	0	0	0	0	0
Pyrethroids	0	0	0	0	0	0
Chlordane	1	2	0	0	0	0
DDTs	1	1	1	1	1	0
Dieldrin	1	0	0	0	0	0

Land use based concentration compilation for EMC development

Concentration ranges (EMCs, FWMCs, means, & ranges)

POC	Open	Agri.	Residential	Commercial	Industrial	Transport
SS (mg/L)	3-500	2-2000	20-1000	20-800	50-500	2-600
Hg (ng/L)	0.6-2000	1.8-120	250-8600	40-500	5-600	7.5-35
Cu (ug/L)	0.22-55	2.7-230	0-270	17-1400	10-400	0.16-140
TOC	-	-	-	-	-	-
PCBs (ng/L)	1.7-62	0.2-1.2	0.001	-	-	0.89
Nitrate	0.02-6	0.4-10	0.12-2.9	0.11-1.0	0.07-2.1	0.12-1.6
Se (ug/L)	0.35	2-8	0.47	0.35	0.59	-
Total P (mg/L)	0.05-6	0.14-1.6	0.13-10.2	0.14-1.9	0.17-5.0	0.07-0.40
PBDEs	-	-	-	-	-	-
Pyrethroids	-	-	-	-	-	-
Chlordane (pg/L)	270	35-130	-	-	-	-
DDTs (ug/L)	0	0.51	0.001	0	0.005	-
Dieldrin (ng/L)	0.22	-	-	-	-	-

Item #6 Sediment EMCs

SSC (mg/L):

Land Use	Alameda (WCC 1991)	Santa Clara (WCC 1991)	BASMAA (1995)	SCCWRP (2000)	Mean SSC	Median SSC
Indust	114	152	135	174	144	144
Trans	192				192	
Comm	192	76	98	118	121	108
Resid	192	76	90	102	115	96
Open	11	85		371	156	85
Agri				2068	2068	

Calculating Mercury EMCs ^{Item #6}

Land Use	literature: Hg EMCs (ng/L)	n	Median of Hg in soil (ppm) world literature data	Local SSC EMCs (mg/L)	[Hg] in soil x local SSC EMCs = Hg (ng/L)
Indust	5-280	4	2.3	144	330
Trans	7.5-35	8	2.3	192	440
Comm	41	1*	0.16	108	17
Resid	46	1*	0.16	96	15
Open	2300	1*	0.053	85	4.5
Agri	120	1*	0.053	2068	110

*of questionable quality due to analytical technique

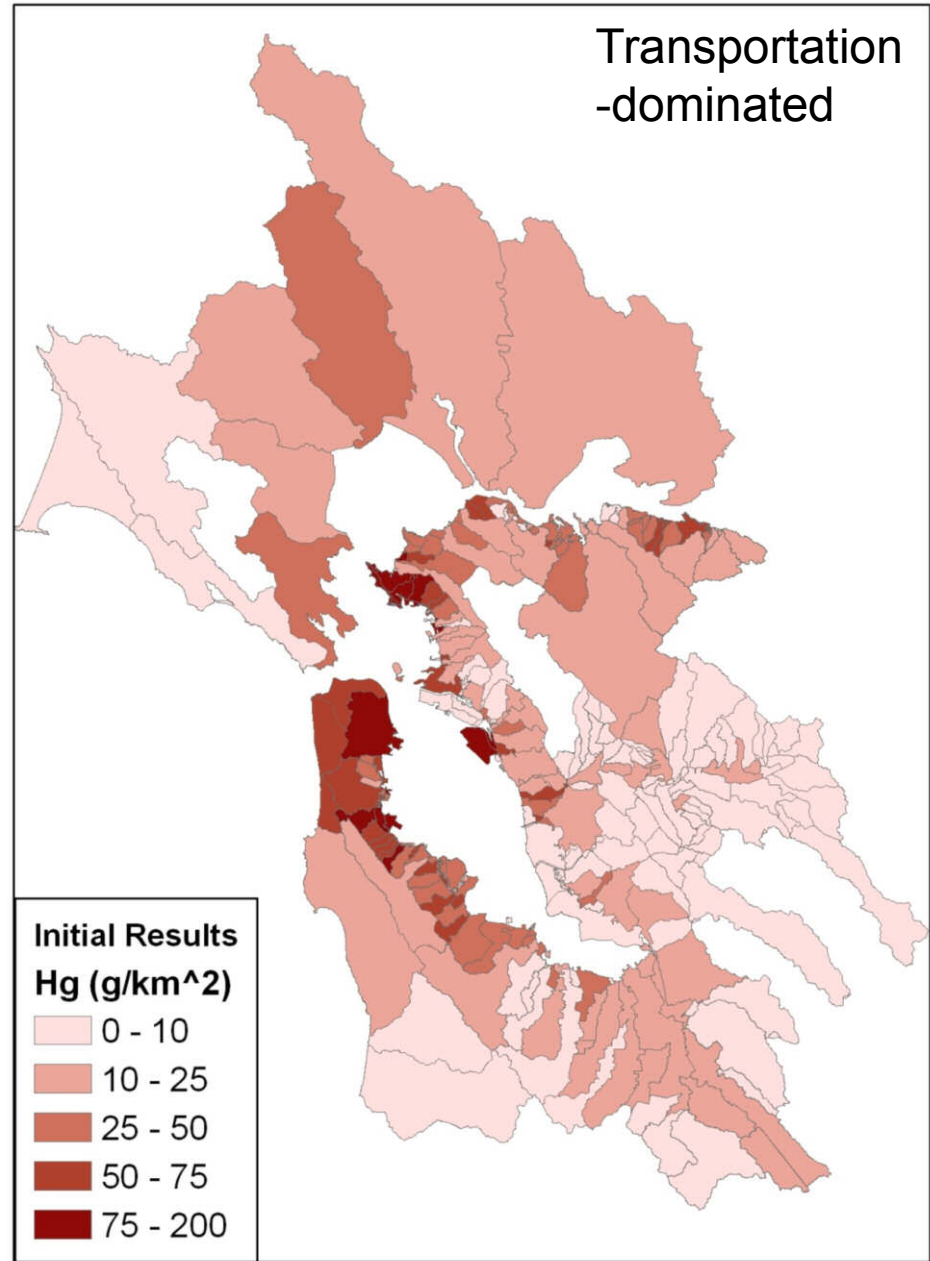
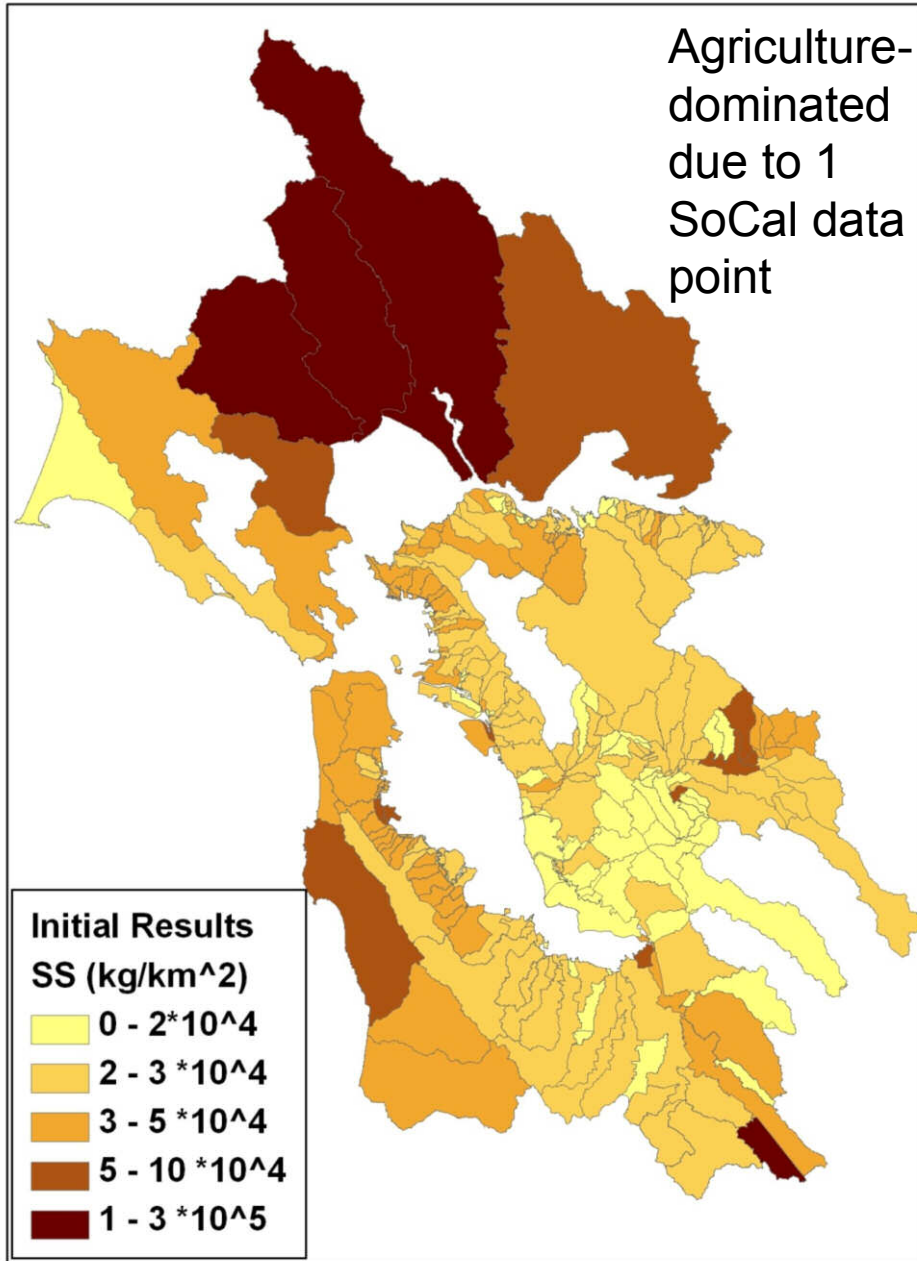
Item #6 Initial Loads Results

POC	Best Estimate*	Regional Output	Bay Drainage Output
S.S. (Mt)	1.28	0.73	0.68
Hg (kg)	185 (+115 Guad)	153	140

Regional results by land use:

	Agri.	Open	Resid.	Comm.	Indust.	Transport
Area (km ²)	1048	4587	1620	477	214	437
S.S. (Mt)	563	75	30	15	9	40
Hg (kg)	30	4	5	2	20	93

* SS load from Lewicki and McKee 2009; POC loads from SPLWG 5-yr workplan 2008



Note – preliminary results don't appear realistic

Item #6 Recommendations for Year 2

- **Continue to refine hydrology model**

- Incorporate likelihood of soil saturation into RC's, e.g.:

Land use	Initial RC	15-25" (-0.05) ↓	25-35" (no change)	35-45" (+0.05) ↑
Open	0.15	0.10	0.15	0.20
Ag	0.25	0.20	0.25	0.30
Residential	0.30	0.25	0.30	0.35

- **Improve sediment model**

- Incorporate regional sediment model (Lewicki and McKee 2009)

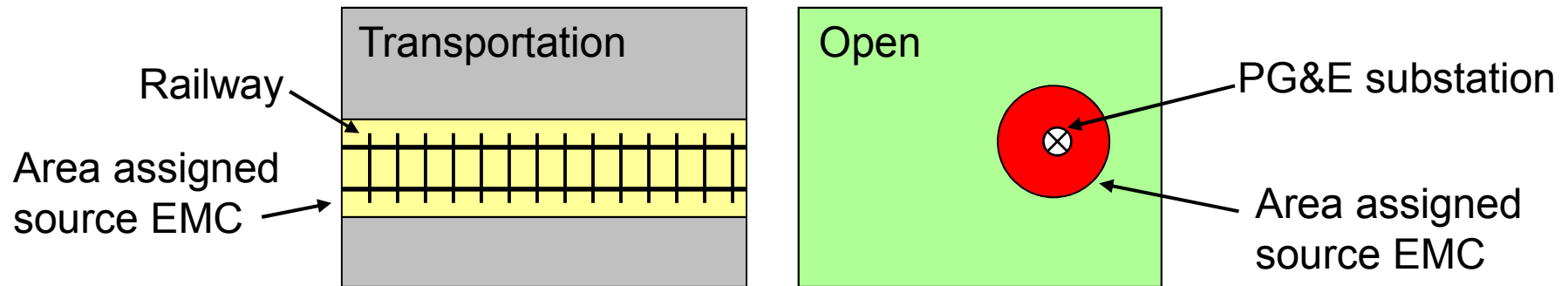
- **Incorporate results of EMC lit. review**

- Add revised land use categories for POCs as data supports (e.g., Cu, P)

Polygon ID	Runoff Land use	RC	...	POC #1 Land Use	POC #2 Land Use	POC #3 Land Use
1	Open	0.15	...	Undev.	Undev.	Open
2	Agriculture	0.25	...	Undev.	Undev.	Agriculture
3	Industrial	0.55	...	Industrial	Urban	Urban
4	Residential	0.30	...	Residential	Urban	Urban

Item #6 Recommendations for Year 3

- Continue refining sediment model, as needed
- Develop methods to incorporate POC source areas into model



- Preliminary optimization of POC model to local data, e.g.,
 - Zone 4 Line A
 - Guadalupe River
 - Coyote Creek
 - Ettie St. pump station
 - Cerrito Creek
 - Richmond pump station
 - WY 2011 wet weather sites?