Stormwater Resource Plan

Matt Fabry, P.E.

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Task Lead
Paradigm Environmental

January 18, 2017

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program

Public Outreach Meetings

- Three workshops
- 62 attendees

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Summary of Comments Received

- 53 Total Comments from 23 different agencies and individuals

Comment Category	Number of Comments
General typographical edits/ suggested wording	22
Specific Concept/Project Input	17
Prioritization Scoring Process & Screening Criteria	10
Outreach / Public Engagement Process	4
Future Planning & Updates, Costs	3
Additions/edits to maps & tables	2
Project submission / IRWMP Process	1
Database / Data Storage	1

Agency Type	Number of Comments
Public*	31
Water Board	8
San Mateo Resource Conservation District	7
County Environmental Health	1
Private Industry	4
City Government**	2

* Residents of Palo Alto, Menlo Park, Milbrae, El Granada, Pacifica

** Daly City, Redwood City (Community Development Dept.)

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Next Steps

- Finalize SRP and prepare response to comments
- CMEQ Committee on Jan 30th
- C/CAG Board Feb 9th
- Submit to Bay Area IRWMP
- Submit to State Water Board by March 1st

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Reasonable Assurance Analysis

Stephen Carter, P.E.
Task Lead

Paradigm Environmental

January 18, 2017

Note: Results are preliminary/draft and should not be quoted or cited.

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Reasonable Assurance Analysis

HSPF

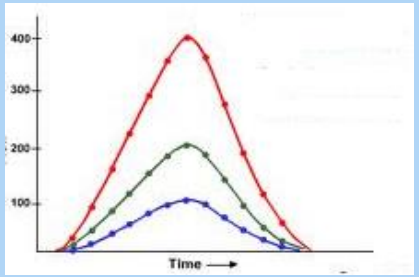
Data

- Rainfall
- HRUs/Land Use
- Impervious
- Elevation
- Slopes
- Evaporation
- Infiltration

Watershed Model

Results

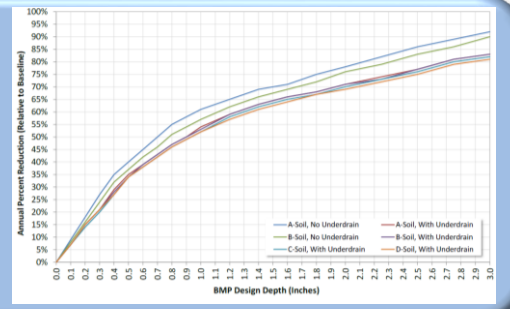
Hourly runoff and sediment/pollutant loads



SUSTAIN

Stormwater Capture Model

GI Response



Stormwater Capture Model

Calculation of project capture volumes

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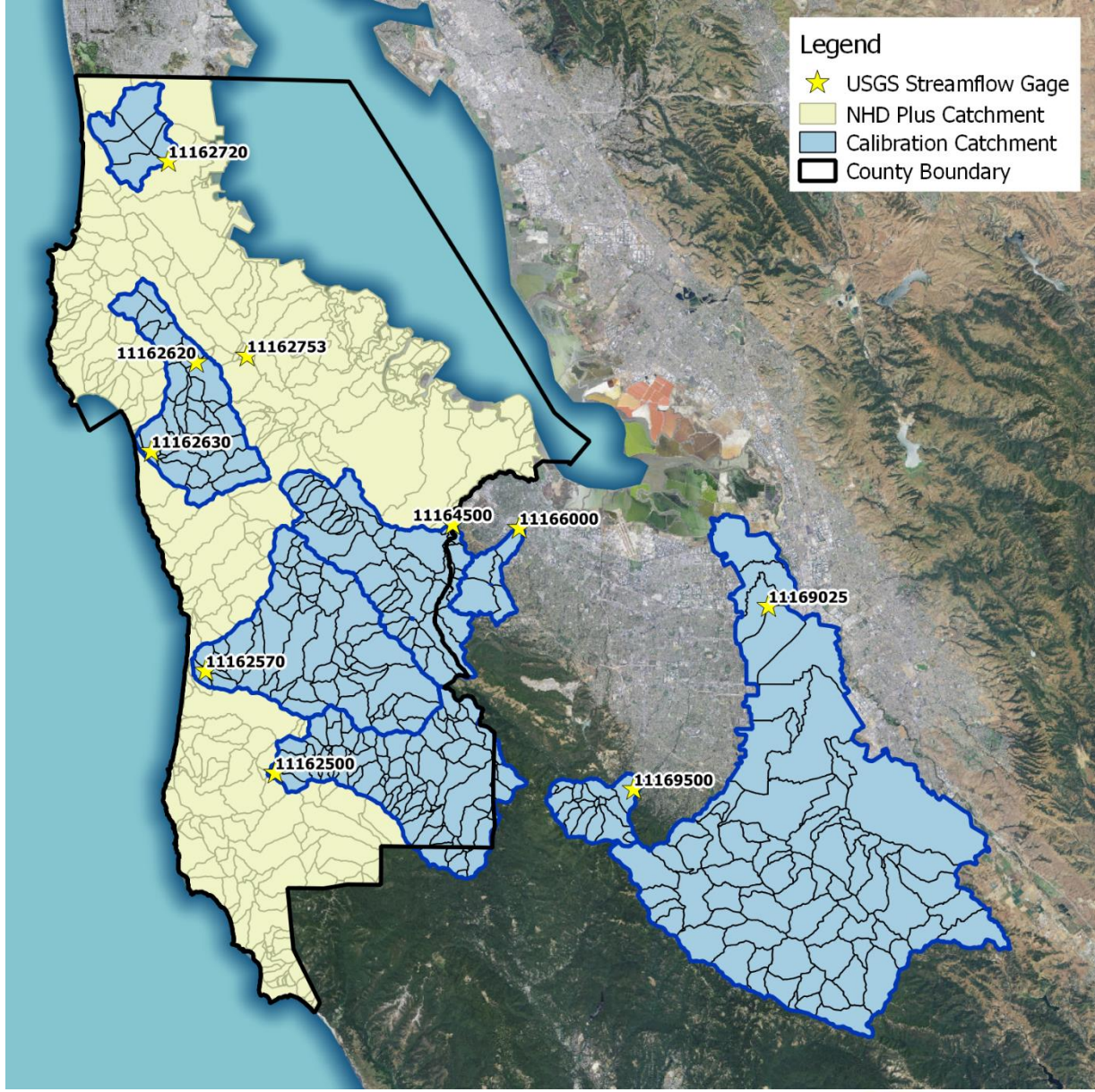
Model Calibration

- Selection of calibration watersheds based on:
  - Available flow and water quality data
  - Representation of land characteristics
  - Spatial and rainfall distribution
- Calibrated set of model parameters were then applied to all County watersheds



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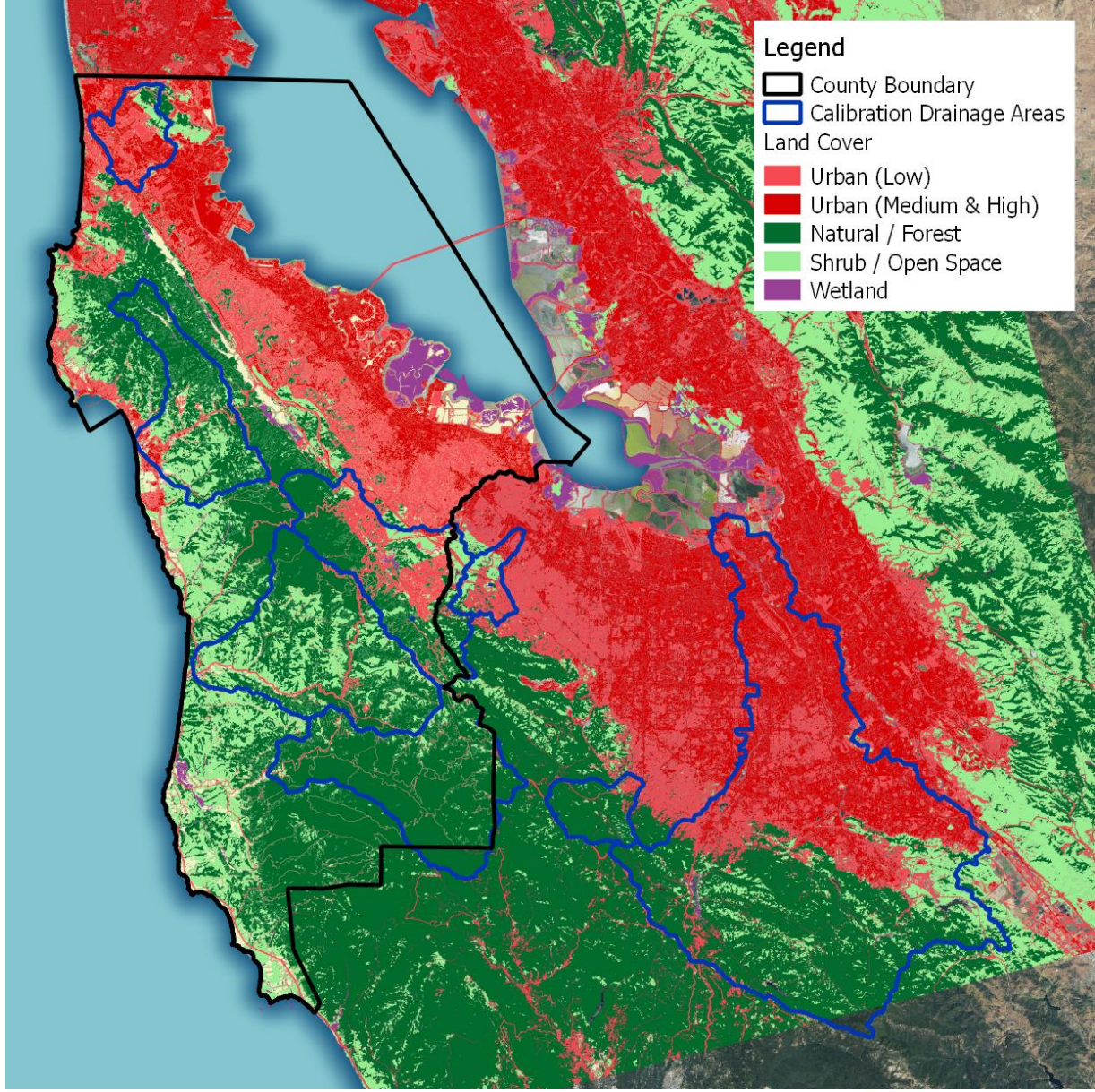
Hydrologic Response Units

- Runoff & Pollutant load:
  - Slope
  - Hydrologic Soil Group (HSG)
  - Land use/cover
  - Impervious cover (DCIA)
- Urban HRU categories:
  - Rooftop, Sidewalk, Driveway, Roads based on analysis of typical parcels



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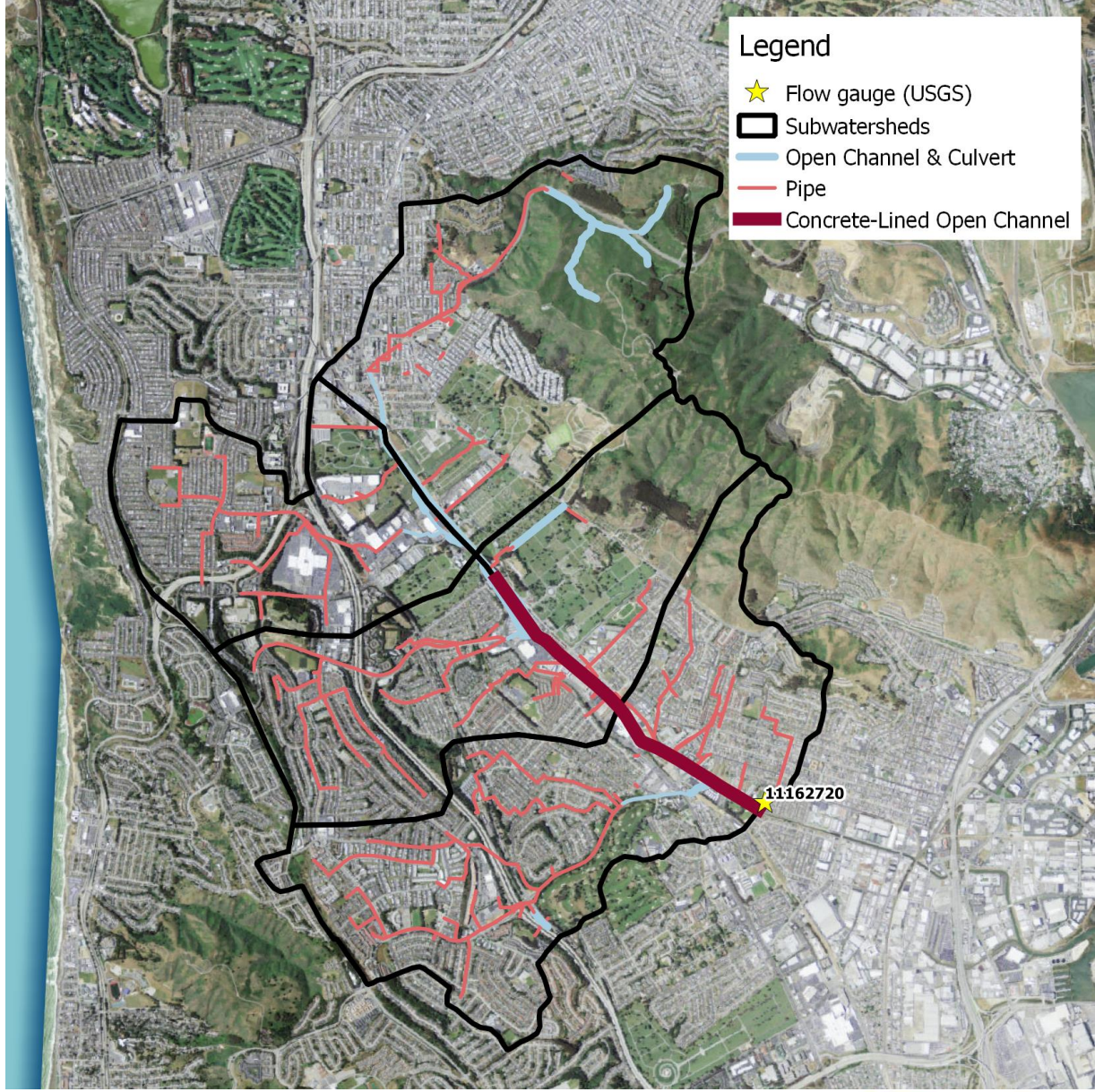
Example Hydrology Calibration Site

- Urban Watershed: Colma Creek
- Used Default BAHM (SMC)
- Added Irrigation
  - Estimated percent irrigated area from aerial photography
  - Cypress Lawn Cemetery
  - Other properties
- Concrete Lined Channel
  - Restricts groundwater flow from adjacent watersheds from entering the reach segment



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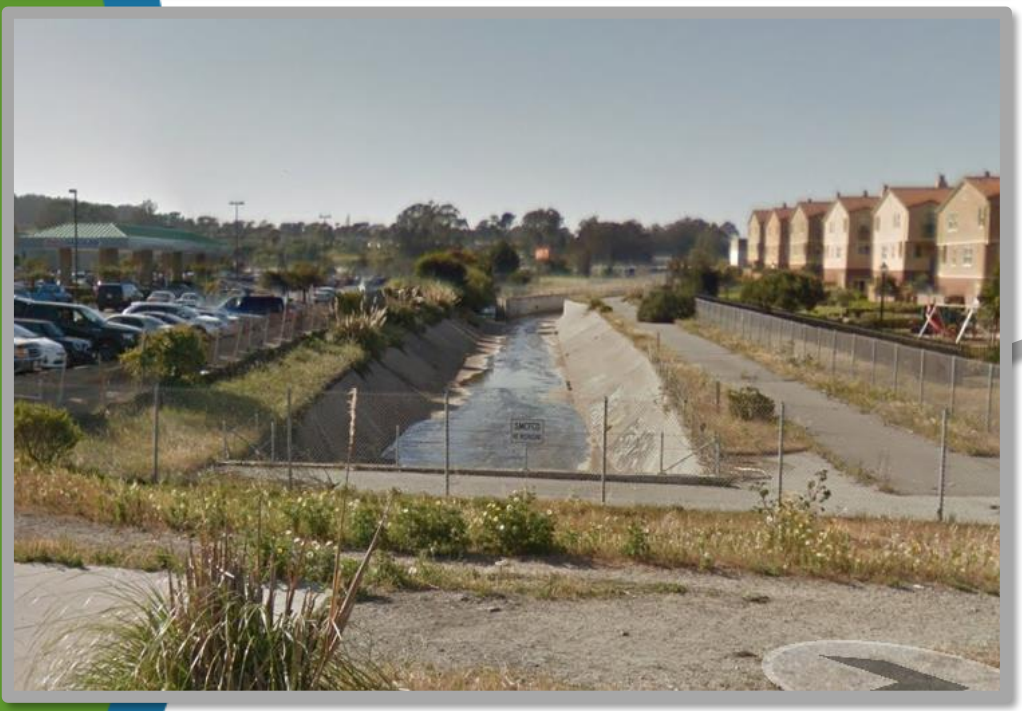
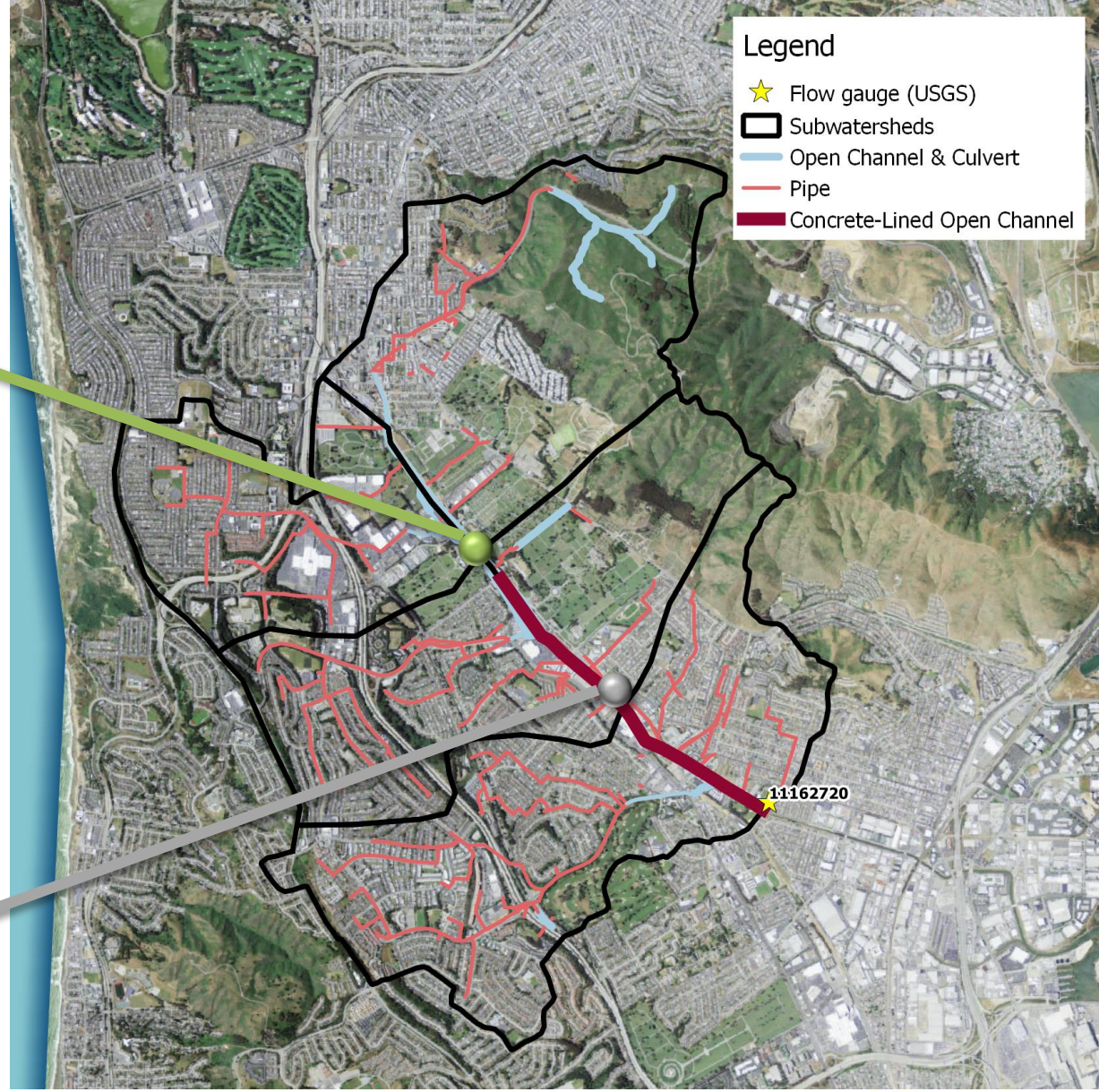
Urban Irrigation

Concrete-Lined Channel





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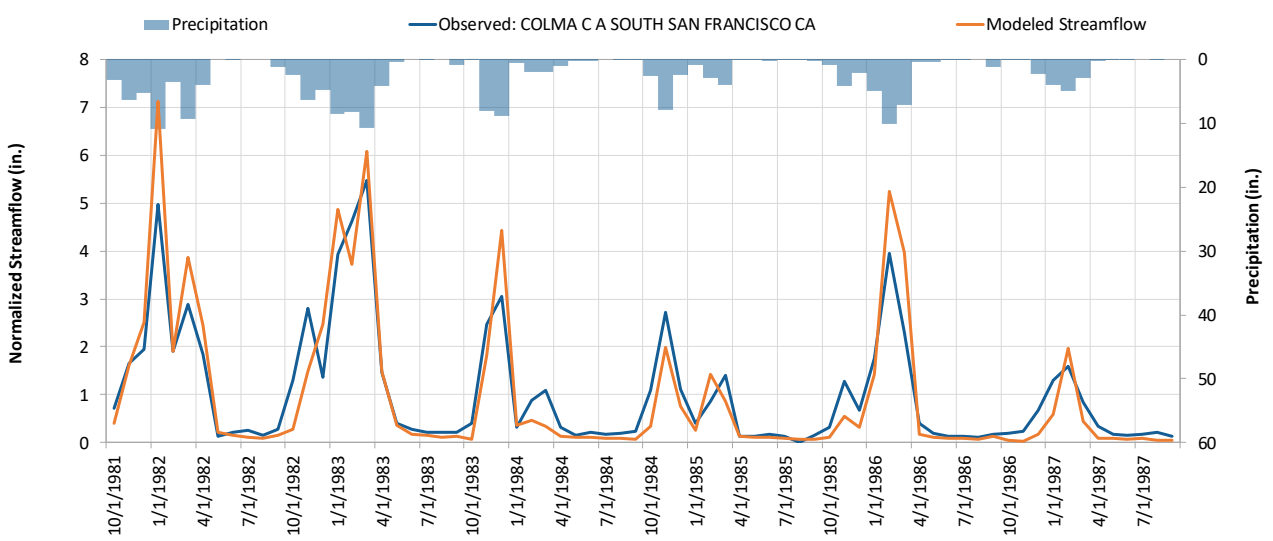
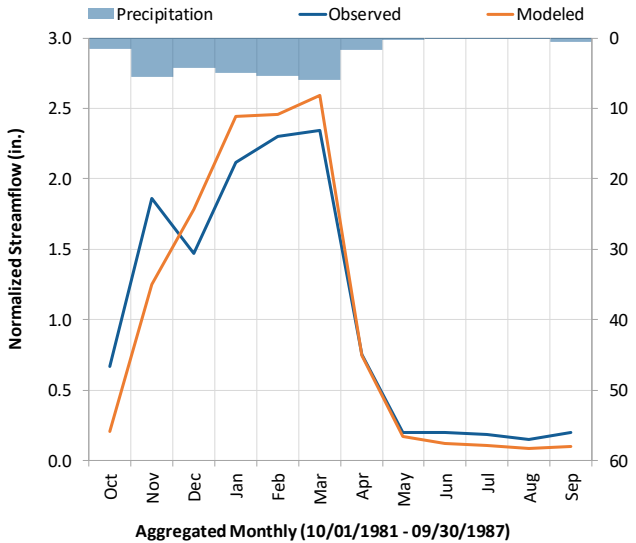
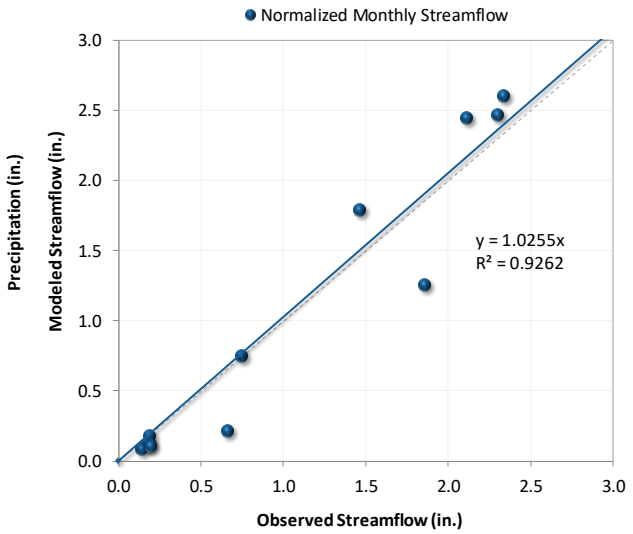
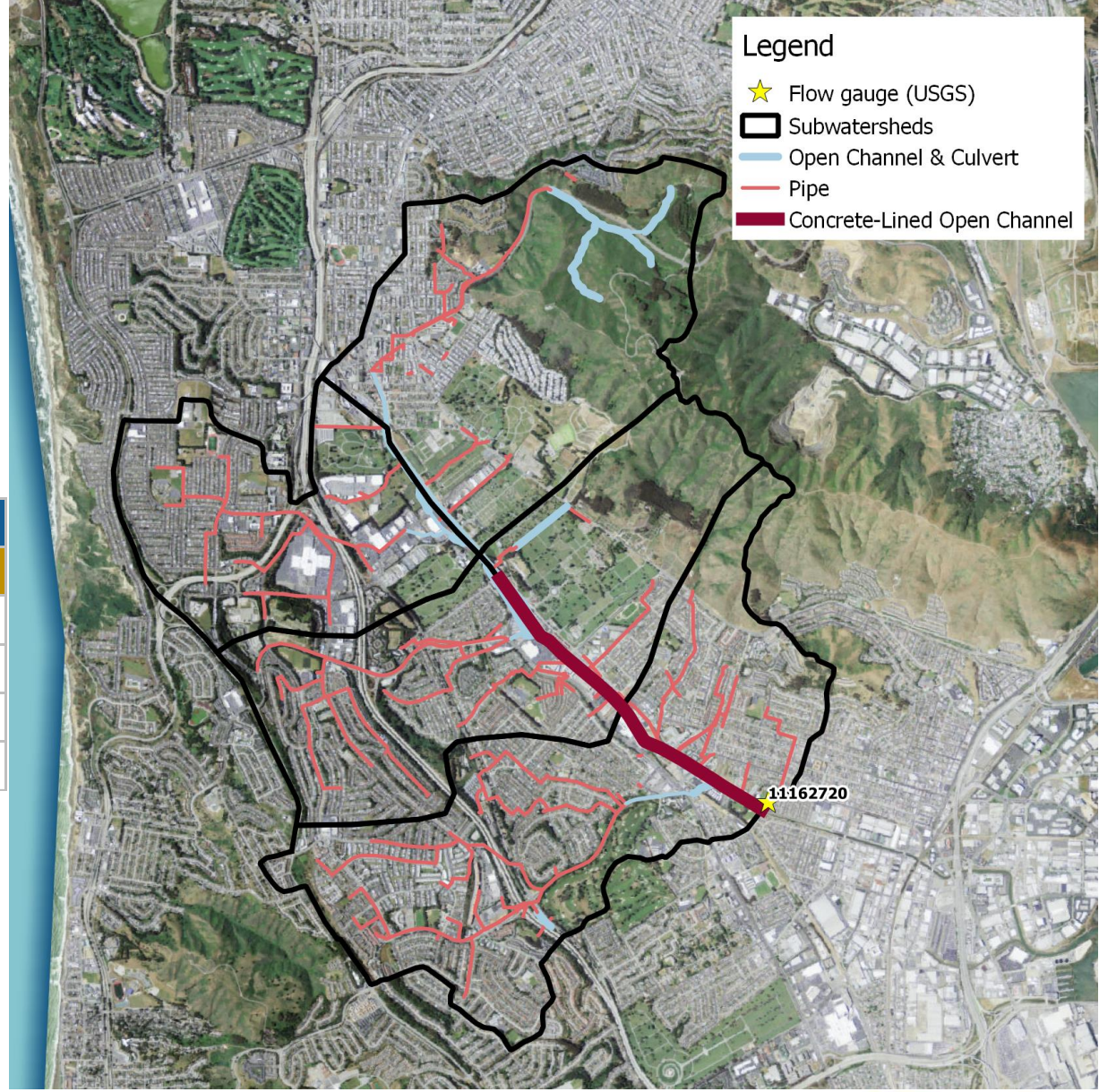


Calibration Metrics (10/01/1981 - 09/30/1987)	Relative Mean Error	Recommended Error Criteria			
		Very Good	Good	Fair	Poor
Total Annual Volume	-3.1%	≤ 5%	5 - 10%	10 - 15%	>15%
Highest 10% of Flows	-0.7%	≤ 10%	10 - 15%	15 - 25%	>25%
Lowest 50% of Flows	6.0%	≤ 10%	10 - 15%	15 - 25%	>25%
Annual Storm Volume	0.6%	≤ 10%	10 - 15%	15 - 25%	>25%







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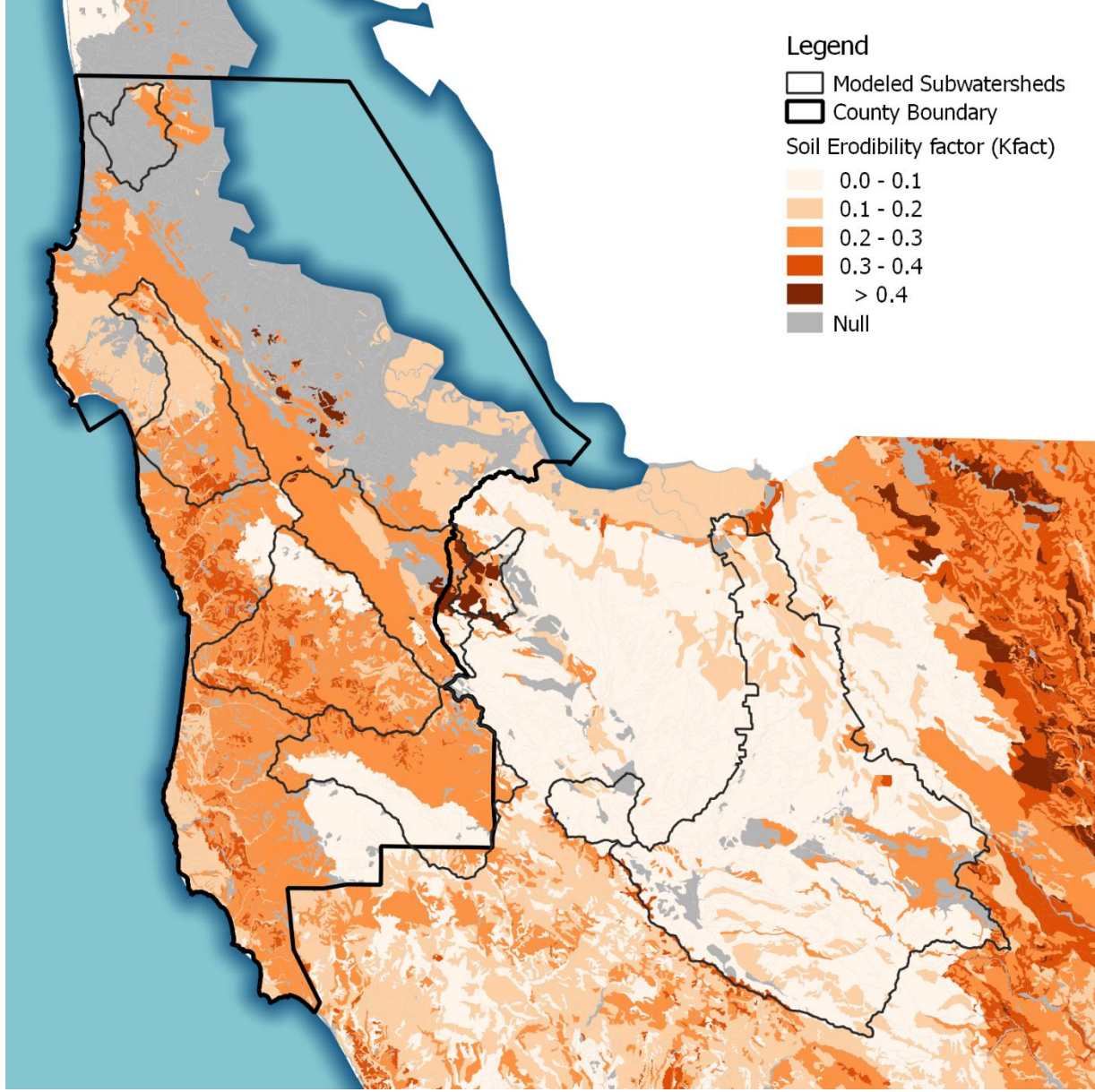
Calibration of Sediment Transport

- Hydrologic Soil Group: infiltration potential
- Erodibility: sediment mobilization potential
- Used as basis to stratify model parameters for erosion and sediment transport processes



Data Source: USDA SSURGO
(Soil Survey Geographic Database)

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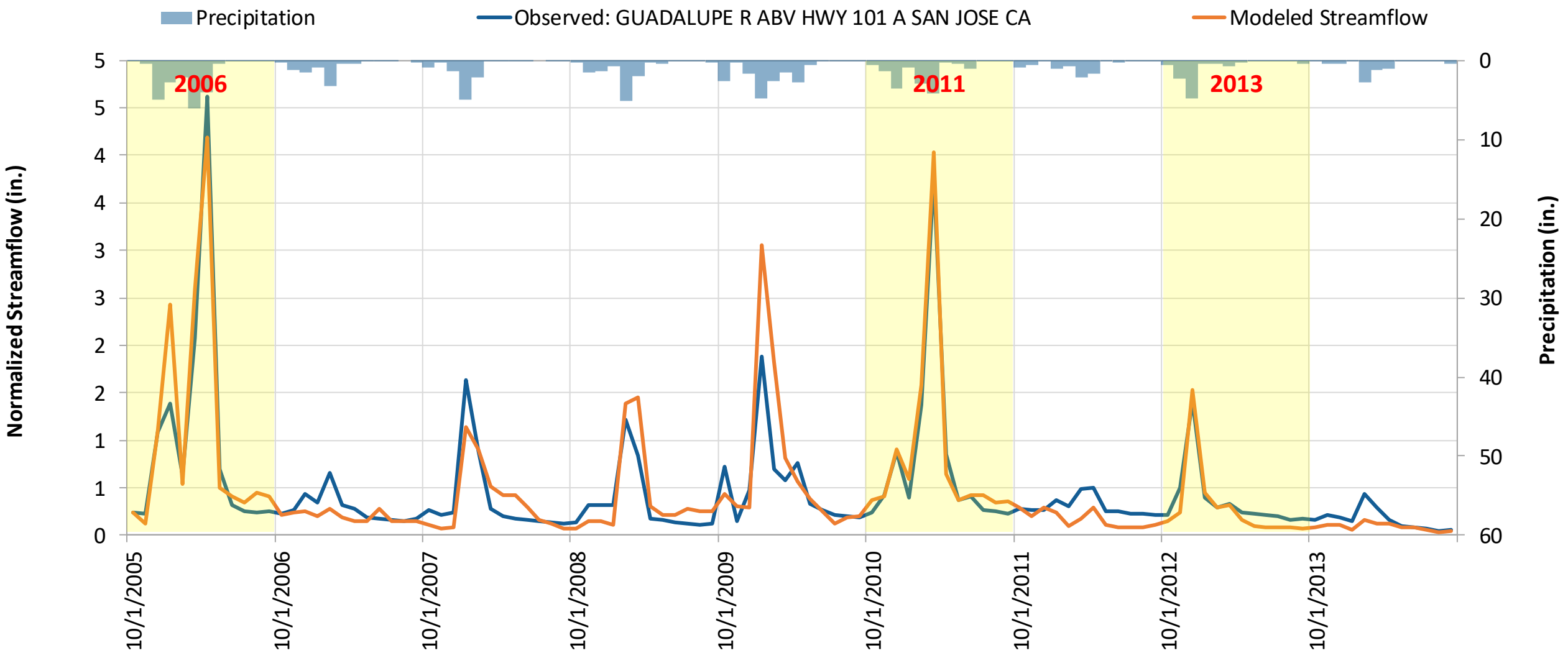
GUADALUPE R ABV HWY 101 A SAN JOSE CA (Station ID: 11169025)



Selected hydrology years have best peak flow calibration

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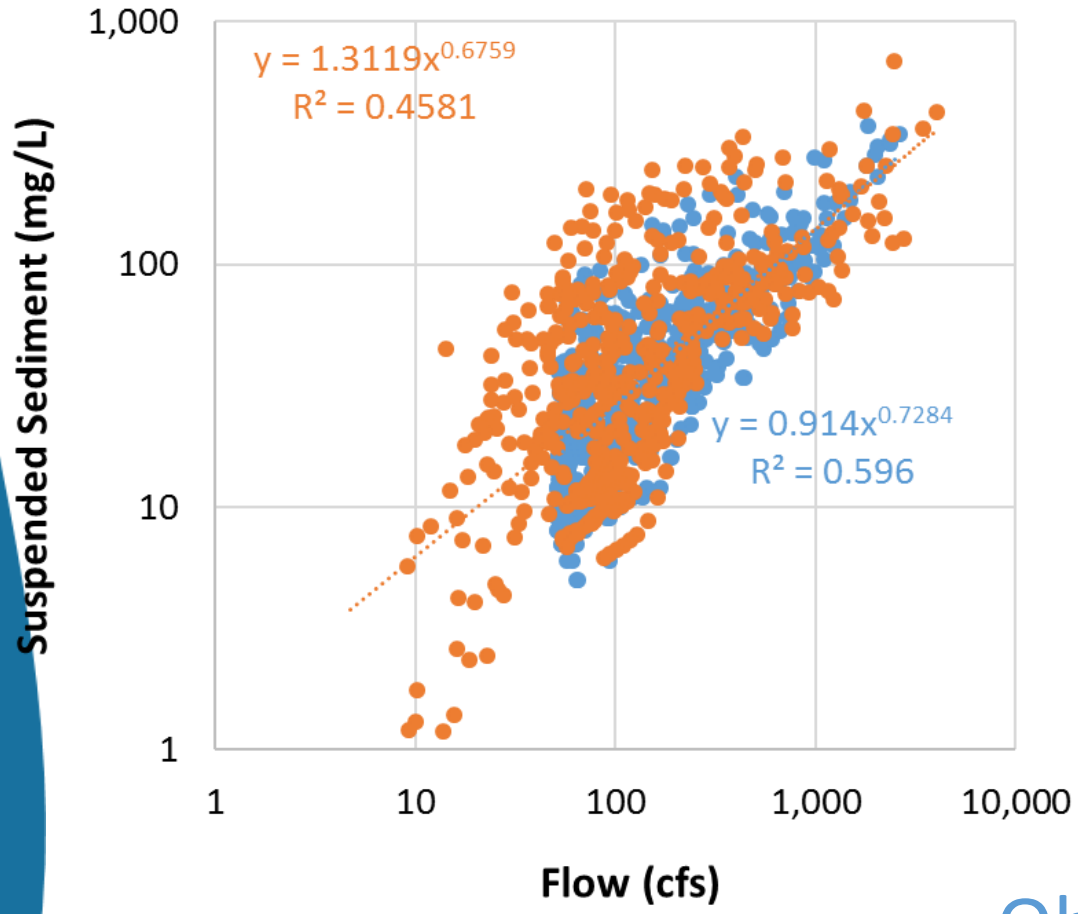
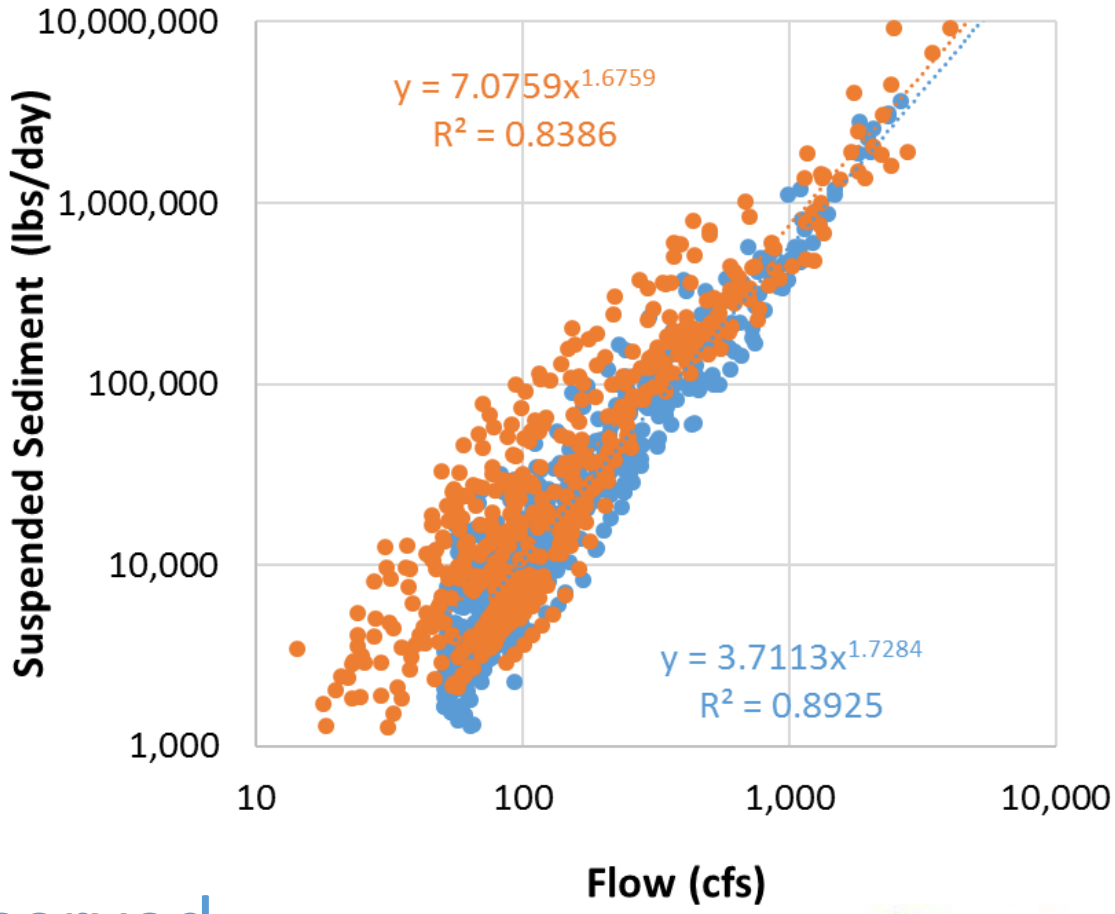
All Water Years: 2006 - 2014





Observed
Modeled

** Observed flow > 50 cfs*

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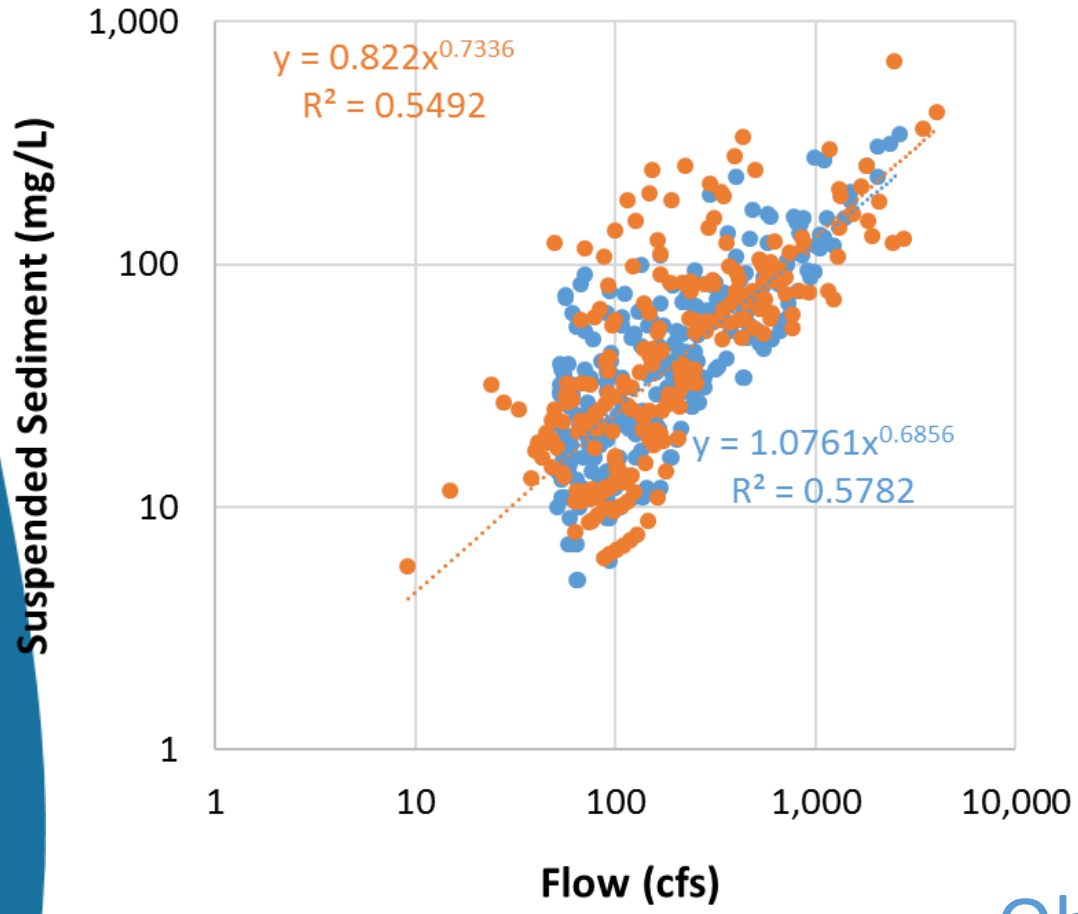
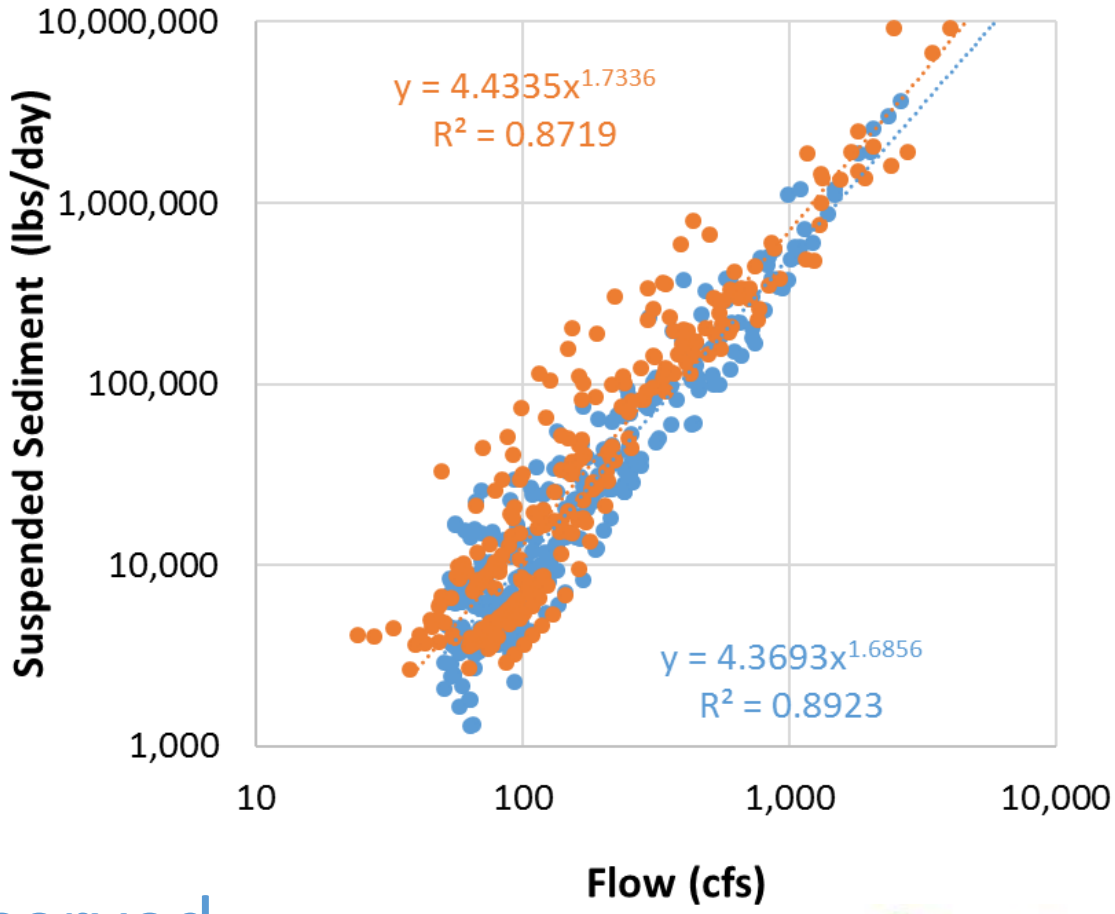
Prevention Program

Selected Water Years: 2006, 2011, and 2013





Observed

Modeled

** Observed flow > 50 cfs*

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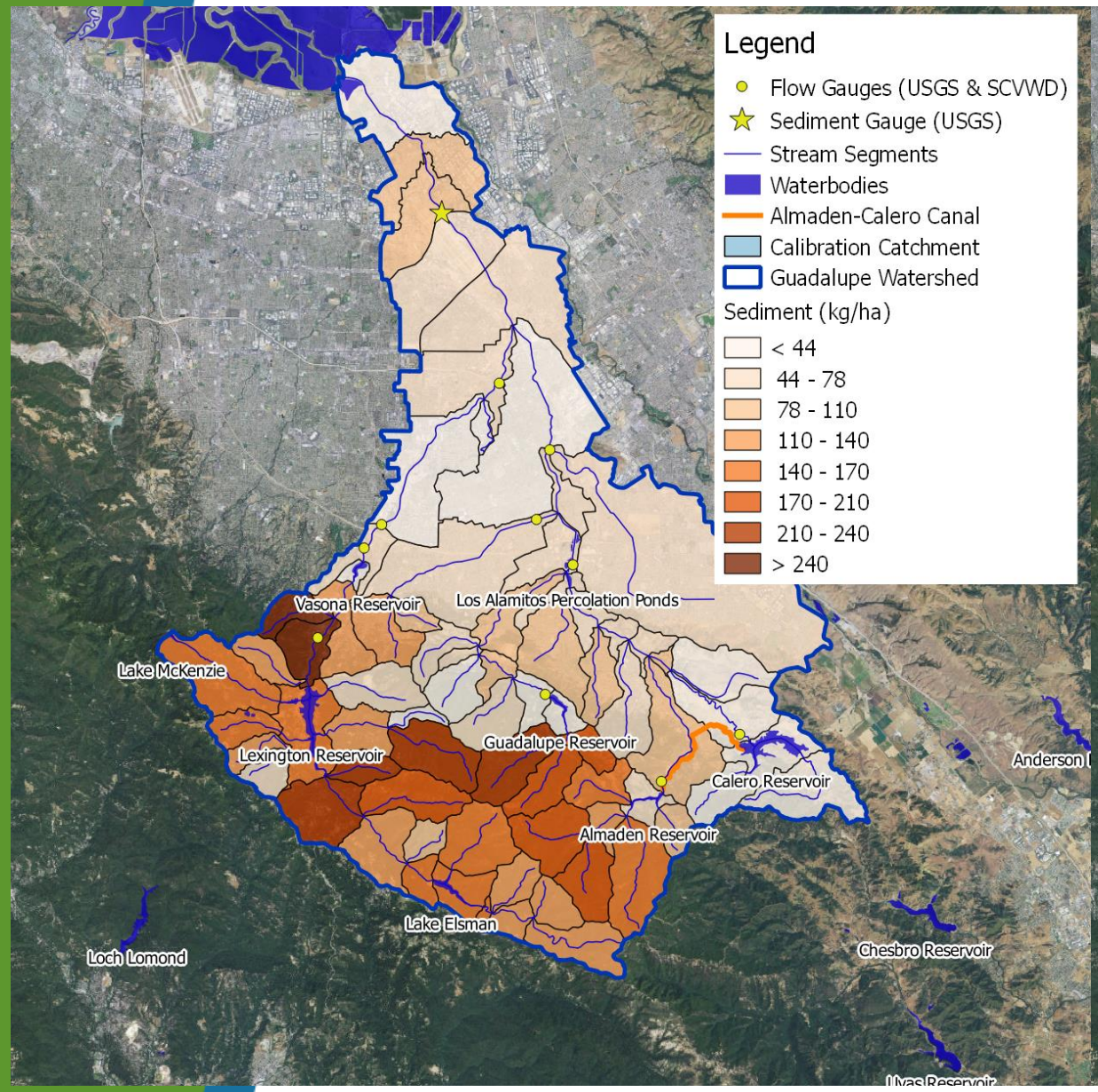
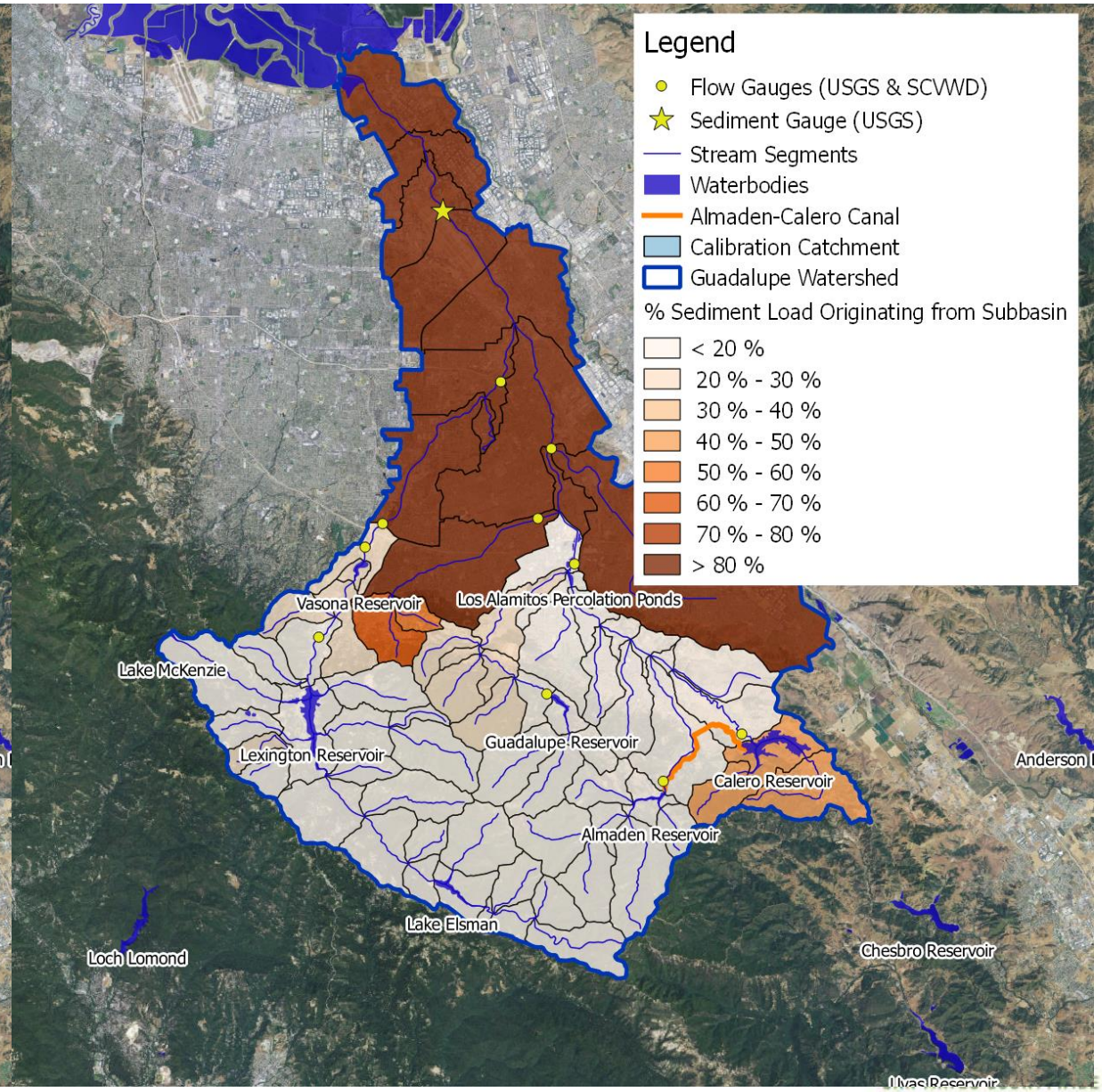
Sediment (at Source)



Sediment (Delivered to Mouth)

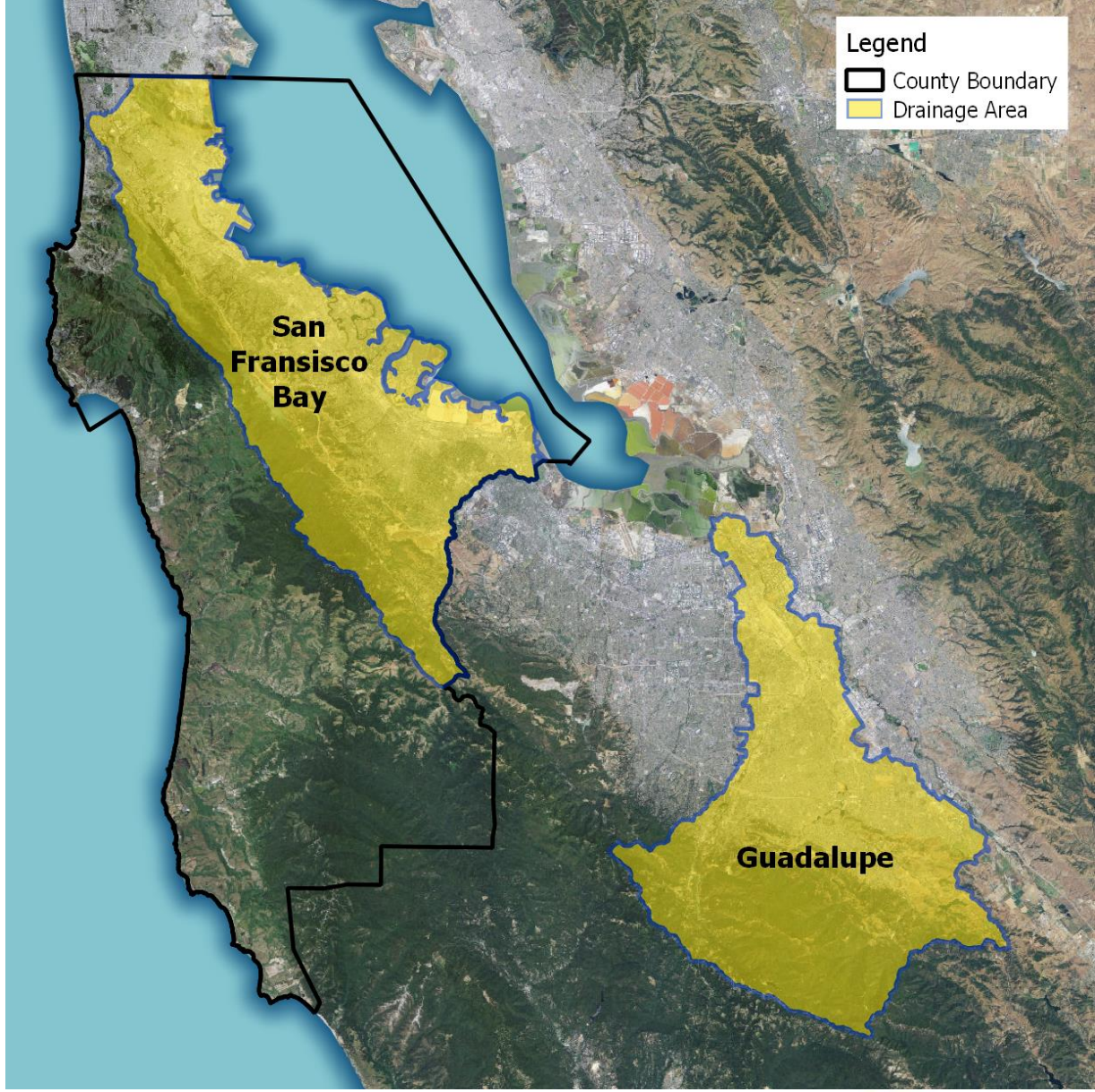


Average Annual Model Results: 10/1/1999 – 9/30/2015

Water Pollution Prevention Program

San Mateo County to Bay

- Guadalupe River Watershed Drainage Area: 414 km^2
- San Mateo County to San Francisco Bay: Drainage Area: 458 km^2



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Comparison of Sediment Load Estimates

Comparison	Units	Guadalupe River		San Mateo to Bay	
		SFEI (2005)	Model (2016)	Model (Total)	Model (Cohesive)
Area	km^2	414	414	453	453
2003	t/year	10,806	9,492	--	--
2004	t/year	8,579	7,801	--	--
Average	t/year	9,693	8,647	15,421	13,232 *
Unit-Area	$t/km^2/year$	23	21	34	29

** Modeled PCBs are associated with cohesive sediment (silt & clay)*

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SMC Flow and Sediment Loads to the Bay

Flow

Urban	Land Use	Area		Rainfall Flow		Delivered Flow	
		(acres)	(%)	(inches)	(%)	(inches)	(%)
Yes	High-Density	5,574	5%	13.3	9%	13.3	8%
	Medium-Density	19,996	18%	7.4	17%	7.4	17%
	Low-Density	20,249	18%	6.1	14%	6.1	14%
	Open Space	28,995	26%	7.2	24%	7.2	23%
No	Non-Urban	37,203	33%	8.3	36%	8.3	34%
	Waterbodies*	--	--	--	--	0.3	4%
Total or Average		**112,017**	**100%**	**7.7**	**100%**	**8.0**	**100%**

Sediment

Urban	Land Use	Area		Source Sediment		Delivered Sediment	
		(acres)	(%)	(t)	(%)	(t)	(%)
Yes	High-Density	5,574	5%	1,577	9%	1,568	12%
	Medium-Density	19,996	18%	2,945	17%	2,837	21%
	Low-Density	20,249	18%	2,953	17%	2,618	20%
	Open Space	28,995	26%	7,465	44%	5,243	40%
No	Non-Urban	37,203	33%	2,025	12%	966	7%
Total		**112,017**	**100%**	**16,965**	**100%**	**13,232**	**100%**

**Waterbodies: Net rainfall & evaporation from water surfaces*

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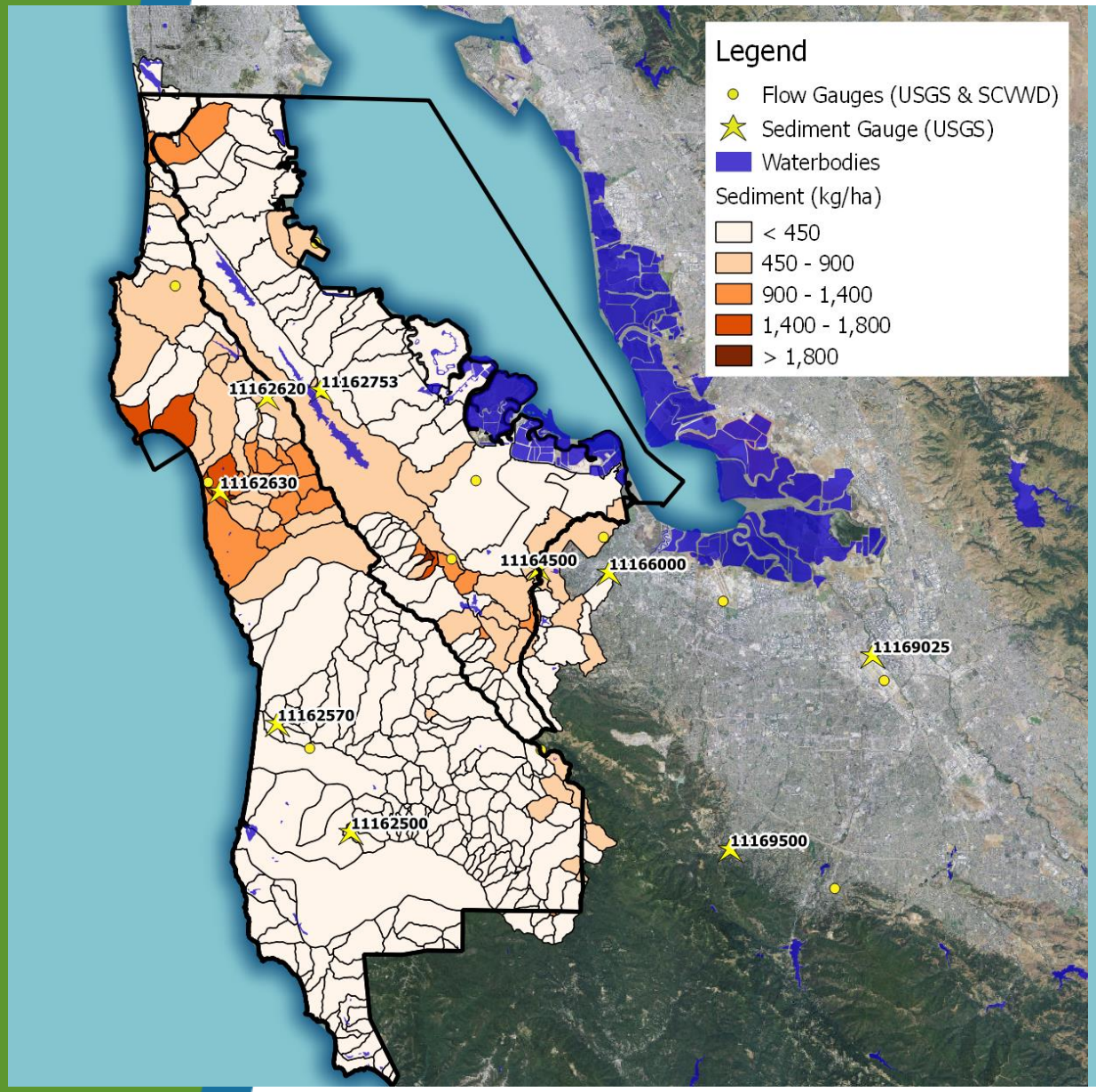
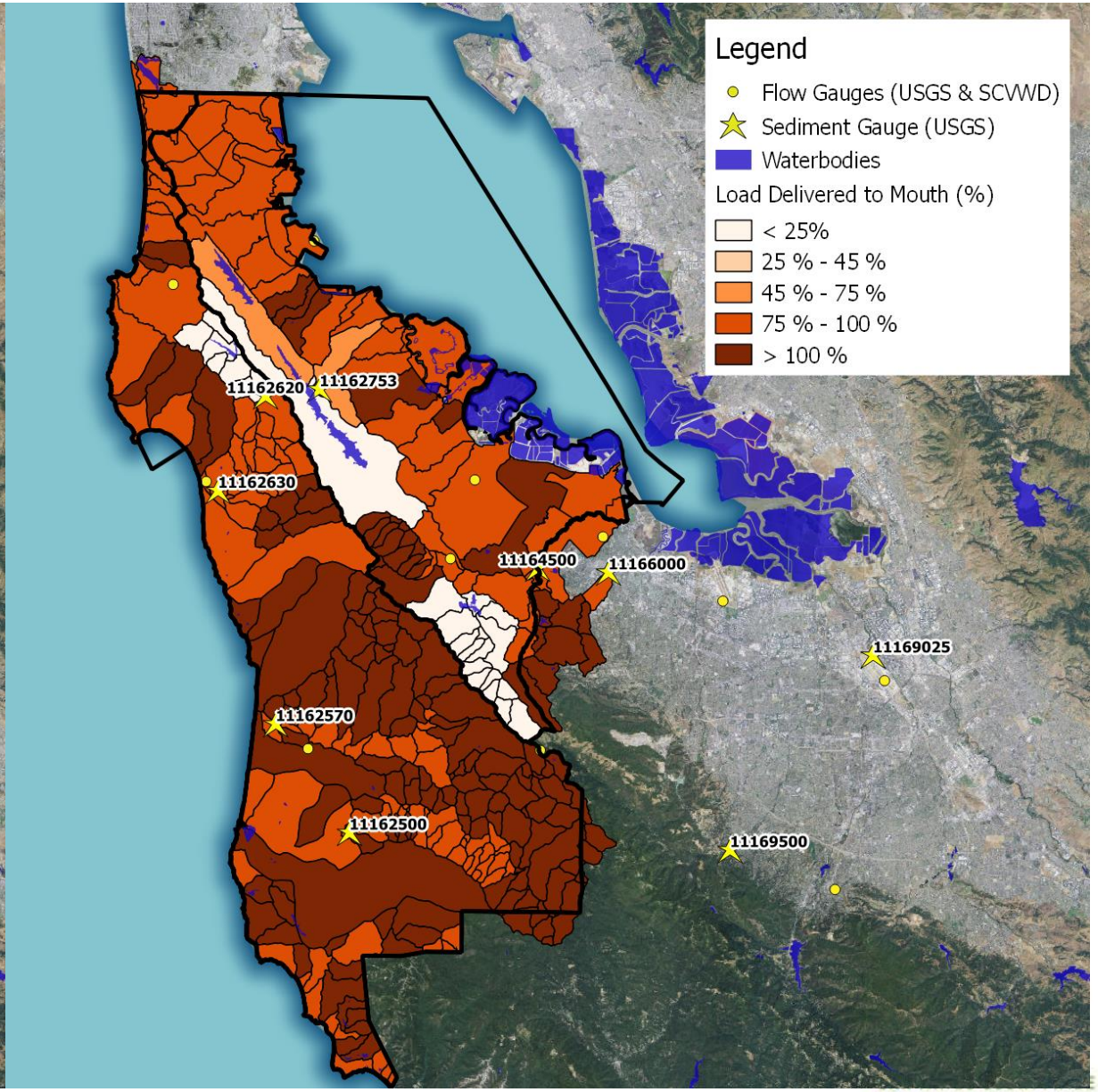
Sediment (at Source)



Sediment (Delivered to Mouth)



Average Annual Model Results: 10/1/2002 – 9/30/2004

Water Pollution Prevention Program

Estimating PCB Loads and Reductions

- Existing PCB loads:
  - Modeled hydrology
  - Land use assumptions for PCB concentrations based on the SFEI Regional Watershed Spreadsheet Model (RWSM)
- Target PCB loads:
  - Modeled sediment loads
  - TMDL target sediment concentration

Land Use	Runoff Concentration (ng/L)		
	Min	Median	Max
Ag/Open/ New Urban	0.2	0.2	1.5
Old Residential	4	4	16
Old Commercial/ Transportation	20	35	70
Old Industrial and Source Areas	100	162	400

Gilbreath, A., J. Wu, L. McKee. 2016 Regional Watershed Spreadsheet Model (RWSM) for PCBs and Hg: Final draft results. PowerPoint Presentation. 9/26/2016.

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Comparison to PCB TMDL

1	2	3	4	5 = 3 x 4	6 = 2 - 5	7 = 6 / 2
Source	Existing PCB Load (kg/year)	Annual Sediment Load (t/year)	Target Sediment Concentration (µg/kg)	PCB Wasteload Allocation (kg/year)	PCB Load Reduction (kg/year)	Percent Reduction
Bay-wide WLA	20	2,000,000	1	2	18	90.0%
SMC portion of WLA				0.2		

Reported in the TMDL/MRP

SAN MATEO COUNTYWIDE Water Pollution Prevention Program

Comparison to PCB TMDL

1	2	3	4	5 = 3 x 4	6 = 2 - 5	7 = 6 / 2
Source	Existing PCB Load (kg/year)	Annual Sediment Load (t/year)	Target Sediment Concentration (µg/kg)	PCB Wasteload Allocation (kg/year)	PCB Load Reduction (kg/year)	Percent Reduction
Bay-wide WLA	20	2,000,000	1	2	18	90.0%
SMC portion of WLA	2	200,000	1	0.2	1.8	90.0%

Reported in the TMDL/MRP

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Water Pollution Prevention Program

Comparison to PCB TMDL

Note: Results are preliminary/draft and should not be quoted or cited.

1	2	3	4	5 = 3 x 4	6 = 2 - 5	7 = 6 / 2
Source	Existing PCB Load (kg/year)	Annual Sediment Load (t/year)	Target Sediment Concentration (µg/kg)	PCB Wasteload Allocation/ Target Load (kg/year)	PCB Load Reduction (kg/year)	Percent Reduction
Bay-wide WLA	20	2,000,000	1	2	18	90.0%
SMC portion of WLA	2	200,000	1	0.2	1.8	90.0%
SMC loads based on RAA		13,232	1	0.013		

Based on Modeled Sediment

SAN MATEO COUNTYWIDE Water Pollution Prevention Program

Comparison to PCB TMDL

Note: Results are preliminary/draft and should not be quoted or cited.

1	2	3	4	5 = 3 x 4	6 = 2 - 5	7 = 6 / 2
Source	Existing PCB Load (kg/year)	Annual Sediment Load (t/year)	Target Sediment Concentration (µg/kg)	PCB Wasteload Allocation/ Target Load (kg/year)	PCB Load Reduction (kg/year)	Percent Reduction
Bay-wide WLA	20	2,000,000	1	2	18	90.0%
SMC portion of WLA	2	200,000	1	0.2	1.8	90.0%
SMC loads based on RAA	In range with above	13,232	1	0.013		Likely > 90%

Based on Modeled Sediment

Based on SFEI RWSM

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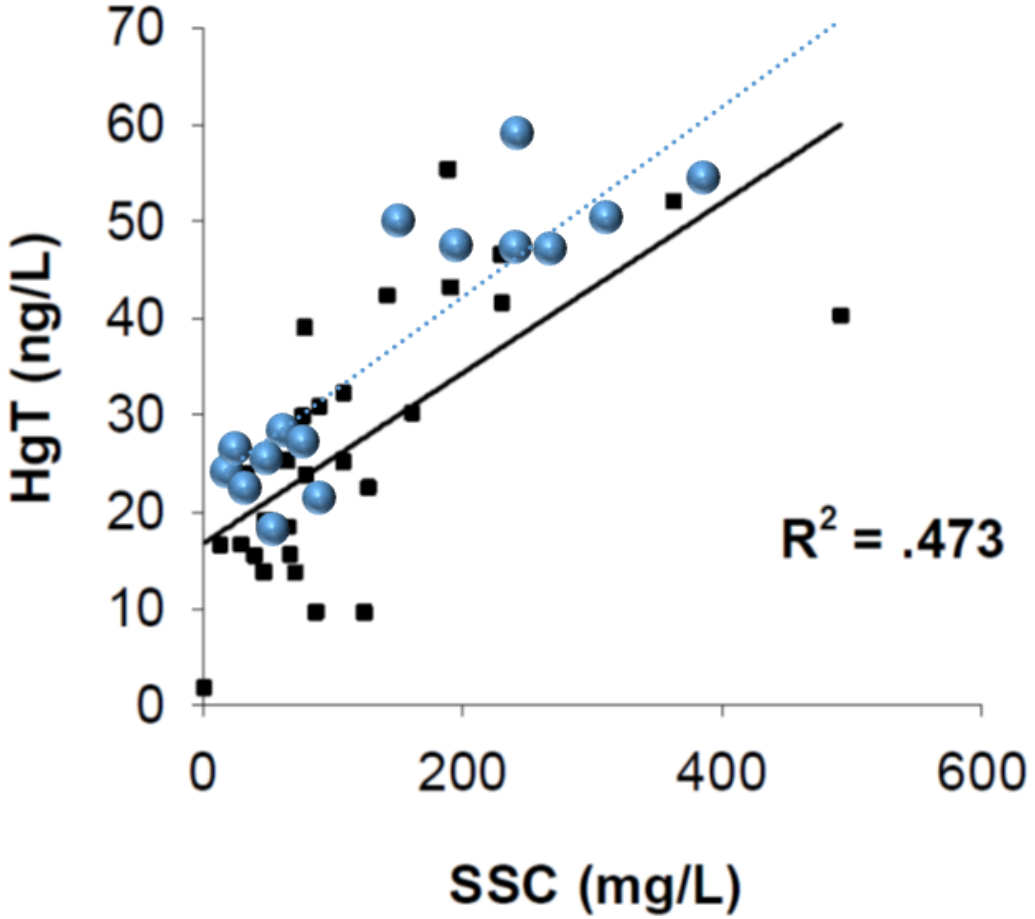
Estimating Mercury Loads and Reductions

- Existing Hg loads:
  - Modeled hydrology and SSC
  - Relationships between Hg and SSC (Paired samples of Hg and SSC in County (**blue**) compared with paired samples from McKee et. al 2009*)
- Target Hg Load
  - Modeled sediment loads
  - TMDL target sediment concentration



* McKee, L., A. Gilbreath, R. Eads. 2009. Concentrations and Loads of Trace Contaminants in the Zone 4 Line A Small Tributary Hayward, California: Water Year 2007. SFEI, Oakland, CA.

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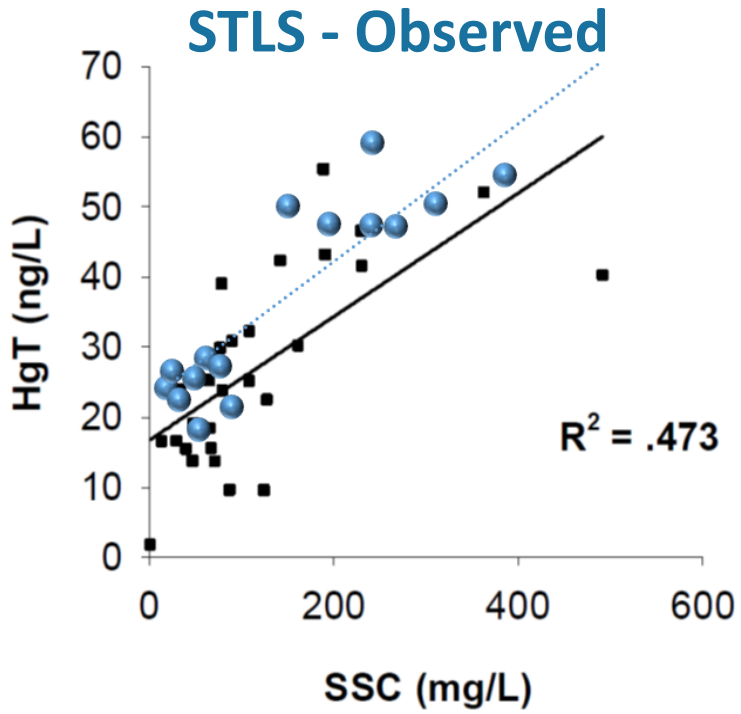
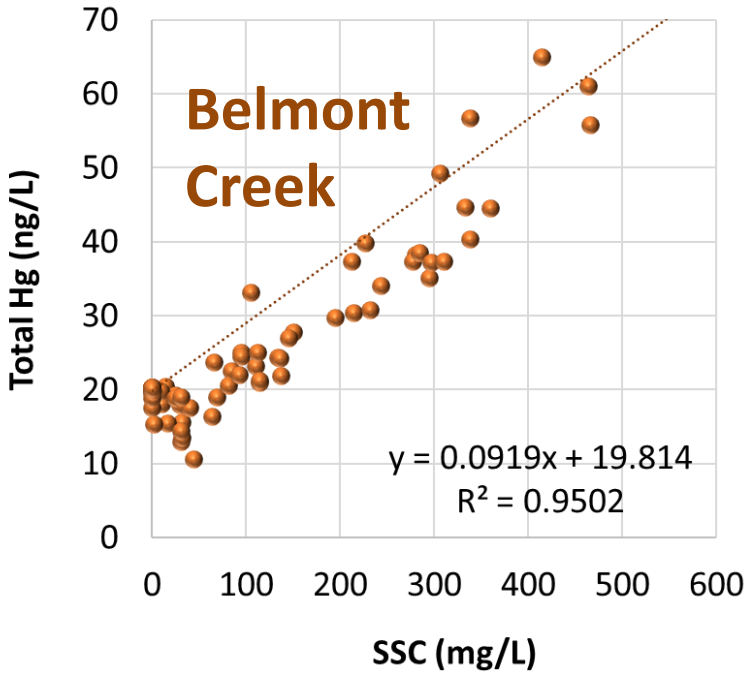
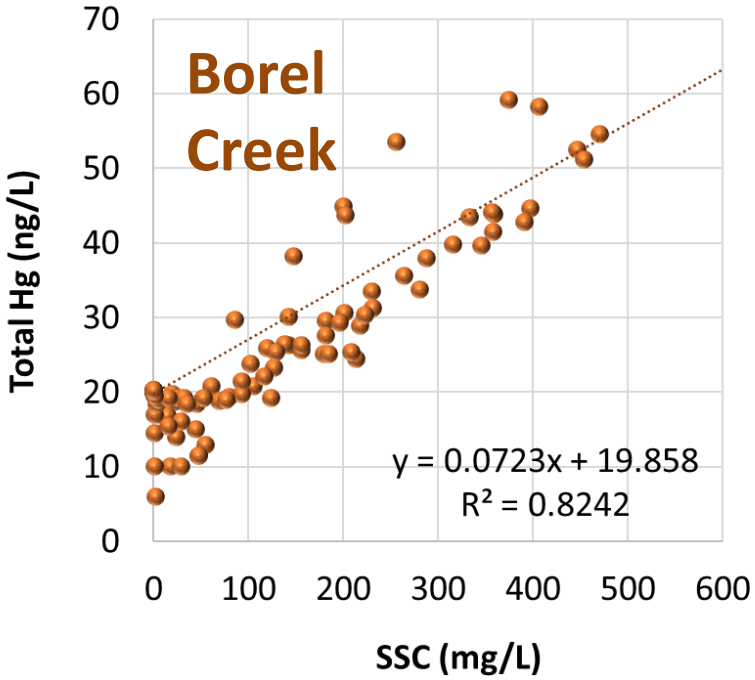
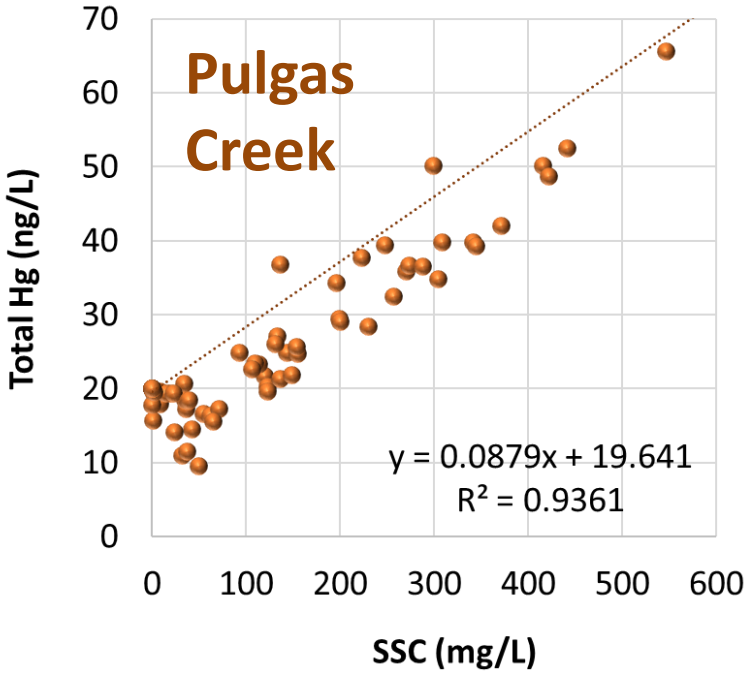
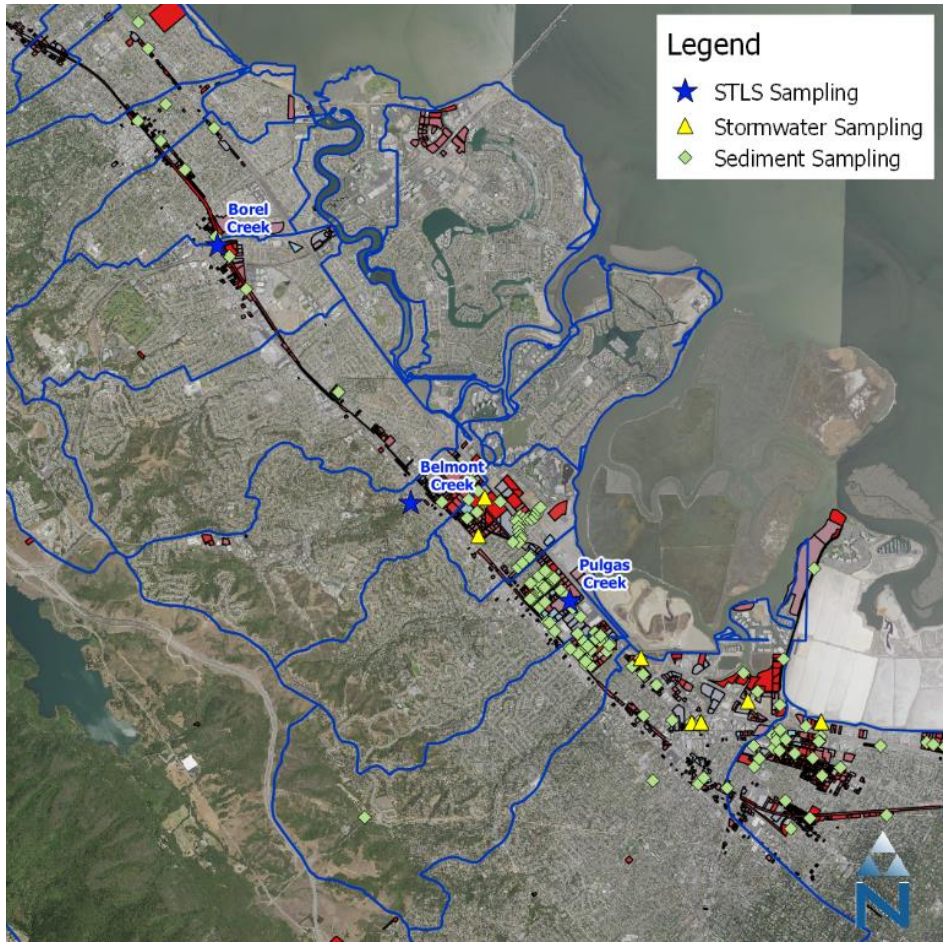
Hg Calibration











STLS - Observed

Model (2016)

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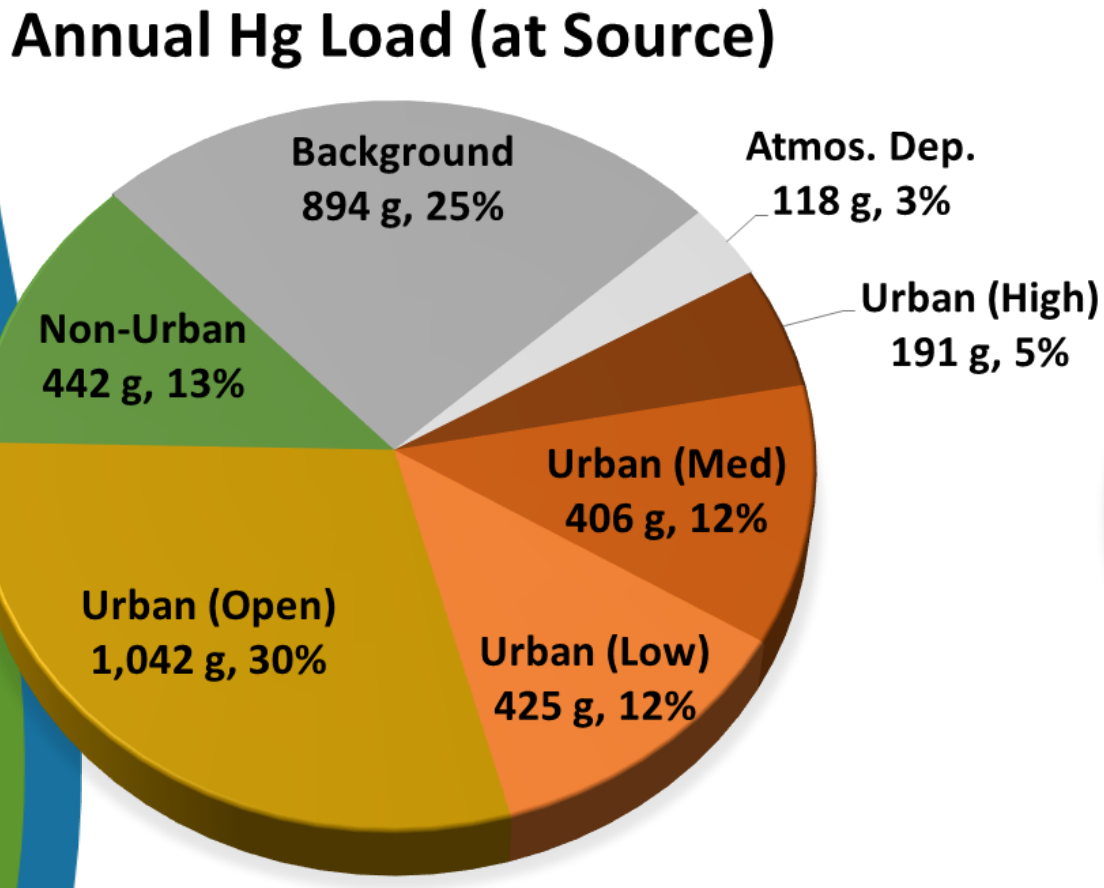
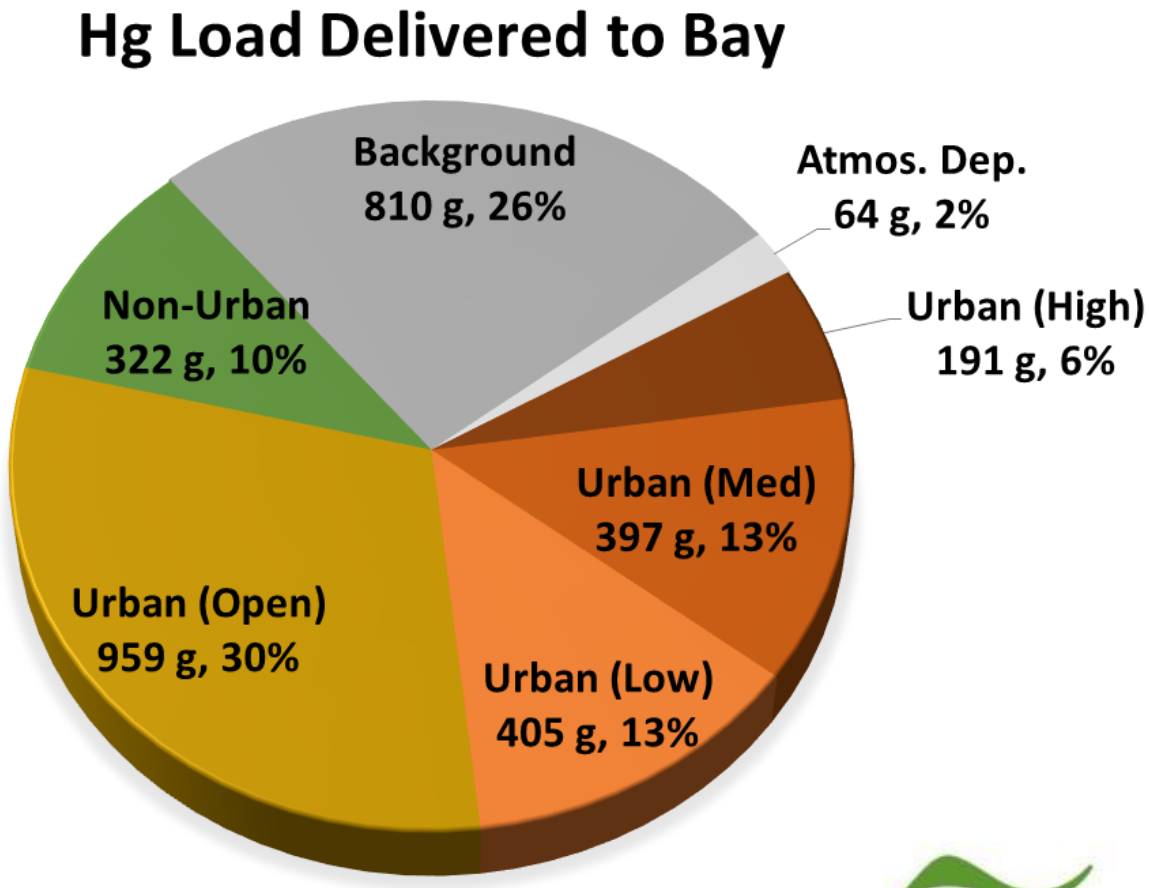
Water Pollution Prevention Program

Annual Hg Loads to the Bay





** Atmos. Dep. represents direct wet/dry deposition to waterbodies*

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Water Pollution
Prevention Program

SMC Sediment and Total-Hg Loads to the Bay

Sediment

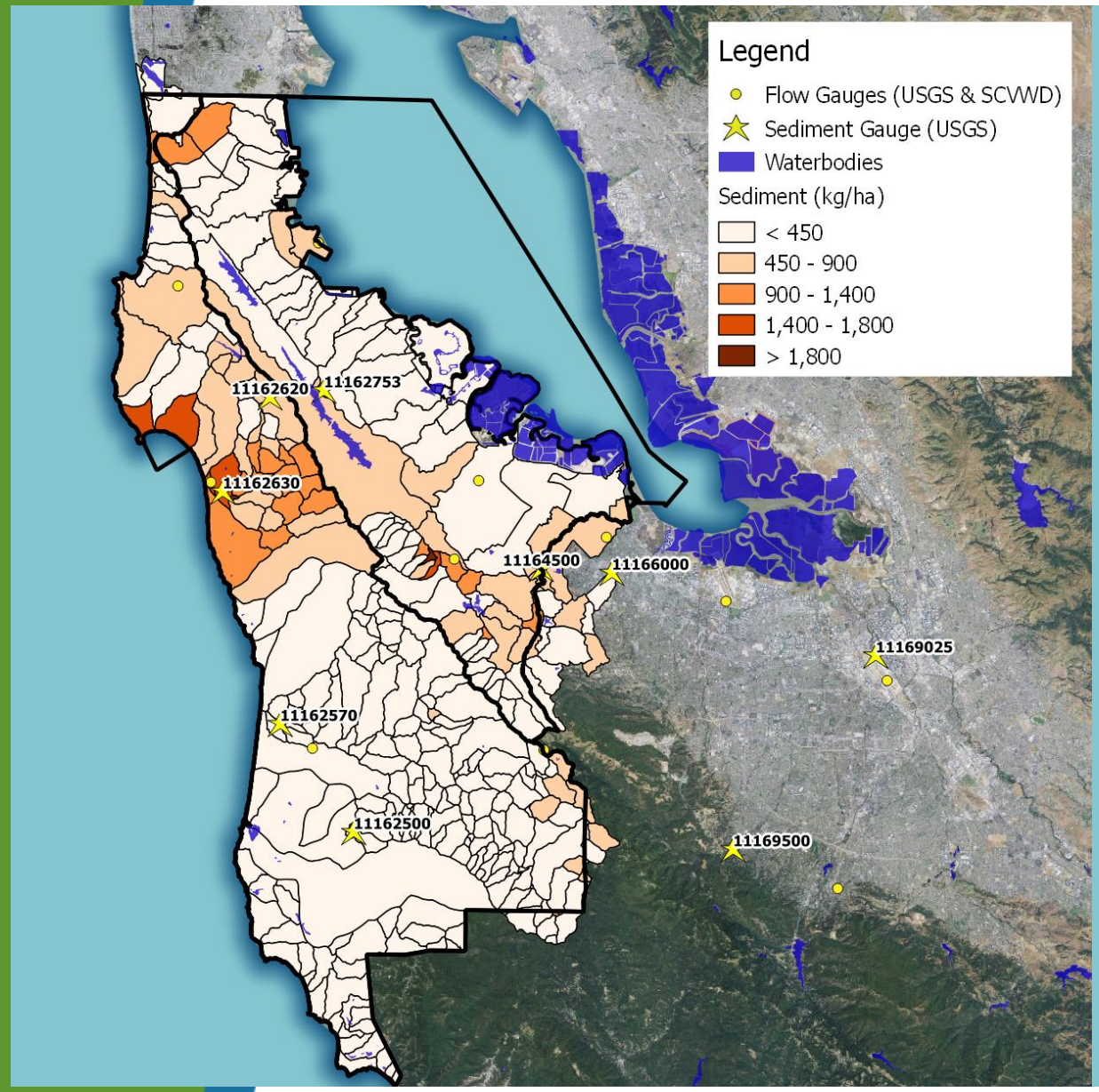
Urban	Land Use	Area		Source Sediment		Delivered Sediment	
		(acres)	(%)	(t)	(%)	(t)	(%)
Yes	High-Density	5,574	5%	1,577	9%	1,568	12%
	Medium-Density	19,996	18%	2,945	17%	2,837	21%
	Low-Density	20,249	18%	2,953	17%	2,618	20%
	Open Space	28,995	26%	7,465	44%	5,243	40%
No	Non-Urban	37,203	33%	2,025	12%	966	7%
Total		**112,017**	**100%**	**16,965**	**100%**	**13,232**	**100%**

Total-Hg

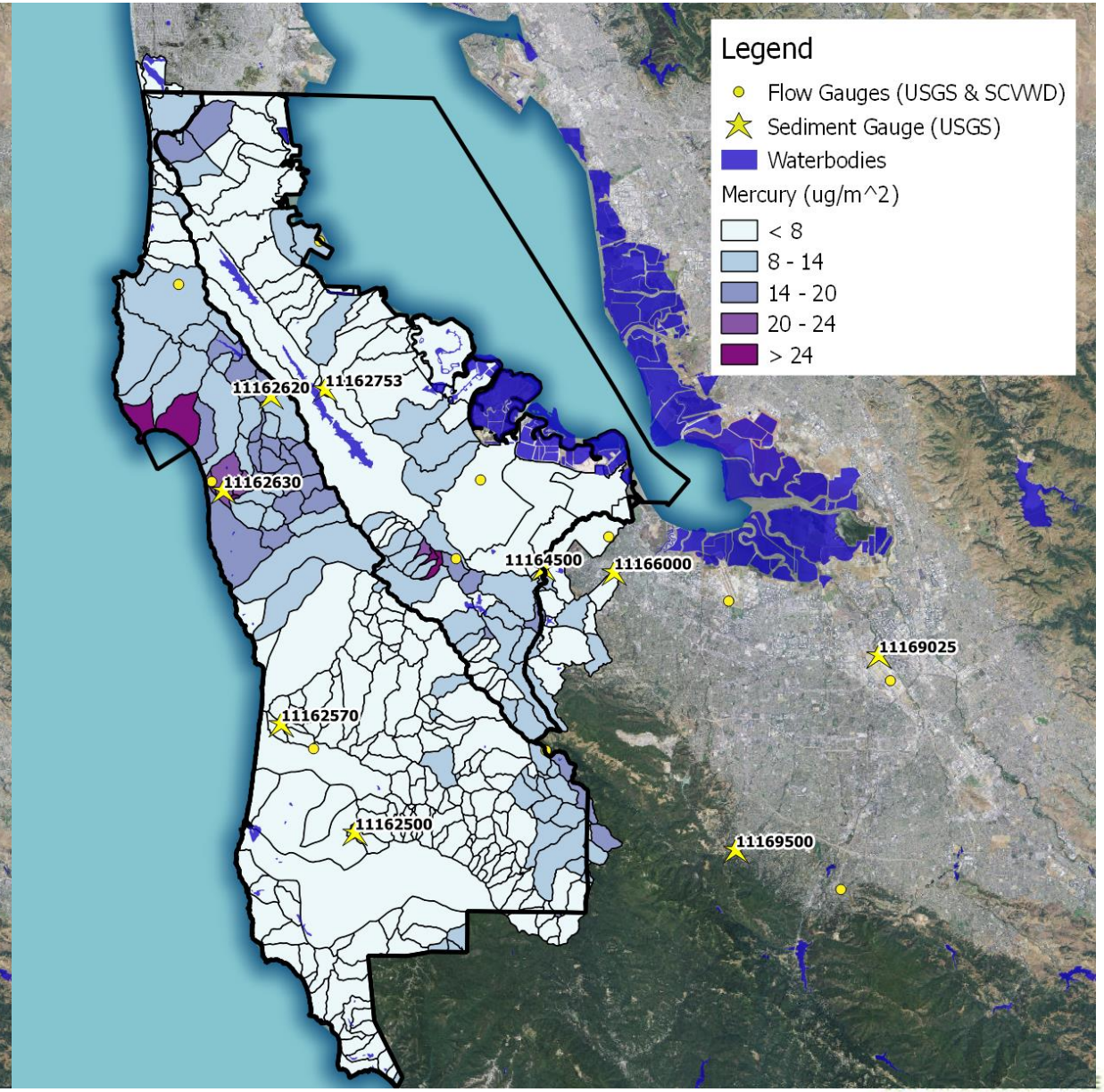
Urban	Land Use	Area		Source Hg		Delivered Hg	
		(acres)	(%)	(g)	(%)	(g)	(%)
Yes	High-Density	5,574	5%	191	5%	191	6%
	Medium-Density	19,996	18%	406	12%	397	13%
	Low-Density	20,249	18%	425	12%	405	13%
	Open Space	28,995	26%	1,042	30%	959	30%
No	Non-Urban	37,203	33%	442	13%	322	10%
	Background	--	--	894	25%	810	26%
	Atmos. Dep.	--	--	118	3%	64	2%
Total		**112,017**	**100%**	**3,518**	**100%**	**3,148**	**100%**

** Atmos. Dep. represents direct wet/dry deposition to waterbodies*

Sediment (at Source)



Total Hg (Delivered to Mouth)



Average Annual Model Results: 10/1/2002 – 9/30/2004

Water Pollution Prevention Program

SFEI RWSM: Hg Concentrations in Runoff

- RWSM land use concentrations available for Hg
- Used for validation of model-predicted ranges of concentrations

Land Use	Runoff Concentration (ng/L)		
	Min	Median	Max
Ag/Open	35	71	105
New Urban	3	3	9
Old Urban	40	40	120
Old Industrial and Source Areas	35	65	105

Gilbreath, A., J. Wu, L. McKee. 2016 Regional Watershed Spreadsheet Model (RWSM) for PCBs and Hg: Final draft results. PowerPoint Presentation. 9/26/2016.

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Side	Urban	Land Use	Annual Hg Levels			Comparison to References
			g	ng/L	µg/m^2	
Bay	Yes	High-Density	191	25	8	<u>SFEI & TMDL</u> Urban loads: possible: 1-24 µg/m^2 typical: 3-5 µg/m^2 <u>SFEI RWSM</u> Total Hg Runoff Concentrations: Range: 3 – 120 ng/L Medians: 40 – 71 ng/L
		Medium-Density	397	26	5	
		Low-Density	405	32	5	
		Open Space	959	45	8	
	No	All Other Sources	1,196	16	3	
Ocean	Yes	High-Density	18	31	12	
		Medium-Density	172	55	15	
		Low-Density	329	82	21	
		Open Space	1,156	83	22	
	No	All Other Sources	3,744	18	5	
San Mateo County:			**8,567**	**26**	**5**	

Comparison to Hg TMDL

Note: Results are preliminary/draft and should not be quoted or cited.

1	2	3	4	5 = 3 x 4	6 = 2 - 5	7 = 6 / 2
Source	Existing Hg Load (kg/year)	Annual Sediment Load (t/year)	Target Sediment Concentration (mg/kg)	Hg Wasteload Allocation/ Target Load (kg/year)	Hg Load Reduction (kg/year)	Percent Reduction
Bay-wide WLA	160	410,000	0.2	82	78	48.8%
SMC portion of WLA	16.4	42,000	0.2	8.4	8	48.8%
SMC loads based on RAA	3.15	13,232	0.2	2.65	0.50	15.9%

Based on Modeled Sediment

Based on STLS × Modeled SSC

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Next Steps

- Complete PCB load reduction analysis
- Separate loads from MS4-permitted urban areas from open space and other NPDES permitted areas
- Project phased load reduction associated with green infrastructure based on new loading estimates
- Initiate SUSTAIN modeling of LID (C.3) and green infrastructure
- Identify modeling scenarios to support C/CAG key decisions

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