Characterization of stormwater debris model parameters in southern California's dense urbanized watersheds

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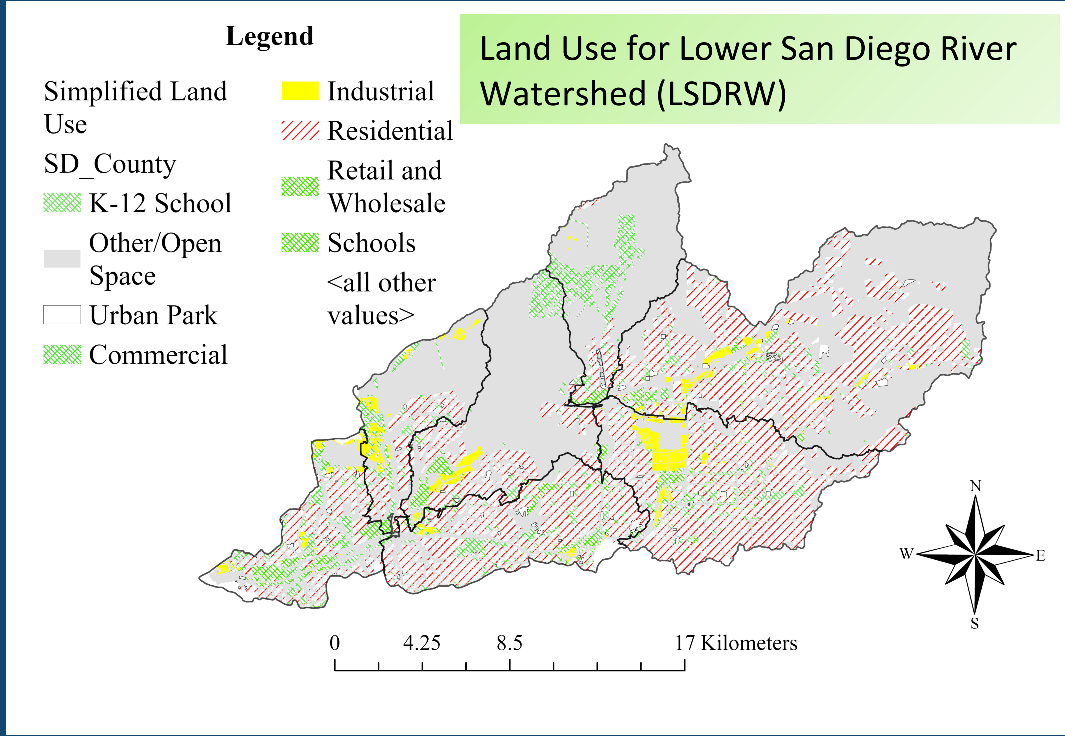
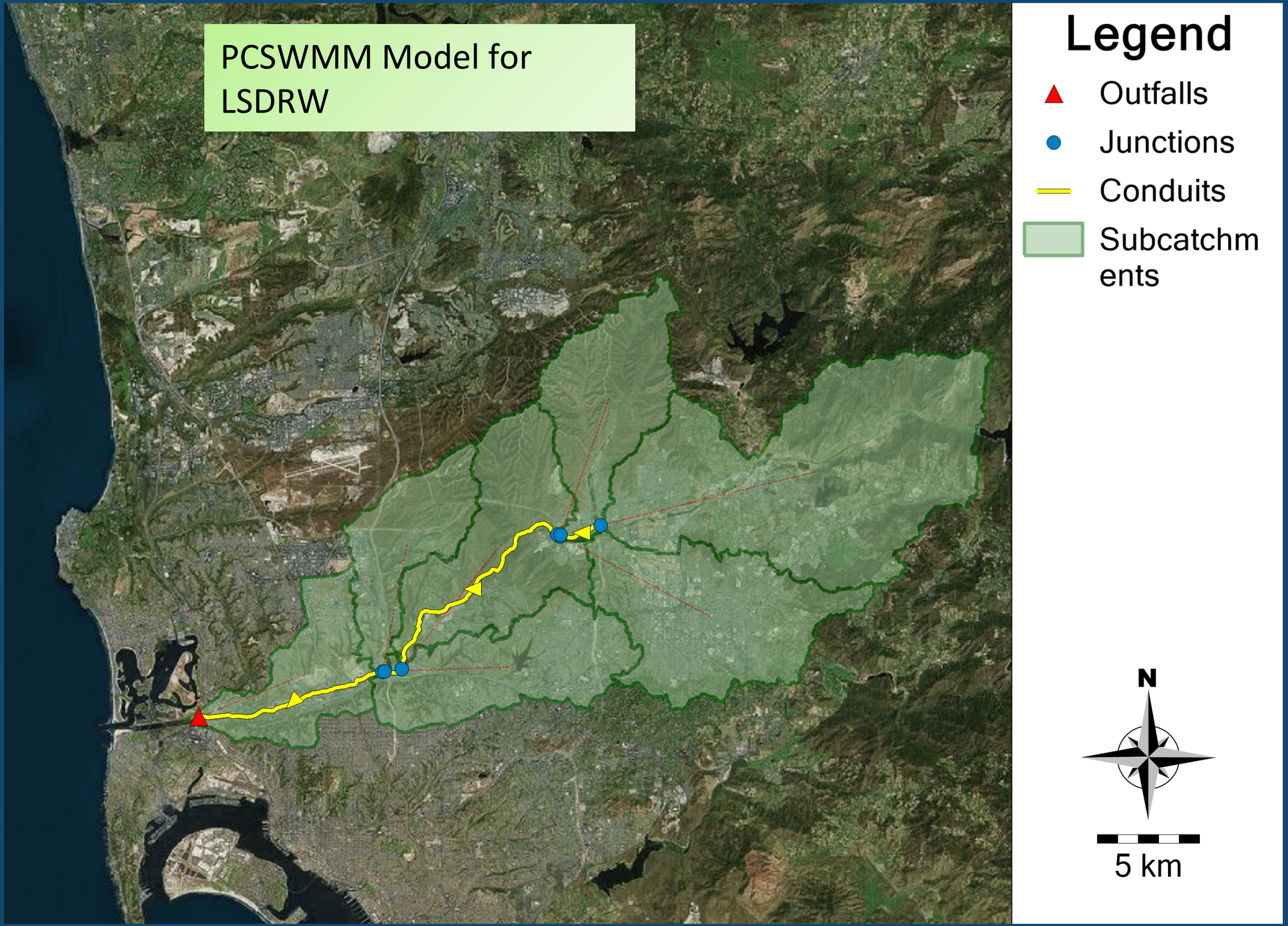
Catch Basin Insert for Trash Removal,
Courtesy of
http://unitedstormwater.com/images/installed_drainpac.jpg

Ballona Creek Trash Boom

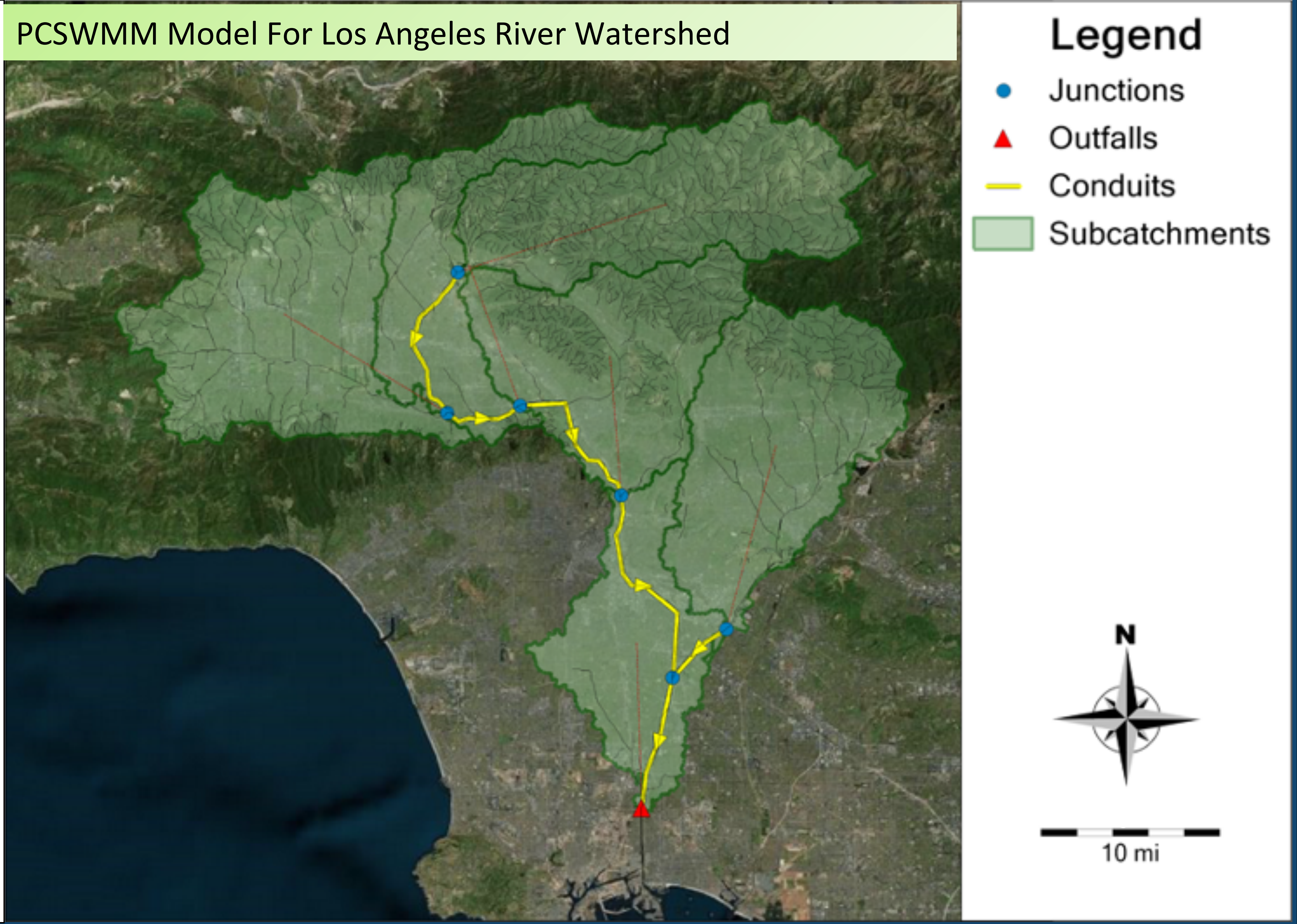
Courtesy of Richard Risemberg:
https://www.flickr.com/photos/rickrise/

Data Input for PCSWMM	Source
Digital Elevation Models	USGS Earth Explorer
Hourly Rainfall Data	NOAA Climate Data Online
Hydrologic soil groups	Soil Survey Geographic Database
Evaporation Data	The California Irrigation Management Information System (CIMIS)
Land Use Data	San Diego Association of Governments (SANDAG) /County of Los Angeles Public Works Website



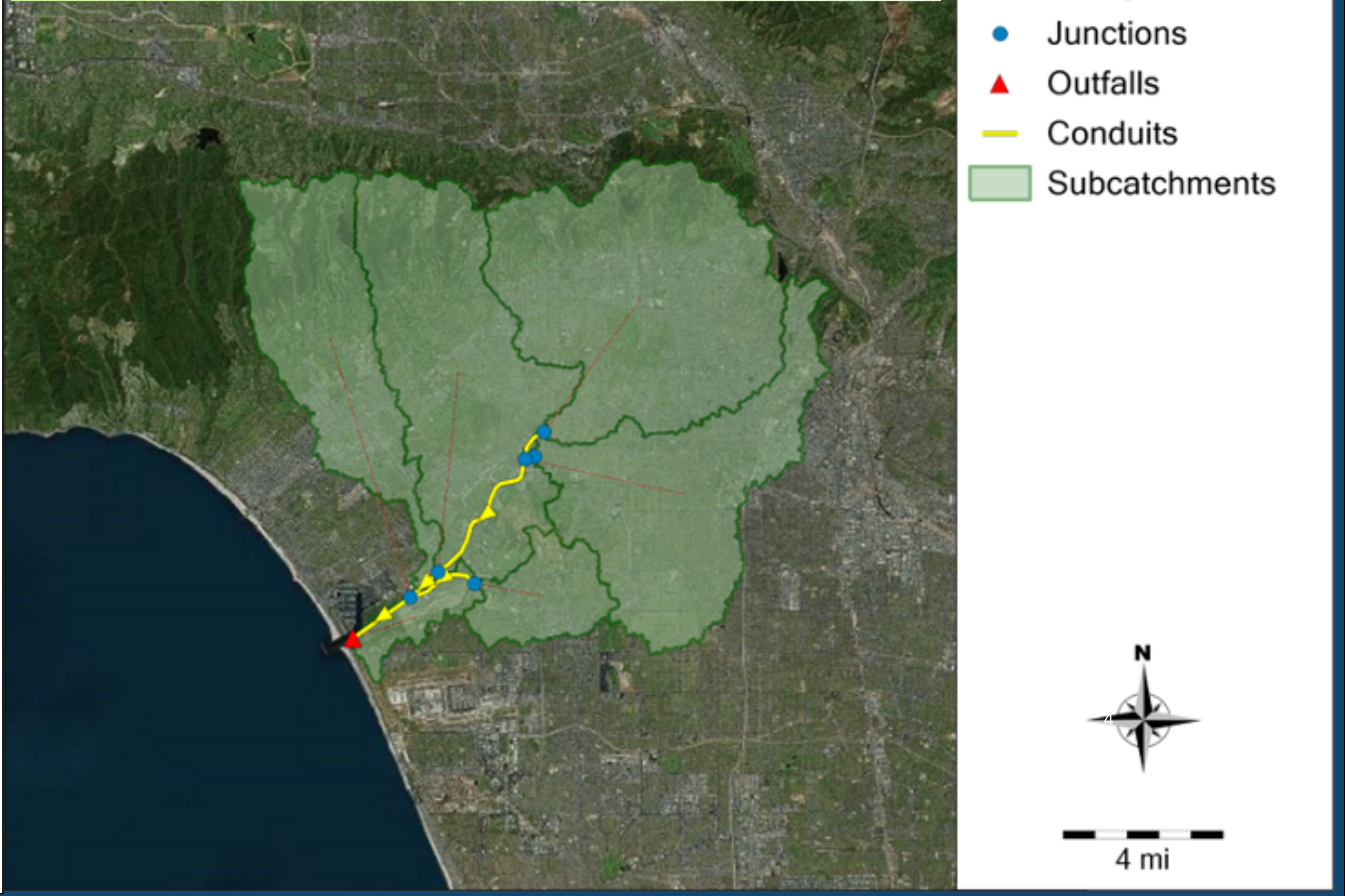


- **Total Area:** 834 sq. miles (533,760 acres)
- **Population:** ~9 million people
- **Percentage of Impervious Surfaces:** ~31 %
- **Land Use**:
  - 37% Residential
  - 8% Commercial
  - 11% Industrial
  - 44% Open Space
- **Mean Annual Rainfall:** ~21 inches



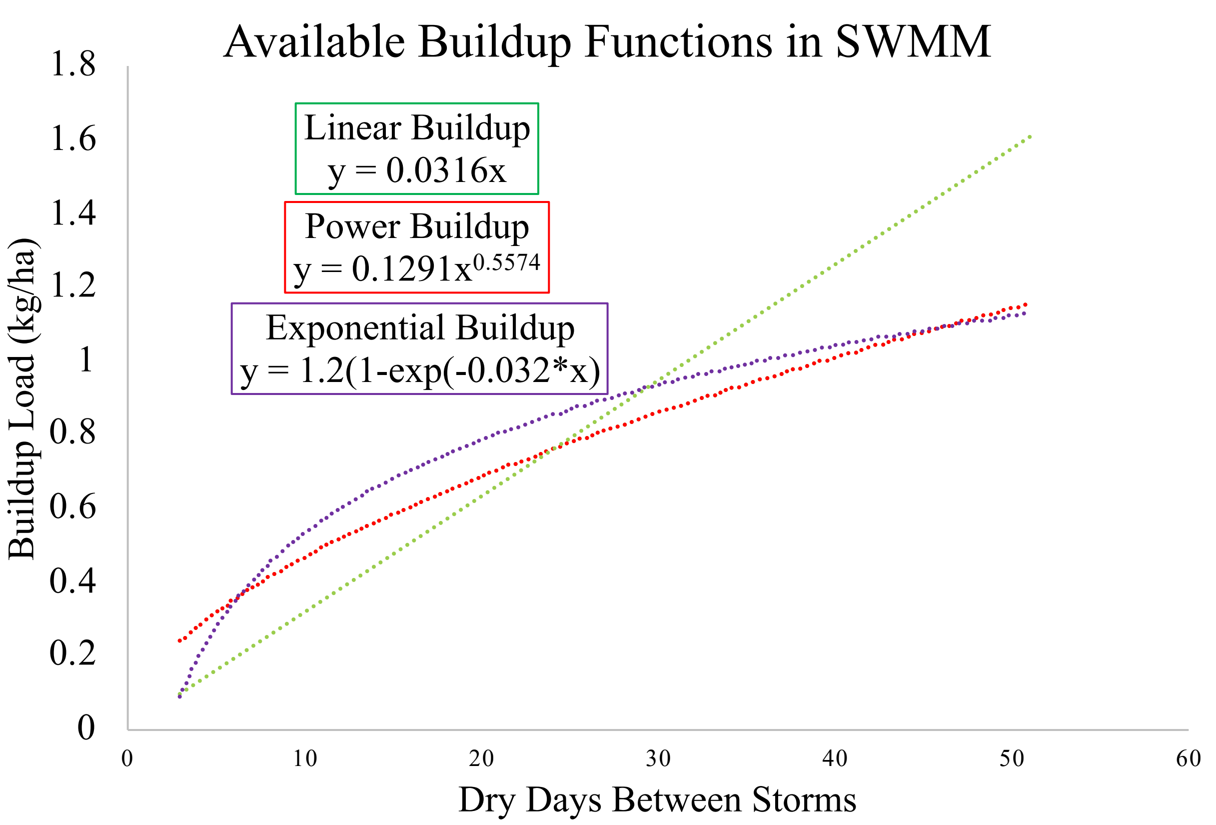
PCSWMM Model For Ballona Creek Watershed

- **Total Area:** 130 sq. miles (83,200 acres)
- **Population:** ~1.5 million people
- **Percentage of Impervious Surfaces:** ~65 %
- **Land Use:**
  - 64% Residential
  - 8% Commercial
  - 4% Industrial
  - 17% Open Space
- **Mean Annual Rainfall:** ~16.4 inches



Buildup and Washoff Governing Equations

- Various functions available in SWMM to simulate pollutant buildup and washoff
- Power buildup can follow a linear or nonlinear trend increasing with dry days
- With exponential washoff the washoff load is dependent on buildup mass available
- Buildup and washoff parameters developed using observed washoff load data



Power Buildup: $b = Min(B_{max}, K_B t^{N_B})$

where,

b	=	buildup, (*kg/ha*)
t	=	buildup time interval, (*days*)
B_{max}	=	maximum buildup possible (*kg/ha*)
K_B	=	buildup rate constant, ($\frac{kg}{ha-days}$)
N_B	=	buildup time exponent, dimensionless

Exponential Washoff: $w = K_w q^{N_w} B$

where,

w = rate of washoff (mg/hr)

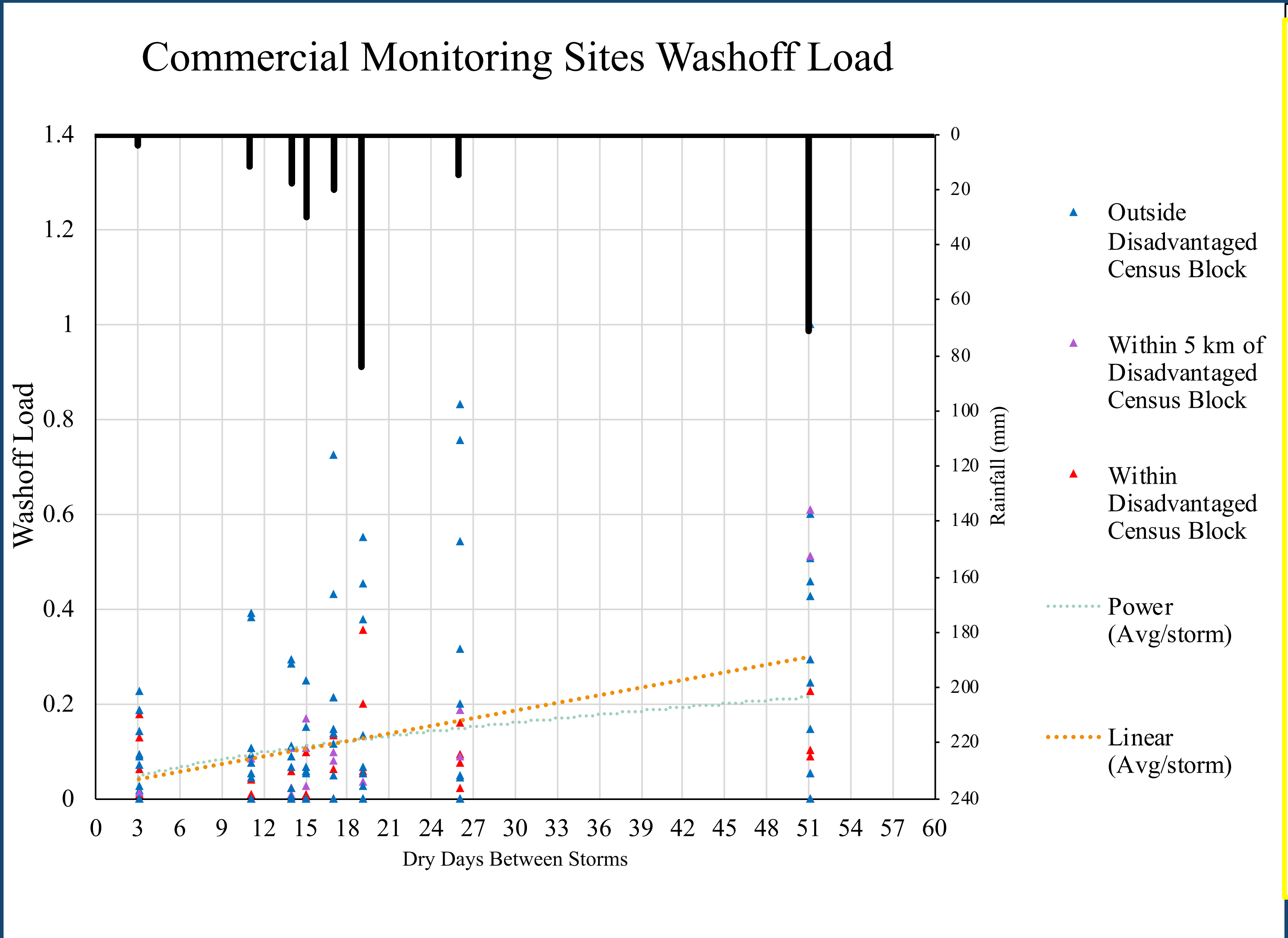
K_w = washoff coefficient (mm^{-1})

N_w = washoff exponent (unitless)

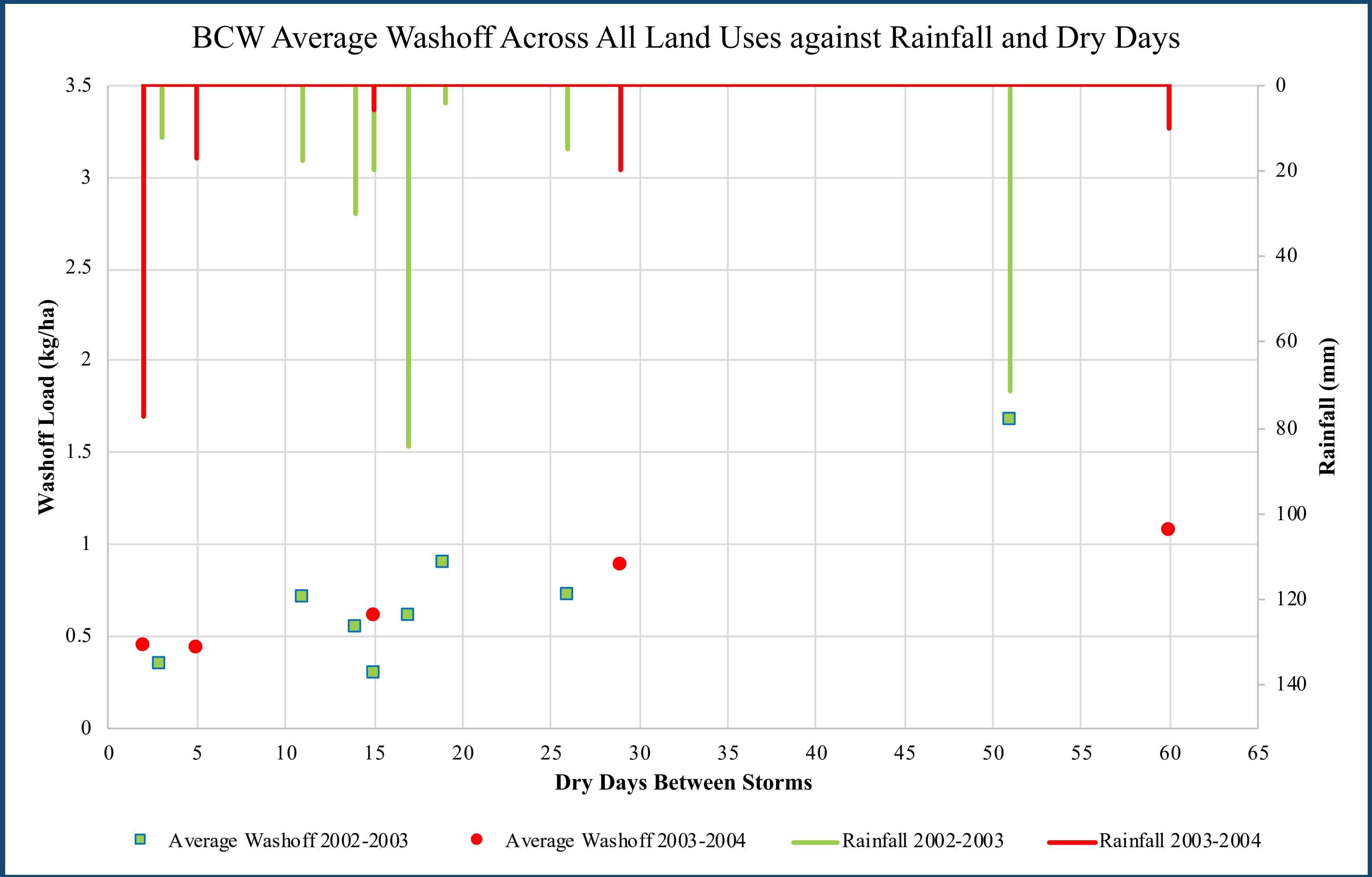
q = runoff rate per unit area (mm/hr)

B = pollutant buildup (kg)

TRASH FROM BALLONA CREEK YEAR 2002-2003



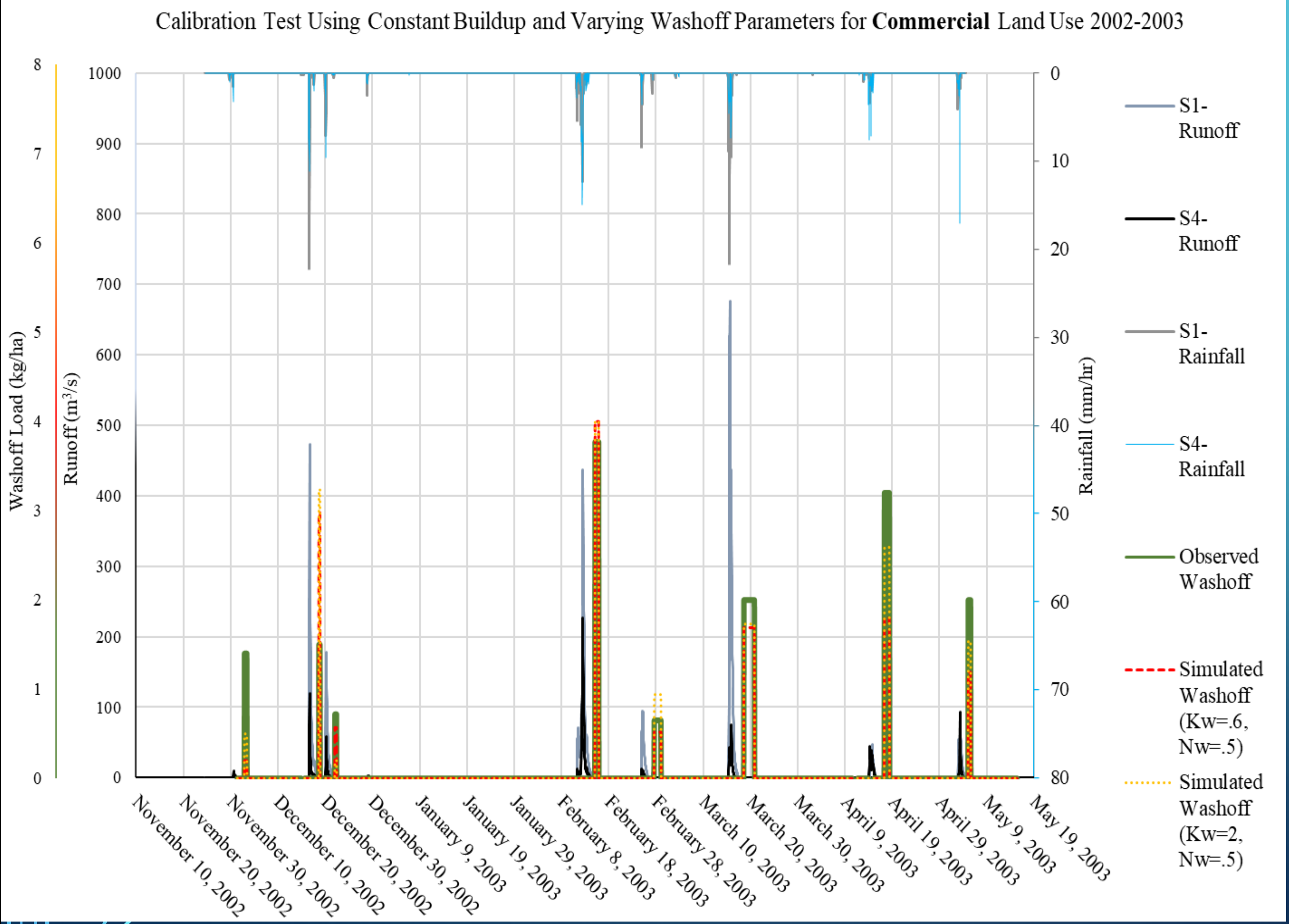
- **Highest rainfall did not produce highest washoff load**
- **High rainfall accompanied with longest accumulation period produced greatest washoff load**
- **There is an upward trend of washoff load with respect to increasing dry days.**
- **With this watershed and land use there is poor correlation between socioeconomic data and washed off litter**



- Figure shows two years of rainfall-washoff (load) for the BCW with observed data
- Different storm events are plotted nonsequential on the top axis.
- The storm events are plotted with total rainfall depth against dry days leading up to storm
- Storm events with similar buildup days but different washoff loads were used as the basis for developing washoff parameters

- The storm that occurred after 50 dry days (2002-2003) produced higher washoff loads than the storm after 60 dry days (2003-2004)
- This suggests that the increased rainfall was able to mobilize more of the available litter load

- First year rainfall **11.32 inches**, with a total load of **3714 lbs.**
- Second year rainfall **5.94** inches with a total load of **1622 lbs.**



- The horizontal axes shows rainfall-runoff for two subcatchments in the LARW
- S4 is further downstream than S1
- Simulated washoff is plotted with observed washoff for each storm in 2002-2003
- Washoff parameters were modified to test the sensitivity of washoff load with respect to washoff parameters.

Results

Watershed	Simulation Year	Total loading from PCSWMM (kg)	Total Loading per unit area (kg/ha)	Total Runoff Volume from PCSWMM (m^3)	Total Rainfall for Simulation Year (mm)
BCW	2002-2003	155,145	4.61	28,588,000	417.1
BCW	2003-2004	103,205	3.07	18,334,400	223.5
LARW	2002-2003	2,486,808	11.51	237,182,300	404.5
LARW	2003-2004	1,584,020	7.33	124,718,100	226.8
LSDRW	2002-2003	275,958	6.58	27,907,600	301.5
LSDRW	2003-2004	141,086	3.36	11,488,400	138.4

Future Work

- Validate LSDRW simulated results with field sampling
- Validate BCW with Ballona Creek Trash Interceptor

Thank you!

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