Santa Ana River Wasteload Allocation Model Update

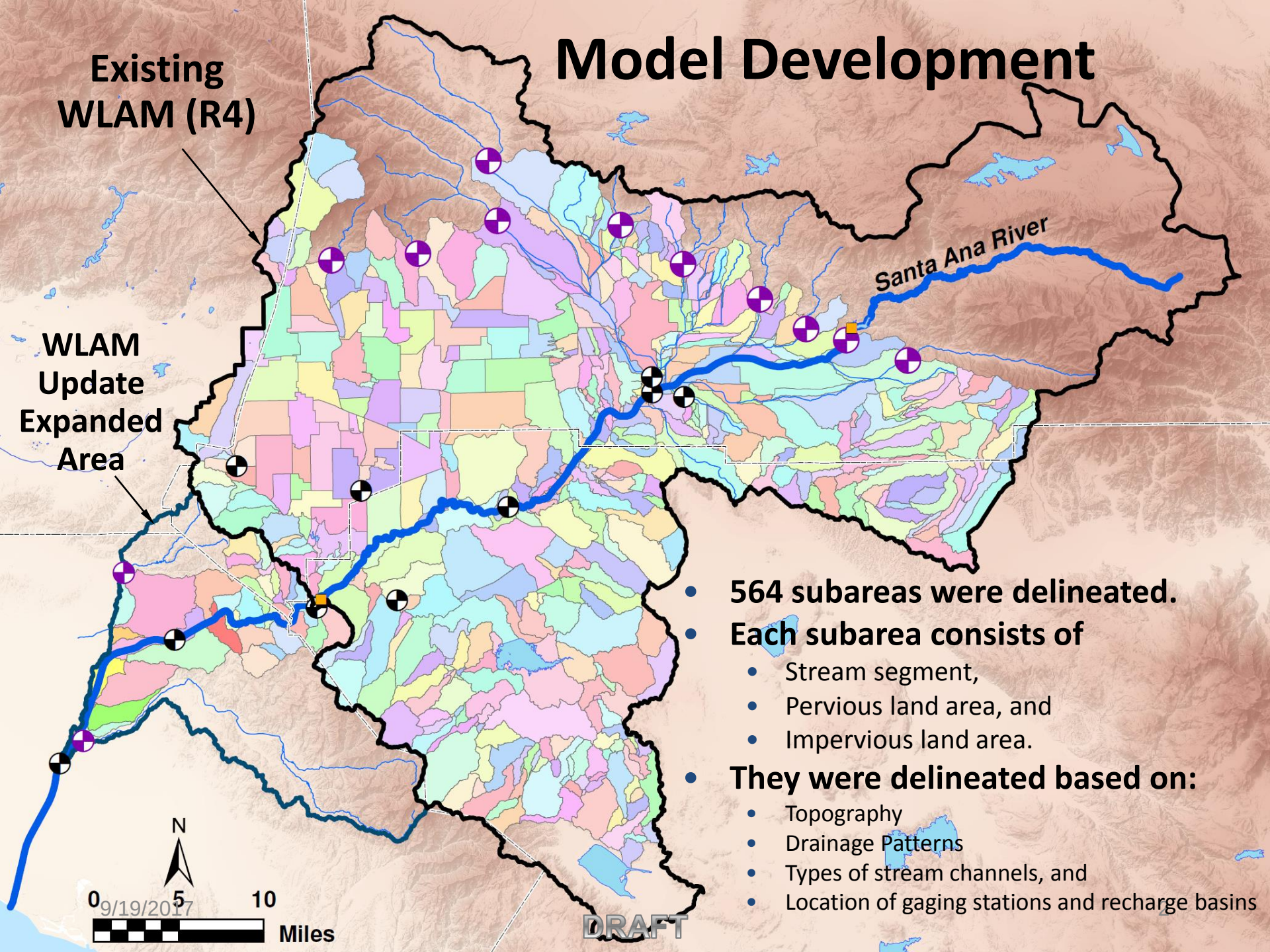
BASIN MONITORING PROGRAM TASK FORCE

September 19, 2017

SAWPA

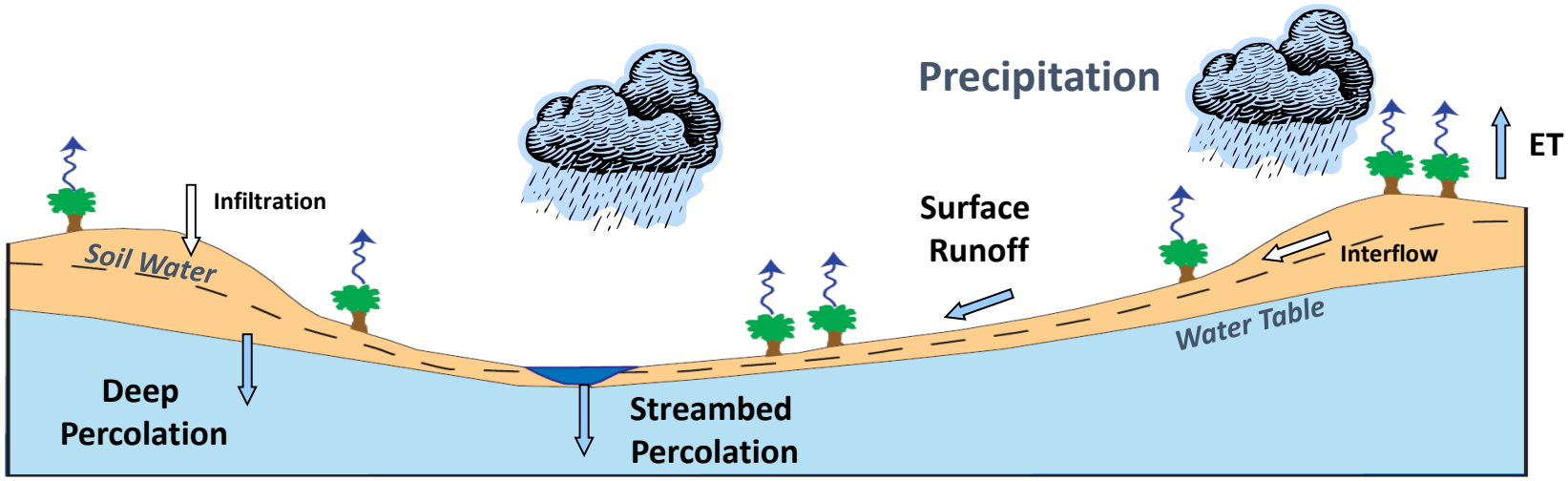
GEOSCIENCE

Model Development



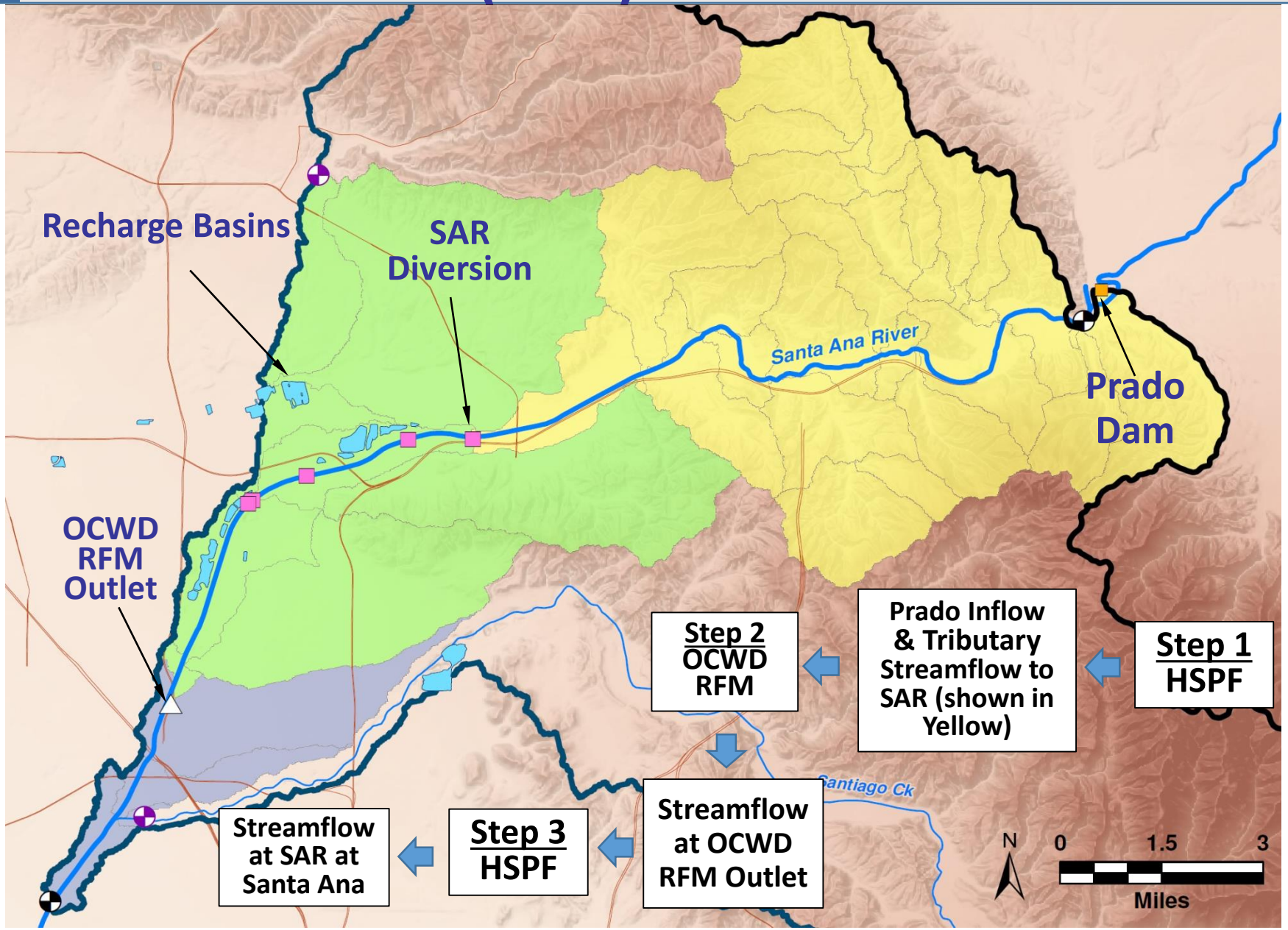
- **564 subareas were delineated.**
- **Each subarea consists of**
  - Stream segment,
  - Pervious land area, and
  - Impervious land area.
- **They were delineated based on:**
  - Topography
  - Drainage Patterns
  - Types of stream channels, and
  - Location of gaging stations and recharge basins

Hydrologic Simulation Program Fortran - HSPF



- Comprehensive & Physically Based,
- Simulates ALL Water Cycle Components & Water Quality,
- Supported & Maintained by Federal Agencies (EPA & USGS),
- Established Standard Guidelines and Calibration Performance Criteria,
- Windows-Based Interface with Powerful Pre- & Post- Processors, and
- Software is Free.

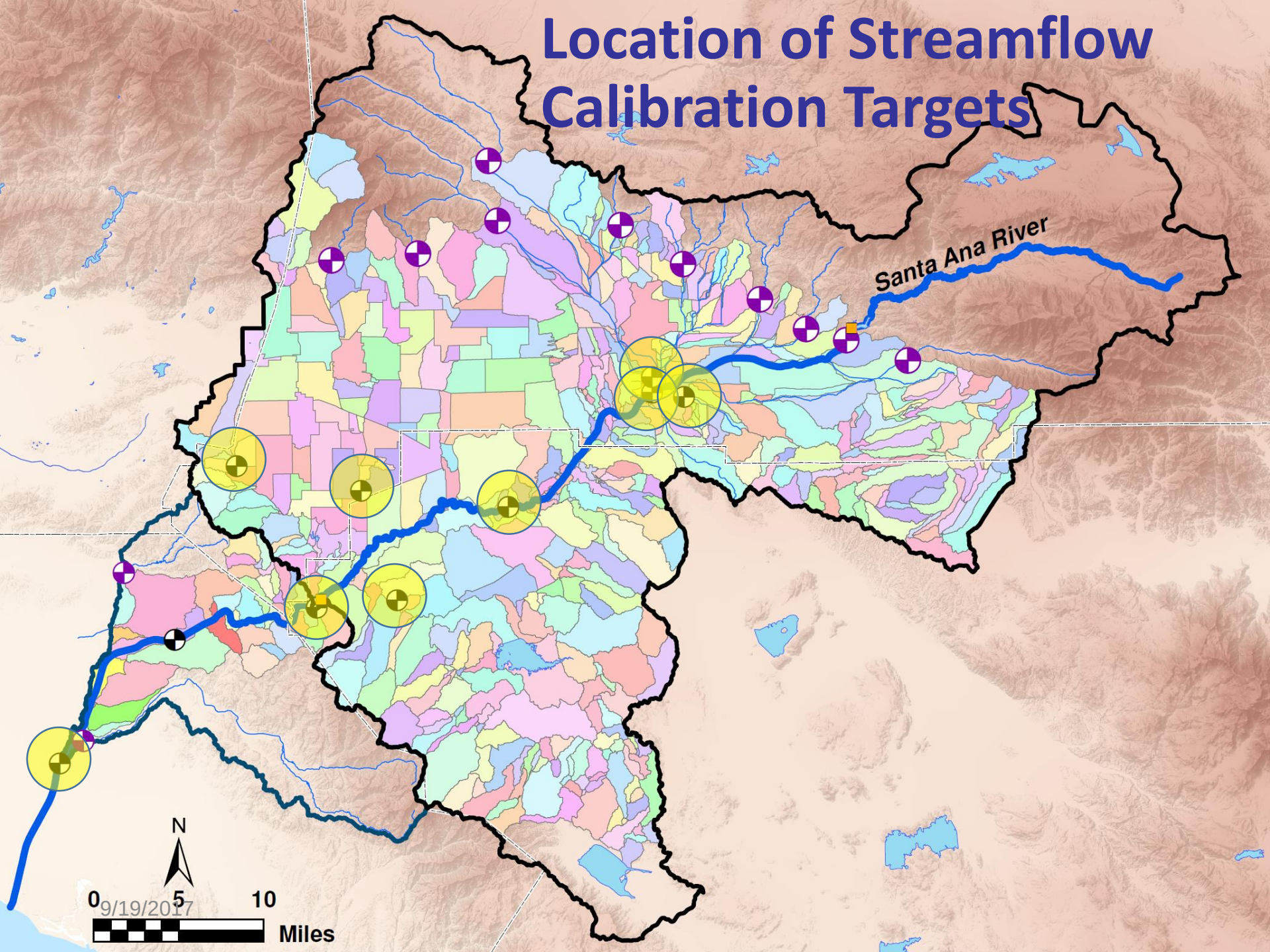
Coupling Process of HSPF and OCWD Recharge Facilities Model (RFM)



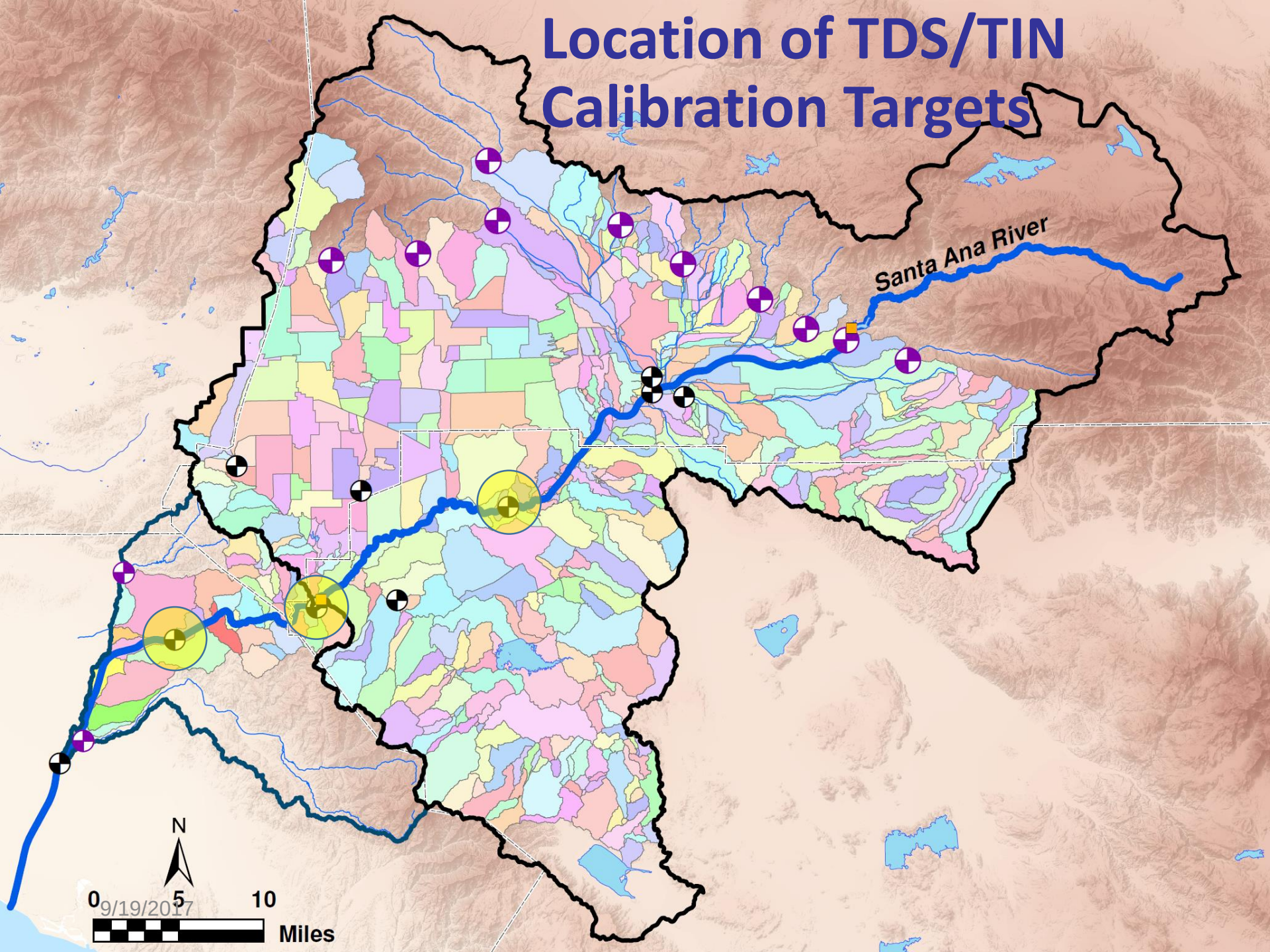
Calibration Process

- **Adjust model parameters until the model provides a reasonable match between the model-simulated and measured data.**
  - **Lower zone nominal soil moisture storage,**
  - **Base groundwater recession,**
  - **Fraction of groundwater inflow to deep recharge,**
  - **Fraction of remaining ET from baseflow,**
  - **Interflow inflow parameter,**
  - **Lower zone ET parameter,**
  - **Function tables (FTABLE) which includes physical information (shape, depth, width, slope, length, Manning Factor, and materials), and infiltration rates for reaches of each sub-watershed, and**
  - **Nitrogen reaction rate coefficient.**

Location of Streamflow Calibration Targets



Location of TDS/TIN Calibration Targets

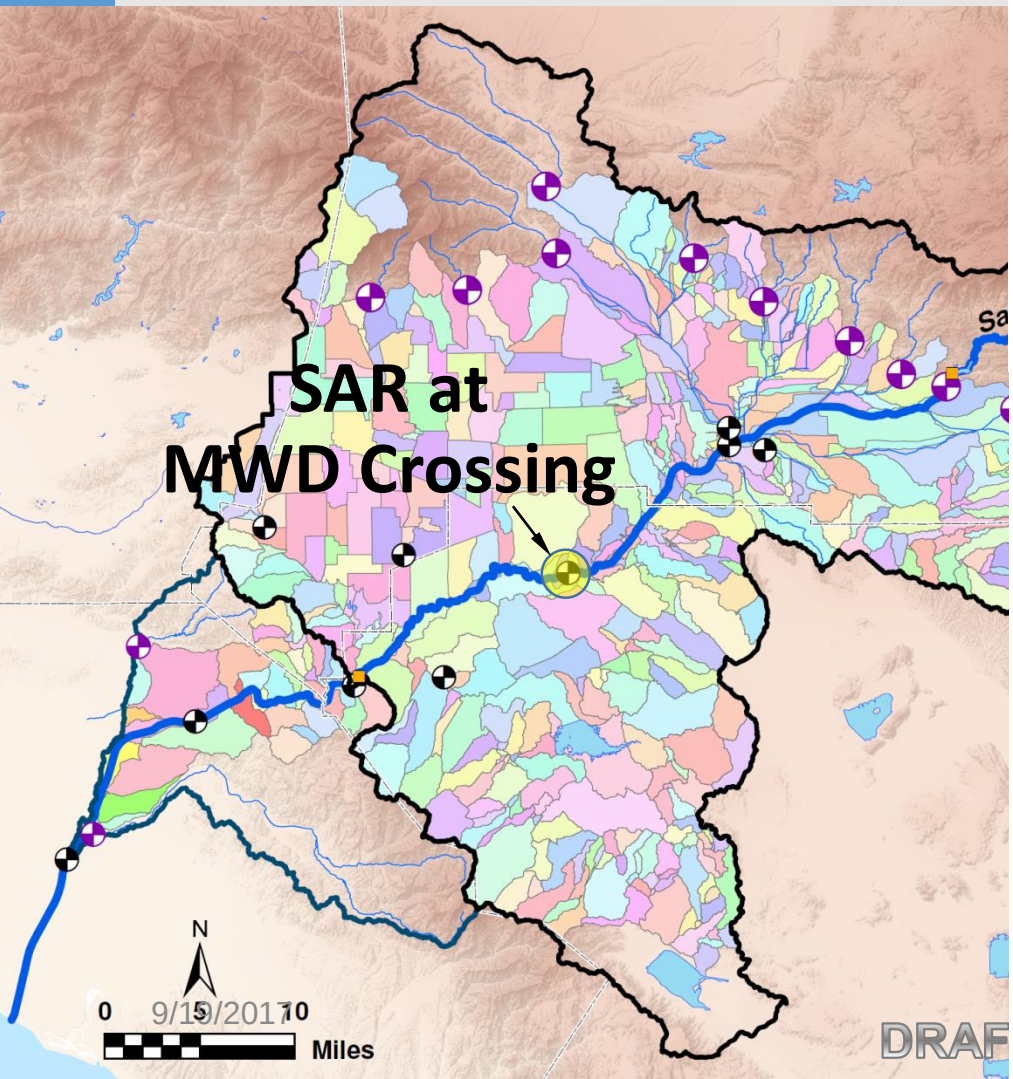


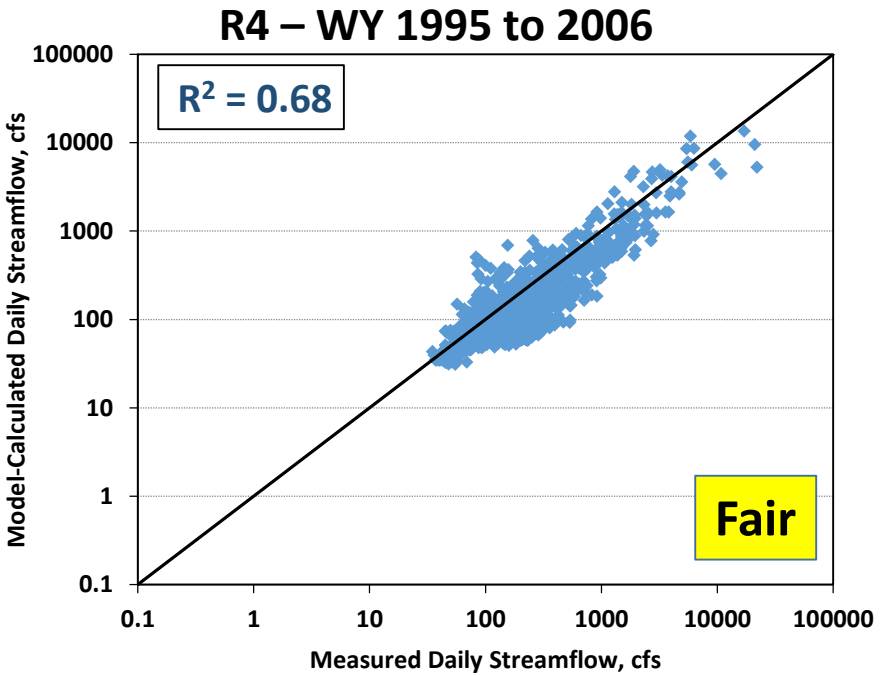
Calibration Performance Criteria

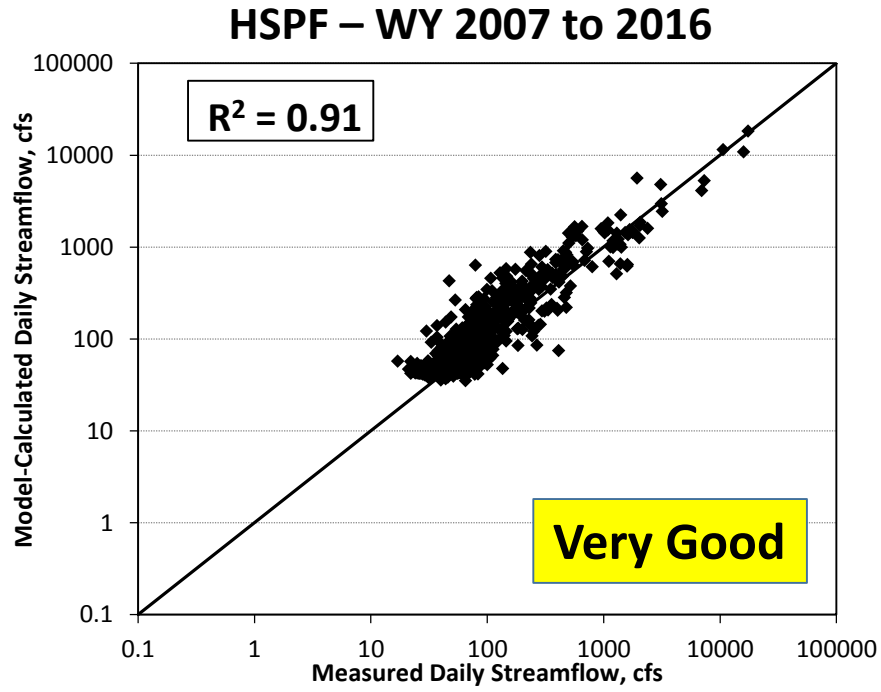
Type of Flow Data	R^2 (Goodness-of-Fit)	Calibration Performance
Daily Flow	$R^2 < 0.60$	Poor
Daily Flow	$0.60 < R^2 < 0.70$	Fair
Daily Flow	$0.70 < R^2 < 0.80$	Good
Daily Flow	$R^2 > 0.80$	Very Good
Monthly Flow	$R^2 < 0.65$	Poor
Monthly Flow	$0.65 < R^2 < 0.75$	Fair
Monthly Flow	$0.75 < R^2 < 0.85$	Good
Monthly Flow	$R^2 > 0.85$	Very Good

Source: Donigian (2002)

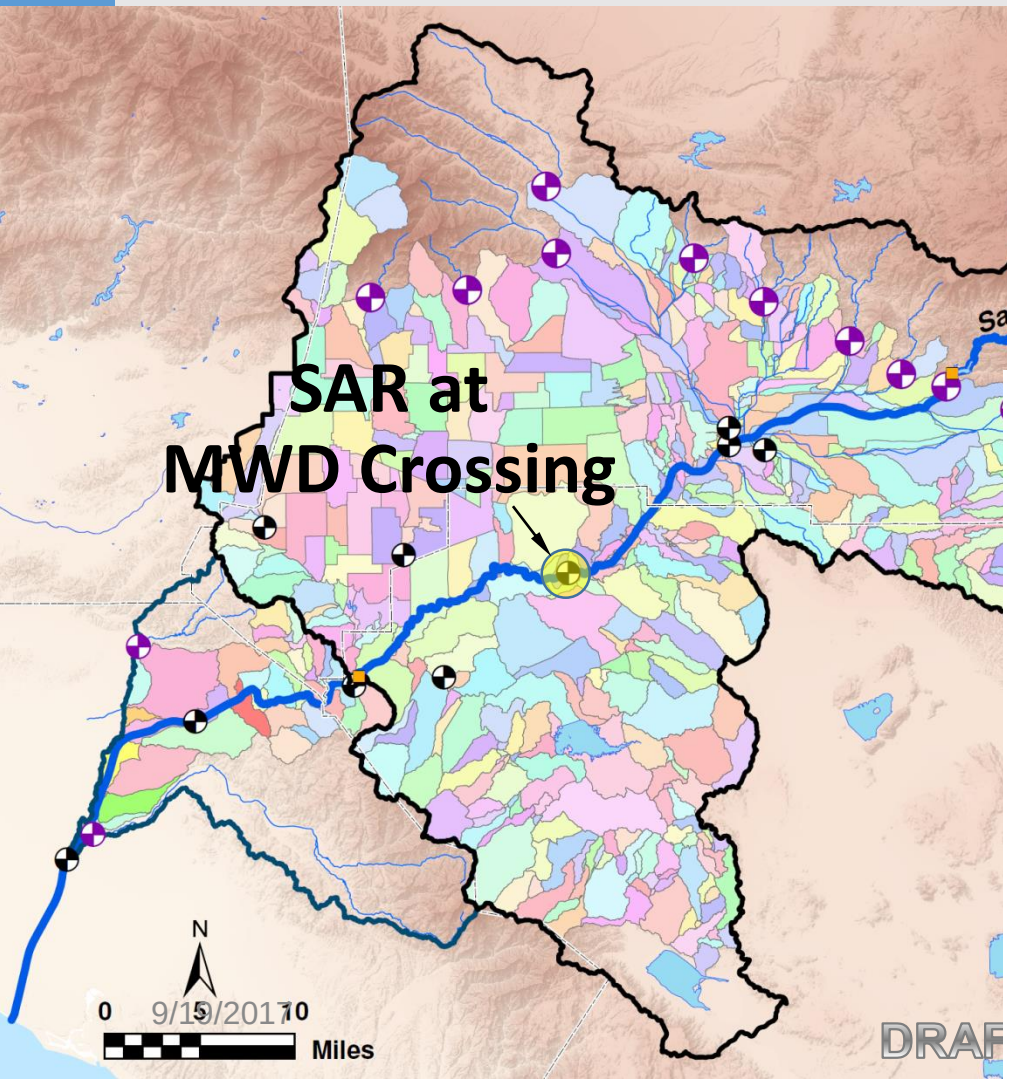
Existing WLAM (R4)
WLAM Update (HSPF)
Daily Streamflow

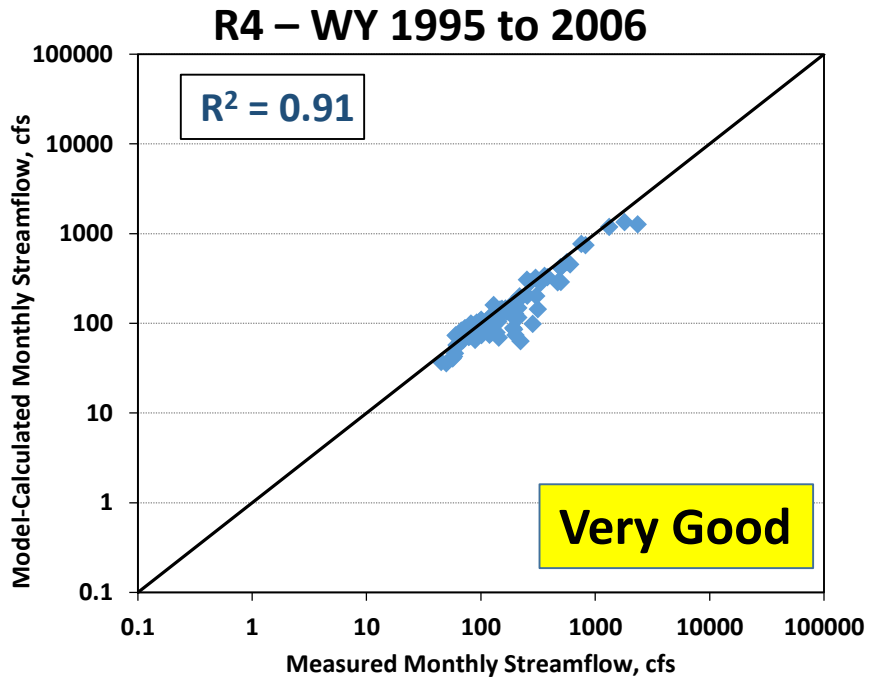


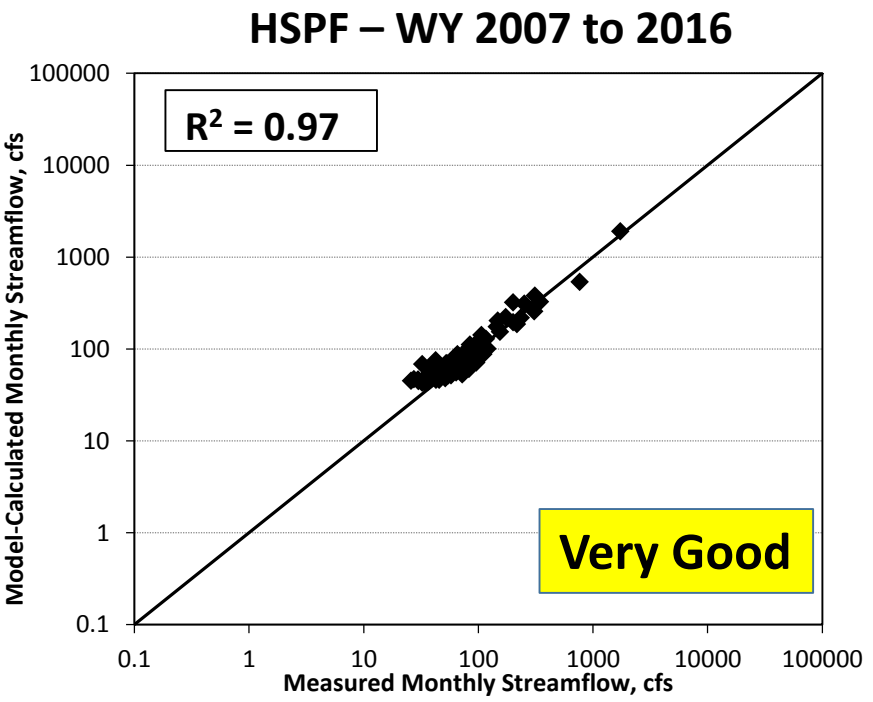




Existing WLAM (R4) WLAM Update (HSPF) Monthly Streamflow



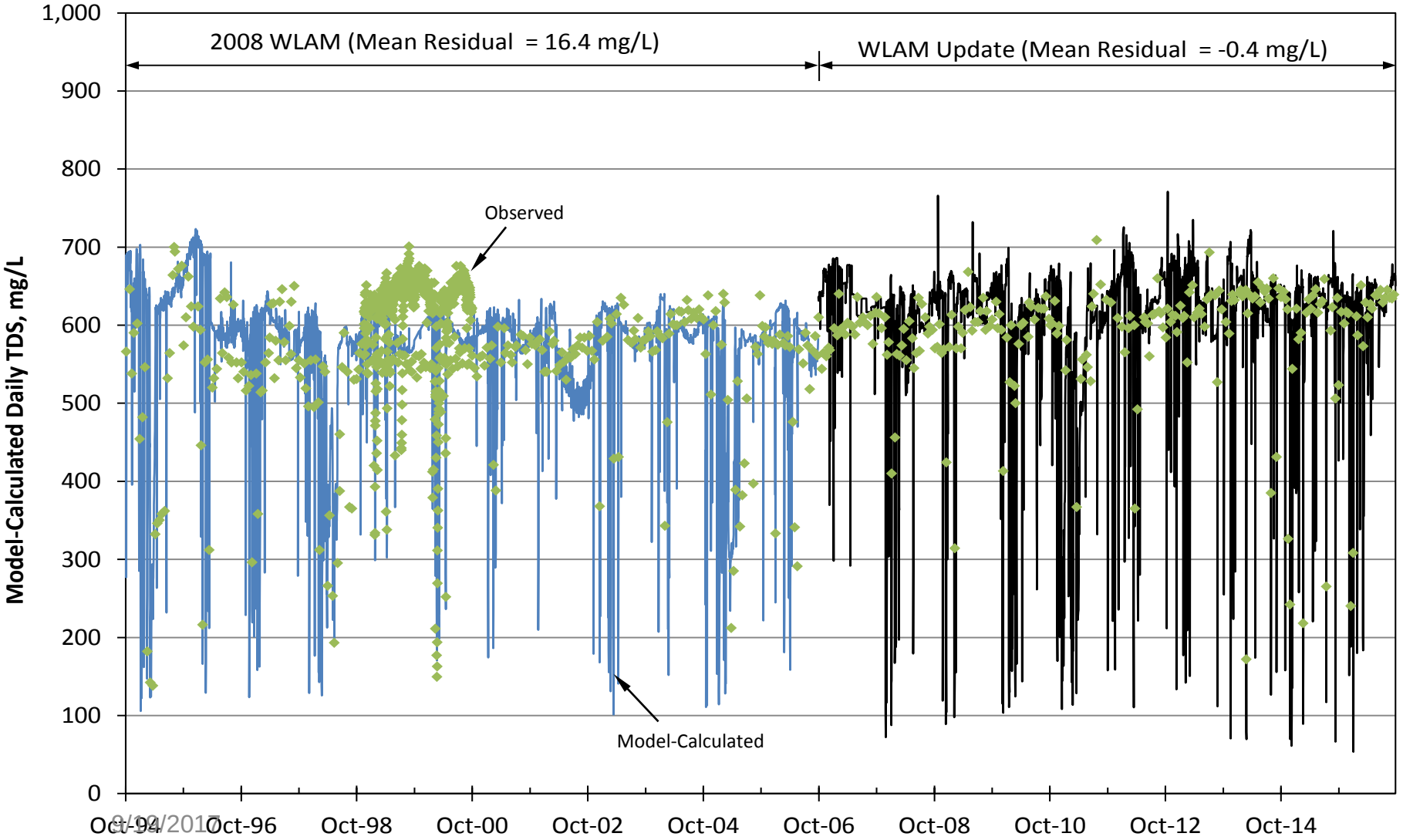




Summary of Streamflow Calibration Performance

Gaging Station	Daily Streamflow		Monthly Streamflow	
	2008 WLAM (R4) WY 1995-2006	WLAM Update (HSPF) WY 2007-2016	2008 WLAM (R4) WY 1995-2006	WLAM Update (HSPF) WY 2007-2016
San Timoteo Ck near Loma Linda	Good	Fair	Good	Fair
Warm Ck near San Bernardino	Fair	Fair	Fair	Very Good
Santa Ana River at E Street	Good	Very Good	Very Good	Very Good
Santa Ana River at MWD Crossing	Fair	Very Good	Very Good	Very Good
Temescal Ck at Main Street	Poor	Fair	Good	Poor
Chino Ck at Schaefer Avenue	Fair	Very Good	Good	Good
Cucamonga Ck near Mira Loma	Poor	Very Good	Good	Very Good
Santa Ana River into Prado Dam	Fair	Very Good	Very Good	Very Good
Santa Ana River at Santa Ana	NA	Poor	NA	Good

Daily TDS at Santa Ana River at MWD Crossing



Summary of TDS/TIN Calibration Performance

Gaging Station	TDS, mg/L		TIN, mg/L	
	2008 WLAM (R4) WY 1995-2006	WLAM Update (HSPF) WY 2006-2016	2008 WLAM (R4) WY 1995-2006	WLAM Update (HSPF) WY 2006-2016
Santa Ana River at MWD Crossing	16.4	-0.4	-0.45	-0.40
Santa Ana River below Prado Dam	20.7	-2.0	-0.07	-0.28
Santa Ana River at Imperial Highway near Anaheim	NA	7.8	NA	-0.21

Summary

- **The WLAM was updated with recent data and recalibrated from October 1, 2006 through September 30, 2016 (Water Years 2007 through 2016).**
- **The calibration results show:**
  - Good to very good performance at the majority of the streamflow gages .
  - The streamflow calibration performance for the WLAM update is equal to or better than the 2008 WLAM at nearly all gages.
  - TDS/TIN residuals from the WLAM update calibration are lower than the 2008 WLAM residuals for nearly all gages.
  - The results indicate a satisfactory model calibration.

Major Assumptions for Waste Load Allocation Scenarios

Scenario	Hydrology	Land Use	Maximum Discharge (Zero Recycled)	Planned Recycled / Discharge)	50% of Planned Recycled
A	WY 1950-2016	2012	X		
B				X	
C					X
D		General Plan (2040)	X		
E				X	
F					X

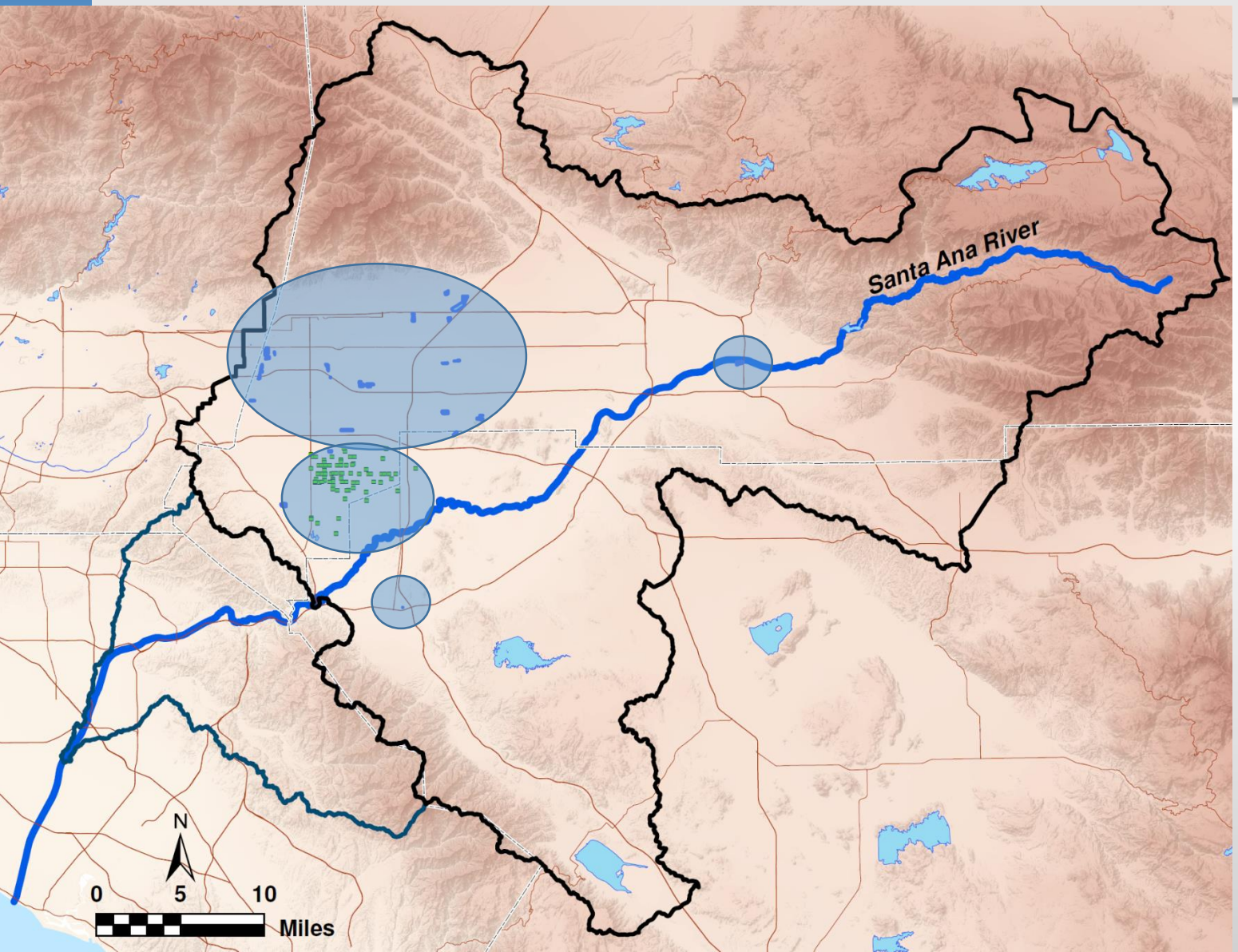
Discharge and Reuse Data

			City of Corona	City of Beaumont	City of Riverside	EVMWD		SBVMWD	WMWD
		Facility	WRF 1		RWQCP	WWTP 001	WWTP 002	SNRC (City Creek)	WRCRW
Discharge (MGD)	Current	Design	11.5	4	46	8	8	0	14
		Max	11.4	3.30975	31.2	8	8	0	7.76
		Ave	3.4	2.9696	26.8	0.5	4.52	0	6.44
		Min	1.5	2.4232	21.8	0.5	4.5	0	5.22
	2020	Design	11.5		46	12	12	7.5	14
		Max	11.5		33.8	12	12	7.5	10.3
		Ave	4.6		25	0.5	7	6.4	7
		Min	1.5		19	0.5	6.5	6	5.7
	2040	Design	15		46	16.8	16.8	7.5	14
		Max	15		46	16.8	16.8	7.5	15.3
		Ave	8.5		22.5	0.5	14	6.4	10
		Min	1.5		19	0.5	13	6	8.5
Reuse of Recycled Water (MGD)	Current	Max	7.1	In house only	1.8	0.3	0.3	0	0
		Ave	2.7	In house only	0.9	0.2	0.2	0	0
		Min	0	In house only	0.6	0.2	0.2	0	0
	2020	Max	10		10	0.45	0.45	7.5	7
		Ave	2.7		4	0.3	0.3	6.4	3
		Min	0		1	0.2	0.2	6	0
	2040	Max	13.5		20	0.63	0.63	7.5	7
		Ave	3.5		16.5	0.42	0.42	6.4	3
		Min	0		3	0.2	0.2	6	0
Water Quality (mg/L)	TIN	Current Discharge Permit	10	6 / 3.6	10	13	NA	NA	10
		12-mos. Average	5.5 / 5.2	4.34	4.5	2.5	NA	NA	2.2
		Est. 12 mos. Average in 2040	5.5 / 5.2		10	Unknown	Unknown	6	2.2
	TDS	Current Discharge Permit	700 / 770	400 / 300	650	700	700	NA	625
		12-mos. Average	655 / 683	434	623	686	686	NA	529
		Est. 12 mos. Average in 2040	655 / 683		650	Unknown	Unknown	463	529

Discharge and Reuse Data

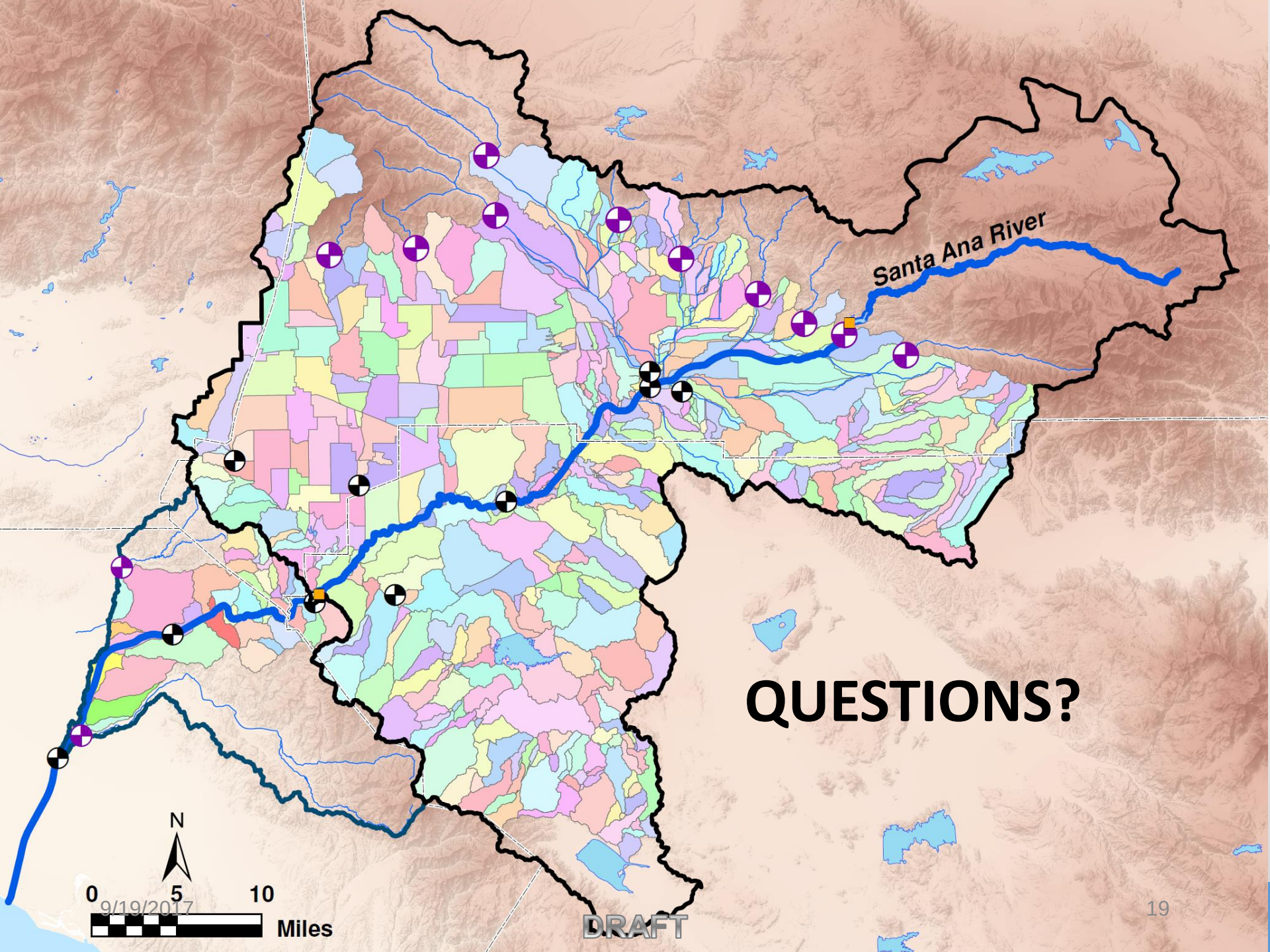
		Facility	EMWD	IEUA	City of Redlands	City of San Bernardino	YVWD
Discharge (MGD)	Current	Design					
		Max					
		Ave					
		Min					
	2020	Design					
		Max					
		Ave					
		Min					
	2040	Design					
		Max					
		Ave					
		Min					
Reuse of Recycled Water (MGD)	Current	Max					
		Ave					
		Min					
	2020	Max					
		Ave					
		Min					
	2040	Max					
		Ave					
		Min					
Water Quality (mg/L)	TIN	Current Discharge Permit					
		12-mos. Average					
		Est. 12 mos. Average in 2040					
	TDS	Current Discharge Permit					
		12-mos. Average					
		Est. 12 mos. Average in 2040					

Evaluation of Wastewater Recharge in Percolation Ponds – Pilot Program



GEOSCIENCE

- City of Redlands,
- Coty of Corona,
- IEUA, and
- Dairy ponds in Chino-North GMZ



QUESTIONS?