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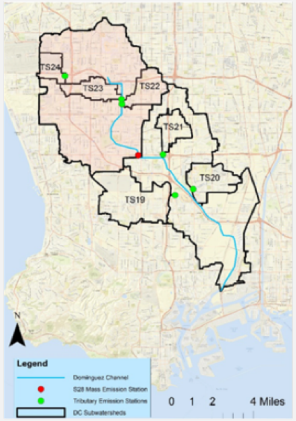
HYDROLOGY & HYDRAULIC MODELING: OVERVIEW, RELEVANT WORK & DATA GAPS

Drs. Terri Hogue, Colin Bell, Nasrin Alamdari, Jordy Wolfand

HOGUE HYDROLOGY GROUP

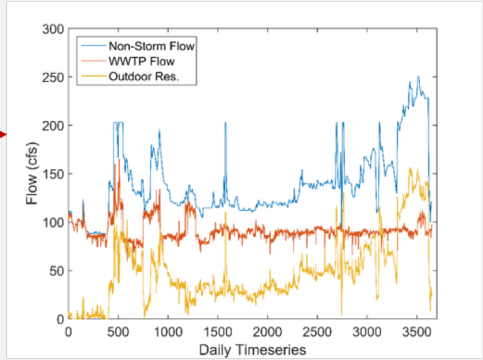
Overall Process



Models

Scenario	Description
1	WRP
2	WRP + stormwater
3	WRP + conservation
4	WRP + stormwater + conservation

Scenarios



Time series output

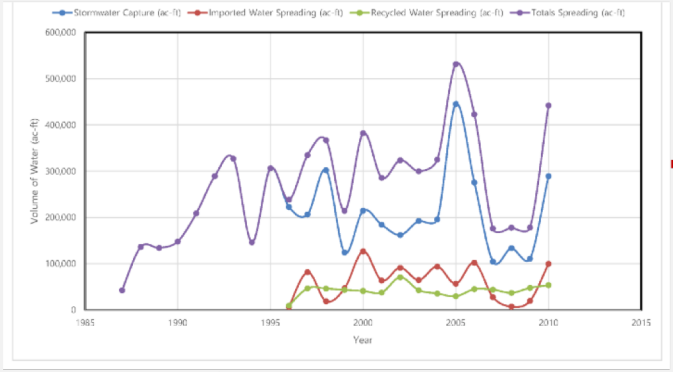
Hydrologic

- Minimum annual flow
- Duration of consecutive minimum annual flow
- Frequency of high winter flows Oct-March
- Frequency of Spring flush flows march-June
- Date of latest flood during the winter
- Decrease in flow per day in Spring following last Winter flood
- Magnitude of summer base flow

Hydraulic

- Presence of riffle (moderate depth, swift current, course substrate) habitat in Spring for spawning
- Percent of habitat as edgewater, riffle, and pools in the Spring and Summer
- Minimum and maximum bottom velocity in the Spring and summer
- Minimum depth of water in Spring, Summer, and Fall

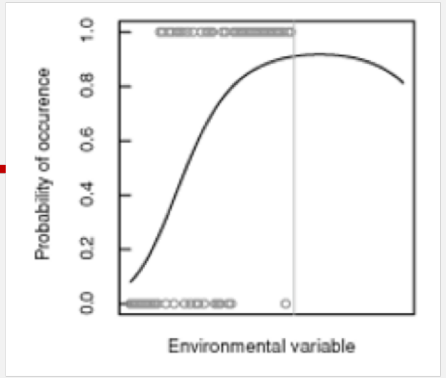
E-flow metrics



Mitigation measures

- **Flow Criteria**
  - ✓ **by reach and season**
- **Management/mitigation recommendations**

Agreed upon criteria



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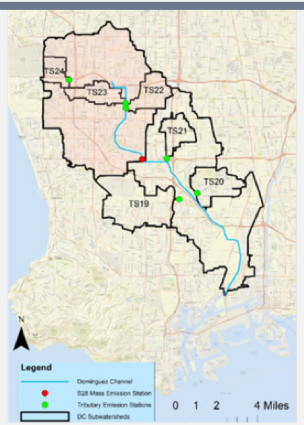

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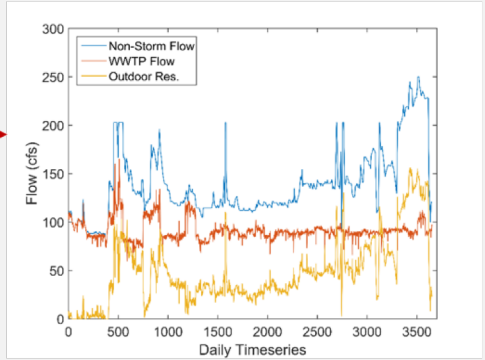

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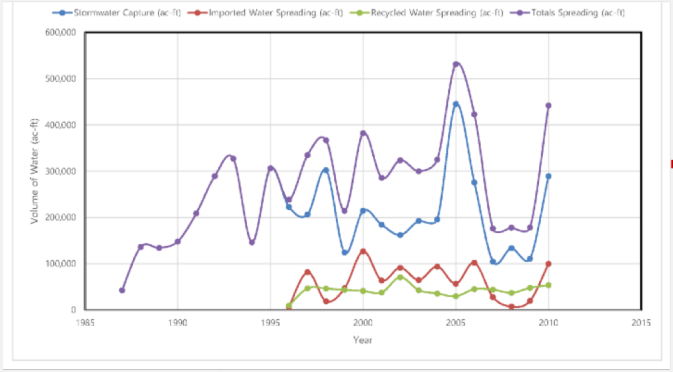

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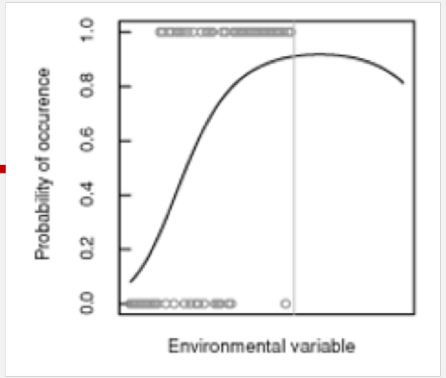

Processes to Model

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HYDROLOGY (Runoff / Point Sources / Diversions)

- Model for scenario testing

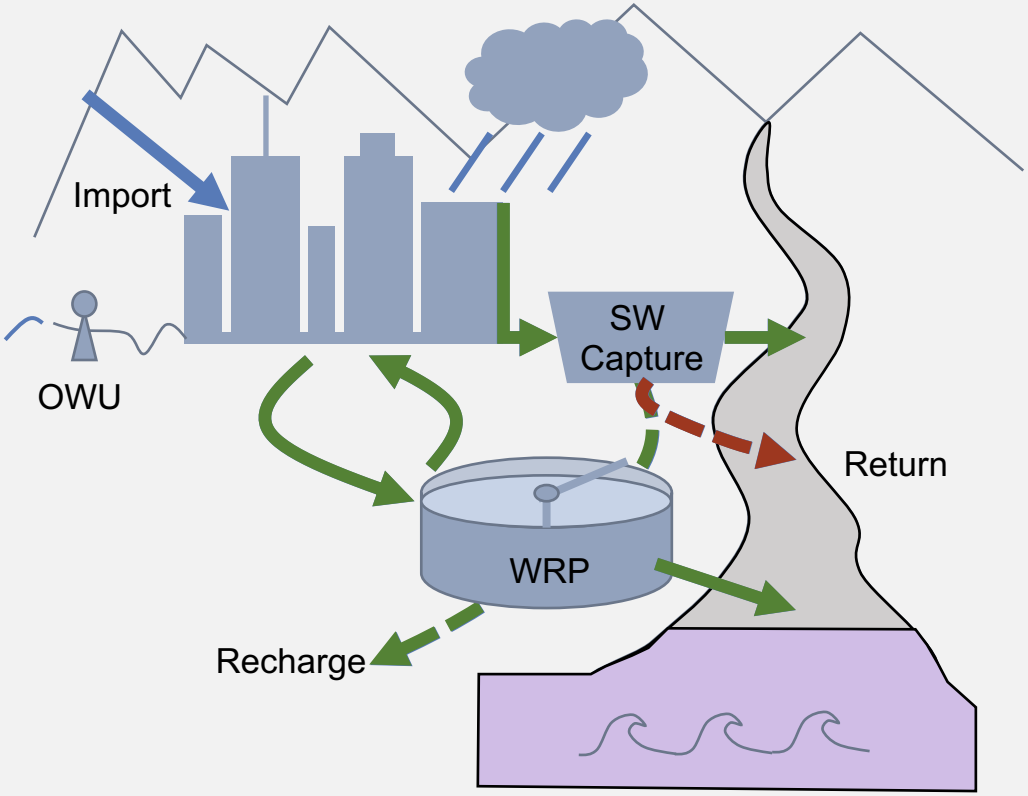
HYDRAULICS (Channel flow)

- Model to generate ecologically-relevant parameters in LA River

GROUNDWATER

TIDAL HYDRODYNAMICS

- Model to generate ecologically-relevant parameters in tidal portion of LA River



Literature Review

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Study	Year	Institution
Water Resources Action Plan	2009	POLA, POLB
LA Basin Study - Task 3.2	2013	LACFCD
LA Basin Study - Task 2	2014	LACFCD
LAR Restoration Study	2015	USACE
Upper LAR EWMP	2015	ULAR EWMP Group
Stormwater Capture Master Plan	2015	LADWP
Urban Water Management Plan	2015	LADWP
LA Sustainable Water: LAR Watershed	**2017**	**LASAN, UCLA, CSM**
Burbank Wastewater Change Petition	2017	Burbank
WRAP Model Development	2017	POLA, POLB
Glendale Wastewater Change Petition	2018	Glendale
One Water Plan: Volume 2: Wastewater	2018	LASAN, LADWP
One Water Plan: Volume 3: Stormwater	2018	LASAN, LADWP
One Water Plan: Volume 4: LAR Flow Study	2018	LASAN, LADWP

Summary of Help Requested from TAC

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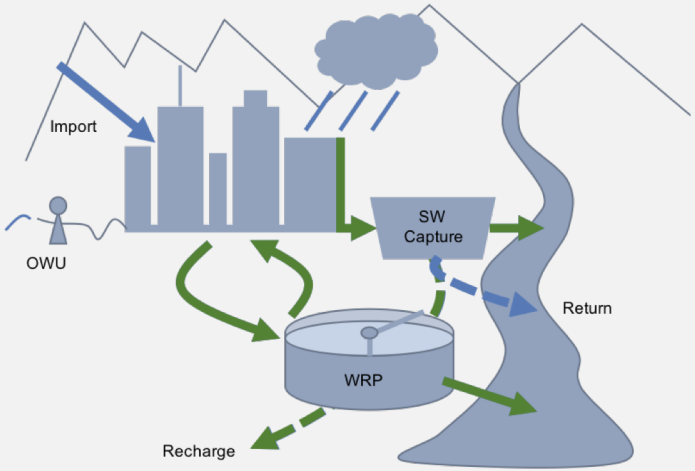
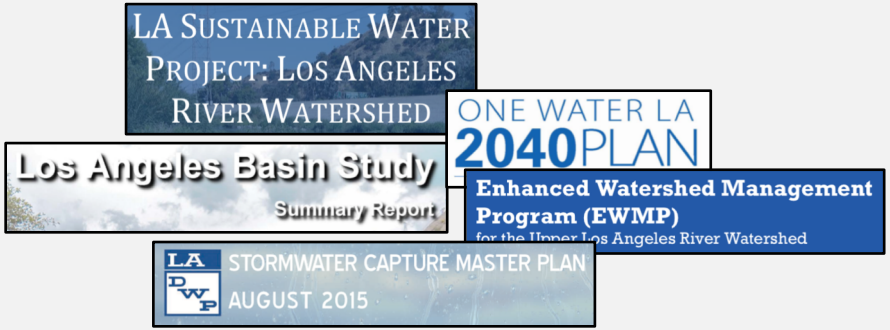
Processes	Guidance from TAC	Modeling Options	Specific Questions / Data Needs
Hydrology	• Choose a hydrology model	• County LSPC model OR • Our SWMM	• When was the last LSPC update? • How was it calibrated? • Acquire LSPC model instances
Hydraulics	• Choose hydraulic model	• Couple hydrology to USACE HECRAS model OR • Recreate HECRAS in SWMM/LSPC	• Does LSPC have channel hydraulics? • Acquire HECRAS model + documentation
Groundwater	• Identify and evaluate existing groundwater models	• Invoke shallow groundwater routines in hydrologic model • Couple hydrology to MODFLOW	• Does LSPC have shallow groundwater model? • Other studies unknown to us?
Tidal Portion Hydrodynamics	• Choose model for tidal portion of River	• Run full WRAP model OR • Use HECRAS	• Can we acquire WRAP model? • Extent of HECRAS model and tidal influence

Hydrology





GUIDANCE NEEDED FROM TAC

- Choose hydrologic model

OPTIONS

- LSPC (WMMS)
  - Pros: Most common in LAR; instances with centralized stormwater capture
- SWMM+SUSTAIN
  - Pros: CSM familiarity; work coupling to groundwater model for parallel project

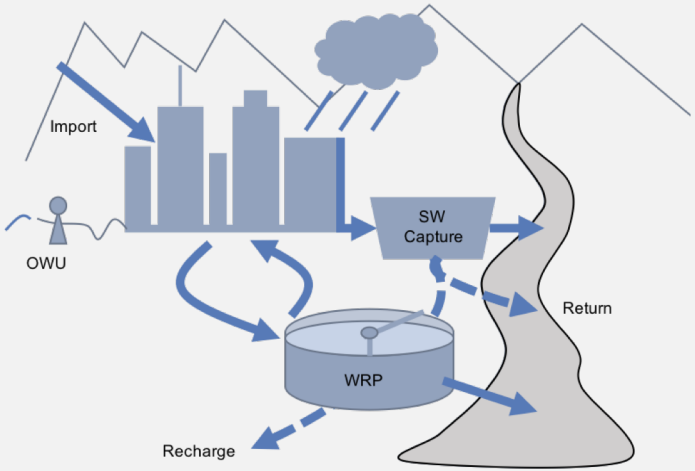
SPECIFIC QUESTIONS

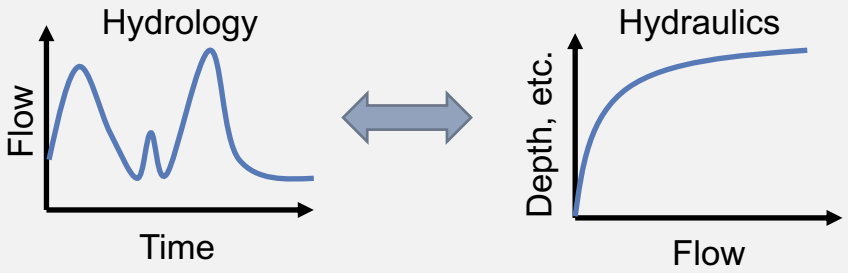
- Last LSPC update? Calibration methods? Run time?

DATA NEEDS

- Acquire LSPC model instances; documentation

Hydraulics





GUIDANCE NEEDED FROM TAC

- Choose hydraulic model

OPTIONS

- Couple hydrologic model to USACE HECRAS model
  - Pros: HECRAS model exists; computation time
- Build into SWMM or LSPC
  - Pros: Single software

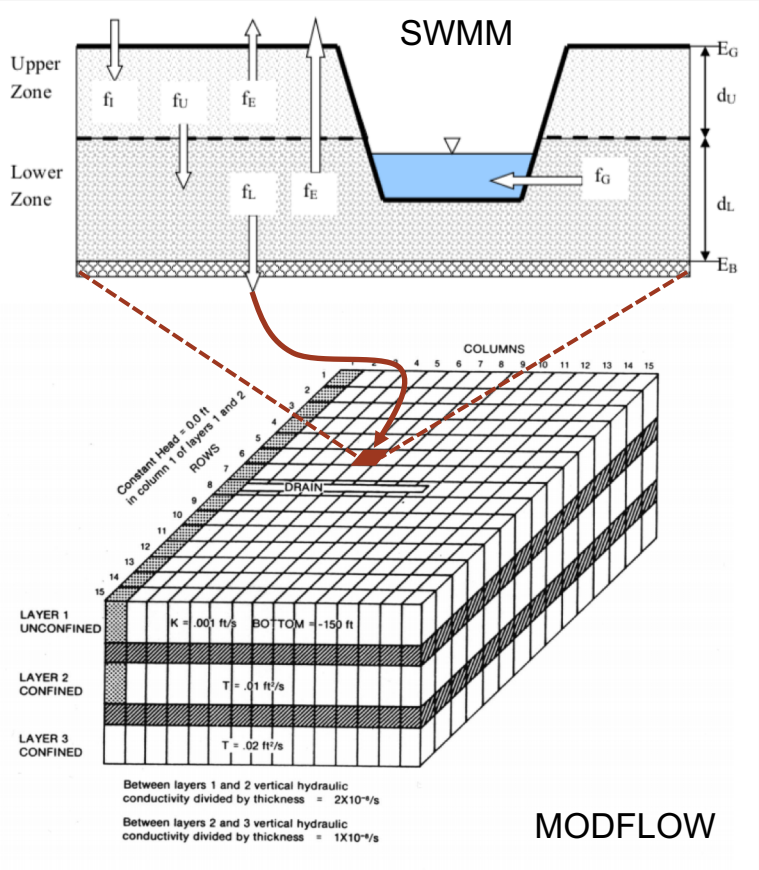
SPECIFIC QUESTIONS

- Does LSPC have channel hydraulics?

DATA NEEDS

- Acquire USACE HECRAS model

Groundwater



GUIDANCE NEEDED FROM TAC

- Information on other coupled groundwater models or studies

OPTIONS

- Use shallow groundwater model in surface hydrology model
- Couple surface hydrology to subsurface

SPECIFIC QUESTIONS

- Does LSPC have shallow groundwater model invoked/calibrated?

DATA NEEDS

- ?

Tidal Hydrodynamics

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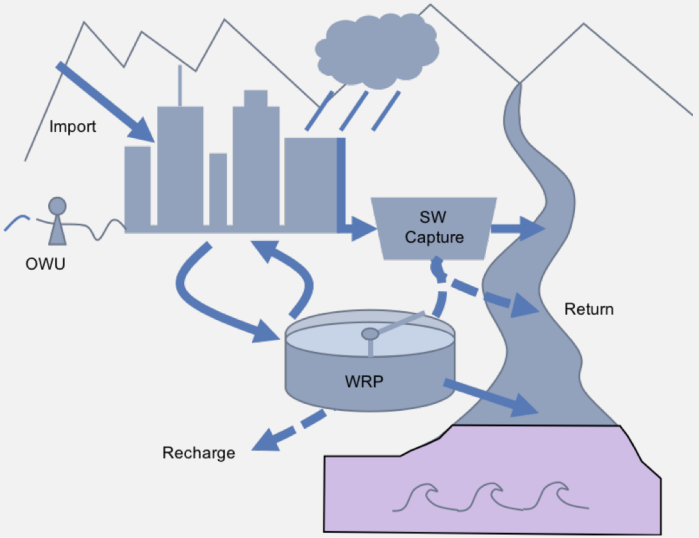

GUIDANCE NEEDED FROM TAC

- Choose model for tidal portion

OPTIONS

- Run WRAP Model
  - Pros: Robust and calibrated model
- Other simpler model (HECRAS)
  - Pros: Simpler; less computation

SPECIFIC QUESTIONS

- Where is tidal limit of LAR? Where does HECRAS model end?

DATA NEEDS

- WRAP model

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CONTACT

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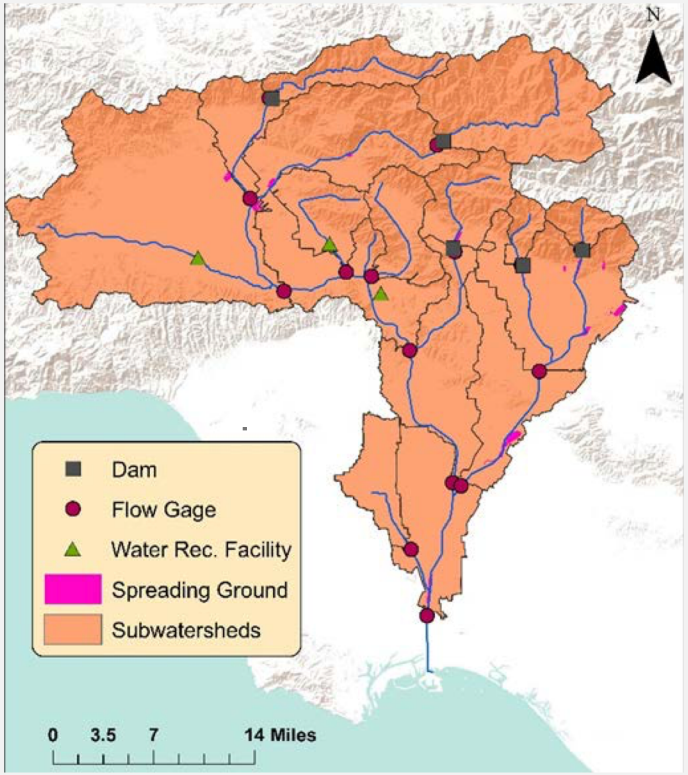
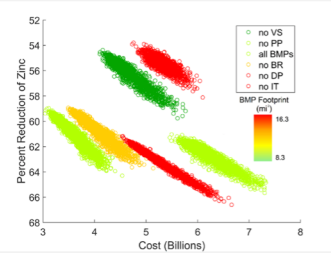
EXTRA SLIDES

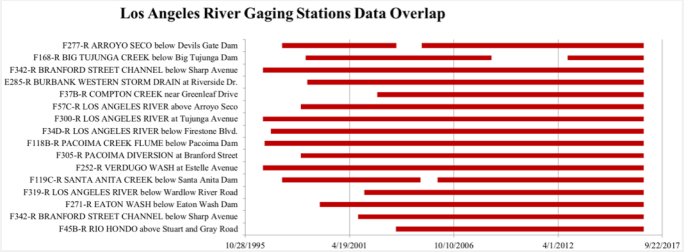
CSM's Existing LAR Model



- In EPA SWMM+SUSTAIN
- Updated to 2016
- 15 subwatersheds
- Dams/diversions
- Water Reclamation Plant (WRP) discharges
- Projected distributed stormwater BMPs
- Coupling to groundwater model (*ongoing*)

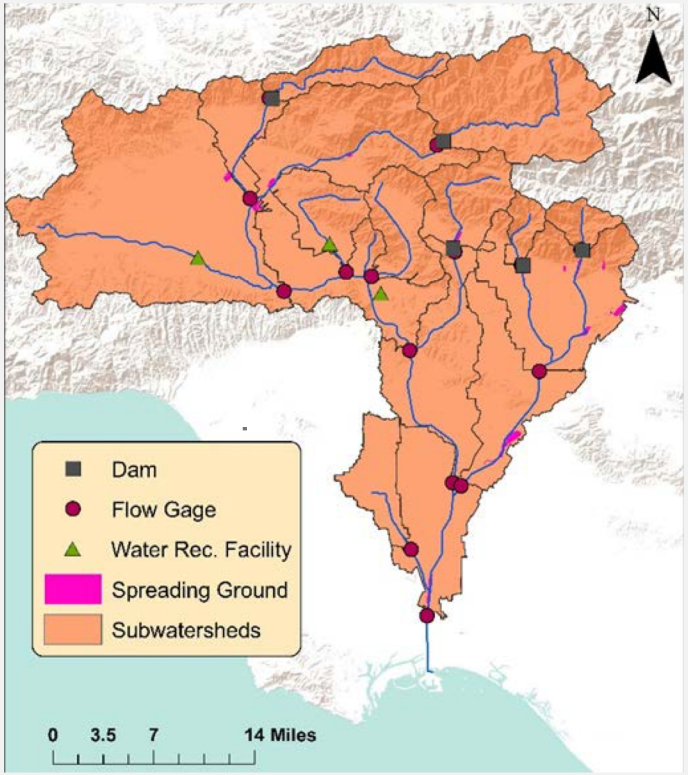


Distributed BMP Scenarios From Mika et al. (2017)

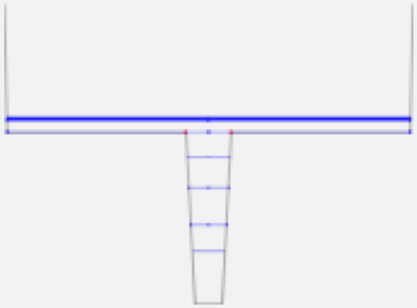


LAR Flow Data Inventory Alamdari, (unpublished)

CSM's Existing LAR Model Deficiencies



- Missing channel hydraulic model



- Only15 subwatersheds
- No scenarios of projected centralized stormwater capture
- No scenarios of projected WRP discharges

RELATED STUDIES LIT REVIEW

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Study	Year	Institution	Model (notes/application)	Supply/Demand			Stormwater Runoff					Water Reclamation Plant Discharge/Recycling		Ground-water	River Channel		River Tidal Portion	
				Conservation	As-Is	Projections	Centralized Capture	Distributed Capture	Water Quality	As-Is	Projections	As-Is	Projections	As-Is	Hydraulics	Ecology	Hydraulics	Ecology
Water Resources Action Plan	2009	POLA, POLB	WRAP Model (limited application here)						x	x							x	
LA Basin Study - Task 3.2	2013	LACFCD	WMMS (w/ climate change, distributed LID)				x	x		x	x							
LA Basin Study - Task 2	2014	LACFCD	Refers to LACFCD WMMS modeling - see Task 3.2	x	x	x	x	x	x	x	x	x	x					
LAR Restoration Study	2015	USACE	1-D HECRAS												x	x		
Upper LAR EWMP	2015	ULAR EWMP Group	WMMS (w/ distributed LID for Water Quality)						x	x	x							
Stormwater Capture Master Plan	2015	LADWP	LSPC + GWAM (centralized and decentralized BMPs based on EWMP)		x		x	x	x	x	x							
Urban Water Management Plan	2015	LADWP	Refers to SCMP's LSPC+GWAM - see SCMP	x	x	x	x	x	x	x	x	x	x	x				
LA Sustainable Water: LAR Watershed	**2017**	**LASAN, UCLA, CSM**	**SWMM (w/ SUSTAIN and distributed LID for Water Quality)**					**x**	**x**	**x**	**x**	**x**						
Burbank Wastewater Change Petition	2017	Burbank	USACE 1-D HEC-RAS (Barham Boulevard and First Street, modeled low flows)									x	x		x	x		
WRAP Model Development	2017	POLA, POLB	WRAP Model						x	x							x	x
Glendale Wastewater Change Petition	2018	Glendale	USACE 1-D HEC-RAS (Burbank reach + Rio Hondo confluence to the estuary)									x	x		x	x		
One Water Plan: Volume 2: Wastewater	2018	LASAN, LADWP	Water balance modeling		x	x						x	x					
One Water Plan: Volume 3: Stormwater	2018	LASAN, LADWP	Used LSPC+GWAM from SCMP		x		x	x	x	x	x							
One Water Plan: Volume 4: LAR Flow Study	2018	LASAN, LADWP	Low-flow balance for each river mile; HEC-RAS at 3 reaches							x	x	x	x	x	x	x		
Stormwater Capture and Recharge	**TBD**	**UCLA, USGS, CSM**	**SWMM (w/ MODFLOW and capture)**				**x**	**x**		**x**	**x**			**x**				

Bold = Colorado School of Mines Study