

USGS Groundwater Investigations in the San Diego area, CA

Wesley R. Danskin

**Research Hydrologist
United States Geological Survey**

What have we accomplished ?

- Data collection
- Geology
- Geochemistry
- Hydraulics
- Modeling



Where we began, in 2001



Objective: Increase the local water supply



Initial data



Where did we start?

Topic		Years behind					Year 2000
		-50	-40	-30	-20	-10	
Geology	Surficial geologic mapping					Yellow	
	Subsurface geology	Pink					
	Remote sensing			Yellow			
	Geologic history				Yellow		
	Geologic framework model					Yellow	
Surface water	Surface-water gages					Yellow	
	Reservoirs						Light Green
	Imported water						
Ground water	Well inventory			Yellow			
	Water levels	Pink					
	Water budget		Pink				
	Aquifer parameters						
	Groundwater flow model			Yellow			
	SW/GW model				Yellow		
	Optimal management model					Yellow	
Water quality	Basic major ions					Yellow	
	Minor constituents				Yellow		
	Contaminants						Light Green
	Geochemical models				Yellow		



Geology – Collect three-dimensional data, cuttings and cores

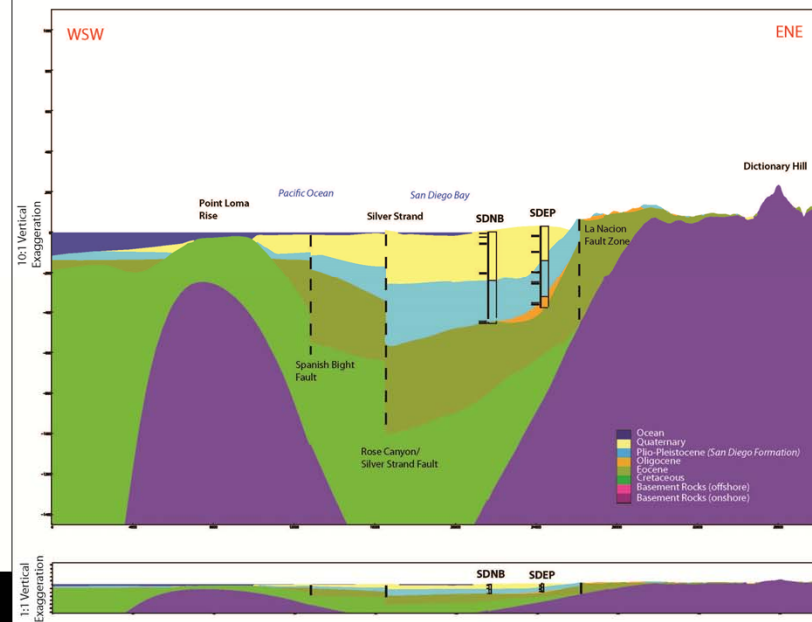
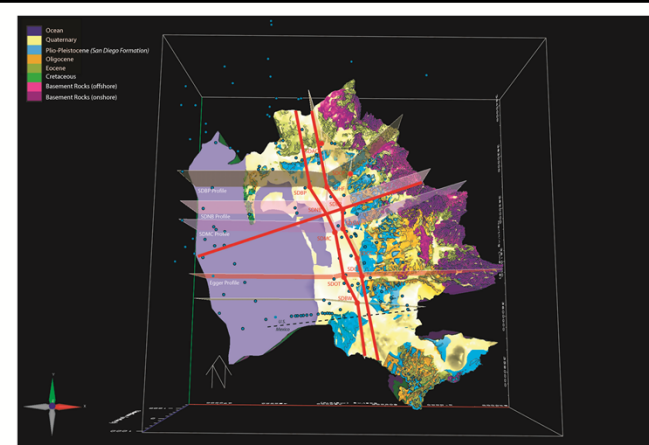
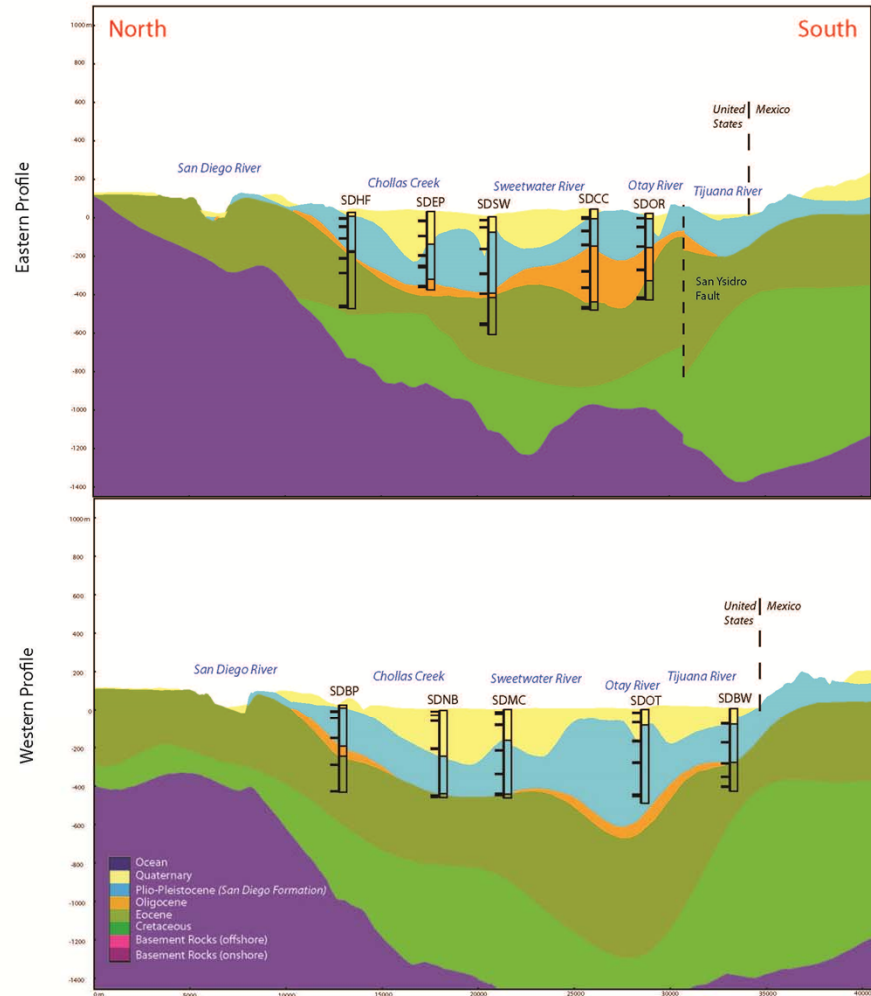


Multiple-depth well data – Understand the aquifer and manage pumpage

16 well sites, 77 wells

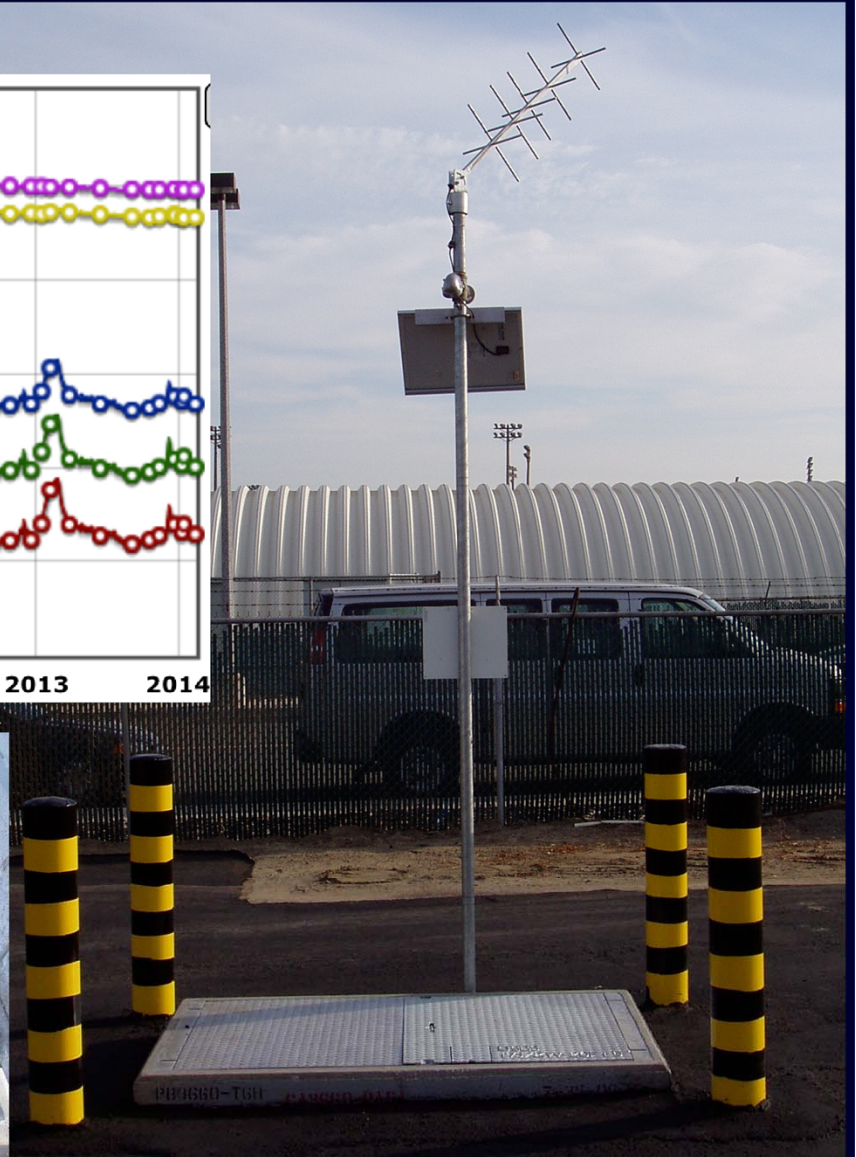
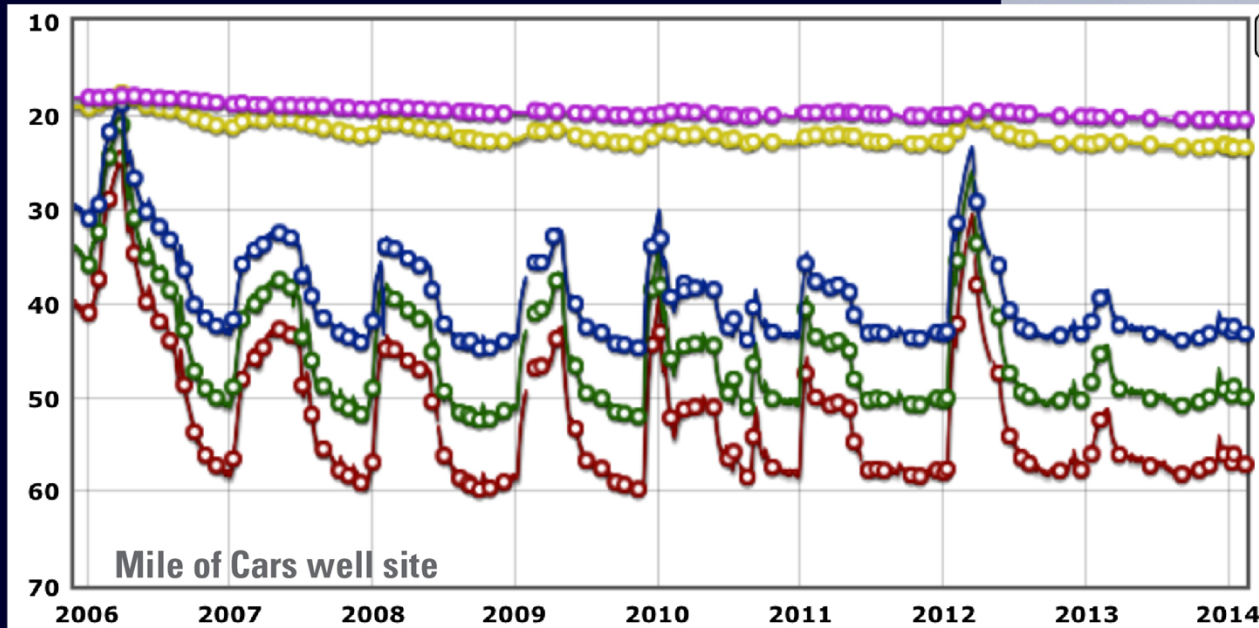


Geologic profiles of the San Diego area



Water-level data – Understand effects of pumpage, calibrate model

● **103 sites, 3 million measurements**

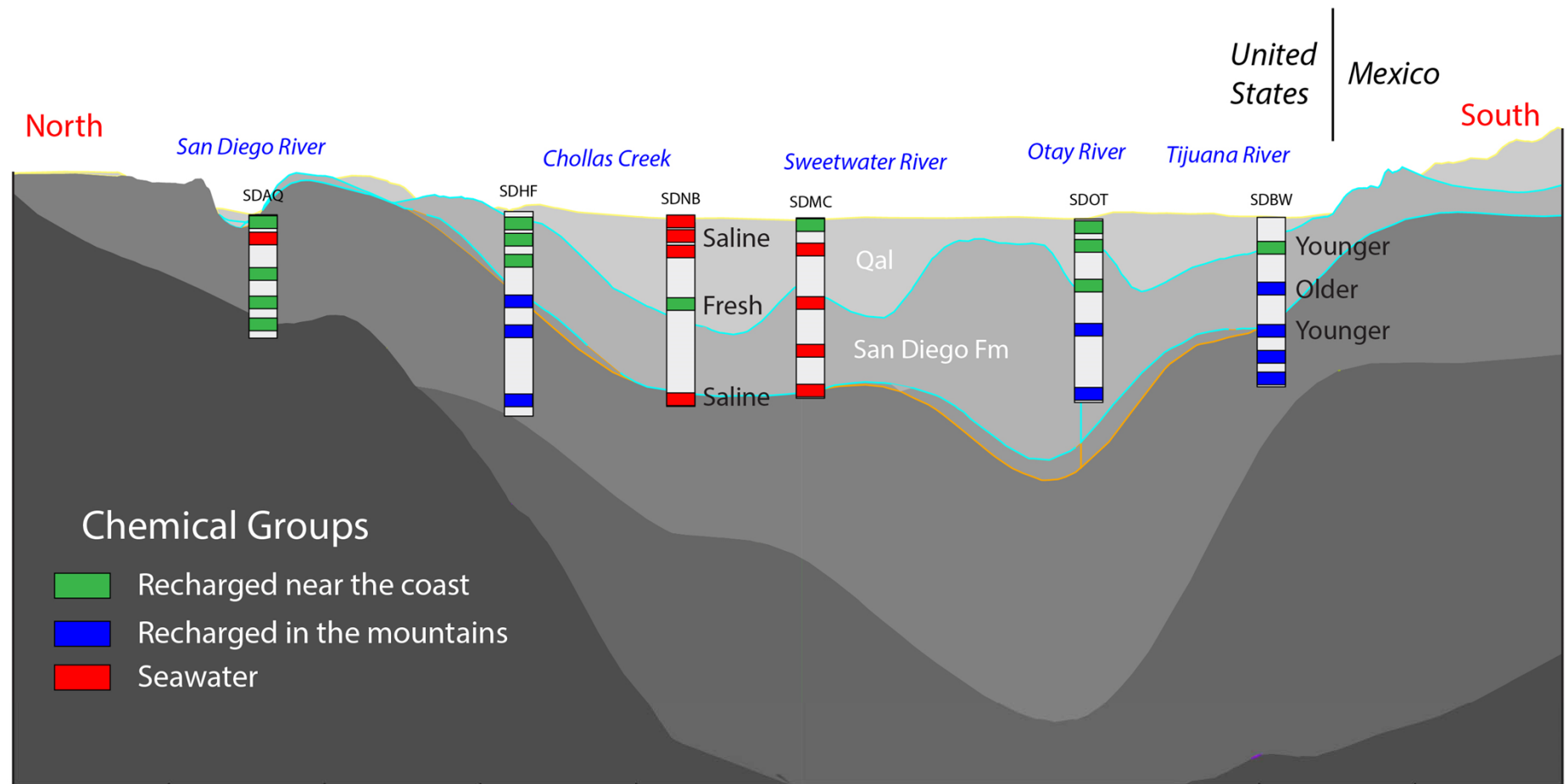


Water-quality data – Track the groundwater

- **Surface water – 49 sites**
- **Lake – 8 sites**
- **Spring – 1 site**
- **Ground water – 148 sites**

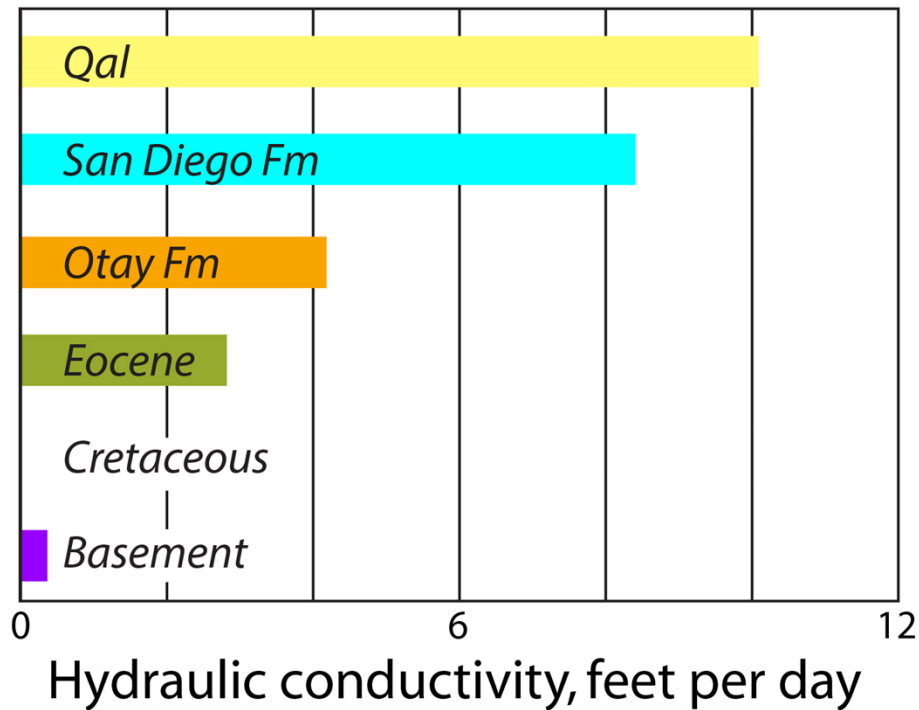


Geochemistry – Identify chemical groups to map groundwater flow

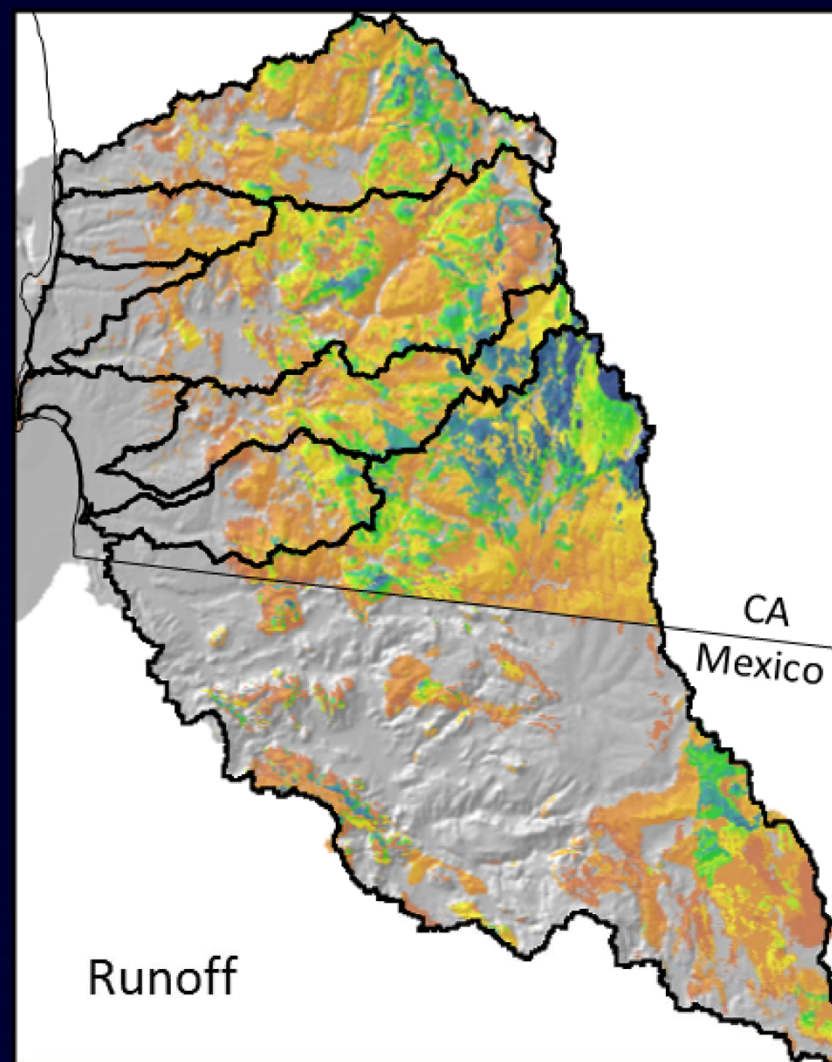
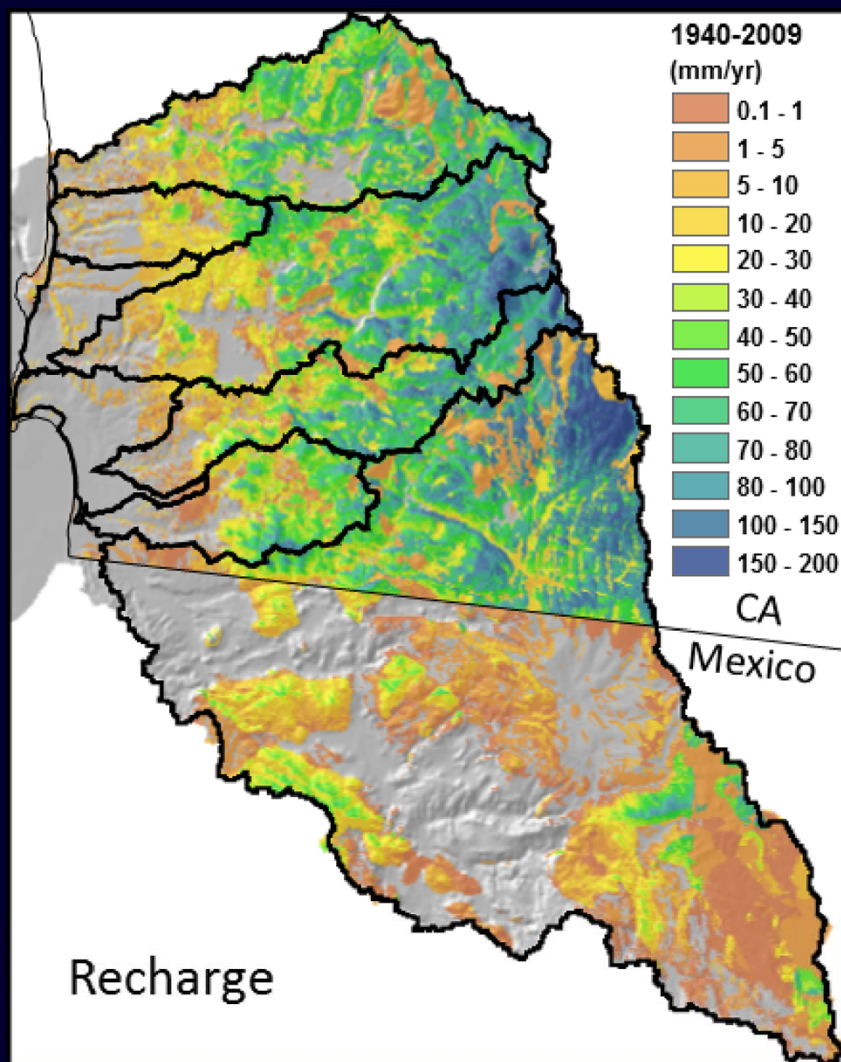


Hydraulics – Conductivity correlates with geologic formation

Results from 300 slug tests on 77 wells



Modeling – Identifying where recharge and runoff occurs



Subsurface flow to the coast is modest

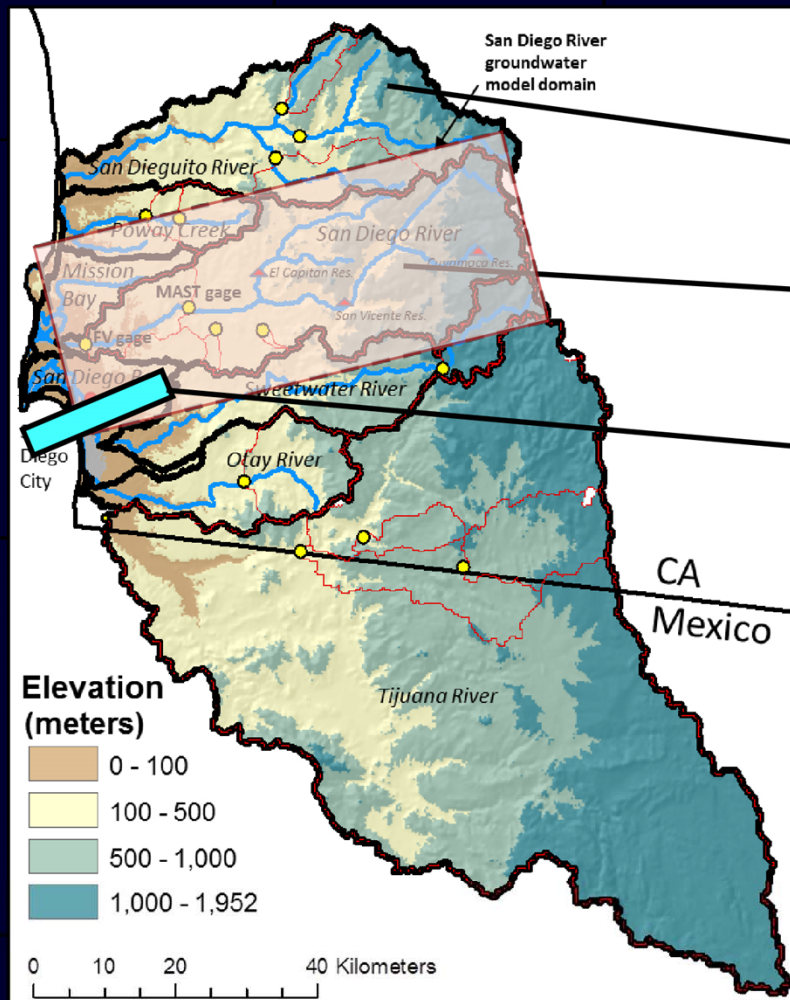
Estimates of subsurface flow to the coast

- San Diego River area — about 10,000 to 23,000 acre-feet per year
- San Diego region — about 40,000 acre-feet per year

Estimates of subsurface flow to the coastal plain (millions of m³/year)

Method	San Diego River basin	San Diego Region
<i>Calibrate BCM regionally to multiple streamgages</i>		
<i>Develop reconstructed flow record for San Diego River for unimpaired flows</i>		
Basin inputs (BCM recharge + runoff) minus outputs (streamflows) (1982-2009)	18.0	
<i>Ratio of basin inputs to outputs = 40/60</i>		
Extrapolated to 3 main river basins draining to coastal plain (1940-2009)	28.3	48.8
BCM partitioned into flow components in the San Diego River (1982-2009)	13.0	
MODFLOW model of San Diego River with BCM boundary conditions (1982-2009)	18.0 - 12.3	

Simulation models test concepts, aid in water management



Rainfall–runoff model

Regional hydrologic model (proposed)

Groundwater flow model of SD River basin

Coastal freshwater/saltwater model

Best available science, vetted and shared with others

- **Learn from and advise local water experts**
- **USGS researchers**
- **Universities**
- **Consulting firms**
- **SD Assoc. Geologists**
- **International outreach**



Simulating coastal groundwater flow

More
freshwater
off the
coast?



Limited
recharge
in the
mountains

