WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA

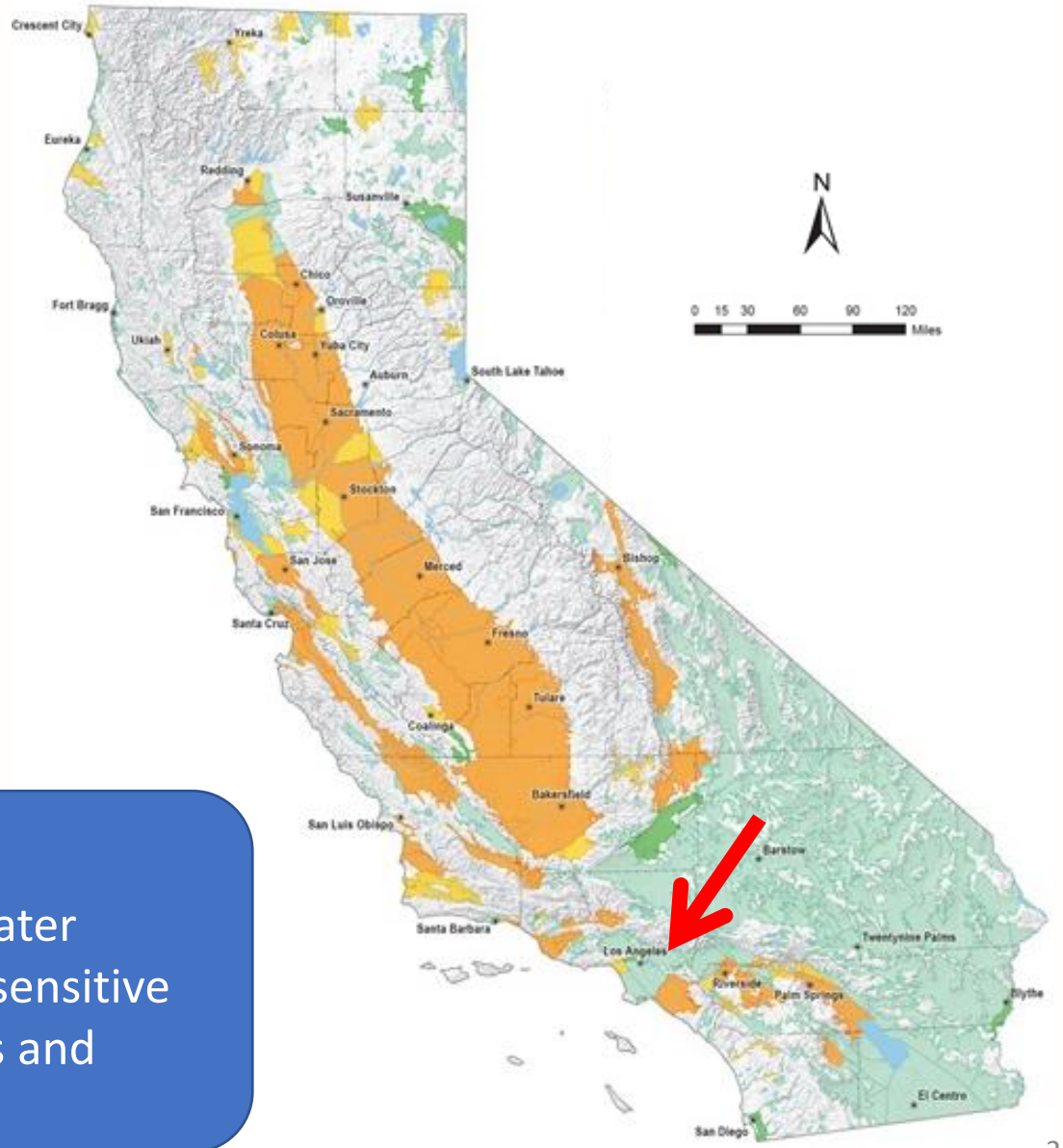
New Data Provider for the NGWMN

Benny Chong & Evan Lue

SECURING OUR WATER FUTURE TODAY

Who is the Water Replenishment District?

- Largest groundwater agency (by population) in California. Located in Southern Los Angeles County (see RED ARROW).
- Manage two groundwater basins; Central Basin and West Coast Basin (CBWCB).
- Formed by a vote of the people in 1959.



OUR MISSION

"To provide, protect and preserve high-quality groundwater through innovative, cost-effective and environmentally sensitive basin management practices for the benefit of residents and businesses of the Central and West Coast Basins."

Our Service Area

SERVICE AREA = 420 SQUARE MILES

43 CITIES

POPULATION > 4 MILLION

550,000 ACRE FEET USED PER YEAR

50% GROUNDWATER FROM LOCAL WATER WELLS

50% IMPORTED WATER

WRD SUPPLEMENTS NATURAL GROUNDWATER RECHARGE

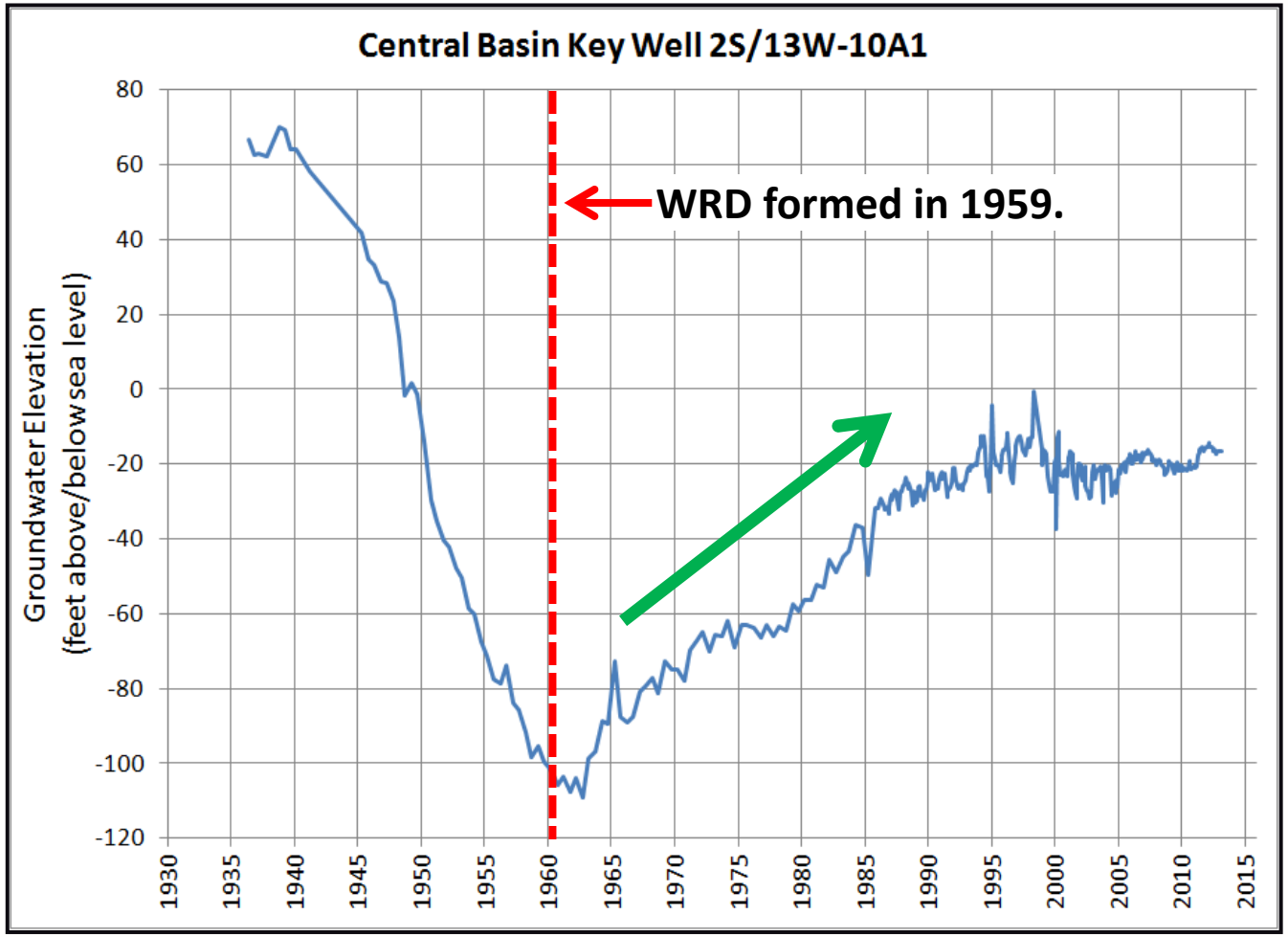
Basin History

Severe Overdraft before 1960

- Plunging Water Levels.
- Seawater Intrusion.
- Wells Went Dry.
- Resources being Depleted.

Recovery Due to…

- Adjudication of Basins.
- Seawater Barrier Wells.
- Formation of WRD.
- Use Imported and Recycled Water for Managed Aquifer Recharge.

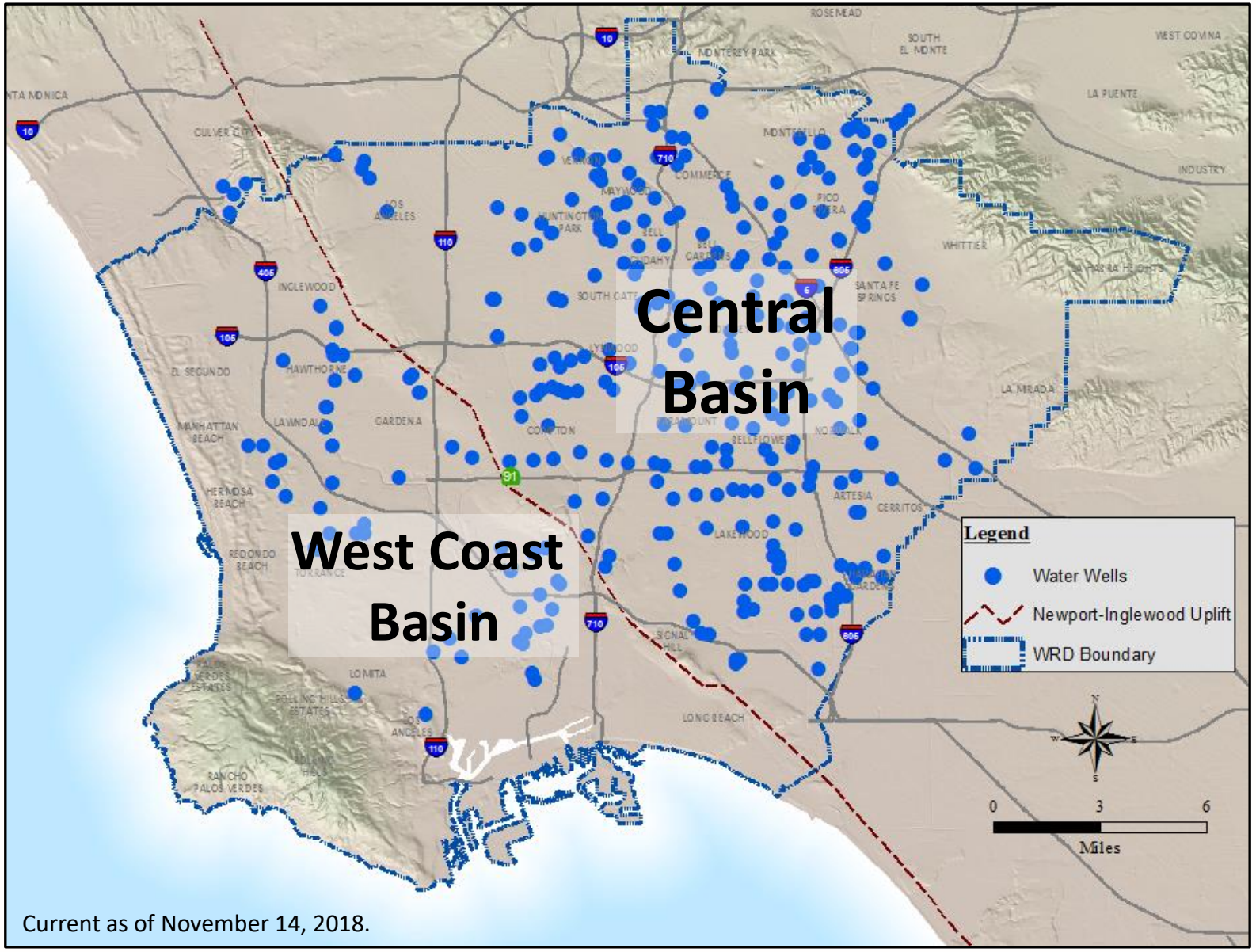


Groundwater Production Wells

Active Wells = 360

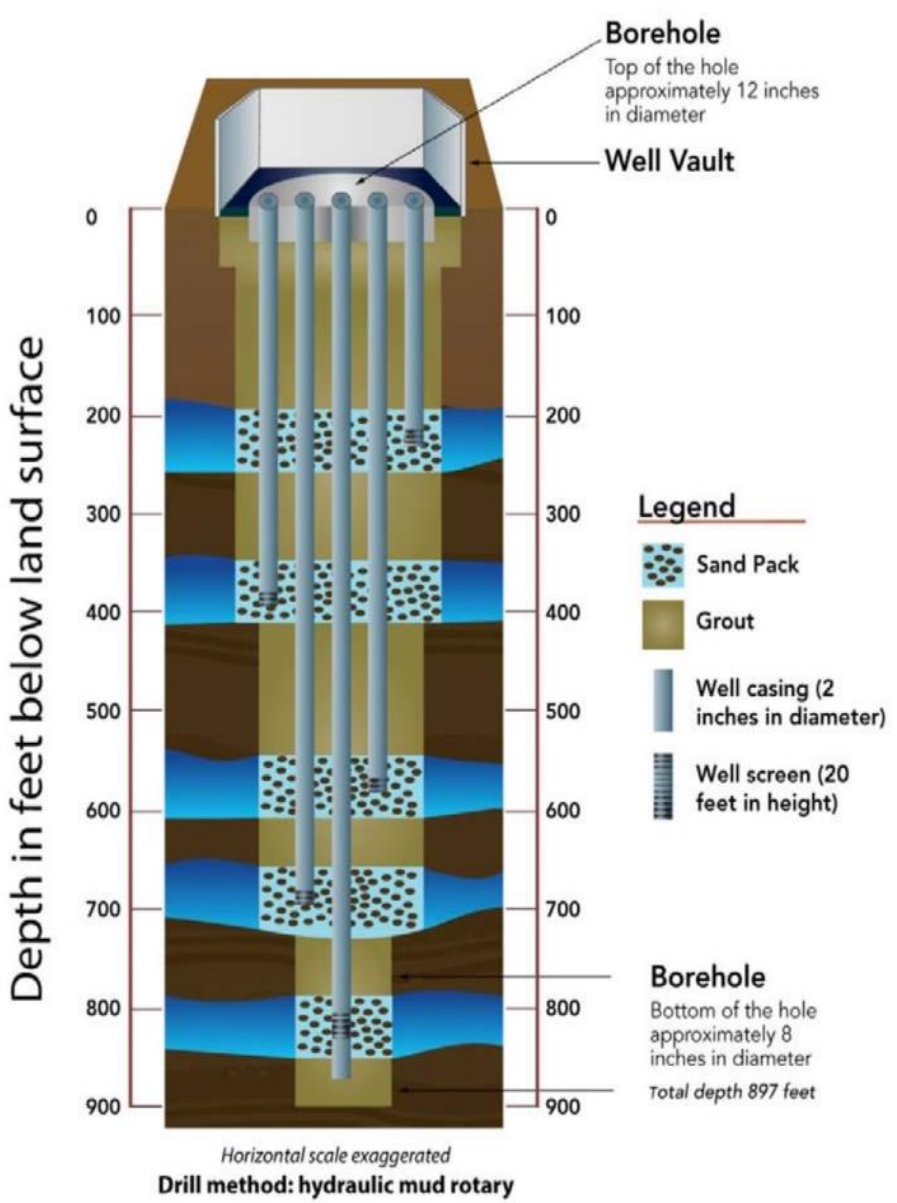
Active Pumpers = 101

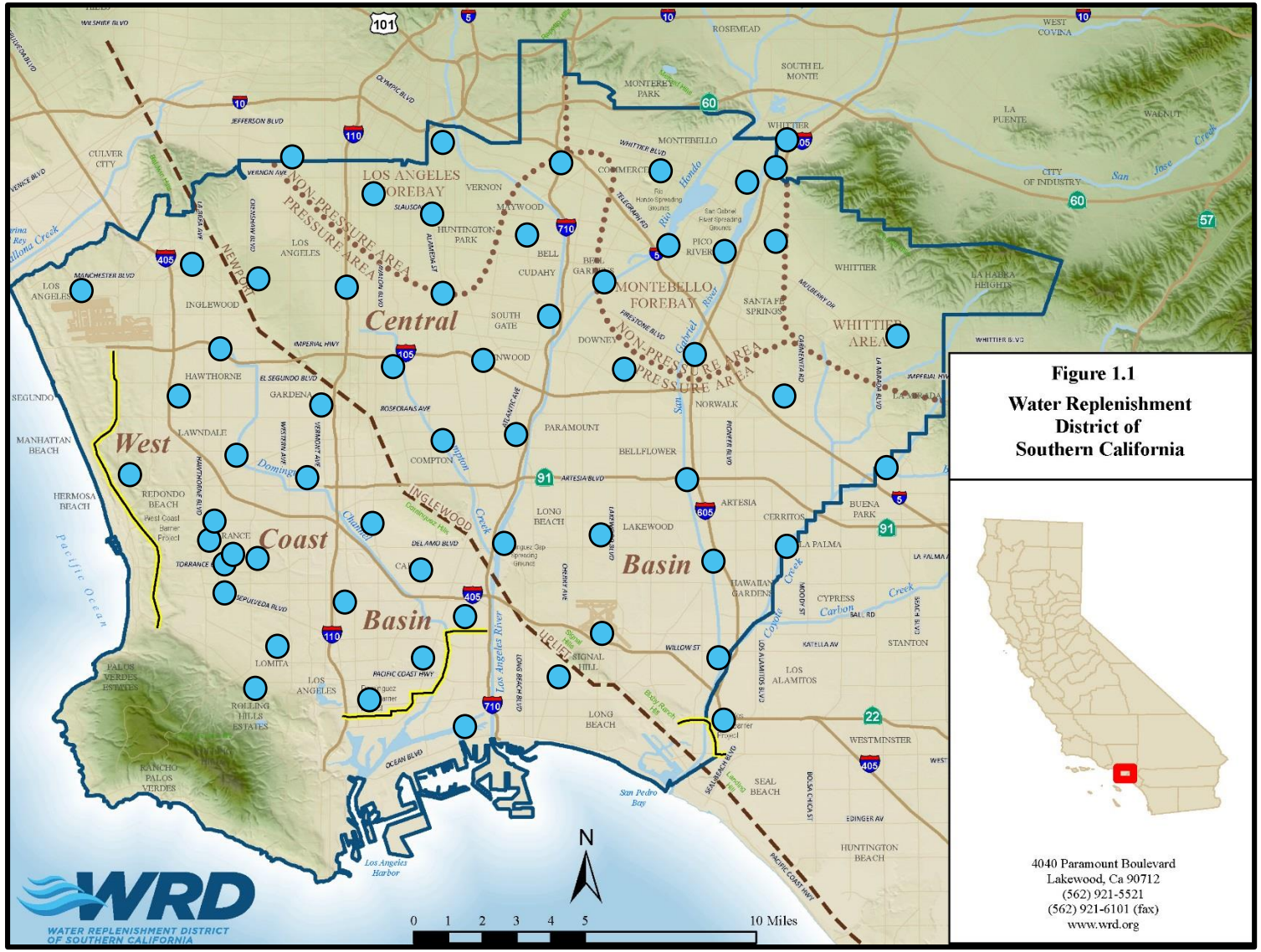
Pumping ~250,000 AFY



Current as of November 14, 2018.

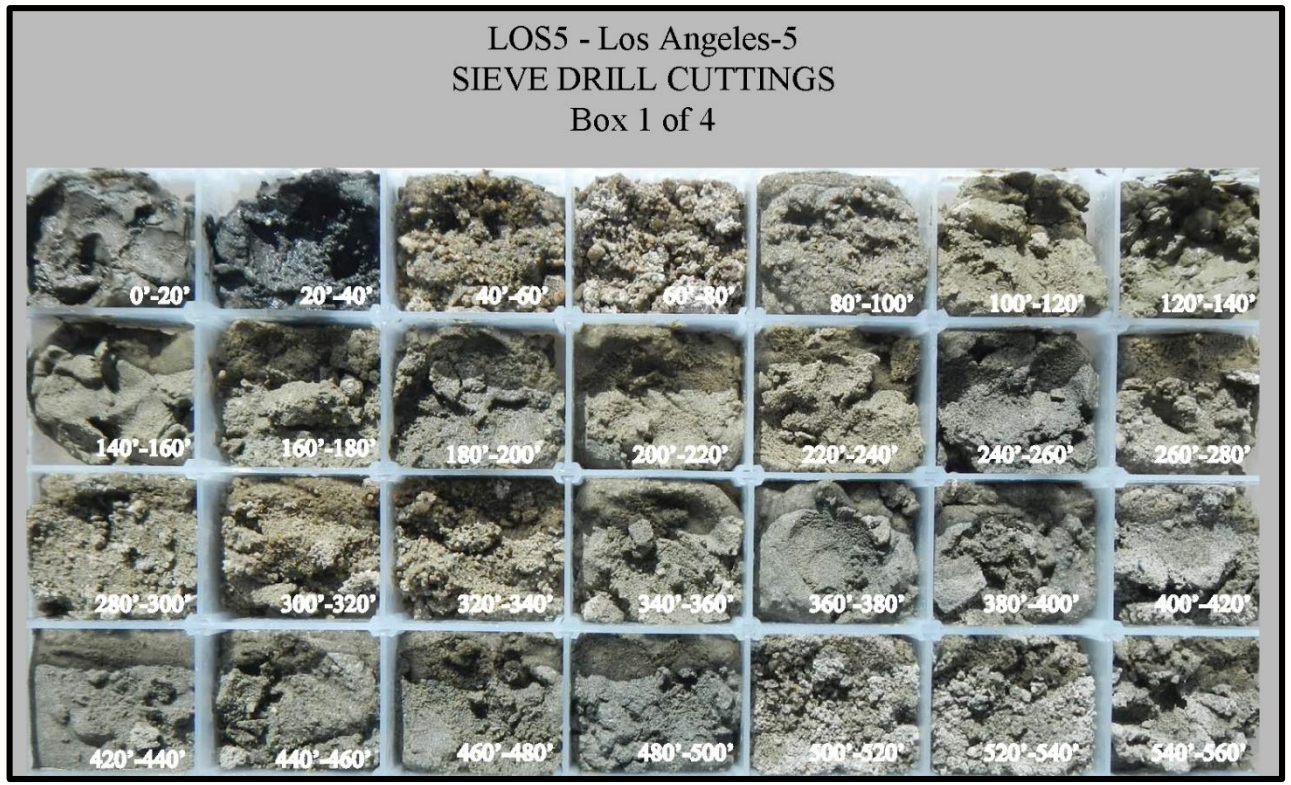
Regional Groundwater Monitoring Network





Regional Groundwater Monitoring Network

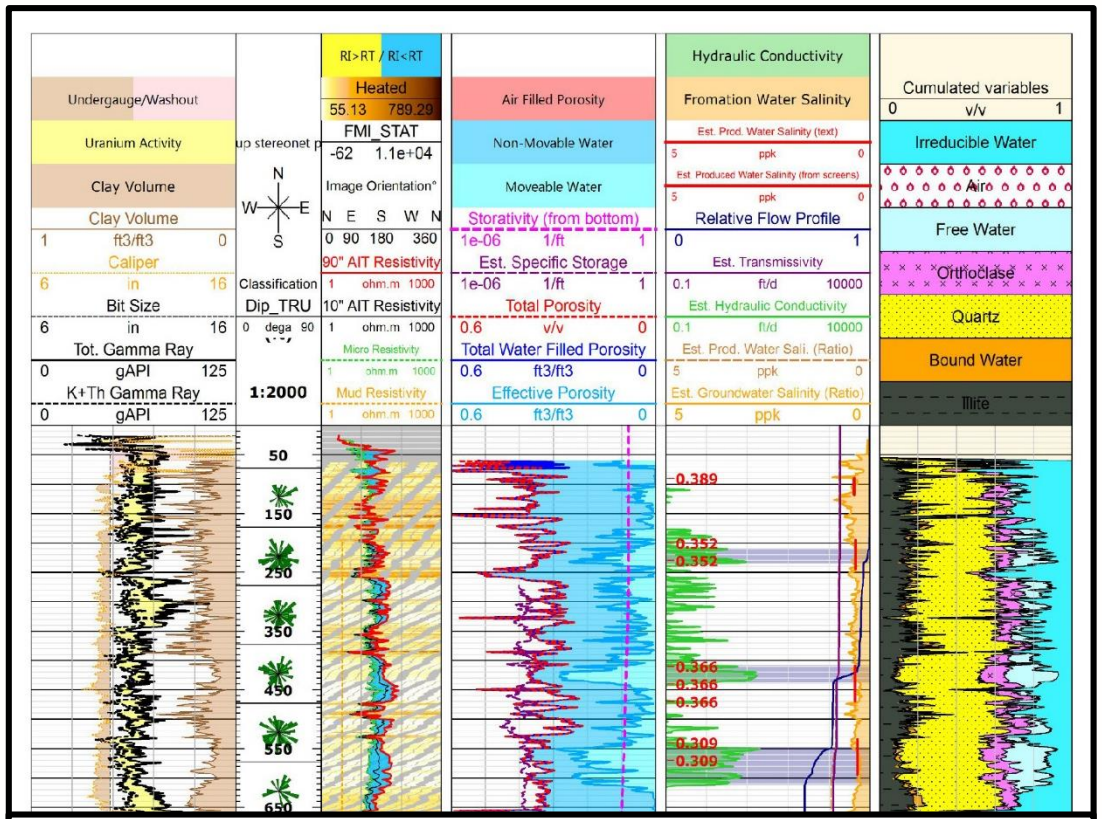
Cuttings logged by USGS



LOS5 Rig Lithology

Beginning Depth (feet)	Ending Depth (feet)	Thickness (ft)	Lithology
548	580	32	Silty sand (vf-m) w/ trace sand (m-vc) and gravels (gran.-sm. peb.); ***almost all cones***
580	600	20	Silty sand (vf-m) w/ trace shell fragments (1-2 mm); ***all cones***
600	620	20	Silty sand (vf-m) w/ trace clay, gravels (gran.-sm. peb.), shell fragments (1-2 mm) and wood fragments (1-3 mm) ; minor clay and moderate shells 618'-620'; ***mostly cones***
620	640	20	Sandy (vf-m) clayey silt w/ shell fragments (1-4mm), wood fragments (1-2 mm) and trace gravels (gran.-sm. peb.); increasing shells 620'-625' and clay 635'-640, decreasing shells 635'-640'

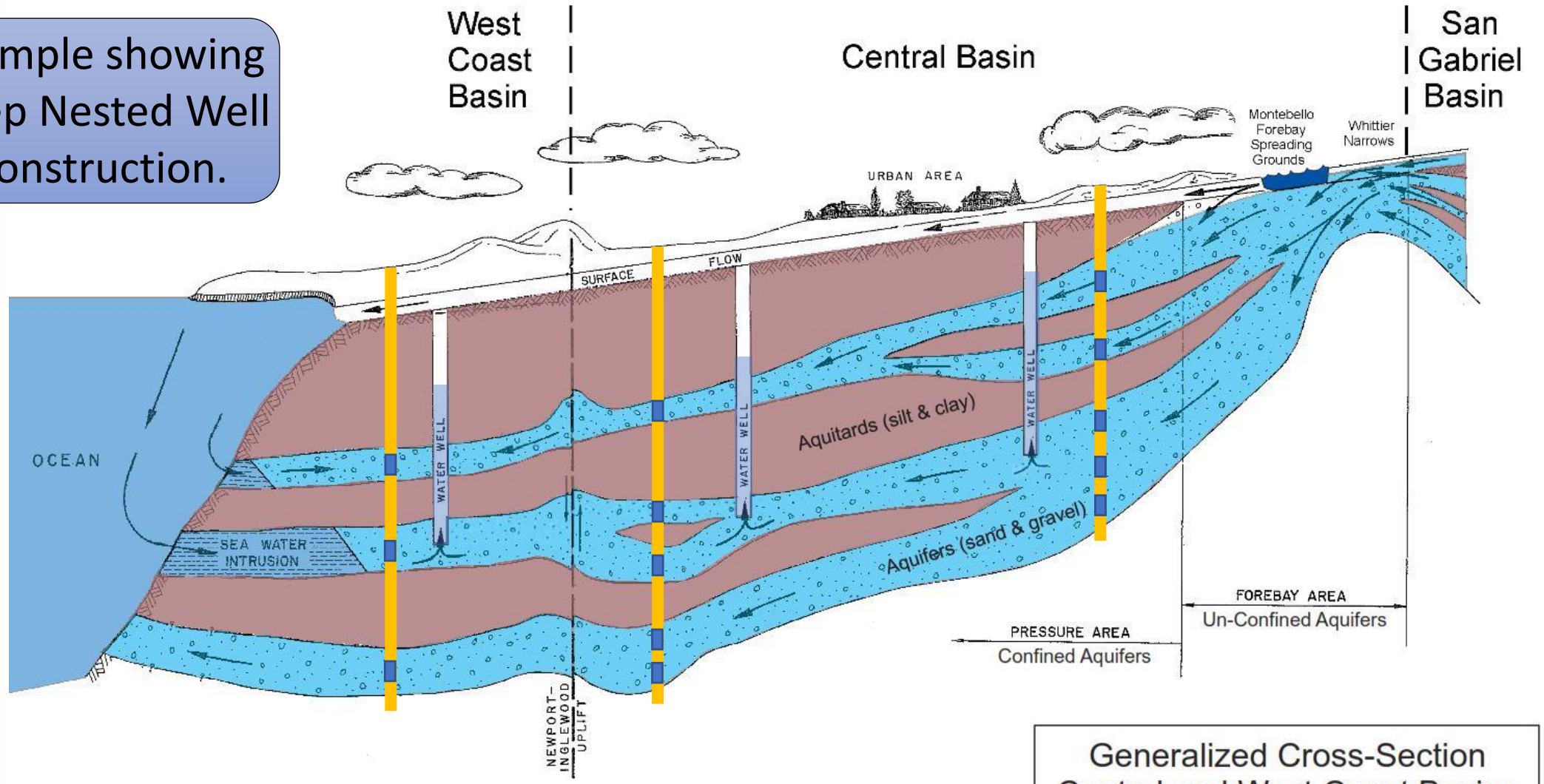
We also use Advanced Geophysics



- Combinable Magnetic Resonance Tool (CMR*)
- Array Induction Tool (AIT*)
- Micro-Cylindrically Focused Log (MCFL*)
- Hostile Natural Gamma Spectroscopy (HNGS*) and gamma ray (SGT*)
- Fullbore Formation Micro-Imager (FMI*)
- Sonic Scanner (MSIP*)

Regional Groundwater Monitoring Network

Example showing Deep Nested Well Construction.



Generalized Cross-Section
Central and West Coast Basins

Base Graphic from California Dept. Water Resources, 1959.
Color and other features added by WRD.
Not to Scale

Regional Groundwater Monitoring Network

Water levels monitored using pressure transducers (mainly In-Situ)

Regional Groundwater Monitoring Network

Wells are sampled semiannually by our Hydrogeology Group

Regional Groundwater Monitoring Network

Over 100 chemicals tested from each sample with over 60,000 results per year

Major Minerals

Total Dissolved Solid (TDS)
Cation Sum
Anion Sum
Iron, Total, ICAP
Manganese, Total, ICAP/MS
Turbidity
Alkalinity
Boron
Bicarbonate as HCO3,calculated
Calcium, Total, ICAP
Carbonate as CO3, Calculated
Hardness (Total, as CaCO3)
Chloride
Fluoride
Hydroxide as OH, Calculated
Langelier Index - 25 degree
Magnesium, Total, ICAP
Mercury
Nitrate-N by IC
Nitrite, Nitrogen by IC
Potassium, Total, ICAP
Sodium, Total, ICAP
Sulfate
Surfactants
Total Nitrate, Nitrite-N, CALC
Total Organic Carbon
Carbon Dioxide

General Physical Properties

Apparent Color
Lab pH
Odor
pH of CaCO3 saturation(25C)
pH of CaCO3 saturation(60C)
Radon
Specific Conductance

Metals

Aluminum, Total, ICAP/MS
Antimony, Total, ICAP/MS
Arsenic, Total, ICAP/MS
Barium, Total, ICAP/MS
Beryllium, Total, ICAP/MS
Chromium, Total, ICAP/MS
Hexavalent Chromium (Cr VI)
Cadmium, Total, ICAP/MS
Copper, Total, ICAP/MS
Lead, Total, ICAP/MS
Nickel, Total, ICAP/MS
Selenium, Total, ICAP/MS
Silver, Total, ICAP/MS
Thallium, Total, ICAP/MS
Zinc, Total, ICAP/MS

Volatile Organic Compounds

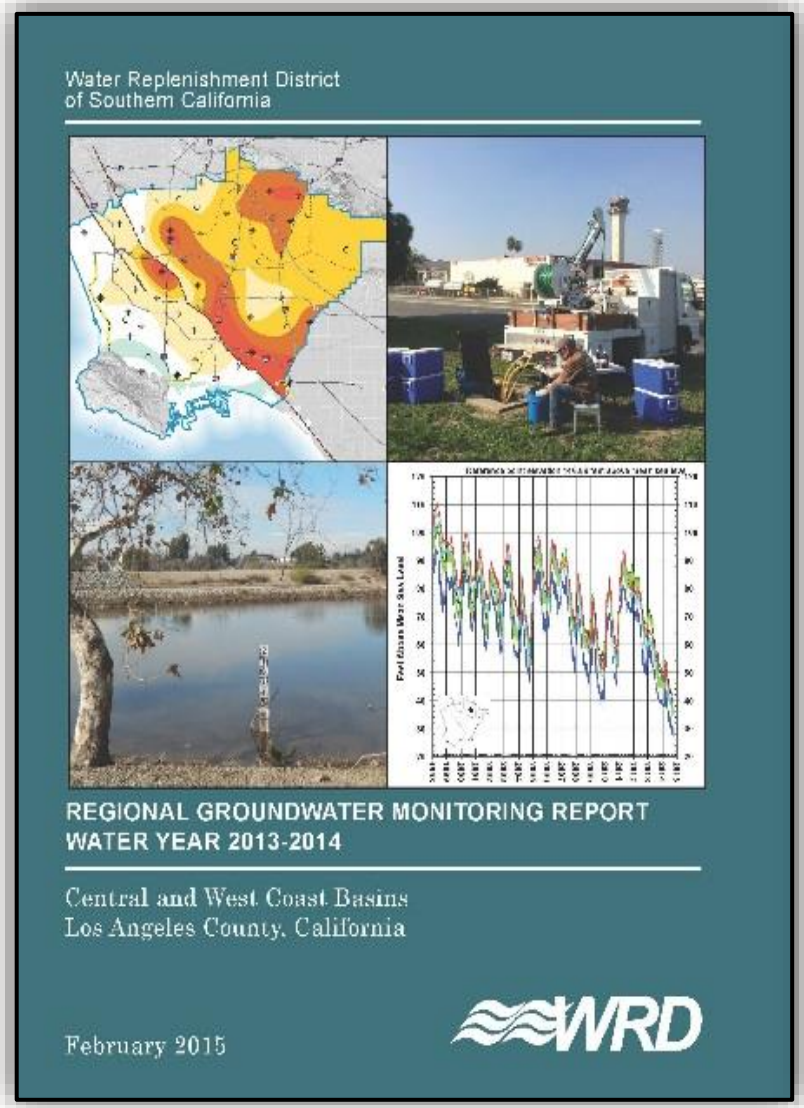
Trichloroethylene (TCE)
Tetrachloroethylene (PCE)
1,1-Dichloroethylene
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
Chloroform (Trichloromethane)
Carbon Tetrachloride
1,1-Dichloroethane
1,2-Dichloroethane
Fluorotrichloromethane-Freon11
Freon 113
Isopropylbenzene
n-Propylbenzene
m,p-Xylenes
Methylene Chloride
Toluene
Dichlorodifluoromethane
Benzene
Ethyl benzene
MTBE
Perchlorate

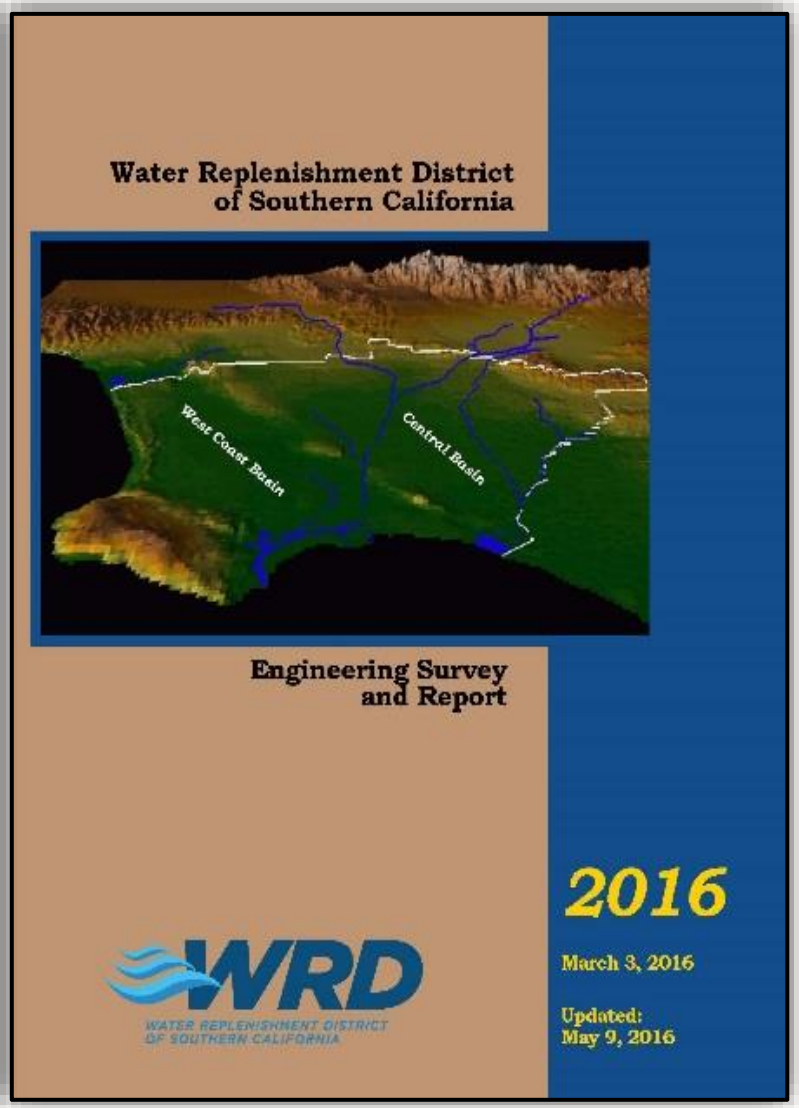
sec-Butylbenzene
1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloropropene
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
2,2-Dichloropropane
2-Butanone (MEK)
4-Methyl-2-Pentanone (MIBK)
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform

Bromomethane (Methyl Bromide)
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloromethane(Methyl Chloride)
cis-1,3-Dichloropropene
Dibromomethane
Hexachlorobutadiene
Naphthalene
n-Butylbenzene
o-Chlorotoluene
o-Dichlorobenzene (1,2-DCB)
o-Xylene
p-Chlorotoluene
p-Dichlorobenzene
p-Isopropyltoluene
Styrene
tert-Butylbenzene
trans-1,3-Dichloropropene
Vinyl chloride (VC)

Regional Groundwater Monitoring Network

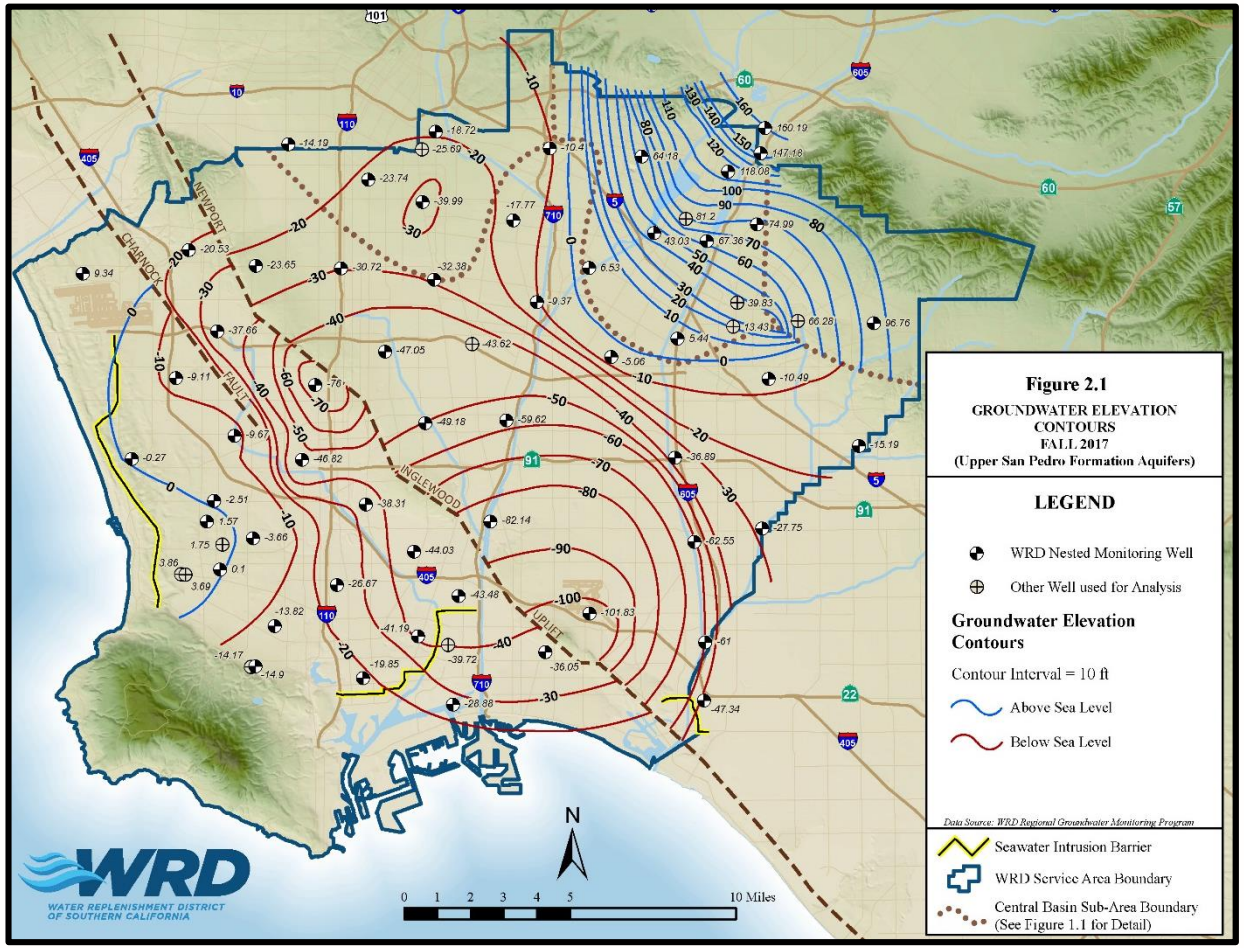
Reports are available to the public via https://www.wrd.org



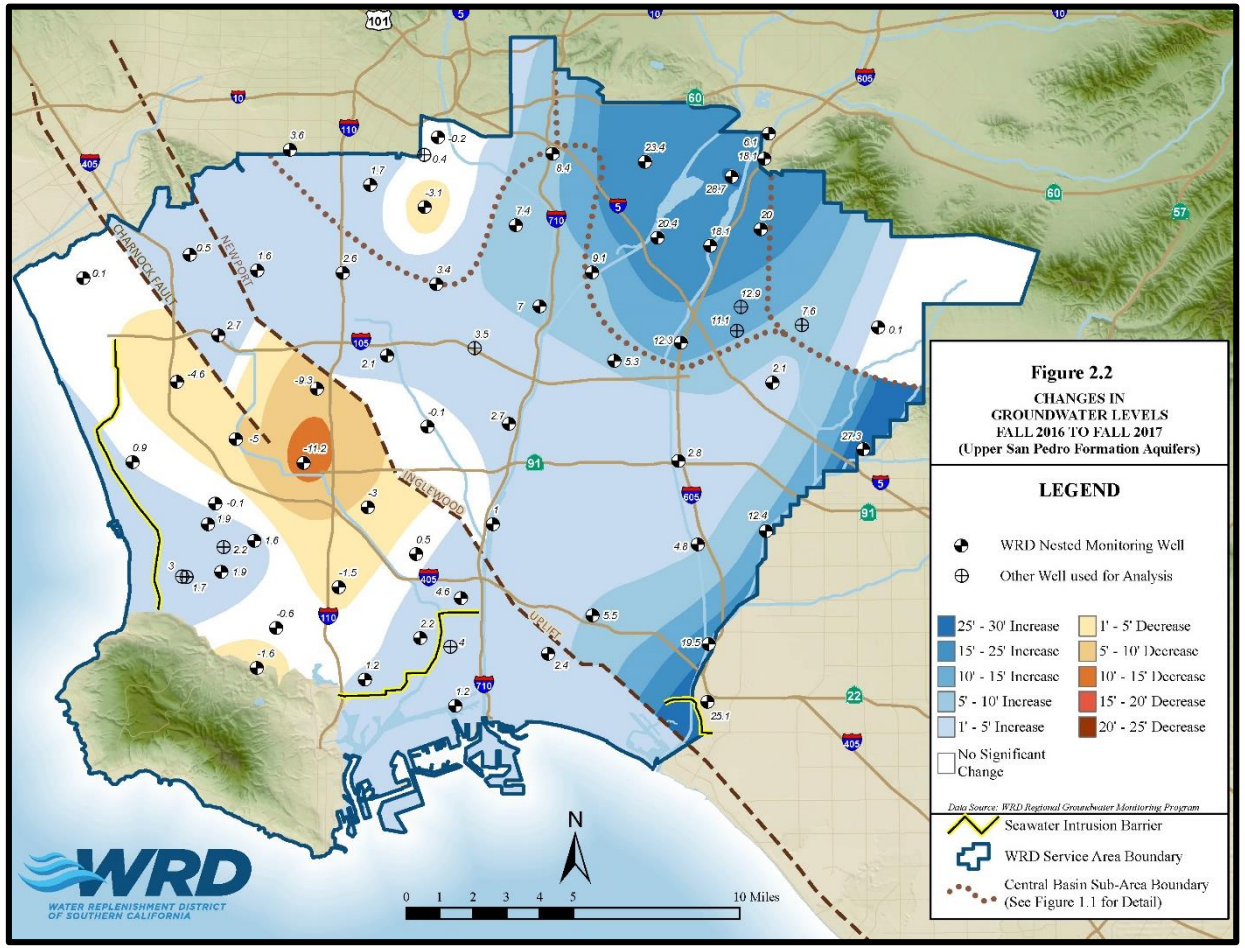


How do we use data from our well network?

Groundwater Elevation Contours

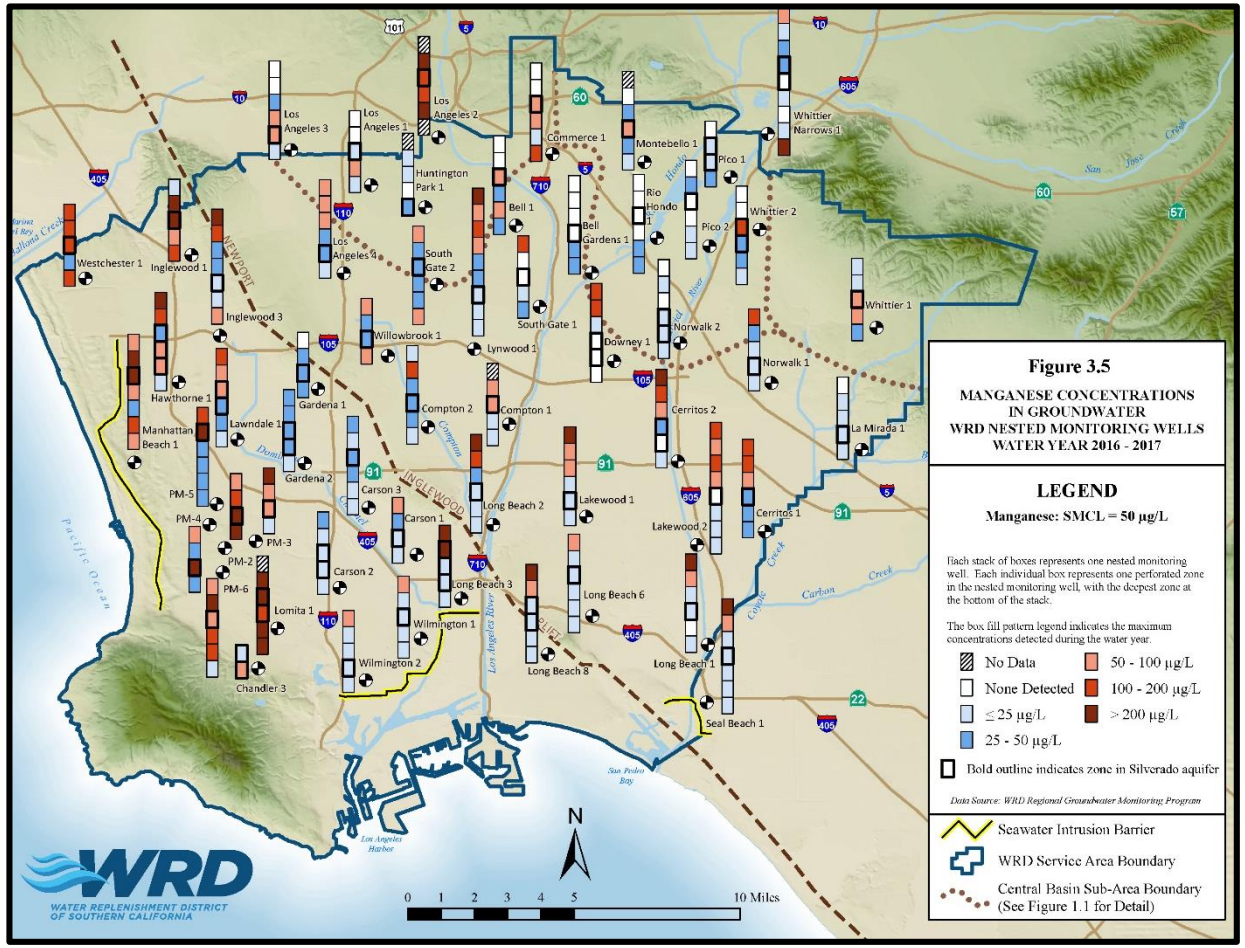


Changes in Groundwater Levels

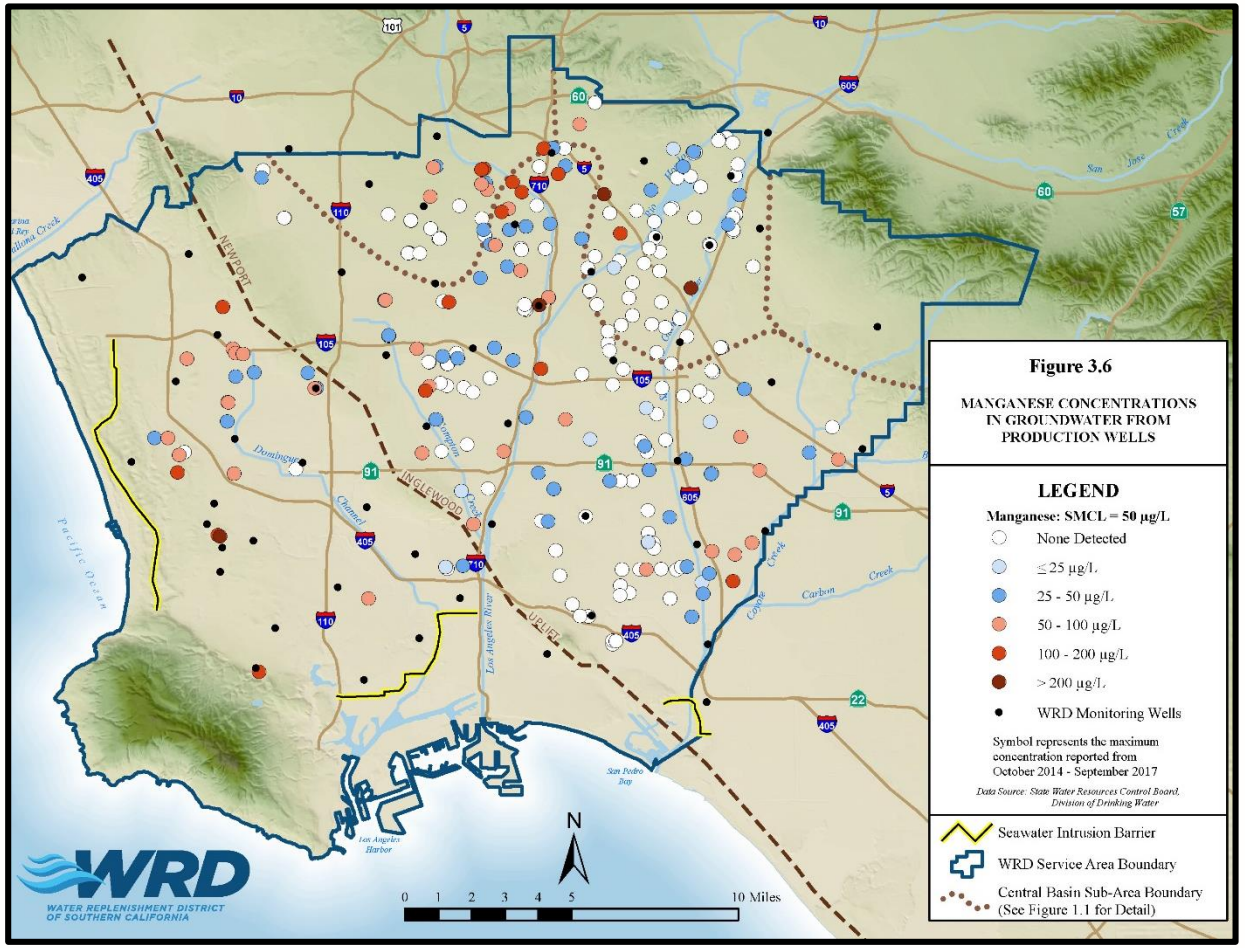


How do we use data from our well network?

Manganese in Monitoring Wells

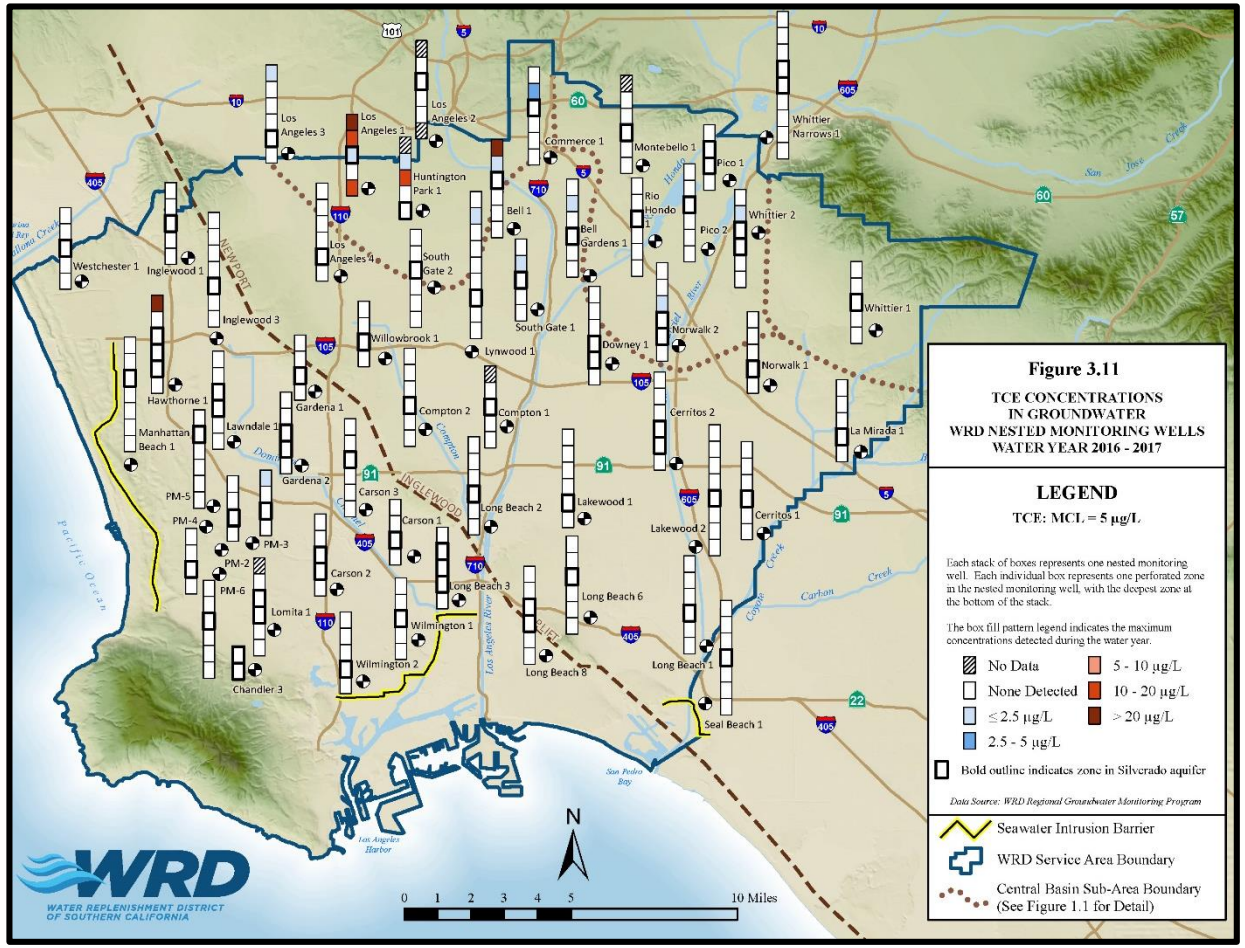


Manganese in Production Wells

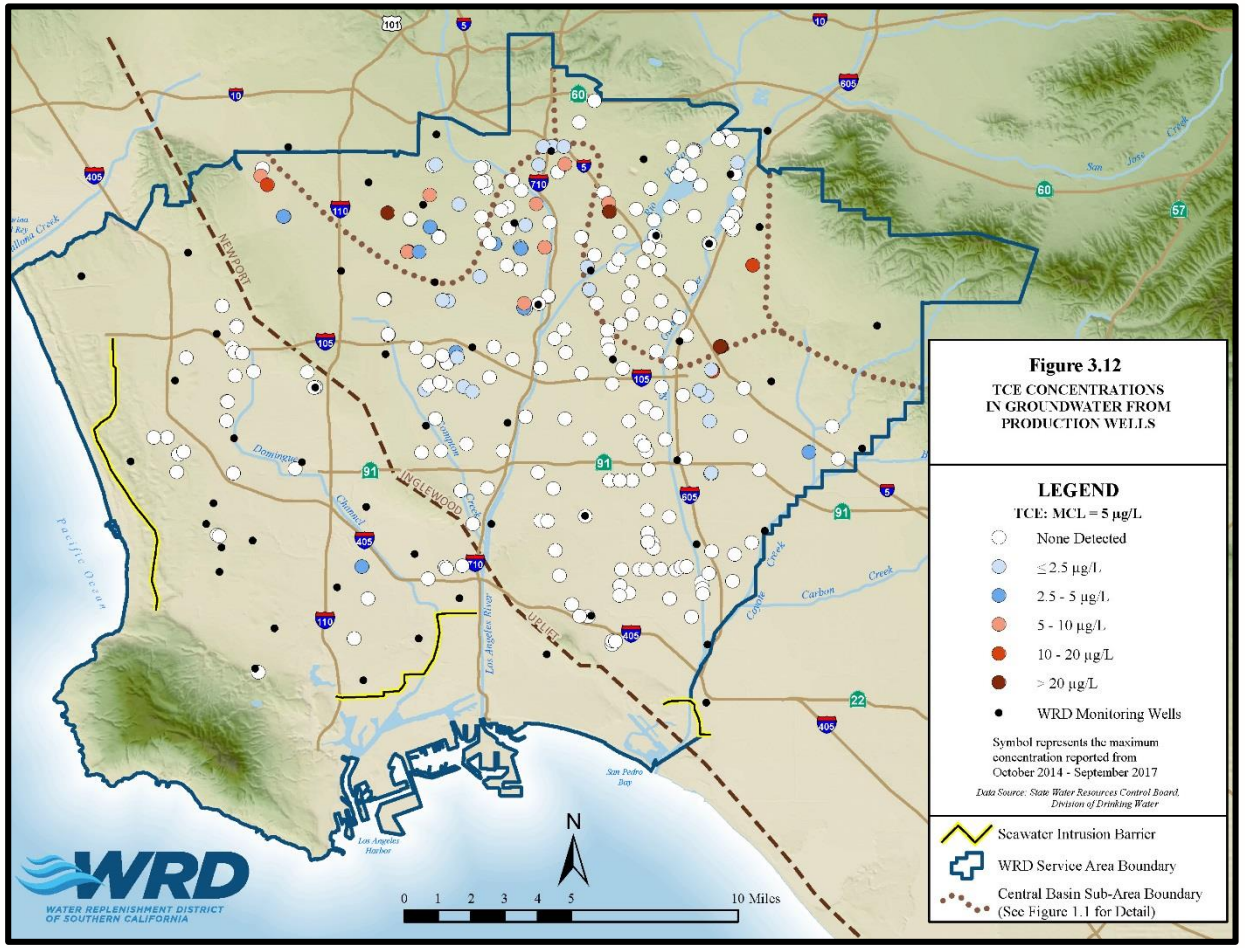


How do we use data from our well network?

TCE in Monitoring Wells

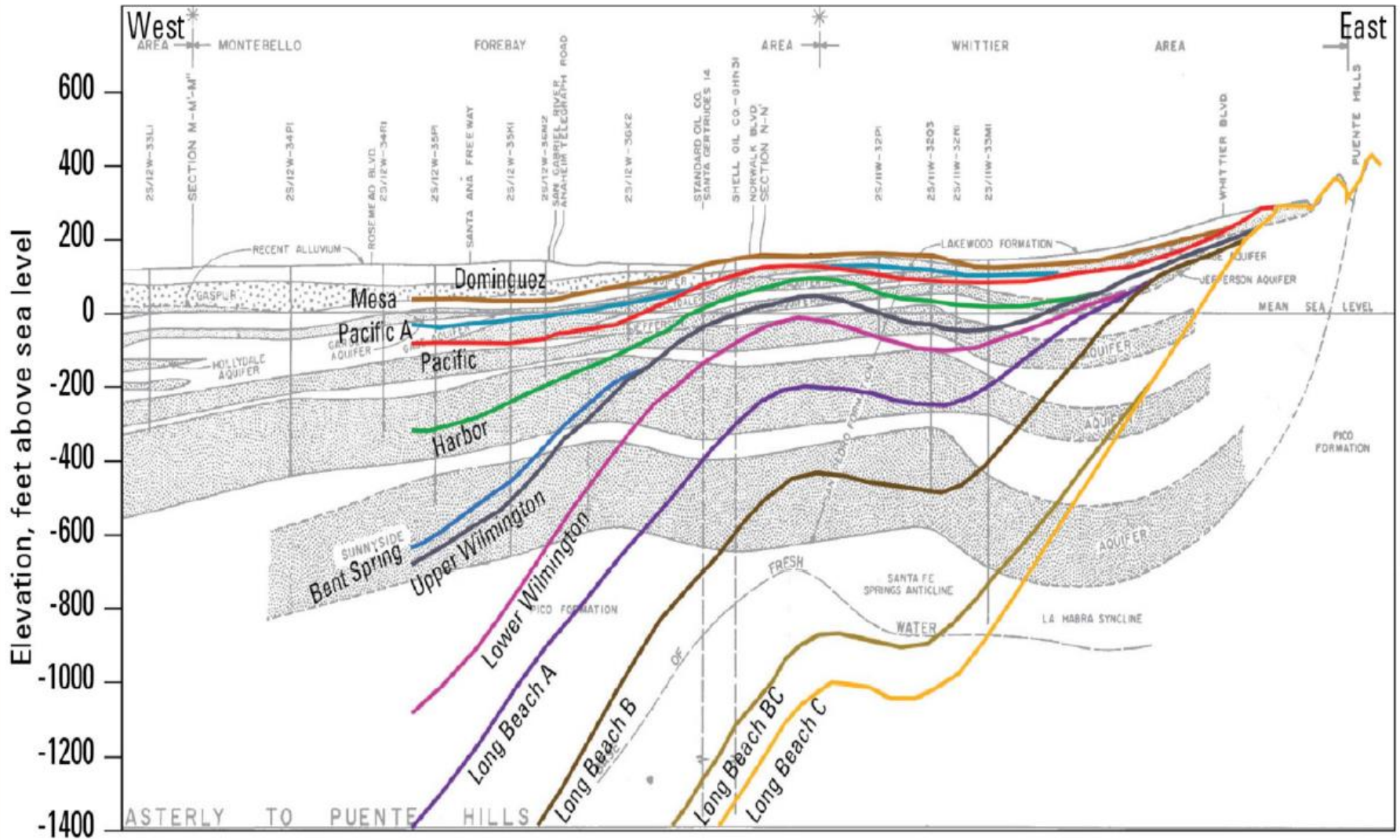


TCE in Production Wells

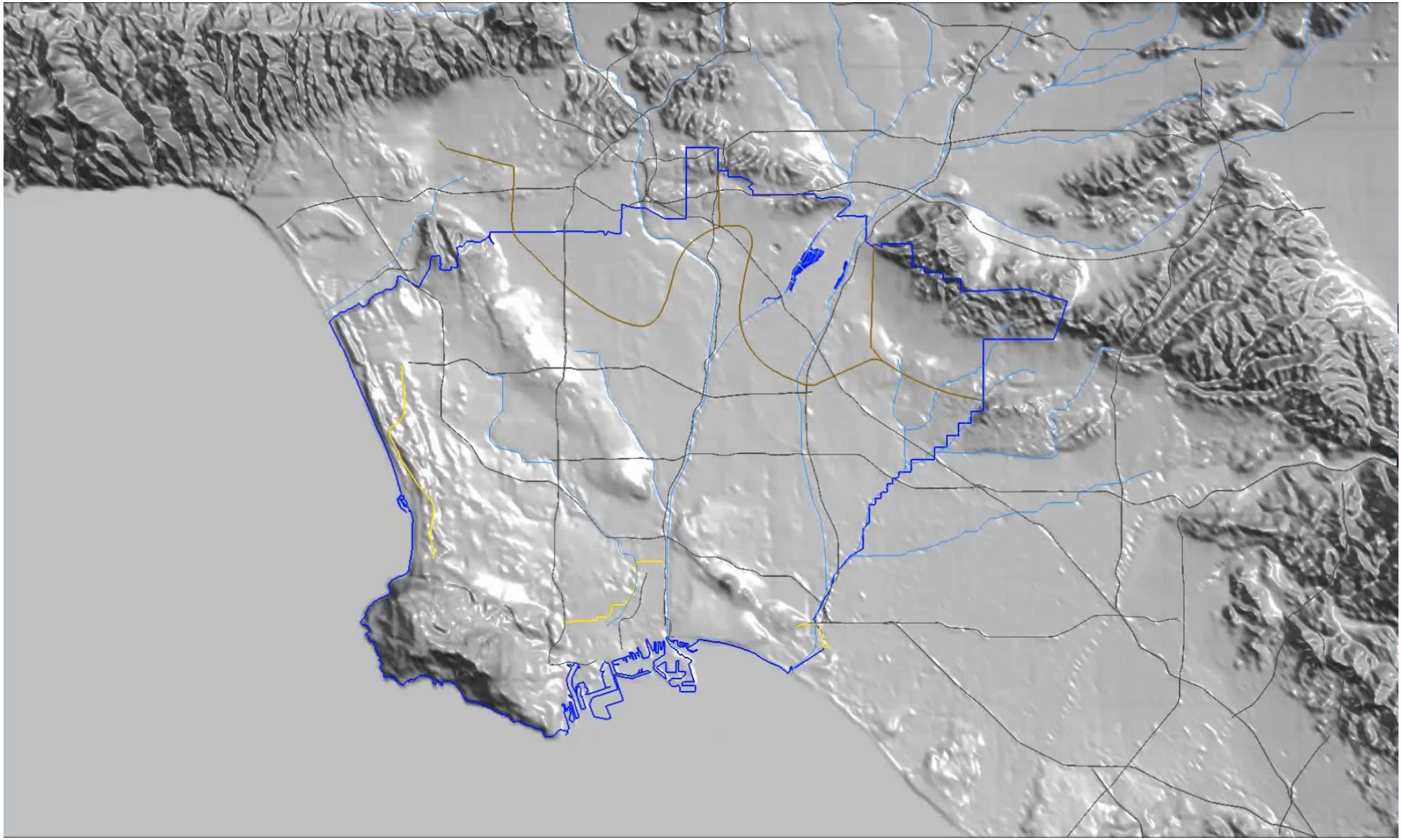


How do we use data from our well network?

Working on a new sequence stratigraphy model with USGS



How do we use data from our well network?



Trans-Boundary Flow Directions and Groundwater Budget

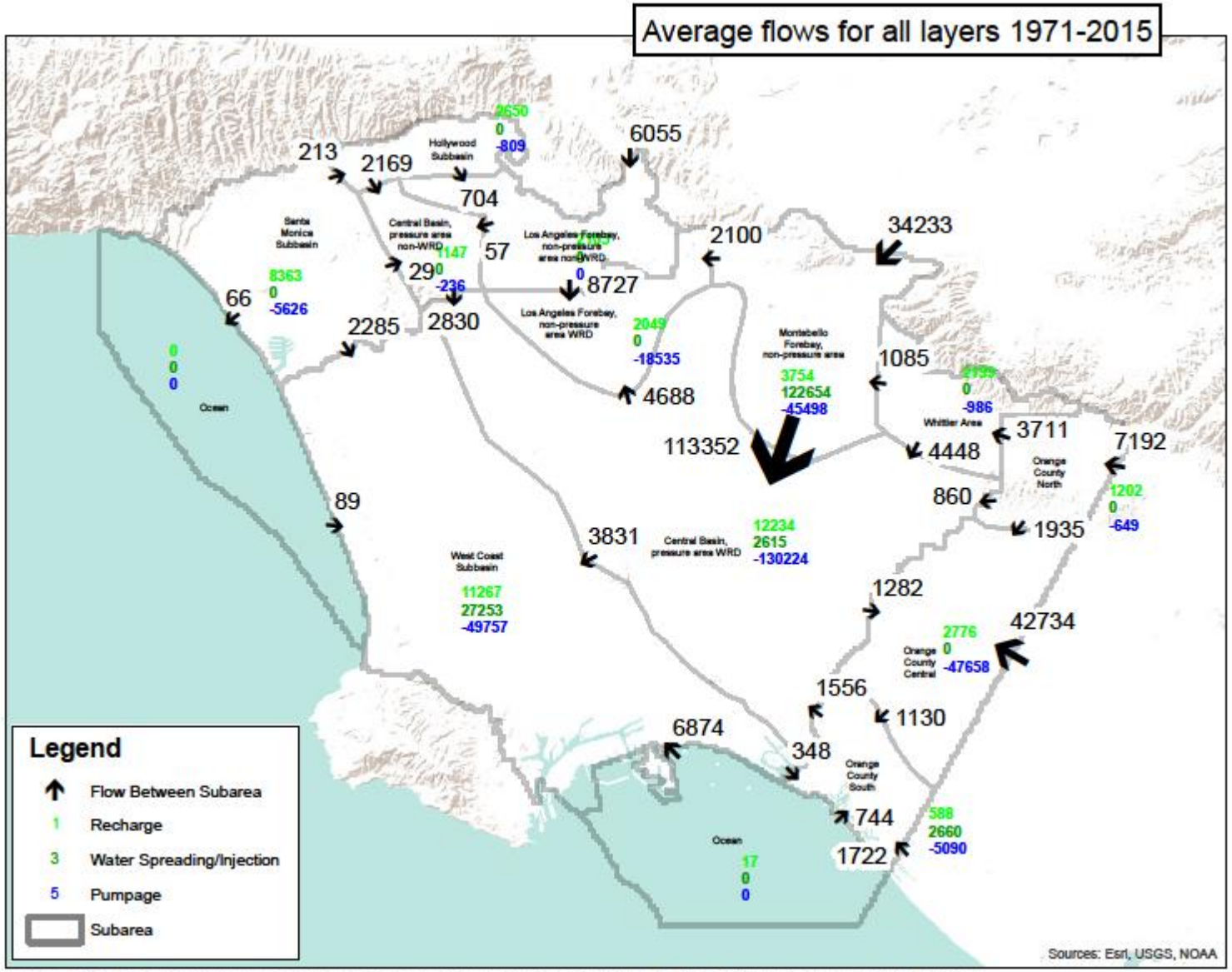


Figure D14. Average groundwater flow between subareas in Los Angeles Coastal Plain, 1971-2015, Los Angeles County, California.

Regional Groundwater Monitoring Network

WRD is also the groundwater monitoring entity for the CBWCB

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA MONITORING PLAN

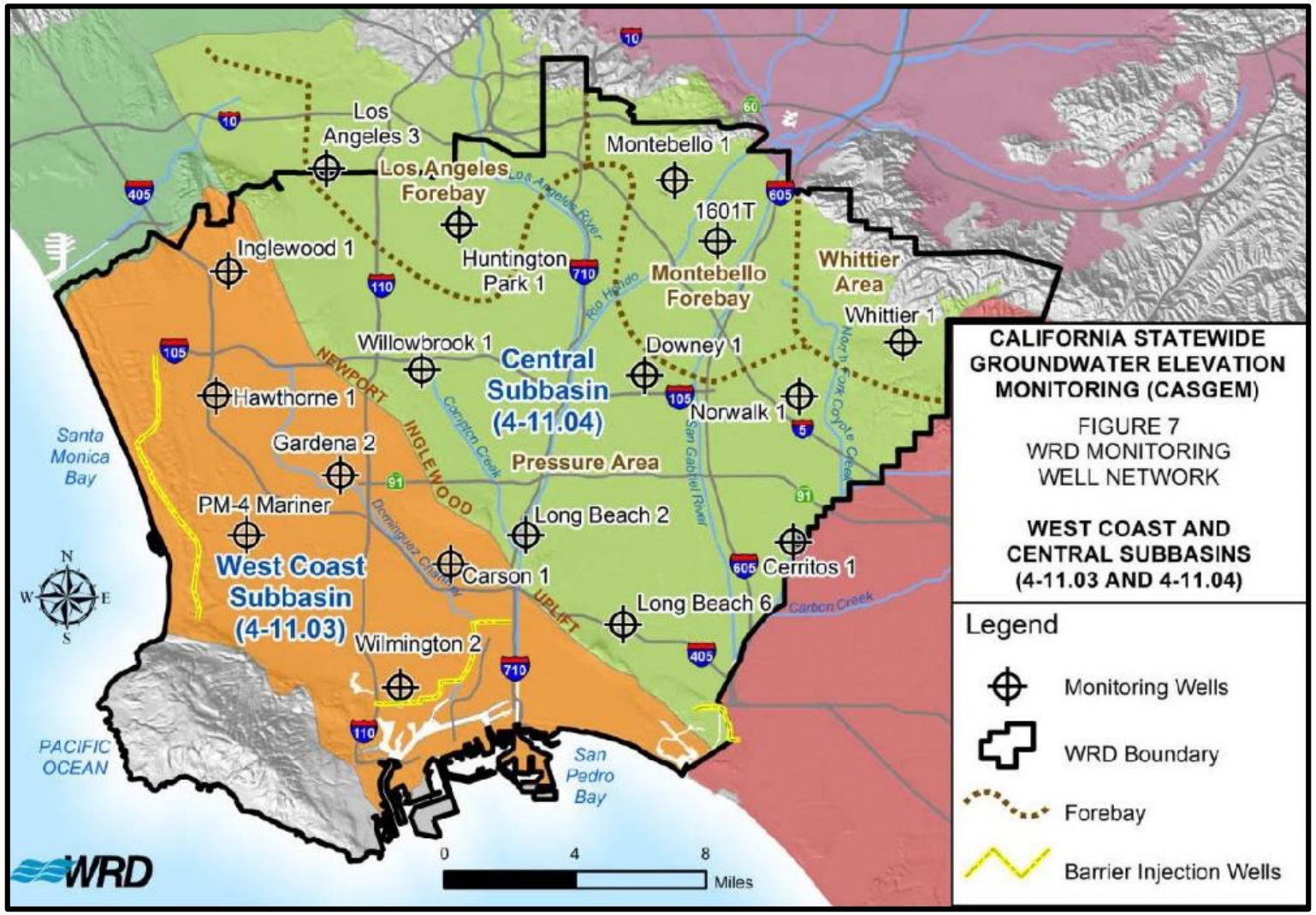
FOR

CALIFORNIA STATEWIDE GROUNDWATER ELEVATION MONITORING (CASGEM) PROGRAM

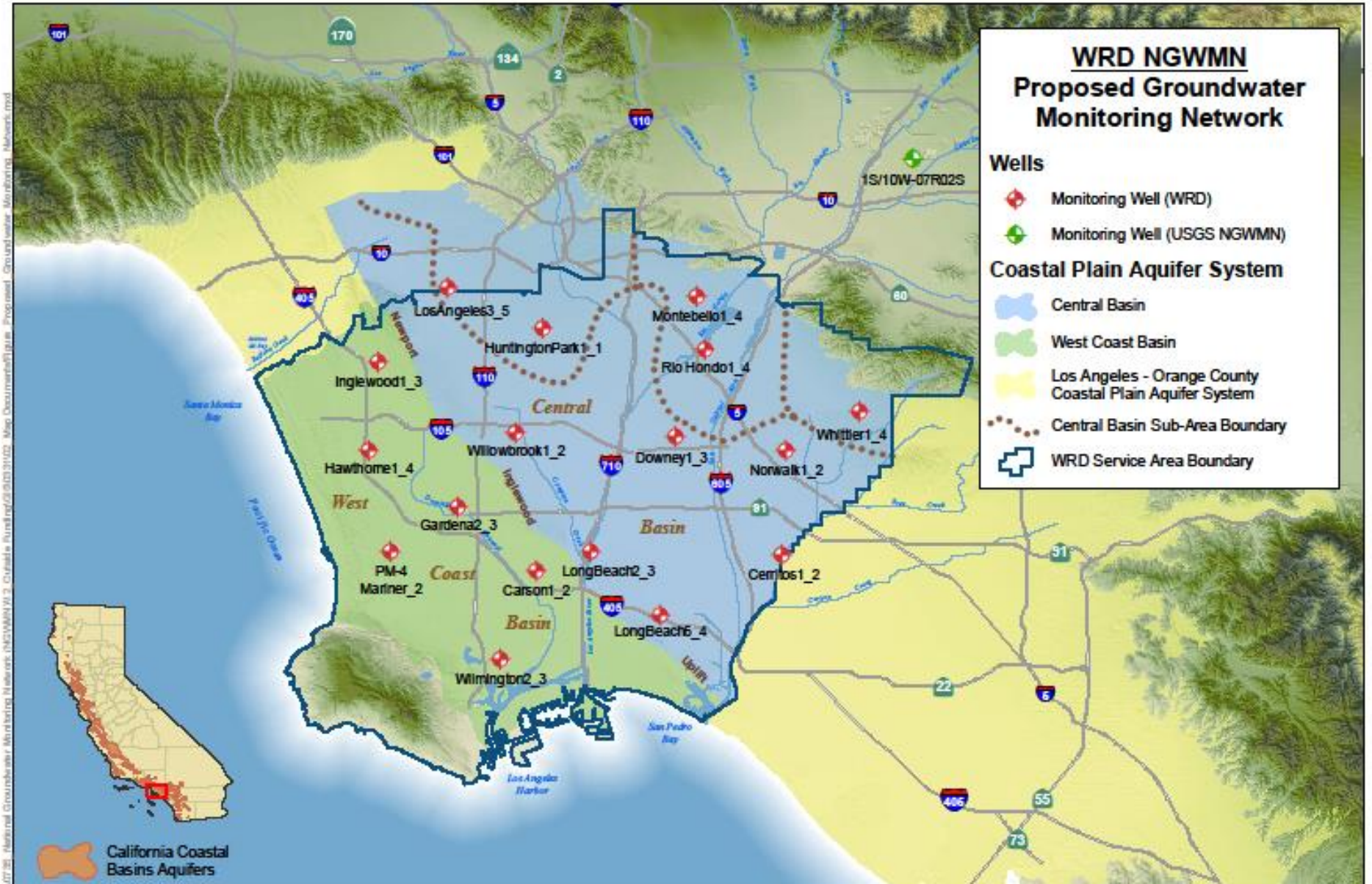
South Coast Hydrologic Region
Basin 4-11 Coastal Plain of Los Angeles County
Subbasin 4-11.03 West Coast
Subbasin 4-11.04 Central

***Final plan submitted* October 25, 2011**

WRD



NGWMN Proposed Network

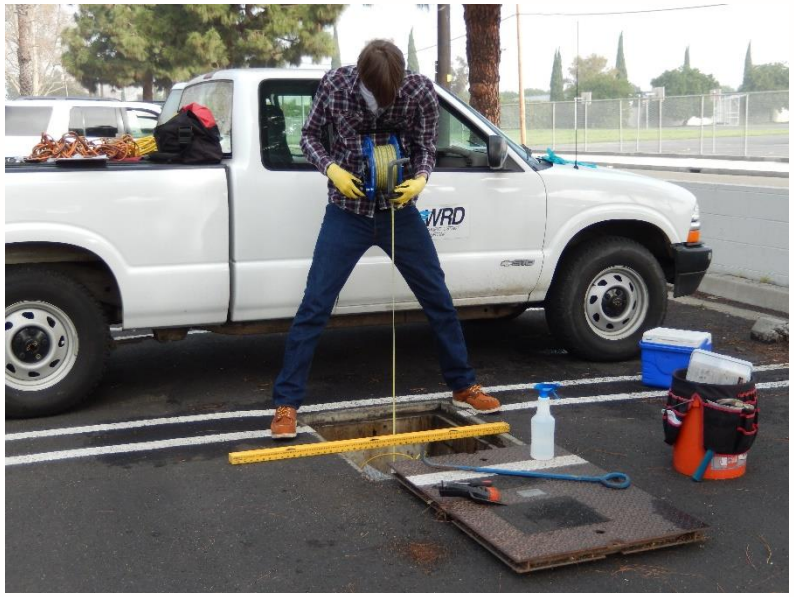


NGWMN Well Selection and Classification

#	Subbasin	State Well Number	Well Name	Well Depth (ft)	Top of Screen (ft)	Bottom of Screen (ft)	Aquifer Screened
1	4-11.03 West Coast	04S13W09H010S	Carson1_2	760	740	760	Silverado
2	4-11.03 West Coast	03S14W25K009S	Gardena2_3	630	610	630	Silverado
3	4-11.03 West Coast	03S14W17G006S	Hawthorne1_4	420	400	420	Silverado
4	4-11.03 West Coast	02S14W28M005S	Inglewood1_3	450	430	450	Silverado
5	4-11.03 West Coast	04S14W04Q002S	PM-4 Mariner_2	550	500	540	Silverado
6	4-11.03 West Coast	04S13W32F003S	Wilmington2_3	560	540	560	Silverado
7	4-11.04 Central	04S11W05P010S	Cerritos1_2	1020	1000	1020	Silverado
8	4-11.04 Central	03S12W09J003S	Downey1_3	600	580	600	Silverado
9	4-11.04 Central	02S13W22C001S	HuntingtonPark1_1	910	890	910	Silverado
10	4-11.04 Central	04S13W01N005S	Long Beach2_3	470	450	470	Silverado
11	4-11.04 Central	04S12W21M011S	Long Beach6_4	500	480	500	Silverado
12	4-11.04 Central	02S14W12E005S	LosAngeles3_5	350	330	350	Silverado
13	4-11.04 Central	02S12W10Q008S	Montebello1_4	390	370	390	Silverado
14	4-11.04 Central	03S11W17F002S	Norwalk1_2	1010	990	1010	Silverado
15	4-11.04 Central	02S12W26D012S	RioHondo1_4	450	430	450	Silverado
16	4-11.04 Central	03S11W02K006S	Whittier1_4	470	450	470	Silverado
17	4-11.04 Central	03S13W08J002S	Willowbrook1_2	520	500	520	Silverado

- Good spatial distribution of wells in WRD service area
- 17 dedicated monitoring wells
- Wells have an average of 18 years of continuous data
- Wells are screened only in the deeper and principal aquifer (Silverado)

Do we collect data differently than the NGWMN?



- Collect quarterly manual water level data via electric sounder and daily pressure transducer data.
- Collect seminannual water quality through grab samples via Grundfos 2” Rediflo and Bennett pumps.

NGWMN Status of Year 1

- Classify sites into subnetworks and monitoring categories for water levels and water quality (Nov – Dec 2018).
- Populate NGWMN Well Registry with site and network information (Dec 2018 – Jan 2019).
- Connect WRD databases to NGWMN Portal using web services (Jan-Mar 2019).
- Collect WL and WQ data for NGWMN (Mar – May 2019)
- Document data collection and management protocols, summary report (May – Jun 2019)

Database structure at WRD

[Water DB]
Normalized and Authoritative

[Data Warehouse for Web Apps]
Completely from [Water DB]

[Data Warehouse for Direct Access]
Mostly from [Water DB]

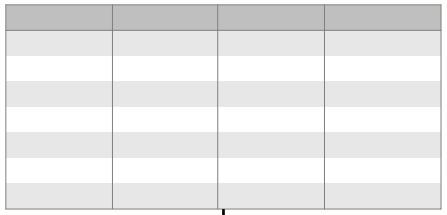
[Geodatabase]
Partially from [Water DB]

Internal
Web Apps

Internal
Microsoft Access

ArcGIS Server to Public Web App

Excel Files
And other loose ends

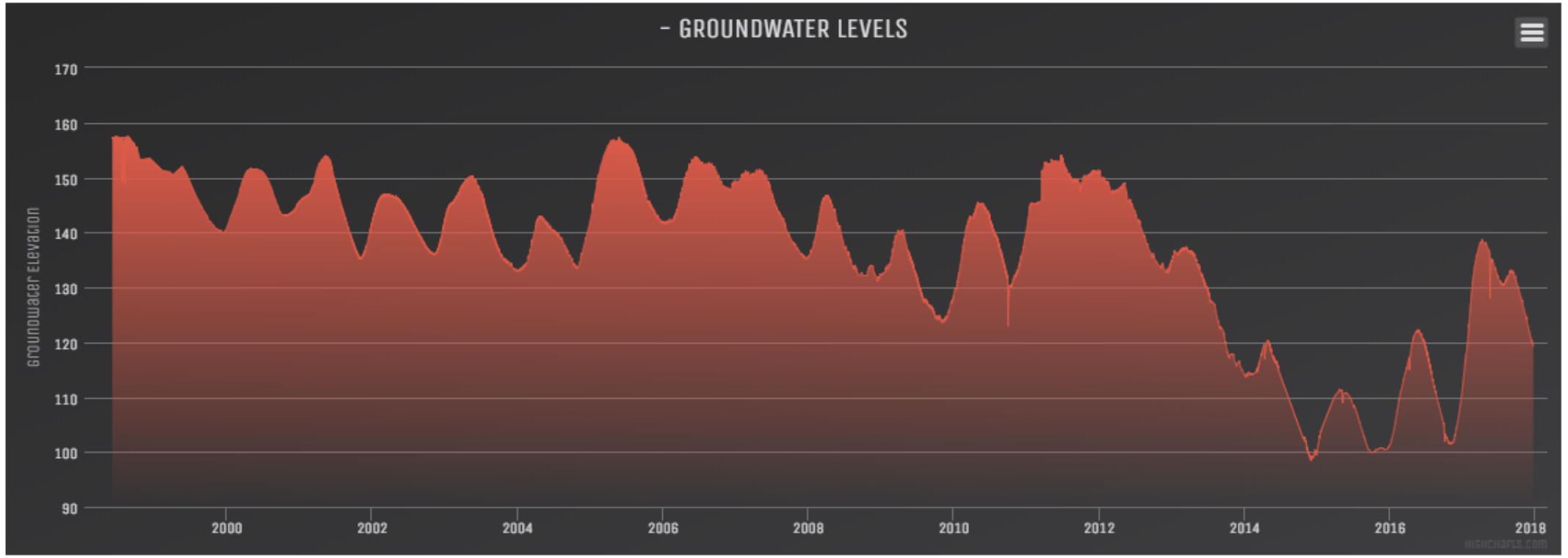


Experience with web applications at WRD

WATER LEVEL DATA FOR WELL

OWNER NUMBER: P1_1

WRD ID: 100001



Experience with web applications at WRD

WRD LAB DATA

Search by Report Number:

Report No.

SEARCH

Search by WRD ID:

WRD ID

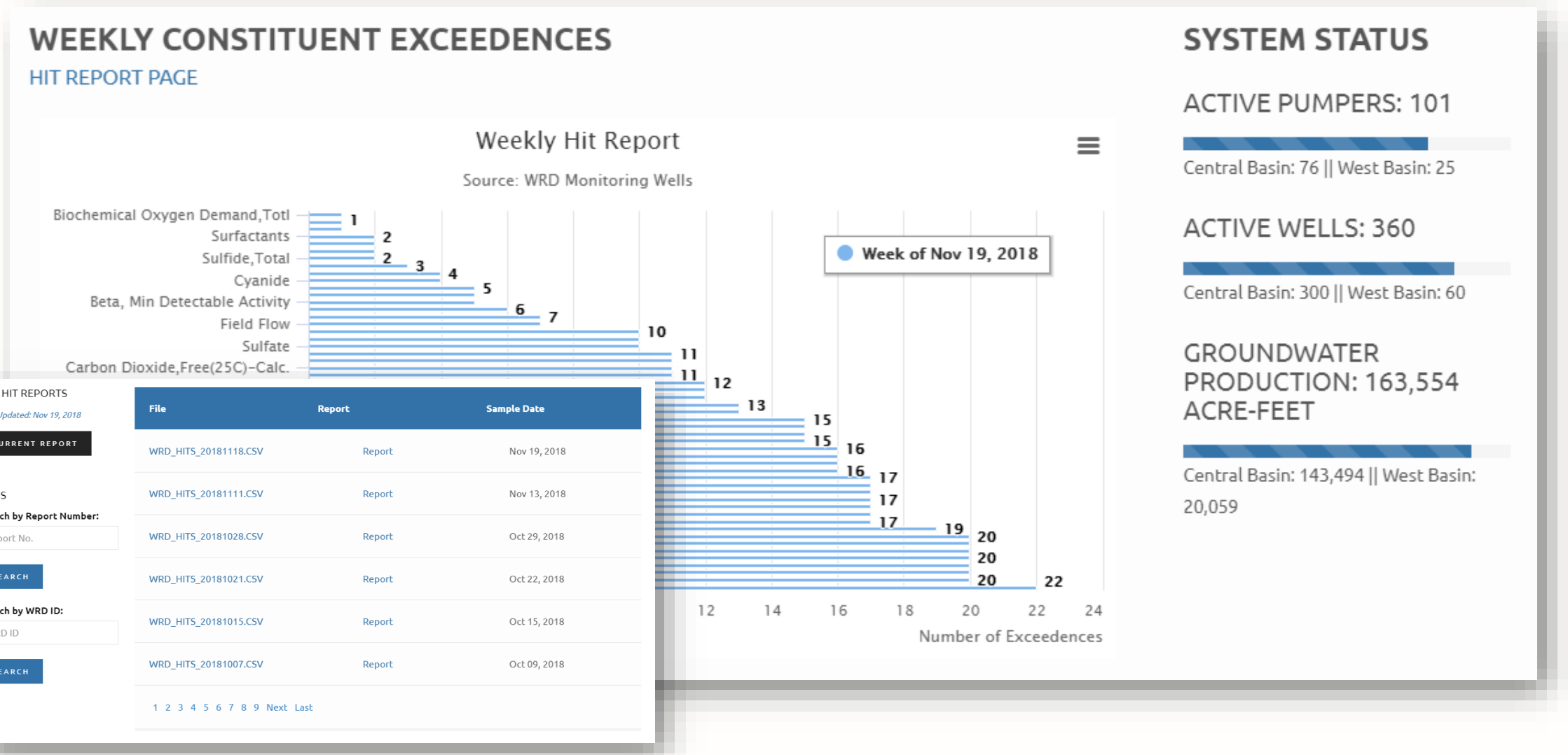
SEARCH

WRD ID	Sample Date	Sample Time	Storet	Constituent	Method	Flag	Value	DL	MDL
100001	2018-05-01	16:30:00	35215	18	SM 2120B		45.000	3.000	3.000
100001	2018-05-01	16:30:00	35216	39	SM 2150B		2.000	1.000	1.000
100001	2018-05-01	16:30:00	35217	41	SM2510B		550.000		
100001	2018-05-01	16:30:00	35221	42	EPA 150.1		8.040		

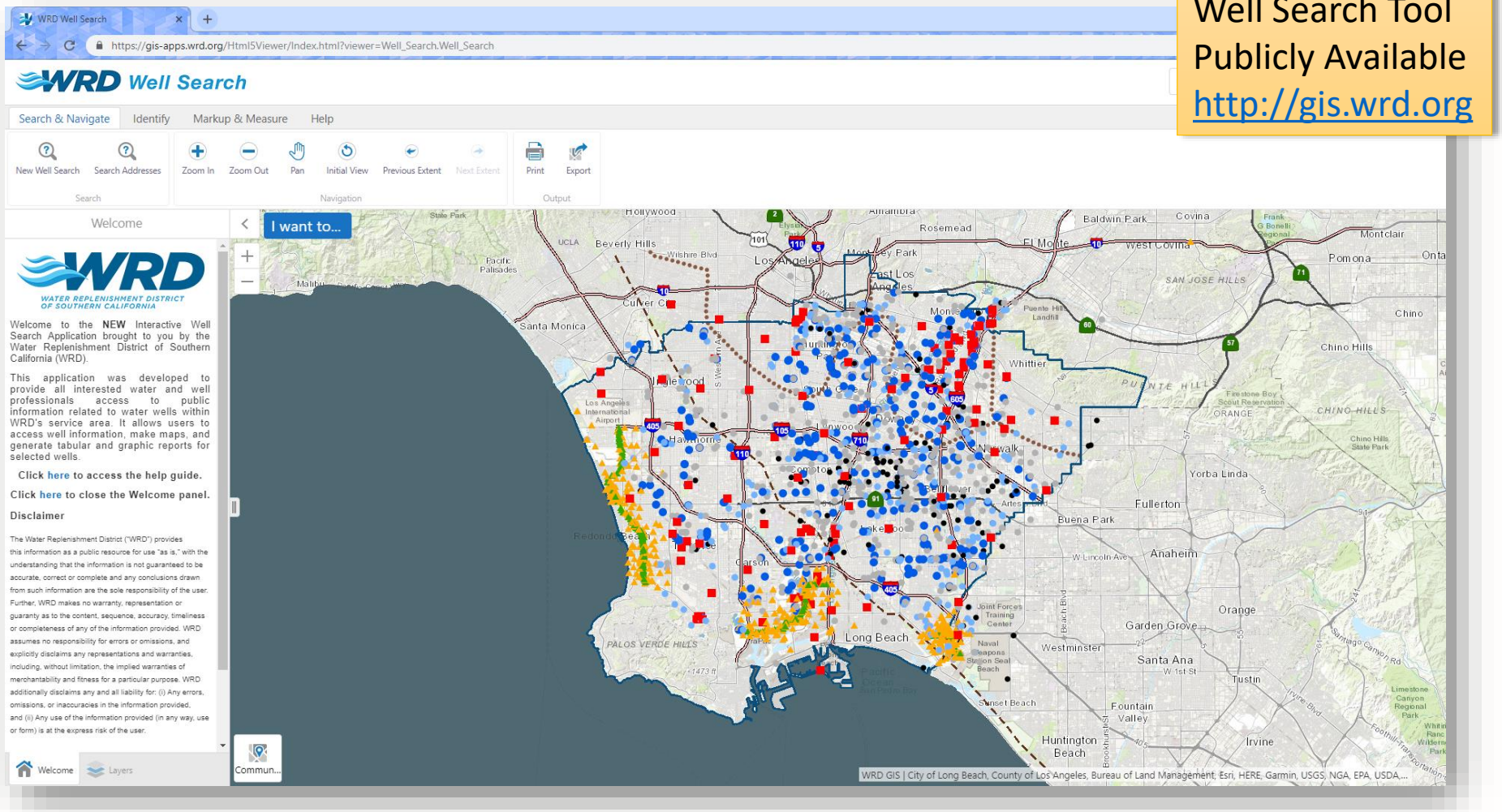
WELL DATA

Construction Date	Destruction Date	Well Depth	Bore Diameter	Bore Depth	Casing Type	Casing Diameter	Drill Method	TOP	BOP
1996		900	9.88	930	PVC80	3	ROT	860	900
NOTES:	Pico Water District Office Yard (562) 692-3756, RPE updated 9/7/16								

Experience with web applications at WRD



Experience with web applications at WRD



Well Search Tool
Publicly Available
http://gis.wrd.org

WRD web service plan for the NGWMN

- TBD
- If possible, our preference is to utilize ArcGIS Server to produce web services for the NGWMN

WIN
WATER INDEPENDENCE NOW

WRD
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

ALBERT ROBLES CENTER
WATER RECYCLING & ENVIRONMENTAL LEARNING

THANK YOU

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