



*WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA*

Contaminants of Emerging Concern Central Basin and West Coast Basin

Brian Partington, PG, CHg
May 2, 2019

SECURING OUR WATER FUTURE TODAY

Overview

- WRD sampling in the Central Basin and West Coast Basins.
- Deep nested groundwater monitoring well network and general basin Geology / Hydrogeology.
- CEC distribution focusing on hexavalent chromium (hex chrome), perchlorate, and 1,4-Dioxane.
- Sampling plan to evaluate PFAS.
- How are we helping to address CECs?

Water Replenishment District



**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**



"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."

Mission Statement

"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."

Routine Sampling Conducted by WRD

Where do we Sample?

1. Spreading Grounds
2. Albert Robles Center AWTF
3. West Coast Barrier Project
4. Dominguez Gap Barrier Project
5. Alamitos Gap Barrier Project
6. Regional Groundwater Monitoring

Why do we sample?

Required by Various Permits

- Water Reclamation Requirements (WRR) / Waste Discharge Requirements (WDR)
- National Pollutant Discharge Elimination System (NPDES)

Voluntary Programs such as our Regional Groundwater Monitoring of wells installed by WRD / USGS.



Sampling Programs

- Very extensive list of analytes mainly driven by permits we get from the RWQCB (WDR, WRR, NPDES).
- WRD also samples various special study constituents selected periodically for Regional Groundwater Monitoring Program. Gives us a “snapshot” of the what’s present in the CBWCB.
- We have hundreds of monitoring points throughout the CBWCB...cost can add up quickly (\$\$\$). Especially for the newer, more exotic ones like PFAS.

Bisphenyl A, boron, carbamazepine, chlorate, hexavalent chromium (CrVI), diazinon, 1,4-dioxane, naphthalene, n-nitrosodiethylamine (NDEA), n-nitrosodi-npropylamine (NDPA), n-nitrosodiphenylamine, n-nitrosopyrrolidine (NPYR), 1,2,3trichloropropane (1,2,3-TCP), tris(2-carboxyethyl)phosphate (TCEP), vanadium, caffeine, gemfibrozil, n,n-diethyl-meta-toluamide (DEET), iopromide, NDMA, sucralose, 17-beta-estradiol (17 β -estradiol), n-nitrosodimethylamine (NDMA), and triclosan...

Special Study Constituents past 20+ Years

Water Year	Routine Constituents													Special Study Constituent including CECs																
	TDS	Fe	Mn	NO3	Hardness	SO4	Cl	TCE	PCE	As	Cr	TOC	Color	ClO4	Cr6	MTBE	CH4	1,4-D	1,2,3-TCP	TBA	DIPE	TAME	ETBE	Radon	TNT	HMX	RDX	NDMA	Other	
1995-1998	1	1	1	•	•	•	•	1	1	•	•	•	•	--	--	--	--	--	--	--	•	--	--	--	--	--	--	--	--	--
1998-1999	1	1	1	1	•	•	•	1	1	1	•	•	•	1	1	1	--	--	--	--	•	--	--	1	--	--	--	--	--	--
1999-2000	1	1	1	1	1	1	1	1	1	1	•	•	•	1	1	1	--	--	•	--	•	•	•	1	--	--	--	--	--	--
2000-2001	1	1	1	1	1	1	1	1	1	1	1	1	1	--	1	1	--	--	•	--	•	•	•	•	--	--	--	--	--	--
2001-2002	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	•	--	•	•	•	•	--	--	--	--	--	--
2002-2003	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	•	--	--	--	•	--	--	--	--	--	--	--
2003-2004	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	•	--	--	--	•	--	--	--	--	--	--	--
2004-2005	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	•	--	•	--	--	--	--	--	--	--	--	--
2005-2006	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	•	--	--	--	--	--	--	--	--	--	--	--
2006-2007	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	1	--	--	•	1	1	•	•	--	--	--	--	--	--	--
2007-2008	1	1	1	1	1	1	1	1	1	1	1	1	1	--	--	1	--	--	•	•	•	•	•	--	--	--	--	--	--	--
2008-2009	1	1	1	1	•	•	1	1	1	1	•	1	•	1	--	•	--	--	•	--	--	--	--	--	--	--	--	--	--	2
2009-2010	1	1	1	1	•	•	1	1	1	1	•	1	•	1	--	--	--	--	•	--	--	--	--	--	--	--	--	--	--	--
2010-2011	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	--	•	--	--	--	--	--	--	--	--	--	--	--
2011-2012	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	1	1	•	•	•	•	--	--	--	--	--	--	--
2012-2013	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	--	•	•	•	•	•	--	--	--	--	--	--	--
2013-2014	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	1	--	•	--	•	•	•	--	--	--	--	--	--	--
2014-2015	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	--	•	--	•	•	•	--	--	--	--	--	--	--
2015-2016	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	--	•	•	•	•	•	--	--	--	--	•	--	--
2016-2017	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	1	•	1	•	•	•	--	--	--	--	•	--	--
2017-2018	1	1	1	1	•	•	1	1	1	1	•	•	•	1	1	•	--	1	•	1	•	•	•	--	•	•	•	--	--	--


Notes:

- Data available, but no figures generated in RGWMR.
- Data not collected for RGWMR.
- 1 Data collected and figures generated in RGWMR.
- 2 Data available for acetaminophen, BPA, carbamazepine, DEET, dilantin, iopromide, meprobamate, TCEP, and trimethoprim.

Regional Groundwater Monitoring Program


- 350 deep nested wells to 2,900’.
- Drilled by USGS.
- WRD staff sample wells using our customized sampling rigs in Fall & Spring.
- Over 100 constituents analyzed with roughly 60,000 data points reported annually in our Regional Groundwater Monitoring Report.
- Data publically available via our Interactive Well Search Website. (<http://gis.wrd.org/>)

Water Replenishment District
of Southern California



REGIONAL GROUNDWATER MONITORING REPORT
WATER YEAR 2016-2017

Central and West Coast Basins
Los Angeles County, California

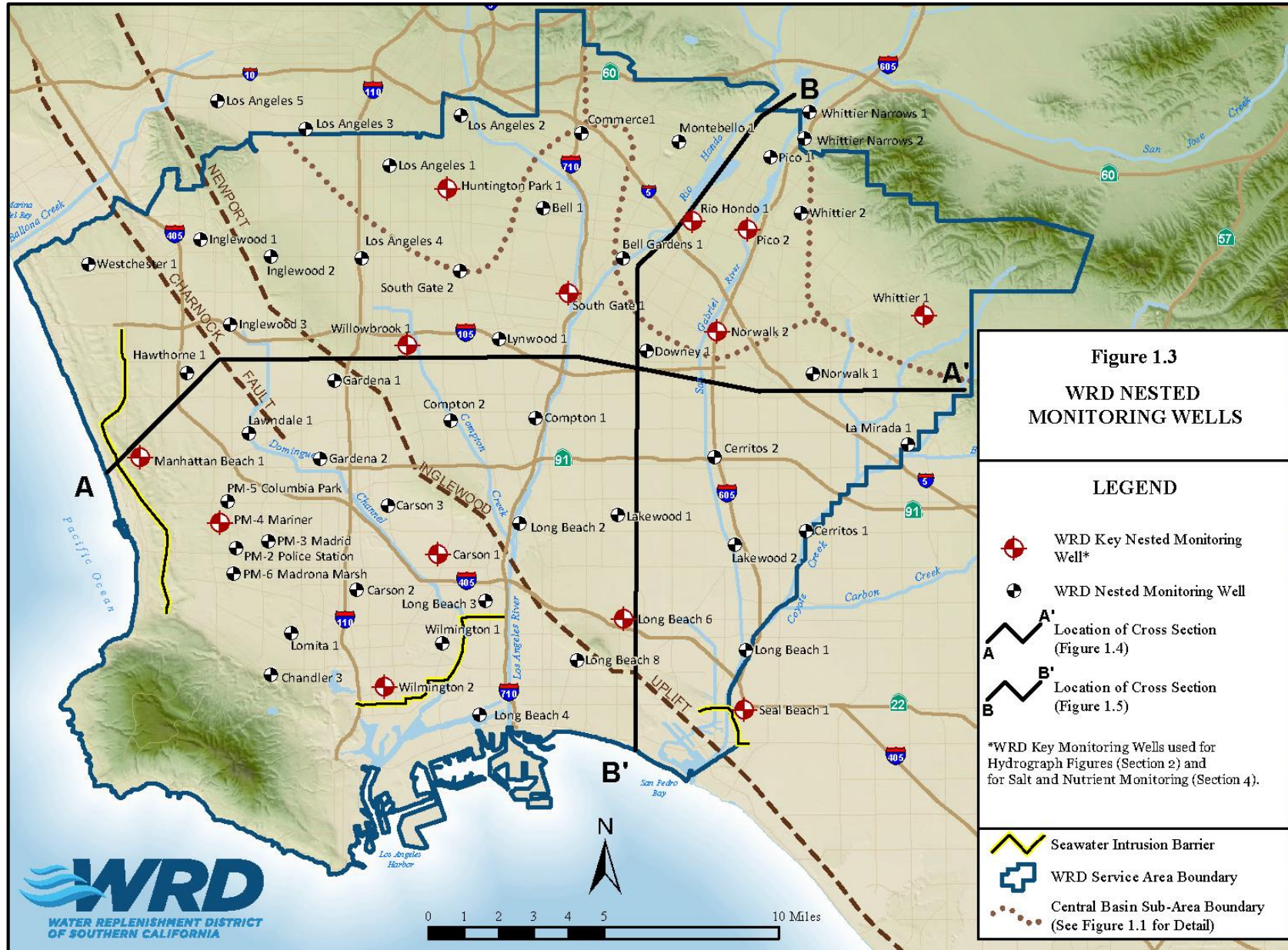


March 2018

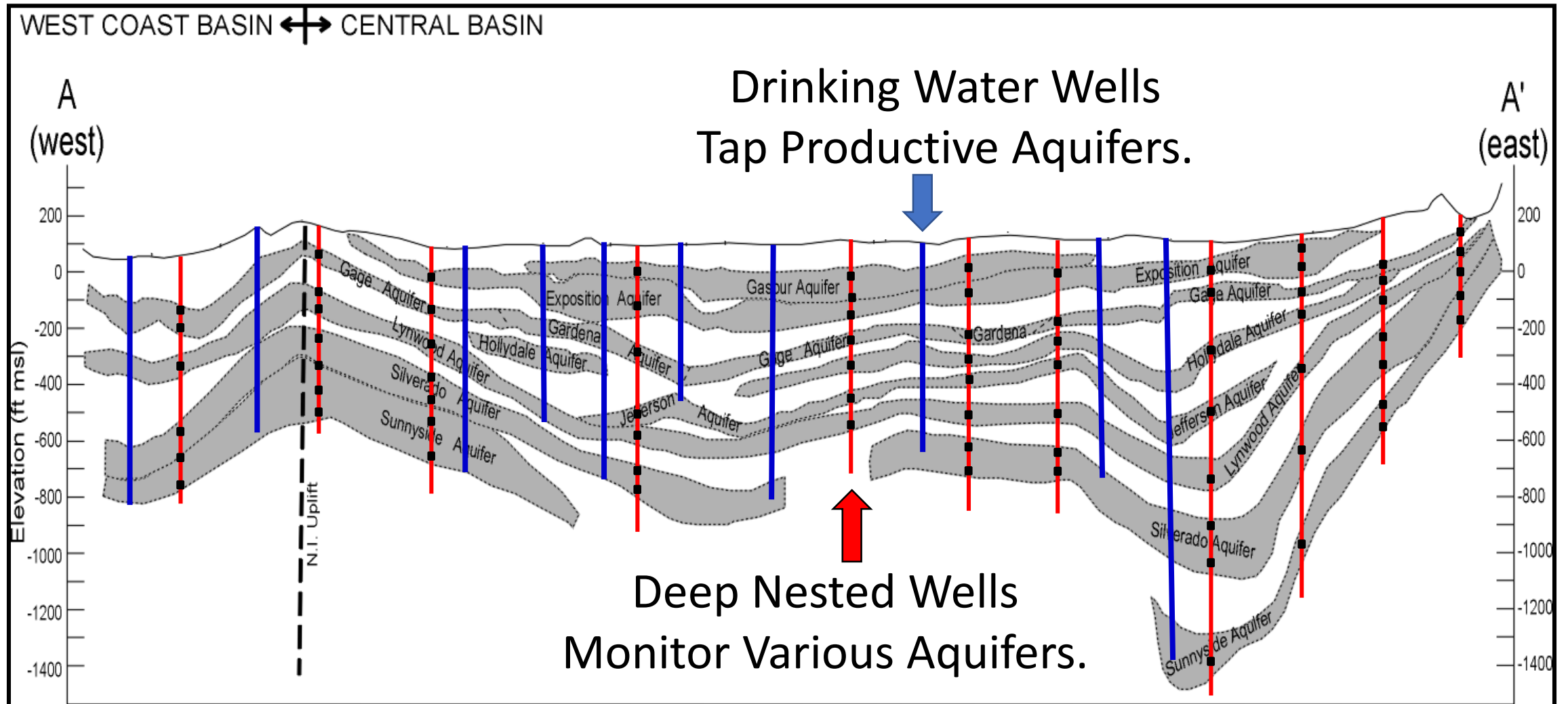
Regional Groundwater Monitoring Program



Regional Groundwater Monitoring Program



Regional Groundwater Monitoring Program

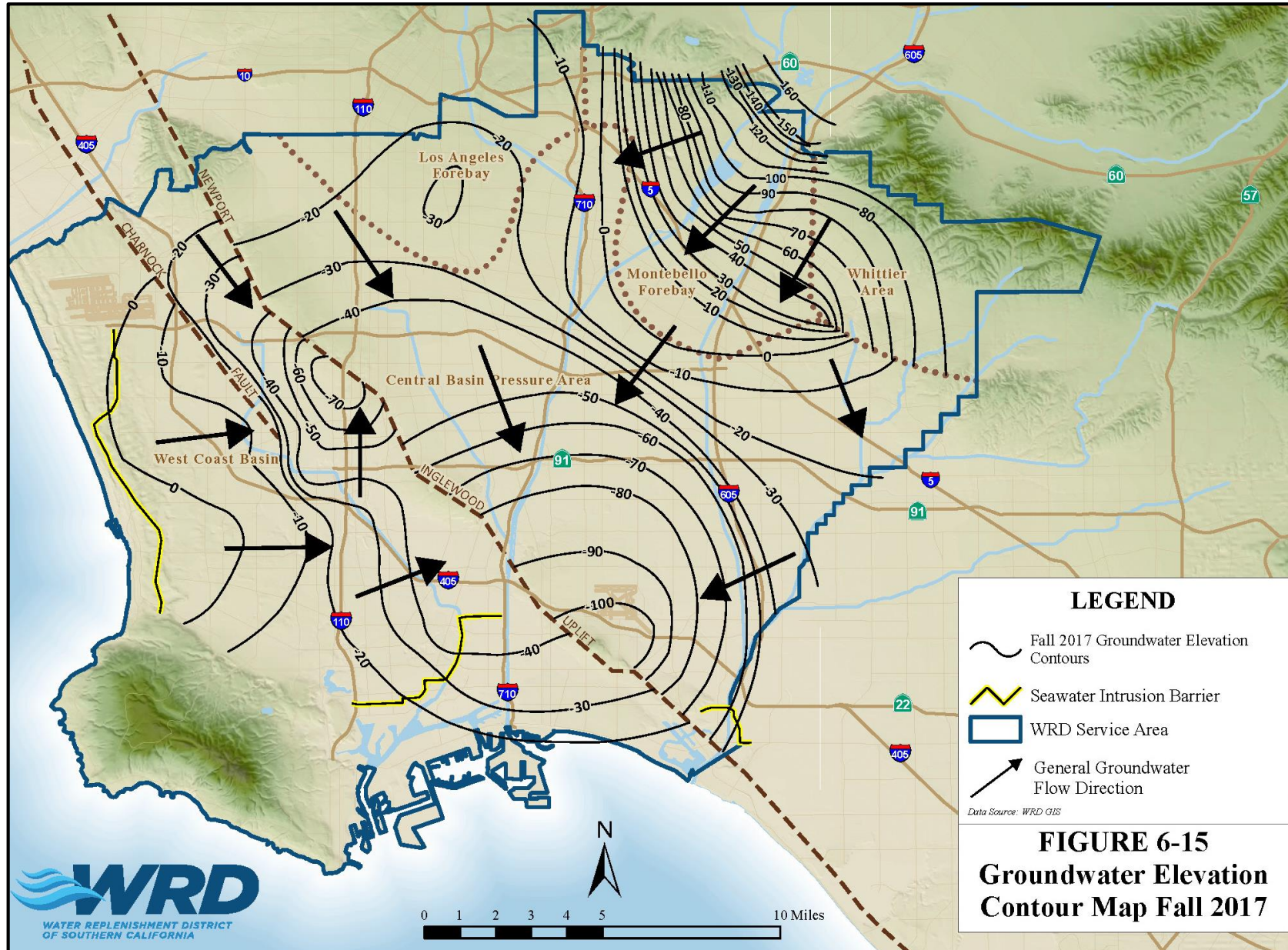


Modified from DWR (1962, Plate 4)

0 4000 8000
Approximate Horizontal Scale (feet)

■ Aquifer
□ Aquitard

Regional Groundwater Monitoring Program

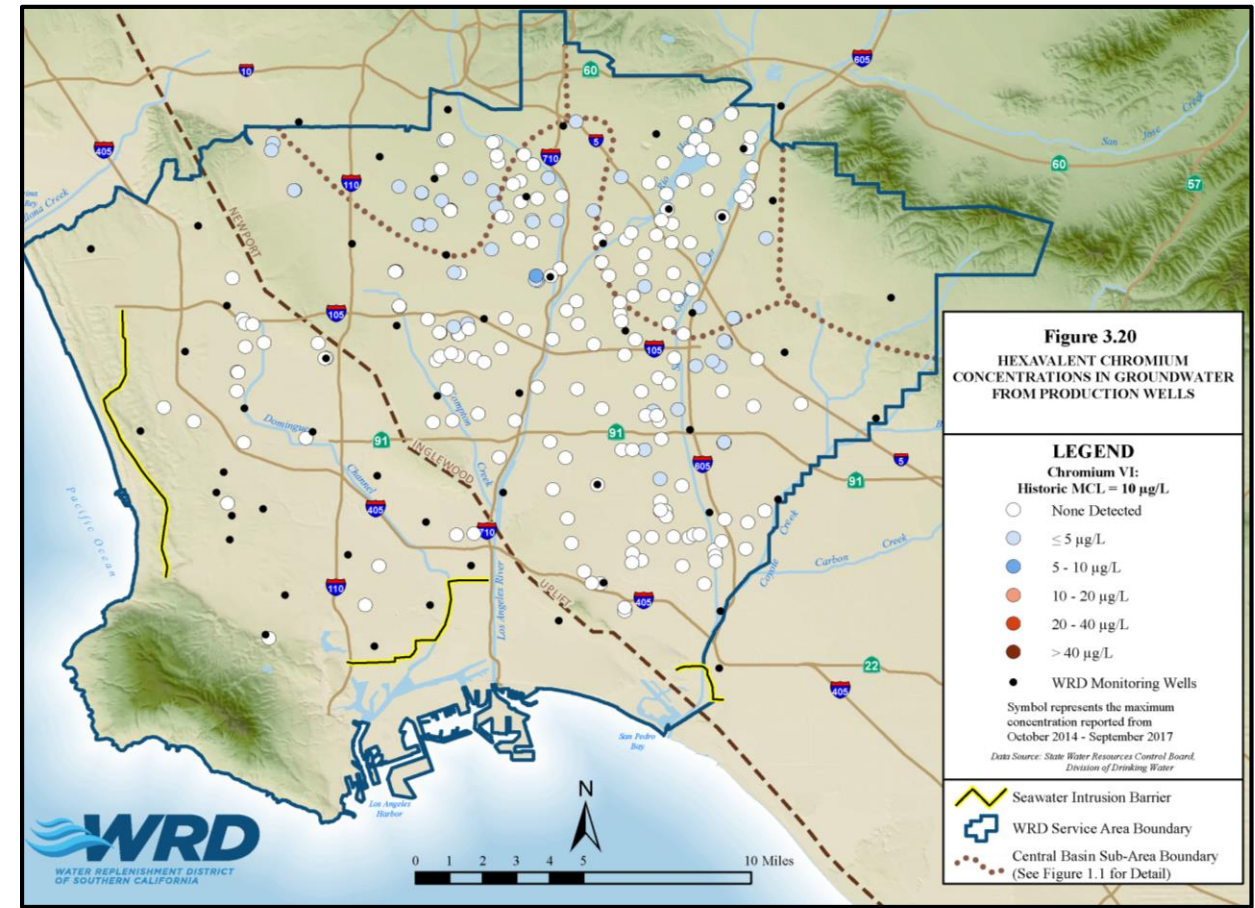
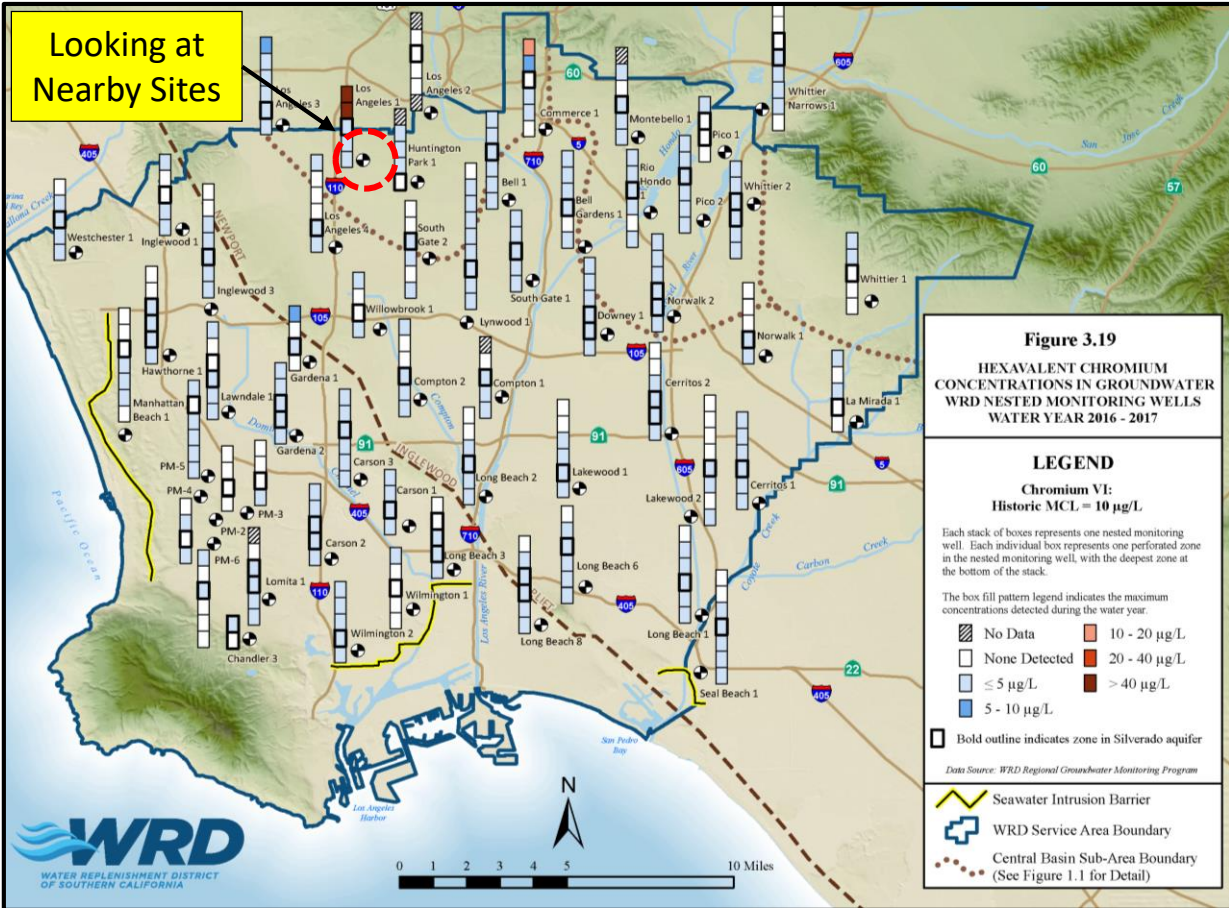


Regional Groundwater Monitoring Program

Hex Chrome in Monitoring Wells

Hex Chrome in Production Wells

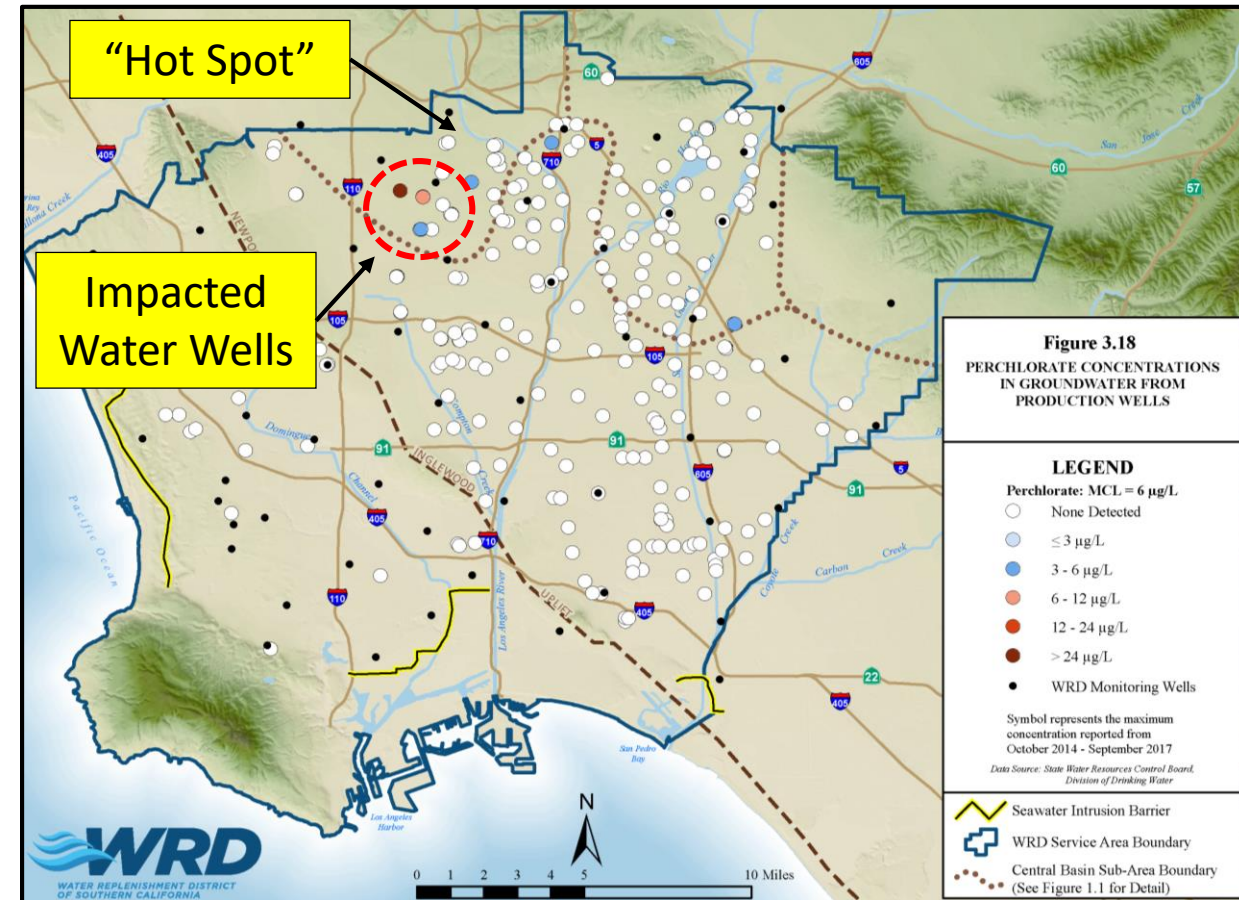
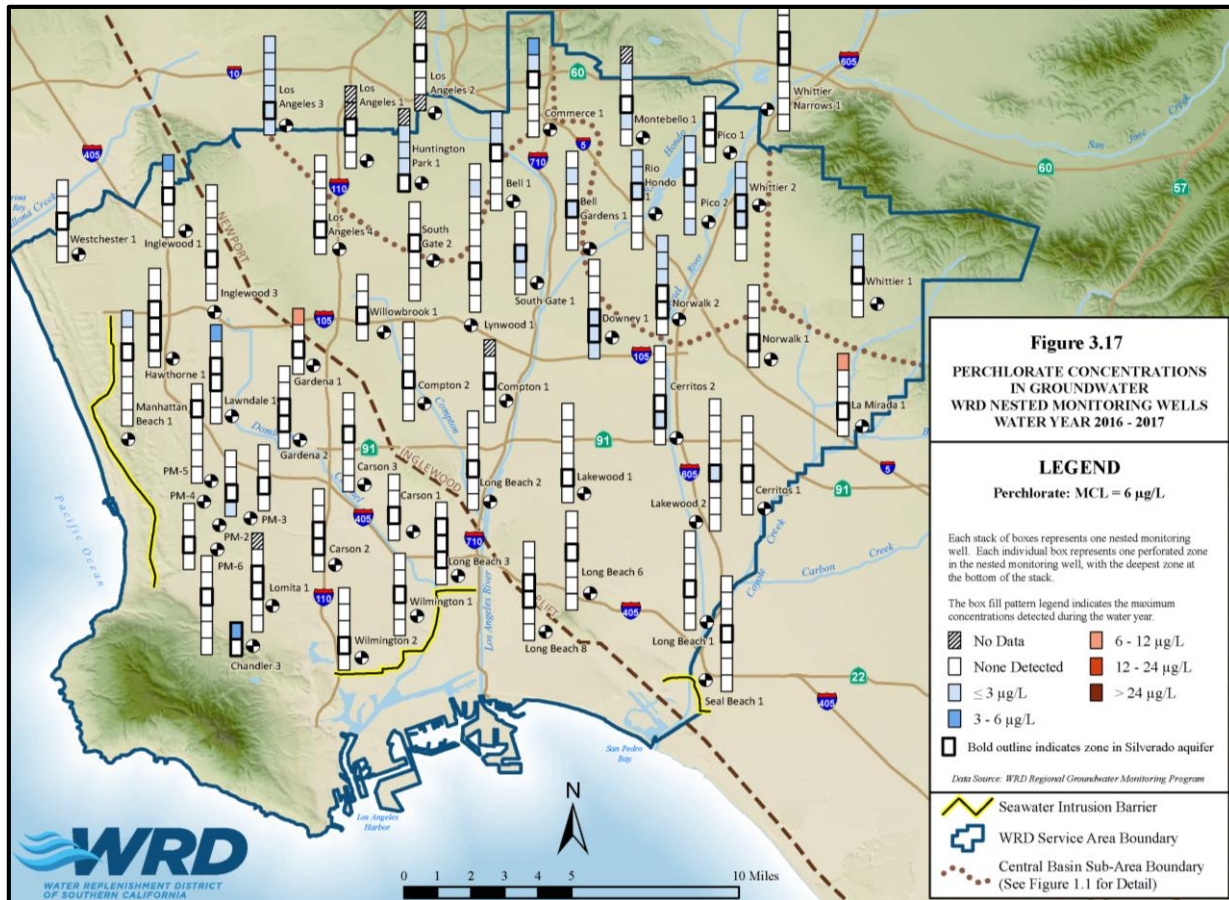
Looking at Nearby Sites



Regional Groundwater Monitoring Program

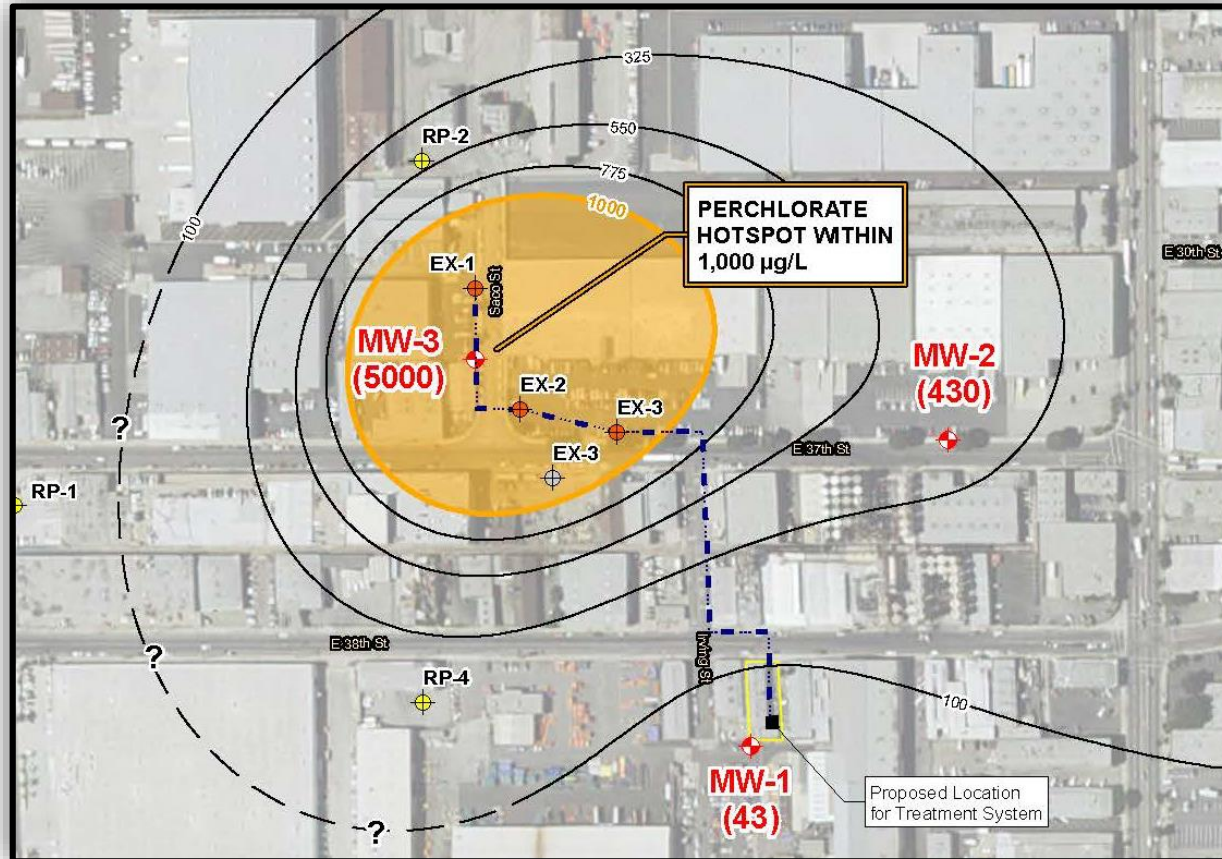
Perchlorate in Monitoring Wells

Perchlorate in Production Wells



Regional Groundwater Monitoring Program

- Grant funding to address “Hot Spot” through Prop 1.
- Install remediation system and several deep nested wells to delineate and identify source of Perchlorate (up to 5,000 µg/L).



State Water Resources Control Board

MAR 30 2017

Theodore Johnson
Water Replenishment District of Southern California
4040 Paramount Boulevard
Lakewood, CA 90712

PROPOSITION 1 GROUNDWATER GRANT FUNDING PRELIMINARY AWARD; WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA (WRD); LOS ANGELES FOREBAY PERCHLORATE AND VOC CLEANUP PROJECT – PHASE 1 (PROJECT) (FAAST #37377)

Dear Mr. Johnson:

Congratulations! By this letter, I am approving the funding for the WRD's Project, as described below, through the Proposition 1 Groundwater Grant Program (GWGP). This implementation project is approved for funding with a preliminary grant award of up to \$7,275,675.

The Project includes a funding request to construct an ex-situ treatment system in the City of Vernon, to cleanup perchlorate and volatile organic compounds (VOCs) from the Los Angeles Forebay area. The Project includes:

1. Installation of three (3) groundwater extraction wells to pump groundwater from the contaminated portion of the aquifer (completed to a depth of approximately 340 feet below ground surface);
2. Construction of subsurface piping to the groundwater treatment system;
3. Construction of the ex-situ treatment system, consisting of pre-filtration bag filters to remove entrained particles or sediment, granular activated carbon for commingled VOC plumes, and a perchlorate selective resin treatment using ion exchange;
4. Installation of four (4) monitoring wells along the plume periphery to monitor the groundwater treatment system operations; these wells also have potential future use as remediation wells during Phase 2; and
5. Discharge of treated groundwater effluent to a local storm drain in compliance with a permit obtained from the Los Angeles Regional Water Quality Control Board (Los Angeles Regional Water Board).

The Project is an eligible implementation project that would cleanup and prevent the spread of contamination to an aquifer that serves as a source of drinking water. The Project has been reviewed by technical experts from the State Water Board, the Los Angeles Regional Water Board, and the Department of Toxic Substances Control (DTSC). The technical experts concur that the Project should achieve its stated objectives. The Project, therefore, is considered eligible for funding, per the [GWGP Funding Guidelines](#) adopted by the State Water Board (Resolution No. 2016-0028).

FELICIA MARCUS, CHAIR | THOMAS HOWARD, EXECUTIVE DIRECTOR

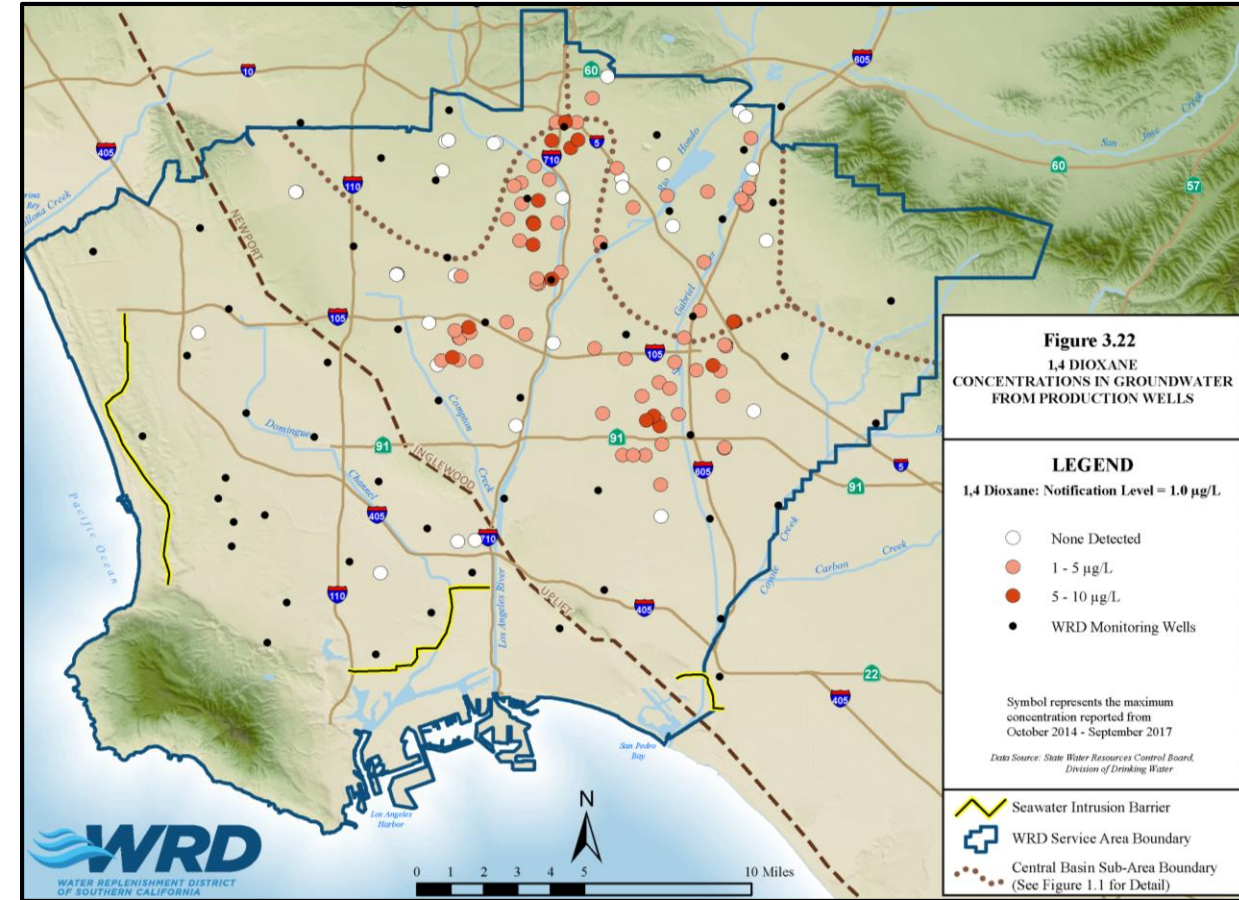
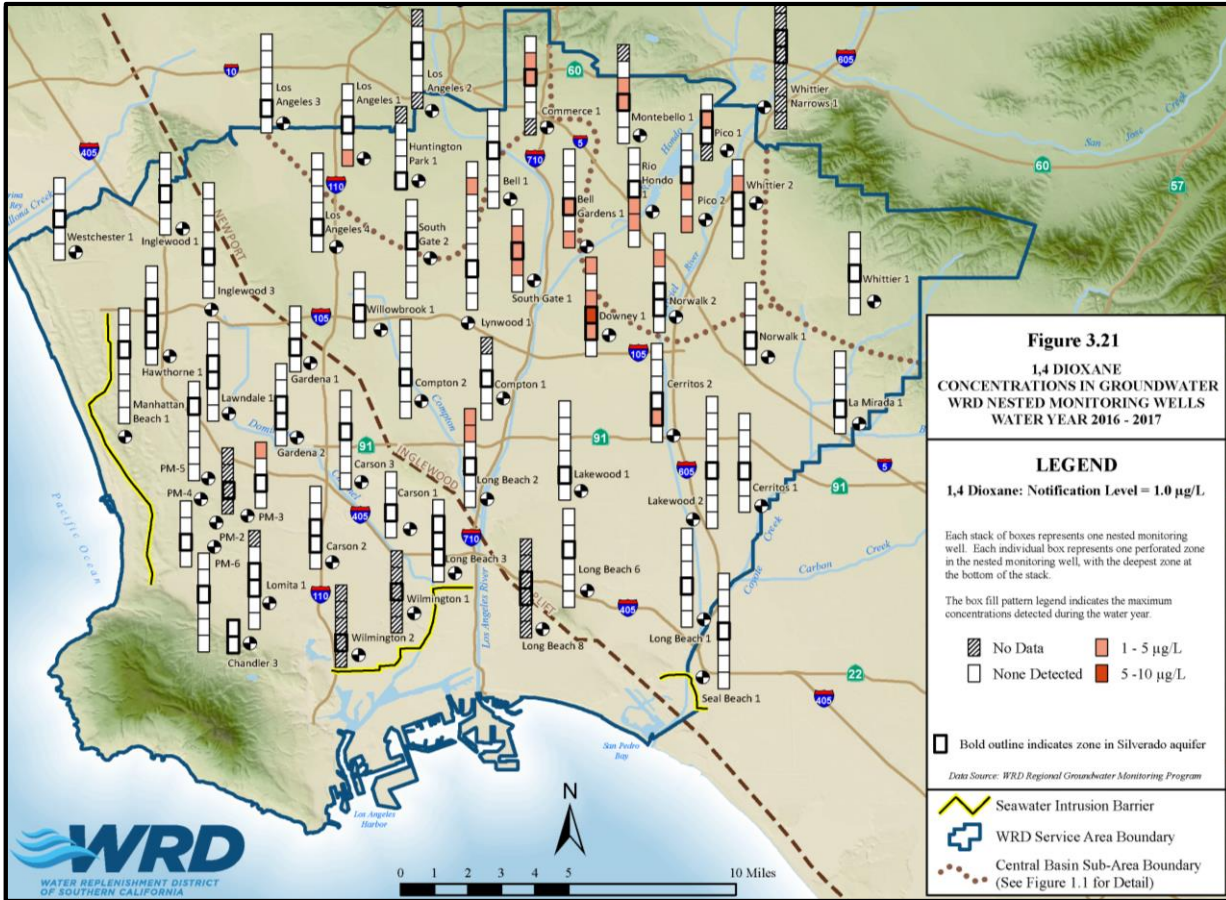
1001 I Street, Sacramento, CA 95814 | Mailing Address: P.O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov



Regional Groundwater Monitoring Program

1,4-Dioxane in Monitoring Wells

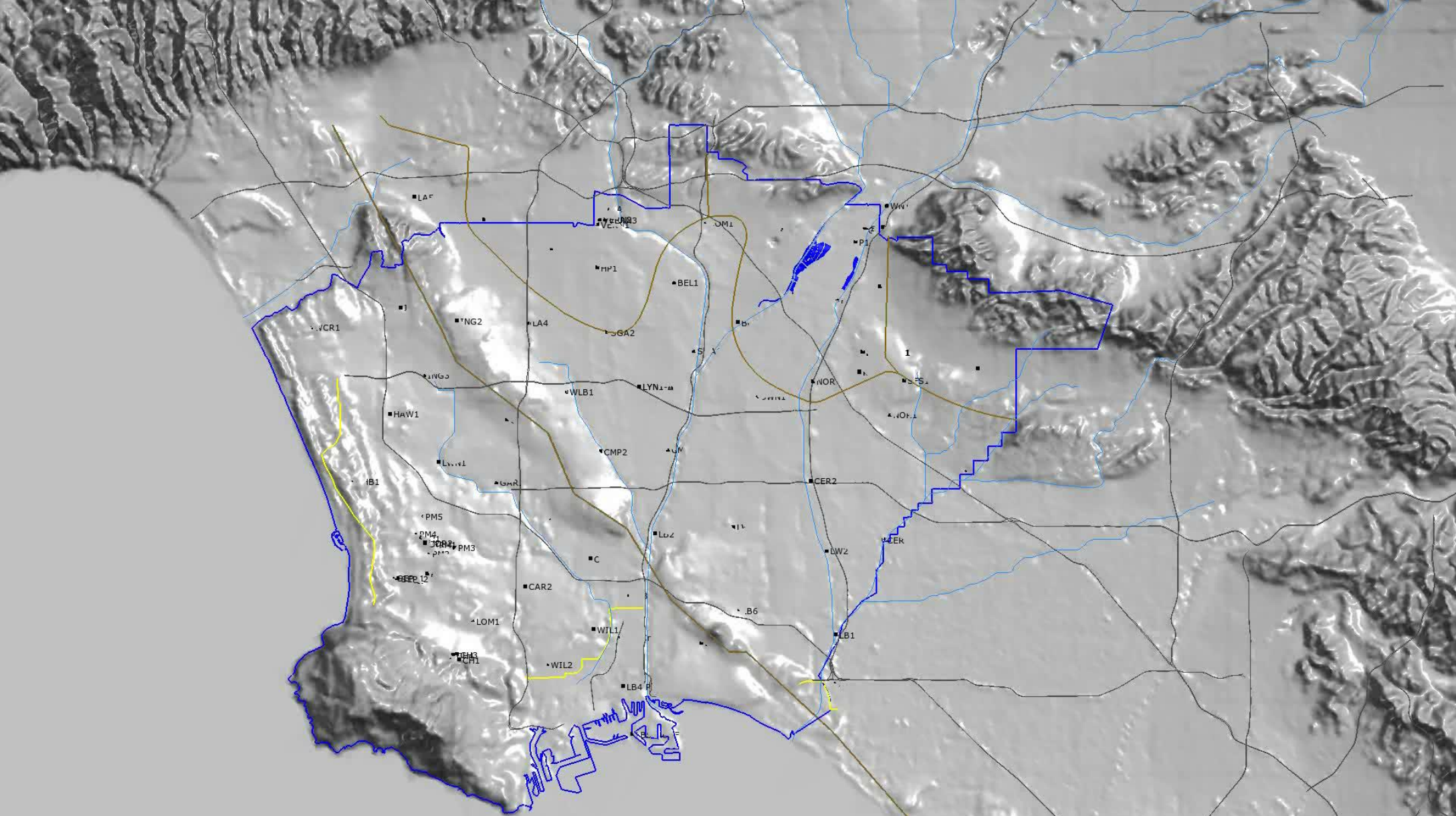
1,4-Dioxane in Production Wells



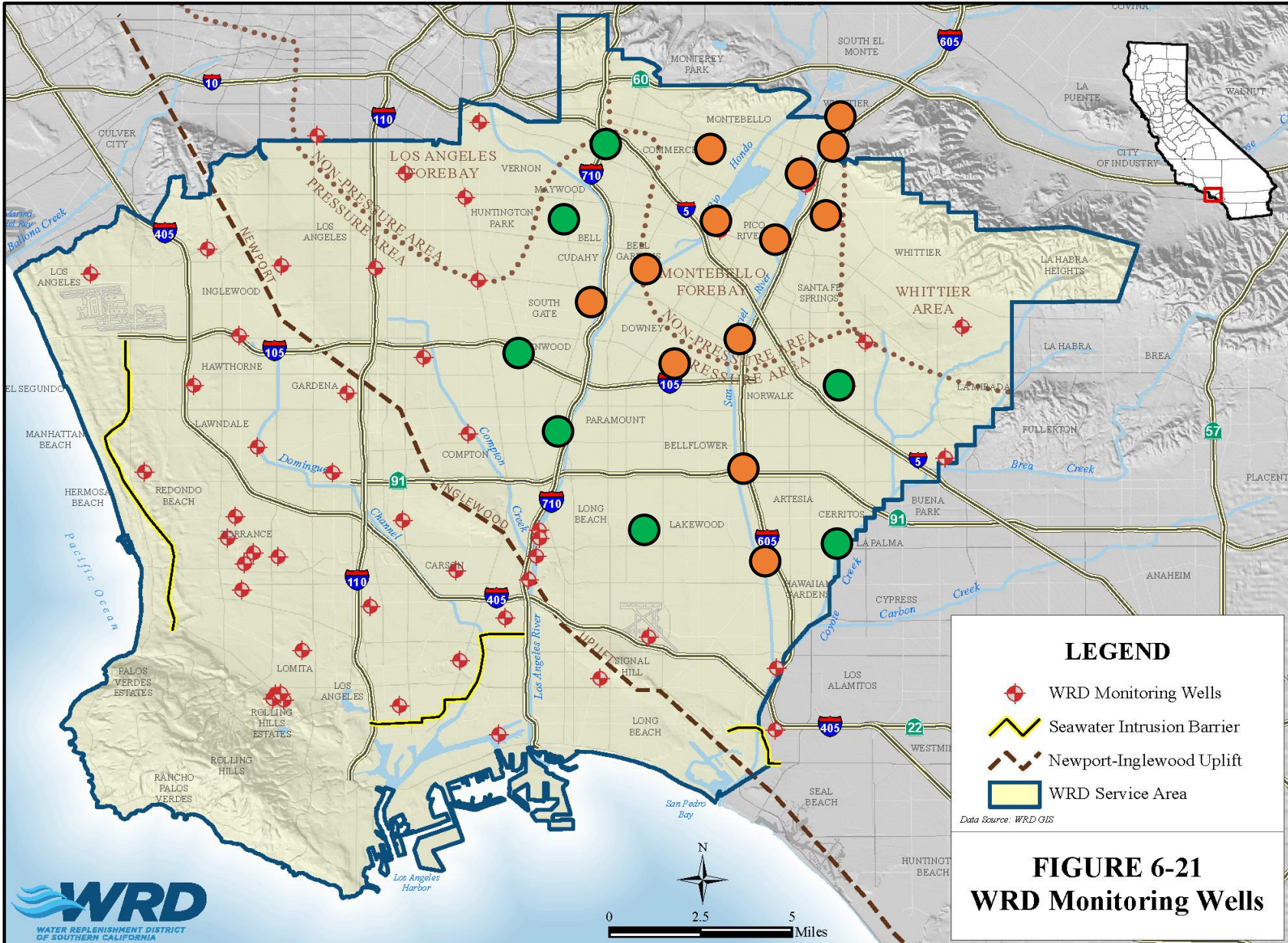
What about the new kid on the block...PFAS?

- Sanitation District sampling wastewater being delivered to the spreading grounds for PFAS. Data requested by the RWQCB.
- WRD recently sampled our regional groundwater monitoring wells based on the results of an artificial sweetener study we performed in 2015/2016.
- It would be very expensive to sample all of our regional groundwater monitoring wells within the CBWCB.
- Artificial sweetener study results used as a tracer to help select monitoring wells that will be sampled by WRD.
- Sampled Spring 2019. 20 locations, total of 124 wells.
- Results will be summarized in our next annual Regional Groundwater Monitoring Report (March 2020).

2015 Artificial Sweetener Study Inform Sampling for PFAS



2015 Artificial Sweetener Study Inform Sampling for PFAS



How are we helping to address CECs?

- Extensive sampling program to identify and track CECs. Data publicly available and used by various stakeholders including our pumpers, regulatory agencies, etc.
- Work closely with our regulatory partners to identify sources, participate in environmental site evaluations...ultimately having a regulatory agency issue investigation and cleanup orders (EPA, DTSC, RWQCB).
- Identify outside funding sources for cleanup projects...
 - WRD addressing perchlorate 'hot spot' with grant funds received from Prop 1 (\$9M).
 - Responsible Party with limited financial funding and large plume referred to SB-445.
 - Wellhead treatment projects through our Safe Drinking Water Program.
- Participate in public education events coordinated by the local Environmental Justice Community. Lately, they've been focusing on PFAS.
- Continue to coordinate with other agencies on best management practices and testing basin to help fund studies to evaluate the degradation of CECs.



THANK YOU

Brian Partington

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Outreach

Presentations to Various Organizations

Groundwater Resources Association
National Ground Water Association
American Groundwater Trust
Association of Groundwater Agencies
American Water Works Association
West Basin Water Association
Central Basin Water Association
Southeast Water Coalition
Los Angeles Basin Geological Society
South Coast Geological Society
Regional Water Quality Control Board
Department of Toxic Substances Control
Environmental Protection Agency
Environmental Justice Network
Various Stakeholder Groups

Workshops for our Pumpers



2017 Safe Drinking Water Workshop
Better Water, Better Wells



2018 Annual Groundwater Quality Workshop

Soil Aquifer Treatment - Attenuation of CECs

Contents lists available at ScienceDirect

Science of the Total Environment

ELSEVIER

journal homepage: www.elsevier.com/locate/scitotenv

Attenuation of contaminants of emerging concern during surface-spreading aquifer recharge

Bonnie V. Laws^a, Eric R.V. Dickenson^{a,*}, Theodore A. Johnson^b, Shane A. Snyder^c, Jörg E. Drewes^a

^a Advanced Water Technology Center (AQWATEC), Environmental Science and Engineering Division, Colorado School of Mines, Golden, CO 80401, USA
^b Water Replenishment District of Southern California (WRD), Lakewood, CA, USA
^c Applied Research and Development Center (ARDC), Water Quality Research and Development Division, Southern Nevada Water Authority, Henderson, NV 89015, USA

Table 3
Removal of trace organic contaminants detected in the basin and selected bulk water quality parameters based on: concentrations at WP Z (travel time = 12 h), the average concentrations in the upper aquifer (MLS 8–PR 11, travel time <3 days), and the average concentrations in the lower aquifer (PR 8, PR 10, travel time = 60 days). Removal of less than 20% was considered negligible and ≥ indicates removal below the minimum reporting level (MRL).

CEC	Attenuation ranking		% Removal (WP Z, travel time = 12 h)	% Removal (average MLS 8-PR 11, travel time <3 days)	% Removal (average PR 8, PR 10, travel time = 60 days)	
					With dilution	Without dilution ^a
	1	Atenolol	98	96	≥99.9	≥99.9
	2	Iopromide	97	98	97	95
	3	Fluoxetine	94	≥97	≥97	≥97
	4	Gemfibrozil	97	92	96	94
	5	Naproxen	74	63	93	88
	6	Diclofenac	55	55	≥99	≥99
	8	Trimethoprim	52	Negligible	94	90
	10	Triclosan	Negligible	Negligible	≥86	≥86
	9	TCP	Negligible	Negligible	89	82
	7	Ibuprofen	Negligible	47	84	74
	11	DEET	27	24	84	75
	12	Meprobamate	Negligible	Negligible	69	50
	13	TCEP	Negligible	Negligible	54	49
	14	Sulfamethoxazole	Negligible	Negligible	42	26
	15	Phenytoin	38	36	47	Negligible
	16	Carbamazepine	Negligible	Negligible	49	Negligible
	17	Primidone	Negligible	Negligible	69	Negligible
Bulk water quality parameters						
		DOC	45	52	78	-
		LVA ₂₅₄	18	26	58	-

^a Removal estimated using 62% reclaimed and 58% native groundwater (assumed to be absent of trace organic chemicals).

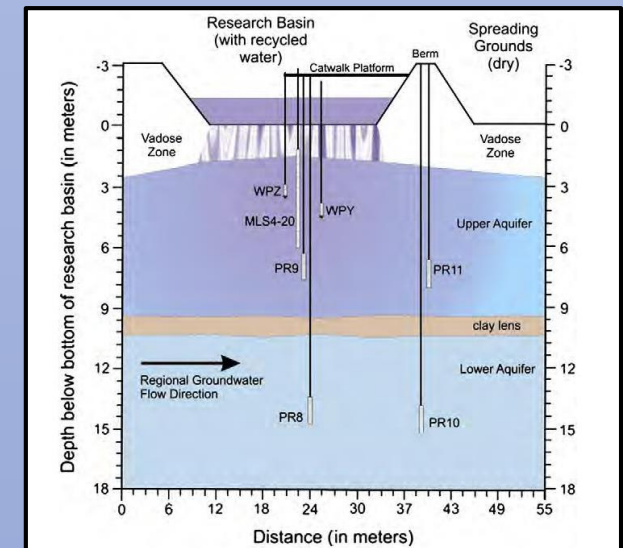


Fig. 2. Schematic of equipment utilized during sampling. Water table approximately 2.4 m below basin at the beginning of synoptic sampling.

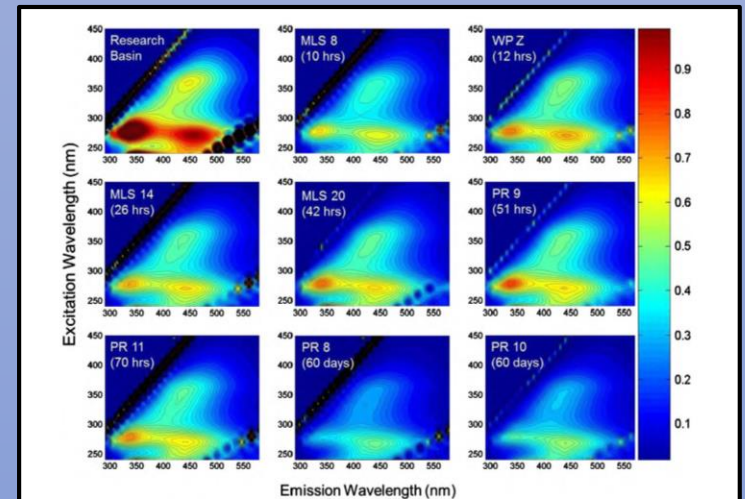


Fig. 3. 3-D fluorescence spectra images highlighting organic matter composition (travel time noted in parentheses). Peak intensity scale is shown along the right-hand side. Peaks, going clockwise starting from lower left corner, represent protein-like, fulvic-like, and humic-like organic matter.