Water Quality in the Desert: Supply Challenges and Treatment Solutions

Ruben Rodriguez, M.S. EnvE

El Paso Statistics

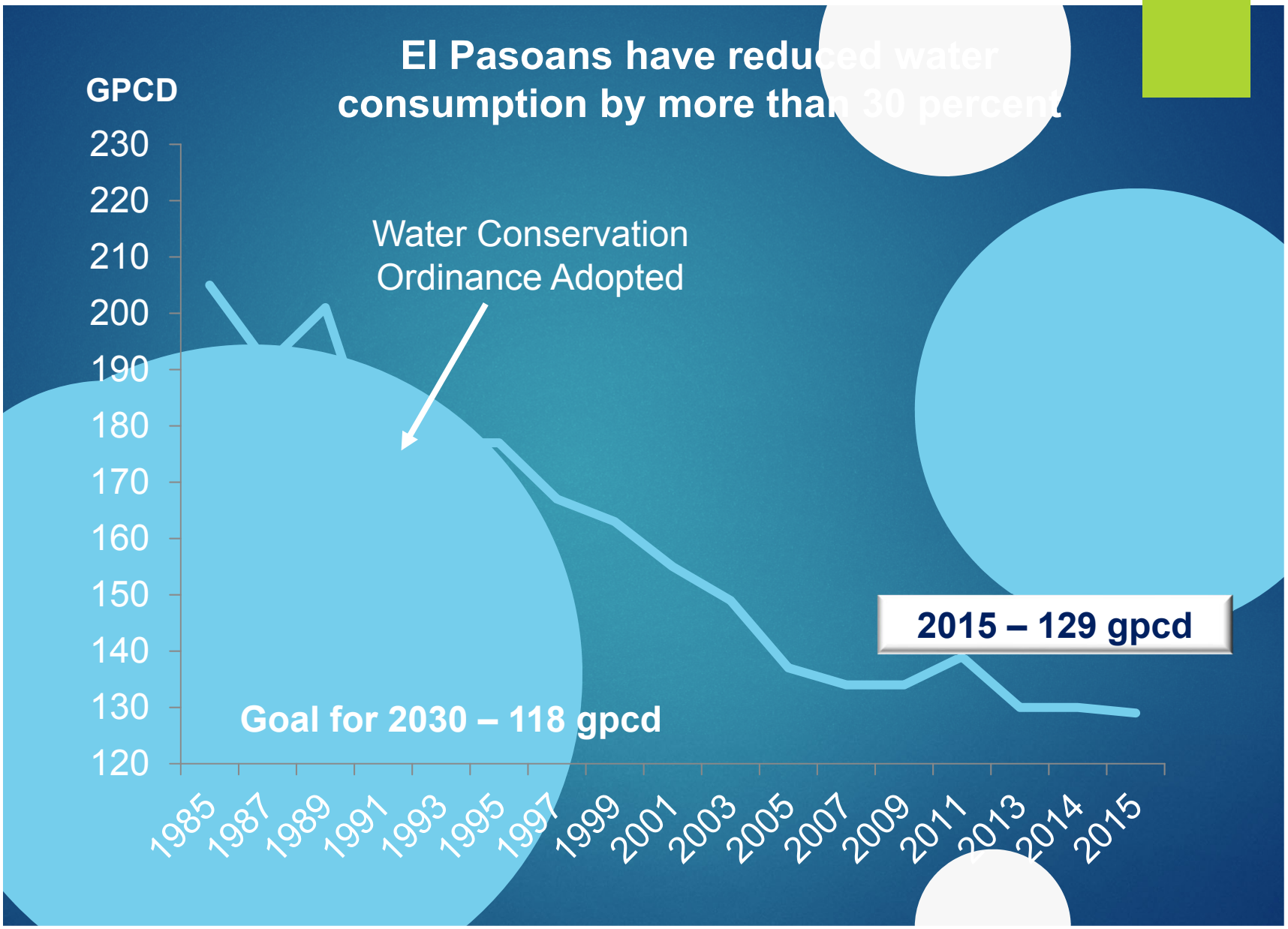
- Estimated population in El Paso County is over 850,000
- Approximately 200,000 water service connections
- AVG demand 100 MGD; Peak 160 MGD
- Average rainfall is 9 to 11 inches per year
- Water conservation is essential
- Recent drought conditions present new challenges

Recent Drought Conditions in El Paso

Elephant Butte Reservoir
June 2, 1994

Elephant Butte Reservoir
July 8, 2013

Images from the NASA Website


El Pasoans have reduced water consumption by more than 30 percent
GPCD
230
220
210
200
190
180
170
160
150
140
130
120
Water Conservation Ordinance Adopted
Goal for 2030 – 118 gpcd
2015 – 129 gpcd
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2014
2015

Diversified Water Resources

The River

Underground Water

Desalination

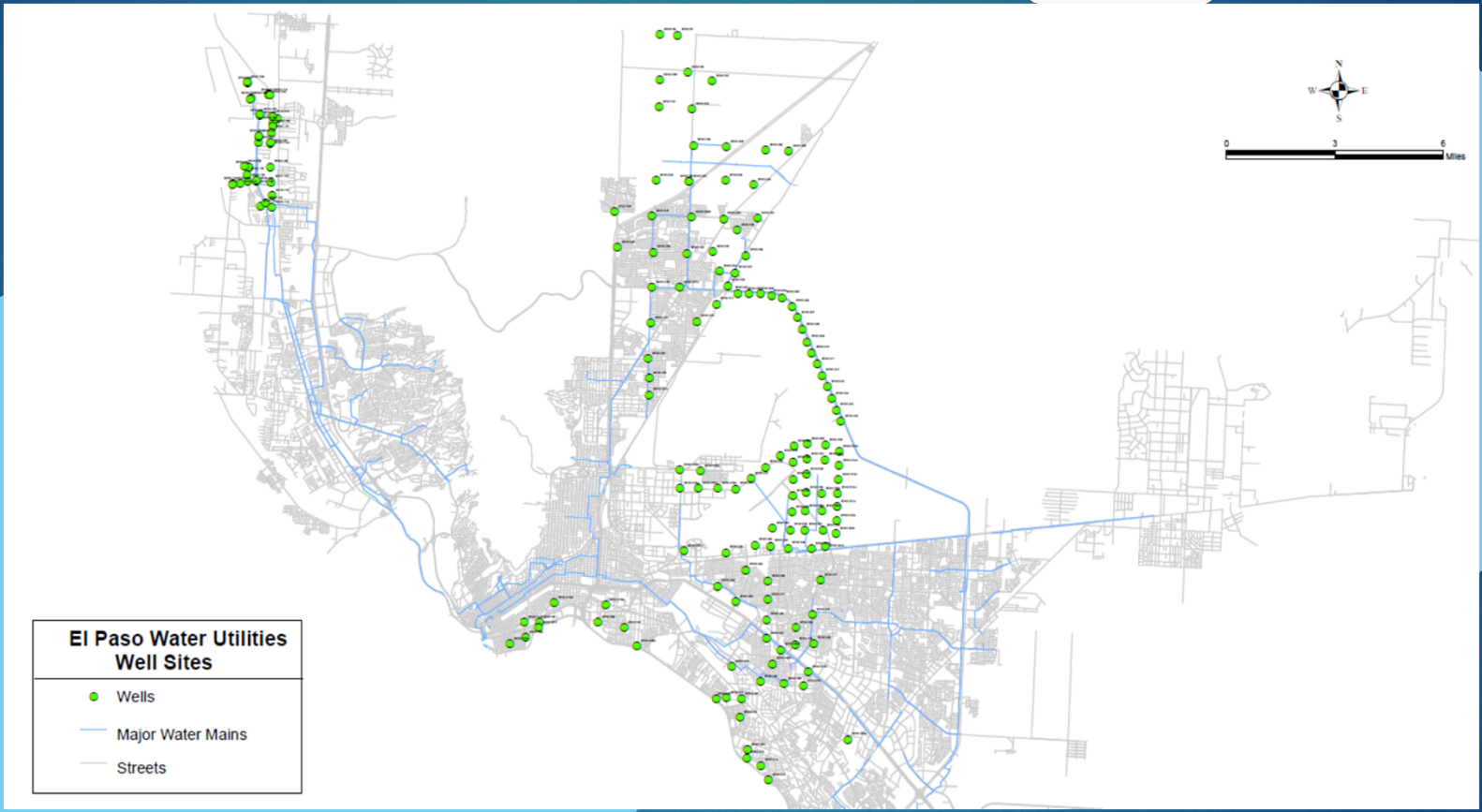
Water Reuse

Conservation

Future Resources

Regional Water Resources

El Paso Water Well Sites



Water Treatment Plants

KBHDP (27.5 MGD)

- Primary purpose is to desalinate high TDS well water from the Hueco Bolson to safe drinking water standards
- This state-of-the-art desalination facility applies an innovative reverse osmosis technology to convert brackish groundwater to high quality drinking water
- Removal of TDS (salts)
- Major unit processes include sand strainer, cartridge filtration, reverse osmosis, blending, corrosion inhibitor, chlorination, concentrate disposal

Upper Valley WTP (60 MGD)

- Primary purpose is to remove arsenic and produce water to safe drinking water standards with a finished water with an arsenic concentration of 8 ppb or less
- Removal of arsenic
- Major unit processes include rapid mix, coagulation via horizontal paddle wheel flocculators, parallel plate sedimentation, GAC filtration, and final disinfection and pH adjustment.

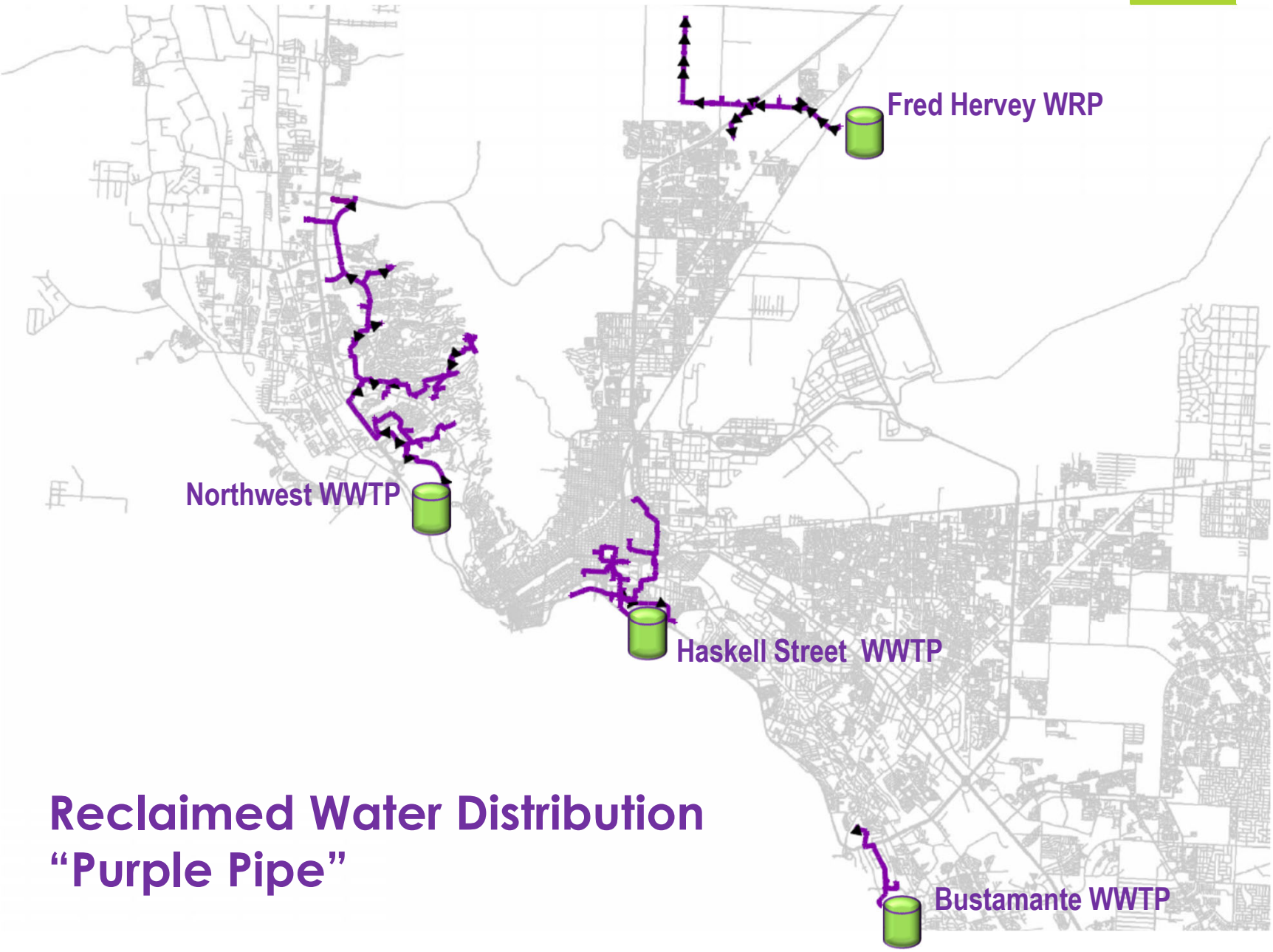
Canal WTP (40 MGD)

- Treat surface water from the Rio Grande and produce water that meets all health and safety standards
- The Canal WTP is a conventional surface water treatment plant using ferrous chloride as coagulant
- Removal of TOC (organics), and large amounts sand, silt and debris
- Major unit plant processes include: Chlorine dioxide, multiple disinfection zones, coagulation, flocculation and sedimentation, GAC filtration, chlorine and UV disinfection.

JRWTP (60 MGD)

- Treat surface water from the Rio Grande River to drinking water standards
- The JRWTP is a conventional surface water treatment plant using ferric chloride as coagulant
- Removal of TOC (organics), sand, silt and debris
- Ozone and chlorine used as disinfectants
- Major unit plant processes include: pre-sedimentation, ozone, coagulation, flocculation and sedimentation, GAC filtration, chlorine disinfection.

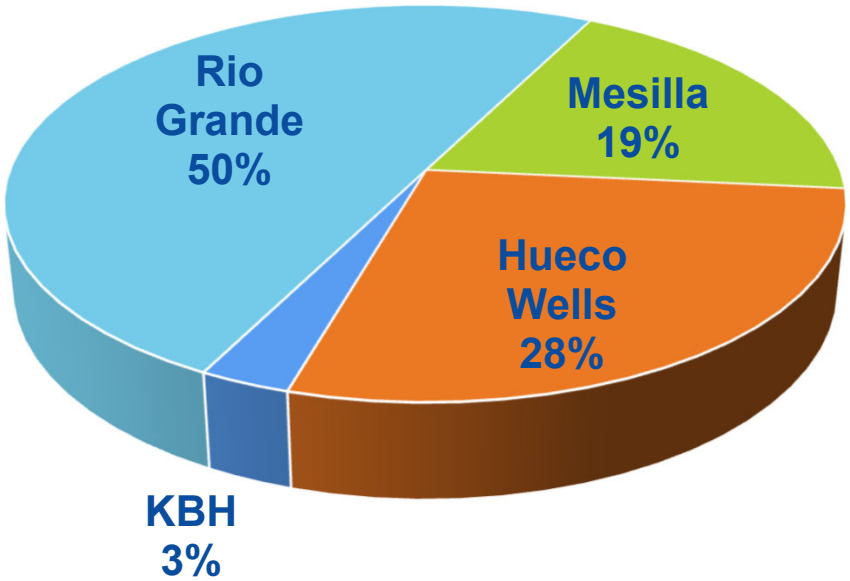
Wastewater Treatment Plants



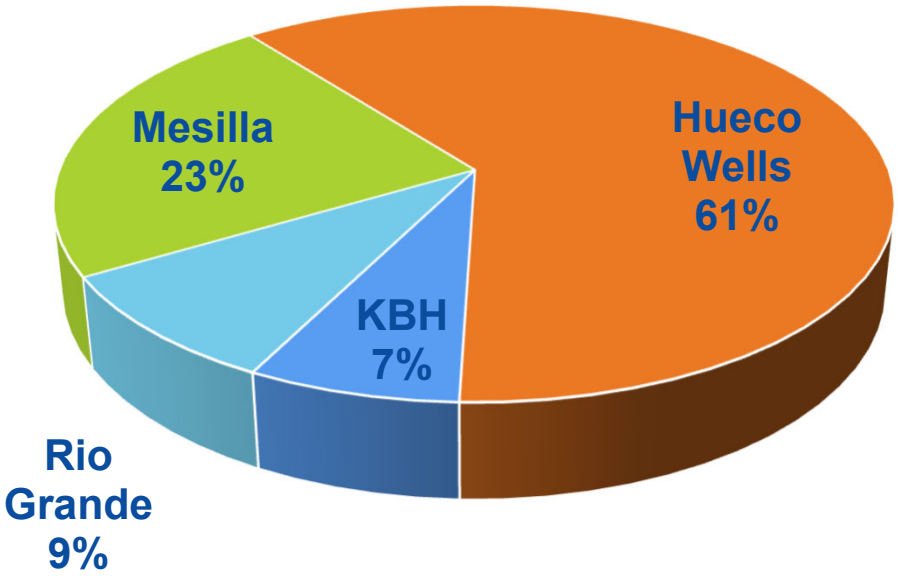
Reclaimed Water Distribution "Purple Pipe"

El Paso Water Production

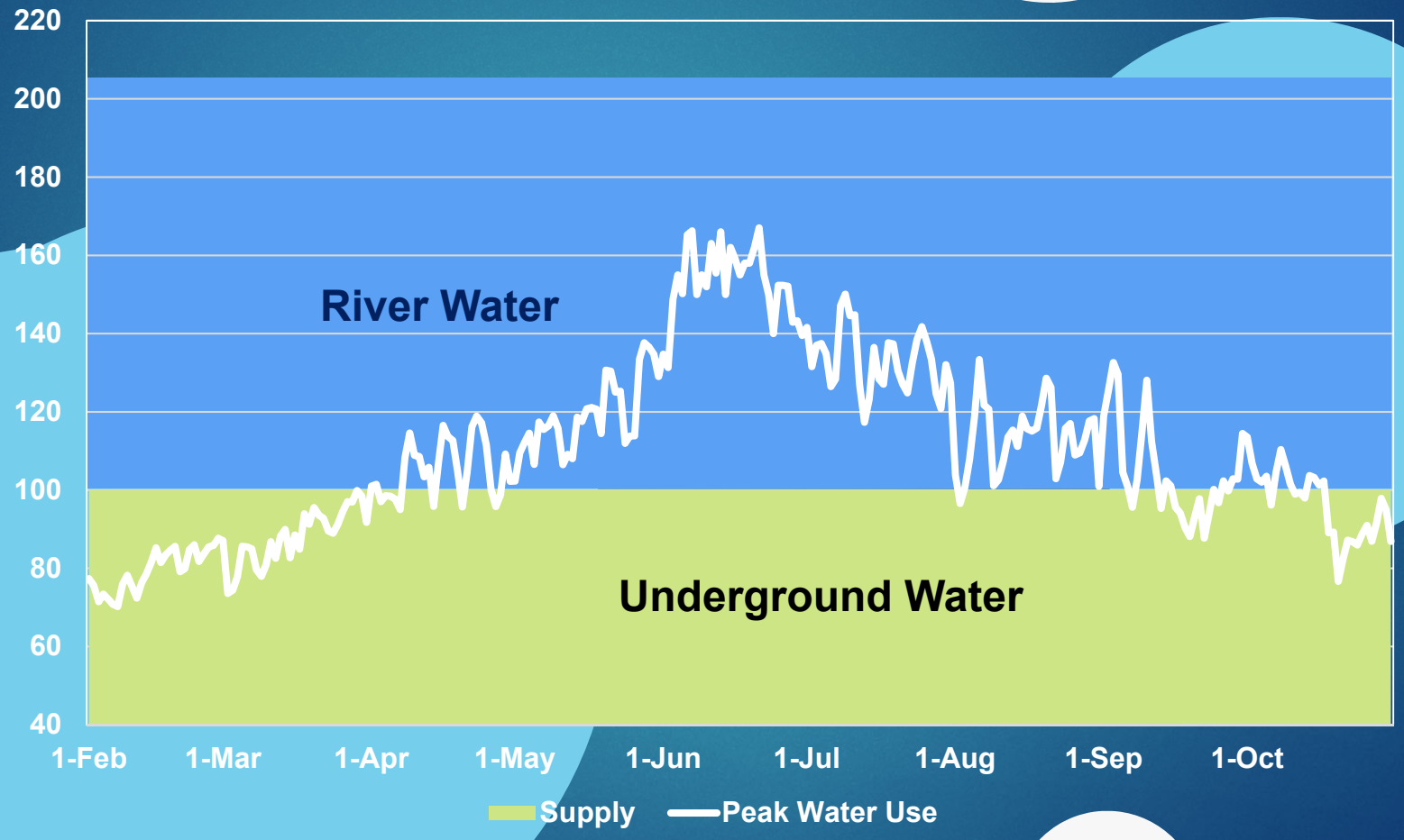
2010
37.9 Billion Gallons



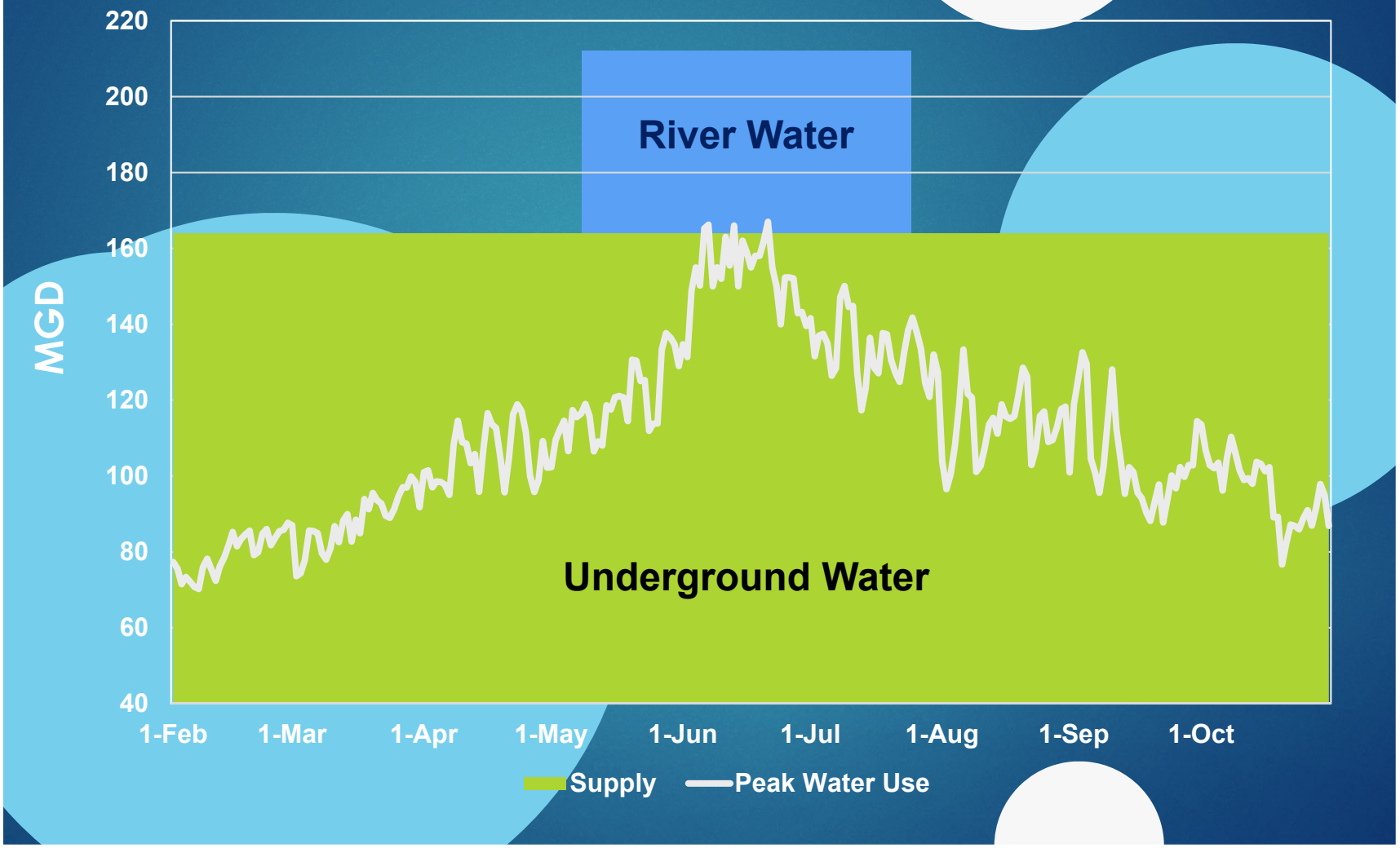
2013
36.8 Billion Gallons



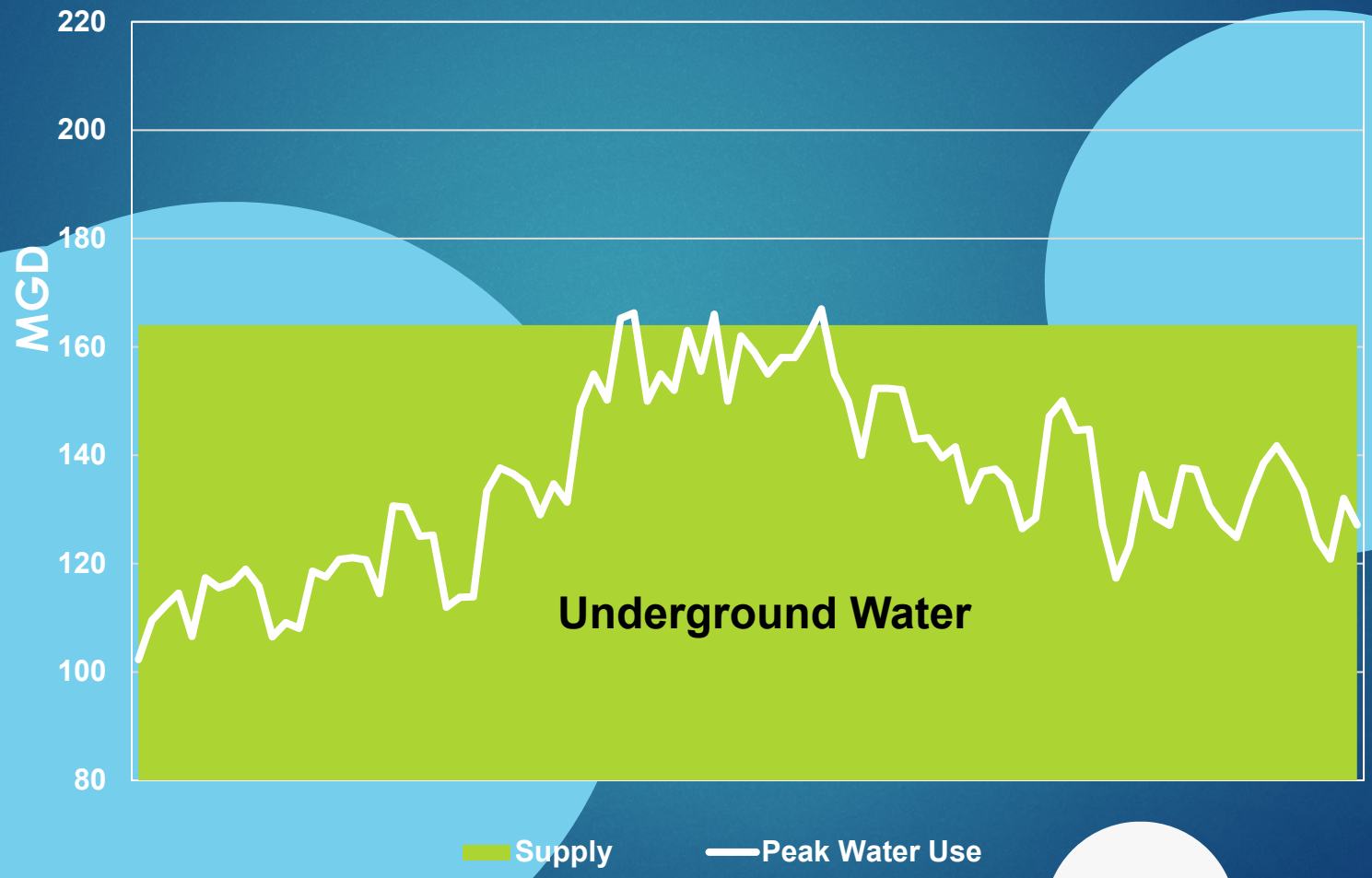
Non-Drought Year



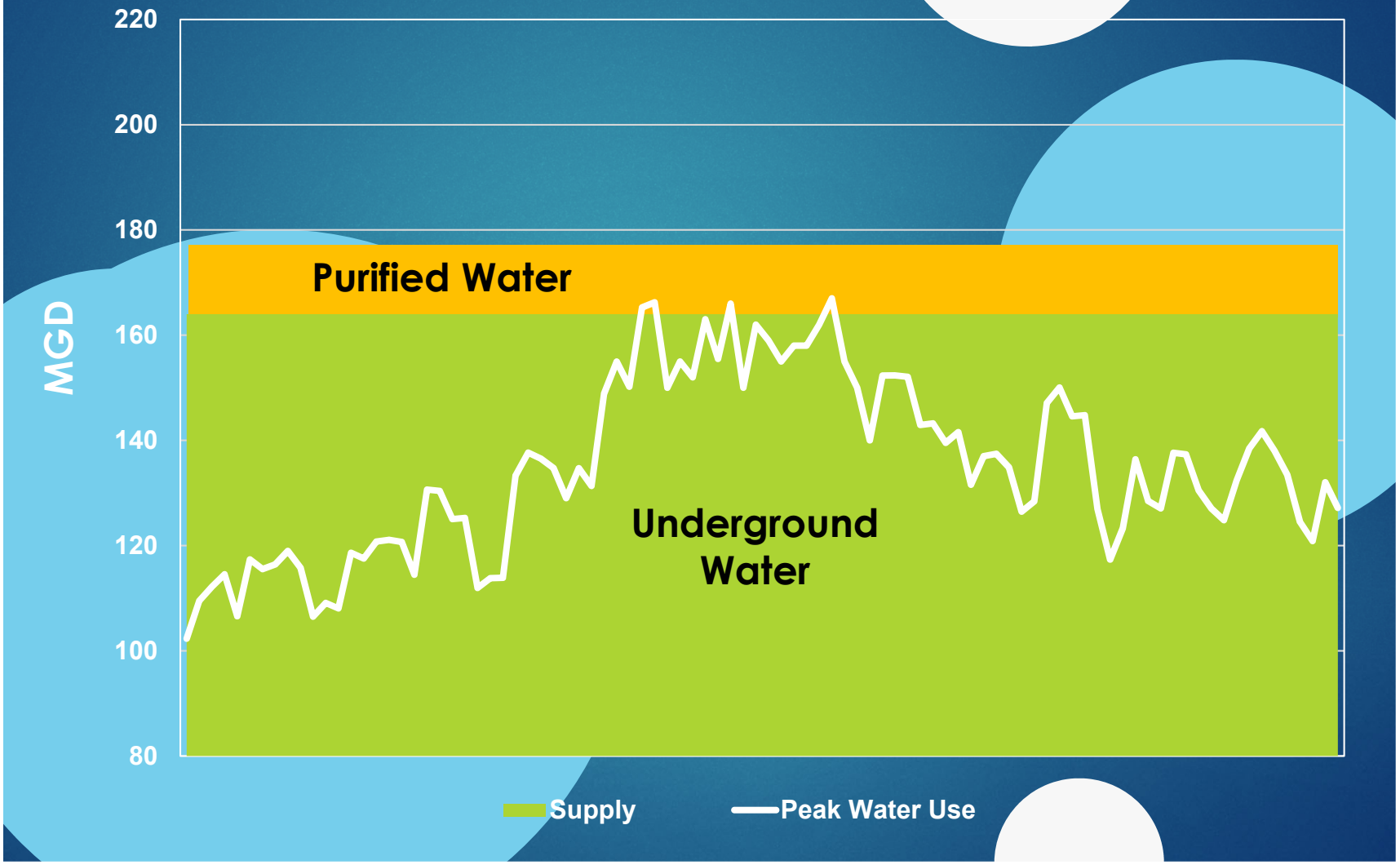
Peak Demand: Drought Year



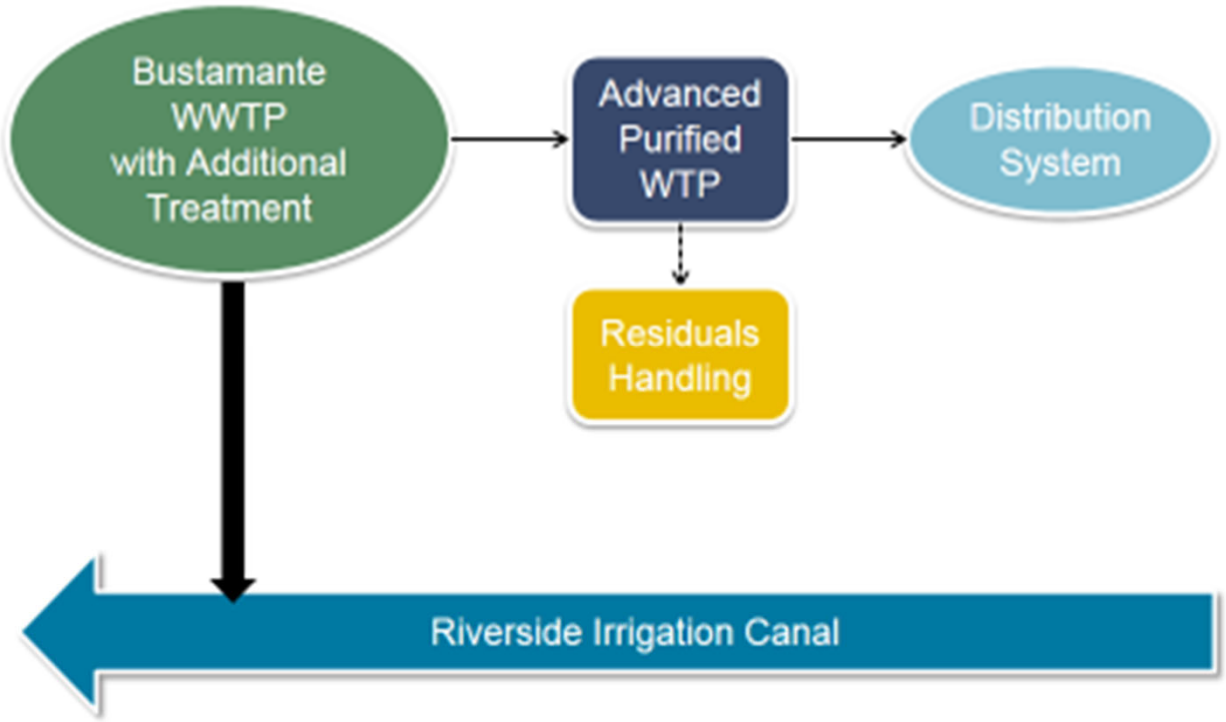
Drought Year Without River Water



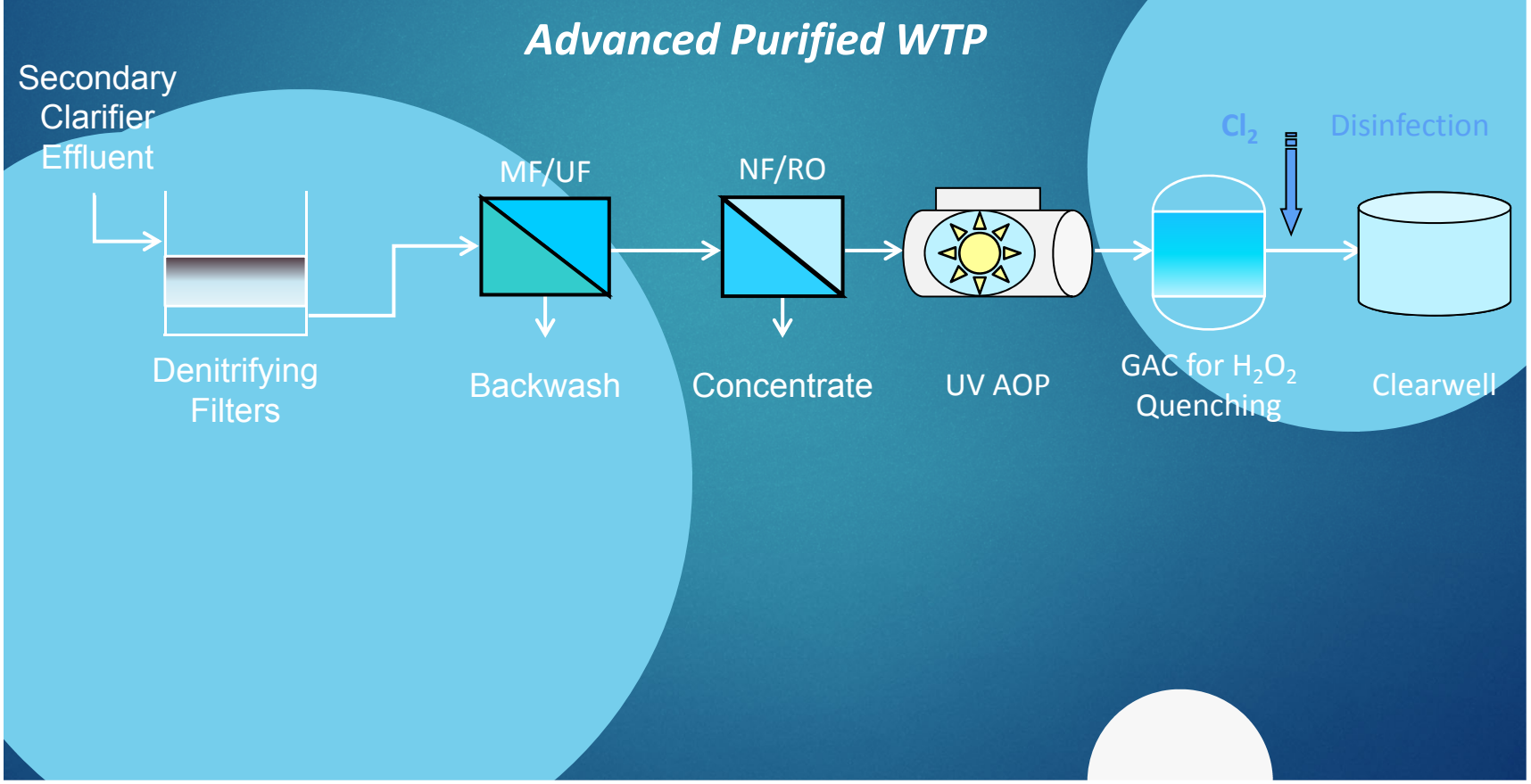
Drought Year Without River Water



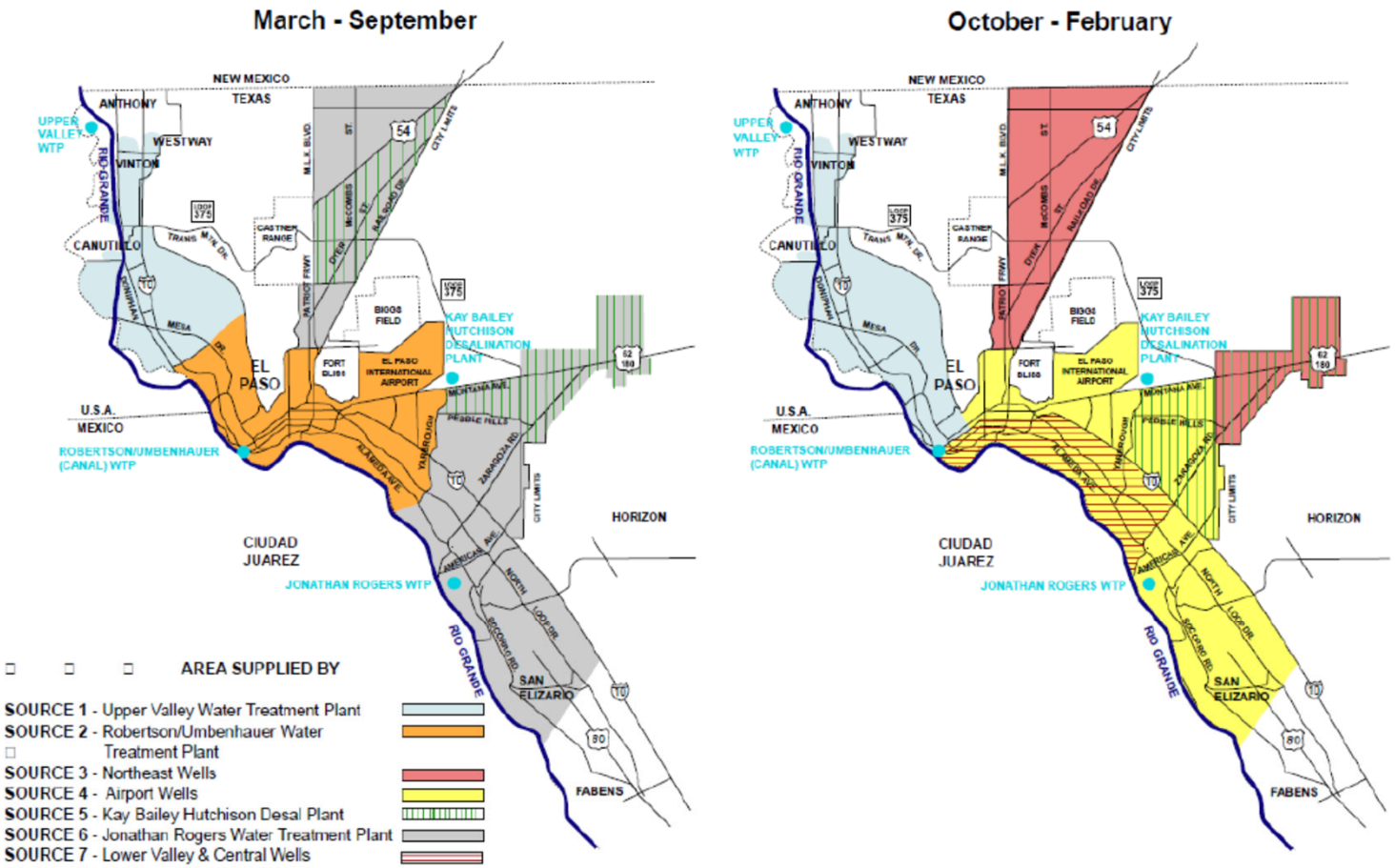
Advanced Purified WTP Concept



Simplified Process Schematic



EL PASO WATER UTILITIES
TYPICAL WATER DISTRIBUTION SUPPLY PATTERN



CITY OF EL PASO
EL PASO WATER
CHEMICAL ANALYSIS – CITY WATER

(All results expressed in milligrams per liter, mg/l)

PARAMETER TESTED	WATER SOURCE LOCATION							MAXIMUM LEVEL PERMITTED
	UPPER VALLEY	DOWNTOWN CENTRAL	NORTHEAST	AIRPORT CENTRAL	FORT BLISS AIRPORT	LOWER VALLEY	LOWER VALLEY CENTRAL	
	UPPER VALLEY WELL FIELD SUPPLIES WELL WATER TO THE UPPER VALLEY WTP *YEAR-ROUND*	ROBERTSON/ UMBENHAUER WTP SUPPLIED BY RIO GRANDE *MAR - SEPT*	NORTHEAST WELL FIELD WELL WATER BLENDED INTO DISTRIBUTION *OCT - FEB*	AIRPORT WELL FIELD WELL WATER BLENDED INTO DISTRIBUTION *OCT - FEB*	FORT BLISS & AIRPORT WELL FIELDS SUPPLY WELL WATER TO KBH DESAL PLANT *YEAR-ROUND*	JONATHAN ROGERS WTP SUPPLIED BY RIO GRANDE *MAR - SEPT*	LOWER VALLEY & CENTRAL WELL FIELDS SUPPLY WELL WATER DIRECTLY INTO DISTRIBUTION *OCT - FEB*	
	SOURCE 1	SOURCE 2	SOURCE 3	SOURCE 4	SOURCE 5	SOURCE 6	SOURCE 7	
	AVG	*AVG*	*AVG*	*AVG*	*AVG*	*AVG*	*AVG*	
Total Dissolved Solids	630	650	470	627	454	700	862	1000 mg/l
Phenol Alkalinity as $CaCO_3$	3.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	Not established
Total Alkalinity as $CaCO_3$	121	130	115	110	24.5	133	125	Not established
Total Hardness as $CaCO_3$	119	235	149	168	63	230	236	Not established
Chlorides as Cl	117	107	177	195	182	133	283	300 mg/l
Sulfates as SO_4	189	191	71	104	14	182	160	300 mg/l
Fluorides as F	0.59	0.58	0.87	0.68	NA	0.62	0.55	4.0 mg/l
Silica as SiO_2	36	20	32	31	NA	20	29	Not established
Nitrates as NO_3	<0.10	0.41	1.96	1.6	NA	2.1	0.95	10 mg/l
Nitrites as NO_2	<0.05	<0.05	<0.05	<0.05	NA	<0.05	0.06	1.0 mg/l
Phosphates as PO_4	<0.05	0.55	<0.05	0.07	0.51	0.68	0.14	Not established
Calcium as Ca	42	71	43	43	14	71	78	Not established
Magnesium as Mg	5.5	15	11.3	13	3.9	15	21	Not established
Sodium as Na	168	130	105	153	109	133	217	Not established
Potassium as K	3.6	7.9	7.3	10.4	4.5	8.6	9.4	Not established
Iron as Fe	<0.020	<0.020	<0.020	<0.020	<0.03	<0.03	0.027	0.3 mg/l
Manganese as Mn	0.050	0.012	<0.010	<0.010	NA	<0.010	0.016	0.05 mg/l
pH	8.1	7.3	7.7	7.9	7.5	7.3	7.6	pH 6.5-8.5

The city is supplied by seven distinct blended sources that are interconnected in the distribution system and it is possible that the water from one source can be distributed to other parts of the city. Normally, the distribution of these sources to the city's areas is as follows: **Upper Valley and Northwest – Source 1; West – Sources 1 & 2; Downtown Central – Sources 2, 4, & 7; Airport Central – Sources 2 & 4; Northeast – Sources 3, 5, & 6; East – Sources 4, 5 & 6; Far East – Sources 3, 5, & 6; and Lower Valley – Sources 4, 6, & 7.** The areas supplied by each of these sources are as indicated by the attached distribution maps on a seasonal basis. However, the ratios of water supplied by one source or another are constantly changing and therefore intermixing of water within these areas is possible.*

In general, the hardness may be considered to average about 175 mg/l or about 10.2 grains per gallon.** The fluoride content is considered ideal for maximum protection of teeth. A chlorine residual of 0.5 to 1.5 mg/l is maintained to prevent tastes and odors and to assure disinfected water. Disinfection is necessary to prevent waterborne illness caused by bacteria, protozoa or viruses.
Primary drinking water regulations establish that surface and ground waters be tested for inorganic chemicals. A list of these chemicals along with their limits (in ppm, unless otherwise specified) follows:

Antimony (0.006 mg/l)	Barium (2.0 mg/l)	Chromium (0.1 mg/l)	Fluoride (4.0 mg/l)	Nitrate as N (10.0 mg/l)	Thallium (0.002 mg/l)
Arsenic (0.01 mg/l)	Beryllium (0.004 mg/l)	Copper (1.3 mg/l)	Lead (0.015 mg/l)	Nitrite as N (1.0 mg/l)	Uranium (0.03 mg/l)
Asbestos (7 MFL***)	Cadmium (0.005 mg/l)	Cyanide (0.2 mg/l)	Mercury (0.002 mg/l)	Selenium (0.05 mg/l)	

Drinking water must also be tested for Organic Chemicals (Pesticides and Insecticides), Disinfectants and Disinfection By-Products (e.g. Total Trihalomethanes (0.08 mg/l) and Haloacetic Acids (0.06 mg/l)), and Microbial Contaminants as specified by the State. Radiochemical analysis is also performed.

* The blended water received by customers meets all standards of the Texas Commission on Environmental Quality for drinking water.
** One grain per gallon = 17.1 mg/l
*** MFL, or million fibers per liter; fiber length greater than 10 µm

Blending Water Sources

- EPWater uses various sources of blended water supplies
- 2 Water Seasons
- Gradual changeover of supply to decrease system “upsets”
- Monitoring and matching of water quality
- Corrosion Control a must

Corrosion Control Treatment

- Poly/Orthophosphate added to drinking water at four treatment plants and throughout system
  - Inhibit corrosion and leaching of Pb and Cu by forming protective coating in pipes
  - Sequestering agent
- Sodium hydroxide is used as needed for pH control and to balance water chemistry

EPW Water Sample Analysis

- EPWater operators analyze some process control samples at each plant
  - turbidity, pH, Temp, chlorine residual, TDS, conductivity alkalinity, total hardness, orthophosphate, arsenic, TOC, chlorite,
- Tens of thousands of yearly samples analyzed at EP Water's International Water Quality Laboratory – National Environmental Laboratory Accreditation Program (NELAP) accredited for many analyses
  - metals, cations/anions, organics, bacteriological analysis, wet chemistry, water quality parameters, DBPs (TTHMs, chlorite, bromate)
- Specialized regulatory samples sent to contract laboratories also NELAP accredited
  - Metals (including lead & copper), organics (herbicides, pesticides, etc.) DBPs, radionuclides, cyanide, asbestos, etc.

Samples are tested at the El Paso Water Utilities International Water Quality Laboratory.

EP Water LCR Results Summary

EP Water Pb & Cu Sample Summary Results							
MP Begin Date	Analyte Name	Type	# Samples	Measure	Units	AL/MCLG	# Samples Exceeding AL
1/1/2017 - 6/30/2017	Lead	90%	100	0.0023	mg/L	0.015	1
	Copper	90%	100	0.4	mg/L	1.3	0
7/1/2016 - 12/31/2016	Lead	90%	100	0.0013	mg/L	0.015	0
	Copper	90%	100	0.12	mg/L	1.3	0
1/1/2013 - 12/31/2015	Lead	90%	50	0.0022	mg/L	0.015	0
	Copper	90%	50	0.47	mg/L	1.3	0
1/1/2010 - 12/31/2012	Lead	90%	50	0.00206	mg/L	0.015	0
	Copper	90%	50	0.51	mg/L	1.3	0
1/1/2004 - 12/31/2006	Lead	90%	50	0.0035	mg/L	0.015	0
	Copper	90%	50	0.671	mg/L	1.3	0

2017 El Paso Water LCR Lead Results

PBCU Sample Results						
Sample No.	Site	Date	Result	Units	Analyte	Laboratory
Q1724535005	LCR108	6/8/2017	0	MG/L	LEAD	LCRA ELS
Q1724535010	LCR078	6/6/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724535009	LCR073	6/6/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724535002	LCR027	6/6/2017	0.0013	MG/L	LEAD	LCRA ELS
Q1724535011	LCR088	6/5/2017	0.0018	MG/L	LEAD	LCRA ELS
Q1724535008	LCR049	6/5/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724535006	LCR046	6/5/2017	0.0043	MG/L	LEAD	LCRA ELS
Q1724535003	LCR032	6/5/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724535001	LCR012	6/5/2017	0.0015	MG/L	LEAD	LCRA ELS
Q1724535004	LCR037	6/2/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724535007	LCR048	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367076	LCR086	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367069	LCR079	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367056	LCR064	6/1/2017	0.0035	MG/L	LEAD	LCRA ELS
Q1724367052	LCR060	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367050	LCR058	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367047	LCR055	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367036	LCR040	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367034	LCR038	6/1/2017	0.0024	MG/L	LEAD	LCRA ELS
Q1724367028	LCR030	6/1/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367077	LCR087	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367075	LCR085	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367074	LCR084	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367068	LCR077	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367067	LCR076	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367066	LCR075	5/31/2017	0.001	MG/L	LEAD	LCRA ELS
Q1724367064	LCR072	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367063	LCR071	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367061	LCR069	5/31/2017	0.0048	MG/L	LEAD	LCRA ELS
Q1724367059	LCR067	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367057	LCR065	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367054	LCR062	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367049	LCR057	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367048	LCR056	5/31/2017	0.0017	MG/L	LEAD	LCRA ELS
Q1724367044	LCR052	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367042	LCR050	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367041	LCR047	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367040	LCR045	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367039	LCR044	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367038	LCR043	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367037	LCR042	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367035	LCR039	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367033	LCR036	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367032	LCR035	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367027	LCR029	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367025	LCR026	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367024	LCR025	5/31/2017	0.001	MG/L	LEAD	LCRA ELS
Q1724367016	LCR017	5/31/2017	0.0014	MG/L	LEAD	LCRA ELS
Q1724367004	LCR004	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367003	LCR003	5/31/2017	no detect	MG/L	LEAD	LCRA ELS

PBCU Sample Results						
Sample No.	Site	Date	Result	Units	Analyte	Laboratory
Q1724367002	LCR002	5/31/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367020	LCR021	5/30/2017	0.0013	MG/L	LEAD	LCRA ELS
Q1724367015	LCR016	5/30/2017	0.0013	MG/L	LEAD	LCRA ELS
Q1724367001	LCR001	5/30/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367089	LCR100	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367088	LCR099	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367087	LCR098	5/26/2017	0.003	MG/L	LEAD	LCRA ELS
Q1724367086	LCR097	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367084	LCR095	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367070	LCR080	5/26/2017	0.0012	MG/L	LEAD	LCRA ELS
Q1724367055	LCR063	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367031	LCR034	5/26/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367060	LCR068	5/25/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367030	LCR033	5/25/2017	0.012	MG/L	LEAD	LCRA ELS
Q1724367006	LCR006	5/25/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367085	LCR096	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367083	LCR094	5/24/2017	0.0013	MG/L	LEAD	LCRA ELS
Q1724367082	LCR093	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367081	LCR092	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367080	LCR091	5/24/2017	0.0039	MG/L	LEAD	LCRA ELS
Q1724367079	LCR090	5/24/2017	0.0015	MG/L	LEAD	LCRA ELS
Q1724367078	LCR089	5/24/2017	0.0028	MG/L	LEAD	LCRA ELS
Q1724367071	LCR081	5/24/2017	0.0011	MG/L	LEAD	LCRA ELS
Q1724367065	LCR074	5/24/2017	0.0049	MG/L	LEAD	LCRA ELS
Q1724367053	LCR061	5/24/2017	0.0012	MG/L	LEAD	LCRA ELS
Q1724367051	LCR059	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367043	LCR051	5/24/2017	0.0023	MG/L	LEAD	LCRA ELS
Q1724367029	LCR031	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367026	LCR028	5/24/2017	0.0011	MG/L	LEAD	LCRA ELS
Q1724367018	LCR019	5/24/2017	0.002	MG/L	LEAD	LCRA ELS
Q1724367012	LCR013	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367008	LCR008	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367007	LCR007	5/24/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367073	LCR083	5/23/2017	0.022	MG/L	LEAD	LCRA ELS
Q1724367072	LCR082	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367062	LCR070	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367058	LCR066	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367046	LCR054	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367045	LCR053	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367023	LCR024	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367022	LCR023	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367021	LCR022	5/23/2017	0.0011	MG/L	LEAD	LCRA ELS
Q1724367019	LCR020	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367017	LCR018	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367014	LCR015	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367013	LCR014	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367011	LCR011	5/23/2017	no detect	MG/L	LEAD	LCRA ELS
Q1724367010	LCR010	5/23/2017	0.001	MG/L	LEAD	LCRA ELS
Q1724367009	LCR009	5/23/2017	0.0014	MG/L	LEAD	LCRA ELS
Q1724367005	LCR005	5/23/2017	no detect	MG/L	LEAD	LCRA ELS

EP Water Pb & Cu Sampling Various El Paso Schools

School	Address	Lead (mg/L)	Copper (mg/L)
Myrtle Cooper Elementary School	1515 Rebeca Ann	ND (0.001)	0.21
O'Shea Keleher Elementary School	1800 Leroy Bonse	0.002	0.704
William D. Slider Middle School	11700 Railroad Dr	0.001	0.37
Vista Del Sol Elementary School	11851 Vista Del Sol	0.002	0.424
Montana Vista Elementary School	3550 Mark Jason	ND (0.001)	0.157
Nixon Elementary School	11141 Loma Rojas	ND (0.001)	0.152
Whitaker Elementary School	4700 Rutherford	ND (0.001)	0.263
Rosa Guerrero Elementary School	7530 Lakehurst	0.001	0.203
Pebble Hills Elementary School	11145 Edgemere	0.002	0.139
Indian Ridge Middle School	11201 Pebble Hills	ND (0.001)	0.27
El Paso High School	800 Schuster Ave	ND (0.001)	0.03
Socorro High School	10150 Alameda Ave	0.001	0.294
Ysleta High School	8600 Alameda Ave	0.01	0.662
Jefferson High School	4700 Alameda Ave	0.002	0.373
Morehead Middle School	5625 Confetti Dr	0.001	0.142
Ramona Elementary School	351 Nichols Rd	ND (0.001)	0.453
	Action Level	*0.015*	*1.3*

Conclusion

- El Paso's water portfolio includes many resources
- Desert and drought conditions call for innovative solutions
- 2 Water seasons present challenges with blended water sources
- Proactive treatment and monitoring is key
- Water quality monitoring is essential

el paso WATER

Questions or comments?

Thank You

Ruben Rodriguez
Water Supply Manager
El Paso Water
915.594.5407
rrodriguez@epwater.org