El Paso's Advanced Water Purification Facility

America's First Direct-to-Distribution Potable Reuse

WESTCAS 2017 Fall Conference
October 25, 2017 - Tucson, AZ

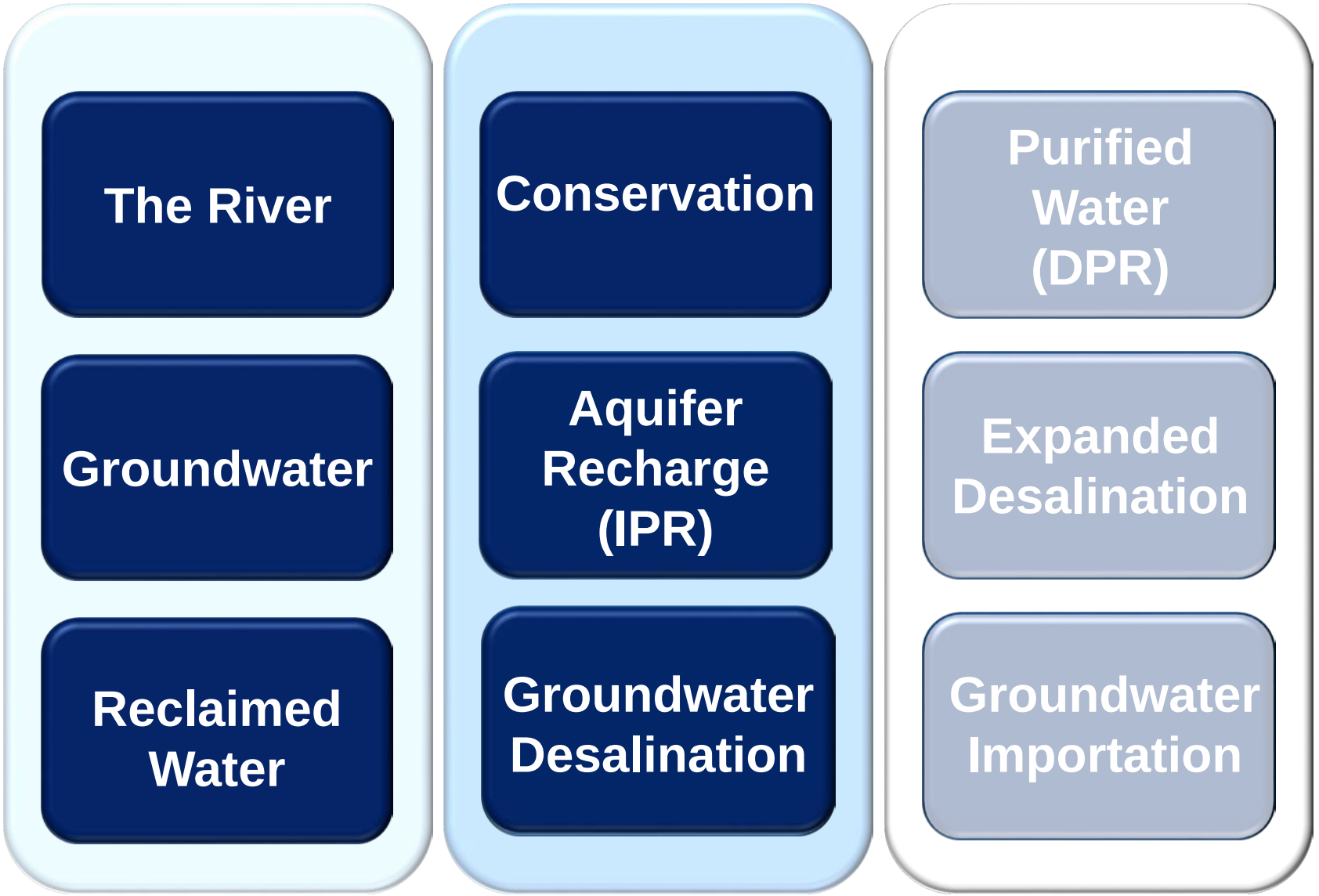
carollo

Presentation Outline

- Water Resources and Challenges
- AWPF Concept
- The Purification Process
- Piloting and Permitting
- The Path Ahead

Water Resources and Challenges

Diverse Portfolio for an Arid Community



el paso WATER

carollo

Long History of Conservation and Reuse

- **1963:** Began delivering reclaimed water for irrigation, industrial, and construction uses.
- **1985:** Began using reclaimed water treated to drinking water standards for aquifer recharge (Fred Hervey WRP)
- **Per capita use:** Reduced from 225 gallons in the 1970s to 132 in 2013

el paso WATER

carollo

The River

Colorado

Taos

Rio Grande

Santa Fe

Albuquerque

New Mexico

Socorro

Elephant Butte Reservoir

Las Cruces

United States

El Paso

Texas

Juarez

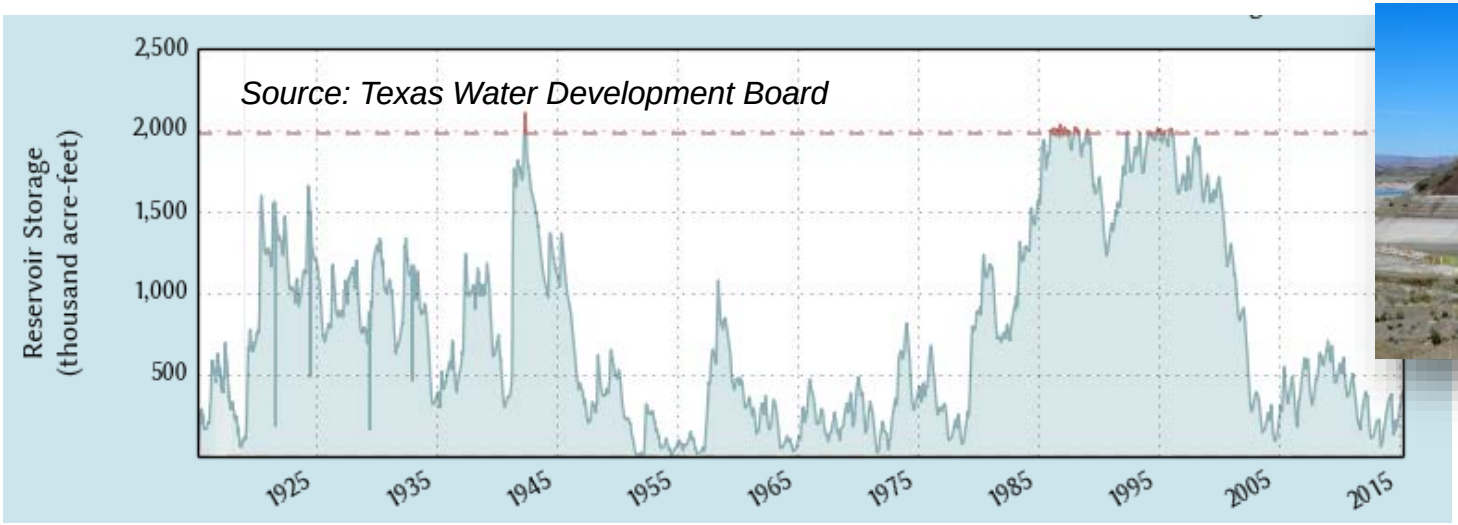
Mexico

Ft. Quitman

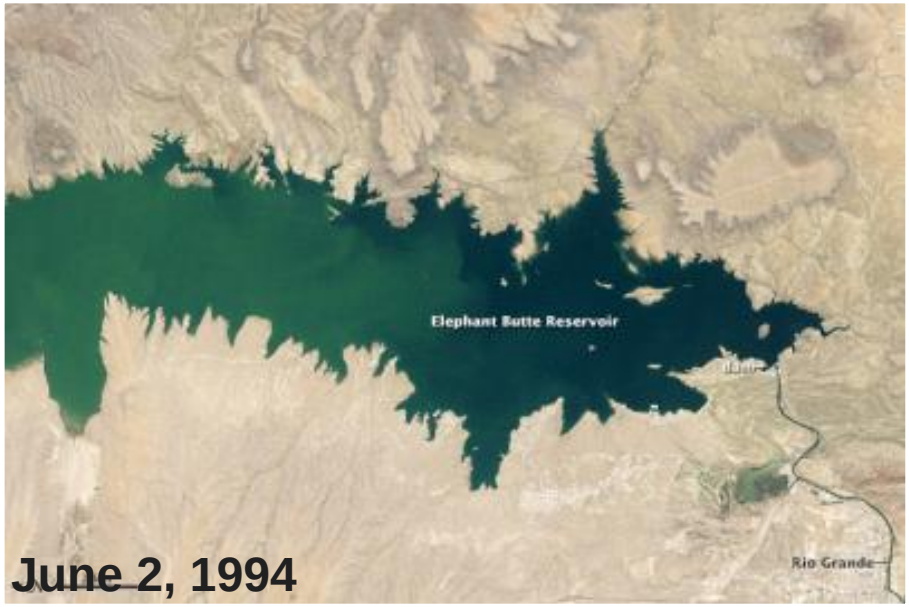
el paso WATER

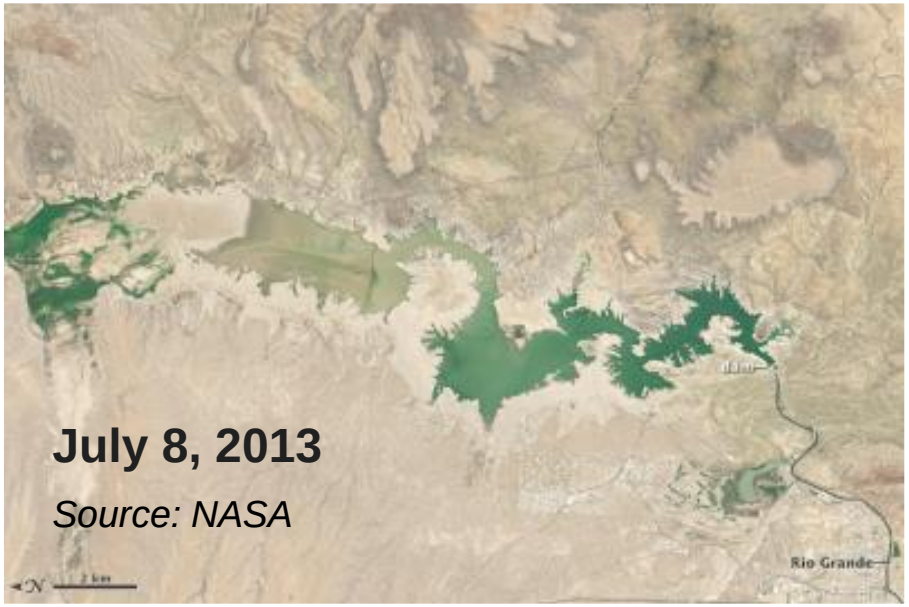
carollo

Drought Conditions



14.7% full as of 10/20/2017

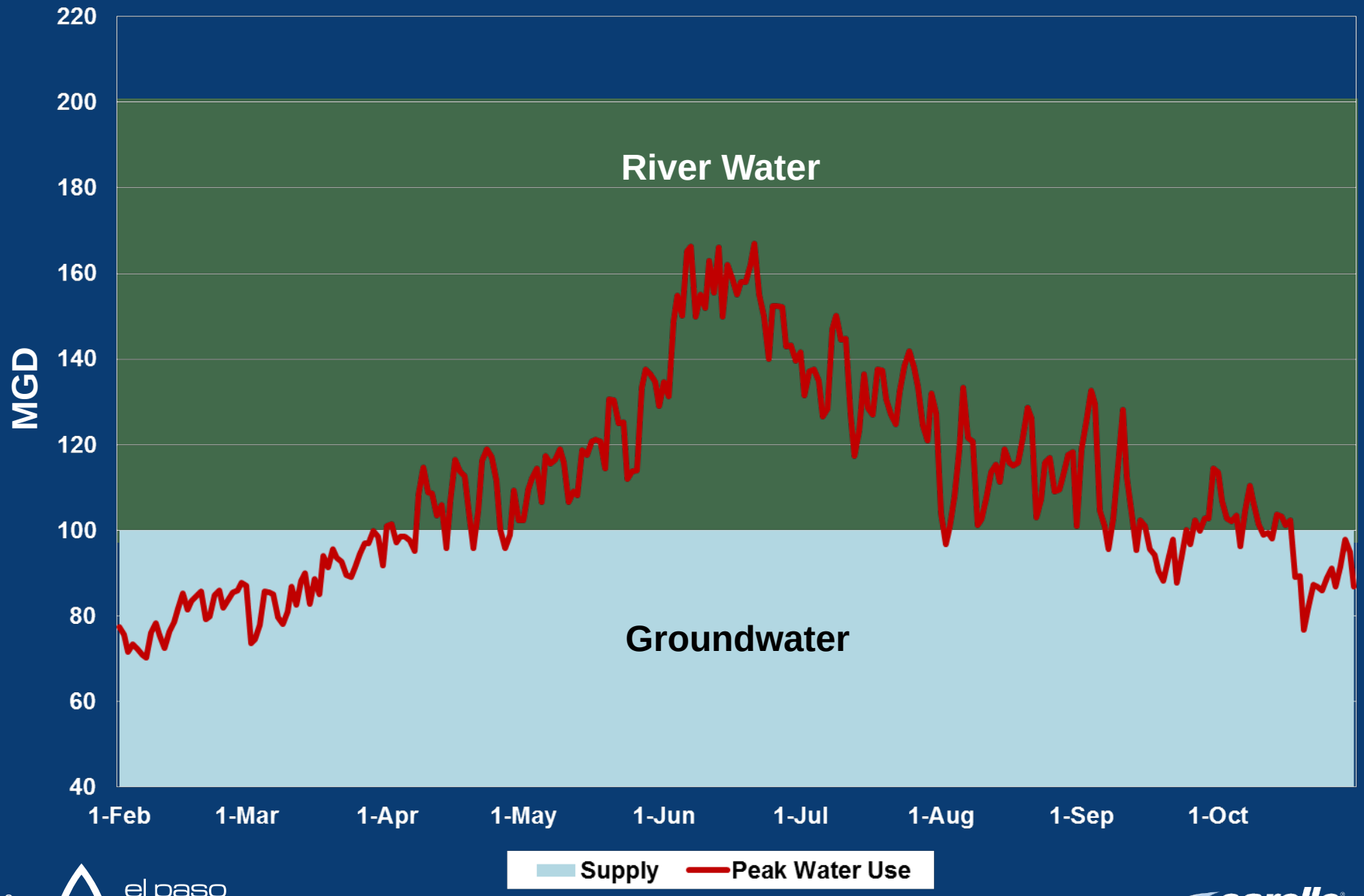




el paso WATER

carollo

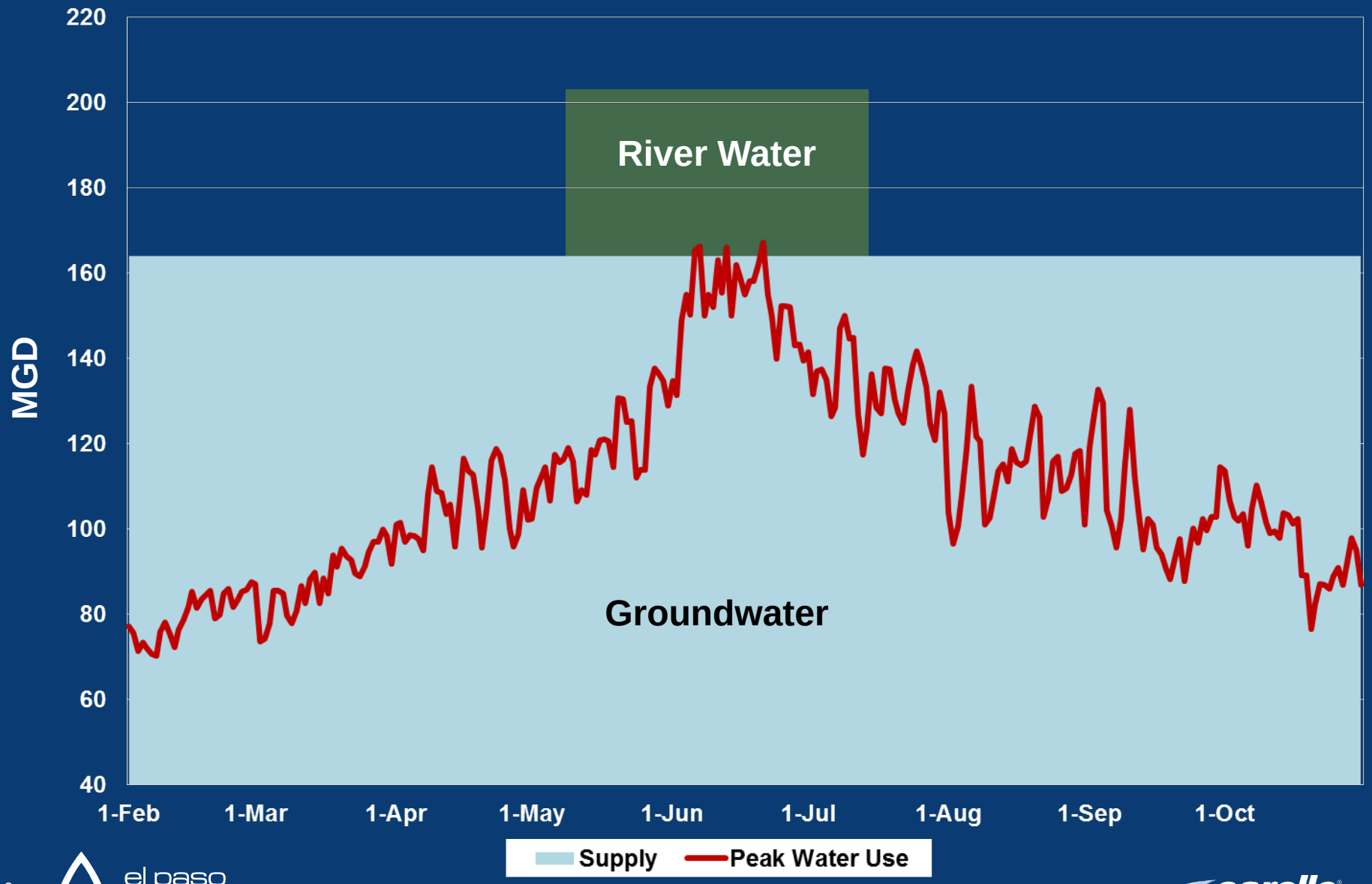
Non-drought Year



el paso WATER

carollo

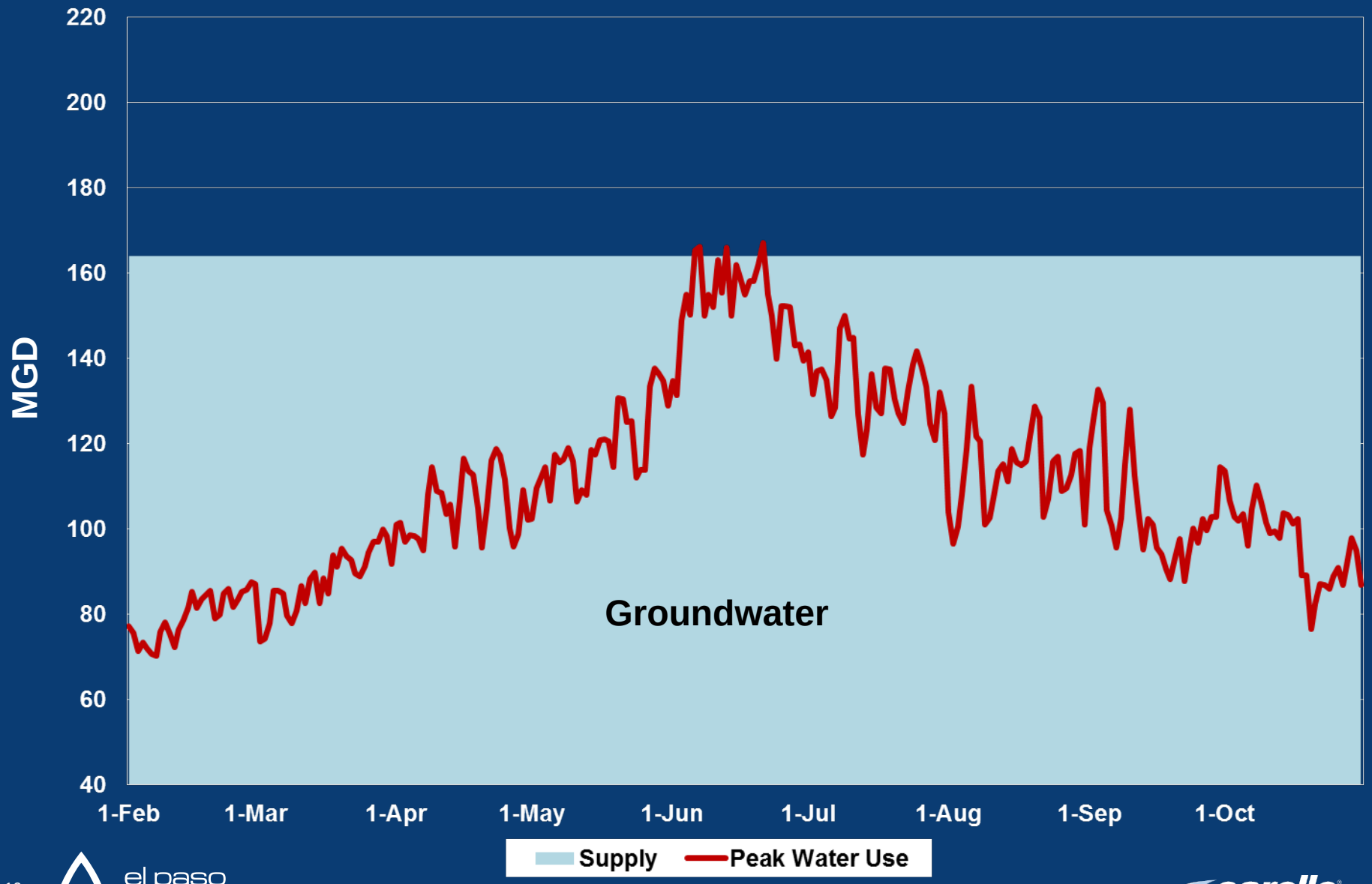
Drought Year



el paso WATER

carollo

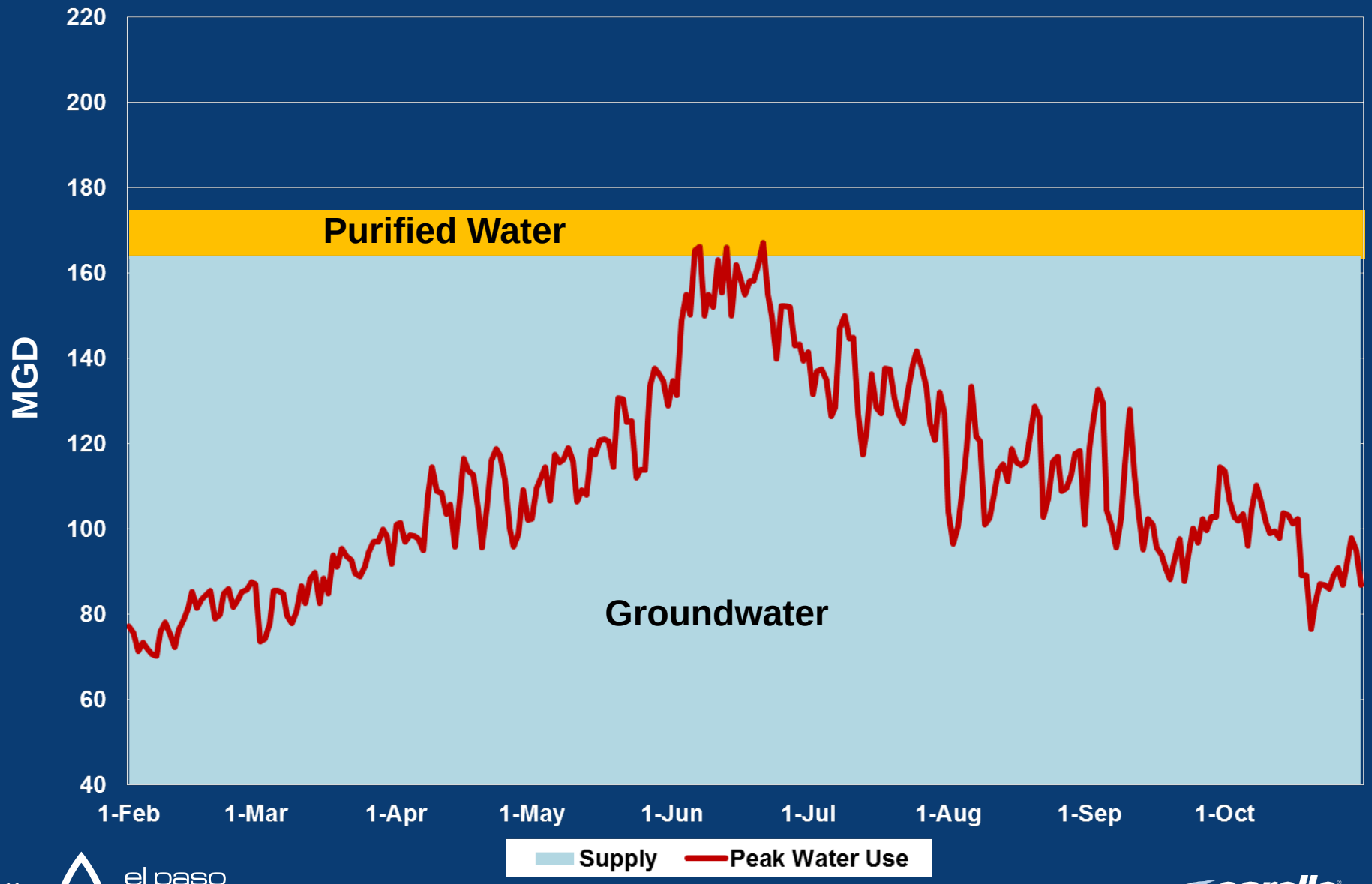
Drought Year without River Water



el paso WATER

carollo

Drought Year without River Water



el paso WATER

carollo

Why Purified Water Now?

Other Choices

- Increased mining of aquifers
- Increased groundwater desalination
- Drastic conservation
- Pump imported groundwater over 100 miles

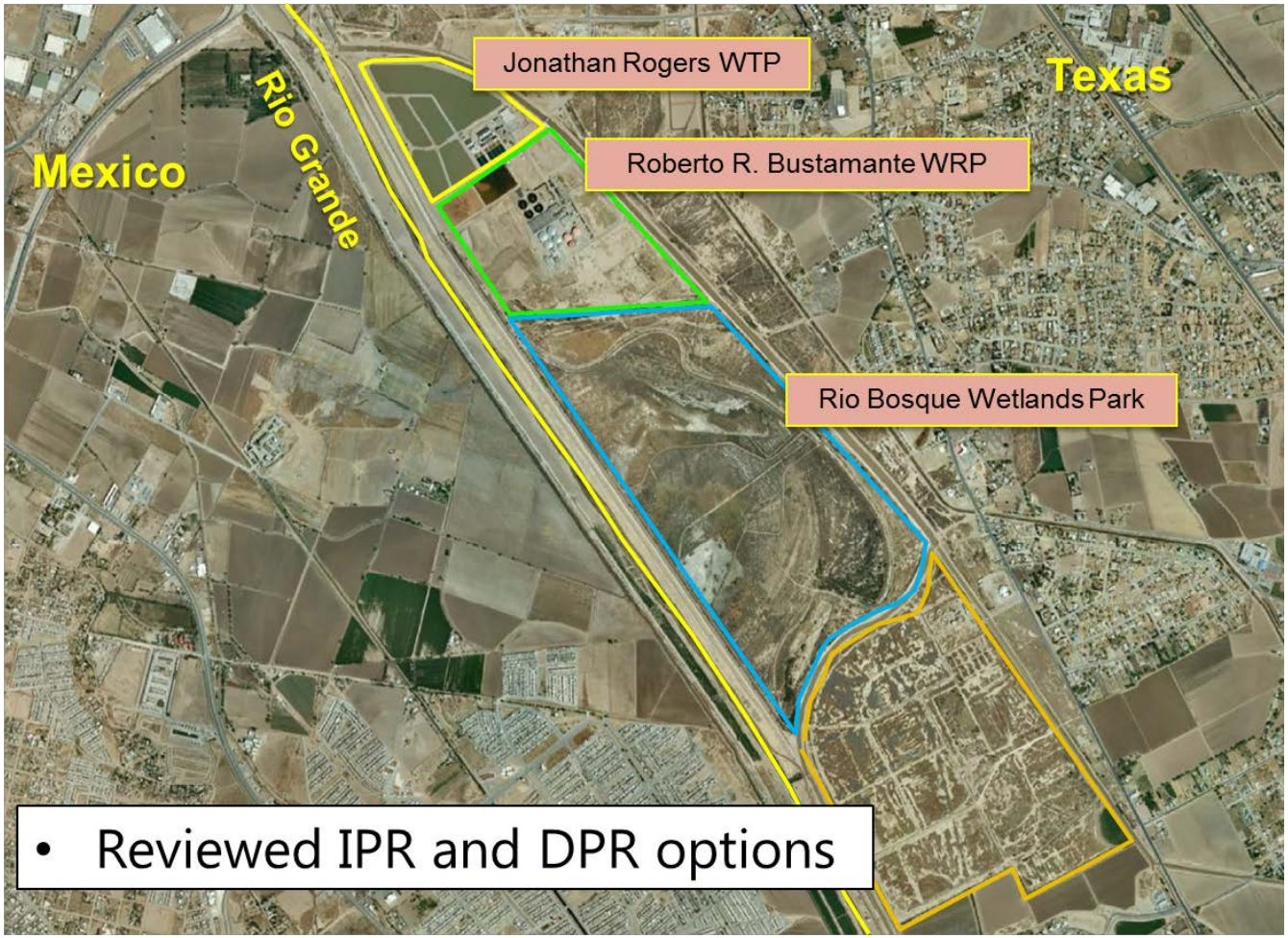
Only purified water is sustainable

el paso WATER

carollo

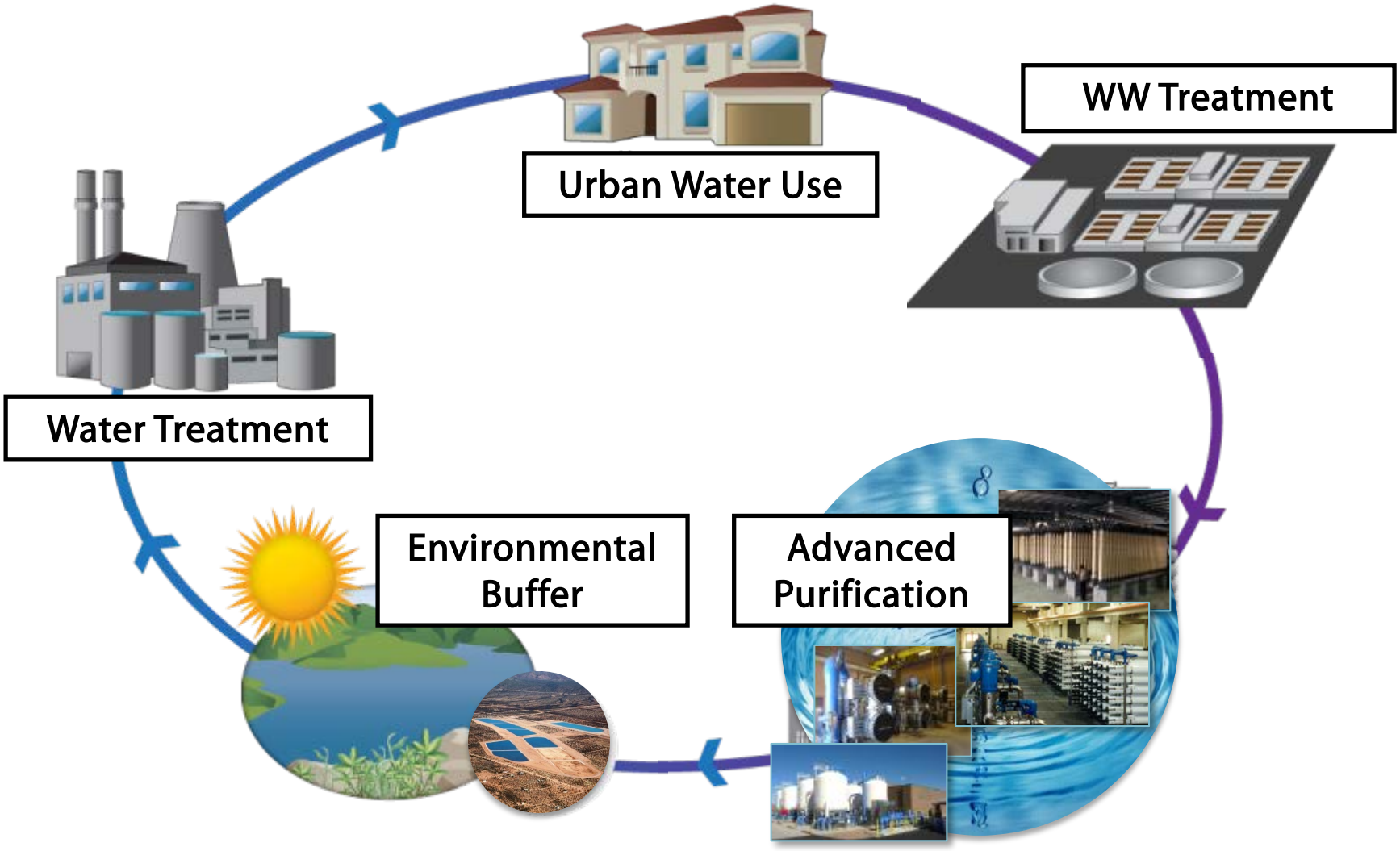
AWPF Concept

Feasibility Assessment and Policy Changes



- 2012 Feasibility Assessment: IPR, wetlands restoration, and DPR concepts
- Potable reuse business case developed
- **May 8, 2013**: EPW Board approves reprogramming of capital funding from “purple pipe” projects to potable reuse

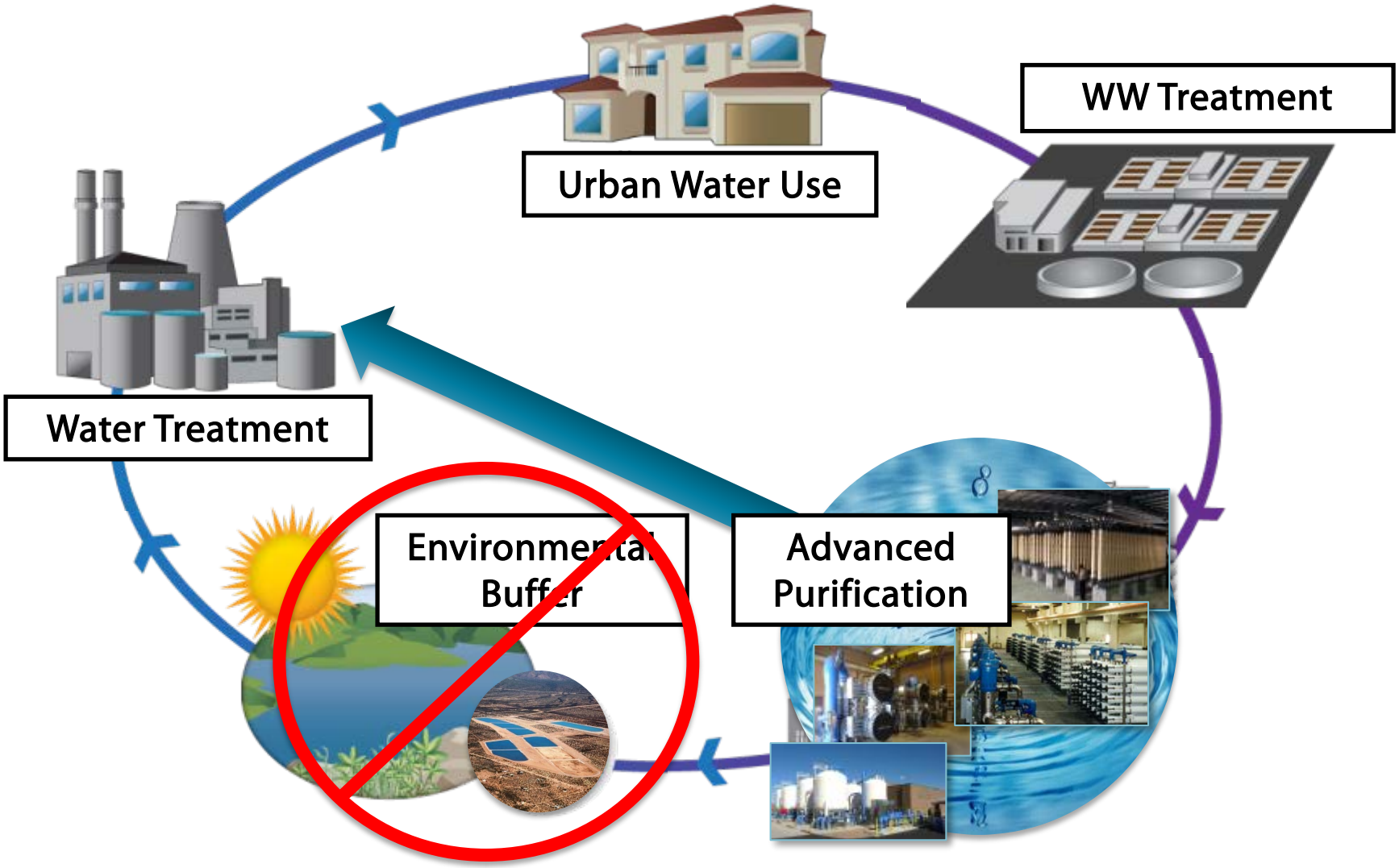
Indirect Potable Reuse



el paso WATER

carollo

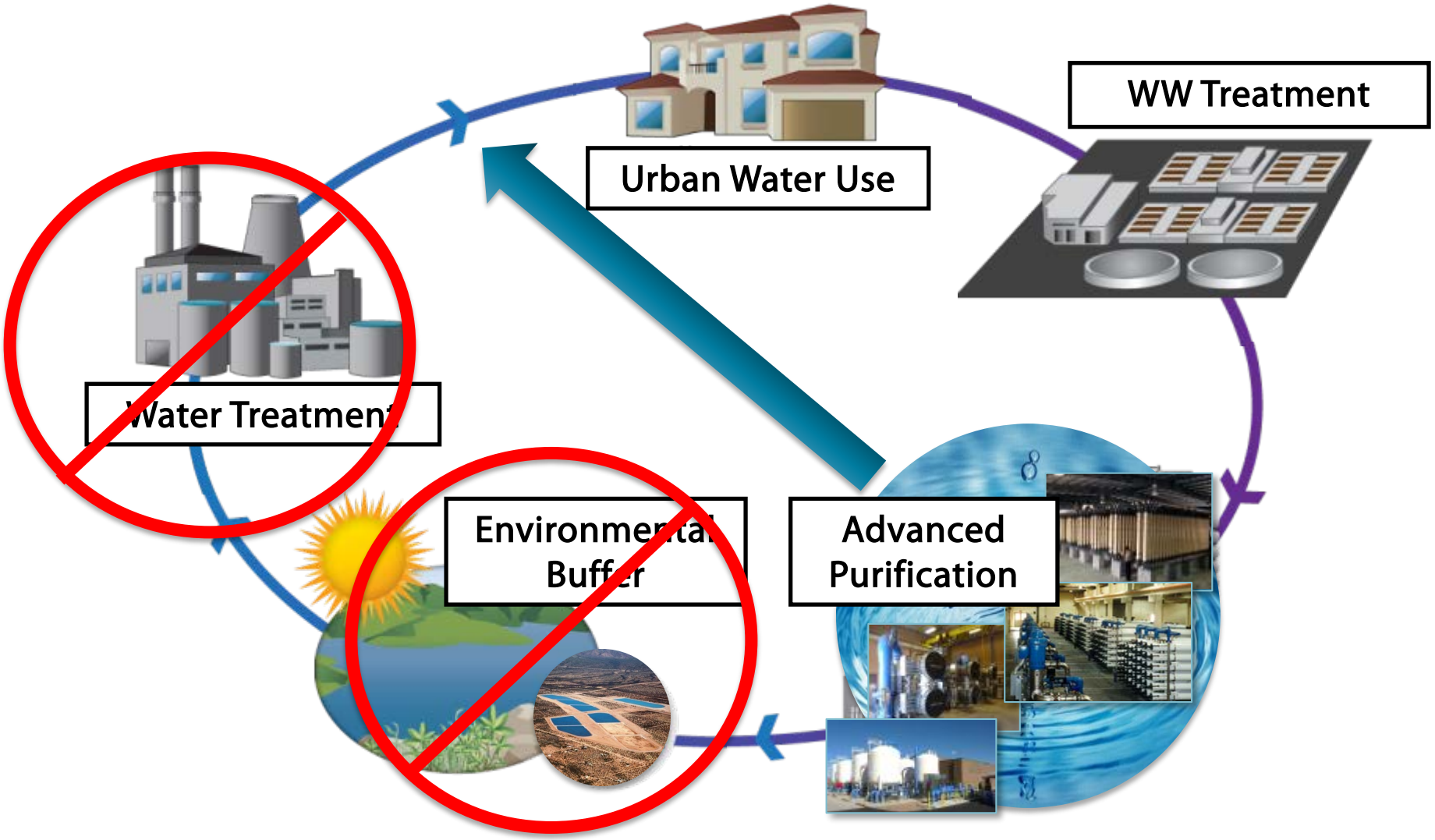
More Direct Potable Reuse



el paso WATER

carollo

Most Direct Potable Reuse



el paso WATER

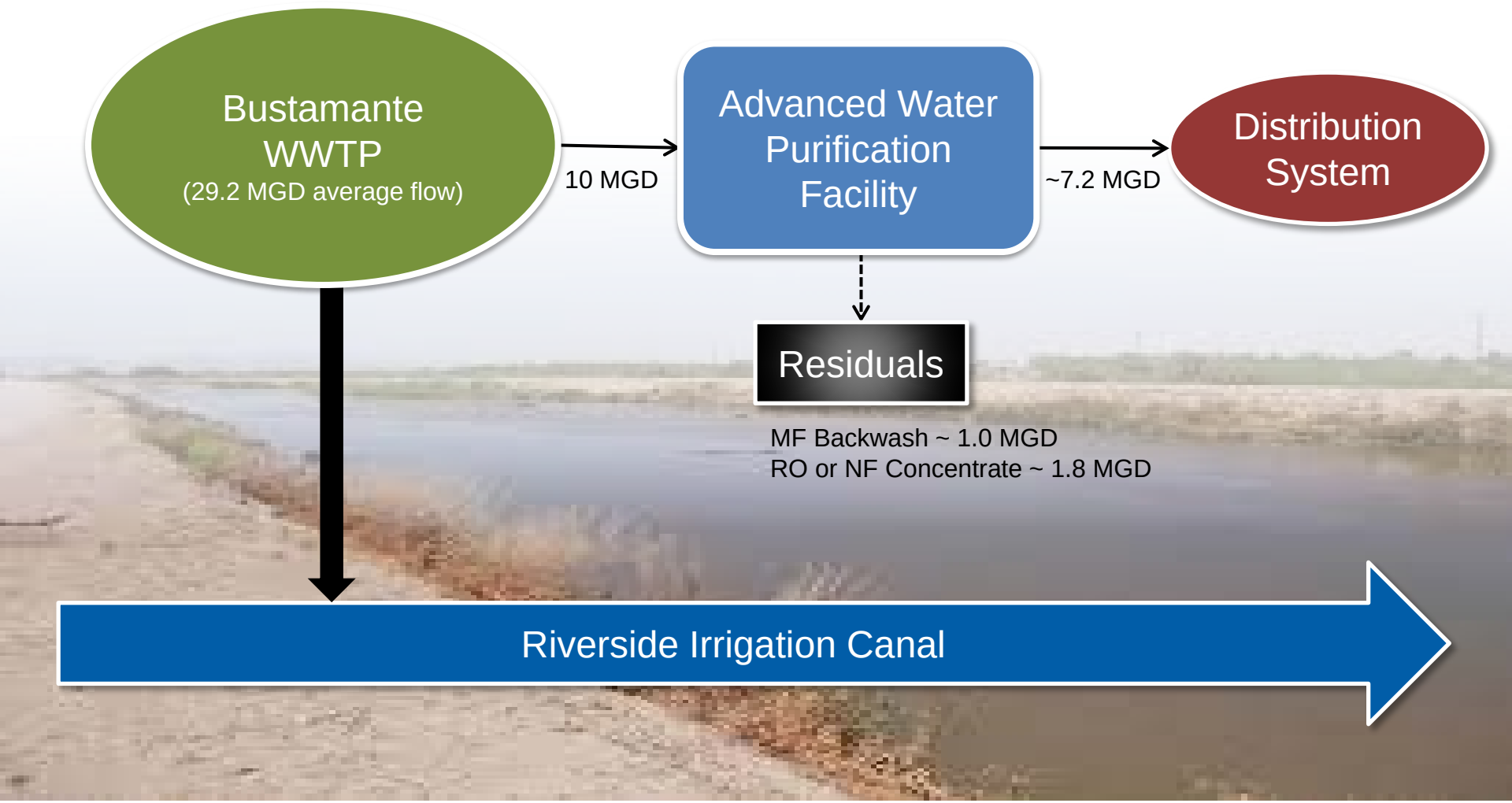
carollo

Why Direct-to-Distribution Potable Reuse?

- Lack of surface water supplies for Jonathan Rogers WTP much of the year
- Confidence in advanced treatment processes and monitoring/control
- Close proximity of Bustamante WRP to Rogers WTP distribution infrastructure
- No regulatory prohibition

Direct-to-Distribution makes sense for El Paso

AWPF Concept

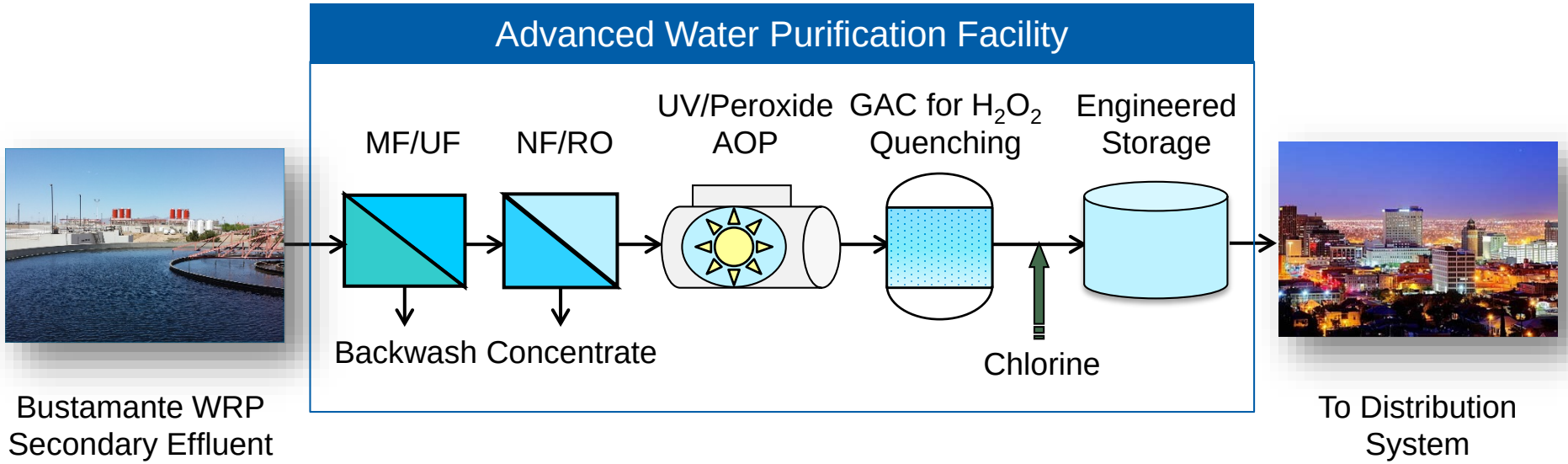


el paso WATER

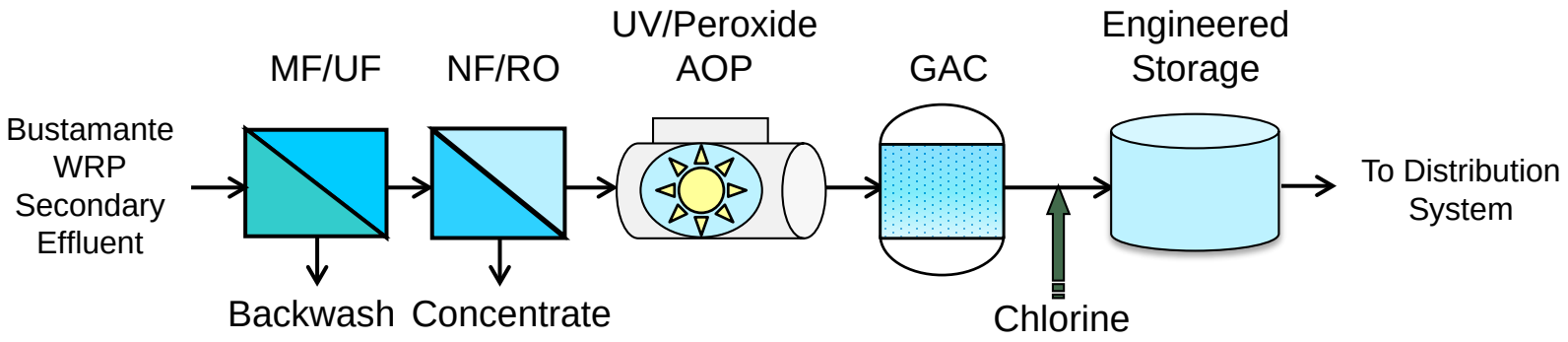
carollo

The Purification Process

AWPF Process Train



Multiple Barrier Approach



PROJECTED RANGE OF TREATMENT EFFECTIVENESS

MF/UF	NF or RO	UV/AOP	GAC	Cl_2	
●	●	○	●	○	**Particulates**
○	◔ ●	○	○	○	**TOC**
○	◕ ●	○	○	○	**Nutrients**
○	● ●	○	○	○	**TDS (Hardness)**
○	◕ ●	○	○	○	**TDS (Chloride)**
○	◔ ●	●	●	○	**Microconstituents**
●	●	●	○	●	**Pathogens**
◕	●	●	○	●	**Viruses**

- ● Primary removal mechanism; >90%
- ● Additional removal mechanism; >90%
- ◔ 75 to 90%
- ◒ 50 to 75%
- ◕ 25 to 50%
- ○ None to <25%

el paso WATER

carollo

Piloting and Permitting

9-Month Pilot Test

Microfiltration/Ultrafiltration

- Pall MF
- Evoqua UF

Reverse Osmosis/Nanofiltration

- Hydranautics ESPA2
- Dow NF90
- Hydranautics ESNA1

UV/Peroxide Advanced Oxidation

- Trojan UVPhox

Granular Activated Carbon

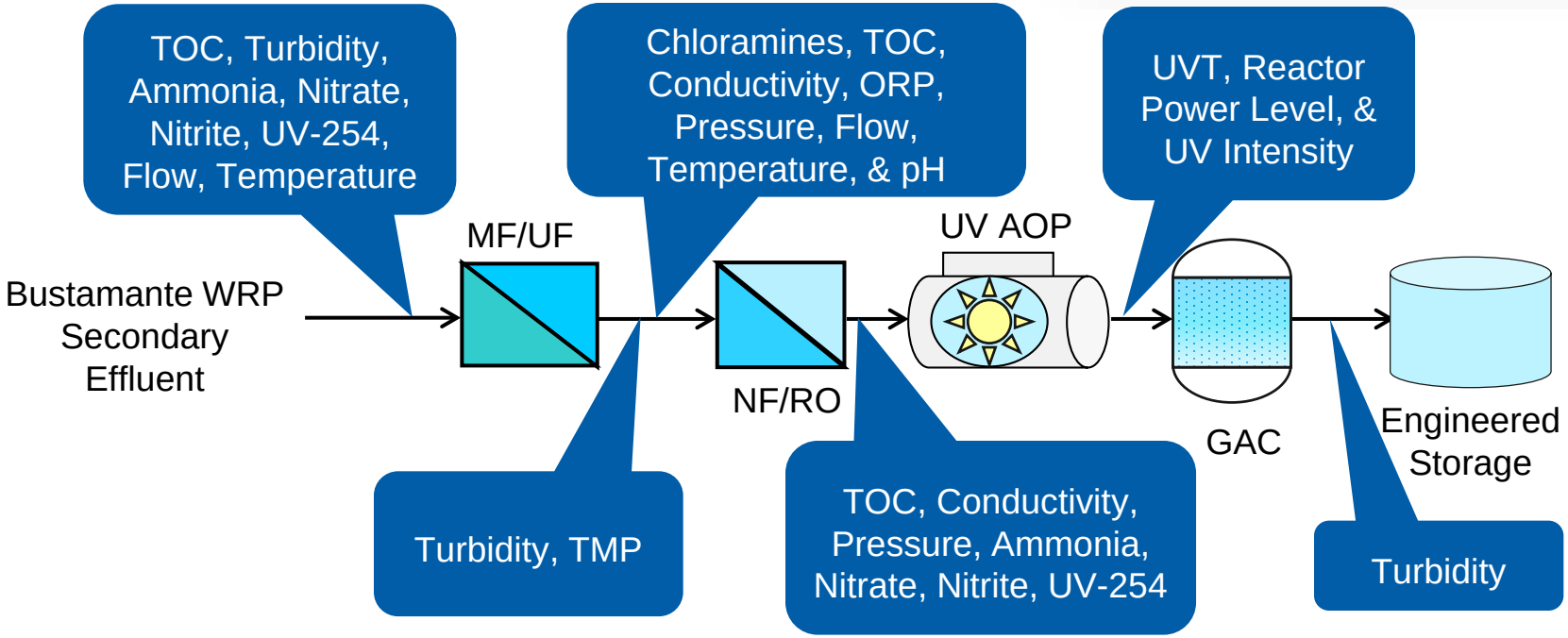
- Catalytic Bituminous (Calgon)
- Catalytic Coconut Shell (Evoqua)
- Non-catalytic Bituminous (Calgon)

el paso WATER

carollo

AWPF Pilot Facility

AWPF Pilot
Online Monitoring



el paso WATER

carollo

Pilot Testing Results Summary

DEMONSTRATED RANGE OF TREATMENT EFFECTIVENESS

	MF/UF	NF/RO	UV AOP	GAC	Cl_2	Demonstrated Performance During Pilot
Particulates	●	●	○	●	○	• Turbidity <0.1 NTU in MF/UF filtrate • Turbidity <0.03 NTU in NF/RO permeate
TOC	○	●	○	◒	○	• >90% removal of TOC by NF/RO • <0.5 mg/L TOC in GAC effluent
Nutrients	○	●	○	○	○	• 70-90% rejection of nitrate and nitrite, with all results below MCLs (RO/tight NF)
TDS	○	●	○	○	○	• >90% removal of TDS • Good correlation with conductivity
Microconstituents	○	●	●	●	○	• 95% reduction in total concentrations from pilot influent to UV AOP effluent • Less than 20 of 96 CECs detected in permeate; only 5 in GAC effluent
Pathogens	●	●	●	○	●	• No coliforms, *Cryptosporidium* or *Giardia* detected downstream of MF/UF
Viruses	◔	●	●	○	●	• Viruses not detected in samples downstream of UV AOP

● Primary removal mechanism; >90%
● Additional removal mechanism; >90%
◔ 75 to 90%
◒ 50 to 75%
◔ 25 to 50%
○ None to <25%

el paso WATER

carollo

Pathogen Removal Credits

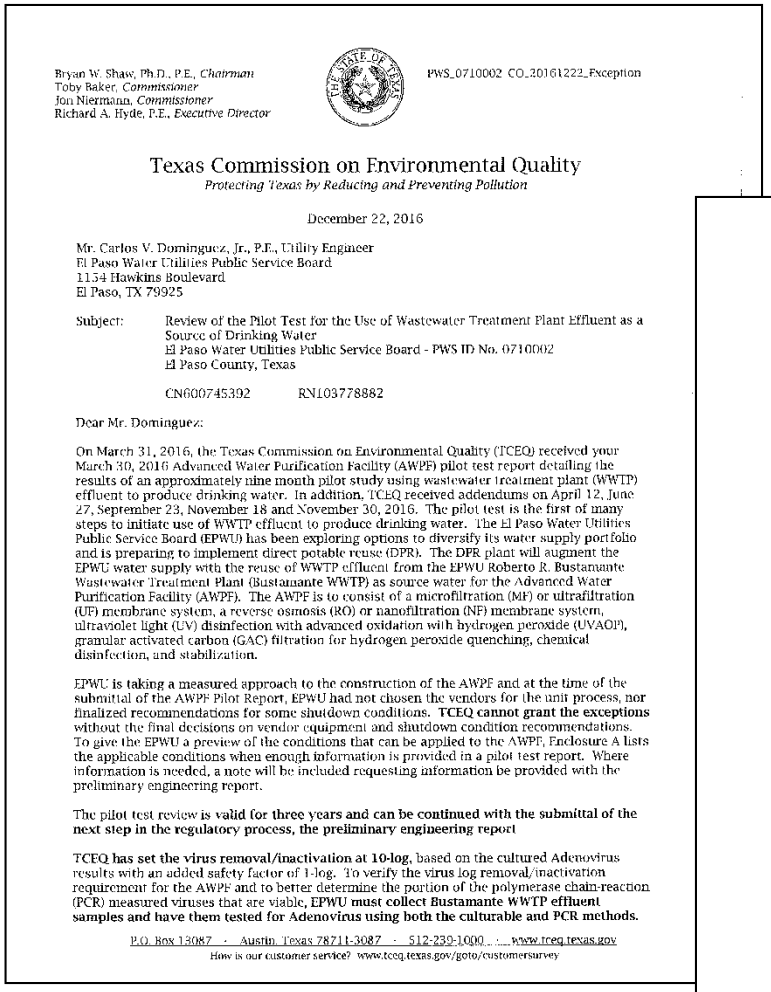
Unit Process	Anticipated TCEQ Log Removal / Inactivation Credits		
	Crypto	*Giardia*	Viruses
MF/UF	4	4	0-1
NF/RO	0-2	0-2	0-2
UV AOP	6	6	6
GAC	0	0	0
Cl_2	0	3	4
Total	**10 - 12**	**13 - 15**	**10 - 13**
Preliminary TCEQ Requirement[1]	6	8	10

[1] *Based on TCEQ Pilot Test Review Letter dated December 22, 2016.*

el paso WATER

carollo

TCEQ Pilot Test Acceptance



Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

PWS_0710002 CO_20161222_Exception

Texas Commission on Environmental Quality
Protecting Texas by Reducing and Preventing Pollution

December 22, 2016

Mr. Carlos V. Dominguez, Jr., P.E., Utility Engineer
El Paso Water Utilities Public Service Board
1154 Hawkins Boulevard
El Paso, TX 79925

Subject: Review of the Pilot Test for the Use of Wastewater Treatment Plant Effluent as a Source of Drinking Water
El Paso Water Utilities Public Service Board - PWS ID No. 0710002
El Paso County, Texas

CN600745392 RN103778882

Dear Mr. Dominguez:

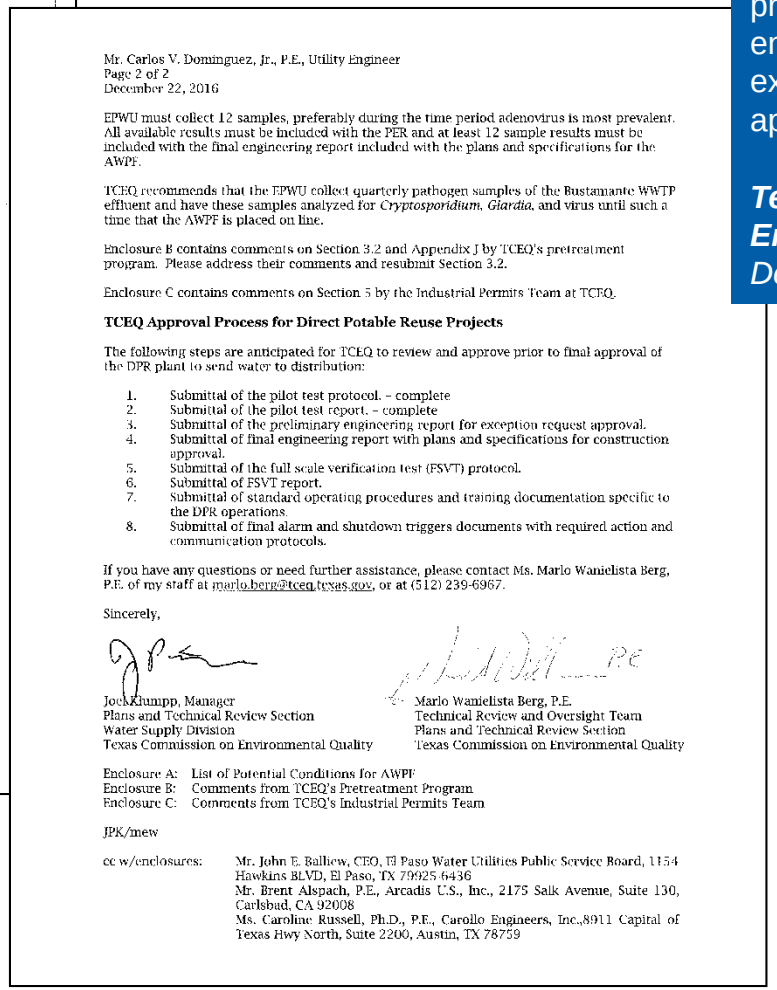
On March 31, 2016, the Texas Commission on Environmental Quality (TCEQ) received your March 30, 2016 Advanced Water Purification Facility (AWPF) pilot test report detailing the results of an approximately nine month pilot study using wastewater treatment plant (WWTP) effluent to produce drinking water. In addition, TCEQ received addendums on April 12, June 27, September 23, November 18 and November 30, 2016. The pilot test is the first of many steps to initiate use of WWTP effluent to produce drinking water. The El Paso Water Utilities Public Service Board (EPWU) has been exploring options to diversify its water supply portfolio and is preparing to implement direct potable reuse (DPR). The DPR plant will augment the EPWU water supply with the reuse of WWTP effluent from the EPWU Roberto R. Bustamante Wastewater Treatment Plant (Bustamante WWTP) as source water for the Advanced Water Purification Facility (AWPF). The AWPF is to consist of a microfiltration (MF) or ultrafiltration (UF) membrane system, a reverse osmosis (RO) or nanofiltration (NF) membrane system, ultraviolet light (UV) disinfection with advanced oxidation with hydrogen peroxide (UVAOP), granular activated carbon (GAC) filtration for hydrogen peroxide quenching, chemical disinfection, and stabilization.

EPWU is taking a measured approach to the construction of the AWPF and at the time of the submittal of the AWPF Pilot Report, EPWU had not chosen the vendors for the unit process, nor finalized recommendations for some shutdown conditions. **TCEQ cannot grant the exceptions** without the final decisions on vendor equipment and shutdown condition recommendations. To give the EPWU a preview of the conditions that can be applied to the AWPF, Enclosure A lists the applicable conditions when enough information is provided in a pilot test report. Where information is needed, a note will be included requesting information be provided with the preliminary engineering report.

The pilot test review is **valid for three years and can be continued with the submittal of the next step in the regulatory process, the preliminary engineering report**

TCEQ has set the virus removal/inactivation at 10-log, based on the cultured Adenovirus results with an added safety factor of 1-log. To verify the virus log removal/inactivation requirement for the AWPF and to better determine the portion of the polymerase chain-reaction (PCR) measured viruses that are viable, **EPWU must collect Bustamante WWTP effluent samples and have them tested for Adenovirus using both the culturable and PCR methods.**

P.O. Box 13087 · Austin, Texas 78711-3087 · 512-239-1000 · www.tceq.texas.gov
How is our customer service? www.tceq.texas.gov/goto/customersurvey



Mr. Carlos V. Dominguez, Jr., P.E., Utility Engineer
Page 2 of 2
December 22, 2016

EPWU must collect 12 samples, preferably during the time period adenovirus is most prevalent. All available results must be included with the PER and at least 12 sample results must be included with the final engineering report included with the plans and specifications for the AWPF.

TCEQ recommends that the EPWU collect quarterly pathogen samples of the Bustamante WWTP effluent and have these samples analyzed for *Cryptosporidium*, *Giardia*, and virus until such a time that the AWPF is placed on line.

Enclosure B contains comments on Section 3.2 and Appendix J by TCEQ's pretreatment program. Please address their comments and resubmit Section 3.2.

Enclosure C contains comments on Section 5 by the Industrial Permits Team at TCEQ.

TCEQ Approval Process for Direct Potable Reuse Projects

The following steps are anticipated for TCEQ to review and approve prior to final approval of the DPR plant to send water to distribution:

1. Submittal of the pilot test protocol. – complete
2. Submittal of the pilot test report. – complete
3. Submittal of the preliminary engineering report for exception request approval.
4. Submittal of final engineering report with plans and specifications for construction approval.
5. Submittal of the full scale verification test (FSVT) protocol.
6. Submittal of FSVT report.
7. Submittal of standard operating procedures and training documentation specific to the DPR operations.
8. Submittal of final alarm and shutdown triggers documents with required action and communication protocols.

If you have any questions or need further assistance, please contact Ms. Marlo Wanielista Berg, P.E. of my staff at marlo.berg@tceq.texas.gov, or at (512) 239-6967.

Sincerely,

Jock Klumpp, Manager
Plans and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

Marlo Wanielista Berg, P.E.
Technical Review and Oversight Team
Plans and Technical Review Section
Texas Commission on Environmental Quality

Enclosure A: List of Potential Conditions for AWPF
Enclosure B: Comments from TCEQ's Pretreatment Program
Enclosure C: Comments from TCEQ's Industrial Permits Team

JPK/mew

cc w/enclosures: Mr. John E. Balliew, CEO, El Paso Water Utilities Public Service Board, 1154 Hawkins BLVD, El Paso, TX 79925-6436
Mr. Brent Alspach, P.E., Arcadis U.S., Inc., 2175 Salk Avenue, Suite 130, Carlsbad, CA 92008
Ms. Caroline Russell, Ph.D., P.E., Carollo Engineers, Inc.,8911 Capital of Texas Hwy North, Suite 2200, Austin, TX 78759

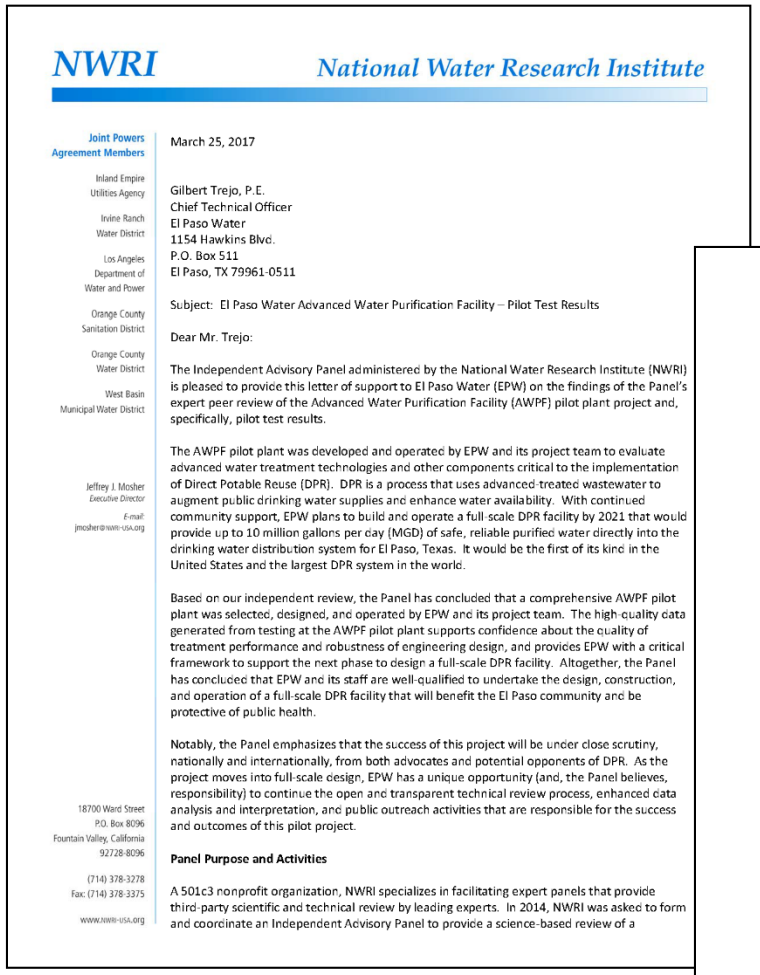
"The pilot test review is valid for three years and can be continued with the submittal of the next step in the regulatory process, the preliminary engineering report for exception request approval."

Texas Commission on Environmental Quality
December 22, 2016

el paso WATER

carollo

NWRI Panel Endorsement



NWRI National Water Research Institute

Joint Powers Agreement Members

Inland Empire Utilities Agency
Irvine Ranch Water District
Los Angeles Department of Water and Power
Orange County Sanitation District
Orange County Water District
West Basin Municipal Water District

March 25, 2017

Gilbert Trejo, P.E.
Chief Technical Officer
El Paso Water
1154 Hawkins Blvd.
P.O. Box 511
El Paso, TX 79961-0511

Subject: El Paso Water Advanced Water Purification Facility – Pilot Test Results

Dear Mr. Trejo:

The Independent Advisory Panel administered by the National Water Research Institute (NWRI) is pleased to provide this letter of support to El Paso Water (EPW) on the findings of the Panel's expert peer review of the Advanced Water Purification Facility (AWPF) pilot plant project and, specifically, pilot test results.

The AWPF pilot plant was developed and operated by EPW and its project team to evaluate advanced water treatment technologies and other components critical to the implementation of Direct Potable Reuse (DPR). DPR is a process that uses advanced-treated wastewater to augment public drinking water supplies and enhance water availability. With continued community support, EPW plans to build and operate a full-scale DPR facility by 2021 that would provide up to 10 million gallons per day (MGD) of safe, reliable purified water directly into the drinking water distribution system for El Paso, Texas. It would be the first of its kind in the United States and the largest DPR system in the world.

Based on our independent review, the Panel has concluded that a comprehensive AWPF pilot plant was selected, designed, and operated by EPW and its project team. The high-quality data generated from testing at the AWPF pilot plant supports confidence about the quality of treatment performance and robustness of engineering design, and provides EPW with a critical framework to support the next phase to design a full-scale DPR facility. Altogether, the Panel has concluded that EPW and its staff are well-qualified to undertake the design, construction, and operation of a full-scale DPR facility that will benefit the El Paso community and be protective of public health.

Notably, the Panel emphasizes that the success of this project will be under close scrutiny, nationally and internationally, from both advocates and potential opponents of DPR. As the project moves into full-scale design, EPW has a unique opportunity (and, the Panel believes, responsibility) to continue the open and transparent technical review process, enhanced data analysis and interpretation, and public outreach activities that are responsible for the success and outcomes of this pilot project.

Panel Purpose and Activities

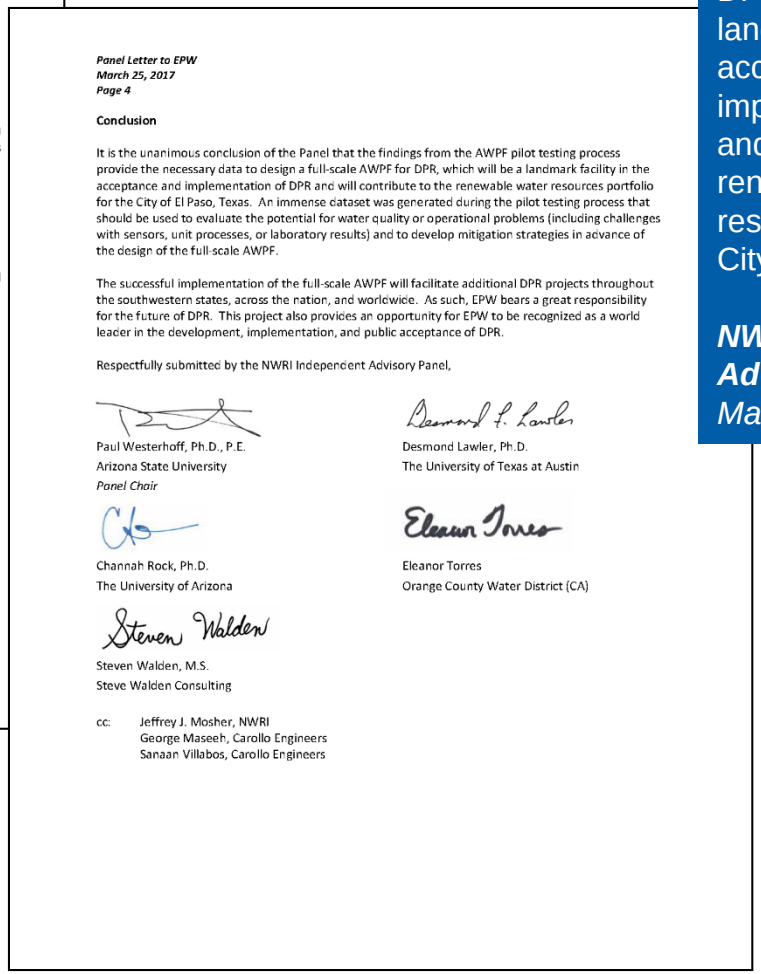
A 501c3 nonprofit organization, NWRI specializes in facilitating expert panels that provide third-party scientific and technical review by leading experts. In 2014, NWRI was asked to form and coordinate an Independent Advisory Panel to provide a science-based review of a

Jeffrey J. Mosher
Executive Director
E-mail: jmosher@nwri-usa.org

18700 Ward Street
P.O. Box 8096
Fountain Valley, California
92728-8096

(714) 378-3278
Fax: (714) 378-3375

www.nwri-usa.org



Panel Letter to EPW
March 25, 2017
Page 4

Conclusion

It is the unanimous conclusion of the Panel that the findings from the AWPF pilot testing process provide the necessary data to design a full-scale AWPF for DPR, which will be a landmark facility in the acceptance and implementation of DPR and will contribute to the renewable water resources portfolio for the City of El Paso, Texas. An immense dataset was generated during the pilot testing process that should be used to evaluate the potential for water quality or operational problems (including challenges with sensors, unit processes, or laboratory results) and to develop mitigation strategies in advance of the design of the full-scale AWPF.

The successful implementation of the full-scale AWPF will facilitate additional DPR projects throughout the southwestern states, across the nation, and worldwide. As such, EPW bears a great responsibility for the future of DPR. This project also provides an opportunity for EPW to be recognized as a world leader in the development, implementation, and public acceptance of DPR.

Respectfully submitted by the NWRI Independent Advisory Panel,

Paul Westerhoff, Ph.D., P.E.
Arizona State University
Panel Chair

Desmond Lawler, Ph.D.
The University of Texas at Austin

Channah Rock, Ph.D.
The University of Arizona

Eleanor Torres
Orange County Water District (CA)

Steven Walden, M.S.
Steve Walden Consulting

cc: Jeffrey J. Mosher, NWRI
George Maseeh, Carollo Engineers
Sanaan Villabos, Carollo Engineers

"It is the unanimous conclusion of the Panel that the findings from the AWPF pilot testing process provide the necessary data to design a full-scale AWPF for DPR, which will be a landmark facility in the acceptance and implementation of DPR and will contribute to the renewable water resources portfolio for the City of El Paso, Texas."

NWRI Independent Advisory Panel
March 25, 2017

el paso WATER

carollo

The Path Ahead

AWPF Project Timeline

TCEQ pilot plant approval

TCEQ pilot results approval

TCEQ design approval target

Pilot Plant Design & Testing

AWPF Design

AWPF Construction

Delivery To Customers

Independent Advisory Panel

Public Outreach

2014 | 2015-2016 | 2017-2019 | 2020-2022

el paso WATER

carollo

Questions

George P. Maseeh, P.E., BCEE
Carollo Engineers
gmaseeh@carollo.com

el paso WATER

carollo