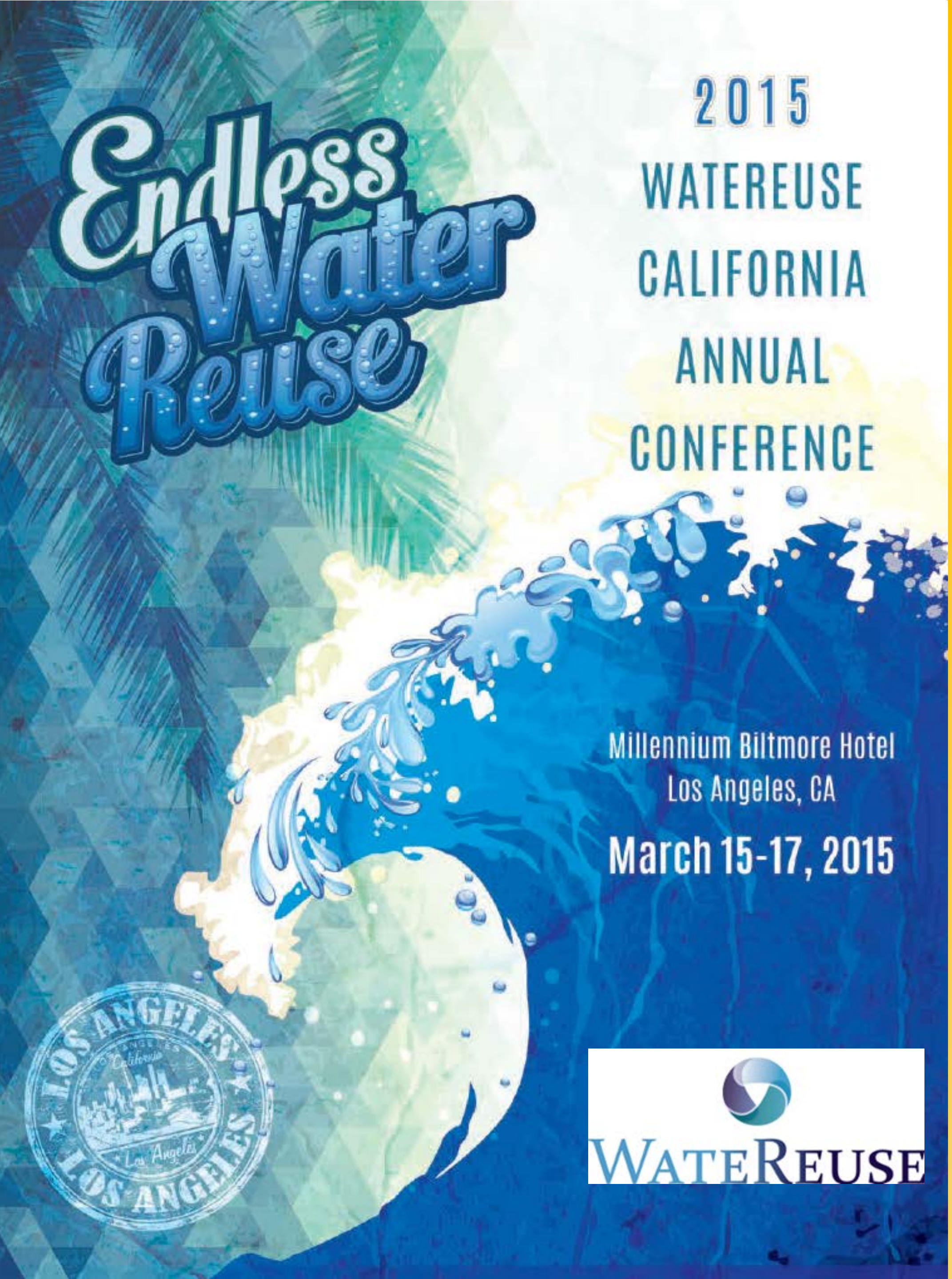

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

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The Advent of True Direct Potable Reuse

Brent Alspach, PE
ARCADIS

Acknowledgements

- Co-Author
  - Gilbert Trejo, El Paso Water Utilities (EPWU)

- El Paso Water Utilities:
  - John Balliew
  - Fernie Rico
  - Aide Zamarron

- ARCADIS
  - Caroline Russell
  - Corin Marron
  - Sanaan Villalobos
  - George Maseeh
  - Dan Olson

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Background

Water Resources Overview

El Paso Water Utilities (EPWU)		
Service area population		~ 800,000
Estimated demand (2013)		~ 118,000 AF (105 MGD)
Specific consumption	1970s	225 gpcd
	2013	132 gpcd
Water sources		• Groundwater • Desalinated brackish groundwater • Rio Grande river • Reclaimed water
Average annual rainfall		8.7 inches

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Water Resources Overview

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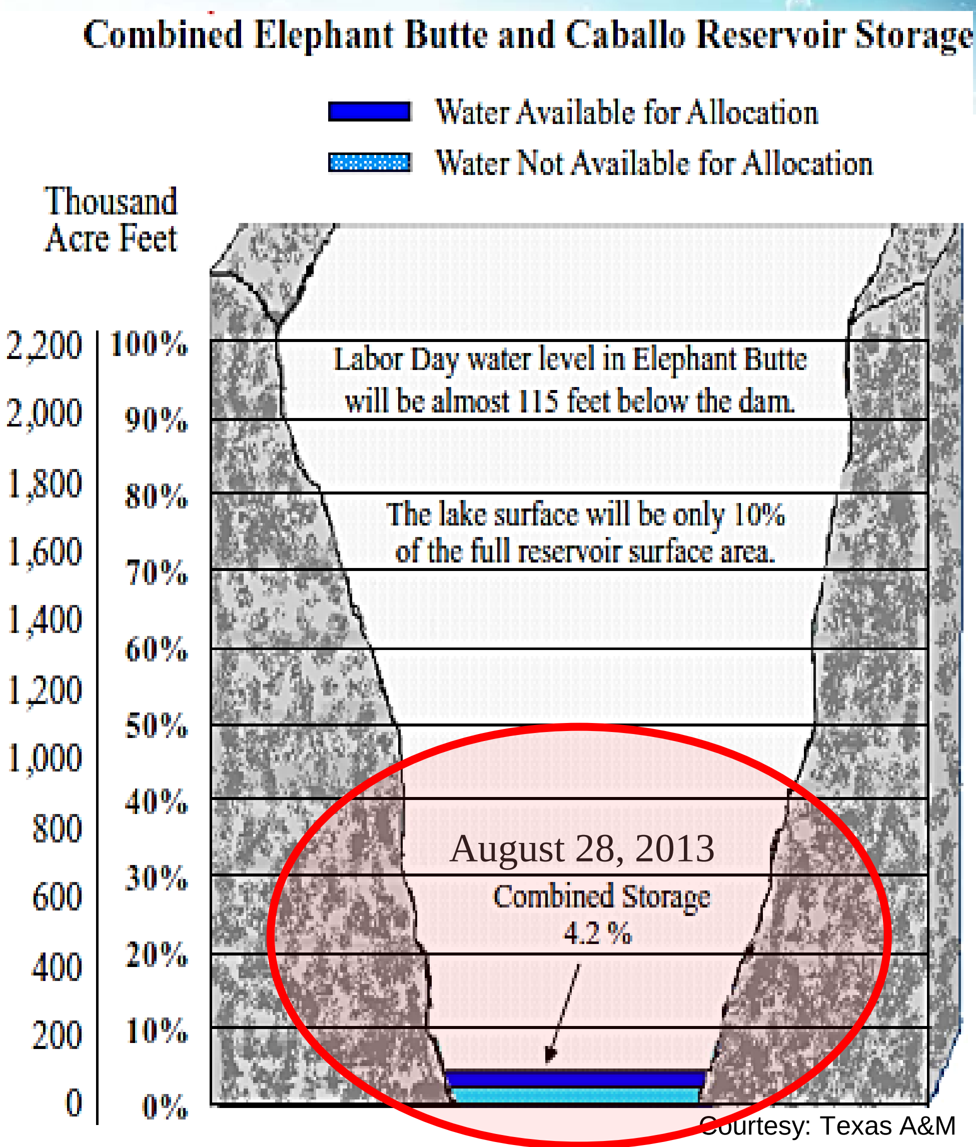
Specific consumption	**1970s**	**225 gpcd**
	2013	**132 gpcd**
Water sources		• Groundwater • Desalinated brackish groundwater • Rio Grande river • Reclaimed water
Average annual rainfall		8.7 inches

Conservation has been effective!

Current Drought Conditions

- Reduced river water allocation:
  - Normal: 60,000 AFY
  - 2013: 10,000 AF
- Received at least average allocation from the Rio Grande only 3 times in the past 17 yrs
- Reservoir storage is low

→ EPWU has instituted several drought support programs



Courtesy: Texas A&M

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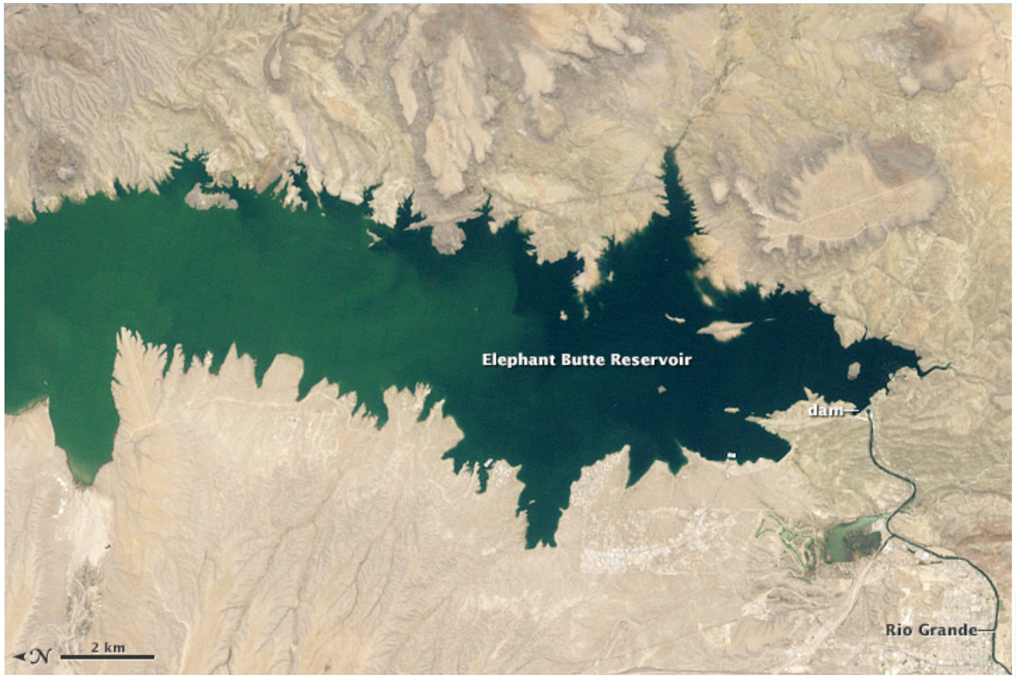
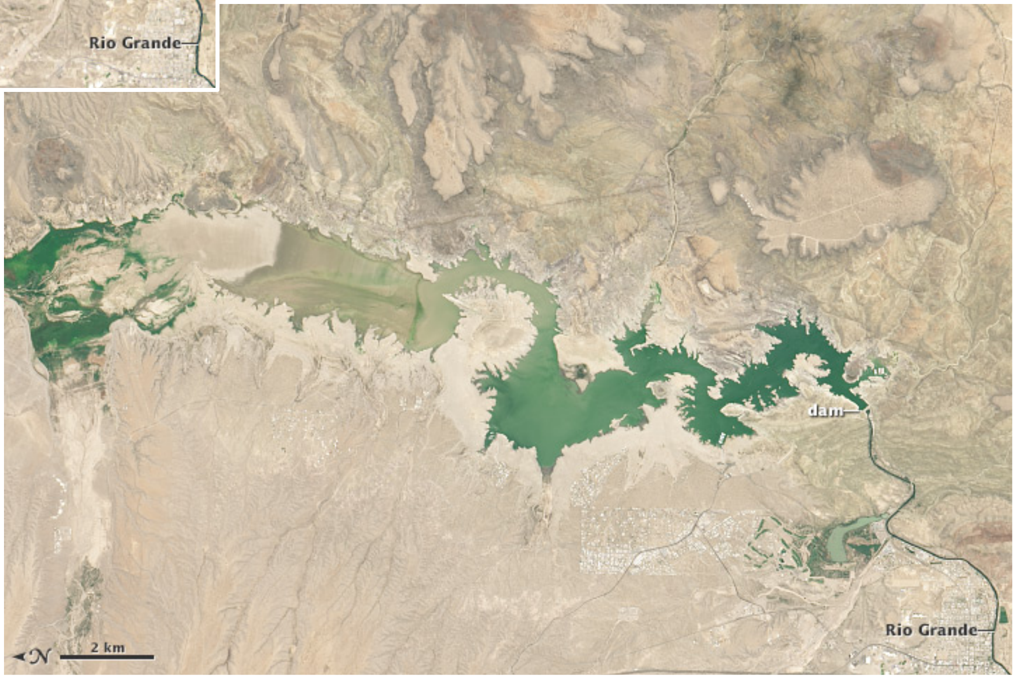


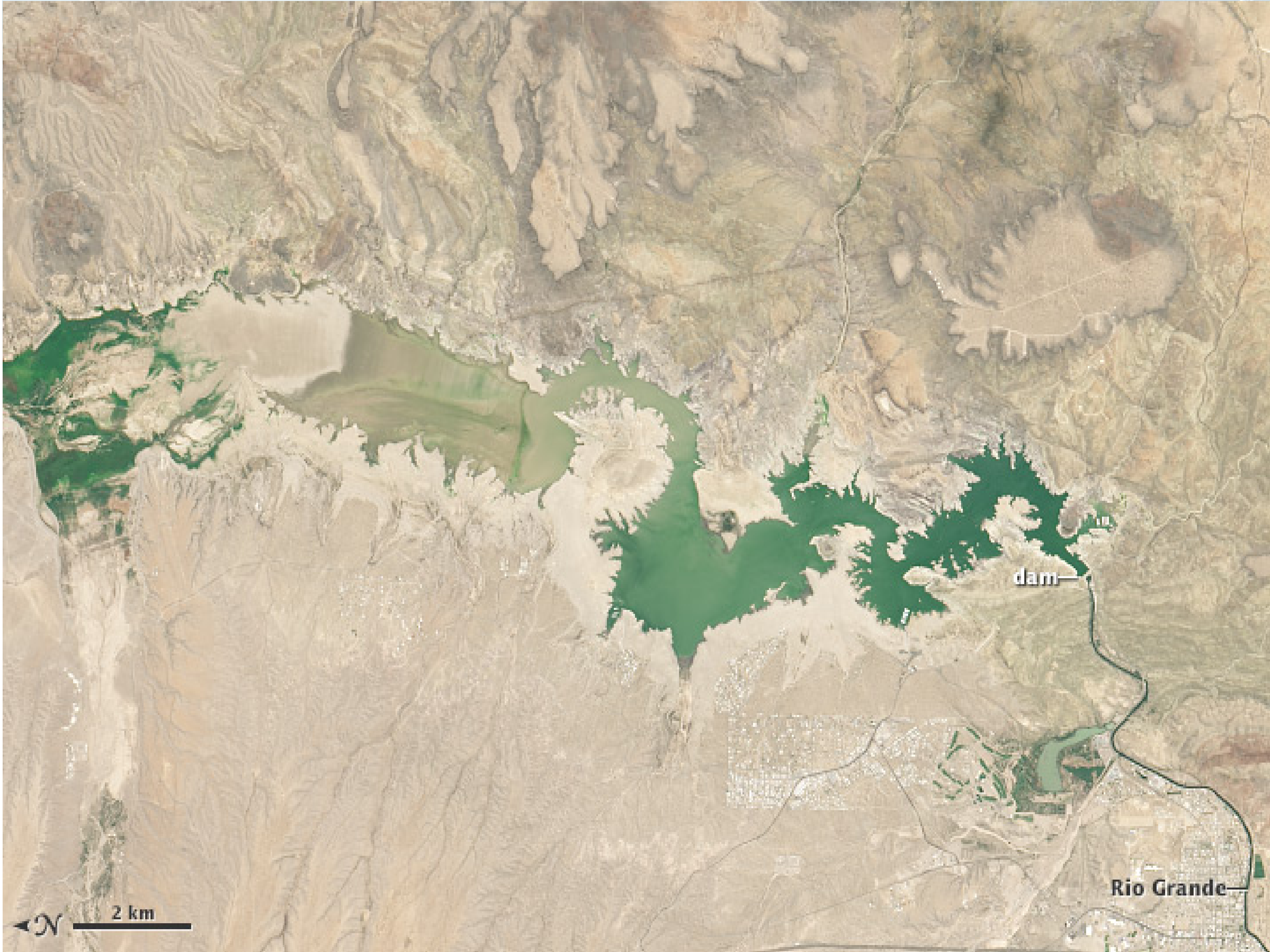
June 2, 1994

July 8, 2013

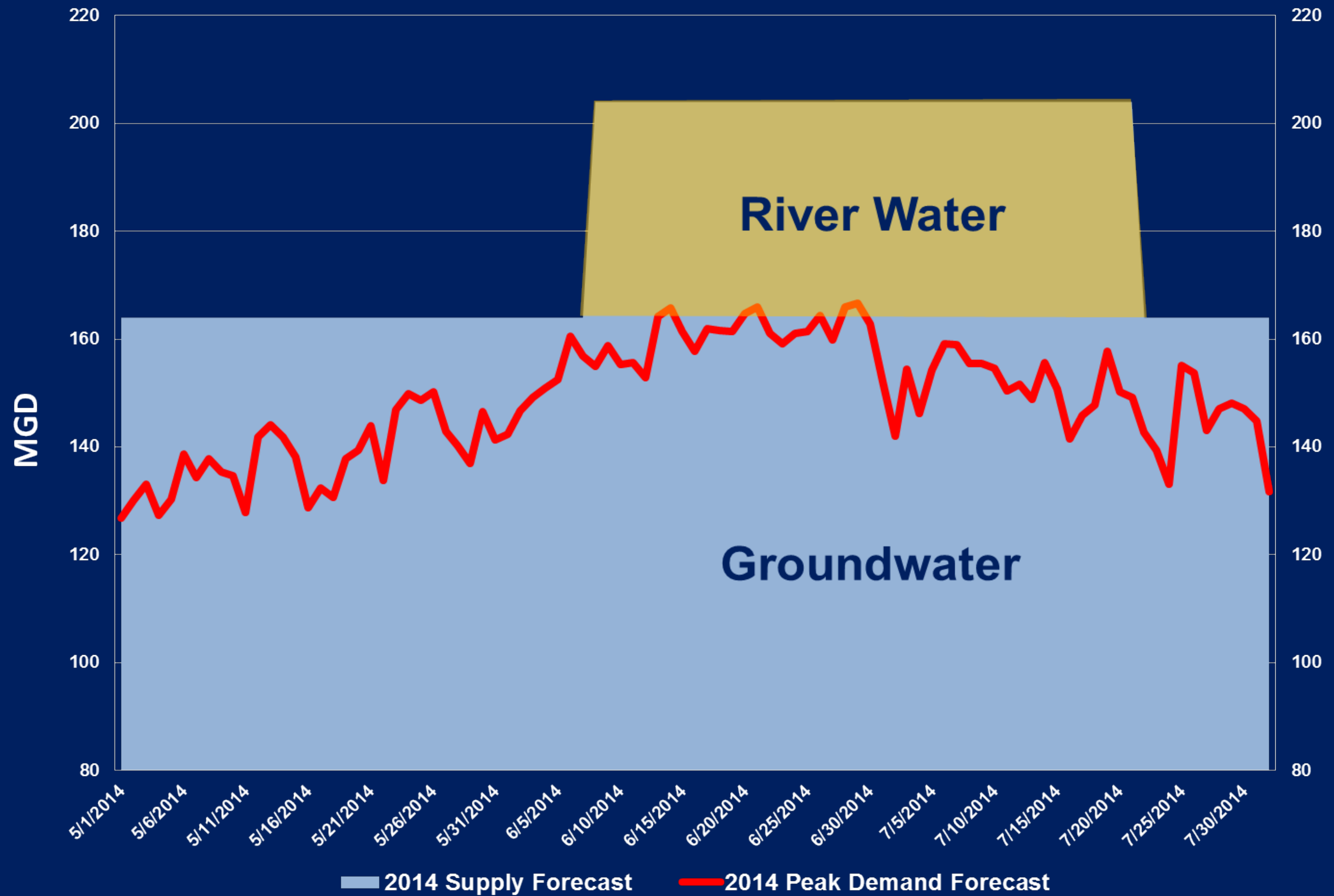


Courtesy: NASA

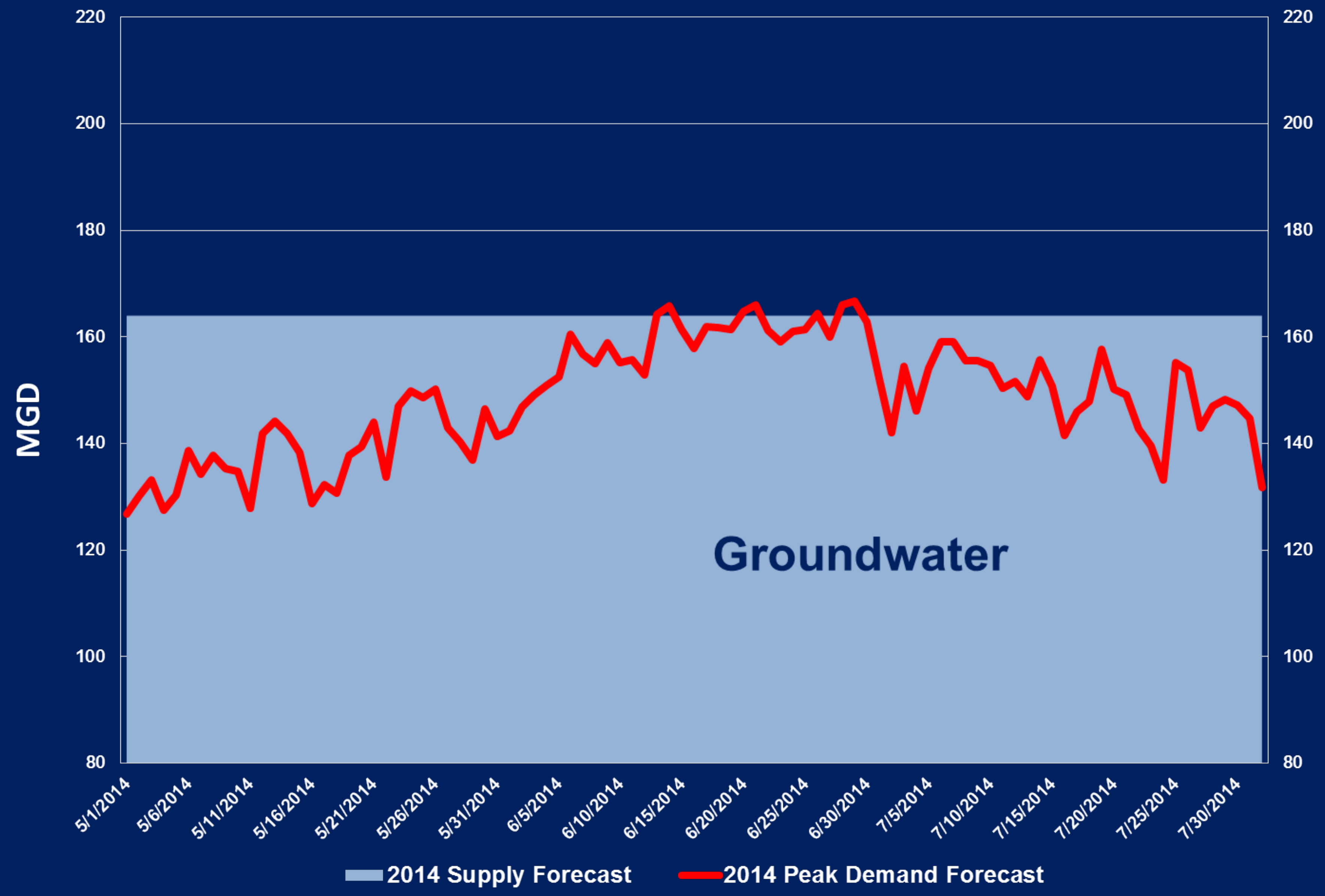

Elephant Butte Reservoir
dam
Rio Grande
N
2 km


dam
Rio Grande
N
2 km

2014 Summer Daily Peak



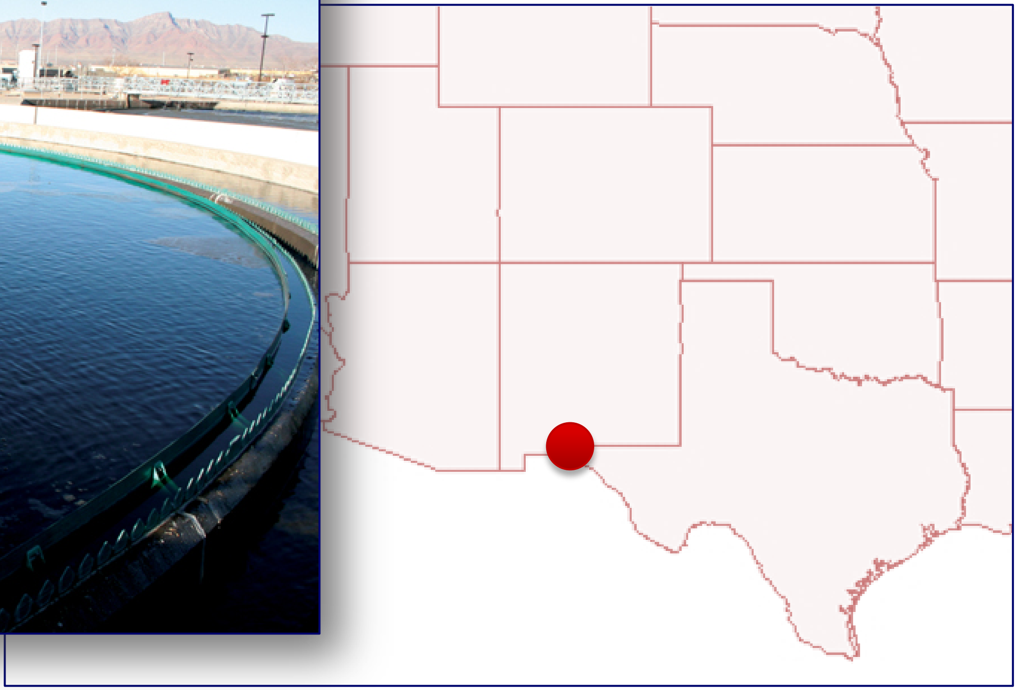
Daily Peak Without River Water



Long History of Reuse

Fred Hervey Water Reclamation Plant

WWTP designed to meet drinking water standards



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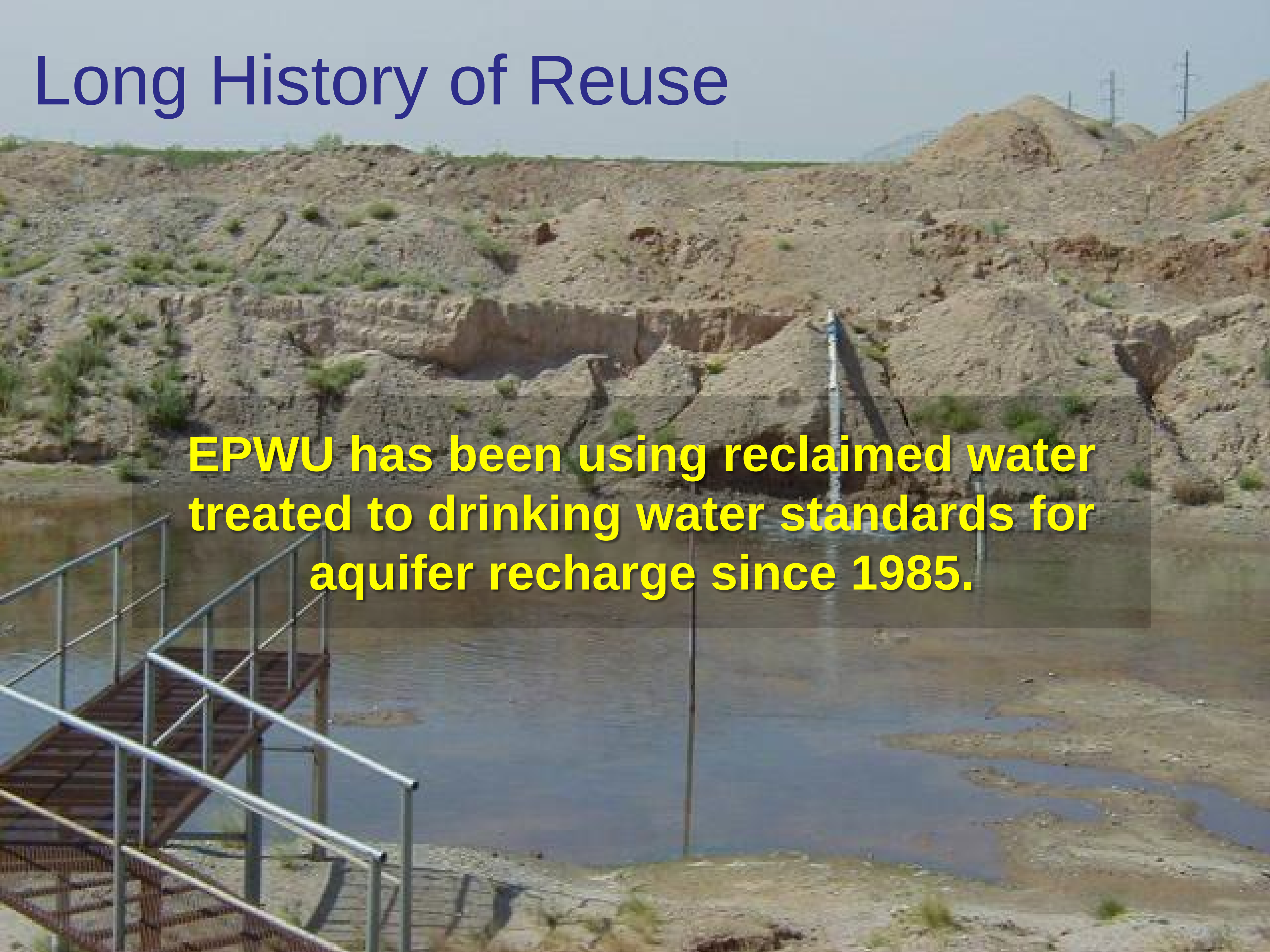
Long History of Reuse



EPWU has been using reclaimed water treated to drinking water standards for aquifer recharge since 1985.

Long History of Reuse

Why not utilize indirect potable reuse?

Source Water Quality Comparison

Parameters	Rio Bosque Shallow Groundwater	Average 2011 Concentrations @...		
		Bustamante WWTP Effluent	Rogers WTP	
			Rio Grande	Shallow Wells
pH	NA	6.9	8.5	7.8
Alkalinity, mg/L as $CaCO_3$	NA	97	176	288
TDS, mg/L	722 - 3,087	1,069	580	791
Hardness, mg/L	NA	228	210	279
TOC, mg/L	NA	NA	4.3	3.8
Turbidity, NTU	NA	3.8	168	1.6
Nitrate, mg/L as N	8 - 88.7	16.4	1.3	NA
Total Phosphorus, mg/L as P	NA	3.1	0.4	NA
Bromide, mg/L	1.3 - 3.2	0.3	0.09	NA

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Additional injection treatment required

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Bromide, mg/L	**1.3 - 3.2**	0.3	0.09	NA

Typical bromide concentrations in conventional supplies:

0.063 mg/L*

* Water Research Foundation (2011)

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Additional extraction treatment required

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Avoid subsurface injection

Source Water Quality Comparison

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✓ **Direct potable reuse**

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Total Phosphorus, mg/L as P	NA	3.1	0.4	NA
Bromide, mg/L	1.3 - 3.2	0.3	0.09	NA

✓ Direct to distribution!

Why Pipe-to-Pipe DPR…?

- Close to proximity of Roberto R. Bustamante WWTP and Jonathan Rogers WTP infrastructure
- Cost of re-treating advanced treated water
- Advanced treated water has better quality than raw water blending supplies [Big Spring (TX) model]
- No regulatory roadblocks

Direct-to-distribution DPR makes sense.

Project Status

Project Status

- Feasibility assessment
- Concept development
- Pilot testing
- Preliminary design
- Detailed design
- Construction

Advanced Purified Water Treatment Plant (APWTP)

El Paso Water Utilities Public Service Board
ARCADIS

Project Status

- ✓ Feasibility assessment
- ✓ Concept development
- Pilot testing
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Advanced Purified Water Treatment Plant (APWTP)

EL PASO WATER UTILITIES PUBLIC SERVICE BOARD

ARCADIS

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- ✓ Feasibility assessment
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- Preliminary design
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Participation By:

- EPWU
- ARCADIS
- NWRI
- Expert Panel
- TCEQ

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Pilot site under construction

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Roberto R. Bustamante WWTP Site

Treatment Processes

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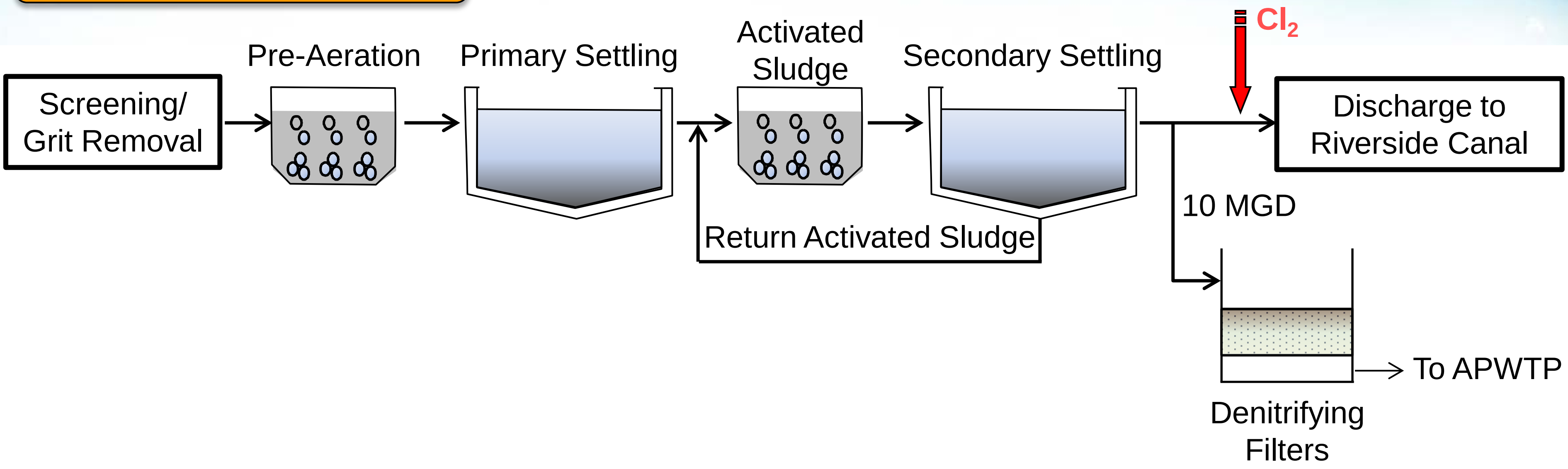
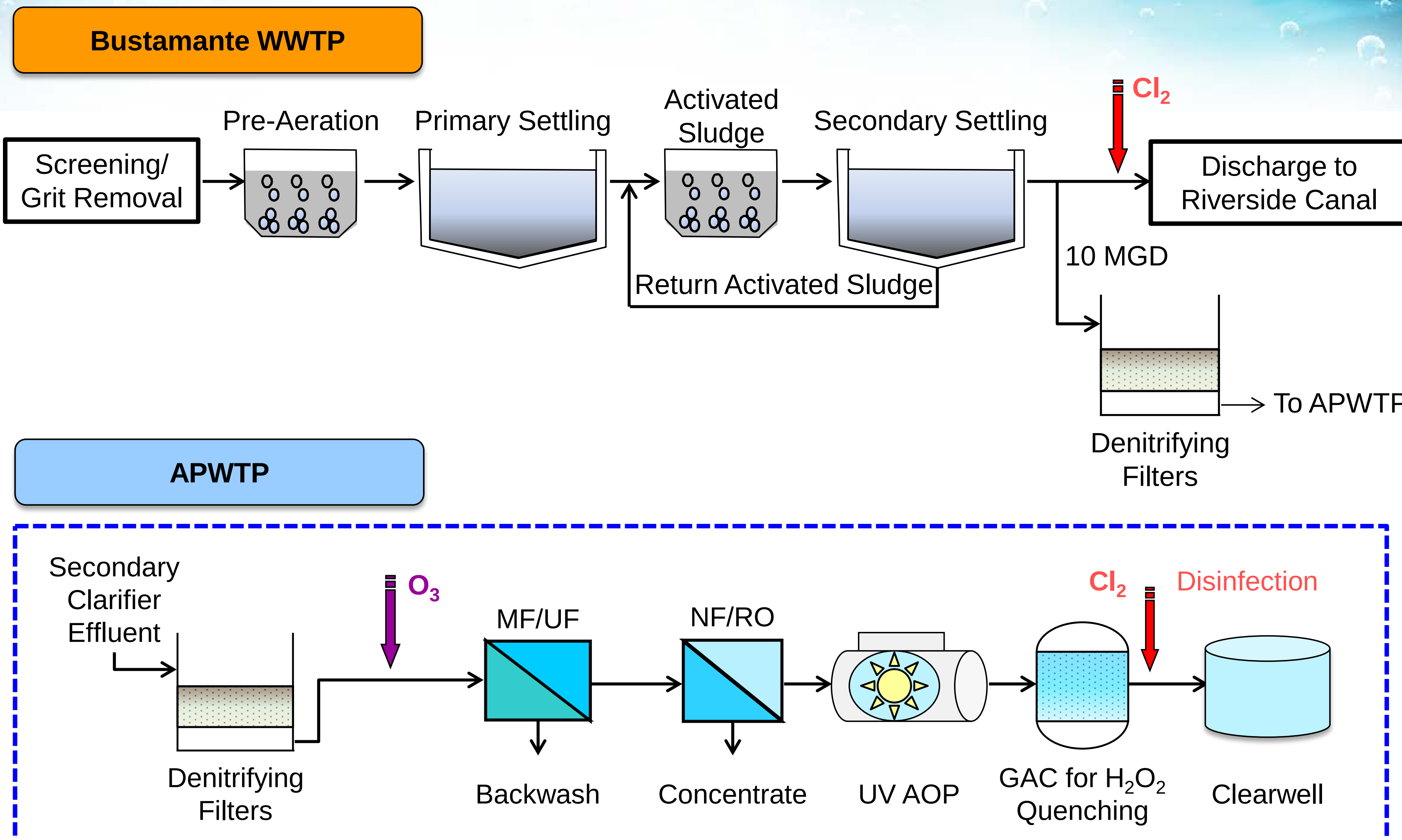
Treatment Processes

Bustamante WWTP



Treatment Processes



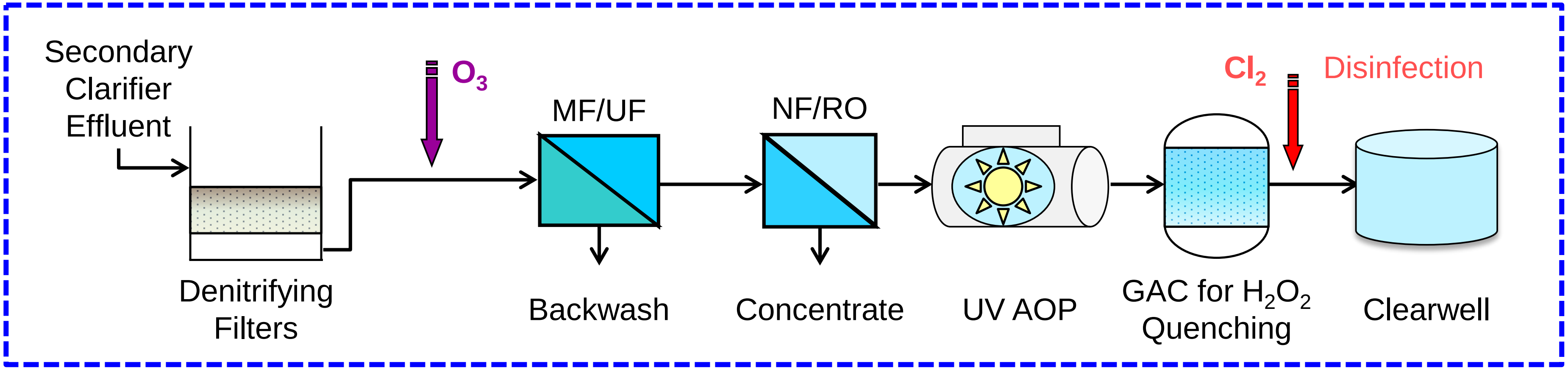
Treatment Processes

Not covered today

Other key pilot test components:

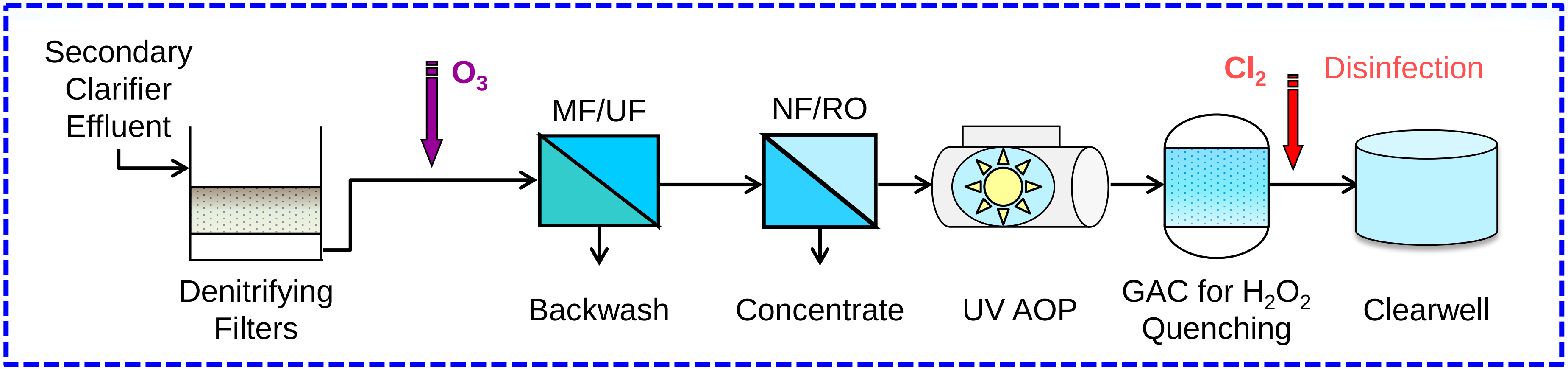
- Coagulant testing
- On-line monitoring evaluation
- Process control study
- Finished water pipe loop testing

APWTP



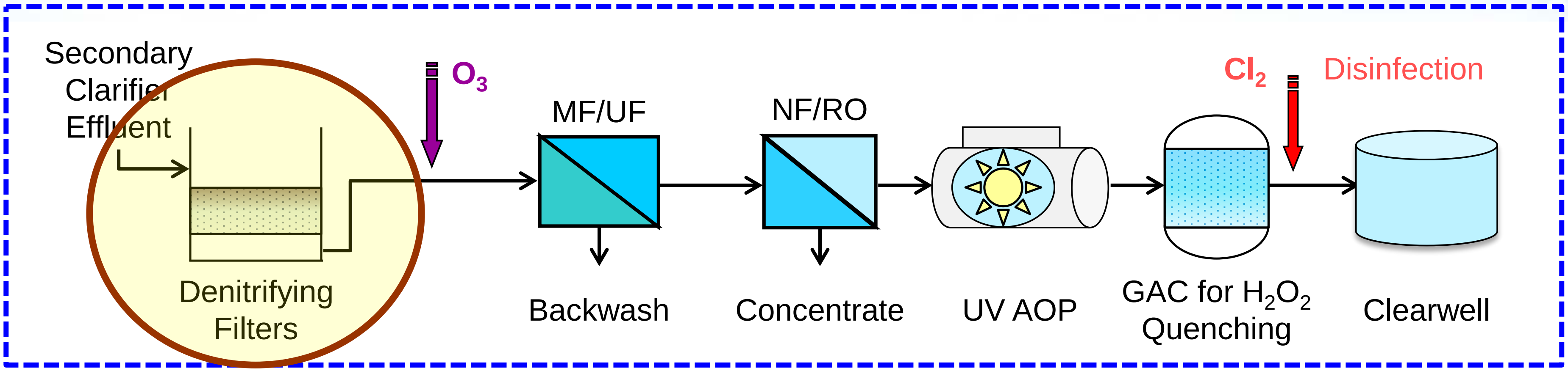
Treatment Processes

APWTP



Denitrifying Filters

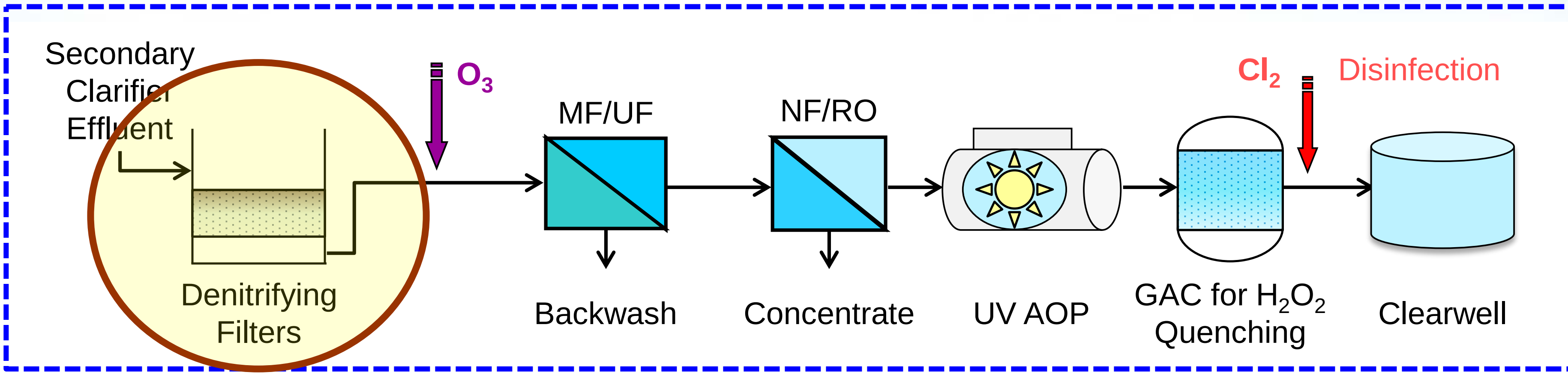
APWTP



Objective(s)	**Benefit(s)**
Convert dissolved NO_3^- to inert N_2	Enable the use of NF (vs. RO)
Remove particulate matter	Enhance MF/UF pretreatment
Provide an additional pathogen barrier	*Further* reduce public health risk

Denitrifying Filters

APWTP



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Convert dissolved NO_3^- to inert N_2	Enable the use of NF (vs. RO)
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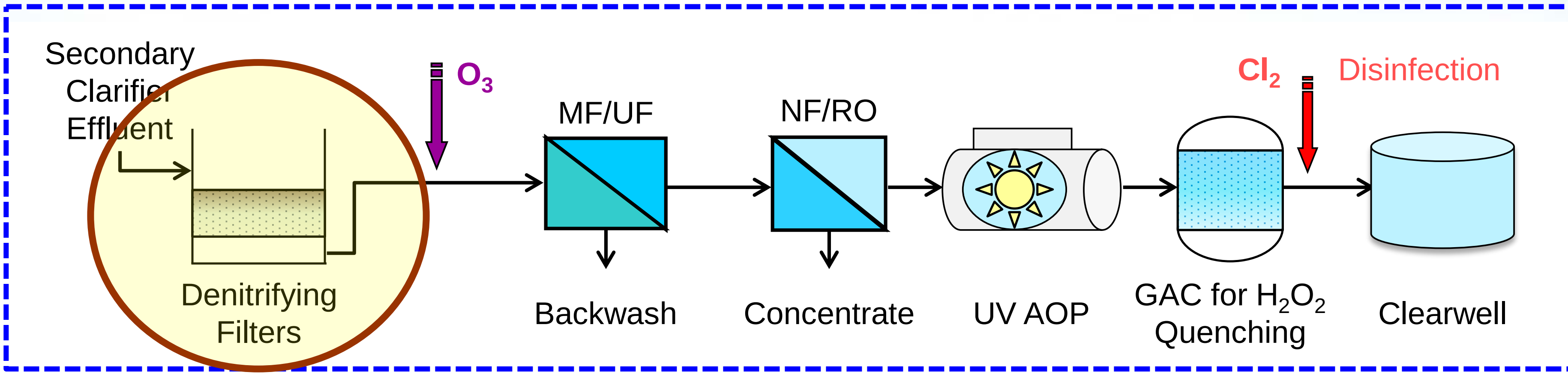
Provide an additional pathogen barrier	*Further* reduce public health risk

Reduced capital & operating costs

Denitrifying Filters

APWTP



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Convert dissolved NO_3^- to inert N_2	Enable the use of NF (vs. RO)
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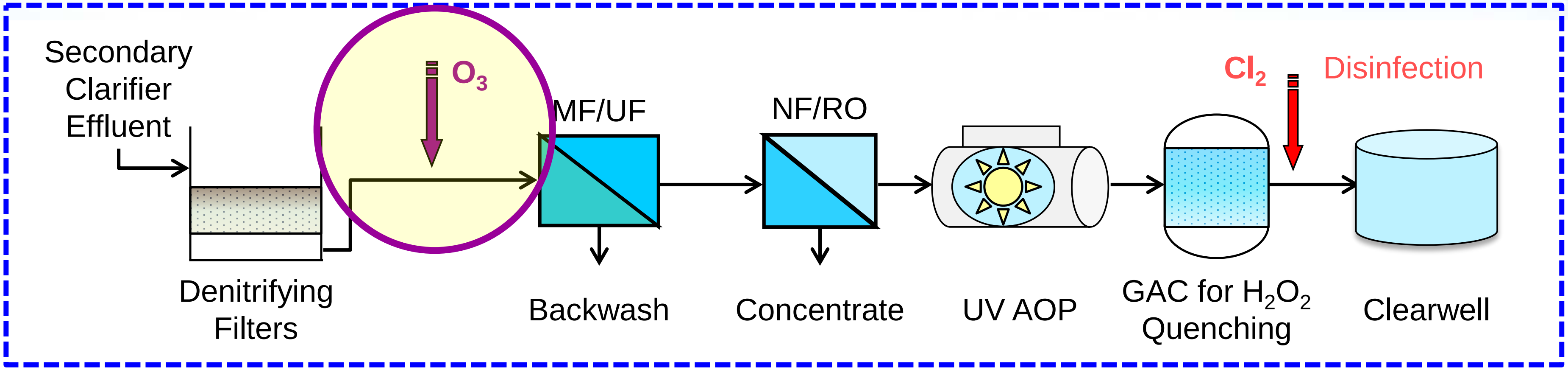
Beneficial whether or not credit is awarded

Ozone

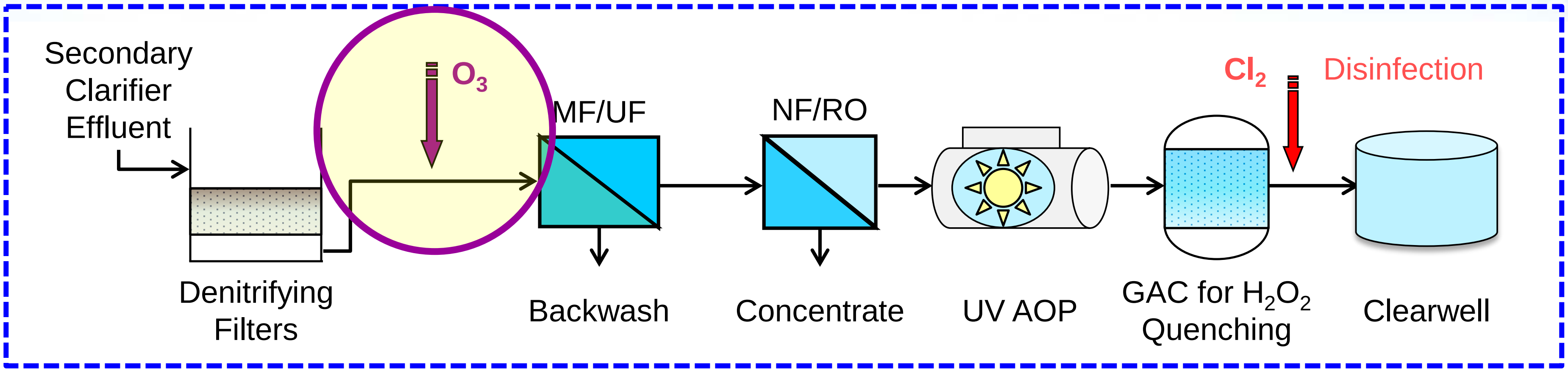
APWTP



Objective(s)	Benefit(s)
Reduce MF/UF cleaning frequency	Reduce capital & operating costs (???)
Increase MF/UF flux	
Extend MF/UF backwash intervals	
Reduce concentrations of emerging contaminants	Provide unquantified (yet) health benefit

Ozone

APWTP



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Increase MF/UF flux	
Extend MF/UF backwash intervals	
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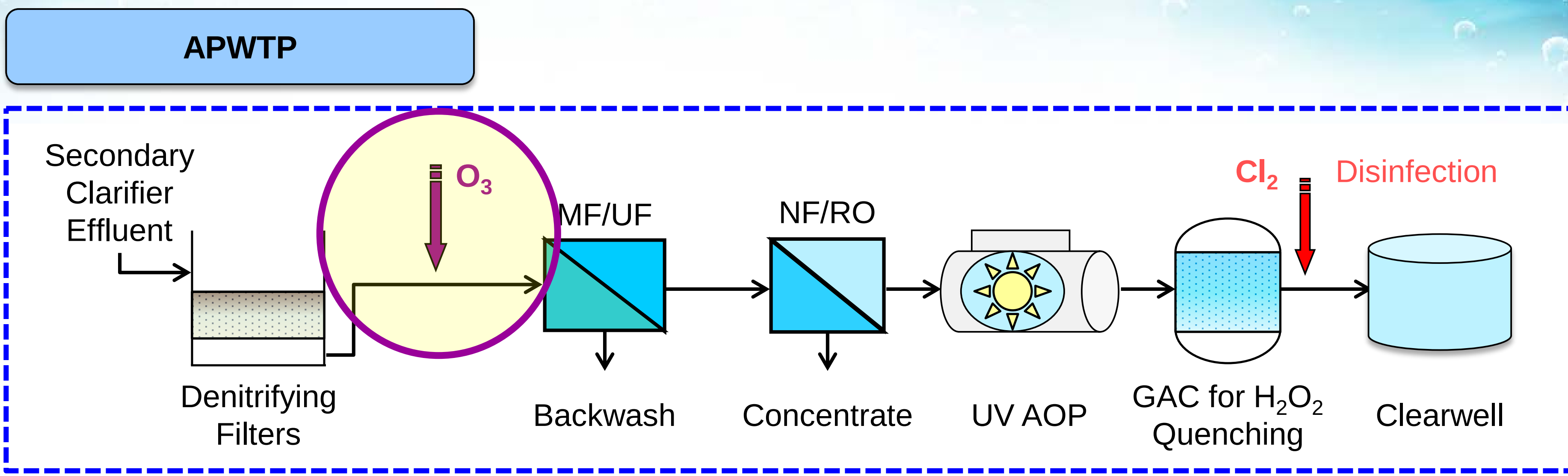
Research is encouraging, but not conclusive

Ozone



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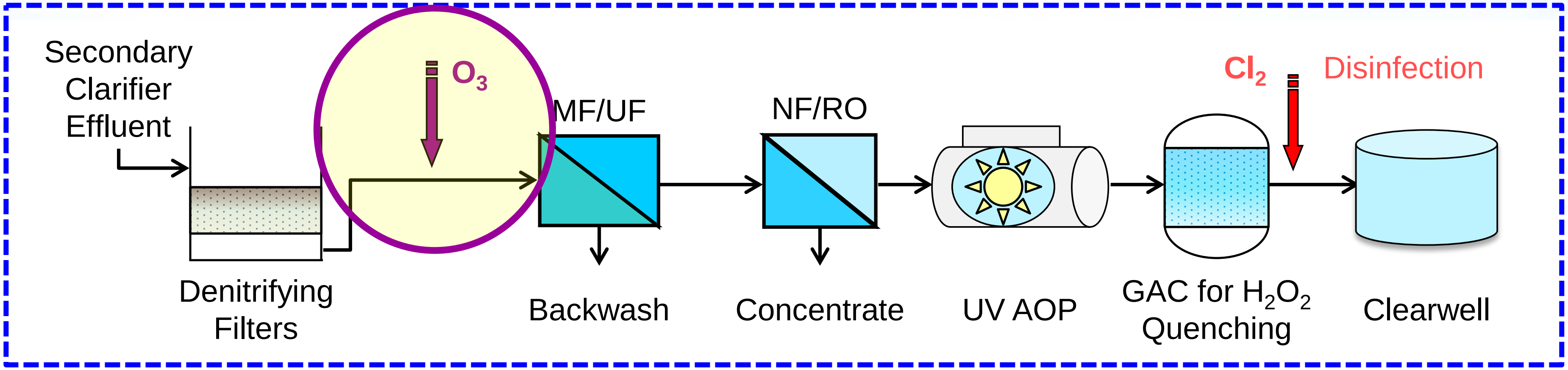
Reduce MF/UF cleaning frequency	Reduce capital & operating costs (???)
Increase MF/UF flux	
Extend MF/UF backwash intervals	
Reduce concentrations of emerging contaminants	Provide unquantified (yet) health benefit

Also improves public / consumer confidence

Ozone

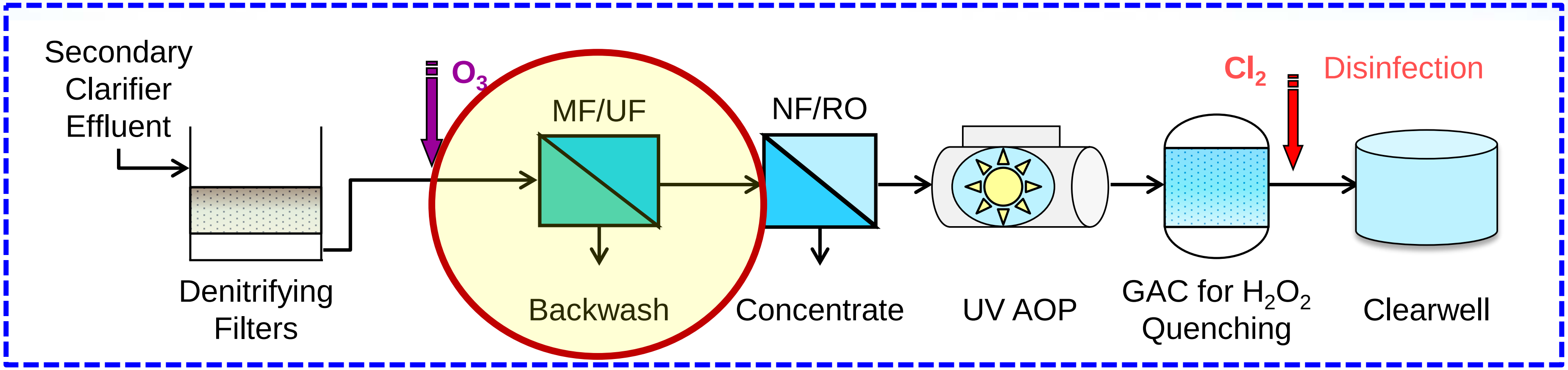
APWTP



Counter Consideration	Impact
No downstream biological filtration to consume assimilable organic carbon (AOC)	Increase RO biofouling?

Membrane Filtration

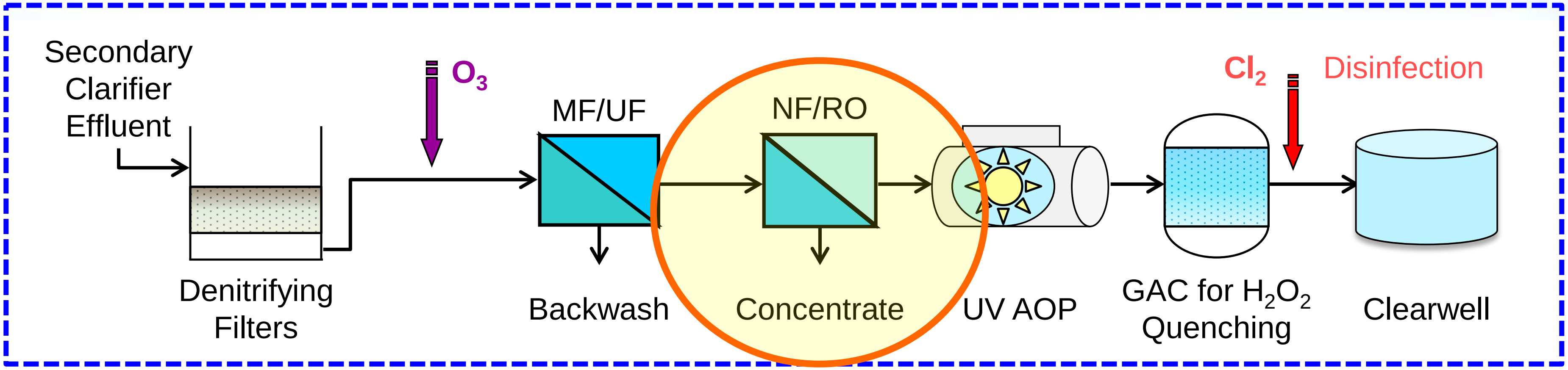
APWTP



Objective(s)	Benefit(s)
Maximize removal of pathogens	Protect public health / achieve compliance
Achieve filtrate turbidity < 0.1 NTU	Exceed SWTR requirements
Provide optimum NF/RO pretreatment	Minimize particulate fouling

Desalination

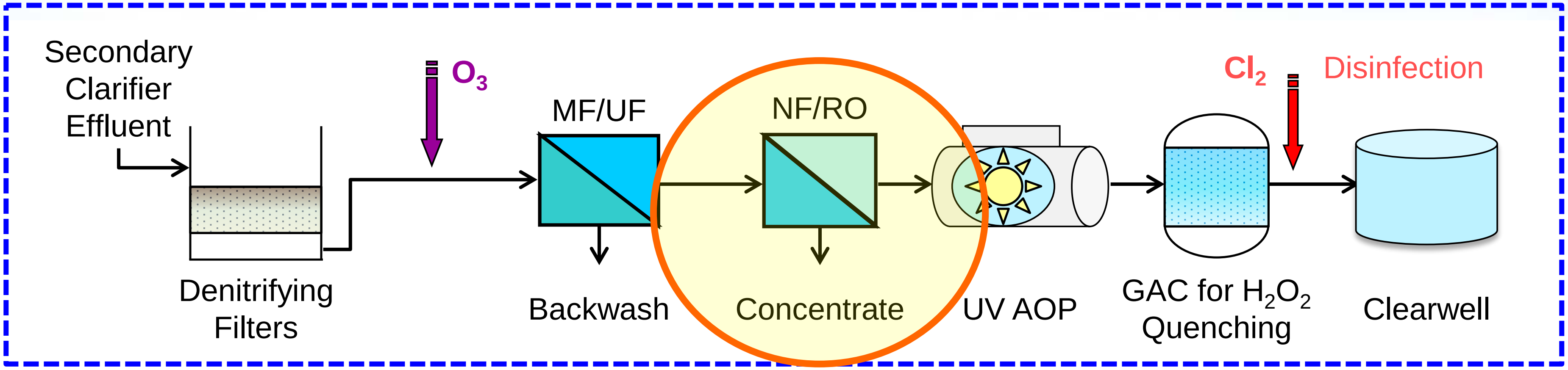
APWTP



Objective(s)	Benefit(s)
Reduce dissolved solids concentrations	TDS ≤ 900 mg/L
	Chloride ≤ 300 mg/L
	Sulfate ≤ 300 mg/L
Achieve all 1º and 2º standards in permeate	Maintain Texas and USEPA compliance

Desalination

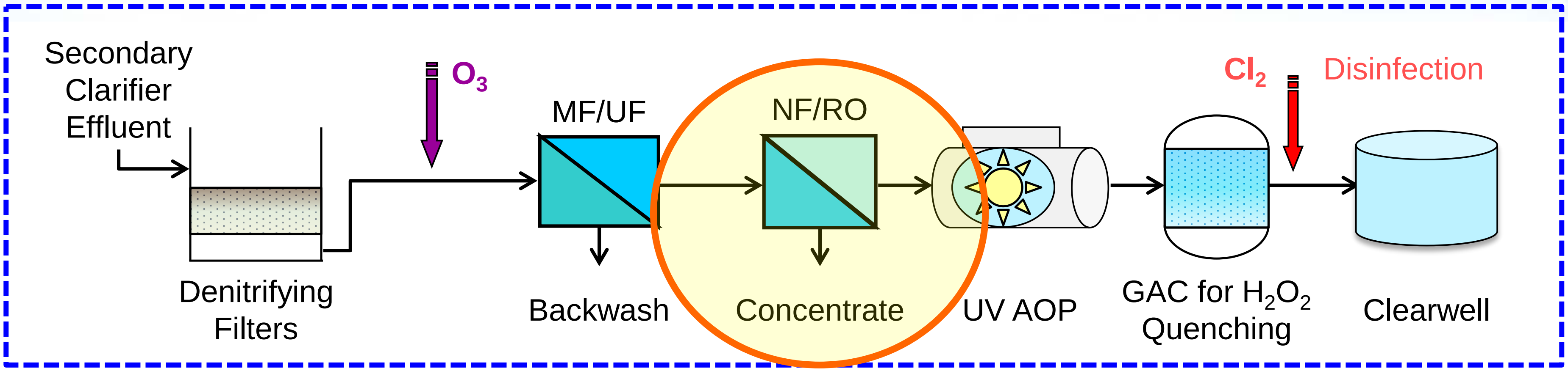
APWTP



Objective(s)	Benefit(s)
Provide an additional pathogen barrier	Protect public health
Reduce / remove emerging contaminants	Provide unquantified (yet) health benefit
Remove DBP precursors (TOC, bromide, etc.)	Minimize DBP formation
Remove DBPs (NDMA, bromate, TTHMs, HAAs…)	Maintain regulatory compliance

Desalination

APWTP



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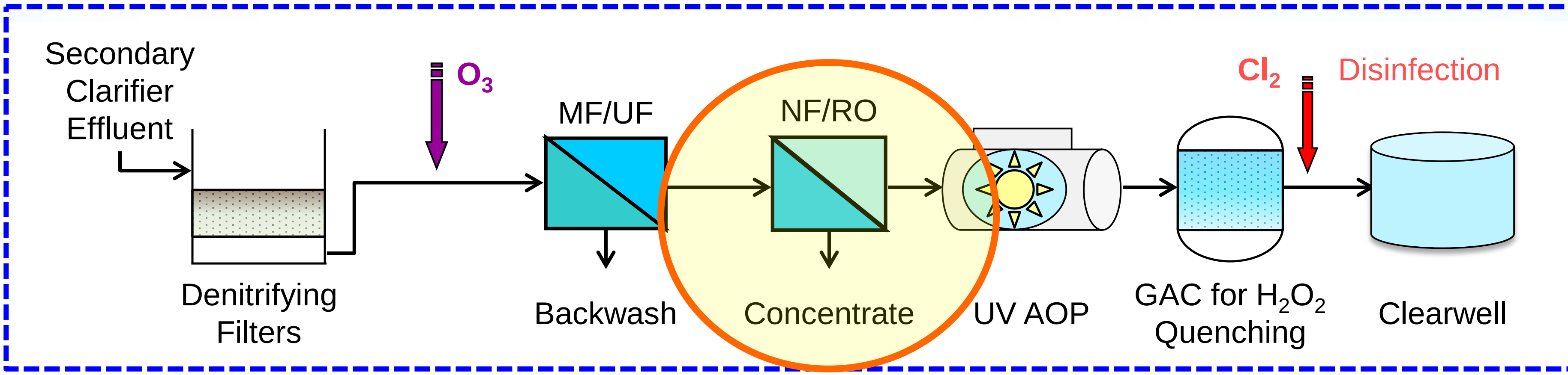
TCEQ has not awarded pathogen removal credit to RO…

Desalination

APWTP



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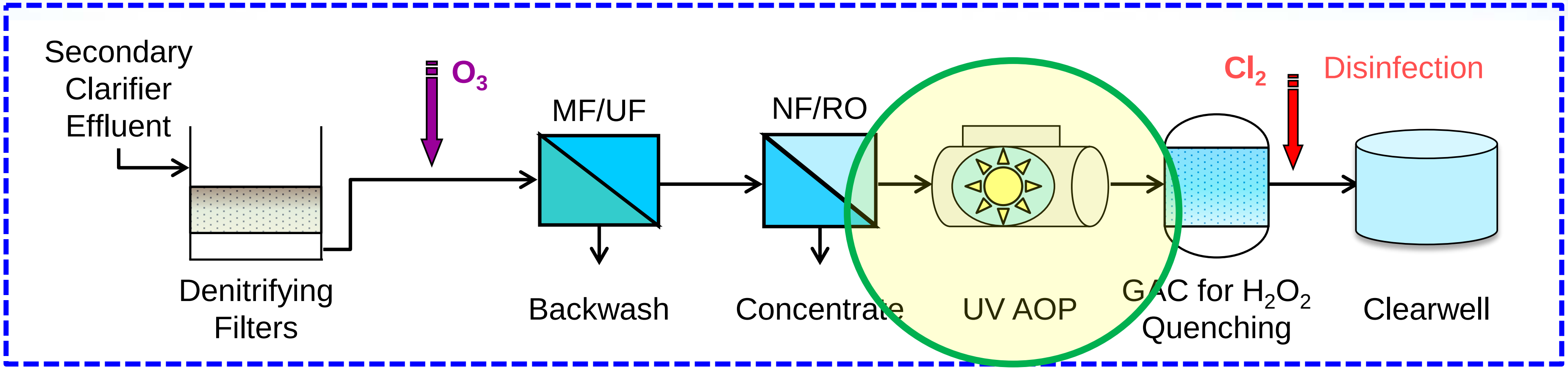
Remove DBP precursors (TOC, bromide, etc.)	Minimize DBP formation
Remove DBPs (NDMA, bromate, TTHMs, HAAs…)	Maintain regulatory compliance

…but public health protection is independent of credit

UV Disinfection / Advanced Oxidation

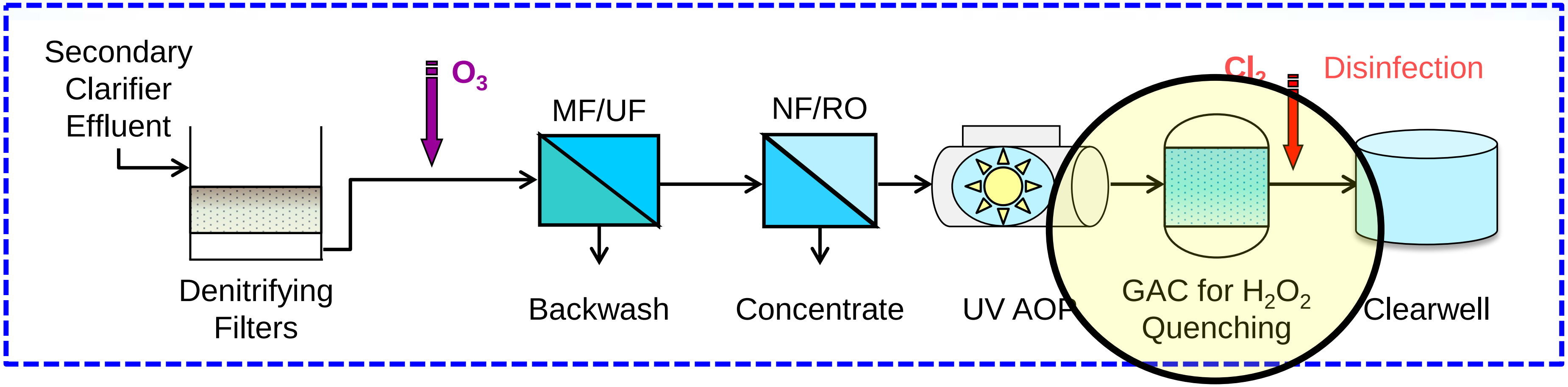
APWTP



Objective(s)	Benefit(s)
Achieve 1.2-log reduction of NDMA	Protect public health
Achieve 0.5-log reduction of 1,4-dioxane	Protect public health
Maximize inactivation of pathogens	Protect public health / achieve compliance
Reduce emerging contaminants	Provide unquantified (yet) health benefit

Granular Activated Carbon

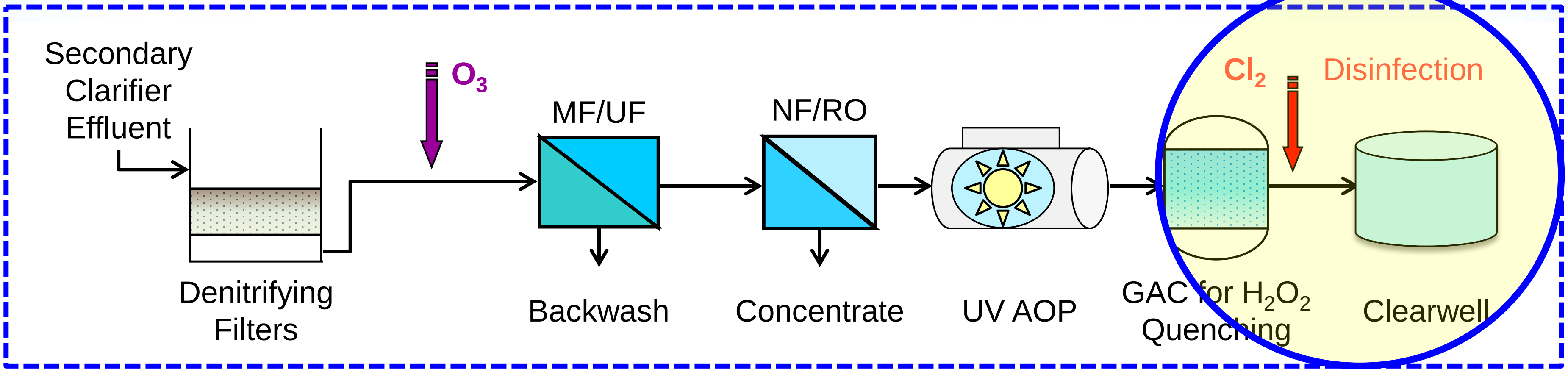
APWTP



Objective(s)	**Benefit(s)**
Quench peroxide	Control oxidation
Remove DBPs	Maintain regulatory compliance
Remove emerging contaminants	Provide unquantified (yet) health benefit
Provide an additional pathogen barrier	Protect public health

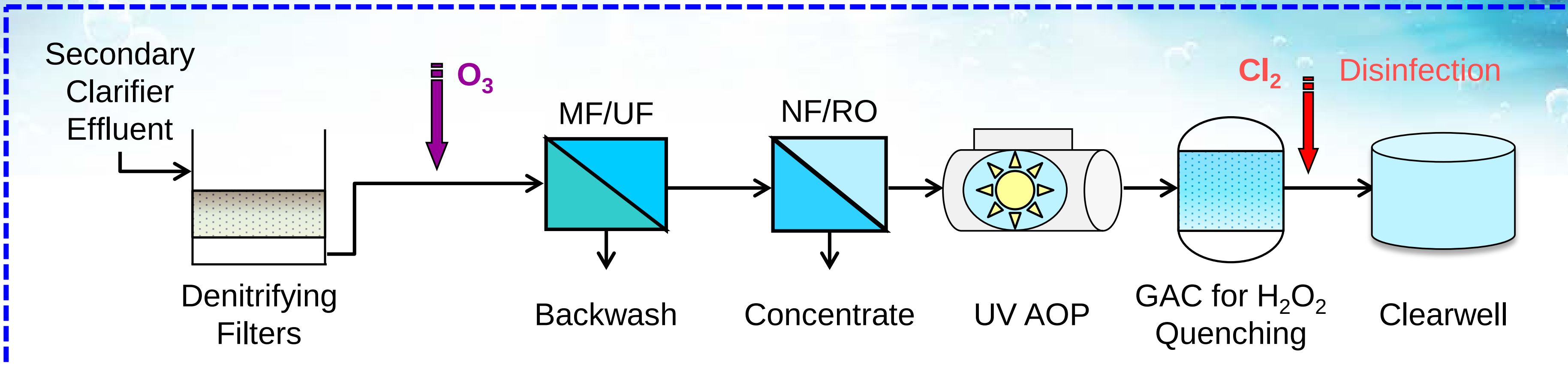
Chemical Disinfection

APWTP



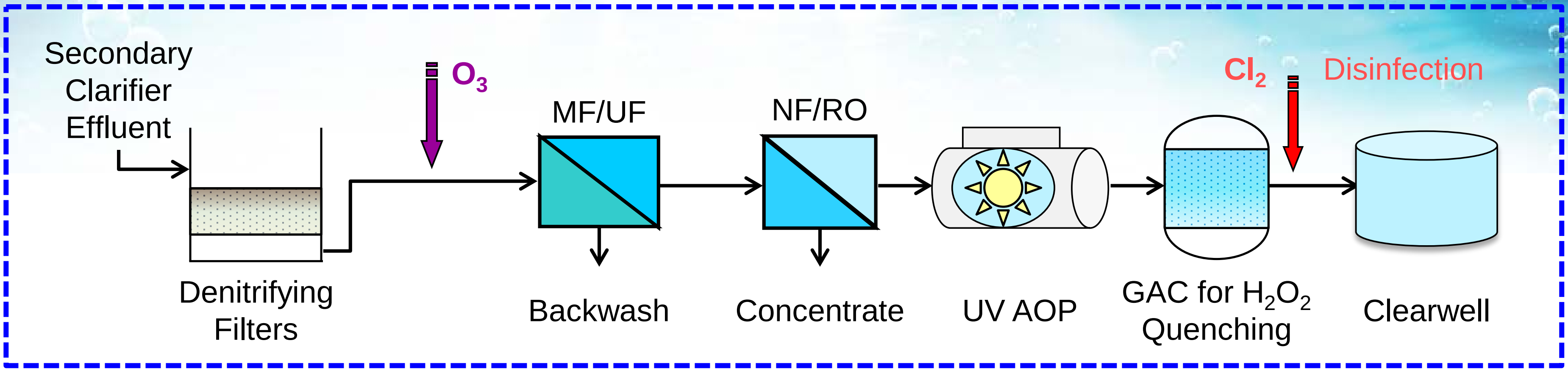
Objective(s)	Benefit(s)
Achieve 3.0-log *Giardia* inactivation	Protect public health / achieve compliance
Achieve 4.0-log virus inactivation	

Microbial Barriers



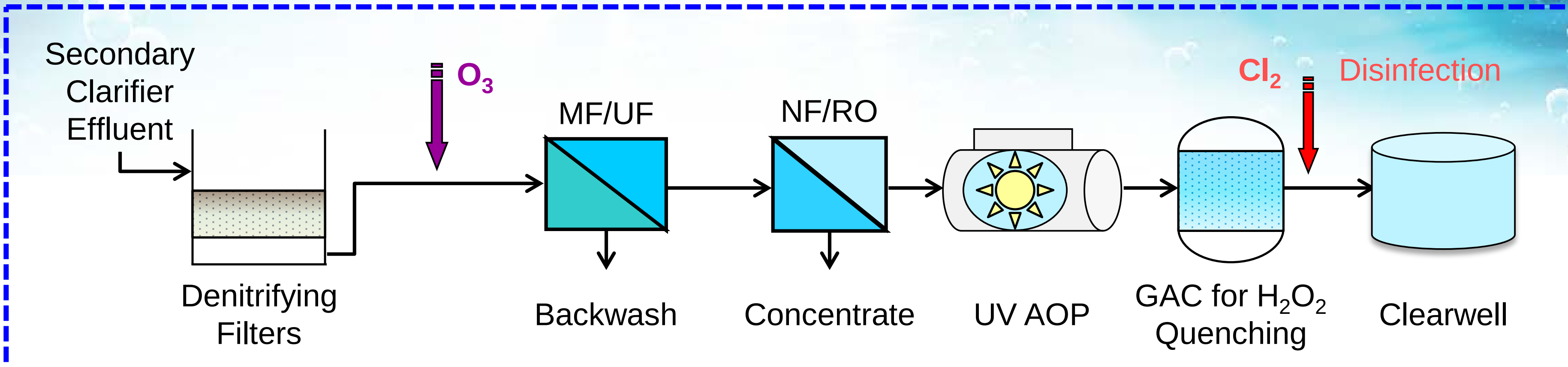
Unit Process	Anticipated Log Removal / Inactivation Credits		
	Crypto	*Giardia*	Viruses
Denitrifying Filters	0	0	0
MF/UF	4	4	0-1
NF/RO	0-2	0-2	0-2
UV AOP	4-6	4-6	4-6
GAC	0	0	0
Cl_2	0	3	4
Total	8-12	11-15	8-13

Microbial Barriers



Unit Process	Anticipated Log Removal / Inactivation Credits		
	Crypto	*Giardia*	Viruses
Denitrifying Filters	0	0	0
MF/UF	4	4	0-1
NF/RO	0-2	0-2	0-2
UV AOP	4-6	4-6	4-6
GAC	0	0	0
Cl_2	0	3	4
Total	8-12	11-15	8-13
Treatment Objective	< 3.0×10^{-5} oocysts/L	< 7.0×10^{-6} cysts/L	< 2.2×10^{-7} MPN/L

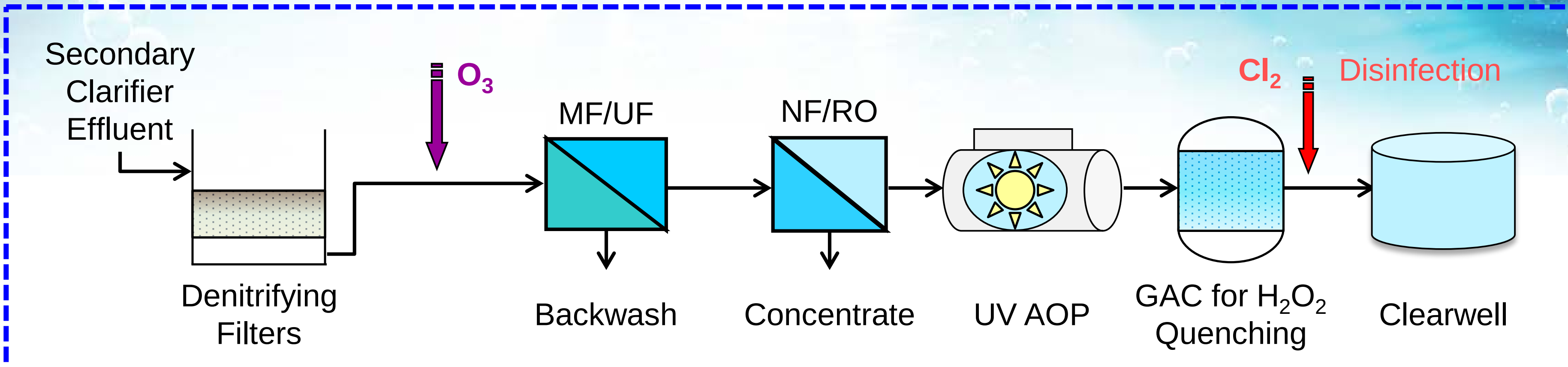
Microbial Barriers



Unit Process	Anticipated Log Removal / Inactivation Credits		
	Crypto	*Giardia*	Viruses
Denitrifying Filters	0	0	0
MF/UF	4	4	0-1
NF/RO	0-2	0-2	0-2
UV AOP	4-6	[illegible]	4-6
GAC	0	0	0
Cl_2	0	3	4
Total	8-12	11-15	8-13
Treatment Objective	**< 3.0 x 10^{-5} oocysts/L**	**< 7.0 x 10^{-6} cysts/L**	**< 2.2 x 10^{-7} MPN/L**

Based on risk of one infection
In 10,000 people per year

Microbial Barriers



Unit Process	Anticipated Log Removal / Inactivation Credits		
	Crypto	***Giardia***	**Viruses**
Denitrifying Filters	[redacted]	[redacted]	[redacted]
MF/UF	[redacted]	[redacted]	[redacted]
NF/RO	[redacted]	[redacted]	[redacted]
UV AOP	[redacted]	[redacted]	[redacted]
GAC	[redacted]	[redacted]	[redacted]
Cl_2	[redacted]	[redacted]	[redacted]
Total	8-12	11-15	8-13
Projected Requirement	**5**	**7**	**8**

Anticipated based on Bustamante WWTP secondary effluent concentrations

Next Steps

Next Steps…

Next Steps… For the Project

- ✓ Feasibility assessment
- ✓ Concept development
- Pilot testing
- Preliminary design
- Detailed design
- Construction

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Nine (9) month pilot test program to begin in April

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Some elements of design may be conducted concurrent with piloting

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Next Steps… For the Industry

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Next Steps… For the Industry

Pipe-to-pipe
DPR is coming

Advanced Purified Water Treatment Plant (APWTP)

Next Steps… For the Industry

…to Texas

Next Steps… For the Industry

…and California?

Next Steps… For the Industry

"Water should not be judged by its history,

but by its quality."

Dr. Louis van Vuuren,

National Institute of Water Research, South Africa (2005)

Questions?

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