Overview of the Texas Direct Potable Reuse Resource Document
Introduction

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Agenda

- Background
  - Definition of DPR
  - Project goals and participants
  - Overview of project scope
- Chapter-by-chapter highlights
Definition of Direct Potable Reuse

“The introduction of advanced-treated reclaimed water either directly into the potable water system or into the raw water supply entering a water treatment plant.”
Project Goals

- Develop a resource document for DPR that can be used by
  - Public Water Systems
  - Agencies
  - Consultants
  - Anyone who wants to know!

- Provide information that is technically sound and promotes safe and practical implementation of DPR in Texas
Project Sponsors

- City of College Station
- San Antonio Water System
- Upper Trinity Water Quality Compact
- Brazos Valley Groundwater Conservation District
- City of Houston
- Tra
- El Paso Water Utilities Public Service Board
- Irving Texas
- Fort Worth
- Lewisville
- Lubbock Texas
- Water Reuse Texas
Planned or Implemented DPR Projects in Texas

- Colorado River Municipal Water District at Big Spring
- Wichita Falls*
- El Paso
- Laguna Madre Water District
- San Angelo
- Brownwood**

*No longer in operation
**Currently on hold
Multiple Barriers for DPR

- Wastewater Treatment
- Advanced Water Treatment
- Performance Monitoring & Operations
- Engineered Storage
- Blending
- Water Treatment
- Pilot Testing/Validation
- Source Control

Multiple Barriers for Direct Potable Reuse
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<th>Title</th>
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<tbody>
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<td>Introduction</td>
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<td>Chapter 2</td>
<td>Relevance of Chemical Contaminants of Concern in Texas</td>
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<td>Chapter 3</td>
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<td>Chapter 8</td>
<td>Regulatory and Legal Considerations for DPR in Texas</td>
</tr>
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<td>Chapter 9</td>
<td>Public Outreach Programs for Potable Reuse Projects</td>
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</tbody>
</table>
Chapter 1: Introduction

- Project background and drivers for DPR in Texas
- Purpose of document
- Structure of document
Chapter 2: Relevance of Chemical Contaminants of Concern in Texas

- What are COCs and CECs?
- Summary of statewide water quality trends
  - Comparison to standards and advisory levels
- Review of state of analytical technology
- Suggested monitoring framework for utilities interested in pursuing DPR
  - Indicators and surrogates
2.1 Introduction

Water quality and the safety of drinking water is a primary focus for any direct potable reuse (DPR) project. For this document, a number of terms are used to discuss water quality, including chemical, compound, contaminant, and constituent, which are defined in the glossary. Two terms will primarily be used throughout the document: (1) constituent, which is used to describe a chemical or compound, and (2) contaminant, which is any physical, chemical, biological, or radiological substance or that has an adverse effect on air, water, or soil substance (often also called pollutants).

When considering DPR projects, pathogens, contaminants of concern (COCs) and constituents of emerging concern (CECs) present in the originating wastewater (source water for DPR treatment schemes) and treated reclaimed water should be evaluated. The objective would be to determine if and what treatment or management strategies may be required to produce a raw source water for further treatment at a water treatment plant.

What are COCs and CECs?

**Contaminants of Concern (COCs) are:**

- Any substance that has an adverse effect on human health that is regulated in drinking water or under consideration for regulation in Texas or at the national level.
- A substance that may not pose a health risk, but that can inform treatment process effectiveness and maintenance.

**Constituents of Emerging Concern (CECs) are:**

- Chemicals or compounds not regulated in drinking water or reclaimed water and/or not routinely monitored. They may be candidates for future regulation depending on their ecological toxicity, potential human health effects, public perception, and frequency of occurrence in environmental media (Lazorchak and others, 2008).
- Constituents that have been present in the environment for a long time, but for which analytical or health data have only recently become available (NRC, 2012).
State Water Quality Trends

Figure 2-1: Total dissolved solids concentrations in Texas groundwater.

Figure 2-2: Texas total dissolved solids (TDS) surface water quality standards and secondary drinking water standards.
Key Questions to Ask when Developing a Monitoring Program

- Has TCEQ approved the monitoring program?
- Is sample size large enough to provide adequate statistical relevance?
- Does program properly capture spatial and temporal variability?
- Are grab or composite samples more appropriate?
**Indicator and Surrogate Concept**

- **Indicators**
  Individual constituents that represent specific physicochemical and biodegradable characteristics of a family of constituents.
  
  *Examples*: caffeine, sucralose, N,N-Diethyl-meta-toluamide (DEET)

- **Surrogates**
  Bulk constituents used to evaluate the performance of individual treatment processes.
  
  *Examples*: total organic carbon, ultraviolet irradiation (UV)
<table>
<thead>
<tr>
<th>Constituent</th>
<th>Rationale</th>
<th>Monitoring Trigger Threshold (ng/L)</th>
<th>Reporting limit (ng/L)</th>
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<tr>
<td>Total trihalomethanes (THMs)</td>
<td>Health</td>
<td>80,000</td>
<td>1,000</td>
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<td>Haloacetic acids (HAA5)</td>
<td>Health</td>
<td>60,000</td>
<td>1,000</td>
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<tr>
<td>N-Nitrosodimethylamine (NDMA)</td>
<td>Health</td>
<td>10</td>
<td>2</td>
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<td>Perfluorooctanoic acid (PFOA)</td>
<td>Health</td>
<td>400</td>
<td>10</td>
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<tr>
<td>Perfluorooctane Sulfonate (PFOS)</td>
<td>Health</td>
<td>200</td>
<td>10</td>
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<tr>
<td>Bromate</td>
<td>Health</td>
<td>10,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Perchlorate</td>
<td>Health</td>
<td>15,000</td>
<td>1,000</td>
</tr>
<tr>
<td>1,4-Dioxane</td>
<td>Health</td>
<td>1,000</td>
<td>100</td>
</tr>
<tr>
<td>17b-Estradiol</td>
<td>Health</td>
<td>&lt;1</td>
<td>0.9</td>
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<tr>
<td>Atenolol</td>
<td>Health/Performance</td>
<td>4,000</td>
<td>100</td>
</tr>
<tr>
<td>Tris(2-chloroethyl)phosphate (TCEP)</td>
<td>Health/Performance</td>
<td>5,000</td>
<td>100</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Performance</td>
<td>800,000</td>
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<tr>
<td>Gemfibrozil</td>
<td>Performance</td>
<td>750,000</td>
<td>50</td>
</tr>
<tr>
<td>Iopromide</td>
<td>Performance</td>
<td>150,000,000</td>
<td>100</td>
</tr>
<tr>
<td>Meprobamate</td>
<td>Health/Performance</td>
<td>200,000</td>
<td>100</td>
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<tr>
<td>N,N-Diethyl-meta-toluamide (DEET)</td>
<td>Performance</td>
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<tr>
<td>Primidone</td>
<td>Performance</td>
<td>10,000</td>
<td>10</td>
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<tr>
<td>Sucralose</td>
<td>Performance</td>
<td>150,000,000</td>
<td>100</td>
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<tr>
<td>Triclosan</td>
<td>Performance</td>
<td>2,100,000</td>
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<tr>
<td>Surrogate Parameter</td>
<td>Unit processes</td>
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<tr>
<td>-----------------------------------------------------------</td>
<td>------------------------------------------------------</td>
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<tr>
<td>Total organic carbon (TOC) or dissolved organic carbon (DOC)</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<td>UV absorbance (254 nm)</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<tr>
<td>Fluorescence indices/ratios</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<tr>
<td>Total dissolved solids (TDS)/electrical conductivity</td>
<td>RO, NF</td>
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<tr>
<td>Boron (surrogate for NDMA)</td>
<td>RO, NF</td>
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<td><strong>Aesthetics</strong></td>
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<tr>
<td>Temperature</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<td>Color (436 nm)</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<tr>
<td>Odor</td>
<td>RO, NF, GAC, PAC, ozone, AOP</td>
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<td>Hardness</td>
<td>RO, NF</td>
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Suggested Monitoring Framework

Phase 1: Initial Assessment
- Begins prior to or during piloting and continues through initial startup
- Meet with the TCEQ to discuss project goals and monitoring requirements
- Identify occurrence of key indicators and surrogates in reclaimed water (can begin prior to piloting)
- Determine treatment effectiveness (during pilot phase)
- Define initial project-specific performance indicators and surrogates to monitor in subsequent phases.

Phase 2: Baseline Monitoring Program
- Begins following initial setup and continues for 3 years
- Assess and refine selection of indicators and surrogates

Phase 3: Standard Operating Monitoring Program
- Begins following baseline monitoring and continues through the life of the project
- Includes monitoring of indicators and surrogates identified during previous monitoring phases
- May be adjusted as project conditions are changed
Chapter 3: Water Quality Performance Targets

- Discussion of constituents of concern
  - Pathogens and chemicals
- Approaches to development of pathogen targets
## Basis of Pathogen Targets

**WateReuse Research Foundation Project 11-02**
- Use EPA $10^{-4}$ risk level in drinking water

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Virus</th>
<th>Cryptosporidium</th>
<th>Giardia</th>
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<tr>
<td>Raw wastewater</td>
<td>IU/L$^a$</td>
<td>$10^5$</td>
<td>$10^5$</td>
<td>$10^5$</td>
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<tr>
<td>Drinking water goal</td>
<td>IU/L</td>
<td>$2 \times 10^{-7}$</td>
<td>$3 \times 10^{-5}$</td>
<td>$6.8 \times 10^{-6}$</td>
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<tr>
<td>Ratio</td>
<td>-</td>
<td>$5 \times 10^{11}$</td>
<td>$3 \times 10^{9}$</td>
<td>$1.5 \times 10^{10}$</td>
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<tr>
<td>Log removal</td>
<td>-</td>
<td>12</td>
<td>10</td>
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</table>

$^a$ IU/L = infectious units per liter
Pathogen Targets

Technical Team Recommendations
– Base on WRRF Project 11-02

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Cryptosporidium</th>
<th>Giardia</th>
<th>Virus</th>
<th>Total Coliform</th>
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<tbody>
<tr>
<td>log₁₀ removal</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>9</td>
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</table>

log₁₀ removal between RAW wastewater and treated drinking water
### Pathogen Targets

#### TCEQ Baseline Pathogen Targets

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Cryptosporidium</th>
<th>Giardia</th>
<th>Virus</th>
<th>Total Coliform</th>
</tr>
</thead>
<tbody>
<tr>
<td>log$_{10}$ removal</td>
<td>5.5</td>
<td>6</td>
<td>8</td>
<td>--</td>
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</tbody>
</table>

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**Diagram:**

1. **Raw WW** → **Secondary/Tertiary Treatment** → **Advanced Water Treatment** → **Conventional Water Treatment** → **Community**

*log$_{10}$ removal between TREATED wastewater and treated drinking water*
Chemical Targets and Aesthetics

- Chemical targets
  - MCLs
  - Indicators and Surrogates from Chapter 2

- Aesthetics
  - Color, odor, etc.
  - Consistency with existing supplies
Chapter 4: Enhanced Source Control

- Summary of federal pretreatment requirements
- Suggested enhanced program elements
Source Control (SC) vs. Pretreatment (PT)

- More than Federal or State PT Programs

- Managerial and operational barriers to:
  - Eliminate or control the discharge of POCs to wastewater that can be difficult to treat and may impair the final quality of the treated water intended for DPR
Not Every POTW is Required to Have a PT Program

- TPDES Permit
  - Approved program if flow > 5 mgd, IUs that could cause pass through or interference, one or more CIUs, other criteria

- Non-TPDES permit (TLAP)
  - Case-by case (only certain PT program elements)

- Program gaps or no program be proactive!
Keep in Mind Effectiveness

- You can measure pollutant in POTW’s influent and collection system and . . .
- Can
  - Identify a source or group of sources that account for a majority of the loading
  - The identified loading is controllable
  - The loading is > pollutant reduction needed
- Is the source within the jurisdiction of the POTW to control?
  - Yes: Industries and businesses
  - No: residential sources (address thru outreach and voluntary behavior changes)
  - No: commercial products (restricted on a local, regional, statewide, or national basis), low level radioactive wastes (voluntary)
What Does Enhanced SC Look Like?
The Basics

- Legal Authority
- Procedures
- Funding
- Local Limits
- Enforcement Response Plan
- IU List
- No All Federal Prohibitions, Standards, etc.
Enhanced SC Recommendations - Consider

- **Tailoring** the program to your service area and treatment system
- Ensuring you have **sufficient legal authority** to take whatever actions are needed to protect your DPR project
- Developing and maintaining a frequently updated **comprehensive inventory** – IUs and POCs
- Developing **comprehensive local limits** that consider a broader spectrum of regulated (MCLs) and non-regulated constituents
Enhanced SC Recommendations - Consider

- Ensuring that you have **effective IU permits** that regulate and reduce the discharge of POCs
- Using **alternative control mechanisms** such as BMPs or self-certification for zero discharge of pollutants (radiator shops, dry cleaners, etc.)
- Creating **comprehensive monitoring programs** that address POCs for DPR
- Developing **rapid response plans** that can identify and respond to discharges of POCs
Enhanced SC Recommendations - Consider

- Conducting outreach to industries and public (stewardship programs, compliance assistance, proper disposal)
- Developing a communication plan between the wastewater & AWT operations and source control to respond to industrial “incidents” and changes in water quality
- Developing MOAs between POTW and RW producer so that appropriate source control actions can be taken if necessary to protect DPR water quality
Chapter 5: Treatment Strategies

- Importance of secondary/tertiary treatment
- Summary of available advanced treatment technologies and log removal capabilities
- Potential treatment schemes
The 4 “R’s” of Treatment for DPR

- Redundancy
  \( f(\# \text{ of barriers targeting a contaminant}) \)

- Robustness
  \( f(\text{treatment process diversity}) \)

- Resilience
  \( f(\text{failure response protocols}) \)
Sample Treatment Schemes

Membrane-based treatment
(17/17/13/20)
(11/11/8)

Ozone/BAC- based treatment
(12/14/13/17)
(10/11/12)

Brine concentrate - can be expensive!

Targets: Crypto/giardia/virus/total coliform
10/10/12/9 (WRRF 11-02)
5.5/6/8/- (TCEQ)
What is Engineered Storage?

- A constructed storage facility that provides a safety factor in the form of response time to address acute risks from pathogens should a treatment system fail or operate below desired performance targets.

- See Project WRFF 12-06, *Guidelines for Engineered Storage for Direct Potable Reuse*
Other Treatment Issues

- DBP Management
  - THMs, HAAs
  - Bromate
  - NDMA

- Residuals Management

- Conventional treatment optimization and control

Source: www.lookhuman.com
## Treatment Scheme Comparative Costs

<table>
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<th>Capacity (MGD)</th>
<th>Treatment Scheme²</th>
<th>Capital Cost ($/MGD)</th>
<th>O&amp;M Cost ($/MGD)</th>
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<td></td>
<td>3</td>
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<td>10</td>
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<td>$1.42</td>
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Chapter 6: Quantitative Relative Risk Assessment Examples

- Overview of risk assessment process
  - Carcinogenic and non-carcinogenic risk
  - Focus on chemicals (not pathogens)
- Benefits of QRRAs
- Summary of 2 case study examples
QRRA

- Identify detected chemicals
- Toxicity assessment
- Exposure assessment
  - Relative – not absolute risk since absolute exposure problematic
- Characterize health risks
WHY do a QRRA?

1. MCL Comparisons: Varying risk levels, technical & cost considerations

2. Epidemiology Studies: Cost, sensitivity, confounding factors, exposure

3. Conventional Risk Assessments: Issues w/ exposure
Case Study Treatment Schemes

Case Study #1: Non-RO AWTF/enhanced WTP
- Secondary/Tertiary Treatment
- MF/UF
- Ozone
- BAC
- Chlorine
- Engineered Storage (Optional)
- Water Treatment Plant

+ enhanced water treatment (ozone/BAC)

Case Study #2: RO AWTF/Conventional WTP
- Secondary/Tertiary Treatment
- MF/UF
- Reverse Osmosis
- UV/AOP
- Stabilization
- Engineered Storage (Optional)
- Water Treatment Plant
Non-Carcinogenic Risk Results

Cumulative Hazard Index >1: Potential Adverse Health Effects
Cumulative Hazard Index < 1: No Potential Adverse Health Effects

No constituent > MCL

Other
Flouride
Nitrate

CS1- No Project
CS1- DPR (Ozone/BAC)
CS2- No Project
CS2- DPR (RO)
Carcinogenic Risk Results

No constituent > MCL or Advisory Level

7.3 E-07
## CEC Risk Exemplar Results

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<thead>
<tr>
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<th>Case Study 1</th>
<th>Case Study 2</th>
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<tr>
<td></td>
<td>No Project Alternative</td>
<td>DPR Alternative</td>
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<tr>
<td># CECs present &gt; MRL</td>
<td>32</td>
<td>46</td>
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<tr>
<td>MOS Range</td>
<td>1.6 – 1.0E10</td>
<td>0.9 – 5.9E10</td>
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<tr>
<td># CECs with MOS 1-10</td>
<td>1</td>
<td>1</td>
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<tr>
<td>CECs with MOS 1-10</td>
<td>Quinoline</td>
<td>Quinoline</td>
</tr>
</tbody>
</table>

<sup>a</sup> Not detected in source water; found in secondary effluent but removed by RO
QRRA Practical Applications for DPR

- Assess short-term drought mitigation vs. long-term water supply
- Assist with decisions on the need for pilot testing
- Assist with decisions on DPR treatment components
- Modify/tailor monitoring to collect data for most relevant contaminants
QRRA Practical Applications for DPR

- Specific source control and/or treatment options:
  - Where the relative risk may increase over time or
  - Reaches a level of potential concern

- Inform the public about the safety of DPR as part of public outreach
Chapter 7: Pilot and Bench-Scale Testing

Pilot- and Bench-Scale Testing for Direct Potable Reuse Treatment Studies

In This Chapter
- Key considerations for Direct Potable Reuse treatment
- Status for developing testing protocols
- Pilot and bench-scale testing protocol outlines
- Example test protocols
- Preliminary assessment of probable test study costs

Road Map
1. Introduction
2. Reference of Chemical Contaminants of Concern in Texas
3. Water Quality Performance Targets for Direct Potable Reuse
4. Enhanced Source Control for Direct Potable Reuse
5. Treatment Strategies for Direct Potable Reuse
6. Chemical Quantitative Risk Assessment Examples
7. Pilot- and Bench-Scale Testing for Direct Potable Reuse Treatment Studies
8. Regulatory and Legal Considerations for Direct Potable Reuse in Texas
9. Public Outreach Programs for Potable Reuse Projects

Alan Davis, P.E.

Chris Boyd, Ph.D., P.E.
Chapter 7: Pilot and Bench-Scale Testing

- Reasons for performing testing studies
- Treatment study considerations
- Treatment study tasks
- Pilot- and bench-scale testing protocol outlines and sample protocols
  - Sample protocols for RO-based treatment and ozone/BAC-based treatment
- Probable costs for treatment testing
Bench & Pilot Testing

• **Pilot-scale treatment studies:**
  - Smaller than full-scale
  - Large enough to behave like full-scale
  - Often use portable treatment units that can be located near the source water.
  - Continuous testing over longer period
  - Used to evaluate different treatment processes or different vendors of the same process.
Bench & Pilot Testing

- **Bench testing:**
  - Typically performed in a laboratory
  - Used to evaluate performance characteristics of treatment processes that can be represented adequately at a laboratory scale.
  - Discrete samples of the water to be treated are typically transported to the laboratory for testing.
Why are we testing?

Regulatory

- Satisfy state and federal pilot- and bench-scale testing requirements

Design

- Establish design criteria and operating procedures
- Evaluate equipment performance
- Optimize treatment
- Determine the influence of a unit process on downstream unit processes
- Evaluate opportunities to reduce operation and maintenance costs
- Provide input to utility's source control program to identify contaminants that are not effectively treated or that negatively impact treatment performance
Why are we testing?

<table>
<thead>
<tr>
<th>Treatment Efficiency</th>
<th>Procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assess treatment performance relative to established water quality goals</td>
<td>• Obtain test data on multiple manufacturers and/or process variations for the equipment selection and bid phases of the full-scale project</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide hands-on training to plant operators and staff</td>
</tr>
<tr>
<td>• Provide an opportunity for research and development</td>
</tr>
<tr>
<td>• Provide an opportunity for public outreach to demonstrate the technology</td>
</tr>
</tbody>
</table>
### Treatment Schemes and Testing Requirements

<table>
<thead>
<tr>
<th>Treatment Scheme No.</th>
<th>AWT Process</th>
<th>Example Test Plan</th>
<th>Feed Source</th>
<th>Typical Testing Consideration&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Secondary/Tertiary</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>MF/UF</td>
<td>Pilot-Scale</td>
<td>Secondary/Tertiary</td>
<td>R,D,T,P,O</td>
</tr>
<tr>
<td></td>
<td>RO</td>
<td>Pilot-Scale</td>
<td>MF/UF</td>
<td>R,D,T,P,O</td>
</tr>
<tr>
<td></td>
<td>UV/AOP</td>
<td>Bench-Scale</td>
<td>RO</td>
<td>D,T,P</td>
</tr>
<tr>
<td></td>
<td>Stabilization</td>
<td>Bench-Scale</td>
<td>RO</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>WTP</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

R = Regulatory  D = Design  T = Treatment Efficiency  O = Other
## Treatment Schemes and Testing Requirements

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<th>Treatment Scheme No.</th>
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<th>Typical Testing Consideration¹</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>Secondary/Tertiary</td>
<td>Pilot-Scale</td>
<td>Secondary/Tertiary</td>
<td>R, D, T, O</td>
</tr>
<tr>
<td></td>
<td>Ozone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BAC³</td>
<td>Pilot-Scale</td>
<td>Ozone</td>
<td>D, T, O</td>
</tr>
<tr>
<td></td>
<td>UV</td>
<td>Bench-Scale</td>
<td>BAC</td>
<td>D, T, P</td>
</tr>
</tbody>
</table>

¹ R = Regulatory  D = Design  T = Treatment Efficiency  O = Other
Costs

- Typical Treatment Study Cost Items
  - Site preparation
  - Equipment shipping
  - Equipment rental
  - Vendor services
  - Engineering fees
  - Water quality sampling
  - Internal operating costs
## Costs

<table>
<thead>
<tr>
<th>Process</th>
<th>Test Scale</th>
<th>Minimum Test Duration¹</th>
<th>Assumed No. of Vendors/OEMs</th>
<th>Preliminary Budgetary Planning Cost²</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAC</td>
<td>Pilot-scale*</td>
<td>3 months</td>
<td>---</td>
<td>$100,000 - $150,000</td>
</tr>
<tr>
<td>MBR</td>
<td>Pilot-scale</td>
<td>3 months</td>
<td>3</td>
<td>$400,000 - $550,000⁴</td>
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<tr>
<td>MF/UF</td>
<td>Pilot-scale</td>
<td>3 months</td>
<td>3</td>
<td>$350,000 - $500,000</td>
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<tr>
<td>Ozone</td>
<td>Pilot-scale*</td>
<td>3 months</td>
<td>1</td>
<td>$150,000 - $250,000</td>
</tr>
<tr>
<td>RO</td>
<td>Pilot-scale</td>
<td>3 months</td>
<td>3</td>
<td>$400,000 - $550,000</td>
</tr>
<tr>
<td>UV</td>
<td>Bench-scale</td>
<td>Single study</td>
<td>$25,000 - $45,000</td>
<td></td>
</tr>
<tr>
<td>UV/AOP</td>
<td>Bench-scale</td>
<td>Single study</td>
<td>$25,000 - $45,000</td>
<td></td>
</tr>
</tbody>
</table>

¹ Minimum Test Duration refers to the duration of the test period.
² Preliminary Budgetary Planning Cost is the estimated cost range for the process.

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1. Process evaluation sampling refers to sampling performed to monitor and assess treatment process performance.
2. Regulatory compliance sampling refers to sampling that may be required by the TCEQ to demonstrate that treatment process(es) meet drinking water standards.
Current regulatory framework for DPR

- Chapter 290
  - Source water approval
  - Innovative/alternative treatment process approval
    - Addressed on case-by-case basis
- Chapter 210
  - Used to authorize delivery of reclaimed water to advanced treatment facility
### Suggested Steps for Obtaining Regulatory Approval

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Initial meeting with TCEQ (Water Supply, Water Quality and Water Availability Divisions)** | • Discuss conceptual alternatives  
• Obtain information about subsequent regulatory process  
• Define anticipated pilot-testing and monitoring requirements |
| **Residuals management (Water Quality Division or Office of Waste)** | • Evaluate disposal requirements for treatment residuals  
• Submit application for discharge permit, deep well injection, or alternative disposal methodology to TCEQ (as needed)  
• TCEQ reviews application and requests additional information (as needed)  
• TCEQ issues draft permit and public notice (as needed)  
• TCEQ issues final permit |
| **Chapter 210 reclaimed water authorization (Water Quality Division)** | • Submit application for authorization to TCEQ (as needed)  
• TCEQ reviews application and requests additional information (as needed)  
• TCEQ issues reclaimed water authorization |
| **Exception request (Water Supply Division)** | • Submit exception request to TCEQ  
• TCEQ reviews application and requests additional information (as needed)  
• TCEQ establishes specific conditions pertaining to sampling, treatment, public notice and other activities associated with the request.  
• TCEQ issues approval of the exception. |
| **Pilot testing (Water Supply Division)** | • Develop pilot/bench testing plan  
• Submit testing plan to TCEQ  
• TCEQ reviews plan and requests additional information (as needed)  
• TCEQ issues approval of testing plan  
• Perform testing  
• Coordinate with TCEQ on approval of testing results and selection of treatment elements |
| **Construction approval (Water Supply Division)** | • Utility to submit plans and specifications prepared by a registered professional engineer  
• TCEQ reviews submittal and requests additional information (as needed)  
• TCEQ issues construction approval |
| **Startup approval (Water Supply Division)** | • Perform required testing at full scale facility and submit to TCEQ  
• TCEQ reviews submittal and requests additional information (as needed)  
• TCEQ issues approval to begin operation |
Chapter 9: Public Outreach Programs

- Lessons learned from existing DPR/IPR projects
- Available tools
- Suggested best practices
Key Tips for Public Outreach and Participation

- Provide compelling and accurate information on the water cycle
- Try to avoid technical jargon
- Proactively work with the media, educational institutions and others to broaden understanding about water
- Focus on creating trust with the community
- ... and more
Model Communication Plans for Increasing Awareness and Fostering Acceptance of Direct Potable Reuse

WateReuse Research Foundation Outreach Tools
Ongoing DPR Research Focus Areas

- Alternative treatment schemes
- Blending and storage needs
- Treatment operations and reliability
- Monitoring strategies
- Quality assurance
- Public education and communication
Questions?