Executive **Summary**

WATER ENVIRONMENT & REUSE FOUNDATION
WE&RF

An engineered storage approach for safe and reliable transition from indirect potable reuse to direct potable reuse

Guidelines for Engineered Storage for Direct Potable Reuse (Reuse-12-06)

The Central Issue

Direct potable reuse (DPR) has inherent risks that differ from treatment of traditional source waters and conventional indirect potable reuse (IPR). Specifically, in DPR there is less time to monitor process water quality and respond to water quality concerns. One basic fact that underlies all types of treatment process design, but has an especially significant impact on the implementation of DPR – Process failure is inevitable. The identification and/or response to that process failure is at the heart of the framework that determines requirements for treatment, monitoring, and engineered storage.

Context and Background

This project aims to support the transition from IPR to DPR by developing an approach to engineered storage that is safe, reliable, and practical. The environmental buffer, whether a groundwater basin or a surface water reservoir, provides a number of benefits, including contaminant removal, dilution and blending, and time to detect and respond to failures before final treatment and distribution. It also provides storage capacity to hold water during periods when production exceeds demand. Eliminating the environmental buffer for potable reuse thus requires replacement of the treatment, monitoring, and response time benefits.

The research evaluated how to replace the environmental buffer characteristic of IPR projects with engineered storage by examining current practices and existing research. The research was completed in three phases:

1. Gathering of performance data, mechanical reliability data, public outreach and perception issues/concerns, and utility perspectives on the value of the environmental storage buffer (ESB) from participating utilities.
2. Development of a framework for sizing ESBs.
3. Application of the framework to several utility case studies that developed treatment, monitoring, and ESB concepts for DPR projects envisioned by utility partners.

Based on these conceptual designs, planning-level costs were also developed. Public outreach and perception issues/concerns were studied by providing a short animation (*The Ways of Water*) to participants to provide information on methods of drinking water delivery and to help them understand the issues related to water reuse. A survey was then conducted to gain an understanding of the public's view of water reuse.

Ways of Water Animation.

Findings and Conclusions

For each unit process and its associated monitoring method, failure response time can be defined as the maximum possible time between when a failure occurs and the system has reacted such that the water produced by the process again meets water quality specifications (or is discarded). Under the proposed framework, the log removal values (LRVs) credited to any process are the minimum of the potential credit based on the actual process efficiency and the credit that can be confirmed bas on the sensitivity of the monitoring technique used. The framework is then expanded from the unit process to the whole treatment train.

The case studies highlight the balance of redundant treatment, monitoring (conventional and advanced), and the ESB. They illustrate the ability to safely implement DPR and do so cost effectively.

The research also suggests that informed public opinion emerges only with presentation of critically important contextual information. Once the public understands existing water management practices and their proven safety, they more readily embrace potable reuse. The message to water consumers should be simple: If water is from the tap, then it is safe, potable water.

Management and Policy Implications

For engineered storage to be practicable; its size must be kept to a minimum within the boundaries of what is safe and reliable. Finding this balance between failure response time, monitoring, and treatment was at the core of this project. The research provides a practical tool for addressing the transition from IPR to DPR, paving the way for the safe and cost-effective implementation of DPR projects in general.

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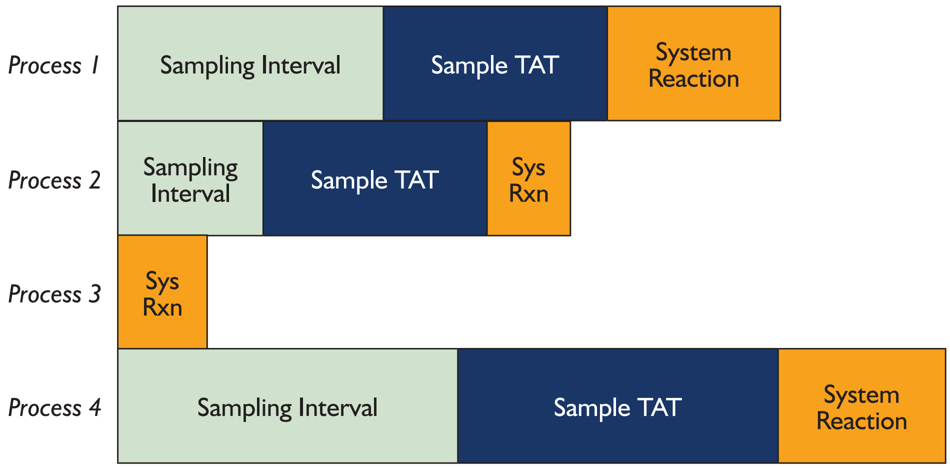

Treatment Train Failure Response Time.
The failure response time (FRT) of the treatment train is the maximum of all the individual process FRTs.
In this example, Process 4 has the longest FRT and therefore dictates the overall system FRT.

Related WE&RF Research

Project Title	Research Focus
Direct Potable Reuse: A Path Forward (WRRF-11-00)	Provides a general overview of current knowledge related to DPR and identification of the information that must develop to inform the public, public and private water agencies, and regulatory agencies of the feasibility of implementing DPR as a viable water supply management option.
Risk Reduction for Direct Potable Reuse (WRRF-11-10)	Identifies how risk reduction and response concepts developed in other industries (structural/bridge, aviation/NASA) can be adapted and applied to DPR. The results provide perspectives on how to consider risk management and an understanding of what engineering practices could be incorporated into the design, control, operation, and maintenance of advanced treatment systems.

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Singapore's Public Utility Board
Upper Occoquan Service Authority
West Basin Municipal Water District
Windhoek, Namibia (insight and guidance based upon their existing DPR facility)

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