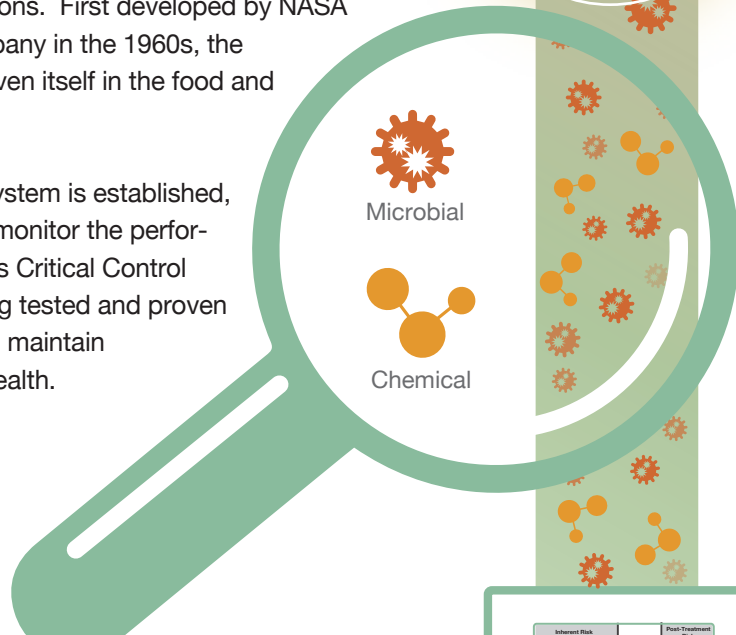


# Engineering Trust in Direct Potable Reuse

Higher contaminant levels in the feed water require direct potable reuse facilities to maintain rigorous health and safety protocols. **Hazen and Sawyer is working with the WaterReuse Research Foundation** to adapt the Hazard Analysis and Critical Control Point methodology to direct potable reuse (DPR) treatment and operations. First developed by NASA for the Pillsbury Company in the 1960s, the methodology has proven itself in the food and beverage industry.

Once the treatment system is established, operators constantly monitor the performance of the system's Critical Control Points (CCP), following tested and proven response protocols to maintain protection of public health.



Inherent Risk	Risk Mitigation-Treatment	Post-Treatment Risk
Microbial	UF, RO, UV, Chlorine	Rare, Low
Organic Chemical	UF, RO, UV, Chlorine	Rare, Low
Inorganic Chemical	UF, RO, UV, Chlorine	Rare, Low

Contaminant	Inherent Risk		Risk Mitigation-Treatment Treatment Barriers	Post-Treatment Risk	
	Likelihood	Risk		Likelihood	Risk
Microbial	Almost Certain	Very High	UF, RO, UV, Chlorine	Rare	Low
Organic Chemical	Almost Certain	Very High	UF, RO, UV, Chlorine	Rare	Low
Inorganic Chemical	Unlikely	Very High	UF, RO, UV, Chlorine	Rare	Low

## 1 Identify & Assess

### Events

Hazardous events that can cause spikes in contaminant concentrations, such as disease outbreaks (e.g., flu season) or accidental chemical discharges into the sewer system, are quantified.

### Contaminants

Chemical and microbial risks are identified from the sewershed. Typical sources include industrial, institutional, medical, and municipal discharges to the sewer.

### Water Quality Goals

Federal, State, and local regulations, as well as system-specific contaminants, combine to determine goals and the required treatment process.

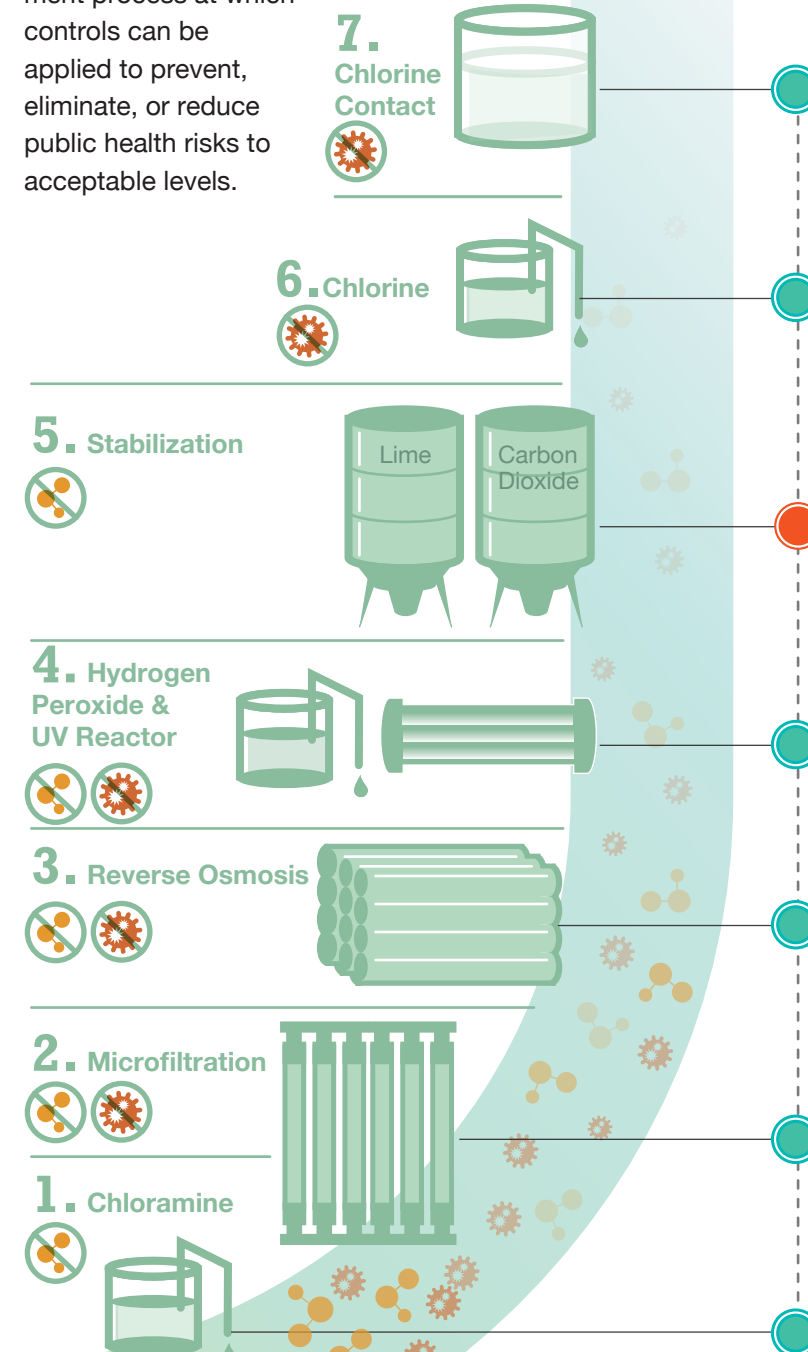
### Risk Register

Hazardous events and baseline conditions are used to confirm that the proposed DPR process and CCPs can manage public health risks.

Multiple barriers **remove** chemical and/or microbial containments

## 2 Critical Control Points

There are seven CCPs in this sample treatment process at which controls can be applied to prevent, eliminate, or reduce public health risks to acceptable levels.



## 3 Operations & Response

CCPs are monitored with process-specific sensors that return data to the operations staff. When a process monitor indicates "Alert" or "Critical" alarms, additional manual testing is triggered. A second Alert or Critical result triggers corrective action, as well as communications and incident recording procedures. Critical limit exceedance results in a process shutdown and immediate corrective action, ensuring continuous protection of public health.

### Sample Operations and Response protocol

