

# Evaluation of Virus Removal Capabilities of Membrane Bioreactor (MBR) Systems in a Full Scale Water Reclamation Facility

**Abstract:** A research study conducted in a full-scale MBR/UV disinfection system at Henderson Water Reclamation Facility to evaluate virus and other pathogenic organism rejection and inactivation efficiencies throughout MBR-UV system under various operating conditions. The study showed that membranes used in the MBR system were so efficient which completely removed bacteria (total and fecal coliform) and most of the viruses (Adenovirus, Norovirus GI and GII, human enterovirus) tested. Only a few occasions, the small viruses (MS-2 and Somatic Coliphage) were detectable in MBR effluent when MBR membranes were clean. Even under clean membrane conditions, the MBR system has shown nearly 2-log MS-2 and Somatic Coliphage removal. Virus remained in MBR effluent, if any, can be inactivated in the water distribution system via chlorination which provides a free chlorine CT of more than 6 mg-min/L which is adequate to get 4-log virus inactivation. Based on the results and free chlorine disinfection capability provided, the agency received 2-log pathogen credits for the MBR systems and eliminated use of UV disinfection system.



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**Professional Background:** Paul Swaim has more than 24 years' experience in the successful completion of water treatment and water reuse projects from process selection through startup. He serves as CH2M HILL's Deputy Global Service Leader for Drinking Water & Reuse and is responsible for leadership across the spectrum of drinking water treatment and reuse processes and services. A recognized international expert in UV disinfection and UV advanced oxidation processes (AOP) for drinking water and reuse applications including regulatory approval, design, construction, startup, and operations. Paul has served as senior reviewer and technical advisor for more than 30 UV projects, including key roles on projects totaling more than 1.4 BGD of capacity. His unmatched experience in delivering pioneering UV projects was developed through his role as project engineer for the first regulator-approved application of UV disinfection for drinking water in the U.S. (in Henderson, NV) to leading several of the largest drinking water UV disinfection projects in North America. His expertise has been built through working with regulators, leading detailed design, overseeing construction, performing equipment and validation testing, and completing UV system start-up and operation.