Brightwater wastewater treatment facility

**Application:** ZeeWeed* MBR used to achieve water reuse and safe discharge to a sensitive environment

**Current Operating Capacity:** Average daily flow of 31 MGD

**Location:** King County, Washington, USA

**Commissioned:** September 2011

**challenge**

King County’s Wastewater Treatment Division services about 1.4 million people in the Seattle, Washington area. Due to expanding population in the region, a new regional wastewater treatment facility, the Brightwater Wastewater Treatment Facility (WWTF), was required. As the Brightwater WWTF discharges treated effluent into Puget Sound, protection of the marine environment was a key factor in the selection of the treatment process for the plant. In addition, King County wanted to be able to produce Class A reclaimed water, allowing reuse of the treated wastewater for non-potable applications such as landscape or agricultural irrigation, heating and cooling, and industrial processing.

**solution**

During the initial predesign evaluation for the Brightwater WWTF, over 40 process technologies were considered. Of these, membrane bioreactor (MBR), and conventional activated sludge (CAS) treatment were selected for detailed evaluation. The detailed evaluation revealed that the MBR and CAS options would be nearly identical in capital cost, and that the MBR option would provide additional benefits that included:

- Production of high-quality effluent meeting Class A standards for reuse, which is seven to 10 times cleaner than effluent from a CAS system
- Reduction of TSS and BOD discharge to Puget Sound by 1,000,000 lbs each year
- Reduced earthwork and construction impacts
- Simplified odor control design for the plant
- Fully nitrified effluent, reducing oxygen demand in Puget Sound
- Positioning King County to cost-effectively address future regulations

MBR technology was selected for the Brightwater WWTF. The procurement process, which included an evaluated bid between two MBR suppliers, resulted in the selection of SUEZ to provide ZeeWeed MBR technology for the project.
When awarded in 2005, the Brightwater WWTF was the largest awarded MBR in the world and as of commissioning is the largest MBR operating in North America.

**process overview**

The Brightwater WWTF treatment process begins with preliminary treatment, including coarse screening, and grit removal. Following primary clarification, the wastewater passes through fine screens prior to entering the MBR. The biological treatment process includes both anoxic and aerobic zones, which will promote the removal of nitrogen from the wastewater, reduce aeration requirements, and improve the alkalinity of the system. The ZeeWeed membranes that form the basis of the MBR plant provide efficient solid/liquid separation, filtering out virtually all solid particles and even bacteria. The facility includes 10 parallel membrane trains, though initially only 8 trains will be populated, with each train containing 20 membrane cassettes to meet the current flow requirements.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Average daily flow</th>
<th>Max daily flow</th>
<th>Peak hourly flow</th>
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<tbody>
<tr>
<td>Designed</td>
<td>31 MGD (117,300 m³/d)</td>
<td>45 MGD (170,300 m³/d)</td>
<td>57 MGD (215,800 m³/d)</td>
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<tr>
<td>Operating</td>
<td>25.2 MGD (95,400 m³/d)</td>
<td>35 MGD (132,500 m³/d)</td>
<td>44 MGD (166,500 m³/d)</td>
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The modular nature of ZeeWeed membranes allows for simple expansion for future flows; two trains are anticipated to be added within five years, with the option for additional trains in the future. Downstream of membrane filtration, the treated water is disinfected with sodium hypochlorite.

The Brightwater WWTF incorporates a novel treatment strategy for large influent flows. Flow rates up to the MBR capacity are processed through conventional primary clarification and the MBR system. Peak flow rates above the capacity of the MBR, however, are diverted, treated simply with chemically-enhanced primary clarification, and then blended with the MBR permeate. This approach was selected in order to most cost-effectively meet secondary treatment requirements for the full peak flows through the plant.

**Carnation wastewater treatment plant**

An interesting aspect of the procurement process of this project was that King County combined the delivery of the Brightwater WWTF with the delivery of a smaller MBR plant, Carnation WWTP. MBR technology was selected also for Carnation WWTP, as this plant produces Class A reclaimed water that is utilized to enhance nearby wetlands. This smaller plant also served as a training and test site for the larger Brightwater plant. The Carnation WWTP has an average design flow of 0.39 MGD, and uses the same ZeeWeed membranes as the Brightwater plant. The Carnation WWTP [pictured below] started operation in May 2008, and a few months later was the recipient of the “Small Project of the Year” award from the WaterReuse Association.