Purified Water Technology Evaluation Project: Results, Findings, Next Steps

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Background and Project Need

As the eighth largest municipal utility in the United States, JEA provides electric, water, wastewater, and reclaimed water systems. It offers water services to a four-county area in northeast Florida with approximately 350,000 customers. Currently, the source of water is 100 percent groundwater. Regional groundwater resources will eventually reach their sustainable limit and JEA is planning for the future by evaluating a range of sustainable alternative water supplies.

Since 1999, JEA has diversified its water portfolio by investing heavily in development and expansion of a large reclaimed water system. It has ten reclaimed water production facilities with over 13,000 customers and a 33-mil-gal-per-day (mgd) production capacity.

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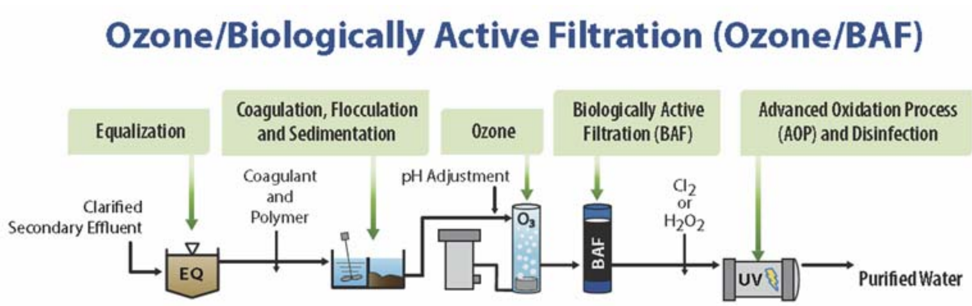

Figure 1. Ozone/Biologically Active Flitration Process

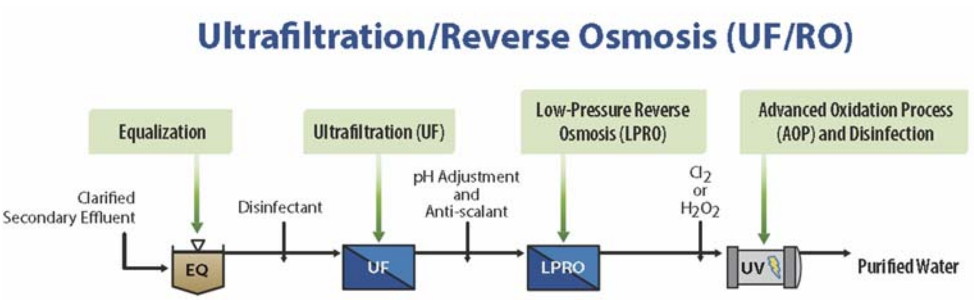

Figure 2. Ultrafiltration/Reverse Osmosis Process

Long-term plans are to continue to expand the reclaimed water system in areas of greatest growth, generally in southern Duval and northern St. Johns counties.

In addition to the development of a reclaimed water program, consumptive use permitting constraints reduced the allowable groundwater allocations in these same areas. One strategy to address these constraints was construction of two river crossings from the north side of the St. Johns River (where permit allocations were available) to the south grid area. These river crossings have the potential to transfer approximately 40 mgd of raw potable water.

While conservation, reclaimed water, and river crossings will address potable demands for the near future, meeting all long-term demands (greater than 20 years) will likely require additional alternative water supplies. In order to prepare for this potential situation, a purified water program was initiated that would treat reclaimed water to drinking water standards. The initial use of the purified water is anticipated to be for aquifer recharge, with an expectation of an offset to the consumptive use permit.

Figures 3 and 4. Purified Water Project Portable Trailers

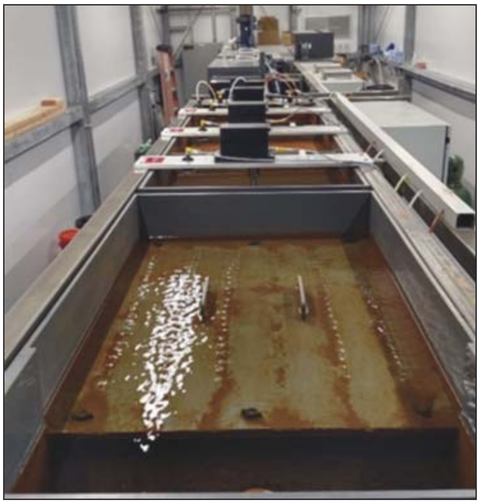

Figure 5. Coagulation/ Flocculation/Sedimentation

Figure 6. Biologically Active Filters

Figure 7. Ultrafiltration

Figure 8. Reverse Osmosis

Figure 9. Advanced Oxidation Process and Disinfection

Purified Water Technology Evaluation

A purified water program was developed that narrowed the potential sites using multiple screening criteria. Availability of reclaimed water and a range of potential feed water quality were two important factors in the selection of the Phase I project. Early in the project development, it was obvious that two of the leading technologies for potable reuse were membrane and biological processes. Both have been successful in particular situations, each with its own set of advantages and disadvantages.

There is confidence in the treatment capability of membrane processes, as their widespread usage has been proven and could likely meet treatment goals with a variety of different feed waters. Biological processes are generally less energy-intensive and do not have the concentrate disposal issues of membranes. The three-phase program was developed to first evaluate the different technologies before moving toward a demonstration study and a potential full-scale purified water plant.

A consultant was chosen to evaluate the two technologies at two different water reclamation facilities (WRFs). One of the facilities (Southwest WRF) serves generally residential and light commercial customers, while the second (Buckman WRF) includes industrial customers, landfill leachate, and biosolids from JEA's other WRFs.

The project team decided on two side-by-side portable treatment facilities for the Phase I technology evaluation project (Figures 3 and 4). The two treatment trains would have to be able to relocate from the first facility to the second.

An important part of the project was a source water characterization task in which sampling and analysis were performed on the source water at each WRF and the Trail Ridge Landfill (leachate) that is processed at the Buckman WRF. Laboratory analyses were conducted for regulated and unregulated constituents, including pharmaceuticals and personal care products, pesticides and herbicides, disinfection byproducts, terpenes and fragrances, and other miscellaneous trace organic compounds.

It was important to know what constituents were in the treatment feed system to measure the effectiveness of both technologies. Not surprisingly, a significant difference in the two source waters was total organic carbon (TOC) concentrations. The more-domestic source water contained approximately 8 mg/L of TOC, while the more-industrial source water contained approximately 15 mg/L of TOC.

The two treatment systems operated for approximately five months at each WRF. The biological system contained flocculation and sedimentation, ozone, biologically active filtration (BAF), and advanced oxidation. The equipment is shown in Figures 5, 6, and 9 and the process flow diagram is shown in Figure 1.

The second treatment system used ultrafiltration (UF), followed by reverse osmosis (RO) and advanced oxidation. The equipment is shown in Figures 7-9 and the process flow diagram is shown in Figure 2.

Along with a comparison of the two technologies, a testing plan was developed that included varying and stressing key treatment parameters/systems, while monitoring system performance. One of the key project treatment goals was Florida's groundwater injection requirements for TOC. Conditions that varied in the tests included coagulants and doses, clarification rates, ozone-to-TOC ratios, BAF column media and filtration rates, UF membrane manufacturers, UF and RO flux rates, and advanced oxidation chemicals.

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Treatment Process Results

In general, the results of both treatment processes met the project's water quality treatment goals. Significant investment was made in laboratory analytical tests for a large number of constituents (over 300 compounds). A key indicator of treatment effectiveness was TOC. The UF/RO treatment generally reduced TOC to nondetect, while the ozone/BAF was under, but close to, the goal of 3 mg/L at both facilities (2.6 and 1.6 mg/L).

Another important treatment parameter was disinfection and oxidation byproducts. Both treatment processes met the goals, with some N-Nitrosodimethylamine (NDMA) being detected in the UF/RO results, but well below the 10 ng/L goal (2.6 ng/L). Sucralose was evident from the ozone/BAF results at the facility with the more-domestic wastewater source water.

As mentioned, a large number of unregulated compounds were analyzed for, and the results indicated that many were below detection limits.

Next Steps: Demonstration and Public Engagement

The first-phase (technology evaluation) testing has concluded. After looking at performance and estimated costs, the JEA team chose membrane technology for the demonstration/optimization testing. A key factor was performance of the membrane system to remove unregulated constituents. Additionally, the project team felt confident that there was enough capacity in the reclaimed/wastewater system to address RO concentrate disposal.

The current demonstration project is for a 1-mgd UF/low-pressure reverse osmosis (LPRO)/advanced oxidation process (AOP) system. Estimated capital costs are approximately $20 million, with annual operations and maintenance of approximately $1 million. The demonstration facility will include an effort for the optimization of treatment efficiency and will be fully expandable to 10 mgd.

The location of the demonstration and full-scale facilities is still being determined. Some of the key factors in determining the location are water availability, areas of greatest demand, and potential aquifer recharge benefits.

The plan for the next phase includes a learning center at the pilot facility to facilitate public outreach and education. An innovative 200-acre wetland restoration and reclaimed water storage component is also being planned by JEA in the near future. Siting studies are currently underway.

A communications plan was developed by JEA and its consultants because advancing public outreach is one the most important parts of the project. The goal of the plan is to guide future communications efforts in order to enhance the public's understanding of the need for purified water. An initial community survey was completed to determine customer perceptions of the purified water concept. The continued update and implementation of the communications is critical to the eventual success of the project.

The JEA purified water project is a logical step to secure the region's future water supply. Water conservation and reclaimed water will extend the time where more-costly alternative water supplies are required, but are not expected to meet all future needs, and JEA is planning for northeast Florida's water future now.