City of Dania Beach Completes 'Green' Water Treatment Plant

The City of Dania Beach, Florida dedicated its new nanofiltration water treatment plant on March 27, 2012. Faced with continuing growth and redevelopment, an aging lime softening water treatment plant, and an increasingly stringent regulatory environment, the City of Dania Beach sought to design-build a new nanofiltration/reverse osmosis membrane process expansion to the existing lime softening treatment plant. Nanofiltration is a membrane separation process that removes a range of inorganic and organic substances from solution in a liquid. The state-of-the-art plant will serve the City's future potable water demands and improve water quality and color. In addition, this plant achieves the City's vision for environmental sustainability though green initiatives including energy performance equipment; construction materials with high recycled content; and lesser water use on site through xeriscaping and low-flow fixtures.

The project was the combined efforts of the City, Florida Atlantic University faculty and student researchers within the College of Engineering and Computer Science, engineers , architects and construction personnel from CDM Smith, The project is the first water treatment plant in the world to receive a Leadership in Energy and Environmental Design (LEED) Gold certification by the U.S. Green Building Council.

"FAU faculty and students contributed to the project by conducting research on increasing the recovery of waste concentrate," said Frederick Bloetscher, Ph.D., P.E., associate professor in the department of civil, environmental and geomatics engineering within FAU's College of Engineering and Computer Science. "This collaboration is a great example of how industry may harness the power of student and faculty intellectual capital for projects that positively impact the economy and environment of our region." The resulting innovative

membrane system design entails a two-stage nanofiltration membrane system with convertible third and fourth-stage reverse osmosis units to meet the project technical challenges. These challenges included providing the operational flexibility to treat variable quality raw water sources, achieving high system recovery, and minimizing raw water consumption and concentrate disposal costs. The convertible third stage either operates as a single stage allowing 91 to 92 percent recovery to meet concentrate disposal restrictions, or reconfigures to a third and fourth stage 2:1 array to maximize system recovery and further reduce operating costs. The pilot testing results, which showed up to 95% recovery was achievable.

The building program involved on-site piping, pretreatment, nanofiltration skids, building, chemical storage, cleaning system, electrical connections, parking improvements, connections to the clear well and other ancillary items. The intention is also to provide operator office and laboratory space as a part of the new facilities, and connect all instrumentation to one central control center in the new operations building.

A number of discussions took place on the means to bid the project. The facilities plan had identified design/build as a potential option. This had worked in Golden Gate City for Dr. Bloetscher in 2000. Timing for funding, and costs, were also issues. Of even more importance to the City, using the Design/Build approach allowed the City to obtain firm pricing for all the project costs in approximately four (4) months from advertisement to receiving bids. With the traditional Design/Bid/Build approach, it is estimated the City would have required approximately one year for completion of the detailed design and the receipt of bids and incurred over a half million in added fees.

Design/build was pursued using a two step process. The first part was qualification based. The contractor, engineer and membrane constructor were identified and evaluated by the

selection committee. Qualifications were received from seven (7) firms. The five (5) person selection committee evaluated the seven (7) qualifications and the scoring indicated that two of the firms had much higher scores than the rest of the firms. As a result, the selection committee requested cost proposals from the two top ranked firms, both of which asked for copies of the FAU student projects as a means to guide them in the bidding process.

After receiving and evaluating Design/Build proposals and conducting interviews with the two prequalified bidders, the City awarded the project for design and construction of the 2.0 MGD nanofiltration process addition and associated improvements to CDM Smith who's bid was the lowest from the pre-qualified bidders. The successful proposal included careful scheduling of improvements for the integration of the new nanofiltration water treatment plant facilities with the existing lime softening plant to minimize disruption of water treatment plant production during construction or temporary purchases of water from the interconnection with the City of Hollywood.

One of the primary advantages of the Design/Build procurement process was that it saved City time in the overall completion of the project. If the City would have stayed with the original Design/Bid/Build procurement process, it was estimated to take 178 weeks to move from the 30 percent design to final completion. With the Design/Build procurement process, the time from 30 percent design to final completion will take 104 weeks, which is a 74 week reduction in the project schedule and approximately a 1- ½ year reduction.

Two FAU civil, environmental and geomatics senior student groups submitted conceptual designs as their capstone project and spent significant time analyzing the process, site and design issues. These students designs were used by CDM Smith and the City of Dania Beach to fully develop the plant concepts, including the idea for LEED certification. "I immediately agreed that

the City should pursue LEED certification as a means to show leadership," said Dominic Orlando, Public Services Director. "We were pleased that we were able to achieve the Gold level of certification with this facility."

The project used funds from the State Revolving Fund. The State Revolving Fund loan priority list designated DEP Project No. DW 0604050 for financing of construction activities associated with the design and construction of the City's nanofiltration process facility. The City of Dania Beach entered into an $8,820,923 loan agreement with the Federal Department of Environmental Protection under the State Revolving Fund for project financing. The Design/Build approach allowed the City to take advantage of a relatively narrow window of opportunity to obtain $2.55 million of ARRA stimulus funding within an $8.82 million state revolving fund loan agreement. The ability to obtain the level of stimulus funding was a determining factor that allowed the City to proceed with the implementation of this facility.

A process schematic for the design of the full scale system is provided in Figure 4. The first two stages of the membrane treatment system will consist of a nanofiltration system that is designed to operate at 85 percent recovery. An interstage boost pump will be provided to boost the pressure of the concentrate leaving the second stage of the nanofiltration unit and feed it to a third stage low pressure reverse osmosis unit. This provides the City with the flexibility to meet their concentrate discharge limits when operating at recoveries in the 92 percent range in the three stage configuration or to increase system recovery by operating in a four stage configuration. Operating at this higher recovery provides the City an opportunity to reduce their concentrate disposal and raw water purchase costs.

The design must incorporate elements of green building (LEED® certification), design for function, aesthetics, security, and safety. Storm drainage will be required to comply with the

South Florida Water Management District (SFWMD) and the requirements of the Broward County Environmental Protection Department (BCEPD). Figures 5 -8 show construction stage photographs. Also noted are the LEED credits that are incorporated with these improvements. Figures 9 – 14 outline the finished process. Figure 15 is the dedication plaque. FAU has submitted the documentation for the LEED Gold certification.

The project was completed in 24 months from contact award, including migration of the existing lime softening electrical system to the new facility. The facility has already won a USEPA award for sustainable infrastructure and an engineering design award and a FICE engineering award from the Florida Engineering Society.

Figure 1 – Student perspective drawing of Dania Beach WTP Option

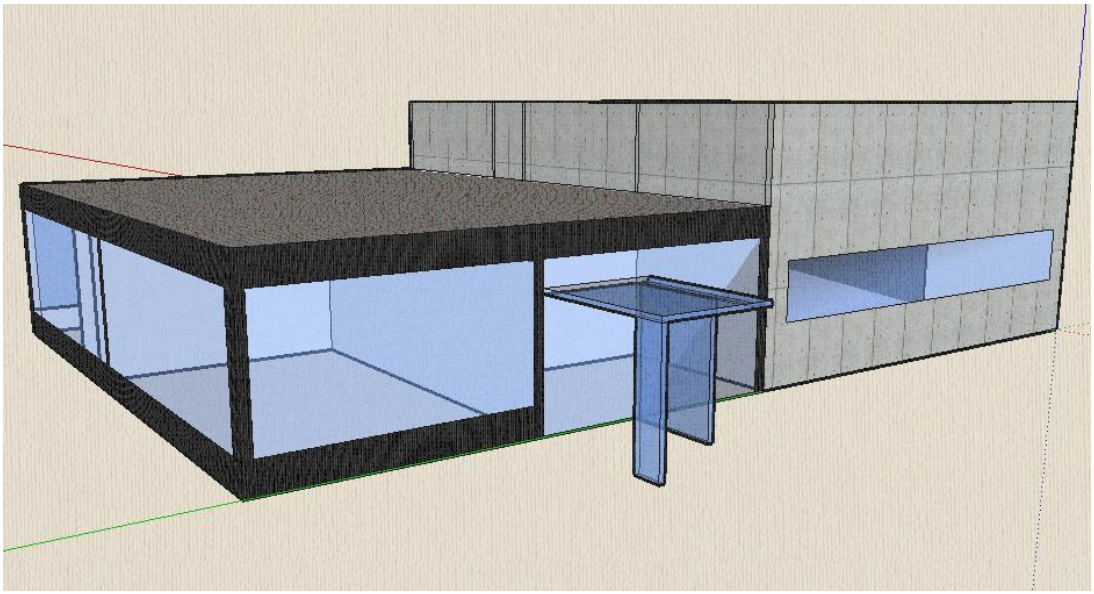

Figure 2 – Student perspective drawing of Dania Beach WTP Option

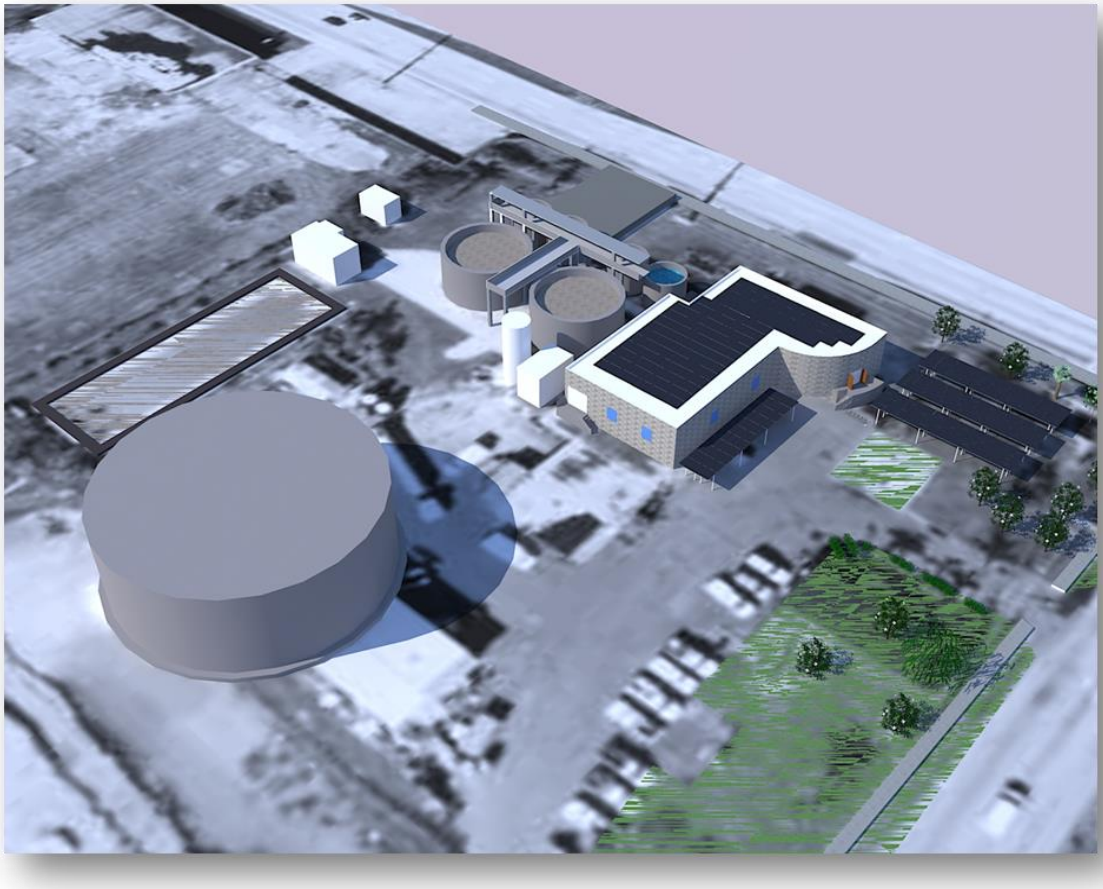

Figure 3 – Student perspective drawing of Dania Beach WTP Option

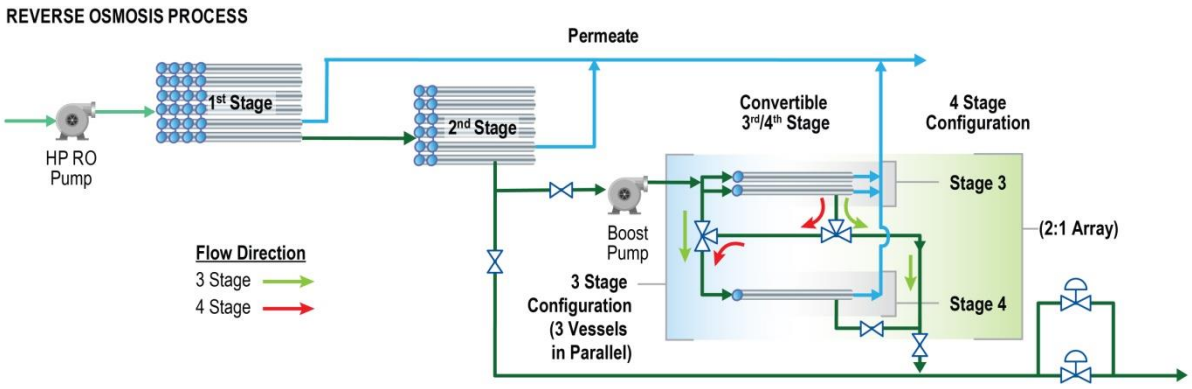

Figure 4 – Nanofiltration with Third Stage Reverse Osmosis

Figure 5 – Existing Lime Softening Water Treatment Plant

Figure 6 – Erection of steel (recycled, local materials) for Membrane building

Figure 7 Nanofiltration building showing white reflective roof (reduced heat island effect), and concrete (recycled, local material) walls.

Figure 8 - Operators Area. The operators area included the use of low VOC paint, glue for tile, carpeting and cabinetry, which was good for 4 LEED points. Also 95 % of the building receives sunlight (another point)

Figure 9 - Sand separators (local materials) used ot remove the bulk of the sand from the raw water

Figure 10 – Chemical Feed systems , and post treatment degasifier to remove excess carbon dioxide

Figure 11 – cartridge Filters used to remove the sand and particulates prior to going into the membranes

Figure 12 – membrane skid testing bank

Figure 13 – Membrane Skid

Figure14 - Final Treatment plant site. Note added green areas, stormwater swales, and improved site access.

Figure 15 - Final Dedication Plaque. Shortly the City expects to receive LEED Gold certification

Figure 16 – March 27 2012 Dedication