

**Client**

City of Pompano Beach

**Scope of Services**

Membrane pilot testing, permitting, preparation of contract documents for direct procurement of membranes as well as membrane element loading, bidding, contract administration, on-site observation during loading, and review of membrane performance testing.

**Contact**

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**Start Date**

03/2016

**Completion Date**

05/2020

**Construction Cost**

\$1.098 million

**Change Orders**

None

**Key MBC Staff**

Frank A. Brinson, P.E.  
Andrew H. Barba, P.E.

**Benefit to the City**

Reduced feed pressure and elimination of chemical pretreatment resulted in a realized annual operating cost savings of \$600,000.

As of March 2025, the new membrane elements have been in service for five years with no chemical pretreatment, meeting all water quality goals, and with four routine cleanings to-date.

## Nanofiltration Pilot Testing and Membrane Element Replacement

Pompano Beach, Florida



### Background

The City of Pompano Beach owns and operates a 50 million gallon per day (mgd) capacity water treatment plant (WTP) which consists of a 10 mgd capacity nanofiltration (NF) process in parallel with a 40 mgd conventional lime softening process. The NF process includes five 2 mgd NF units arranged in a two-stage, 36:16 array, and the system was designed to operate at an 85% recovery rate. The NF units were populated with a hybrid of 1,820 membrane elements (Hydranautics models ESNA1-LF and ESNA1-LF2), which were installed in 2009. NF membrane elements typically have a useful service life of 5 to 7 years. In 2016, the City was ready to begin pilot testing to prepare for replacing the membrane elements that were installed in 2009.

### The Project

In preparation for the membrane element replacement, the City and MBC designed, permitted, and constructed a pilot unit that utilized three full-size (8-inch diameter, 7-element) pressure vessels in a 2:1 array with independent cartridge filters and pre-

treatment chemical feed systems. The pilot unit was permitted to withdraw feedwater from the NF process raw water header and discharge permeate and concentrate to the full-scale plant's respective headers.

MBC assisted the City in requesting letters of interest (LOI) from three leading NF membrane element manufacturers (MEMs): Hydranautics, Dow Water and Process Solutions, Inc. (Dow), and Koch Membrane Systems, Inc. The City received affirmative responses from Hydranautics and Dow.

Membrane element selections from both MEMs were pilot tested in two phases:



*Full Size 8-inch Pilot Unit*

- Phase 1 was aimed at confirming that MEM's proposed membranes would meet the specified permeate quality and membrane performance requirements under the current operating conditions of full-scale NF process (i.e., with acid and antiscalant chemical pretreatment). Meeting the specified permeate quality and membrane performance requirements during this phase of testing constituted prequalification of the MEM's proposed membranes for the full-scale membrane re-load. Both MEM's were successfully prequalified for the full-scale membrane replacement.
- Phase 2 of the testing was conducted to evaluate the performance of the membrane element selections and potential long-term fouling tendencies under modified operating conditions and with no chemical pretreatment (acid and antiscalant pretreatment were eliminated during Phase 2).



*New membrane elements*

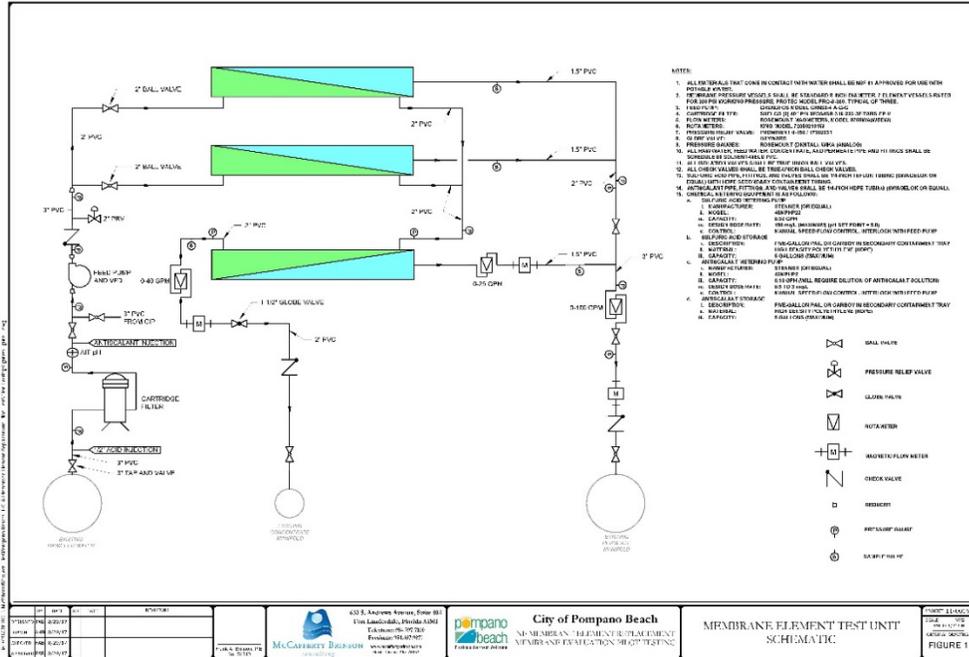
As noted above, both MEM's were prequalified during the Phase 1 testing. The Phase 2 testing was successful in demonstrating stable operation with no chemical pretreatment, and the City made the decision to proceed with the full-scale membrane replacement with no chemical pretreatment in the full-scale plant. In May 2019 the City advertised for bids for the membrane element replacement. Hydranautics was the successful low bidder, and the City issued a notice to proceed in December 2019.



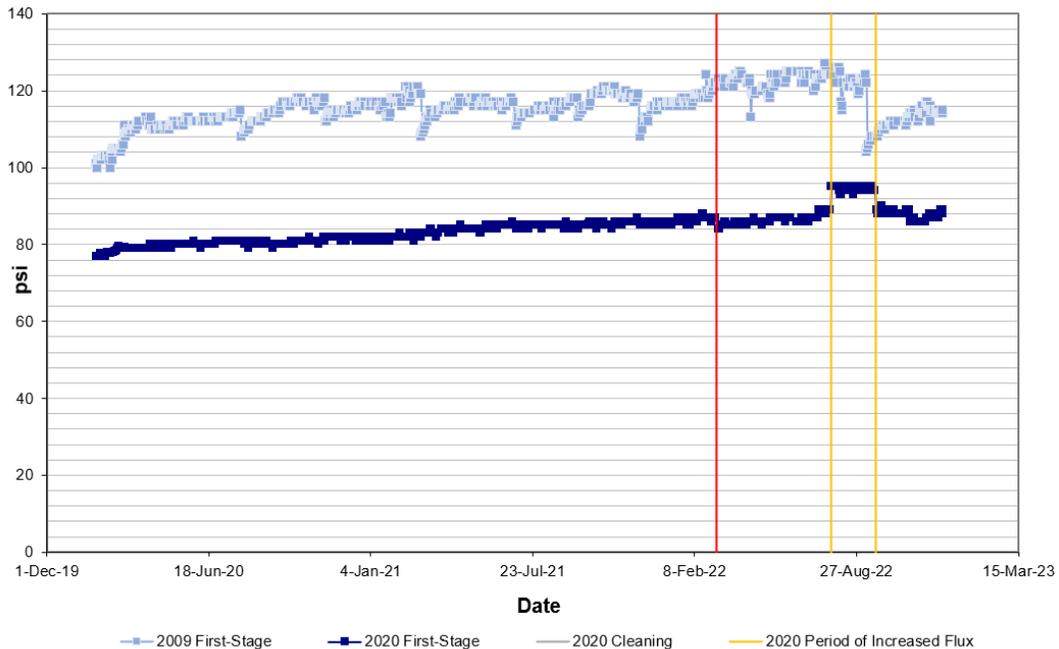
*Membrane element loading*

The initial hybrid membrane arrangement was consistent with the pilot unit (first-stage: 7 ESPA 4-LD elements, second-stage: 7 ESNA-LF2-LD elements). However, during the start-up performance acceptance testing of the first full-scale NF unit, it was found that this loading configuration did not meet the specified permeate quality requirements. Hydranautics modified the loading configuration, as allowed in the contract.

The modified loading configuration allowed the full-scale NF process to meet specified performance and permeate quality requirements, with no acid and antiscalant chemical pretreatment. The project was completed in May 2020, six months ahead of schedule with no change orders.



At start-up, the average feed pressure of the NF units was 73 psi with the new membrane elements, approximately 17 psi lower than the start-up pressure of the City's previous membrane elements. **As of March 2025, the new membrane elements have been in service for five years with no chemical pretreatment, meeting all water quality goals, and with four routine cleanings to-date.** The elimination of acid and antiscalant chemical pretreatment, coupled with the reduction in feed pressure, resulted in a realized total annual operating cost savings to the City of \$600,000.



Comparison of Start-Up Feed Pressure: 2009 vs. 2020