CITY OF FORT LAUDERDALE

City of Fort Lauderdale
Granular Activated Carbon Pilot and Plant Evaluation at the Fiveash Water Plant

EXECUTIVE SUMMARY

FINAL REDACTED | December 2019

carollo

CERTIFICATE OF AUTHORIZATION NO. 8571

In September of 2018 the City of Fort Lauderdale (City) issued solicitation 12191-996, Granular Activated Carbon (GAC) Pilot and Plant Evaluation at the Fiveash Water Plant. In May of 2019, the City initiated the project with Carollo Engineers, Inc. (Carollo). The primary objectives of this effort was to perform an investigation into the use of granular activated carbon (GAC) for water color control at the existing Fiveash Water Treatment Plant (WTP), and evaluate options for the future of the overall Fiveash water treatment system (for this study the timeframe was established to be through 2035).

A small scale research trial was conducted at a remote laboratory facility utilizing water from the Fiveash facility to determine the viability of GAC as a treatment option. In addition, an in-depth investigation into how best to develop a future treatment system which meets the goals and objectives of the City for the Fiveash water service system. A description of the technical tasks performed and a summary of findings with recommendations is included below.

Summary of Study and Findings

GAC Evaluation

The raw water source that feeds the Fiveash WTP is from the Biscayne Aquifer, which is a shallow aquifer that exists throughout southeast Florida. A characteristic of this aquifer water is an extremely high organic content that imparts significant water coloration. This water color cannot be removed to desired levels by the existing treatment processes.

In order to determine GAC viability, water from the Fiveash WTP was delivered to a research facility which specializes in performing water testing. At this facility a number of experiments were conducted with multiple GAC's that are commercially available. The results of all of the carbon removal experiments indicated that GAC was not a viable treatment alternative. Although the GAC was able to remove the carbon, it was exhausted to the point where regeneration or replacement was required every few days. The associated cost to regenerate or replace the GAC at this frequency was determined to be impractical as a long term solution to water coloration.

Fiveash WTP Options for the Future

Several tasks were incorporated into the project to evaluate options for the future of the Fiveash water treatment system. These included the following.

- Existing Facility Status Confirming Condition Assessment. The 2017 Comprehensive Utility Strategic Master Plan (CUSMP 2017) noted that the Fiveash WTP would require extensive renewal, rehabilitation, and replacement to be a viable option for future potable water production. A high level, brief, general assessment of Fiveash WTP was completed by the Carollo team and the CUSMP 2017 findings were confirmed.
- WTP Performance Goals Determination. Carollo worked closely with staff to develop specific detailed water treatment facility goals associated with capacity, potable water quality, infrastructure requirements, and operation and maintenance activities. The goals included compliance with existing regulatory drinking water standards as well as additional goals deemed necessary to meet the level of service expected from the City's customers.

- Water Treatment Process Evaluation. Multiple tasks were performed as part of this treatment process evaluation effort including a desk-top technology review, bench-scale process testing at the existing facility, and GAC small-scale testing at a remote laboratory. Seventeen conventional treatment alternatives were initially considered, of which 10 were determined to not meet the water quality goals, having a higher cost, reduced flexibility, or having excess or redundant processes. The remaining list of 7 were compared and debated by the project team and ultimately 3 alternatives were shortlisted for further evaluation. The 3 shortlisted alternatives are summarized below:
  - Treatment Scheme 2 – Lime Softening and Fixed Bed Ion Exchange (IX)
  - Treatment Scheme 7 – Enhanced Coagulation with Pellet Softening and Fixed Bed IX
  - Treatment Scheme 11 – Nanofiltration and Fixed Bed IX
- Alternate Facility Location Study. The feasibility of locating a treatment facility on property at the Prospect Wellfield locale was investigated as an alternative to constructing a new facility at the existing Fiveash WTP site. This investigation included an overview of existing zoning requirements and site conditions, and identified three potential sites within the Prospect Wellfield property that could accommodate any of the three shortlisted alternatives.
- Water Supply Investigation. This evaluation consisted of a review and investigation into the current water supply sources, alternative water supply sources, water use allocations per the existing South Florida Water Management District (SFMWD) water use permit (WUP), and subsequent raw water needs based on identified treatment technologies. Assuming the alternative requiring the most water supply (Treatment Scheme 11) was selected, it was estimated that year 2035 demand could be met with the existing WUP allocation.
- C-51 Reservoir Water Supply versus Florida Aquifer Water Supply Comparison. Water supply needs associated with future potable water requirements beyond 2035 will likely need to be met from a source that is in addition to what is currently provided in the existing SFWMD WUP. The team compared the options of obtaining water from the C-51 Reservoir System (C-51) versus water obtained from the Floridan Aquifer and determined that the C-51 water supply option was more cost-effective.
- WTP Facility Siting. The team determined conceptual size requirements for each of the three shortlisted water treatment processes. These size requirements were overlaid on corresponding areas at the Fiveash and Prospect Wellfield sites to determine if adequate space was available for facility implementation. It was determined that all three of the alternatives would fit on the Prospect Wellfield site, but only one of the alternatives (Treatment Scheme 11) may fit on the Fiveash WTP site.
- Conceptual Capital, Operations/Maintenance Costs, and Net Present Worth Determinations. Conceptual costs to construct, and operate and maintain were estimated. A net present value comparison was conducted for the three treatment process alternatives.

Comparison of WTP Options/Alternatives

A comparison of the qualitative primary features and the capital costs of the alternatives was developed. These comparisons are summarized in the following table.

Comparison of WTP Alternatives

Evaluation Criteria	Treatment Scheme 2 Lime Softening + Ion Exchange	Treatment Scheme 7 Enhanced Coagulation with Pellet Softening + Ion Exchange	Treatment Scheme 11 Nanofiltration + Ion Exchange
Capital Cost			Fiveash Site:
Capital Cost 1(1)	$310.02 M	$343.91 M	$315.12 M
Capital Cost 2(2)	$393.73 M	$427.61 M	$348.47 M
Capital Cost 1(1)			Prospect Site:
Capital Cost 2(2)			$348.56 M $432.26 M
Meets Water Quality Goals	Yes	Yes	Yes
Proven Technology at this scale	Yes	Yes	Yes
Color and Organics Removal	Good	Excellent	Superior
Effectiveness for potential future regulated contaminants	Limited	Limited	Very good
Size of footprint	Large; will not fit on Fiveash site	Smaller than Alt 2; but will not fit on Fiveash site	Smaller than Alts 2 and 7, and will fit on Fiveash site
Operations	Similar to existing Fiveash WTP; high degree of manual operation	High degree of manual operation	Highly automated; minimal manual operation; less operational staff required
Water recovery	High water recovery > 97%	High water recovery > 97%	Lower water recovery than Alts 2 & 7 – approx. 85 – 88%
Byproduct Disposal	Significant solids to dispose of; future disposal alternatives unknown	Less solids than Alt 2; but still significant solids to dispose of – future disposal alternatives unknown	No solids disposal; Injection wells required for disposal of liquid byproduct
Chemical usage	Similar to current Fiveash WTP operation	Less than current operation; no dry chemicals to handle	Similar to Peele Dixie WTP per mgd
Energy requirements	Similar to current Fiveash WTP operation	Similar to current Fiveash WTP operation	Significantly more than current Fiveash; similar to Peele Dixie WTP per mgd

Notes:

(1) **Concept Level Capital Cost Estimate 1** – This estimate represents the cost of the proposed full treatment system but relies on using existing Fiveash WTP infrastructure of storage tanks, high service pumps, and auxiliary power generators associated with pumps, and retrofitting the existing raw water transmission main which transfers raw water from the Prospect Wellfield to the Fiveash WTP into a finished water line feeding the distribution system pumps.

(2) **Concept Level Capital Cost Estimate 2** – This estimate represents the cost of the proposed full treatment system as well as two new storage tanks, high service pumps, auxiliary power generators for the pumps, and a new 54 inch potable water pipeline from Prospect site to Fiveash site.

Recommendation

In summary, all the shortlisted treatments schemes are effective at achieving project goals associated with capacity, water quality, and infrastructure sustainability. The level of each technology to meet the operation and maintenance goals varies due to chemical and power usage, labor requirement, and byproducts disposal.

A key objective of the Utility Vision as noted in the CUSMP 2017 is for "…, all of our water treatment facilities will be state of the art by 2035, …" State of art implies the most recent stage in development of a product incorporating the newest ideas, etc. Of the three short-listed technologies the most state of the art technologies are included in Scheme 11. These technologies of nanofiltration and ion exchange are tried and true over decades of utilization. In addition to a solid performance track record, the industry continues to support significant research and development (R&D) to address existing and potential future challenges.

Based on the analysis and evaluation described herein, it is recommended that the City proceed with design and construction of a new state-of-the-art water treatment facility at the Prospect Wellfield site with a proposed treatment process consisting of a combination of nanofiltration and ion exchange (Treatment Scheme 11). The City could minimize capital costs in the short term by utilizing existing infrastructure at Fiveash Water Treatment Plant (WTP) including the high service pump station, generators, storage tanks, etc. as defined in "Capital Cost Estimate 1." The conceptual cost estimate for this alternative is approximately $350 million.

This recommended alternative utilizes a technology of which the City is familiar, along with an additional technology that results in a robust treatment system. These technologies are highly automated requiring less manual operation and best meet the City's desire for color elimination and other specific project goals. Further, this recommended alternative is best suited to minimize the potential impacts of future uncertainties including future regulated contaminants and treatment system byproduct disposal.