C-43 West Basin Storage Reservoir (WBSR) Water Quality Component (WQC) Siting Evaluation Public Meeting Minutes

September 13, 2021 10:00 AM – 11:00 AM
Webinar

Meeting Welcome

Kim Fikoski, South Florida Water Management District (SFWMD) Project Manager, welcomed everyone to the seventh and final public meeting for the C-43 WQC project. During the meeting, the J-Tech consulting team supporting this project will provide an overview of the methodology and timeline. She introduced the J-Tech team members. Kim thanked and introduced the Working Group members who have spent many hours over the past two years providing input throughout the process. She also introduced Cassondra Armstrong, SFWMD Water Quality Treatment Section Administrator, who has been running a parallel pilot study that will be discussed during the meeting.

Jennifer Reynolds, SFWMD Director of Ecosystem Restoration and Capital Projects, thanked Kim for leading the project and for everyone who has called in and supported the project. She noted that this is an exciting day and the team has a lot of good information to share. The WQC and reservoir itself have been going really well. These projects have been a long time in the making and it is exciting to see that they are at the point of taking shape. For those who have been following this project, one important part of the WQC is the in-reservoir alum injection system, which has been presented during past meetings. The modeling of this system shows it can meet the water quality targets for total nitrogen (TN) and total phosphorus (TP) within the reservoir. The modeling also looked at the sedimentation rates and sulfate effects on the reservoir components and operations, potential for alum micro floc, and other items related to alum injection.

Jennifer stated that she knows people have concerns about alum, which have been looked into and the team will discuss today. SFWMD has determined that the in-reservoir alum will meet the goals set by Governor DeSantis in his Executive Order to improve water quality in, and leaving, the C-43 WBSR to prevent creating an environment within the reservoir that would lead to algae blooms. SFWMD is confident that alum will meet those goals and work within our limited legislative dollars. She noted that people may have expected something more like a stormwater treatment area (STA) or wetland system. SFWMD understands the concerns about alum and water quality treatment projects and intends to do more treatment in the future that benefits the river and estuary. While the District moves forward the in-reservoir alum injection system to meet the water quality requirements for the reservoir, they will look for options to improve water quality for the estuary using available land and funds. For this project, SFWMD is focused on how to meet the water quality requirements for the reservoir in a timely manner and is excited about the path forward.

Project Background

Georgia Vince, J-Tech, stated that in January 2019, Governor DeSantis signed an Executive Order to greater the protection of Florida's environment and water quality. It included efforts to reduce harmful algae blooms and, specific to today's meeting, it included a directive to study additional water quality treatment opportunities for water leaving the C-43 WBSR.

Georgia showed a map and noted that the C-43 WBSR is in western Hendry County. The reservoir, currently under construction, has two cells, is 10,700 acres in size, and will store 170,000 acre-feet of water. The reservoir will intake and discharge water to and from the Caloosahatchee River through the Townsend Canal. Generally, the reservoir will be filled and emptied once a year, storing water during the wet season and discharging water during the dry season to maintain prescribed flows for the downstream estuary. The reservoir is located downstream of the S-78 Ortona Lock structure and upstream of the S-79 Franklin Lock structure. The S-78 water quality monitoring station was used to determined nutrient concentrations for the water entering the reservoir. The S-79 structure monitoring was used to identify the reservoir outflow water quality targets, which will be presented today.

WQC Feasibility Study (Phase I) Summary

Georgia stated that the Phase I primary objective was to identify opportunities to provide treatment and improve water quality leaving the C-43 WBSR using conventional and innovative technologies with an emphasis on nitrogen removal.

The Water Quality Feasibility Study (WQFS) began by evaluating 38 treatment technologies from the Florida Department of Environmental Protection's (DEP) Technology Library with the Final Information Collection Summary Report evaluating 25 technologies that were further refined to five alternatives.

The WQFS evaluated water quality improvement technologies prior to, during, and after storage with the ultimate goal of identifying alternatives that are compatible with the WBSR objectives and can be ready when the reservoir starts operations. Biological, chemical, and physical water quality treatment technologies were considered. One of the biggest challenges was ensuring that the technology was scalable to treat the large flows expected to leave the reservoir and ensure it would be applicable for long-term use. Ultimately, a cost-benefit analysis was conducted with capital construction costs and operation and maintenance over 20 years to identify the most cost-effective technologies.

The final results of the WQFS were presented to the public in December 2020 and identified alum treatment as most-cost effective. Bold and Gold® media, which is a tire crumb, sand, and clay mixture, combined with an STA was number two. Hybrid wetland treatment technology (HWTT), which is a combination of alum and constructed wetland cells, was number three. A sand filter and Bold and Gold® combination was number four. The least cost-effective was the 5,000-acre STA. The WQFS documents are available at https://www.sfwmd.gov/content/c43waterqualitystudy.

WQC Siting Evaluation (Phase II) Overview

Georgia stated that Phase II included siting the WQC, and was kicked off in December 2020. This included looking at the available lands within near the C-43 WBSR, evaluating water routing, analyzing water quality, and conducting water quality modeling. A more detailed evaluation of the in-reservoir alum injection system was also conducted. SFWMD initiated a pilot study to further evaluate the use of alum and Bold and Gold®.

J-Tech developed a technical memo to evaluate the in-reservoir alum injection system, which was the most cost-effective water quality treatment technology identified in Phase I. The memo evaluated how alum could be applied at the WBSR inflow pump station. A model, Sumo, was used to determine the dosing for the inflows. A cost estimate based on conceptual design determined that system construction is approximately $5 million. SFWMD executed a contract for full design of the in-reservoir alum injection system, which will be completed by October 2021.

Cassondra stated since Bold and Gold® was one of the top technologies that was moved forward from Phase I, she thought it would be worth the time and effort to evaluate the performance using C-43 water. The pilot study found that Bold and Gold® is very good at removing TN (32%). However, it was mostly nitrate and C-43 water is mostly dissolved organic nitrogen. The percent removal in the pilot study was much lower than the estimates provided by the vendor for the study, which is how the cost estimate was derived. The conclusion was that this media would be more expensive than originally presented. Therefore, SFWMD did not recommend using Bold and Gold® in the WQC.

Cassondra stated that they used a sand filter as a control during the Bold and Gold® study. The sand filter removed almost all the particulate nitrogen, and would be good for micro floc, but the TN removal is low at 13%.

Cassondra explained that the pilot study also included jar studies for alum using water collected in September 2020 and January 2021 to capture the wet and dry seasons. They first started by evaluating the maximum nutrient removal, which occurred at a dosing rate between 12 and 14 milligrams per liter (mg/L). This resulted in TN removals of 43% in the wet season and 51% the dry season, and TP removals of 90% in the wet season and 94% in the dry season. Cassondra noted that the wet season represents when water would be entering the reservoir. They also wanted to determine the nutrient removal rate from the proposed in-reservoir alum injection system. They modified the dosing to 0.6 mg/L and 1.2 mg/L. The removal was 30–33% for TN and 62–72% for TP.

Cassondra showed graph with the components of nitrogen. C-43 water is mostly dissolved organic nitrogen with little dissolved inorganic or particulate nitrogen. Bold and Gold® reduces almost all the dissolved inorganic nitrogen and some particulate nitrogen, which was likely removed by the sand. The sand filter reduced particulate nitrogen but created a little dissolved inorganic nitrogen. She also showed graphs with the in-line alum dosing at 0.6 mg/L and 1.2 mg/L. The TN and TP concentrations were significantly reduced within a few weeks, and should reduce further over time. The pilot study will end this month.

Georgia stated that the water quality project siting evaluated use of lands within two miles of the reservoir. The Siting Evaluation identified limited lands to the north and south due to planned developments. The lands to east and west are privately-owned agricultural lands. There are water conveyance restrictions to implementing a project west of the reservoir. It was determined that the SFWMD-owned lands to the north provide the best opportunity for siting the WQC.

A cost-benefit analysis for the alternatives was conducted in the WQFS. As part of the Siting Evaluation, the cost estimates were updated. For the full-scale, 5,000-acre STA, the updated cost estimate with contingency and 50 years of operation and maintenance is approximately $300 million plus the added cost of land acquisition. There are socioeconomic concerns related to encumbering large areas of land for an STA. Therefore, the full-scale STA was eliminated during the Siting Evaluation and did not move to conceptual design.

Georgia stated that the final piece of the Siting Evaluation was to identify the project water quality targets to ensure the WQC could effectively treat the high volume flows leaving the reservoir. The S-79 structure water quality data were evaluated to identify the most conservative values during the time of year when the reservoir would likely be releasing water to the river and estuary. The targets included a reduction in TN of 26% and TP of 40%.

First Round of Questions

- Q: Have Water Quality-Based Effluent Limits (WQBELs) been determined yet for TN and TP?
- A: WQBELs have not been determined at this time. Traditionally, that work is done when the facility comes in for its operation permit. DEP does not expect a QBEL will be included in the operations permit for the reservoir.

- Q: We (www.carbotura.com) are open to suggestions from SFWMD. Our project bio-remediates 13 million gallons of water per day, per facility. We are planning 36 facilities across Florida. We are not seeking public funding, only assistance in selecting the most opportune locations. We are profitable via our carbon capture and nano-biomaterials outputs. We were selected as the world's top 50 most innovative companies in the world from 130+ countries from 1,000's of companies. Based in Naples, FL (https://www.linkedin.com/company/carbotura). These facilities create 500 construction jobs and 100 permanent high paying jobs per facility. Zero waste, negative emissions. We can remediate Piney Point and Lake Okeechobee, as well. $200 million in local annual economic impact per module as well. Here is the viral video about us. We have islands and countries from around the world wanting to license our projects. Since we are based in Naples, it's best for us to work with local stakeholders (https://www.youtube.com/watch?v=AWwQGb5KWXM).

- A: Thank you for providing your information. The Study evaluated technologies that were included in the DEP Technologies Library. Consideration for your technology could be included in future efforts.

WQC Conceptual Design

Georgia stated that the designs from the WQFS were refined for the remaining four alternatives: post-storage alum treatment, STA and Bold and Gold®, sand filter and Bold and Gold®, and HWTT. J-Tech also identified a new option to address feedback received from the Working Group and public. The new option is a 150-acre sand filter. The cost estimates were updated based on the design refinements. The nutrient reduction resulting from the in-reservoir alum injection system were also applied. In addition, the results from the SFWMD pilot study were included.

J-Tech re-evaluated the ranking criteria that had been used throughout the Study to develop a criteria matrix to compare the alternatives. Criteria included natural systems with habitat value, confidence in technology performance, operational simplicity, energy efficiency, and net present value cost. Net present value cost was given a slightly higher weight. The alternatives were then scored and ranked.

The Final Design Report ranked sand filter first and HWTT second based on the criteria. The net present value ranking resulted in the sand filter with the lowest cost at $175 million and HWTT with the second lowest cost at $213 million.

The final Study results identified the most cost-effective and technically feasible WQC is a combination of the in-reservoir alum injection system with a post-storage sand filter. Based on SFWMD recommendations from pilot testing, the Bold and Gold® alternatives were removed from further consideration. The post-storage alum treatment and HWTT were removed because of the dual alum treatment, production of residuals, and higher net present value costs. Concurrence for the sand filter alternative was received from SFWMD and the selection was presented to the Working Group.

This combination reduces opportunity for algae development within the reservoir, meets the target water quality concentrations, and can accommodate the targeted flows up to 611 cubic feet per second (cfs).

Sand Filter

Georgia showed photographs of example large-scale sand filter projects that have been implemented in Florida. This is a proven technology using a natural media and is often combined with alum treatment systems. The sand could be sourced from onsite near the WBSR and is more cost-effective than other media options. The 150-acre sand filter would be constructed on SFWMD lands just north of the reservoir with conveyance from the perimeter canal through the sand filter with discharge to the Townsend Canal.

In-Reservoir Alum System

Jim Bays, J-Tech, stated that the in-reservoir alum injection system is currently in the final design stages. The alum injection system will be located at the C-43 WBSR S-470 pump station. The system will include a tank farm for storing alum, which will be located on the north side of the building; an injection pump system; a recirculation pump to maximize alum dissolution and mixing with the incoming water; and instrumentation and controls for operation. The project takes advantage of the intense mixing provided by the large pump station, and the huge area for settlement and storage of solids provided by the reservoir. An Intermediate Design was developed in June, which included additional modeling using the Sumo model and sediment transport. The Final Design will be submitted to SFWMD for review on September 15.

In March 2021, a detailed technical memorandum was prepared that reviewed the literature on alum treatment and injection in lakes and reservoirs. While alum has a long history dating back many years for treatment of water supplies and wastewater, alum has been used effectively for over 20 years in Florida lakes for treatment of nutrients, primarily phosphorus. Studies have shown that a range of 20–40% for TN removal and 60–90% for TP removal can be expected. These ranges have been validated by the SFWMD pilot project and related modeling by J-Tech.

To address concerns about the use of chemical treatment, previous studies of alum ecological safety were reviewed. Dozens of projects have been implemented in Florida, including several alum treatment projects permitted in the past 10 years by DEP in north, central, and west-central Florida. The St. Johns River Water Management District has over 20 years of experience with the practical application of alum to wetlands for nutrient reduction. No toxic responses have been noted for typical application, which includes concerns about decreases in water acidity and increases in aluminum. Since 2004, the North American Lake Management Society has endorsed the use of alum for lake and reservoir management.

Jim noted that the effect of sulfate was also investigated. As alum sulfate comes into contact with water, it dissolves into alum and sulfate ions. The sulfate added is on the order of 5 mg/L or less depending upon the dosage, and the final concentration is well within the normal range of fluctuation in the C-43.

Given that this project came after the design and start of construction for the pump station, concerns were relayed in meetings and document reviews about the potential for corrosion. While alum by itself is corrosive, when mixed in water, its corrosivity is related to the water quality and strength of concentration. In this application, the range of doses proposed will give concentrations that will be well below levels that would be corrosive and will not harm any reservoir components, including metals, soil-cement, and other materials.

The project looked at other commercial forms of alum commonly available, such as aluminum chlorohydrate, and similar results were noted with alum sulfate being less expensive in the long-term.

Jim stated that, for this project, an alum dose of 0.6 mg/L was determined to meet the goals. Initially, the objective was to suppress algae growth in the reservoir to prevent algal bloom formation. This is a relatively low dose compared to other alum projects. As a result, the accumulation of residuals is expected to be very low and well within the capacity of the reservoir. Based on initial chemical modeling and supported by detailed sediment transport modeling conducted by the project team and SFWMD, the rate of accumulation will be very small, about 0.3 centimeters or less than 0.25 inches, per year. Modeling indicates that most of the alum will be deposited near the pump station inlet in Cell 1 but will not exceed 0.3 centimeters per year. Any deposition in Cell 2 would be less than that and would be attributed to wind-related resuspension.

Based on the literature of alum injection in lakes, any floc that forms will consolidate in the first 30 days and become stabilized within 60–90 days. This is within the duration of the typical storage portion of the reservoir operational schedule. At these rates, it will take a century to accumulate 13 inches (a little more than 1 foot) of solids. The long-term fate of alum in the sediments is crystallization. A benefit of the alum sequestered in the sediments is that it will provide a mechanism for preventing internal loading from sediments.

The design of the alum injection system takes advantage of the large volume of water, and the multiple inlet bays of the S-470 pump station. An alum injection feed line will be installed in each inlet bay that will receive alum pumped from the tank farm in proportion to the flow, and will only operate when the pump station is flowing. Water will be recirculated by a pump to create a high-energy flow to mix with the injected alum, which will dissolve the alum immediately in the inlet bay. The alum and water mix will then be dispersed into the flow through the pump station and into the reservoir. This approach prevents any accumulation of alum within the inlet bays and maintains alum at target concentrations through the pump station for the most effective mixing and to avoid corrosion.

During the design of the alum injection system, additional work was performed on the Sumo alum model. This model takes into account more than 85 variables and is the only model that allows the evaluation of water quality changes, aluminum concentrations, solids, and other factors. This work included the use of an updated version of the model with improvements in characterization of inflow solids, algal growth, and nitrogen processes. The revised modeling indicating that adding more aluminum only slightly increased nutrient removal. A doubling of dose only changed the TN and TP removal by a small percentage and did not significantly increase the amount of sediment. In all cases, the total aluminum remained well below the state water quality standard and U.S. Environmental Protection Agency critical concentration criterion. Sulfate levels increased by less than 5 mg/L, which would not increase the corrosive potential of the water. The conclusion is that the original dose of 0.6 mg/L was appropriate to meet the water quality targets. As a result, there is no need to modify the design or operational approach.

Jim stated that the initial project modeling established that an alum treatment system at the head of the reservoir could accomplish most of the targeted nutrient removal. Alum treatment model results at the time showed that the reservoir discharge would just meet the nutrient targets. As the WQC project moved forward, all technologies were evaluated and confirmed that they could meet the additional target. The revised analysis using the alum treatment model confirmed that the water quality targets could be met by the reservoir alone without the need for a post-storage WQC. Results of the Intermediate Design model indicate that the 0.6 mg/L dose will remove TP on average by 60% to 0.06 mg/L and TN by 25% to 1.0 mg/L, which are below the targets of 0.08 mg/L and 1.2 mg/L, respectively.

Cassondra stated that there were concerns about what the reservoir water would look like post-alum dosing. The photograph on the slide from the pilot study shows that the water is clear to a depth of 2.5 feet, whereas river water is very dark with visibility only a few centimeters deep. Dissolved aluminum was also of concern but the concentration in the water from the pilot study is declining over time and should continue to decline. The aluminum concentrations are well below the 1,500 micrograms per liter standard so there would be no ecological harm. The sulfate concentrations increased from 27 mg/L to 29 mg/L, which is within natural variability of the river, so there would be no impact from the slight increase. Therefore, the residuals do not need to go through a polishing step to be ready for discharge from the reservoir.

Georgia stated that the results of the additional analysis and inclusion of the in-reservoir alum injection system show that the reservoir water can be treated to the intended targets. The net present value cost comparison shows the in-reservoir alum injection system is the lowest cost alternative.

WQC Plan Selection

Kim stated that the in-reservoir alum injection system meets the water quality targets, reduces the opportunity for harmful algal blooms in the reservoir, is the most cost-effective treatment, and will be online concurrently with the reservoir's first fill in summer 2024. J-Tech's modeling and Cassondra's pilot study have also demonstrated sedimentation rates, sulfate concentrations, and alum micro floc are not an issue for reservoir operation, water quality, or benthic and wildlife health. The SFWMD-owned lands to the north of the reservoir will be available for future watershed water quality projects where we can get a bigger benefit for our legislative dollars. SFWMD will continue to identify and work to fund additional water quality projects in the Caloosahatchee River Watershed.

Second Round of Questions

- Q: I always worry about the real world and these projects look nice but the question I have is what percentage of Caloosahatchee River water is going into the reservoir? Particularly, what percentage of water will go to the reservoir when the Lake Okeechobee gates are open, and what will the impact be on the system when there is a rain event and the Lake Okeechobee gates are open because that is when we have problems?
- A: My understanding is that the about 10% of the basin flows will be captured by the reservoir on an annual basis, but this will need to double checked. [Note: After the meeting, J-Tech reviewed the modeling and the flows captured range from 1% to more than 50%, depending on the year, with the median of 18%.]
- Q: What will the impact of treatment of this small amount be on the ecological system in the estuary?
- A: When we think about water quality features going into the future, SFWMD will use the available lands for treatment for the estuary, instead of just focusing on the reservoir itself. What this study demonstrated is that we can address the concerns about the reservoir conditions by making sure the water quality does not come out worse because it has been sitting in the reservoir. The alum injection system does that by treating the water going into the reservoir before it is discharged to the river. SFWMD is looking at a variety of projects in the basin to help improve water quality as part of the Caloosahatchee Watershed Protection Plan.
- Comment: When the reservoir was first discussed, the main purpose was to take freshwater and store it to help meet the minimum flows and levels when the river needed water. The project did not say anything about water quality. We need to do something for the Caloosahatchee River and I have real doubts that water in the reservoir will be much better because of this project. Even if it is, the little bit being treated will not help the river. We are spending a lot of money that only impacts no more than 10% of the flows. [Note: After the meeting, J-Tech reviewed the

modeling and the flows captured range from 1% to more than 50%, depending on the year, with the median of 18%.]

- Q: Recognize that many of the District canals are contaminated with sulfate so comparing this new source to current conditions, a contaminated system, is not appropriate. The levels reported here are similar to sulfate levels in seawater, which has a natural source.
- A: Sulfate concentrations in the river are high and from multiple sources, so the nominal addition of sulfate from the reservoir is mere noise to what is in the river. The goal of the project was for the reservoir to do no harm. The analysis was relative to the concentrations in water coming in from the river, and addressing the other sulfate sources is outside the scope of this study.

- Comment: Thank you to SFWMD for recognizing and addressing the need to treat the water stored in the reservoir, so we can get sufficient clean freshwater flow needed to sustain aquatic resources in the Caloosahatchee River and Estuary. And glad to hear that this is not the only planned water quality treatment to help us reach that objective.

- Q: During the dry period, the proportion of water from the reservoir will be much higher than 10%.
- A: Agree and this is why the WQC project targets are based on the dry season flows and water quality.

Wrap Up

Kim stated that if there are other questions, she can be reached at kfikoski@sfwmd.gov. She noted that the project files are posted to the SFWMD website at https://www.sfwmd.gov/content/c43waterqualitystudy. Kim thanked J-Tech, Working Group, and SFWMD Design Review Team for their diligent efforts. She also thanked everyone who has attended these meetings and provided thoughtful questions and comments.