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CITY OF ST. PETERSBURG

TECHNICAL MEMORANDUM

AWWRF STARTUP EVALUATION

July 2016

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CITY OF ST. PETERSBURG

TECHNICAL MEMORANDUM

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AWWRF STARTUP EVALUATION

1.0 INTRODUCTION

In early 2015, the City of St. Petersburg Water Resources Department (WRD) decommissioned the Albert Whitted Water Reclamation Facility (AWWRF). In 2010, the City completed the AWWRF Operation Alternatives Report (CDM, 2010) that evaluated the options for keeping the AWWRF in service and options for decommissioning and transferring wastewater to the City's other water reclamation facilities.

According to the report, the main reason for decommissioning the AWWRF was the requirements by the Florida Department of Environmental Protection (FDEP) for the City to manage their reject water with reject water storage for re-treatment rather than disposal down the existing deep injection wells. New reject storage would have to been constructed and operated, adding significant costs to the City.

New reject storage facilities would have to be located off-site since there was inadequate space at the existing facility location. This only available property noted in the AWWRF Operation Alternatives Report was a significant distance from the AWWRF and would have to be purchased by the City. In addition, aging facilities would require other extensive capital improvements to meet reliability concerns. The recommendation for decommissioning the AWWRF and pumping wastewater to the SWWRF for treatment was implemented by the City.

Instead of treating wastewater at the AWWRF, wastewater is now pumped to the City's Southwest Water Reclamation Facility (SWWRF) for treatment. To accomplish this, Lift Station 85 was constructed on-site at the AWWRF and new forcemains were added to the SWWRF.

Between late July and early August 2015, the City experienced 21 days of extreme wet weather that overwhelmed parts of the collection system and water reclamation facilities. Due to capacity limitations, these facilities discharged overflows into Clam Bayou near the SWWRF and stored wastewater in empty basins at the AWWRF when the discharges ended. When the basins were full, some wastewater was discharged to the Tampa Bay.

In June of 2016, another wet weather event again forced the City to use the AWWRF for wet weather storage with some wastewater discharged into the Tampa Bay. The stored wastewater from this event was eventually pumped back to the SWWRF for treatment.

To reduce wet weather overflows, the City is implementing a hydraulic expansion of the SWWRF and an infiltration and inflow evaluation of the collection system. In addition, the City is considering restarting the AWWRF for short- and long-term durations. As such, the

City developed three options for restarting the AWWRF as soon as is practicable. The purpose of this TM is to evaluate those options.

1.1 The Albert Whitted Water Reclamation Facility

The AWWRF is a conventional activated sludge process with a permitted capacity of 12.4 mgd and produces effluent for public access reuse in the City's reclaimed water distribution system.

At the AWWRF, wastewater enters the facility through an influent structure located in the main pump station. From there, the wastewater is pumped to preliminary treatment (headworks and grit removal) followed by complete mix aeration basins and then flows by gravity to the clarifiers. Effluent from the clarifiers flows into traveling bridge filters that filter the effluent before chlorination. After flowing by gravity to a ground storage reservoir, the reclaimed effluent can be pumped to the reclaimed water distribution system or to the deep well injection system.

Solids are wasted to an aerated holding tank and then thickened with gravity belt thickeners. The thickened sludge is anaerobically digested, dewatered with belt filter presses, and finally hauled offsite for disposal.

Figure 1 is an aerial site plan of the AWWRF.

1.2 Existing Conditions

Since the decommissioning in early 2015, the AWWRF facilities and tankage have sat empty awaiting demolition. Maintenance investment and activities within the AWWRF was kept to a minimum preceding the decommissioning. Since then, City staff has removed selected equipment, components, and materials for use at other facilities or salvage. Remaining structures and equipment have been exposed with no environmental controls and had no maintenance or upkeep since decommissioning.

The first step in determining the options for, and associated efforts to restart the AWWRF, is to assess the condition of the AWWRF. On June 22, 2016, Carollo Engineers completed a site visit with the WRD operations and maintenance staff. The purpose of this visit was to complete a visual and cursory review of the current conditions of the liquid stream treatment facilities and equipment. Solids handling facilities and equipment were not reviewed, as any approach to restarting the AWWRF would include the transfer of waste solids to the SWWRF through Lift Station 85. No handling or treatment of solids would occur at the AWWRF.

1. New Lift Station 85 that transfers all flow to the SWWRF.
2. Influent Pump Station and Administration Building.
3. Preliminary Treatment – Headworks and Grit Handling.
4. Aeration Basins.
5. Clarifiers 1&2.
6. Clarifiers 3&4.
7. Traveling Bridge Filters.
8. Chlorine Contact Tanks.
9. Reclaim Storage Reservoir and High Service Pumps.
10. Sludge Holding Tank.
11. Thickening Building.
12. Digesters.
13. Dewatering Building.

AWWRF SITE PLAN

FIGURE 1

ST. PETERSBURG
AWWRF STARTUP EVALUATION

Figure 2A and Figure 2B highlight the specific findings from the site visit. Assessment of the many corresponding and critical features that make a wastewater treatment facility function in a reliable manner and meet regulatory requirements were not able to be conducted. Carollo Engineers discussed these features with City staff that need consideration before restarting the AWWRF. A summary of these considerations include:

1. Large and small diameter piping was not emptied after decommissioning. It is likely that piping would require cleaning to remove the solids and grit that have settled and hardened.
2. Remaining valves and gates would require testing to determine maintenance needs or possible replacement.
3. Most, if not all remaining pumps, would require some form of maintenance or possible replacement and testing.
4. Gear boxes and drive units would need maintenance including lubrication and oil.
5. Motors would need to be re-wound or replaced.
6. General electrical distribution gear and wiring would need to be tested and possibly replaced.
7. The standby generator will be removed and installed at the SWWRF as part of another project. A new standby generator would be required to supply backup power.
8.
9. Most, if not all, instrumentation and controls would need to be replaced and tested. This includes monitoring instruments and PLC's.
10. Incidentals would need to be replaced (materials, supplies, tools, dumpsters, vehicles, etc.).

2.0 OPTIONS FOR RESTARTING THE AWWRF

Sections 2.1-2.3 describe the options developed by the City for restarting the AWWRF. Each section includes an implementation approach, schedule, and planning level costs.

2.1 Option 1 - Continue Wet Weather Storage at the AWWRF

While this option does not consider restarting treatment facilities, it does provide a limited capability of reducing overflows during significant wet weather events. With this option, the City would continue to store excess wastewater at the AWWRF and return the wastewater for treatment after the wet weather event subsides. In emergency cases where the City decides to bypass wastewater to prevent other system overflows after maximizing system storage, a controlled discharge is available through the existing outfall to the Tampa Bay.

1. New Lift Station 85:
   - Temporary discharge piping to influent pumps.
2. Influent Pump Station and Administration Building:
   - All administrative facilities removed.
   - All plant controls inoperable.
   - Laboratory equipment removed.
   - 3 Influent pumps operable, 1 influent pump condition unknown.
3. Preliminary Treatment – Headworks and Grit Handling:
   - Mechanical bar screens removed.
   - Conveyors removed.
   - Channel grating removed.
   - Control panels components removed.
   - Odor control inoperable.
   - Power/control wiring removed to equipment and meters.
   - Grit unit motor removed.
4. Aeration Basins:
   - One RAS pump removed, one inoperable.
   - Mixers gear boxes/motors questionable.
   - Some gates/valves removed.
   - Electrical distribution gear removed.
5. Clarifiers 1&2:
   - Scraper mechanism corroded.
   - Drive units questionable.
   - Scum & WAS pumps inoperable.
6. Clarifiers 3&4:
   - Launder damaged.
   - Scum & WAS pumps inoperable.

AWWRF EXISTING CONDITION

FIGURE 2A

ST. PETERSBURG
AWWRF STARTUP EVALUATION

7. Traveling Bridge Filters:
   - Media removed.
   - Overhead power cables cut.
   - Backwash pumps inoperable.
   - Electrical gear removed.
8. Chlorine Contact Tanks:
   - Chemical feed equipment removed.
   - Chemical meters and analyzers removed.
9. Reclaim Storage Reservoir and High Service Pumps:
   - 2 large high service pumps removed.
   - Valves removed.
   - Electrical gear removed.
   - Piping connection to distribution system removed.

AWWRF EXISTING CONDITION

FIGURE 2B

ST. PETERSBURG
AWWRF STARTUP EVALUATION

During the 2015 and 2016 wet weather events, the City used the AWWRF's influent wet well, aeration basins, clarifiers, filter basins, and chlorine contact chamber to hold excess wastewater. These basins have a total volume of approximately 5 million gallons.

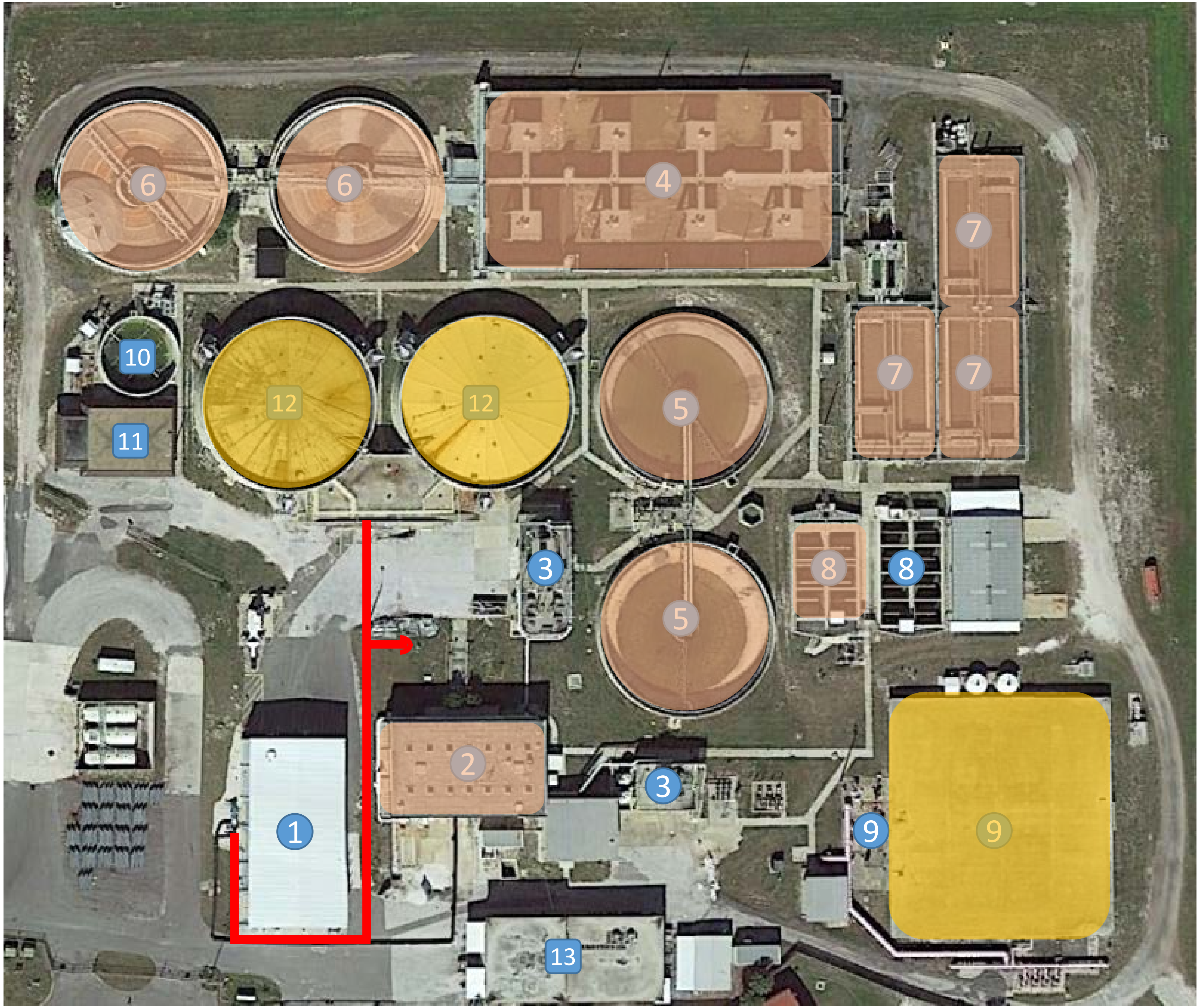
To get the excess wastewater in the AWWRF tanks, the City installed a temporary discharge pipe from Lift Station 85 to the influent wet well. From there it was pumped with the existing influent pumps to the aeration basins. As the aerations basins filled, the wastewater flowed by gravity to the other basins through existing piping. After the wet weather event, the City returned the stored wastewater to Lift Station 85 by using temporary pumps to drain the basins through the existing AWWRF drain system.

To increase the total equalization volume, the City could use additional basins at the AWWRF, including the anaerobic digesters and the reclaimed water storage reservoir. Using the digesters and reclaimed storage reservoir would add approximately 3 million gallons of additional storage volume.

Figure 3 shows the wet weather storage arrangement and work needed to add the additional storage volume.

To add approximately 3 million gallons of additional storage volume, the City would need to complete the following:

1. Clean both digesters to utilize the entire volume. The City has a contract pending for approval in July 2016 with a contractor to complete this cleaning by the end of the year.
2. Connect temporary discharge piping and flow control valve from Lift Station 85 to the below-grade piping leaving the existing influent pump station. This allows pumping directly to the aeration basins via Lift Station 85. This connection would eliminate the need to re-pump excess wastewater from the existing influent pump station, and eliminate the constant monitoring required to prevent the influent pump station from overflowing.
3. Connect temporary discharge piping and flow control valve from Lift Station 85 to the digester facility for filling the digester tanks separately from the other tanks.
4. Add additional portable pumps for removing the stored wastewater from the additional tanks.



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Basins used for storage in previous wet weather events (~ 5 million gallons)

Basins to add additional storage (~ 3 million gallons)

Temporary piping and valving from Lift Station 85:
- Connect to below grade discharge pipe from influent pump station.
- Connect to the digester facility

OPTION 1 – CONTINUE WET WEATHER STORAGE

FIGURE 3

ST. PETERSBURG
AWWRF STARTUP EVALUATION

2.1.1 <u>Option 1 Schedule</u>

The tasks and estimated duration to implement Option 1 is shown below. This schedule assumes that all work would be completed by City staff.

- Total duration = 4 months
  - 3 months to clean the digesters and make ready to hold wastewater.
  - 1 month connect temporary discharge piping and valving.

2.1.2 <u>Option 1 Estimated Cost</u>

The total estimated cost assumes that the City has allocated the expense for cleaning the digesters and is not included in this estimate. The estimated cost to implement this option for piping/valves and installation is approximately $350,000 - $400,000.

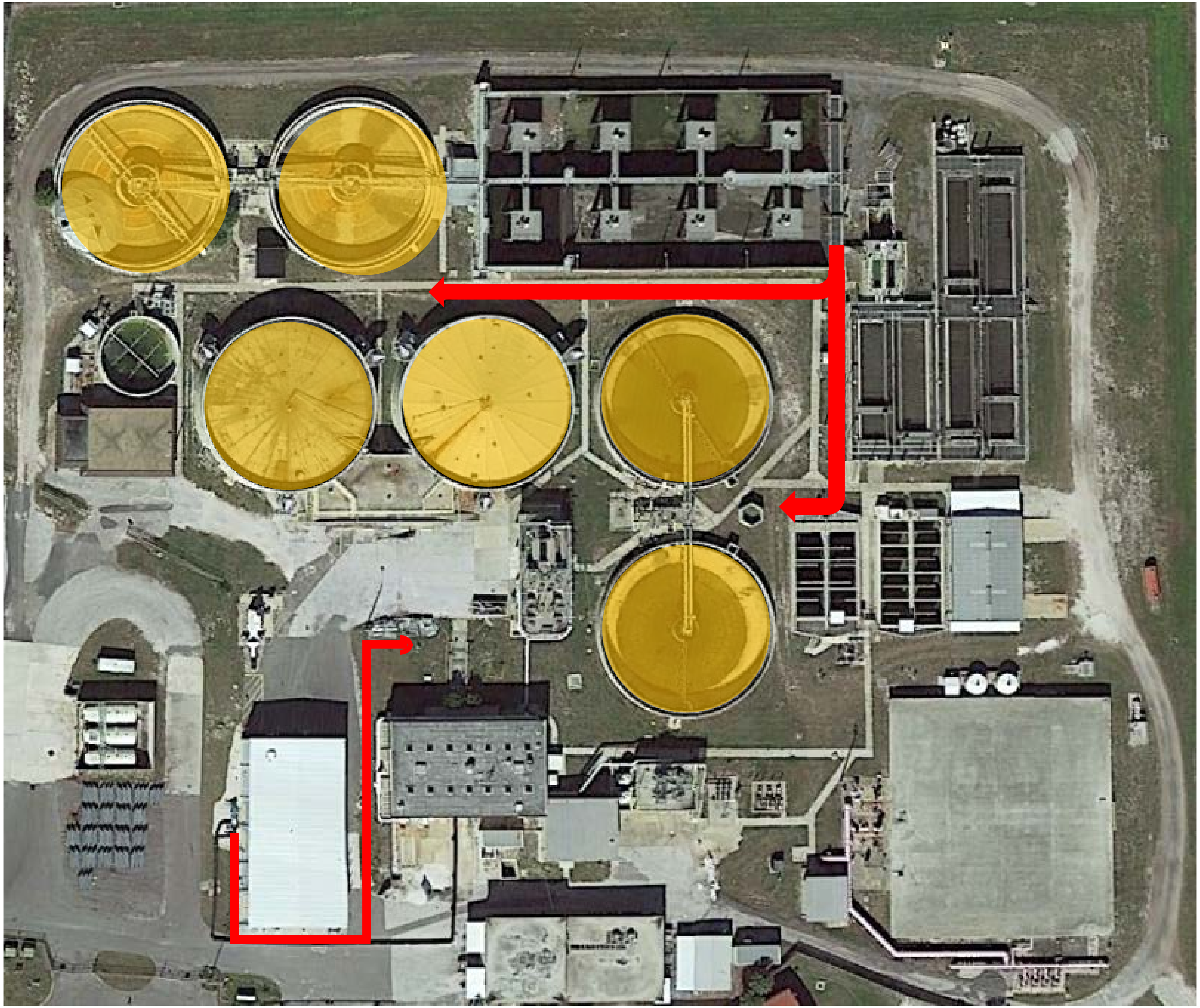
2.2 Option 2 - Restart the AWWRF Liquid Stream Treatment

Under Option 2, the liquid stream facilities and equipment would be restarted to treat the permitted capacity (12.4 mgd) to effluent limits for public access reclaimed water and pumped to the City's reclaimed distribution system. *The intention of this option would be to restart the AWWRF only until the expansion of the SWWRF is complete, and then resume transferring wastewater to the SWWRF.*

Reject water would have to be disposed either down the deep injection wells or pumped offsite to new storage facilities. At this time, it is unknown whether the FDEP would allow the continued use of the deep injection wells for reject disposal. Therefore, this option considers the schedule and cost impacts for both reject disposal alternatives.

The AWWRF would operate under reduced level of automation as before being decommissioned. To meet this level of operation, processes and equipment would require rehabilitation and replacement. Section 1.2 described the existing conditions and needs for repairing and replacing equipment for the liquid stream treatment operations and would be considered a significant investment in time and cost.

Starting the AWWRF's biological treatment process could be challenging. If the City would be allowed to discharge effluent to the deep injection wells that doesn't meet permit quality standards during the startup period, growing the proper biological mass for stable operation would be simplified. However, if this is not allowed, another approach to starting the biological process is summarized in Figure 4.



Biological Startup w/o Discharge

1. Bring in RAS from the other City WRF's (check for filamentous growth).
2. Begin filling aeration basins with raw wastewater from Lift Station 85.
3. Begin aeration of combined RAS and raw wastewater.
4. Recirculate combined flow using RAS pumps from aeration basins to clarifiers and digester tanks.
5. Add supplemental carbon feed.
6. Match up the influent flow to the clarifier and digester volume.
7. Do not release any flow until clarifier/digester effluent meets permit limits.
8. After effluent meets permit, slowly increase raw wastewater flow.
9. Waste solids when required.
10. Use chlorine to control filament growth until biomass and influent are stable.

OPTION 2 – RESTART AWWRF LIQUID STREAM TREATMENT

FIGURE 4

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AWWRF STARTUP EVALUATION

Disposal of waste solids to the SWWRF for treatment would require a complicated batch wasting and pumping operation. The influent gravity pipe to the AWWRF was filled with concrete after Lift Station 85 was put in service. Therefore, Lift Station 85 would be needed as the influent pump station for the AWWRF. Since Lift Station 85 would also be needed to transfer waste solids to the SWWRF, pumping waste solids to the SWWRF would interrupt the influent flow to the AWWRF. The amount of waste solids is not enough to pump alone through Lift Station 85 force main, and would need to be diluted with influent wastewater to provide adequate flow. One sequence in how this could be controlled after the AWWRF is restarted is as follows:

1. Waste solids would be stored in the aerated holding tank.
2. When the holding tank is full, all or partial discharge from Lift Station 85 would be directed to the SWWRF. During this time, influent flow to the AWWRF would be reduced or stopped.
3. Waste solids from the holding tank would be pumped to the wet well in Lift Station 85, combined with influent wastewater, and then pumped to the SWWRF.
4. After the holding tank is empty, and enough flow has been pumped through the forcemain to pass the waste solids all the way to the SWWRF, the discharge from Lift Station 85 could be redirected back to continuing feeding the AWWRF.

Another consideration for handling the waste solids disposal after restarting the AWWRF would be a contract operation. This would include a contractor providing a mobile dewatering unit located at the AWWRF and hauling and disposal of the dewatered solids.

2.2.1 Option 2 Schedules

Since it is unknown at this time whether the FDEP would grant an extension for allowing reject water to be pumped down the deep injection wells, two schedules have been developed for this option. Table 2.1 summarizes the schedule durations.

Table 2.1 - Option 2 Schedule Durations

Reject Water Pumped to Deep Injection Wells		
TASK	DURATION (MONTHS)	COMMENT
Engineering procurement, design, permitting, and contractor procurement	10-12	Assumes design for rehabilitation of existing equipment only
Rehabilitation, replacement, and construction	12-14	Assumes accelerated delivery for new reclaim pumps and generator
Testing and startup	3-4	
TOTAL DURATION	*25-28*	
Reject Water Stored Offsite		
TASK	DURATION (MONTHS)	COMMENT
Engineering procurement, design, permitting, offsite property purchase, and contractor procurement	16-18	Assumes purchase of offsite property to be completed before contractor is procured
Rehabilitation, replacement, and construction	18-20	Longer duration included for new reject pump station, forcemain, and storage offsite
Testing and startup	2-3	Assumes using new offsite reject storage to reduce startup time
TOTAL DURATION	*36-41*	

If the reject water has to be pumped and stored offsite, the time to implement this option increases significantly by having to purchase the offsite property and construct new facilities (reject pump station, forcemain, and storage tank).

The work required to implement this option impedes the opportunity to restart the AWWRF in less than 2 years. It is likely the SWWRF expansion would be completed concurrently, or shortly after the AWWRF could be operating under this option.

2.2.2 Option 2 Estimated Costs

The total estimated costs assume that the City would procure an engineering firm to develop the rehabilitation/replacement and construction documents, and procure a contractor to complete the work. It is assumed the startup of the AWWRF would be completed by City staff.

The estimated costs to implement this option are shown in Table 2.2.

Table 2.2 - Option 2 Estimated Costs

Reject Water Pumped to Deep Injection Wells	
ITEM	ESTIMATED COST [1]
Rehabilitation/Replacement of treatment facilities summarized in Section 1.2	$6,000,000 to $8,000,000
New reclaimed distribution pumps, valves, and piping	$1,000,000
New standby generator	$1,000,000
Subtotal	$8,000,000 to $10,000,000
Contingency (30%)	$2,400,000 to $3,000,000
TOTAL ESTIMATED PROJECT COST	$10,400,000 to $13,000,000
Estimated O&M Cost / Year [3]	$2,700,000
Reject Water Stored Offsite	
Rehabilitation/Replacement of treatment facilities summarized in Section 1.2	$6,000,000 to $8,000,000
New reclaimed distribution pumps, valves, and piping	$1,000,000
New standby generator	$1,000,000
New property and offsite reject storage facilities [2]	$14,500,000
Subtotal	$22,500,000 to $24,500,000
Contingency (30%)	$6,800,000 to $7,400,000
TOTAL ESTIMATED PROJECT COST	$29,300,000 to $31,900,000
Estimated O&M Cost / Year [4]	$3,000,000

(1) Total costs based on a Class 4 "Study Level" estimate according to the Recommended Practice 18R-97 Cost Estimate Classification System for the Process Industries, published in 1998 (revised March 2016) by the Association for the Advancement of Cost Engineering (AACE).

(2) From AWWRF Operation Alternatives Report (CDM, 2010). No escalation included.

(3) Based on 2014 actual O&M costs.

(4) Escalated 2014 actual O&M costs to include new offsite storage facilities.

Due to the unknown condition of most equipment and electrical components, the risk is high that costs could escalate significantly after the true condition is determined during the design and construction of this option.

2.3 Option 3 - Convert the AWWRF to Advanced Wastewater Treatment

For this option, the existing facilities would be modified to treat a baseline flow to Florida's Advanced Wastewater Treatment (AWT) standards. The baseline flow would be developed from the capacity of what the modified existing basins could treat to AWT. As a result, no additional treatment basins would be added under this option. Effluent would be disposed by pumping to the existing reuse system, discharging to the Tampa Bay, or through deep injection wells.

This option was considered as it eliminates the problems with reject water disposal. All flow would be discharged to the Tampa Bay eliminating the use of deep injection wells or offsite storage. This option is also based on a permanently operating AWWRF into the future.

A high-level, conceptual evaluation of alternatives to upgrade the AWWRF to meet AWT is included in this option. Any facility discharging reclaimed water to Tampa Bay must produce reclaimed water that meets Florida's AWT water quality limits and not exceed disinfection byproduct (DBP) limits from chlorination if discharging to a surface water. Therefore, to avoid compliance violations from DBP's, many wastewater facilities in Florida that surface water discharge have been changing to alternative disinfection strategies. One of the most common technology used to eliminate the DBP issue is ultraviolet disinfection (UV). For this option, it has been assumed that the AWWRF would convert from chlorination to UV for disinfection.

Florida statutes define AWT treatment as reclaimed water containing no more the 5 mg/L five-day carbonaceous biochemical oxygen demand (cBOD5), 5 mg/L total suspended solids (TSS), 3 mg/L total nitrogen (TN), and 1 mg/L total phosphorus (TP). Although phosphorus removal is not currently required for discharge to Tampa Bay, this evaluation assumes that the facilities would be provided to precipitate and remove phosphorus using an appropriate chemical like ferric chloride or aluminum sulfate. In addition to the requirement to meet Florida AWT standards, any discharge to Tampa Bay or its tributaries would be required to meet annual and five-year limits on the total mass of nitrogen discharged as determined by the Tampa Bay Nitrogen Consortium. These mass limits could ultimately require nitrogen removal to concentrations less than 3 mg/L. Reclaimed water that is suitable for discharge to Tampa Bay can also be used for public access reuse.

A range of technologies are available to meet virtually any water quality standard, although the cost and full-scale operating experience vary over a wide range from tried and true technologies to innovative technologies that have only recently been proven at full-scale. Technologies that have been evaluated for other Florida utilities include the following:

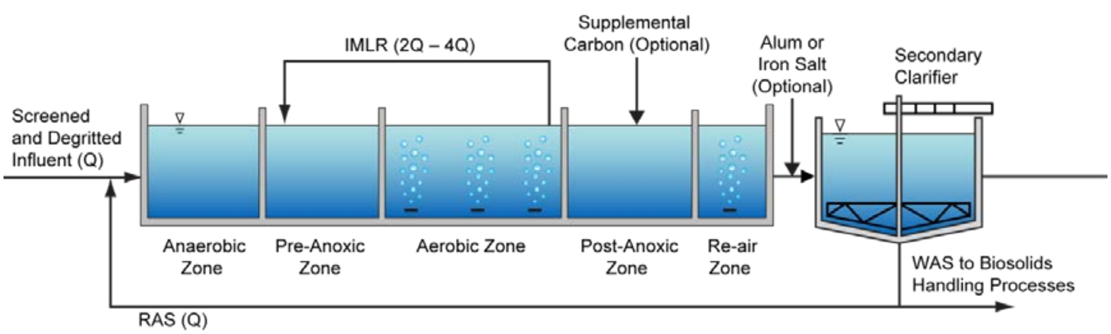
- Conventional (four-stage) Bardenpho process (B4)
- Integrated fixed-film activated sludge (IFAS) in a Bardenpho configuration
- Biological Active Filters (BAFs)
- Moving Bed Biofilm Reactor (MBBR) in a Bardenpho configuration
- Membrane bioreactor (MBR) in a Bardenpho configuration
- Ballasted activated sludge (BAS) in a Bardenpho configuration
- Granular activated sludge (GAS)

Alternative B4 represents a well-proven treatment technology that is capable of meeting AWT limits. The B4 process is also the most frequently used AWT process in Florida. At the other extreme of full-scale use is Alternative GAS. GAS has been proven at full-scale elsewhere in the world, but it has not been implemented at any water reclamation facilities in the United States.

To illustrate the range of technologies that could be implemented at AWWRF, we have selected the B4 and BAS processes. Both alternatives use a Bardenpho configuration; however, BAS allows the existing tanks to hold a larger biomass inventory, and therefore this technology can provide more treatment capacity.

2.3.1 Bardenpho Process

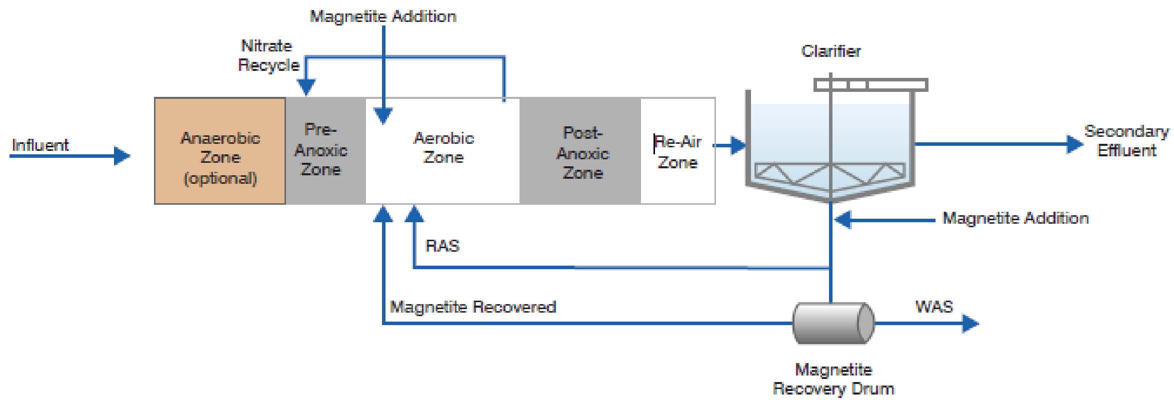
The conventional (four-stage) BardenphoTM process consists of pre-anoxic, aerobic, post anoxic, and reaeration zones in sequence. Traditional gravity clarifiers separate the mixed liquor generated within the biological process. Suspended solids escaping the secondary clarifiers are further removed using filters. The pre-anoxic zone provides for initial removal of nitrate nitrogen using the influent cBOD5 as the food source. In the pre-anoxic zone heterotrophic bacteria reduce the nitrates recycled back from the aerobic zone to nitrogen gas. The denitrification reaction rate within the post anoxic zone is generally endogenous and slower than that compared to the denitrification rate within the pre-anoxic zone upstream of the aerobic zone. A small final aeration step is added after the post anoxic zone to strip nitrogen gas and to convert any ammonia released in the post anoxic zone to NO3-N. The four-stage BardenphoTM process can consistently achieve effluent TN concentrations of less than 3 mg/L. A filtration step after the final clarifiers provides the solids removal needed to meet a TSS limit of 5 mg/L.



Process Flow Schematic for a Bardenpho Upgrade

2.3.2 Ballasted Activated Sludge Process

BAS technology allows for a higher biomass concentration than a conventional B4 process by physically improving solids-liquid separation in the clarifiers with a weighting or ballast material. The ballast material is magnetite which is a naturally magnetic, plentiful, dense, and inert iron oxide. Large amounts of magnetite find use in the manufacture of steel, abrasives, and iron salts, and in the mining industry to separate coal with low sulfur content. BAS is a relatively new process that has gained a foothold in the 1-10 mgd market quickly since the first full-scale installation in 2011. There are now a total of eight full scale plants in operation, four in start-up, and four in construction.



Process Flow Schematic for a Ballasted Activated Sludge Upgrade

BAS is especially well suited to retrofitting existing plants because its use does not require structural alterations to existing tanks. BAS does require covered floor-space to house the magnetite feeding and recovery equipment. Magnetite is recovered from waste activated sludge (WAS) using a shear mill and a magnetic recovery drum and reused. Around a 1:1 mass ratio of magnetite to biomass is added to the mixed liquor, allowing for a mixed liquor volatile suspended solids (MLVSS) concentration of 5,000-6,000 g/L or a total suspended solids (TSS) concentration of 10,000-12,000 mg/L. Because the specific gravity of magnetite is high, about 5.2, it has ample ability to increase MLSS settling velocities significantly, and is around 90 to 95% recoverable via its magnetic properties.

2.3.2.1 Design Assumptions

Historical data presented in the *2002 City of St. Petersburg Master Plan-Phase 1 Albert Whitted Water Reclamation Facility* and typical textbook nutrient ratios were the basis for the raw wastewater characteristics were assumed in this analysis. The existing activated sludge process at the AWWRF is assumed to consist of two parallel aeration tanks with a capacity of 1.2 million gallons each, and four circular clarifiers with diameters of 100 feet.

2.3.2.2 Facility Requirements and Capacity

To implement either the B4 or BAS technology in the existing tanks, the existing aerator platforms must be removed, and intermediate baffle walls constructed to divide each tank into four zones - pre-anoxic, aeration, post anoxic, and reaeration. Both technologies require that the existing aeration tanks be subdivided approximately as shown below.

Zone	Volume (mgal)
Pre-anoxic	0.50
Aerobic	1.10
Post anoxic	0.60
Reaeration	0.20
Total	2.40

For both technologies, mixers are required in each anoxic zone, and a new diffused aeration system must installed in both aerobic zones. In addition, mixed liquor recycle pumps are needed to recycle nitrate rich mixed liquor from the main aeration zones back to the pre-anoxic zones. At the same time, it would be prudent to renovate the final clarifiers by replacing the internal flow inlets and sludge collection mechanisms in each final clarifier and to install new return activated sludge (RAS) pumps to pump the solids separated in the clarifiers back to the head of the bioreactors. New waste pumps will be needed to remove surplus sludge from the process.

The BAS technology will also require a magnetite storage, feed and recovery system. This includes a fine screen system for the WAS, a magnetite feed system, magnetite recovery system, storage silo, controls, and associated meters, valves, and pumps. The magnetite system must be enclosed in a structure.

The treatment capacity that could be achieved by each technology is:

- B4 process would have a maximum month treatment capacity of approximately 4-5 mgd
- BAS process would have a maximum month treatment capacity of approximately 8-9 mgd.

2.3.3 <u>Option 3 Schedule</u>

The tasks and estimated durations to implement Option 3 are shown below and would be longest duration of any option.

- Total duration = 38-43 months
  - Engineering procurement, design, permitting, and contractor procurement = 16-18 months.
  - Rehabilitation, replacement, and construction = 18-20 months.
  - Testing and startup = 4-5 months.

2.3.4 Option 3 Estimated Costs

Based on historical bid prices, and using overall construction costs per unit of treatment capacity, the estimate for upgrading the AWWRF to meet AWT standards using a conventional B4 process would cost approximately $8.00/gpd of average day/maximum month treatment capacity for approximately 5 mgd of capacity, or $40 million.

Using an innovative BAS process would cost approximately $8.50/gpd of average day/maximum month treatment capacity, or approximately $42.5 million for approximately 10 mgd capacity when compared to the B4 alternative.

3.0 RECOMMENDATION

Based on this limited evaluation of the options for restarting the AWWRF, it appears that the best course of action is to continue with Option 1 - Continue Wet Weather Storage at the AWWRF until the expansion of the SWWRF is completed.

Each option has its advantages and disadvantages. However, considering the urgency and costs associated with any action the City undertakes with the AWWRF, Option 1 fares better than the other options for the following reasons:

- Option 1 is the quickest, least complex, and lowest cost option to implement. However, there is no guarantee this option would prevent future discharges before the planned expansion of the SWWRF is completed.
- Option 2 - Restart the AWWRF Liquid Stream Treatment has a significant cost and duration. By the time this option could be implemented, the planned expansion of the SWWRF is scheduled to be near completion. The effort and expense associated with Option 2 for the limited time it may be in operation makes this the least desirable approach of all options.
- Option 3 - Convert the AWWRF to Advanced Wastewater Treatment is a significant investment and the longest duration to implement. Option 3 would change the ongoing long-term approach to wastewater treatment by committing to operating the AWWRF into the future.