The recommended pumping upgrade at EWRF will increase the reliable capacity of the PAR pump station from the existing 0.5 MGD to 2.5 MGD for Phase VI conditions, to reliably meet the targeted level-of-service (peak hour factor of 10.5) for direct PAR customers. Based on the targeted level-of-service, the PAR demand that can reliably be served by the facilities in the ESA, after the proposed next phase of expansion, was determined to be 5.6 MGD AADF (**Table ES-1**). The estimated 5.6 MGD AADF PAR demand was used as the ESA PAR demand corresponding to the Phase VI EWRF wastewater flow of 31.0 MGD AADF in the reclaimed water capacity analysis to determine the supplemental supply and wet weather needs for next phase of facilities expansion in the ESA. For the next phase of expansion and at future build-out, note that the ERRWDS may still be used to serve some portion of OCU ESA PAR demands; however, for conservative planning, the recommended sizes of OCU reclaimed water pump stations were selected assuming a worst-case condition of no flow served through ERRWDS.

Although the ESA PAR demand for next phase of facilities expansion in the ESA was estimated to be 5.6 MGD AADF, it is possible that PAR demand can grow more than the estimated 5.6 MGD AADF prior to wastewater flow reaching 31.0 MGD AADF in the ESA. Likewise, the Curtis H. Stanton Energy Center (SEC) demand can change to more than or less than 8.0 MGD AADF. Therefore, a reclaimed water capacity analysis was performed for the ESA to capture the uncertainty in future demands and capacity of wet weather facilities. The goal of the reclaimed water capacity analysis was to identify shortfalls in the existing system when meeting future expected demands and to determine the need for additional supplemental supplies and wet weather flows.

For the assumed Phase VI demand (PAR = 5.6 MGD AADF; SEC = 8.0 MGD AADF) and supply (31.0 MGD AADF) conditions, the water budget modeling results indicate that supplemental supplies are not needed for this demand level; however, a need for additional wet weather facility capacity was predicted, as the demand-to-supply ratio was rather low (45%).

The water budget model also shows that the need for supplemental supply for the PAR system is contingent upon the demand-to-supply ratio. The capacity analysis shows that the ESA reclaimed water system can serve demands reliably up to a demand-to-supply ratio of approximately 60-65%, before additional supplemental supplies will likely be needed. The water budget model predicted no shortfall in wet weather needs for a demand-to-supply ratio of 80%. At ratios of less than 80%, the wet weather shortfall depends on the assumed capacity of the EWRF on-site wetlands, which makes these wetlands a key component of EWRF's long term wet weather management strategy.

Based on past performance, there is uncertainty regarding the long term hydraulic capacity of the wetlands. If the wetlands can perform at their permitted rate of 12.2 MGD AADF on a long-term basis, the need for additional wet weather capacity (at the suggested 90% reliability level) varies from 0.5 to 0 MGD AADF at demand-to-supply ratios of 56% to 65%, respectively. However, if the wetlands underperform on long-term basis, the wet weather deficit would increase. For example, at an assumed wetlands capacity of 8.5 MGD AADF, the need for additional wet weather management facility capacity at the 90% reliability level is predicted to vary from 2.1 to 0.6 MGD AADF, for demand-to-supply ratios of 56% to 65%.

The reclaimed water analysis suggests that there is a “sweet spot” at a total demand-to-supply ratio for the ESA of about 60-65% (with 31 MGD AADF EWRF supply, 8 MGD AADF SEC demand, and 12 MGD AADF ESA PAR demand), where both the predicted supply shortfall and wet weather facility deficit may be balanced and minimized, with limited needs for new supplemental supply or additional wet weather infrastructure. Because the SEC is the largest reclaimed water user, its demand variability impacts EWRF reclaimed water management strategies. Therefore, OCU should obtain a firm understanding of OUC’s needs for reclaimed water over the short term (next 10 years) and long term (> 10 years). Understanding the future needs of the SEC is critical for OCU to determine how much additional PAR demand can be connected to the EWRF system to achieve a target of 60-65% demand-to-supply ratio.

1 INTRODUCTION

Orange County Utilities (OCU) owns and operates the Eastern Water Reclamation Facility (EWRF) located at 1621 South Alafaya Trail in east Orange County (**Figure 1**). The EWRF is an advanced wastewater treatment facility that serves residential, commercial and industrial customers in the County's East Service Area (ESA) (**Figure 1**), which includes rapidly growing areas such as Lake Nona, Lee Vista and Moss Park. With several new developments, such as Sunbridge, Starwood, Storey Park, Camino Reale and others in various stages of planning and approvals, growth in the ESA is expected to be robust in the foreseeable future.

Since starting operations in 1982, EWRF has undergone several phases of upgrades to meet the growing needs of the ESA, including the Phase V upgrades currently under construction. With the expected completion of Phase V construction in 2019, the permitted capacity at EWRF will increase from 19.0 million gallons per day (MGD) on annual average daily flow (AADF) basis to 24.0 MGD AADF. The Florida Department of Environmental Protection (FDEP) permit for EWRF allows discharge of the treated effluent (reclaimed water) to the following systems for reuse or wet weather disposal:

1. A local public access reuse (PAR) system in OCU's ESA
2. A regional PAR system (via agreement with the City of Orlando)
3. A nearby power plant - Curtis H. Stanton Energy Center (SEC) for use as cooling water
4. An on-site constructed and natural wetland system that discharges to a tributary of the Big Econlockhatchee River
5. Rapid infiltration basins (RIBs) located on the EWRF site

Flow through EWRF has averaged above 19 MGD since 2015, with the potential for rapid growth in the ESA to continue, further expansion of EWRF treatment is needed. Therefore, OCU is planning an additional 7-MGD upgrade as part of the next phase (Phase VI) of expansions at EWRF, which will increase the treatment capacity of the plant to 31.0 MGD AADF. The Phase VI expansion for EWRF has been split into two separate and successive projects: Phase VI-A, for reclaimed water management infrastructure and improvements, and Phase VI-B, for EWRF treatment facility infrastructure upgrades.

Carollo Engineers, Inc. (Carollo), with assistance from WSP USA (WSP), has been tasked to prepare a Basis of Design Report (BODR) for the Phase VI-A expansions at EWRF. The BODR will provide the design criteria for the expansion of the reclaimed water storage, pumping and transmission systems at the EWRF as part of the proposed Phase VI upgrades. This technical memorandum provides a basis for determining the storage and pumping and a high-level assessment of the various reclaimed water management alternatives for Phase VI conditions. The technical memorandum will evaluate the following:

1. Storage and high service pumping need for PAR at EWRF
2. Supplemental supply needs and reliability of wet weather management alternatives for the ESA

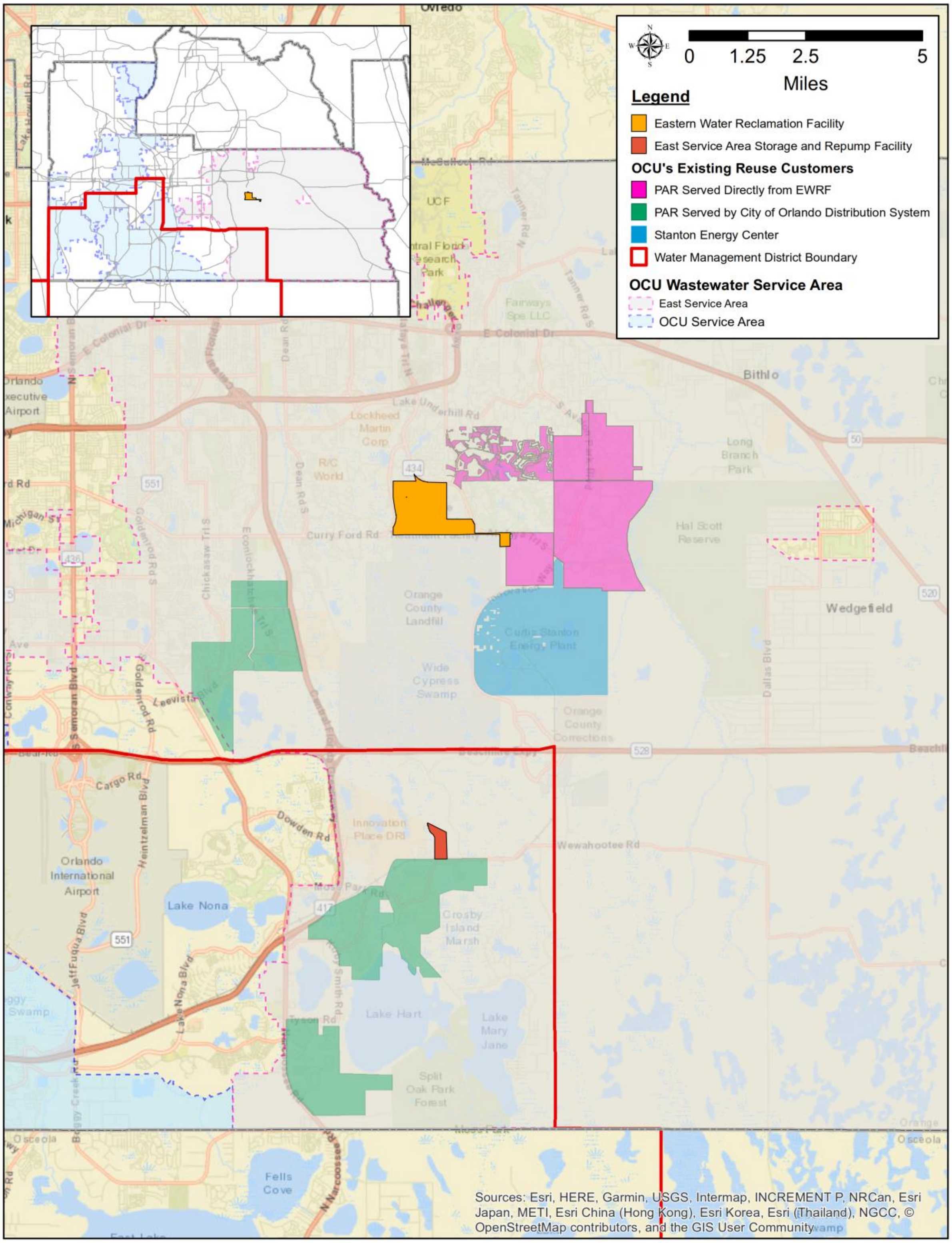

Figure 1. Location Map

2 FUTURE CONDITIONS

2.1 Wastewater Flow Projections

Eastern Water Reclamation Facility (EWRF) is currently undergoing Phase V construction that will increase its treatment capacity from 19.0 million gallons per day (MGD) annual average daily flow (AADF) to 24.0 MGD AADF. For Phase VI Improvements at EWRF, Orange County Utilities (OCU) has decided to construct a 7.0-MGD expansion in treatment capacity; therefore, 31.0 MGD AADF was used as the Phase VI-A capacity of EWRF for the reclaimed water management analysis for the East Service Area (ESA). While flow projections were not developed as part of this project, previous studies (e.g., PB, 2011) have projected that EWRF flows likely will reach 31.0 MGD AADF sometime during the 2030's.

2.2 Reclaimed Water Demands

Reclaimed water in the ESA is currently used for cooling purposes at the Orlando Utilities Commission's (OUC's) Stanton Energy Center (SEC) and for public access reuse (PAR) irrigation by OCU ESA residential customers. While SEC is currently the largest reclaimed water customer in the ESA, PAR demands are expected to grow in the future.

2.2.1 PAR Irrigation Demand

OCU's reclaimed water infrastructure currently does not reach all its existing customers in the ESA; therefore, only a portion of the current ESA PAR demand is served directly from EWRF. A significant portion of the existing ESA PAR demand is served indirectly via the City of Orlando's Eastern Regional Reclaimed Water Distribution System (ERRWDS) pipeline. As of 2016, the total PAR demand in the ESA was estimated to be 3.5 MGD AADF. Approximately 1.5 MGD AADF of ESA PAR demand in 2016 was served directly from EWRF, while the remaining 2.0 MGD AADF was served from the ERRWDS. PAR irrigation demand is projected to increase in the future and comprise the bulk of the long-term reclaimed demand in the ESA. OCU provided build-out estimates of reclaimed water demands associated with the major planned developments (PDs) in the ESA. **Table 1** provides a summary of build-out reclaimed water demands for the known PDs in the ESA. OCU has indicated that all existing developments in the ESA are at or near build-out and will not contribute significant additional demand in the future. As shown in **Table 1**, PAR irrigation demand in the ESA is expected to increase by an estimated 15.19 MGD AADF, to reach a total build-out demand of 18.69 MGD AADF.

Table 1. Future PAR Irrigation Demand for OCU ESA

Development Name	Average Demand (MGD) (1)
Existing PAR Demands (2016)	**3.50** (2)
Future PAR Demands	**15.19**
Vista Park	0.91
Morgran	0.49

Table 1. Future PAR Irrigation Demand for OCU ESA

Development Name	Average Demand (MGD) [1]
Spring Isle	0.05
Sunbridge/ICP	3.16
Camino Reale	0.80
Starwood	1.96
Storey Park	0.87
Eagle Creek Development	0.68
Eagle Creek Golf	0.50
Lake Hart	0.95
Moss Park	1.26
Moss Park Preserve	0.08
Poitras	1.53
Narcoossee Road (South of 417)	0.16
Lake Pickett (North and South)	1.78
Total Build-out PAR Demand	18.69

[1] Build-out Demand provided by OCU

[2] As of 2016, approximately 1.5 MGD served directly from EWRF and 2.0 MGD served from the ERRWDS

2.2.2 SEC Demand

OCU's SEC is a power plant that uses a multitude of fuel sources such as natural gas, landfill methane gas, coal and solar for generating electricity. The SEC uses reclaimed water for cooling purposes. It is permitted to use up to 13.0 MGD of reclaimed water for cooling. Historical data suggests that demand for cooling water at the SEC peaked at 10.6 MGD AADF in 2006, and had since declined substantially. Diversification of fuel sources has led to the reduction in the need for cooling water. Flow to SEC has averaged about 6-8 MGD AADF in recent years. While it is difficult to predict the long term need for reclaimed water at the SEC, it is not expected that the SEC will need reclaimed water at its full contracted/permitted capacity because of the diversification of fuel sources. For the purposes of this study, it was assumed that flow to the SEC will average at about 8.0 MGD AADF in the future. However, with no contractual obligations for a minimum withdrawal, the SEC demand creates uncertainty in EWRF's future reclaimed water management strategy.

2.2.3 Wetland Hydration Demand

Although the on-site wetlands at EWRF are used primarily to manage excess reclaimed water during wet weather conditions, they do need a minimum hydration level to maintain a healthy vegetation coverage. Most of the minimum hydration need for the wetlands is met by rainfall. However, during periods of dry weather, reclaimed water augmentation is needed. Previous studies have developed estimates of a typical annual reclaimed water augmentation need of approximately 0.3-0.4 MGD AADF. Reclaimed water augmentation demand for minimum wetland hydration was developed as part of a water budget analysis for this project.

2.3 Reclaimed Water Supply

While a large portion of existing PAR demand in OCU's ESA is currently served indirectly via the City of Orlando's ERRWDS pipeline system, OCU is in the process of constructing reclaimed water infrastructure in the ESA to reach those customers. OCU has indicated that most of the customers currently served from the ERRWDS will be served directly by the OCU system in the future, once the infrastructure is constructed. Some customers in the ESA, mainly in the Lee Vista area, may still be served from the ERRWDS in the future; however, that portion of the PAR demand served from the ERRWDS in the future is expected to be only a small fraction of the overall PAR demand in the ESA. Therefore, for the purposes of the reclaimed water management analysis, it was assumed that all existing OCU customers will be switched from ERRWDS to the OCU system before the end of the planning horizon (Phase VI), receiving water from OCU's ESA or from the South Service Area (SSA) distribution system via an ESA-SSA interconnection, currently under construction. This assumption is a conservative approach with regard to the sizing of recommended future OCU reclaimed water infrastructure. However, per its contract with the City, OCU can use up to 4.0 MGD AADF of the capacity in the ERRWDS to serve its customers or for wet weather flow management. The reclaimed water management analysis, discussed later in this Technical Memorandum, relies on using up to 4.0 MGD AADF capacity in the ERRWDS for wet weather management.

Most of the future PAR demand in the ESA is expected to occur in the southeastern portion of Orange County. To serve the future PAR demands in this area of the County, a remote reclaimed water storage and repump facility (SRF) known as the East Service Area (ESA) SRF was recently completed on Wewahootee Road in the Moss Park area (**Figure 1**). All future OCU PAR demands in southeastern Orange County are expected to be served directly from the ESA SRF. OCU is planning upgrades to the ESA SRF to meet the future PAR needs in the ESA. A second SRF is also being planned to serve the developments in the Lake Pickett area located north of State Road 50.

Both SRFs will have above ground storage tanks to store reclaimed water received from EWRF, and commensurate pumping capacity to serve the local PAR demands during peak periods. OCU provided guidance on the likely split of reclaimed water supply from the different facilities in the ESA to meet build-out PAR needs. As shown in **Table 2**, EWRF is expected to serve about 30% (5.63 MGD) of the build-out PAR demand, while ESA SRF will serve about 60% (11.28 MGD), with the remaining 10% (1.78 MGD) being served by the Lake Pickett SRF.

Table 2. Estimated ESA PAR Irrigation Supply Served Directly at Build-out

Direct Source of Reclaimed Water	Annual Average Daily Flow (MGD)	Future PDs Served
EWRF	5.63	Sunbridge [1], Vista Park, Morgran Property and Spring Isle
ESA SRF	11.28	Sunbridge [1], Camino Reale, Starwood, Storey Park, International Corporate Park (ICP) PD/LUP [3]
Lake Pickett SRF	1.78	Lake Pickett area development
Total Reclaimed Water Supply	**18.69**	

Notes: [1] Per OCU guidance an estimated 86% of Sunbridge PAR demand will be served from EWRF and 14% from ESA.
[3] PD/LUP is Planned Development / Land Use Plan

3 STORAGE AND PUMPING INFRASTRUCTURE NEEDS

3.1 Reclaimed Water Peaking Factors

Capacities for future reclaimed water facilities (storage and pumping) are evaluated based on peak hour and maximum day demands. Peaking factors used for determining future infrastructure needs were developed for the ESA, as described below.

3.1.1 Daily

Historical data from actual PAR demands measured in the ESA were used to compute observed daily peaking factors. A frequency distribution of daily historical PAR demand in the ESA during recent years (2013, 2014 and 2016) was developed to determine the theoretical maximum day factor from the observed data (**Figure 2**).

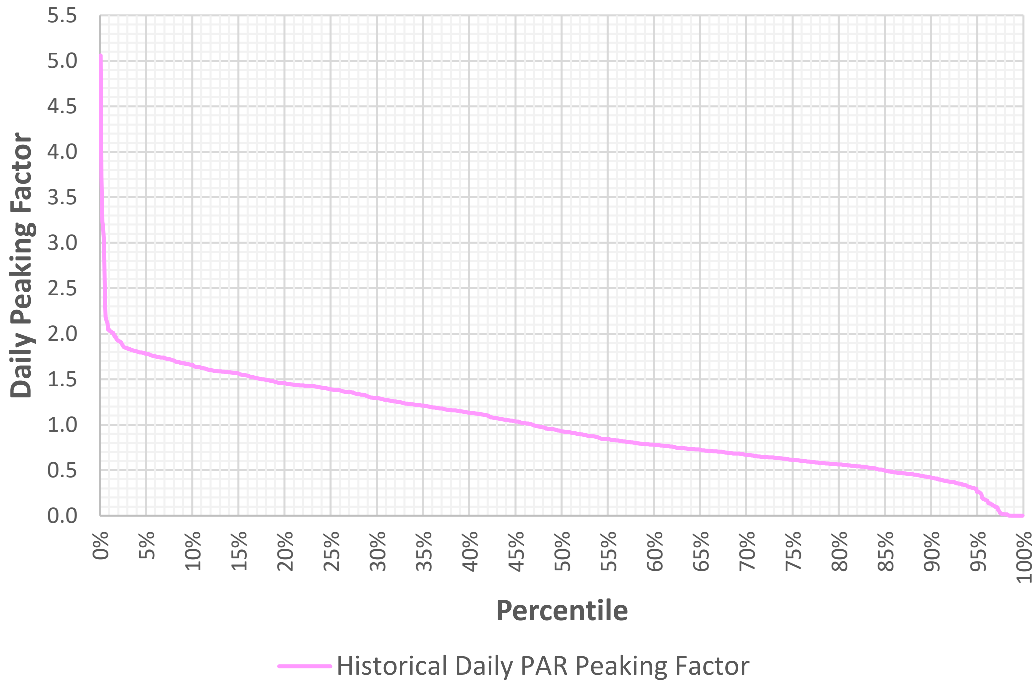

Figure 2. Historical ESA PAR Daily Demand Peaking Factor Frequency Distribution

As shown in **Figure 2**, the highest maximum day peaking factor observed during the 3-year period was 5.0. From the maximum observed value, the peaking factor drops sharply to a value of 2.0, which has a small probability of occurrence of only 1.5% on any given day. With a low probability of occurrence, a maximum day peaking factor of 2.0 is a conservative estimate for future design and therefore was selected to be used for this analysis.

3.1.2 Hourly

Hourly data for ESA PAR demand was not available to compute peaking factors. Therefore, Orange County's guidance was used to develop the peak hour demand factor, as follows:

Number of irrigation days in a week = 4 days
Weekly irrigation day peak factor = 7 days ÷ 4 days = 1.75
Duration of irrigation on irrigation days = 4 hours
Irrigation hour factor = 24 hours ÷ 4 hours = 6.0
Effective total peak hour demand peaking factor on irrigation day for ESA = 1.75 × 6.0 = 10.5

Peak hour factors used for planning level analyses typically vary from 4.0 to 6.0. However, Orange County staff provided anecdotal information of very high peaking factors during extreme drought conditions in 2017. OCU wants to maintain its level-of-service for similar drought conditions in the future. Therefore, per OCU guidance, a maximum peak hour factor of 10.5 was assumed for evaluation of reclaimed water facilities for Phase VI conditions. As the PAR system grows in the ESA and approaches build-out in the future, the system will become more mature with possible future regulations restricting water use. Therefore, it is expected that the peak hour peaking factor will decline and reach a more typical value of 4.0 to 6.0 by build-out conditions.

3.2 Storage

Estimation of storage was based on providing sufficient capacity to store a maximum day PAR demand for the customers served directly by each facility. To be conservative, it was also assumed that only 85% of the total storage capacity will be available for effective operational use (i.e., some water will remain in each tank). Storage needs for each facility were estimated as described below.

3.2.1 EWRF

To meet a level-of-service of daily peak PAR demand equal to 2.0 times the annual average demand for customers served directly, the total build-out storage need for EWRF was estimated as follows:

Average PAR demand to be served directly at Build-out condition = 5.63 MGD AADF
Maximum day peaking factor = 2.0
Useable storage capacity = 85%
Minimum daily storage requirement = (5.63 × 2.0) ÷ 85% = 13.2 million gallons (MG)
Existing PAR storage = 3.0 MG
Estimated additional storage need for Build-out = 13.2 MG – 3.0 MG = 10.2 MG

While the build-out storage need for EWRF was estimated to be 10.2 MG, storage for the next phase of expansion (Phase VI) was determined based on discussions with OCU staff. Based on OCU's preference, three (3) additional ground storage tanks (GSTs), at 3.0 MG each, are recommended for the Phase VI upgrades at EWRF (**Appendix A**).

Suggested additional storage capacity for Phase VI at EWRF = 3 x 3.0 MG = 9.0 MG

The 9.0 MG of additional storage at EWRF will provide a total storage capacity of 12.0 MG. Total storage of 12.0 MG will be sufficient to meet a future PAR demand of 5.1 MGD AADF directly served from EWRF meeting the level-of-service maximum daily peaking factor of 2.0.

3.2.2 ESA SRF

To meet a level-of-service of daily peak demand equal to 2.0 times average demand for the customers served directly, the build-out storage need for the ESA SRF was estimated as follows:

Average PAR demand to be served directly at Build-out condition = 11.28 MGD AADF
Maximum day peaking factor = 2.0
Useable storage capacity = 85%
Minimum daily storage requirement = (11.28 × 2.0) ÷ 85% = 26.5 MG
Existing PAR storage = 0 MG *(assumes existing 1.5 MG storage will be repurposed for other uses and not available at build-out)*
Estimated additional storage need for Build-out = 26.5 MG

While the build-out storage need for ESA SRF was estimated to be 26.5 MG, storage for the next phase of expansion (Phase II) was determined based on discussions with OCU staff. Two (2) GSTs, 5.0 MG each, are recommended during the next phase of expansion at the ESA SRF (**Appendix A**).

Suggested storage expansion for Phase II at ESA SRF = 2 x 5.0 MG = 10.0 MG

A total storage of 10.0 MG constructed during ESA SRF Phase II will be sufficient to meet a future PAR demand of 4.3 MGD AADF directly served from ESA SRF meeting the level-of-service maximum daily peaking factor of 2.0. Based on discussion with County staff, it is assumed that the existing 1.5 MG storage at ESA SRF will be repurposed for other uses and not available for future phases of the facility.

3.2.3 LAKE PICKETT SRF

To meet a level-of-service daily demand peaking factor of 2.0 for the customers served directly, the build-out storage need for Lake Pickett SRF was estimated as follows:

Average PAR demand to be served directly = 1.78 MGD AADF
Maximum day peaking factor = 2.0
Useable storage capacity = 85%
Minimum daily storage requirement = (1.78 × 2.0) ÷ 85% = 4.2 MG
Suggested storage capacity = 4.0 MG

While the build-out storage need for Lake Pickett SRF was estimated to be 4.2 MG, this entire volume does not need to be constructed during the first phase of expansion. Based on discussion with County staff, one (1) GST of 2.0 MG is recommended during the first phase of construction at Lake Pickett SRF (**Appendix A**).

Suggested storage capacity for Phase I at Lake Pickett SRF = 1 x 2.0 MG = 2.0 MG

Based on the daily peaking factor of 2.0, the 2.0 MG of storage capacity during the first phase of Lake Pickett SRF will be sufficient to meet a future PAR demand of 0.85 MGD AADF served directly.

3.2.4 Storage Summary for Next Phase of Expansion in the ESA

In summary, the total proposed storage for the next phase of expansion at the PAR facilities in the ESA is estimated to be 24.0 MG (**Table 3**), detailed in **Appendix A**.

Table 3. Summary of Storage for Next Phase of Expansion in ESA

Facility	Existing Storage (MG)	Additional Storage (MG)	Total Storage (MG)
EWRF	3.0	9.0	12.0
ESA SRF	1.5 [1]	10.0	10.0
Lake Pickett SRF	-	2.0	2.0
TOTAL ESA	4.5	21.0	24.0

Note: [1] Assumed that existing 1.5 MG GST will be repurposed for other uses and not available for PAR in the future

3.3 High Service PAR Pump Station

The estimation of pumping requirements for the reclaimed water facilities in the ESA was based on providing sufficient pumping capacity at each facility to provide the estimated peak hour flow to the PAR customers served directly by each facility. Based on discussion with County staff, a maximum hourly peaking factor of 10.5 was assumed for the next phase of expansion at each facility. Subsequently, the assumed peak hour factor was reduced to 6.0 for the build-out condition.

3.3.1 EWRF

The EWRF has three (3) existing 2,000 gallon per minute (gpm) pumps serving the direct PAR customers in the ESA. The existing PAR pump station at EWRF has a firm pumping capacity (estimated as the pumping capacity with the largest pump out of service) of 4,000 gpm. EWRF currently serves about 1.5 MGD AADF of the 3.5 MGD AADF PAR demand in the ESA. The existing firm capacity of the PAR pump station at EWRF is sufficient to meet a peak hour factor of less than 4.0, when serving a 1.5 MGD AADF demand. For the target peak hour factor of 10.5, the existing PAR pump station at EWRF would be capable of serving only 0.5 MGD PAR demand, on a firm capacity basis. Therefore, the existing PAR pump station capacity is considered inadequate to meet OCU's targeted level-of-service peaking factors of 10.5 in the near term or 6.0 in the long term for its existing direct PAR customers.

Using a peak hour factor of 6.0, the pumping requirement for build-out conditions at EWRF was estimated to be 23,460 gpm to serve the 5.63 MGD AADF of PAR demand directly. The pumps at EWRF currently have 6,000 gpm capacity. Therefore, a total increase of 17,460 gpm in pumping capacity is needed for the build-out demand to be served directly from EWRF. However, as discussed previously, the level-of-service peak hour factor prior to build-out (Phase VI) is 10.5. Pump sizes for Phase VI were discussed with OCU staff. Based on OCU preference, as documented in **Appendix A**, the following were selected for pumping additions at EWRF for Phase VI:

Existing pumping capacity = 3 x 2,000 = 6,000 gpm
Four (4) additional pumps of 4,000 gpm = 4 x 4,000 gpm = 16,000 gpm
Total Phase VI Pumping Capacity = 22,000 gpm
Phase VI Firm Pumping Capacity = 18,000 gpm (with largest pump out of service)

A firm pumping capacity of 18,000 gpm will be sufficient to meet a PAR demand of 2.5 MGD AADF with a peak hour factor of 10.5. The proposed increase in pumping capacity at EWRF will increase the reliable capacity of the PAR pump station from 0.5 MGD AADF to 2.5 MGD AADF, to meet the targeted peak hour factor of 10.5 for Phase VI conditions.

Two (2) additional pumps of 4,000 gpm will be needed at build-out to meet the projected build-out PAR demand of 5.63 MGD AADF with a peak hour factor of 6.0.

3.3.2 ESA SRF

Using a peak hour factor of 6.0, the pumping requirement for build-out conditions for the ESA SRF was estimated to be 47,000 gpm to serve the 11.3 MGD AADF of PAR demand directly. Two existing pumps at the ESA SRF site currently have 6,000 gpm capacity; however, these pumps are expected to be re-purposed in the future and no longer available by build-out. Therefore, a total increase of 47,000 gpm in pumping capacity is needed for the build-out demand to be served directly from ESA SRF.

As discussed previously, the level-of-service peak hour factor in the interim (before build-out) is 10.5. Based on discussion with OCU staff, as documented in **Appendix A**, the following recommendations were selected for pumping additions at the ESA SRF for its next phase of expansion (Phase II):

> Existing pumping capacity = 0 *(assumes existing two pumps will be repurposed and not available for future use)*
> Four (4) additional pumps of 6,000 gpm = 4 x 6,000 gpm = 24,000 gpm
> Total Phase II Pumping Capacity = 24,000 gpm
> Phase II Firm Pumping Capacity = 18,000 gpm (with largest pump out of service)

Based on discussion with County staff, it is assumed that the two (2) existing 3,000 gpm pumps at the ESA SRF will be repurposed for other uses and not available for future phases of the facility. The firm pumping capacity of 24,000 gpm will be sufficient to meet a PAR demand of 2.5 MGD AADF with a peak hour factor of 10.5. Four (4) to five (5) additional pumps of 6,000 gpm will be needed at build-out to meet the PAR demand of 11.3 MGD AADF with a peak hour factor of 6.0.

3.3.3 Lake Pickett SRF

Using a peak hour factor of 6.0, the pumping requirement for the build-out condition for the Lake Pickett SRF was estimated to be 7,400 gpm to serve the 1.8 MGD AADF of PAR demand directly. Because the area served directly from Lake Pickett SRF is relatively small, it may have higher a peaking factor than the remainder of the ESA. Therefore, a pumping requirement for build-out conditions (12,950 gpm) using a peaking factor of 10.5 was also estimated for conservatism.

Based on discussion with County staff, as documented in **Appendix A**, the following were selected for pumping additions at the Lake Pickett SRF for its initial phase of construction (Phase I):

> Two (2) pumps of 4,400 gpm = 2 x 4,400 gpm = 8,800 gpm
> Total Phase VI Pumping Capacity = 8,800 gpm
> Firm Pumping Capacity = 4,400 gpm (with largest pump out of service)

The firm pumping capacity of 4,400 gpm will be sufficient to meet a PAR demand of 0.6 MGD AADF with a peak hour factor of 10.5. One (1) to two (2) additional pumps of 4,400 gpm will be needed at build-out to meet the PAR demand of 1.8 MGD AADF with a peak hour factor ranging from 6.0 to 10.5.

3.3.4 Pumpage Summary for Next Phase of Expansion in the ESA

In summary, the total proposed pumpage for the next phase of expansion of the facilities in the ESA is estimated to be 54,800 gpm (**Table 4**), detailed in **Appendix A**.

Table 4. Summary of Pumping for Next Phase of Expansion in ESA

Facility	Existing (gpm)	Expansion (gpm)	Total (gpm)	Firm (gpm)
EWRF	6,000	16,000	22,000	18,000
ESA SRF	6,000 [1]	24,000	24,000	18,000
Lake Pickett SRF	-	8,800	8,800	4,400
TOTAL ESA	12,000	48,800	54,800	40,400

Note: [1] Assumed that existing pumps will be repurposed for other uses and not available for PAR in the future

Based on the recommended pumping additions at the three ESA facilities in the next phase of expansion to meet the level-of-service peak hour factor of 10.5, the total PAR demand that can reliably be served was estimated as 5.6 MGD AADF (2.5 MGD from EWRF, 2.5 MGD from ESA SRF and 0.6 MGD from Lake Pickett SRF). At this next phase of expansion, the ERRWDS may still be used to serve some portion of OCU ESA PAR demands; however, for conservative planning, recommended sizes of OCU PAR pump stations were selected assuming a worst-case condition of no flow from ERRWDS.

For this reclaimed water capacity analysis, this estimated 5.6 MGD AADF was used as the anticipated ESA PAR demand corresponding to the 31.0 MGD AADF wastewater flow (reclaimed water supply) at EWRF, for Phase VI planning.

4 RECLAIMED WATER CAPACITY ANALYSIS

Because of the highly weather dependent nature of reclaimed water demands, it is important to consider the variability of both the reclaimed water supply and demand in estimating future source and facility deficits that may occur. Driven by weather, irrigation demands can vary significantly from month-to-month, typically peaking by the end of the dry season (e.g., May), then declining during the summer wet season. Demand from the SEC, which also fluctuates with the power needs of OUC's customers, generally peaks in the summer. In contrast, the supply of reclaimed water is somewhat less dependent on weather and mostly driven by indoor use, especially during the dry months. Reclaimed water supply can increase during the wet season due to infiltration and inflow (I&I) into the sewer system, which also is a time when the irrigation demands are lower. The result is a temporal mismatch between customer demand and available supply. Limited supply during the peak irrigation demand season could lead to supply shortfalls. On the other hand, reduced irrigation demand during wet periods results in excess reclaimed water that must be stored or discharged to wet weather management facilities such as rapid infiltration basins (RIBs).

To evaluate the reclaimed water facilities over the planning horizon, a long-term monthly water budget model was developed. The water budget model applied the historical variability of reclaimed water supply and demand to the various future demand-level scenarios, and was used to identify the need for future supplemental supply and wet weather management facilities. Results from the water budget analysis were used to assess the needs for potential supplemental supply and wet weather facilities for next phase of expansion in the ESA.

4.1 Water Budget Model

A 23-year continuous simulation monthly water budget model was developed using historical data between 1995 and 2017. This 23-year period was used to develop the water budget model because of availability of sufficient meteorological data to develop reclaimed water demands, since historical reclaimed water demands for ESA go back only about 10 years. A detailed description of the water budget model, its inputs and set up is provided in **Appendix B**.

The water budget model uses the predicted normalized series of reclaimed water supply peaking factors and reclaimed water demand peaking factors to develop predicted (future) supply and demands series for a 23-year period of climatic variability. Reclaimed water augmentation for wetland hydration was estimated each month as rainfall deficit from the estimated 1.0 MGD AADF minimum wetland hydration need. Finally, a future storage capacity of 24 MG in GSTs (12 MG at EWRF, 10 MG at ESA SRF and 2 MG at Lake Pickett SRF) was used in the water budget model for the assumed EWRF Phase VI flow conditions.

The predicted needs for future supplemental supply and additional wet weather discharge facility capacity were determined using the water budget model as follows:

- For any month when the reclaimed water demand exceeded the supply from the plant and the GSTs, the unmet demand was the supplemental supply need predicted for that month.
- In contrast, if reclaimed water supply remained after meeting all demands, filling available storage and sending the maximum feasible amounts to the EWRF wetlands, EWRF RIBs and the Orlando Easterly Wetland (OEW) system, the computed leftover supply represented the predicted need for additional wet weather management facility capacity for that month.

4.2 Phase VI Flow and Demand Condition

Information regarding the timeline of when PAR demand will reach build-out in the ESA was not available. However, to assess reclaimed water management alternatives for Phase VI conditions, an estimated ESA PAR demand corresponding to the EWRF wastewater flow of 31 MGD AADF is needed. Since OCU desires to maintain a level-of-service peak hour demand factor of approximately 10.5 for the next phase of expansion, the reclaimed water demand for the next phase of expansion was estimated as the PAR demand that could be reliably met by the planned facilities at the assumed level-of-service criteria. As discussed in Section 2, the ESA PAR demand that could be met at a peak hour factor of 10.5, based on the proposed pumping and storage infrastructure expansions, was estimated to be 5.6 MGD AADF (2.5 MGD from EWRF, 2.5 MGD from ESA SRF and 0.6 MGD from Lake Pickett SRF) for next phase of expansion in the ESA.

4.3 Phase VI Conditions – Model Results

The reclaimed water supply/demand continuous simulation model was used to determine expected system performance for the Phase VI projected wastewater flow (31.0 MGD AADF) and reclaimed water demands (PAR = 5.6 MGD AADF, SEC = 8.0 MGD AADF, and EWRF wetlands minimum hydration = 0.3 MGD AADF), and EWRF wetlands receiving up to about 70% of its permitted capacity (8.5 MGD

AADF). **Table 5** shows the results of the water budget modeling for these estimated Phase VI conditions.

Table 5. ESA Water Budget Results for Estimated Phase VI Conditions

Description	Flow (MGD)
Phase VI Wastewater Flow	**31.0**
Phase VI Reclaimed Water Demand	**13.9**
PAR Demand	5.6
SEC Demand	8.0
Wetland Demand	0.3
Demand-to-Supply Ratio	**45%**
Supplemental Supply Need	
Annual Average Supplemental Supply Needed	0.0
90^{th} Percentile Supplemental Supply Needed	0.0
Wet Weather Needs	
Annual Average Total Wet Weather Need	17.1
Average Wet Weather Flow to EWRF Wetlands	8.2
Average Wet Weather Flow to EWRF RIBs	1.2
Average Wet Weather Flow to ERRWDS	3.5
Additional Wet Weather Need on Annual Average Basis	**4.11**
90th Percentile Additional Wet Weather Need (Annual Average basis)	4.9
90th Percentile Additional Wet Weather Need (Maximum Month)	16.9

Because the total demand for the ESA system for the estimated Phase VI scenario was relatively low at 13.9 MGD AADF (45%) for an available reclaimed water supply of 31.0 MGD AADF, additional supplemental supply was not needed to meet peak demands. However, significant wet weather needs in addition to the existing facilities is projected. While the annual average wet weather need was estimated to be 3.5 MGD AADF, for a 1-in-10 condition the average wet weather need increased to 4.9 MGD AADF. The maximum month wet weather need for a 1-in-10 scenario was estimated to be 16.9 MGD, average daily flow (ADF) (**Table 5**).

Although the results in **Table 5** are based on an estimated ESA PAR demand of 5.6 MGD AADF, it is possible that PAR demand can grow more than the estimated 5.6 MGD AADF prior to wastewater flow reaching 31.0 MGD AADF in the ESA. Likewise, the SEC demand can change to more than or less than 8.0 MGD AADF. Therefore, a reclaimed water capacity analysis was performed for the ESA to capture the uncertainty in future demands and capacity of wet weather facilities. The goal of the reclaimed water capacity analysis was to identify shortfalls in the existing system when meeting future expected demands and to determine the need for additional supplemental supplies and wet weather flows.

4.4 Reclaimed Water System Capacity Analysis

To understand the system needs due to the uncertainty in the future PAR and SEC demands and the performance of wetlands to accept wet weather flows, additional modeling scenarios were run using the water budget model. The additional scenarios analyzed the system performance to determine supplemental and wet weather needs for the ESA reclaimed water system due to uncertainties from the following:

1. Change in PAR demand
2. Change in SEC demand
3. Varying performance (peak acceptance capacity) of the wetlands

The supplemental and wet weather needs for the ESA reclaimed water system were analyzed for the following scenarios using the water budget model:

I. Demand Scenarios: Two demand scenarios were simulated.

Scenario 1: *Variable SEC demand*. For this scenario, the SEC demand was varied between 4 MGD AADF and 13 MGD AADF, with a fixed ESA PAR irrigation demand of 5.6 MGD AADF. Under this scenario, a total of five model simulations were run, with SEC demand at 4, 6, 8, 10 and 13 MGD AADF. The demand-to-supply ratio varied from 32% to 61% for these scenarios (Scenario 1).

Scenario 2: *Variable PAR irrigation demand*. This scenario evaluates the system performance if the PAR demand in the ESA grows to more than the estimated 5.6 MGD AADF. The SEC demand was held at a constant 8.0 MGD AADF for all the scenarios. Under this scenario, a total of five model simulations were run, with PAR demand assumed at 9, 11, 12, 15 and 18.7 MGD AADF. The demand-to-supply ratio varied from 56% to 87% for these scenarios (Scenario 2).

II. Wet Weather System Capacity Alternatives:

Four alternatives (A through D) were simulated, with variable assumed functional capacity of the wetlands, ranging from the permitted 12.2 MGD AADF (full capacity) down to 8.5 MGD AADF (70% of the permitted capacity).

- Alternative A – Wetland capacity of 12.2 MGD AADF (Full permit capacity)
- Alternative B – Wetland capacity of 11.0 MGD AADF (90% of permitted capacity)
- Alternative C – Wetland capacity of 9.8 MGD AADF (80% of permitted capacity)
- Alternative D – Wetland capacity of 8.5 MGD AADF (70% of permitted capacity)

The variable wetland capacity in the Alternatives A through D simulate the effect of increasing flow to the wetlands from its recent average flows of 8.6 MGD AADF (2015-16) to the full permitted capacity of 12.2 MGD AADF. The variable range of wetland capacity was simulated as a percentage of full permit capacity.

4.4.1 Reliability of Supply to Meet Reuse Demands

Using results from the long-term monthly water budget model, the predicted future capacity of the reclaimed water system was evaluated in terms of overall system reliability. Reliability may be defined as the probability of success of a system, and it can be estimated as 1 minus the probability of system failure. As an example, if during the 23-year (276-month) water budget modeling period there were 6 months where the system did not have enough reclaimed water supply to meet the reclaimed water demands, it would mean that the system supply failed about 2% of the time, or had a long-term total monthly supply reliability rate of 98%. **Figure 3** shows the system supply reliability (ability to meet monthly demands) estimated by the model for the Demand Scenario 1 (Demand-to-supply ratio = 32%-61%) and Demand Scenario 2 (Demand-to-supply ratio = 56%-87%) simulations, across the range of total demand-to-supply ratios assumed in the two sets of simulations.

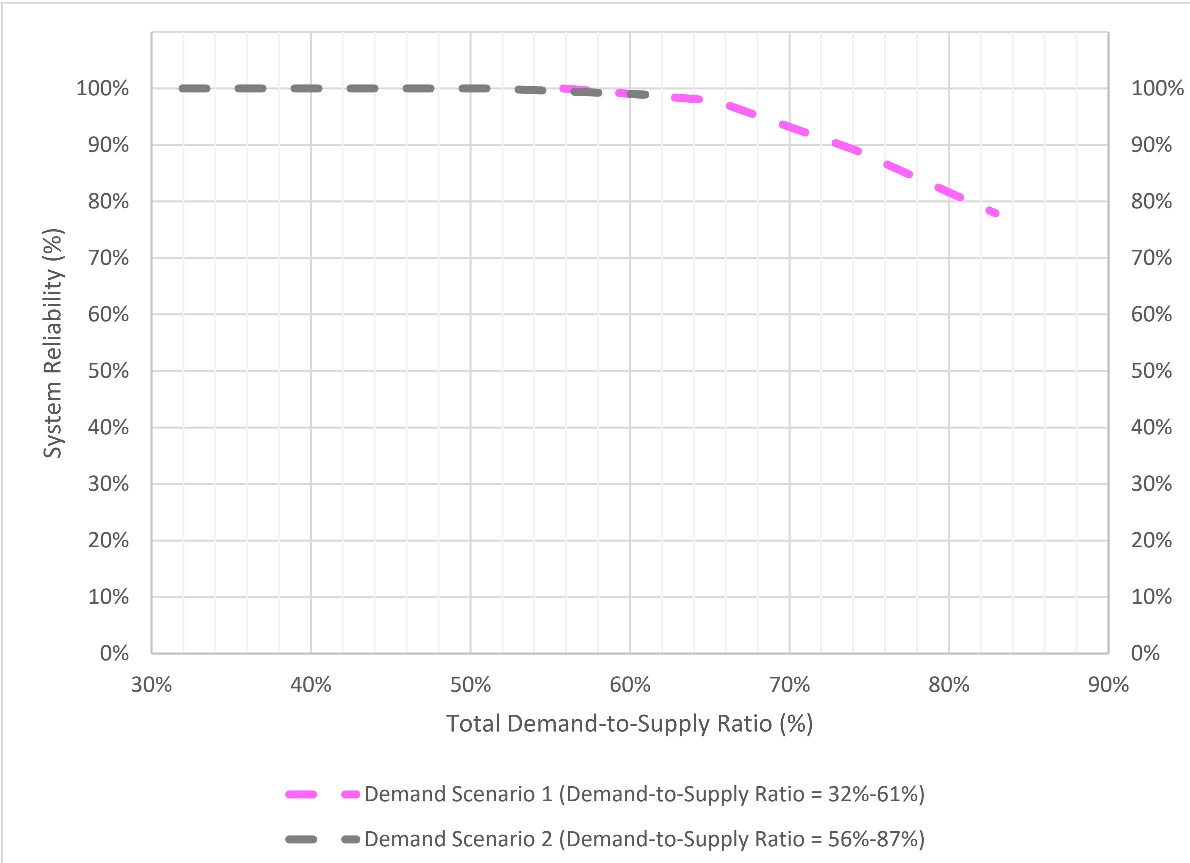

Figure 3. Reliability of Supply in Meeting Total ESA Reuse Demand

The total reclaimed water demand (PAR, SEC and wetland hydration) to available supplies (demand-to-supply) ratio is an important factor that plays a critical role in determining the reliability of a reclaimed water system. While reuse demand, largely driven by weather, is highly variable, reclaimed water supply is less variable and often does not peak at the same time as the demand. Therefore, there is an inherent imbalance between the demand and supply. As the demand-to-supply ratio becomes larger, a reclaimed water system becomes less reliable without supplemental supply. As evident from **Figure 3**, regardless of the type of demand (PAR or SEC), the reliability of the reclaimed water system is largely driven by the total demand-to-supply ratio.

Results indicate that the EWRF reclaimed water system can reliably serve customer demands at a total demand-to-supply ratio of approximately 60% without the need for additional supplemental supplies. When the ratio exceeds about 60%, reliability of the system starts to decrease indicating a supplemental supply deficit. These results are typical of reuse systems in central Florida, due to maximum month demand peaking factors (during the hot, dry season), which can be 1.5 to 2 times annual average demand.

4.4.2 Supplemental Supply

The water budget model was used to determine the EWRF supplemental supply needs for a range of demand-to-supply ratios, from a low of 32% to a high of 87%, using the two sets of simulations (**Table 6**). Supplemental supply from the groundwater well, permitted at 0.274 MGD AADF, was considered in estimating the need for additional supplies but supplies from the ERRWDS were not considered for this analysis. The need for additional supplemental supplies on long term annual average basis (beyond the available existing supplemental supply well at EWRF) is predicted to start when the demand-to-supply ratio approaches 60%.

Table 6. Summary of Additional ESA Supplemental Supply Need for Extreme Conditions

Simulation	Wetland Hydration Demand (MGD AADF)	ESA PAR Demand (MGD AADF)	SEC Demand (MGD AADF)	Total Demand-to-Supply Ratio	Long-Term Annual Average Deficit (MGD AADF)	Annual Average Deficit, 80th Percentile (MGD AADF)	Maximum Month Deficit, 80th Percentile (MGD AADF)
Demand Scenario 1 (Variable SEC Demand)							
Sim 1	0.3	5.6	4.0	32%	0	0	0
Sim 2	0.3	5.6	6.0	38%	0	0	0
Sim 3	0.3	5.6	8.0	45%	0	0	0
Sim 4	0.3	5.6	10.0	51%	0	0	0
Sim 5	0.3	5.6	13.0	61%	0.043	0	0
Demand Scenario 2 (Variable PAR Demand)							
Sim 1	0.3	9.0	8.0	56%	0	0	0
Sim 2	0.3	11.0	8.0	62%	0.014	0	0
Sim 3	0.3	12.0	8.0	65%	0.044	0.12	0.88
Sim 4	0.3	15.0	8.0	75%	0.269	0.73	5.33
Sim 5	0.3	18.7	8.0	87%	1.142	1.85	11.38

While supplemental needs are typically determined on an annual average basis, it is important to consider needs based on more severe climatic events. No standard guidelines are currently available for the selection of reliability goals for reclaimed water systems in Florida. As a purchased commodity, reclaimed water service should be provided at a sufficient level of reliability acceptable to rate-paying utility customers. Even so, reclaimed water is not an essential service like potable water. The target level of reliability for a reclaimed water system therefore need not be as high as that for potable water. Selection of the desired reliability level for a reuse system is a policy decision for each individual utility.

As a potentially reasonable target, it is recommended that the EWRF reclaimed water supply system aim for a minimum 80% reliability level, considering both annual average and annual peak month predicted ESA demands. In other words, it is suggested that the system try to secure sufficient supply to meet predicted annual average and maximum month demands at least 8 out of every 10 years. The water management districts typically issue irrigation permit allocations at the 2-in-10-year drought demand level, which is generally consistent with this 80% reliability goal.

Although the above reliability goal means a 20% chance of a reclaimed water service interruption in any given year, in practical terms, a service interruption (i.e., total system demand predicted to exceed available supply) will not necessarily result in a complete loss of service to customers. If the difference is not too large, periods during which demands temporarily exceed supplies likely would result only in reduced pressures in remote areas of the reclaimed water distribution system. Reduced pressures in the ESA distribution system could result in a temporary loss of service to some customers or a reduced irrigation system pressure to some customers. Systems with lower reliability will have a higher probability of occurrences of loss of service or reduced service pressure.

Table 6 shows supplemental supply needs (beyond the available existing supplemental supply) predicted by the model for the two sets of demand scenarios at the system reliability goal of 80% (2-in-10 drought year). Both the annual average deficit in the 80% driest year, and the maximum month deficit during that same year, are shown in **Table 6**. The capacity analysis shows a small annual average supplemental supply deficit (0.12 MGD ADF) at a demand-to-supply ratio of 65%. However, the predicted need of 0.12 MGD ADF is not a significant shortfall considering it occurs when the total demand on the system is approaching 20 MGD (SEC = 8 MGD; PAR = 12 MGD). If the long-term SEC demand stays around 8 MGD, the PAR system demand can effectively grow to more than three times the current ESA PAR demand (3.5 MGD AADF) before additional supplemental supplies would be needed. Based on the results of the capacity analysis, it is recommended that as wastewater flows in the ESA increase, OCU should try to expand the PAR customers as quickly as possible.

4.4.3 Wet Weather Management

The water budget model also predicts an annual average shortfall in wet weather management capacity for future reclaimed water flows under most simulated conditions (**Table 7**). Similar to the supplemental supplies, design of wet weather facilities should consider severe climatic events rather than just annual average conditions. The Florida Department of Environmental Protection (FDEP) requires that sufficient wet weather management facilities are available to handle the wet weather reclaimed water storage volume associated with a 10-year recurrence interval (Rule 62-610.414(1)(b), Florida Administrative Code (FAC)). Therefore, by regulation, EWRF must plan on having wet weather facilities sufficient to manage excess reclaimed water supplies during at least the 1-in-10-year rainfall event. Consistent with FDEP rules, it is recommended for this study that EWRF's wet weather management system be planned for a minimum 90% reliability level, considering expected annual average and annual peak month projected loading rates. In other words, it is suggested that the EWRF system be designed to handle predicted annual average and annual maximum month loadings of excess reclaimed water at least 9 out of every 10 years.

Table 7. Summary of Additional ESA Wet Weather Capacity Need for Extreme Conditions

Simulation	Demand Scenario 1 (Variable SEC Demand)			Demand Scenario 2 (Variable PAR Demand)		
	Demand-to-Supply Ratio	Annual Average Deficit, 90th Percentile (MGD AADF)	Maximum Month Deficit, 90th Percentile (MGD AADF)	Demand-to-Supply Ratio	Annual Average Deficit, 90th Percentile (MGD AADF)	Maximum Month Deficit, 90th Percentile (MGD AADF)
Wetlands Capacity at 12.2 MGD AADF						
Sim 1	32%	4.3	14.6	56%	0.5	6.0
Sim 2	38%	2.8	13.7	62%	0.3	3.6
Sim 3	45%	1.4	9.4	65%	0	0
Sim 4	51%	0.7	8.2	75%	0	0
Sim 5	61%	0.3	3.1	87%	0	0
Wetlands Capacity at 11.0 MGD AADF						
Sim 1	32%	5.5	15.1	56%	0.7	4.3
Sim 2	38%	4.0	13.6	62%	0.3	3.6
Sim 3	45%	2.6	11.9	65%	0.2	1.9
Sim 4	51%	1.1	4.1	75%	0	0
Sim 5	61%	0.6	4.1	87%	0	0
Wetlands Capacity at 9.8 MGD AADF						
Sim 1	32%	6.7	22.1	56%	1.3	9.4
Sim 2	38%	5.1	12.9	62%	0.7	8.8
Sim 3	45%	3.7	14.0	65%	0.2	2.5
Sim 4	51%	2.0	11.1	75%	0	0
Sim 5	61%	0.5	6.5	87%	0	0
Wetlands Capacity at 8.5 MGD AADF						
Sim 1	32%	7.9	28.4	56%	2.1	9.6
Sim 2	38%	6.3	18.4	62%	1.2	11.0
Sim 3	45%	4.9	16.9	65%	0.6	7.0
Sim 4	51%	3.0	14.8	75%	0.1	1.4
Sim 5	61%	1.0	7.8	87%	0	0

The water budget model was used to determine the wet weather deficits (beyond the existing wet weather facilities) at the 90% (1-in-10-year probability of deficit) reliability target for the different demand conditions, summarized in **Table 7**. In general, the model predicts no shortfall in wet weather needs for a demand-to-supply ratio above 80% for the 1-in-10-year reliability target. At ratios of less than 80%, the shortfall between the wet weather needs and existing wet weather facility capacity will depend on the assumed capacity of the EWRF wetlands. Performance of the EWRF wetlands, with its permitted capacity of 12.2 MGD AADF, is a key component of EWRF's long-term wet weather management strategy.

Higher wetland flows will alleviate the need for additional wet weather facilities. If the wetlands can perform at their permitted rate of 12.2 MGD AADF on a long-term basis, the need for additional wet weather capacity (at the 90% reliability level) varies from 0.5 to 0 MGD AADF at demand-to-supply ratios of 56% to 65%, respectively. However, if the wetlands underperform on a long-term basis, the wet weather facility deficit would increase. In the past, flows above 10 MGD AADF have placed some pressure on the existing wetlands as currently constructed; therefore, assumed wetland capacities between 8.5 and 9.8 MGD AADF may be more likely scenarios for the wetland capacity in the future. At 8.5 MGD AADF wetland capacity, the need for additional wet weather management facility capacity at the 90% reliability level is predicted to vary from 2.1 to 0.6 MGD AADF, at demand-to-supply ratios of 56% to 65%.

Below a demand-to-supply ratio of 50%, there is a substantial increase in the wet weather needs. In contrast, the existing wet weather facilities become quite reliable once the demand-to-supply ratio approaches 75% or greater (**Table 7**). But a downside of such a high demand-to-supply ratio is an increased supplemental supply deficit (**Table 6**). A trade-off exists between the supplemental supplies needed to reliably serve the demands and the need for additional wet weather management capacity. As the County adds more customers to the EWRF reclaimed water system, it reduces the need for wet weather facility capacity; however, the need for supplemental supply increases.

Water budget results indicate that there is a "sweet spot" at a total demand-to-supply ratio for the ESA of about 60-65% (at 31 MGD AADF EWRF supply, 8 MGD AADF SEC demand, and approximately 12 MGD AADF ESA PAR demand), where both the predicted supply shortfall and wet weather facility deficit may be balanced and minimized, with little supplemental supply need (0.12 MGD or less) and small (1.0 MGD or less) need for additional wet weather capacity. The predicted need for additional wet weather capacity increases dramatically when the demand-to-supply ratio fall below 60%.

The SEC is the largest reclaimed water user in the ESA; therefore, its demand variability substantially impacts EWRF reclaimed water management strategies. If the long-term SEC demand stays around 8 MGD AADF, OCU can add additional PAR customers to achieve the 60-65% demand-to-supply ratio. However, if SEC demand changes in the future, it will affect how soon OCU would need to plan supplemental supplies or wet weather facilities. The existing PAR system in the ESA is relatively small compared to the reclaimed water supply; therefore, the wet weather management facility deficits appear to be more critical than supplemental supply needs during the near-term planning period, and additional wet weather capacity options or strategies should be evaluated. As the PAR system expands in the future, the wet weather deficits are expected to decline.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions are presented based on the analysis performed for EWRF Phase VI reclaimed water flow and reuse demand conditions.

- Storage and pumping upgrade recommendations for the ESA facilities were developed using the level-of-service peaking factors, as follows:
  - EASTERN WATER RECLAMATION FACILITY - (PHASE VI-A)
    - **Storage**: Three (3) new 3-MG ground storage tanks (9-MG increase)
    - **Pumping**: Four (4) new 4,000-gpm pumps (16,000-gpm increase); with space for two (2) additional 4,000-gpm future pumps
  - EAST SERVICE AREA STORAGE AND REPUMP FACILITY (ESA SRF) - (PHASE II)
    - **Storage**: Two (2) new 5-MG ground storage tanks (10-MG increase)
    - **Pumping**: Four (4) new 6,000-gpm pumps (24,000-gpm increase); with space for 4 to 5 additional 6,000-gpm future pumps
  - LAKE PICKETT STORAGE AND REPUMP FACILITY - (PHASE I)
    - **Storage**: One (1) new 2-MG ground storage tank (2-MG increase)
    - **Pumping**: Two (2) new 4,400-gpm pumps (8,800-gpm increase); with space for two (2) additional 4,400-gpm future pumps
- Recommended pumping upgrade at EWRF will increase the reliable capacity of the PAR pump station from 0.5 MGD AADF under current conditions to 2.5 MGD AADF for Phase VI conditions, to reliably met at the targeted level-of-service (peak hour factor of 10.5) for PAR customers served directly from EWRF.
- Based on the recommended pumping capacity in the next phase for the ESA, the PAR demand that can be reliably met at the targeted level-of-service (peak hour factor of 10.5) was determined to be 5.6 MGD AADF, which was used as the ESA PAR demand corresponding to the Phase VI EWRF wastewater flow of 31.0 MGD AADF. With SEC demand at 8.0 MGD AADF, the water budget modeling results indicate that supplemental supplies are not needed for this demand level; however, a need for additional wet weather facility capacity was predicted, as the demand-to-supply ratio was rather low (45%). The need for wet weather facility capacity decreases as the demand-to-supply ratio increases.
- A reclaimed water system capacity analysis was performed using the water budget model to capture the uncertainty in the growth of future ESA PAR demand, reliability of SEC demands and the performance of the on-site wetland system to accept wet weather flows. The following conclusions are developed based on the capacity analysis:
  - The predicted need for supplemental supply is contingent upon the demand-to-supply ratio. The capacity analysis shows that the ESA reclaimed water system can

serve demands reliably up to a demand-to-supply ratio of approximately 60-65%, before additional supplemental supplies will likely be needed.

- With SEC demand at 8.0 MGD AADF (recent average), the predicted annual average additional supplemental water need is estimated to be 0.12 MGD AADF (at the suggested 2-in-10 reliability goal) for a PAR demand of 12.0 MGD AADF. This represents a total demand-to-supply ratio of approximately 65%. If the long-term SEC demand remains 8.0 MGD AADF or less, the ESA PAR system demands can effectively grow to more than three times the current demands (3.5 MGD AADF) before additional supplemental supplies are expected to be needed.
- The water budget model predicted no shortfall in wet weather needs for a demand-to-supply ratio of 80%. At ratios of less than 80%, the wet weather shortfall depends on the assumed capacity of the EWRF on-site wetlands, which makes these wetlands a key component of EWRF's long term wet weather management strategy.
- Based on past performance, there is uncertainty regarding the long term hydraulic capacity of the wetlands. If the wetlands can perform at their permitted rate of 12.2 MGD AADF on a long-term basis, the need for additional wet weather capacity (at the suggested 90% reliability level) varies from 0.5 to 0 MGD AADF at demand-to-supply ratios of 56% to 65%, respectively.
- However, if the wetlands underperform on long-term basis, the wet weather deficit would increase. For example, at an assumed wetlands capacity of 8.5 MGD AADF, the need for additional wet weather management facility capacity at the 90% reliability level is predicted to vary from 2.1 to 0.6 MGD AADF, for demand-to-supply ratios of 56% to 65%.
- Because the existing PAR system in the ESA is relatively small compared to the EWRF reclaimed water supply, the wet weather management facility deficits appear to be more critical than supplemental supply needs during the next 15-year planning period. As the PAR system expands in the future, these wet weather capacity deficits are expected to decline. However, in the near term, additional wet weather capacity options or strategies should be considered.
- Based on the above, there appears to be a "sweet spot" at a total demand-to-supply ratio for the ESA of about 60-65% (with 31 MGD AADF EWRF supply, 8 MGD AADF SEC demand, and 12 MGD AADF ESA PAR demand), where both the predicted supply shortfall and wet weather facility deficit may be balanced and minimized, with limited needs for new supplemental supply or additional wet weather infrastructure.

5.2 Recommendations

Based on the analysis presented herein, the following recommendations are presented for OCU's consideration:

- To minimize the need for additional wet weather facilities, OCU should consider connecting new ESA PAR customers as soon as feasible, to increase the total demand-to-supply ratio for the ESA system to approximately 60-65%.
- Wet weather management facility deficits for the ESA system appear to be more critical during the planning horizon than supplemental supply needs. It is recommended that OCU begin developing additional wet weather capacity options or strategies in the range of 1.0 to 4.0 MGD AADF, if the PAR grows only to 5.6 MGD AADF by the time wastewater flow reach 31 MGD AADF.
- Because the SEC is the largest reclaimed water user, its demand variability impacts EWRF reclaimed water management strategies. OCU should obtain a firm understanding of OUC's needs for reclaimed water over the short term (next 10 years) and long term (> 10 years). Based on that feedback regarding needs, a modification of the existing contract may be warranted. Understanding the future needs of the SEC is critical for OCU to determine how much additional PAR demand can be connected to the EWRF system to achieve a target of 60-65% demand-to-supply ratio.
- OCU should begin developing strategies to manage the predicted maximum month conditions for extreme weather considering use of the existing EWRF wetlands, on-site storage (RIBs), use of the ERRWDS, supplemental water supply and other options OCU may wish to include.

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APPENDIX A

Reclaimed Water Infrastructure Expansion for Public Access Reuse (PAR) in the East Service Area

Submitted to OCU on August 23, 2018

TO:	Orange County Utilities
FROM:	Carollo Engineers, Inc. and WSP USA Inc.
SUBJECT:	Reclaimed Water Infrastructure Expansion for Public Access Reuse (PAR) in the East Service Area
DATE:	August 23, 2018

This document provides a summary of the discussions from a meeting between Orange County staff, Carollo and WSP on August 20, 2018.

1. PROPOSED IMPROVEMENTS FOR NEXT PHASE OF EXPANSION

EASTERN WATER RECLAMATION FACILITY - (PHASE VI-A)

Storage: Three (3) new 3-MG ground storage tanks (9-MG increase)

Pumping: Four (4) new 4,000-gpm pumps (16,000-gpm increase); with space for two (2) additional 4,000-gpm future pumps

EAST SERVICE AREA STORAGE AND REPUMP FACILITY (ESA SRF) - (PHASE II)

Storage: Two (2) new 5-MG ground storage tanks (10-MG increase) [1]

Pumping: Four (4) new 6,000-gpm pumps (24,000-gpm increase); with space for 4 to 5 additional 6,000-gpm future pumps [2]

LAKE PICKETT STORAGE AND REPUMP FACILITY - (PHASE I)

Storage: One (1) new 2-MG ground storage tank (2-MG increase)

Pumping: Two (2) new 4,400-gpm pumps (8,800-gpm increase); with space for two (2) additional 4,400-gpm future pumps

2. IMPROVEMENTS FOR BUILD-OUT CONDITIONS

The proposed improvements described below for the build-out condition are based on the latest available data and assumptions about future conditions. A potential range of improvements is recommended, depending on the level of conservatism (peaking factor) desired by OCU. Revisiting assumptions and reevaluating proposed improvements for the build-out condition will be warranted in the future, when more reliable long-term data is available from the East Service Area. The proposed components below are in addition to the near-term improvements listed in Section 1 above.

EASTERN WATER RECLAMATION FACILITY

Storage: Either zero (0) or one (1) new 3-MG ground storage tank (0 to 3-MG increase)

Pumping: Two (2) new 4,000-gpm pumps (8,000-gpm increase)

EAST SERVICE AREA STORAGE AND REPUMP FACILITY

Storage: From two (2) to four (4) new 5-MG ground storage tanks (10 to 20-MG increase) [1]

Pumping: Four (4) to five (5) new 6,000-gpm pumps (24,000 to 30,000-gpm increase) [2]

LAKE PICKETT STORAGE AND REPUMP FACILITY

Storage: One (1) new 2-MG ground storage tank (2-MG increase)

Pumping: Two (2) new 4,400-gpm pumps (8,800-gpm increase)

NOTES:

[1] It is assumed that the existing 1.5-MG tank at the ESA SRF will be repurposed for other uses and not available for PAR storage at build-out.

[2] It is assumed that the two (2) existing 3,000-gpm Phase I pumps at the ESA SRF may be repurposed and not available for PAR use at build-out.

APPENDIX B

Water Budget Model Description

Water Budget Model

For the reclaimed water capacity analysis for the East Service Area (ESA), a 23-year continuous simulation monthly water budget model was developed using historical data between 1995 and 2017. This 23-year period was used to develop the water budget model because of availability of sufficient meteorological data to develop reclaimed water demands, since historical reclaimed water demands for ESA go back only about 10 years. Flow data was available for reclaimed water supply and SEC demands for the selected 23-year period. For robust planning, it was also important to consider whether the rainfall during this 23-year period is representative of long term historic climatic variability. Rainfall, which is a measure of climatic variability, is the primary factor driving irrigation demand. A comparison of the 23-year period rainfall with long term historical data is discussed below.

Model Inputs

Peaking factors are often used to describe the temporal variability of reclaimed water supply and non-potable water demand within a given timeframe. This variability is typically assessed on an hourly, daily, weekly or monthly basis. Peaking factor analyses facilitate the understanding of how supply and demand may change in response to changes in season or climate. Peaking factors can be derived from the assessment of historical data or estimated based on theoretical approaches. These factors express time-specific (i.e., daily, weekly or monthly) supply and demand relative to a corresponding longer term (typically annual) average conditions. For instance, a monthly peaking factor of 1.4 indicates that the average flow or demand for that specified month is about 40% greater than the annual average flow. Conversely, a monthly peaking factor of 0.8 would indicate a monthly average flow or demand that is about 20% lower than the annual average flow for the corresponding year.

For use in the water budget analysis, monthly peaking factors were developed for each demand and supply series by normalizing each monthly flow during a year with the annual average flow for that year, as described below.

Rainfall

Rainfall data was available from a nearby OCU rainfall station at the Eastern Regional Water Supply Facility (ERWSF). However, rainfall from the ERWSF dated back to 1997 with 2 years of missing data in 1998 and 2000. The National Oceanic and Atmospheric Administration (NOAA) rainfall station at the Orlando International Airport (OIA) has long term rainfall data starting in 1949 and is often used as an indicator of long term rainfall trends in central Florida region. Data from the OIA rainfall station was used to fill the gaps for years when rainfall data was not available from the ERWSF.

Long term OIA data was also compared to the data from the ERWSF to compare the climatic variability during the 23-year modeling period with the long-term variability for the region. The annual average rainfall for the 23-year period 1995 to 2017 was 50.9 inches, just above the nearly 50 inches of long term average rainfall observed at OIA. The minimum and maximum annual rainfall recorded during this period was 30.4 inches and 74.9 inches, respectively, demonstrating a considerable variability in climatic conditions during this period. Due to the considerable variability in rainfall observed, this period was deemed to provide an adequate range of potential climatic variability for the reclaimed water capacity analysis for the planning duration of this analysis.

It is worth noting, however, that the results of the capacity analysis presented below are predicated on a similar level of future climatic variability. Extreme climatic conditions in the future—outside the range of conditions observed during the 1995-2017 period—could result in the potential need for infrastructure improvements beyond those estimated in this report.

Reclaimed Water Supply Variability

Figure B-1 shows the historical reclaimed water supply from the Eastern Water Reclamation Facility (EWRF) for the 23-year water budget period.

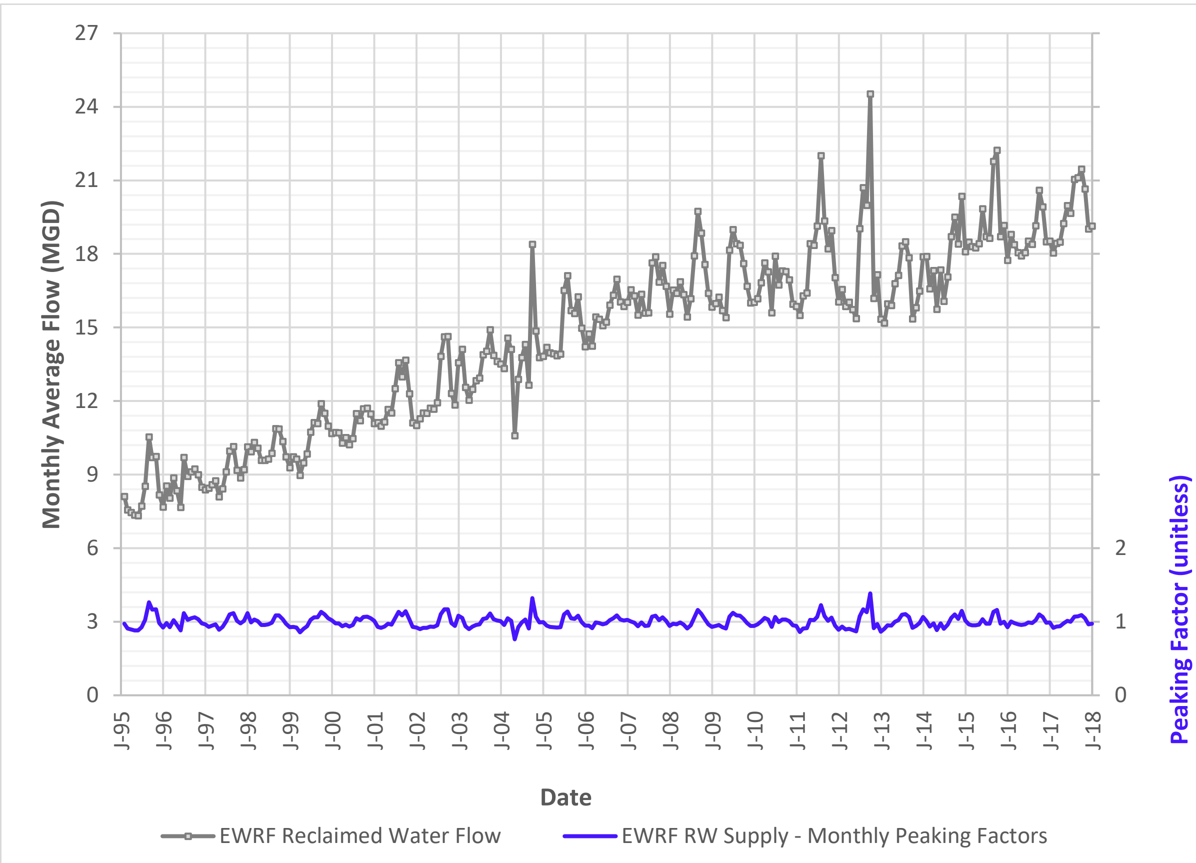

Figure B-1. Historical Reclaimed Water Supply and Monthly Peaking Factors for EWRF

The figure also shows the historical monthly peaking factors (normalized variability) for the reclaimed water supply from the EWRF. The reclaimed water monthly supply peaking factors experienced during the period from 1995 through 2017 ranged from 0.76 to 1.39. The observed variability in reclaimed water supply in EWRF is similar to the variability observed for other wastewater treatment facilities (WWTFs) in central Florida. Reclaimed water production is largely driven by indoor use with some contributions from infiltration and inflow into the sewer system. Because reclaimed water production