Marco Island 2024 Capacity Analysis Report

Prepared for:

City of Marco Island

PWS 5110183

Prepared by

Jacobs

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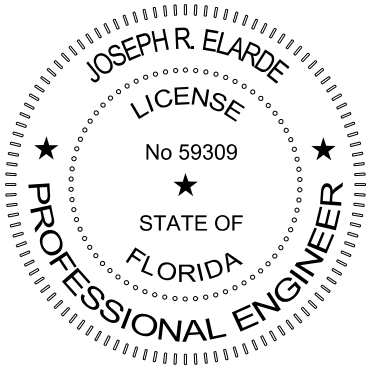

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1. Introduction

The City of Marco Island (City) operates two water treatment plants (WTPs) on Marco Island that are permitted with the Florida Department of Environmental Protection (FDEP) under Public Water Supply (PWS) ID Number 5110183. They are the North Water Treatment Plant (NWTP), which treats raw water from Marco Lakes surface water supply using lime softening and microfiltration, and the South Water Treatment Plant (SWTP), which desalts brackish groundwater from the Mid-Hawthorn aquifer using reverse osmosis (RO). The permitted operating capacity of the NWTP is 6.67 million gallons per day (mgd) and the permitted capacity of the SWTP is 6.0 mgd, for a total WTP production capacity of 12.67 mgd. The two WTPs supply water to the Marco Island service area.

FDEP rule 62-555.348 "Planning for Expansion of Public Water System Source, Treatment, or Storage Facilities," requires water suppliers to routinely compare the total net quantity of finished drinking water produced each day by their treatment plant(s) with the total permitted maximum-day operating capacity of their plant(s). This Capacity Analysis Report (CAR) evaluates the capacities of the source, treatment, and storage facilities connected to the Marco Island water system, and contains the following information:

- The maximum-day and annual average daily quantities of finished water produced by each plant during each of the past ten years.
- Projected total water demands: total annual average daily demand and total maximum day demand.
- The capacity of each WTP's source water facilities and treatment facilities, the permitted maximum day operating capacity and, if applicable, permitted peak operating capacity of the WTP facilities, and the useful capacity of each finished water storage facility.
- An estimate of the time remaining before the maximum-day water demand, including fire-flow demand, exceeds the current total permitted maximum-day operating capacity of the WTPs, and an estimate of the time remaining before the finished-water storage needs, including fire storage, exceed the existing total useful finished-water storage capacity.

WTP operating data through December 2024 provided by the City, previous capacity analysis reports developed by Jacobs, City of Marco Island Comprehensive Plan Update dated September 29, 2020, and the 2017 Water Use Permit issued by the South Florida Water Management District were utilized to write this report. Updated residential and commercial development unit data were taken from these resource documents. This 2024 Capacity Analysis Report (CAR) update meets the requirements of FDEP rule 62-555.348.

2. Potable Water Service Area

The City of Marco Island's potable water service area includes Marco Island and Marco Shores as shown in Figure 2-1. The NWTP and SWTP supply potable water to Marco Island. The City has an interconnection with Collier County (County) for bulk sale of potable water. Each year, the City sells the County bulk finished water and the County distributes the water through direct sales to customers in the Goodland and Key Marco developments. The City resumed supplying potable water to Marco Shores in January 2020. Therefore, the water demand projections beyond 2020 include water demands from Marco Shores.

Figure 2-1 Marco Island Water Service Area

3. Water Demand Projection

3.1 Land Use, Equivalent Residential Connection and Population

The Marco Island service area contains a mix of land use categories, including single-family homes, multi-family homes, hotels, restaurants, government/municipal and commercial units (including recreational and institutional facilities), and the bulk sale of water to Collier County. Collier County Bulk Sales are to the homes in Goodland and Key Marco.

Table 3-1 presents the summarized land use, equivalent residential connection (ERC), and estimated effective population equivalent during peak season in the Marco Island Service Area. The population, single family and multifamily unit data in Table 3-1 is updated based on recent land use from the 2020 Marco Island Comprehensive Plan Update, while the other land use data is from the 2023 Marco Island Ten Year Water Supply Work Plan.

The Marco Island Service area land use was estimated to be near build-out per the 2023 10-year Work Plan. Single family homes were estimated to be at 86 percent of build out, homes in the Collier County bulk sale area at 85 percent, and multi-family units at 98 percent. There were no plans for future development of hotels, commercial buildings, restaurants, or government/municipal buildings, which are assumed to be at 100 percent of build-out. Total land use was estimated to be at 93 percent of build-out.

An equivalent residential connection, or ERC, has a water demand equivalent to one residential single-family home. According to the City's historical water demand data, Single family and County units are weighted at 1.0 ERC/unit in this study. Multi-family, condo, and timeshare units are weighted at 0.8 ERC/unit. Hotel and Government/Municipal ERC equivalents were estimated by dividing known water use, in 2011, by a gpd/ERC ratio equivalent to that of one residential ERC. Commercial units were given an ERC weighting from the City's ERC factor tables. The annual ERC represents the number of units connected to the service system at the end of the year.

Table 3-1 Marco Island Service Area – Land Use, Estimated Peak Season Population, and ERC

Land Use	Land Use (2024)	Buildout Land Use (2040)	ERC Factor (ERC/Land Use Unit)[a]	ERC (2024)	Buildout ERC (2040)	Peak Season Population (2024)[a]	Buildout Population (2040)[a]
Bulk Collier Sales (Key Marco & Goodland)	511	600	1.00	511	600	1,061	1,278
Single Family	7,657	8,841	1.00	7,657	8,841	15,883	18,831
Multi-Family; Condominium; Timeshare	11,417	11,521	0.8	9,134	9,217	18,742	19,427
Hotel Rooms	1,163	1,163	0.57	663	663	1,412	1,412
Commercial	2,625	2,889	0.227	596	656	1,236	1,397
Restaurants [b]	120	120	9.1	1,092	1,092	2,326	2,326
Government/Municipal	136	136	2.03	276	276	588	588
Total	23,629	25,150	-	19,929	21,345	41,248	45,260

a. The population is the estimation of effective population equivalent during peak season that results in maximum day demand, used for information only. The average equivalent population factor per ERC is estimated to be 2.13 capita per dwelling unit per US 2020 census quick facts.
b. Restaurants are assumed to have 100 seats per unit x 0.091 ERC/seat = 9.1 ERC/unit

3.2 Historical Water Demand (2014 – 2024)

The historical water demand data from 2014 to 2024, shown in Table 3-2, was provided by the City. The water demand data allows for the calculation of annual average day demand (ADD), maximum day demand (MDD), and the average day demand of the highest water use month, or maximum month. The MDD and ADD can be used to calculate a peaking factor ratio to predict future water usage, and the maximum month average daily demand (MMADD) and ADD can be used to predict the ratio for the peak water use month.

The land use units at build-out, establishing the ERC at year end for 2040, are taken from the 2024 Marco Island 10-Year Water Supply Work Plan. The ERC at year end for 2013 through 2024 were estimated, assuming a linear increase for each year towards levels determined in 2024.

Historical data shows that the ADD increased, from 7.24 mgd in 2014 to 9.92 mgd in 2024 (Table 3-2). The data presented in Table 3-2, shows the ADD and average usage declined in 2019 and 2020, with some impacts likely due to Covid-19. However, the ADD and average usage have since increased at a higher rate than previous trends. The highest ADD (9.99 mgd) and highest average water usage per

connection (506 gpd/ERC) are from 2023. Since 2021, these demands have increased beyond the historically highest ADD (8.26 mgd in 2004 and 2006) and the historically highest average water usage per connection observed (489 gpd/ERC in 2000). The drop was primarily due to the City connecting condominiums to the reclaimed water distribution system for irrigation in 2008, which reduced potable water usage. Potable water usage has increased due to land development beyond the beneficial impact of the reclaimed water for irrigation for large users that helped to offset the demand per ERC. Starting in 2020, the City of Marco Island supplied water to Marco Shores. The ADD in 2020 and beyond includes this water demand from adding an estimated 675 ERCs to the existing system.

To project future water demands, the past three years of historical data (2022 through 2024) are used to calculate average usage per connection, ratio of MDD/ADD, and the ratio of MMADD/ADD.

Table 3-2 Marco Island Service Area Historical Water Demand Data

Year	ERC at Year End[a]	Average Usage per ERC	Annual Day Demand (ADD)	Maximum Day Demand (MDD)	Ratio (MDD/ADD)	Maximum Monthly Average Day Demand (MMADD)	Ratio (MMADD/ADD)
2014[b]	18,650	388	7.24	10.10	1.40	8.45	1.17
2015	18,742	394	7.39	10.91	1.48	8.79	1.19
2016	18,835	406	7.65	10.89	1.42	9.27	1.21
2017	18,928	409	7.75	11.05	1.43	9.63	1.24
2018	19,021	433	8.24	11.28	1.37	9.33	1.13
2019	19,114	428	8.17	11.82	1.45	9.59	1.17
2020[c]	19,365	420	8.14	11.17	1.37	9.81	1.21
2021	19,495	439	8.57	11.63	1.36	10.41	1.22
2022	19,625	465	9.12	11.84	1.30	10.72	1.18
2023	19,754	506	9.99	12.19	1.22	10.80	1.08
2024	19,884	499	9.92	12.73	1.28	11.30	1.16
2022-2024 Three Year Average		**490**			**1.31**		**1.14**

a. ERC: equivalent residential connection. ERC for 2012 through 2023 are estimated assuming a linear increase.
b. From Marco Island Water Treatment Facilities 2020 Capacity Analysis Report.
c. Estimated using the updated land use data from the 2020 Marco Island Comprehensive Plan Assessment Report.

Figure 3-1 shows the Marco Island system finished water demand between December 2010 and December 2024. The data shows a relatively steady increase in average and maximum daily demand from 2011 to 2019. Demand remained steady through 2020 due to a combination of adding the Marco Shores distribution area combined with a decreased seasonal population due to Covid-19. However, demands have been increasing at a higher rate since 2020 including a higher than normal low-demand season (June-September) in 2023. The 2024 low-demand season (June-August) data shows a return to the previous growth rate observed since 2020 indicating that the 2023 elevated demands may have been the result of higher off-season population during the hurricane Ian restoration efforts.

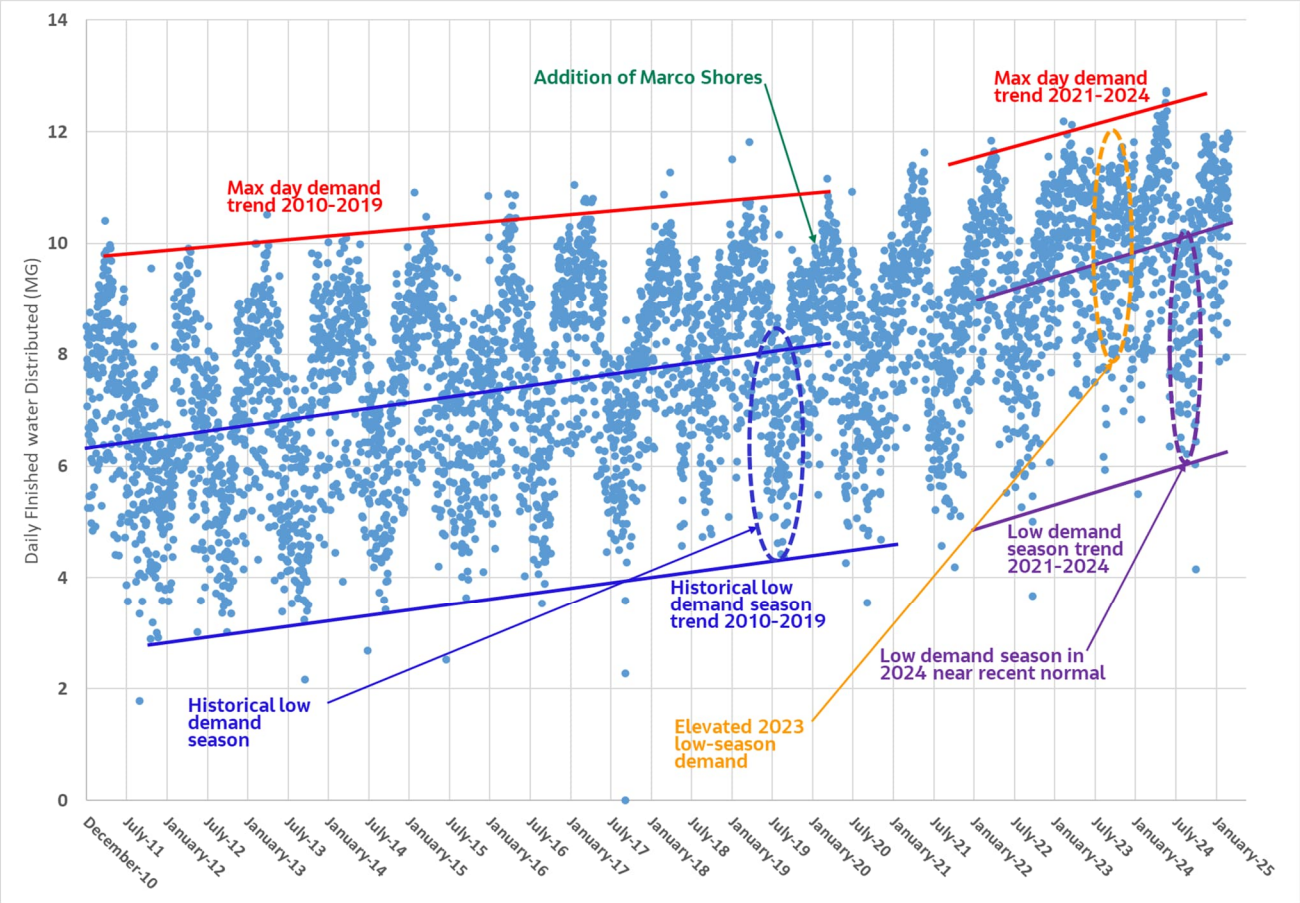

Figure 3-1 Marco Island Service Area - Daily Finished Water Demand between 2011-2024

3.3 Future Projected Water Demand (2025-2040)

Future annual average daily water demands (ADD) were calculated based on the projected future ERC counts, water usage, and maximum day water demands. The ERC counts from 2024 through 2040 were estimated using a linear growth projection between the 2023 ERC count and the 2040 build-out ERC count. As presented in Table 3-3, the average water use is 490 gallons per day (GPD) per ERC connection, which is an average usage from 2021 to 2024 excluding 2023 where the off-season demand and resulting annual ADD was higher than normal. The projected maximum day water demands were calculated using an MDD/ADD ratio of 1.31, which is the average ratio from 2022 to 2024. The peak month average daily demands were calculated using a MMADD/ADD ratio of 1.14, which is an average ratio from 2022 to 2024 (Table 3-2).

Figure 3-2 shows the existing water demand data from 2013 to 2024, with the projected future water demand data. The projected 2040 ADD is 10.41 mgd, MDD is 13.67 mgd, and MMADD is 11.86 mgd. The data shows that the MDD water demands reached WTP capacity in 2024 and an exceedance in WTP capacity after 2024. The ADD in the projected growth curve in Figure 3-2 is linear due to the linear projected growth of the remaining ERCs.

Table 3-3 Marco Island Service Area Projected Future Water Demand Data

Year	ERC at Year End[a]	Average Usage per ERC[b]	Annual Day Demand (ADD)	Maximum Day Demand (MDD)	Ratio (MDD/ADD)[c]	Maximum Monthly Average Day Demand (MMADD)	Ratio (MMADD/ADD)[d]
		(GPD/ERC)	(MGD)	(MGD)		(MGD)	
2025	20,014	490	9.80	12.87	1.31	11.17	1.14
2026	20,112	490	9.85	12.94	1.31	11.22	1.14
2027	20,211	490	9.90	13.00	1.31	11.28	1.14
2028	20,309	490	9.95	13.06	1.31	11.33	1.14
2029	20,408	490	9.99	13.13	1.31	11.39	1.14
2030	20,506	490	10.04	13.19	1.31	11.44	1.14
2031	20,594	490	10.08	13.25	1.31	11.49	1.14
2032	20,683	490	10.13	13.30	1.31	11.54	1.14
2033	20,771	490	10.17	13.36	1.31	11.59	1.14
2034	20,859	490	10.21	13.42	1.31	11.64	1.14
2035	20,947	490	10.26	13.47	1.31	11.69	1.14
2036	21,008	490	10.29	13.51	1.31	11.72	1.14
2037	21,068	490	10.32	13.55	1.31	11.75	1.14
2038	21,128	490	10.35	13.59	1.31	11.79	1.14
2039	21,188	490	10.38	13.63	1.31	11.82	1.14
2040	21,249	490	10.41	13.67	1.31	11.86	1.14

a. ERC: equivalent residential connection. ERC for 2023 through 2040 calculated proportional to estimated population rate increase.
b. Future average usage per ERC calculated using average of 2021 – 2024, excluding 2023.
c. Future ratio (MDD/ADD) calculated using average of 2022 – 2024.
d. Future ratio (MMADD/ADD) calculated using average of 2022 – 2024.

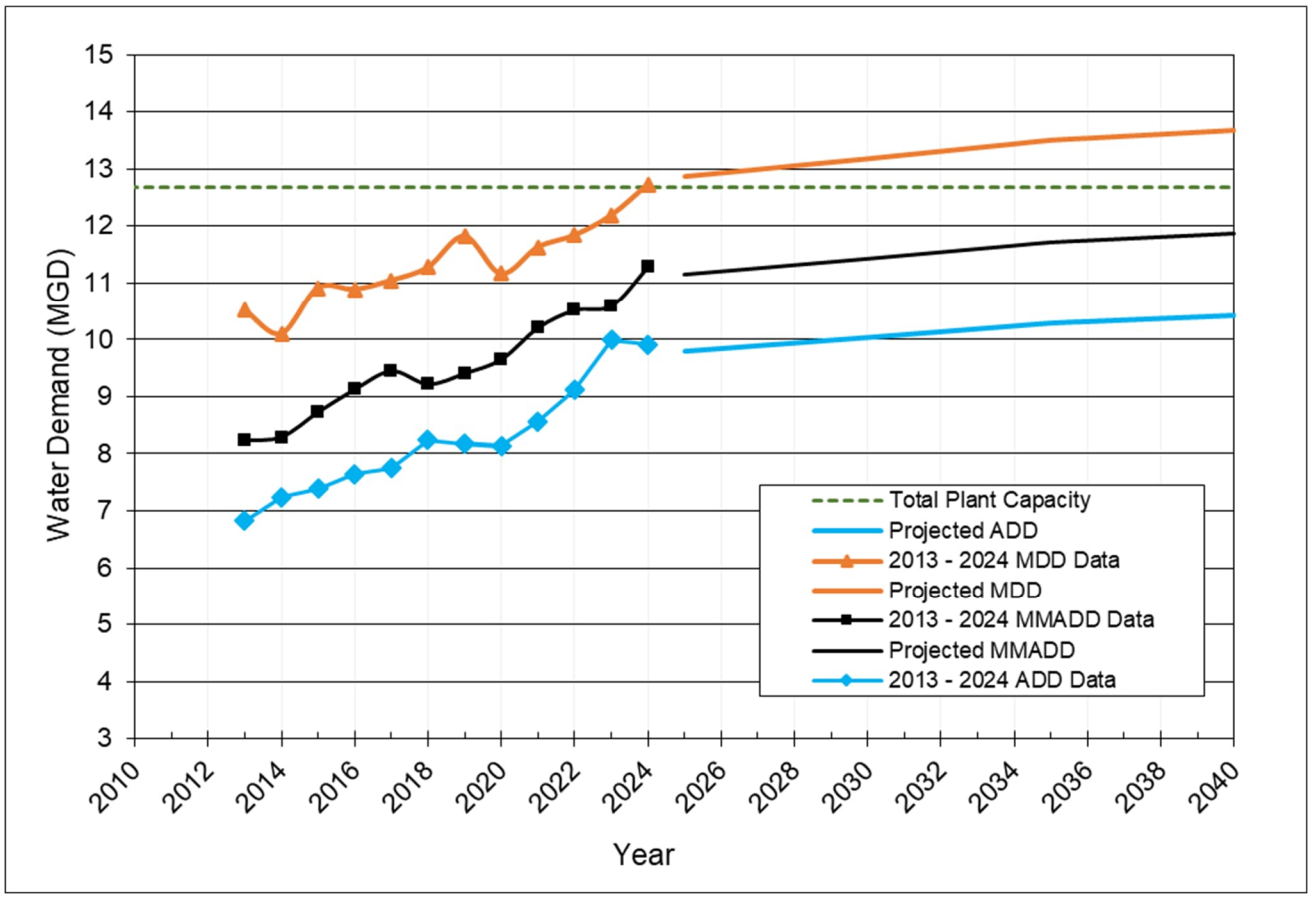

Figure 3-2 Future Water Demand Projection

4. Raw Water Supply

The South Florida Water Management District (SFWMD) granted the City of Marco Island a water use permit (WUP) to use the following three raw water sources:

- Surface water from Marco Lakes.
- Aquifer storage and recovery (ASR) in the Upper Floridan Aquifer, which uses stored surface water from Marco Lakes.
- Brackish groundwater from the Mid-Hawthorn Aquifer.

The WUP, issued in 2017, authorizes an annual allocation of 4,801.86 million gallons (MG) and maximum monthly allocation of 954.93 MG for all sources of water. The allocation breakdown is listed in Table 4-1. The NWTP uses the Marco Lakes surface water and water recovered from the ASR wells, while the SWTP uses the water from the Mid-Hawthorn wellfield.

Table 4-1 Raw Water Source and Allocation

Source	Annual Allocation (MG)	Max Monthly Allocation (MG)
Marco Lakes (for Service Area)	1966.37	244.16
Marco Lakes (for ASR)	1,515.21	546.84
Mid-Hawthorn Aquifer	1,320.28	163.93
Total	4,801.86	954.93
WUP 11-00080-W, SFWMD, 2017		

4.1 NWTP Raw Water Supply

The existing Marco Lakes raw water system (Figure 4-1) is located nine miles north of the NWTP and includes the following major components:

- Two man-made Lakes (Marco Lakes A & B). Lake A can receive diverted flows from Henderson Creek Canal when the canal level is above 3.5 feet NGVD. The flow is controlled by a sluice gate.
- One 0.5 MG ground storage tank (GST) for on-site storage of raw or recovered ASR water.
- Two raw water intake pumps (SWP-1 and SWP-2), each with a rated capacity of 2,300 gpm, and pump raw water from the lakes to GST.
- Two raw water intake pumps (SWP-3 and SWP-4), each with a rated capacity 5,000 gpm. These pumps can transfer raw water from the lakes to the GST or inject water into the ASR system.
- An ASR system, including seven (7) ASR wells, each with an injection capacity of 1,100 gpm (1.58 mgd) per well, and 7,700 gpm (11.10 mgd) total. Each well can recover and pump water from Upper Floridan Aquifer to GST.The City will also install two new ASR wells.

- Five (5) high service raw water pumps that transfer water from the Marco Lakes GST to NWTP. Two pumps have a rated capacity 5,200 gpm, two pumps have a rated capacity of 4,000 gpm, and one pump has rated capacity of 4,300 gpm. The firm capacity is 17,500 gpm (25.20 mgd). However, the maximum flow in the raw water transmission main to the NWTP is approximately 7,000 gpm (10.08 mgd). The limit is due to the maximum velocity and pressure drop in the transmission main.

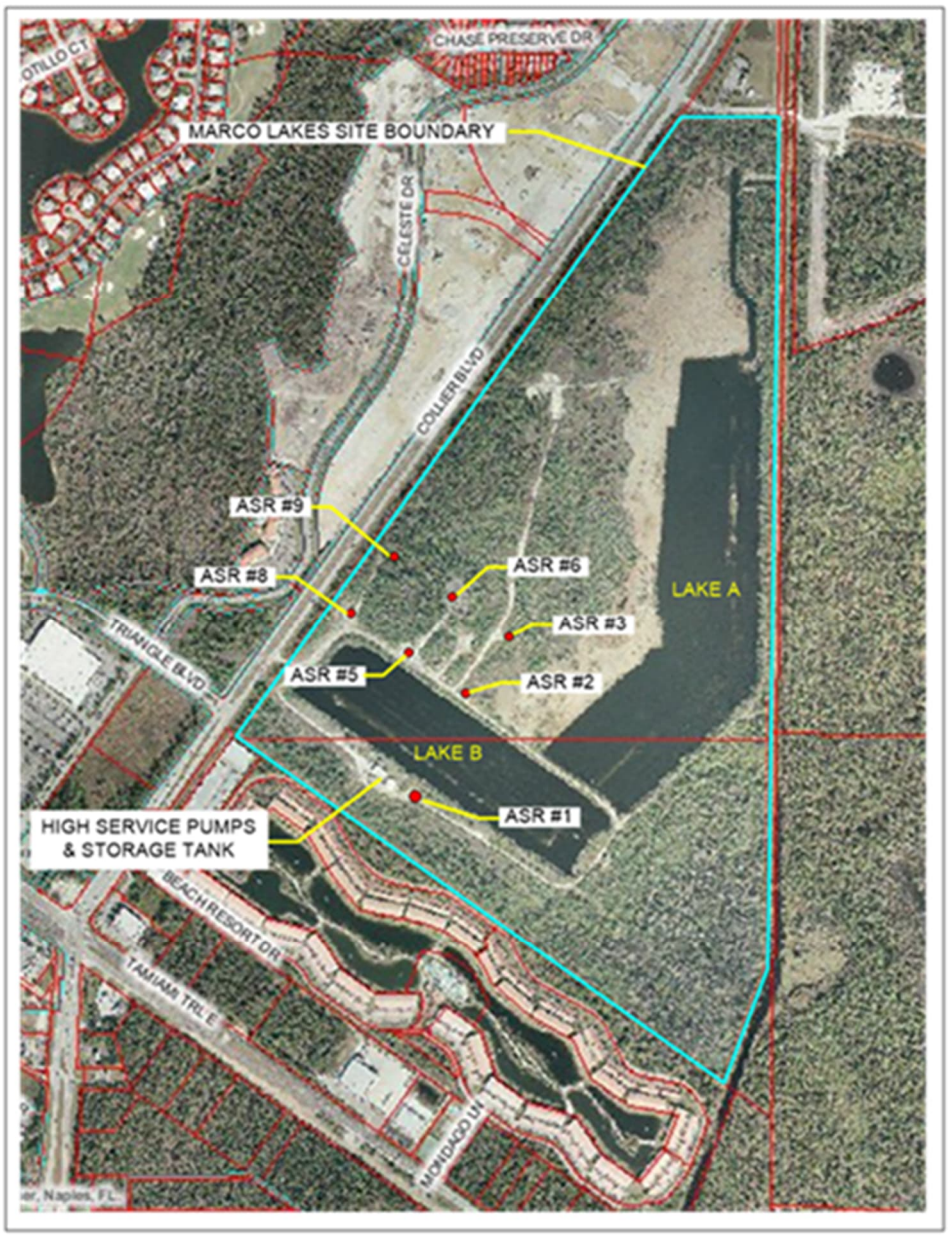

Figure 4-1 Marco Lakes Raw Water Source Facilities and ASR Wells

The WUP has an annual withdrawal limit of 1,966.37 million gallon per year (MGY) from Marco Lakes, or 5.39 mgd annual average withdrawal limit. During the wet season, June 1st to November 30th, the maximum monthly allocation of the Marco Lakes water limits the amount of water available for treatment to 244.16 MG, which is an average of 7.88 mgd for a 31-day month. The ASR withdrawals are typically

made in the dry season between December 1st and May 31st to meet additional demand. There is an allocated 1,515.21 MGY for withdrawal from the ASR. This is equivalent to an average withdrawal of 8.33 mgd from the ASR during that 182-day period, in addition to water available from Marco Lakes.

The ASR wells are used to provide year-round water supply by storing large quantities of Marco Lakes water during the wet season, when lake water is plentiful, and for later recovery during the dry season when lake water is limited. Injection into the ASR can occur when the following three conditions are met:

- The date is June 1st to November 30th (183 days)
- The stage level of Henderson Creek Canal exceeds 3.5 feet NGVD
- The stage level of Marco Lakes exceeds 2 feet NGVD.

The raw lake water is stored in a deep but unused aquifer, which minimizes the flow of the fresh water away from the well. The ambient water in the storage aquifer is higher-density brackish water. There is a significant stratification of the fresh and brackish water, and the injected raw water creates a "bubble" of fresh water within the brackish aquifer. This stratification can minimize mixing two sources of water and keep a similar lake water quality for future recovery. Typically, only about 70 – 80 percent of the bubble of water is recovered before exceeding the drinking water standards for total dissolved solids (TDS) and chloride level. ASR water generally has less than 150 mg/L chloride concentration and do not exceed 250 mg/L to meet the operational requirements of NWTP.

There is a 100 MGY Marco Lakes withdrawal allocated to supplement the reclaimed water system and irrigation water to golf courses on Marco Island, with a maximum of 1.0 mgd flow during the dry season. Therefore, the remaining 1866.37 MGY of the Marco Lakes water is used as raw water supply to NWTP, leaving a 5.11 mgd annual average withdrawal limit for treatment. Of the approximately 10 mgd transfer capacity of the Marco Lakes transmission main, there is a 9 mgd remaining hydraulic capacity available to the NWTP for treatment for peak day treatment. Overall, the NWTP's raw water supply system has sufficient capacity to supply the permitted 6.67 mgd to the plant.

The existing raw water transfer pumps, raw water high pressure transmission main pumps, and ASR well pumps are also adequate to supply the 6.67 mgd of feedwater needed for the NWTP, as well as the 9 mgd for the future expanded capacity.

4.2 SWTP Raw Water Supply

Raw water for the RO system at the SWTP is supplied by the Mid-Hawthorn Aquifer brackish wellfield located on Marco Island, as shown on Figure 4-2. There is a total of 21 wells of which 14 are currently in operation. The City of Marco Island has abandoned and plugged five brackish wells (RO-2, RO-3, RO-5, RO-6, and RO-9) due to increasing salinity. Two of the wells (RO-7 and RO-8) are disconnected from the system and are maintained as standby wells. Table 4-2 shows the rated capacity of each of the operating brackish wells.

The SWTP has a rated production capacity of 6.0 mgd, and the RO treatment process operates at 75 percent recovery, which means that the SWTP requires 8.0 mgd of raw water to meet treatment capacity. The total capacity of the wells with the largest well out of service is 7.90 mgd, as shown in Table 4-2, which is less than the required 8.0 mgd. The WUP lists an annual withdrawal limit of 1320.28 MG (3.62 mgd on average) from the Mid-Hawthorn Aquifer, and a maximum month allocation of 163.93 MG (5.46 mgd on average). Therefore, the SWTP can produce an annual average of 2.72 mgd, or a maximum month average of 4.10 mgd, assuming 75 percent recovery.

Figure 4-2 Brackish RO Groundwater Supply Wells Location

Table 4-2 SWTP Mid-Hawthorn Wellfield Summary

Name of Well	Design Capacity of Well Pump (mgd)
RO well 1	0.69
RO well 2	Not in use – filled in
RO well 3	Not in use - filled in
RO well 4	0.65
RO well 5	Not in use - filled in
RO well 6	Not in use - filled in
RO well 7	Out of Service
RO well 8	Out of Service
RO well 9	Not in use - filled in
RO well 10	0.60
RO well 11	0.79
RO well 12	0.76
RO well 13	0.79
RO well 14	0.61
RO well 15	0.43
RO well 16	0.69
RO well 17	0.63
RO well 18	0.51
RO well 19	0.63
RO well 20	0.63
RO well 21	0.69
Wellfield Firm Capacity (largest well out of service)	7.90

5. Water Treatment, Storage Pumping Facilities and Disinfection

5.1 North Water Treatment Plant

5.1.1 Treatment, Storage and Pumping Facilities

The NWTP is a lime softening and membrane filtration (MF) WTP located at Elkcam Circle and Windward Drive in the northern part of Marco Island (Figure 5-1). Marco Lakes and the Marco Lakes ASR wellfield, located 9 miles north of Marco Island, provide raw water to the NWTP. The NWTP has a permitted production capacity of 6.67 mgd and transfers a portion of its finished water to the SWTP to blend with RO permeate.

Figure 5-1 NWTP Location

The NWTP uses a lime softening reactor/clarifier followed by MF. All treatment components are sized to operate at greater than 6.67 mgd in accordance with FDEP rules. The facility was limited to the current 6.67 mgd capacity by the dual media filters that were replaced by the MF system in 2013. The facility was not re-rated at that time because the water projections did not show the need for expanded capacity. The facility is also permitted to bypass the lime reactor and conduct direct filtration treatment with in-line alum injection before the MF system. Lime and an aluminum-based coagulant are added to the reactor/clarifier to remove TOC, color, hardness, and alkalinity from the raw water. The lime process is used for hardness removal and not required to meet primary or secondary drinking water standards. Primary disinfection of viruses is accomplished by adding sodium hypochlorite to the lime reactor/clarifier effluent or to the bypass line feeding the MF system. The MF system removes turbidity from the bypass or lime softening process and provides a critical removal barrier for pathogens. The MF system is comprised of six (6) membrane filter racks. Each rack can treat up to 2.5 mgd, to a maximum of 10.0 mgd with two

trains out of operation. The MF filtrate is treated with ammonia to form chloramines for residual disinfection. The filtrate is also treated with a phosphate-based corrosion inhibitor.

The finished water is sent to the 4.0 MG GST at the NWTP or transferred to the SWTP GSTs. Finished water from the NWTP 4.0 MG GST is sent to distribution using the onsite high service pump station (HSPS). The HSPS consists of four (4) pumps, each with a rated capacity of 3,300 gpm. The NWTP HSPS firm capacity is 9,900 gpm (14.26 mgd), with a total capacity of 13,200 gpm (19.0 mgd).

Finished water is directed to the SWTP using two (2) transfer pumps, each with a rated capacity of 3,500 gpm. Typically, 3.0 to 3.5 mgd of finished water from the NWTP is transferred to the SWTP to blend with RO permeate.

The lime sludge from the reactor/clarifier and the backwash water from the MF process flow to the on-site settling ponds to remove solids and recycle water back to the lime reactor. The chemical cleaning waste from MF maintenance events flows to the Reclaimed Water Production Facility (RWPF) for treatment and is then distributed as reclaimed water for irrigation or disposed via a Class I injection well.

Table 5-1 summarizes the capacity of the components of the NWTP water supply and treatment facilities.

Table 5-1 NWTP Process Unit and Capacity Summary

Component	Number and Rated Capacity	Firm Capacity
Raw Water Intake or ASR Injection Pumps	2 @ 5,000 gpm ea.	13.83 mgd
Raw Water Intake Pumps	2 @ 2,300 gpm ea.	
ASR well pumps	7 @ 1,100 gpm ea.	9.51 mgd
Raw Water High Service Pump	2 @ 5,200 gpm ea.	25.22 mgd
	2 @ 4,000 gpm ea.	
	1 @ 4,300 gpm ea.	
Lime Softening Reactor/Clarifier	>7.50 mgd	>7.50 mgd
Membrane Filtration	6 @ 2.5 mgd	10.0 mgd
SWTP Transfer Pumps	2 @ 3,500 gpm ea.	5.04 mgd
High Service Pumps	4 @ 3,300 gpm ea.	14.26 mgd
Storage Tanks	1 @ 4 MG	4 MG

Firm capacity of pumps is calculated assuming the biggest pump out of service.
Firm capacity of process units is the rated capacity.

5.1.2 NWTP Disinfection Requirements

The NWTP treats a surface water source and is therefore required by the surface water treatment rule and FDEP rules to meet disinfection requirements. Coagulation assisted microfiltration achieves the following log removal credits: 3.0-log for Giardia, 3.0-log for Cryptosporidium, and 1.0-log for Viruses. These removal credits are dependent upon daily direct integrity testing of the membrane fibers, and continuous indirect integrity testing monitoring filtrate turbidity. The system achieves the remaining 3.0-log removal

of viruses using free chlorine contact time to comply with the 4.0-log removal of viruses for a system exposed during treatment to open atmosphere. With the implementation of the microfiltration system, the plant no longer requires the use of GST hydraulic retention time for disinfection.

5.2 South Water Treatment Plant

5.2.1 Treatment, Storage and Pumping Facilities

The SWTP is a reverse osmosis (RO) WTP located in the southern part of Marco Island off Lily Court (Figure 5-2). Raw water is provided to the facility by 15 brackish wells located in the central and eastern portion of the island. The SWTP has a permitted production capacity of 6.0 mgd and receives 3.0 to 3.5 mgd of additional finished water from the NWTP for blending with RO permeate before distribution at the SWTP.

Figure 5-2 SWTP Location

The SWTP utilizes sand separation, cartridge filtration, and scale inhibitor as pretreatment to a two-stage RO desalination system. The RO system is comprised of six (6) trains that produce 1.0 mgd each and are designed to treat brackish water up to 11,000 mg/L total dissolved solids (TDS) at approximately 75 percent recovery. Hydrogen sulfide is removed from the RO permeate by forced air degasification. The RO concentrate is discharged to a deep injection disposal well (Class I injection well) located at the RWPF.

The SWTP has two 2.0 MG GSTs, one 3.0 MG GST, and one 1.0 MG GST, for a total of 8 MG storage capacity. The SWTP has one operating HSPS facility, the east HSPS. The previously operational west HSPS has been demolished. The east HSPS has a total of four high service pumps with a firm capacity of 9,900 gpm (14.26 mgd) and a total capacity of 13,200 gpm (19.0 mgd). The east HSPS has four pumps, each rated at 3,300 gpm.

A new west HSPS is currently under construction that will have two pumps, each with a rated capacity of 3,300 gpm, with room for a future third pump. After the west HPS construction completion in 2025, the

SWTP will have a total of six high service pumps with a firm capacity of 16,500 gpm (23.76 mgd) and a total capacity of 19,800 gpm (28.51 mgd).

Table 5-2 summarizes the capacity of the components of the SWTP water supply and treatment facilities.

Table 5-2 SWTP Process Unit and Capacity Summary

Component	Number and Rated Capacity	Firm Capacity
Wellfield Wells/Pumps	15 @ 9.39 mgd total	8.60 mgd
Sand Separators	2 @ 5.38 mgd	10.76 mgd
Cartridge Filters	6 @ 1.87 mgd	9.35 mgd
RO Feed Pumps	6 @ 1.34 mgd	6.7 mgd
RO Trains	6 @ 1.0 mgd	5.0 mgd
	(75% recovery)	
Degasifiers	2 @ 3.0 mgd	3.0 mgd
Transfer Pumps		
High Service Pumps	4 @ 3,300 gpm	14.26 mgd
	2 @ 3,300 gpm (online in 2025)	23.76 mgd (in 2025)
Storage Tank	2 @ 2 MG	8 MG
	1 @ 3 MG	
	1 @ 1 MG	
Firm capacity of pumps and cartridge filters is assumed the largest capacity pump out of service. Firm capacity of sand separator, RO feed pumps, and storage tanks are the rated capacity.		

5.2.2 SWTP Disinfection Requirements

The SWTP treats a ground water source that is only required to meet 4-log virus inactivation by the Groundwater Rule. The SWTP achieves 4-log virus inactivation through a combination of removal credits from the RO treatment process, free chlorine inactivation, and chloramine inactivation. The SWTP achieves 2-log virus removal credit using RO by limiting the maximum salt passage to 5 percent. The additional 2-log virus inactivation is achieved using free chlorine injected after the transfer pumps. Ammonia is injected into the SWTP process water to form chloramines as a residual disinfectant prior to blending with the NWTP finished water. Chloramines provide additional virus inactivation within the GST tanks if needed.

6. Capacity Analysis for Projected Water Demand

6.1 Raw Water Supply and Water Treatment Plant Capacity

The projected ADD in 2040 is 10.41 mgd, as shown in Table 3-3. The NWTP can produce up to 6.67 mgd with the SWTP supplying the difference in flow. The Marco Lakes and ASR water allocation is sufficient to support the production of the permitted 6.67 mgd for each day of a year. The Mid-Hawthorn Aquifer allocation has an annual average raw water withdrawal of 3.62 mgd. With this allocation, the SWTP can produce an annual average of 2.71 mgd operating the RO trains at 75 percent recovery. Together, the NWTP and SWTP can produce 9.38 mgd of finished water on an annual average basis which is not sufficient to meet the projected 10.42 mgd of ADD in 2040.

The projected MDD in 2040 is 13.67 mgd, as shown Table 3-3. The NWTP can produce 6.67 mgd, the permitted capacity, and the SWTP can supplement the remaining demand within its 6.0 mgd permitted capacity. This is in addition to the combined storage of 12 MG that could help cover peak water demands. The projected MDD of 13.67 mgd in 2040 is 108 percent of the existing total WTP capacity of 12.67 mgd.

The projected MMADD in 2040 is 11.86 mgd, as shown in Table 3-3. The maximum month allocation of the Marco Lakes is 244.16 MG, a 7.88 mgd average day withdrawal for a 31-day period but could be 6.88 mgd if the golf courses are taking 1 mgd of flow during this period. The Marco Lakes ASR, during the dry season when accessible, has a maximum month allocation of 546.84 MG (17.64 mgd average day withdrawal for a 31-day period). So, the NWTP has sufficient raw water to produce the permitted 6.67 mgd of each day during maximum month period. The maximum month allocation of the Mid-Hawthorn Aquifer is 163.92 MG (5.28 mgd average day withdrawal for a 31-day period). If the SWTP RO is operating at 75 percent recovery, the Mid-Hawthorn Aquifer allocation allows the SWTP to produce 3.96 mgd during a maximum month. Together, the NWTP and SWTP can produce a total 10.63 mgd water which does not meet the projected 11.56 mgd of MMADD in 2040.

The existing raw water supply and WTP combined permitted capacity of 12.67 mgd is not sufficient to meet the future 2040 ADD, MDD, and MMADD water demands.

6.2 Fire Flow Storage and WTP System Storage

6.2.1 Fire Flow Requirement

The NWTP and SWTP also provide the water for the fire protection of the Marco Island Service Area. The City can provide fire flow for residential, multi-family, or commercial areas. The assumed fire flow rates are conservatively based on typical American Water Works Association (AWWA) rates. Fire flow storage requirement applies to the entire WTP system and is based on maintaining the single highest fire flow rate of 3,500 gpm (commercial) for four (4) hours. The total storage volume required to meet the four hours of fire flow demand is 840,000 gallons. Table 6-1 shows the estimated fire flow requirements of each land use category, with the commercial land use being the worst-case scenario.

6.2.2 Finished Water Storage Capacity

The fire flow storage requirement can be met using the combined storage at the NWTP and the SWTP. In addition, the FDEP finished water storage requirement for meeting diurnal peak demands is that the total system storage is 25 percent of the MDD. The required FDEP finished water storage volume is determined as follows:

1. A volume equal to a fire flow volume of 0.84 MG, plus;

2. 25 percent of the service area MDD, with a projected future MDD of 13.67 mgd in 2040 (Table 3-3), this volume is 3.42 MG.

Based on the above criteria, the minimum usable storage volume required for the NWTP and SWTP combined is 4.26 MG. This requirement does not include the minimum volume storage for 4-log removal at the SWTP. A minimum 2.45 MG volume is required for virus inactivation in the storage tanks at the SWTP. The total required storage volume is therefore 6.7 MG. The SWTP has 8 MG of storage and the total WTP system finished water storage capacity is 12 MG. The existing combined 12 MG storage capacity at the NWTP and SWTP is adequate to meet the current and future finished water storage requirements.

Table 6-1 Estimated Fire Flow Requirements

Land Use	Fire Flow Rate	Fire Flow Storage[a]
	(gpm)	**(gallons)**
Single-family residential	1,500	360,000
Multifamily residential	2,500	600,000
Commercial (hotel)	3,500	840,000
Maximum fire flow storage		**840,000**

a. Fire flow storage is storage for four hours of operation at the fire flow rate.

6.3 High Service Pumping Capacity and Distribution Transmission Line

The NWTP and SWTP supply water to the same interconnected distribution system, which allows for the high service pumping requirements to be met with a combination of pumps located at both plants. The current and future capacity of the HSPSs and projected peak hourly flows in the service area are shown in Table 6-2.

The total pumping capacity should meet the greater of the following flows:

1. The sum of the fire flow and the MDD flow, which is 3,500 gpm for the fire flow and 8,791 gpm for the projected MDD in 2040 for a total of 12,291 gpm.

2. The projected peak hourly flow, calculated by multiplying the MDD by a max hour peaking factor. The maximum peaking factor on high demand days from 2023 to 2024 was 2.9. The projected 2040 peak hourly flow is 27,523 gpm using this peaking factor with the 2040 13.67 mgd maximum day demand.

The current firm capacity of the combined HSPSs NWTP and SWTP is 23,100 gpm with the largest pump out of service. After completing the ongoing SWTP HSPS modifications in 2025, the combined NWTP and SWTP HSPS firm capacity will be 29,700 with the largest pump out of service, which will meet the 2040 peak hourly flow rate of 27,523 gpm. The City will have the option to add one pump within the future space at the SWTP HSPS to increase the combined NWTP and SWTP HSPS build-out firm capacity to a total of 33,000 gpm if needed.

The NWTP HSPS connects to a 30-inch distribution pipeline, and the SWTP HSPS connects to a 24-inch and 30-inch distribution pipeline. The two plants together can transfer a total flow of 27,523 gpm flow with a pipe flow velocity less than 5.2 ft/s. The distribution pipeline sizing will have sufficient capacity to carry the build-out peak hourly flow.

Table 6-2 Marco Island Service Area High Service Pump Capacity

Location	Pumps and Capacity	Firm Capacity (gpm)	Projected Peak Hourly Flow (gpm)
NWTP	Pumps 1-4 (13,200 gpm)	9,900	
SWTP	Pumps 1-4 (13,200 gpm)	9,900	
Total (Current)	**Pumps 1-8 (26,400 gpm)**	**23,100**	**23,540**
NWTP	Pumps 1-4 (13,200 gpm)	9,900	
SWTP	Pumps 1-6 (19,800 gpm)	16,500	
Total (2025)	**Pumps 1-10 (33,000 gpm)**	**29,700**	**25,924**
NWTP	Pumps 1-4 (13,200 gpm)	9,900	
SWTP	Pumps 1-7 (23,100 gpm)	19,800	
Total (Build-Out)	**Pumps 1-11 (36,300 gpm)**	**33,000**	**27,523**

6.4 Future North Water Treatment Plant Improvement

The City conducted an evaluation of expansion options for the NWTP and found low pressure reverse osmosis (LPRO) to be the best option to replace the existing lime softening reactor/clarifier to significantly reduce operating cost while meeting treatment goals for hardness, chloride, organics, PFAS and other emerging contaminant removal. The City conducted a pilot test program in 2018-2020 that confirmed the feasibility of LPRO to treat the existing MF filtered water and meet City treated water goals. The upgrade to LPRO would increase permitted treatment capacity of the NWTP to at least 8.5 mgd while using the existing MF and chemical feed systems. The Marco Lakes and ASR facilities, the NWTP storage, and high service pumps capacity would remain the same. However, LPRO will produce concentrate waste which will increase water usage. As a worst-case scenario, assuming LPRO will operate at 85% recovery, the raw water required to produce the 8.5 mgd water would be 10 mgd. The raw water transmission line will have sufficient capacity to accommodate this potential plant improvement.

6.5 Summary

The capacity analysis summary is presented in Table 6-3. The existing source water and treatment capacity of NWTP and SWTP exceeds the projected 2040 ADD, MDD, and MMADD. The existing storage tanks capacity exceeds the projected storage requirements in 2040. The HSPS with future expansion will exceed the projected 2040 hourly peak flow.

Table 6-3 Capacity Analysis Summary

Plant	Permitted Plant Capacity	Projected Maximum Day Demand (2040)	Available Annual Average Production	Projected Annual Average Day Demand (2040)	Available Maximum Monthly Average Day Production	Projected Maximum Monthly Average Day Demand (2040)	Existing Storage Capacity	Required Storage Capacity with Fire Flow and 4-Log (2040)	Existing Firm HSPS Capacity[e]	Future Firm HSPS Capacity at Build-Out[e]	Projected Peak Hourly Flow (2040)
	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MG)	(MG)	(gpm)	(gpm)	(gpm)
NWTP	6.67		6.67[a]		6.67[c]		4		9,900	9,900	
SWTP	6.0		2.71[b]		3.96[d]		8		13,300	19,800	
Total	12.67	13.67	9.38	10.42	10.63	11.86	12	6.71[f]	23,200	33,000	27,523

a. The annual allocation for Marco Lakes of 1,866.37 MG and the annual allocation for the Marco Lakes ASR of 1,515.21 MG has sufficient raw water for NWTP to produce 6.67 mgd water on annual average day basis.
b. Assuming 365 days of the annual allocation for Mid-Hawthorn Aquifer of 1,320.28 MG and the SWTP RO system operating at 75 percent recovery.
c. The maximum allocation of Marco Lakes is 244.16 MG (7.88 MGD assuming 31 days per month) which is sufficient for NWTP to operate at the permitted 6.67 mgd.
d. Assuming 31 days per month for authorized maximum monthly allocation for Mid-Hawthorn Aquifer of 163.93 MG and 75 percent recovery.
e. Assumes that the NWTP and SWTP each have their largest pump out of service.
f. The storage volume includes the minimum storage volume to meet 4–log removal at the SWTP.

7. Summary and Recommendations

7.1 Water Demands

- Water demand projections show that while the increased off-season demand of 2023 was not repeated in 2024, there is a higher rate of growth since 2020.
- The maximum day demand has already exceeded the current rated capacity of the combined NWTP and SWTP of 12.67 mgd. These high demand days can be accommodated using on-site storage, however while only 2 days exceeded 12 mgd in 2023, 13 days exceeded 12 mgd in 2024. If this trend continues, making up flow through storage will be difficult within 5 years when average day demand is projected to exceed 10 mgd and max day demand is projected to exceed 13.2 mgd. This is especially true if the SWTP cannot operate at its full capacity of 6 mgd regularly.
- Build-out maximum day potable water demand is anticipated to reach 13.67 mgd at the current level of service. WTP expansion for at least this capacity added capacity should be considered.
- Annual review of the Marco Island distribution system flow data should be conducted to monitor these trends and project when WTP capacity will become critical without a reduction in level of service.

7.2 Source Water Capacity

- The NWTP annual average withdrawal limit is 5.39 mgd (5.11 mgd after raw water use for irrigation), while the SWTP wellfield annual average withdrawal limit is 3.62 mgd. When accounting for current RO recovery, the actual amount the SWTP can produce is 2.72 mgd. The combined annual average production can therefore peak at 7.83 mgd without adjusting raw water irrigation. The current annual average potable water demand of 9.92 mgd exceeds this allocation amount.
- Marco Island will need to work with the SFWMD to increase allocation to meet average day demands as well as future maximum day demands. The SWTP wellfield is most limited, however added capacity at the Marco Lakes will also be needed for buildout 10 mgd average day demand.
- Marco Island may conduct a review of SWTP RO system recovery for the potential to increase the current 75 percent recovery using newer scale inhibitors, booster pumps and high recovery RO technologies.

7.3 Treatment Facility Expansion and Future Regulations

- The SWTP capacity is limited by aging equipment and limited source water. A condition assessment is recommended of both the SWTP treatment system and source water wells to determine the most economical way to maximize reliable capacity and improve source water recovery as finished water.
- The NWTP is operating near the permitted 6.67 mgd capacity that was limited by the dual media filters replaced in 2013 by MF. Jacobs recommends re-rating the facility to 8+ mgd to take full advantage of the installed MF system capacity and available source water in the short term before future WTP improvements.
- MF system fouling issues continue to reduce reliability and do not allow the system to operate continuously at the rated 10 mgd. Before implementing future treatment improvements, installing the new BAF system will be required to solve many of these issues. However further looks at alternative cleaning recipes and membrane elements may improve overall MF system performance.

- Jacobs recommends that the City purchase an MF/UF pilot for existing module flow testing, cleaning testing and alternative membrane manufacturer testing.
- PFAS testing in the NWTP source water has found potential seasonal PFAS concentrations that exceed the new regulatory limit of 4 ng/L. While currently ultimately below the limit on an annual average basis, additional monthly testing is recommended, especially within the dry season, to confirm that the PFAS trends will not cause future issues.
- Jacobs recommends implementing advanced treatment to expand the facility while treating potential issues with PFAS. LPRO, GAC and IX are considered best available technology (BAT) options to treat for PFAS, however the City's expansion options evaluation showed that LPRO is the most cost effective solution given the City's treatment goals for chloride, TOC, hardness and other emerging contaminants.
- The combined finished water storage and high service pumping after the current SWTP HSPS expansion will be sufficient for buildout.

8. References

- Marco Island Utilities, 2009 – 2024 Monthly Water Flow Data, Marco Island, FL.
- South Florida Water Management District . 2017. *Water Use Permit, 11-00080-W*.
- Jacobs. June 2021. *Marco Island Water Treatment Facilities 2020 Capacity Analysis Report.*
- *City of Marco Island Comprehensive Plan Update* dated September 29, 2020
- Jacobs. January 2024. *2023 Marco Island Ten Year Water Supply Work Plan*.