Potable Water Master Plan Update - Final

Englewood Water District

District Agreement No. 2022-129

Englewood, FL
January 31, 2024

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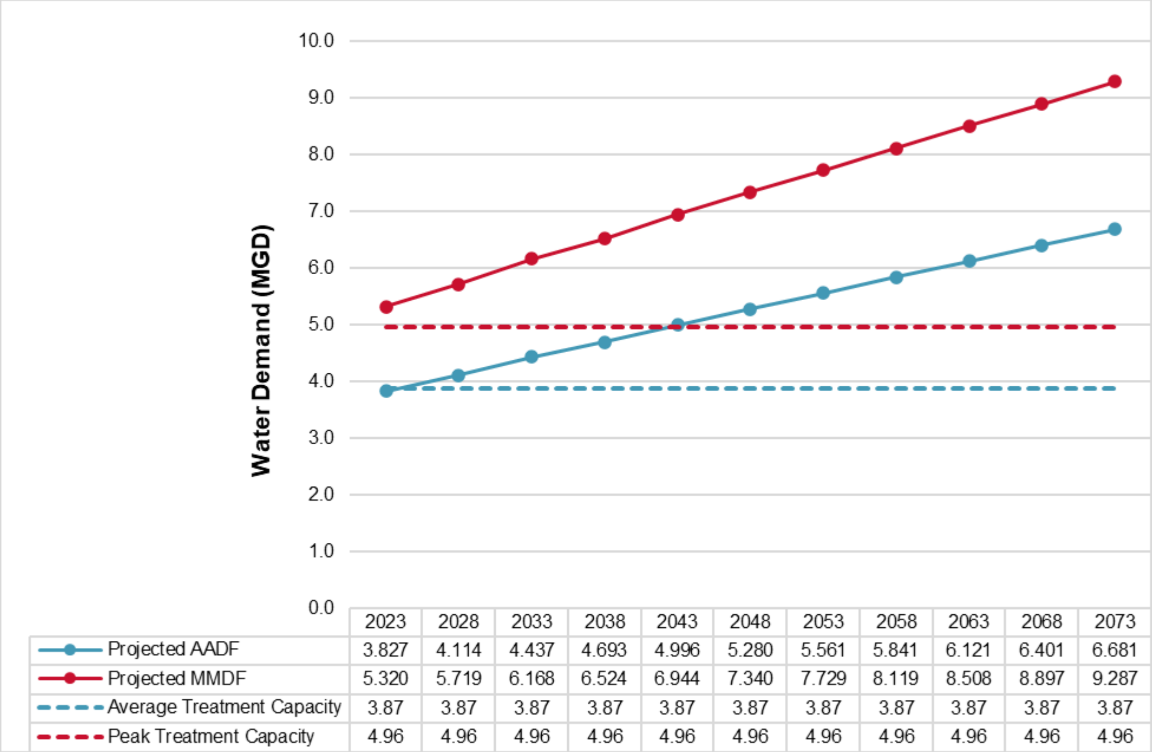
Executive Summary

The District retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan Update. This Master Plan Update assesses the District's water service and facility needs for a 20-year planning period from 2023 through 2043 and a longer 50-year period from 2023 to 2073. For this effort, HDR performed a condition assessment of the existing water treatment plant, developed updated demand projections, and evaluated several alternatives for water supply, treatment, and distribution capacity expansion. This report summarizes findings and recommendations from each of these tasks to inform future decisions regarding needed expansion and improvements to the potable water system.

Condition Assessment Findings: The HDR team performed a walkthrough of the lime softening and reverse osmosis plants in March 2023. This resulted in a high-level assessment of the structural, mechanical, electrical, and instrumentation aspects of major plant processes, based on physical observations and input on performance and age from the District. The condition assessment indicated mechanical and structural concerns with the lime softening treaters, overall concerns regarding the condition of the media filters at the lime softening plant, and structural and electrical deficiencies within the RO system.

Demand Projections Findings: HDR developed per capita demand estimates and multiplied these by four alternative population projections to estimate a 2043 service area Average Annual Day Flow (AADF) demand of 4.996 million gallons per day (MGD) and Maximum Monthly Day Flow (MMDF) of 6.944 MGD. Based on this analysis, it is recommended to expand the water treatment plant to provide a finished water capacity of 7 MGD (see Figure ES- 1).



	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2073
Projected AADF	3.827	4.114	4.437	4.693	4.996	5.280	5.561	5.841	6.121	6.401	6.681
Projected MMDF	5.320	5.719	6.168	6.524	6.944	7.340	7.729	8.119	8.508	8.897	9.287
Average Treatment Capacity	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
Peak Treatment Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96

Figure ES- 1: Englewood Water District Future Finished Water Needs to 2073

Water Supply and Treatment Findings: HDR evaluated five alternatives to meet future demand projections and water treatment plant performance needs:

- Alternative 1a – Rehabilitate the Existing LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitate and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Rehabilitate and Expand the RO Plant in Place
- Alternative 3b – Decommission LS Plant and Completely Replace Existing RO Plant at Expanded Capacity with a New RO Plant

Though each alternative reasonably increases the water treatment capacity expansion to 7 MGD, Alternative 3b is recommended. The alternative provides the District with a new single treatment process allowing for modernizations in process energy and operational efficiencies for a more reliable facility for the community. A new RO facility and hardened building with new laboratory, modern operations control room, staff breakroom and restrooms, and emergency operations center could also attract new workers. Furthermore, RO treatment is the only process considered for reasonable plant upgrades that inherently removes contaminants of emerging concern, creating a safer drinking water for District customers. Figure ES- 2 shows a proposed layout of Alternative 3b.

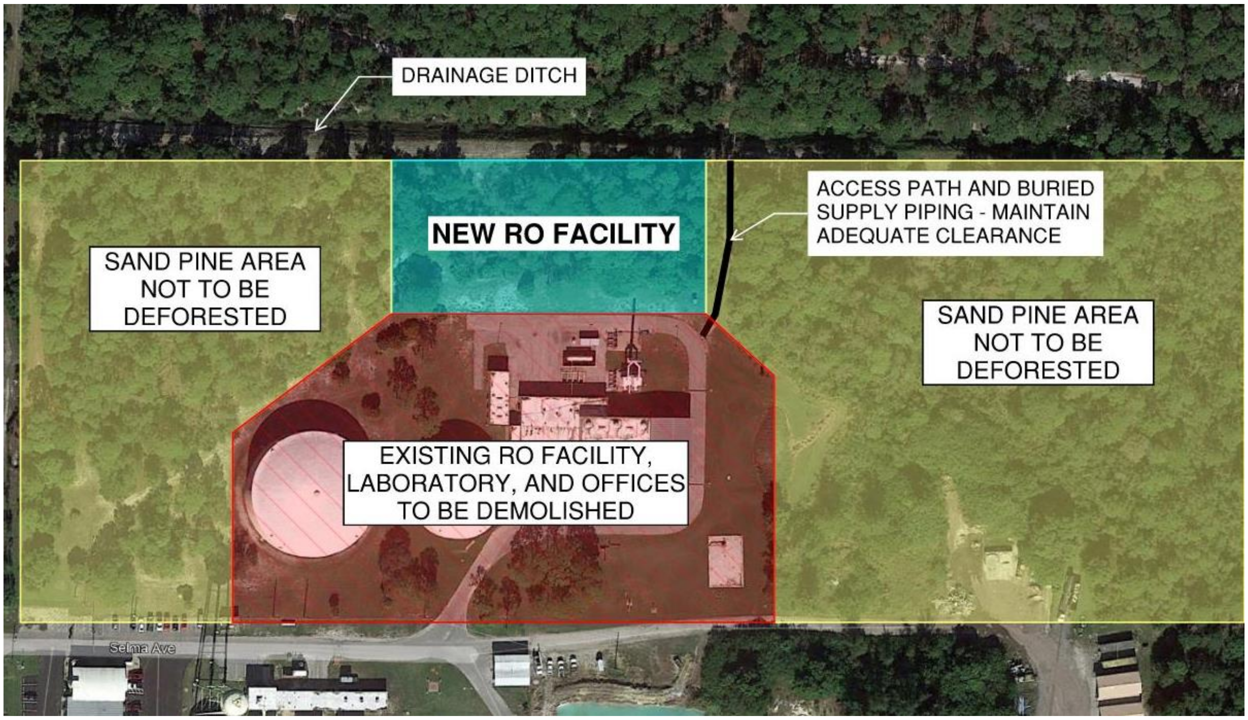


Figure ES- 2: Alternative 3b Future RO Plant Location

Distribution Findings: To assess the distribution system, HDR updated the existing District WaterGEMS Hydraulic Model. Building off District-provided GIS and geocoded water meter data, HDR identified 165 pipes as new or necessary and included them in the modeling update. HDR validated this uncalibrated model to May 2023 customer use data.

Five modeled scenarios were developed to analyze high water demand in the District's distribution system. These entailed existing conditions, 2043 conditions with the distribution system expanded to planned developments, and 2073 conditions to validate potential pipe velocities for the expanded distribution system.

For the distribution system, HDR recommends addressing the primary areas of concern seen in the model: Manasota Key, Japanese Gardens, Englewood Isles, Englewood Rd, and the Southeast Region of Grove City and Mobile Gardens. The areas show a sensitivity to increased demand resulting in an increase in head loss. Additionally, increasing high service pump station's VFD set pressure to 70 psi will improve pressures for the extents of the distribution system. Accordingly, provisions to the elevated storage tank would need to be made, such as adding an altimeter valve to limit the tank being overfilled or replacing it with a hydropneumatic tank at ground level. Recommended projects are shown in Figure ES- 3.

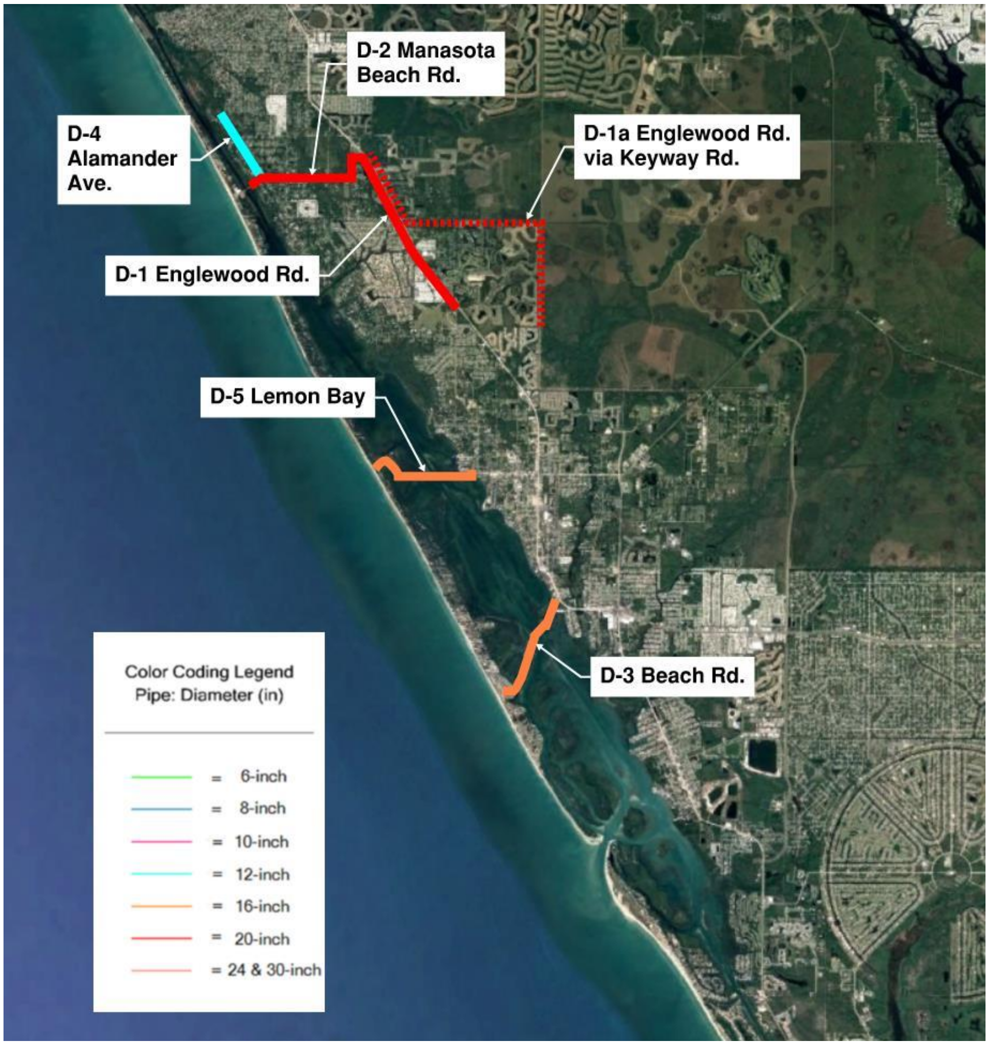


Figure ES- 3: Distribution System Improvement Consideration

Resulting CIP Recommendations: HDR developed AACEI Class IV cost estimates in 2023 dollars for all proposed capital projects, which has an accuracy range of -30% to +50%. A timeline with recommended years for project initiation was developed based on assessed urgencies and project interdependencies as shown in Table ES- 1.

Table ES- 1: CIP Project Descriptions and Capital Costs in 2023 Dollars

ID	Name	Description	Total Cost	Timeline
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.	$8,100,000	2028
D-1a	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.	$15,100,000	2028
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.	$7,820,000	2031
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.	$2,890,000	2034
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.	$3,170,000	2036
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.	$9,490,000	2031
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.	$2,220,000	2026
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.	$400,000	2032
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system regarding water quality, energy, and operation.	$50,000	2024
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.	$81,580,000	2025
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.	$33,610,000	2025
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.	$800,000	2025
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.	$8,660,000	2025
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.	$450,000	2025
T-7	New Degasifier	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.	$1,360,000	2025
T-8	Clearwell Repairs	Repair areas with corrosion damage.	$260,000	2026
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.	$13,450,000	2026
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.	$810,000	2030

1 Introduction

1.1 District Background

Englewood Water District (District) was created in 1959 and is classified as a political sub-division of the State of Florida under Chapter 2004-439. The District owns and operates a public utility that provides water services within the unincorporated areas of Sarasota and Charlotte Counties, generally known as Englewood, Grove City, and Manasota Key. The District's current service area boundary encompasses approximately 44.5 square miles. In addition, the District has interlocal agreements for the delivery of potable water to Bocilla Utilities for the residents of Don Pedro and Knight/Palm Island in Charlotte County.

1.2 Master Plan Update Purpose

The District retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan Update. This Master Plan Update assesses the District's water service and facility needs for a 20-year planning period from 2023 through 2043 and a longer 50-year period from 2023 to 2073. For this effort, HDR developed updated demand projections, performed a condition assessment of the existing water treatment plant, and evaluated several alternatives for water supply, treatment, and distribution capacity expansion. This report summarizes findings and recommendations from each of these tasks to inform future decisions regarding needed expansion and improvements to the potable water system.

HDR reviewed historical documents, GIS data, SCADA information, operations data, and site visit findings, and held multiple meetings with District staff to develop the findings, conclusions, and recommendations provided herein.

1.3 Existing Facilities and Distribution System

The District's current Water Use Permit (WUP) issued by the Southwest Florida Water Management District (SWFWMD) (WUP No. 20 004866.012) authorizes total groundwater withdrawals of up to 5,360,000 gallons per day (annual average) and 6,590,000 gallons per day (peak month) while establishing maximum flows within each water type and individual wellfield. These quantities were last allocated to meet the District's potable water demand through 2050; however, as shown in Section 3 of this report, additional drinking water supply is needed to meet increased demand. The District's WUP expires on December 9, 2050.

The District's water supply, treatment and distribution facilities include:

- Five (5) groundwater wellfields
    - Four (4) freshwater well systems with aggregated permitted withdrawal capacities of up to 3.54 MGD (annual average) and up to 4.35 MGD (peak month) within Wellfields 1, 2, 3, and 5 provided the current total WUP allocation is not exceeded.
    - Two (2) brackish water well systems with aggregated permitted withdrawal capacities of up to 4.25 MGD (annual average) and up to 5.44 MGD (peak month) within Wellfields 2 and 4 provided the current total WUP allocation is not exceeded.
- Two (2) water treatment plants
    - One (1) lime softening plant built in 1961 at 3.0 MGD design capacity for treatment of the freshwater wellfield supply; however, the District can only reliably treat 2 MGD of this capacity.

  - One (1) reverse osmosis (RO) Plant built in 1981 at 3.0 MGD design capacity for treatment of the brackish water wellfield supply
- Four (4) finished water storage tanks with a combined capacity of 7.5 million gallons, and one (1) elevated storage tank with 100,000-gallon capacity used to dampen the amplitude of distribution system pressures
- Two (2) deep injection wells
  - One (1) 1.58-MGD deep injection well (DIW-1) onsite for RO concentrate disposal
  - One (1) 2.94-MGD deep injection well (DIW-2) offsite at the Holiday Ventures Lift Station for reclaimed water disposal and backup RO concentrate disposal. Backup capacity is limited due to existing use by the South Water Reclamation Facility (WRF) and future use by the North WRF that is being currently planned.
- Over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties.

The two water treatment plants exist on the same site at Englewood's water treatment plant (WTP) site. A plant aerial is show in Figure 1-1 and a process flow diagram of the two treatment trains in Figure 1-2. The extent of the District's potable distribution network is shown in Figure 1-3.

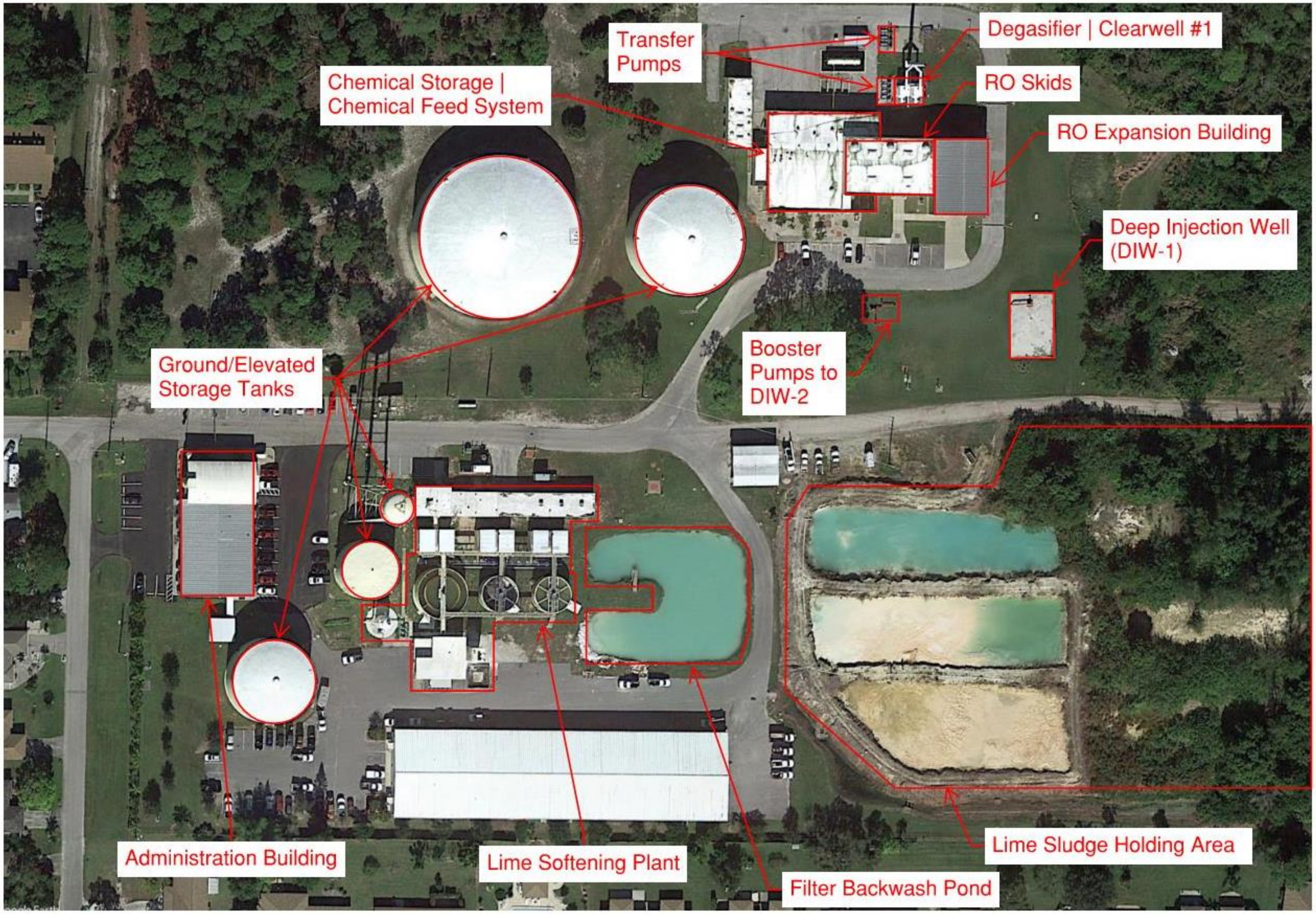


Figure 1-1: Englewood Water Treatment Plant Site

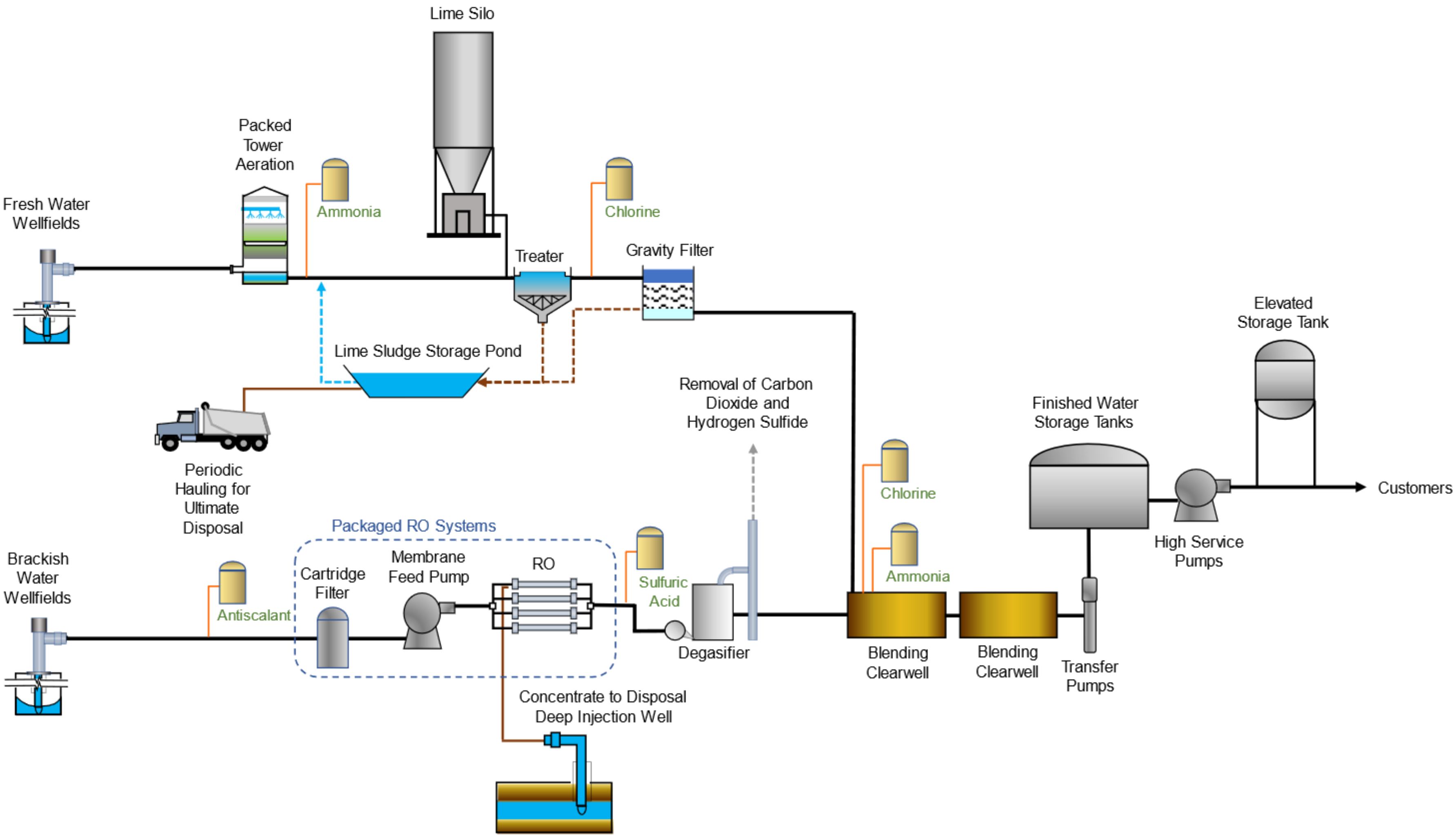
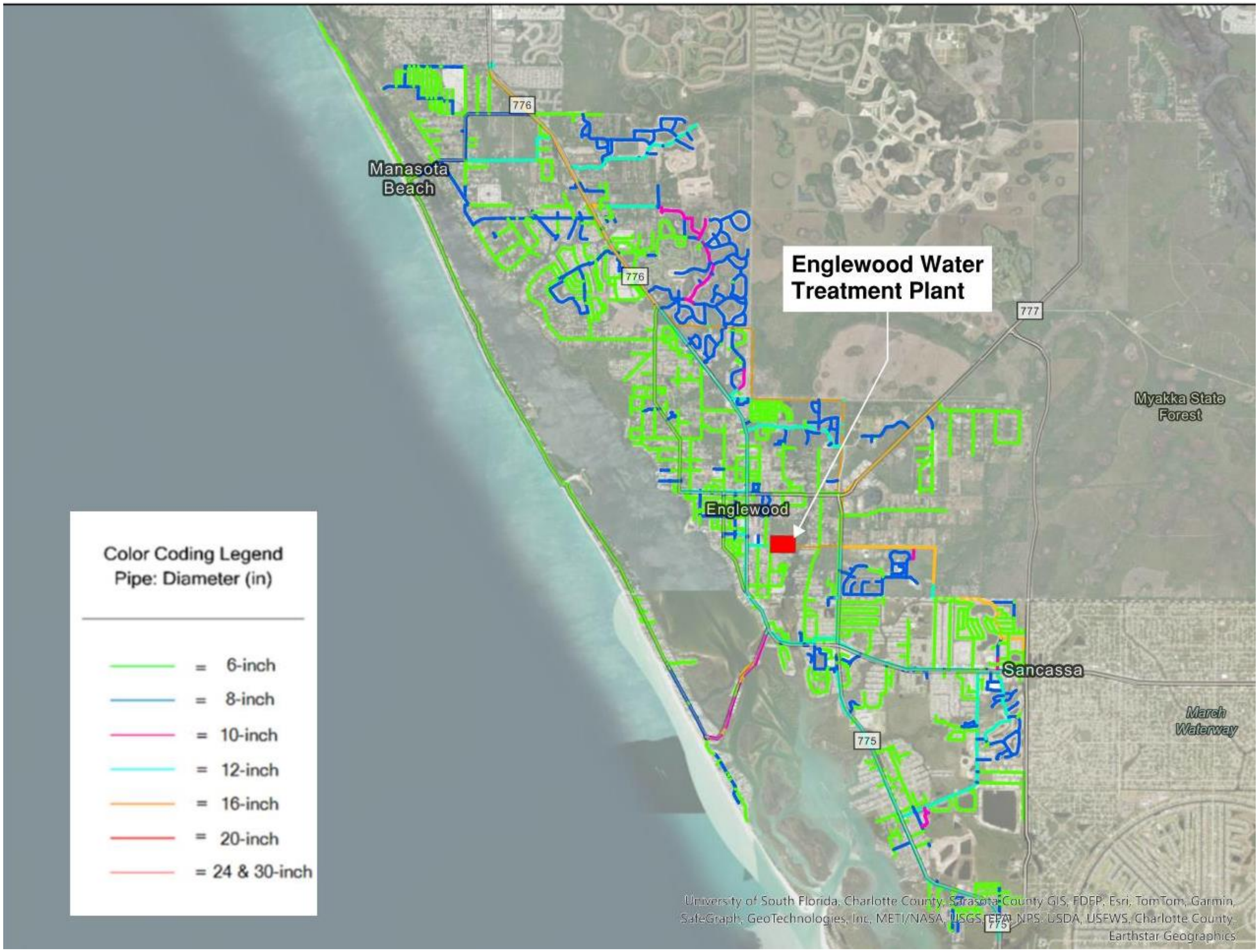


Figure 1-2: Englewood WTP Process Flow Diagram



University of South Florida, Charlotte County, Sarasota County GIS, FDEP, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Charlotte County, Earthstar Geographics

Figure 1-3: Englewood Water Distribution Network (<6-inch not shown)

2 Condition Assessment

2.1 Condition Assessment Background

The HDR team performed a walkthrough of the lime softening and reverse osmosis plants with Keith Ledford, Technical Support Manager, and Dewey Futch, Water Operations Manager, from the District on Friday, March 31, 2023. The District provided a short overview presentation explaining the layout and flow routing through the plants. The HDR team provided a high-level assessment of the structural, mechanical, electrical, and instrumentation aspects of major plant processes, based on physical observations and input on performance and age from the District. HDR rated the assessed facilities on criteria detailed below.

2.2 Framework & Criteria

The condition assessment framework was based on a three-tier asset hierarchy consisting of the following:

- Level 1: Facility (General Site, Lime Softening, Reverse Osmosis)
- Level 2: System (Site Security, General Plant Facilities, Packed Tower Aerator, Lime Feed System, Lime Treaters, Dual-Media Filters, RO Trains, Disinfection, Clearwells, New/Old High Service Pump Stations, Finished Water Storage Tanks)
- Level 3: Discipline (Structural, Mechanical, Electrical, Instrumentation)

Scores for each Level 3 asset were provided from 1 – 5, with 1 being the best condition and 5 being the worst. Scores were based on a combination of observed conditions and comments on functionality and performance from accompanying Englewood Water District staff.

2.3 Summary of Results

The HDR team used the findings from the condition assessment to assign scores to each major process. Table 2-1 shows the scoring for each process area sorted by discipline. The condition assessment scores are further detailed in the Englewood Condition Assessment Technical Memorandum in Appendix A. A color-coding legend is explained below:

Table 2-1: Condition Assessment Results Summary

Facility	System	Condition Score				
		Structural	Mechanical	Electrical	Instrumentation	Average
General Site	Site Security	1	1	1	2	1
Lime Softening	General Facility	2	4	1	1	3
Lime Softening	Packed Tower Aerator	1	2	1	2	2
Lime Softening	Lime Feed System	3	2	2	2	2
Lime Softening	Treater 1	3	3	2	1	2
Lime Softening	Treater 2	4	3	2	1	2
Lime Softening	Treater 3	4	3	2	1	2

Color Coding Reference:

Green – Very Good
Yellow – Good
Gray – Average
Orange – Poor
Red – Very Poor

Facility	System	Condition Score				
		Structural	Mechanical	Electrical	Instrumentation	Average
Lime Softening	Filters	4	4	2	4	4
Lime Softening	Old High Service Pump Station	1	2	1	1	1
Lime Softening	New High Service Pump Station	1	2	1	1	1
Lime Softening	Chemical Storage and Dosing	2	2	1	1	2
Reverse Osmosis	General Facility	3	3	1	1	2
Reverse Osmosis	Electrical & Control Rooms	4	1	4	4	3
Reverse Osmosis	RO Train A	5	4	2	3	4
Reverse Osmosis	RO Train B	5	2	2	2	3
Reverse Osmosis	RO Train C	5	1	2	3	3
Reverse Osmosis	RO Train D	5	4	2	2	3
Reverse Osmosis	RO Train E	2	2	2	3	2
Reverse Osmosis	RO Train F	1	3	2	2	2
Reverse Osmosis	Clearwell 1	4	3	2	3	3
Reverse Osmosis	Clearwell 2	1	1	2	2	2
Reverse Osmosis	Chemical Storage and Dosing	2	1	1	1	1

Color Coding Reference:

Green – Very Good
Yellow – Good
Gray – Average
Orange – Poor
Red – Very Poor

2.4 Condition Assessment Recommendations

Table 2-2 lists the recommendations compiled by HDR to address deficiencies observed on site during the condition assessment.

Table 2-2 Condition Assessment Recommendations

Plant	System	Recommendation
General	Site Security	Increase security cameras and footage storage.
General	Disinfection (Sitewide)	Consider switching to liquid chlorine and consolidate storage to one location on site.
General	Disinfection (Sitewide)	Consider using free chlorine instead of chloramines.
Lime Softening	Lime Softening (General)	Conduct lime dosing optimization study to reduce lime use and assess caustic to filter effluent or clearwell for finished water pH balance.
Lime Softening	Treater 1	Replace drive unit.
Lime Softening	Treater 2	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Treater 3	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Filters	Consider raising troughs to reduce media carryover.
Lime Softening	Filters	Add air scour and media sweeps to improve backwashing and prevent media hardening.

Plant	System	Recommendation
Lime Softening	Filters	Replace existing local control panels containing backwash controls.
Lime Softening	Filters	Replace missing and deteriorating guardrails.
Lime Softening	New HSP Station	Replace check valves at Pumps 7 and 9 with Slaminator check valves.
Lime Softening	Chemical Storage and Dosing	Store anhydrous ammonia in a cooler location without exposure to direct sunlight.
Reverse Osmosis	RO General Facility	Evaluate alternatives for electrical supply to future RO expansion.
Reverse Osmosis	RO General Facility	Increase raw water pipe sizes to remove bottlenecks.
Reverse Osmosis	RO General Facility	Reroute raw water piping to RO plant from below the building.
Reverse Osmosis	Electrical & Control Rooms	Move some equipment to new electrical supply room to meet code.
Reverse Osmosis	Electrical & Control Rooms	Reroute roof drain along outside of building.
Reverse Osmosis	Electrical & Control Rooms	Repair damage from fire and replace failed control system enclosure components
Reverse Osmosis	RO (General)	Perform CIPs as needed to extend membrane service life.
Reverse Osmosis	RO (General)	Review and trend operating data and water quality to optimize operation, including alternative pH adjustment or antiscalant chemicals/doses.
Reverse Osmosis	RO (General)	If reusing membranes from Train B-F is needed, make relocation to Train A as soon as possible to avoid membrane drying.
Reverse Osmosis	RO (General)	Repair/replace concrete pedestals.
Reverse Osmosis	RO (General)	Perform electrical study and check pump performance metrics to troubleshoot Train C supply pump motor issues.
Reverse Osmosis	RO (General)	Repair/replace leaking joints.
Reverse Osmosis	Clearwell 1	Repair eroded concrete from degasification unit and make modifications to clearwell to prevent future damage.
Reverse Osmosis	Chemical Storage and Dosing	Repair damage to sump beneath sulfuric acid storage tank.

3 Basis of Planning

Basis of planning informs capacity upgrades and facility improvements through pertinent information review, baseline calculations, and baseline modeling including:

- Review of current and emerging regulations
- Calculating system demand projections using historic flows
- Performing an analysis of water quality
- Assessing and updating hydraulic modeling to develop improved alternative analyses

3.1 Regulatory

Any water treatment facility upgrades must meet the rules and regulations set by national and local governing bodies. The US Environmental Protection Agency (EPA) set drinking water Maximum Contaminant Levels (MCLs) in the Primary and Secondary Drinking Water Standards. The Florida Department of Environmental Protection (FDEP) regulates Florida public water systems and adopts EPA criteria. The Department of Health (DOH) can regulate distribution system maintenance and was also taken in consideration. HDR utilized the above governing bodies to compare existing water quality data detailed in the next section. There is also ongoing newer legislation as shown in Table 3-1 related to cybersecurity and emerging contaminants (i.e., PFAS) which will contain broader implications to water treatment facility upgrades.

Table 3-1: Relevant Rules and Regulations

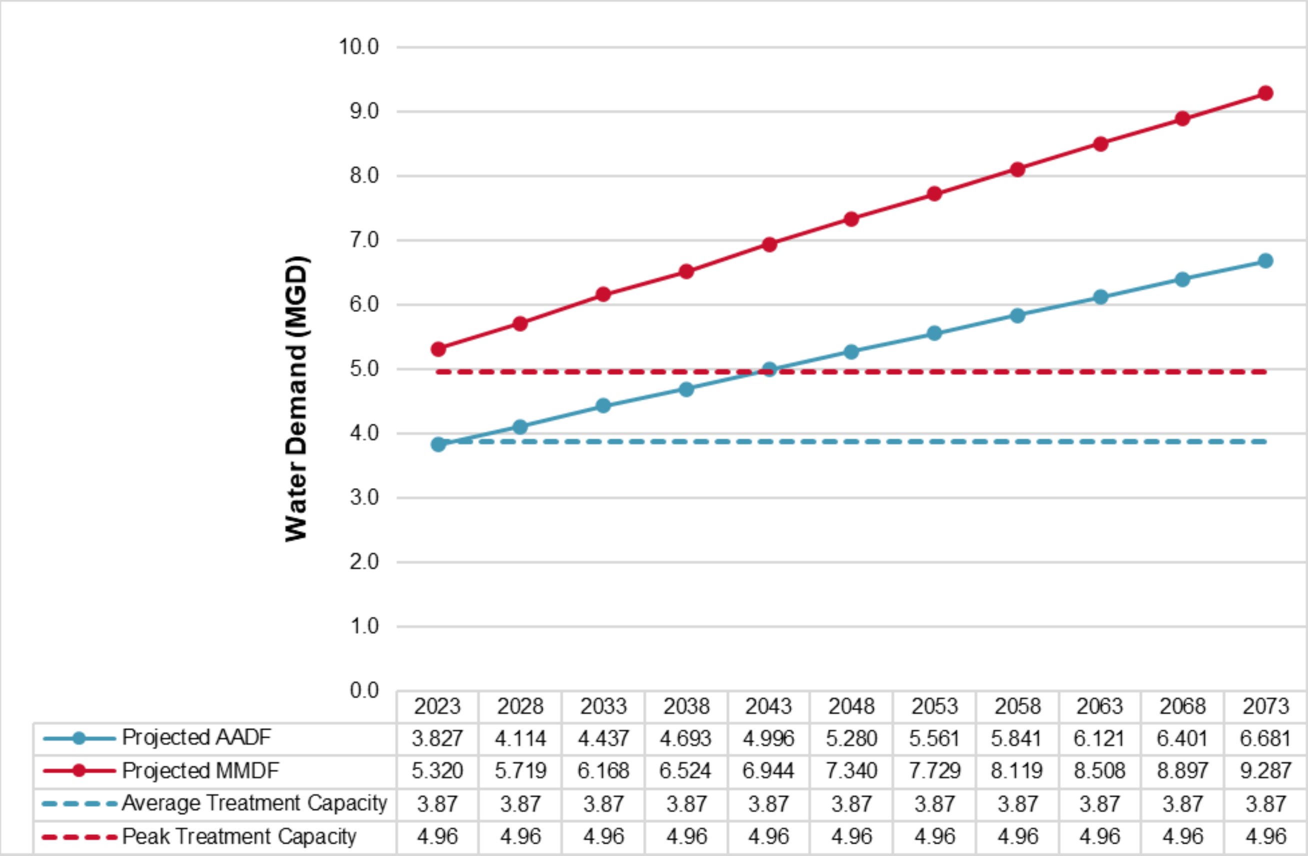
Legislation Category	Rules and Regulations	Description
Groundwater Supply	F.S. 120 & 373 F.A.C. 40D-1 & 40D-2	• Establishes application requirements for Water Use Permits (WUPs) prior to groundwater withdrawal • Delegates WUP issuance to Water Management Districts
Groundwater Supply	F.A.C. 40D-3	• Requires well construction permit prior to the construction, repair or abandonment of a well
Water Distribution System	F.A.C. 62-555	• Establishes requirements for design, construction, operation, and maintenance of a public water system
Drinking Water Standards	F.A.C. 62-550	• Establishes Maximum Contaminant Levels (MCLs) for primary and secondary drinking water standards • Defines monitoring, reporting, and recordkeeping requirements for various drinking water quality constituents
Recent Legislation	40 CFR 141(I) Lead and Copper Rule	• Sets lead trigger level (TL) at 10 µg/L
Cybersecurity	CS/HB 7055/ 282.318, F.S.	• Strengthens the existing Florida State Cybersecurity Act • Outlaws compliance with any ransomware attacks • Redefines security threat levels
Cybersecurity	S.3600 Strengthening American Cybersecurity Act of 2022	• Requires WTPs to: ○ Report cyber incidents and ransom payments within a specified time frame ○ Limit the use and disclosure of reported information ○ Update reporting protocol to match the standardized protocol
PFAS	H.R.2467 – PFAS Action Act of 2021	• Limits the use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) and remediate PFAS in the environment • Directs EPA to designate PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) as hazardous substances
PFAS	S.B. 7012 – A bill to be titled.	• Provides the membership, organization, and duties of a PFAS task force within FDEP
PFAS	C.S./H.B. 1475 – Cleanup of Perfluoroalkyl and Polyfluoroalkyl Substances.	• Requires DEP to adopt statewide rules for PFAS cleanup target levels in drinking water, groundwater, & soil

3.2 Population and Flow Projections

HDR used a Per Capita Model for forecasting water supply demands. The Per Capita Model calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. A simple forecasting method, it requires only historical production or consumption data, historical population, and forecast of population through the demand forecasting horizon.

Utilizing the District's historical (2018-2022) records of production data as well as the Historical Population Served reported on the District's Public Supply Annual Reports (PSAR's) to the Southwest Florida Water Management District, a per capita usage of 80 gallons per capita per day (gpcd) was calculated. With a conservative population projection, this usage was projected from 2023 to 2073, shown in Figure 3-1. As an approximate 20-year equipment service life is standard, the water treatment capacity should be focused from 2023 to 2043. Thus, the projected annual average water supply demands for the Englewood Water District within its current service boundary ranges from 3.827 MGD in 2023 to 4.996 MGD in 2043. The projected peak month water supply demands ranges from 5.320 MGD in 2023 to 6.944 MGD in 2043. Therefore, it is recommended to expand the water treatment plant to provide a finished water capacity of 7 MGD.

A more detailed evaluation of the water demand projections can be found in the Population and Demand Projections Technical Memorandum in Appendix B.



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Peak Treatment Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96

Figure 3-1 Englewood Water District Future Finished Water Needs to 2073

3.3 Water Quality Analysis

HDR assessed water quality data from raw water flowing into the lime-softening (LS) and reverse osmosis (RO) plants. The data includes recent wellfield sampling from March to May 2023 and several sampling events conducted in December of 2022. The minimum, average, 90th percentile, and maximum values from each data parameter were calculated, and a flow weighting applied for the varied data time periods. HDR compared the cleaned water quality data to the Maximum Contaminant Levels (MCLs) from the Primary Drinking Water Standards set by the U.S. Environmental Protection Agency (EPA).

The LS and RO wellfields differ mostly in salinity which is to be expected since the LS wellfield is a freshwater source while the RO wellfield is a brackish water source. There is also a difference between the water sources' nitrate levels with freshwater wellfields being below and brackish wellfields being above nitrate MCL levels of 10 mg/L. Total organic carbon is high for the freshwater source; this raises concerns for water color issues which have been observed by District staff and should continue to be monitored as it could be indicative of dissolved organic material. It is also worth noting that chloride trigger levels are imposed on the LS wellfields, which cause the District to restrict use of wells that have chloride trigger level exceedances.

Both freshwater and brackish water wellfields observed total dissolved solids (TDS) concentrations above the secondary MCL of 500 mg/L. In the WY 2021 EWD Annual Wellfield Report, trend analysis of the monthly TDS concentrations collected from the RO WF 2 and RO WF 4 production wells were conducted using the Seasonal Kendall Tau test. The results of the Seasonal Kendall Tau tests project RO WF2 to have 2051 TDS concentrations of 7,579 mg/L, up from the current 4,957 mg/L. RO WF4 to have 2051 TDS concentrations of 14,491 mg/L, up from the current 4,827 mg/L. The RO plant will need further assessments to determine if the existing membranes could handle these projected TDS concentrations with reasonable performance efficiency long term.

The full water quality data results and comparison to standards can be found in Appendix C in the Englewood Water District Master Plan Alternatives Analysis Technical Memorandum.

3.4 Hydraulic Modeling Analysis

3.4.1 Model Background and Validation

HDR updated the existing District Model of the distribution system as part of this Master Plan Update effort. Building off District-provided GIS and geocoded water meter data, HDR identified 165 pipes as new or necessary and included them in the modeling update. It should be noted the model does not include all pipes; because of this, there is limited accuracy in the analysis of pressures and available fire flow (FF) at many locations within the District. The minimum pipe diameter included in the pipe network was 8 inches (with a few exceptions to complete some large pipe looping) and the analysis is based on the locations where service mains tie into the transmission mains.

To allocate system demands, water billing data was geolocated. Meter address data was collected, cleaned, and imported into the GIS model. The current demand was compared to the total produced finished water for the month of March 2023. The lost and unaccounted water consist of 17% of the finished water, as determined in this project's Population and Flow Projections Technical Memorandum, Appendix B.

HDR developed a future system expansion scenario based on District-provided planned developments and projected maximum month daily (MMD) water demands within the District from the Population and Flow Projections Technical Memorandum, Appendix B.

3.4.2 Model Simulations and Results

The existing system model simulated steady state conditions at the MMD with diurnal peaking factor as noted in Appendix D. The high service pump station operates on a VFD set at 57 pounds per square inch (psi). The model accounts for this with a valve that reduces the pressure at the pump station to simulate standard operating conditions of the District's typical water distribution.

The existing model simulated a 10.6 MGD flow from the WTP showing system wide moderate pressure reductions, Figure 3-2. The largest areas of pressure drop occurred in the north (29 psi pressure reduction from WTP) and south extremes (11psi pressure reduction from WTP). The existing model results confirmed the District's capacity issues on Manasota Key.

An immediate consideration to the system is to increase the target discharge pressure at the high service pump station. Typical preferred distribution pressures range from 40psi to 80 psi. Increasing high service pump station's VFD set pressure to 70 psi will improve pressures for the extents of the distribution system. Accordingly, provisions to the elevated storage tank would need to be made, such as adding an altimeter valve, to limit the tank being overfilled or replacing it with a hydropneumatics tank at ground level.

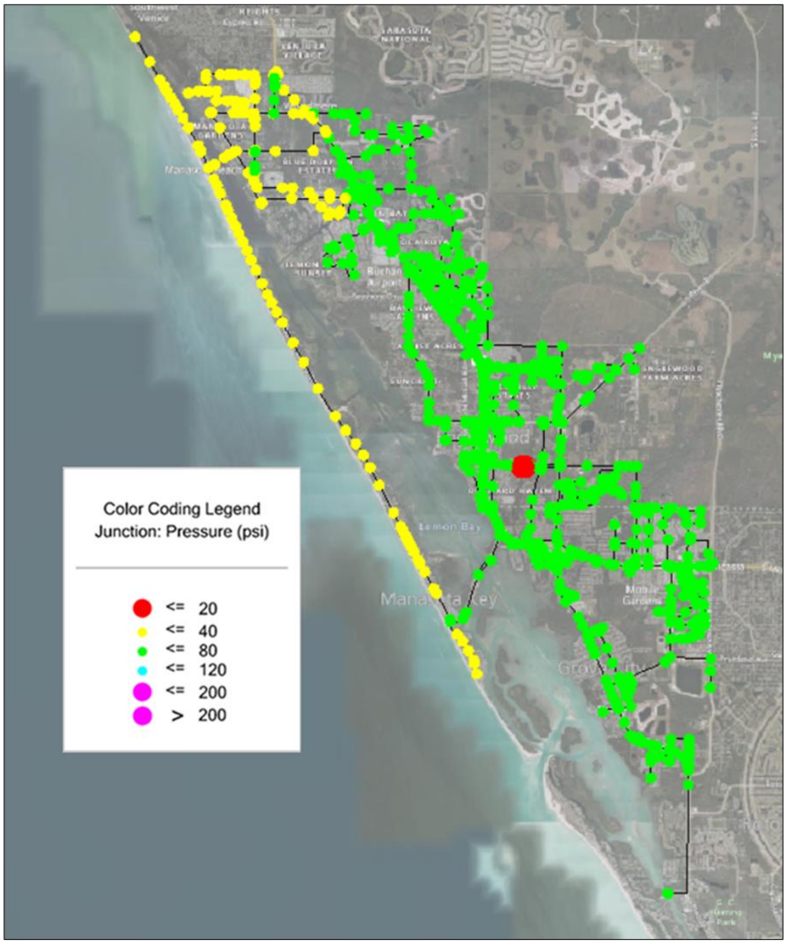


Figure 3-2 Pressure Results from Existing Model MMD

HDR simulated the projected 2043 and 2073 systems at steady state conditions at the MMD with a diurnal peaking factor of 2.0, see Appendix D for further details. The 2043 model simulated a total flow of 13.8 MGD and the 2073 model a flow of 18.6 MGD. Both model simulations showed pressure drops across the network, Figure 3-3 for 2043 and Figure 3-4 for 2073. A key concern is in Manasota Key where pressures drop below 20 psi. In 2073, half the system is below acceptable pressures with any further demand increases compromising the system pressures more especially at Manasota Key.

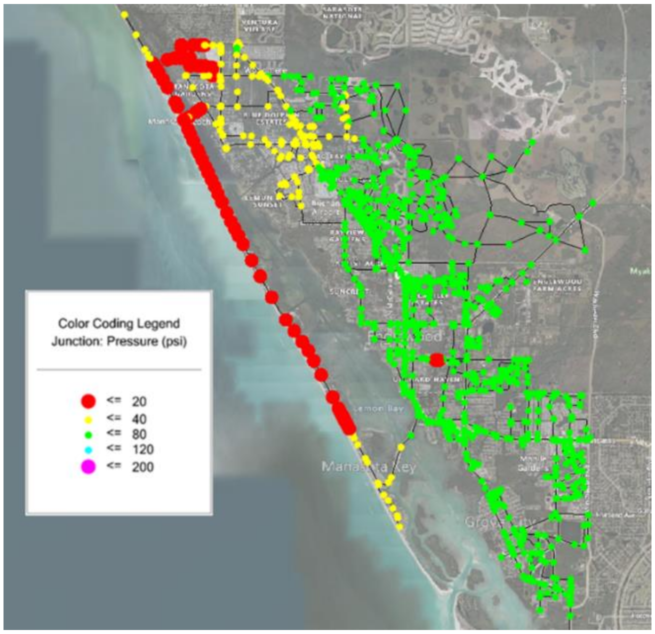


Figure 3-3 Pressure Results from Future Systems Model MMD 2043

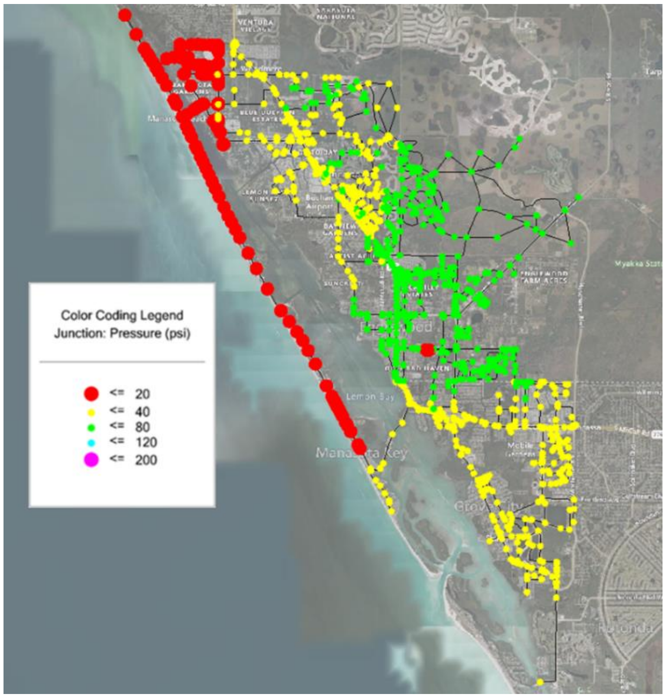


Figure 3-4 Pressure Results from Future System Model MMD 2073

4 Water Supply and Treatment Alternatives

HDR evaluated five alternatives to meet future demand projections and water treatment plant performance needs. A projected peak finished water capacity of 7.0 MGD was used for planning.

- Alternative 1a – Rehabilitate the Existing LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitate and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Rehabilitate and Expand the RO Plant in Place
- Alternative 3b – Decommission LS Plant and Completely Replace Existing RO Plant at Expanded Capacity with a New RO Plant

The alternatives were the results of a site visit and engineering best practices to evaluate design hydraulic and treatment capacity relative to current unit process performance. Alternatives were considered on non-cost factors such as water quality, energy efficiency, operational complexity, and concentrate/residuals disposal. Planning-level cost estimates were developed for each alternative. See Appendix C for further information on alternatives.

4.1 Alternative 1 – Rehabilitate LS Plant and Rehabilitate and Expand RO Plant

Alternative 1 involves upgrading the existing WTP infrastructure and maintaining parallel treatment trains of non-membrane softening and RO. This alternative contains two options, alternative 1a and 1b. The optimal alternative is dependent on the results of the softening upgrades study. Alternative 1a includes rehabilitating the LS plant to maintain the lime softening process. Alternative 1b includes converting the LS plant to pellet softening. Both alternatives include simultaneously rehabilitating and expanding the existing RO plant to produce a combined total of up to 7.0 MGD of finished water. This purpose of this alternative is to prolong the life of existing facilities. The LS plant will continue to produce up to 2.0 MGD (current reliable capacity), and the RO plant production will increase from the current design of 3.0 MGD up to 5.0 MGD. Major projects required for this alternative are shown below and in Figure 4-1.

Studies and Evaluations:

- LS Plant Filter Evaluation.
- LS Plant Softening Upgrades Study.
- RO Plant Membrane Management Study.

Capital Projects:

- LS Plant rehabilitation (1a) or pellet softening conversion (1b).
- LS Plant Filter rehabilitation.
- Increasing brackish water well capacity.
- RO system rehabilitation.
- RO plant expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post treatment chemical upgrades.
  - Corrosion control and post-treatment.
  - Conversion of chlorine gas to liquid sodium hypochlorite.

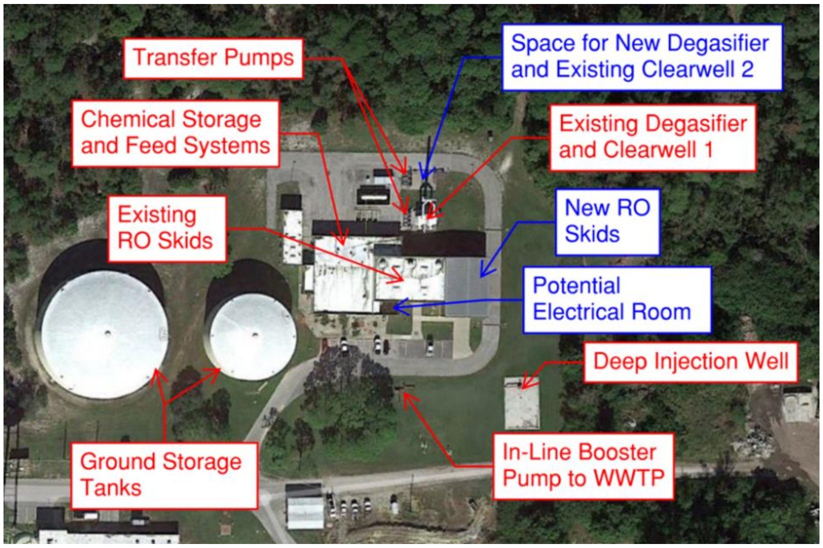


Figure 4-1 Existing and Future RO Plant System Locations

4.2 Alternative 2 – Replace the LS Plant with a Nanofiltration Plant and Rehabilitate and Expand the RO Plant

Alternative 2 considers replacing the existing LS plant with nanofiltration (NF) membranes (2 MGD finished water capacity) and along with rehabilitating and expanding the existing RO plant (5 MGD finished water capacity) to produce a total of 7.0 MGD. The purpose of this alternative would be to move away from LS and granular media filtration and rely on membranes for treatment. NF membranes operate like RO but use less pressure, operate at higher recoveries, and are often used in softening applications to treat fresh groundwater. Shared components include cartridge filters, feed pumps, membrane skids, degasification, and sulfuric acid/antiscalant chemicals. Major projects required of this alternative are shown below and in Figure 4-2.

Studies and Evaluations:

- Membrane (RO) Management Study.
- Softening Upgrades Study

Capital Projects:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Media filter rehabilitation
- NF Plant construction.
- RO system rehabilitation.
- RO system expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control and post-treatment.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

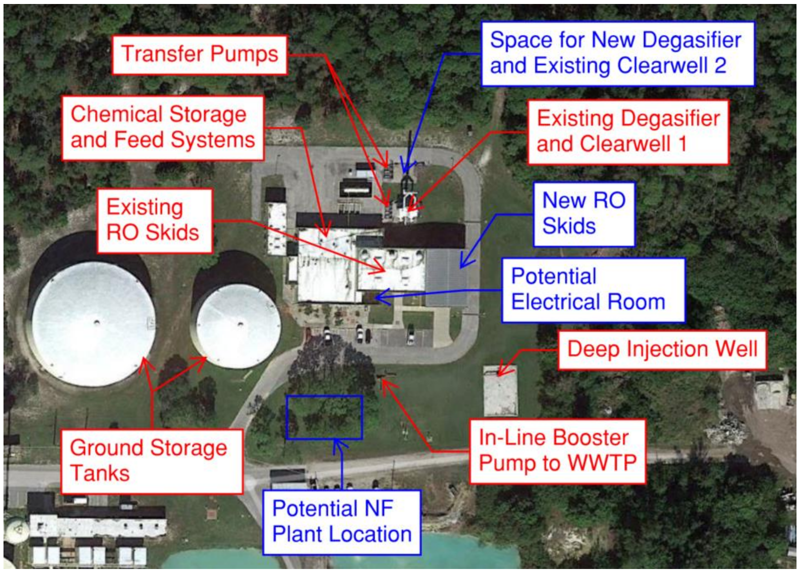


Figure 4-2 Existing and Future RO Plant and Future NF Plant Locations

4.3 Alternative 3 – Complete Replacement

Alternative 3 evaluated decommissioning the LS plant and utilizing an all-RO system. This alternative contains two options, alternative 3a and 3b. These options include (3a) expanding the existing RO plant to 7 MGD in the existing structure as best as possible or (3b) replacing the existing RO Plant with a new hurricane-hardened 7 MGD RO facility, including a new laboratory and housing quarters for staff during severe weather events. Option 3b would entail constructing a new 7.0 MGD RO Plant north of the existing RO facility and then demolishing or repurposing the existing LS Plant and RO Plant infrastructure.

Major scope items involved in Alternative 3a – Decommission LS Plant and Expand Existing RO Plant:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Existing RO system rehabilitation.
- RO system expansion in existing building.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

Major scope items involved in Alternative 3b – Decommission LS Plant and Construct New RO Facility:

- Increasing brackish water well capacity.
- LS Plant demolition.
- RO Plant demolition.
- New RO facility construction, including laboratory and staff housing
- RO system replacement and expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

A phased approach would be required to continue providing water while construction occurs, Figure 4-3. The new RO Plant would be constructed in the wooded area located north of the existing RO Plant, Figure 4-4.

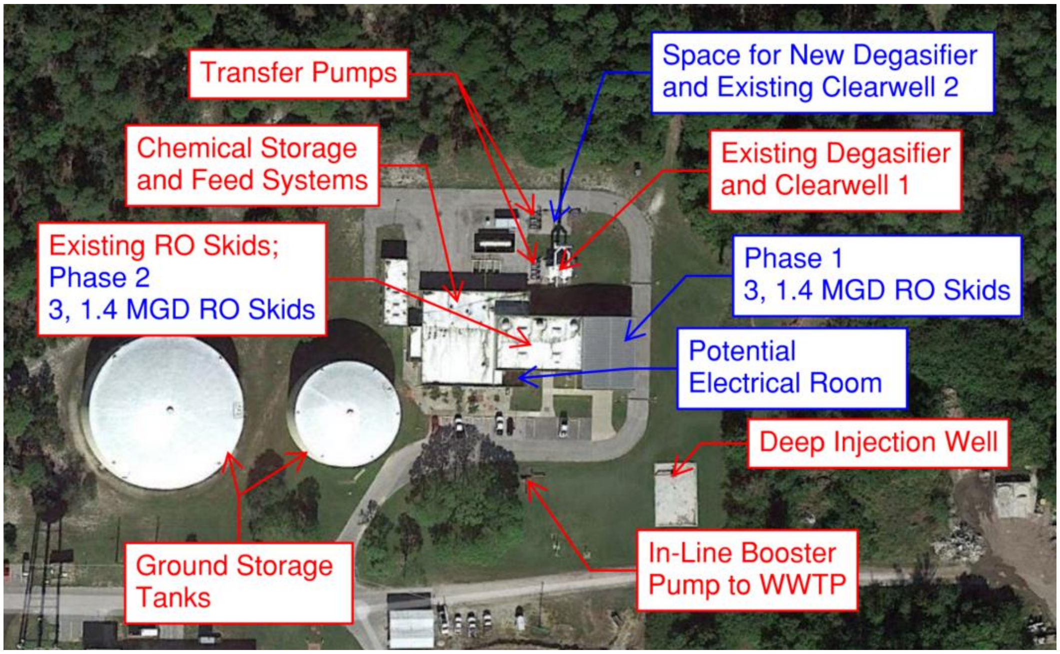


Figure 4-3 Alternative 3a Existing and Future RO Plant Locations (Phase 1 and 2)

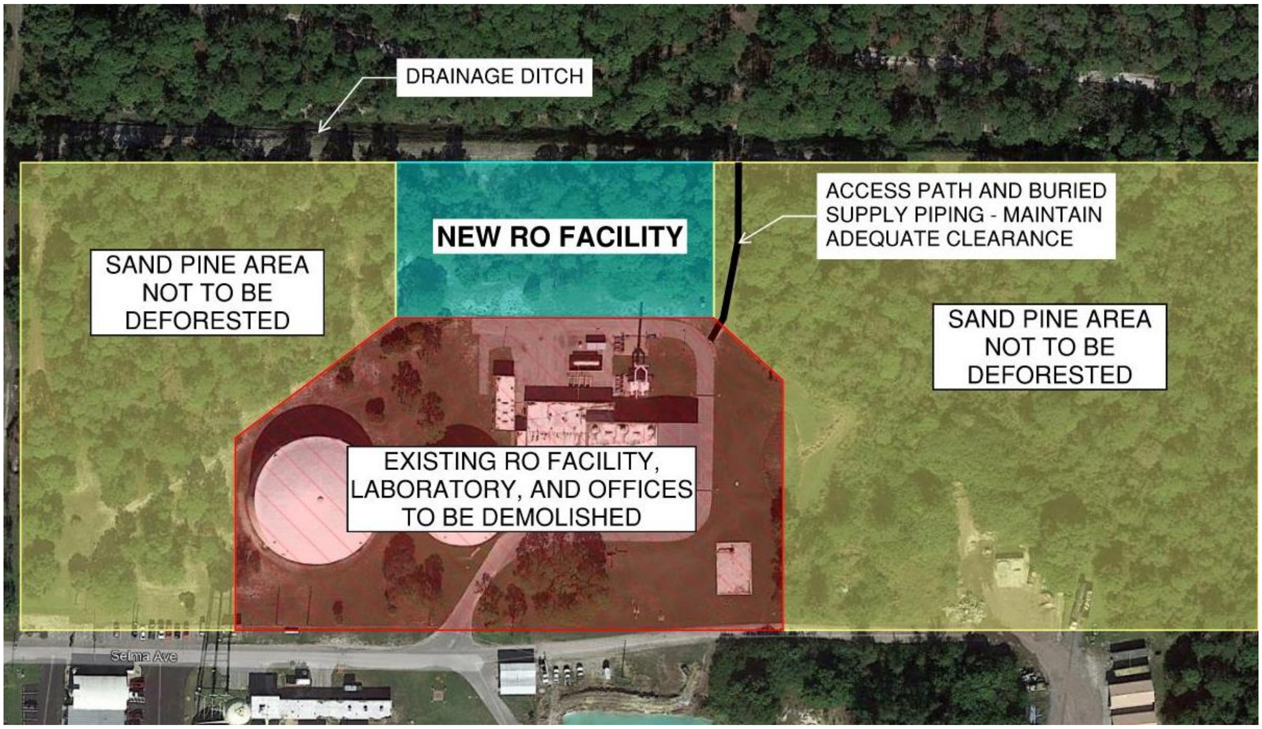


Figure 4-4 Alternative 3b Future RO Plant Location

4.4 Alternative Summary

The alternatives' advantages, disadvantages, and high-level costs of each alternative are summarized in Table 4-1.

Table 4-1 Water Supply and Treatment Alternative Comparison

Alternative	Estimated Capital Cost (2023 Dollars)	Key Advantages	Key Disadvantages
Alternative 1a – Rehabilitate the LS Plant and Rehabilitate and Expand the RO Plant	$40,520,000	• Less disruption to the current process • Shorter construction durations	• Lime sludge waste generation remains • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 1b - Convert the LS Plant to Pellet Softening and Rehabilitation and Expand the RO Plant	$40,950,000	• Less waste generated • Uses caustic instead of lime	• Not in widespread use, emerging technology • Disruptive to the current site, longer construction • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant	$50,520,000	• Compared to RO option: ○ Lower feed pressure ○ Operate at higher recoveries • Similar components used between the RO plant and NF plant • Enhanced TOC removal	• More costly than other softening options • Disruptive to the current site, longer construction • Increased membrane cleaning and replacement
Alternative 3 – Decommission LS Plant and Rehabilitate and Expand Existing RO Plant	$88,370,000	• Smaller footprint • Single treatment process • Allows upgrades to modern components and materials of construction	• Costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required • Risk of unforeseen site space and facility retrofit challenges
Alternative 3b – Decommission LS Plant and Rehabilitate and Construct New, Expanded RO Facility	$141,000,000	• Smaller footprint than current plant • Single treatment process • Allows upgrades to modern components and materials of construction • Hurricane hardened facility • New laboratory and emergency housing for employees • Least complicated construction • Can repurpose existing buildings for alternative uses to save cost	• Most costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required

5 Recommendations

5.1 Water Supply and Treatment Recommendations

While each alternative is reasonable to create the water treatment capacity expansion to 7 MGD, Alternative 3b is recommended. Providing the District with a new single treatment process with modernizations for process energy and operational efficiencies would allow for a more reliable facility for the community. A new RO facility and hardened building with new laboratory, modern operations control room, staff breakroom and restrooms, and emergency operations center could attract new workers. Construction would have the least impact to current operations. During construction, District staff can learn about modern processes installed, and the system can be placed online when all staff are comfortable with doing so. This alternative may require the least amount of piloting with any upgrade and lessen the complexity of blending two water types. Using RO treatment solely has the added benefit of potentially lessening system disinfection costs overall by having the highest probability of allowing the District to convert their disinfection strategy from chloramination to free chlorine, thereby eliminating the need for ammonia dosing systems. Furthermore, RO treatment is the only process considered for reasonable plant upgrades that inherently removes contaminants of emerging concern, creating a safer drinking water for Distrist customers. Table 5-1 below lists all the proposed projects for Alternative 3b.

Table 5-1 New WTP Projects for Alternative 3b

Master Plan ID	Name	Description
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system in regard to water quality, energy, and operation.
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.
T-7	New Degasifiers	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.
T-8	Clearwell Repairs	Repair areas with corrosion damage.
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.

5.2 Distribution System Recommendations

For the distribution system, HDR recommends addressing the primary areas of concern seen in the model: Manasota Key, Japanese Gardens, Englewood Isles, Englewood Rd, and the Southeast Region of Grove City and Mobile Gardens. The areas show a sensitivity to increased demand resulting in an increase in head loss.

As shown in Figure 5-1 and Table 5-2, there are five pipelines that are recommended for CIPs. The CIPs are numbered according to priority: number D-1 being the most urgent and the most impactful to the system and number D-5 affecting the least number of customers. Each of these CIPs was modeled as an additional parallel pipeline with no tie overs along the assumed path. Before any of these improvements were analyzed the discharge pressure at the Pump Station was increased to 70 psi as recommended for consideration in Project 6. Additionally, Project D-7 is recommended to improve distribution system understanding and effectiveness of the modeling tool.

HDR modeled how the future distribution system will perform after the above CIPs are implemented. Two alternatives provided similar levels of service in the results because project D-5 could replace projects D-2 and D-3. Projects D-1, D-4, D-5, D-6, and D-7 will be considered Alternative 1 and projects D-1, D-2, D-3, D-4, D-6, and D-7 will be considered Alternative 2.

Alternatives 1 and 2 both evenly distribute pressure throughout the system in the 2043 projection. In the 2073 projection, Alternative 1 has lower pressure in the southmost area of the system, while Alternative 2 keeps a low pressure throughout the system. The velocity distributions are similar for both alternatives; however, Alternative 1 distributes a higher velocity at the center of Manasota Key, while Alternative 2 distributes a higher velocity at the ends of Manasota Key. Both Alternatives provide similar fire flow distribution; however, Alternative 1 provides more fire flow availability at Manasota Key.

Alternatives 1 and 2 provide similar improvements of the systems velocity distribution and fire flow availability, but Alternative 2 provides a better long-term distribution of pressure throughout the network. Alternative 1 will be less impactful on the community, while construction on the beach roads in Alternative 2 will require a traffic control plan.

The full detail of these projects and recommendations is in the Distribution System Evaluation TM in Appendix D.

Table 5-2: Proposed Distribution System Improvement Projects

Master Plan ID	Name	Description
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.
D-1a (Alternative Route)	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.

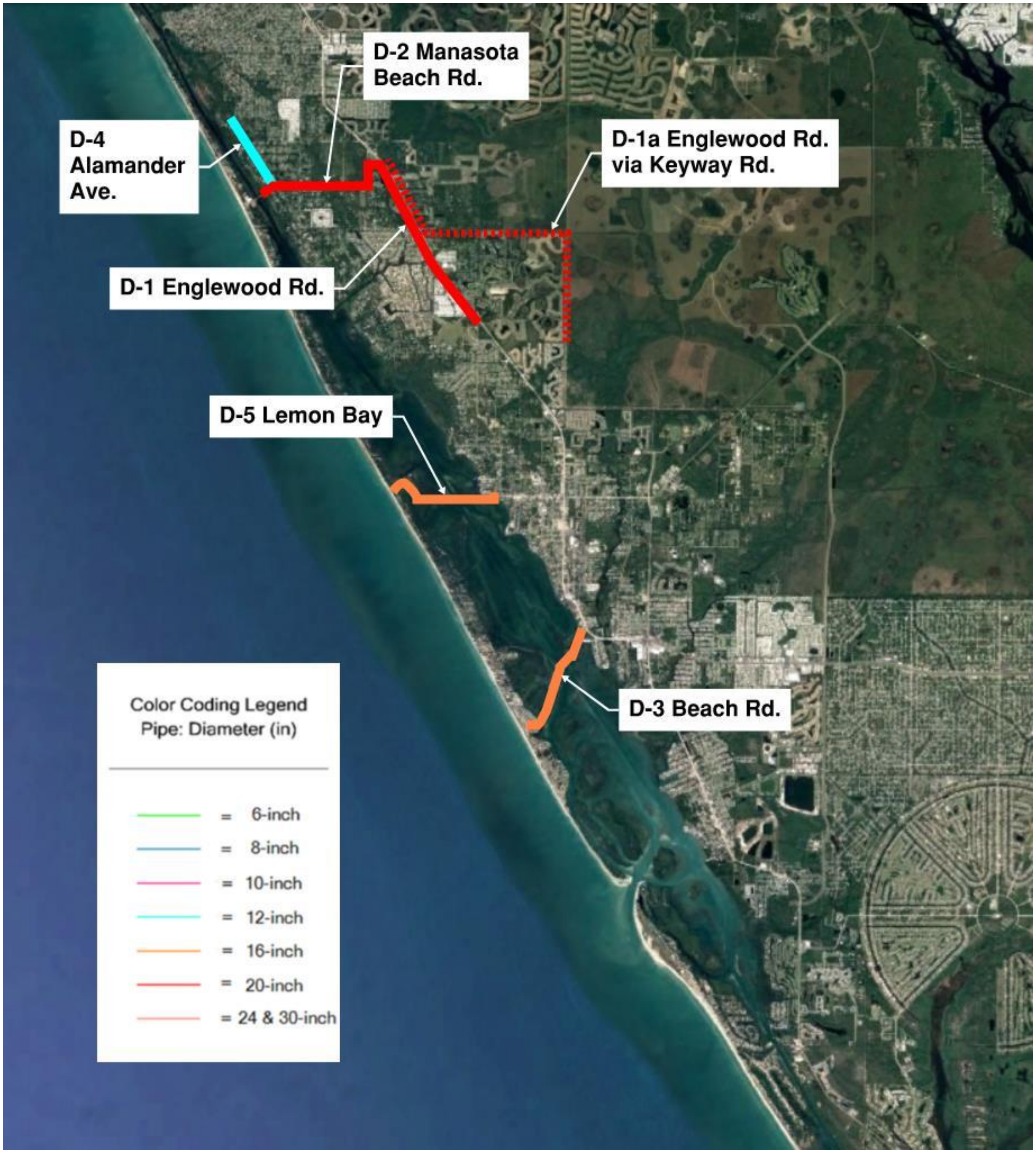


Figure 5-1 Distribution System Improvement Considerations

6 Capital Planning

Facility improvements identified are to be incorporated into the District's capital improvement plan (CIP). CIP planning involved Class V capital cost estimation, benefit scoring, and economic analysis. These efforts are further described in the following subsections.

6.1 Capital Cost Development

HDR proposes 17 projects to address the recommendations in this Master Plan update. Capital costs for each of these projects were developed through a combination of three methods:

1. CostSPACE – HDR's proprietary parametric tool which uses actual costs from HDR projects to develop cost curves for major WTP and pump station processes. Users input capacity demand for the process and the tool provides an estimate of capital cost, annual O&M costs, and 20-year net present value. This method was used to estimate costs of major processes such as the vertical turbine pump stations.
2. Quantity take-offs – Standard method of applying a unit cost to an estimated quantity of material. This method was used to estimate the cost of improvements such as the transmission main replacements.
3. Vendor quotes – Vendor costs were used to estimate costs of major process equipment such as pumps and electrical equipment.

Base costs were developed into capital costs after the application of appropriate multipliers and contingencies. Cost estimates are in 2023 dollars and include applicable demolition, sitework, electrical components, instrumentation, and electrical equipment. HDR does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost that HDR prepares. The following assumptions were applied to estimate these factors:

- Costs are AACE Class IV estimates (-30% / +50%)
- Costs based on 2023 dollars
- Distribution system project (D-#) costs are based on the following:
  - Length and diameter of pipe
  - HDPE pipe
  - Type of construction (trenchless or open cut)
- Treatment project (T-#) costs include the following:
  - Equipment
  - Demolition
  - Sitework
  - Electrical
  - Instrumentation

initiation.

Table 6-1 lists the recommended CIP projects along with their respective costs and a recommended year to begin design and construction. Project scheduling is based on assessed urgencies and dependencies, but the District may choose to alter the project timelines as needed. Figure 6-1 illustrates the total costs laid out on the recommended timeline, assuming that all project costs are encumbered the year of project initiation.

Table 6-1: CIP Project Descriptions and Capital Costs in 2023 Dollars

ID	Name	Description	Total Cost	Timeline
D-1	Englewood Road Pipeline Upgrade	Consists of 11,000 ft of 20-in diameter pipe improvements along Englewood Rd.	$8,100,000	2028
D-1a	Englewood Road Pipeline Upgrade – Alternative Route via Keyway Road	Consists of 20,500 ft of 20-in diameter pipe improvements connecting to the existing 24-in diameter pipe east of Boca Royale Development, and traveling north to Keyway Rd, west along Keyway Rd, and then north along Englewood Rd. This alternative will be more costly than D-1 but will cause less disturbance to customers.	$15,100,000	2028
D-2	Manasota Beach Road Pipeline Upgrade	Consists of 8,800 ft of 20-in diameter pipe improvements along Manasota Beach Rd.	$7,820,000	2031
D-3	Beach Road Pipeline Upgrade	Consists of 6,000 ft of 16-in diameter pipe improvements along Beach Rd.	$2,890,000	2034
D-4	Alamander Avenue Pipeline Upgrade	Consists of 5,000 ft of 12-in diameter additional pipe along Alamander Ave.	$3,170,000	2036
D-5	Lemon Bay Pipeline Upgrade	An alternative to projects D-2 and D-3, pipe improvements consisting of 5,100 ft of trenchless 16-in diameter pipe and 2,500 ft of open cut 16-in diameter pipe along Lemon Bay.	$9,490,000	2031
D-6	Pump Station Rehabilitation and Upgrade	This project provides funding for pump station to be able to serve 70 psi to the distribution system. Includes a new centrifugal pump (12.9 MGD) and a new 10,000-gallon hydropneumatic tank to maintain system pressure of 70 psi.	$2,220,000	2026
D-7	Hydraulic Model Upgrades	This project includes a further analysis of the distribution system. These upgrades will include adding smaller pipes to the model as well as water quality test points to fine tune areas of impact and identify and address “dead zones” in the system.	$400,000	2032
T-1	RO Plant Studies and Evaluations	Consists of further evaluations of an all-RO system regarding water quality, energy, and operation.	$50,000	2024
T-2	New RO Facility	Includes the design and construction of a new RO facility with membrane components, non-membrane systems, and chemical systems, general plant site work, connecting to the existing system, and taking the existing RO and LS plants offline. To be online by 2028.	$81,580,000	2025
T-3	New Supply Wells	Project includes design and construction additional brackish supply wells for increased demand.	$33,610,000	2025
T-4	Disinfection Upgrades	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.	$800,000	2025
T-5	New Deep Injection Well	Consists of designing and constructing a new deep injection well for the increased brine reject from the new RO facility.	$8,660,000	2025
T-6	Upsize Ammonia System	Upsize ammonia storage and dosing system to treat 7 MGD.	$450,000	2025
T-7	New Degasifiers	Construct a new 5-MGD degasifier on Clearwell #2 and replace 3-MGD unit with a new 5-MGD unit to provide adequate redundancy in case one unit needs to be taken offline. Assumes that two clearwells will be adequate to treat 7 MGD. Further evaluation needed to consider expansion of clearwell capacity to meet required contact time.	$1,360,000	2025
T-8	Clearwell Repairs	Repair areas with corrosion damage.	$260,000	2026
T-9	New Supply Well Pipeline	Project includes a supply well pipeline from the wellfield to the treatment facilities site.	$13,450,000	2026
T-10	Abandonment of Freshwater Wellfields	Plug and cap existing wells and demolish existing wellheads. To be started after lime softening process has been decommissioned.	$810,000	2030

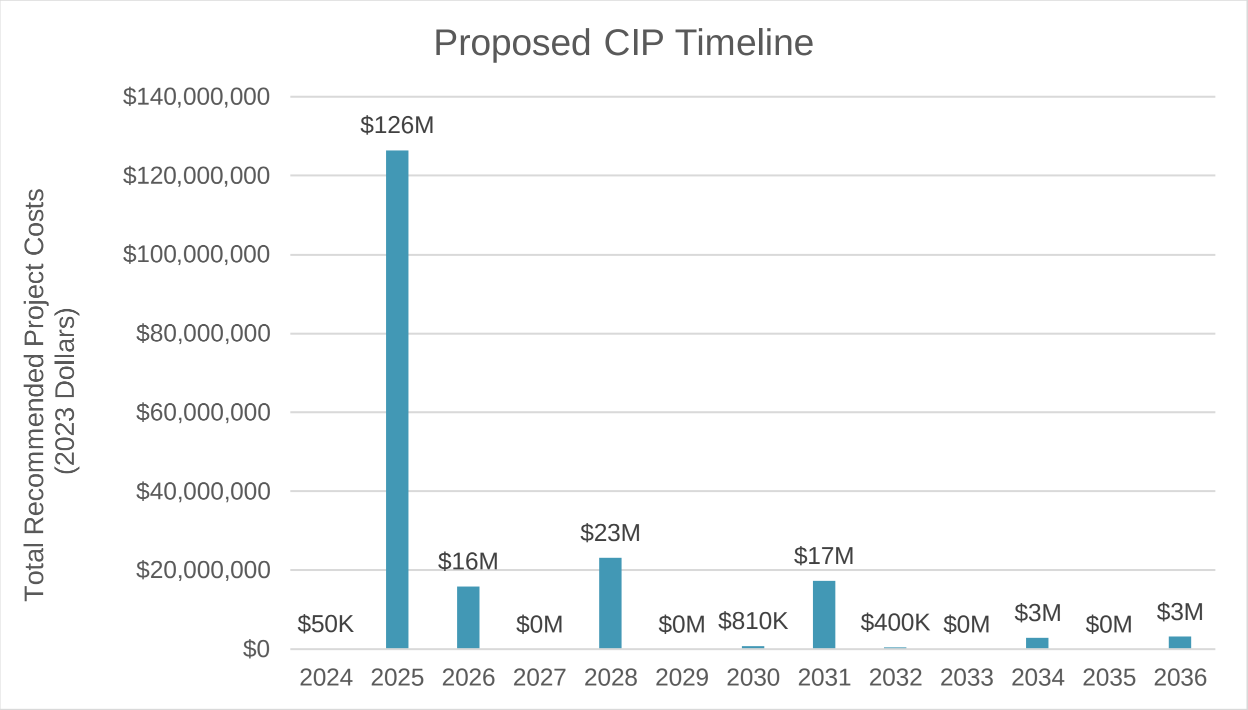


Figure 6-1: Total Recommended CIP Encumbered Costs and Timeline

A

Appendix A – Condition Assessment Technical Memorandum

Potable Water Master Plan - Condition Assessment Technical Memorandum

Englewood Water District

District Agreement No. 2022-129

Englewood, FL
October 19, 2023

Contents

Tables

1 Introduction

The Englewood Water District (District) has retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan Update. This Master Plan will assess the District's water service and facility needs for the next 20-year planning period from 2023 through 2043 and the next 50-year period from 2023 to 2073. The purpose of this Technical Memorandum is to present the findings from HDR's condition assessment of the lime softening and reverse osmosis drinking water treatment plants, performed on March 31, 2022, and the resulting recommendations.

2 Background

The District was created in 1959 and is classified as a political sub-division of the State of Florida under Chapter 2004-439. The District owns and operates a public utility that provides water services within the unincorporated areas of Sarasota and Charlotte Counties, generally known as Englewood, Grove City, and Manasota Key. The District's current service area boundary encompasses approximately 44.5 square miles. In addition, the District has interlocal agreements for the delivery of potable water to Bocilla Utilities for the residents of Don Pedro and Knight/Palm Island in Charlotte County.

2.1 Existing Facilities

The District's current Water Use Permit (WUP) issued by the Southwest Florida Water Management District (SWFWMD) (WUP No. 20 004866.012) authorizes groundwater withdrawals of 5,360,000 gallons per day (annual average) and 6,860,000 gallons per day (peak month). These quantities were allocated to meet the District's potable water demand through 2050. The District's WUP expires on December 9, 2050. The District's water supply, treatment and distribution facilities include:

- Five (5) groundwater wellfields
    - Four (4) freshwater well systems with aggregated permitted withdrawal capacities of up to 3.54 MGD (annual average) and up to 4.35 MGD (peak month) within Wellfields 1, 2, 3, and 5 provided the current total WUP allocation is not exceeded.
    - Two (2) brackish water well systems with aggregated permitted withdrawal capacities of up to 4.25 MGD (annual average) and up to 5.44 MGD (peak month) within Wellfields 2 and 4 provided the current total WUP allocation is not exceeded.
- Two (2) water treatment plants
    - One (1) lime softening plant built in 1961 at 3.0 MGD design capacity for treatment of the freshwater wellfield supply; however, the District can only reliably treat 2 MGD of this capacity.
    - One (1) reverse osmosis (RO) Plant built in 1981 at 3.0 MGD design capacity for treatment of the brackish water wellfield supply
- Four (4) finished water storage tanks with a combined capacity of 7.5 million gallons, and one (1) elevated storage tank with 100,000-gallon capacity used to dampen the amplitude of distribution system pressures
- Two (2) deep injection wells

    - One (1) 1.58-MGD deep injection well (DIW-1) onsite for RO concentrate disposal
    - One (1) 2.94-MGD deep injection well (DIW-2) offsite at the Holiday Ventures Lift Station for reclaimed water disposal and backup RO concentrate disposal. Backup capacity is limited due to existing use by the South Water Reclamation Facility (WRF) and future use by the North WRF that is being currently planned.
- Over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties.

3 Condition Assessment Framework & Criteria

The Englewood Water District condition assessment framework was based on a three-tier asset hierarchy consisting of the following:

- Level 1: Facility (General Site, Lime Softening, Reverse Osmosis)
- Level 2: System (Site Security, General Plant Facilities, Packed Tower Aerator, Lime Feed System, Lime Treaters, Dual-Media Filters, RO Trains, Disinfection, Clearwells, New/Old High Service Pump Stations, Finished Water Storage Tanks)
- Level 3: Discipline (Structural, Mechanical, Electrical, Instrumentation)

Scores for each Level 3 asset were provided from 1 – 5, with 1 being the best condition and 5 being the worst. Scores were based on a combination of observed conditions and comments on functionality and performance from accompanying Englewood Water District staff.

The following Table 3-1 shows the criteria used for assigning a condition assessment score to each asset.

Table 3-1: Detailed Condition Assessment Criteria Reference

Score	Meaning	Explanation
1	Very Good	Fully operable, well maintained, and consistent with current standards. Little wear shown. No defects noted.
2	Good	Sound and well maintained but may be showing slight signs of early wear. Delivering full efficiency with little or no performance deterioration. Only minor renewal or rehabilitation may be needed in the near term.
3	Average	Functionally sound and acceptable showing normal signs of wear. May have minor failures or diminished efficiency with some performance deterioration or increase in maintenance cost. Moderate renewal or rehabilitation needed in near term.
4	Poor	Functions but requires a high level of maintenance to remain operational. Shows abnormal wear and is likely to cause significant performance deterioration in the near term. Replacement or major rehabilitation needed in the near term.
5	Very Poor	Effective life exceeded and/or excessive maintenance cost incurred. A high risk of breakdown or imminent failure with serious impact on performance. No additional life expectancy with immediate replacement needed.

4 Condition Assessment Summary

The HDR team performed a walkthrough of the lime softening and reverse osmosis plants with Keith Ledford, Technical Support Manager, and Dewey Futch, Water Operations Manager, from the District on Friday, March 31, 2023. The District provided a short overview presentation explaining the layout and flow routing through the plants. The HDR team provided a high-level assessment of the structural, mechanical, electrical, and instrumentation aspects of major plant processes, based on physical observations and input on performance and age from the District.

The HDR team used the findings from the condition assessment to assign scores to each major process. Table 4-1 shows the scoring for each process area sorted by discipline. Color-coding is explained below:

Table 4-1: Condition Assessment Results Summary

Facility	System	Condition Score				
		Structural	Mechanical	Electrical	Instrumentation	Average
General Site	Site Security	1	1	1	2	1
Lime Softening	General Facility	2	4	1	1	3
Lime Softening	Packed Tower Aerator	1	2	1	2	2
Lime Softening	Lime Feed System	3	2	2	2	2
Lime Softening	Treater 1	3	3	2	1	2
Lime Softening	Treater 2	4	3	2	1	2
Lime Softening	Treater 3	4	3	2	1	2
Lime Softening	Filters	4	4	2	4	4
Lime Softening	Old High Service Pump Station	1	2	1	1	1
Lime Softening	New High Service Pump Station	1	2	1	1	1
Lime Softening	Chemical Storage and Dosing	2	2	1	1	2
Reverse Osmosis	General Facility	3	3	1	1	2
Reverse Osmosis	Electrical & Control Rooms	4	1	4	4	3
Reverse Osmosis	RO Train A	5	4	2	3	4
Reverse Osmosis	RO Train B	5	2	2	2	3
Reverse Osmosis	RO Train C	5	1	2	3	3
Reverse Osmosis	RO Train D	5	4	2	2	3
Reverse Osmosis	RO Train E	2	2	2	3	2
Reverse Osmosis	RO Train F	1	3	2	2	2
Reverse Osmosis	Clearwell 1	4	3	2	3	3
Reverse Osmosis	Clearwell 2	1	1	2	2	2
Reverse Osmosis	Chemical Storage and Dosing	2	1	1	1	1

Color Coding Reference:

Green – Very Good
Yellow – Good
Gray – Average
Orange – Poor
Red – Very Poor

5 Condition Assessment Findings

5.1 General Site – Site Security

General site refers to the site as a whole, including both the lime softening and reverse osmosis plants. Site security is adequate but could be improved. The site has one main point of entry at the administrative building with a motor-operated slide gate. There are several security cameras which feed footage to control rooms at each of the two plants. Security camera footage is only kept for 24 hours. The District has at least two operators on site at all times.

Table 5-1: Condition Assessment Results - Site Security

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	1	• No defects noted
Electrical	1	• No defects noted
Instrumentation	2	• Few security cameras • Security camera footage only kept for 24 hours

5.2 Lime Softening Plant

The existing lime softening plant consists of an influent packed tower aerator with a DeLoach degasification unit, a lime slaker, three (3) 32-foot-diameter lime softening treaters, three (3) dual-media gravity filters, chlorine gas and anhydrous ammonia stored in covered areas, the 3.25-MGD Old High Service Pump Station, the 8.64-MGD New High Service Pump Station, a backwash storage pond, a 0.5-MG finished water storage tank, a 1.0-MG finished water storage tank, and a 100,000-gallon elevated finished water storage tank. The 0.5- and 1.0-MG finished water storage tanks were not visually assessed during this site visit; however, the District's prior inspections have determined the 0.5-MG finished water storage tank, which is steel, is in bad condition internally and in need of repair.

5.2.1 General Lime Softening Facility

The elevated storage tank was structurally rehabilitated in September 2023. The District is planning to sandblast and repaint the tank in the near future.

The plant achieves clarification, softening, and pH adjustment through the use of three (3) hydrotreaters. District personnel stated that all three treaters are operated to achieve a pH around 10 to provide water stability and meet finished water pH goals of 9.2 to 9.4 when filter effluent combines with RO permeate. In general, the use of lime has resulted in plantwide operational issues such as clogging of lime feed lines, lime buildup and media calcification in filters, and lime settling, dredging, drying, and hauling from the backwash pond. In an effort to minimize lime use, it is suggested that a lime dosing optimization study be conducted and evaluate if caustic instead be added to either Clearwell 1 or filter effluent to raise the pH of the combined filter effluent and RO permeate. This would raise the pH without the operational issues and costs associated with using high quantities of lime.

A pond is located just east of the lime softening plant which is used for filter backwash wastewater and treater wastewater storage. Water is decanted from the pond and sent back to the lime treaters to reduce system water losses. The backwash pond fills quickly with lime sludge and requires regular dredging, which was last performed in 2019. The spent lime is then dried out in adjacent ponds and eventually landfilled; however, the drying process takes a long time, and the site is running out of space to dry the lime sludge. The District has also stated that it is difficult to find reliable and steady services to accept and dispose of the spent lime.

Table 5-2: Condition Assessment Results - General Lime Softening Facility

Discipline	Condition Assessment Score	Comments
Structural	2	• No plantwide defects noted • Per District, 0.5-MG storage tank liner has leaked and is in need of repair. It is offline but its use has not been critical.
Mechanical	4	• High lime use has resulted in process inefficiencies such as clogging of lime feed lines, frequent filter media replacement, and high sludge dredging/drying demands.
Electrical	1	• No plantwide defects noted
Instrumentation	1	• No plantwide defects noted

5.2.2 Packed Tower Aerator

The packed tower aerator was upgraded in 2020 with a new tank and degasification unit. Given the recent upgrade, few defects were noted other than some performance issues reported by District personnel and minor mechanical issues. One of the pumps was being replaced at the time of this site visit.

District personnel noted that they do experience occasional binding of the media within the degasification unit to form what is known as “degas balls”. This binding is caused by the attachment of elemental sulfur and sulfur-eating bacteria to the polypropylene media. This issue can be remedied through media replacement or the application of a weak acid to remove some sulfur buildup in between replacements. The District noted this as a minor maintenance issue and not requiring immediate or drastic improvement.

Table 5-3: Condition Assessment Results – Packed Tower Aerator

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	2	• Pump station post-tank aged but performing well • Degas blower aging but in fair condition (no pitting) • Some issues with degas balls
Electrical	1	• No defects noted
Instrumentation	2	• Level transmitter showing normal instrument wear • Instrument piping insulation should be replaced

5.2.3 Lime Feed System

The lime feed system consists of the lime slaker unit and the surrounding building. District personnel noted some recent upgrades to the system including the replacement of the lime slaker motor, replacement of structure beams, and rewelding of the supports. Some missing panels from the structure and rusting were noted as remaining damage from the recent hurricane. The containment skirt for the slaker is replaced by the District staff as needed.

District personnel stated that the lime lines clog frequently, sometimes daily. The operators run the system at about 130 – 140ºF; typical systems run closer to 160-180ºF.

Table 5-4: Condition Assessment Results - Lime Feed System

Discipline	Condition Assessment Score	Comments
Structural	3	• Damage due to hurricane
Mechanical	2	• Lime lines clog up frequently
Electrical	2	• Electrical equipment inside of slaker enclosure showing normal wear
Instrumentation	2	• Pressure gauges and float switch showing normal instrument wear

5.2.4 Treater 1

Each of the District’s three treaters were evaluated separately due to differences in tank and internal materials. District personnel noted that covers have been removed from the treaters due to the “greenhouse” conditions which lead to unwanted plant growth. It was also mentioned that the District no longer runs lime recirculators because of the resulting turbidity of water in the treaters.

Treater 1 is made of a painted steel tank with painted steel internals. Treater 1 is typically sandblasted and coated in the summer when flows are lower. Treater 1 was out of service for repairs at the time of observation. No operational issues were noted by District personnel for Treater 1 during this site visit.

Table 5-5: Condition Assessment Results – Treater 1

Discipline	Condition Assessment Score	Comments
Structural	3	• Moderate rust on all endpoints • Internal coating pulling off • Some paint/concrete issues
Mechanical	3	• Normal wear, could use new paint • Drive not in good shape
Electrical	2	• Disconnect switches and conduits aging but operational
Instrumentation	1	• No defects noted

5.2.5 Treater 2

Treater 2 is made of a CROM prestressed concrete tank with stainless steel internals. Treater 2 was recently rehabilitated in 2021. This treater was filled at the time of this site visit but appeared to be in overall good operational condition. Though not impacting operation, the CROM tanks were showing external moisture under the paint coat, which provides evidence of possible waterstop failure. The rust color of moisture spots seen on the external of the tank walls may indicate waterstop or rebar corrosion.

Table 5-6: Condition Assessment Results - Treater 2

Discipline	Condition Assessment Score	Comments
Structural	4	• Tank showing signs of waterstop failure
Mechanical	3	• No air source or mixers
Electrical	2	• Disconnect switches and conduits aging but operational
Instrumentation	1	• No defects noted

5.2.6 Treater 3

Treater 3 is made of a CROM prestressed concrete tank with painted steel internals. Treater 3 was rehabilitated in 2020. This treater was filled at the time of this site visit but appeared to be in overall good operational condition. Though not impacting operation, the CROM tanks were showing external moisture under the paint coat, which provides evidence of possible waterstop failure. The rust color of moisture spots seen on the external of the tank walls may indicate waterstop or rebar corrosion.

Table 5-7: Condition Assessment Results – Treater 3

Discipline	Condition Assessment Score	Comments
Structural	4	• Tank showing signs of waterstop failure
Mechanical	3	• No air source or mixers
Electrical	2	• Disconnect switches and conduits aging but operational
Instrumentation	1	• No defects noted

5.2.7 Filters

The District operates three (3) dual-media gravity filters downstream of the lime treaters. The filters consist of layers of anthracite, sand, and gravel above a Wheeler underdrain system. District personnel stated that filter media is replaced every 3 to 5 years; typical recommended service life of filter media is about 10 to 20 years. The lime treaters use a high quantity of lime to raise the pH to around 10 so that finished water pH goals are met when filter effluent combines with RO permeate. This lime builds up in the filters and causes calcification and blowouts in the filter media. It is suspected that the lack of mechanical sweeps and halting the use of backwash air scour in the filters provides inadequate backwashing, resulting in faster calcification and blowouts. The District also reported that there is a lot of media carry over into the backwash troughs. This is likely because troughs are low and close to the media surface.

The backwash pump has not been replaced in many years but is operating well. The District does have another backwash pump in storage in case the existing one needs replacement in the future. No defects were noted with the backwash pump.

Table 5-8: Condition Assessment Results - Filters

Discipline	Condition Assessment Score	Comments
Structural	4	• Rusting • Coating peeling off the walls • Troughs lower than the media
Mechanical	4	• Media calcification and blowout • No air scour • No mechanical mixers
Electrical	2	• Conduits in aging but in fair condition
Instrumentation	4	• Local control panels for filters in poor condition and not up to industry standards • LCP for Filter #3 missing front door and conduit is detached from panel exposing wire

5.2.8 Old High Service Pump (HSP) Station

The Old High Service Pump (HSP) Station contains the backwash pump along with one (1) 30-HP pump and three (3) 50-HP pumps (Pumps 1, 2, 3, and 4) and all related electrical and controls equipment. All four pumps and valves have been replaced since 2018 and are in good condition. It was noted that check valves installed in vaults in the floor are not able to be easily replaced due to the small and deep configuration of the vaults.

Table 5-9: Condition Assessment Results – Old High Service Pump (HSP) Station

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	2	• Check valves in vaults are unreplaceable • Moderate corrosion on small pump distribution
Electrical	1	• No defects noted
Instrumentation	1	• No defects noted

5.2.9 New High Service Pump (HSP) Building

The New High Service Pump Station consists of three (3) large pumps (Pump 7, 8, and 9) with space for two (2) more pumps to be installed in the future. Check valves installed on Pumps 7 and 9 within the New High Service Pump Building cause the whole building to shake. District personnel mentioned that Pump 8 has a “Slaminator” check valve which is effective for reducing the shaking and vibrating. The District would like to install similar check valves on pumps 7 and 9, as well.

Table 5-10: Condition Assessment Results - New High Service Pump (HSP) Building

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	2	• Severe vibrations from Pumps 7 and 9
Electrical	1	• No defects noted
Instrumentation	1	• No defects noted

5.2.10 Chemical Storage and Dosing

Both the lime softening and reverse osmosis plants blends chlorine gas and anhydrous ammonia to produce chloramines for disinfection. The District has expressed interest in switching from using chlorine gas to liquid chlorine. Liquid chlorine would be safer for handling and storage, and it would potentially allow the District to consolidate their chlorine storage into one location for the site. The District has had difficulty finding suppliers for liquid chlorine. If possible, the District also expressed a desire to use free chlorine instead of chloramines.

Chlorine gas for the lime softening plant is stored in a covered building with a chain link fence to prevent unwanted entry. Safety signage and security appear to be adequate. A gantry crane is used to moved chlorine tanks in and out of the building for refill and replacement. The gantry crane mechanism had moderate rusting, but the District did not state any operational issues.

The District blends chlorine gas with anhydrous ammonia to form chloramines. Anhydrous ammonia for the lime softening plant is stored in a pressure vessel covered by an awning adjacent to the chlorine storage room. The awning appeared to be in good structural condition; however, in order to maximize safety and shelf life, it is recommended that the anhydrous ammonia be stored in a covered room (similar to the chlorine storage) so that it remains cool and away from direct sunlight.

Chemical dosing, monitoring instrumentation is mounted on the north interior wall of the Old High Service Pump Station building. This instrumentation appeared to be in good condition and no performance issues were noted by District personnel.

Table 5-11: Condition Assessment Results – Chemical Storage and Dosing

Discipline	Condition Assessment Score	Comments
Structural	2	• Anhydrous ammonia stored outdoors with only an awning for cover
Mechanical	2	• Some rusting/corrosion of gantry crane mechanism in chlorine storage room
Electrical	1	• No defects noted
Instrumentation	1	• No defects noted

5.3 Reverse Osmosis (RO) Plant

The existing RO plant consists of an electrical supply room, six (6) RO trains, chlorine gas and ammonia for disinfection, chemical feed rooms, a generator room, two (2) clearwells operating in series which accept treated water from both the lime softening and RO plants, a 0.5-MG finished water storage tank, a 1-MG finished water storage tank, a 2-MG finished water storage tank, and a 4-MG finished water storage tank. The finished water storage tanks were not assessed during this site visit. The following subsections describe specific condition-related observations made for each of these processes within the RO plant.

5.3.1 General RO Facility

The RO system and electrical supply are housed in a large building (approximately 4,000 ft^2) along the north side of Selma Avenue. This facility includes a 3,500 ft^2 addition which was constructed to expand the RO process to treat 2 MGD of additional flow with four new trains. The District noted that the electrical room, which was designed to provide power to the new RO trains, was too small and did not meet current electrical codes and standards. The District would like to find an alternative site for the electrical room if the RO system is expanded in the future.

The RO Facility includes a large generator room which contains two (2) 500 KW (480V/3P/60Hz) Caterpillar generators and includes space for a third. These generators were replaced in 2019 and appear to be in good condition. The District did not note any operational concerns with the generators.

The RO Facility also includes a large laboratory where the District analyzes samples daily from its lime softening, RO, and wastewater plants for regulatory compliance. The District performs its own bacteriological testing. The HDR team noted some leak staining on ceiling panels due to Hurricane Ian. The lab appeared to be in good condition otherwise.

Brackish raw water flows through several bottlenecks in the piping system before reaching the plant. Raw water from Wellfield 2 flows through a 16-inch pipe before combining with raw water from Wellfield 4 into a 12-inch pipe. This is the first bottleneck in the influent brackish water feed to the RO plant. District personnel mentioned another bottleneck directly in front of the reverse osmosis facility. Specifics of this second bottleneck are not yet known but will be further investigated using as-builts to be provided by the District.

Table 5-12: Condition Assessment Results - General RO Facility

Discipline	Condition Assessment Score	Comments
Structural	3	• Addition for RO expansion does not have space for compliant electrical room. • Minor staining of ceiling panels in laboratory.
Mechanical	3	• Bottlenecks in influent piping.
Electrical	1	• No plantwide defects noted
Instrumentation	1	• No plantwide defects noted

5.3.1.1 Background on RO Filtration System

The RO plant operates six (6) trains, known as Trains A through F, which utilize Protec pressure vessels and Hydranautics CPA5-LD membranes. Each RO skid consists of two (2) trains of pressure vessels with six (6) rows of pressure vessels on each side, resulting in twelve (12) total rows of pressure vessels. Skids are mounted on reinforced concrete pedestals. Each train has its own pump to provide pretreated feedwater to the membranes. These pumps are not the same but generally supply between 100 and 150 HP to the RO trains. The District also keeps a universal standby pump (Pump "S") which can connect to any RO train in case a duty pump is temporarily out of service. During the site visit, Pump S was out of service. Pumps are not connected to VFDs.

The RO skids were designed to provide 0.5 MGD of permeate and typically operate at 70% recovery, although this fluctuates and was noted to be as low as 60% recently. Low recovery is often due to fouling or scaling of the membranes, which results in a higher differential pressure that feed pumps cannot overcome. Performing an analysis using operating and water quality data could provide recommendations for more optimized operation of the RO system.

Membrane permeate is routed out of the south end of the RO building to Clearwell 1, where it is mixed with filter effluent and disinfected. Concentrate flows out along the north end of the building and is disposed of through the deep injection well on the property. In the event that the deep injection well capacity is met, the District sends concentrate to their Deep Injection Well 2 (DIW2) located at the Holiday Ventures site..

Vertically-oriented cartridge filters are located upstream of each RO skid for pretreatment. Cartridge filters are 5-micron in size. Cartridge filters are replaced based on a differential pressure drop of around 10 psi.

District personnel stated that the membranes are typically replaced in-house every 5 to 7 years. The District also stated that they have a regular practice of attempting to extend the service life of membranes by moving used membranes into Train A, which has the highest rated pump. Used membranes are left in the open air before being placed into Train A, which introduces risk of drying and biofouling.

The District also stated that they do not clean membranes. Periodically performing clean-in-place (CIP) events could help to extend their useful life. Operating performance and autopsy results would be required to recommend a specific cleaning schedule and procedure.

The team noted structural and mechanical issues including severe deterioration of the concrete pedestals, leakage, and corrosion of mechanical joints installed vertically between membranes.

5.3.2 Electrical & Control Rooms

Structural, mechanical, and electrical issues were observed within the electrical and control rooms which provide power and controls for the RO trains. The electrical room is generally undersized and does not meet code requirements for motor control center (MCC) and variable frequency drive (VFD) spacing. Prior to Hurricane Ian, a leak in the roof caused a fire in the control room. The leak has been repaired but damages from the fire have not been fully repaired. The team noted that there is a roof drain which runs along the ceiling within the electrical room. This is a cause for concern as leaks or damage to this pipe could result in further equipment damage. The team also noted that new MCC equipment was installed within the existing MCC enclosures. This new equipment is too large for the enclosures and prevents them from closing.

Table 5-13: Condition Assessment Results - Electrical & Control Rooms

Discipline	Condition Assessment Score	Comments
Structural	4	• Room is undersized; does not meet code • Roof drain runs along ceiling
Mechanical	1	• No defects noted
Electrical	4	• MCC enclosures in poor condition • MCC enclosure doors cannot be closed because equipment does not fit inside enclosures
Instrumentation	4	• Control system enclosure in poor condition and not up to industry standards • Fire damage visible on existing control system enclosure • Some equipment indicating lights not functioning • New Siemens PLC

5.3.3 RO Train A

RO Train A is located on the easternmost end of the RO system and is operated by a 150-HP pump. Train A was installed in 1980. Used membranes from other RO trains are often placed into Train A to extend their service lives since Train A has the highest power pump. The S-pump is also located next to Train A was out of service. Additional observations are listed in the table below.

Table 5-14: Condition Assessment Results – RO Train A

Discipline	Condition Assessment Score	Comments
Structural	5	• Severe erosion of concrete pedestals
Mechanical	4	• Significant leaking but operational
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	3	• Instruments and enclosures showing rust/corrosion

5.3.4 RO Train B

RO Train B is the second easternmost train of the RO system and is operated by a 100-HP pump. Train B was installed in 1982. Additional observations are listed in the table below.

Table 5-15: Condition Assessment Results - RO Train B

Discipline	Condition Assessment Score	Comments
Structural	5	• Severe erosion of concrete pedestals • Exposed rebar
Mechanical	2	• Minor corrosion on spacers • No leaking apparent
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	2	• Instruments and enclosures showing rust/corrosion

5.3.5 RO Train C

RO Train C is the third easternmost train of the RO system and is operated by a 100-HP pump. Train C was installed in 1982. This train was offline during inspection, and the District determined that this was due to a bad pump/motor assembly as the motor was overheating within 2 hours of running. District personnel stated that two membranes from Train C were recently sent out for autopsy, but these results have not come in yet. Additional observations are listed in the table below.

Table 5-16: Condition Assessment Results - RO Train C

Discipline	Condition Assessment Score	Comments
Structural	5	• Severe erosion of concrete pedestals
Mechanical	5	• Nonfunctional pump/motor assembly
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	3	• Instruments and enclosures showing rust/corrosion

5.3.6 RO Train D

RO Train D is the third westernmost train of the RO system and is operated by a 125-HP pump. Train D was installed in 1989. Additional observations are listed in the table below.

Table 5-17: Condition Assessment Results - RO Train D

Discipline	Condition Assessment Score	Comments
Structural	5	• Severe erosion of concrete pedestals
Mechanical	4	• Severe corrosion on pump valving
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	2	• Instruments and enclosures showing rust/corrosion

5.3.7 RO Train E

RO Train E is the second westernmost train of the RO system and is operated by a 125-HP pump. Train E was installed in 1992. Additional observations are listed in the table below.

Table 5-18: Condition Assessment Results - RO Train E

Discipline	Condition Assessment Score	Comments
Structural	2	• Minor erosion of concrete pedestals
Mechanical	2	• Minor corrosion on pump valving
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	3	• Instruments and enclosures showing rust/corrosion

5.3.8 RO Train F

RO Train F is the westernmost train of the RO system and is operated by a 125-HP pump. Train F was installed in 2006. Additional observations are listed in the table below.

Table 5-19: Condition Assessment Results: RO Train F

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	3	• Minor leaks on multiple tubes • Minor corrosion on spacers • Moderate wear
Electrical	2	• Conduits showing normal signs of wear
Instrumentation	2	• Instruments and enclosures showing rust/corrosion

5.3.9 Clearwell 1

District personnel explained that water from both the lime softening and RO plants flows into Clearwell 1 and then flows by gravity into Clearwell 2, where it is then pumped to the finished water storage tanks via transfer pumps in Clearwell 2. Clearwell 1 contains an attached degasification unit which was recently constructed and is in good structural condition. District personnel noted that water from the degasification unit has eroded a fair amount of concrete within Clearwell 1. The District prefers not to operate the pumps at Clearwell 1 whenever possible.

Table 5-20: Condition Assessment Results - Clearwell 1

Discipline	Condition Assessment Score	Comments
Structural	4	• Turbulent water causing concrete to chip away
Mechanical	3	• Disconnected pump • Hanging wires • No pressure gages present on 2 of the 3 pumps
Electrical	2	• Disconnect switches and conduits in good shape
Instrumentation	3	• Instruments missing on pump discharge piping

5.3.10 Clearwell 2

Clearwell 2 was constructed more recently than Clearwell 1 and is in good condition overall. Clearwell 2 contains new pressure gages and pressure switches. The transfer pumps at Clearwell 2 appear to be performing well.

Table 5-21: Condition Assessment Results - Clearwell 2

Discipline	Condition Assessment Score	Comments
Structural	1	• No defects noted
Mechanical	1	• No defects noted
Electrical	2	• Disconnect switches and conduits aging but performing well
Instrumentation	2	• Some rusting/corrosion on instruments

5.3.11 Chemical Storage and Dosing

Sulfuric acid and an antiscalant are added upstream of membranes for pretreatment. Sulfuric acid (50%) is stored in an elevated 300-gallon tank above a low concrete sump. Some damage to the concrete sump bottom and coating indicates minor leaks have occurred in the past. Sulfuric acid is fed from two ProMinent peristaltic pumps. The antiscalant used is the PWT SpectraGuard^{TM} 350. This product is diluted to 11.5% antiscalant prior to feeding to the RO feedwater. Two small LMI pumps are used to feed the antiscalant.

Both the lime softening and reverse osmosis plants blends chlorine gas and anhydrous ammonia to produce chloramines for disinfection. The District has expressed interest in switching from using chlorine gas to liquid chlorine. Liquid chlorine would be safer for handling and storage, and it would potentially allow the District to consolidate their chlorine storage into one location for the site. The District has had difficulty finding suppliers for liquid chlorine. If possible, the District also expressed a desire to use free chlorine instead of chloramines.

Chlorine gas for the RO plant is stored in a covered room attached to the RO Facility with a chain link fence to prevent unwanted entry. Safety signage and security appear to be adequate. No structural deficiencies were observed, other than minor rusting of the chain link fence.

The District blends chlorine gas with anhydrous ammonia to form chloramines. Anhydrous ammonia for the RO plant was not observed during this site visit.

Chemical dosing pumps and instrumentation appeared to be in good condition. No deficiencies were observed visually or noted by District personnel.

Table 5-22: Condition Assessment Results – Chemical Storage and Dosing

Discipline	Condition Assessment Score	Comments
Structural	2	• Minor rusting of chain link fence around chlorine storage • Coating damage and minor corrosion of sump beneath sulfuric acid tank
Mechanical	1	• No defects noted
Electrical	1	• No defects noted
Instrumentation	1	• No defects noted

6 Recommendations

The HDR team has compiled the following recommendations to address the defects noted in this report. In future submittals, alternatives for future changes to treatment processes will be modeled and analyzed. Some of the recommendations listed below may be deemed unnecessary based on the results of these analyses. Therefore, the recommendations in Table 6-1 should be considered short-term and subject to change in future submittals.

Table 6-1: Recommendations from Condition Assessment

Plant	System	Recommendation
General	Site Security	Increase security cameras and footage storage.
General	Disinfection (Sitewide)	Consider switching to liquid chlorine and consolidate storage to one location on site.
General	Disinfection (Sitewide)	Consider using free chlorine instead of chloramines.
Lime Softening	Packed Tower Aerator	Replace blower.
Lime Softening	Lime Softening (General)	Conduct lime dosing optimization study to reduce lime use and assess caustic to filter effluent or clearwell for finished water pH balance.
Lime Softening	Treater 1	Replace drive unit.
Lime Softening	Treater 2	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Treater 3	Observe for worsening external moisture and consider performing structural testing for tank integrity.
Lime Softening	Filters	Consider raising troughs to reduce media carryover.
Lime Softening	Filters	Add air scour and media sweeps to improve backwashing and prevent media hardening.
Lime Softening	Filters	Replace existing local control panels containing backwash controls.
Lime Softening	Filters	Replace missing and deteriorating guardrails.
Lime Softening	New HSP Station	Replace check valves at Pumps 7 and 9 with Slaminator check valves.
Lime Softening	Chemical Storage and Dosing	Store anhydrous ammonia in a cooler location without exposure to direct sunlight.

Reverse Osmosis	RO General Facility	Evaluate alternatives for electrical supply to future RO expansion.
Reverse Osmosis	RO General Facility	Increase raw water pipe sizes to remove bottlenecks.
Reverse Osmosis	RO General Facility	Reroute raw water piping to RO plant.
Reverse Osmosis	Electrical & Control Rooms	Move some equipment to new electrical supply room to meet code.
Reverse Osmosis	Electrical & Control Rooms	Reroute roof drain along outside of building.
Reverse Osmosis	Electrical & Control Rooms	Repair damage from fire and replace failed control system enclosure components
Reverse Osmosis	RO (General)	Perform CIPs as needed to extend membrane service life.
Reverse Osmosis	RO (General)	Review and trend operating data and water quality to optimize operation, including alternative pH adjustment or antiscalant chemicals/doses.
Reverse Osmosis	RO (General)	If reusing membranes from Train B-F is needed, make relocation to Train A as soon as possible to avoid membrane drying.
Reverse Osmosis	RO (General)	Repair/replace concrete pedestals.
Reverse Osmosis	RO (General)	Perform electrical study and check pump performance metrics to troubleshoot Train C supply pump motor issues.
Reverse Osmosis	RO (General)	Repair/replace leaking joints.
Reverse Osmosis	Clearwell 1	Repair eroded concrete and make modifications to clearwell to prevent future damage.
Reverse Osmosis	Chemical Storage and Dosing	Repair damage to sump beneath sulfuric acid storage tank.

B

Appendix B –Demand Projections Technical Memorandum

Water Master Plan

Population and Flow Projections Technical Memorandum (WMP Section 3)

Englewood Water District

District Contract No. 2022-129

Englewood, FL
August 25, 2023

Contents

Tables

Figures

1 Introduction

The Englewood Water District (District) has retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan. This Master Plan will assess the District's water service and facility needs for the next 20-year planning period from 2023 through 2043 for treatment and pumping equipment upgrades needed and the next 50-year period from 2023 to 2073 for verifying useful life of new wells, pipelines, and treatment basins with recommended upgrades. The purpose of this Technical Memorandum is to present the assumptions, methodologies, and sources used to develop the District's water supply and distribution demands over the 20-year and 50-year planning periods.

2 Background

The District was created in 1959 and is classified as a political sub-division of the State of Florida under Chapter 2004-439. The District owns and operates a public utility that provides water services within the unincorporated areas of Sarasota and Charlotte Counties generally known as Englewood, Grove City, and Manasota Key. The District's current service area boundary encompasses approximately 44.5 square miles. In addition, the District currently has an interlocal agreements for the delivery of potable water to Bocilla Utilities for the residents of Don Pedro and Knight/Palm Island in Charlotte County.

2.1 Existing Facilities

The District's current Water Use Permit (WUP) issued by the Southwest Florida Water Management District (SWFWMD) (WUP No. 20 004866.012) authorizes total groundwater withdrawals of up to 5,360,000 gallons per day (annual average) and up to 6,860,000 gallons per day (peak month). These quantities were allocated to meet the District's potable water demand through 2050; however, this Master Plan evaluates the needs for applying to adjust the current allocated freshwater wellfield and brackish water supplies in Section 3.3 below. The District's WUP expires on December 9, 2050. The District's water supply, treatment and distribution facilities generally include:

- Five (5) groundwater wellfields
  - Four (4) freshwater well systems with aggregated permitted withdrawal capacities of up to 3.54 MGD (annual average) and up to 4.35 MGD (peak month) within Wellfields 1, 2, 3, and 5 provided the current total WUP allocation is not exceeded.
  - Two (2) brackish water well systems with aggregated permitted withdrawal capacities of up to 4.25 MGD (annual average) and up to 5.44 MGD (peak month) within Wellfields 2 and 4 provided the current total WUP allocation is not exceeded.
- Two (2) water treatment plants
  - One (1) lime softening plant built in 1961 at 3.0 MGD design capacity for treatment of the freshwater wellfield supply; however, the District can only reliably treat 2 MGD of this capacity.
  - One (1) reverse osmosis (RO) Plant built in 1981 at 3.0 MGD design capacity for treatment of the brackish water wellfield supply
- Four (4) finished water storage tanks with a combined capacity of 7.5 million gallons, and one (1) elevated storage tank with 100,000-gallon capacity used to dampen the amplitude of distribution system pressures

- Two (2) deep injection wells
    - One (1) 1.58-MGD deep injection well (DIW-1) onsite for RO concentrate disposal
    - One (1) 2.94-MGD deep injection well (DIW-2) offsite at the Holiday Ventures Lift Station for reclaimed water disposal and backup RO concentrate disposal. Backup capacity is limited due to existing use by the South Water Reclamation Facility (WRF) and future use by the North WRF that is being currently planned.
- Over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties.

3 Historical Population and Flow

3.1 Information Sources

Various information sources were gathered to compile a comprehensive view of the District's historical and future population estimates. The following referenced materials were used in the development of the population projections:

- Englewood Water District – Monthly Operating Reports (2015 - 2022)
- Englewood Water District – Annual Wellfield Report (2022)
- Englewood Water District – Public Supply Annual Reports (2014 – 2021)
- Englewood Water District – Bocilla Supply Meter Reading Reports (2018 – 2023)
- Sarasota County – GIS parcel data
- Charlotte County – GIS parcel data

3.2 Historical Trends

The following subsections describe observed trends in population growth and water demands based on data provided by the District. These trends will be used to inform and adjust population and flow projections developed in later sections.

3.2.1 Historic Population

The District's Public Supply Annual Reports (PSARs) from 2018 to 2021 (see Table 3-1) indicate a population growth rate of 2.8% over the 4-year period. This averages to an annual growth rate of about 0.70%, as illustrated in Figure 3-1.

Table 3-1: Service Area Historical Population from PSARs

Year	Functional Population (PSAR)
2018	37,217
2019	37,540
2020	38,271
2021	38,260

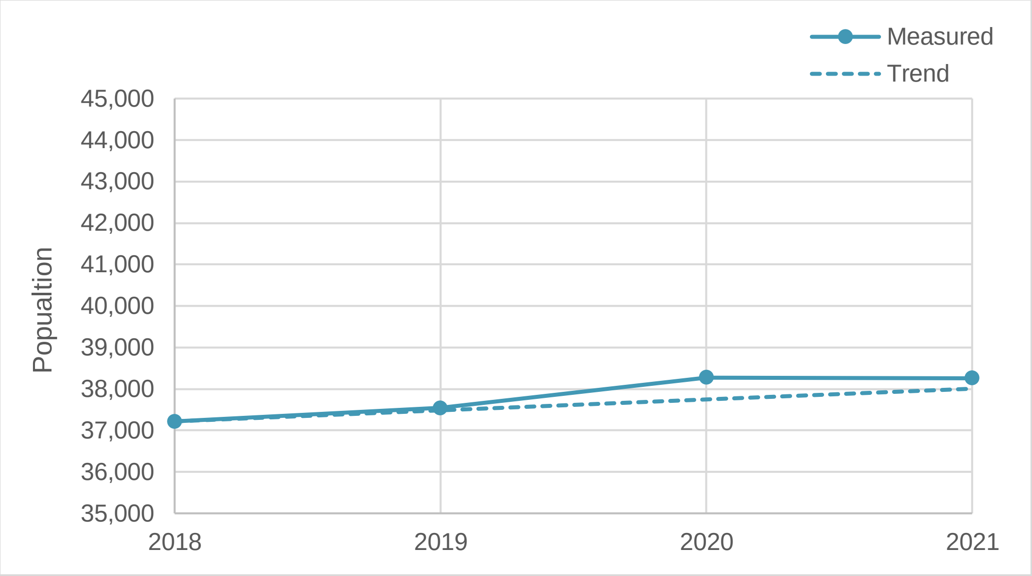


Figure 3-1: Englewood Historical Population from PSARs

3.2.2 Historic Water Demand

Based on the District's last 5 years of monthly operating reports (MORs), and as illustrated in Figure 3-2 below, the annual average rate of increase of metered water service connections from January 2018 through December 2022 is approximately 0.99%. The District saw an increase of approximately 949 new metered services over the last five years. The annual rates of increase in metered services range from a low of 0.57% in 2020 and a high of 1.49% in 2022.

This meter increase corresponds to an increase in average annual demand of 1.03% between 2018 and 2022 based on the values presented in Table 3-2: Annual Average Water Demand and Maximum Month. Demands fluctuate over this time period within a range of 1.1 MGD (October 2022) and 5.3 MGD (July 2019). It should be noted that the District has experienced slight overall reductions in average annual demand over the past three years (-1.49% average).

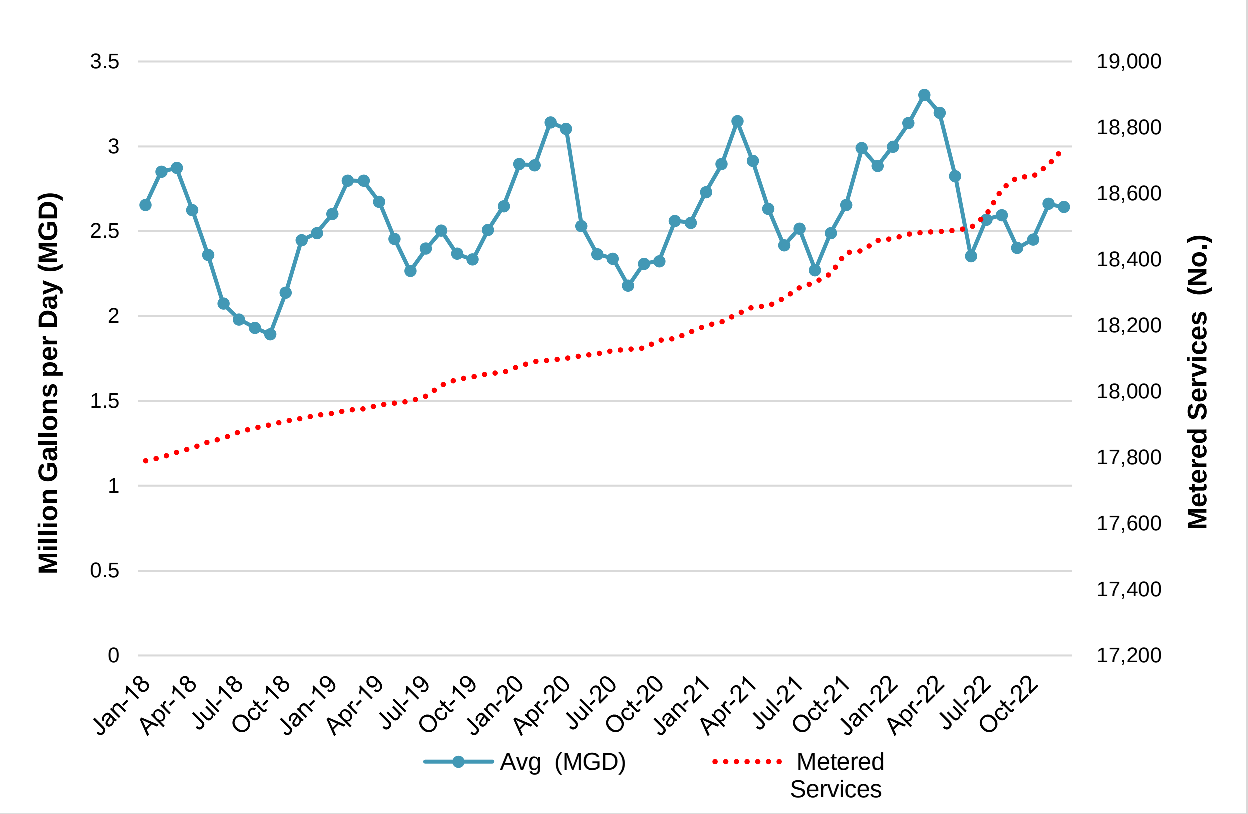


Figure 3-2: Water Consumption and Metered Service Connections

Table 3-2: Annual Average Water Demand and Maximum Month

Year	Annual Average Treated to System (MORs)	Maximum Month	Maximum Month Ratio
2018	2.611	3.825	1.193
2019	3.005	5.295	1.586
2020	2.975	4.500	1.670
2021	2.922	4.403	1.303
2022	2.872	3.854	1.198

Utilizing the District's historical (2018-2022) records of production data as well as the Historical Population Served reported on the District's Public Supply Annual Reports (PSARs) to the SWFWMD, a determination of per capita usage was calculated and is shown in Table 3-3 below.

Table 3-3: Historical Public Supply Annual Reports

Year	Annual Average Treated to System (MOR's)*	Functional Population (PSAR)	District Resident Gallons per capita/day (gpcd)
2018	2.611	37,217	75
2019	3.005	37,540	76
2020	2.975	38,271	79
2021	2.922	38,260	76

*Includes Bocilla Utilities Exported Water

3.2.3 Additional Water Demands

The District currently provides potable water to Bocilla Utilities through a bulk service agreement for the residents of Don Pedro Island (also known as Knight and Palm Island) in Charlotte County. Currently, Bocilla Utilities services approximately 400 residences on the island including private homes, condominiums and a vacation resort. The District's billing records for 2022 indicate that the average daily usage was 120,425 gpd, resulting in a usage rate of about 300 gpd per residence. Aerial photographs of the island suggest that it is approximately 75% built out.

3.2.4 Water Losses

PSARs provided from 2018 to 2021 indicate significant losses between the District's withdrawals and treated water supply. Table 3-5 below shows that the annual average water loss between 2018 and 2021 was about 17%, with a peak loss of 19% in 2020. An annual addition of 17% will be included in total projected water demands to account for these losses within the system.

Table 3-4: Annual Losses Recorded in PSARs

Year	Losses (GPD)	% Loss
2018	432,243	15.58%
2019	478,119	16.80%
2020	582,665	19.24%
2021	464,732	16.04%
Average (2018 – 2021)	489,440	16.92%

3.3 Permitted Withdrawals

Determination of the quantity and timing of projected water supply resources is accomplished by comparing the projected water supply demands to the utility system's existing finished water capacity on an annual basis. The raw water required to produce the estimated potable water demand is also related to the water treatment recovery efficiency. Water treatment recovery efficiency is a function of the treatment method used. Historical water treatment production data received from the District on the RO water treatment plant generally indicates a treatment efficiency of 65%. The combined withdrawals from RO Wellfields 2 and 4 are limited by the WUP to 4.25 MGD average annual and 5.44 MGD peak month. In order to stay below the overall permitted withdrawal limit of 5.36 MGD average and 6.86 MGD peak, well fields 1, 2, 3 and 5 are limited to a permitted average and peak day quantity of 1.11 MGD and 1.42 MGD, respectively. In addition, the WUP establishes a Chloride Concentration Trigger Level (CCTL) of 250 mg/L for each freshwater well within Wellfields 1, 2, 3, and 5 which may limit withdrawals and raw water production in the future.

Table 3-5: Available Water Supply Resource Analysis

Supply	Permitted Source AAD (MGD)	Permitted Source Peak Day (MGD)	WTP Efficiency %	Finished Water AAD (MGD)	Finished Water Peak Day (MGD)
RO Wellfields 2, 4	4.25	5.44	65%	2.76	3.54
Wellfields 1, 2, 3, and 5	1.11	1.42	100%	1.11	1.42
Total Supply	**5.36**	**6.86**		**3.87**	**4.96**

4 Population Projections

4.1 Information Sources and Methodology

Population projections were developed for the District to facilitate the development of water demand projections. Various information sources were gathered to compile a comprehensive view of the District's historical and future population estimates. The following referenced materials were used in the development of the population projections:

- Bureau of Economic and Business Research – Florida Estimates of Population 2022 (April 1, 2022)
- Bureau of Economic and Business Research – Florida Estimates of Population 2022 (Vol. 55, Bulletin 192, February 2022)
- Englewood Water District – Master Plan Development Table (2023)
- Southwest Florida Water Management District – 2023 Water Supply Demand Projections

Several different population projection methodologies are used across the country for infrastructure planning. These methodologies can be broken down into the following general categories: Trend Based Methods; Ratio Methods; Component Methods; forecasts derived directly from specific estimates of economic projections (employment/labor); comparative or analogy to similar areas; and forecasts derived from assigning an ultimate holding capacity or build out limit and projecting to that limit.

Specific to population projection methodologies used in Florida, the most common data sources referenced by the Metropolitan Planning Organizations (MPOs), Water Management Districts (WMDs), County Planning Departments and Regional Planning Councils (RPCs) include the following:

- **University of Florida's Bureau of Economic and Business Research (BEBR):** Estimates are produced using the housing unit method, in which changes in population are based on changes in occupied housing units (or households).
- **US Census Bureau National Projections:** Estimates of annual projections of resident populations are produced using the Component Method and assumptions about demographic components of change (future trends in births, deaths, and net international migration).
- **Comprehensive Planning Documents:** Florida Statutes require that municipal entities prepare comprehensive plans on a regular basis (every five years), and

> that these plans shall be based upon permanent and seasonal population estimates and projections. Projections shall be based on either the University of Florida's BEBR population estimates or generated by the local government based upon a professionally acceptable methodology. If using BEBR, the plan must be based on at least the minimum amount of land required to accommodate the Medium projections of the University of Florida's Bureau of Economic and Business Research for at least a 10-year planning period unless otherwise limited under s. 380.05, including related rules of the Administration Commission.

4.2 Base Year Population

An important part of the population forecasting process is the estimation of the actual population at or near the time the study is undertaken (the base year). If the study is undertaken at the same time as a census, or within one or two years of such a census, it may be acceptable to utilize the census counts with only gross adjustments. Since the United States census is performed only at 10-year intervals, and Florida does not make intermediate census determinations, a base year population estimate for the District was determined without utilizing census data.

The methodology used to determine the District's population projections through 2073 included determination of the base year (2021) population, with a "trend based" percent growth applied at 5-year incremental periods over the 20-year planning horizon.

To determine the District's 2021 Base Year Population, the following two sources of information were compiled and reviewed.

1. *Published population estimates from the Southwest Florida Water Management District.*
2. *District's published 2021 Public Supply Annual Report (PSAR).*

First, as a condition of the District's Water Use Permit (WUP), a Public Supply Annual Report (PSAR) must be submitted to the SWFWMD. This Report contains documentation of the number and type of residential and non-residential water service categories. In 2021, the District's estimated functional population is calculated to be 38,260.

Additionally, in 2023, the SWFWMD provided Adjusted Total Functional Populations from 2021 to 2050 for the Englewood Water District. Table 4-1 illustrates these projections. This population projection utilized the "component based" method, which disaggregates BEBR projections to land parcel levels with a geographic information system (GIS) overlay. These projections estimate a 2021 functional population of 38,260, which agrees with the PSAR's submitted to SWFWMD.

Table 4-1: SWFWMD Population Projections

County	WUP No.	Utility Name	Estimated Total Functional Population 2021	Adjusted Total Functional Population 2025	Adjusted Total Functional Population 2030	Adjusted Total Functional Population 2035	Adjusted Total Functional Population 2040	Adjusted Total Functional Population 2045	Adjusted Total Functional Population 2050
Combined (Charlotte & Sarasota)	4866	Englewood Water District	38,260	40,129	42,162	44,118	45,565	47,010	48,309
Annual % Increase			--	1.22%	1.01%	0.93%	0.66%	0.63%	0.55%

It is noted that this population projection is for the area within the District's service area and does not include populations within the areas currently serviced with bulk water or sewer agreements including Bocilla Utilities, Utilities, Inc. of Sandalhaven or Charlotte County. These additional bulk water trends are however incorporated into the water demands evaluation as part of Section 5 below.

4.3 Population Projection Sources

Following the determination of the Base Year Population (2021), evaluations and comparisons of three different data sets are completed to determine “percent growth” or “trend based” projections to be applied to the Base Year Population estimate. The following four sources of information are used in the development of the “percent growth” or “trend-based” population projections for the District:

1. *Historical populations from PSARs*
2. *Projections developed by the University of Florida’s Bureau of Economic and Business Research (BEBR) on a County-wide basis*
3. *Projections developed by the Southwest Florida Water Management District (SWFWMD), published April 17, 2023*
4. *Future Planned Residential Developments*

An examination of these data sources predicts that the population within the District’s service area is most likely to experience annual increases between 0.70% and 4.16% over the 20-year planning horizon. This growth rate range covers the District’s historical growth patterns as well as the BEBR and SWFWMD’s projected population growth rates. It is noted that the BEBR and SWFWMD projections have near-term growth rates that are higher and then taper as the planning horizon increases.

4.3.1 Historic Population from PSARs

Historic PSARs show an average annual population increase of 0.70% between 2018 and 2021. For more information, refer to Section 3.2.2 above.

4.3.2 Countywide Population Projections - BEBR

The population projections developed by BEBR are generally accepted as the standard throughout Florida. These projections are made at the County level and can only be used to project future growth trends within the region. BEBR develops three projections for each county: “low”, “medium” and “high”. Table 4-2 and Table 4-3 identify BEBR’s population projections for Sarasota and Charlotte Counties. An annual average growth rate was calculated based on their respective 5-year incremental rates of increase.

Figure 4-1 and Figure 4-2 graphically illustrate Charlotte and Sarasota County’s population projections respectively. It should again be noted that these populations do not represent the EWD’s service area populations; they are only used to better understand growth trends in the region where the EWD is located.

The Annual Average population growth rates presented in Table 4-2 (1.08%) and Table 4-3 (0.93%) represent the total **medium** population increase rate averaged over the 30-year period from 2020 to 2050.

Table 4-2: Countywide Population Estimates – Charlotte County (BEBR 2022)

County	Census Estimates			Projections						Annual Average
	2015	2020		2025	2030	2035	2040	2045	2050	
Charlotte										
			Low	188,800	190,900	190,200	188,000	185,100	181,600	
Total Population	167,141	187,904	**Medium**	203,000	215,700	225,800	234,300	241,900	248,800	
			High	217,200	240,500	261,400	280,600	298,800	315,900	
Medium Projection Increase (%)		12.42%		8.03%	6.26%	4.68%	3.76%	3.24%	2.85%	**1.08%**

Table 4-3: Countywide Population Estimates – Sarasota County (BEBR 2022)

County	Census Estimates			Projections						Annual Average
	2015	2020		2025	2030	2035	2040	2045	2050	
Sarasota										
			Low	439,700	444,000	443,300	440,200	435,600	429,800	
Total Population	392,090	438,816	**Medium**	467,700	493,300	514,000	532,000	547,900	561,800	
			High	495,800	542,700	584,700	623,700	660,200	693,900	
Medium Projection Increase (%)		11.92%		6.58%	5.47%	4.20%	3.50%	2.99%	5.60%	**0.93%**

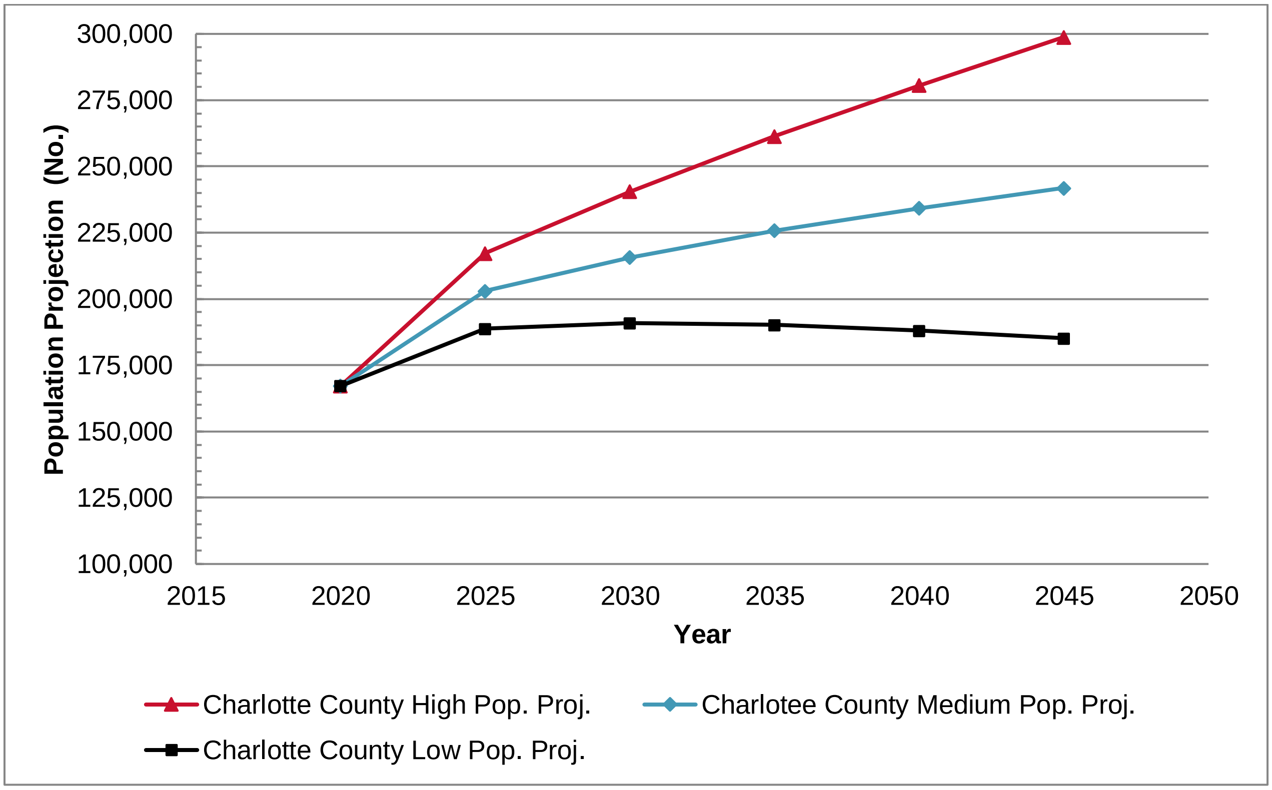


Figure 4-1: BEBR Population Projections: Charlotte County

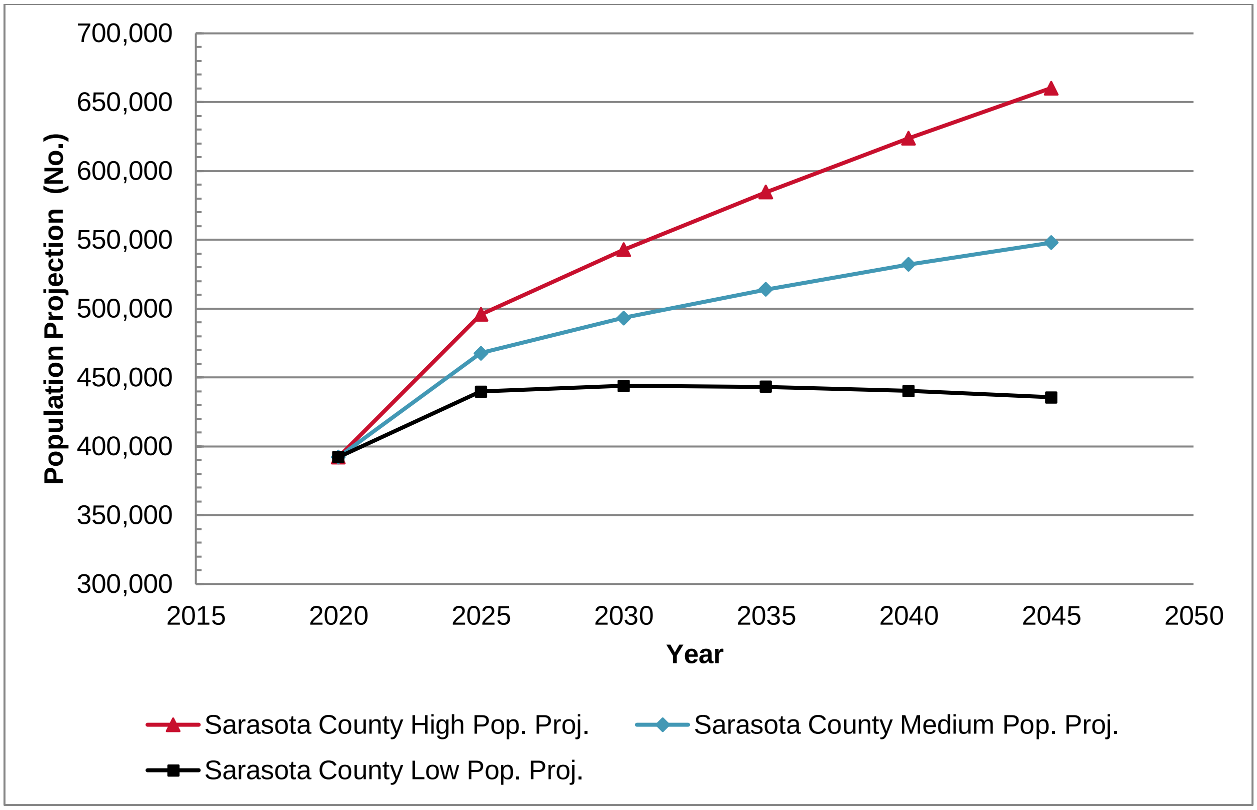


Figure 4-2: BEBR Population Projections: Sarasota County

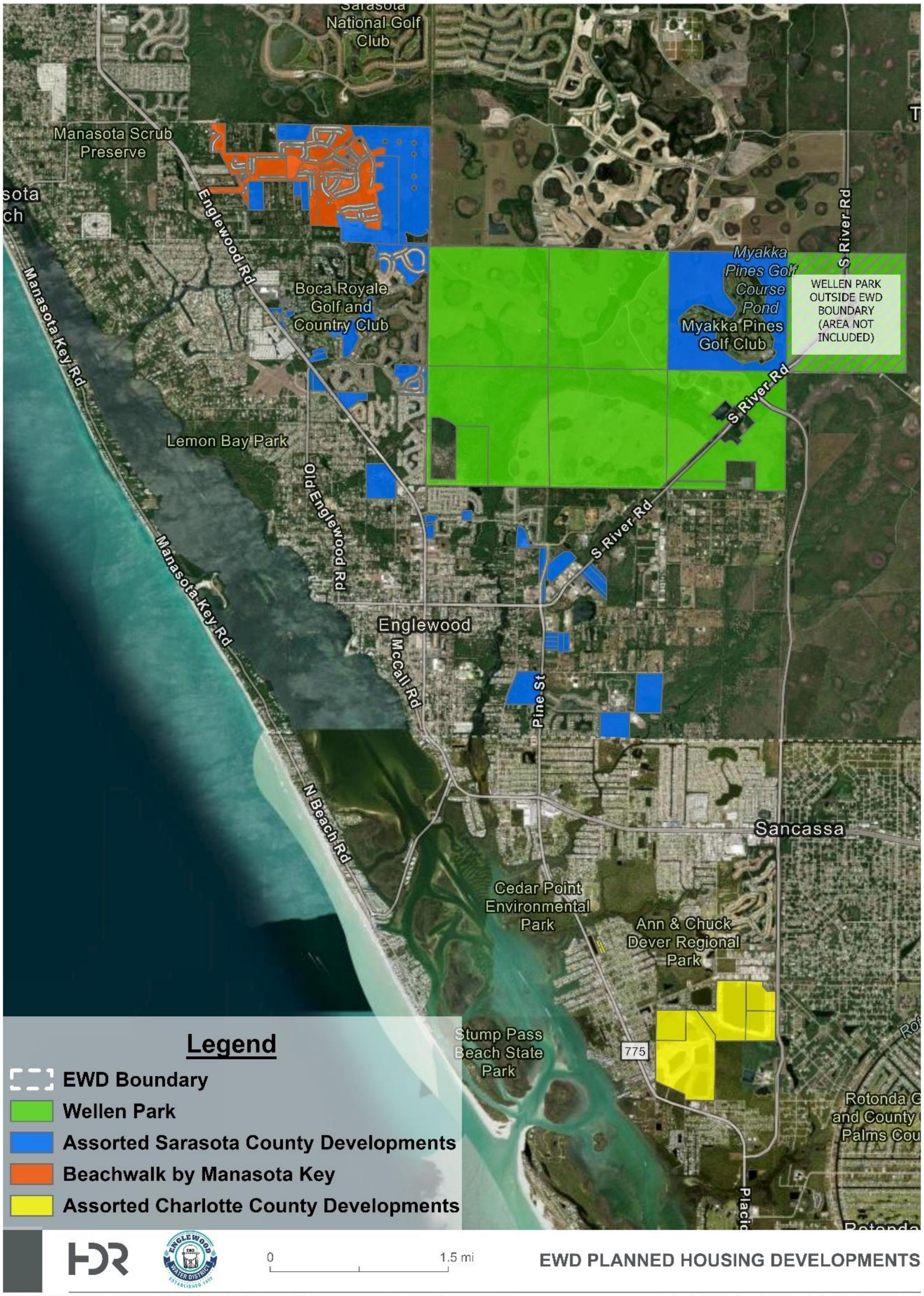
By taking an average of the medium BEBR projections for Charlotte and Sarasota counties weighted by the populations projected for each, a two-county-wide annual average population growth of 0.98%. This percentage will be carried into population projections presented in Section 4.4 below.

4.3.3 Southwest Florida Water Management District – Population Projections

As discussed in Section 4.2 above, the SWFWMD’s population projections for the District through 2050 have an average annual rate of growth of approximately 0.91%.

4.3.4 Future Planned Residential Developments

The District has provided GIS showing significant planned residential development within its service area in upcoming years. Wellen Park and Beachwalk by Manasota Key are two major planned developments, covering a total area of nearly 3,500 acres. These two housing developments, as well as a collection of smaller planned housing developments within Sarasota and Charlotte counties, are shown in Figure 4-3 below. Table 4-4 lists the developments, their sizes, their expected rates of buildout over time, and approximations of their resulting increases in water demand.



UNIVERSITY OF SOUTH FLORIDA, CHARLOTTE COUNTY, SARASOTA COUNTY GIS, FDEP, ESRI, TOMTOM, GARMIN, SAFEGRAPH, GEOTECHNOLOGIES, INC, METI/NASA, USGS, EPA, NPS, USDA, USFWS, CHARLOTTE COUNTY, EARTHSTAR GEOGRAPHICS

Figure 4-3: Planned Housing Developments

The total expected increase in Equivalent Residential Connections (ERCs) from 2023 to 2043 is 14,851. Using a value of 2.19 persons per household as estimated by the 2020 US Census Bureau for both Charlotte and Sarasota counties, this corresponds to an estimated population increase of 32,524 persons over the 20-year planning horizon. This results in an overall service area population increase of 83.1% over 20 years, or a 4.2% annual service area population increase.

Table 4-4: Developments within the District's Service Area

Development	Proposed Units (ERC)	Expected Buildout % by Year (Year 0 = 2023)				Calculated Population Increase (Year 0 = 2023)			
		0-4	5-10	11-14	15+	0-4	5-10	11-14	15+
Water Available - Not Connected	400	25%	25%	25%	25%	219	219	219	219
Water Not Available	100		50%	50%		0	110	110	0
200 Artists	404	100%				885	0	0	0
Beachwalk by Manasota Key PH1	479	100%				1,050	0	0	0
Beachwalk by Manasota Key PH2	470	100%				1,030	0	0	0
Beachwalk by Manasota Key PH3	253	75%	25%			416	139	0	0
Beachwalk by Manasota Key PH4	363		100%			0	795	0	0
Beachwalk Outparcels	132		100%			0	290	0	0
Boca Royale Unit 13	1	100%				3	0	0	0
Boca Royale Unit 14	80	100%				176	0	0	0
Boca Royale Unit 16	25	100%				55	0	0	0
Boca Royale Unit 17	19	100%				42	0	0	0
Boca Royale Unit 18	18	100%				40	0	0	0
Boca Royale Unit 19	3	100%				7	0	0	0
Boca Royale East (Wellen Park D)	825	50%	50%			904	904	0	0
Englewood Gardens	252	100%				552	0	0	0
Gateway Court	63	100%				138	0	0	0
Generation of Englewood	306	100%				671	0	0	0
Heritage Oaks Multifamily	225		50%	50%		0	247	247	0
Island Lake Estates/Coco Bay	400	100%				876	0	0	0
Lake Emily	171	100%				375	0	0	0

Development	Proposed Units (ERC)	Expected Buildout % by Year (Year 0 = 2023)				Calculated Population Increase (Year 0 = 2023)			
		0-4	5-10	11-14	15+	0-4	5-10	11-14	15+
Manatee Cay	85	50%	50%			94	94	0	0
Medical Twins	298	50%	50%			327	327	0	0
Fairway Vistas at Myakka Pines	877	50%	50%			961	961	0	0
Park Forrest 7	56	50%	50%			62	62	0	0
Paddock Pines	30		100%			0	66	0	0
Prose Apartments	300		100%			0	657	0	0
Sandy Lane Townhomes	41	100%				90	0	0	0
Wellen Park A	266		100%			0	583	0	0
Wellen Park B	1,796		30%	30%	40%	0	1,180	1,180	1,574
Wellen Park C	1,415		40%	40%	20%	0	1,240	1,240	620
Wellen Park D (Remaining)	278			100%		0	0	609	0
Wellen Park E	1,432			33%	67%	0	0	1,035	2,102
Wellen Park F	1,848			25%	75%	0	0	1,012	3,036
Wellen Park G	549		50%	50%		0	602	602	0
Wellen Park H	214				100%	0	0	0	469
Wellen Park I	377				100%	0	0	0	826
Totals	**14,851**	-	-	-	-	**8,963**	**8,468**	**6,252**	**8,843**

4.4 Trend Based Population Projections

As shown in Table 4-5, a comparison of the population projection methodologies and their associated annual average growth rate was used to determine the variability in the methods.

Table 4-5: Annual Average Growth Rate by Methodology

Method	Historical Population Growth	Countywide BEBR Projections	SWFWMD	Future Developments
Reference	*Historical PSARs*	*BEBR*	*SWFWMD 2023*	*EWD-provided ERCs*
Estimated Annual Average Population Growth	0.70%	0.98%	0.91%	4.16%

Examining the data sources listed above, it appears that population within the District's service area could experience annual increases between 0.70% and 4.16% over the 20-year planning horizon. This growth rate range covers the District's historical growth patterns, the SWFWMD and BEBR projected population growth rates, and projected growth rates based on planned housing developments. The higher near-term growth rates are reduced at the later stages of the planning horizon.

Because of the addition of new developments, it is anticipated that the District will see a trend of a higher growth rate in the near term (1-10 years) as service to these new developments is initiated, with a tapering or leveling-off of growth as in-fill and build out of the developments occur in later years. Beyond the 20-year planning horizon, population growth based on planned housing developments is expected to taper off as residentially-zoned areas become saturated. All 20-year projections are shown in Figure 4-4.

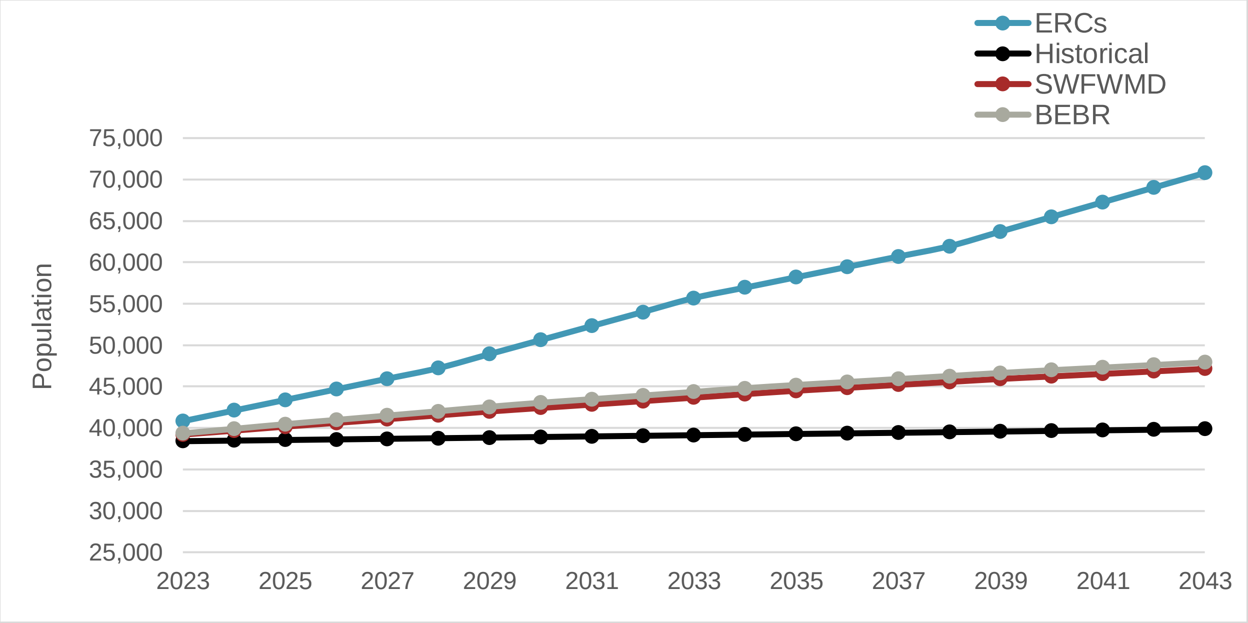


Figure 4-4: Comparison of Population Projections

As shown in Figure 4-4, the expected developments show a high growth rate over the next 20 years, whereas the historical trends from the PSARs indicate a low growth rate. The most reasonable 20-year population projection is developed by taking the year-over-year average of these four projections. Moreover, to project populations between 2043 and 2073, the 20-year average annual population increase of 598 people are added year-over-year. The resulting 50-year population projection is shown in Table 4-6 and Figure 4-5.

Table 4-6: Englewood Water District Most Reasonable Population Projection

20-year projection row	**Total Functional Population 2021 (Base Year)**	**Total Functional Population 2023**	**Total Functional Population 2028**	**Total Functional Population 2033**	**Total Functional Population 2038**	**Total Functional Population 2043**
Annual %		1.54%	1.49%	1.57%	1.14%	1.29%
Population	**38,260**	**39,442**	**42,383**	**45,708**	**48,317**	**51,426**
50-year projection row	**Total Functional Population 2048**	**Total Functional Population 2053**	**Total Functional Population 2058**	**Total Functional Population 2063**	**Total Functional Population 2068**	**Total Functional Population 2073**
Annual %	1.16%	1.10%	1.04%	0.99%	0.94%	0.90%
Population	**54,418**	**57,411**	**60,403**	**63,395**	**66,388**	**69,380**

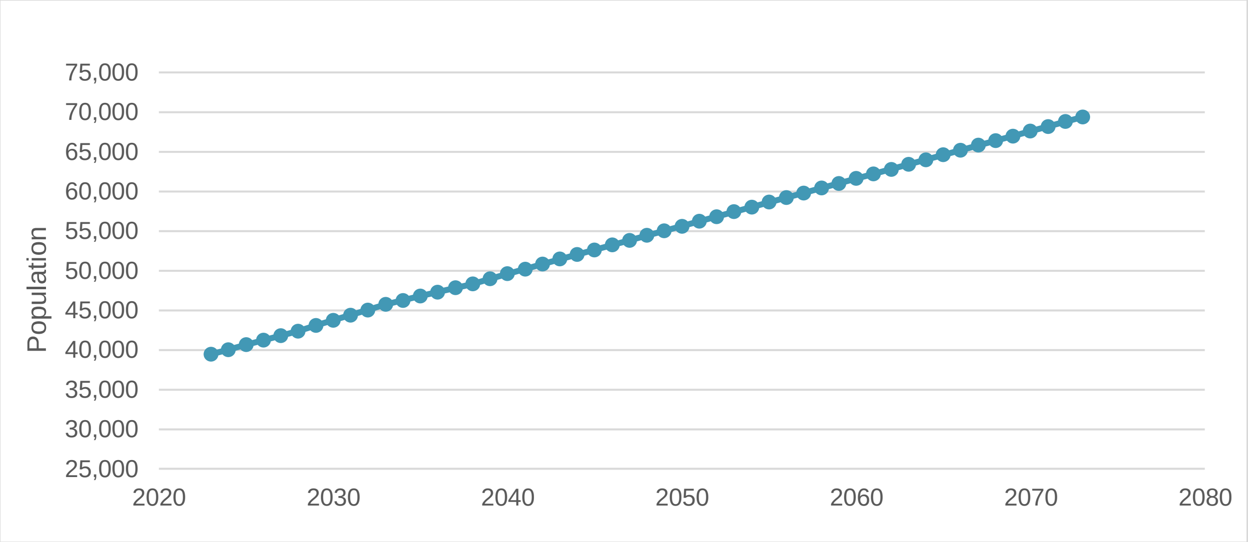


Figure 4-5: Englewood Water District Most Reasonable Population Projection

5 Water Demand Projections

Future water demands are estimated to assess the urgency and degree to which the District will need to expand their existing water treatment and distribution infrastructure over the 20- and 50-year planning horizons in order to accommodate population growth and development. The following subsections explain how future demands are estimated, what these future demands are expected to be, and when the District should respond.

5.1 Water Demand Methodology

For this Water Master Plan, the Per Capita Model for forecasting water supply demands was used. The Per Capita Model calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. This is the simplest forecasting method and requires only historical production or consumption data, historical population, and forecast of population through the demand forecasting horizon. This approach produces satisfactory results as long as the population forecast is reasonable, and the customer mix does not change substantially.

SWFWMD’s 2020 RWSP uses the average per capita demand from 2011 to 2015 to estimate an average per capita demand of 68 gpcd for the District. However, for the purposes of this report, this number is considered outdated and not a conservative basis for per capita demand when compared to the adjusted gross demand per capita in the PSARs from 2018 to 2021. The PSARs show an average per capita demand of 77 gpcd with a maximum of 79 gpcd in 2020. This maximum value will be rounded off to 80 gpcd and used to estimate future water demands for the remainder of this report. This is considered reasonable given low population growth expectations in the region and conservative given the expected developments to be constructed in the area.

U.S. Census Bureau data from 2014 to 2021 indicates an average household size of 2.19 persons for both Charlotte and Sarasota counties. This household size is assumed to be typical of the region and the service area of the District. Table 5-1 illustrates the projected annual average water supply demands for the District within its current service boundary in 5-year increments from 2023 to 2073.

Table 5-1: Annual Average Water Demands within the District

Year	Projected Population	Projected District Resident Demand (gpcd)	Projected Annual Average Water Demands (MGD)*
2023	39,442	80	3.155
2028	42,383	80	3.391
2033	45,708	80	3.657
2038	48,317	80	3.865
2043	51,426	80	4.114
2048	54,418	80	4.353
2053	57,411	80	4.593
2058	60,403	80	4.832
2063	63,395	80	5.072
2068	66,388	80	5.311
2073	69,380	80	5.550

*Not including Bocilla Utilities or system losses

5.1.1 Additional Water Demands

As discussed in Section 3.2.3, the District currently provides potable water to Bocilla Utilities in Charlotte County. Assuming the Island would be 100% built out with 533 residences at the end of the 20-year planning period, the ultimate average annual water demand is estimated to be 160,466 gpd. This final buildout flow was carried forward for all years in the 50-year planning horizon.

5.1.2 Water Losses

As discussed in Section 3.2.4, an annual addition of 17% will be included in total projected water demands to mitigate expected losses within the system based on historical averages.

5.2 Total Demands

Historical water production data from 2013 through 2022 was used to determine the average monthly peaking factors for peak month demand projections. The peak month demand is defined as the average daily demand during the highest demand month throughout a year. The average maximum month peaking factor from 2013 through 2022 was 1.39. This peaking factor was used for determining peak monthly water demands.

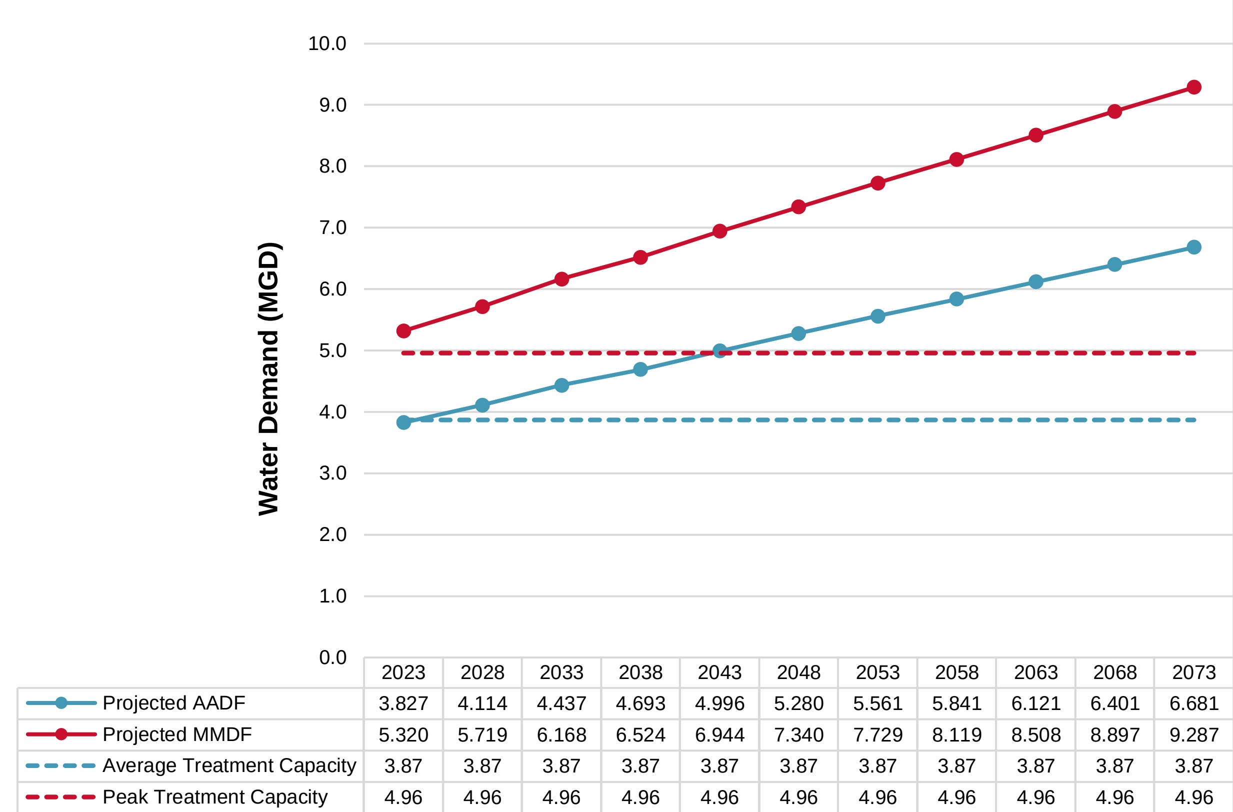
Table 5-2 and Figure 5-1 illustrate the total projected annual average and peak month finished water demands for the District over the 20-year planning period.

Table 5-2: Total Projected Finished Water Demands

Year	Projected Functional Population	Projected District Resident Demand (gpcd)	Projected Annual Average Water Demands (MGD)	Bocilla Utilities Projected Annual Average Water Demands (MGD)	Total Annual Average Water Demands (MGD)*	Projected Peak Month Water Demands (MGD)**
2023	39,442	80	3.155	0.116	3.827	5.320
2028	42,383	80	3.391	0.126	4.114	5.719
2033	45,708	80	3.657	0.136	4.437	6.168
2038	48,317	80	3.865	0.146	4.693	6.524
2043	51,426	80	4.114	0.156	4.996	6.944
2048	54,418	80	4.353	0.160	5.280	7.340
2053	57,411	80	4.593	0.160	5.561	7.729
2058	60,403	80	4.832	0.160	5.841	8.119
2063	63,395	80	5.072	0.160	6.121	8.508
2068	66,388	80	5.311	0.160	6.401	8.897
2073	69,380	80	5.550	0.160	6.681	9.287

*Includes provision to make up for annual 17% water loss.

******Historical Annual Average to Peak Month Ratio of 1.38.

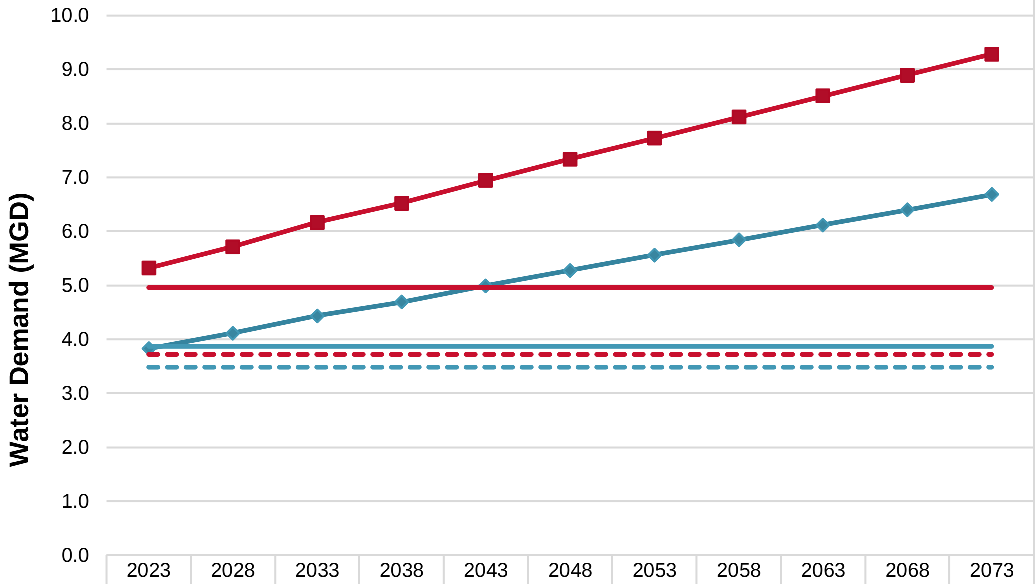


	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2073
Projected AADF	3.827	4.114	4.437	4.693	4.996	5.280	5.561	5.841	6.121	6.401	6.681
Projected MMDF	5.320	5.719	6.168	6.524	6.944	7.340	7.729	8.119	8.508	8.897	9.287
Average Treatment Capacity	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
Peak Treatment Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96

Figure 5-1: Englewood Water District Future Finished Water Needs to 2073

5.3 Water Resource and Treatment Analysis

In accordance with paragraph 62-555.348(3) (a), Florida Administrative Code (F.A.C.), an initial capacity analysis report must be submitted to the Department of Environmental Protection (DEP) within six months after the month in which the total maximum-day quantity of finished water produced by the District's water treatment plants exceeds seventy-five percent (75%) of the total permitted maximum-day operating capacity of the plants. Utilizing the combined permitted plant peak day capacity of 4.96 MGD from Table 3-6 above, when the District has a finished water peak day of 3.72 MGD, an initial capacity analysis report will need to be submitted to the DEP within six months. Based on the projected water supply demands shown in Figure 5-2, the District's Peak Month is projected to exceed 75% of the current permitted peak day capacity in 2023.



	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2073
Projected AADF	3.827	4.114	4.437	4.693	4.996	5.280	5.561	5.841	6.121	6.401	6.681
AADF Capacity	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
90% AADF Capacity	3.483	3.483	3.483	3.483	3.483	3.483	3.483	3.483	3.483	3.483	3.483
Projected Peak Month	5.320	5.719	6.168	6.524	6.944	7.340	7.729	8.119	8.508	8.897	9.287
Peak Capacity	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96
75% Peak Capacity	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72

Figure 5-2: Englewood Water District Future Finished Water Needs to 2073

It is a general industry standard that when establishing the need for additional sources of water supply, new sources should be brought on-line when the projected finished water supply demand reaches 90% of the existing AAD treatment capacity.

As shown in Figures 5-1 and 5-2 above, water demand projections for the next 20 years indicate that a new water source and associated treatment capacity will need to be brought on-line as soon as possible. It is noted that new water supply sources and treatment capacities may take up to 10 years to permit, design and construct. It is recommended that the District include in its capital improvement plan the conceptual planning, permitting, design and construction of a new or expansion of the existing water supply source and treatment as soon as possible.

It is recommended that the water supply and treatment both be expanded to accommodate an initial finished water capacity of 7 mgd peak month with phasing to accommodate additional flows beyond 2043 as projected.

C

Appendix C –Alternatives Analysis Technical Memorandum

Englewood Water District Utility Plan – Supply and Treatment System Capacity Evaluation and Improvement Alternatives Technical Memorandum

Englewood Water District

District Contract No. 2022-129

Englewood, FL
January 12, 2024

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1 Introduction

The Englewood Water District (District) has retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan for the Englewood Water Treatment Plant (WTP). The Master Plan will assess the District's water service and facility needs for the next 20-year planning period from 2023 through 2043 and the next 50-year period from 2023 to 2073. Included in these services is an evaluation of the water supply and treatment system capacities of both the District's Lime Softening (LS) Plant and Reverse Osmosis (RO) Plant.

The District's water supply consists of multiple sources including shallow potable groundwater and deeper brackish supply wells. The LS plant treats raw fresh groundwater supplied by Wellfields 1, 2, 3, and 5 whereas the RO plant treats raw brackish groundwater supplied by Wellfield 4 and Wellfield 2, referred to herein as RO WF2 and RO WF4. Note that Wellfield 2 contains both types of wells. The wellfields are permitted for a combined average annual withdrawal of 5.36 MGD and peak month withdrawal of 6.59 MGD under Water Use Permit (WUP) No. 4866.010. Wellfield 1 is located immediately west and north of the plant., Wellfield 2 and RO WF2 are approximately 2 miles north of the plant. Wellfield 3 is located in the north-central part of the District's service area, approximately 4 miles north of the plant, which is currently under development. RO WF4 is located on the plant property to the north of plant infrastructure and bordered by Wellfield 1. Wellfield 5 is the newest constructed wellfield located along the east side of Indiana Avenue and over 1 mile north of the plant. Both plants are co-located at the District's main site at 201 Selma Avenue, Englewood, Florida, and the finished water from each plant is blended before distribution. The LS plant was built in 1961 with 3 MGD treatment capacity; however, the District has not historically treated more than 2 MGD with the plant. The RO plant was placed into service in 1982 and continues to treat its designed capacity of 3 MGD.

The purpose of this Technical Memorandum, as one component of the Master Plan, is to evaluate the hydraulic design and treatment capacity of the unit processes at the utility plant across both the LS and RO treatment trains and to identify any infrastructure or capacity deficiencies. This Memorandum will also include the assessment of three different facility improvement alternatives based on the future demand projections and water treatment performance needs. Environmental impacts, including wetlands and threatened and endangered species, will be evaluated within the impact of the water plant expansion limits.

1.1 Background

Created in 1959, the District classifies as a political sub-division of the State of Florida under Chapter 2004-439. The District owns and operates a public utility that provides water services within the unincorporated areas of Sarasota and Charlotte Counties generally known as Englewood, Grove City, and Manasota Key. The District's current service area boundary encompasses approximately 44.5 square miles. In addition, the District currently has an interlocal agreements for the delivery of potable water to Bocilla Utilities for the residents of Don Pedro and Knight/Palm Island in Charlotte County.

The District's water supply, treatment, and distribution facilities include:

- Five (5) groundwater wellfields

  - Four (4) freshwater well systems with aggregated permitted withdrawal capacities of up to 3.54 MGD (annual average) and up to 4.35 MGD (peak month) within Wellfields 1, 2, 3, and 5 provided the current total WUP allocation is not exceeded.
  - Two (2) brackish water well systems with aggregated permitted withdrawal capacities of up to 4.25 MGD (annual average) and up to 5.44 MGD (peak month) within Wellfields 2 and 4 provided the current total WUP allocation is not exceeded.
- Two (2) water treatment plants
  - One (1) lime softening plant built in 1961 at 3.0 MGD design capacity for treatment of the freshwater wellfield supply; however, the District can only reliably treat 2 MGD of this capacity.
  - One (1) reverse osmosis (RO) Plant built in 1981 at 3.0 MGD design capacity for treatment of the brackish water wellfield supply
- Four (4) finished water storage tanks with a combined capacity of 7.5 million gallons, and one (1) elevated storage tank with 100,000-gallon capacity used to dampen the amplitude of distribution system pressures
- Two (2) deep injection wells
  - One (1) 1.58-MGD deep injection well (DIW-1) onsite for RO concentrate disposal
  - One (1) 2.94-MGD deep injection well (DIW-2) offsite at the Holiday Ventures Lift Station for reclaimed water disposal and backup RO concentrate disposal. Backup capacity is limited due to existing use by the South Water Reclamation Facility (WRF) and future use by the North WRF that is being currently planned.
- Over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties.

The LS Plant treats raw water through a series of unit processes including aeration, lime feed system, treaters, and dual media filters. The RO plant treats brackish water using cartridge filters, semi-permeable membranes, and chemical feed pumps, and degasifiers. Effluent from both plants is blended and treated to finished water quality through chemical feed for chloramination, and clearwells prior to finished water storage and high service pumping. A more detailed list of the processes utilized by each plant and their functions is shown in Table 1-1, and a process flow diagram is shown in Figure 1-1.

Table 1-1: Existing Facility Processes

Process	No. Units	Purpose / Notes
Lime Softening Plant		
Wells	54	Wellfields 1, 2, 3, and 5. Wells provide raw fresh surficial groundwater to the plant
Aerator	1	3 MGD, removes hydrogen sulfide and carbon dioxide, and adds oxygen
Lime Slaker	1	Forms lime slurry to soften the water with lime
Treater/Filter	3	Provides turbidity and suspended solids removal.
Reverse Osmosis Plant		
Wells	17	Wellfields 2 and 4. Wells provide brackish groundwater to the plant
Antiscalant Storage and Dosing System	1	Increases solubility of soluble salts, protecting membranes from scaling
Sulfuric Acid Storage and Dosing System	1	Decreases pH to reduce precipitation of soluble salts on membranes, protecting them from scaling
Feed Pumps	7	Provides feedwater to RO units, one per skid, and one backup to provide flow to any skid
Cartridge Filters	6	Provides pretreatment filtration upstream of RO membranes
RO Skids	6	Provides removal of dissolved constituents
Degasifier	1	Removes carbon dioxide and dissolved sulfide gases
CIP System	1	Can provide chemical cleaning of RO membranes, not currently in use
Deep Injection Well	2	Class I- Receives the concentrate from the RO plant and injects it into a saline aquifer (DIW-1). An inline booster pump to DIW-2 serves as a backup.
Post-Treatment		
Chlorine Storage and Dosing System	1	Provides disinfection upstream of filters and at blending clearwell
Ammonia Storage and Dosing System	1	Provides disinfection at blending clearwell
Clearwell	2	Water from both plants is blended together
Ground Storage Tanks	4	Combined capacity of 7.5 MGD- provides finished water storage
Elevated Storage Tank	1	Controls pumping and pressure fluctuations at the high service pumping system
Old High Service Pumps	4	Four pumps rated at 800 gpm (4.5 MGD) each - maintains a constant pressure in the potable water distribution system
New High Service Pumps	3	Three pumps rated at 3,000 gpm (12.9 MGD) each - maintains a constant pressure in the potable water distribution system

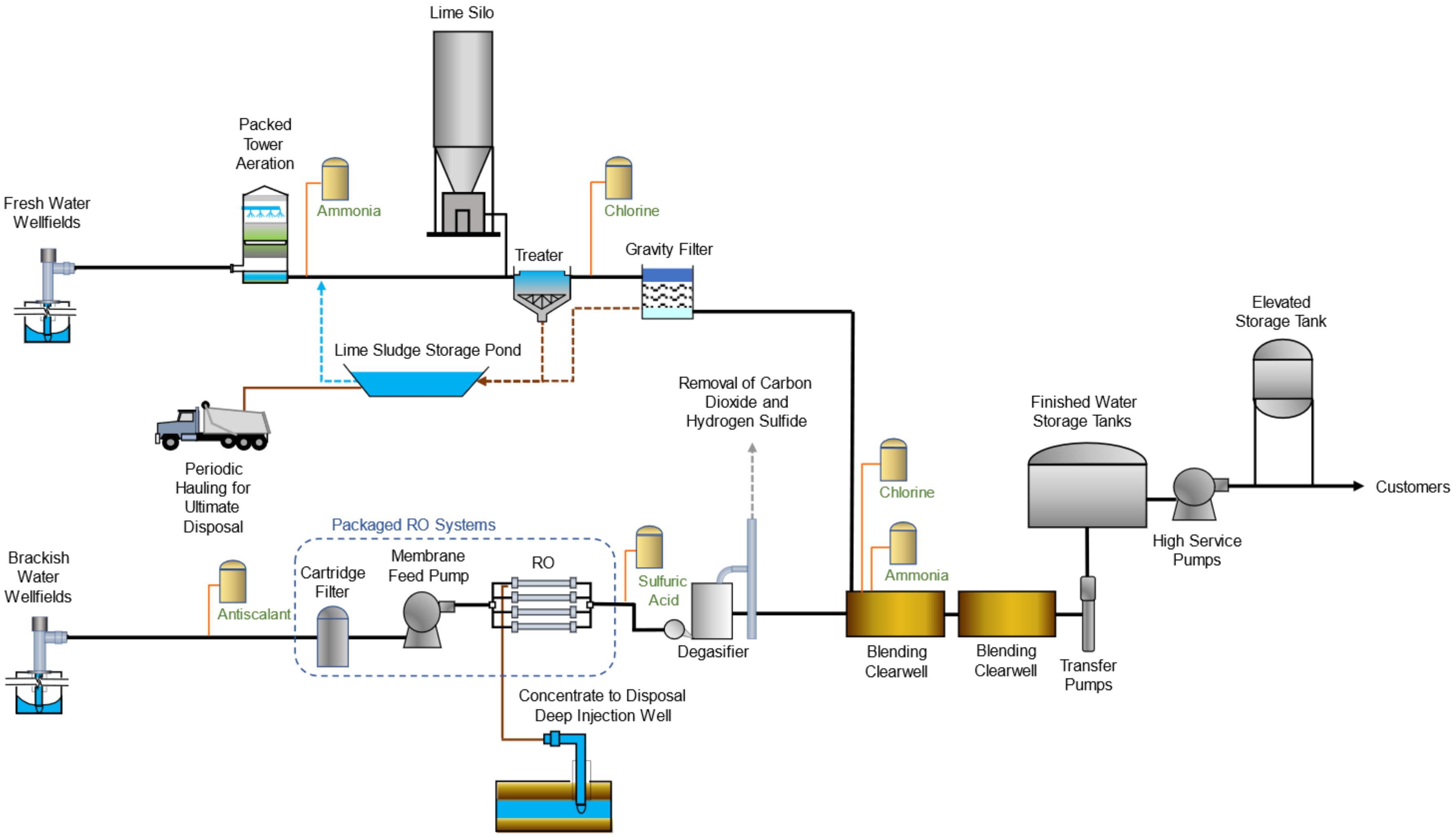

Figure 1-1. Englewood WTP Process Flow Diagram

1.2 Demand Projections

For the District's Utility Master Plan, the Per Capita Model for forecasting water supply demands was used. The Per Capita Model calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. This is the simplest forecasting method and requires only historical production or consumption data, historical population, and forecast of population through the demand forecasting horizon.

Utilizing the District's historical (2018-2022) records of production data as well as the Historical Population Served reported on the District's Public Supply Annual Reports (PSAR's) to the Southwest Florida Water Management District, a determination of per capita usage was calculated. Based on the Districts demographic data taken from the 2014 to 2021 U.S. Census Bureau Data, it was determined that the average household size is 2.19 persons for both Charlotte and Sarasota counties. This household size is assumed to be typical of the region and the service area of the District. The District's PSARs show an average per capita demand of 77 gallons per capita per day (gpcd) with a maximum of 79 gpcd in 2020. Given low population growth expectations in the region and taking a conservative approach given the expected developments to be constructed in the area, the maximum value of 79 gpcd was rounded up to 80 gpcd and used to estimate the future water demands. Water supply demands are calculated and projected from 2023 to 2073. For water treatment capacity, an expected equipment service life correlates to approximately 20 years. Thus, the projected annual average water supply demands for the Englewood Water District within its current service boundary ranges from 3.827 MGD in 2023 to 4.996 MGD in 2043. The projected peak month water supply demands ranges from 5.320 MGD in 2023 to 6.944 MGD in 2043. Therefore, it is recommended to expand the water treatment plant to provide a finished water capacity of 7 MGD.

A more detailed evaluation of the water demand projections can be found in the Population and Demand Projections Technical Memorandum (HDR, 2023).

1.3 Water Quality Analysis

Table 1-2 presents water quality results from sampling the LS Plant raw water and Table 1-3 presents water quality results from the RO Plant raw water. These values include recent wellfield sampling from March to May 2023 and several sampling events conducted in December of 2022. The minimum, average, 90th percentile, and maximum values from each data parameter were calculated and flow weighting was applied. The flow weighting calculations took into consideration the daily well production of each wellfield in March to May 2023 and December of 2022 accordingly. For the LS plant, wellfields 1, 2, 3, and 5 productions fell within the range of 0.3 MG to 0.5 MG for March to May of 2023 and 12.3 MG to 16.6 MG for December 2022. For the RO plant, RO wellfields 2 and 4 production fell within the range of 0.7 MG to 1.9 MG for March to May of 2023 and 35.0 MG to 43.0 MG for December 2022. Applying flow weighting allows for a more accurate representation of the sample results from wellfield to wellfield on different sampling dates.

Primary Drinking Water Standards are standards that have been set by the U.S. Environmental Protection Agency (EPA) as part of establishing National Primary Drinking Water Regulations (NPDWR). These standards are also known as Maximum Contaminant Levels (MCLs) which are put in place to control the level of contaminants in drinking water. The data presented in Tables 1-2 and 1-3 below was compared against these standards to assess the quality of the water for each treatment process. The water quality data results showcase some notable differences between the two raw water sources. The total dissolved solids (TDS), salinity, and total organic carbon for both water sources earn some attention. The freshwater source shows normal salinity values but, the brackish water source has high salinity values. This is expected since brackish water is a mixture of fresh and salt water. It is recommended that total dissolved solids follow the secondary MCL of 500 mg/L. In both the fresh and brackish water sources, higher values of total dissolved solids were recorded. The total organic carbon is very high for the freshwater source. These factors are enough to warrant a concern for color issues. Color may be indicative of dissolved organic material and therefore should be monitored.

In the WY 2021 EWD Annual Wellfield Report, trend analysis of the monthly TDS concentrations collected from the RO WF 2 and RO WF 4 production wells were conducted using the Seasonal Kendall Tau test. Kendall Tau and the Seasonal Kendall Tau tests are nonparametric statistical tests used to analyze data for trends. The results of the Seasonal Kendall Tau tests show statistical increases in TDS concentrations at RO WF 2 and RO WF 4. The Report projects RO WF2 to have 2051 TDS concentrations of 7,579 mg/L up from the current 4,957 mg/L and RO WF4 to have 2051 TDS concentrations of 14,491 mg/L up from the current 4,827 mg/L. The RO plant will need further assessments to determine if the existing membranes could handle these projected TDS concentrations with reasonable performance efficiency long term.

Both water sources are showing low levels of iron and manganese. The secondary MCLs for iron and manganese are 0.3 mg/L and 0.05 mg/L accordingly. There is a significant difference in the nitrate levels of each water source. With the MCL for nitrate being 10 mg/L the freshwater source has low levels of nitrate, and the brackish water source has fairly elevated levels of nitrate. Elevated levels of nitrate might indicate runoff from fertilized soil, urban drainage, or industrial discharges. The total phosphorous levels between the two water sources are similar and not of concern.

Table 1-2. Surficial Aquifer Water Quality Data

Parameter	Units	Minimum	Average	90th Percentile	Maximum
Field Parameters					
Salinity	ppt	0.4	0.45	0.49	0.5
Temperature	°C	25	25	25	25
pH	SU	7.5	7.8	8.2	8.3
Color	CU	22	52	85	131
Alkalinity	mg/L as CaCO3	179	265	309	330
Hardness	mg/L as CaCO3	176	287	341	365
Turbidity	NTU	0.41	4.7	10	16
Other Water Quality Parameters					
Total Dissolved Solids	mg/L	270	459	565	680
Total Suspended Solids	mg/L	1.0	2.1	3.4	4.0
Total Organic Carbon	mg/L	9.9	11	11.7	12
Total Carbon Dioxide	mg/L	226	245	253	254
Metals					
Ammonium	mg/L	0.39	0.45	0.52	0.52
Barium	mg/L	0.0092	0.010	0.011	0.011
Calcium	mg/L	60	100	120	127
Iron	mg/L	0.03	0.053	0.066	0.069
Magnesium	mg/L	5.1	8.6	11.4	13.1
Manganese	mg/L	0.0050	0.0051	0.0053	0.0054
Potassium	mg/L	1.12	1.35	1.47	1.5
Sodium	mg/L	16	37	49	81
Strontium	mg/L	0.86	0.88	0.89	0.89
Anions					
Bromide	mg/L	0.32	0.34	0.36	0.36
Chloride	mg/L	24	81	127	162
Fluoride	mg/L	0.18	0.28	0.39	0.40
Nitrate (as N)	mg/L	0.12	0.34	0.70	0.90
Sulfate	mg/L	20	38	59	73
Total Phosphorus	mg/L	0.15	1.23	2.3	2.3
Neutrals					
Boron	mg/L	0.046	0.063	0.09	0.1
Silicon Dioxide	mg/L	8.4	9.3	9.9	10

Table 1-3. Brackish Aquifer Water Quality Data

Parameter	Units	Minimum	Average	90th Percentile	Maximum
Field Parameters					
Salinity	ppt	7.4	8.03	8.42	8.51
Temperature	°C	25	25	25	25
pH	SU	7.4	7.4	7.5	7.6
Alkalinity	mg/L as CaCO3	135	146	152	155
Hardness	mg/L as CaCO3	1,448	2,068	2,405	2,559
Other Water Quality Parameters					
Conductivity	umhos/cm	12,674	13,350	13,918	14,000
Total Dissolved Solids	mg/L	5,954	8,531	10,330	11,064
Total Suspended Solids	mg/L	1.0	3.5	5.4	6.2
Total Organic Carbon	mg/L	2.0	2.2	2.5	2.6
Total Carbon Dioxide	mg/L	120	128	132	133
Metals					
Ammonium	mg/L	0.72	0.81	0.93	1
Barium	mg/L	0.075	0.079	0.083	0.084
Calcium	mg/L	291	366	404	428
Iron	mg/L	0.0067	0.012	0.016	0.017
Magnesium	mg/L	225	293	340	362
Manganese	mg/L	0.005	0.005	0.005	0.005
Potassium	mg/L	62	62	63	64
Sodium	mg/L	1,420	2,068	2,514	2,746
Strontium	mg/L	40	42	43	43
Anions					
Bromide	mg/L	15	18	20	21
Chloride	mg/L	3,267	4,608	5,628	6,046
Fluoride	mg/L	1.8	6.4	14.5	20
Nitrate (as N)	mg/L	1.2	12.2	31.9	45
Sulfate	mg/L	516	731	938	967
Total Phosphorus	mg/L	0.15	1.23	2.3	2.3
Neutrals					
Boron	mg/L	0.30	0.32	0.33	0.34
Silicon Dioxide	mg/L	10	11	12	13

1.4 Raw Water Source Reliance

The District obtains source water from a combination of freshwater wells which draw from surficial aquifers and brackish water wells which draw from a deeper, higher salinity aquifer. To meet projected demands, the District will need to increase withdrawals from one or both sources to supply a peak flow of 7 MGD of finished drinking water to its customers. Discussions with the District have led to the conclusion that expansion into the brackish water aquifer as opposed to surficial aquifer will be better for optimal long-term operation. The reasons for this preference include:

- Ongoing concerns with continually drawing from the surficial aquifer as more frequent periods of drought occur and more water is being drawn than what can be replenished from rainfall and other surficial influences. The surficial aquifer is also under a dry season minimum flow requirement, which can significantly reduce the availability of this water supply when potable water demands are usually highest. The brackish water source is understood to have a confining interval between it and the surficial aquifer source, which lead the brackish water source to be more reliable and abundant long-term.
- The brackish water aquifer interval yields higher capacities per well, allowing for fewer wells for each expansion alternative.
- The deeper, confined depths of the brackish water aquifer will allow for further dissociation from current water quality impediments including intermittent color spikes and chloride concentration variations that limit the use of the surficial aquifer as well as watershed issues such as nutrients and emerging contaminants, which includes PFAS.
- Freshwater WF2 and WF3 wellfields have strong influences on the local wetlands.
- Wellfield WF3 taps where a community development is being constructed. This development aims to source groundwater from the surficial aquifer for irrigation purposes, which would compete with the WF3 flows for potable water supply.

2 Environmental Assessment

A desktop environmental analysis was performed for the areas at the Englewood Water Treatment Plant that were assessed for plant expansion. The intent of the desktop assessment is to determine the potential for wetland impacts, endangered species impacts, and the resulting permitting required for the Englewood Water District Utility Plan project.

An analysis for the presence or absence of wetlands and other surface waters for each water reclamation site was conducted based on a review of aerial imagery from Google Earth and on information obtained on the U.S. Fish & Wildlife Service National Wetlands Inventory (NWI). It was found that no wetlands exist on site. Although the plant is geographically located between a creek and Lemon Bay, it is not anticipated that any construction will be completed near the water's edge, and these bodies of water will not be affected.

To obtain baseline information on threatened and endangered species that may be present on or utilize the project sites, an Information for Planning and Consultation (IPaC) Resource List was downloaded from the U.S. Fish and Wildlife Service (USFWS) website. It was found that no critical habitats for threatened or endangered species are located on the property or within areas of influence near the property.

Although no longer a listed species, the bald eagle is protected under the Bald and Golden Eagle Protection Act (BGEPA). This act protects eagle nest sites by establishing a 660- foot protection buffer around the nest tree that limits activity within the buffer zone. The nearest known bald eagle nest to the plant is located over a mile away from the project site. The proposed construction activities for the plant will not have any effect on this eagle nest based on the BGEPA guidelines.

Additionally, the District has noted the presence of sand pines on the water treatment plant property. The 2023 Sarasota County Comprehensive Plan requires that all sand pine scrub be preserved (Chapter 1, Paragraph X(2)(a)). It is recommended that additional survey be performed to protect sand pines prior to any development of wooded areas on the plant site.

3 Alternatives Analysis

Five alternatives were evaluated to meet future demand projections and water treatment plant performance needs. These alternatives reflect a completed set of projects to upgrade and expand supply and treatment.

- Alternative 1a – Rehabilitate the Existing LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitate and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Rehabilitate and Expand the RO Plant in Place
- Alternative 3b – Decommission LS Plant and Completely Replace Existing RO Plant at Expanded Capacity with a New RO Plant

These alternatives were evaluated after conducting a site visit at the WTP and by utilizing engineering best practices to evaluate design hydraulic and treatment capacity relative to current unit process performance. Alternatives were considered on non-cost factors such as water quality, energy efficiency, operational complexity, and concentrate/residuals disposal. Planning-level cost estimates were developed for each alternative.

A projected peak finished water capacity of 7.0 MGD was used to evaluate each alternative for rehabilitation and expansion.

4 Alternative 1 – Rehabilitate LS Plant and Rehabilitate and Expand RO Plant

4.1 Alternative Description

Alternative 1 involves upgrading the existing WTP infrastructure and maintaining parallel treatment trains of non-membrane softening and RO. This alternative contains two options that are broken down further into alternative 1a and 1b. The optimal alternative is dependent on the results of the softening upgrades study. Alternative 1a includes rehabilitating the LS plant to maintain the lime softening process. Alternative 1b includes converting the LS plant to pellet softening. Both alternatives include simultaneously rehabilitating and expanding the existing RO plant to produce a combined total of up to 7.0 MGD of finished water. This purpose of this alternative is to prolong the life of existing facilities. The LS plant will continue to produce up to 2.0 MGD (current reliable capacity), and the RO plant production will increase from the current production of 3.0 MGD up to 5.0 MGD.

Major projects required of this alternative are:

Studies and Evaluations:

- LS Plant Filter Evaluation.
- LS Plant Softening Upgrades Study.
- RO Plant Membrane Management Study.

Capital Projects:

- LS Plant rehabilitation (1a) or pellet softening conversion (1b).
- LS Plant Filter rehabilitation.
- Increasing brackish water well capacity.
- RO system rehabilitation.
- RO plant expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post treatment chemical upgrades.
    - Corrosion control and post-treatment.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

4.2 Modifications and Recommendations

A site visit and condition assessment were performed on March 31, 2023. Recommendations from this assessment are documented in the *Potable Water Master Plan – Condition Assessment Technical Memorandum* (HDR, 2023). Table 4-1 presents a list of equipment evaluated during this assessment and whether the equipment needs rehabilitation or replacement for this alternative to be implemented.

Table 4-1: Water Treatment Plant Equipment

Equipment Name	Total Quantity		Recommendation / Notes
	Current	Expanded	
Lime Softening Plant			
Packed Tower Aerator	1	1	No attention needed; blower was rebuilt in August of 2023
Lime Slaker	1	1	No attention needed; Lime slaker skirt is replaced as needed
Treater 1	1	1	No attention needed. Drive recently replaced.
Treater 2	1	1	No attention needed; Rehabilitated about four years ago
Treater 3	1	1	No attention needed; Rehabilitated about three years ago
Filters	3	3	Needs rehabilitation, including filter evaluation study, possible air scour addition, structural improvements; Media is currently replaced every 3 to 5 years
Filter Backwash Pump	1	1	No attention needed
Old High Service Pumps	4	4	No attention needed
New High Service Pumps	3	3	Repairs needed, including check valve replacement for pumps 7 and 9; Severe vibrations from pumps 7 and 9
Backwash Storage Pond	1	1	Needs routine cleaning. Stored lime needs hauling.
RO Plant			
Antiscalant System	1	1	Upsize to serve increased capacity
Cartridge Filters	6	10	Current cartridge filters could be rehabilitated or replaced. Add new cartridge filters to accompany new RO skids
Membrane Feed Pumps	7	11	Replace motors. Add new feed pumps to accompany new RO skids. Motors in some pumps are undersized and do not provide adequate capacity to the skids
RO Skids	6	10	Rehabilitate components as needed. Conduct membrane management study to improve performance. Add new skids to treat a total of 5 MGD.
Sulfuric Acid System	1	1	Repair damage to the sump located beneath the storage tank and upsize to serve increased capacity
CIP System	1	1	Has not been operated recently. Test system to evaluate status
Degasifiers	1	2	Add new 5 MGD degasifier. Replace existing 3 MGD unit with new 5 MGD unit.
Deep Injection Well	2	3	Additional deep injection well capacity will likely be needed to accommodate higher concentrate flow. As mentioned previously the plant uses DIW-2 as its second well (a backup well)
Blending Clearwell	2	2	Pitting noted during site visit. Repair areas with corrosion damage
Common Plant Infrastructure			
Ground Storage Tanks	4	4	No attention needed
Elevated Storage Tank	1	1	Cross members have been repaired. May be replaced with hydropneumatic tank.
Chlorine Gas System	1	1	Convert to liquid sodium hypochlorite and upsize during expansion to treat 7 MGD
Ammonia System	1	1	No attention needed to current system. Upsize during expansion to treat 7 MGD

4.3 Lime Softening Plant

This section describes modifications and upgrades to the LS Plant.

4.3.1 Filter Evaluation

Based on the condition assessment and analysis to date, a comprehensive filter evaluation is recommended. The goal of this filter evaluation is to provide valuable information on current filter operation, cleaning effectiveness, operational improvements, and future capital improvements. A filter evaluation involves the following:

- Collecting samples and testing media (offsite) to determine how effective size, specific gravity, and uniformity coefficient compares to design specifications.
- Collecting samples and testing media (offsite) for calcium carbonate calcification.
- Evaluating backwashing performance (onsite) such as turbidity reduction over time, floc retention analyses, and media expansion.
- Analyzing performance data (desktop analysis) including filter effluent turbidity, filter run times, head loss, unit filter run volume (UFRV), etc.

Potential recommendations could include operational changes such as modifying filter influent pH, decreasing lime dose, operating at a different loading rate, or changing backwash strategy (e.g., rates, frequency, duration). Recommendations could also include design modifications including adding air scour, elevating troughs, changing media type/size, etc. These changes could improve filter effluent water quality and/or prolong media life.

For three filters, field work would be completed over the course of several days. The typical field investigations could be scheduled over the course of several weeks to minimize downtime. In total, this task would require about 2 to 3 months, and this includes offsite media testing, drafting a report, providing recommendations, etc.

Potential capital improvements to filters include:

- Raising backwash water collection troughs to avoid media loss
- Installing air scour to improve backwashing performance
- Replacing existing local control panels
- Replacing missing and deteriorating guardrails

4.3.2 Softening Upgrades Study

A study is recommended to identify the preferred upgrades to maintain non-membrane softening in the plant. Keeping the existing lime softening process, converting to pellet softening, or converting to nanofiltration all have potential value. The study would have four components: 1) desktop analysis for lime softening process optimization; 2) pellet softening investigation and pilot; 3) nanofiltration investigation and pilot; and 4) conceptual development of the chosen upgrades.

The lime softening optimization study would involve a desktop analysis evaluating the use of additional / alternative chemicals at the WTP, including carbon dioxide to decrease pH upstream of filters, soda ash to maintain alkalinity, and caustic to increase pH at the clearwells.

The pellet softening investigation and pilot would compare pellet softening to conventional lime softening with regard to water quality, chemical usage, maintenance, and residuals management. Pellet softening offers a process that can utilize caustic for pH adjustment, eliminating the need for lime, and will greatly reduce the residuals volume as no lime sludge is produced. A pilot is recommended due to the relatively few full-scale municipal installations of pellet softening in our region. Because this technology is offered by a single vendor (Veolia), it is suggested that the District and their engineer coordinate with Veolia on a pilot to gather the data necessary to make the decision.

The conclusion of this study will be to select either maintaining the existing lime softening plant or converting to pellet softening and to develop a conceptual design.

This study would be performed in parallel with the RO Plant expansion, as both softening upgrades and RO Plant expansion will alter the finished water quality. Expected LS Plant and RO Plant blended water quality with the expansion of RO (without LS Plant changes) is discussed in greater detail in Section 4.5.

4.4 RO Plant

This section describes upgrades to the RO Plant included in this Alternative.

4.4.1 Brackish Well Capacity Increase

There are currently 17 brackish wells (Wellfields 2 and 4) with a permitted combined peak month withdrawal of 5.44 MGD. To achieve an RO permeate production rate of 5.0 MGD and assuming operation at 70% recovery, the RO feed flow will need to be 7.14 MGD. This means the brackish well capacity will need to increase by a minimum of 1.70 MGD. A study evaluating ideal brackish well locations and depths is recommended. Based on an assumed well capacity of 0.4 MGD, it is preliminarily estimated that 5 new brackish water supply wells will need to be installed to provide the necessary RO feed flow. It would be preferable that the new wells could be added to the RO WF2 or RO WF4 system for minimal piping upgrade requirements to convey the needed flow to the RO Plant.

4.4.2 RO Rehabilitation and Membrane Management Evaluation

The RO skids are aging, and a condition assessment showed there are areas within the system that could be rehabilitated to extend system life. Rehabilitation could be performed on the following components:

- Replace cartridge filter vessels and corroded valves. These vessels could be replaced with horizontal units to provide easier access.
- Replace field instruments and instrument panels.
- Replace corroded grooved end couplings.
- Replace corroded pressure vessels.
- Replace skid valves.
- Install new variable frequency drives (VFDs).

The RO skids were designed to operate at 70% recovery, but often operate at lower recoveries (60%). Membranes are replaced every 5 to 7 years. This low recovery and frequent replacement could be due to non-optimal pretreatment (e.g., antiscalant chemical/dose or cartridge filter selection), reusing membranes that have lost production capabilities after they have been removed and dried from other skids, or lack of clean-in-place (CIP) events. Brackish water RO plants typically operate at 70% to 85% recovery when adequate pretreatment and cleaning strategies are employed, and can have 10 year lifespans (03-AMTA-Fact-Sheet-NF-and-RO-Rev1.pdf (amtaorg.com)). A holistic evaluation could be performed for the WTP to assess available operating data, operating procedures, and management practices to evaluate the system's performance. This evaluation could include the following components:

- A site visit and interviews with WTP staff to understand current operations and management of the RO Plant.
- Evaluating historical water quality, cleaning procedures, and operating data trends to provide pretreatment, post-treatment, and cleaning recommendations.
- Having a third-party perform a membrane autopsy to determine impacts of fouling/scaling, which could impact pretreatment and cleaning recommendations.
- A full-scale membrane cleaning study based on membrane autopsy results to identify the optimal cleaning strategy.

The outcome of this evaluation would include recommendations to improve membrane operations (efficiency), prolong membrane life, and help plan for future membrane replacement/rotation.

4.4.3 RO Expansion

Expanding the RO Plant from 3.0 MGD to 5.0 MGD will require the following:

- Additional equipment – Chemical feed system expansion, cartridge filters, feed pumps, skids, pressure vessels, membranes, instrumentation, etc.
    - Four, 0.5 MGD skids (same size/capacity as existing skids) operating at 70% to 75% recovery
- Corrosion control and post-treatment modifications (see Section 4.5.1 below).
- Engineering services for the design of the new system.
- Construction activities within the building adjacent to the existing building.
- Increased monitoring due to installation/operation of additional skids.

4.4.4 RO Modeling

Modeling was performed to estimate operating parameters, permeate water quality, and concentrate water quality from the new RO skids. Modeling was performed with RO feed water data provided by the WTP. Table 4-2 presents expected design and operation of a new RO system at both skid size options.

Table 4-2: New Reverse Osmosis System Design and Operational Modeling Results

Design / Operation Parameter	Units	Four, 0.5 MGD Skids
No. Skids	No.	4
Capacity per Skid	MGD	0.5
Array	N/A	8:4 per skid
No. Pressure Vessels per Skid	No.	12
No. Elements per Pressure Vessel	No.	7
Total No. Elements per Skid	No.	84
Feed Flow Rate	gpm	495
Permeate Flow Rate	gpm	347
Concentrate Flow Rate	gpm	148
Feed TDS	ppm	12,000
Average Flux	gfd	13.5
System Recovery	%	70-75
Feed Pressure	psi	376
Concentrate Pressure	psi	316

Table 4-3 presents RO system water quality results from modeling. In the modeling software, metals, anions, and neutrals must be balanced with respect to ion charge. Therefore, feed water quality in the table were slightly modified as needed from the data presented previously in Table 1-3 for the ions to balance.

Table 4-3. Reverse Osmosis Modeling Results

Parameter	Units	Feed	Permeate	Concentrate
Field Parameters				
Temperature	°C	25	25	25
pH	SU	7.5	6.5	7.6
Alkalinity	mg/L as CaCO3	158	12.3	484
Hardness	mg/L as CaCO3	982	34	3,408
Other Water Quality Parameters				
Conductivity	umhos/cm	8,288	558	23,564
Total Dissolved Solids	mg/L	4,722	278	15,089
Total Carbon Dioxide	mg/L	6.05	6.88	10.2
Metals				
Ammonium	mg/L	0.69	0.07	2.1
Barium	mg/L	0.07	0.0	0.23
Calcium	mg/L	173	6.18	562
Magnesium	mg/L	256	9.4	832
Potassium	mg/L	49	3.7	155
Sodium	mg/L	1,122	79	3,557
Strontium	mg/L	35	1.25	114
Anions				
Bromide	mg/L	12	1.1	38
Chloride	mg/L	2,375	146	7,578
Fluoride	mg/L	1.8	0.15	5.7
Nitrate (as N)	mg/L	1.2	0.4	3.1
Sulfate	mg/L	488	12.5	1,598
Neutrals				
Boron	mg/L	0.48	0.33	0.82
Silicon Dioxide	mg/L	11.3	0.52	36

4.4.5 Degasifier Expansion

With the expansion of the RO system, the existing 3.0 MGD degasifier system will also need expansion. A new, 5.0 MGD degasifier would be added adjacent to the existing system, which is shown in Photo 4-1. This larger unit could handle the full flow of the RO system, allowing some flexibility to be added to the degasification process by allowing for the existing unit to be taken offline. The new degasifier would be constructed on top of the second clearwell, located north of the first clearwell and existing degasifier. It is also recommended that the existing 3.0 MGD degasifier be replaced with a 5.0 MGD degasifier to provide adequate redundancy in case one unit needs to be taken offline.

Photo 4-1: Existing RO Degasifier

4.4.6 Concentrate Disposal

With the expansion of the RO Plant and assuming a 70% recovery efficiency, there will be approximately 2.14 MGD of l RO concentrate produced, which will require disposal. Relying only on DIW-1 with a maximum capacity of 1.85 MGD, a new deep injection well onsite will likely be needed to accommodate this higher flow rate. The current deep injection well is aging (Photo 4-2).

Alternatively, a portion of the concentrate flow could be sent to DIW-2 at the Holiday Ventures Lift Station. This would require coordination with the WRF to ensure flows and water quality are acceptable. It should be noted a new North WRF will begin using DIW-2 as well, and an additional deep injection well onsite would provide more system reliability potentially without the need of pumping that occurs to convey concentrate to DIW-2.

Photo 4-2: Existing Deep Injection Well

4.5 Blended Water Analysis

The current finished water blend operationally consists of around 44% LS Plant effluent (up to 2.0 MGD) and 56% RO Plant permeate (up to 3.0 MGD). Table 4-4 presents typical LS Plant effluent and RO Plant permeate prior to blending in the clearwell based on daily data collected in September 2023.

Table 4-4: Current LS Plant Effluent and RO Permeate Water Quality

Water Quality Parameter	**LS Plant Effluent**			**RO Plant Permeate**		
	Min	Avg	Max	Min	Avg	Max
pH	10.1	10.8	11.2	7.1	7.4	8.2
Alkalinity	60	87	124	4.0	8.5	12
Hardness	152	175	208	4.0	12	24

With the LS Plant capacity remaining at 2.0 MGD and capacity expansion of only the RO Plant to reach a total facility production rate of 7.0 MGD, this will result in 5.0 MGD produced by RO and minorly change the design finished water composition to about 29% LS Plant effluent and 71% RO Plant permeate. Operating more in favor of utilizing RO treatment could change finished water quality, which would trigger needing changes to post-treatment and likely a corrosion control study to maintain compliance with the Lead and Copper Rule Revisions (LCRR).

Table 4-5 presents current and expected finished water quality that impacts corrosion (without post-treatment modifications) with the addition of RO Plant capacity. With the new LS/RO blend, the finished water pH, alkalinity, and hardness should be like the current finished water quality.

Table 4-5: Alternative 1 Current Finished Water Quality and Expected Changes

Water Quality Parameter	Current (4.5 MGD)		Current (4.5 MGD)		Future (7.0 MGD)	
	LS: 1.5 MGD 33%	RO: 3.0 MGD 66%	LS: 2.0 MGD 44%	RO: 2.5 MGD 56%	LS: 2.0 MGD 29%	RO: 5.0 MGD 71%
pH	8.5		8.9		8.4	
Alkalinity	35		43		31	
Hardness	66		84		59	

4.5.1 Corrosion Control and Potential Post-Treatment

Currently, LS Plant effluent and RO Plant permeate are blended in a clearwell below the RO degasifier. Since the blend ratio of LS effluent to RO permeate will change, a corrosion control study will be needed to determine new post-treatment requirements and ensure Lead and Copper Rule (LCR) compliance. Potential post-treatment options include any or all of the below strategies:

1. pH adjustment at the clearwell using caustic.
2. Corrosion inhibitor addition at the clearwell or storage tanks.
3. Blending with surficial groundwater (if well withdrawal capacity allows).

These strategies would be evaluated at the pilot scale prior to RO expansion and would follow guidelines established in the EPA *Optimal Corrosion Control Treatment Evaluation Technical Recommendations* document and in the Lead and Copper Rule (40 CFR 141(I)).

4.6 RO Expansion Location

The new RO skids would be located in the metal building adjacent to the existing RO skids (see Photo 4-3). This building was designed to accommodate four additional 0.5 MGD skids. New electrical components could either be located within this building or in an existing outdoor space adjacent to the building, which would need to be enclosed. Figure 4-1 shows the location of existing components and where new systems could be located.

Photo 4-3: RO Expansion Building

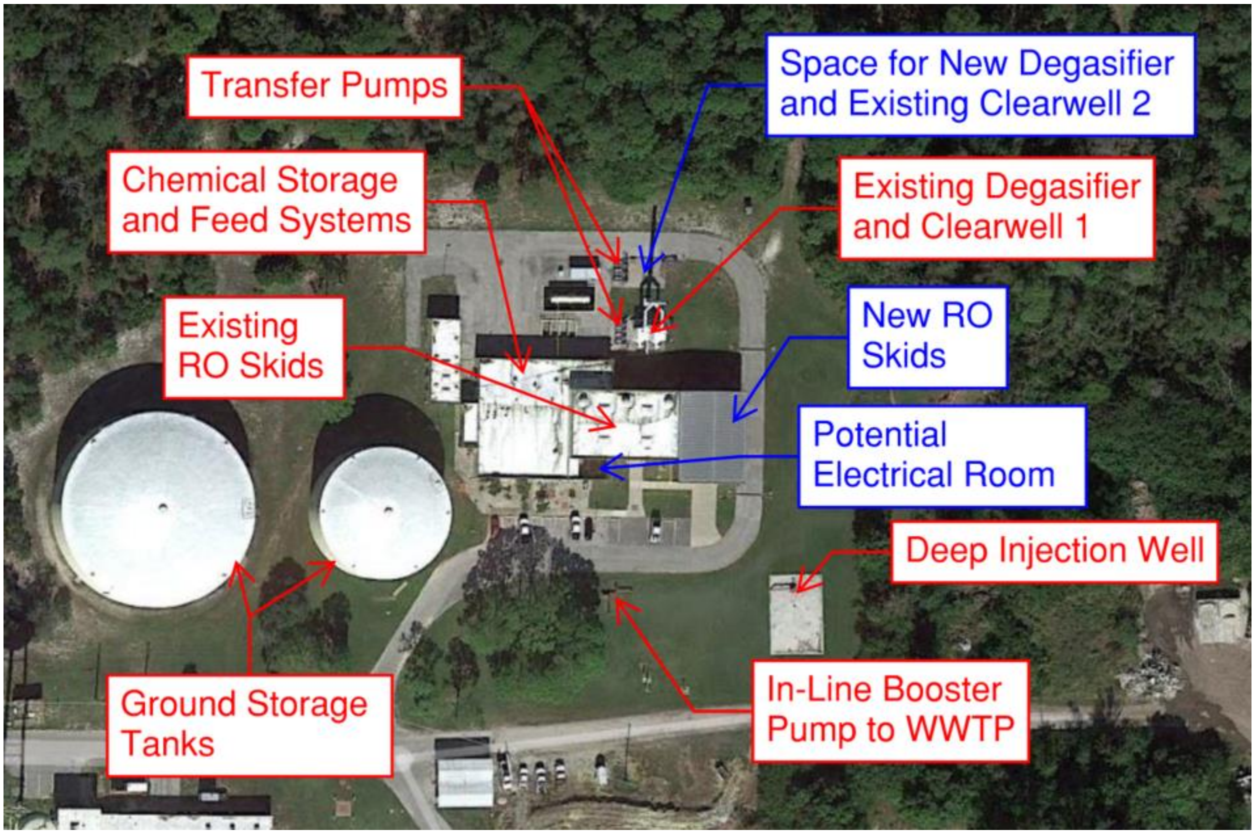

Figure 4-1. Existing and Future RO Plant System Locations

4.7 Cost Estimate

Table 4-6 presents a planning-level cost estimate developed for Alternative 1A and 1B. Cost estimates are in 2023 dollars and include applicable demolition, sitework, electrical components, and instrumentation. Future refinements to this estimate may be presented in the final Master Plan. Opinions of probable cost provided by HDR are based on information available to HDR and on the basis of HDR's experience and qualifications and represents the professional judgment of HDR's engineers. However, since HDR has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, HDR does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost that HDR prepares.

Table 4-6: Alternative 1 High-Level Cost Estimate (2023 Dollars)

Plant Area	Total Estimated Cost (2023 Dollars)	
	Option 1A: Lime System Rehab	Option 1B: Pellet Softening System
Lime Softening	$3,860,000	-
Pellet Softening System	-	$4,320,000
RO Expansion	$4,180,000	$4,180,000
RO Rehabilitation	$5,400,000	$5,400,000
Non-Membrane RO System Components	$930,000	$930,000
Deep Injection Well	$8,660,000	$8,660,000
Supply Wells	$14,010,000	$14,010,000
Supply Well Piping	$340,000	$340,000
General Plant	$2,840,000	$2,840,000
Studies/Evaluations	$300,000	$270,000
Total	**$40,520,000**	**$40,950,000**

5 Alternative 2 – Replace the LS Plant with a Nanofiltration Plant and Rehabilitate and Expand the RO Plant

5.1 Alternative Description

Alternative 2 considers replacing the existing LS plant with nanofiltration (NF) membranes (2 MGD finished water capacity) and along with rehabilitating and expanding the existing RO plant (5 MGD finished water capacity) to produce a total of 7.0 MGD.

The purpose of this alternative would be to move away from LS and granular media filtration and rely on membranes for treatment. This would change the finished water quality of the facility.

Major projects required of this alternative are:

Studies and Evaluations:

- Membrane (RO) Management Study.

- Softening Upgrades Study (as mentioned in section 4). If the NF pilot done as part of this study indicated NF is a preferred process for softening, the following capital projects would apply.

Capital Projects:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Media filter rehabilitation (optional)
- NF Plant construction.
- RO system rehabilitation.
- RO system expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control and post-treatment.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

NF membranes operate similar to RO but use less pressure, operate at higher recoveries, and are often used in softening applications to treat fresh groundwater. The same components used for RO would also be used for NF, including the following:

- Chemicals including sulfuric acid and antiscalant.
- Cartridge filters
- Feed pumps
- Membrane skids
- Degasification
- CIP system

5.2 Modifications and Recommendations

A site visit and condition assessment were performed on March 31, 2023. Recommendations from this assessment are documented in the *Potable Water Master Plan – Condition Assessment Technical Memorandum* (HDR, 2023). Table 5-1 presents a list of new components for the NF Plant and RO equipment evaluated during this assessment and whether the equipment needs rehabilitation or expansion for this alternative to be implemented.

Table 5-1: New and Rehabilitated WTP Equipment for Alternative 2

Equipment Name	Total Quantity		Recommendation / Notes
	Current	Expanded	
NF Plant			
Sulfuric Acid System	None	1	Install one system (including redundancy) for the NF Plant
Antiscalant System	None	1	Install one system (including redundancy) for the NF Plant
Cartridge Filters	None	4	One cartridge filter per skid
Membrane Feed Pumps	None	4+1	One dedicated feed pump per skid with one swing pump that can serve any skid
NF Skids	None	4	0.66 MGD capacity per skid
CIP System	None	1	Install one CIP system for the NF Plant
RO Plant			
Antiscalant System	1	1	Upsize to serve increased capacity
Cartridge Filters	6	10	Current cartridge filters could be rehabilitated or replaced. Add new cartridge filters to accompany new RO skids
Membrane Feed Pumps	7	11	Replace motors. Add new feed pumps to accompany new RO skids. Motors in some pumps are undersized and do not provide adequate capacity to the skids
RO Skids	6	10	Rehabilitate components as needed. Conduct membrane management study to improve performance. Add new skids to treat a firm total of 5 MGD. Membrane replacement is staggered; oldest membranes were installed in 2020.
Sulfuric Acid System	1	1	Repair damage to the sump located beneath the storage tank and upsize to serve increased capacity
CIP System	1	1	Has not been operated recently. Test system to evaluate status
Degasifiers	1	2	Add new 5 MGD degasifier. Replace existing 3 MGD unit with new 5 MGD unit.
Deep Injection Well	2	3	A new well will likely be needed to accommodate higher concentrate flow from NF and RO processes. As mentioned previously the plant uses DIW-2 as its second well (a backup well)
Blending Clearwell	2	2	Pitting noted during site visit. Repair areas with corrosion damage
Common Plant Infrastructure			
Ground Storage Tanks	4	4	No attention needed
Elevated Storage Tank	1	1	Cross members have been repaired. May be replaced with hydropneumatic tank.
Chlorine Gas System	1	1	Convert to liquid sodium hypochlorite.
Ammonia System	1	1	No attention needed to current system. Upsize during expansion to treat 7 MGD

5.3 NF Plant

Due to the surficial aquifer turbidity levels up to 29 NTU, pretreatment upstream of NF skids is recommended to prolong the life of cartridge filters and NF membranes. This could include:

- Utilizing the existing granular media filters. This is a low-cost option that would only require decommissioning of lime and clarifier systems.
- Construction of an ultrafiltration (UF) system. This is a higher cost option that would involve decommissioning the lime, clarifier, and filter systems, and then designing and constructing the UF system. The UF requires additional building space, electrical, pumps, backwash system, chemicals, and compressor.

The NF Plant would be sized to produce up to approximately 2 MGD of permeate with one skid offline for maintenance or cleaning. It is recommended to install four, 0.66 MGD NF skids.

Assuming an 80% recovery for NF treatment systems, a surficial aquifer supply of 3.3 MGD is required.

5.3.1 NF Modeling

Modeling was performed to estimate operating parameters and water quality. Table 5-2 presents expected operational parameters for NF system, including flow rates, flux, recovery, and pressures. The NF Plant could operate at a higher recovery and lower pressures compared to the RO Plant since fresh surficial groundwater is utilized. An NF membrane that allows more passage of divalent ions (e.g., calcium and magnesium) was selected to allow more hardness and alkalinity in the NF/RO blend. This type of membrane also allows for operation at higher recovery and lower feed pressures.

Table 5-2. Nanofiltration Design and Operational Modeling Results

Design / Operation Parameter	Units	Result
No. Skids	No.	4
Capacity per Skid	MGD	0.66
Array	N/A	10:5
No. Pressure Vessels	No.	15
No. Elements per Pressure Vessel	No.	7
Total No. Elements per Skid	No.	105
Feed Flow Rate	gpm	573
Permeate Flow Rate	gpm	458
Concentrate Flow Rate	gpm	115
Feed TDS	ppm	836
Average Flux	gfd	14.3
System Recovery	%	80
Feed Pressure	psi	63
Concentrate Pressure	psi	34

Table 5-3 presents NF system water quality results from modeling. In the modeling software, metals, anions, and neutrals must be balanced with respect to ion charge. Therefore, feed water quality in the table were slightly modified as needed from the data presented previously in Table 1-2 for the ions to balance. Similar to LS Plant effluent, NF permeate would be blended with RO permeate prior to post-treatment and distribution.

Table 5-3. Nanofiltration Water Quality Modeling Results

Parameter	Units	Feed	Permeate	Concentrate
Field Parameters				
Temperature	°C	25	25	25
pH	SU	7.6	7.5	7.9
Alkalinity	mg/L as CaCO3	165	107	394
Hardness	mg/L as CaCO3 [1]	145	80	400
Other Water Quality Parameters				
Conductivity	umhos/cm	430	269	1,040
Total Dissolved Solids	mg/L	339	214	837
Total Carbon Dioxide	mg/L	6.1	6.2	7.0
Metals				
Ammonium	mg/L	0.03	0.02	0.06
Barium	mg/L	0.01	0.0	0.02
Calcium	mg/L	55	31	150
Magnesium	mg/L	3.8	1.4	13
Potassium	mg/L	0.88	0.69	1.7
Sodium	mg/L	28	22	49
Strontium	mg/L	0.71	0.36	2.1
Anions				
Bromide	mg/L	0.20	0.20	0.18
Chloride	mg/L	18	16	25
Fluoride	mg/L	0.18	0.17	0.21
Nitrate (as N)	mg/L	0.12	0.15	0.01
Sulfate	mg/L	20	1.2	95
Neutrals				
Boron	mg/L	0.07	0.08	0.06
Silicon Dioxide	mg/L	7.1	6.0	12

[1] Estimated Using Calcium and Magnesium Results.

5.3.2 NF Concentrate Management

NF concentrate will need disposal, which can be accomplished using multiple techniques. Assuming 80% recovery efficiency, a 2 MGD finished water NF capacity would require approximately 0.66 MGD of concentrate disposal. Potential techniques for the WTP include:

1. Deep well injection – Deep well injection would require the construction of a new well onsite and supply pipeline. This concentrate could be combined with the RO Plant concentrate through a single new deep injection well needed.
2. Conveyance to DIW-2 – Conveyance to DIW-2 would need to be discussed with District staff to determine acceptable flow rates and water quality. A new in-line booster pump or expansion of the existing in-line booster pump station would be required.

3. Recycling to the head of the RO Plant – Recycling to the head of the RO Plant would warrant pilot testing to ensure NF concentrate will not adversely impact RO operations.
4. Any combination of the above – Depending on restrictions of the above options, a combination of these options could be utilized.

5.4 RO Plant

5.4.1 Brackish Well Capacity Increase

There are currently 17 brackish wells (Wellfields 2 and 4) with a peak month permitted withdrawal of 5.44 MGD based on withdrawal data from April and May of 2023. To achieve an RO permeate production rate of 5 MGD, the RO feed flow will need to be 7.14 MGD. This means the brackish well capacity will need to increase. A study evaluating ideal brackish well locations and depths is recommended. Based on an assumed well capacity of 0.4 MGD, it is preliminarily estimated that 5 new brackish water supply wells will need to be installed to provide the necessary RO feed flow.

5.4.2 RO Rehabilitation and Membrane Management Evaluation

This recommendation is the same as what was presented previously in Section 4.4.2. Rehabilitation of existing components can prolong their lifespan without needing to replace the entire existing RO system. The RO skids were designed to operate at 70% recovery, but often operate at lower recoveries (60%). A holistic evaluation could be performed for the WTP to improve performance.

5.4.3 RO Expansion

This recommendation is the same as what was presented previously in Section 4.4.3. Four 0.5 MGD RO skids designed to match the existing RO skids would be installed to bring the total RO Plant capacity from 3.0 to 5.0 MGD. Associated equipment, post-treatment modifications, engineering and construction services, and monitoring would be required.

5.4.4 RO Modeling

RO modeling results were discussed previously in Table 4-3. Permeate water quality would be the same as Alternative 1, but blended water quality would differ since RO permeate would be blended with NF permeate instead of LS effluent.

5.4.5 Degasifier Expansion

This recommendation is the same as what was presented previously in Section 4.4.5 above.

5.4.6 Concentrate Disposal

This recommendation is the same as what was presented previously in Section 4.4.6 above. With the combined concentrate disposal of 2.64 MGD from NF and RO systems, a single onsite new deep injection well of similar capacity to DIW-1 would be required. Alternatively, a larger deep injection well to handle all concentrate disposal could be beneficial to allow DIW-1 to be taken offline and maintained.

5.5 Blended Water Analysis

The current finished water blend consists of around 44% NF Plant permeate (up to 2.0 MGD) and 56% RO Plant permeate (up to 3.0 MGD). This water quality was provided previously in Table 4-4.

With the installation of NF membranes and the expansion of the RO Plant to reach a total facility production rate of 7.0 MGD, this will result in 5.0 MGD produced by RO and change the finished water composition to about 25% to 31% NF Plant permeate and 69% to 75% RO Plant permeate, whereas the current LS/RO blend ratio is closer to 40% to 60%. This will change finished water quality, requiring changes to post-treatment and likely a corrosion control study to maintain compliance with the LCRR.

Table 5-4 presents the possible NF/RO operating scenarios using 0.66 MGD NF and 0.5 MGD RO skids.

Table 5-4: Possible NF/RO Operating Scenarios (NF Skids 0.66 MGD, New RO Skids 0.5 MGD)

Scenario	NF Skids Online	RO Skids Online	NF Production (MGD)	RO Production (MGD)	Total WTP Production (MGD)	NF/RO Percent Contribution to Total Capacity (%)
1	4	9	2.64	4.36	7.00	38 / 62
2	3	10	1.98	5.00	6.98	28 / 72
3	2	8	1.32	4.00	5.32	25 / 75
4	1	3	0.66	1.50	2.16	31 / 69

Table 5-5 presents current and expected finished water quality that impacts corrosion (without post-treatment modifications) with the addition of RO Plant capacity.

Table 5-5: Alternative 2 Current Finished Water Quality and Expected Changes

Water Quality Parameter	Current (4.5 MGD)		Current (4.5 MGD)		Future (7.0 MGD)	
	LS: 1.5 MGD 33%	RO: 3.0 MGD 66%	LS: 2.0 MGD 44%	RO: 2.5 MGD 56%	NF: 2.0 MGD 28%	RO: 5.0 MGD 72%
pH	8.75		8.66		6.79	
Alkalinity	40		38		39	
Hardness	77		73		47	

5.5.1 Post-Treatment Requirements

Similar to Alternative 1, post-treatment and a corrosion control study would be required with the construction of a NF Plant. The options presented previously in Section 4.5.1 would also be explored with this alternative.

5.6 Potential Site Layout

The NF plant could be located in the open space south of the existing RO Plant, as shown in Figure 5-1. This new building would include the four, 0.66-MGD NF skids with components integral to the system (pumps, cartridge filters), pretreatment chemical storage and feed systems, an electrical room, and CIP system.

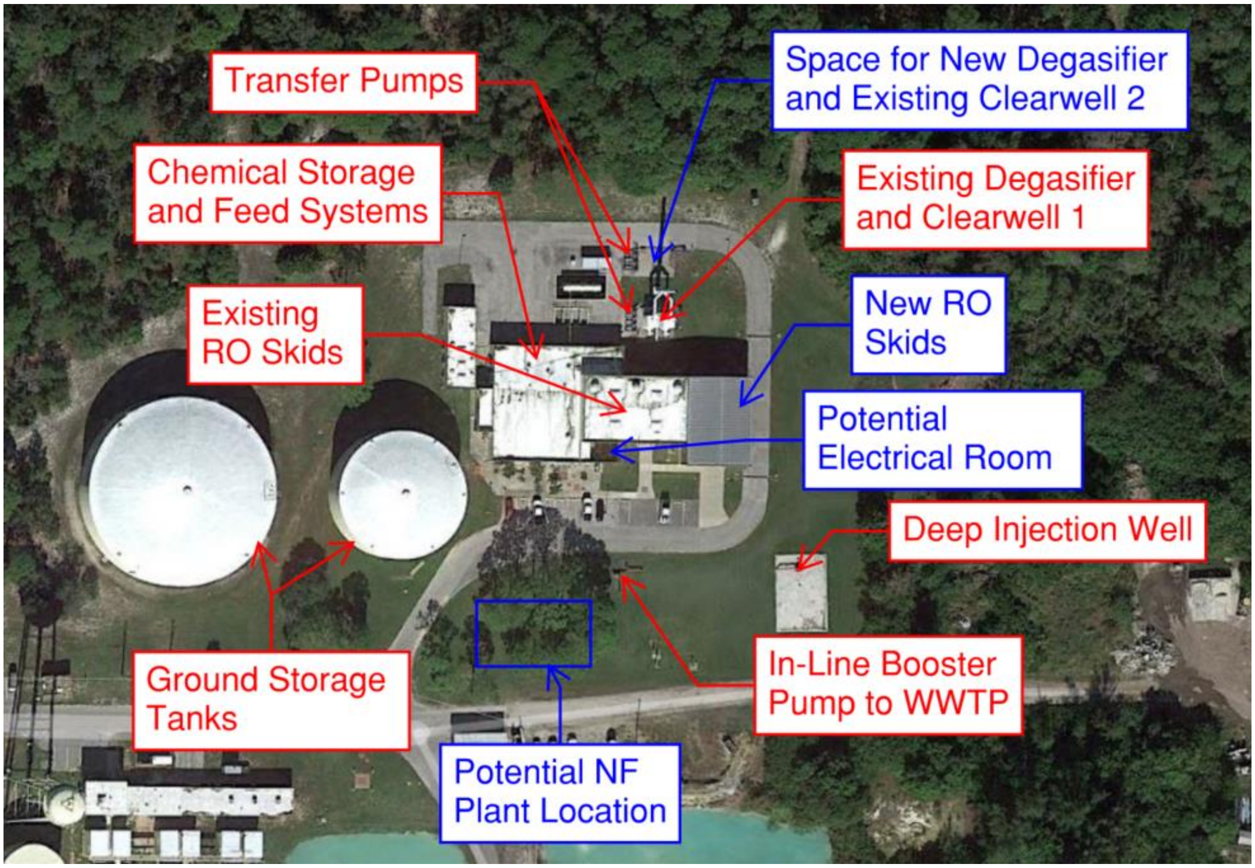

Figure 5-1. Existing and Future RO Plant and Future NF Plant Locations

5.7 Cost Estimate

Table 5-6 presents a planning-level cost estimate developed for Alternative 2. Cost estimates are in 2023 dollars and include applicable demolition, sitework, electrical components, and instrumentation. Refinements to this estimate may be presented in the final Master Plan. Opinions of probable cost provided by HDR are based on information available to HDR and on the basis of HDR’s experience and qualifications and represents the professional judgment of HDR’s engineers. However, since HDR has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, HDR does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost that HDR prepares.

Table 5-6: Alternative 2 High-Level Cost Estimate (2023 Dollars)

Plant Area	Total Estimated Cost (2023 Dollars)
RO Expansion	$4,180,000
RO Rehabilitation	$5,400,000
Nanofiltration	$8,640,000
Media Filter Rehabilitation	$3,510,000
Non-Membrane System Components	$2,690,000
Deep Injection Well	$8,660,000
Supply Wells	$14,010,000
Supply Well Piping	$340,000
General Plant	$2,840,000
Studies/Evaluations	$250,000
Total	**$50,520,000**

6 Alternative 3 – Decommission LS Plant and Expand to All RO Treatment

6.1 Alternative Description

Alternative 3 evaluated decommissioning the LS plant and utilizing an all-RO system. This alternative contains two options, alternative 3a and 3b. These options include (3a) expanding the existing RO plant to 7 MGD in the existing structure as best as possible or (3b) replacing the existing RO Plant with a new hurricane-hardened 7 MGD RO facility, including a new laboratory and housing quarters for staff during severe weather events. Option 3b would entail demolishing the existing LS Plant and RO Plant and constructing a new 7.0 MGD RO Plant north of the existing RO facility.

Since RO membranes reject many ions, blending with untreated groundwater from the freshwater wells is a possibility. This alternative is only preferred if the previously discussed Softening Upgrades Study, Nanofiltration Pilot, and Membrane Management Study indicate that an all-RO option is advantageous.

Major scope items involved in Alternative 3a – Decommission LS Plant and Expand Existing RO Plant:

- Increasing the brackish water well capacity.
- LS Plant demolition.
- Existing RO system rehabilitation.
- RO system expansion in existing building.
- Degasifier Expansion

- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

Major scope items involved in Alternative 3b – Decommission LS Plant and Construct New RO Facility:

- Increasing brackish water well capacity.
- LS Plant demolition.
- RO Plant demolition.
- New RO facility construction, including laboratory and staff housing
- RO system replacement and expansion.
- Degasifier Expansion
- Additional Deep Injection Well
- Post Treatment Chemical Upgrades
    - Corrosion control evaluation.
    - Conversion of chlorine gas to liquid sodium hypochlorite.

A phased approach would be required to continue providing water while construction occurs. The new RO Plant would be constructed in the wooded area located north of the existing RO Plant. This phased approach is discussed in Section 6.3.2.

6.2 Modifications and Recommendations

A site visit and condition assessment were performed on March 31, 2023. Recommendations from this assessment are documented in the *Potable Water Master Plan – Condition Assessment Technical Memorandum* (HDR, 2023). Table 6-1 below lists all the proposed equipment needs for Alternative 3a. It should be noted that Alternative 3a involves a two-phase expansion of the RO system. In Phase 1, three (3) new, larger RO skids (1.40 MGD) will be installed alongside the existing six (6) 0.5-MGD skids. Between Phases 1 and 2, there will be one (1) standby feed pump for the 0.5-MGD skids and one (1) standby feed pump for the 1.40-MGD skids, resulting in eleven (11) total feed pumps. In Phase 2, the existing six (6) RO skids will be removed and replaced with three (3) more 1.40-MGD skids. It should be noted that the replacement of the existing RO skids with larger skids within the existing footprint may not be constructible without major modifications to the system structural mounting pads, piping and conduit, and electrical and instrumentation feed systems.

Table 6-1: New WTP Equipment for Alternative 3a

Equipment Name	Total Quantity			Recommendation
	Current	Phase 1	Phase 2	
RO Plant				
Antiscalant System	1	1	1	Upsize during Phase 1 and 2 expansions
Cartridge Filters	6	9	6	One per membrane skid and one spare. The 6 current cartridge filter vessels will be demolished during Phase 2 and replaced with fewer, larger cartridge filter vessels
Membrane Feed Pumps	7	11	7	One per membrane skid and one spare. The 7 current feed pumps will be demolished during Phase 2 and replaced with larger feed pumps.
RO Skids	6	9	6	Phase 1 – add 3, 1.40 MGD skids; Phase 2 – demolish existing 0.5 MGD skids and replace with 3, 1.40 MGD skids
Sulfuric Acid System	1	1	1	Upsize during Phase 1 and 2 expansions
CIP System	1	1	1	One CIP system for the RO Plant, upsized to clean one 1.40 MGD skid during Phase 1
Degasifier	1	2	2	Add new 5 MGD degasifier. Replace existing 3 MGD unit with new 5 MGD unit.
Deep Injection Well	2	3	3	A new well will likely be needed to accommodate higher concentrate flow. As mentioned previously the plant uses DIW-2 as its second well (a backup well)
Blending Clearwell	2	2	2	Pitting noted during site visit. Repair areas with corrosion damage.
Common Plant Infrastructure				
Ground Storage Tanks	4	4	4	No attention needed
Elevated Storage Tank	1	1	1	Cross members have been repaired. May be replaced with hydropneumatic tank.
Chlorine Gas System	1	1	1	Convert to liquid sodium hypochlorite, upsize with Phase 1 and 2 expansions
Ammonia System	1	1	1	No attention needed, upsize with Phase 1 and 2 expansions.

If an all-new RO facility is constructed, the phasing plan proposed for Alternative 3a will not be applicable. Both the lime softening and existing RO plants will need to remain online while the new facility is constructed. Table 6-2 below lists all the proposed equipment needs for Alternative 3a.

Table 6-2: New WTP Equipment for Alternative 3b

Equipment Name	Recommendation		
	Current	**Proposed**	
Antiscalant System	1	1	Upsize to accommodate increased capacity.
Membrane Feed Pumps	7	7	One per membrane skid and one spare.
RO Skids	6	6	Construct 6 new 1.40-MGD skids
Sulfuric Acid System	1	1	Upsize to accommodate increased capacity.
CIP System	1	1	Upsize to accommodate increased capacity.
Degasifier	1	2	Add new 5 MGD degasifier. Replace existing 3 MGD unit with new 5 MGD unit.
Deep Injection Well	2	3	A new well will likely be needed to accommodate higher concentrate flow. As mentioned previously the plant uses DIW-2 as its second well (a backup well)
Blending Clearwell	2	2	Pitting noted during site visit. Repair areas with corrosion damage.
Ground Storage Tanks	4	4	No attention needed.
Elevated Storage Tank	1	1	No attention needed. May be replaced with hydropneumatic tank.
Chlorine Gas System	1	1	Convert to liquid sodium hypochlorite and upsize to accommodate increased capacity.
Ammonia System	1	1	Upsize to accommodate increased capacity.
New Building	1	1	New facility to include RO system, all associated electrical and I&C, a new laboratory, and housing accommodations for staff during severe weather events.

6.3 RO Plant

6.3.1 Brackish Well Capacity Increase

There are currently 17 brackish wells (Wellfields 2 and 4) with a peak month permitted capacity of 5.44 MGD based on withdrawal data from April and May of 2023. To achieve an RO permeate production rate of 7.0 MGD without the use of other processes, the RO feed flow will need to be 10 MGD which will require 12 new brackish supply wells. This means the brackish well capacity will need to significantly increase. A study evaluating ideal brackish well locations and depths is recommended.

6.3.2 RO Expansion Phases

To expand the existing RO Plant to 7.0 MGD of finished water (Alternative 3a), adding 1.4 MGD skids is recommended. Adding fewer, larger skids saves on capital cost due to fewer skids, pumps, cartridge filters, valves, etc. However, for operational flexibility and maintenance, it is recommended that the District install no fewer than four skids. Modifications to the new RO building would be required since this building was designed with the intent of adding 0.50 MGD skids. Adding the intended four, 0.50 MGD skids would only provide 5.0 MGD of RO permeate. The phased approach of construction is shown in Table 6-3.

Table 6-3: Proposed New RO Plant Construction Phases for Alternative 3a

Phase	No. New Skids / Capacity	New Added Capacity (MGD)	Total Capacity with All Units Online (MGD)	Capacity with Largest Unit Offline (MGD)
Current	N/A	N/A	3	2.5
Phase 1	3 / 1.4 MGD per skid	4.2	7.2	5.8
Phase 2	3 / 1.4 MGD per skid[1]	4.2	8.4	7.0

[1] Replace existing 0.5-MGD skids with three (3) 1.4-MGD skids

For Alternative 3b, the lime softening and existing RO plants will need to remain online while the new facility is constructed. Once the new facility is commissioned and brought online, the existing lime softening and RO plants may be demolished at the District's discretion.

6.3.3 RO Modeling

Modeling was performed to estimate operating parameters, permeate water quality, and concentrate water quality from the new RO skids. Modeling was performed with RO feed water data provided by the WTP. Table 6-4 presents expected design and operation of a new RO system at both skid size options.

Table 6-4. New Reverse Osmosis System Design and Operational Modeling Results

Design / Operation Parameter	Units	Result
No. Skids	No.	6 (3 skids per phase)
Capacity per Skid	MGD	1.4
Array	N/A	24:12
No. Pressure Vessels per Skid	No.	36
No. Elements per Pressure Vessel	No.	7
Total No. Elements per Skid	No.	252
Feed Flow Rate	gpm	1,389
Permeate Flow Rate	gpm	972
Concentrate Flow Rate	gpm	416
Feed TDS	ppm	12,000
Average Flux	gfd	12.9
System Recovery	%	70-75
Feed Pressure	psi	366
Concentrate Pressure	psi	311

Table 6-5 presents RO system water quality results from modeling. In the modeling software, metals, anions, and neutrals must be balanced with respect to ion charge. Therefore, feed water quality in the table were slightly modified as needed from the data presented previously in Table 1-3 for the ions to balance.

Table 6-5. Reverse Osmosis Modeling Results

Parameter	Units	Feed	Permeate	Concentrate
Field Parameters				
Temperature	°C	25	25	25
pH	SU	7.5	6.6	7.4
Alkalinity	mg/L as CaCO3	130	10.7	398
Hardness	mg/L as CaCO3	982	36	3,042
Other Water Quality Parameters				
Conductivity	umhos/cm	8,249	588	23,396
Total Dissolved Solids	mg/L	4,675	291	14,899
Total Carbon Dioxide	mg/L	4.99	5.66	8.40
Metals				
Ammonium	mg/L	0.69	0.07	2.13
Barium	mg/L	0.070	0.00	0.23
Calcium	mg/L	173	6.57	561
Magnesium	mg/L	256	9.9	830
Potassium	mg/L	49	3.9	154
Sodium	mg/L	1,109	83	3,504
Strontium	mg/L	35	1.3	114
Anions				
Bromide	mg/L	12	1.1	37
Chloride	mg/L	2,375	156	7,555
Fluoride	mg/L	1.80	0.16	5.6
Nitrate (as N)	mg/L	1.2	0.41	3.0
Sulfate	mg/L	488	13.3	1,596
Neutrals				
Boron	mg/L	0.48	0.34	0.81
Silicon Dioxide	mg/L	11.3	0.58	36

6.3.4 Degasifier Expansion

This recommendation is the same as what was presented previously in Section 4.4.5 above. However, with up to 7 MGD required to be processed through degasification, a new 5 MGD degasifier would not allow the current degasifier to be redundant. It is recommended that the existing 3.0 MGD degasifier be replaced with a 5.0 MGD degasifier to provide adequate redundancy in case one unit needs to be taken offline.

6.3.5 Concentrate Disposal

This recommendation is the same as what was presented previously in Section 4.4.6 above. With the concentrate disposal need of approximately 3.0 MGD, a single onsite new deep injection well of similar capacity to DIW-1 would be required. Alternatively, a larger deep injection well to handle all concentrate disposal could be beneficial to allow DIW-1 to be taken offline and maintained.

6.4 Finished Water Analysis

The current finished water consists of LS Plant effluent and RO Plant permeate. With the decommissioning of the LS Plant and reliance solely on the brackish aquifer wells and RO treatment, this will significantly change the WTP finished water quality. There are multiple options for operating the new RO Plant, none of which are expected to change finished water quality since the same technology is used. The only difference in options is the capacity produced.

Table 6-6 presents current and expected finished water quality that impacts corrosion (without post-treatment modifications) with the addition of RO Plant capacity.

Table 6-6: Alternative 3 Current Finished Water Quality and Expected Changes

Water Quality Parameter	Current (4.5 MGD)		Current (4.5 MGD)		Future (7.0 MGD)
	LS: 1.5 MGD 33%	RO: 3.0 MGD 66%	LS: 2.0 MGD 44%	RO: 2.5 MGD 56%	RO: 7.0 MGD 100%
pH	8.75		8.66		6.6
Alkalinity	40		38		10.7
Hardness	77		73		36

6.4.1 Post-Treatment Requirements

Similar to Alternatives 1 and 2, post-treatment and a corrosion control study would be required with the demolition of the LS Plant and construction of new RO facilities. The options presented previously in Section 4.5.1 would also be explored with this alternative.

6.5 Potential Site Layout

For Alternative 3a, the RO expansion would be located within the existing RO buildings as shown in Figure 6-1. Phase 1 would involve the construction of three, 1.4 MGD RO skids in the metal building adjacent to the existing RO skids. Phase 2 would involve demolishing the existing 0.5 MGD skids and constructing three new 1.4 MGD RO skids. It is assumed that a new 1.4 MGD CIP system will be constructed in the metal building, electrical expansion will be in the metal building or the space located south of the existing RO skids, and there is enough space in the chemical rooms to accommodate additional antiscalant and acid storage and feed pumps during Phase 1.

For Alternative 3b, the new RO facility would be constructed in the currently wooded area just north of the existing RO facility (see Figure 6-2). The boundaries of the proposed site are the drainage ditch north of the existing RO facility, the existing RO facility to the south of the site which will need to remain online during construction, the existing raw water supply piping buried along the east boundary of the site, and the wooded areas to the east and west of the site. These wooded areas have been identified as containing sand pines (see Section 2).

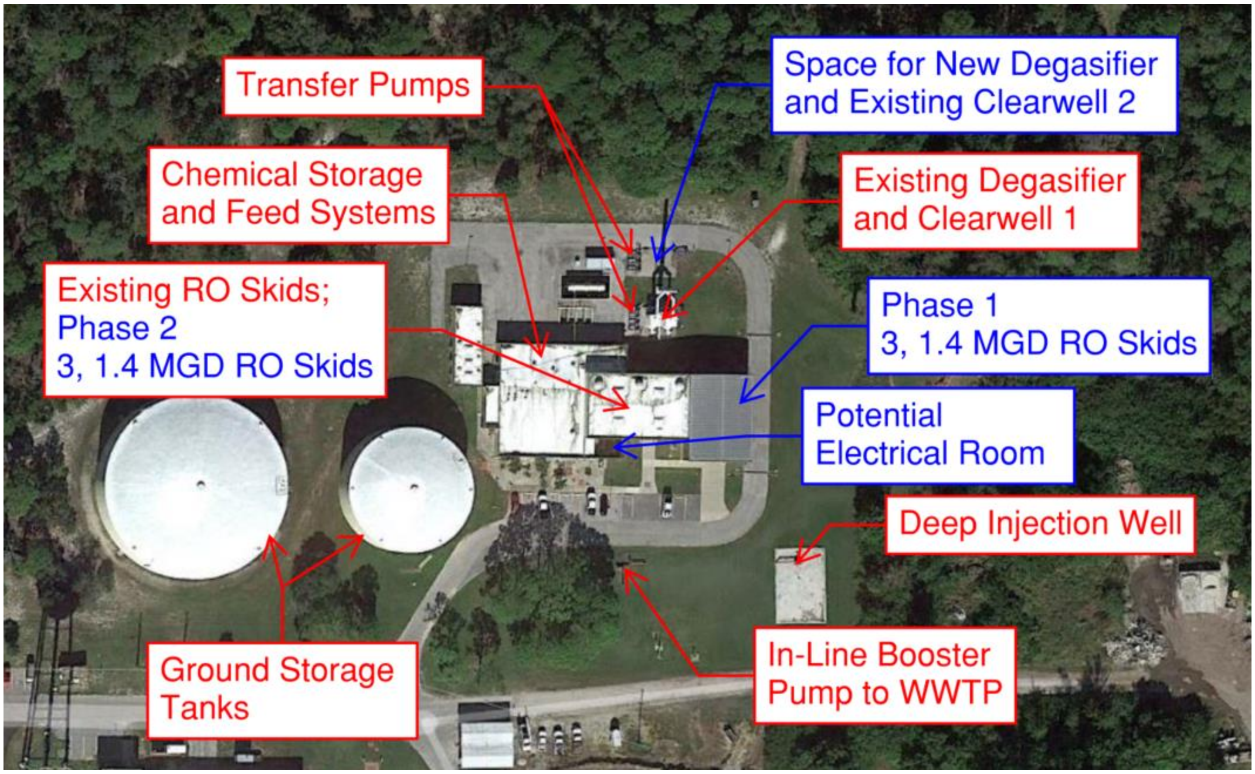

Figure 6-1. Alternative 3a Existing and Future RO Plant Locations (Phase 1 and 2)

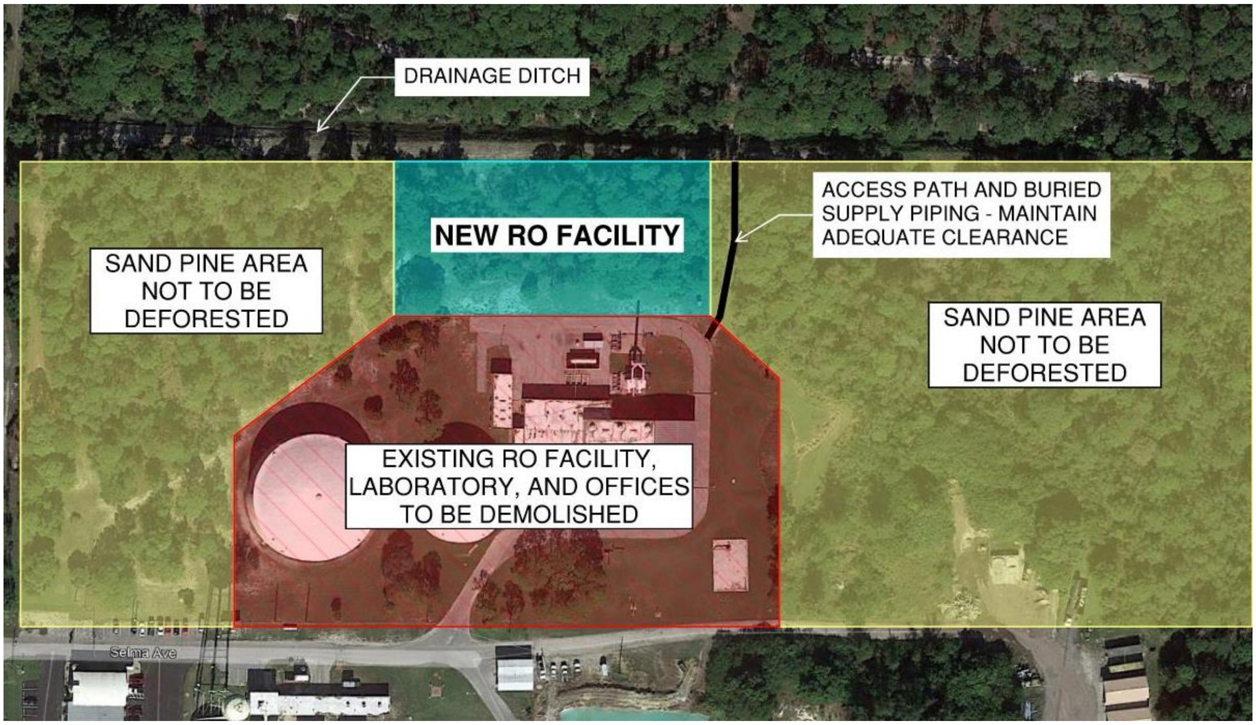

Figure 6-2: Alternative 3b Future RO Plant Location

6.6 Cost Estimate

Table 6-7 presents a planning-level cost estimate developed for Alternatives 3a and 3b. Cost estimates are in 2023 dollars and include applicable demolition, sitework, electrical components, and instrumentation. Refinements to this estimate may be presented in the final Master Plan. Opinions of probable cost provided by HDR are based on information available to HDR and on the basis of HDR's experience and qualifications and represents the professional judgment of HDR's engineers. However, since HDR has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, HDR does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost that HDR prepares.

Table 6-7: Alternative 3 High-Level Cost Estimate (2023 Dollars)

Plant Area	Total Estimated Cost (2023 Dollars)	
	Alternative 3a	Alternative 3b
New 1.4-MGD RO Skids	$26,140,000	-
O&M for 0.5-MG Skids Until Replacement	$1,000,000	-
New RO Facility (Includes all membrane components & chemical systems)	-	$81,580,000
Non-Membrane System Components	$1,810,000	-
Deep Injection Well	$8,660,000	$8,660,000
Supply Wells	$33,610,000	$33,610,000
Supply Well Piping	$13,450,000	$13,450,000
Abandon Freshwater Wells	$810,000	$810,000
General Plant	$2,840,000	$2,840,000
Studies/Evaluations	$50,000	$50,000
Total	**$88,370,000**	**$141,000,000**

7 Common Plant Infrastructure

Common plant infrastructure includes the disinfection systems (chlorine and ammonia) and storage tanks (ground and elevated). These components will need a detailed evaluation during plant expansion design. Disinfection systems will likely need an expansion when the new RO skids are brought online, but a detailed evaluation will be needed including a review of historical chemical use for the last several years. For rehabilitation, conversion from chlorine gas to sodium hypochlorite is recommended.

There are currently four storage tanks with a combined capacity of 7.5 million gallons (MG) and one elevated storage tank with a capacity of 100,000 gallons. The elevated storage tank is used to dampen the amplitude of distribution system pressures. A distribution system modeling analysis is needed to confirm if additional finished storage is warranted; however, for purposes of this study, it is assumed that existing storage is sufficient.

7.1 Conversion from Chlorine Gas to Liquid Sodium Hypochlorite

The WTP currently uses chlorine gas for disinfection. Switching to liquid sodium hypochlorite could be beneficial as there is only one local supplier of chlorine gas. Additionally, transport and on-site storage of chlorine gas poses an undesirable safety risk to plant staff.

To construct a sodium hypochlorite system, the following would be needed:

- Chemical delivery access and a fill station.
- An emergency eyewash and shower station.
- Storage tanks to provide a minimum 30 days of storage of the diluted storage concentration at maximum design treatment flow rate.
- A chemical feed system including redundant pumps.
- Transfer / recirculation pumps for onsite dilution.
- Secondary containment.

Should the District choose to switch to liquid sodium hypochlorite at 12.5 wt% Cl_2, onsite dilution with RO permeate to 6 wt% Cl_2 could allow for a more stable solution and increase protection of assets from chlorine vapors. This strategy could be considered more if this option is chosen. It is assumed that with 6 wt% Cl_2 sodium hypochlorite solution, the facility will require two storage tanks with a storage capacity of about 15,000 gallons each to accommodate a future flow of 7 MGD. A minimum of two feed pumps per injection point is also required.

8 Summary

Projected water demands for the Englewood Water District service area show that the District will need to increase total finished water to 7 MGD. The Englewood Water Treatment Plant is comprised of a 2-MGD LS plant which treats freshwater drawn from surficial aquifer wells and a 3-MGD RO plant which treats brackish water drawn from deeper wells.

After evaluating the hydraulic design and treatment capacity of the unit processes at the LS and RO plants, four separate alternatives have been developed for consideration by the District. These four alternatives are as follows:

- Alternative 1a – Rehabilitate the LS Plant and Rehabilitate and Expand the RO Plant
- Alternative 1b – Convert the LS Plant to Pellet Softening and Rehabilitation and Expand the RO Plant
- Alternative 2 – Replace the LS Plant with a NF Plant and Rehabilitate and Expand the RO Plant
- Alternative 3a – Decommission LS Plant and Expand Existing RO Plant
- Alternative 3b - Decommission LS Plant and Construct New RO Facility

Alternative 1 involves rehabilitating or modifying the existing lime softening system and improving RO membrane operations, prolonging the membrane life, and planning for future membrane replacement/rotation at the RO plant. Alternative 1a includes rehabilitation of the existing lime softening system. Alternative 1b replaces the existing LS system with a pellet softening system. This is only slightly more expensive than 1a but will require some piloting to ensure that it will work well with the source water and existing infrastructure at the WTP. Expanding the RO system would require additional brackish water capacity, additional equipment (i.e., chemical feed system expansion, cartridge filters, feed pumps, skids, pressure vessels, membranes, instrumentation, etc.), corrosion control and post-treatment modifications, and increased monitoring.

Alternative 2 involves demolishing the existing LS plant, adding NF in a new building, and expanding RO capacity. NF membranes operate like RO but use less pressure, operate at higher recoveries, and are often used in softening applications to treat fresh groundwater. The same components used for RO would also be used for NF, including chemicals, cartridge filters, feed pumps, membrane skids, degasification, and a CIP system.

Alternative 3 evaluated a complete replacement of infrastructure with a new RO treatment system. Alternative 3a includes demolishing the existing LS plant and upsizing all RO trains to produce 7.0 MGD within the current RO Building. Alternative 3b includes constructing an entirely new RO facility to provide 7.0 MGD, as well as a new laboratory and new staff housing for severe weather events. This alternative would provide treatment with a single process train utilizing six RO skids. One major benefit of this alternative is the use of fewer, larger skids than the 10 skids needed in Alternatives 1 and 2. This may be a higher capital cost than other alternatives, but fewer, larger skids would save footprint, reduce instrumentation and controls, allow upgrades to modern components, materials of construction, and more efficient pumps. Adding fewer, larger skids saves on capital cost due to fewer skids, pumps, cartridge filters, valves, etc.

The advantages, disadvantages, and high-level costs of each alternative are summarized in Table 8-1.

Table 8-1: Alternative Comparison

Alternative	Estimated Total Capital Cost (2023 Dollars)	Key Advantages	Key Disadvantages
Alternative 1a – Rehabilitate the LS Plant and Rehabilitate and Expand the RO Plant	$40,520,000	• Less disruption to the current process • Shorter construction durations	• Lime sludge waste generation remains • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 1b - Convert the LS Plant to Pellet Softening and Rehabilitation and Expand the RO Plant	$40,950,000	• Less waste generated • Uses caustic instead of lime	• Not in widespread use, emerging technology • Disruptive to the current site, longer construction • Continued vulnerability of surficial aquifer to water supply stresses and wetland influence
Alternative 2 – Replace the LS Plant with A Nanofiltration (NF) Plant and Rehabilitate and Expand the RO Plant	$50,520,000	• Compared to RO option: o Lower feed pressure o Operate at higher recoveries • Similar components used between the RO plant and NF plant • Enhanced TOC removal	• More costly than other softening options • Disruptive to the current site, longer construction • Increased membrane cleaning and replacement
Alternative 3a – Decommission LS Plant and Rehabilitate and Expand Existing RO Plant	$88,370,000	• Smaller footprint than current plant • Single treatment process • Allows upgrades to modern components and materials of construction	• Costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required • Risk of unforeseen site space and facility retrofit challenges
Alternative 3b – Decommission LS Plant and Rehabilitate and Construct New, Expanded RO Facility	$141,000,000	• Smaller footprint than current plant • Single treatment process • Allows upgrades to modern components and materials of construction • Hurricane hardened facility • New laboratory and emergency housing for employees • Least complicated construction • Can repurpose existing buildings for alternative uses to save cost	• Most costly • Increased membrane cleaning and replacement • Significant brackish water supply expansion required

9 Recommendations

While each alternative is reasonable to create the water treatment capacity expansion to 7 MGD, Alternative 3b is recommended. Providing the District with a new single treatment process with modernizations for process energy and operational efficiencies would allow for a more reliable facility for the community. A new RO Facility and hardened building with new laboratory, modern operations control room, staff breakroom and restrooms, and emergency operations center could attract new workers. Construction would have the least impact to current operations. During construction, District staff can learn about modern processes installed, and the system can be placed online when all staff are comfortable with doing so. This alternative may require the least amount of piloting with any upgrade and lessen the complexity of blending two water types. Using solely RO treatment has the added benefit of potentially lessening system disinfection costs overall by having the highest probability of allowing the District to convert their disinfection strategy from chloramination to free chlorine, thereby eliminating the need for ammonia dosing systems. Furthermore, RO treatment is the only process considered for reasonable plant upgrades that inherently removes contaminants of emerging concern, creating a safer drinking water for Distrist customers.

D

Appendix D – Water Distribution System Evaluation Technical Memorandum

Water Master Plan

Distribution System Evaluation Technical Memorandum (WMP Section 5)

Englewood Water District

District Contract No. 2022-129

Englewood, FL

December 15, 2023

Contents

Tables

Figures

1 Introduction

The Englewood Water District (District) has retained HDR Engineering, Inc. (HDR) to provide professional services to develop a Potable Water Master Plan. This Master Plan will assess the District's water service and facility needs for the next 20-year planning period from 2023 through 2043 for treatment and pumping equipment upgrades needed and the next 50-year period from 2023 to 2073 for verifying useful life of new wells, pipelines, and treatment basins with recommended upgrades. The purpose of this Technical Memorandum is to evaluate the distribution system infrastructure needs with corresponding projected distribution demands over the 20-year and 50-year planning periods.

2 Background

Since 1959, the District has developed a finished water distribution system within approximately 44.5 square miles and consisting of over 3,571 miles of water transmission and distribution pipelines and appurtenances, with emergency interconnections with Sarasota and Charlotte Counties. There is one High Service Pump Station located at the water treatment plant (WTP) to convey finished water to the elevated storage tank and distribution system.

As part of the 2017 Utility Master Plan, a potable water distribution system hydraulic model (Model) was developed using Bentley WaterGEMS to provide the District a tool that can conduct ongoing evaluations of their existing and future potable water system infrastructure. This model was rudimentary, and calibration of this hydraulic model was documented as beyond the scope of the 2017 Utility Master Plan, and it is beyond the scope of this 2023 Water Master Plan. However, this rudimentary hydraulic model was carried forward to this Master Plan effort. This hydraulic model is now updated with pipelines installed through 2022 using the District's GIS information, updated with customer demand information from March 2023, and has been validated for a snapshot of March 2023 distribution system flow and contributing high service pump station capabilities as discussed in section 3 below. The updated and validated hydraulic model network was also expanded to evaluate the pipe sizes needed for future development service mains as discussed in section 4 below. The updated and validated hydraulic model was also used to assess system pressures using 2023, 2043, and 2073 conditions as discussed in sections 5, 6, and 7 below.

3 Model Update and Validation

HDR updated the existing District Model as part of this Water Master Plan effort. The updates included pipe imports from District-provided GIS and demand updates from geocoded water meter data. To update the pipe network, the Model was compared with the GIS provided by the District. 165 pipes were identified as new or necessary (Figure 3-1). These pipes were added to the distribution system as part of the model update. This model does not include all pipes; because of this, there is limited accuracy in the analysis of pressures and available fire flow (FF) at many locations within the District. All analysis is based on the location where the service mains tie into the transmission mains. A minimum pipe diameter of 8 inches was kept for the pipe network. A few smaller connections were added later in the process to improve the accuracy of customer meter connections. System pipe diameters can be seen in Figure 3-2.

To allocate system demands, water billing data was geolocated. The meters were imported from a 1-month consumption data table representing March 2023 for Charlotte and Sarasota County. The data was then filtered by zip code to remove any addresses outside of the District. Once the data was filtered, it was imported into the GIS model. Geocoded addresses were used to match the meter addresses to the parcel data in the model. Once matched, the meters could then be imported and adjusted in the WaterGEMS model. The current demand was compared to the total produced finished water for the month of March and was acceptable.

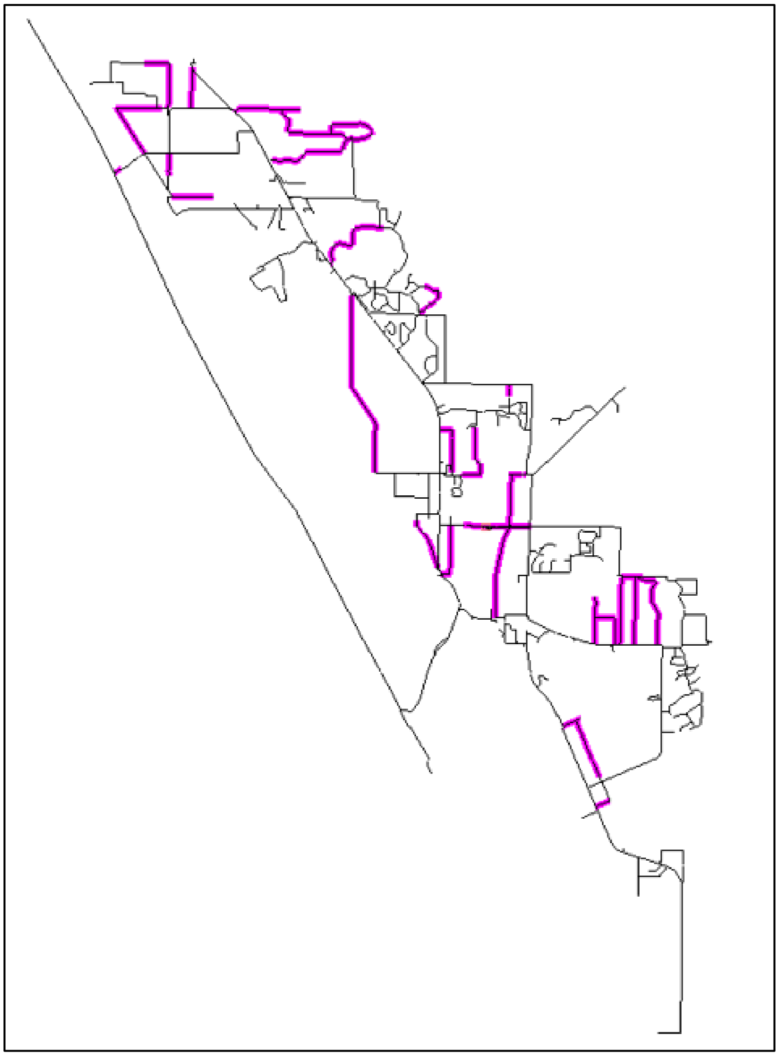

Figure 3-1: Baseline Model Pipe Additions Highlighted

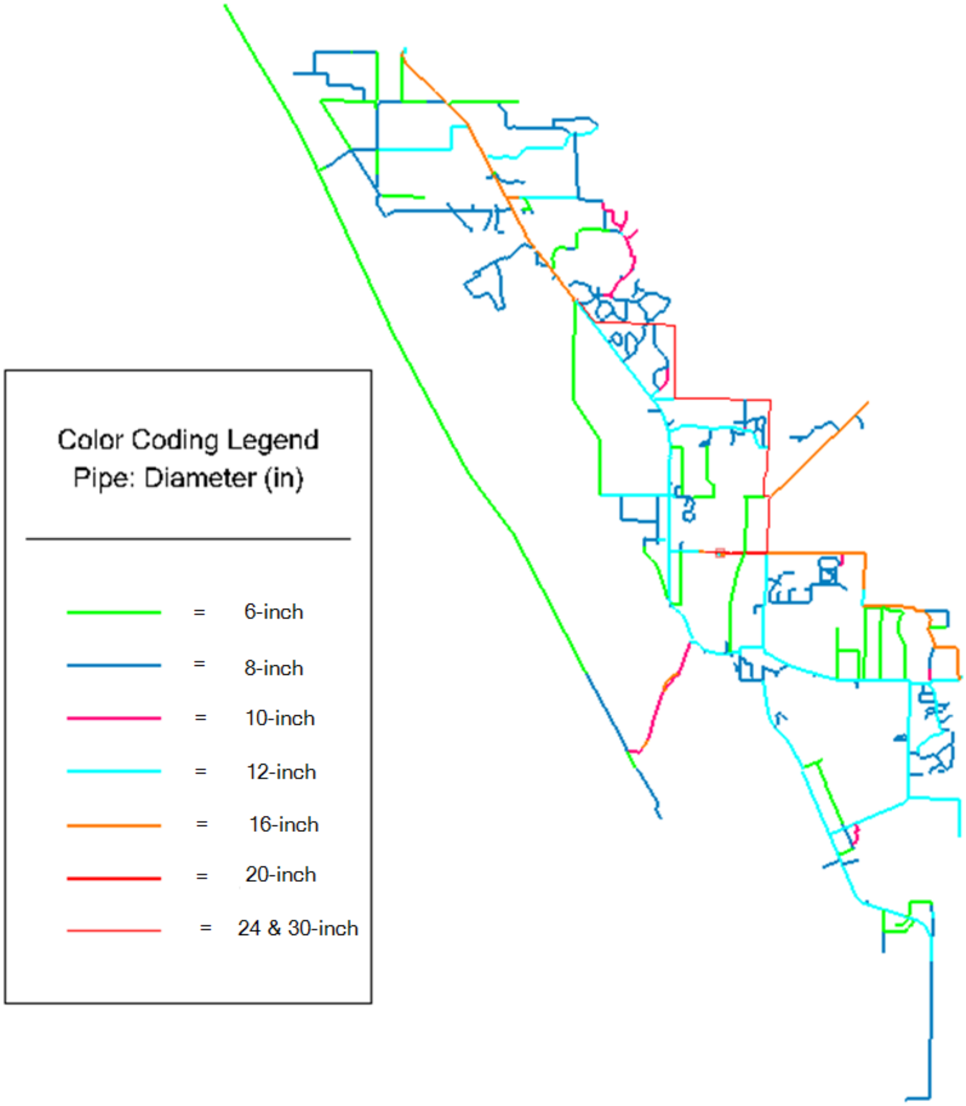

Figure 3-2: Baseline Model Pipe Diameters

4 Future Development Model Additions and Assessment

Future demands were allocated using a list of planned developments provided by the District and projected maximum month daily (MMD) water demands within the District from the Population and Flow Projections TM, section 4.3.4. Forecast water production can be seen in Table 4-2. HDR and the District discussed potential piping connections and details about each development site. The District provided a development master plan, which shows a 15+ year projection of build out percentages for all new developments. HDR considered these in the future projections and included them in the model. The details of FF requirement, land use type and expected demand were verified in the meeting. Anticipated piping was sized based on max day demand + FF. Suggested pipe diameters can be seen below in Table 4-1. It is assumed that all pipes within neighborhoods that are not included in Table 4-1 are 8-inch looped main. A loop will have two connections to the main sized in Table 4-1. Wellen Park is the most complex of the expected developments and will require 16-inch and 12-inch mains. To clarify requirements, Figure 4-1 displays Wellen Park minimum pipe diameters for water mains and includes an example of an 8-inch loop neighborhood.

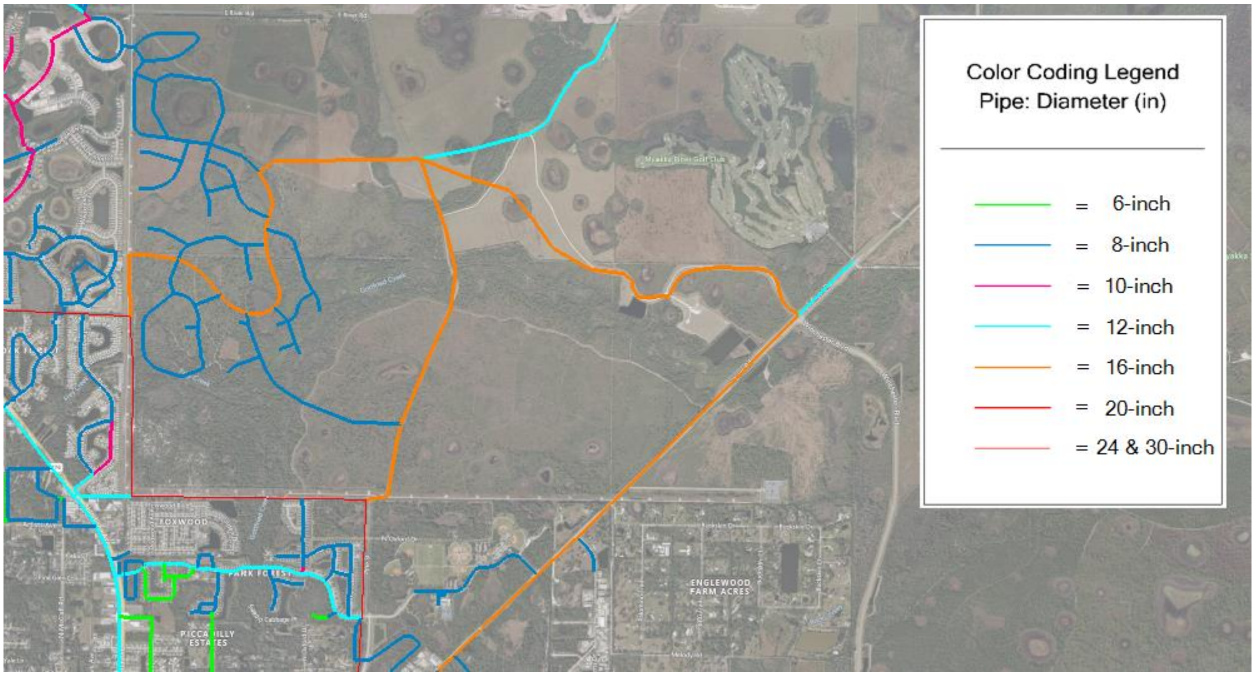

Figure 4-1: Suggested Wellen Park Pipe Diameters

Table 4-1: Suggested Minimum Diameters for New Developments

Development	Minimum Diameter
Wellen Park	16-inch main loop with 12-inch piping as needed
Beachwalk PH1 & 2	12-inch
Beachwalk PH3 & 4	12-inch
Beachwalk Outparcels	8-inch
Boca Royale Unit 14 & 16	10-inch

Development	Minimum Diameter
Boca Royale Unit 17 & 18	8-inch
Gateway Court	8-inch
Prose Apartments	8-inch
200 Artists	8-inch
Park Forest 7	8-inch
Paddock Pines	8-inch
Englewood Gardens	8-inch
Generation of Englewood	8-inch
Manatee Cay	8-inch
Medical Twins	8-inch
Sandy Lane Townhomes	8-inch
Heritage Oaks Multifamily	8-inch
Lake Emily	8-inch
Island Lake Estates-Coco- Bay	8-inch

Projected water flows were allocated to the added junctions at each of the new developments. In addition to the planned developments, assumed build-out and period water flows from future developments in the District were considered for the 2043 projected model. These additional 2043 system demands were distributed throughout the customer meter network. For the 2073 projection, an adjustment was made based on the MMD water demands in 2043 shown in Table 4-2. Future 2073 system demands were assumed to be added throughout the District.

Table 4-2: Projected Max Month Water Demands within the District

Year	MMD (mgd)	MMD with Diurnal Peaking Factor of 2 (mgd)
2023	5.320	10.640
2043	6.944	13.888
2073	9.287	18.574

Five modeled scenarios were developed to analyze the District’s level of service:

- 2023 Existing condition MMD
- 2023 Existing condition MMD + FF
- 2043 With CIP MMD
- 2043 With CIP MMD + FF
- 2073 With CIP MMD

After the scenarios and physical network were completed and capacity assessments were conducted, the modeled demand and FF availability were compared using existing pipe geometry and proposed projects for improvements. One component that is not able to be assessed by the current model is water age. Water age is an indicator of disinfection biproducts such as trihalomethanes (THMs). An extended period simulation is required to calculate water age. The capacity of the system was assessed using the following criteria:

- Pressures no lower than 40 psi during MMD
- Velocities to remain below 10 fps
- Pressures during MMD + FF no lower than 20 psi

The updated and validated hydraulic model was used to evaluate system pressures and velocities for 2023 Existing Condition MMD, 2043 existing condition MMD, and FF scenarios for both Existing Condition MMD and 2043 MMD with a diurnal peaking factor of 2.0 for existing infrastructure conditions. Pipe velocities and junction pressures were analyzed to determine low service areas and corridors for capital improvement projects (CIP). After CIPs were identified these projects were incorporated into the model making the CIP pipe network. The CIP hydraulic model network was used to evaluate 2043 MMD, 2043 MMD + FF, and 2073 MMD with a diurnal peaking factor of 2.0.

5 Model Results – Existing System

The existing system model was simulated for steady state conditions at the MMD with diurnal peaking factor as noted above. Conversations with the District led to an understanding that the discharge from the Pump Station operates under a variable frequency drive (VFD) and the setting for the VFD is 57 pounds per square inch (psi) from the high service pump station. The model has a valve that reduces the pressure at the pump station to simulate standard operating conditions of the District’s typical water distribution.

The existing model scenario simulation showed moderate pressure reduction throughout the system. The largest areas of pressure drop were at the north and south extremes where head losses have been able to accumulate. The pressure reduction from the WTP to the farthest north and south junctions is approximately 65.78 feet (29 psi) of head and 25.94 feet of head (11 psi) respectively. Modeled pressures in the distribution system can be seen on Figure 5-2. The existing model results confirmed the District’s capacity issues on Manasota Key. This model simulation delivers a total flow of 7,390 gpm (10.64 MGD) from the WTP which is within the operating range of the existing high service pump station. Similarly, most of the distribution piping system appeared adequate with few locations of major head loss gradients greater than 1 foot per 1,000 feet (ft/1,000 ft) and no single pipe velocity greater than 4 feet per second (fps). The average velocity within the distribution system for this model simulation is 1.12 fps (Figure 5-1). FF availability was modeled for the system and can be seen in Figure 5-3. The available FF is low in the extremes of the system due to the head loss gradient to the location. Available FF is also affected by pipe diameter. In many locations within the system there is additional piping that will significantly contribute head losses. If the District would like to better analyze available FF throughout the system, an all-pipes model and calibration is recommended. An immediate consideration to the system is to increase the target discharge pressure at the Pump Station. Typically pressures between 40-80 are preferred pressures and are standard operating pressures in a distribution system. Increasing the target pressure of the VFD at the Pump Station to 70 psi right now will improve the pressure issues at the extents of the distribution system. Accordingly, provisions to the elevated storage tank would need to be made, such as adding an influent pressure reducing valve, to limit the tank being overfilled.

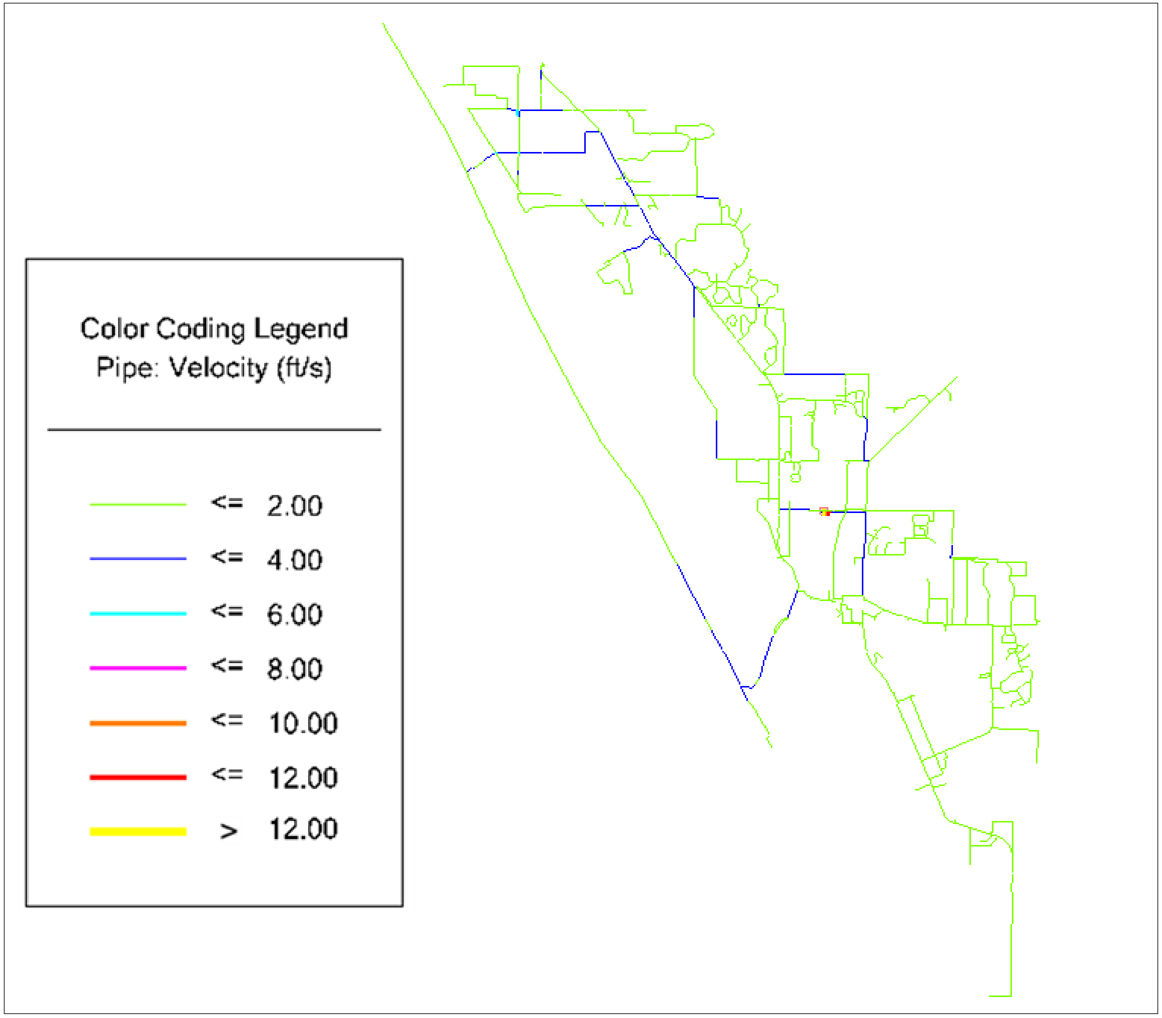

Figure 5-1: Velocity Results from Existing Model MMD

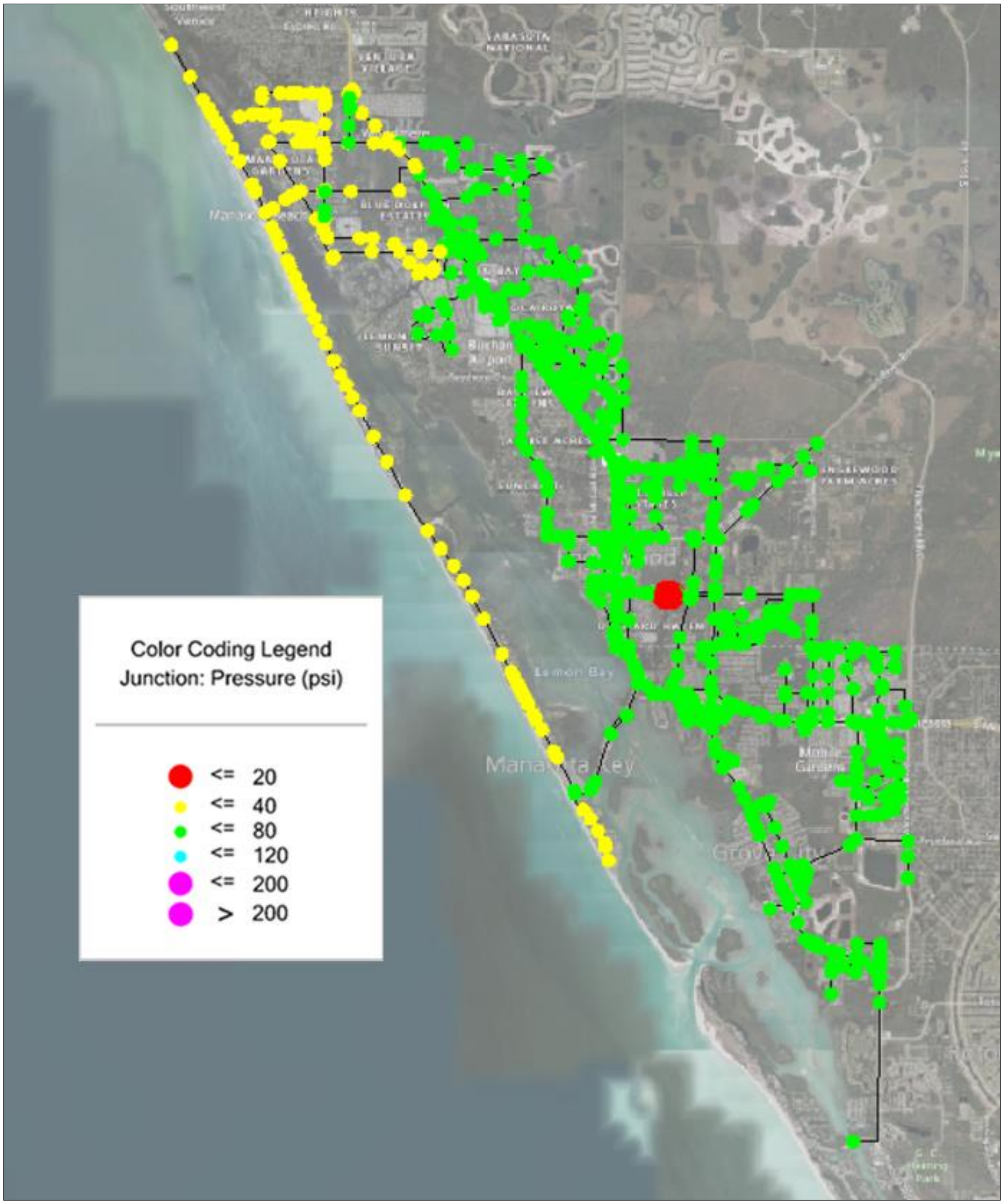

Figure 5-2: Pressure Results from Existing Model MMD

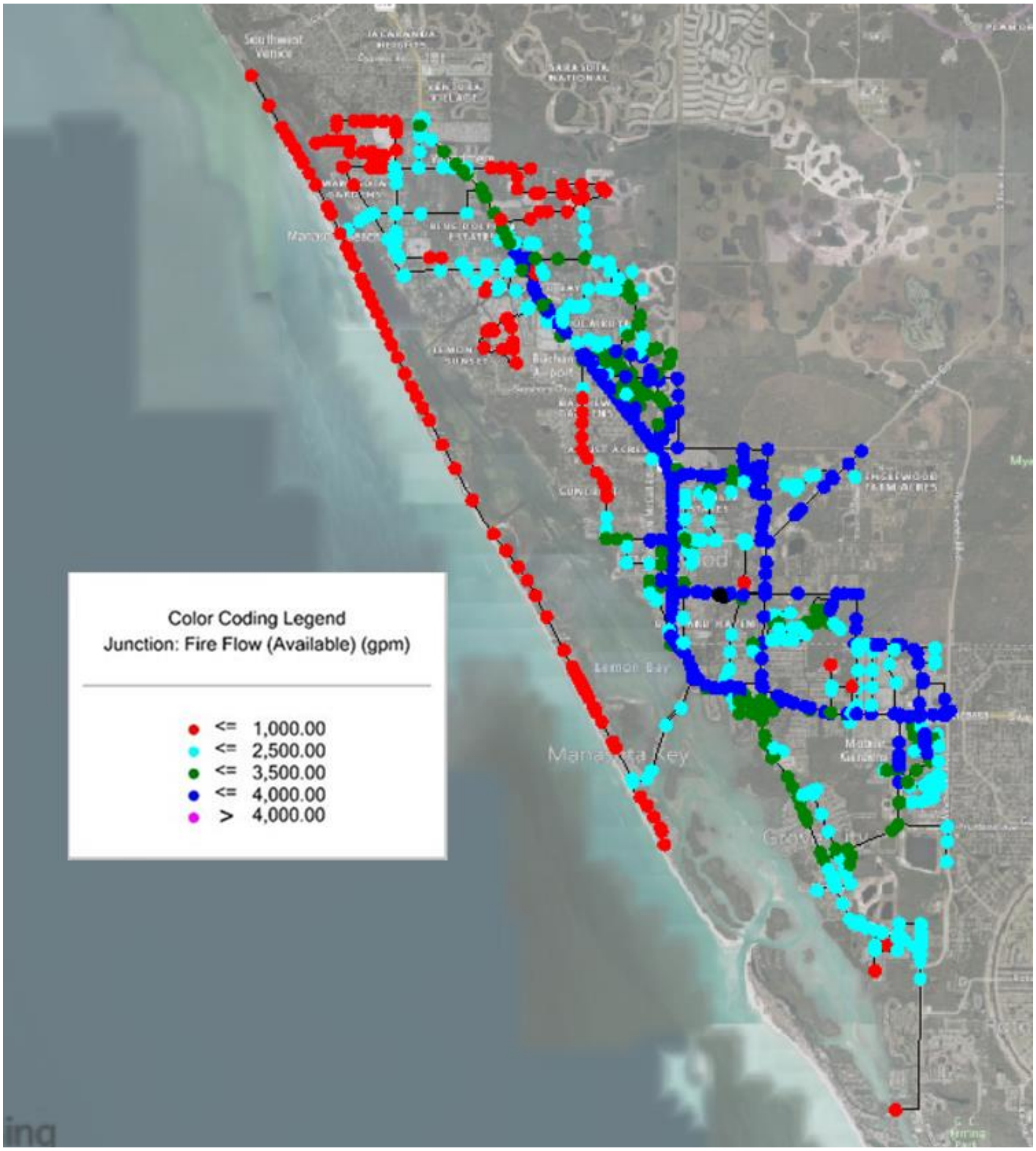

Figure 5-3: Fire Flow Results from Existing Model MMD

6 Model Results – Future System in 2043

The future system model was simulated for steady state conditions at the MMD with diurnal peaking factor of 2.0. Demands in the model were adjusted to the MMD water demands shown in table 4-2. This model simulation delivers a total flow of 9582.40 gpm. The pressure reduction from the WTP to the farthest north and south junctions is approximately 103.03 feet (45 psi) of head and 62.38 feet of head (27 psi) respectively. This model simulation showed that the pressure reductions (Figure 6-2) for the modeled future demand period were significant. Results show the average head loss gradient of the 20-year future demand projection is approximately 1.67 ft/1000ft. The average velocity within the distribution system is 1.14 fps (Figure 6-1). The area with the lowest level of service is Manasota Key, which according to the results of the existing model, showed increased head losses in the system along Beach Road and moving north on the barrier island. Because the head losses on the existing system were already significant, any further reductions due to increased demands elsewhere in the system may further compromise the ability to provide service to Manasota Key. FF availability was also modeled for this scenario and can be seen in Figure 6-3. The available FF is low in the extremes of the system, especially in areas like Manasota Key, Japanese Gardens and Englewood Isles.

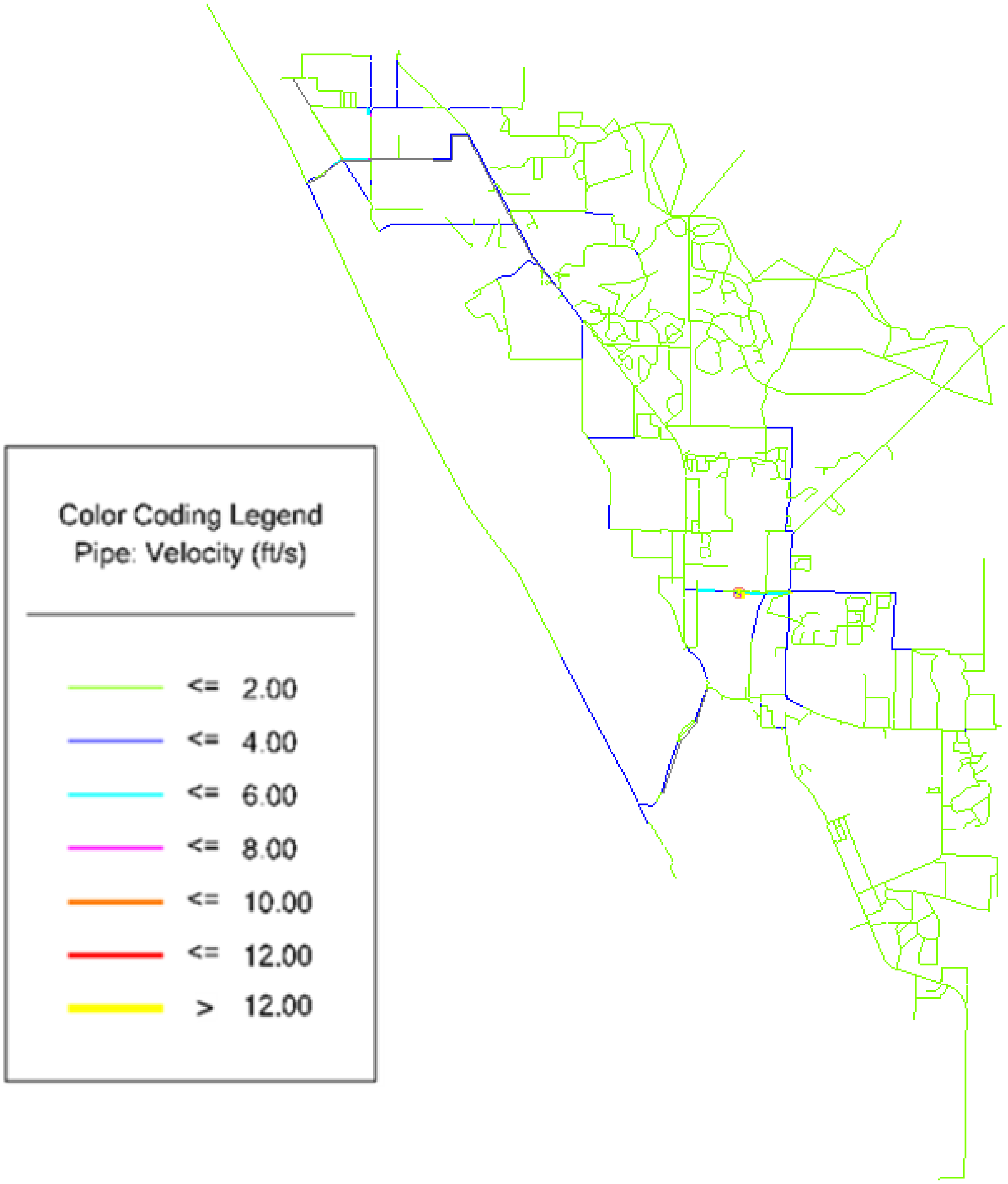

Figure 6-1: Velocity Results from Future System Model MMD 2043

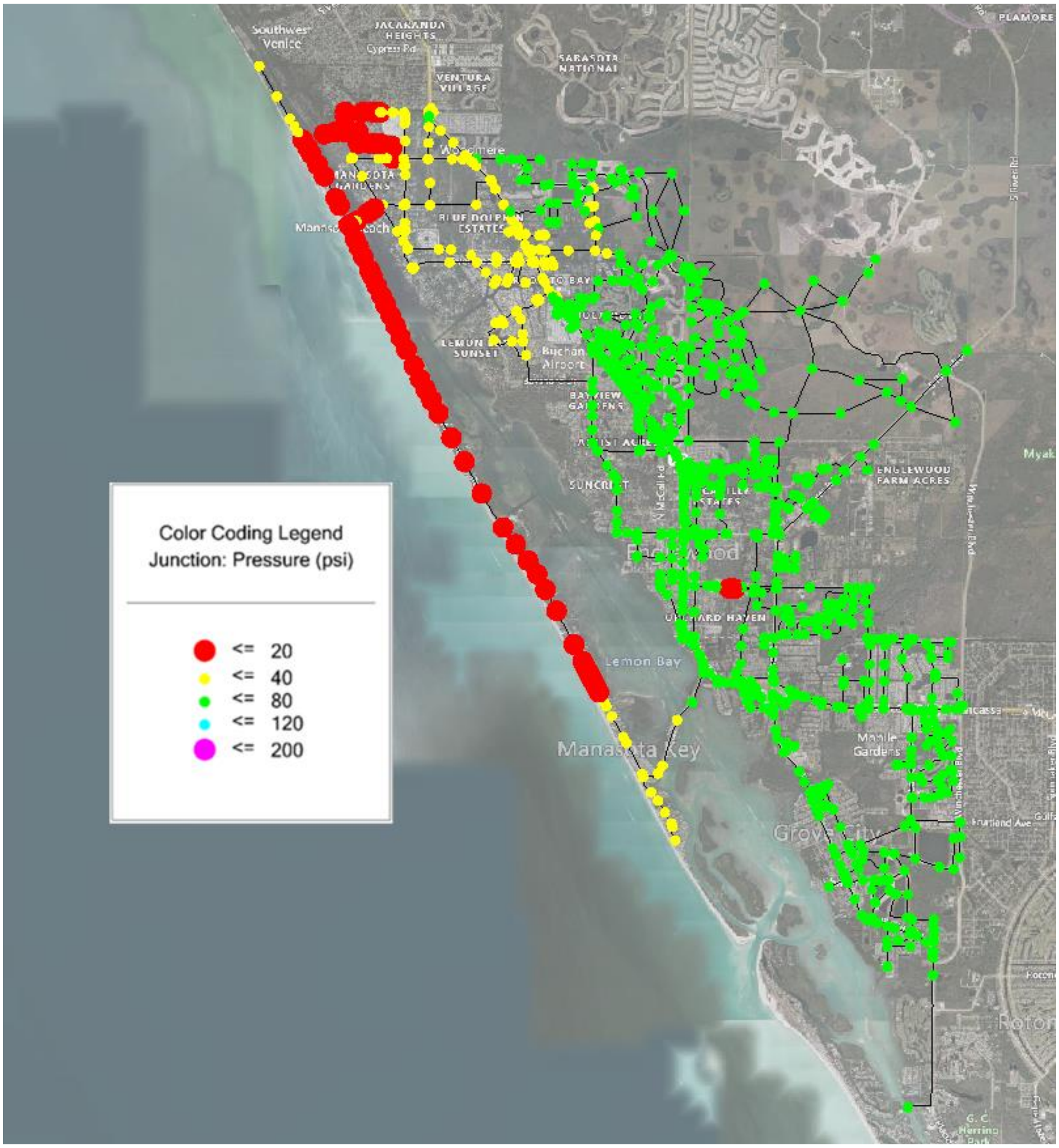

Figure 6-2: Pressure Results from Future System Model MMD 2043

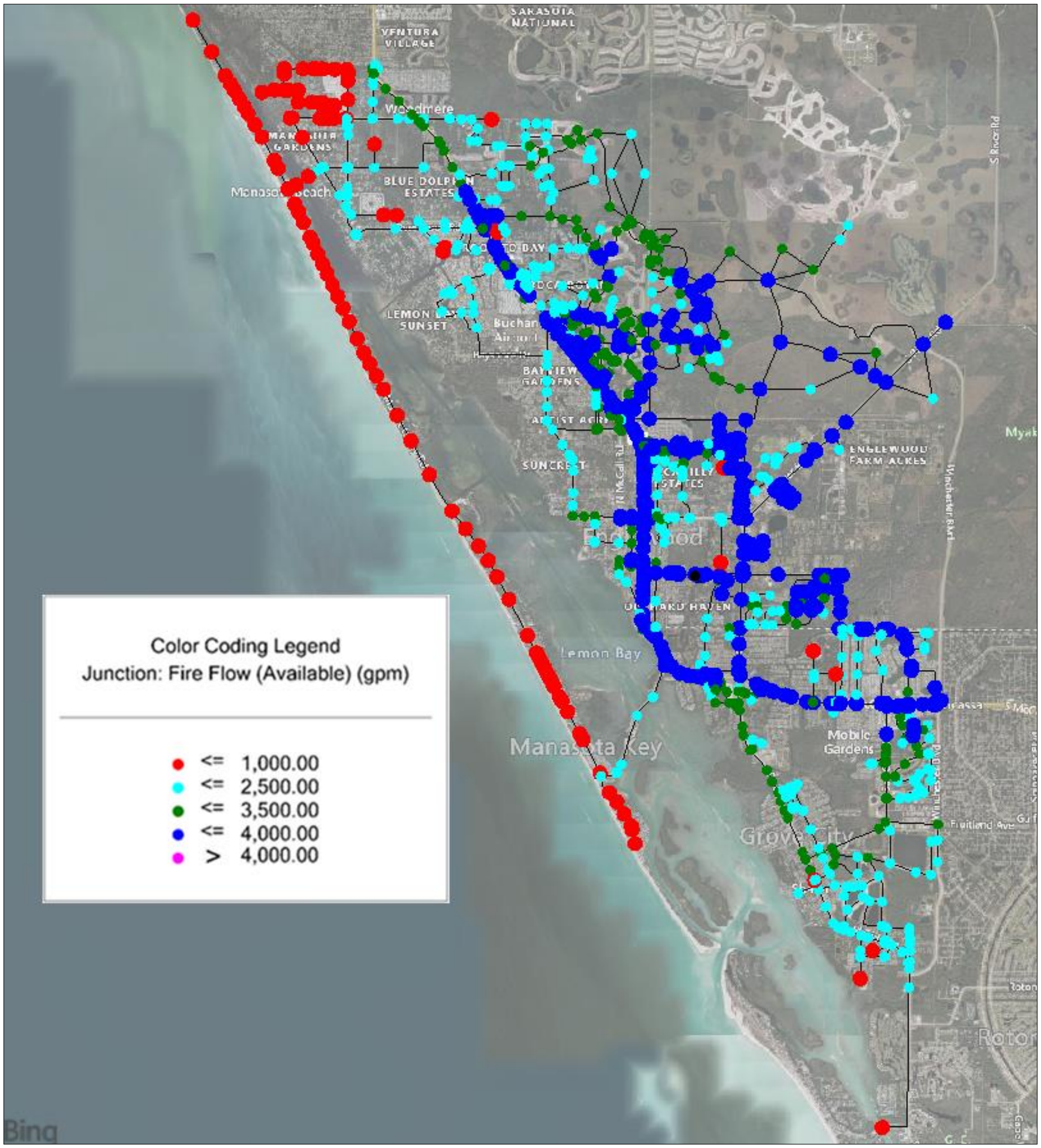

Figure 6-3: Fire Flow Results from Future System Model MMD 2043

7 Model Results – Future System in 2073

The future system model was simulated for steady state conditions at the MMD with diurnal peaking factor as noted above. The 2073 model was used to validate long-term pipeline capacities, particularly for new piping or current piping that needs replacement. Demands were taken from the 2043 model and were then adjusted by allocating demands to areas of future developments (Figure 4-1). This model simulation delivers a total flow of 12,893.40 gpm and showed that the pressure reduction for the future 2073 system was significant. The pressure reduction from the WTP to the farthest north and south junctions is approximately 126.91 feet (54 psi) of head and 120.7 feet of head (51 psi) respectively. Modeled pressures in the distribution system can be seen in Figure 7-2, showing major pressure loss in areas such as Manasota Key and Japanese Gardens. Results show the average head loss gradient of the 50-year future demand projection is approximately 3 ft/1000ft. The average velocity within the distribution system is 1.61 fps (Figure 7-1). Based on these results the existing system will not be adequate to handle the future demands in the locations of the anticipated developments with respect to system head losses. One area of concern is Manasota Key where pressures drop below 20 psi., however, over half the system is below acceptable pressure if there are no improvements before 2073.

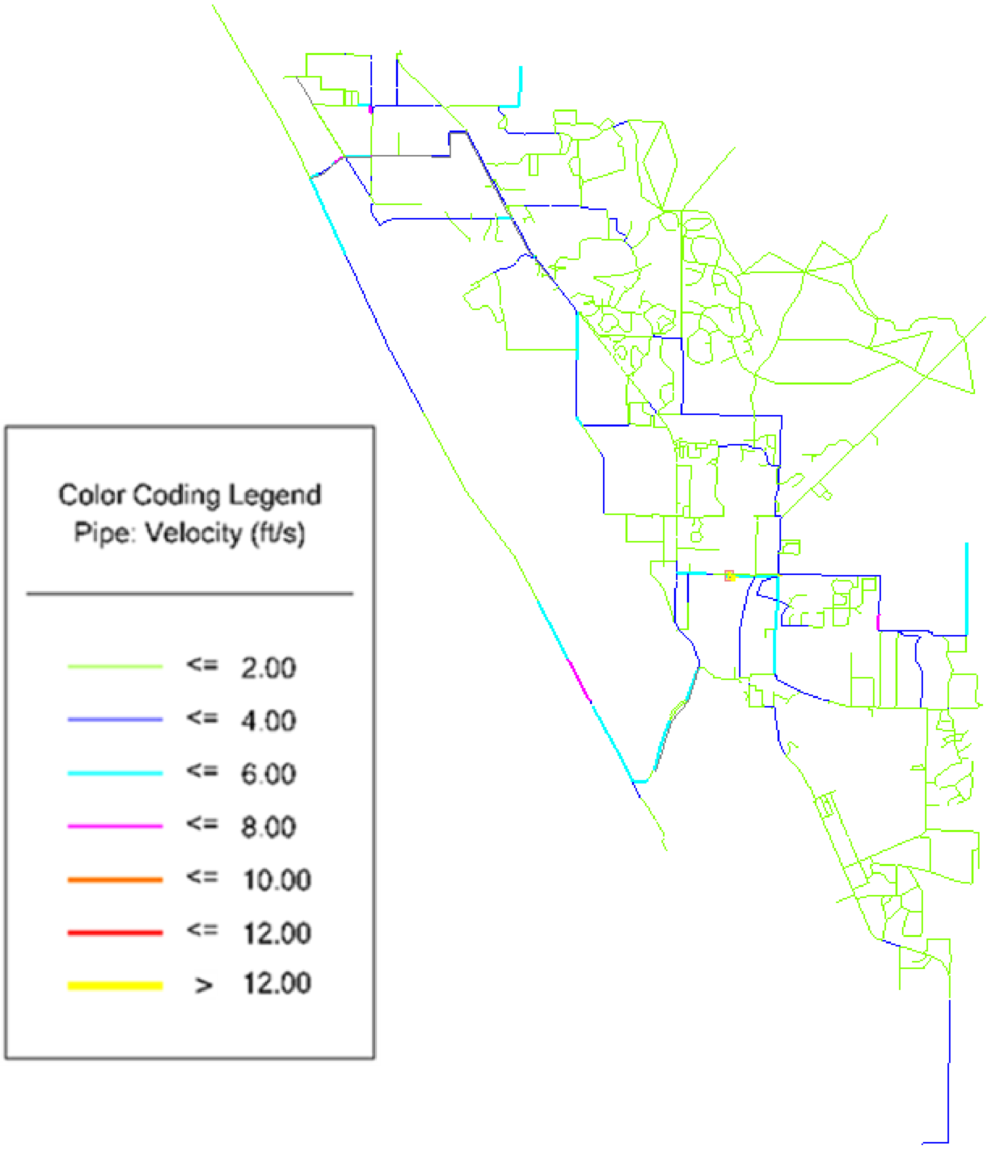

Figure 7-1: Velocity Results from Future System Model MMD 2073

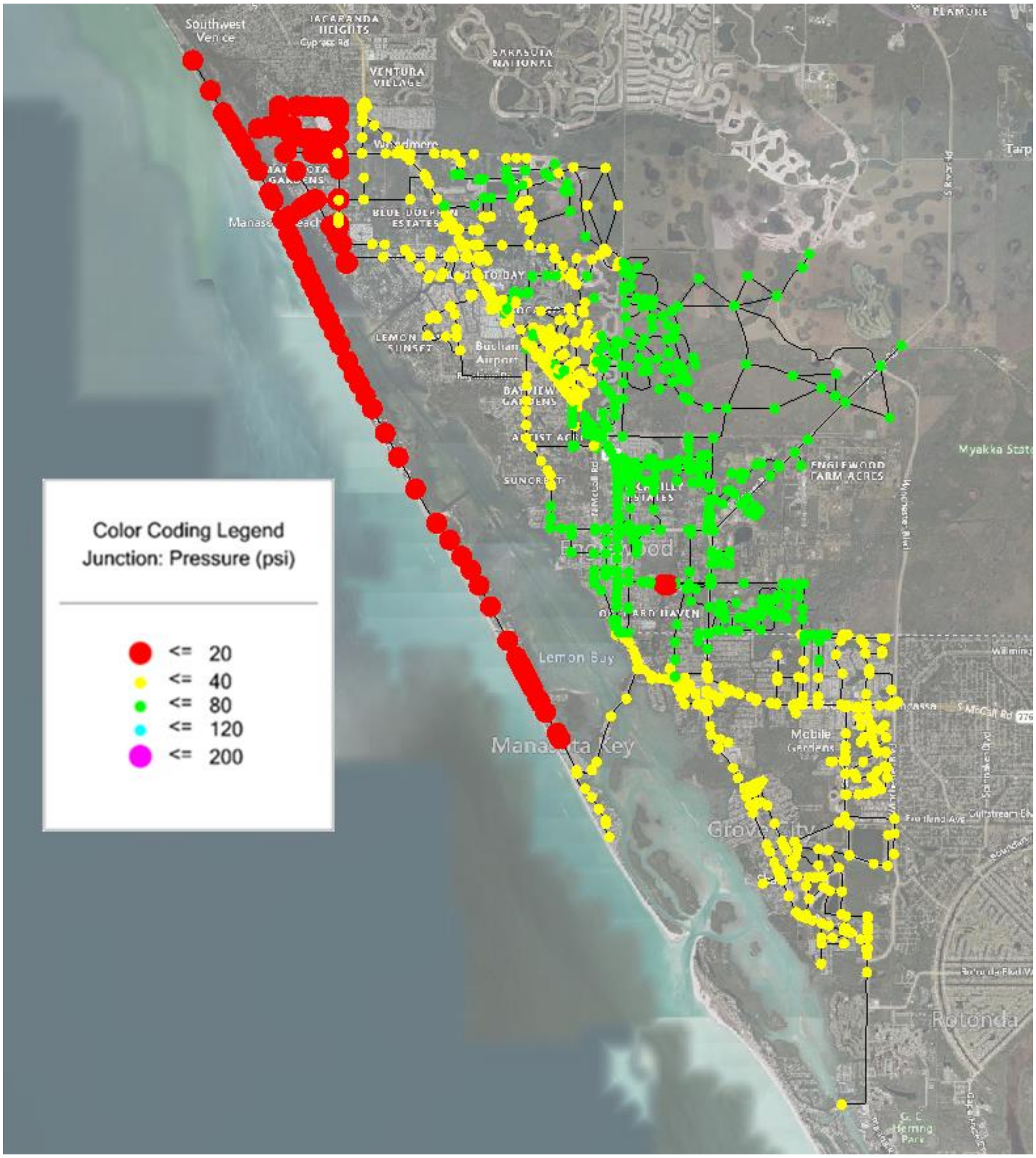

Figure 7-2: Pressure Results from Future System Model MMD 2073

8 Distribution System Recommendations

The primary areas of concern in the model are Manasota Key, Japanese Gardens, Englewood Isles, Englewood Rd, and the Southeast Region of Grove City and Mobile Gardens. These areas have shown a sensitivity to increased demand which results in an increase in head loss. There are five pipelines that are recommended for CIPs (Figure 8-1). The CIPs are numbered according to priority: number 1 being the most urgent and the most impactful to the system and number 5 affecting the least number of customers. Each of these CIPs was modeled as an additional parallel pipeline with no tie overs along the assumed path. Before any of these improvements were analyzed the discharge pressure at the Pump Station was increased to 70 psi as recommended for consideration in Project 6. Additionally, Project 7 is recommended to improve distribution system understanding and effectiveness of the modeling tool.

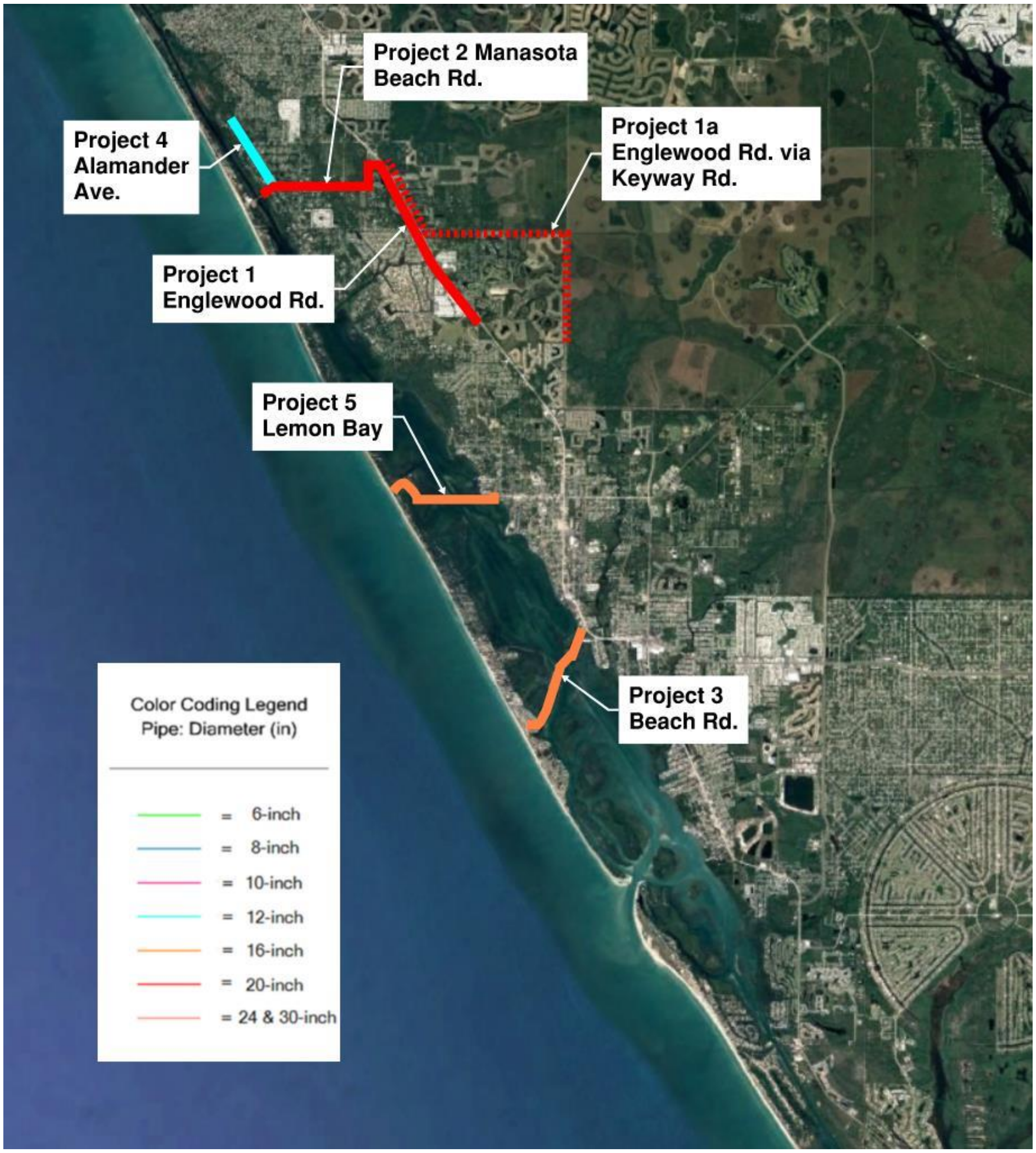

Figure 8-1: Recommended Pipeline Projects Overview

Project 1 – Englewood Rd

Project 1 will increase capacity to the northwest part of the District and is the most critical of all the projects. It will improve service to north Manasota Key and the areas of the system that are currently showing deficiencies. It consists of improvements along Englewood Rd and starts within the intersection of Englewood Rd and Old Englewood Rd. The project consists of approximately 11,000 ft of 20-inch diameter pipe. It runs with the alignment of Englewood Rd. and ends at the intersection of Englewood Rd and Shane Rd.

An alternative layout to Project 1, herein called Project 1a, is also shown in Figure 8-2. This alternative would connect to the existing 24-inch pipe which runs east of the Boca Royale development, run north to Keyway Rd, follow Keyway Rd west until reaching Englewood Rd, and would then run northwest along the same path as Project 1. This project (20,500 ft) would be considerably longer than Project 1 and more costly but would be less disruptive during construction since the majority of the alignment avoids major roads. In addition, this alternative route may create less pressure to customers tying into the existing 16-inch main along Englewood Rd between Keyway Rd and Old Englewood Rd. A more detailed and calibrated hydraulic model may be beneficial to view the intricacies in all neighborhoods.

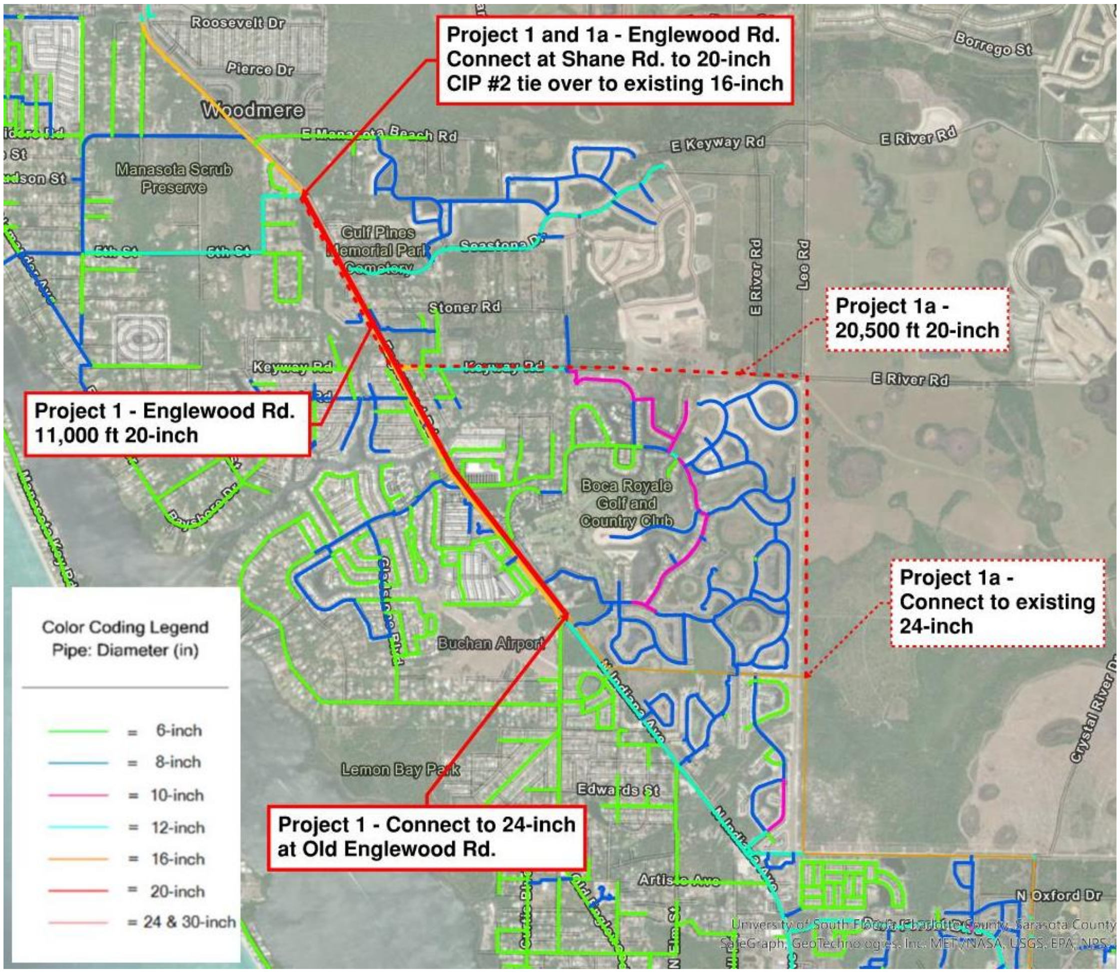

Figure 8-2: Project 1 and 1a – Englewood Rd

Project 2 – Manasota Beach Rd

Project 2 consists of improvements along Manasota beach Rd, 5th St, Belle Rd., and Shane Rd. The improvements start within the intersection of Englewood Rd and Shane Rd. The pipeline heads west within Shane Rd. for 1,000 ft. then turns south at the Bell Rd. for 1,300 ft. At the intersection of 5th St. and Belle Rd., the pipeline turns and travels west 5,500, then turns southwest at Alamander Ave. and travels 1,000 ft within Manasota Beach Rd. until it ends and connects to the 8-inch line that crosses Lemon Bay. The project consists of 8,800 ft. of 20-inch diameter pipe.

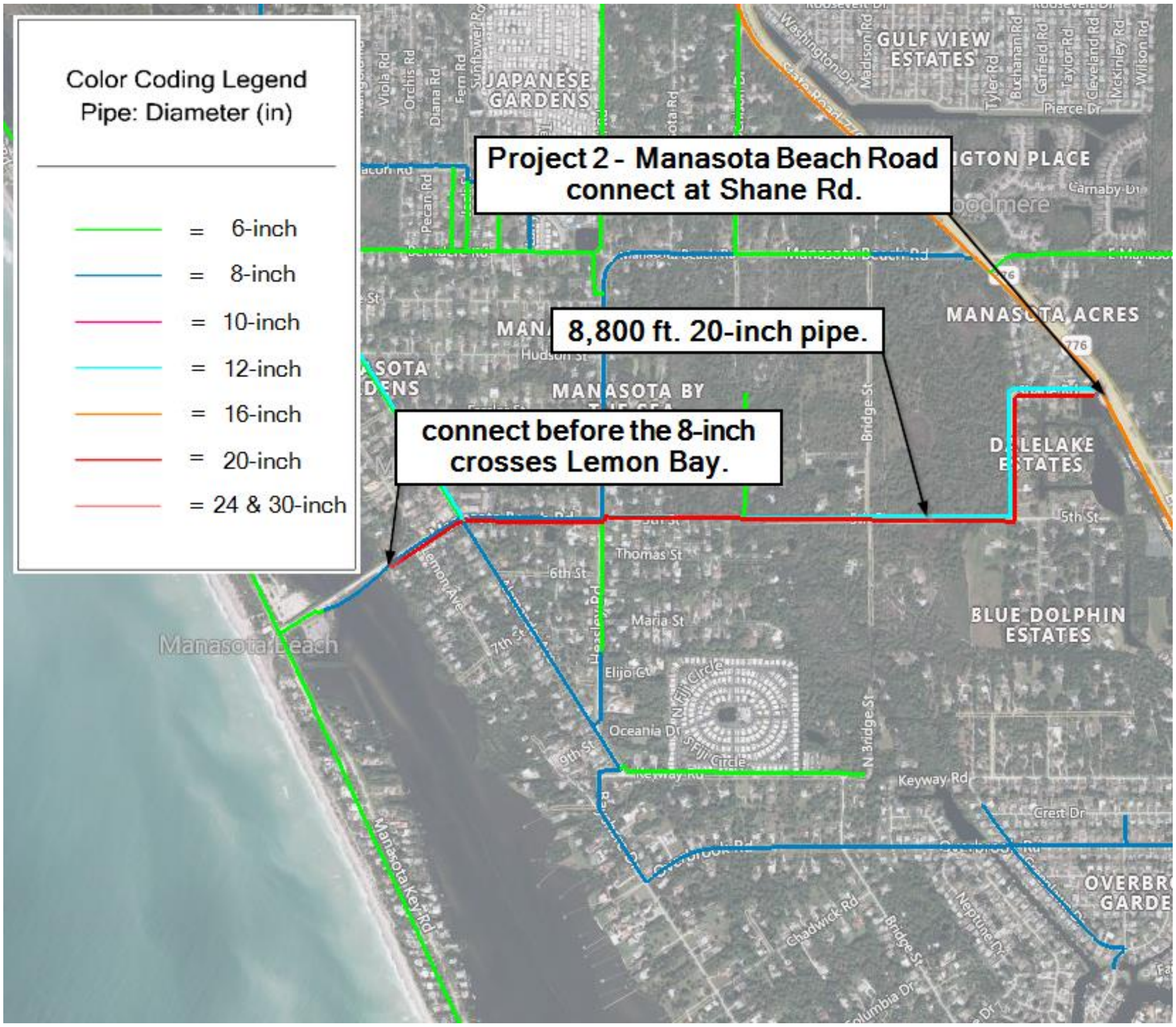

Figure 8-3: Project 2 – Manasota Beach Rd

Project 3 – Beach Rd

Project 3 consists of improvements along Beach Rd and starts within the intersection of Beach Rd and S McCall Rd. The project will consist of 6,000 ft. of 16-inch diameter pipe and ends at the intersection of Beach Rd, Gulf Blvd., and N Beach Rd. The project will add parallel pipes where there are mains less than 16 inches. The bridges currently have 16-inch mains crossing the bay and will not have improvements. The Project consists of three segments of pipe within the land portion of the road. The segments are 1,000, 3,000, and 2,000 feet long.

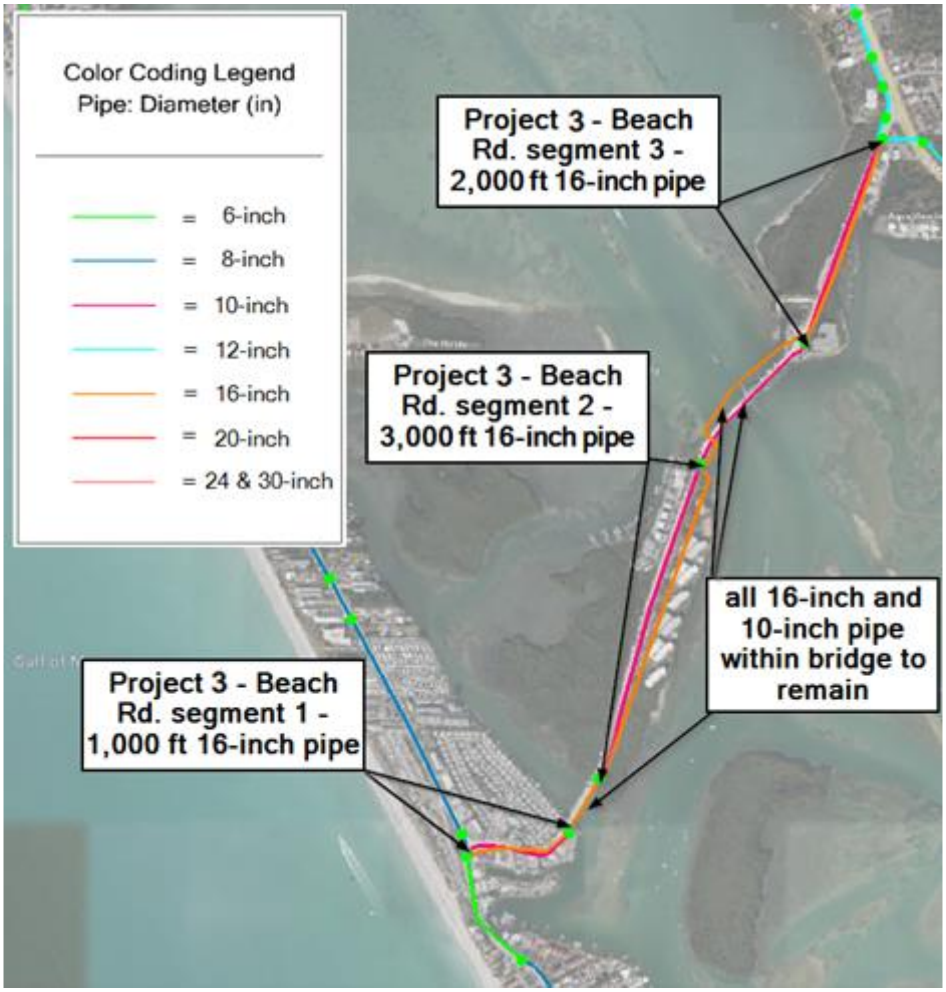

Figure 8-4: Project 3 – Beach Rd

Project 4 – Alamander Ave

Project 4 consists of an additional pipe along Alamander Ave. This project builds upon project 1 and increases capacity to the northwest. Project 4 starts within the intersection of Alamander Ave and Manasota Beach Rd. The project consists of 5,000 ft. of 12-inch diameter pipe and ends at the intersection of Alamander Ave and Ocelot Rd.

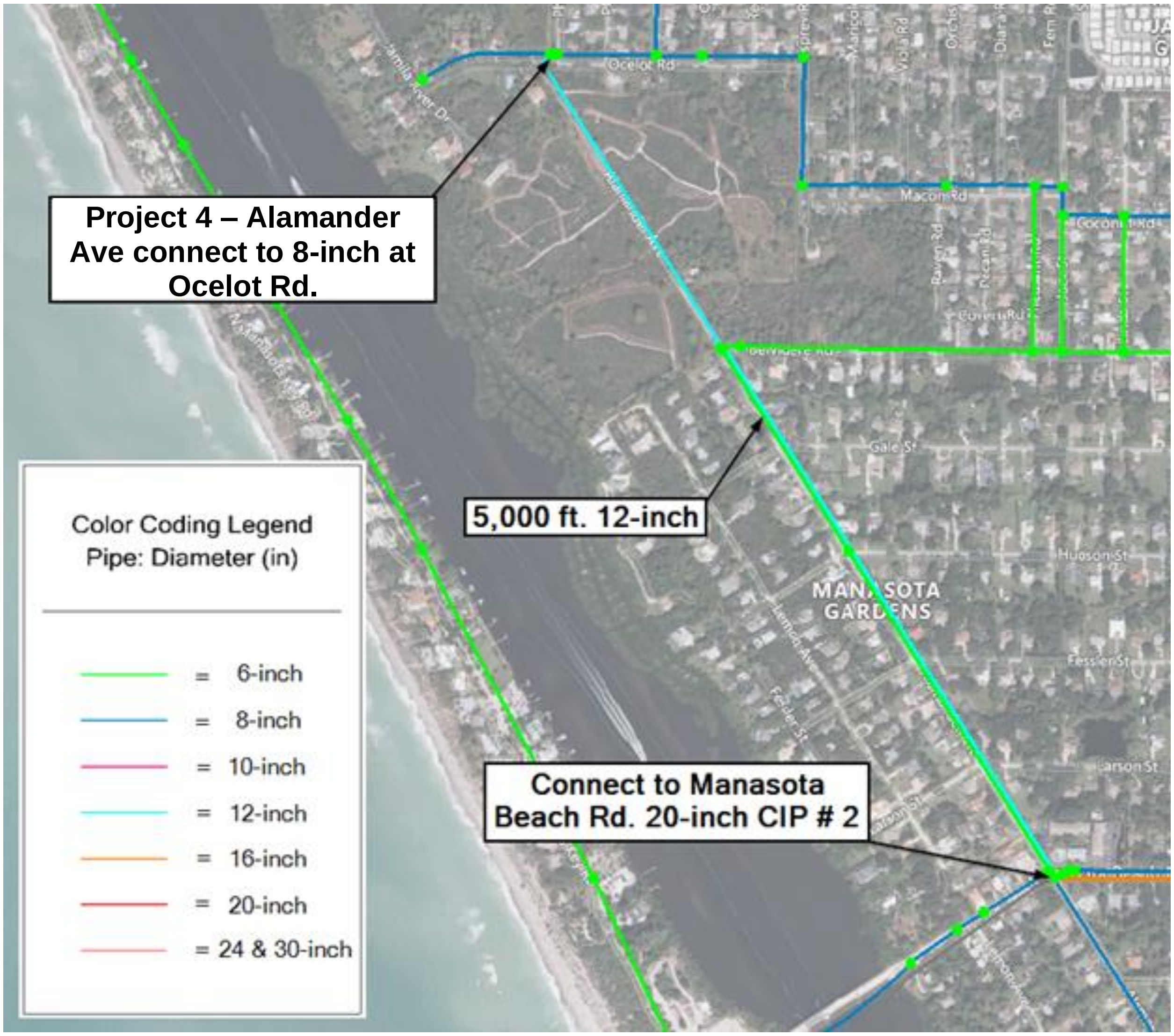

Figure 8-5: Project 4 – Alamander Ave

Project 5 – Lemon Bay

Project 5 is an alternative to projects 2 and 3. It consists of a directional drill across Lemon Bay and additional piping within the land. The directional drill will be 5,100 ft. of 16-inch pipe and the pipeline on land will be approximately 2,500 ft. The pipeline will connect to the 12-inch pipe within the intersection of Dearborn St. and Old Englewood Rd. Then the pipe will route to a pit location and be directionally drilled across Lemon Bay due west. From the receiving pit the pipe will then connect to the existing 6-inch pipe within Manasota Key Rd. This alternative brings more redundancy to the system, but it does not provide as high a level of service to the northwest part of the district as projects 2 and 5. There are pressures at 39 and 40 psi near Lemmon Ave. and Beach Rd. during the 2043 simulation.

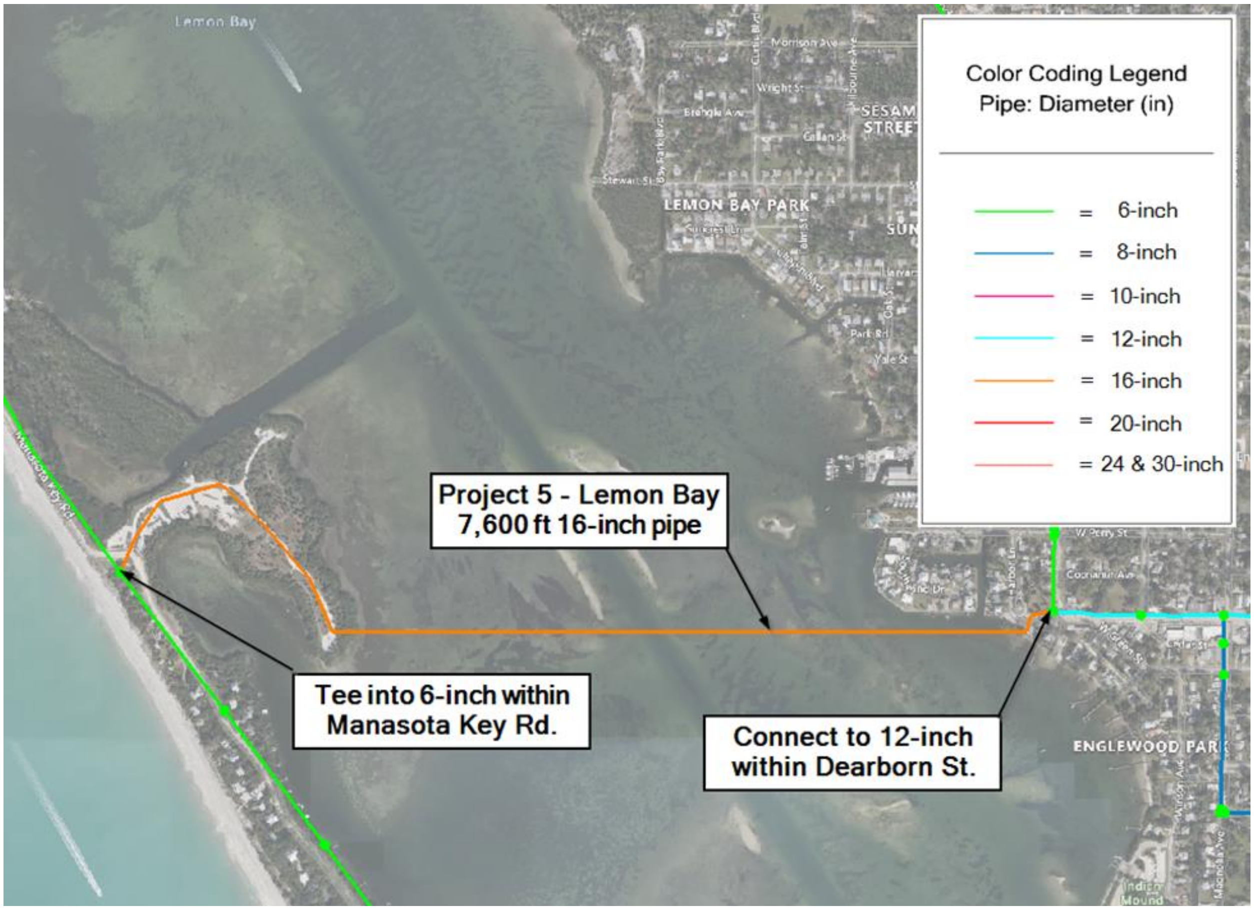

Figure 8-6: Project 5 – Lemon Bay

Project 6 – Pump Station Upgrades

This project would involve upgrades to the booster pump station to increase pressure through the distribution system and achieve additional capacity. It is recommended that the District consider increasing the pumping pressure from 57 to 70 psi. Increasing the pressure threshold in with the VFD is recommended for the existing system as well as for the 2043 and 2073 scenarios to increase pressure throughout the system and deliver targeted level of service.

In the state of Florida, statutes require the largest pump at a pump station to be considered out of service to determine firm capacity. With a projected peak flow of over 9,500 gpm, the existing pumping station will be operating at or beyond its firm capacity within the next 20 years. Additional pumping capacity is recommended to achieve the projected operating requirements. This pump will need to be equal to or greater than the largest existing pump. Correspondingly, increasing the pumping pressure to 70 psi requires provisions to the elevated storage tank would need to be made, such as adding an altitude valve, to limit the tank being overfilled. This tank may also be replaced with a hydropneumatic tank at ground level or a reinforced concrete elevated storage tank.

Project 7 – Hydraulic Model Upgrades

Consider improving the WaterGEMS steady-state hydraulic model to include a more comprehensive network to better analyze fire flow, water age, and Diurnal patterns. This would include further expansion of the hydraulic model network with GIS information, performing field testing of system pressures and flows, calibrating the hydraulic model, and running flow scenarios.

9 Conclusions

HDR has modeled how the future distribution system will perform after all the above CIPs are implemented. There are two options to provide similar levels of service. As stated earlier, project 5 can replace projects 2 and 3. Projects 1, 4, 5, 6, and 7 will be considered Alternative 1 and projects 1, 2, 3, 4, 6, and 7 will be considered Alternative 2. Neither alternative modeled herein shows results with Project 1a utilized.

Alternatives 1 and 2 both evenly distribute pressure throughout the system in the 2043 projection. In the 2073 projection, Alternative 1 has lower pressure in the southmost area of the system, while Alternative 2 keeps a low pressure throughout the system. The velocity distributions are similar for both alternatives, however, Alternative 1 distributes a higher velocity at the center of Manasota Key, while Alternative 2 distributes a higher velocity at the ends of Manasota Key. Both Alternatives provide similar fire flow distribution, however, Alternative 1 provides more fire flow availability at Manasota Key.

Alternatives 1 and 2 provide similar improvements of the systems velocity distribution and fire flow availability, but Alternative 2 provides a better long-term distribution of pressure throughout the network. Alternative 1 will be less impactful on the community, while construction on the beach roads in Alternative 2 will require a traffic control plan.

9.1 Alternative 1

Alternative 1 will meet or exceed the design criteria established for the master plan in the modeled 2043 scenario and will require additional infrastructure upgrades by 2073. During model simulations Alternative 1 Improved velocity and pressure modeled in 2043 and 2073. Results are shown in Figure 9-1, Figure 9-2, Figure 9-3, and Figure 9-4. Additionally, a FF test was also run with the CIP recommendations for the 2043 scenario shown in Figure 9-5. In addition to Project 6 upgrades to the booster station should be anticipated before 2073 and after 2043.

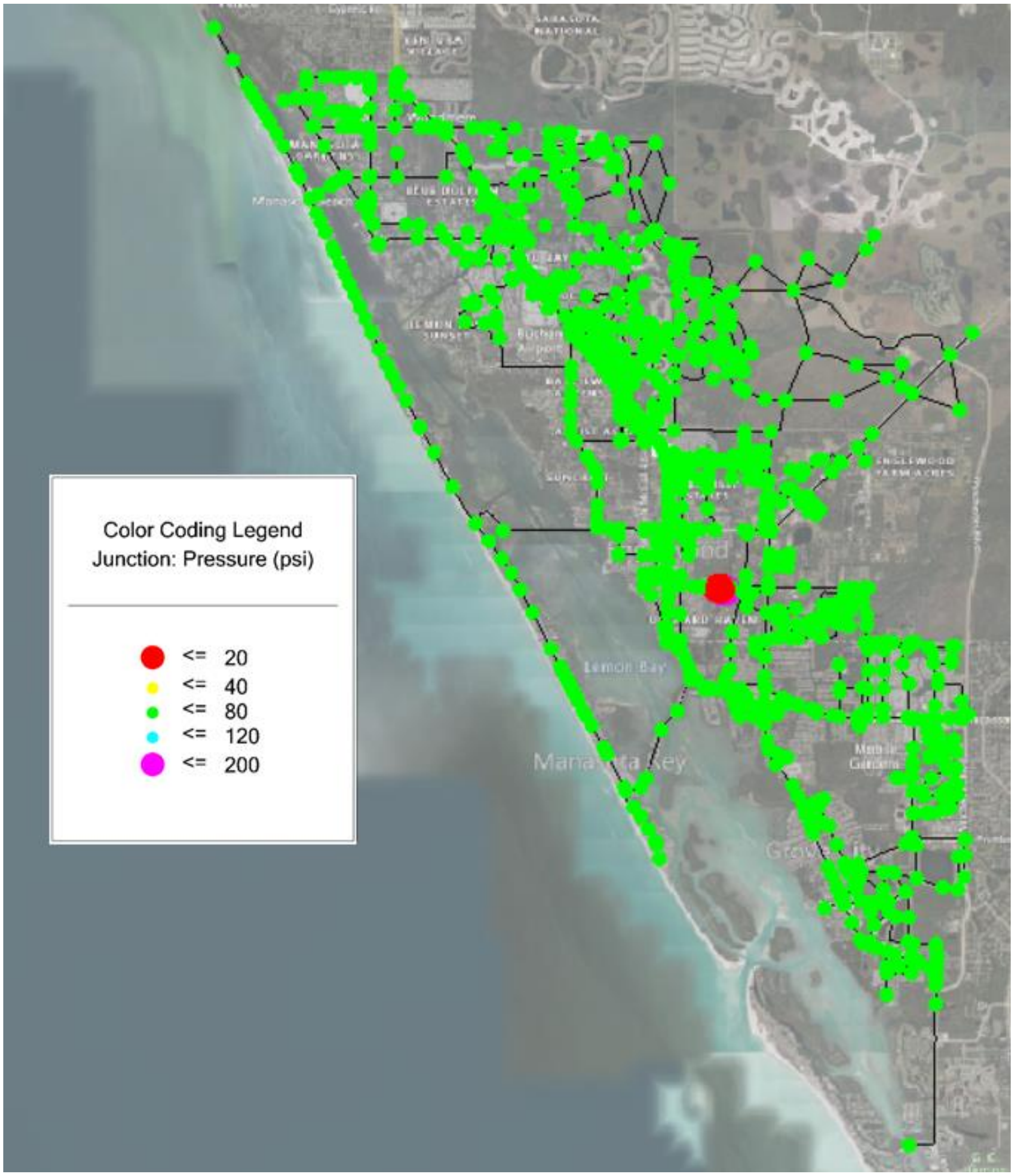

Figure 9-1: Alternative 1 Pressure Results from CIP Improvements Simulation in 2043

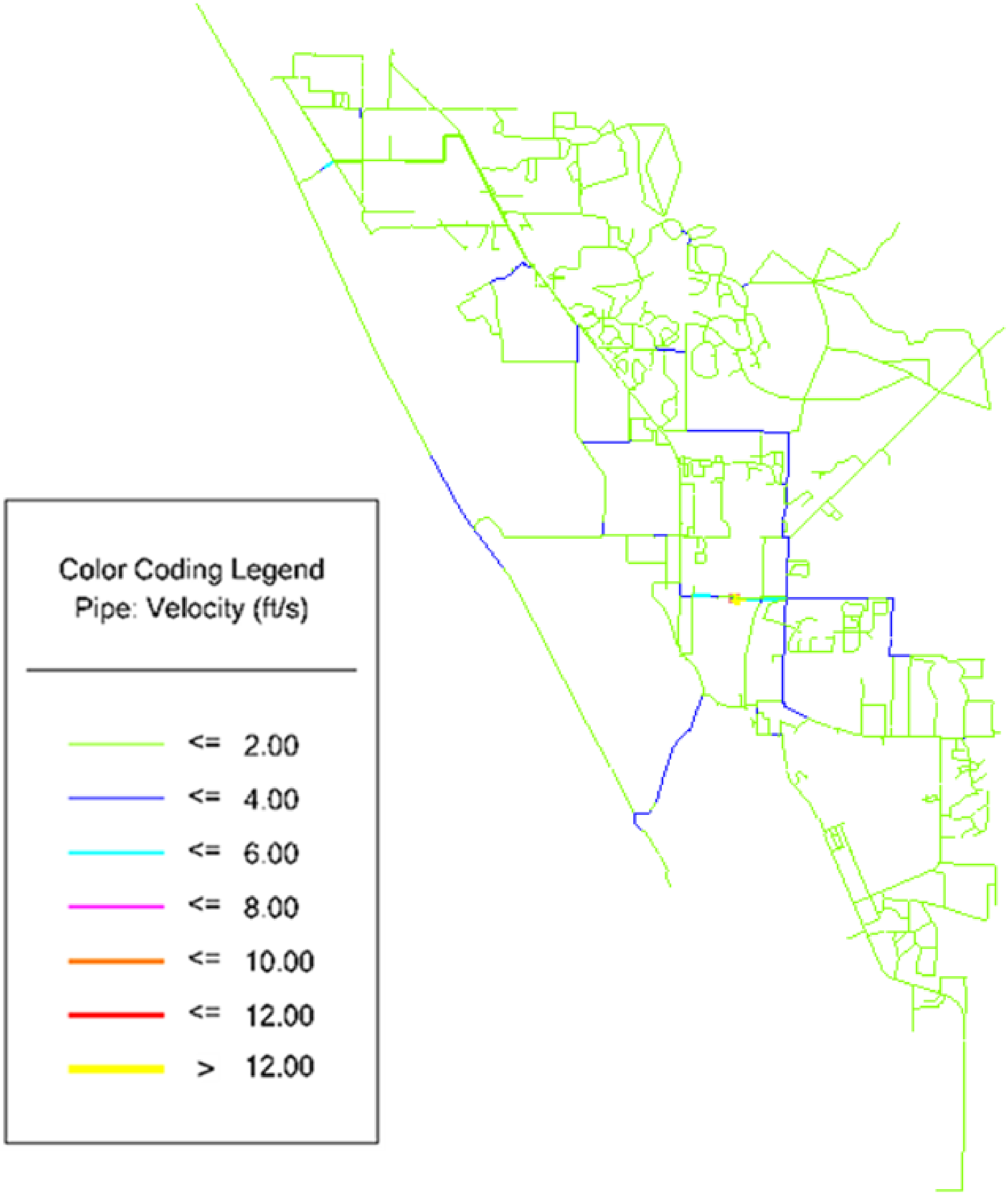

Figure 9-2: Alternative 1 Velocity Results from CIP Improvements Simulation in 2043

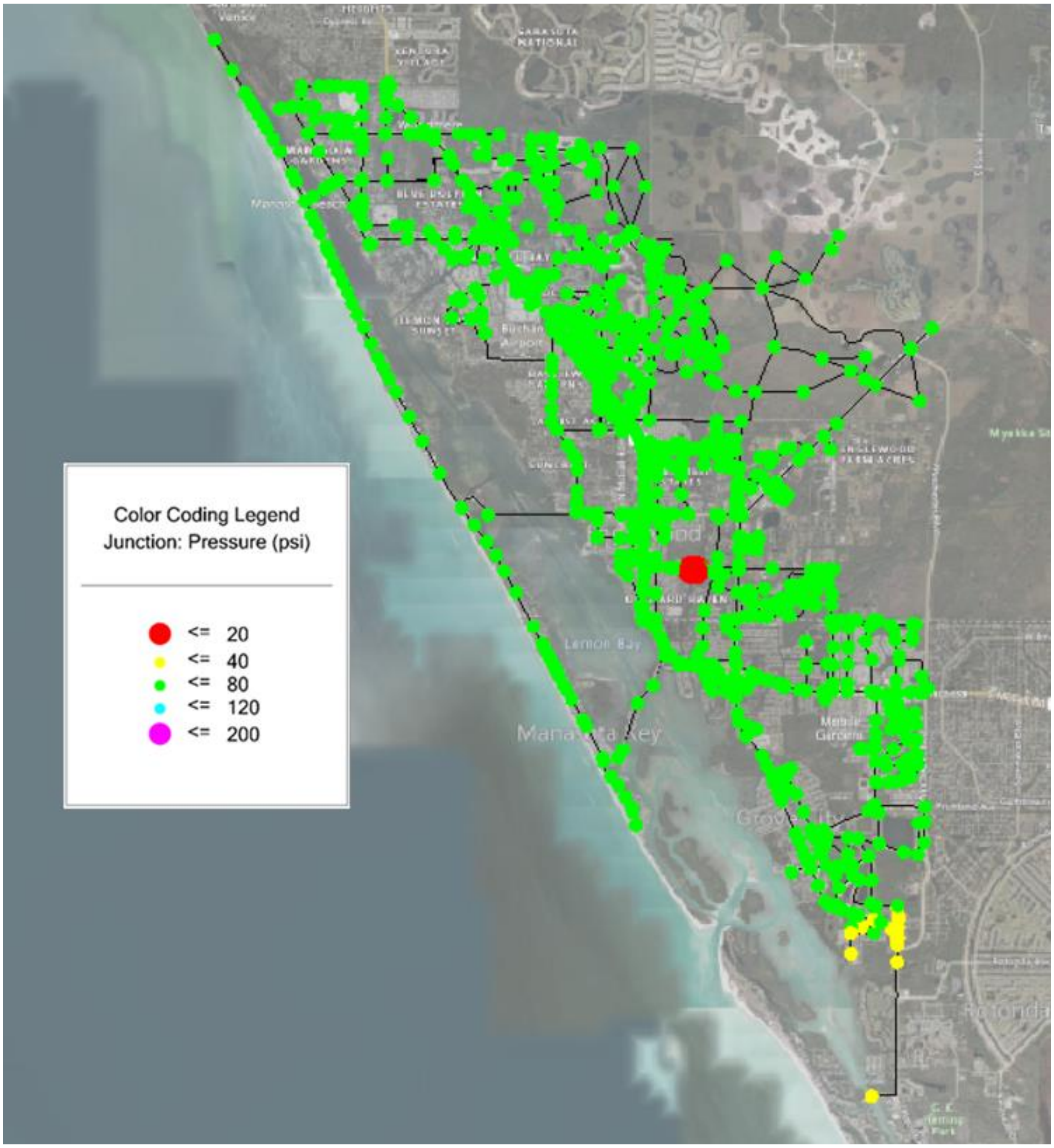

Figure 9-3: Alternative 1 Pressure Results from CIP Improvements Simulation in 2073

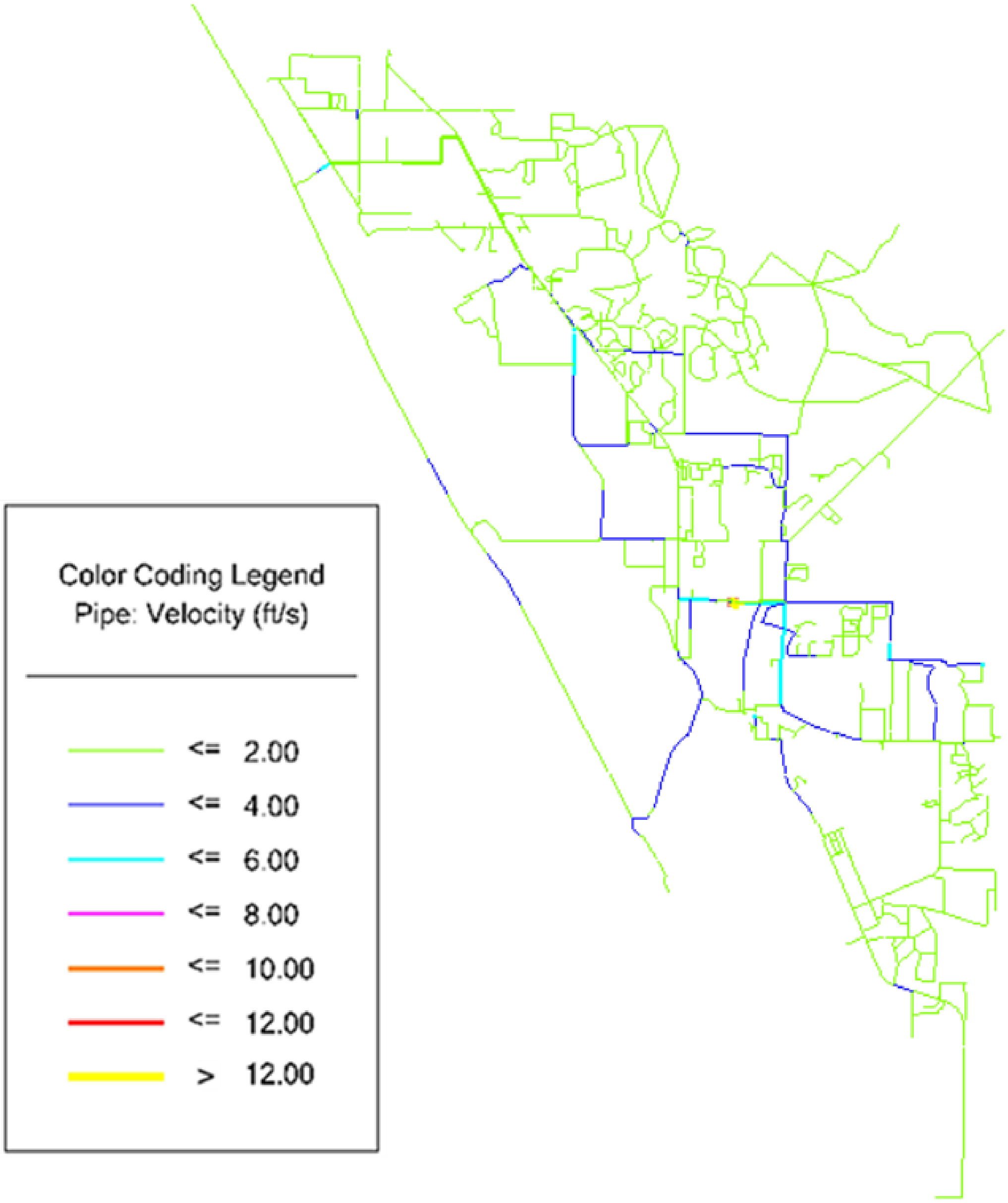

Figure 9-4: Alternative 1 Velocity Results from CIP Improvements Simulation in 2073

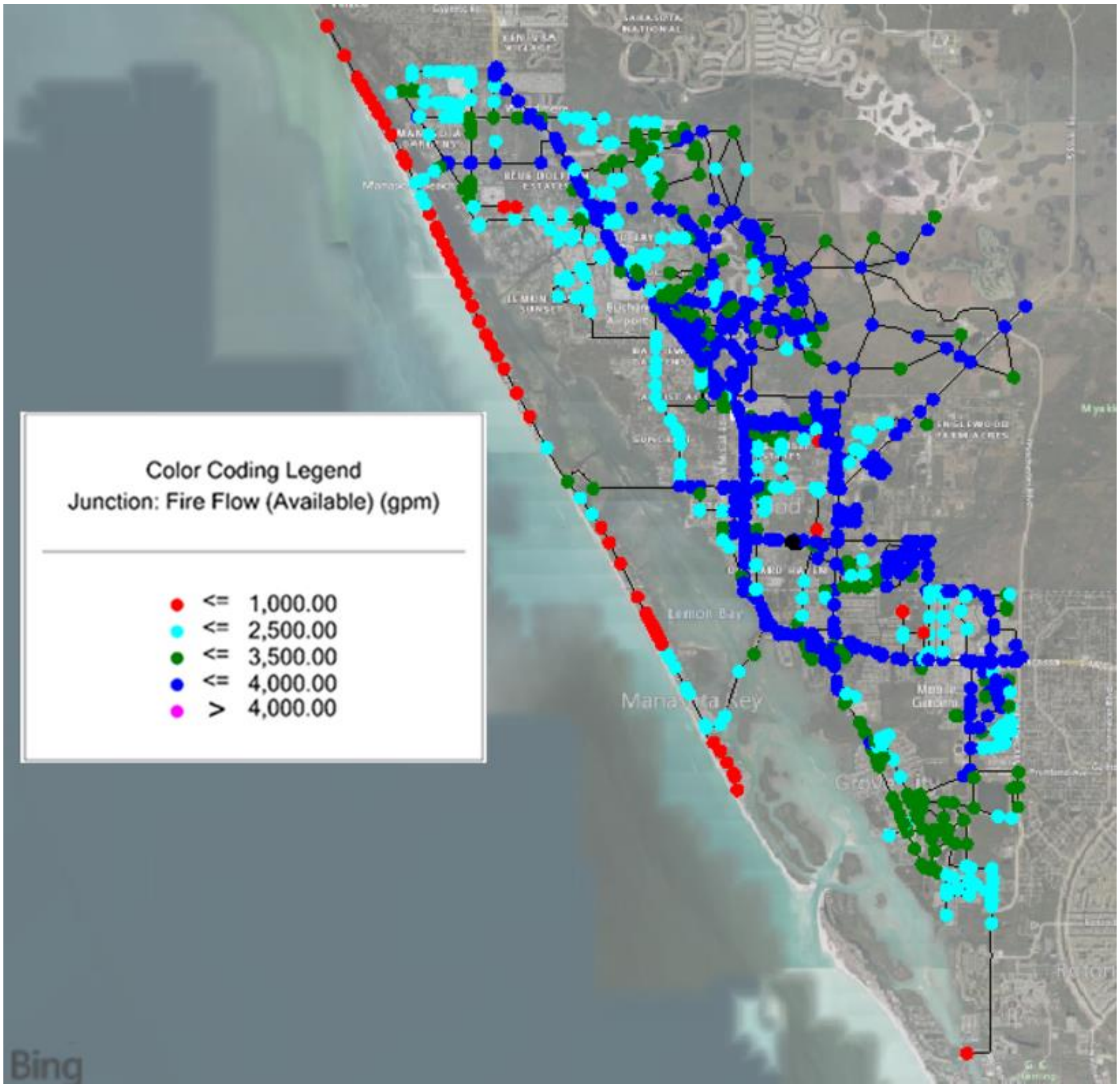

Figure 9-5: Alternative 1 Fire Flow Results from CIP Improvements Simulation in 2043

9.2 Alternative 2

Alternative 2 will meet or exceed the design criteria established for the master plan. During model simulations Alternative 2 Improved velocity and pressure modeled in 2043 and 2073 results are shown in Figure 9-6, Figure 9-7, Figure 9-8, and Figure 9-9. Additionally, a FF test was also run with the CIP recommendations for the 2043 scenario shown in Figure 9-10. In addition to Project 6 upgrades to the booster station should be anticipated before 2073 and after 2043.

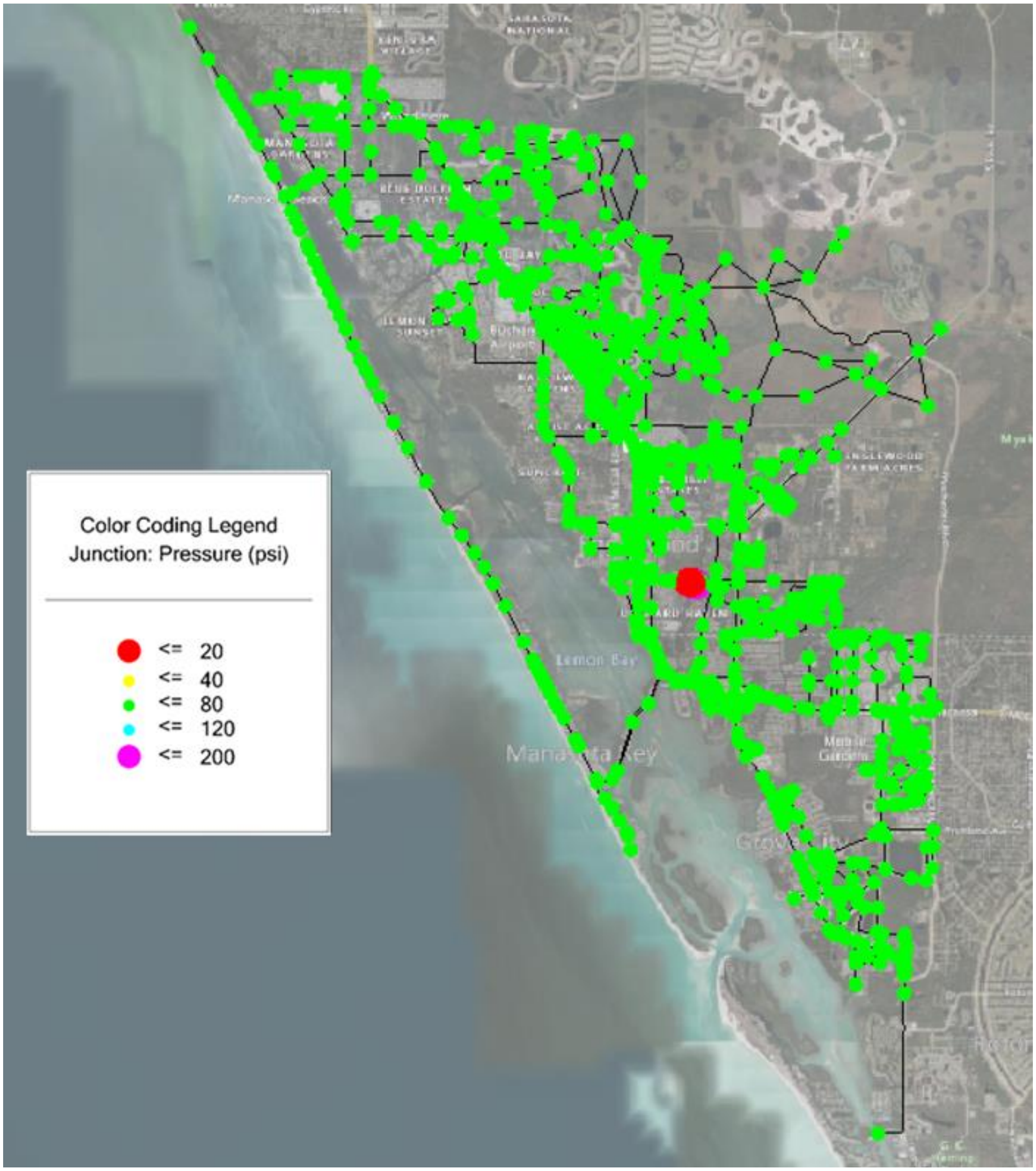

Figure 9-6: Alternative 2 Pressure Results from CIP Improvements Simulation in 2043

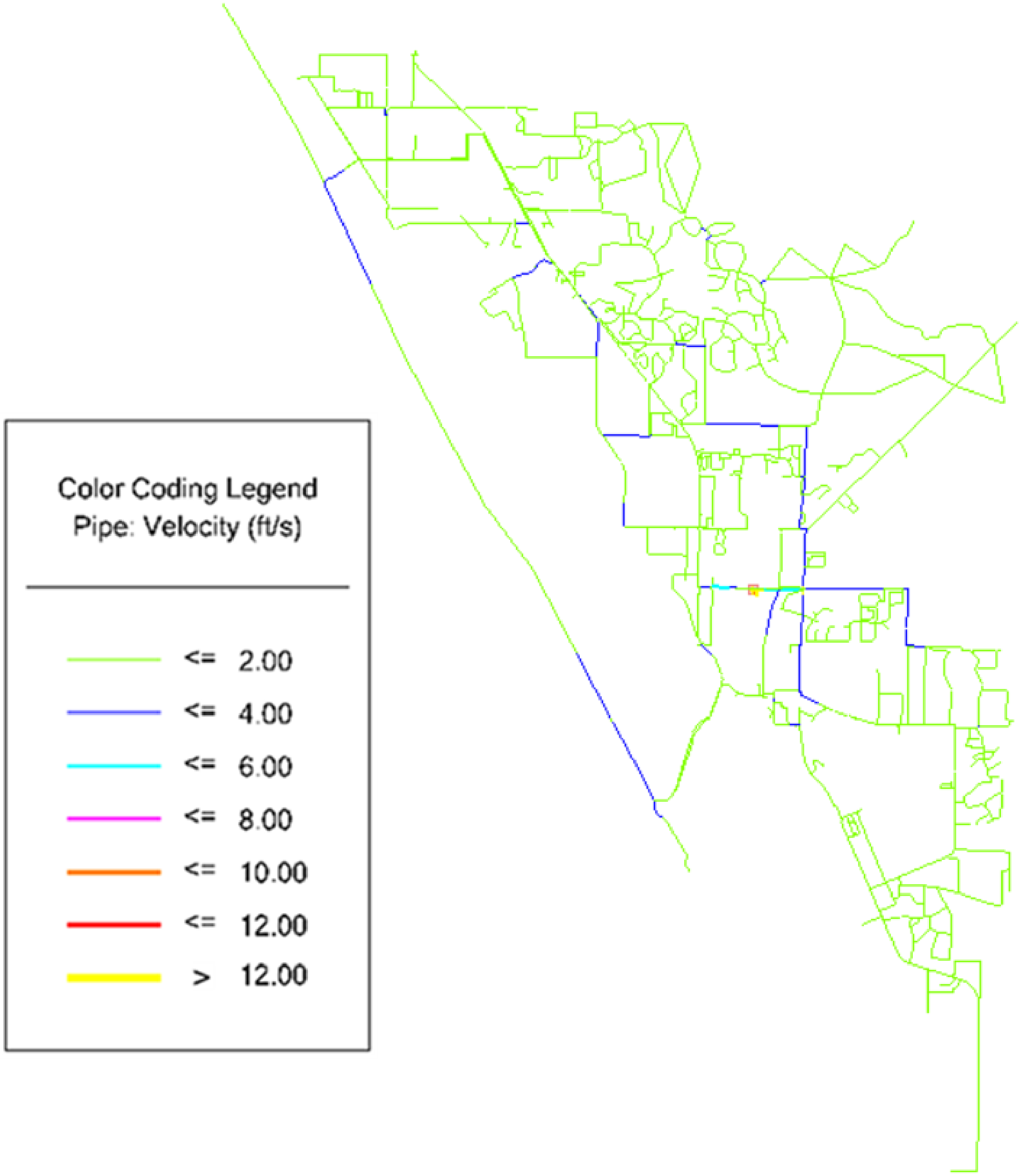

Figure 9-7: Alternative 2 Velocity Results from CIP Improvements Simulation in 2043

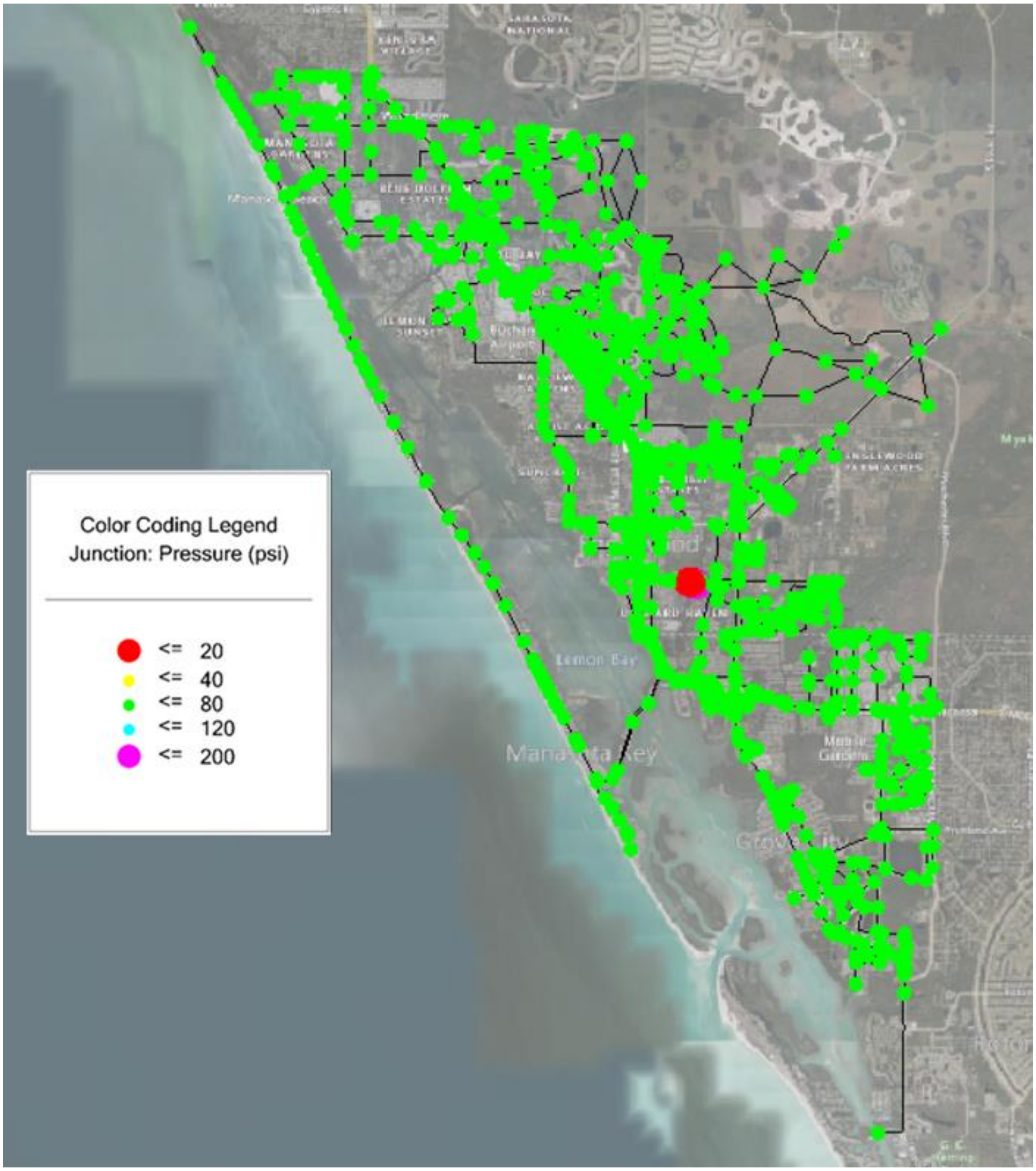

Figure 9-8: Alternative 2 Pressure Results from CIP Improvements Simulation in 2073

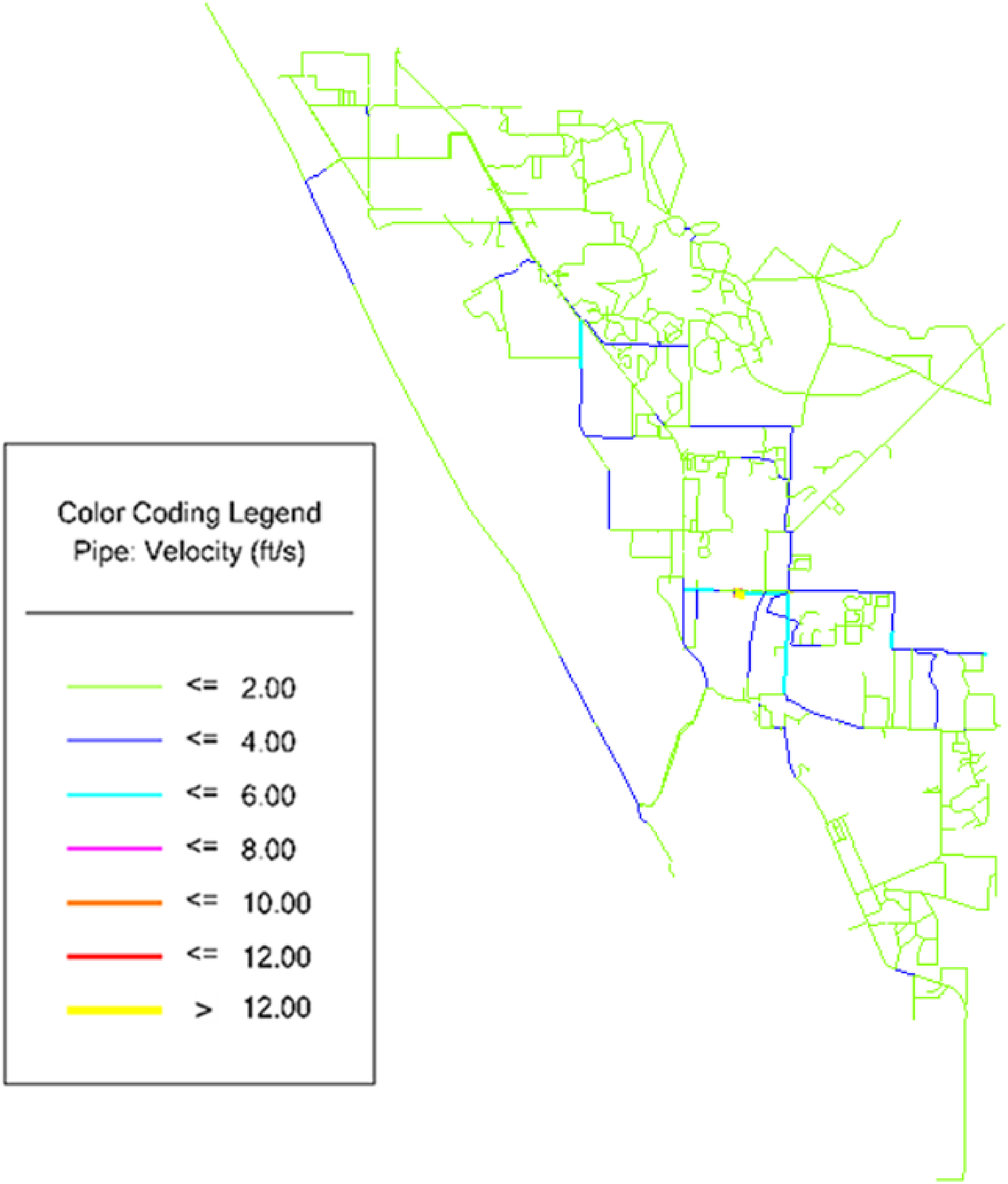

Figure 9-9: Alternative 2 Velocity Results from CIP Improvements Simulation in 2073

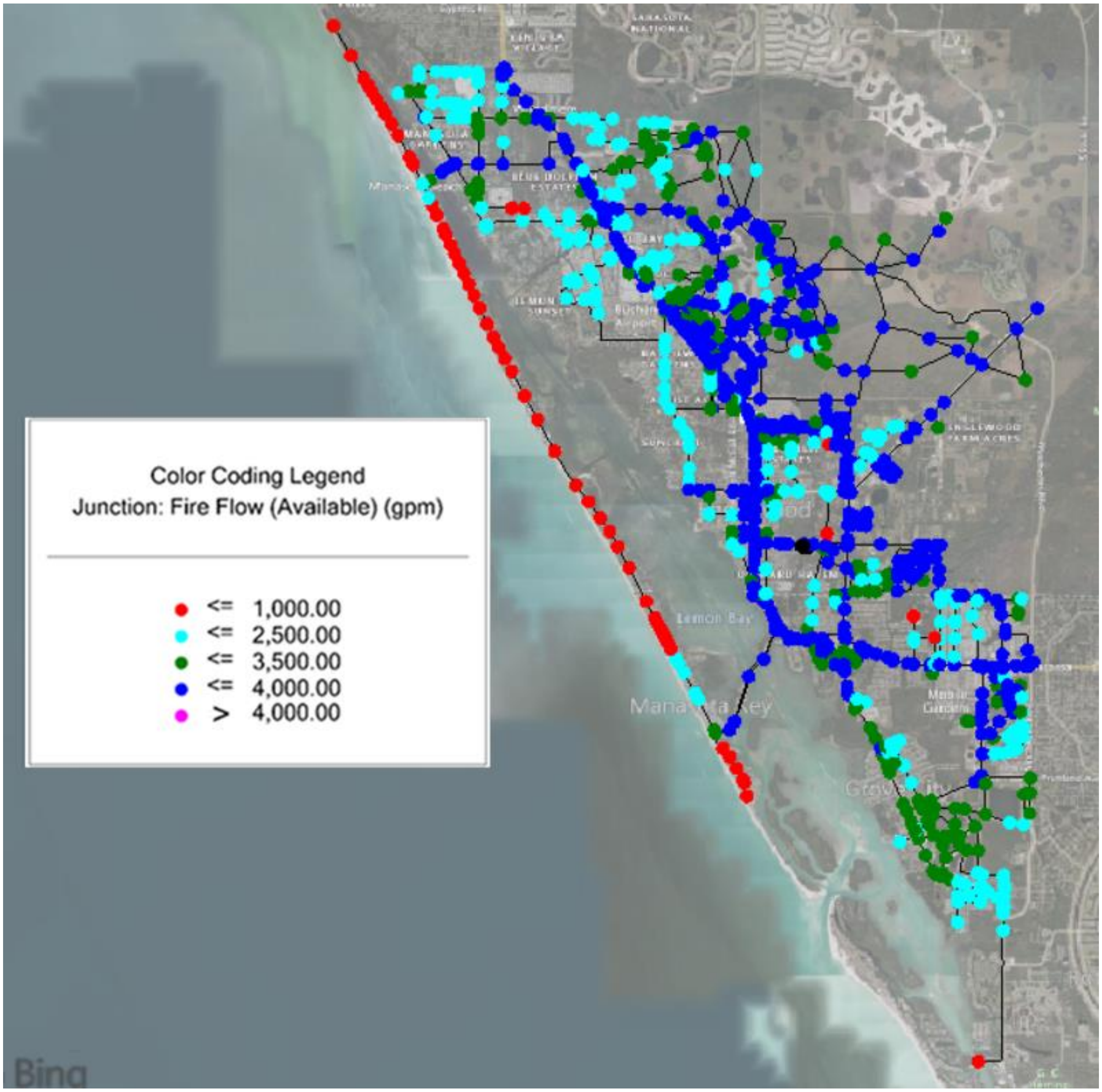

Figure 9-10: Alternative 2 Fire Flow Results from CIP Improvements Simulation in 2043