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MOUNT PLEASANT WATERWORKS CLEAN WATER

Ex-Officio
Will Haynie, Mayor
Joe Bustos, Chair
Water Supply Committee, Town Council

Clay Duffie, **General Manager**

RECEIVED
JUL 31 2018
BUREAU OF WATER

Dr. Mike Marcus
Chief
Bureau of Water
2600 Bull Street
Columbia, SC 29201

Re: Groundwater withdrawal permitting for the Trident Capacity Use Area

Dear Dr. Marcus:

It has been a pleasure reacquainting with you and hope you will enjoy your new position as Chief for the Bureau of Water.

The information contained herein is supplemental to the renewal application for a groundwater withdrawal permit for Mount Pleasant Waterworks (MPW), public water supply 10WS006 dated July 31, 2018.

In a conversation with you and Director of Environmental Affairs, Myra Reece, you offered to answer any and all questions we may have relative to positions of the Department, its regulations, policies, and procedures. We may not have included all of our questions, but this should get us started.

Groundwater Management Plan (GMP) for the Trident Capacity Use Area
As noted in previous correspondence and conversations involving the Berkeley, Charleston, Dorchester Technical Advisory Committee (BCD TAC), there is a desire to involve local stakeholders in making revisions and additions to the current plan. This process was not possible to include this round of permit renewals. A subcommittee to recommend criteria for evaluating local permits has been formed and has met twice, see attached agenda/packet from the July 12, 2018, meeting and minutes from the August 15, 2017 meeting. We would hope the Department would allow this committee to do its work and BCD TAC to make recommendations on the elements missing from the current plan. Working together over the next permitting cycle should provide adequate time for this work to be completed.

Is the Department willing to accept recommendations from the local stakeholders on making revisions and additions to the current plan?

Chapter 5 of the Groundwater Use and Reporting Act, Section 49-5-60 specifies the Department shall issue permits in accordance with the approved plan.

Is language in the GMP or regulation that covers the process recently used by the Department?

Is there language in the GMP or regulation for presenting a "suggested" withdrawal amount on the permit?

Is there language in the GMP or regulation to support the calculation for the corrected suggested limit based on the maximum annual withdrawal over the last 10 years plus 20%? If no, then please provide the basis for this calculation.

We believe the approach the Department is implementing is arbitrary and capricious. The Department's letter says the rationale for the suggested limit is based on the maximum annual withdrawal over the last ten years plus 20%. Our maximum annual withdrawal over the past ten years was 1700 mg/y in 2017, adding 20% would calculate to 2040 mg/y. See the attached table. Can you please explain how the corrected suggested limit of 1350 mg/y was calculated?

In the Department's letter dated July 9, 2018, under "**Your Suggested Permit Withdrawal Limit"** states that " Per R.61-113, Sections E and F, justification is required if a withdrawal limit exceeds the suggested limit is requested for consideration". Out of an abundance of caution, our permit application complies with these Sections as MPW is requesting limits above the corrected suggested limits in your letter.

Is language in R.61-113 that makes the above-quoted statement? Can you clarify how this requirement is applied since "suggested limits or corrected suggested limits" is not in the language of these Sections?

Why did MPW not get the April 24, 2018 letter sent to all other permittees in the Trident Area?

What prompted the Department to correct their suggested withdrawal limits and return the total permitted withdrawals back to the original limit for 7 permittees? See an attached summary of the July 9, 2018 letters sent by the Department.

In the **Trident Capacity Use Area Groundwater Evaluation** presented at the BCD TAC meeting on July 19, 2018, a couple of terms need clarifying. Page 24, the word "severe" cone of depression is used, and on Page 25, the word "stress" on the aquifer is used. Are these terms clearly defined in regulation or the GMP?

State Water Plan

As you are aware, the State Water Planning process is now moving forward on several fronts. The USGS has been engaged by SCDNR to perform a regional groundwater assessment. This groundwater flow model should be complete in the summer of 2019. A groundwater flow model technical advisory committee (TAC) has been formed with the Department represented by Alex Butler and Rob Devlin along with other SCDNR folks, academics, and four groundwater users. This group hopes to provide a white paper with recommendations on evaluation criteria for groundwater management decisions, see attached minutes.

With the State Water Plan a few years off, it seems logical to use the State Water Plan as guidance in developing local evaluation criteria. The State Plan should be substantially complete before the 2023 permit renewals are considered.

Is the Department willing to wait on the development of criteria for evaluating groundwater withdrawals as part of the State Water Plan before "suggesting" limits below current permit limits? If no, please explain why not.

Fiscal Impact of the Departments Suggested Withdrawal Limits

Being a public agency, MPW uses publicly available financing for our long-range capital improvements recommended in our Utility Master Plan. Our financing can be provided by revenue bonds, bank loans, and the State Revolving Loan (SRF) program. MPW is rated by the Standard and Poors and Moodys, with ratings of AA+ and Aa1 respectively. We have received these ratings based on our capital improvement plans, our Cost Recovery Policy, and fiscal management that support the security of our bonds and

subsequent ability to repay these loans. Enclosed is our Comprehensive Annual Financial Report. Please note in the Management Discussion and Analysis section, page 18, the schedule of outstanding debt and annual debt service. ***The Department suddenly reducing our ability to meet current water demand would result in MPW not meeting revenue projections and financial obligations.*** Our bond holders and the SRF could conceivably call our bonds, declare MPW in default of our bond ordinances or downgrade our credit rating. Any of these possible actions could have a devastating fiscal impact on MPW customers.

Is the Department required to evaluate the economic impact of permit decisions, particularly sudden and severe impact?

Reducing MPW's groundwater withdrawal to 1350 mg/y will mean MPW cannot meet our current water demand for our 90,000 customers this year. Therefore, the beneficial use of groundwater is to meet the domestic needs of these 90,000 people, provide for our commercial businesses and economic development, while providing fire protection in the Town of Mount Pleasant and Charleston County. Our public water system provides public health and safety to our community.

MPW is providing documentation and justification that the current withdrawal limit of 3953 mg/y remain unchanged.

We would appreciate a response to our questions prior to our meeting with the Department, which we requested for early September.

Sincerely,

MOUNT PLEASANT WATERWORKS

Clay Duffie
General Manager

CC: Myra Reece
MPW Board of Commissioners

Elected
Rick M. Crosby, Chair
Susan I. Mellichamp, Vice-Chair
H. Mac Jenkinson, Secretary-Treasurer
Diane D. Lauritsen, Ph.D.
John W. Burn

Ex-Officio
Will Haynie, Mayor
Joe Bustos, Chair
Water Supply Committee, Town Council

Clay Duffie, **General Manager**

July 30, 2018

RECEIVED
JUL 31 2018
Water Monitoring, Assessment & Protection Division

Alexander Butler
Manager
Water Quantity Permitting Section
Bureau of Water
S.C. Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

RE: Groundwater Withdrawal Permit Renewal/#10WS006 Charleston County.

Dear Mr. Butler:

The following is Mount Pleasant Waterworks' (MPW) response to the letter dated July 9, 2018 from the South Carolina Department of Health and Environmental Control (SCDHEC) regarding Groundwater Withdrawal Permit Renewal/#10WS006 Charleston County.

On behalf of the 90,000 customers served by MPW, all of whom rely on MPW for their daily water needs, and following the application process outlined in SCDHEC's letter, we have enclosed a completed renewal application and provided documentation to justify MPW's application request as described in R61-113, E and F.

As the sole water provider for one of the fastest growing communities in the country, MPW is sensitive to the protection of all water sources and cautiously request use of our most precious natural resource. Our track record clearly shows our dedication to the sustainability and protection of our water sources.

Mount Pleasant Waterworks request the Department not reduce any permitted withdrawals for the October 31, 2018 renewals and work with the local stakeholders as we develop better science and stakeholder-driven local criteria for the 2023 round of permit renewals.

Once the Department has reviewed the material submitted, we would appreciate a meeting in early September.

Sincerely,

MOUNT PLEASANT WATERWORKS

Clay Duffie
General Manager

CC: Myra Reece, Director of Environmental Affairs
Dr. Mike Marcus, Chief, Bureau of Water
Rob Devlin
MPW Commissioners

Application for Groundwater Withdrawal Permit
Bureau of Water - Renewal

RECEIVED
JUL 31 2018
Water Monitoring, Assessment & Protection Division

A. General Information.

1. Facility Name: Mount Pleasant Waterworks

2. Owner: Mount Pleasant Waterworks - 1010002	7. Contact: Clay Duffie
3. Address: PO Box 330 city: Mount Pleasant state: SC zip: 29465	8. Address: PO Box 330 city: Mount Pleasant state: SC zip: 29465
4. Telephone Number: (843) 884-9626	9. Telephone Number: (843) 884-9626
5. Fax Number: (843) 388-1177	10. Fax Number: (843) 388-1177
6. E-mail Address: clayduffie@mpwonline.com	11. E-mail Address: clayduffie@mpwonline.com

12. Type of Application: ☐ New ☐ Modification X RENEWAL

13. Total Requested Withdrawal Rates.

A. Million gallons Per Month: B. Million gallons Per Year: 3953

14. Purpose of Groundwater Withdrawal: (please indicate number of wells beside description which best applies, total below should equal total number of wells owned).

6	Water Supply (WS)		Industrial (IN)
	Golf Course Irrigation (GC)		Aquaculture (AQ)
	Agricultural Irrigation (AI)		Other (OT)

15. With this application include a road map showing the site location, (please make sure all roads leading to the site entrance are labeled).

16. With this application include a detailed site map with the location of all wells planned to be used for any type of groundwater withdrawal. Each existing and proposed well must include an owner ID on the map.

A. If groundwater wells are to be used for any type of irrigation the site map must include irrigated fields, which source will be irrigating specific fields, vegetation type, and total acres of each field.

17. The original application along with site and location maps must be mailed to SCHEC, 2600 Bull Street, Columbia, SC 29201, Groundwater Management Section.

An application guideline, permitting process outline, and a brief summary of the Groundwater use and Reporting Act is included with this application. The Groundwater use and Reporting Act summary provides the owner with a brief description of the laws that govern this application. The guideline is provided to help the applicant correctly complete the application. The outline provides a list of steps to be completed by the applicant and the Department. It is important that these steps be followed closely because no action will be taken by the Department until each step in the outline is completed and correct. If any information received is not correct, then the party in charge of the permitting will be informed. If the required information is not received, or is late, and the Department is not notified at least 15 days prior, the permit may be delayed, denied, or revoked.

18. Complete the following table for proposed wells. (*10WS006G05 Abandoned / Scheduled for Replacement)

Owner ID	Latitude	Longitude	Depth	Screened/Open Interval	Est. Yield (In GPM)	Flow Measurement Method
1) 10WS006G01	32.877655	-79.7653424	2297	See Tab B Water Master Plan		
2) 10WS006G02	32.8081976	-79.8917683	1993	See Tab B Water Master Plan		
3) 10WS006G03	32.7882799	-79.871895	1919	See Tab B Water Master Plan		
4) 10WS006G04	32.8435511	-79.8267041	2141	See Tab B Water Master Plan		
5) 10WS006G05*	32.8267078	-79.8486898	1960	See Tab B Water Master Plan		
6) 10WS006G06	32.820519	-79.8370998	1984	See Tab B Water Master Plan		
7)						
8)						

19. Complete the following table for all wells. Use abbreviations provided on previous page for Type of Use.

Owner ID	Type of Use	Max. monthly withdrawal rate (in million gallons)	Max. yearly withdrawal rate (in million gallons)
1) 10WS006G01	WS		10WS006 – Total Withdrawal 3953
2) 10WS006G02	WS		10WS006 – Total Withdrawal 3953
3) 10WS006G03	WS		10WS006 – Total Withdrawal 3953
4) 10WS006G04	WS		10WS006 – Total Withdrawal 3953
5) 10WS006G05	WS		10WS006 – Total Withdrawal 3953
6) 10WS006G06	WS		10WS006 – Total Withdrawal 3953
7)			
8)			
9)			
10)			
11)			
12)			
13)			
14)			
15)			
16)			
17)			
18)			

20. Please complete the following table for all other sources of water.

Owner ID - Purchased, Effluent, or Surface Water	Type of Use	Million gallons per month	Million gallons per year
Charleston Water System	WS	180	2190

21. Please describe any groundwater conservation methods that are in implemented or will be implemented within the next two years. (These include but are not limited to such practices as highly efficient equipment, wetting agents, other water sources, groundwater recycling, withdrawing from alternate aquifers, maintaining equipment, etc).

1. Implementation of Tiered water rate structure, referred to as "excessive use charges" in the mid-1990's.
2. Researched and developed the first permitted Aquifer Storage and Recovery Well in SC. We now have 3 ASR wells with plans to expand their use.
3. MPW website has conservation techniques highlighted.
4. MPW provides free water audits for homes and businesses.
5. MPW is implementing Advanced Metering Infrastructure (AMI) technology. 60% of all meter have been changed out. Change our project should be complete in 2019.
6. MPW uses AWWA M36 manual to evaluate water loss. Water loss is measured monthly with a goal of reducing water losses year to year.
7. MPW has implemented a Maximo work order system also known as Computerized Maintenance Management System (CMMS) to track preventative and corrective maintenance and ensure efficient operation.
8. MPW has implemented reuse for irrigation at two Town of Mount Pleasant recreational facilities.

B. Irrigation.

Field / Course ID	Vegetation	Acres
1)		
2)		
3)		
4)		
5)		
6)		
7)		
8)		
9)		
10)		
11)		
12)		
	Total Acres Irrigated:	

C. Industrial

1. Describe your operation, including the types of products produced, and the uses for groundwater in the industrial process. Please include reason to use groundwater rather than alternative sources of water.

2. Please Estimate to the best of your ability the volume of groundwater to be withdrawn and used for each industrial process. i.e. If you have 3 seperate cooling processes, please list them seperately by a known name such as 1,2,3, etc.

Process ID	**Million gallons per month**	**Million gallons per year**
Processing:		
Cleaning:		
Cooling:		

D. Signature.

I certify the information enclosed is true, complete, and that conservation measures will be researched and enacted when economically feasible.

Clay Duffie Printed/Typed Name	General Manager (Mount Pleasant Waterworks) Title
Clay Duffie Signature	07.24.2018 Date

Reasonable and appropriate documentation that the proposed water use is necessary (R.61-113, E.j.2.a.)

To live up to its Mission, Mount Pleasant Waterworks is also planning and evaluating alternatives to ensure it protects public health by providing safe clean water and protecting the environment by ensuring adequate water sources are sustainable and available for future generations. To do this effectively significant time and effort is spent planning. Two of the most significant water related planning reports have been included in this section. They are:

- *Mount Pleasant Waterworks Comprehensive Utility Master Plan, Five Year Update*; January 2016, prepared by CDM
- *Mount Pleasant Waterworks Water Supply Master Plan*; May 2018, prepared by Carollo

The above noted and attached reports provide information on the aspects of water use identified in the Trident Area Groundwater Management Plan as needed to accomplish the three primary goals of the Plan. Using exerts from the planning reports information for aspects will be noted below:

<u>Groundwater Sources Currently Utilized:</u>

MPW withdrawals groundwater from the Middendorf aquifer (McQueen Brach) using 6 deep wells.

Deep Well Components: 3,953 MGY – permitted withdrawal

- Water Supply Master Plan; pg. 2-4 & 2-5; Table 2.1

RO Treatment Plant Components: 8.1 MGD – plant capacity

- Water Supply Master Plan; pg. 2-6 & 2-7; Table 2.2

<u>Current Water Demand by Type and Amount Used:</u>

Summary of Current Supply: 18.5 MGD (includes storage) 14.0MGD (w/o storage)

- Water Supply Master Plan; May 2018; pg. 5-3; Table 5.1

Summary of Current Usage (2017): ADD – 9.0MGD MDD – 12.4MGD

- Surface Water (CWS): ADD - 6MGD MDD – 6MGD
- Groundwater (RO): ADD – 3.0MGD MDD – 6.4MGD

Groundwater Withdrawal					
Year	MGY	GPD	Production GPD	CWS contract, GPD	Nominal Water Demand
2004	2,744.57	7,519,373	6,955,419.66	2,000,000	8,955,420
2005	2,148.71	5,886,866	5,445,350.82	4,000,000	9,445,351
2006	1,782.78	4,884,329	4,518,004.11	4,500,000	9,018,004
2007	1,468.58	4,023,496	3,721,733.70	5,500,000	9,221,734
2008	1,279.00	3,504,110	3,241,301.37	5,500,000	8,741,301
2009	1,097.16	3,005,918	2,780,473.97	5,500,000	8,280,474
2010	1,172.05	3,211,096	2,970,263.70	5,500,000	8,470,264
2011	1,196.10	3,276,986	3,031,212.33	5,500,000	8,531,212
2012	1,221.40	3,346,301	3,095,328.77	5,500,000	8,595,329
2013	970.61	2,659,205	2,459,765.07	5,500,000	7,959,765
2014	1,233.80	3,380,274	3,126,753.42	5,500,000	8,626,753
2015	1,413.05	3,871,370	3,581,017.12	5,500,000	9,081,017
2016	1,700.04	4,657,644	4,308,320.55	5,500,000	9,808,321
2017	1,559.31	4,272,082	3,951,676.03	6,000,000	9,951,676
				Average Daily (MGD)	8,906,187

Current Aquifer Storage and Recovery and Water Reuse:

MPW has three aquifer storage and recovery wells and two water reuse systems.

ASR Components:

- Water Supply Master Plan; pg. 2-12; Table 2.3

Reuse at RRRWWTP (Sloan Park): 689,500 GPY

Reuse at CSWWTP (Duffy Park): 539,400 GPY

Population and Growth Projections:

Current Population: 90,000 (85,044 [TOMP] + 4,900 [Charleston County])

- Town of Mount Pleasant – Department of Planning: 2018 Demographics; pg. 4
- Charleston County – per billing data approx. 5.5% of total customers in the county

Projected Population: 115,000 – 125,000

Current Residential Equivalent Units (REU) Served: 52,392 (June 2018)

- Mount Pleasant Waterworks – Commission Meeting: July 22, 2018

Projected REU's Buildout: 72,078

- Comprehensive Utility Master Plan; pg. 2-11, Figure 2-7 & Table 2-5

Water Demand Projections

Buildout Water Demand Projections: 15.9MGD – ADD 25.4MGD – MDD

- Comprehensive Utility Master Plan; pg. 2-15, Table 2-6 and Figure 3.2

Buildout Seasonal Projections (ADD):

- Winter-14.08 MGD
- Summer-20.64MGD
- Shoulder-17.2MGD
- Water Supply Master Plan; pg. 3-5, Table 3.5

Buildout MDD Supply(s):

- CWS-Purchased: 12MGD
- RO/(Deep Well): 8.9MGD/(3898MGY)
- ASR: 2.5MGD
- CWS – Wholesale: 2.0MGD
- TOTAL 25.4MGD

Projected Opportunities for Aquifer Storage and Recovery, as well as reuse

Summary of Potential Sources:

- CWS, RO/Deep wells, ASR, Indirect Potable Reuse, Desalinization, Conservation, and Reclaimed Water System
- Water Supply Master Plan; pg. 5-18, Figure 5.9

Additional ASR facilities were evaluated to meet future MDD supply. It will require 5 new ASR wells.

- Water Supply Master Plan; pg. 5-32, Figure 5.13

Reuse was evaluated; traditional reclaimed water for large scale irrigation was determined not to be feasible.

Projected Groundwater and Surface Water Options

Summary of Potential Sources:

- CWS, RO/Deep wells, ASR, Indirect Potable Reuse (IPR), Desalinization, Conservation, and Reclaimed Water System
    - Water Supply Master Plan; pg. 5-18, Figure 5.9

MPW Strategic Plan (Tab 1) shows our commitment to further evaluate the use of ASR, IPR, and alternative reuse options.

Third Connection to Charleston Water System (CWS)

In February 2017, MPW and CWS signed a cost sharing agreement to design and construct a 3rd connection between the two systems. The location of the connection will originate on Sullivan's Island at CWS's 20-inch transmission line and will be bored under the intercoastal waterway and tie into MPW's 12-inch line on Ben Sawyer Blvd. A basis of design has been completed identifying several routes and

associated preliminary costs. Surveying and engineering design in underway on the selected route and construction is anticipated to begin in late 2019, early 2020.

Water Conservation Measures

Noted on Permit Renewal Application (Tab A) Item A.21.

Completed Renewal Application and locations of all existing and/or proposed wells
(R.61-113,E.1 and E.2, and E.2.c and E.j.1, and E.2.d-h, and E.2.b)

Mount Pleasant Waterworks is submitting our Application for Groundwater Withdrawal Permit – Bureau of Water – Renewal for the total withdrawal rate of **3953MGY.**

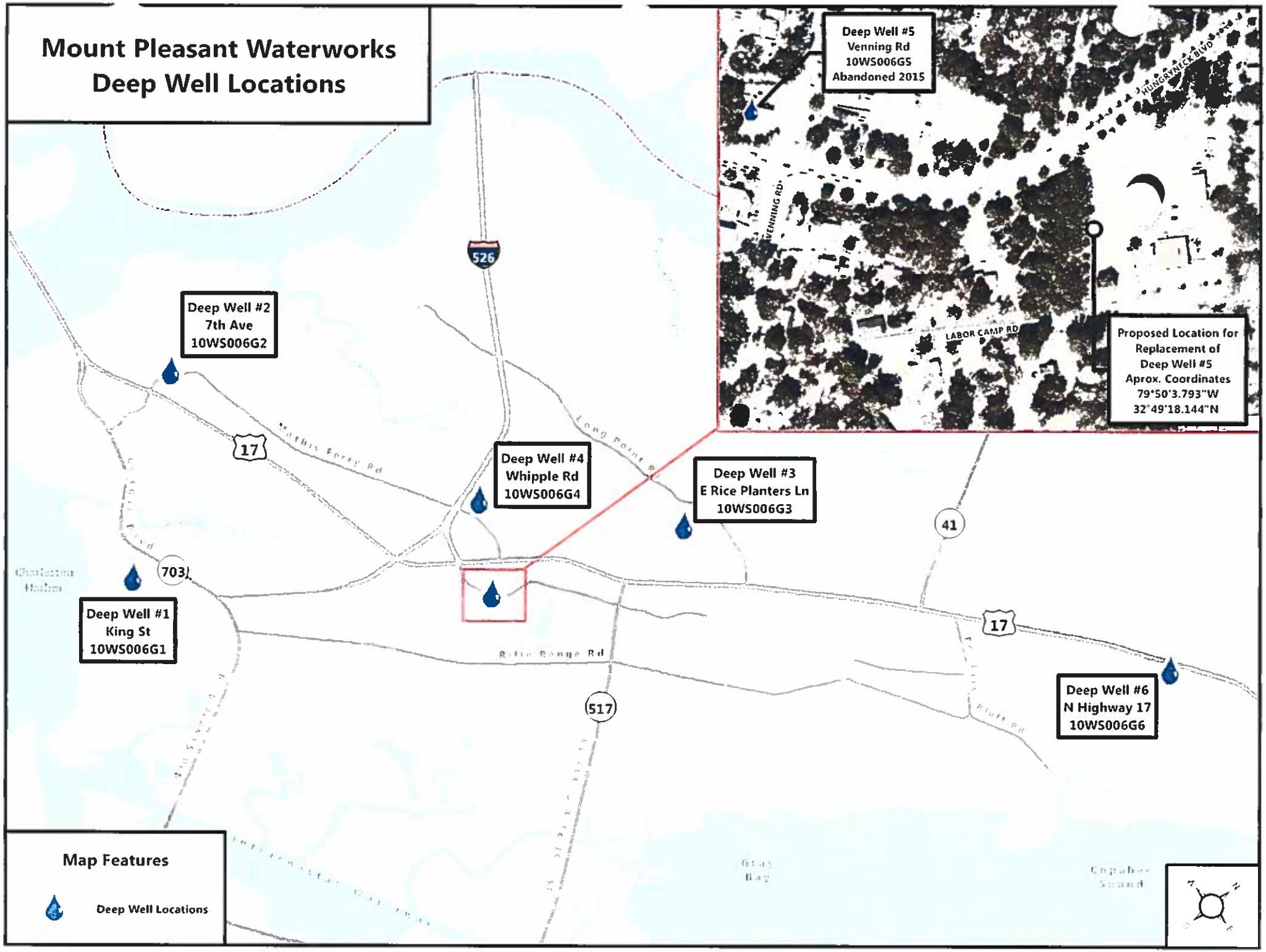
Our water management strategies include planning, funding and building facilities to meet the sustainable water needs of MPW's served population of 90,000 and the future customers that will need to be served. This planning effort starts with community/stakeholder input on local, regional and industry trends that must be considered as an organization to plan for the long-term success of MPW, our community and the resources we have been entrusted to protect. Using that input, MPW has recently completed our Strategic Plan 2018, enclosed herein. MPW's Strategic Plan includes several water management strategies and actions we will be implementing over the next few years. They include:

1. Research and evaluate the feasibility of alternative water sources by completing a 3rd connection with Charleston Water, improving blending, continue evaluation of groundwater flow models and expand the use of reclaimed water.
2. Plan, fund and build for growth by providing concurrent water and wastewater capacity for our customers.
3. Formally evaluate and utilize new and emerging technologies such as, groundwater recharge, potable water reuse along with our reporting and information technology.
4. Fully implement asset management to ensure our facilities are renewed and replaced in an efficient manner.
5. Implement a plan for improving product quality and operational efficiency by reducing non-revenue water.
6. Enhance environmental protection by engaging in the AWWA Partnership for Safe Water for distribution.

Many of these strategies and actions have already begun. In addition to just saying MPW will undertake these strategies and actions, dollars have been committed to studying, purchasing, and constructing these initiatives. In addition, Section 5- Capital Improvement Plan of our Annual Budget document has been enclosed to show that significant funds have been appropriated to completing our water management strategies.

Being a public agency, MPW uses publicly available financing for our long-range capital improvements recommended in our Utility Master Plan. Our funding can be provided by revenue bonds, bank loans, and the State Revolving Loan program. MPW is rated by the Standard and Poors and Moodys, with ratings of AA+ and Aa1 respectively. We have received these ratings based on our capital improvement plans, our Cost Recovery Policy, and fiscal management that support the security of our bonds and subsequent ability to repay these loans. Enclosed is a link to our Comprehensive Annual Financial Report. Please note in the Management Discussion and Analysis section, page 18, the schedule of outstanding debt and annual debt service. ***Should be Department suddenly reduce our ability to meet our current water demand would result in MPW not meeting our revenue projections and financial obligations.*** Our bondholders and the SRF could conceivably call our bonds, declare MPW in default of our bond ordinances or downgrade our credit rating. Any of these possible actions could have a devastating fiscal impact on MPW customers.

Mount Pleasant Waterworks Deep Well Locations



MOUNT PLEASANT WATERWORKS

STRATEGIC PLAN 2018

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MESSAGE FROM THE GENERAL MANAGER

IT HAS BEEN A GREAT PLEASURE TO WORK WITH THE BOARD OF COMMISSIONERS, STAFF, AND VARIOUS STAKEHOLDERS TO EXAMINE OUR STRENGTHS, OPPORTUNITIES, ASPIRATIONS, AND RESULTS, AND TO UPDATE OUR OVERALL STRATEGIC DIRECTION. THIS WILL ENSURE THAT WE REMAIN ACCOUNTABLE TO OUR RATEPAYERS AND MEET THE CHALLENGES AHEAD.

The Strategic Plan is a blueprint for excellence in service, technology, innovation, and environmental sustainability. The services we provide are vital to every person and business in our service area. It is our priority to prepare for challenges by developing solutions for today and the future.

At Mount Pleasant Waterworks, we will utilize the Strategic Plan as a clear vision for efficient and effective performance, financial responsibility, outreach, and leadership. It will make us leaders in our industry in the areas of customer service, technology, environmental protection, and business. I look forward to the steps we will take together and the impact in making sure that every dollar from our ratepayers goes farther, while improving our services to our customers, our town, and the environment.

—

Clay Duffie
General Manager

MESSAGE FROM THE COMMISSION CHAIR

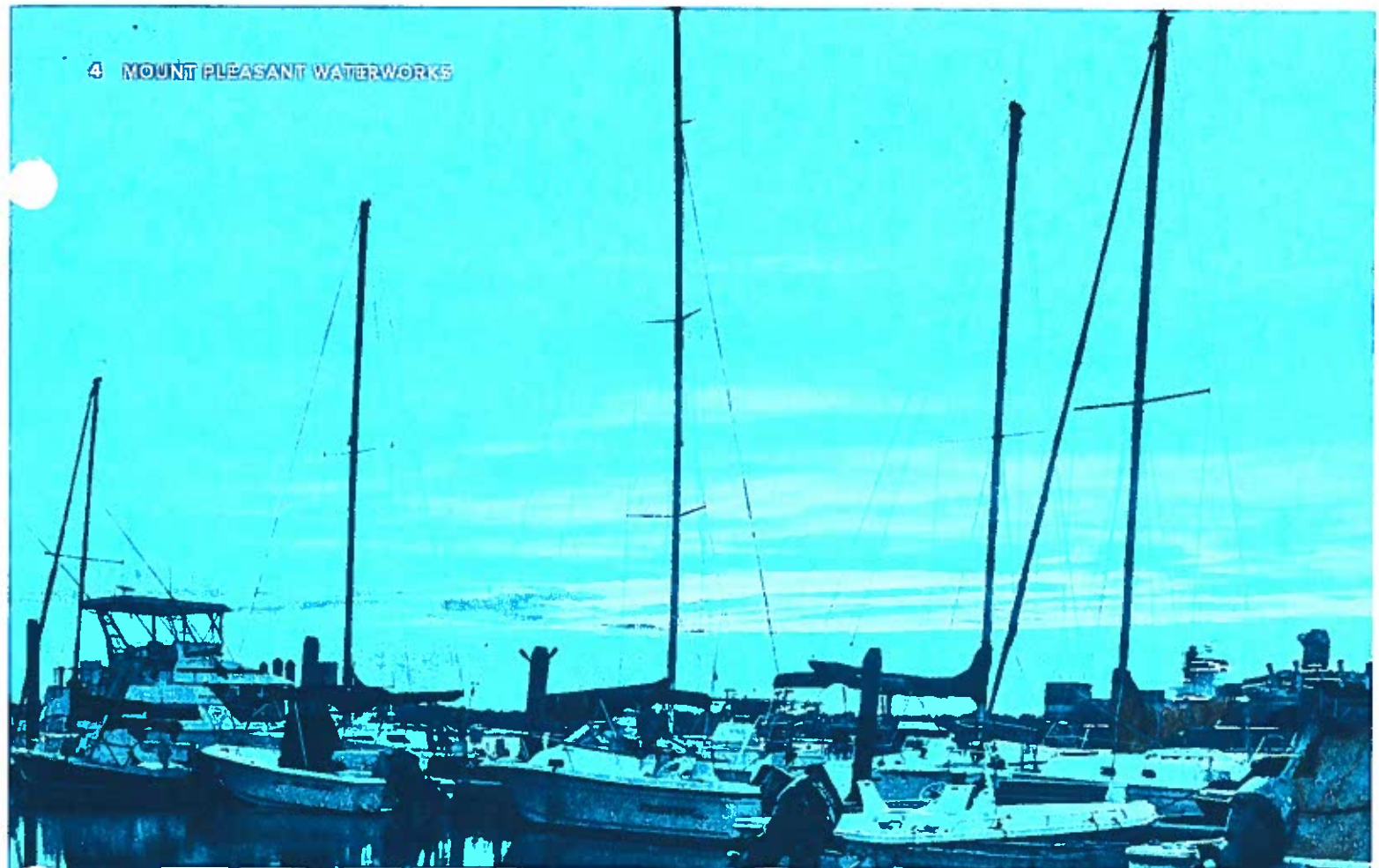
The Board of Commissioners and staff have collaborated to assess key industry trends and community needs, and to identify the critical factors important to Mount Pleasant Waterworks' long-term success. We have a strong course of action, with clear goals, strategies, and objectives that will guide Mount Pleasant Waterworks progress for years to come.

I look forward to working with the General Manager and staff to ensure Mount Pleasant Waterworks reaches its full potential.

—

Rick M. Crosby
Commission Chair

MOUNT PLEASANT WATERWORKS IS MOVING INTO A PERIOD OF CHALLENGES AND OPPORTUNITIES THAT WILL BE DIFFICULT TO NAVIGATE WITHOUT CAREFUL PLANNING AND A CLEAR VISION FOR THE FUTURE. THAT VISION IS SUMMARIZED IN THIS DOCUMENT.



INTRODUCT

OVERVIEW

Building on a legacy of successful strategic planning, including a comprehensive strategic plan in 2012 and a plan update in 2014, Mount Pleasant Waterworks (MPW) initiated a process to establish an updated vision and mission and a framework for guiding the organization toward achievement of its ultimate goals. This process was driven by the Commission and the MPW leadership team, and included opportunities for employees and external stakeholders to contribute their thoughts to the planning efforts. The strategic framework presented in this document will help guide organizational decision making and resource allocations for the next five years.

PROCESS

The MPW strategic planning process was designed to establish:

- A shared vision of the organization's goals and desired future state
- Acceptance of the direction and importance of the Strategic Plan for achieving MPW's ultimate goals
- A collective understanding of the resource needs, commitments, working environment, and principles upon which progress will be based

To achieve these conditions for success, MPW's strategic planning process involved input from a broad group of internal and external stakeholders through the following key tasks.

Strategic Plan Progress Review:
Evaluated the accomplishments since the last update and determined those strategies that require additional attention during the next several years.

Stakeholder Engagement:
Obtained input and insight from key stakeholders and involved them in the process to encourage their support for the resulting strategic plan. Utilized "WaterOpolis," a distinctive stakeholder engagement tool that helped the Commission, selected employees, and community stakeholders openly discuss issues and choices regarding MPW operations.

Commission Workshop:
Developed the fundamental elements of the MPW Strategic Plan (vision, values, mission).

Management Strategic Planning Workshop:
Drafted the updated strategic framework, including a review of the Commission input and the development of the draft vision, values, mission, goals, strategic measures, strategies, and objectives.

Commission and Senior Staff Workshop:
Finalized the 2018 MPW Strategic Plan and discussed implementation issues.

PROGRESS SINCE 2014 STRATEGIC PLAN UPDATE

A review of MPW's accomplishments since the 2014 strategic plan update indicated that:

- Progress was made on every strategy included in the previous plan. Some strategies are complete and need not be replicated in the updated plan, some need to be revised to reflect the current and anticipated operating environment, while others need continued attention, but not revision.
- Most of the Strategic Measures were met. Upon review, it was determined that some need to be more challenging, some need to be revised to be more meaningful, and some should not be included in the updated strategic plan.

In summary, the MPW Leadership Team believes that the 2012 Strategic Plan and the 2014 update were successful and have enhanced MPW's performance and position as a leader in the community and industry.

ENVIRONMENTAL SCAN

OVER THE LAST 20 YEARS, MOUNT PLEASANT HAS EVOLVED FROM A SMALL TOWN OF JUST OVER 6,000 RESIDENTS TO A LARGELY AFFLUENT, PROFESSIONAL, URBAN COMMUNITY WITH AN ESTIMATED POPULATION OF 84,000 PEOPLE IN 2016.

As part of the strategic planning process, MPW conducted an Environmental Scan to document its current operating environment and industry trends influencing how the organization conducts business. The scan considered local and regional demographics while identifying key issues, challenges and industry trends that will have a significant impact on MPW's ability to successfully meet the evolving needs of the service area.

The results of the Environmental Scan are summarized on the following pages. The information gained through the scan was used to form the basis of this strategic plan.

COMMUNITY PROFILE

Mount Pleasant is currently the fourth largest city in South Carolina, located in Charleston County on the east side of Charleston Harbor. In 2018, the Town of Mount Pleasant won a national competition to be named an All-America City by the National Civic League. There are a number of recreational and historic facilities located in Mount Pleasant, including the Patriot's Point Naval and Maritime Museum, as well as the Old Village Historic District. The Arthur Ravenel Bridge, which opened in 2005 and spans the Cooper River to connect Mount Pleasant with Charleston, is one of the longest cable stayed bridges in the western hemisphere. Residents and visitors to the area now have easy access to beaches on two barrier islands: Isle of Palms and Sullivan's Island.

As of December 2016, the unemployment rate in Mount Pleasant was only 3.7%. This compares favorably to the unemployment rates in South Carolina (4.6%) and the United States as a whole (5.2%). The estimated median household income in Mount Pleasant is $77,262. This indicates the affluence of the area, particularly when compared to the median household income in the US, which is $53,482. However, the cost of living in Mount Pleasant is 37.5% higher than the United States median.

The leading industries in Mount Pleasant and the surrounding areas are healthcare and social assistance professional; scientific and technical services; accommodation and food services; and retail trade. Some of the largest employers in Charleston County include US Military Joint Base Charleston, Medical University of South Carolina, Boeing, and Roper St. Francis Healthcare. Long-term prospects for growth in the Mount Pleasant community and surrounding areas are excellent.

Mount Pleasant Waterworks provides drinking water and wastewater services to residents of the Town of Mount Pleasant and some surrounding areas. MPW has been on a strong financial trajectory: in 2013, Standard and Poor's upgraded the utility' rating to AA+, and in 2015, Moody's upgraded it to Aa1. These ratings were reaffirmed by the two credit rating agencies in 2017. MPW and its employees are recipients of a number of accolades from the water and government industry groups including the Certificate of Achievement for Excellence in Financial Reporting and the Distinguished Budget Presentation, awarded by the Government Finance Officers Association of the United States and Canada. The South Carolina Department of Health and Environmental Controls (DHEC) Facility Excellence Award was awarded to both wastewater treatment plants. Additionally, MPW was listed for two years as one of the *Top 25 Places to Work in South Carolina* by SC Biz News.

	MOUNT PLEASANT, SC	SOUTH CAROLINA	UNITED STATES
Median Household Income	$77,262	$45,033	$53,482
Cost of Living Index*	137.5	92.6	100
Unemployment Rate	3.7%	4.6%	5.2%

*Cost of living index is based on a U.S average of 100. An amount below 100 indicates below average cost of living, while an amount above 100 indicates an above average cost of living. (Source: Sperling's Best Places, www.bestplaces.net)

TRENDS

MPW'S WATER AND WASTEWATER SERVICES ARE CRITICAL TO THE SUSTAINED VITALITY OF THE SERVICE AREA.

To ensure continued success, MPW's leadership reviewed a series of industry trends that must be considered as the organization plans for its future. Trends were considered in terms of:

- **Changes since the 2014 update**
- **Expectations for the future**
- **Potential MPW actions relating to the respective trends**

01

POPULATION

CHANGES SINCE 2014

- Population is growing more rapidly than expected (the 4.2% increase since 2014 has resulted in an additional 10,000 people)
- Water customers have grown by 3%, resulting in increased demand despite declines in per capita water use

EXPECTATIONS FOR THE FUTURE

- Continued substantial growth in population and customers is expected
- MPW will face pressure to serve customers beyond the existing infrastructure

MPW ACTIONS

- Continue to add capacity, buildings, and staff to meet expected demand
- Assure that expected growth is considered in all Capital Improvement Program (CIP) projects
- Continue and enhance a focus on technology and innovation
- Explore and, if appropriate, implement innovations in water treatment

02

POLITICAL ENVIRONMENT

CHANGES SINCE 2014

- Increased citizen engagement
- New Town Council (new Water Supply Chair and new Mayor)
- Withdrawal permit request and aquifer demands have created capacity issues

EXPECTATIONS FOR THE FUTURE

- There will be additional economic development and growth management issues that, along with road improvements, will affect the water and wastewater systems, water quality initiatives, supply, and capacity utilization

MPW ACTIONS

- Increase communications, build advocates, and increase stakeholder involvement
- Focus on meeting demand with new people, facilities and improvements
- Adjust funding plan to align with the Town's Growth Management Plan

03

REGULATIONS

CHANGES SINCE 2014

- A new federal administration is impacting Environmental Protection Agency (EPA) regulations, shifting to more "common sense" regulations with a greater focus on the state, rather than federal, responsibility
- Expanded stormwater regulations will impact construction projects

EXPECTATIONS FOR THE FUTURE

- Larger easements will be required
- Longer lead times for approvals and higher costs for projects

MPW ACTIONS

- Continue to monitor and respond to the regulatory environment
- Assure constant communication at the local and state level
- Provide internal training and ensure awareness of changes
- Update standards and specifications to be current with regulatory changes
- Obtain land necessary for larger easements and new facilities
- Increase funding to meet higher construction costs

04

WORKFORCE ISSUES

CHANGES SINCE 2014

- MPW has implemented many workforce-related improvements including:
  - Conducted workforce analysis
  - Reorganized staff
  - Attracted a larger staff to meet increased demand
  - Began succession planning to address aging workforce
  - Increased training and cross training
  - Conducted a comprehensive Wage/Compensation Study
- Increased competition from manufacturing companies for some positions

EXPECTATIONS FOR THE FUTURE

- Increased difficulty in attracting workers due to limited availability of skilled applicants
- Increased competition for employees
- Lack of education relating to mechanical positions
- Higher cost of living in the region

MPW ACTIONS

- Expand the visibility of recruiting advertisements
- Reach out to local and regional community colleges to develop educational programs
- Develop relationships with veterans' organizations
- Promote MPW's position as one of the *Best Places to Work* in South Carolina for three years in a row
- Maintain competitive compensation by conducting formal wage/compensation studies

PROMOTE MPW'S POSITION AS ONE OF THE *BEST PLACES TO WORK* IN SOUTH CAROLINA FOR TWO YEARS IN A ROW.

05

TECHNOLOGY

CHANGES SINCE 2014

- MPW is implementing Advanced Metering Infrastructure (AMI), an architecture for automated, two-way communication between a smart utility meter and MPW
- Maximo asset management system has started to mature
- Cloud-based system for billing/online payments and other billing improvements have been implemented
- Other technology, including SCADA to Cell, Office 365, and solar technology has been put in place
- Leveraged social media
- Increased telecommuting opportunities

EXPECTATIONS FOR THE FUTURE

- Greater emphasis on cloud services
- Increased and improved data analytics will be necessary
- System integration will be vital to optimizing operations
- Customer expectations for online services will increase
- Mobile applications will become more important
- The workforce will continue to become more technologically savvy

MPW ACTIONS

- Evaluate the existing Customer Information System (CIS)
- Implement network improvements for security/performance/reliability/surveillance
- Use business cases to evaluate technology alternatives
- Increase training to support new technology
- Explore technology for operational innovation such as direct and indirect water reuse and aquifer recharge

06

CUSTOMER EXPECTATIONS

CHANGES SINCE 2014

- The number of customers served by MPW has increased
- Experienced a water quality incident in 2017, which increased customer interest in water quality and expectations for testing
- MPW has taken a number of actions to better meet the needs of its customers, including:
  - Implemented the customer care program
  - Increased social media usage
  - Enhanced ability to communicate usage changes with customers utilizing AMI
  - Initiated a Citizens' Water Academy
  - Improved the Online Account Management System by changing to a new cloud based platform that offers more options and features than the previous system
  - Started an evaluation of the Customer Information System and Billing Software to research and analyze the current system and options available for systems in the future

EXPECTATIONS FOR THE FUTURE

- Customer demand for effective communications will increase
- Customer demand for improved customer service, especially as related to technology, will increase
- Desire for quicker response times related to field, emergency, and service responses
- Continued desire for low rates
- More millennial customers and people moving to the service area from other places may shift customer desires and expectations

MPW ACTIONS

- Increase and improve customer communication activities
- Implement consistent and effective stakeholder engagement activities
- Continue to increase and improve social media presence
- Further develop the Citizens' Water Academy
- Enhance and improve customer experience with technology and data
- Develop the AMI Customer Portal
- Increase Customer Service Training
- Develop a comprehensive customer feedback plan and reporting system

07

TOTAL WATER MANAGEMENT

CHANGES SINCE 2014

- Since 2014, MPW has:
  - Signed a new contract with Charleston Water
  - Initiated discussions with Google regarding aquifer withdrawals
  - Initiated an evaluation of treatment assets with an asset class engineer
  - Improved accounting for lost water
  - Developed groundwater management plans
  - Engaged with the United States Geological Survey (USGS) to study future groundwater use
  - Completed the Water Supply Master Plan

EXPECTATIONS FOR THE FUTURE

- Water source will become more strained
- Increased water and wastewater infrastructure will be required to meet demand

MPW ACTIONS

- Implement the Water Supply Master Plan
- Improve deep well infrastructure
- Assess facilities for replacement or expansion
- Recharge resources with treated wastewater
- Implement efforts to continue to reduce inflow and infiltration
- Develop approaches to improve quality and to blend water

08

FINANCIAL CONSTRAINTS

CHANGES SINCE 2014

- MPW has experienced:
  - Continuous increase in cost of doing business
  - Unexpected road widening projects
  - Increased demand for infrastructure
  - Aging assets
  - Increased personnel costs

EXPECTATIONS FOR THE FUTURE

- More capital projects will be required
- Residential equivalent policy changes for commercial customers are expected
- Regulations will continue to increase

MPW ACTIONS

- Update MPW's Cost Recovery Policy
- Improve stakeholder communication plans
- Work to "right-size" assets
- Continue and enhance asset management and strategic planning efforts
- Pursue funding from outside sources for utility line relocations due to road improvements

09

ENERGY

CHANGES SINCE 2014

- Energy costs are continuing to increase
- MPW has installed solar panels and researched other energy savings options

EXPECTATIONS FOR THE FUTURE

- Continued cost increases
- Dramatic changes are not expected

MPW ACTIONS

- Continue to explore energy reduction and cost-saving opportunities

10

INCREASED RISK PROFILE

CHANGES SINCE 2014

- Increased risk of cyber-attacks
- Natural disasters are becoming more severe and frequent
- Violence and terrorism are increasing worldwide
- Loss of water from Charleston Water System is a risk outside of MPW's control
- Increased demand for public awareness relative to unregulated compounds

EXPECTATIONS FOR THE FUTURE

- Increasing number and severity of risks

MPW ACTIONS

- Increase knowledge and preparation for cybersecurity and implement more comprehensive strategies
- Continue developing policies, training, and plans for emergency management and security
- Identify and mitigate the safety and security threats through facility improvements and surveillance
- Improve interconnectability with adjacent systems
- Increase employee emergency response training

STRENGTHS, OPPORTUNITIES, ASPIRATIONS, & RESULTS

To help form the foundation for the updated Strategic Plan, the MPW Commissioners and Management Team identified their collective view of the utility's strengths, opportunities for improvement, aspirations for the future, and desired results. These are summarized below and are embedded in the updated MPW Strategic Plan.

STRENGTHS

- Product quality
- Employee commitment, loyalty, pride and "investment" in MPW
- Excellent customer service and responsiveness
- Leadership

OPPORTUNITIES

- Continue to develop and enhance infrastructure
- Assure sufficient supply of high quality water to meet increased demand
- Further develop the MPW workforce

ASPIRATIONS

- Recognized as an industry standard of excellence
- Enhanced level of operational excellence
- High value products and services
- Investment in sufficient, skilled, and engaged staff

RESULTS

- Sufficient capacity and supply of high quality water
- Reasonable rates
- Excellent financial position
- Environmental protection

STAKEHOLDER ENGAGEMENT

On February 15, MPW's Commissioners and Management Team participated in a facilitated exercise called WaterOpolis, which simulated a utility budgeting process. WaterOpolis is designed to demonstrate the tensions that can arise between diverse organizational priorities and scarce resources in the water utility industry. Participants set organizational values, prioritize activities, and manage the utility's response to external events. Subsequently, MPW's Citizen's Water Academy members participated in the same exercise as the Citizen's Water Academy inaugural event.

This engagement was used to inform the development of the foundational elements of the 2018 MPW Strategic Plan.

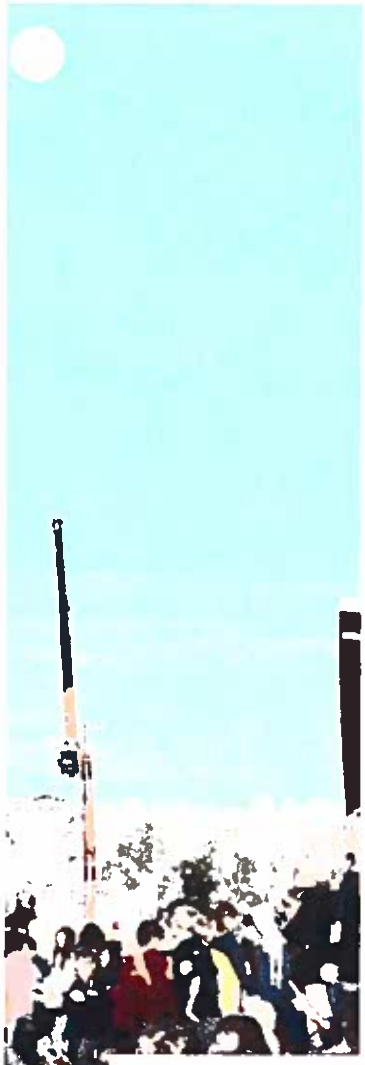
CRITICAL ISSUES

MPW's Commissioners and Management Team evaluated the most critical issues that MPW is likely to face over the next several years, which were determined to be:

- Infrastructure and operational excellence
- Quality of water, environmental protection, and customer service
- Water supply
- Workforce
- Financial viability
- Cybersecurity

STRATEGIC DIRECTION

MPW's Strategic Plan serves as a blueprint for future decision making and provides a structure for periodic reviews to assure that Goals, Strategic Measures, Strategies, and Objectives retain their relevance over time. By documenting a course of action, this Plan represents a disciplined process for making the fundamental decisions that will shape MPW's future.



VISION

Ultimately, implementation of this plan will enable MPW to achieve its desired future state, as articulated in its Vision:

Mount Pleasant Waterworks strives to be a trusted leader in our community and the water industry.

MISSION

The Mission describes the organization's purpose and role within the service area. After carefully considering these factors, and evaluating its strengths, the commissioners and management articulated MPW's Mission as:

The MPW Team provides water services of exceptional quality, value, and reliability, while protecting public health, safety, and the environment.

VALUES

Values articulate MPW's deeply held beliefs, norms, and qualities, which drive day-to-day activities. The MPW Value Statement is:

The MPW team is passionately committed to:

- ***HONESTY*: In all actions by employees and commissioners**
- ***FAIRNESS*: To our customers, employees, and other stakeholders**
- ***QUALITY*: Of our products, services, and processes**
- ***INNOVATION*: By seeking positive change**

GOALS

GOALS REPRESENT THE MOST IMPORTANT ISSUES THAT MPW MUST ADDRESS TO ACHIEVE ITS DESIRED FUTURE.

Since 2012, MPW's Goals were driven by the industry standard known as Effective Utility Management (EUM). This focus on EUM in the strategic planning process has served MPW well and helped assure that the organization focused on key attributes of success. The 2012 Strategic Plan and the 2014 update considered each of the Ten Attributes of an Effectively Managed Utility as separate goals. To develop a more tightly focused strategic plan for 2018 and the next several years, MPW has consolidated the Ten Attributes into four key goals that both reflect EUM principles and consider the issues that MPW Commissioners and Management believe are most critical to success. The goals and the respective EUM attributes addressed are:

FINANCIAL VIABILITY

Recover all costs in a fiscally responsible, fair, and equitable manner.

As a complex enterprise, MPW must manage its revenues, debt, and expenses in an effective and strategic manner to assure that exceptional service is provided now and for future generations.

EUM Attribute Addressed: Financial Viability

WORKFORCE DEVELOPMENT

Recruit, train, and support qualified, committed, mission-driven employees.

MPW is proud of its high performing workforce, but recognizes that it must continue to recruit, develop, and retain excellent and committed people.

EUM Attribute Addressed: Employee and Leadership Development

CUSTOMER SERVICE

Achieve customer satisfaction through excellent communication, service, and stakeholder engagement.

Customers and other external stakeholders are critically important to MPW's long-term success, and it is important that they understand the issues MPW faces, the need for sufficient revenues, and the value that MPW provides to the community.

EUM Attributes Addressed: Customer Satisfaction, Stakeholder Understanding and Support, Community Sustainability

OPERATIONAL EXCELLENCE

Develop, maintain, and improve MPW infrastructure to provide reliable services and exceptional water quality while protecting resources and the environment.

MPW is an asset-intensive organization and the effective management of existing and future infrastructure is critical to meeting the current and future community needs for high quality water service and for protection of the environment.

EUM Attributes Addressed: Operational Optimization, Product Quality, Infrastructure Stability, Operational Resiliency, Water Resource Adequacy

STRATEGIES AND STRATEGIC MEASURES

Strategic measures demonstrate the accomplishment of the goals. Strategies are the approaches and key allocations of resources to be used in achieving each goal. These critical elements of the MPW Strategic Plan, along with the vision, values, mission, and goals, are presented in the strategic framework on the following pages.

STRATEGIC *framework*

VISION

Mount Pleasant Waterworks strives to be a trusted leader in our community and the water industry.

MISSION

The MPW Team provides water services of exceptional quality, value, and reliability, while protecting public health, safety, and the environment.

VALUES

The MPW team is passionately committed to:

- **Honesty** – In all actions by employees and commissioners
- **Fairness** – To our customers, employees, and other stakeholders
- **Quality** – Of our products, services, and processes
- **Innovation** – By seeking positive change

GOALS

FINANCIAL VIABILITY

Recover all costs in a fiscally responsible, fair, and equitable manner

WORKFORCE DEVELOPMENT

Recruit, train, and support qualified, committed, mission-driven employees

CUSTOMER SERVICE

Achieve customer satisfaction through excellent communication, service, and stakeholder engagement

OPERATIONAL EXCELLENCE

Develop, maintain, and improve MPW infrastructure to provide reliable services and exceptional water quality while protecting resources and the environment

MOUNT PLEASANT WATERWORKS CLEAN WATER

WATER FOR LIFE

STRATEGIC MEASURES

- Meet all objectives of the Cost Recovery Policy

STRATEGIES

1. Meet all objectives of the Cost Recovery Policy
2. Ensure the comprehensive financial health of the organization
3. Maintain sufficient rates

- Maintain at least 95% of full complement of active positions
- Increase the percentage of employees who meet training requirements in professional development plans
- Reduce workers' compensation experience modifier to less than or equal to 1

1. Continue recruiting efforts to add new talent and support succession planning
2. Complete Phase II of the Workforce Analysis Project
3. Fully implement Waterworks University
4. Improve employee input on decision making
5. Implement Knowledge Management Program
6. Improve workplace safety

- Strive for a customer satisfaction rating of 90% or better
- Increase customer and stakeholder engagement
- Promote value of Services
- Enhance outreach efforts

1. Improve customer satisfaction rating
2. Train, educate, and inform all employees on providing excellent service through communication and engagement
3. Enhance MPW's community presence & stakeholder engagement
4. Enhance customer services

- Meet or exceed all state and federal regulatory requirements
- Complete CIP projects on time and on budget
- Provide concurrent water and wastewater capacity for growth
- Maintain an optimal preventative maintenance to corrective maintenance ratio of 80:20 on non-linear assets

1. Research and evaluate the feasibility of alternative water sources
2. Plan, fund, and build for growth
3. Formally evaluate and utilize new and emerging technologies
4. Accept new infrastructure that meets MPW standards
5. Fully implement asset management
6. Implement plan for improving product quality and operational efficiency
7. Enhance environmental protection

OBJECTIVES

OBJECTIVES ARE THE MEASURABLE STEPS THAT MPW WILL TAKE TO IMPLEMENT AND ACHIEVE THE STRATEGIES.

GOAL: FINANCIAL VIABILITY

Strategies	Objectives
1. Meet all objectives of the Cost Recovery Policy	• Meet 100% of the Cost Recovery Policy Objectives • Perform an annual review of the Cost Recovery Policy
2. Ensure the comprehensive financial health of the organization	• Present a monthly financial report • Conduct an annual audit and prepare the Comprehensive Annual Financial Report (CAFR) • Prepare an annual budget • Provide a quarterly report by GM on financial viability, including CIP project status
3. Maintain sufficient rates	• Determine annual revenue requirements, and evaluate and adjust rates and charges accordingly • Implement Cost of Service recommendations • Evaluate a funding plan for utility line relocations related to road improvements and develop a cost containment plan • Conduct an impact fee study

GOAL: WORKFORCE DEVELOPMENT

Strategies	Objectives
1. Continue recruiting efforts to add new talent and support succession planning	• Develop standards and timeline for job postings and advertisements • Streamline and improve onboarding • Maintain 95% full complement of active positions • Maintain turnover under 3% • Formalize an internship/mentorship/apprenticeship program
2. Complete Phase II of the Workforce Analysis Project	• Engage a workforce analysis consultant by September, 2018
3. Fully implement Waterworks University	• Develop personal development plans for each employee • Develop training to fill competency gap • Create a baseline percentage of employees who meet training requirements in professional development plans
4. Improve employee input on decision making	• Analyze *Best Places to Work* Employee Survey results and mitigate areas of concern • Develop cross-functional teams for strategic plan implementation
5. Implement Knowledge Management Program	• Update Standard Operating Procedures, as necessary • Develop and implement formal knowledge transfer program
6. Improve workplace safety	• Reduce workers' compensation experience modifier to less than or equal to 1 • Implement healthy workforce activities

ESHMENT

GOAL: CUSTOMER SERVICE

Strategies	Objectives
1. Improve customer satisfaction rating	• Achieve a Customer Satisfaction Rating of 90% or better • Continue bi-annual customer surveys • Conduct a comprehensive review of all customer surveys and response reports, and make recommendations for improvements
2. Train, educate, and inform all employees on providing excellent service through communication and engagement	• Continue to conduct quarterly employee communications and customer service training
3. Enhance MPW's community presence & stakeholder engagement	• Increase customer engagement through outreach events and media publications • Increase employee involvement with community events • Increase understanding of the value of services
4. Enhance customer services	• Complete the comprehensive AMI plan • Continue to promote and measure benefits of the Service Line Care Program • Promote benefits and analyze use of the Customer Care Program

GOAL: OPERATIONAL EXCELLENCE

Strategies	Objectives
1. Research and evaluate the feasibility of alternative water sources	• Complete 3rd Connection with CWS • Evaluate and, if appropriate, implement source water blending • Continue to update and implement the groundwater model • Evaluate expanded use of reclaimed water
2. Plan, fund, and build for growth	• Complete the Utility Master Plan after Town's Comprehensive Plan update • Work closely with the Town to coordinate a growth management plan • Provide concurrent water & wastewater capacity for growth • Revaluate extension and expansion (E&E) projects to align with the Town's growth management policy
3. Formally evaluate and utilize new and emerging technologies	• Evaluate and, if appropriate, implement groundwater recharge • Evaluate and, if appropriate, implement potable reuse • Evaluate and, if appropriate, implement a sustainable biosolids program • Complete and implement the SCADA master plan • Evaluate and, if appropriate, replace the current billing system • Complete and implement an IT master plan • Perform IT integration to optimize business & operational processes
4. Accept new infrastructure that meets MPW standards	• Review and inspect 100% of new infrastructure • Perform testing to verify MPW standards are met • Implement a formal commissioning and acceptance process
5. Fully implement asset management	• Complete CIP projects on time and on budget • Decrease the frequency and severity of failures by asset class • Optimize the ratio of preventative to corrective maintenance • Expand planning and scheduling programs • Finalize and implement an asset management guidance document • Evaluate and improve mobile work order processes • Expand reliability-centered maintenance programs beyond pump stations
6. Implement plan for improving product quality and operational efficiency	• Maintain regulatory compliance • Reduce non-revenue water • Implement a collection system optimization strategy • Develop and implement a water quality improvement program • Minimize SCADA and IT downtime • Monitor effectiveness of MPW's inflow and infiltration (I&I) abatement program
7. Enhance environmental protection	• Assist in improving water quality in Shem Creek • Maintain reportable overflows to a level below EPA standards • Engage in partnership for Safe Water Distribution

IMPLEMENTATION

MPW HAS DEVELOPED A PLAN THAT WILL TAKE TIME AND EFFORT TO IMPLEMENT, BUT WILL SERVE AS A LONG-TERM GUIDE TO ENHANCE THE ORGANIZATION'S STRATEGIC SUCCESS.

MOUNT PLEASANT WATERWORKS

CLEAN WATER

WATER FOR LIFE

WWW.MOUNTPLEASANTWATERWORKS.COM

1619 RIFLE RANGE ROAD
MOUNT PLEASANT, SC 29464

SECTION 5 Capital Improvements Plan

FY2019-2020

ANNUAL BUDGET DOCUMENT

Introduction

The Capital Improvement Plan or CIP is the Commission's ten-year roadmap for creating, maintaining and funding present and future infrastructure requirements. The CIP addresses the Commission's needs related to the acquisition, expansion, and rehabilitation of long-lived facilities and infrastructure. The CIP serves as a planning instrument to identify needed capital expenditures and to coordinate the financing and timing of improvements in a way that maximizes the return to the customers.

Capital improvement planning is a process used to provide the efficient and effective provision of MPW facilities/assets. Planning for capital facilities over time can promote better use of MPW's limited financial resources and assist in coordination of capital projects. In addition, the planning process is a valuable means of coordinating and taking advantage of joint planning and development of projects where possible. By looking beyond year to year budgeting and projecting what, where, when and how capital investments should be made, capital programming enables MPW to maintain an effective level of service for both present and future customers.

A critical element of a balanced CIP is the provision of funds to both preserve or enhance existing facilities and provide new assets to respond to changing service needs and the growth of the community. While the CIP serves as a long range plan, it is reviewed annually and revised based on current circumstances and opportunities. Priorities may be changed due to funding opportunities or circumstances that cause a more rapid deterioration of an asset. It serves as a "blueprint" for the future of the community and is a dynamic tool, it is not static.

The CIP is primarily a planning document. As such, it is subject to change each year as the needs of the community become better defined and projects move closer to final implementation.

The adoption of the CIP is neither a commitment to a particular project nor a limitation to a particular cost. As a basic tool for scheduling anticipated capital projects and capital financing, the CIP is a key element in planning and controlling future debt service requirements. For this reason, the CIP includes some projects where needs have been defined, but specific solutions, and funding amounts, have not been determined. When adopted, the CIP provides the framework for management and for the Commissioners with respect to rates, financing, investment planning, and project planning.

Goals of the CIP

The Capital Improvement Plan takes a critical look at the entire organization, to identify what is good, what could be improved, and where opportunities for new projects may exist. For this reason, MPW has the following goals for its CIP process:

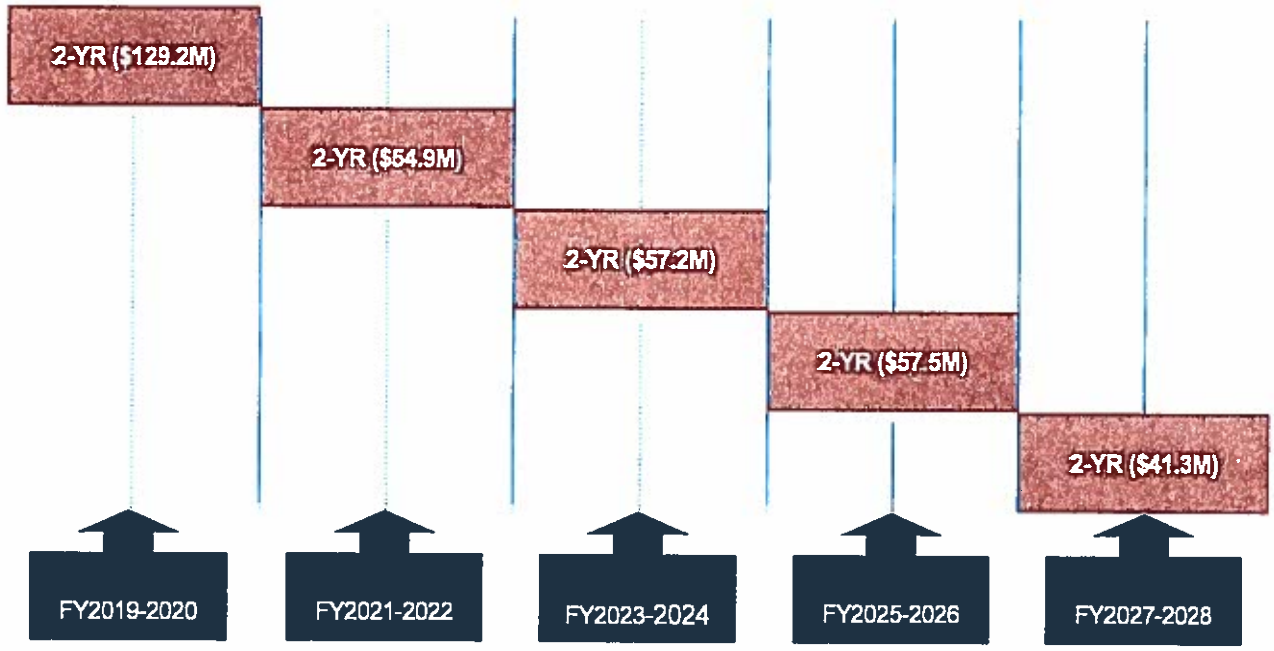
- *Ensure that MPW's 10-Year Capital Improvement Plan is affordable and finances only necessary capital expenditures.*
- *Enable informed capital investment decisions according to a fair, open and objective process.*
- *Emphasize the requirement for long-term planning.*
- *Enhance the linkage between the Capital and Operating Budgets.*
- *To avoid the need to impose "crisis" rate increases.*
- *To focus customer's attention on MPW's goals, needs and priorities.*
- *To serve as an educational tool for the community and MPW.*

Capital Planning Process

The "Capital Planning Process" is intended to be a vehicle to meet specific MPW goals and/or objectives and be consistent with strategic, business and master plans. The purpose of the planning process is to encourage the flow of ideas and allow for advanced planning. During this period of time, departments are reviewing maintenance records, performing master planning efforts, reviewing the conditions of assets and undertaking any other necessary planning efforts. From these activities, the departments should become familiar with overall condition of their assets and problems/needs. If these problems/needs require the expenditure of capital dollars, each department will be responsible for completing the appropriate Capital Project Request. These requests include: year funds requested, brief description, project justification, rough estimate of project cost, resulting benefit, any backup documentation to facilitate the review/approval process.

The procedures for the development of the CIP will generally follow the schedule below:

10-Year Budget Timeline



Revenue Sources

The CIP is funded in accordance with the latest Cost Recovery Policies through three primary revenue sources, operating revenues, growth-related revenues, and debt proceeds.

Operating Revenues: Referred to though this Section as renewal and replacement or R&R. Operating revenues are MPW's primary source of funds. These revenues come from monthly use charges including basic facilities charges, volumetric rates for water and wastewater, water and wastewater connection charges for new customers, and miscellaneous charges for ancillary services.

Growth-Related Revenues: Referred to throughout this Section as Impact Fees (E&E). Growth related revenues are impact fee payments made by homebuilders or developers to pay for capital facilities needed for these future customers. Case law requires that impact fee revenues be expended for the direct benefit of the future customers for whom they were paid. Thus, the flow of impact fee funds is kept separate from other revenues. All impact fee revenues that are not transferred into the Growth Cost Recovery Fund will be transferred to the Extension and Expansion fund and spent directly on capital projects for the benefit of future customers.

Debt Proceeds: Debt proceeds are sources of funds provided by lenders that are restricted to expenditures on specific capital projects, regardless of the intended beneficiary. MPW's rapid rate of growth and demand for new facilities, coupled with R&R projects, has necessitated incurrence of debt. Under the FY 2019-2020 Capital Budget, MPW will request the following projects be funded through the State Revolving Fund Loan Program.

- Park West Forcemain Replacement ($5.5M)
- Gravity Collection System Rehab Program ($7M)
- Replacement of Deep Well 2 ($2.2M/Partial Funding)
- Highway 17 @ Park West Blvd Forcemain Replacement ($2.5M)
- Pump Station Conversion/Rehab Program ($5.5M)

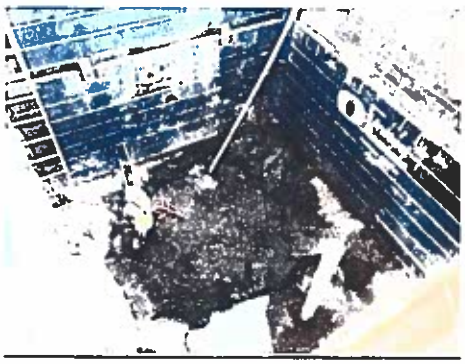
It is the intent to cash fund R&R projects whenever possible, while maintaining fund balances, rates, fees, and charges at reasonable levels. However, for higher cost, longer-life capital assets, the policy will provide for the use of debt financing if market conditions dictate that such funding would be a better solution for all customers.

Project funding decisions will follow the Cost Recovery Policy Objective 6 – *Establish Long-Term Cost Recovery Objectives*.

- Cash fund capital projects and assets with estimated useful lives of ten or less years.
- Fund capital projects and assets with estimated useful lives of over ten year by using debt or cash financing, depending on prevailing economic conditions.

Projects Funded through the State Revolving Fund Program

4-Year Gravity Line Rehab Program (FY2015-2018) throughout MPW's service area $14M



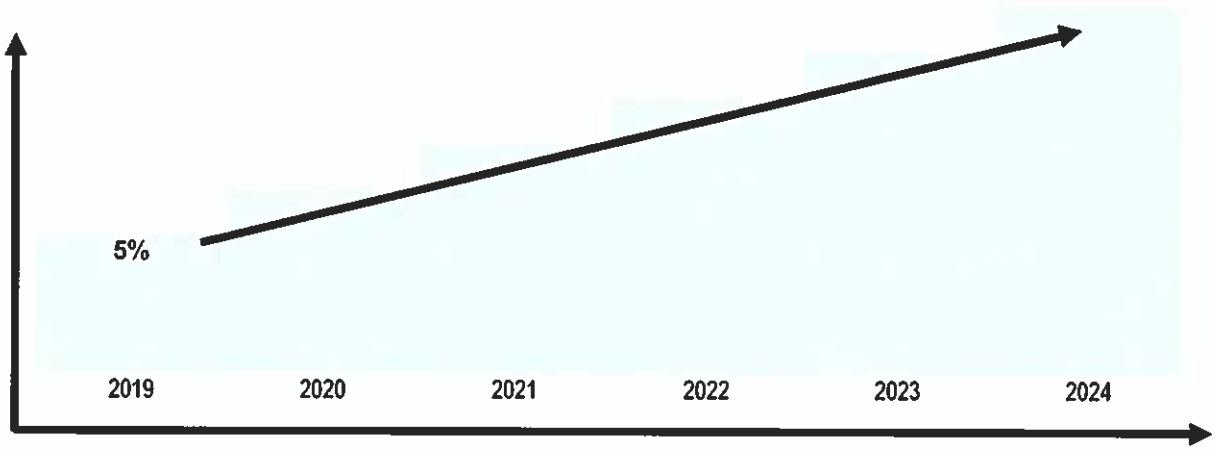
FY2017-2018 Pump Station Rehabilitation Program ($3.6M)

Cost Escalation Factor

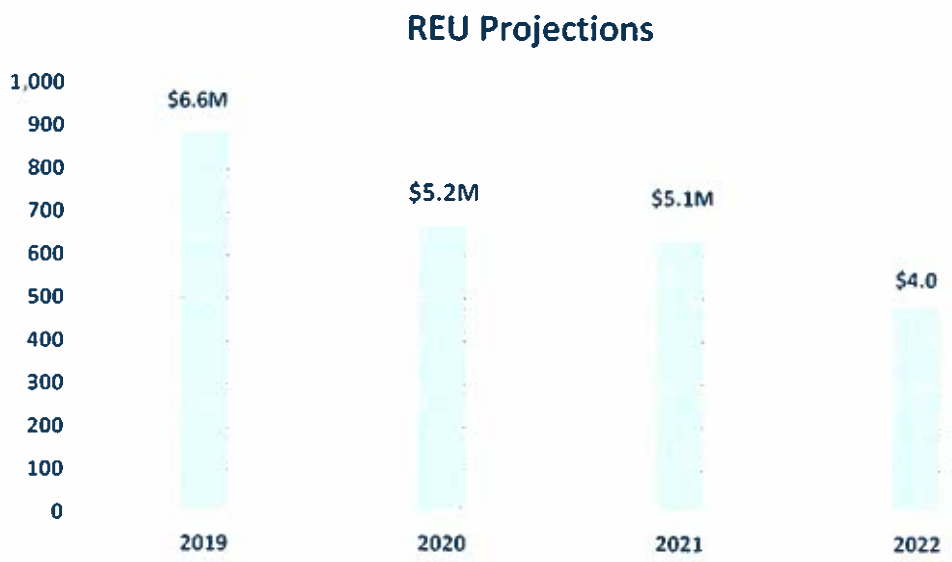
Due to the strong economy and higher than normal inflation rate being experienced in the region, construction cost has been driven up on many projects. This has resulted in projects coming in at a much higher cost when bid that what was original estimated by the Asset Class Engineers. Based on this MPW used 5% to bring projects that were already in the CIP up to 2018 dollars.

In addition, future project dollars are anticipated to continue to increase. It is projected inflation will continue to increase as well. To account for future inflation, projects beyond FY2019 have been inflated 5% per year. The following graph shows how the current inflation and future inflation adjustments have been accounted for in the CIP.

Note: MPW had been applying 3% for both project adjustment to current dollars, and future inflation, in prior budget years



Projected Growth

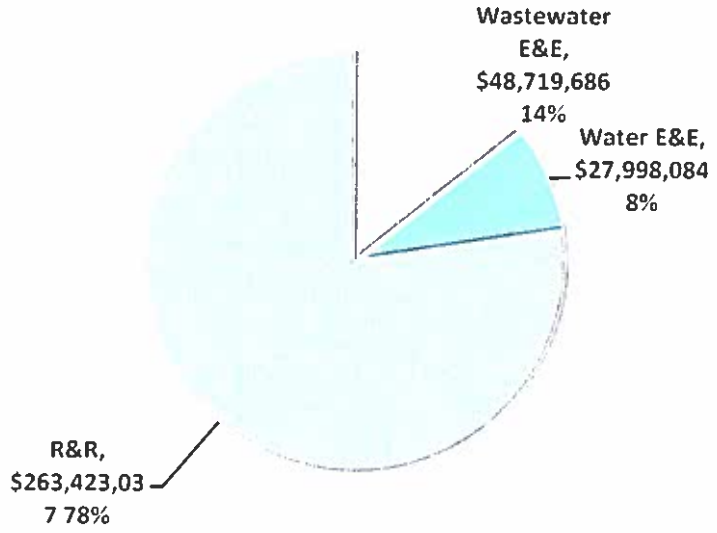


Note impact fees increase 3.5% annually.

10-Year Capital Improvements Plan Summary

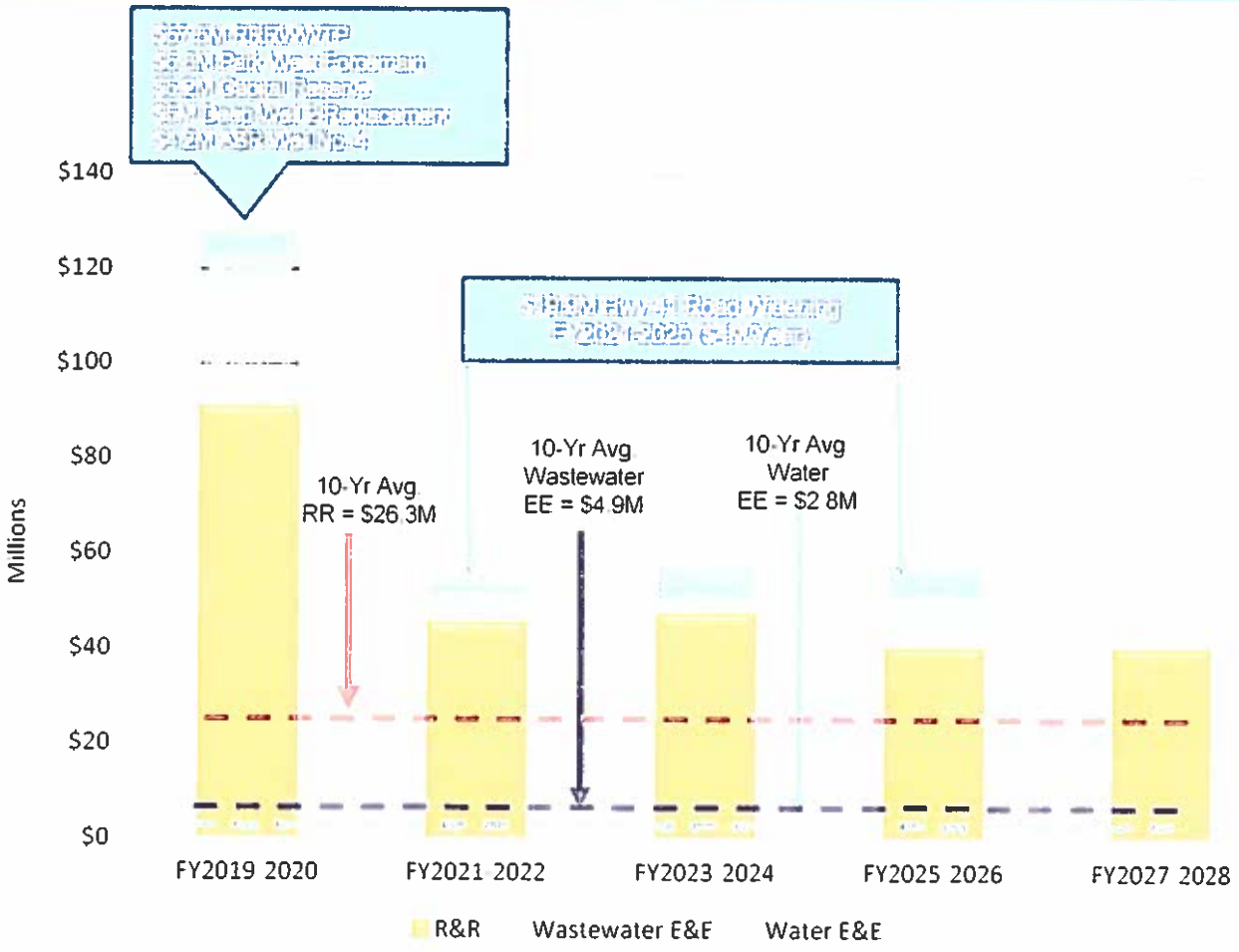
FY2019-2028 Capital Program

FY2019-2028 Capital Improvements Plan By Funding



FY2019-2028 CIP Total
$340,140,807

10-Year Projected Annual Expenditures



FY2019-2020 Capital Budget

Budget Development

Development of the FY 2019-2020 Capital Budget began in the fall of calendar year 2018. When developing the budget, Engineering staff used the following:

- **Master Plan Recommendations**: These are growth related projects based on the Town's Comprehensive Plan and shown under the 10-Year Capital Improvements Plan Summary, and the 2-Year Capital Budget Summaries as either Wastewater E&E or Water E&E Projects. Funding of these projects makes up 30% of the FY2019-2020 Capital Budget.

- **Asset Management**: The replacement value of MPW's assets in 2017 dollars is $1.8B, or four (4) times greater than the current book value. In addition, 70% of the FY2019-2020 Capital Budget is for renewal and replacement of MPW's existing assets and will be funded through rates.

  With such a large percent of the CIP now focused on renewal and replacement, continued implementation of an Asset Management Program is critical. MPW needs to ensure that funds are being spent where they are truly needed by using a systematic approach to the assessment of its existing assets. To help meet this goal, a new position will be added to the Engineering Department for an Asset Management Program Manager. This position will oversee the Asset Engineer and facilitate the data collection (condition assessment), evaluation and implementation of 5-year Asset Class Programs. The Asset Management Program Manager will spearhead the prioritization of CIP projects and assist in the development of scope and budget of future projects. This position will also work closely with the Technical Services Department, analyzing data from "Maximo," which will be used to establish data collection criteria.

Mid-Year Commission Retreat

A Mid-Year Retreat was held with Commissioners, Town's Water Supply Committee members, Town Staff, MPW Staff and Asset Class Engineers. The purpose of the retreat was to allow the participants to spend an entire day interacting with MPW's Operations Staff and Asset Class Engineers to:

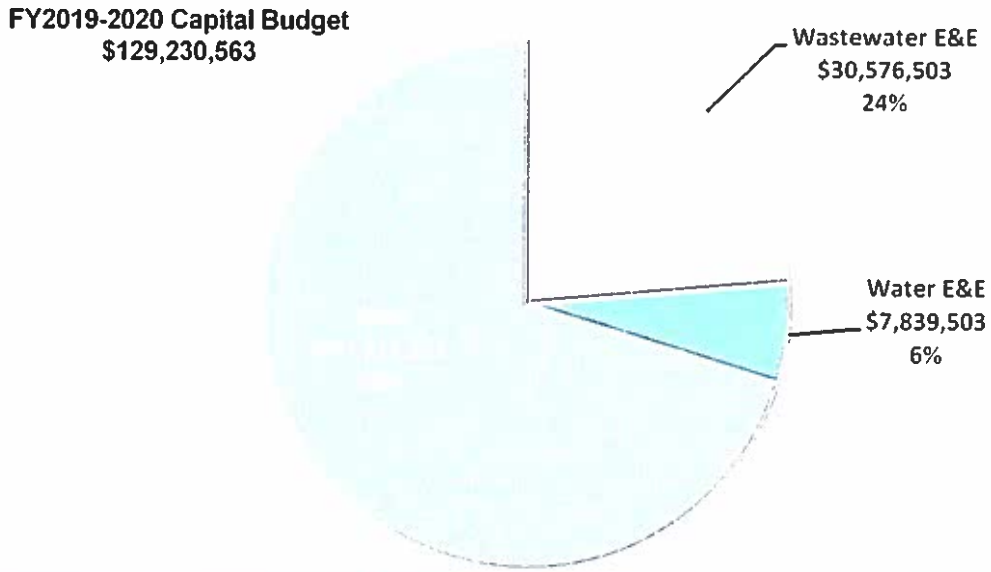
- Give Commissioner's one-on-one interaction with Operations Staff to better understand the day-to-day functions of each asset;
- Allow the Operations Staff the opportunity to discuss what is needed to perform their jobs, and keep assets in good working order;
- Current and future needs of each asset class; and
- Value of each asset class in current dollars, and the funding request for the proposed FY2019-2020 CIP.

The finalized FY2019-2020 Capital Budget was then presented during the normal annual retreat. Commissioners were able to ask more informed questions and have a better overall understanding of the funding needs for each asset class. This approach made for a more efficient and effective development of the FY2019-2020 CIP.

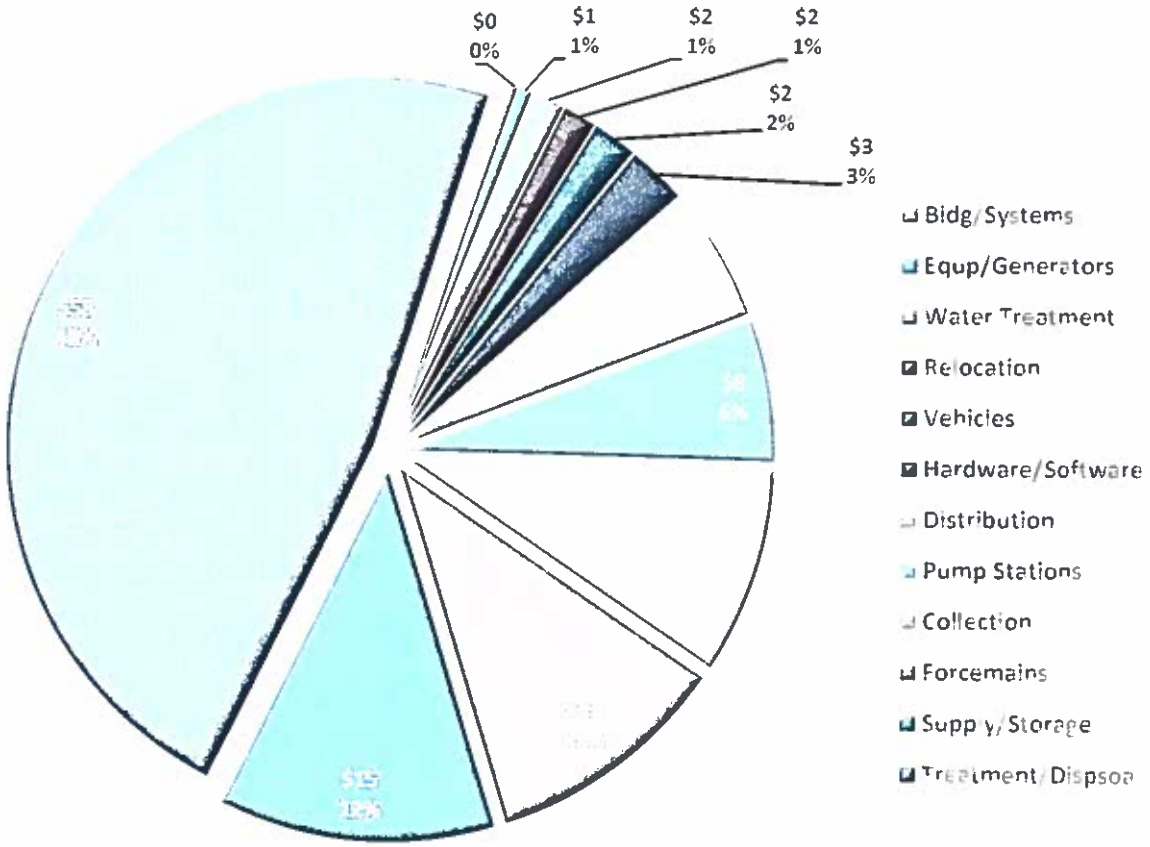
2-Year Capital Budget Summary

FY2019-2020 Capital Program

FY2019-2020 Capital Budget By Funding



FY2019-2020 Capital Budget By Asset Class (Millions)



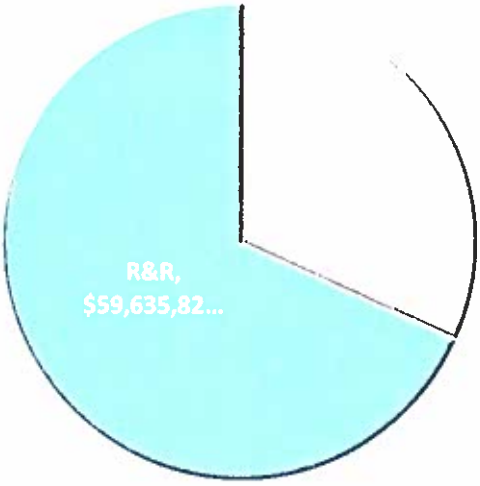
10-Year Water Capital Improvements Plan

FY2019-2028 Capital Program

Water System Summary

MPW manages and operates a complex and integrated water supply infrastructure, including distribution, storage, supply and treatment to support MPW's Strategic Business Plan goals Objectives over the next five years include:

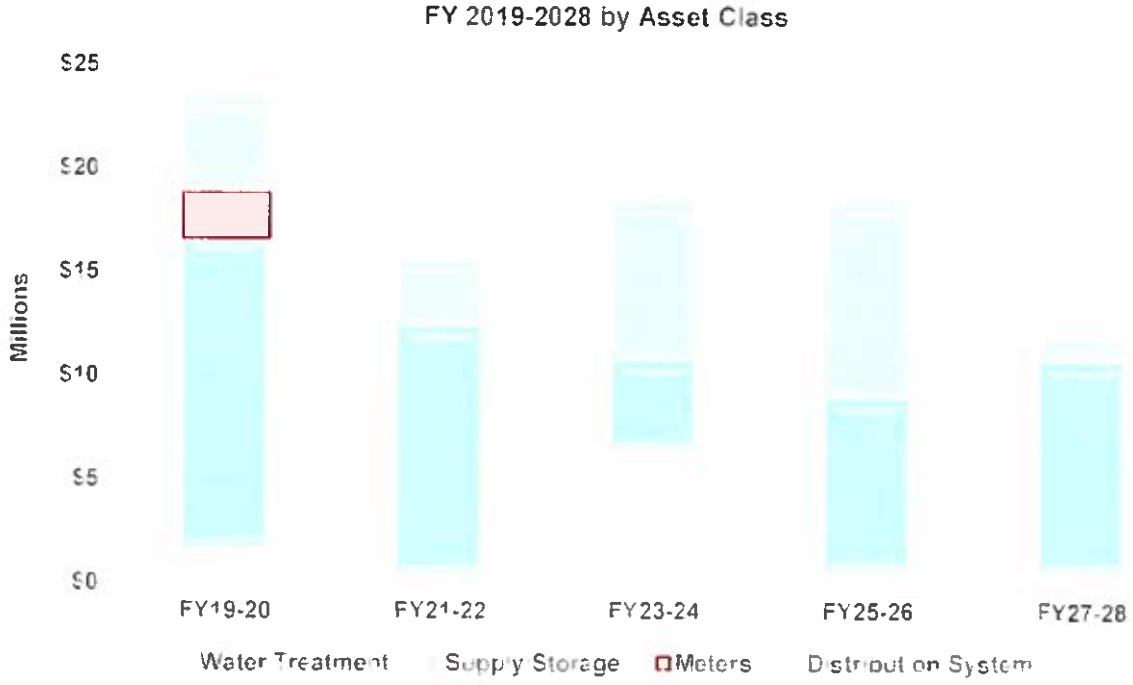
- Complete 3rd Connection with CWS
- Evaluate and, if appropriate, implement source water blending
- Continue to update and implement the groundwater model
- Evaluate expanded use of reclaimed water
- Provide water capacity for growth
- Evaluate and, if appropriate, implement groundwater recharge
- Evaluate and, if appropriate, implement potable reuse
- Decrease the frequency and severity of failures by asset class
- Maintain regulatory compliance
- Reduce non-revenue water
- Develop and implement a water quality improvement program



The overall system includes (as of 6/30/18):

- 4 Reverse Osmosis water treatment plants
- 571.6 miles of water mains
- 152.1 miles of service lines
- 3,889 fire hydrants
- 13,402 system valves
- 39,803 Meters (Ranging in size from 5/8" to 6")
- 8 ground storage tanks
- 1 elevated storage tank
- 3 Aquifer Storage & Recovery Wells
- 2 Wholesale Water Purchase Points

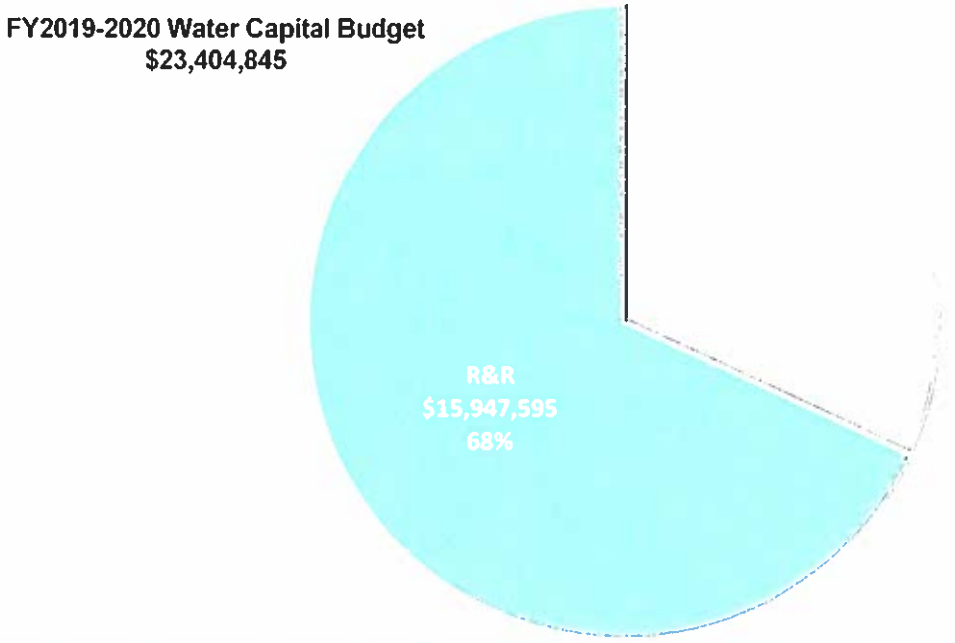
FY2019-2028 CIP Total
$87,251,657



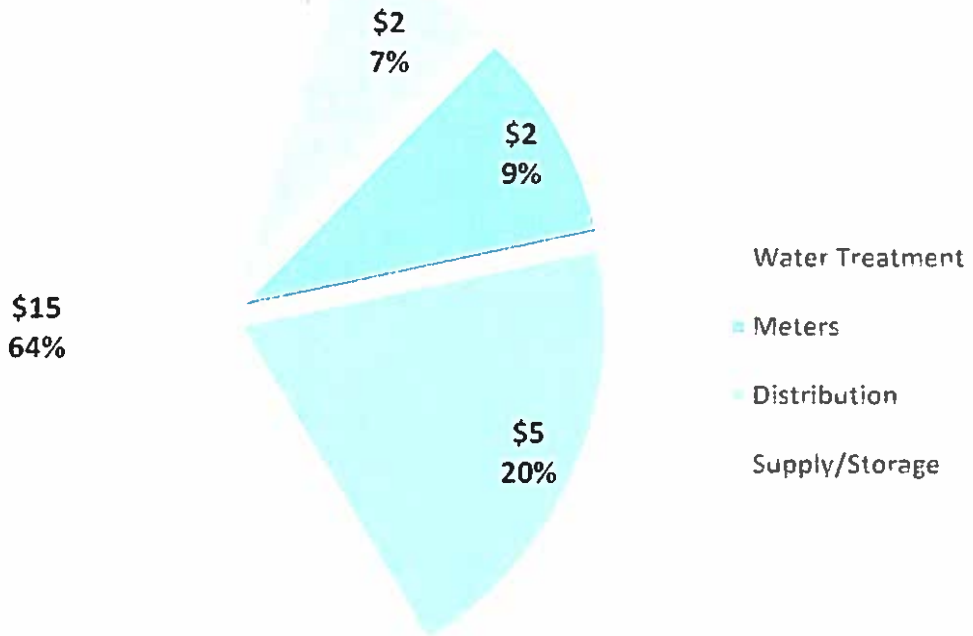
2-Year Water Capital Budget Summary

FY2019-2020 Capital Program

FY2019-2020 Capital Budget By Funding

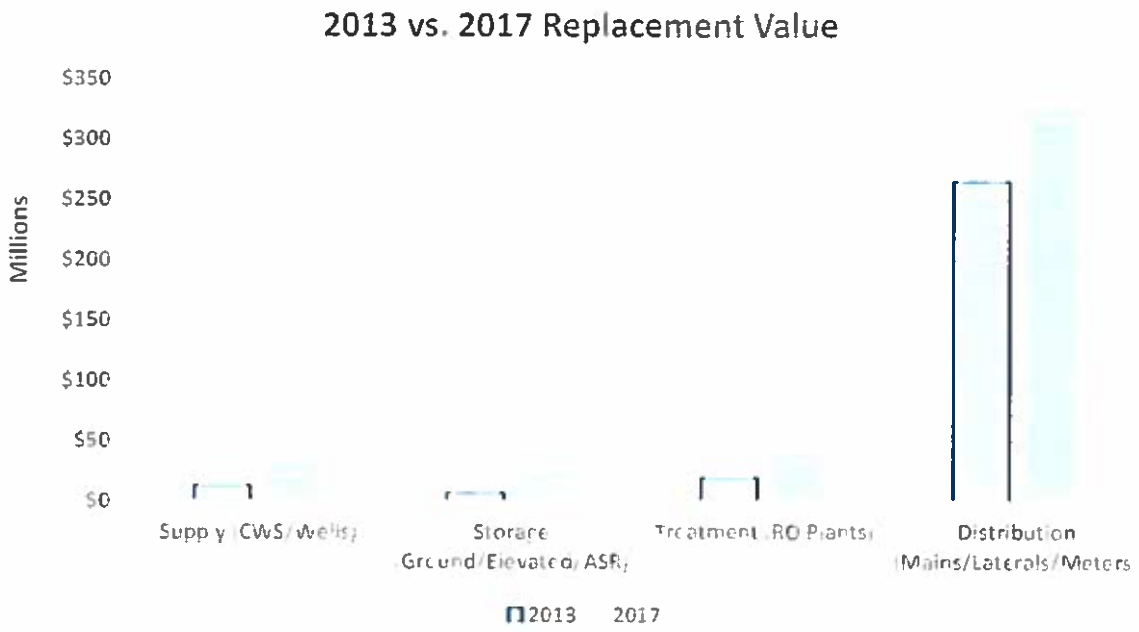


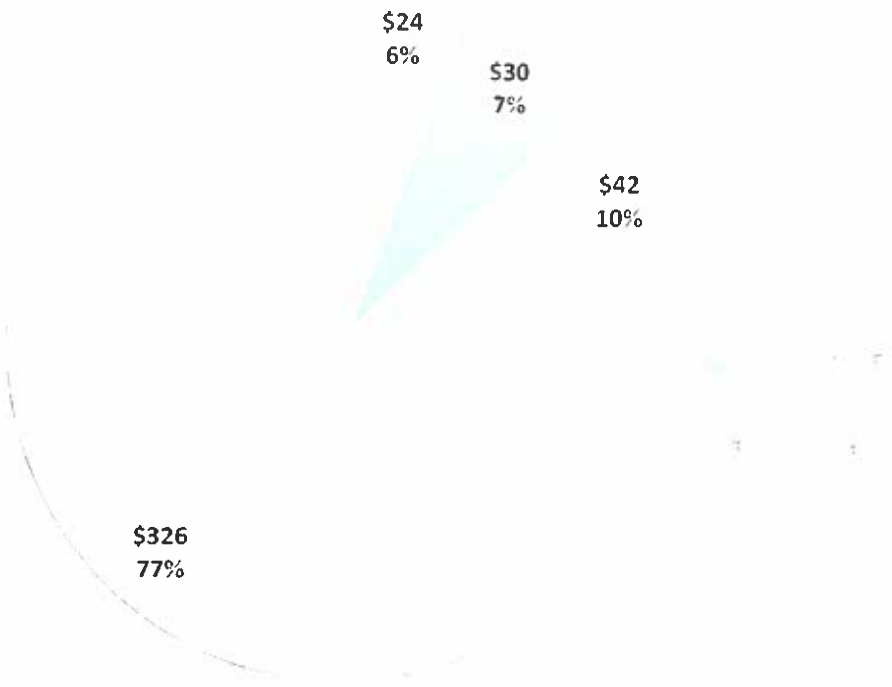
FY2019-2020 Capital Budget By Asset Class (Millions)



Asset Management (Renewal and Replacement)

In 2013, as part of the Asset Management Program, MPW completed a detailed evaluation of its assets, which included the valuation of assets in 2013 dollars. In 2017 MPW once again conducted a valuation of the assets to bring them up to current day dollars. MPW continues to implement its program using the data and tools developed in 2013





Assets in this classification have a typical useful life of 20-60 years

Water Supply Master Plan

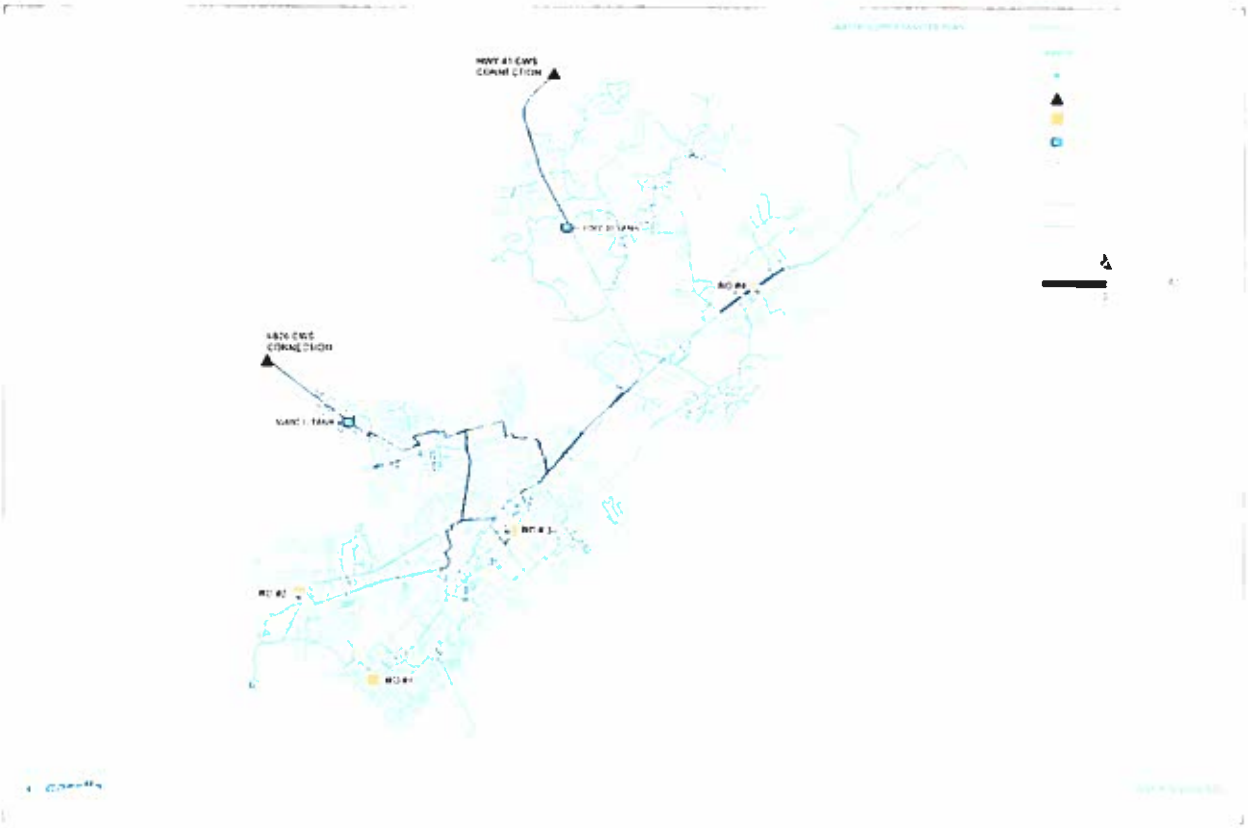
In 2017, MPW contracted Carollo Engineering, Inc to complete a Water Supply Master Plan as a supplement to the 2015 Utility Master Plan. A brief summary is provided below

Purpose

The purpose of the plan was to develop a water supply strategy that considers reliability and resiliency, as well as identifying water supply opportunities for obtaining additional and adequate water supplies for the planning period. These opportunities can be developed into the future using a combination of factors including operational flexibility, cost effectiveness, and long-term sustainability and redundancy.

To provide water supply reliability and protect against loss of infrastructure a combination of approaches were considered in developing the plan:

1. Maintenance Best Practices
2. Redundant Equipment
3. Supply Diversification
4. Excess Supply Capacity



Demands Projections

Demand projections were based on best estimates of customer growth and water use. The 2015 Utility Master Plan developed future water demand projections for the near term, mid-term, and buildout planning periods. Carollo uses these demand projections to evaluate future supply needs, projecting that MPW's customer base would grow considerably:

- Annual water use is anticipated to double from 2014 to 2024
- Future Maximum Day Demand (MDD) is anticipated to be 60% higher than average annual water use

MDDs are typically driven by irrigation and other outdoor water uses. MPW's supplies must be able to meet the future MDDs, requiring extensive supply infrastructure.

Reliability of Existing Supplies

A condition assessment to evaluate the reliability of MPW's existing water supplies was performed. The assessment included an on-site inspection of the major components of MPW's water supply system, including: deep wells, storage tanks, high service pump stations, and water treatment plants. Following the evaluation, each component was scored in four categories: condition, capacity, performance, and reliability and redundancy. It was noted that MPW's supply infrastructure is generally well maintained with adequate capacity and acceptable performance, with the exception of Reverse Osmosis Water Treatment Plant (ROWTP) No. 2, No. 3, and No 4. Reliability and redundancy was the most common category found to require improvement.

Future Supplies

Charleston Water Supply (CWS) can provide sufficient future supplies as demonstrated in the 2015 Utility Master Plan. However, as MPW's reliance on CWS increases, there is a corresponding decrease in MPW's supply diversification. Consequently, this would increase the severity of a loss of service. In particular, the loss of CWS Point of Delivery No. 1 (Daniel Island) would have great impacts because it is anticipated to supply a large portion of MPW's future supply. Therefore, to meet MPW's water supply reliability goal multiple cost-effective and reliable future supply options were considered:

1. CWS,
2. Deep Wells/RO WTPs, and
3. ASR.

Water supplies are evaluated against future supply needs during (1) annual demands; and (2) the MDD.

Annual Supply Strategy

Future annual supply will continue to be from CWS, the ROWTPs (deep wells), and ASR, where available, to meet summer demands. To determine the quantity and timing of these supplies, two supply options were considered:

- Option 1 - Buy CWS Later /Increase Deep Well Withdrawals
- Option 2 - Buy CWS Now /Delay Increase in Deep Well Withdrawals.

Option 1 – Buy CWS Later/Increase Deep Well Withdrawals is recommended as the preferred annual supply strategy to provide reliability, operational flexibility, long-term sustainability, and cost-effectiveness. In the next ten years, the major projects for the strategy includes:

- Increased use of Deep Wells.
- Expanding ROWTPs 3 and 4
- Replacement of Deep Wells 2, 3, 4, and 5
- Membrane Element Replacement at Plants 1, and 2
- Develop an ASR well in the Northern portion of MPW's transmission system.
- Construct CWS Delivery Point No. 3 (Sullivan's Island) to improve reliability of the CWS supplies.

This annual supply strategy was used as a basis to determine additional supplies needed to meet the MDDs.

MDD Supply Strategy

Meeting future MDD requires additional supply beyond the annual supply strategy. No additional projects are required beyond the Annual Supply Strategy Option 1 within the next 10-years to meet the MDD. The MDD supply strategy after this period was left open-ended to allow MPW to take advantage of cost-effective opportunities that arise in the intervening period. Therefore, MPW may implement a single or combination of the following supplies long-term:

- Purchase additional CWS capacity from the existing Points of Delivery beyond the Annual Supply Strategy;
- Purchase CWS Wholesale from Sullivan's Island Point of Delivery;
- Construct a total of five (5) ASR Wells, three (3) additional ASR wells beyond the two currently planned; and
- Develop additional deep wells and related ROWTP capacity

To increase CWS reliability, it is recommended that MPW participate in projects that can increase the reliability of CWS transmission to MPW's points of delivery.

Capital Improvement Plan

The Water Supply Master Plan has provided updated capital projects under the following Asset Classes

- Supply and Storage: CWS, wells, raw water transmission mains, storage and associated booster pump stations
- Water Treatment: ROWTPs and associated concentrate disposal infrastructure
- Distribution: Distribution system piping

Overall Condition of Assets

MPW's supply comes from two sources, groundwater and surface water. Groundwater can be produced at a rate up to 10.72 MGD from 6 deep wells in the Charleston (aka Middendorf) Aquifer.

Surface water is delivered via an agreement with CWS from 2 feed points, one at I-526 and the second one at Highway 41. CWS currently supplies 6 MGD through these 2 connections points, MPW's agreement allows the purchase of up to 12 MGD. MPW is contractually obligated to pay an annual prorated share for capital outlay expenditures incurred by CWS for providing water to MPW. The overall condition of the 2 supply lines is rated at good to excellent.

The overall condition of 5 of MPW's deep wells is rated at average to poor and their evaluations have been planned over the next 10-years.

MPW has 8 ground storage tanks and one elevated tank with a total storage capacity of 12.3 MGD. These assets are in overall good condition, requiring normal routine maintenance.

In 1996, MPW was the first utility in South Carolina to place an aquifer storage and recovery (ASR) well into operation. The calculated ASR storage volume is between 21.9 million gallons and 211 million gallons. MPW currently maintains about 60 million gallons in annual storage via ASR. An additional ASR well is planned in FY2019.

Objective...what we are trying to accomplish

The objective of this asset class is to ensure that an adequate volume of treatable water is available from redundant local groundwater supplies and treated wholesale supplies to meet current and future service demands. It also ensures that adequate water storage capacity exists to meet SCDHEC regulations, and to provide maximum operational efficiency for the purchased and groundwater supplies as well as fire protection.

How to Achieve Our Objective

The CIP includes renewal and replacement projects needed to maintain adequate water supplies and storage to meet current water demands.

Deep Well 6 Electrical Room Upgrade

Before

After

FY2017-FY2018 Highlighted Accomplishments

Groundwater Model Update: Worked with USGS to develop the Simulation of Groundwater Flow in the Charleston Aquifer near Mount Pleasant, SC. Evaluation of the aquifer was necessary to provide planning information for the Water Supply Master Plan for future RO Plant expansions

Total Cost = $137K

Deep Well 5 Replacement: Design was completed in FY2018. Construction of the well will take place under the FY 2021-2022 Capital Budget.

Total Spent FY2018 = $570K

CWS Water Supply: MPW purchased an additional 0.5 MGD of surface water; met its annual contractual payments for capital outlay; paid a capacity transfer fee; and entered into an agreement for the preliminary engineering study for a third connection through Sullivans Island

Total Cost = $5.5M

FY2019-2028 Capital Program Funding for Supply and Storage

FY2019-2020	FY2021-2022	FY2023-2024	FY2025-2026	FY2027-2028	10-Year Total
$14,876,550	$11,842,023	$4,168,305	$8,188,269	$10,013,436	$49,088,583

Overall Condition of Assets

In 1991, with the completion of three water treatment plants, MPW was the state's first utility to use high-tech reverse osmosis (RO) treatment. In 2004, a fourth RO treatment plant was added, for a total daily treatment capacity of 7 MGD. The plants are in overall good condition.

The major components of the treatment plants are the trains that hold the reverse osmosis membranes. Membrane replacement is required when performance (i.e., energy efficiency, product flow, and/or salt rejection) has deteriorated and cannot recover through chemical cleaning. The average life of the membranes is 10 to 15 years. To date membranes have been replaced at RO Plants 1, 2 and 3, and 1 of two trains at RO Plant 4.

RO 1 Control Upgrades

RO 3 VFD Replacement

Objective...what we are trying to accomplish

The objective of this asset class is to ensure exceptional treatment facilities are being maintained to produce water quality that exceeds drinking water standards.

How to Achieve Our Objective

The CIP includes renewal and replacement of equipment, membranes, disinfection units and electrical/control components; and expansion of plants to ensure water quality exceeds federal and state drinking water standards at all times, and current and future demands are met.

FY2017-FY2018 Highlighted Accomplishments

Water Supply Master Plan: As discussed early in this section, Carollo, MPW's Asset Class Engineer for Water Supply, Storage and Treatment contracted Carollo to develop a Water Supply Master Plan that looked at short-term, mid-term, and long-range needs in supply, storage and treatment.

Total Cost = $392K

RO Plant Blending Project: Reinstall equipment necessary to blend groundwater with RO treated water at all four water plants prior to discharging to the distribution system. This practice was eliminated in 2010 to better match the quality of water purchased from CWS. MPW contracted with Carollo Engineers to evaluate the water production, corrosion and cost benefits of groundwater blending. It was their recommendation that MPW should reinstated the blending of groundwater with RO water. Construction was completed in FY2018 to allow groundwater blending.

Total Cost = $228,113

Disinfection Improvements at RO Plants. Carollo completed design, permitting, and bidding for this project in FY2018. Construction will begin fourth quarter of FY2018 and is anticipated to be completed by the end of the third quarter of FY2019.

Total Spent FY2018 = $425K

FY2019-2028 Capital Program Funding for Water Treatment

FY2019-2020	FY2021-2022	FY2023-2024	FY2025-2026	FY2027-2028	10-Year Total
$1,723,613	$476,073	$6,486,382	$652,543	$594,350	$9,932,961

Distribution

Overall Condition of Assets

In October 1935, MPW began formal operation of a water distribution system. The distribution system consisted of 5.8 miles of 2-inch, 6-inch and 8-inch mains and 21 fire hydrants. In 1990, MPW acquired Bulls Bay Rural Community Water District. The current distribution system consists of over 551 miles of water mains, with the majority of these being constructed by residential developers, making it a relatively young system, in good condition.

Objective...what we are trying to accomplish

The objective of this asset class is to support the ongoing rehabilitation of existing water lines, improvements related to optimizing system performance and reliability, e.g. looping, paralleling lines, replacing lines approaching capacity, and adding new transmission and distribution mains to support growth and service deficiencies in specific areas.

How to Achieve Our Objective

The CIP includes renewal and replacement and extension of lines as well as water quality projects that are needed to maintain MPW's water distribution assets in good condition, enabling MPW to meet water demands.

Groves Water Line Project

FY2017-FY2018 Highlighted Accomplishments

Hwy 41 Area Saddles and Bolts Replacement. MPW completed the 4-Year Distribution Rehabilitation Program (FY2015-2018) funded through SRF for replacing saddles and bolts in the Hwy 41 region. With the completion of this project saddles and bolts in Rivertowne, Park West and Dunes West have been replaced with stainless steel materials, which was necessary as a direct result of corrosive soils throughout this portion of MPW's services area. Through FY 2018, MPW has reinvested $3.7M on these assets.

Total Spent FY2018 = $1.6M

The Groves Water Line. This project was a continuation of MPW's efforts to eliminate 2" galvanized pipes (the cause of red water) and increase fire flows throughout the older neighborhoods of MPW. The project also allowed MPW to "loop" the system from the new 16" lines on Johnnie Dodds Blvd to Scott Street.

Total Cost = $3M

Fixed Based System Meter Replacement Project. A contractor began replacement of all MPW meters in July 2017. Through the end of FY2018 approximately 17,394 meters have been replaced with the remaining scheduled during FY2019. This is a multi-year project with a budget of $13.5M.

Total Spent FY2018 = $8.6M

FY2019-2028 Capital Program Funding for Distribution

FY2019-2020	FY2021-2022	FY2023-2024	FY2025-2026	FY2027-2028	10-Year Total
$6,804,683	$3,218,053	$7,700,529	$9,460,048	$1,046,800	$28,230,113

Mount Pleasant Waterworks

Mount Pleasant, South Carolina

Comprehensive Annual Financial Report

For the Fiscal Years Ended June 30, 2017 and 2016

Mount Pleasant Waterworks

Annually, Mount Pleasant Waterworks holds a Poster Contest open to all students; public, private or home-schooled from kindergarten through 8th grade. The theme of the posters are a celebration of our most precious natural resource, WATER. Presented on the cover is the 8th grade winner for 2017, Abigail Higbie, a student at Cario Middle School in Mount Pleasant, South Carolina. Below are other 1st place winners in their respective grades. Their wonderful creativity and talent with an understanding of the value of water is impressive and inspirational.

Annual Drinking Water Week Poster Contest 1st Place

Alexandria Trann
5th Grade
Whitesides

Annual Drinking Water Week Poster Contest 1st Place

Pace Hylton
2nd Grade
Mount Pleasant Academy

MOUNT PLEASANT WATERWORKS

COMPREHENSIVE ANNUAL FINANCIAL REPORT

Fiscal Years Ended June 30, 2017 and 2016

Prepared By:

Financial Services Department

Mark L. Coffin, CGMA
Chief Financial Officer

Jeffrey Clark
Accounting Supervisor

Brian King
Budget & Procurement Supervisor

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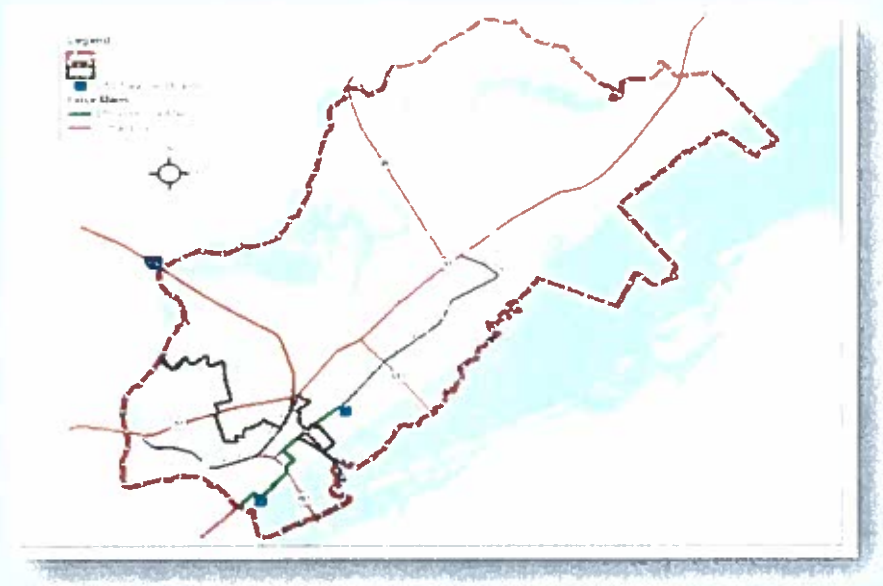


Mount Pleasant Waterworks' Service Area

Introductory Section

- Letter of Transmittal
- Organizational Chart
- Elected and Appointed Officials
- GFOA Certificate of Achievement

MOUNT PLEASANT WATERWORKS
CLEAN WATER

VISION

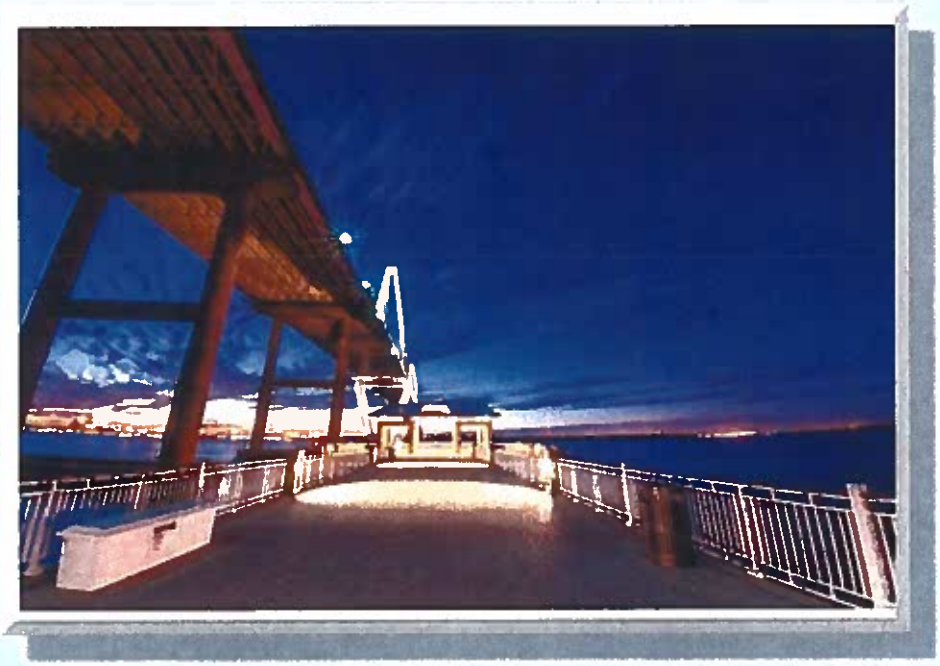
Through the unified and committed efforts of each and every employee, Mount Pleasant Waterworks will be a leader in our industry and community.

MISSION

To provide our customers with water and wastewater services of exceptional quality and value, while protecting public health and the environment.

VALUES

Fairness: To our customers, employees, and other stakeholders
Integrity: In all actions by employees and commissioners
Quality: In our products, services, and processes



Elected
Rick M. Crosby, Chairman
Susan I. Mellichamp, Vice Chairman
H. Mac Jenkinson, Secretary-Treasurer
Diane D. Lauritsen, Ph.D.
John Burn

Ex-Officio
Linda Page, Mayor
Mark Smith, Chairman
Water Supply Committee, Town Council

Clay Duffie, **General Manager**

LETTER OF TRANSMITTAL

October 23, 2017

To the Customers, Commissioners and Employees of
Mount Pleasant Waterworks, Mount Pleasant, South Carolina:

State law and bond covenants require the preparation of annual audited financial statements of Mount Pleasant Waterworks (the Commission). This Comprehensive Annual Financial Report (CAFR) is published to fulfill that requirement for the fiscal year ended June 30, 2017. The CAFR is available on the Commission's website at:

www.mountpleasantwaterworks.com

Management assumes the responsibility for the completeness and reliability of the information contained in this report, based upon a comprehensive framework of internal controls established for this purpose. The cost of internal controls should not exceed the anticipated benefits. Accordingly, the objective of internal controls is to provide reasonable, rather than absolute assurance that the financial statements are free of material misstatements.

This Comprehensive Annual Financial Report conforms to generally accepted accounting principles as defined by the Governmental Accounting Standards Board (GASB). Management's Discussion and Analysis (MD&A), included in the financial section of the report, complements this letter of transmittal and should be read in conjunction with it.

PROFILE OF THE GOVERNMENT

The Commission, empowered by South Carolina Code of Laws section 5-31-210, is governed by seven Commissioners, five elected by the public for staggered terms of six years, the Mayor and the Chairman of the Water Supply Committee of Town Council. The Commissioners elect a Chairman, Vice-Chairman and a Secretary/Treasurer in compliance with state law. There are no limits on terms of service. Ownership of the system rests with the Town of Mount Pleasant. Only Town Council is empowered to approve the borrowing of money for system purposes; however, the sole power to impose and fix rates, dispose of surplus revenues, and otherwise control and direct the fiscal affairs of the system, is vested with the Commissioners.

The Commission was established as a body politic and corporate, whose principal functions are to acquire supplies of fresh water, capable of being used for domestic and commercial purposes, and to distribute such potable water for domestic and commercial use within its service area; and to acquire, construct, operate and maintain such wastewater treatment and collection facilities as the Commission deems necessary. The Commission's operating revenues are derived from three principal sources: water system revenues, wastewater system revenues and miscellaneous fees and charges.

The Commission was originally designated to provide water and wastewater services within the corporate limits of the Town of Mount Pleasant. In accordance with the Water Quality Management Plan required by PL 92-500, Section 208, the wastewater service area was expanded in 1985 to include all areas within Charleston County between the Wando River, the Intracoastal Waterway and the Town of Awendaw, including the Town of Mount Pleasant. With the merger of the Bulls Bay Rural Community Water District in March 1990, the water service area was extended from the Santee River to the Cooper River, an area 42 miles in length. Enlargement of the Commission's service area demonstrated the need for progressive provision of adequate water and wastewater services to the East Cooper area of Charleston County.

The popular name of the Commission is Mount Pleasant Waterworks (MPW).

COMMISSIONERS OF PUBLIC WORKS OF THE TOWN OF MOUNT PLEASANT
1619 Rifle Range Road • Mount Pleasant, South Carolina 29464
Phone 843-884-9626

The Commission is organized into eight departments – Administration, Communications, Financial Services, Human Resources, Technical Services, Engineering, Operations and Field Services. The Commission was reorganized in January 2017 combining plant operations (water and wastewater) into one department and field services (water and wastewater) into a separate department. This realignment brought the organization under a functional (plant or field) approach rather than a utility-based (water or wastewater) approach. It is further organized into twenty-five functional sub-departments with each having its own budget for fiscal control. Each department reports directly to the General Manager. As of June 30, the Commission had 122 employees. The State of South Carolina requires that personnel involved in water distribution, water treatment and wastewater treatment be licensed by the South Carolina Environmental Certification Board. In addition, there is a Voluntary Certification Program for wastewater collection system operators that is a tiered professional licensing program much like the mandatory certification program regulated by the State. Employees have successfully attained 173 environmental licenses and continue to maintain these licenses annually through mandatory continuing education.

The South Carolina Department of Health and Environmental Control (SCDHEC) has regulatory control over the Commission's water and wastewater activities.

The Commission began formal operation of a water distribution system from shallow wells in December 1935. With the Safe Drinking Water Act amendments of 1986 and concern for drinking water quality, the Commission became the first municipal water system in the State of South Carolina to provide state of the art reverse osmosis (RO) treated water to its customers in August 1991. Reverse osmosis treatment has greatly improved water quality through taste, hardness and appearance.

The water system has the capacity to deliver groundwater up to 10.72 million gallons per day (MGD) from five deep wells in the Middendorf Aquifer. The Commission currently operates four RO plants with a total daily treatment capacity of 7.5 MGD. The Commission also has an agreement with Charleston Water System (CWS) to purchase capacity as needed to serve the East Cooper population. CWS currently supplies 6.0 MGD. In addition, the Commission has eight ground storage tanks and one elevated tank with a total capacity of 12 million gallons, and aquifer storage and recovery facilities with an annual usage capacity of 130 million gallons. During fiscal year 2017, the Commission supplied 2.9 billion gallons of water through 561 miles of water lines to approximately 38,000 customer accounts.

Wastewater collection was first provided in the early 1940's through a gravity collection system which discharged to the Charleston Harbor. Construction began on the first wastewater treatment facility in 1969, with operations initiated in 1971. In the 1980s, under the PL92-500 EPA federal program, the Commission expanded its 1.4 MGD wastewater treatment facility to its present permitted capacity of 3.7 MGD. At that time, four small package wastewater treatment plants were taken out of service and flow from these plants was diverted to the expanded Center Street Wastewater Treatment Facility.

In 1987, a master plan was developed at the request of the Commission and pursuant to this plan; the Commission purchased a 40-acre tract of land on which future facilities could be built. The Commission requested and received from the South Carolina DHEC an expanded service area to meet the growth needs. Construction of a major wastewater transmission system was completed to serve this expanded area. In 1993, construction was completed on a second wastewater treatment facility designed for expansion and estimated to meet the continuing growth demands of Mount Pleasant well into the twenty-first century. The Commission's outfall into Charleston Harbor has a hydraulic capacity of 17 MGD. The Commission presently operates two wastewater treatment facilities. During fiscal year 2017, the Commission treated 2.95 billion gallons of wastewater and 1,897 dry tons of bio-solids. The Commission also maintains 497 miles of combined gravity wastewater collection lines and force mains and 161 pump stations serving about 34,000 customers.

LOCAL ECONOMY

Mount Pleasant is located near the resort beaches of Sullivan's Island and Isle of Palms; however, tourism does not dramatically impact the operations of the system, nor is the Commission significantly dependent upon tourist generated revenue. The Commission does, however, serve a major tourist attraction in the State, the aircraft carrier U.S.S. Yorktown at Patriots Point and the Congressional Medal of Honor Society Museum.

Reflecting the growth of the Charleston metropolitan area in general, and the attractiveness of Mount Pleasant as a residential community in particular, the Town of Mount Pleasant's growth remains strong, with economic indicators reinforcing residential and commercial development. The Commission's projected multi-year capital improvements plan reflects this growth and the Commission's plans to keep pace well into the twenty-first century. The Commission's financial stability is a direct reflection of the continued economic growth of the expanding East Cooper community and the Commission's commitment to provide quality service at the most affordable rates possible.

The Charleston regional economy continues to grow driven by major business investments from Boeing, Mercedes-Benz, Volvo Cars, and expansion of the South Carolina State Ports Authority (SCSPA). The Charleston Regional Development Alliances (CRDA) reported that $3.9 billion in economic impact announcements were made during 2015 and 2016.

The per capita income for Mount Pleasant increased by 3% to $44,071 (U.S. Census Bureau) in 2016. The Town annexed 1.27 square miles during 2016. 1,622 dwelling permits were issued in 2016, an increase of 38%. The unemployment for the Town for 2016 was 2.6% compared to a national rate of 4.7%.

To respond to the new investments, many of the region's educational institutions are moving towards a STEM-based (science, technology, engineering and math) curriculum to include K-12 schools. Laing Middle School, located in Mount Pleasant, was ranked as the number one STEM middle school in America at the 37th National Future of Education and Technology Conference 2017. Trident Technical College, in November of 2016, broke ground on the S.C. Aeronautical College, an $80 million investment. The Bosch Community Fund awarded $477,000 in local grants promoting STEM education.

The Town of Mount Pleasant population grew in 2016 by 3.5% to approximately 84,000, as estimated by the U.S. Census Bureau. The population of Charleston County grew 4.1%, the Metropolitan Statistical Areas (MSA, comprising Berkeley, Charleston and Dorchester County) grew by 4.6% and the state grew by 2.7% in 2016. The CRDA estimates 45 new people are relocating to the Charleston region every day.

Boeing has invested $2 billion into the region since 2009 and in 2017 rolled out the new 787-10 Dreamliner. The 787-10 will be manufactured completely in North Charleston. The impact from Boeing to the local economy is estimated at $19 billion.

Volvo Cars is in the process of building its first U.S. manufacturing plant with an initial investment of $500 million and is estimating production of 100,000 cars a year. The plant will produce the new S60 sedan and over the next ten years will hire 2,000 employees. The estimated annual economic impact is $4.8 billion. Subsequent event: On September 19, 2017, Volvo Cars announced a second production line and that its investment will increase to over $1 billion.

In 2017, the last steel beam has been set on the Mercedes-Benz Vans plant in North Charleston. The new plant, an investment of $500 million, will provide up to 1,300 jobs and estimates are up to 400 at area suppliers assembling Sprinter vans.

The Charleston International Airport posted a record 3.7 million passengers in 2016 and is projecting 4 million during 2017. This was the sixth straight year of increasing passenger traffic. The airport recently completed a $200 million expansion and renovation of its terminal. The economic impact is estimated at over $1 billion a year.

The South Carolina State Ports Authority (SCSPA), an economic driver for more than 300 years, provides $6.3 billion to the local economy and $53 billion statewide. In January 2016, the U.S. Congress passed the funding resolution for the deepening of the Charleston Harbor. The port will be able to accommodate the fully-loaded, new Panamax container ships at all tides. Up to 70% of the BMW vehicles manufactured in Greer, South Carolina are shipped through the Charleston Port. The State Port Authority celebrated its 75th anniversary in March and received its first 14,000 TEU (twenty-foot equivalent unit) ship in May 2017. The Mercedes-Benz and Volvo Cars investment will provide more positive economic impact to the SCSPA for both import and export activities.

The Milken Institute ranked the Charleston MSA 16th out of the 25 best performing large cities in America, citing the high-tech economy growing 20 percent faster than the nation overall. The Port of Charleston being a key asset for the manufacturing segment and for the major manufacturing investments in the region were cited as well.

In 2017, the Brookings Institution, a nonprofit public policy organization based in Washington, DC, cited Charleston as one of the 11 out of 30 metro areas to achieve inclusive economic outcomes in which all sectors of the population achieve growth of some kind in the expansion of the regional economy.

In a 'Readers' Choice Award survey, *Condè Nast Travel* announced Charleston as the nation's top small city for the sixth time in a row. A survey by *Travel and Leisure* ranked Charleston as the best tourist destination in the world. A *Southern Living* survey cited Charleston as the best city in the South. Tourism provides an estimated $3.7 billion in annual economic impact.

CAPITAL PROGRAM

MPW's Capital Program places a major focus on "Asset Management." Asset management is a fundamental step in determining financial resources needed to operate the water and wastewater systems and pay for rehabilitation or replacements. In addition, MPW has developed a Utility Master Plan that provides the road map for system extensions and expansions to ensure adequate capacity is in place to meet the high growth demands.

HIGHLIGHTED PROJECTS COMPLETED AND IN-PROGRESS IN FY2017

New Forcemain from Mathis Ferry Road to Coleman Boulevard: This project included the installation of new 8-inch; 12-inch; 14-inch; 16-inch; and 18-inch forcemains. This new forcemain network, identified in our Utility Master Plan, was necessary to meet current and future wastewater flow demands in this portion of MPW's service area.
Total spent FY2017 = $1.9 million

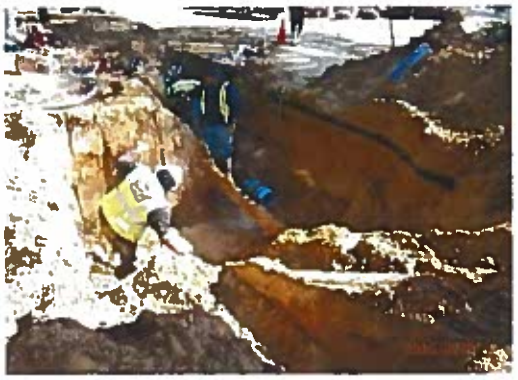
Collection System Rehabilitation Program: MPW continued its work under the Collection System Rehabilitation Program being funded over a 4-year period through SRF for gravity line repairs and replacements throughout MPW's service area. The SRF Funded Program began in Fiscal Year 2015 with a total budget of $14 million. In FY2017, 12,000 linear feet of gravity line was replaced using traditional construction methods and 67,000 linear feet of gravity line rehabilitated using trenchless. ***Total spent during FY2017 = $6.6 million***

Rifle Range Road Wastewater Treatment Plant Effluent Pumping System Modification: Modifications and upgrades to this system included new energy efficient submersible pumps, discharge piping, wetwell modifications, new instrumentation, and upgrades to the control building electrical room.
Total spent FY2017 = $3.2 million

Property Acquisition for the Rifle Range Road Wastewater Treatment Plant 9.2 MGD Expansion: Additional land was purchased for the expansion of this plant currently under design. The construction will run from March 2018 through December 2020. The purchase of this additional 13.23 acres will allow for future plant expansions needed to meet wastewater demands through buildout of the MPW service area.
Total spent during FY2017 = $3.9 million

Distribution System Rehabilitation Program: MPW continued its work under the Distribution Rehabilitation Program being funded over a 4-year period through SRF for replacing saddles and bolts in the Highway 41 region. The SRF Funded Program began in Fiscal Year 2015 with a total budget of $2.5 million. At the completion of this project saddles and bolts in Rivertowne, Park West, and Dunes West will have been replaced with stainless steel materials. This was a direct result of corrosive soils throughout this portion of MPW's service area.
Total spent during FY2017 = $800 thousand

The Groves Water Line: This project is a continuation of MPW's efforts to eliminate 2" galvanized pipes (the cause of red water) and increase fire flows throughout the older neighborhoods of MPW. The project also allowed MPW to "loop" the system from the new 16" lines on Johnnie Dodds Blvd to Scott Street.
Total spent FY2017 = $3 million



Charleston Water Supply: MPW negotiated a new 30-year contract with Charleston Water System that included:

- Purchase of an additional 0.5 MGD of water capacity = $2.6 million
- Capacity Transfer Fee = $1.7 million
- MPW Annual Capital Outlay Fee = $750 thousand
- Preliminary Engineer Report for 3rd Connection from Sullivan's Island = $29 thousand
  Total spent during FY2017 = $5.1 million

LONG-TERM FINANCIAL PLANNING

Cost Recovery Policy:

The Cost Recovery Policy, originally developed in 1992 and last revised in June 2017, delineates the cost recovery philosophies of the Commission. The policy is a framework in which 1) a fair and reasonable system of charges for utility services is developed, administered, and maintained; and 2) long-term financial stability is achieved. Although this policy is viewed as an official guideline, its policies are regarded as changeable and adaptable, rather than fixed and permanent.

Customers, Commissioners, or Commission staff may request revision of the Policy annually prior to adoption of budgets and new rates. The cost recovery goal of the Commission is to fully and equitably recover all costs of operating, maintaining, and expanding the water and wastewater utilities from the customers of the service areas while maintaining a high degree of financial stability. A copy of the Cost Recovery Policy is available on the Commission's website, www.mountpleasantwaterworks.com, or by written request.

The Commission annually updates its Ten-Year Financial Plan to assess the financial feasibility of planned and budgeted activities within the guidelines of the cost recovery goals, objectives, and policies. In addition, rates, fees, and charges undergo a comprehensive review at least every five years by a qualified, independent consultant to maintain a sufficient and equitable cost recovery system. Cost recovery studies are conducted more frequently if major changes occur in 1) forecasts of costs to be incurred by the Commission, 2) regulations governing system operation, 3) operating technologies, or 4) the demographics of the customer base. The independent study produces a comprehensive schedule of rates, fees, and charges that reflect stated policies and provide defensible documentation of the calculations used in designing the rates, fees, and charges.

Water and Wastewater Impact Fees:
To help prevent existing customers and long-term residents of the Town of Mount Pleasant from subsidizing the cost of capital facilities required for growth and development in the service area, the Commission levies impact fees designed to recover identified major capital costs associated with providing water and wastewater facilities, including but not limited to water treatment plants, storage facilities, pumps, and distribution mains; wastewater collection, transmission, storage, and treatment facilities; and other capital equipment with expected useful lives of 10 years or more. These fees are paid by developers and customers for all projects which require water or wastewater capacity. Fees collected are restricted to certain projects and are segregated. Impact fees are recorded as contributions to capital. Impact fees are an equitable means of allocating the costs of utility and other governmental facilities directly to the individuals who benefit from the facilities. Existing customers do not fully bear the costs of capacity expansion for future customers through rates. Thus, monthly basic facility charges and volumetric charges for all customers can be kept lower than would otherwise be necessary. To the nearest extent practical, the Commission requires that growth pays for growth.

BUDGETARY CONTROLS

The Commission maintains budgetary controls at the object level (per line item) within each department. Control is accomplished by maintaining appropriations and expenditures by line item within each department, which is reported monthly by income statement to the General Manager. Department managers are held directly accountable for accomplishing departmental goals within budget and in a manner consistent with adopted policies and procedures.

AWARDS

The Government Finance Officers Association of the United States and Canada (GFOA) awarded a Certificate of Achievement for Excellence in Financial Reporting to the Commission for its comprehensive annual financial report (CAFR) for the fiscal year ended June 30, 2016.

This was the twenty-first consecutive year that the Commission has achieved this prestigious award. In order to be awarded a Certificate of Achievement, a government must publish an easily readable and efficiently organized comprehensive annual financial report. This report must satisfy both generally accepted accounting principles and applicable legal requirements.

The GFOA also presented the Commission with a Distinguished Budget Presentation Award for the Annual Budget beginning July 1, 2016. This was the eighth consecutive year that the Commission has achieved this prestigious award. In order to receive this award, a governmental unit must publish a budget document that meets program criteria as a policy document, as an operations guide, as a financial plan and as a communications device.

SCDHEC Facility Excellence Award

The South Carolina Department of Health Environmental Control has presented the 2016 Facility Excellence Award to Mount Pleasant Waterworks for both plants, Center Street Wastewater Treatment Plant and Rifle Range Road Wastewater Treatment Plant, in recognition of facility personnel who are striving for excellence in the protection of the environment and meeting or exceeding expectations.

This program is for organizations committed to protecting and preserving South Carolina's environment. To be eligible, a company or facility must be committed to reducing waste streams through pollution prevention (P2) activities and/or reducing energy or other resource consumption.

Several benefits to the South Carolina Environmental Excellence Program (SCEEP) are public recognition as an environmental leader in the state, participation with senior regulatory officials on Environmental Excellence Council and Opportunities for regulatory flexibility on identified issues.

Individual Awards

Operator Foreman Troy Newton (left) was named the Water Environment Association of SC Operator of the Year. This award was given for his excellent achievement in the direct operation of a wastewater treatment plant system in South Carolina.

Lenard Sinclair (right), Water Quality Operator was presented with the Distribution Operator of the Year Award for his excellent achievement in the area of water distribution.

Kenda Conley, MPW Intern and College of Charleston student, was the winner of the SC Environmental Conference Student Poster Contest. She presented a poster titled "Removal of Microplastics by Wastewater Treatment Plants in Charleston, SC and Survey Operators". The Water Environment Association of SC is sending Kenda to compete in the national contest this fall.

General Manager Clay Duffie was awarded the William T. Linton Service Award, the highest and most prestigious award presented by the Water Environment Association of South Carolina. The award reads: "For recognition of outstanding service, leadership and devotion to the state of South Carolina in preserving and protecting its valuable water resources." This lifetime achievement award is presented on a very selective basis through nominations made to the Executive Committee of the Water Environment Association of South Carolina.

Best Places to Work in South Carolina

Mount Pleasant Waterworks, for the second year in a row, was recently named as one of the Best Places to Work in South Carolina. The Best Places to Work program, created by SC Biz News, the South Carolina Chamber of Commerce and Best Companies Group, was designed to identify, recognize, and honor employers in the state that benefit the state's economy, workforce, and businesses.

In order to qualify for this award, an extensive two-part survey process was conducted. The first part consisted of evaluating our company's workplace policies, practices, philosophy, systems, and demographics. The second part consisted of an employee survey to measure employee opinions. The combined scores determined the top companies and the final rankings

Seventy companies from across the state were recognized, and Mount Pleasant Waterworks ranked in the top 16 of South Carolina employers for 2017, moving up 8 places on the company rankings list from 2016.

UTILITY CREDIT RATING

During the bond issuance process in 2017, Mount Pleasant Waterworks' credit ratings were reaffirmed by Moody's and Standard & Poor's with rating of Aa1 and AA+ respectively. The agencies noted the Commission's strong debt service coverage supported by prudent fiscal policies, improving liquidity, willingness to adjust rates, growing service areas benefiting from the Charleston regional economy, and strong operational management practices and policies.

INDEPENDENT ANNUAL AUDIT

The Commission requires an annual audit of the financial records, transactions, and an internal control evaluation of all the administrative departments by independent certified public accountants. The accompanying financial statements were audited by the Commission's independent Certified Public Accountants, Mauldin & Jenkins, LLC. Their unmodified report on the financial statements is included in the financial section of this report.

ACKNOWLEDGMENTS

This report could not have been prepared without the efficient and dedicated services of all the Commission employees who assisted and contributed to its preparation. The Comprehensive Annual Financial Report, with exception to the auditor's report, was prepared by Mark L. Coffin, Chief Financial Officer, with the assistance of the Finance and Accounting staff. We would like to express sincere appreciation to our Commissioners for their vision, leadership, and guidance in helping us provide high-quality services, information, and education resulting in the best possible water and wastewater services at affordable rates while protecting our natural resources and the environment.

Sincerely,

Clay Duffie
General Manager

Mark L. Coffin, CGMA
Chief Financial Officer

MOUNT PLEASANT WATERWORKS

CLEAN WATER

dhec

S.C. Department of Health and Environmental Control

FACILITY EXCELLENCE AWARD

2016

Presented to:

MOUNT PLEASANT WATERWORKS

CENTER STREET WWTP, RIFLE RANGE ROAD WWTP

This award is given in recognition of facility personnel who are striving for excellence in the protection of the environment and are meeting or exceeding compliance expectations.

Presented this 13th day of March, 2017

David G. Baize
Chief, Bureau of Water

Myra C. Reece
Director of Environmental Affairs

Cost Recovery Policy

Excerpt from the Cost Recovery Policy
Revised June 2017

Introduction

This document contains the Cost Recovery Policies of the Commissioners of Public Works for the Town of Mount Pleasant, South Carolina herein after referred to as "the Commission". By virtue of SC Code of Laws, *Section 5-31-250,* conducting the financial affairs of the Commission is vested with the elected Commissioners. This document, adopted and approved by the Commissioners, includes the public policies whereby the Commission will recover the cost of providing water and wastewater services to its customers.

Section 1 Purpose

This policy document provides clear public policies used as guidance by the Commissioners when making financial decisions and plans relating to the provision of water and wastewater service to existing and future customers. These policies are designed to create long-term financial stability for a public utility, while ensuring that the charges for services are as fair, reasonable and equitable as possible. Adopted during the course of public meetings, this document is also amended through the public meeting process.

Section 2 Cost Recovery Philosophy

Policy 2.1 Cost Recovery

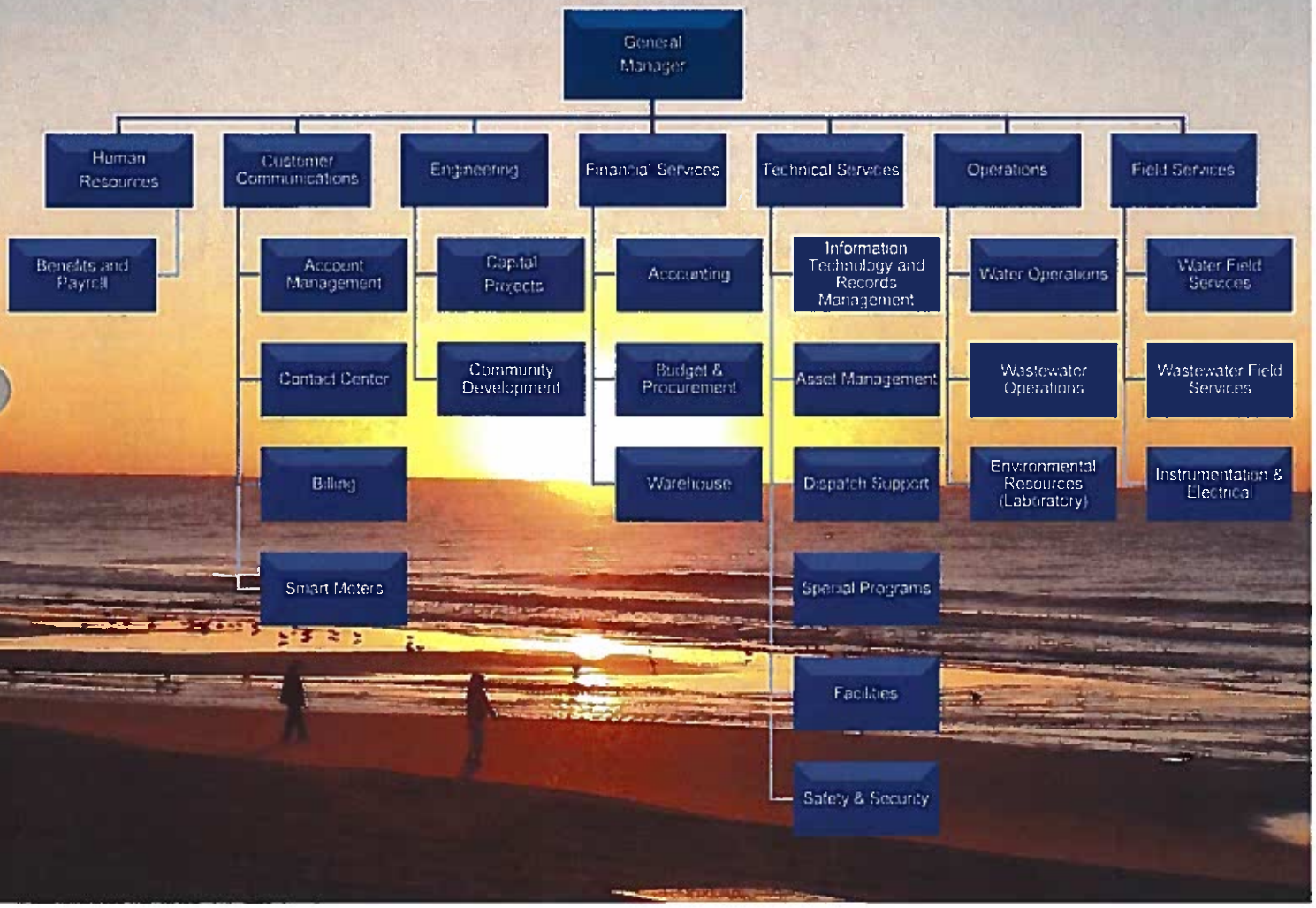
> *To fully and as equitably as possible recover all costs of operating, maintaining, and expanding the water and wastewater utilities from the customers of the service area while maintaining financial stability and sufficiency.*

The mission of the Commission is to provide excellent quality water and wastewater services to its customers, while meeting all applicable Federal, State and local laws and regulations. All of the costs to provide these services must be fully recovered by the Commission. In addition, rates must be as equitable as possible among customer classifications, and between existing and future customers. Financial stability ensures that rates remain reasonable, and that the utility's borrowing ability is maintained.

For the full Cost Recovery Policy reader is directed to the Commission's Website at

http://www.mountpleasantwaterworks.com

Mount Pleasant Waterworks
Organizational Chart



Mount Pleasant Waterworks Commissioners

Back Row: Mark Smith, Rick Crosby, Chairman, Diane Lauritsen, Ph.D., John Burn

Front Row: Mac Jenkinson, Secretary-Treasurer, Mayor Linda Page, Susan Mellichamp, Vice Chairman

ELECTED COMMISSIONERS

COMMISSIONERS	YEAR FIRST ELECTED	TERM EXPIRES	POSITION
Rick M. Crosby	1998	2019	Chairman
Diane Lauritsen, Ph.D.	2002	2021	Commissioner
Susan I. Mellichamp	2004	2017	Vice-Chairman
H. Mac Jenkinson	2009	2021	Secretary-Treasurer
John Burn	2013	2019	Commissioner
Linda Page	2013	2017	Mayor, Mount Pleasant
Mark Smith	2013	2017	Town Council Member Chairman Town Water Supply Committee

MANAGEMENT TEAM

TEAM MEMBERS	YEAR FIRST APPOINTED	POSITION
H. Clay Duffie	1989	General Manager
David P. Niesse	2004	Engineering Manager
Brian P. Head	2006	Technical Services Manager
Nicole F. Bates	2006	Customer Communication Manager
Christi A. Fowler	2009	Human Resources Manager
Mark L. Coffin	2013	Chief Financial Officer
Ross Wattay	2015	Field Services Manager
Franklin Allan Clum, Jr.	2016	Operations Manager

WATER & WASTEWATER SYSTEMS

The Town of Mount Pleasant began operating its water system in 1935, and designed the system to have 160,000 gallons per day capacity. The system initially included 179 water meters to serve the Town's population. Now, MPW serves more than 38,000 water accounts, with an average daily usage of 8.9 MGD. MPW also purchases approximately 62% of its water from the Charleston Water System (CWS). In addition, MPW operates four reverse osmosis plants, six deep wells, and seven ground or elevated storage facilities, with 561 miles of water mains.

The wastewater system began operation in 1942 by collecting wastewater for discharge into the Charleston Harbor. Construction started on the first primary treatment facility in 1969 and commenced operations in June 1970. This initial facility had a treatment capacity of 1.4 MGD, but was expanded in 1976 to process as much as 3.7 MGD. In 1989, an outfall line was constructed to transport all of MPW's treated wastewater 4,700 feet into the Charleston Harbor, to ensure maximum dilution. In 1995, the Rifle Range Road Treatment Plant came on line with an initial capacity of 3 MGD. Currently, the wastewater treatment capacity is 9.7 MGD, and an average of 8.1 MGD is treated. The system includes 497 miles of lines, and 161 wastewater pump stations.

Government Finance Officers Association

Certificate of Achievement for Excellence in Financial Reporting

Presented to

Mount Pleasant Waterworks
South Carolina

For its Comprehensive Annual
Financial Report
for the Fiscal Year Ended

June 30, 2016

Executive Director/CEO

MOUNT PLEASANT WATERWORKS
CLEAN WATER

The Financial Services Department's mission is to provide outstanding financial leadership and accounting, ensuring accountability and transparency through integrity, teamwork, expertise, and outstanding customer service in an efficient and effective manner and in conformity with professional, ethical, industry and legal requirements and standards.

Financial Section

- Independent Auditor's Report
- Management's Discussion & Analysis
- Basic Financial Section
- Supplementary Information

MAULDIN & JENKINS

INDEPENDENT AUDITOR'S REPORT

To the Honorable Chairman and Members of the Commission
of the Mount Pleasant Waterworks
Mount Pleasant, South Carolina

Report on Financial Statements
We have audited the accompanying financial statements of the **Mount Pleasant Waterworks** (the "Commission"), as of and for the years ended June 30, 2017 and 2016, and the related notes to the financial statements, which collectively comprise the Commission's basic financial statements as listed in the table of contents.

Management's Responsibility for the Financial Statements
Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility
Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the Mount Pleasant Waterworks as of June 30, 2017 and 2016, and the changes in financial position and cash flows for the years then ended in accordance with accounting principles generally accepted in the United States of America.

Other Matters

Required Supplementary Information

Accounting principles generally accepted in the United States of America require that the Management's Discussion and Analysis (on pages 4 through 20), the Schedule of Funding Progress and Employer Contributions on page 61 and the Schedule of the Employer's Proportionate Share of the Net Pension Liability on page 62 be presented to supplement the basic financial statements. Such information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board, who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. We have applied certain limited procedures to the required supplementary information in accordance with auditing standards generally accepted in the United States of America, which consisted of inquiries of management about the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audit of the basic financial statements. We do not express an opinion or provide any assurance on the information because the limited procedures do not provide us with sufficient evidence to express an opinion or provide any assurance.

Other Information

Our audit was conducted for the purpose of forming an opinion on the financial statements that collectively comprise the Commission's basic financial statements. The introductory section, Schedule of Departmental Operating Expenses Excluding Depreciation, Schedule of Capital Assets by Function and Type, and the statistical section, are presented for purposes of additional analysis and are not a required part of the basic financial statements.

MAULDIN & JENKINS

The Schedule of Departmental Operating Expenses Excluding Depreciation and the Schedule of Capital Assets by Function and Type are the responsibility of management and were derived from and relate directly to the underlying accounting and other records used to prepare the basic financial statements. Such information has been subjected to the auditing procedures applied in the audit of the basic financial statements and certain additional procedures, including comparing and reconciling such information directly to the underlying accounting and other records used to prepare the basic financial statements or to the basic financial statements themselves, and other additional procedures in accordance with auditing standards generally accepted in the United States of America. In our opinion, the Schedule of Departmental Operating Expenses Excluding Depreciation and the Schedule of Capital Assets by Function and Type are fairly stated in all material respects in relation to the basic financial statements as a whole.

The introductory and statistical sections have not been subjected to the auditing procedures applied in the audit of the basic financial statements and, accordingly, we do not express an opinion or provide any assurance on them.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated October 23, 2017, on our consideration of the Commission's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts and grant agreements, and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the Commission's internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the Commission's internal control over financial reporting and compliance.

Mauldin & Jenkins, LLC

Macon, Georgia
October 23, 2017

MAULDIN & JENKINS

Management's Discussion & Analysis

MOUNT PLEASANT WATERWORKS CLEAN WATER

U.S. PUBLIC FINANCE

MOODY'S INVESTORS SERVICE

CREDIT OPINION
13 April 2017

New Issue

Mount Pleasant (Town of) SC Water and Sewer Enterprise

New Issue: Moody's Assigns Aa1 to Town of Mount Pleasant, SC's $111M Rev. Bonds, Ser 2017A

S&P Global Ratings

Mount Pleasant, South Carolina; Water/Sewer

Credit Profile

[illegible]		
Long Term Rating	AA+/Stable	New
Mount Pleasant wtr & swr		
Long Term Rating	AA+/Stable	Affirmed

This discussion and analysis provides management's overview of the Commission's financial condition and activities for the fiscal years ended June 30, 2017 and 2016. To enhance the reader's understanding, management encourages considering the information contained in the Management's Discussion and Analysis (MD&A) in conjunction with the audited financial statements, the transmittal letter, and statistical information. All amounts presented in this MD&A are in thousands of dollars, whereas amounts presented elsewhere in the report are expressed in dollars.

Management has prepared and is responsible for the financial statements and related information included in this report. Such information has been subjected to the Commission's system of internal accounting controls and audited by independent external auditors. In management's opinion, the financial statements present fairly, in all material respects, the financial position of Mount Pleasant Waterworks at June 30, 2017 and 2016 and the results of its operations for the years then ended in conformity with accounting principles generally accepted in the United States of America.

General Trends and Significant Events

- The Mount Pleasant community, along with the Charleston region, continues to grow at significant rates. As estimated by the United States Census Bureau, the Town's population grew 3.5% during 2016 to approximately 84,000. The town has grown by an average 4% over the last four years. Between 2014 and 2015 the town grew by 4.7% earning the ranking of the tenth fastest growing communities in the United States and number one, east of the Mississippi River.

- The Commission's customer base grew by 3.3% and 3.4% during fiscal year 2017 and fiscal year 2016 respectively. Water gallons sold increased 6.3% and wastewater billed increased 4.0% during fiscal year 2017 as compared to the 3.2% increase in water gallons sold and 2.2% increase in wastewater billed during fiscal year 2016.

- The growth in the Mount Pleasant customer base and water consumption is being driven by the economic expansion of the Charleston region led by Boeing, Mercedes-Benz, Volvo Cars and the State Ports Authority.

- On May 17, 2017, the Commission issued $111 million Waterworks and Sewer System Revenue Parity Bonds, Series 2017A, to finance the capacity related expansion and upgrade of the Rifle Range Road Wastewater Treatment Plant, water capacity purchases from Charleston Water System, AMI meter replacement project, and other water and wastewater treatment, distribution and collection improvements and system rehabilitation projects.

- During the bond issuance process, Mount Pleasant Waterworks' credit ratings were reaffirmed by Moody's and Standard & Poor's with rating of Aa1 and AA+ respectively. The agencies noted the Commission's strong debt service coverage supported by prudent fiscal policies, improving liquidity, willingness to raise rates, growing service areas benefiting from the Charleston regional economy, and strong operational management practices and policies.

- In November 2016, The Commission signed a thirty-year extension of its wholesale contract with Charleston Water System securing a long term source of water. The Commission also purchased an additional .5 MGD (millions of gallons) of capacity increasing its daily supply to 6 MGD. The contract provides for additional purchases of capacity to meet growth and demand.

- In 2017, the Commission embarked on a project to replace its 38,000 AMR (automatic meter reading) system with a AMI (advanced meter infrastructure) system. The state of the art AMI system will greatly improve the process of obtaining meter reading and provide hourly usage data. This project is anticipated to take three years.

- Hurricane Matthew passed through the Mount Pleasant community in October 2016 with 10" of rain and high winds. The Commission weathered the storm with minimal impact. A FEMA claim was submitted and 75% of the Commission's cost was reimbursed in July 2017 with additional reimbursement anticipated from the State of South Carolina in the fall of 2017.

- For the second year in a row, Mount Pleasant Waterworks was acknowledged as one of the best places to work in South Carolina, achieving a rank of 16th best in the small and medium category.

Financial Highlights

- The Commission's Net Position improved by **$16.3** million or **6%** during fiscal year 2017.
    - Operating revenues increased by **$4.3** million or 10% during fiscal year 2017 as compared to the $4.4 million or 12% increase during fiscal year 2016.
    - Net operating revenues, operating revenue less operating expense not including amortization and depreciation, increased to **$22.5** million during fiscal year 2017 as compared to $20.3 million during 2016, a 10.5% increase.
    - Unrestricted Net Position increased by **$12.6** million during fiscal year 2017 as compared to $8.0 million increase during fiscal year 2016, an 86% increase.
    - Capacity (impact) fees and developer contributions to the system provided **$11.9** million during fiscal year 2017 as compared $16.5 million during fiscal year 2016.
- The Commission's debt coverage remains strong with net earnings coverage at **402%** and net operating earning coverage at **316%.**

Overview of the Financial Statements

The Financial section of the Comprehensive Annual Financial Report includes the independent auditor's report, management's discussion and analysis (MD&A), the basic financial statements, and supplementary schedules. The basic financial statements also include notes that explain in more detail some of the information in the financial statements.

Required Financial Statements

The basic financial statements are presented on the full accrual basis of accounting in accordance with accounting principles generally accepted in the United States of America. The statements are prepared in a manner similar to that used by private sector companies. However, rate-regulated accounting principles applicable to private sector utilities are not used by government utilities. The basic financial statements include statements of net position; statements of revenues, expenses, and changes in net position; statements of cash flows; and notes to the financial statements.

Statements of Net Position

The Statements of Net Position present the financial position of the Commission on a full accrual, historical basis. The statements present information on all the Commission's assets and liabilities, with the difference reported as net position. *The Statements of Net Position* may serve as a useful indicator of the Commission's financial position, capital structure and liquidity, and financial viability. The statements present the net position at year-end.

Statements of Revenues, Expenses and Changes in Net Position

The Statements of Revenues, Expenses, and Changes in Net Position present the business activity and results of operations for the fiscal year. The statements measure the success of the Commission's operations and can be used to evaluate the profitability and credit worthiness of the Commission, and that it has successfully recovered all its costs through user fees and other charges. The statements present the change in net position during the fiscal year.

Statements of Cash Flows

The Statements of Cash Flows present changes in cash and cash equivalents, resulting from operations, capital and non-capital financing and investing activities. The statements provide information as to the sources and uses of cash, where the cash was derived from, what the cash was used for, and what was the change in the cash balance during the reported period.

Notes to the Financial Statements

The Notes to the Financial Statements provide required disclosures and other information that is essential to a full understanding of data provided in the statements. The notes present descriptions of the entity, summary of significant accounting policies, significant account balances and activities, material risks, obligations, commitments, contingencies, and subsequent events, if any. Required supplementary information and other supplementary information is also provided.

Required Supplementary Information

In addition to the basic financial statements and accompanying notes, this report also presents *Required Supplementary Information* concerning the Commission's progress in funding its obligations to provide OPEB benefits to its employees and schedule of changes in the net pension liability, components of current-period pension expense and changes in deferred pension outflows and deferred pension inflows of resource. The Management's Discussion and Analysis is considered required supplementary information.

The basic financial statements were prepared by the Commission's staff from the detailed books and records of Mount Pleasant Waterworks. The basic financial statements were audited and adjusted, if material, during the independent audit process.

Financial Analysis

The following summarizes the Commission's financial position and fiscal performance during the past three years using comparative, condensed financial statements followed by substantive highlights of the information contained in the statements.

Condensed Statement of Net Position

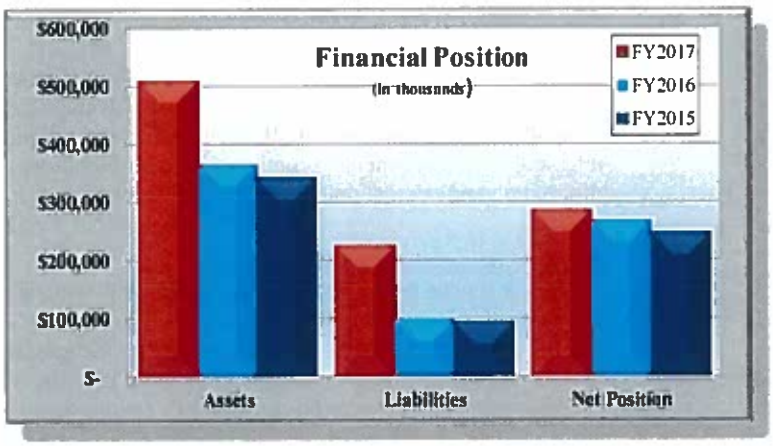
(in thousands)

	Balances at June 30			Increases (Decreases)			
				Dollars		Percentages	
	2017	2016	2015	2017 to 2016	2016 to 2015	2017 to 2016	2016 to 2015
Current and other assets	$ 186,202	$ 53,869	$ 46,763	$ 132,333	$ 7,106	246%	15%
Capital assets	322,783	313,353	294,635	9,430	18,718	3%	6%
Total assets	**508,985**	**367,222**	**341,398**	**141,763**	**25,824**	**39%**	**8%**
Total deferred outflows of resources	**3,266**	**2,164**	**1,193**	**1,102**	**971**	**51%**	**81%**
Current and other liabilities	17,743	15,947	12,365	1,796	3,582	11%	29%
Long term liabilities	208,201	83,190	82,321	125,011	869	150%	1%
Total liabilities	**225,944**	**99,137**	**94,686**	**126,807**	**4,451**	**128%**	**5%**
Total deferred inflows of resources	**532**	**779**	**987**	**(247)**	**(208)**	**-32%**	**-21%**
Net Position							
Net investment in capital assets	231,801	232,296	216,011	(495)	16,285	0%	8%
Restricted	26,696	22,486	24,287	4,210	(1,801)	19%	-7%
Unrestricted	27,278	14,688	6,620	12,590	8,068	86%	122%
Total net position	**$ 285,775**	**$ 269,470**	**$ 246,918**	**$ 16,305**	**$ 22,552**	**6%**	**9%**

** Fiscal year 2015 includes restatement of beginning net position related to the implementation of GASB 68 and 71, relating to pension liability*

Ratio Analysis- The Current Ratio at June 30, 2017, 2016 and 2015 were 4.0, 2.4, and 2.8, respectively. The increase in cash and cash equivalents by 94% during fiscal year 2017 is primarily a result of the increase in restricted cash associated with the issuance of $111 million in revenue bonds and an increase in revenues. Current assets increased by 83% while current liabilities increased by 11% over fiscal year 2016. The increase in current liabilities is attributable to the increase in customer security and escrow deposits and an increase in the current portion of debt.

Debt to Net Position Ratio at June 30, 2017, 2016 and 2015 were 70%, 28% and 31%, respectively, and primarily a result of the issuance of $111 million in revenue bonds. During fiscal year 2017, total assets increased by $142 million (39%) including an increase in capital assets of $33 million and $108 million increase in restricted cash and cash equivalents associated with the revenue bonds issuance. Total liabilities increased by $127 million (128%) primarily as the result of the issuance of $111 million in revenue bonds, $8.9 million in SRF draws, and an increase in customer security and escrow deposits. Net position increased by $16.5 million (6%) during fiscal year 2017.



Readers interested in more detailed information are referred to: Note 5, Capital Assets; Note 6, Capital related accounts and retainage payables; Note 7, Long-Term Liabilities; Note 11, Contributed Capital; and Note 13, Net Pension Liability in the Notes to the Financial Statements in the Financial Section of the Comprehensive Annual Financial Report.

Total Net Position

The financial position of the Commission improved during fiscal year 2017 in terms of net position.

Total Assets as of June 30, 2017 and 2016 increased $141.7 million or 39% and $25.8 million or 8% respectively.

- Restricted cash increased during fiscal year 2017 by **$108.4** million or 427% as compared to the decrease of $1.2 million or 4% during fiscal year 2016. The increase in fiscal year 2017 is primarily a result of the issuance of **$111** million in revenue bonds. The decrease in fiscal year 2016 was a result of the capital expenditures and the $5 million drawdown of unspent bond proceeds.

- Unrestricted cash increased during fiscal year 2017 by **$1.7** million or 8% as compared to the increase of $6.9 million or 48% during fiscal year 2016. The increase in fiscal years 2017 and 2016 is the result of higher sales than anticipated.

- Net capital assets increased during fiscal year 2017 by **$9.4** million or 3% as compared to the increase of $18.7 million or 6% during fiscal year 2016. During fiscal year 2017 capital assets increased by $25.4 million including $5.8 million from developer contributions. Construction-in-progress increased during fiscal year 2017 by $11.0 million. The increase in fiscal year 2016 was primarily due to the completion of the Center Street Wastewater Treatment Plant Expansion and Upgrade project of $30.2 million.

Total Liabilities as of June 30, 2017 and 2016 increased by $126.8 million or 128% and $4.5 million or 5% respectively.

- Long-term liabilities increased during fiscal year 2016 by **$125 million** or 150% which includes the issuance of **$111** million in revenue bonds, draws of **$8.9** million from SRF loans and an increase in net pension liability of **$2.0** million. The increases during fiscal year 2016 of $890 thousand or 1% included $5.8 million in SRF loan draws and $1.5 million increase in net pension liability.

- Other liabilities increased during fiscal year 2017 by **$1.8 million** or 11% primarily as the result of an increase in customer security and maintenance bond deposits due to the continued growth of the utility's service area.

Total Net Position as of June 30, 2017 and 2016 increased by $16.3 million or 6% and $22.5 million increase or 9% respectively.

- Net investment in capital assets during fiscal year 2017 decreased by **$495 thousand** primarily due to the issuance of $111 million in revenue bonds during the year. Net capital assets increased by $9.4 million during fiscal year 2017 as compared to $18.7 million during fiscal year 2016.

- Restricted net position during fiscal year 2017 increased by **$4.2** million or 19% as compared to the decrease of $1.8 million or 7% during fiscal year 2016. The increase during fiscal year 2017 is attributable to the increase in restricted cash associated with the issuance of $111 million in revenue bonds and an increase in customer security and escrow deposits.

- Unrestricted net position during fiscal year 2017 increased by **$12.6** million or 86% as compared to the $8.0 million increase or 122% during fiscal year 2016. The increase in unrestricted net position is a result of higher sales. The 122% increase during fiscal year 2016 is attributable to the impact of the implementation of GASB 68 during fiscal year 2015, which reduced unrestricted net position by $11.5 million.

Readers interested in more detailed information are referred to: Note 5, Capital Assets; Note 7, Long-Term Liabilities; Note 8, Net Position; Note 11, Contributed Capital; and Note 13, Net Pension Liability in the Notes to the Financial Statements in the Financial Section of the Comprehensive Annual Financial Report.

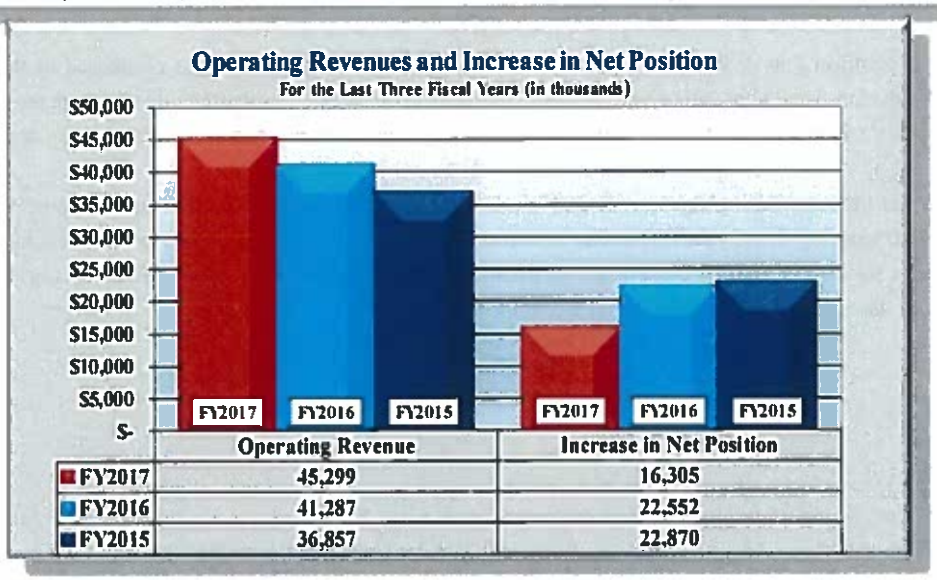
Revenues and Expenses

While the statements of net position show the change in financial position, the statements of revenues, expenses, and changes in net position provide information as to the nature and source of these changes. The following are condensed statements of revenues, expenses, and changes in net position and selected performance indicators for comparison.

Condensed Statement of Revenues, Expenses & Changes In Net Position

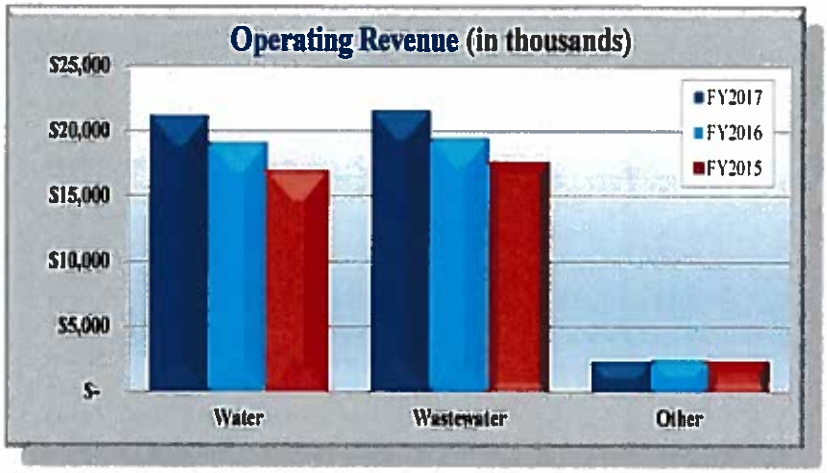
	(in thousands) Activity for Fiscal Years Ended June 30			Increases (Decreases) Dollars		Increases (Decreases) Percentages	
	2017	2016	2015 *	2017 to 2016	2016 to 2015	2017 to 2016	2016 to 2015
Revenues:							
Water Sales	$ 21,265	$ 19,245	$ 16,899	$ 2,020	$ 2,346	10%	14%
Wastewater Service Charges	21,648	19,511	17,539	2,137	1,972	11%	11%
Other Operating Revenues	2,386	2,531	2,418	(145)	113	-6%	5%
Total Revenues	45,299	41,287	36,856	4,012	4,431	10%	12%
Expenses:							
Operating Expenses:							
Personnel Services	11,988	10,848	9,605	1,140	1,243	11%	13%
Contractual Services	6,778	6,560	5,914	218	646	3%	11%
Supplies and Materials	2,176	1,769	1,743	407	26	23%	1%
Education and Travel	310	294	271	16	23	5%	9%
Repairs & Maintenance	896	848	1,155	48	(307)	6%	-27%
Other Operating Expenses	627	590	531	37	59	6%	11%
Total Operating Expenses	22,775	20,909	19,218	1,866	1,691	9%	9%
Net Operating Revenues	22,524	20,378	17,638	2,146	2,740	11%	16%
Depreciation & Amortization Expense	(16,149)	(13,302)	(11,398)	(2,847)	(1,904)	21%	17%
Nonoperating Revenues	612	345	357	267	(12)	77%	-3%
Nonoperating Expenses	(2,608)	(1,340)	(1,011)	(1,268)	(329)	95%	33%
Increase (decrease) in Net Position, before Capital Contributions	4,379	6,081	5,587	(1,702)	494	-28%	9%
Capital Contributions	11,926	16,471	17,282	(4,545)	(812)	-28%	-5%
Increase (decrease) in Net Position,	16,305	22,552	22,870	(6,247)	(318)	-28%	-1%
Net Position, at beginning of year	269,470	246,918	235,587	22,552	11,331	9%	5%
Prior Period Adjustment *			(11,539)	-		0%	0%
Net Position as Restated	269,470	246,918	224,048	22,552	11,331	9%	5%
Net Position, at end of year	$ 285,775	$ 269,470	$ 246,918	$ 16,305	$ 22,552	6%	9%

** Restatement for the implementation of GASB Statement No.68 and 71 Relating to Pension Liability*



Revenues

Operating revenues increased $4.0 million or 10% during fiscal year 2017 as compared to the $4.4 million or 12% increase during fiscal year 2016. Water revenues increased 10% during fiscal year 2017 as compared to the 14% increase during fiscal year 2016. Wastewater revenues increased 11% during both fiscal years.

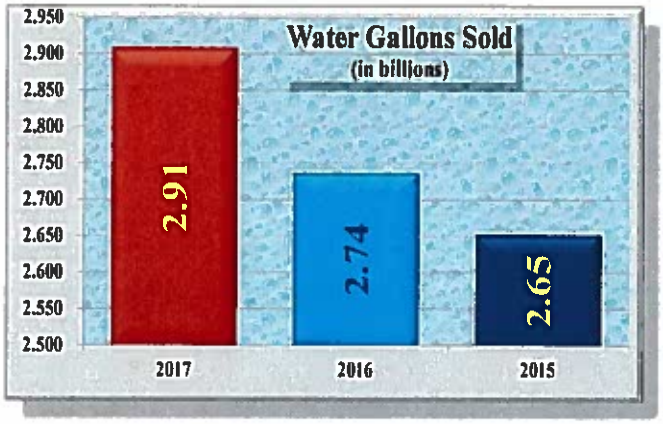


The increase in revenue for fiscal year 2016 is attributable to the increase in basic facility charges (BFC) effective for July 1, 2015. The combined BFC increased from $18.00 per residential equivalent unit (REU) to $22.00 per REU generated an additional $2.4 million in revenues during fiscal year 2016.

Other revenues, which includes account management fees (late and delinquent penalties and fees, reconnection charges, new account fees) and other operating fees and charges decreased by 6% during fiscal year 2017 as compared to the 5% increase during fiscal year 2016. Other revenues fluctuate with customer and developer activities.

Volume/Sales: Total water gallons sold, including irrigation water sales, increased by 6.3% during fiscal year 2017 as compared to the 3.2% increase during fiscal year 2016. Irrigation gallons sold increased by 22.5% during fiscal year 2017 as compared to the 13.3% increase during fiscal year 2016. Wastewater billed increased by 4.0% during fiscal year 2017 as compared to a 2.2% decrease during fiscal year 2016. The increase is attributable to the growth of the customer base and effects of rainfall. Rainfall can influence water sales based on the timing and quantity received. Rainfall during fiscal year 2017 was 25% lower than the previous fiscal year.

Sales in Gallons (in millions)	FY2017	FY2016	Change	% Change	FY2015	% Change
Water	2,499	2,402	97	4.1%	2,356	2.0%
Irrigation	410	335	75	22.5%	295	13.3%
Subtotal	2,909	2,736	173	6.3%	2,651	3.2%
Wastewater	2,428	2,334	94	4.0%	2,283	2.2%



Rates: The Commission increased only water and wastewater volumetric (consumption) rates effective July 1, 2016 by 7% after increasing basic facility charges (BFC) from a combined $12.30 to $22.00 per residential equivalent unit (REU) during fiscal year 2015 and 2016.

Consumption			Type	Gallons/REU	FY 2018	FY 2017	%	FY 2016	%	FY 2015	%	FY 2014
Water	All	Tier 1	All	0-9,200	$ 4.57	$ 4.35	5.1%	$ 4.07	6.9%	$ 4.07	0.0%	$ 4.07
		Tier 2	All	9,201-18,400	$ 9.14	$ 8.70	5.1%	$ 8.14	6.9%	$ 8.14	0.0%	$ 8.14
		Tier 3	All	18,401 - 27,600	$ 13.71	$ 13.05	5.1%	$ 12.21	6.9%	$ 12.21	0.0%	$ 12.21
		Tier 4	All	27,601 or more	$ 18.28	$ 17.40	5.1%	$ 16.28	6.9%	$ 16.28	0.0%	$ 16.28
Irrigation	All	Tier 1	All	0-9,200	$ 7.04	$ 6.69	5.2%	$ 6.26	6.9%	$ 6.26	0.0%	$ 6.26
		Tier 2	All	9,201-18,400	$ 9.14	$ 8.70	5.1%	$ 8.14	6.9%	$ 8.14	0.0%	$ 8.14
		Tier 3	All	18,401 - 27,600	$ 13.71	$ 13.05	5.1%	$ 12.21	6.9%	$ 12.21	0.0%	$ 12.21
		Tier 4	All	27,601 or more	$ 18.28	$ 17.40	5.1%	$ 16.28	6.9%	$ 16.28	0.0%	$ 16.28
Wastewater	In-Town	Tier 1	Residential	0-9,200	$ 5.52	$ 5.25	5.1%	$ 4.90	7.1%	$ 4.90	0.0%	$ 4.90
		Tier 2 *	Residential	9,201-18,400	$ 11.04	$ 10.50	5.1%	$ 9.80	100.0%		0.0%	
		Tier 1	Non-Residential	0-9,200	$ 6.48	$ 6.16	5.2%	$ 5.76	6.9%	$ 5.76	0.0%	$ 5.76
		Tier 2 *	Non-Residential	9,201-18,400	$ 12.96	$ 12.32	5.2%	$ 11.52	100.0%		0.0%	
		Tier 3 *	Non-Residential	18,401 - 27,600	$ 19.44	$ 18.48	5.2%	$ 17.28	100.0%		0.0%	
		Tier 4 *	Non-Residential	27,601 or more	$ 25.92	$ 24.64	5.2%	$ 23.04			0.0%	
	Out-of-Town	Tier 1	Residential	0-9,200	$ 6.07	$ 5.78	5.1%	$ 5.39	7.1%	$ 5.39	0.0%	$ 5.39
		Tier 2 *	Residential	9,201-18,400	$ 12.14	$ 11.55	5.1%	$ 10.78	100.0%		0.0%	
		Tier 1	Non-Residential	0-9,200	$ 12.96	$ 12.32	5.2%	$ 11.52	6.9%	$ 11.52	0.0%	$ 11.52
		Tier 2 *	Non-Residential	9,201-18,400	$ 25.92	$ 24.64	5.2%	$ 23.04	100.0%		0.0%	
		Tier 3 *	Non-Residential	18,401 - 27,600	$ 38.88	$ 36.96	5.2%	$ 34.56	100.0%		0.0%	
		Tier 4 *	Non-Residential	27,601 or more	$ 51.84	$ 49.28	5.2%	$ 46.08	100.0%		0.0%	
Basic Facility Charges					FY 2018	FY 2017	%	FY 2016	%	FY 2015	%	FY 2014
Water	All		All	REU	$ 8.40	$ 8.00	5.0%	$ 8.00	0.0%	$ 6.00	33.3%	$ 3.33
Irrigation	All		All	REU	$ 8.40	$ 8.00	5.0%	$ 8.00	0.0%	$ 6.00	33.3%	$ 3.33
Wastewater	In-Town		Residential	REU	$ 14.70	$ 14.00	5.0%	$ 14.00	0.0%	$ 12.00	16.7%	$ 8.97
			Non-Residential	REU	$ 14.70	$ 14.00	5.0%	$ 14.00	0.0%	$ 12.00	16.7%	$ 8.97
	Out-of-Town		Residential	REU	$ 16.17	$ 15.40	5.0%	$ 15.40	0.0%	$ 13.20	16.7%	$ 9.87
			Non-Residential	REU	$ 29.40	$ 28.00	5.0%	$ 28.00	0.0%	$ 24.00	16.7%	$ 17.94

** Tier 2, Tier 3 and Tier 4 for Wastewater established January 1, 2016* REU - Residential Equivalent Unit

Basic Facility Revenues: Basic facility charges (BFC) are billed based on a residential equivalent unit (REU), and are not as subject to effects of the climate or economic environment. BFC increased effective July 1, 2015 from a combined $18.00 per REU to a combined $22.00 per REU and contributed to the increase of BFC revenues by $2.4 million (25.9%). The increase from $12.30 to $22.00 per REU contributed to the increase in annual BFC revenues by over $5 million.

BFC (in thousands)	FY2017	FY2016	Change	% Change	FY2015	% Change
Water	$ 4,251	$ 4,118	$ 133	3.2%	$ 3,013	36.7%
Irrigation	373	352	21	6.0%	250	40.7%
Subtotal	4,624	4,470	154	3.5%	3,263	37.0%
Wastewater	7,245	7,019	227	3.2%	5,862	19.7%
Total	$ 11,870	$ 11,489	$ 381	3.3%	$ 9,125	25.9%

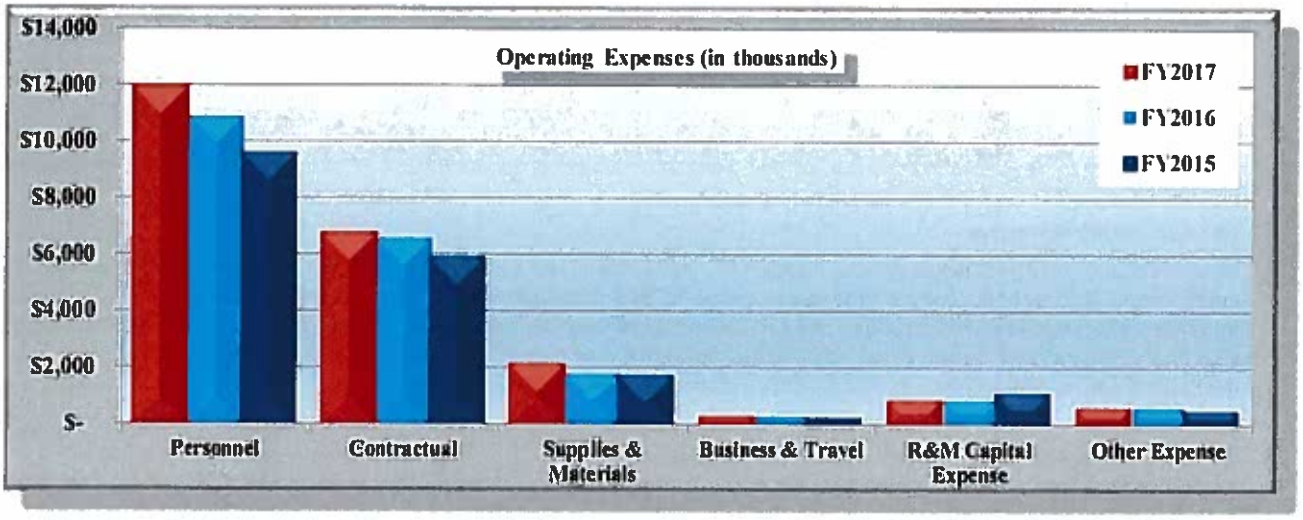
Operating Expenses

Operating expenses before depreciation increased by $1.87 million or 9% during fiscal year 2017 as compared to the $1.7 million or 9% increase during fiscal year 2016. The Commission for the second year in a row faced a significant weather event. Hurricane Matthew passed through the Mount Pleasant community in October of 2016. Not only do these events impact operating expenses, they also impact operating revenues. The increase in I&I (inflow and infiltration) of water into the wastewater system requires additional operating expenses to collect and treat, and may impact the utility for several months.

Personnel services expense increased by $1.1 million or 11% during fiscal year 2017 as compared to the $1.2 million or 13% increase during fiscal year 2016. The increase in fiscal year 2017 is a result of additional staff added to the workforce, and to the additional pension expense of $634 thousand related to GASB 68, a 146% increase over the previous year. The increase during fiscal year 2016 was a result of the near full complement of employees, increases in health insurance expenses of $440 thousand, and additional pension expense of $246 thousand related to GASB 68.

Contractual expenses increased by $218 thousand or 3% during fiscal year 2017 as compared to the $646 thousand or 11% increase during fiscal year 2016. The Commission purchased an additional .5 MGD water supply from Charleston Water System (CWS) effective April 1, 2017. Other increases include legal fees, bill print, GIS, bio-solids, and website/intranet.

Supplies & Materials expense increased by $407 thousand or 23% during fiscal year 2017 driven by increased usage for calcium chloride and chlorine supplies, meter parts, pump parts, and water and wastewater repair and maintenance supplies and materials. During fiscal year 2016, the $26 thousand or 1% was related to an increase in chemical, pump parts, and supplies and materials for repair of water and wastewater infrastructure.



Education & Travel increased $16 thousand or 5% during fiscal year 2017 as compared to the $23 thousand or 9% increase during fiscal year 2016 as the Commission continues its investment in employee education and development.

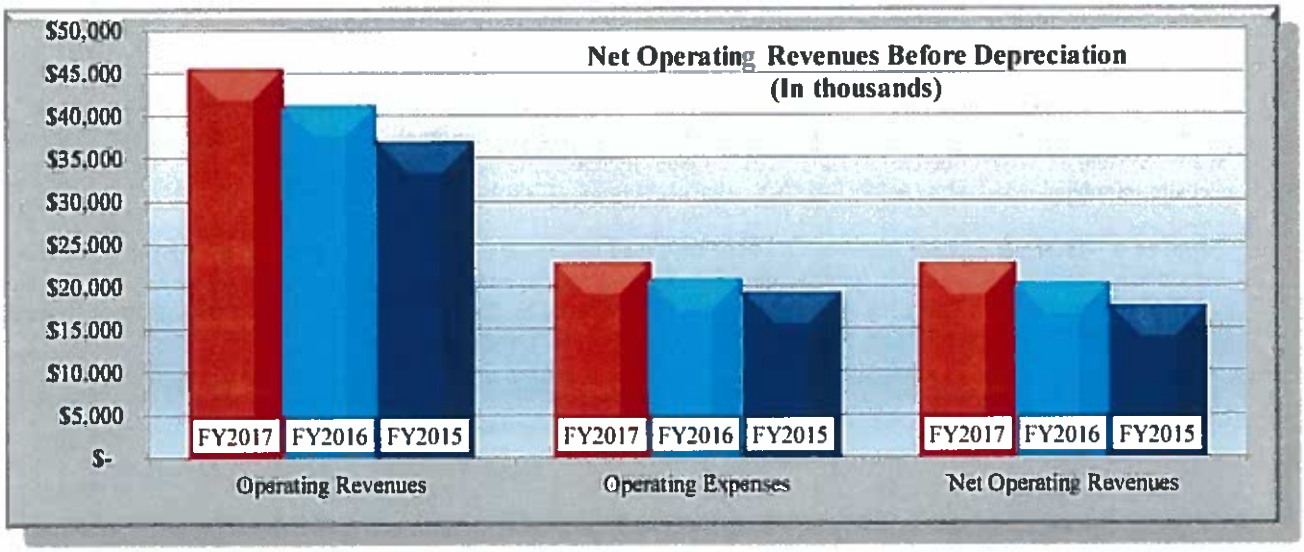
Repairs & Maintenance funded by the capital budget increased by $48 thousand or 6% during fiscal year 2017 compared to a decrease of $307 million or 27% during fiscal year 2016. Repair and maintenance expenses fluctuate with the needs of the Commission's system assets and includes cost of studies and assessments that do not meet the requirements for capitalization.

Other Expenses increased by $37 thousand or 6% during fiscal year 2017 as compared to a $59 thousand or 11% increase during fiscal year 2016. Other expenses include, but are not limited to, bad debt expense, bank and merchant fees, payment-in-lieu-of-taxes, and damage expense.

Net Operating Revenues before Depreciation and Amortization

Net operating revenues (operating revenues less operating expenses) before depreciation and amortization expense increased by $2.1 million or 11% during fiscal year 2017 as compared to the $2.7 million or 16% increase during fiscal year 2016. The increase during fiscal year 2017 is attributable to higher water and wastewater sales.

The increase in revenue during fiscal year 2016 is attributable to the BFC rate increase of 6.4% effective July 1, 2015 (fiscal year 2016) which contributed an additional $2.4 million in revenue. Operating expenses increased by $1.9 million or 8.9% during fiscal year 2017 as compared to the $1.7 million or 8.8% decrease during fiscal year 2016.



Non-Operating Revenues

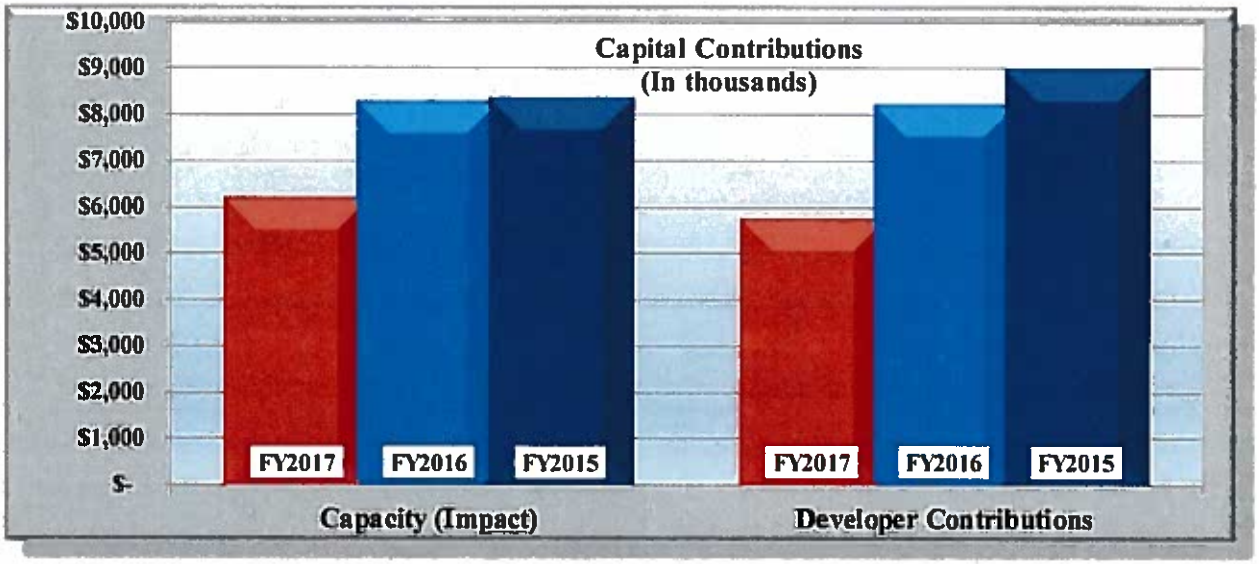
Interest earnings on investments, gain on disposal of capital assets, and miscellaneous income increased $267 thousand or 77% during fiscal year 2017 as compared to the decrease of $12 thousand or 3% during fiscal year 2016. Interest earnings on investments increased to $408 thousand or 240% during fiscal year 2017 as compared to $120 thousand or 305% during fiscal year 2016. The increase during fiscal year 2017 is attributable to higher interest earnings and an increase in cash reserves at the South Carolina State Treasurer's Local Government Investment Pool.

Non-Operating Expenses

Interest expense makes up the majority of the non-operating expenses. Interest expense increased during fiscal year 2017 by 14% as compared to the 33% increase during fiscal year 2016 as the result of an increase in long-term debt. The increase during 2016 was primarily due to the change in accounting for the amortization of bond premium from a straight-line method to the effective interest method. As a result of the issuance of $111 million in revenue bonds, bond costs totaling $869 thousand were recorded for fiscal year 2017.

Contributed Capital

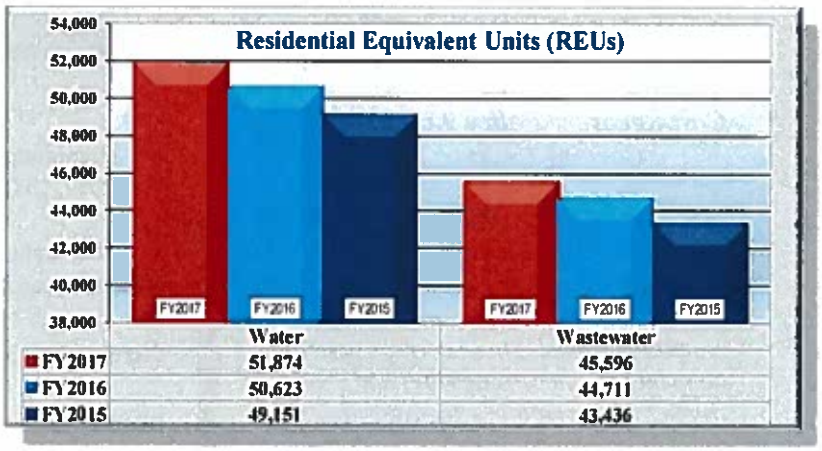
Overall capital contributions decreased by 28% during fiscal year 2017 as compared to the 5% decrease during fiscal year 2016. Capacity fees (impact fees) from customers decreased by 25.3% during fiscal year 2017 as compared to the 1% decrease during fiscal year 2016. Approximately 940 water and irrigation and 900 wastewater impact fees were received during fiscal year 2017 as compared to 1,326 water and irrigation and 1,241 wastewater impact fees received during fiscal year 2016. Receipt of impact fees is subject to the completion of the development project.



Developer contributions to the system decreased by 30% during fiscal year 2017 as compared to the 8% decrease during fiscal year 2016. Developer contributions including lines, hydrants, manholes, pump stations and other system assets are conveyed to the Commission upon completion of the development project. The Commission requires a maintenance bond from the developer to provide protection to the utility. That bond is refunded after a designated time and successful performance of the contributed assets.

REUs (residential equivalent units)

An REU is based on 300 gallons of day of capacity and equal to one impact fee. Water REUs, including irrigation increased by 2.5% during fiscal year 2017 as compared to the 3.0% increase during fiscal year 2016. Wastewater REU increased by 2.0% during fiscal year 2017 as compared to 2.9% during fiscal year 2016.



Readers interested in more detailed information are referred to: Note 11, Contributed Capital in the Notes to the Financial Statements in the Financial Section of the Comprehensive Annual Financial Report.

Debt Coverage

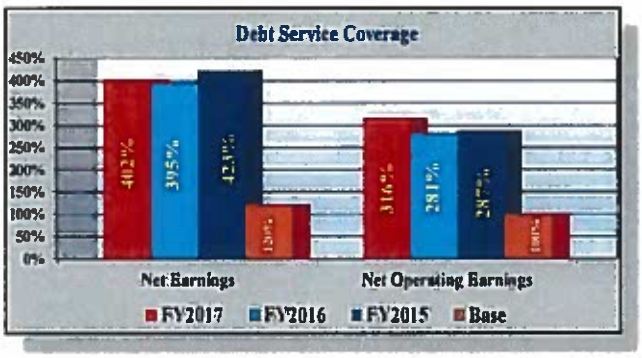
Earnings coverage of principal and interest payments is a primary industry measure of financial strength and additional borrowing capacity. The following chart indicates the Commission's debt coverage percentages required by debt covenants.

Debt Service Coverage

(in thousands)	Activity for Fiscal Years Ended June 30			Increases (Decreases)			
		Revised		Dollars		Percentages	
	2017	2016	2015	2017 to 2016	2016 to 2015	2017 to 2016	2016 to 2015
Revenues and Receipts from Operations of the System	$ 51,641	$ 49,680	$ 45,104	$ 1,962	$ 4,575	4%	10%
Expenses of Operating and Maintaining the System	22,774	20,909	19,218	1,865	1,691	10%	9%
Net Earnings	**28,867**	**28,770**	**25,886**	**96**	**2,884**	**0%**	**11%**
Debt Service	**7,188**	**7,288**	**6,116**	**(100)**	**1,172**	**-1%**	**19%**
Debt Coverage from:							
Net Earnings	402%	395%	423%			2%	-7%
Net Operating Earnings	316%	281%	287%			12%	-2%

** Fiscal year 2015 includes restatement of beginning net position related to the implementation of Gasb 68 and 71, relating to pension liability*

Debt coverage, the capacity for net earnings or net operating earnings to cover debt service payments, for fiscal years ending June 30, 2017, June 30, 2016 and June 30, 2015 exceeded both bond ordinances and the Commission's Cost Recovery Policy requirements. Net earnings are net operating earnings plus impact fees. Bond covenant ratios require debt service coverage at 120% for net earnings (Test 2) and 100% for net operating earnings (Test 1). The Commission's Cost Recovery Policy requires Test 1 at 200%.



Cost Recovery Policy 9.6 Debt Service Coverage Action Trigger

*Whenever Test 1 is estimated to equal **2.00** or less, the Commission will take necessary corrective actions to ensure that the ratio remains at or above the mandatory level. These corrective actions may include increasing rates and charges, reducing operating expenses, deferring capital projects or retiring existing debt.*

- Net earnings coverage was 402%, 397%, and 428% for fiscal year 2017, 2016, and 2015, respectively.

- Net operating earnings coverage was 316%, 284%, and 293% for fiscal year 2017, 2016 and 2015, respectively.

The increase in debt service coverage is attributable to slight decrease in debt service and increase in net earnings.

Bond Ratings: As part of the issuance of $111 million in revenue bonds during fiscal year 2017, Standard & Poor's and Moody's reaffirmed the Commission's credit rating of AA+ and Aa1, respectively.

Readers interested in the full Cost Recovery Policy are directed to the Commission's Website: mountpleasantwaterworks.com.

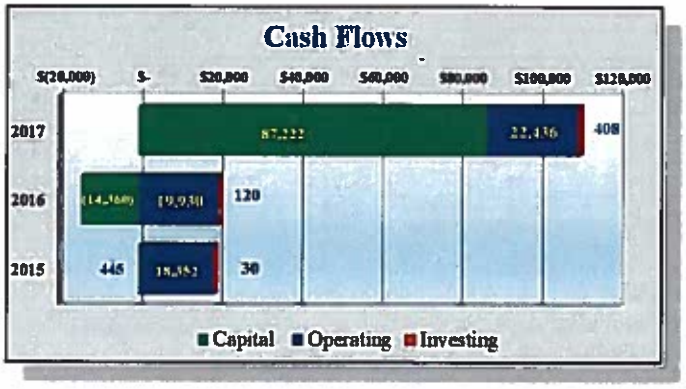
Cash Flows

Net cash flows increased by $110 million during fiscal year 2017 as compared to $5.7 million during fiscal year 2016. Cash from operating activities increased $2.5 million during fiscal year 2017 as compared to the increase of $1.6 million during fiscal year 2016. The increase in cash from operations for fiscal year 2017 is attributable to the increase in revenues. Cash for capital and related financing activities increased $102 million during fiscal year 2017 as compared to the decrease of $14.8 million during fiscal year 2016. The increase is related to the issuance of $111 million in revenue bonds during fiscal year 2017. The increase in cash of $288 provided by investing activities is a result of higher interest earnings.

Condensed Statements of Cash Flows
(in thousands)

	Activity for Fiscal Years Ended June 30			Increases (Decreases) Dollars		Increases (Decreases) Percentages	
	2017	2016	2015	2017 to 2016	2016 to 2015	2017 to 2016	2016 to 2015
Net cash flow provided (used) by:							
Operating activities	$ 22,436	$ 19,930	$ 18,352	$ 2,506	$ 1,578	13%	9%
Capital and related financing activities	87,222	(14,360)	445	$ 101,582	(14,805)	-707%	-3327%
Investing activities	408	120	30	288	90	240%	300%
Net cash flow	**110,066**	**5,690**	**18,827**	**104,376**	**(13,137)**	**1834%**	**-70%**
Cash and cash equivalents at:							
Beginning of year	46,582	40,892	22,065	5,690	18,827	14%	85%
Cash at Year End	**$ 156,648**	**$ 46,582**	**$ 40,892**	**$ 110,066**	**$ 5,690**	**236%**	**14%**

** Restatement for the implementation of GASB Statement No.68 and 71 Relating to Pension Liability*



Cash Reserves:

- Restricted cash increased by $108 million as a result of the issuance of the $111 million in revenue bonds.
- Unrestricted cash increased by $1.7 million as a result of increased revenues, to $22.9 million.
  - This represents approximately 340 days of cash-on-hand.

Cost Recovery Policy 10.1 Operating Fund Balance

The Commission will meet or exceed minimum Fund balance requirements including mandatory requirements specified in the existing bond ordinance and maintain a minimum balance of not less than 200 days of unrestricted cash.

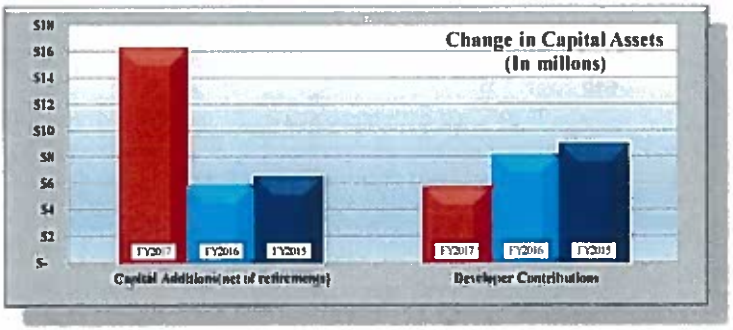
Readers interested in more detailed information are referred to: Note 3, Cash Equivalents, Deposits and Investments, of the Notes to the Financial Statements in the Financial Section of this Comprehensive Annual Financial Report.

Capital Assets

The following tables present year end balances and changes in the Commission's capital assets.

(in thousand)	Balances at June 30			Change			
				Dollars		Percentages	
				2017	2016	2017	2016
	2017	2016	2015	to 2016	to 2015	to 2015	to 2015
Utility Plant in Service:							
Lines, Mains & Pipes	$ 244,925	$ 238,262	$ 231,339	$ 6,663	$ 6,922	3%	3%
Equipment	39,495	36,340	28,257	3,155	8,083	9%	29%
Water Capacity Rights	17,904	13,430	13,438	4,474	(8)	33%	0%
Manholes	14,287	13,606	12,547	681	1,059	5%	8%
Valves	13,019	12,228	11,186	791	1,042	6%	9%
Tanks (Storage & Process)	12,198	12,198	12,365	-	-	0%	0%
Pumps	9,654	8,237	13,751	1,417	(5,514)	17%	-40%
Wells	9,591	8,922	8,542	669	380	7%	4%
Hydrants	5,901	5,532	5,205	369	327	7%	6%
Meters	4,558	6,703	11,925	(2,145)	(5,222)	-32%	-44%
Aquifer Storage Recovery	1,606	1,606	1,606	-	(0)	0%	0%
Membranes	402	402	1,854	-	-	0%	0%
Total Utility Plant in Service	**373,540**	**357,466**	**352,013**	**16,074**	**5,452**	**4%**	**2%**
Admin Assets							
Buildings	38,038	37,933	27,112	105	10,820	0%	40%
Site Improvement	3,021	2,901	2,575	120	326	100%	0%
Computers, Hardware & Software	5,455	4,727	8,478	728	(3,751)	15%	-44%
Generators	2,457	2,457	2,677	0	(221)	0%	-8%
Furniture, Fixture & Equipment	586	581	872	5	(291)	1%	-33%
Vehicles	5,514	4,494	4,190	1,020	305	23%	7%
Total Admin	**55,071**	**53,092**	**45,904**	**1,979**	**7,187**	**4%**	**16%**
Land and Easements	11,954	8,013	6,526	3,941	1,487	49%	23%
Total Land & Easement	**11,954**	**8,013**	**6,526**	**3,941**	**1,487**	**49%**	**23%**
Subtotal	**440,565**	**418,570**	**404,444**	**21,995**	**14,126**	**5%**	**3%**
Construction in Progress	31,496	20,496	35,163	11,000	(14,667)	54%	-42%
Total Capital Assets	**472,061**	**439,066**	**439,607**	**32,995**	**(541)**	**8%**	**0%**
Accumulated Depreciation	**(139,278)**	**(125,713)**	**(144,972)**	**(13,565)**	**19,259**	**11%**	**-13%**
Net Capital Assets	**$ 332,783**	**$ 313,353**	**$ 294,635**	**$ 19,430**	**$ 18,718**	**6%**	**6%**

Capital assets, before depreciation and construction-in-progress increased $22 million (5%) during fiscal year 2017 as compared to $14.1 million (3%) during fiscal year 2016. The increase includes capital additions of $25.4 million including developer contributions of $5.8 less $3.4 million in retirement. During fiscal year 2016, $32.4 million in fully depreciated assets were retired from the fixed asset register.



Depreciation expense for fiscal year 2017 was $16.1 million as compared to $13.3 million for fiscal year 2016 as additional capital assets have been added to the system. Construction-in-progress increased by $11.0 million during fiscal year 2017.

Readers interested in more detailed information are referred to: Note 5, Capital Assets, of the Notes to the Financial Statements in the Financial Section of this Comprehensive Annual Financial Report.

Long-Term Debt and Debt Administration

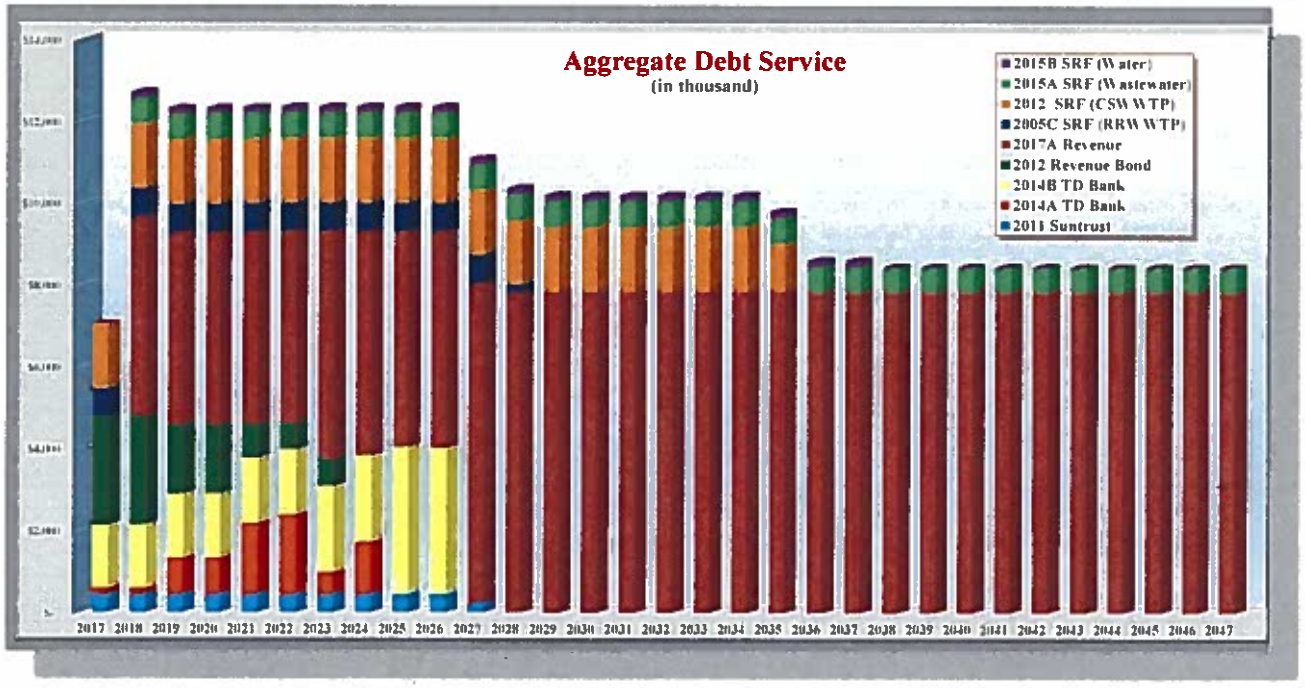
As of June 30, 2017, the Commission's long-term debt consisted of state revolving fund loans, revenue bonds and direct bank loans. The following table presents the total outstanding principal on the long-term debt as of the end of fiscal year 2017, 2016 and 2015, respectively.

	June 30		
(in thousands)	FY 2017	FY 2016	FY 2015
Revenue bonds, with interest ranging from 4.00% to 5.00% maturing in 2047	$ 118,390	$ 9,625	$ 12,907
South Carolina Water Quality Revolving Funds Loans, with interest ranging from 1.65% to 3.25%, maturing in 2047. $8.9 million of the 2015A and 2015B SRF loans were drawn during fiscal year 2017	43,010	35,798	32,363
Direct Bank Loans with interest ranging from 2.09% to 2.43% maturing 2027	27,514	28,996	30,684
Total Outstanding Long-Term Debt	**$ 188,914**	**$ 74,419**	**$ 75,954**

Total debt increased during fiscal year 2017 by $119 million with $111 million in revenue bonds and $8.9 million State Revolving Loans (SRF) draws less principal payments.

Aggregate Debt Service

The following chart shows the Commission's future debt service for all debt authorized. It shows that all of this debt is scheduled to be paid before anticipated build out of the service area currently expected to occur in 2047.



Requests for Information:

This financial report is designed to provide customers and creditors with a general overview of the Commission's finances, and to demonstrate the Commission's accountability for the funds it receives. Questions concerning any of the information provided in this report or requests for additional information should be addressed to the Chief Financial Officer, Mount Pleasant Waterworks, 1619 Rifle Range Road, Mount Pleasant, South Carolina 29464.

Readers interested in more detailed information are referred to: Note 7, Long-Term Liabilities, of the Notes to the Financial Statements in the Financial Section of this Comprehensive Annual Financial Report.

Key Financial and Statistical Data

		2017	2016	2015	Increase (Decrease) Units or Dollars 2016 to 2017	Units or Dollars 2015 to 2016	% Change 2016 to 2017	% Change 2015 to 2016
Operational Optimization								
Operate an efficient and effective utility through the use of technology, processes, and people.								
Production Numbers (In millions of gallons)								
Water	Gallons Sold	2,909	2,736	2,651	173	86	6.3%	3.2%
	Gallons Produced & Distributed	3,262	3,116	3,008	146	109	4.7%	3.6%
	Non-Revenue Water	353	380	357	(27)	23	-7.2%	6.5%
	Percent Non-Revenue Water	10.8%	12.2%	11.9%			-1.4%	0.3%
Wastewater	Gallons Billed	2,428	2,334	2,283	94	51	4.0%	2.2%
	Gallons Treated	2,947	3,091	2,810	(143)	281	-4.6%	10.0%
	Unbilled Wastewater	519	756	526	(237)	230	-31.4%	43.7%
	Percent Unbilled	17.6%	24.5%	18.7%			-6.9%	5.8%
Revenue and O&M Costs per 1,000 Gallons Sold and Billed								
Water	Water Revenues	$ 7.31	$ 7.03	$ 6.37	$ 0.28	$ 0.66	3.9%	10.3%
	O&M Costs including 1/2 support *	$ 2.06	$ 2.10	$ 1.98	$ (0.04)	$ 0.12	-1.8%	5.9%
	O&M Costs including 1/2 support and 1/2 admin *	$ 3.31	$ 3.34	$ 3.19	$ (0.03)	$ 0.15	-0.8%	4.7%
Wastewater	Wastewater Revenues	$ 8.91	$ 8.36	$ 7.68	$ 0.56	$ 0.68	6.7%	8.8%
	O&M Costs including 1/2 support	$ 3.08	$ 3.06	$ 2.86	$ 0.01	$ 0.20	0.4%	7.0%
	O&M Costs including 1/2 support and 1/2 admin	$ 4.57	$ 4.52	$ 4.26	$ 0.06	$ 0.25	1.3%	5.9%
	** O&M cost includes division costs plus 1/2 support operations (electrical, lab and site restoration) and 1/2 administration (not including engineering)*							
O&M Costs per 1,000 Gallons Produced & Distributed and Treated								
Water	Water Gallons Produced & Distributed	3,262	3,116	3,008	146	108	4.7%	3.6%
	O&M Costs including 1/2 support	$ 1.84	$ 1.84	$ 1.74	$ (0.00)	$ 0.10	-0.3%	5.5%
	O&M Costs including 1/2 support and 1/2 admin	$ 2.95	$ 2.93	$ 2.81	$ 0.02	$ 0.12	0.7%	4.3%
Wastewater	Wastewater Gallons Treated	2,947	3,091	2,810	(144)	281	-4.7%	10.0%
	O&M Costs including 1/2 support	$ 2.53	$ 2.31	$ 2.33	$ 0.22	$ (0.01)	9.6%	-0.5%
	O&M Costs including 1/2 support and 1/2 admin	$ 3.77	$ 3.41	$ 3.46	$ 0.36	$ (0.05)	10.5%	-1.6%
Percent of Support	Engineering Department Expense	15.2%	9.6%	8.8%			5.6%	0.8%
	Administrative Expense (not including Engineering)	54.0%	52.6%	54.3%			1.4%	-1.7%
Number of Accounts (Average)	Water Customer Accounts (Active) *	38,152	36,946	35,811	1,206	1,135	3.3%	3.2%
	Wastewater Customer Accounts (Active)	33,361	32,425	31,498	936	927	2.9%	2.9%
	** Water customer accounts include irrigation accounts*							
O&M Cost Per Customer Account	Water O&M Cost per Account *	$ 252	$ 247	$ 236	$ 5	$ 11	2.0%	4.7%
	Wastewater O&M Cost per Account *	$ 333	$ 325	$ 309	$ 8	$ 16	2.5%	5.2%
	** O&M cost includes division costs plus 1/2 support operations (electrical, lab and site restoration) and 1/2 administration (not including engineering)*							
Number of Employees	Water Division Employees plus 1/2 support *	54.0	51.5	52.0	2.5	(0.5)	4.9%	-1.0%
	Wastewater Division Employees plus 1/2 support *	68.0	64.5	65.0	3.5	(0.5)	5.4%	-0.8%
	Total	122.0	116.0	117.0	6.0	(1.0)	5.2%	-0.9%
	** Support includes 1/2 support operations (electrical, lab, meter reading and site restoration) and 1/2 administration and engineering - 2016 and 2015 employee count adjusted to split meter reading between water and wastewater*							
Accounts Per Employee	Water	707	717	689	(10)	28	-1.4%	4.1%
	Wastewater	491	503	485	(12)	18	-2.4%	3.7%
Millions Gallons Per Day (MGD)	MGD Water Produced and Distributed	8.94	8.54	8.24	0.40	0.30	4.7%	3.6%
	MGD Wastewater Treated	8.08	8.47	7.70	(0.39)	0.77	-4.6%	10.0%
MGD Per Employee	Water Division Employees plus 1/2 support *	0.17	0.17	0.16	-	0.01	0.0%	6.3%
	Wastewater Division Employees plus 1/2 support *	0.12	0.13	0.12	(0.01)	0.01	-7.7%	8.3%
	** Support includes 1/2 support operations (electrical, lab, and site restoration) and 1/2 administration and engineering*							
REU (Residential Eqivalent Units)	Residential Water	32,729	31,896	30,940	833	956	2.6%	3.1%
	Commercial Water	12,389	12,118	11,598	271	520	2.2%	4.5%
	Residential Irrigation	2,843	2,652	2,351	191	301	7.2%	12.8%
	Commercial Irrigation	1,349	1,292	1,259	57	33	4.4%	2.6%
	REU (residential equivalent unit) based on 300 gallons per day per REU							
Gallons per REU	Residential Water	4,687	4,640	4,694	47	(54)	1.0%	-1.2%
	Commercial Water	4,622	4,590	4,669	32	(79)	0.7%	-1.7%
	Residential Irrigation	5,561	4,750	4,644	811	106	17.1%	2.3%
	Commercial Irrigation	14,366	12,577	11,466	1,789	1,111	14.2%	9.7%

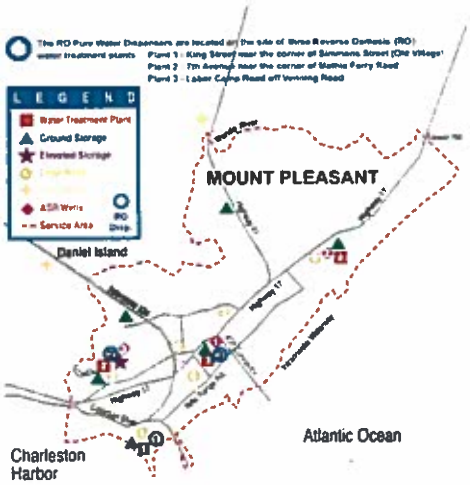
Key Financial and Statistical Data (continued)

		2017	2016	2015	Increase (Decrease) Units or Dollars 2016 to 2017	Units or Dollars 2015 to 2016	% Change 2016 to 2017	% Change 2015 to 2016
Operational Optimization (Continued)								
Operate an efficient and effective utility through the use of technology, processes, and people.								
Statistics Per Service Address	Average Number of Service Addresses	38,577	37,688	36,669	889	1,019	2.4%	2.8%
	Water Gallons Sold Per Day	207	199	198	8	1	4%	1%
	Wastewater Gallon Billed Per Day	209	225	210	(16)	15	-7%	7%
	Water and Wastewater Revenue	$ 1,112	$ 1,028	$ 939	$ 84	$ 89	8%	9%
	Operating & Maintenance (O&M) Expense	$ 590	$ 555	$ 524	$ 35	$ 31	6%	6%
	Total Debt	$ 5,153	$ 1,995	$ 2,071	$ 3,158	$ (76)	158%	-4%
Statistics Per Employee	Average Number of Employees	119.0	116.5	115.5	3	1	2.1%	0.9%
	Service Addresses	324	324	317	-	7	0.0%	2.2%
	Water sold, in millions of gallons	24.4	23.5	23.0	0.9	0.5	3.8%	2.2%
	Water produced in millions of gallons	27.4	26.8	26.0	0.6	0.8	2.2%	3.1%
	Wastewater treated, in millions of gallons	24.8	26.5	24.3	(1.7)	2.2	-6.4%	9.1%
	Water and wastewater revenues in thousands	$ 361	$ 333	$ 298	$ 28	$ 35	8%	11%
	O&M Expenses in thousands	$ 191	$ 179	$ 166	$ 12	$ 13	7%	7%
Infrastructure Stability								
Provide and maintain an efficient infrastructure								
Cost of Non-Revenue Water:	Non-Revenue Water (in millions)	353	380	357	(27)	23	-7.1%	6.4%
	Percent Non-Revenue	10.8%	12.2%	11.9%			-1.4%	0.3%
	Cost of Non-Revenue Water (in million)	$ 1.04	$ 1.11	$ 1.00	$ (0.07)	$ 0.11	-6.5%	11.1%
Cost of Unbilled Wastewater:	Unbilled Wastewater (in millions)	519	756	526	(237)	230	-31.3%	43.7%
	Percent Unbilled	17.6%	24.5%	18.7%			-6.9%	5.8%
	Cost of Unbilled Wastewater (in million)	$ 1.96	$ 2.58	$ 1.82	$ (0.62)	$ 0.76	-24.2%	41.5%
Financial Viability								
Maintain financial stability by recovering all costs of operating, maintaining, improving and expanding the water and wastewater systems.								
Debt Analysis								
Debt Coverage Ratios	Net Earnings (in thousands)	$ 28,867	$ 28,770	$ 25,886	$ 97	$ 2,884	0.3%	11.1%
	Debt Service (in thousands)	$ 7,188	$ 7,288	$ 6,116	$ (100)	$ 1,172	-1.4%	19.2%
	Debt Coverage - Net Earnings	4.02	3.95	4.23			6.9%	-28.5%
	Debt Coverage - Net Operating Income	3.16	2.81	2.87			34.3%	-5.7%
Bond Ratings	Moody's	Aa1	Aa1	Aa2				
	Standard and Poor's	AA+	AA+	AA+				
Debt Ratios	Total Debt (bond, SRF & bank) (in thousands)	$ 198,785	$ 75,200	$ 75,954	$ 123,585	$ (754)	164%	-1%
	Debt to Asset Ratio	39.1%	20.5%	22.2%			18.6%	-1.7%
	Debt to Net Position (Equity)	69.6%	27.9%	30.8%			41.7%	-2.9%
	Debt to Unrestricted Net Assets	728.7%	512.0%	1147.2%			216.7%	-635.2%
Debt Per Capita	Population*	87,537	84,170	81,317	3,367	2,853	4.0%	3.5%
	Debt Per Capita	$ 2,271	$ 893	$ 934	$ 1,378	$ (41)	154.3%	-4.4%
	** Population for 2015 and 2016 Estimated US Census Bureau, 2017 estimated at plus 4%*							
Debt Per Customer Account	Water Debt (in thousands)	$ 38,677	$ 13,229	$ 13,715	$ 25,448	$ (486)	192%	-4%
	Per Customer Account	$ 1,014	$ 358	$ 383	$ 656	$ (25)	183%	-7%
	Wastewater Debt (in thousands)	$ 160,108	$ 61,971	$ 62,240	$ 98,137	$ (269)	158%	0%
	Per Customer Account	$ 4,799	$ 1,911	$ 1,976	$ 2,888	$ (65)	151%	-3%
	** $111 million in Revenue Bonds issued May 2017*							
Net Position Analysis	Change In Net Position (in thousands) *	$ 16,305	$ 22,552	$ 22,870	$ (6,247)	$ (318)	-28%	-1%
	Return on Assets	3.2%	6.1%	6.7%			-2.9%	-0.6%
	Return on Total Net Position	5.7%	8.4%	9.3%			-2.7%	-0.9%
	Return on Unrestricted Net Position	59.8%	153.5%	345.4%			-93.7%	-191.9%
	** Before the implementation of GASB 68 relating to Pension Liability and Expense.*							
Operating Income Analysis	Operating Income before depreciation (in thousands) *	$ 22,524	$ 20,378	$ 17,638	$ 2,146	$ 2,740	11%	16%
	Assets	4.4%	5.5%	5.2%			-1.1%	0.3%
	Total Net Position	7.9%	7.6%	7.1%			0.3%	0.5%
	Unrestricted Net Position	82.6%	138.7%	266.4%			-56.1%	-127.7%
	** Operating income is the net operating revenues less operating expense before depreciation*							

2016 water QUALITY report

MOUNT PLEASANT WATERWORKS CLEAN WATER

MPW Service Area



Board of Commissioners:

Rick M. Crosby, Chair

Susan I. Mellichamp, Vice-Chair

H. Mac Jenkinson, Secretary-Treasurer

Diane D. Lauritsen, Ph.D., Commissioner

John W. Burn, Commissioner

Mark Smith, Chair of Town of Mount Pleasant Water Supply Committee

Linda Page, Town of Mount Pleasant Mayor

Commission Meetings

The Commissioners meet on the third Monday of each month beginning at 6:00 p.m. in the Public Meeting Room at the MPW Operations Center, 1619 Rifle Range Road. The public is invited to attend. Please confirm meeting date and time by visiting our website www.mountpleasantwaterworks.com. If you have questions, please call Customer Service at (843) 884-9626, or send an email to customerservice@mpwonline.com.

Mount Pleasant Waterworks … Making the Grade

This document is in effect a report card for your drinking water, detailing how well we performed to meet the standards set forth by the federal Environmental Protection Agency (EPA) for drinking water quality. As you read the detailed findings in this report you will see for yourself that Mount Pleasant Waterworks' drinking water exceeds these standards. So go ahead…..turn on your tap!

A+

About Our Water Sources

Mount Pleasant Waterworks (MPW) has two water sources: groundwater from the Middendorf Aquifer, and purchased surface water from Charleston Water System (CWS).

The Middendorf is a large body of pristine groundwater between 1,800 to 2,000 feet deep beneath Charleston, Dorchester and Berkeley counties. MPW treats the raw water using state-of-the-art Reverse Osmosis (RO) technology. The treated surface water provided by CWS is from the Bushy Park Reservoir and the Edisto River.

South Carolina's Department of Health and Environmental Control (DHEC) administers a Source Water Assessment and Protection (SWAP) plan for the state's public water systems. The report helps identify all potential sources of contamination for each watershed in the state. The SWAP reports for both the MPW and CWS water systems can be downloaded from DHEC's website at: http://www.scdhec.gov/environment/water/srcewtrreports.htm.

The 2016 Water Quality Report can be located at:

http://www.mountpleasantwaterworks.com

Financial Statements

- Statements of Net Position
- Statements of Revenues, Expenses and Changes in Net Position
- Statements of Cash Flows
- Notes to the Financial Statements

MOUNT PLEASANT WATERWORKS

STATEMENTS OF NET POSITION

FISCAL YEARS ENDED JUNE 30, 2017 AND 2016

	June 30	
	2017	2016
ASSETS		
Current assets:		
Unrestricted cash and cash equivalents	$ 22,867,542	$ 21,191,104
Restricted cash and cash equivalents	38,658,803	10,515,077
Unrestricted receivables, net	7,079,953	5,900,923
Restricted receivables, net	33,700	65,816
Inventories	1,155,501	347,476
Prepaids	1,361,171	892,579
Total current assets	71,156,670	38,912,975
Noncurrent assets:		
Restricted cash and cash equivalents	95,122,133	14,876,045
Capital assets:		
Cost	472,060,708	439,065,637
Accumulated depreciation	(139,277,802)	(125,713,035)
Capital assets, net	332,782,906	313,352,602
Restricted receivables, net	48,272	80,908
Prepaid bond interest	9,875,303	-
Total noncurrent assets	437,828,614	328,309,555
Total assets	$ 508,985,284	$ 367,222,530
Deferred outflows of resources		
Deferred charge on bond refunding	108,447	130,136
Defered outflows related to pension	3,157,173	2,033,549
Total deferred outflows of resources	$ 3,265,620	$ 2,163,685

See Notes to the Financial Statements

MOUNT PLEASANT WATERWORKS

STATEMENTS OF NET POSITION

FISCAL YEARS ENDED JUNE 30, 2017 AND 2016

	June 30	
	2017	2016
LIABILITIES AND NET POSITION		
Current liabilities payable from unrestricted current assets:		
Accounts payable for operations	$ 590,846	$ 420,425
Accrued compensation and benefits	1,280,727	928,501
Current portion of long-term debt	4,489,591	3,902,032
Accrued interest payable	312,743	236,905
Total current liabilities payable from unrestricted current assets	6,673,907	5,487,863
Current liabilities payable from restricted current assets:		
Capital related accounts and retainage payables	5,458,797	5,856,539
Current portion of long-term debt	1,571,298	1,524,106
Accrued interest payable	26,358	26,358
Customer security and maintenance deposits	3,940,582	2,988,820
Unearned revenue, capacity fees and grants	72,769	63,252
Total current liabilities payable from restricted current assets	11,069,804	10,459,075
Total current liabilities	17,743,711	15,946,938
Noncurrent liabilities:		
Long-term debt, less current portion and premium, net	192,724,354	69,773,693
Long-term portion of leave accrual	309,263	254,332
Net pension liablity	15,166,990	13,162,045
Total noncurrent liabilities	208,200,607	83,190,070
Total Liabilities	225,944,318	99,137,008
Deferred inflows of resources		
Defered inflows related to pension	531,801	779,040
Total deferred inflows of resources	$ 531,801	$ 779,040
Net Position:		
Net investment in capital assets	231,801,488	232,426,368
Restricted:		
Capital projects	25,305,837	21,425,149
Debt service	1,389,546	1,060,625
Unrestricted	27,277,914	14,558,025
Total net position	$ 285,774,785	$ 269,470,167

See Notes to the Financial Statements

MOUNT PLEASANT WATERWORKS

STATEMENTS OF REVENUES, EXPENSES AND CHANGES IN NET POSITION

FISCAL YEARS ENDED JUNE 30, 2017 AND 2016

	Years Ended June 30	
	2017	2016
Operating revenues:		
Water sales	$ 20,809,526	$ 18,718,748
Water service connection charges	455,234	526,222
Wastewater service charges	21,648,141	19,510,600
Other miscellaneous fees and charges	2,385,380	2,531,367
Total operating revenues	45,298,281	41,286,937
Operating expenses before depreciation:		
Personnel services	11,987,759	10,847,409
Contractual services	6,777,744	6,560,438
Supplies and materials	2,176,364	1,769,048
Education and travel	310,861	294,374
Repair and maintenance funded by capital budget	896,079	848,149
Other expenses	625,659	589,672
Total operating expenses before depreciation	22,774,466	20,909,090
Operating income before depreciation	22,523,815	20,377,847
Depreciation and amortization expense	16,149,684	13,301,407
Operating income	6,374,131	7,076,440
Nonoperating income and (expense):		
Interest expense	(1,292,125)	(1,125,087)
Bank and financial services expense	(249,243)	(215,222)
Bond issuance costs	(868,701)	-
Interest income	408,225	120,174
Gain/(Loss) on sales/disposal of capital assets	(197,793)	61,192
Miscellaneous income	204,050	163,556
Total nonoperating income (expense)	(1,995,587)	(995,387)
Increase (decrease) in net position, before capital contributions	4,378,544	6,081,053
Capital contributions:		
Capacity fees from customers	6,156,590	8,243,883
Developer impact fees	21,189	19,034
Developer contribution of systems	5,748,294	8,207,903
Total capital contributions	11,926,073	16,470,820
Increase in net position	16,304,617	22,551,873
Net position, at beginning of year	269,470,167	246,918,294
Net position, at end of year	$ 285,774,784	$ 269,470,167

See Notes to the Financial Statements

MOUNT PLEASANT WATERWORKS
STATEMENTS OF CASH FLOWS
FISCAL YEARS ENDED JUNE 30, 2017 AND 2016

	Years Ended June 30	
	2017	2016
Cash flows from operating activities:		
Receipts from customers and others	$ 45,275,063	$ 40,921,787
Payments to suppliers of goods and services	(11,892,903)	(10,539,801)
Payments to employees for services	(10,946,521)	(10,452,432)
Net cash provided by operating activities	22,435,639	19,929,554
Cash flows from capital and related financing activities:		
Purchase/construction of capital assets	(31,060,376)	(20,624,721)
Proceeds from sale of capital assets	633,146	61,192
Net Proceeds from issuance of debt	118,843,093	5,112,787
Revenue bond costs	(404,106)	-
Principal payments on bonds and state revolving loans	(5,426,138)	(5,515,715)
Interest paid on borrowings, fiscal agent fees and bank fees	(1,615,282)	(1,648,646)
Capital contributions from customers and grants, net of receivables	6,252,051	8,255,352
Net cash provided by (used in) capital and related financing activities	87,222,388	(14,359,752)
Cash flows from investing activities:		
Interest received on investments	408,225	120,174
Net cash provided by investing activities	408,225	120,174
Increase (decrease) in cash and cash equivalents	110,066,252	5,689,976
Cash and cash equivalents at beginning of year	46,582,226	40,892,250
Cash and cash equivalents at end of year	$ 156,648,478	$ 46,582,226

See Notes to the Financial Statements

MOUNT PLEASANT WATERWORKS
STATEMENTS OF CASH FLOWS
FISCAL YEARS ENDED JUNE 30, 2017 AND 2016

	Years Ended June 30	
	2017	2016
Reconciliation of operating income to net cash provided by operating activities:		
Operating income	$ 6,374,131	$ 7,076,440
Adjustments to reconcile operating income to net cash provided by operating activities:		
Depreciation and amortization	16,149,684	13,301,407
Miscellaneous income	204,050	163,556
Change in operating accruals:		
Assets (increase) decrease:		
Customer accounts receivable and deposits	(227,268)	(528,707)
Inventory and prepaid expenses	(1,276,617)	(295,095)
Pension Expense	634,082	257,636
Liabilities increase (decrease):		
Accounts payable and compensation related	577,577	(45,683)
Net cash provided by operating activities	$ 22,435,639	$ 19,929,554
Supplemental disclosures of cash flow information:		
Noncash capital and related financing activities:		
Developer contribution of systems	$ 5,748,294	$ 8,207,903

See Notes to the Financial Statements

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NOTE 1 - DESCRIPTION OF ENTITY

The Commissioners of Public Works for the Town of Mount Pleasant, South Carolina (the Commission) was created and empowered by the Town of Mount Pleasant, South Carolina (the Town) and State of South Carolina in 1935 under South Carolina Code of Laws section 5-31-210. The popular name of the Commission is Mount Pleasant Waterworks.

The Commission is governed by seven Commissioners, consisting of the Town's Mayor and Chairman of the Town's Water Supply Committee, and five Commissioners elected by Town voters. The elected Commissioners have staggered terms of six years.

The Commission is responsible for providing water and wastewater services within the Town and other areas within Charleston County between the Wando River and the Intracoastal Waterway and the Francis Marion National Forest. The water service area was enlarged in 1990 to include the territory from the Santee River to the Cooper River; however, water systems and services are currently limited in this area. The Commission's current water supply is from various deep well aquifers and surface water treated by and purchased from The Commissioners of Public Works of the City of Charleston (Charleston Water System). Water directly accessed from aquifers is treated by reverse osmosis (RO) processes at four RO plants. Tanks and ASR (Aquifer storage and recovery) wells are used to meet peak demands. The Commission operates two wastewater treatment facilities.

The Commission will continue to have a fiscal dependency upon the Town of Mount Pleasant, requiring the Town to approve all debt issuance and grants, however, there is no financial benefit or burden relationship. Based on accounting standards, the Commission is not a component unit of the Town.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

A. Basis of Accounting and Presentation - The Commission's financial statements are presented on the full accrual basis of accounting in accordance with accounting principles generally accepted in the United States of America. The Commission applies all relevant Government Accounting Standards Board (GASB) pronouncements.

All activities of the Commission are accounted for within a single enterprise fund. The accounting and financial reporting treatment applied to the Commission is determined by its measurement focus. The transactions of the Commission are accounted for on a flow of economic resources measurement focus. With this measurement focus, all assets and all liabilities associated with the operations are included on the Statements of Net Position. Net Position (i.e. total assets plus deferred outflows less deferred inflows and total liabilities) is segregated into classes: net investment in capital assets; restricted; and unrestricted. The operating statement (Statements of Revenues, Expenses, and Change in Net Position) present increases (e.g. revenues and capital contributions) and decreases (e.g. expenses) in net position.

The GASB standards require the presentation of a Management's Discussion and Analysis, which precedes the basic financial statements.

The Commission has established criteria for determining the scope of the reporting entity for financial statement presentation, in accordance with GASB standards. Accordingly, an accountability perspective has been the basis for defining the financial reporting entity. These financial statements present the government and all of the activities for which the Commission is accountable.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

Adopted GASB Statements

Statement No. 75, ***Accounting and Financial Reporting for Postemployment Benefits Other Than Pensions*** was issued in June of 2015, and is effective for financial statements for periods beginning after June 15, 2017, which will impact the Commission's fiscal year ending June 30, 2018. This statement could easily be described as the GASB No. 68 for postemployment benefit plans due to the fact that it will closely follow the provisions of GASB No. 68 for pension plans.

The primary objective of this statement is to improve accounting and financial reporting by state and local governments for postemployment benefits other than pensions (OPEB). It also improves information provided by state and local governmental employers about financial support for OPEB that is provided by other entities. This statement results from a comprehensive review of the effectiveness of existing standards of accounting and financial reporting for all postemployment benefits (pensions and OPEB) with regard to providing decision-useful information, supporting assessments of accountability and inter-period equity, and creating additional transparency.

This statement replaces the requirements of Statements No. 45, Accounting and Financial Reporting by Employers for Postemployment Benefits Other Than Pensions, as amended, and No. 57, OPEB Measurements by Agent Employers and Agent Multiple-Employer Plans, for OPEB. Statement No. 74, Financial Reporting for Postemployment Benefit Plans Other Than Pension Plans, establishes new accounting and financial reporting requirements for OPEB plans.

The scope of this statement addresses accounting and financial reporting for OPEB that is provided to the employees of state and local governmental employers. This statement establishes standards for recognizing and measuring liabilities, deferred outflows of resources, deferred inflows of resources, and expense/expenditures. For defined benefit OPEB, this statement identifies the methods and assumptions that are required to be used to project benefit payments, discount projected benefit payments to their actuarial present value, and attribute that present value to periods of employee service. Note disclosure and required supplementary information requirements about defined benefit OPEB also are addressed.

In addition, this statement details the recognition and disclosure requirements for employers with payables to defined benefit OPEB plans that are administered through trusts that meet the specified criteria and for employers whose employees are provided with defined contribution OPEB. This statement also addresses certain circumstances in which a non-employer entity provides financial support for OPEB of employees of another entity.

In this statement, distinctions are made regarding the particular requirements depending upon whether the OPEB plans through which the benefits are provided are administered through trusts that meet the following criteria:

- Contributions from employers and non-employer contributing entities to the OPEB plan and earnings on those contributions are irrevocable.
- OPEB plan assets are dedicated to providing OPEB to plan members in accordance with the benefit terms.
- OPEB plan assets are legally protected from the creditors of employers, non-employer contributing entities, the OPEB plan administrator, and the plan members.

The requirements of this statement will improve the decision-usefulness of information in employer and governmental non-employer contributing entity financial reports and will enhance its value for assessing accountability and inter-period equity by requiring recognition of the entire OPEB liability and a more comprehensive measure of OPEB expense. Decision-usefulness and accountability also will be enhanced through new note disclosures and required supplementary information.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

Statement No. 82, *Pension Issues – an amendment of GASB Statements No. 67, 68 and 73* was issued in April 2016, and is effective for the first reporting period in which the Commission's pension plan's measurement date is on or after June 15, 2017. The Commission is adopting this statement effective June 30, 2017. No real significant matters noted in this standard which addresses:

- Presentation of payroll-related measures in the Required Supplementary Information of the annual audited financial report. Covered payroll is defined as the payroll on which contributions are based.
- Selection of actuarial assumptions. Any deviation from guidance of Actuarial Standards Board is not in conformity with GASB No. 67 & 68.
- Classification of payments made by employers to satisfy contribution requirements:
  - Payments made by employer to satisfy contribution requirements that are identified as plan member contributions should be classified as "plan member contributions" for GASB No. 67, and as "employee contributions" for GASB No. 68.
  - Expense to be classified as other compensation elements.

B. Budgetary Accounting - The Commission adopts annual operating and capital budgets. The current operating budget details the Commission's plans to receive and expend funds for charges incurred for operations, maintenance, certain interest, capital outlay for certain administrative and general functions, and other charges for the fiscal year. The capital budget details the plan to receive and expend impact fees, special assessments, grants, borrowings and certain revenues for capital projects. Prior to July 1, the budget is enacted by a resolution.

The General Manager is authorized to transfer appropriations between general classifications, divisions or departments in the operating budget and within functional project categories in the capital projects budget. Increases or decreases in total operating and total capital project budgets, as well as the functional capital projects budgets require the approval of the Commissioners. All unexpended and unencumbered appropriations in the operating budget lapse at the end of the fiscal year. No appropriation for a capital project in the capital budget lapses until the purpose for which the appropriation was made has been accomplished or abandoned.

Budgets are adopted on a basis which approximates accounting principles generally accepted in the United States of America, except that the budgetary basis excludes depreciation and amortization expense and developer contributions of systems, and recognizes debt service payments and capital projects and other capital assets as expenditures. The budgetary basis of accounting is consistent with the methodology used in the Commission's rate making model.

C: Cash Equivalents, Deposits and Investments and Related Restrictions - Cash and cash equivalents, for purposes of the Statements of Cash Flows, include restricted and unrestricted cash on hand or on deposit, certain bank money market funds, interests in the State Treasurer's Pool, repurchase agreements and investments with an original maturity of three months or less.

The Commission is permitted to invest through various investment advisors in a pool managed by the South Carolina State Treasurer, certificates of deposit, repurchase agreements, guaranteed insurance contracts and U.S. or State of South Carolina general obligations. It is the Commission's policy to only invest in these permitted instruments. Investments are stated at fair value, equal to the value of shares in the above-mentioned pool. The total fair value of the Pool is apportioned to the entities with funds invested on an equal basis for each share owned, which are acquired at a cost of $1.00 per share.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

Fair Value Measurements. The Commission categorizes its fair value measurements within the fair value hierarchy established by generally accepted accounting principles. The hierarchy is based on the valuation inputs used to measure the fair value of the asset. Level 1 inputs are quoted prices in active markets for identical assets; Level 2 inputs are significant other observable inputs; and Level 3 inputs are significant unobservable inputs. The South Carolina Local Government Investment Pool (SCLGIP) is an investment pool which does not meet the criteria of GASB Statement No. 79 and is thus valued at fair value in accordance with GASB Statement No. 31. As a result, the Commission does not disclose investment in the SCLGIP within the fair value hierarchy.

Restricted asset accounts are established to account for assets reserved for specific purposes. Certain construction and capital project accounts, and debt service fund accounts are reserved and restricted by certain bond ordinance and state revolving fund (SRF) loan agreements. Capacity (impact) fees are restricted by State legislation. The restricted capital projects accounts represent 1) impact fees charged to new customers to recover the costs associated with unutilized capacity or to build new capacity, 2) special assessments to provide capital improvements, 3) unspent bond and revolving loan proceeds for capital purposes, 4) related investment income on such accounts and the depreciation fund, and 5) other customer contributions for which related capital assets have not been funded.

Reserve/restricted funds may to be established at the discretion of the Commissioners from time to time. The action establishing such reserve funds will define the restricted/unrestricted nature of the fund, the segregation of the fund, the use and disbursement policy, the accounting and management of the fund, and the inclusion or exclusion of the fund balance towards any fund balance goal. The Commission has established the following reserve/restricted funds: capital reserve, impact fee reserve, medical reserve, customer security deposit, and maintenance bond deposit funds.

D. Receivables and Payables - Receivables and payables between departments are eliminated. Customer receivables represent various volume, availability, impact and special assessment service fees earned but not yet collected. Unbilled (i.e. cycle billings) receivables at year end are estimated to record revenues earned through year end. Receivables are reported net of applicable allowances for uncollectible accounts and bad debt expense.

E. Inventories – Inventories consist of construction material, repair parts, and chemicals. Materials and supplies inventories are stated at the lower of average cost or market.

F. Capital Assets, Depreciation and Expenditures - Property, plant, equipment, and capacity purchases are classified as capital assets and are recorded at cost, if purchased or constructed, and the cost exceeds $5,000. Assets acquired through contributions from developers or other entities are capitalized at their estimated fair value, if available, or at engineers' estimated fair value or cost to construct at the date of the contribution. Costs of studies that directly result in specific construction projects are capitalized. Computer software developed or acquired for internal use, is capitalized and depreciated over anticipated useful lives.

Interest costs during construction are capitalized for qualified property. Interest costs of tax exempt borrowings are capitalized net of related investment earnings on the proceeds. Interest is not capitalized on assets acquired or constructed with gifts and grants (e.g. contributions, special assessments) that are restricted by the donor or grantor to acquisition of those assets.

Losses from impairments of capital assets are recognized for capital assets no longer used or damaged, or for which their service utility is significantly diminished. Insurance recoveries, which are received or certain as to recovery, are offset against such impairment losses.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

The cost of acquiring long-term capacity rights in other utilities' water or wastewater systems, including funding of plant expansion, betterments or renewals, is capitalized and amortized over the shorter of the life of the applicable plant or system, or term of the rights, not to exceed 40 years. Although the rights are perpetual, the nature of direct funding of related plant additions and the possibility of future abandonment of the source justify amortization of the rights.

Certain repair, maintenance, studies and other expenses funded by capital projects accounts, which do not meet the requirements for capitalization, are presented in the Statements of Revenues, Expenses and Change in Net Position as repairs and maintenance funded by capital budget.

Assets are depreciated on the straight-line method. Depreciation is calculated using the following estimated useful lives: utility plant and systems, excluding equipment, 20-60 years, utility plant equipment and tools 2-20 years, water capacity rights, if no contract life, 20-40 years, buildings 30-40 years, site improvements 20-30 years, generators 5-25 years, furniture and fixtures 3-30 years, computers 2-15 years and vehicles 5-10 years.

Utility Plant and System Assets	20-60 Years	Generators	5-25 Years
Water Capacity Rights	20-40 Years	Computers	2-15 Years
Buildings	30-40 Years	Furniture & Fixtures	3-30 Years
Site Improvement	20-30 Years	Vehicles	5-10 Years
Equipment	2-20 Years		

G. Long-term Obligations and Costs – Long-term obligations are reported at face value, net of applicable premiums and discounts. Premiums and discounts, and gains or losses on advance refundings and defeasances, are deferred and amortized over the life of the applicable bonds. Beginning in fiscal year 2015, the amortization of bond premium was changed from a straight-line amortization to the effective interest method of amortization.

H. Net Pension Liability – For purposes of measuring the net pension liability, deferred outflows of resources and deferred inflows of resources related to pensions, and pension expense, information about the fiduciary net position of the South Carolina Retirement System (SCRS) and additions to/deductions from SCRS's fiduciary net position have been determined on the same basis as they are reported by SCRS. For this purpose, benefit payments (including refunds of employee contributions) are recognized when due and payable in accordance with the benefit terms. Investments are reported at fair value.

I. Compensation for Future Absences – Vacation and any sick leave eligible to be paid to employees at termination is recorded as an expense and a current liability as the benefits are earned and become vested.

J. Claims and Judgments – These activities and obligations are recorded on the accrual basis, when the event occurs and obligation arises.

K. Capital Contributions – Contributions include impact fees, developer contributions of systems, and other capacity and supplemental support by other utilities and governments. Impact fees represent charges against new development to recover capital costs previously incurred for available system capacity or to develop new service capacity. Developers contribute completed systems they have constructed under state and local guidelines. Developers generally do not desire and are not permitted to operate water and wastewater systems.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

Impact fees and developer contributions of systems represent imposed nonexchange transactions and voluntary nonexchange transactions, respectively. Impact fees are recognized in the Statements of Revenues, Expenses and Changes in Net Position when legally enforceable or probable of legal enforcement, or if no restrictions, when use of the resources is first permitted. Impact fees received from developers and commercial entities are permitted to be used upon receipt, subject to refund prior to initiation of construction. Accordingly, impact fees are recognized in the financial statements upon receipt. An allowance is recorded in anticipation of refunds, when applicable. Historically, refunds of impact fees have been negligible and assessed as highly remote.

L. Net Position – Net position is the difference between assets, deferred outflows, deferred inflows and liabilities. Net position comprises the various net earnings from operating and non-operating revenues, expenses and contributions of capital. Net position is classified in the following three components: net investment in capital assets; restricted for capital activity and debt service; and unrestricted net position. Net investment in capital assets consists of all capital assets, net of accumulated depreciation and reduced by outstanding debt and other liabilities that is attributable to the acquisition, construction and improvement of those assets; unspent debt proceeds or other restricted cash and investments is excluded from the determination. Restricted for capital projects and debt service consists of net position for which constraints are placed thereon by external parties, such as lenders, grantors, contributions, laws, regulations and enabling legislation less any related liabilities. The Statements of Net Position reports restricted net position of **$26,695,383** and $22,485,774 at June 30, 2017 and 2016, of which **$15,240,272** and $15,800,543 were restricted by enabling legislation. Unrestricted net position consists of all other net position not included in the above categories.

M. Operating Revenues and Expenses and the Rate Structure – Revenues from water and wastewater services are recognized on the accrual basis and as earned. Services are supplied to customers under a rate structure designed to produce revenues sufficient to provide for operating and maintenance costs, capital costs related to renewal and replacement assets, and certain debt service for related operating and maintenance costs.

> **Operating revenues & expenses** are those revenues generated from existing customers and those expenses that benefit existing customers.
>
> **Non-operating revenues and expenses** are those revenues and expenses that are not generated or incurred from normal operations and include, but not limited to, interest and investment earnings, gain or loss from sale or disposal of assets, insurance reimbursements, and interest expense.

N. Deferred Outflow/Inflows of Resources

In addition to assets, the Statement of Net Position will sometimes report a separate section for deferred outflows of resources. This separate financial statement element, deferred outflows of resources, represents a consumption of net position that applies to a future period(s) and so will not be recognized as an outflow of resources (expense) until then. The Commission had four items that qualified for reporting in this category. They are the differences between expected and actual experience, the difference in investment earnings, the changes in proportion and differences in employer contributions and proportionate share of contribution, and the pension contribution subsequent to the measurement date, which are consumptions of net position in future periods, resulting in recognition as deferred outflows of resources. The Commission had deferred gains on debt refunding, which qualify for reporting in this category. Deferred charges on refunding result from the difference in the carrying value of the refunded debt and its reacquisition price. The amount is deferred and amortized over the shorter of the life of the refunded or refunding debt.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

In addition to liabilities, the Statement of Net Position will sometimes report a separate section for deferred inflows of resources. This separate financial statement element, deferred inflows of resources, represents an acquisition of net position that applies to future period(s) and so will not be recognized as an inflow of resources (revenue) until that time. The Commission had two item that qualified for reporting in this category. They are the net difference between projected and actual investment earnings on pension plan investments and differences in experience are acquisitions of net position which apply to future periods, resulting in recognition as a deferred inflow of resources.

O. Use of Estimates

The preparation of the financial statements in conformity with GAAP requires management to make certain estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities as of the date of the financial statements and the reported amount of revenue and expenses during the reporting period. Estimates are used to determine depreciation expense, the allowance for doubtful accounts and certain claims and judgment liabilities, among other accounts. Actual results may differ from those estimates.

NOTE 3 - CASH EQUIVALENTS, DEPOSITS AND INVESTMENTS

Deposits – Custodial credit risk is the risk that in the event of a bank failure, the Commission's deposits may not be returned. The Commission's policy is to request collateral for all bank deposits in excess of insured amounts, excepting uncollateralized amounts up to $250,000 per custodian with major banking institutions with high credit rating and primary financial indicators with federal and state regulator limits. There is no limit placed on the maximum amount deposited with one institution. As of June 30, 2017 and 2016 uncollateralized deposits did not exceed this amount. The carrying balances of deposits at June 30, 2017 and 2016 were **$20,667,711** and $17,755,783 with corresponding bank balances of **$21,094,637** and $18,623,186 respectively.

Investments – For an investment, custodial credit risk is the exposure that a counterparty fails, absent collateral, and the Commission is unable to recover its investment value. The Commission has no policy restricting the amounts or percentages of investments that may be invested in authorized investments. Investments at June 30, 2017 and 2016 were respectively comprised of **$134,562,763** and $27,737,360 funds held by the State Treasurer's Local Government Investment Pool and **$1,415,904** and $1,086,982 funds held by US Bank for debt service. The fair value and cost of these investments were the same.

	June 30,	
	2017	2016
SC Local Government Pool	$ 134,562,763	$ 27,737,360
US Bank (Debt Service)	$ 1,415,904	$ 1,086,982

The Commission invested certain funds with the South Carolina State Treasurer's Office which established the South Carolina Local Government Investment Pool (SCLGIP) pursuant to Section 6-6-10 of the South Carolina Code. The Pool is an investment trust fund, in which public monies in excess of current needs which are under the custody of any county treasurer or any governing body political subdivision of the State may be deposited. The SCLGIP is permitted to purchase obligations of the United States, its agencies and instrumentalities, and any corporation within the Unites Sates if such obligations bear any of the three highest ratings of at least two national recognized rating services. The investment in the South Carolina Local Government Investment Pool is valued at fair market value.

NOTE 3 - CASH EQUIVALENTS, DEPOSITS AND INVESTMENTS(continued)

A reconciliation of deposits and investments within this footnote, and cash and cash equivalents and investments as shown on the statement of net position is as follows:

		June 30, 2017	June 30, 2016
Deposits and Investments:			
	Cash on Hand	$ 2,100	$ 2,100
	Deposits Carrying Amounts	20,667,711	17,755,783
	Investments Carrying Amounts	135,978,667	28,824,343
	Total Cash, Deposits and Investments	**156,648,478**	**46,582,226**
Balance Sheet and Cash Flow Statement Amounts			
	Unrestricted	22,867,542	21,191,104
	Restricted: Debt Service Accounts	1,415,904	1,086,982
	Customer and Other Deposits	3,214,610	2,550,932
	Capital Projects	129,150,422	21,753,208
	Total Restricted	**133,780,936**	**25,391,122**
	Total Cash, Cash Equivalents and Investments	**156,648,478**	**46,582,226**
Restricted Cash & Investments			
	Debt Service	1,415,904	1,086,982
	Impact Fees	15,240,272	15,800,543
	Bond Proceeds	103,154,174	10,300
	Capital & Other Deposit Funds	13,970,586	8,491,297
	Total Restricted Cash & Investments	**133,780,936**	**25,389,122**
Investment Custodial Credit Risk			
	State Treasurer's Local Government Investment Pool	134,562,763	27,737,361
	US Bank (Debt Service)	1,415,904	1,086,982
	Total Investments	**$ 135,978,667**	**$ 28,824,343**

Collateral

Tri-Party Collateral Agreement Between Mount Pleasant Waterworks, Wells Fargo Bank, N.A. and The Bank of New York Mellon. Instruments included FNMA, Piedmont Municipal, and State of South Carolina Bonds with a market value as of June 30, 2017 of **$20,834,285.**

Capital & Other Deposits Funds totaling $13,970,586 includes Commission designated reserve/restricted funds including a capital reserve fund, medical reserve fund, impact fee reserve, escrow and security deposit funds. The Commission's Cost Recovery Policy details governance over these funds.

NOTE 4 - RECEIVABLES

Customer receivables include the following:

	June 30, 2017	June 30, 2016
Customer Accounts Receivable - Current	$ 4,624,372	$ 3,811,369
Financed customer receivables - restricted:		
Current	33,700	65,816
Noncurrent	48,272	80,908
Total Financed Receivables	81,972	146,724
Other Receivables	209,298	100,894
Unbilled Revenues	4,087,451	3,779,829
Total Receivables	**9,003,093**	**7,838,815**
Less Allowance for Doubtful Accounts	(1,841,168)	(1,791,168)
Receivables, net	**$ 7,161,925**	**$ 6,047,647**
Receivables Summary:		
Current Unrestricted	$ 7,079,953	$ 5,900,923
Current Restricted	33,700	65,816
Noncurrent Restricted	48,272	80,908
Receivables, net	**$ 7,161,925**	**$ 6,047,647**

Unbilled Revenue

Unbilled volumetric water and wastewater revenues were **$4,087,451** and $3,779,829 for 2017 and 2016, respectively.

Financed Impact Fee

Financed receivables represent capacity (impact) fees financed for periods ranging from one to twenty years at interest rates ranging from 0% to 4.25%. Financed receivables are transferred to current billed receivable on the payment due date. Financed impact fees with an initial term of three years or more are secured by a lien on related property. Future maturities of financed receivables, which have not been transferred to billed receivables, are listed in the following table.

Fiscal Year	Amount
2018	$ 33,760
2019	22,291
2020	9,741
2021	8,865
2022	5,255
Thereafter	2,060
Total	$ 81,972

Allowance for Doubtful Accounts

The allowance for doubtful accounts was increased by **$50,000** during fiscal years 2017 and 2016 to provide for sufficient coverage of accounts deemed uncollectible.

NOTE 5 - CAPITAL ASSETS

Summary of Capital Assets by Type

Systems	Balance 6/30/2016	Additions	Transfers	Disposals / Retirements	Balance 6/30/2017
Lines, Mains & Pipes	$ 238,261,533	$ 4,350,055	$ 2,312,806	$ -	$ 244,924,394
Equipment	36,340,014	465,873	2,724,529	(35,120)	39,495,296
Water Capacity Right	13,430,492	-	4,473,047	-	17,903,539
Manholes	13,605,555	-	681,190	-	14,286,745
Valves	12,227,608	688,190	103,512	-	13,019,310
Tanks(Store/Process)	12,198,049	-	-	-	12,198,049
Pumps	8,237,293	27,200	1,389,604	-	9,654,097
Wells	8,921,589	12,952	656,764	-	9,591,305
Hydrants	5,532,078	333,867	35,434	-	5,901,379
Meters	6,703,540	-	565,411	(2,711,101)	4,557,850
ASR	1,606,476	-	-	-	1,606,476
Membranes	402,012	-	-	-	402,012
Total Utility Plant In Service	**$ 357,466,239**	**$ 5,878,137**	**$ 12,942,297**	**$ (2,746,221)**	**$ 373,540,452**
Buildings	37,932,573	-	$ 105,360	-	38,037,933
Vehicles	4,494,240	-	$ 1,377,247	(357,900)	5,513,588
Computer Hardware and Software	4,726,606	-	$ 728,631	-	5,455,237
Site Improvement	2,901,056	-	$ 119,856	-	3,020,912
Generators	2,456,552	-	$ -	-	2,456,552
Furniture, Fixtures & Equipment (Admin)	580,502	-	$ 5,910	-	586,412
Total Admin Assets	**$ 53,091,529**	**$ -**	**$ 2,337,004**	**$ (357,900)**	**$ 55,070,634**
Land & Easements	8,012,417	-	$ 4,253,315	(311,735)	11,953,997
Total Capital Assets	**$ 418,570,185**	**$ 5,878,137**	**$ 19,532,616**	**$ (3,415,856)**	**$ 440,565,082**
Construction In Progress	20,495,452	30,532,790	(19,532,616)	-	31,495,626
Total Costs	**$ 439,065,637**	**$ 36,410,927**	**$ -**	**$ (3,415,856)**	**$ 472,060,708**
Utility System	(107,790,538)	(13,508,271)	-	2,201,835	(119,096,974)
Building & Site Improvements	(10,844,131)	(1,329,406)	-	-	(12,173,537)
Computer Hardware and Software	(2,997,727)	(623,042)	-	-	(3,620,769)
Vehicles	(2,501,212)	(505,006)	-	383,082	(2,623,136)
Generators	(1,400,910)	(131,639)	-	-	(1,532,549)
Furniture, Fixtures & Equipment (Admin)	(178,517)	(52,320)	-	-	(230,837)
Total Accumulated Depreciation	**$(125,713,035)**	**$ (16,149,684)**	**$ -**	**$ 2,584,917**	**$(139,277,802)**
Net Capital Assets	**$ 313,352,602**	**$ 20,261,243**	**$ -**	**$ (830,939)**	**$ 332,782,906**

NOTE 5 - CAPITAL ASSETS (continued)

Summary of Capital Assets by Type

Systems	Balance 6/30/2015	Additions	Transfers	Disposals / Retirements	Balance 6/30/2016
Lines, Mains & Pipes	$ 231,339,081	$ 5,529,654	$ 1,794,803	$ (402,004)	$ 238,261,533
Equipment	28,256,647	109,000	19,163,802	(11,189,435)	36,340,014
Manholes	12,547,273	1,026,575	43,683	(11,976)	13,605,555
Water Capacity Right	13,437,630	-	25,257	(34,395)	13,430,492
Valves	11,185,610	509,248	556,087	(23,337)	12,227,608
Tanks(Store/Process)	12,364,634	-	-	(166,585)	12,198,049
Wells	8,541,883	363,490	387,360	(371,144)	8,921,589
Pumps	13,750,856	283,600	223,527	(6,020,690)	8,237,293
Meters	11,924,779	-	364,788	(5,586,027)	6,703,540
Hydrants	5,204,900	364,836	83,246	(120,904)	5,532,078
ASR	1,606,476	-	-		1,606,476
Membranes	1,853,707	-	-	(1,451,696)	402,012
Total Utility Plant In Service	**$ 352,013,476**	**$ 8,186,403**	**$ 22,644,553**	**$ (25,378,193)**	**$ 357,466,239**
Buildings	27,112,457	-	105,360	(1,984,860)	37,932,573
Computer Hardware and Software	8,478,020	-	730,914	(4,155,025)	4,726,606
Vehicles	4,189,630	-	1,377,248	(174,024)	4,494,240
Site Improvement	2,575,483	-	117,573	-	2,901,056
Generators	2,677,160	-	-	279,524	2,456,552
Furniture, Fixtures & Equipment (Admin)	871,611	-	5,911	(588,764)	580,502
Total Admin Assets	**$ 45,904,361**	**$ -**	**$ 14,369,365**	**$ (7,182,197)**	**$ 53,091,529**
Land & Easements	6,526,121	21,500	1,464,796	-	8,012,417
Total Capital Assets	**$ 404,443,958**	**$ 802,903**	**$ 3,847,871**	**$ (32,560,390)**	**$ 418,570,185**
Construction In Progress	35,163,094	23,811,072	(38,478,714)	-	20,495,452
Total Costs	**$ 439,607,052**	**$ 32,018,975**	**$ -**	**$ (32,560,390)**	**$ 439,065,637**
Utility System	(119,680,925)	(11,531,389)	-	23,421,776	(107,790,538)
Building & Site Improvements	(11,403,652)	(627,340)	-	1,186,861	(10,844,131)
Computer Hardware and Software	(6,575,213)	(575,257)	-	4,152,743	(2,997,727)
Vehicles	(4,922,554)	(394,802)	-	2,816,144	(2,501,212)
Generators	(1,664,445)	(130,567)	-	394,102	(1,400,910)
Furniture, Fixtures & Equipment (Admin)	(725,229)	(42,052)	-	588,764	(178,517)
Total Accumulated Depreciation	**$(144,972,018)**	**$ (13,301,407)**	**$ -**	**$ 32,560,390**	**$(125,713,035)**
Net Capital Assets	**$ 294,635,034**	**$ 18,717,568**	**$ -**	**$ -**	**$ 313,352,602**

NOTE 5 - CAPITAL ASSETS (continued)

Summary of Capital Assets Activity by Utility and Function

Systems	Balance 6/30/2016	Additions	Transfers	Disposals / Retirements	Balance 6/30/2017
Water					
Distribution	$ 119,424,757	$ 2,924,651	$ 1,045,577	$ (2,711,101)	$ 120,683,885
Treatment	10,454,829		24,086		10,478,915
Supply	19,025,964		4,806,928		23,832,892
General	891,171			(4,031)	887,140
Total Water	**149,796,721**	**2,924,651**	**5,876,591**	**(2,715,132)**	**155,882,832**
Wastewater					
Collections	170,167,856	2,953,485	2,647,254		175,768,595
Treatment	74,665,065		7,416,783		82,081,848
General	397,454		-	(18,584)	378,870
Total Wastewater	**245,230,375**	**2,953,485**	**10,064,037**	**(18,584)**	**258,229,313**
General and administrative	23,543,089		3,591,988	(682,140)	26,452,937
Total Assets in Service	**418,570,185**	**5,878,136**	**19,532,616**	**(3,415,856)**	**440,565,082**
Construction In Progress	20,495,452	30,532,790	(19,532,616)	-	31,495,626
Total Capital Assets	**$ 439,065,637**	**$ 36,410,926**	**$ -**	**$ (3,415,856)**	**$ 472,060,708**
Water	(49,885,561)	(5,020,296)	-	2,191,897	(52,713,960)
Wastewater	(66,007,511)	(9,439,614)	-	-	(75,447,125)
General and administrative	(9,819,963)	(1,689,774)	-	393,020	(11,116,717)
Total Accumulated Depreciation	**(125,713,035)**	**$ (16,149,684)**		**$ 2,584,917**	**$ (139,277,802)**
Net Capital Assets	**$ 313,352,602**	**$ 20,261,242**	**$ -**	**$ (830,939)**	**$ 332,782,906**

Systems	Balance 6/30/2015	Additions	Transfers	Disposals / Retirements	Balance 6/30/2016
Water					
Distribution	$ 121,534,956	$ 3,194,677	$ 1,310,264	$ (6,615,140)	$ 119,424,757
Treatment	19,376,098			(8,921,269)	10,454,829
Supply	19,906,424		27,257	(907,717)	19,025,964
General	1,867,288		10,383	(986,500)	891,171
Total Water	**162,684,765**	**3,194,677**	**1,347,904**	**(17,430,626)**	**149,796,721**
Wastewater					
Collections	166,711,599	5,013,226	3,562,540	(5,119,509)	170,167,856
Treatment	47,230,732		32,518,330	(5,083,997)	74,665,065
General	599,572		116,487	(318,605)	397,454
Total Wastewater	**214,541,903**	**5,013,226**	**36,197,357**	**(10,522,111)**	**245,230,375**
General and administrative	27,217,289		933,453	(4,607,653)	23,543,089
Total Assets in Service	**404,443,958**	**8,207,903**	**38,478,714**	**(32,560,390)**	**418,570,185**
Construction In Progress	35,163,094	23,811,072	(38,478,714)		20,495,452
Total Capital Assets	**$ 439,607,052**	**$ 32,018,975**	**$ -**	**$ (32,560,390)**	**$ 439,065,637**
Water	(62,932,358)	(4,416,029)	-	17,462,826	(49,885,561)
Wastewater	(69,016,134)	(7,444,998)	-	10,453,621	(66,007,511)
General and administrative	(13,023,526)	(1,440,380)	-	4,643,943	(9,819,963)
Total Accumulated Depreciation	**(144,972,018)**	**$ (13,301,407)**	**$ -**	**$ 32,560,390**	**$ (125,713,035)**
Net Capital Assets	**$ 294,635,034**	**$ 18,717,568**	**$ -**	**$ -**	**$ 313,352,602**

NOTE 5 - CAPITAL ASSETS (continued)

During fiscal year 2017, **$25.4** million in capital projects and outlays were transferred into the fixed asset register. Of this amount, **$5.9** was from developer additions and **$19.5** million from capital projects and outlay.

Meter Replacement Project and Early Retirement of Meters - The Commission embarked on a project to replace approximately 38,000 AMR (automatic meter reading) meters over the next three years with AMI (advanced metering infrastructure) meters. As such, many of the meters being replaced remain on the fixed asset registers and will be retired early. During fiscal year 2017, meters with a net book value of $519,000 were retired.

Direct and Indirect Labor Costs of the Commission's water, wastewater, and engineering departments were capitalized in the approximate amount of **$1,052,000** and $989,000 during fiscal year 2017 and 2016, respectively.

Capitalized Interest – During 2017 and 2016 interest expense was capitalized in the amounts of **$395,000** and $339,000, respectively.

Capacity Purchase - During December 1995, the Commission entered into a wholesale water contract with the Charleston Water System (CWS) to purchase water supply, treatment and transmission services. The initial capacity purchase was 1 MGD for approximately $1.6 million effective January 1, 1996. An additional 1 MGD, effective July 1, 2000 was purchased for $1.63 million. During 2006, the Commission purchased an additional 2 MGD for $3.6 million. An interim amendment of the original contract was executed in 2007 with the purchase of an additional .5 MGD capacity for $898 thousand at the first point of delivery and the construction of a second point of delivery and an additional 1 MGD capacity for $2.5 million. The Commission signed a thirty-year extension on their intergovernmental wholesale water purchase agreement with CWS on November 1, 2016. The Commission expended $1.7 million for the transfer of capacity delivery from the first point of delivery to the second point of delivery and purchased an additional .5 MGD capacity for $2.6 million. The total capacity purchase increased to 6 MGD.

The Commission is obligated to fund capital additions and enhancements to the related plant and system based on its acquired capacity. The Commission's share of capital improvements to CWS water plant for fiscal year 2017 was **$110,748**.

Various provisions are provided to adjust the charges as a result of water used in excess of the contracted capacity, changing costs of the systems, and other conditions. The initial consumption fee was $.54 per thousand gallons for actual water used. The consumption rate is adjusted annually based on a cost of service model. The effective rate during fiscal year 2017 and 2016 was **$.75** and $.68 per thousand gallons, respectively. The Commission purchased **62%** and 64% of its water supply from CWS in each of the fiscal years ended June 30, 2017 and June 30, 2016.

Construction-in-Progress – The Commission recorded **$31.5** million and $20.5 million of construction-in-progress for the fiscal years ended June 30, 2017 and June 30, 2016, respectively. Wastewater collection projects accounted for 66% of the construction in progress as of June 30, 2017.

NOTE 5 - CAPITAL ASSETS (continued)

Construction in Progress - Construction in progress include the following:

Project Description	June 30, 2017	June 30, 2016
Repair and Replacement of Existing Gravity Lines in Mount Pleasant (SRF Contract A CMOM)	$ 6,850,198	$ 3,263,257
Inspection and Rehab of Existing Gravity Lines in Mount Pleasant (SRF Contract B - Trenchless)	5,946,803	2,795,477
Regional Sewer Main Project	4,621,720	840,899
New Water Line - Coleman to Johnnie Dodds Blvd	3,463,013	2,547,159
RRRWWTP Rehab and Expansion - Phase 1	3,390,550	296,086
Distribution Rehab Program / Replace Bolts and Saddles - Dunes West and Park West (SRF)	2,110,083	1,146,445
PS3 (Center Street) Rehab	1,015,888	-
SSES TV Inspection and Evaluation (SRF Project)	755,482	848,361
SRF PS Rehab Program - Engineering, Permitting, Loan Information	331,679	-
Water Extensions Related to Growth	299,391	374,155
Coleman Boulevard Road Improvements	263,402	236,347
Upgrade RO Plant PLC Systems	210,742	-
Disinfection Improvements at RO Plants	207,749	-
RRRWWTP Automatic Bar Screen Replacement	200,410	-
Modeling - Hwy 41 Hydraulic/Capacity Issues	195,327	-
CWS Water Contract and Groundwater Model Update	188,316	-
Replacement of Deep Well 5	113,717	-
Wando Bridge Replacement	107,365	-
Directional Bore from Grassy Creek to Tidal Walk	100,945	-
RRRWWTP Effluent Pumping System Modification	-	3,052,953
New Forcemain Mathis Ferry to Coleman Blvd	-	2,163,600
TMS 560-00-00-017 Deveaux Property (1491 S Venning)	-	1,338,810
New Water Line on Bank and Carr Streets in the Old Village	-	281,633
Plant 4, Well 6 Rehabilitation	-	281,191
Utility Master Plan - Five Year Update	-	218,250
Other Projects Not Scheduled	1,122,846	810,829
Total Construction in Progress	**$ 31,495,626**	**$ 20,495,452**

NOTE 5 - CAPITAL ASSETS (continued)

The following Capital Budget funded projects are expensed in the accompanying Statements of Revenues, Expenses and Change in Net Position:

	June 30,	
Project Description	**2017**	**2016**
TV Inspection/Evaluation of Wastewater System	$ 346,237	$ -
Utility Master Plan - Five Year Update	218,250	-
Replacement of Deep Well 5	78,810	-
Fixed Base Meter Reading System	70,867	-
Wastewater Model Evaluation and CIP Development Assistance for FM and PS Assets	43,922	-
Grinder Pump RTUs and Control Panels	34,131	-
Upgrade of Pump Station (75) and Forcemain on National Drive	-	110,793
CSWWTP Capacity Enhancement (FY11-15)	-	90,594
CSWWTP Generator Relocation to RO 1	-	80,850
Collection System Reliability Assessment	-	75,344
Hwy 41 Pump Station/ Forcemain Study	-	68,837
Replacement of Failed Itron Units and Transponders on Existing Meters	-	68,295
Odor Control Study	-	59,948
CSWWTP Final Site Restoration	-	59,811
Upgrade Moscad RTUs to ACE and Migrate to Cellular	-	43,670
Other Projects Not Scheduled	103,862	190,007
Total Repairs and Maintenance Expenses, Studies and Surveys Funded By The Capital Budget	**$ 896,079**	**$ 848,149**

NOTE 6 - CAPITAL RELATED ACCOUNTS AND RETAINAGE PAYABLES

Capital related accounts and retainage payables includes unpaid invoices, contracts and retainage associated with the acquisition, construction and/or improvement of capital assets, which includes projects that are in construction-in-progress as of June 30, 2017. As of June 30, 2017, and 2016, the balance for capital related accounts and retainage payables were **$5,458,797** and $5,856,539 respectively.

NOTE 7 - LONG-TERM LIABILITIES

Revenue bonds, state revolving loans and bank loans were comprised of the following individual issues:

	June 30 2017	June 30 2016
Waterworks & Sewer Systems Revenue Refunding & Improvement Bonds		
Series 2012, $16,000,000 refunding revenue bond, remaining annual principal and semi-annual interest installments of $632,400 to $2,659,400 (principal of $180,000 to $2,350,000) through December 2023, interest only due each June 1, principal and interest due each December 1, interest at 2% to 5%.	$ 7,390,000	$ 9,625,000
Series 2017, $111,000,000 revenue bond, remaining annual principal and semi-annual interest installments of $705,379 to $7,671,188 (principal of $625,000 to $7,530,000) through June 2047, interest only due each June 1, principal and interest due each December 1, interest at 2% to 5%. Interest only for the first five years with interest capitalized at 70% for the first three years.	111,000,000	-
Total Revenue Refunding and Improvement Bonds	118,390,000	9,625,000
State Revolving Loan:		
Series 2005C, $10,663,300 loan at 3.25% interest with quarterly principal and interest payments of $181,793 beginning November 2007 through August 2027, construction period interest of $265,889 through July 2007 paid August 2007, 70% of proceeds received during fiscal year 2006 and 2007. $3,199,914 was drawn in Fiscal Year 2008. The South Carolina State Budget and Control Board reduced the interest to 2.25% beginning in February 2012. Quarterly principal and interest payments were reduced to $168,852 for the balance of the loan.	6,167,217	6,696,400
Series 2012B, $27,133,904 loan at a blend rate of 1.65% with quarterly principal and interest payments of $398,708 beginning in May 2015 through February 2035 for the Center Street Wastewater Treatment modernization projects completed during fiscal year 2016.	24,504,377	25,684,902
Series 2015A, $14,000,000 loan at 2.00% with quarterly principal and interest payments of $155,429 beginning in July 1, 2017 through April 2047 for Collection System Rehabilitation projects. Draws during fiscal year 2017 totaled $8,580,210.	11,036,305	2,456,095
Series 2015B, $2,500,000 loan at 2.20% with quarterly principal and interest payments of $38,712 beginning in August 1, 2017 through May 2037 for Water Distribution Rehabilitation projects. Draws during fiscal year 2017 totaled $341,607.	1,302,409	960,802
Total State Revolving Loans	43,010,308	35,798,200
Bank Loan		
Series 2011 Loan from SunTrust Bank for $5,550,000, semi-annual principal and interest payments of $221,869 beginning April 2012 through October 2026 with an interest rate of 2.43%.	3,744,138	4,090,567
Series 2014A Loan from TD Bank for $7,000,000, due in annual principal and semi-annual interest installments of $84,529 to $1,926,117 (principal of $250,000 to $1,870,000) beginning June 1, 2015 through December 2023, interest only due each June 1, principal and interest due each December 1, with an interest rate of 2.09%	6,750,000	6,750,000
Series 2014B Loan from TD Bank for $20,000,000 to refinance the 2005B revenue bond, due in annual principal and semi-annual interest installments of $1,001,092 to $3,585,168 (principal of $745,000 to $3,515,000) beginning December 2014 through December 2025, interest only due each June 1, principal and interest due each December 1, with an interest rate of 2.29%.	17,020,000	18,155,000
Total Bank Loan	27,514,138	28,995,567
Total Debt	188,914,446	74,418,767
Unamortized Revenue Bond Premiums	9,870,797	781,064
Total Debt, Net of Premiums	$ 198,785,243	$ 75,199,831
Total Current Portion of Debt	(6,060,889)	(5,426,138)
Long-Term Portion of Debt, Net	$ 192,724,354	$ 69,773,693

NOTE 7 – LONG-TERM LIABILITIES (continued)

Following is a summary of changes in the major classes of long-term liabilities:

	June 30, 2016	Additions	Reductions	June 30, 2017	Due within One Year
Revenue bonds	$ 9,625,000	$ 111,000,000	$ (2,235,000)	$ 118,390,000	$ 2,350,000
Bond Premiums	781,064	9,389,187	$ (299,454)	9,870,797	-
Net Revenue Bonds	10,406,064	120,389,187	(2,534,454)	128,260,797	2,350,000
State revolving loans	35,798,200	8,921,817	(1,709,709)	43,010,308	2,185,989
Direct Bank Loan	28,995,567	-	(1,481,430)	27,514,138	1,524,900
Net debt	75,199,831	129,311,004	(5,725,593)	198,785,243	6,060,889
Compensated Absences	652,684	820,033	(716,247)	756,470	447,207
Long-Term Liabilities	$ 75,852,516	$ 130,131,037	$ (6,441,841)	$ 199,541,713	$ 6,370,152

	June 30, 2015	Additions	Reductions	June 30, 2016	Due within One Year
Revenue bonds	$ 11,775,000	$ -	$ (2,150,000)	$ 9,625,000	$ 2,235,000
Bond Premiums	1,131,836	-	(350,772)	781,064	-
Net Revenue Bonds	12,906,836	-	(2,500,772)	10,406,064	2,235,000
State revolving loans	32,362,965	5,112,787	(1,677,552)	35,798,200	1,709,708
Direct Bank Loan	30,683,730		(1,688,163)	28,995,567	1,481,430
Net debt	75,953,531	5,112,787	(5,866,487)	75,199,831	5,426,138
Compensated Absences	582,184	583,931	(513,431)	652,684	398,352
Long-Term Liabilities	$ 76,535,715	$ 5,696,718	$ (6,379,918)	$ 75,852,516	$ 5,824,490

Annual debt service requirements to maturity for the above are as follows:

Fiscal Year(s)	Revenue Bonds		State Revolving Loan		Direct Bank Loan		Total		Total Principal & Interest
	Principal	Interest	Principal	Interest	Principal	Interest	Principal	Interest	
2018	$ 2,350,000	$ 5,176,301	$ 2,185,989	$ 860,815	$ 1,524,900	$ 606,276	$ 6,060,889	$ 6,643,392	$ 12,704,281
2019	1,490,000	4,897,425	2,227,089	819,716	2,313,576	562,616	$ 6,030,665	6,279,757	12,310,422
2020	1,565,000	4,821,050	2,268,999	777,806	2,372,464	509,995	$ 6,206,463	6,108,851	12,315,314
2021	765,000	4,766,625	2,311,736	735,068	3,306,570	446,887	$ 6,383,306	5,948,580	12,331,886
2022	600,000	4,739,325	2,355,316	691,487	3,590,898	370,933	$ 6,546,214	5,801,745	12,347,959
2023-2027	6,860,000	23,236,325	12,461,064	2,772,956	14,405,730	728,025	$ 33,726,794	26,737,306	60,464,100
2028-2032	18,765,000	20,301,375	10,311,587	1,714,244	-	-	$ 29,076,587	22,015,619	51,092,206
2033-2037	23,015,000	16,059,575	7,427,615	840,993	-	-	$ 30,442,615	16,900,568	47,343,183
2038-2042	28,360,000	10,710,825	2,671,015	437,561	-	-	$ 31,031,015	11,148,386	42,179,401
2043-2047	34,620,000	4,449,325	2,951,185	157,390	-	-	$ 37,571,185	4,606,715	42,177,900
Total	$ 118,390,000	$ 99,158,151	$ 47,171,595	$ 9,808,036	$ 27,514,138	$ 3,224,732	$ 193,075,733	$ 112,190,919	$ 305,266,652

The annual debt service schedule above includes two State Revolving Fund (SRF) Loans (2015A and 2015B) that have not been fully drawn as of June 30, 2016. Funds are drawn as project costs are expended. As of June 30, 2016, approximately $4.2 million remain undrawn. However, the amortization period began in fiscal year 2018 for both loans based on the original loan amount. Upon completion of the project, the loans may be re-amortized based on the final draw.

NOTE 7 - LONG-TERM LIABILITIES (continued)

The bonds and loans, which are in the name of the Town of Mount Pleasant, South Carolina, are secured by a pledge of, and lien upon, all revenues derived from the operations of the Commission and all funds and accounts derived from such revenues. The Town is not obligated to pay any of these bonds or loans, or any interest thereon, except from the revenues pledged to the payment thereof. All long-term debt was issued for the purpose of system expansion and improvement and was issued at parity.

On May 17, 2017, the Commission issued $111,000,000 30-year Waterworks and Sewer System Revenue Parity Bonds, Series 2017A, to finance the capacity related expansion and upgrade of the Rifle Range Road Wastewater Treatment Plant, water capacity purchases from Charleston Water System, AMI meter replacement project, and other water and wastewater treatment, distribution and collection improvements and system rehabilitation projects. The resulting sales generated a premium of $9.4 million with an all-in true-interest costs of 3.66%. Terms include interest only payments for the first five years with the first three years' interest capitalized at 70%. As of June 30, 2017, $103,154,174 of the bond proceeds were unspent.

On April 24, 2015, the Commission issued $14,000,000 in Waterworks and Sewer System Revenue Parity Bonds, Series 2015A, through the South Carolina Water Quality Revolving Fund Authority to finance cost for the Collection System Rehabilitation with a term of 30-years with 2.00% interest with debt service beginning July 1, 2017. Draws during fiscal year 2017 totaled $8,580,210 for a total drawn to date of $11,036,305.

On April 24, 2015, the Commission issued $2,500,000 in Waterworks and Sewer System Revenue Parity Bonds, Series 2015B, through the South Carolina Water Quality Revolving Fund Authority to finance cost for the Water Distribution Rehabilitation with a term of 20-years with 2.25% interest with debt service beginning August 1, 2017. Draws during fiscal year 2017 totaled $341,607 for a total drawn to date of $1,302,409.

On November 3, 2014, the Commission issued $7,000,000 in Waterworks and Sewer System Revenue Bonds, Series 2014A, to TD Bank, N.A. to fund various water and sewer projects to include the rehabilitation and expansion of pump stations to improve operating efficiency, control system and increase capacity and replacement of aging process equipment and system assets with a term of 10 years and 2.09% interest.

On November 3, 2014, the Commission refinanced the 2005B Revenue Bond through the issuance of $20,000,000, Series 2014B, fixed rate bonds from TD Bank, N.A. with a term of 11 years with 2.29% interest.

On December 11, 2012, the Commission received a loan, Series 2012B, from the South Carolina Water Quality Revolving Fund Authority (SRF) not to exceed $27,273,000 to finance the Center Street Wastewater Treatment Plant Capacity Enhancement project. The project was completed in early fiscal year 2016. The final loan amount was $27,133,904 with quarterly debt service payments of $398,708 beginning the fourth quarter of fiscal year 2015. The loan has a 1.65% per annum blended rate based on $19,295,636 at 1.90% (standard rate) and $7,838,268 at 1.00% (green rate) for the following aspects of the project which reduce energy cost by 20% or more or demonstrate innovative technology: new high efficiency blowers; new electrical switchgear and distribution; new generator meeting Tier 2 emissions criteria; adjustable frequency drives and high-efficiency motors; new biological treatment improvements and new secondary clarifiers; and BioMix technology as innovations technology and energy efficiency.

NOTE 7 - LONG-TERM LIABILITIES (continued)

On September 7, 2012, the Commission refinanced $17,925,000 of the 2002 Revenue Bonds through the issuance of $16,000,000 of Series 2012 Revenue Refunding Bonds and from the resulting issuance premium of $2,368,000. As a result of a favorable financial market the all-in true interest cost for the new bonds is 1.556% and allowed the Commission to reduce the term of the bonds from 20 years to 10 years. The net present value (NPV) savings of the refinancing was $4,100,000, a percentage savings of 22.89%. The refunding generated an economic gain of approximately $506,000, which will be amortized over the life of the 2012 Revenue Bonds.

Through June 30, 2017 the Commission met the various arbitrage rebate tests to avoid arbitrage obligations.

The bond ordinance provides that all revenue bonds and other obligations issued pursuant to such ordinance shall be secured by a pledge of, and a lien upon, revenues less amounts required to fund the expenses of operating and maintaining the system. The term revenues mean all fees, tolls, rates, rentals and charges to be levied in connection with, and all other income and receipts of whatever kind or character derived from the operation of the system, except customer deposits, proceeds of grants and special assessments for water and wastewater improvements or any other amounts required by law or agreement to be paid to the State of South Carolina. The bond ordinance specifically includes as revenues all water or wastewater tap-in fees, connection fees, and impact fees, less any adjustment for refunded impact fees.

The Commission, in accordance with the bond ordinance, covenants and agrees to establish, levy, maintain, revise and collect such fees, rentals, rates and other charges in connection with the system as may be necessary to produce net earnings at all times at least as sufficient after making due and reasonable allowances for contingencies to produce at least one hundred twenty percent (120%) of the annual principal and interest requirements on the outstanding bonds (less payments made from the proceeds of the bonds), to be funded from revenues during the fiscal year with respect to which such rates are being established. For fiscal years 2017 and 2016 the Commission surpassed this requirement, with net earnings covering debt service at **402%** and 395%, respectively.

The Commission further covenants and agrees to operate the system in an efficient and economical manner and establish, levy, maintain, revise and collect such fees, rentals, rates, and other charges, which together with other revenues shall produce operating revenues (meaning all revenues except impact fees) which shall at all times be at least sufficient after making due and reasonable allowances for contingencies (a) to pay all current expenses of operating and maintaining the system, (b) to produce at least 100% of the annual principal and interest requirements on the outstanding bonds (less payments made from the proceeds of bonds) to be funded from revenues during the fiscal year with respect to which such rates are being established, (c) to maintain the debt service reserve fund requirement in the debt service reserve fund, (d) to build up a reserve for depreciation and to build up a reserve for improvements, betterments and extensions to the system, (e) to comply in all respects with the terms of the act and the bond ordinance or any other contract or agreement with the holders of the bonds, and (f) to meet any other obligations of the commission which are charges, liens, or encumbrances upon the revenues. For fiscal years 2017 and 2016 the Commission surpassed the 100% coverage requirement, achieving **316%** and 281% of debt service respectively, and complied with the debt service reserve requirements of each loan. A specific depreciation reserve and reserve for improvements, betterments and extensions has not been defined and required by the Commissioners, bond holders or trustees; management believes the Commission's rate structure and existing cash and investment reserves are adequate to meet intended reserve requirements.

The bonds and loans require the Commission to maintain various restricted cash and investment accounts to control the receipt and use of revenues, contributions of borrowings, and maintain certain bond and loan sinking and reserve funds.

NOTE 8 - DEFERRED OUTFLOWS AND DEFERRED INFLOWS OF RESOURCES

Deferred Outflows of Resources	June 30, 2016	Additions	Reductions	June 30, 2017
Deferred amount on bond refunding	$ 130,136	$ -	$ 21,689	$ 108,447
Deferred amount related to pension expense				
Difference in earnings, experience and allocation	1,273,219	1,110,496	76,621	2,307,094
Difference in contributions	760,330	850,079	760,330	850,079
Total	$ 2,163,685	$ 1,960,575	$ 858,640	$ 3,265,620

Deferred Outflows of Resources	June 30, 2015	Additions	Reductions	June 30, 2016
Deferred amount on bond refunding	$ 151,826	$ -	$ 21,690	$ 130,136
Deferred amount related to pension expense				
Difference in earnings, experience and allocation	331,644	941,575	-	1,273,219
Difference in contributions	709,268	760,330	709,268	760,330
Total	$ 1,192,738	$ 1,701,905	$ 730,958	$ 2,163,685

Deferred Inflows of Resources	June 30, 2016	Additions	Reductions	June 30, 2017
Deferred amount related to pension expense				
Difference in earnings & experience	$ 779,040	$ -	$ 247,239	$ 531,801
Total	$ 779,040	$ -	$ 247,239	$ 531,801

Deferred Inflows of Resources	June 30, 2015	Additions	Reductions	June 30, 2016
Deferred amount related to pension expense				
Difference in earnings & experience	$ 986,739	$ -	$ 207,699	$ 779,040
Total	$ 986,739	$ -	$ 207,699	$ 779,040

On September 7, 2012, the Commission refinanced the Series 2002 Revenue Bonds through the issuance of Series 2012 Revenue Refunding Bonds. The refunding created an economic gain of $506,622. As of June 30, 2012, the unamortized loss on the 2002 Revenue Bond was $723,516. The result of the refinance was a net economic gain of $216,894, which will be amortized over the life (10 years) of the new revenue bond.

The Commission adopted and implemented GASB Statement No. 68, *Accounting and Financial Reporting for Pensions* and GASB Statement No. 71, *Pension Transition for Contributions Made Subsequent to the Measurement Date*: an amendment to GASB Statement No. 68; which results in the recording of Deferred Outflows of Resources and Deferred Inflows of Resources related to pension expense. Additional details pertaining to net pension liability and expense can be found in Note 13.

NOTE 9 – NET POSITION

Net Position represents the difference between assets, deferred outflows, deferred inflows and liabilities. Net position amounts were as follows:

		June 30		
		2017		2016
Net Investment in Capital Assets				
Net property, plant and equipment		$ 332,782,906	$	313,352,602
Net debt, excluding proceeds not yet used for above assets				
Add:	Unspent Bond Proceeds	103,154,174		-
	Deferred amount on Bond Refunding	108,447		130,136
Less:	Revenue Bonds	(118,390,000)		(9,625,000)
	State Revolving Loan	(43,010,308)		(35,798,200)
	Direct Bank Loans	(27,514,138)		(28,995,567)
	Premium on Bond Refunding	(9,870,796)		(781,064)
	Capital related accounts and retainage payables	(5,458,797)		(5,856,539)
	Total	$ 231,801,488	$	232,426,368
Restricted For				
Capital Projects				
Restricted cash and investment		$ 30,626,762	$	25,391,122
Restricted receivables:		81,972		146,724
Less restricted assets related to debt service and restricted liabilities				
Debt service accounts, derived from revenues		(1,389,546)		(1,060,625)
Customer security and maintenance deposits		(3,940,582)		(2,988,820)
Unearned revenue, capacity fees and grants		(72,769)		(63,252)
Total Restricted for Capital Projects		$ 25,305,837	$	21,425,149
Debt Service:				
Restricted cash and investment for debt service		1,415,904		1,086,983
Less liabilities (related to expenses) applicable to restricted debt service assets:				
Accrued interest on deposits		(26,358)		(26,358)
Total Restricted for Debt Service		1,389,546		1,060,625
Total Restricted		$ 26,695,383	$	22,485,774
Unrestricted		27,277,914		14,558,025
Total Net Position		$ 285,774,785	$	269,470,167

NOTE 10 - LEASES

The Commission has entered into various leases to allow communication companies to install and operate cellular telephone towers on Commission land or on water towers or storage facilities. Lease revenues during 2017 and 2016 were approximately **$170,000** and $165,000, respectively. Future minimum lease revenues for the next six years are approximately $175,000, $180,000, $186,000, $191,000, $197,000 and $203,000. Leases are cancelable only as a result of certain licensing and regulatory change events, which are not expected, or at the end of subsequent five-year lease periods.

NOTE 11 - CONTRIBUTED CAPITAL

Following is a summary of capital contribution activity recorded in the Statements of Revenues, Expenses and Changes in Net Position:

	Year Ended June 30	
	2017	2016
Customers - Cash and Financed:		
Water Impact Fees	$ 1,949,497	$ 2,659,721
Wastewater Impact Fees	4,207,093	5,584,162
Total Customers - Cash and Financed	**$ 6,156,590**	**$ 8,243,883**
Developer Contributed Systems:		
Water	$ 2,851,776	$ 3,194,677
Wastewater, other than pump stations	2,856,366	4,231,036
Wastewater, pump stations	40,152	782,190
Developer Impact Fees	21,189	19,034
Total Developer Contributions	**$ 5,769,483**	**$ 8,226,937**
Total Capital Contributions	**$ 11,926,073**	**$ 16,470,820**

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NOTE 12 - EMPLOYEE BENEFIT PLANS

A. Other Postemployment Benefits (OPEB)

Plan Description

The Commission sponsors a single-employer defined benefit health care plan (the Plan) that provides postretirement health and dental insurance premium benefits for employees and Commissioners who have achieved twenty years of service with the Commission, retire under the South Carolina Retirement System (SCRS), have begun receiving SCRS benefits and have applied for and enrolled in all Medicare plans for which they are eligible. During fiscal year 2017, fifteen individuals met these eligibility requirements. Prior to fiscal year 2011, the Commission financed the plan on a pay-as-you-go basis. The Commission joined the South Carolina Other Retirement Benefits Employer Trust (SC ORBET), an agent multiple-employer investment plan administered by the Municipal Association of South Carolina. SC ORBET issues a publicly available financial report that includes financial statements and required supplementary information for the Plan. A copy of the report may be obtained through the Chief Financial Officer for Risk Management Services, Municipal Association of SC, Post Office Box 12109, Columbia, SC 29211.

Funding for OPEB

The Commission's annual other postemployment benefit (OPEB) cost (expense) is calculated based on the annual required contribution (ARC) of the employer, an amount actuarially determined in accordance with the parameters of GASB statement number 45. The ARC represents a level of funding that, if paid on an ongoing basis, is projected to cover normal costs each year and amortize any unfunded liabilities (UAAL) or funding excess over a period not to exceed 30 years. The ARC rate for fiscal year 2017 was **8.49%** of the annual covered payroll.

Annual OPEB Cost and Funding Status and Progress

For 2017, the Commission's annual OPEB cost (expense) was $547,473. The following table shows the components of the Commission's annual OPEB cost for the years ending June 30:

Annual Required Contribution (ARC)	FY2017	FY2016
Normal Costs	$ 299,146	$ 272,390
30 Year Amortization of Unfunded Accrued Liability (UAL)	244,092	229,242
Expenses	4,235	3,909
Total Annual Required Contribution	**$ 547,473**	**$ 505,541**
Contribution As A Percentage Of Expected Payroll	8.49%	8.49%
Contribution to SC ORBET Trust	$ 436,902	$ 421,523
Direct Premium Payment for Retirees	110,571	84,018
Total Contributions	**$ 547,473**	**$ 505,541**

Contributions made for fiscal year 2017 includes $436,902 made by the Commission to the Plan and $110,571 made by the Commission for retiree premiums.

NOTE 12 - EMPLOYEE BENEFIT PLANS (continued)

The Commission's annual OPEB cost, the percentage of annual OPEB cost contributed to the plan, and the net OPEB obligation were as follows:

Fiscal Year Ended	Annual OPEB Costs	Percentage Contributed
6/30/2015	$ 488,824	100%
6/30/2016	505,541	100%
6/30/2017	547,473	100%

OPEB Funding Status and Progress: - the funded status of the plan as of January 1, 2017, the most recent actuarial valuation date, was as follows:

Actuarial accrued liability (AAL)	$	11,454,685
Actuarial value of plan assets		(2,585,518)
Unfunded actuarial accrued liability (UAAL)	$	8,869,167
Funded ration (actuarial value of plan assets (AAL)		22.57%
Covered payroll (active plan members)	$	7,228,705
UAAL as a percentage of covered payroll		122.69%

Actuarial Methods and Assumptions

Actuarial valuations of an ongoing plan involve estimates of the value of reported amounts and assumptions about the probability of occurrence of events in the future. Examples include assumptions about future employment, mortality, and the healthcare cost trend. Amounts determined regarding the funded status of the plan and the annual required contributions of the employer are subject to continual revision as actual results are compared with past expectations and new estimates are made about the future.

The amount of funding is based on an actuarial valuation based on the population of the existing employee base to include demographics, further employment, age of the population, length of service, mortality and healthcare cost and trends. The actuarial valuations will be performed every other year to ensure an adequate contribution to the plan. The actuarial methods and assumptions used are designed to reduce short-term volatility in actuarial accrued liabilities and the actuarial value of assets, consistent with the long-term perspective of the calculations.

In the January 1, 2017 actuarial valuation, the entry age normal method was used. The actuarial assumption used a 4.75% investment rate of return (net of administrative and investment related expenses), which is a blended rate of the expected long-term investment returns on the plan assets and on the employer's own investments calculated based on the funded level of the plan at the valuation date, and an ultimate medical cost trend rate of 5.0%. The actuarial valuation assumes a 2.75% inflation rate and a 3.0% payroll growth rate. The schedule of funding progress – other postemployment benefits is presented as required supplementary information following the notes to the financial statements.

NOTE 12 - EMPLOYEE BENEFIT PLANS (continued)

Valuation Date:	January 1, 2017
Actuarial Cost Method:	Entry Age Normal
Amortization Method:	Level Percent of pay, closed
Remaining Amortization Period	30 Years
Asset Valuation Method:	5-Year Smoothed Market Value
	80% to 120% Corridor
Actuarial Assumptions:	
Investment Rate of Return	4.75%
Medical Cost Trend Rate	
Pre-Medicare Trend Rate	7.50% - 5.00%
Post-Medicare Trend Rate	5.50% - 5.00%
Ultimate Trend Rate	5.00%
Year of Ultimate Trend Rate	2023
Inflation Rate:	2.75% per year
Payroll Growth:	3.00% per year

B. Deferred Compensation Plan - The Commission has two approved deferred compensation plans under either Internal Revenue Service Section 401(K) or 457, in which employees may elect to participate. Both plans are administered by the South Carolina Public Employees Deferred Compensation Commission.

C. Termination Benefits – No termination benefits have been established.

D. TERI Program - Employees eligible for service retirement may participate in the Teacher and Retiree Incentive Program (TERI). TERI participants may retire and begin accumulating retirement benefits on a deferred basis without terminating employment for up to five years. Upon termination of employment or at the end of the TERI period, whichever is earlier, participants will begin receiving monthly service retirement benefits which will include any cost of living adjustments granted during the TERI period. TERI participants who entered the program after July 1, 2005 are required to pay the same pre-tax contribution to the SCRS during the TERI period and they do not earn service credit.

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NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE

Description of the Entity

The South Carolina Public Employee Benefit Authority (PEBA), which was created July 1, 2012, administers the various retirement systems and retirement programs managed by its Retirement Division. PEBA has an 11-member Board of Directors, appointed by the Governor and General Assembly leadership, which serves as co-trustee and co-fiduciary of the systems and the trust funds. By law, the Budget and Control Board (State Fiscal Accountability Authority effective July 1, 2015), which consists of five elected officials, also reviews certain PEBA Board decisions regarding the funding of the South Carolina Retirement Systems (Systems) and serves as a co-trustee of the Systems in conducting that review.

For purposes of measuring the net pension liability, deferred outflows and inflows of resources related to pensions, and pension expense, information about the fiduciary net position of the Systems and additions to/deductions from the Systems fiduciary net position have been determined on the accrual basis of accounting as they are reported by the Systems in accordance with generally accepted accounting principles (GAAP). For this purpose, revenues are recognized when earned and expenses are recognized when incurred. Benefit and refund expenses are recognized when due and payable in accordance with the terms of the plan. Investments are reported at fair value.

PEBA issues a Comprehensive Annual Financial Report (CAFR) containing financial statements and required supplementary information for the Systems' Pension Trust Funds. The CAFR is publicly available through the Retirement Benefits' link on PEBA's website at **www.peba.sc.gov**, or a copy may be obtained by submitting a request to PEBA, 202 Arbor Lake Drie, Columbia, SC 29223. PEBA is considered a division of the primary government of the state of South Carolina and therefore, retirement trust fund financial information is also included in the comprehensive annual financial report of the state.

Plan Description

The South Carolina Retirement System (SCRS), a cost–sharing multiple-employer defined benefit pension plan, was established effective July 1, 1945, pursuant to the provisions of Section 9-1-20 of the South Carolina Code of Laws for the purpose of providing retirement allowances and other benefits for employees of the state, its public school districts, and political subdivisions.

Membership

Membership requirements are prescribed in Title 9 of the South Carolina Code of Laws. A brief summary of the requirements under each system is presented below.

> SCRS - Generally, all employees of covered employers are required to participate in and contribute to the system as a condition of employment. This plan covers general employees and teachers and individuals newly elected to the South Carolina General Assembly beginning with the November 2012 general election. An employee member of the system with an effective date of membership prior to July 1, 2012, is a Class Two member. An employee member of the system with an effective date of membership on or after July 1, 2012, is a Class Three member.

Benefits

Benefit terms are prescribed in Title 9 of the South Carolina Code of Laws. PEBA does not have the authority to establish or amend benefit terms without a legislative change in the code of laws. Key elements of the benefit calculation include the benefit multiplier, years of service, and average final compensation. A brief summary of the benefit terms for each system is presented below.

SCRS - A Class Two member who has separated from service with at least five or more years of earned service is eligible for a monthly pension at age 65 or with 28 years credited service regardless of age. A member may elect early retirement with reduced pension benefits payable at age 55 with 25 years of service credit. A Class Three member who has separated from service with at least eight or more years of earned service is eligible for a monthly pension upon satisfying the Rule of 90 requirements that the total of the member's age and the member's creditable service equals at least 90 years. Both Class Two and Class Three members are eligible to receive a reduced deferred annuity at age 60 if they satisfy the five- or eight-year earned service requirement, respectively. An incidental death benefit is also available to beneficiaries of active and retired members of employers who participate in the death benefit program.

NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE (continued)

The annual retirement allowance of eligible retirees or their surviving annuitants is increased by the lesser of one percent or five hundred dollars every July 1. Only those annuitants in receipt of a benefit on July 1 of the preceding year are eligible to receive the increase. Members who retire under the early retirement provisions at age 55 with 25 years of service are not eligible for the benefit adjustment until the second July 1 after reaching age 60 or the second July 1 after the date they would have had 28 years of service credit had they not retired.

Contributions

Contributions are prescribed in Title 9 of the South Carolina Code of Laws. Upon recommendation by the actuary in the annual actuarial valuation, the PEBA Board may adopt and present to the Budget and Control Board for approval an increase in the SCRS employer and employee contribution rates, but any such increase may not result in a differential between the employee and total employer contribution rate that exceeds 2.9 percent of earnable compensation for SCRS. An increase in the contribution rates adopted by the Board may not provide for an increase of more than one-half of one percent in any one year. If the scheduled employee and employer contributions provided in statute or the rates last adopted by the Board are insufficient to maintain a thirty-year amortization schedule of the unfunded liabilities of the plans, the Board shall increase the contribution rates in equal percentage amounts for the employer and employee as necessary to maintain the thirty-year amortization period; and, this increase is not limited to one-half of one percent per year.

Required employee contribution rates[1] are as follows:

	Fiscal Year 2017	Fiscal Year 2016
SCRS		
Employee Class Two	8.66%	8.16%
Employee Class Three	8.66%	8.16%

Required employer contribution rates[1] are as follows:

SCRS		
Employer Class Two	11.41%	10.91%
Employer Class Three	11.41%	10.91%
Employer Incidental Death Benefit	0.15%	0.15%

[1] *Calculated on earnable compensation as defined in Title 9 of the South Carolina Code of Laws.*

Actuarial Assumptions and Methods

Actuarial valuations involve estimates of the reported amounts and assumptions about the probability of occurrence of events far into the future. Examples include assumptions about future employment, mortality, and future salary increases. Actuarial assumptions and methods used during the annual valuation process are subject to periodic revision, typically with an experience study, as actual results over an extended period of time are compared with past expectations and new estimates are made about the future.

South Carolina state statute requires that an actuarial experience study be completed at least once in each five-year period. An experience report on the Systems was most recently issued as of July 1, 2015. The June 30, 2106, total pension liability, net pension liability, and sensitivity information were determined by the Systems' consulting actuary, Gabriel, Roeder, Smith and Company (GRS) and are based on the July 1, 2015, actuarial valuations, as adopted by the PEBA Board and SFAA which utilized membership data as of July 1, 2015. The total pension liability was rolled-forward from the valuation date to the Systems' fiscal year ended June 30, 2016, using generally accepted actuarial principles. Information included in the following schedules is based on the certification provided by GRS.

NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE (continued)

The following provides a summary of the actuarial assumptions and methods used in the July 1, 2015, valuations for SCRS.

South Carolina Retirement System	
Actuarial cost method	Entry age normal
Actuarial assumptions:	
Investment rate of return	7.50%
Projected salary increases	3.5% to 12.5% (varies by service)
Includes inflation	2.75%
Benefit adjustments	lesser of 1% or $500

The post-retiree mortality assumption is dependent upon the member's job category and gender. This assumption includes base rates which are automatically adjusted for future improvement in mortality using published Scale AA projected from the year 2000. Assumptions used in the July 1, 2015, valuations for SCRS.

Former Job Class	Males	Females
Educators and Judges	RP-2000 Males (with White Collar adjustment) multiplied by 110%	RP-2000 Females (with White Collar adjustment) multiplied by 95%
General Employees and Members of the General Assembly	RP-2000 Males multiplied by 100%	RP-2000 Females multiplied by 90%
Public Safety, Firefighters and members of the South Carolina National Guard	RP-2000 Males (with Blue Collar adjustment) multiplied by 115%	RP-2000 Females (with Blue Collar adjustment) multiplied by 115%

Net Pension Liability

The net pension liability (NPL) is calculated separately for each system and represents that particular system's total pension liability determined in accordance with GASB No. 67 less that System's fiduciary net position. NPL totals, as of June 30, 2016, for SCRS are presented below.

System	Total Pension Liability	Plan Fiduciary Net Position	Employers' Net Pension Liability (Asset)	Plan Fiduciary Net Position as a Percentage of the Total Pension Liability
South Carolina Retirement System	$ 45,356,214,752	$ 23,996,360,354	$ 21,359,854,398	52.91%
Commission's Share (0.07101%)	$32,206,086	$17,039,096	$15,166,990	52.91%

The total pension liability is calculated by the Systems' actuary, and each plan's fiduciary net position is reported in the Systems' financial statements. The net pension liability is disclosed in accordance with the requirements of GASB 67 in the Systems' notes to the financial statements and required supplementary information. Liability calculations performed by the Systems' actuary for the purpose of satisfying the requirements of GASB Nos. 67 and 68 are not applicable for other purposes, such as determining the plans' funding requirements.

NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE (continued)

Change in the Net Pension Liability	South Carolina Retirement System	Commission's Share
Service Cost	$ 763,357,253	$ 542,037
Interest	3,231,571,484	2,294,642
Benefit Changes	-	-
Difference between actual and expected experience	46,713,913	33,170
Assumption Changes	-	-
Benefit Payments	(2,782,738,128)	(1,975,939)
Net Change in Total Pension Liability	1,258,904,522	893,910
Total Pension Liability – Beginning 06/30/2015	44,097,310,230	31,312,176
Total Pension Liability - Ending 06/30/2016 (a)	45,356,214,752	32,206,086
Contributions - Employer	1,072,659,190	761,663
Contributions - Member	754,152,784	535,501
Refunds of contributions to members	(93,694,477)	(66,530)
Retirement benefits	(2,668,384,443)	(1,894,740)
Death benefits	(20,659,208)	(14,669)
Net Investment Income	(165,393,807)	(117,441)
Administrative Expense	(13,149,023)	(9,337)
Net transfers to affiliated systems	(996,763)	(708)
Other	-	-
Net Change in Plan Fiduciary Net Position	(1,135,465,747)	(806,260)
Plan Fiduciary Net Position – Beginning 06/30/2015	25,131,826,101	17,845,356
Plan Fiduciary Net Position – Ending 06/30/2016 (b)	23,996,360,354	17,039,096
Net Pension Liability 06/30/2016 (a) - (b)	**$ 21,359,854,398**	**$ 15,166,990**

The Commission's share is .07101%

Long-term Expected Rate of Return

The long-term expected rate of return on pension plan investments, as used in the July 1, 2015, actuarial valuations, was based upon the 30-year capital market outlook at the end of the third quarter 2015. The long-term expected rate of returns represent assumptions developed using an arithmetic building block approach primarily based on consensus expectations and market based inputs. Expected returns are net of investment fees.

The expected returns, along with the expected inflation rate, form the basis for the target asset allocation adopted beginning January 1, 2016. The long-term expected rate of return is produced by weighting the expected future real rates of return by the target allocation percentage and adding expected inflation and is summarized in the table on the following page. For actuarial purposes, the 7.50 percent assumed annual investment rates used in the calculation of the total pension liability includes a 4.75 percent real rate of return and a 2.75 percent inflation component.

NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE (continued)

Asset Class	Target Asset Allocation	Expected Arithmetic Real Rate of Return	Long Term Expected Portfolio Real Rate of Return
Global Equity	**43.0%**		
Global Public Entity	34.0%	6.52%	2.22%
Private Equity	9.0%	9.30%	0.84%
Real Assets	**8.0%**		
Real Estate	5.0%	4.32%	0.22%
Commodities	3.0%	4.53%	0.14%
Opportunistic	**20.0%**		
GTAA/Risk Parity	10.0%	3.90%	0.39%
HF (Low Beta)	10.0%	3.87%	0.39%
Diversified Credit	**17.0%**		
Mixed Credit	5.0%	3.52%	0.18%
Emerging Markets Debts	5.0%	4.91%	0.25%
Private Debt	7.0%	4.47%	0.31%
Conservative Fixed Income	**12.0%**		
Core Fixed Income	10.0%	1.72%	0.17%
Cash and Short Duration (Net)	2.0%	0.71%	0.01%
Total Expected Return Rate	100%		5.10%
Inflation for Actuarial Purposes			2.75%
Total Expected Normal Return			7.85%

Discount Rate
The discount rate used to measure the total pension liability was 7.50 percent. The projection of cash flows used to determine the discount rate assumed that the funding policy specified in the South Carolina State Code of Laws will remain unchanged in future years. Based on those assumptions, each System's fiduciary net position was projected to be available to make all projected future benefit payments of current plan members. Therefore, the long-term expected rate of return on pension plan investments was applied to all periods of projected benefit payments to determine the total pension liability.

Sensitivity Analysis
The following table presents the collective net pension liability of the participating employers calculated using the discount rate of 7.50 percent, as well as what the employers' net pension liability would be if it were calculated using a discount rate that is 1.00 percent lower (6.50 percent) or 1.00 percent higher (8.50 percent) than the current rate.

Sensitivity of the Net Pension Liability to Changes in the Discount Rate			
System	1.00% Decrease 6.50%	Current Discount Rate 7.50%	1.00% Increase 8.50%
South Carolina Retirement System	**$ 23,910,053,704**	**$ 21,359,854,398**	**$ 14,821,302,520**
Commission's Share (0.07101%)	**$ 16,977,812**	**$ 15,166,990**	**$ 10,524,162**

NOTE 13 – NET PENSION LIABLITY, DEFERRED OUTFLOWS OF RESOURCE AND INFLOWS OF RESOURCES, AND PENSION EXPENSE (continued)

Pension Expense and Changes in Deferred Outflows and Inflows of Resources

For the year ended June 30, 2017, the Commission recognized pension expense of $1,486,752. At June 30, 2017 the Commission reported deferred outflows of resources and deferred inflows of resources related to pension from the following sources:

	Deferred Outflows of Resources	*Deferred Inflows of Resources*
Difference between expected and actual experience	$ 157,224	$ 16,471
Net difference between projected and actual earning on pension plan investments	1,791,362	515,330
Change in proporation and difference between Employer's contributions and share of total plan contributions	358,508	-
Commission contributions subsequent to the measurement date	850,079	-
Total	$ 3,157,173	$ 531,801

The $850,079 reported as deferred outflows of resources related to pensions resulting from Commission contributions subsequent to the measurement date will be recognized as a reduction of the net pension liability in the year ended June 30, 2018. Other amounts recorded as deferred outflows of resources and deferred inflows of resources will be recognized in pension expense as follows:

Year Ending June 30,	*Amount*
2018	$ 485,674
2019	$ 403,492
2020	$ 590,828
2021	$ 295,299

Additional Financial and Actuarial Information

Detailed information regarding the fiduciary net position of the plans administered by PEBA is available in the Systems' audited financial statements for the fiscal year ended June 30, 2016 (including the unmodified audit opinion on the financial statements) is publicly available through the Retirement Benefits' link on PEBA's website at **www.peba.sc.gov**. Additional actuarial information is available in the accounting and financial reporting actuarial valuation as of June 30, 2016.

NOTE 14 - COMPENSATED ABSENCES

Commission employees are provided paid annual leave which accrues each pay period based on years of service. The total accrued leave cannot exceed 360 hours. Employees have the opportunity to sell back annual leave hours (once per calendar year), provided they have taken at least (40) hours of leave in the last (12) months and have (40) hours of accrued annual leave remaining after the sell back.

Commission employees accrue six (6) hours of sick leave for each calendar month of continuous service and can accrue up to a maximum of 1,440 hours. Upon termination, employees with 5-19 years of continuous service are paid one week (40 hours) of sick leave. Employees with 20 plus years of continuous service are paid two weeks (80 hours) of sick leave at the time of termination. Also upon termination, Commission employees are paid for all accrued unused annual leave.

	FY 2017	FY 2016
Annual Leave	$ 636,419	$ 535,453
Sick Leave	120,051	117,231
Total	$ 756,470	$ 652,684

NOTE 15 - CUSTOMER SECURITY DEPOSITS

The Commission in July 2010, fiscal year 2011, amended its security deposit policy in order to reduce the bad debt expense to include restrictions on the refunding of deposits. Homeowners will be eligible for a refund of their security deposit provided there are no delinquencies or returned payments over a consecutive 12-month period. Residential renter's security deposits will be credited to their final bills. Commercial accounts can request a reduction in their deposit to twice their monthly average bill provided there are no delinquencies or return payments. The Commission during fiscal year 2014 implemented an automatic refund process for homeowners with no delinquencies. Refunds of security deposits are credited to current and final bills. The increase during fiscal year 2017 is the result of new customers added to the system.

	FY 2017	FY 2016
Security Deposits	$ 1,208,366	$ 1,131,443
Percent Increase	7%	14%

NOTE 16 - MAINTENANCE BONDS ESCROW

The Commission requires developers to post escrow bonds to provide readily available funds, which the Commission may draw to make corrections to system deficiencies in the event the Developer fails to comply with the Commission's standard water and/or wastewater contract. The escrow, less any cost of repairs or system deficiencies, is refunded 24-months after issuance of the South Carolina Department of Health operating permits. The increase during fiscal year 2017 is due to the increase in developer activity.

	FY 2017	FY 2016
Maintenance Bonds	$ 2,043,724	$ 1,394,042
Percent Increase	47%	27%

NOTE 17 - COMMITMENTS AND CONTINGENCIES

Construction Contracts - In the normal course of business, the Commission enters into agreements with contractors and consultants for the construction and expansion of the system. At June 30, 2017 and 2016, open contracts and obligations for construction approximated **$16.9 million** and $11.1 million, respectively.

The following schedule details the contract commitments broken down by asset class.

Asset Class	FY 2017	FY 2016
Wastewater Treatment	$ 6,211,285	$ 661,106
Wastewater Collection	4,949,573	7,521,529
Water Distribution	3,245,462	2,281,022
Utility Relocation	751,145	7,378
Water Treatment	695,920	
Water Supply/Storage	583,128	92,000
Administrative	520,658	581,715
Total	$ 16,957,171	$ 11,144,750

NOTE 18 - RELATED PARTY TRANSACTIONS

The Commission incurred expenses to the Town of Mount Pleasant of approximately **$371,000** and $325,000 during fiscal years 2017 and 2016, respectively, for payments in lieu of taxes and for various economic development and other supporting services. The Commission will continue to incur expenses to include payments in lieu of taxes calculated at 1% of water and wastewater volumetric sales and basic facility charges.

The Commission provides water and wastewater services to the Town of Mount Pleasant at rates which are nonstandard. The Town does not pay water or wastewater impact fees. During fiscal years 2017 and 2016, the Commission billed the Town approximately **$413,000** and $325,000, respectively, for water and wastewater services. As of June 30, 2017 and 2016, approximately **$4,448** and $4,147 were due or receivable for these services, respectively.

Related Party Transactions	FY 2017	FY 2016
Payment in lieu of Taxes	$ 370,000	$ 325,000
Billed to Town	413,000	325,000
Receivable from Town	4,448	4,147

NOTE 19 - RISK MANAGEMENT

The Commission is exposed to various risks of loss relating to torts; theft of, damage to, and destruction of assets; errors and omissions and natural disasters. To insure against casualty risks the Commission is a member of the State of South Carolina Insurance Reserve Fund, a public entity risk pool currently operating as a common risk management insurance program for local governments in South Carolina. The Commission pays annual premiums to the State Insurance Reserve Fund for its general insurance. The State Insurance Reserve Fund is self-sustaining through member premiums and reinsures through commercial companies for certain claims. The Commission acquires insurance from the State Accident Fund for job related injury and illness (workers' compensation) to its employees.

The Commission incurred no significant uninsured claims during fiscal years 2017 and 2016. There was no liability or expense recorded for other actual claims, and management does not believe any provision for unasserted claims is necessary. Settled claims have not exceeded coverage in any of the last three years. There were no significant reductions in coverage compared to the prior year.

Self-Insurance Health Plan

The Commission on July 1, 2011 established a partial self-insurance program for medical and dental coverage for Commission employees. The Commission has contracted with a plan administrator that directly handles the settlement of all claims. The Commission's health plan has an individual stop loss insurance amount of $75,000 and carries an aggregate stop loss of $1.2 million. The Commission established and funded a liability reserve account during Fiscal Year 2012 for claims carried forward into future fiscal periods that is recorded in the financial statement as a component of accrued compensation and benefits.

Changes in the reported health liabilities as of June 30, 2017:

Fiscal Year Ending	Beginning of Fiscal Year Liability	Claims, Administrative Costs, and Changes in Estimates	Claims, Administrative Payments	End of Fiscal Year Liability
June 30, 2017	$ 95,521	$ 2,135,772	$ 1,939,777	$ 291,516
June 30, 2016	$ 206,711	$ 1,971,141	$ 2,082,331	$ 95,521

During fiscal year 2017, the Commission incurred one claims in excess of the $75,000 individual stop loss, which as of June 30, 2017 remained unsettled.

NOTE 20 - CLAIMS

During fiscal year 2017, the Commission did not experience any uninsured claims. Accordingly, there was no liability or expense recorded for other actual claims and management does not believe any provision for unasserted claims is necessary. The Commission is party to various legal proceedings that normally occur in Commission operations. Management believes the legal proceedings are not likely to have a material adverse effect on the Commission's financial position.

Mount Pleasant Waterworks Moves to Advance Metering Infrastructure (AMI)

Mount Pleasant Waterworks (MPW) after an evaluation and pilot program determined that the newer more advanced technology would better benefit both customers and the utility. The new AMI (advanced metering infrastructure) system will replaced the current AMR (automatic meter reading) system. The AMR system requires the meters to be read through a radio frequency signal as a meter reading vehicle passes by each meter. The new AMI system will enable a two-way communication from the meter through three antennas strategically placed in the Commission's service area to MPW using "smart meters". The new system will provide better data, enhanced leak detection and improve the timing of the meter reading and billing.

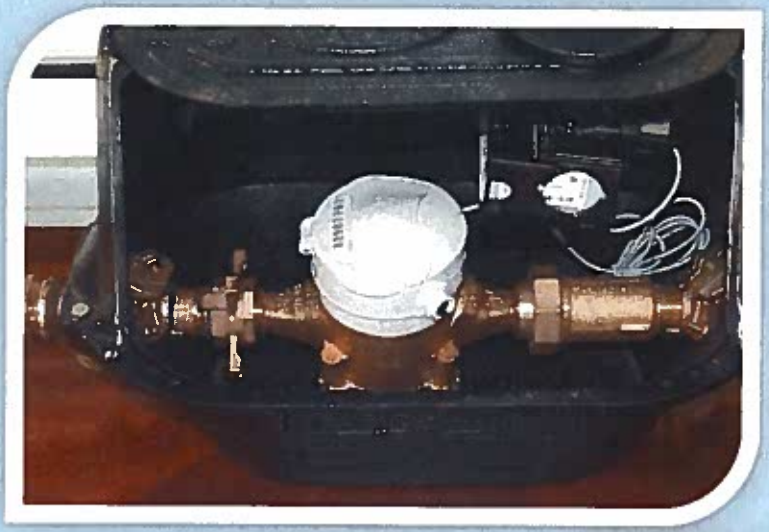
Benefits to the Customer

- track consumption (hourly reading available)
- advanced leak detection
- higher reliability due to timely readings
- closer meter reading and billing data
- problem solving capability and
- improved customer engagement and service

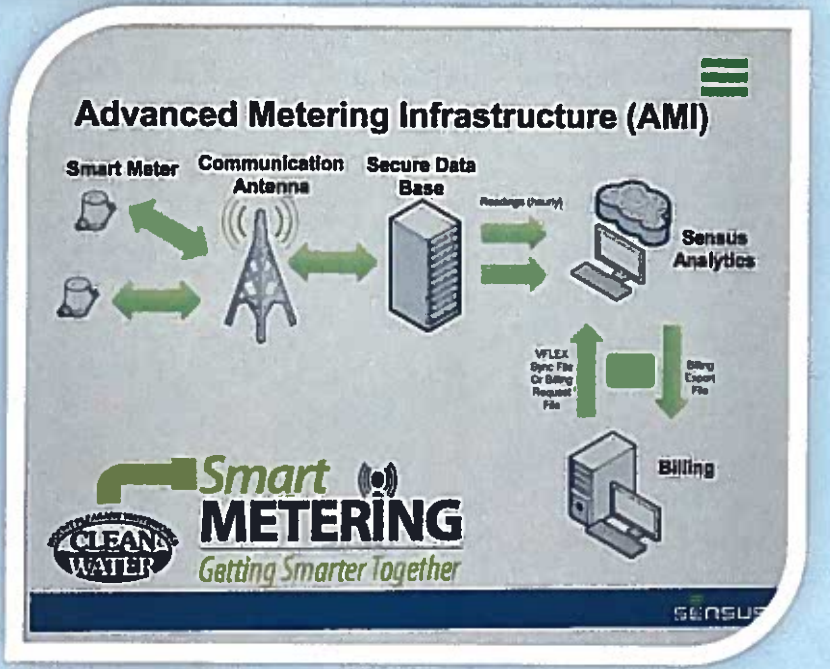
Benefits to Mount Pleasant Waterworks

- improve customer relationship
- improve billing efficiency
- improve operations
- reduction of labor costs and operating costs
- improve non-revenue water analysis
- improve workforce management and
- reduce the Commission's carbon footprint

The $15 million-dollar project will replace approximately 38.000 AMR meters over the next three years.



AMI Sensus Meter



EXCELLENCE IN ALL WE DO

Develop and maintain a passion for the continuous improvement and impression that will propel Smart Metering into a long-term, upward spiral of accomplishment and performance!

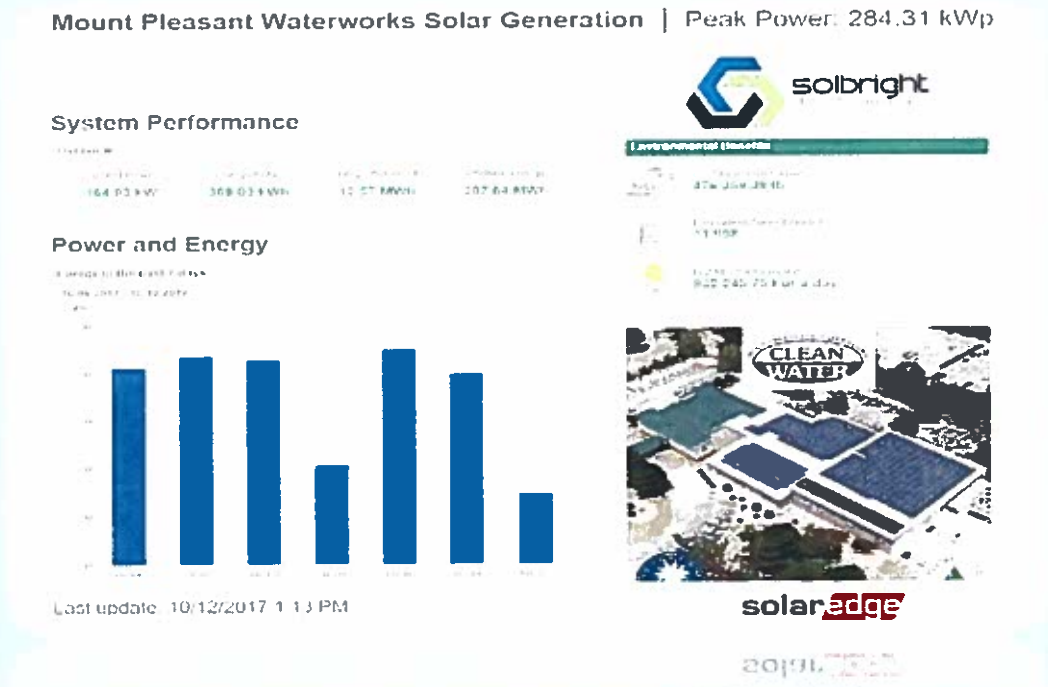
MOUNT PLEASANT WATERWORKS
CLEAN WATER

Mount Pleasant Waterworks Goes Solar

Mount Pleasant Waterworks took advantage of the rooftop of its administrative building on Rifle Range Road to install solar panels. The 284-kW DC Solar Project will generate 382,900 kWh in its first year. This is enough energy to energize 28 homes for a year and removes 269 metric tons of carbon from the atmosphere.

Mount Pleasant Waterworks will reduce energy cost by $52,000 annually. This will provide a 9-year payback and an estimated total savings of $832,000.

Performance of the solar system. Display located in the Commission's Lobby.



Supplementary Information

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- Other Supplementary Information
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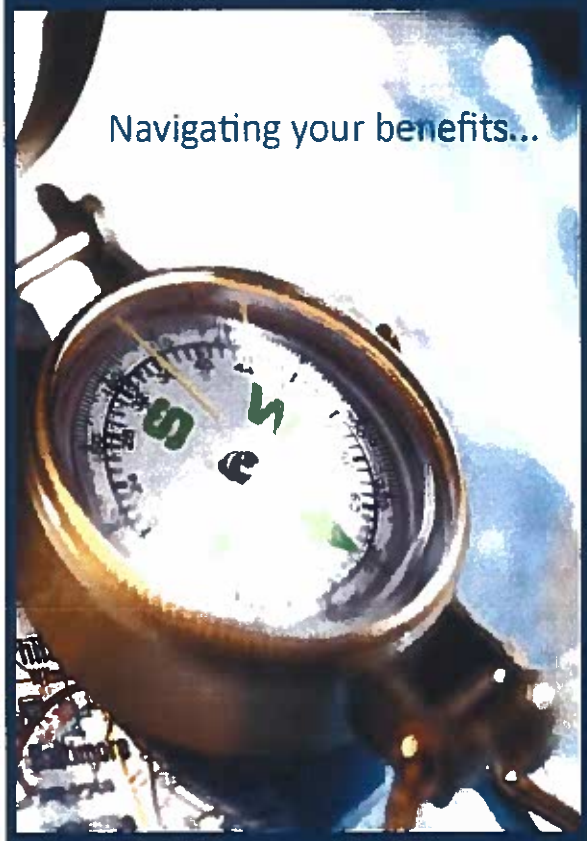
  - Capital Assets by Function and Type

MOUNT PLEASANT WATERWORKS

Employee Benefits Guide



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Other Postemployment Benefits – Defined Benefit Health Care Plan
Schedule of Funding Progress and Employer Contributions
Year Ended June 30, 2017

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (b)	Unfunded Actuarial Accrued Liability (b - a)	Funded Payroll (a/b)	Covered Payroll (c)	Unfunded Actuarial Accrued Liability as a Percentage of Covered Payroll ((b-a)/ c)
July 1, 2011	$ 878,526	$ 3,179,452	$ 2,300,926	27.63%	$ 5,620,591	40.94%
July 1, 2013	1,405,582	5,730,974	4,325,392	24.53%	5,760,446	75.09%
July 1, 2015	2,108,403	6,578,050	4,469,647	32.05%	6,859,166	65.16%
January 1, 2017	2,585,518	11,454,685	8,869,167	22.57%	7,228,705	122.69%

Fiscal Year Ended	Annual OPEB Costs	Percentage Contributed	Net Obligation
6/30/2015	$ 488,824	100%	-
6/30/2016	505,541	100%	-
6/30/2017	547,473	100%	-

The South Carolina Public Employee Benefit Authority (PEBA)

https://www.peba.sc.gov/retirement.html

Schedule of the Employer's Proportionate Share of the Net Pension Liability

	FY2015	FY2016	FY2017
Employer's proportion of the net pension liability (assets)	0.067981%	0.069400%	0.071007%
Employer's proportionate share of the net pension liability	$ 11,704,074	$ 13,162,045	$ 15,166,990
Employer's covered payroll	6,507,048	6,874,590	7,353,621
Employer's proportionate share of the net pension liability (assets) as a percentage of its covered payroll	179.87%	191.46%	206.25%
Plan fiduciary net position as a percentage of the total pension liability	59.90%	56.99%	52.91%

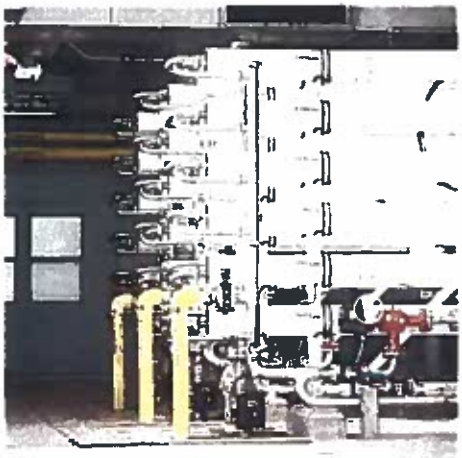
Schedule of Employer's Pension Contribution

Fiscal Year	Actuarial required contributions	Actual contributions	Contribution deficiency (excess)	Employer's covered payroll	Contribution as a percentage of covered payroll
2008	$ 542,263	(542,263)	$ -	$ 5,887,762	9.21%
2009	579,979	(579,979)	-	6,176,561	9.39%
2010	545,655	(545,655)	-	5,811,022	9.39%
2011	534,472	(534,472)	-	5,691,925	9.39%
2012	577,995	(577,995)	-	6,061,821	9.54%
2013	643,421	(643,421)	-	6,070,008	10.60%
2014	654,209	(654,209)	-	6,171,784	10.60%
2015	709,268	(709,268)	-	6,507,048	10.90%
2016	760,330	(760,330)	-	6,874,590	11.06%
2017	850,079	(850,079)	-	7,353,621	11.56%

MOUNT PLEASANT WATERWORKS

ANNUAL BUDGET DOCUMENT

Fiscal Year 2018



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About Us – Financial Information

Schedule of Departmental Operating (O&M) Expenses
Excluding Depreciation, Amortization and Non-Operating Expenses

		Year Ended June 30	
		2017	2016
Administration			
	Personnel services	$ 560,646	$ 524,890
	Contractual services	99,940	62,705
	Supplies and materials	5,572	3,678
	Business and travel expenses	108,093	116,007
	Capital expenditures	-	-
	Other expenses	409,744	359,597
Total Administration		**$ 1,183,995**	**$ 1,066,877**
Human Resources			
	Personnel services	$ 454,966	$ 393,102
	Contractual services	67,707	94,377
	Supplies and materials	5,875	5,586
	Business and travel expenses	6,653	8,406
	Capital expenditures	-	-
	Other expenses	14,747	4,269
Total Human Resources		**$ 549,948**	**$ 505,740**
Customer Communication			
	Personnel services	$ 932,540	$ 905,750
	Contractual services	166,634	205,764
	Supplies and materials	19,301	17,046
	Business and travel expenses	24,783	26,678
	Capital expenditures	-	-
	Other expenses	84,291	136,189
Total Customer Communications		**$ 1,227,549**	**$ 1,291,427**
Billing			
	Personnel services	$ 239,628	$ 224,796
	Contractual services	144,269	152,046
	Supplies and materials	3,906	40,869
	Business and travel expenses	-	2,159
	Capital expenditures	-	-
	Other expenses	-	-
Total Billing		**$ 387,803**	**$ 419,870**
Smart Meters			
	Personnel services	$ 406,040	$ 313,061
	Contractual services	44,830	41,363
	Supplies and materials	29,997	49,550
	Business and travel expenses	10,989	2,332
	Capital expenditures	-	-
	Other expenses	94	-
Total Smart Meters		**$ 491,950**	**$ 406,306**
Engineering			
	Personnel services	$ 684,241	$ 620,855
	Contractual services	388,675	345,790
	Supplies and materials	39,861	15,130
	Business and travel expenses	30,043	19,561
	Capital expenditures	891,474	238,143
	Other expenses	12,284	1,412
Total Engineering		**$ 2,046,578**	**$ 1,240,891**

Schedule of Departmental Operating (O&M) Expenses
Excluding Depreciation, Amortization and Non-Operating Expenses

		Year Ended June 30	
		2017	2016
Accounting			
	Personnel services	$ 1,307,099	$ 1,133,862
	Contractual services	185,573	199,442
	Supplies and materials	19,599	11,384
	Business and travel expenses	20,908	14,759
	Capital expenditures	2,927	12,715
	Other expenses	8,458	2,362
Total Accounting		**$ 1,544,564**	**$ 1,374,524**
Technical Services			
	Personnel services	$ 252,666	$ 158,298
	Contractual services	8,254	8,750
	Supplies and materials	3,860	1,218
	Business and travel expenses	19,621	6,907
	Capital expenditures	1,677	13,691
	Other expenses	-	-
Total Technical Services		**$ 286,078**	**$ 188,864**
IT & Records Management			
	Personnel services	$ 375,709	$ 368,763
	Contractual services	202,949	236,513
	Supplies and materials	12,094	18,838
	Business and travel expenses	6,316	3,684
	Capital expenditures	-	-
	Other expenses	-	-
Total It & Records Managements		**$ 597,068**	**$ 627,798**
Asset Management			
	Personnel services	$ 232,707	$ 236,767
	Contractual services	26,203	32,886
	Supplies and materials	5,174	7,921
	Business and travel expenses	11,363	13,564
	Capital expenditures	-	-
	Other expenses	-	-
Total Asset Management		**$ 275,447**	**$ 291,138**
Dispatch			
	Personnel services	$ 157,802	$ 172,586
	Contractual services	15,112	15,685
	Supplies and materials	8,638	7,171
	Business and travel expenses	-	-
	Capital expenditures	-	-
	Other expenses	-	-
Total Dispatch		**$ 181,552**	**$ 195,442**
Facilities			
	Personnel services	$ 175,140	$ 200,642
	Contractual services	208,103	256,241
	Supplies and materials	50,252	39,070
	Business and travel expenses	1,998	1,728
	Capital expenditures	-	27,666
	Other expenses	-	-
Total Facilities Services		**$ 435,493**	**$ 525,347**

Schedule of Departmental Operating (O&M) Expenses
Excluding Depreciation, Amortization and Non-Operating Expenses

		Year Ended June 30	
		2017	2016
Special Programs			
	Personnel services	$ 47,462	$ 61,300
	Contractual services	61	9,575
	Supplies and materials	3,389	2,218
	Business and travel expenses	-	-
	Capital expenditures	-	-
	Other expenses	-	-
Total Special Programs		**$ 50,912**	**$ 73,093**
Safety & Security			
	Personnel services	$ 46,218	$ -
	Contractual services	9,580	-
	Supplies and materials	821	-
	Business and travel expenses	1,275	-
	Capital expenditures	-	-
	Other expenses	-	-
Total Safety & Security		**$ 57,894**	**$ -**
Operations			
	Personnel services	$ 180,394	$ 181,014
	Contractual services	2,486	1,816
	Supplies and materials	4,561	1,102
	Business and travel expenses	5,016	1,214
	Capital expenditures	-	-
	Other expenses	-	-
Total Operations Management		**$ 192,457**	**$ 185,146**
Water Treatment			
	Personnel services	$ 447,022	$ 423,214
	Contractual services	2,561,082	2,226,325
	Supplies and materials	367,713	270,971
	Business and travel expenses	210	2,934
	Capital expenditures	-	144,795
	Other expenses	53,696	45,051
Total Water Treatment		**$ 3,429,723**	**$ 3,113,290**
Wastewater Plant Ops			
	Personnel services	$ 791,964	$ 688,968
	Contractual services	7,406	-
	Supplies and materials	5,231	-
	Business and travel expenses	12,393	12,665
	Capital expenditures	-	-
	Other expenses	(1,344)	-
Total Wastewater Admin. And Support		**$ 815,650**	**$ 701,633**
Center Street WWTP			
	Personnel services	$ -	$ 9,796
	Contractual services	561,190	528,215
	Supplies and materials	90,677	98,843
	Business and travel expenses	-	-
	Capital expenditures	-	150,405
	Other expenses	3,402	5,942
Total Center Street WWTP		**$ 655,269**	**$ 793,201**

Schedule of Departmental Operating (O&M) Expenses
Excluding Depreciation, Amortization and Non-Operating Expenses

	Year Ended June 30	
	2017	2016
Rifle Range Road WWTP		
Personnel services	$ -	$ 6,591
Contractual services	1,108,212	1,045,856
Supplies and materials	127,094	128,358
Business and travel expenses	-	-
Capital expenditures	-	-
Other expenses	5,804	4,505
Total Rifle Range Road WWTP	**$ 1,241,110**	**$ 1,185,310**
Laboratory		
Personnel services	$ 357,572	$ 342,749
Contractual services	31,053	38,044
Supplies and materials	62,202	65,804
Business and travel expenses	6,774	8,750
Capital expenditures	-	-
Other expenses	-	-
Total Laboratory	**$ 457,601**	**$ 455,347**
Field Services		
Personnel services	$ 182,733	$ 253,435
Contractual services	2,252	2,915
Supplies and materials	13,652	3,024
Business and travel expenses	2,060	4,923
Capital expenditures	-	7,922
Other expenses	-	-
Total Field Services Management	**$ 200,697**	**$ 272,219**
Water Quality		
Personnel services	$ 407,918	$ 390,593
Contractual services	149,716	132,543
Supplies and materials	37,534	25,491
Business and travel expenses	6,365	4,528
Capital expenditures	-	-
Other expenses	696	-
Total Water Quality	**$ 602,229**	**$ 553,155**
Water Maintenance		
Personnel services	$ 457,417	$ 480,442
Contractual services	(5,243)	49,697
Supplies and materials	236,925	150,548
Business and travel expenses	5,786	9,628
Capital expenditures	-	98,099
Other expenses	2,942	4,554
Total Water Maintenance	**$ 697,827**	**$ 792,968**
Site Restoration		
Personnel services	$ 283,307	$ 290,970
Contractual services	21,498	20,574
Supplies and materials	107,374	104,529
Business and travel expenses	450	1,337
Capital expenditures	-	-
Other expenses	501	1,100
Total Site Restoration	**$ 413,130**	**$ 418,510**

Schedule of Departmental Operating (O&M) Expenses Excluding Depreciation, Amortization and Non-Operating Expenses

	Year Ended June 30	
	2017	2016
Wastewater Field Services		
Personnel services	$ 236,614	$ 167,010
Contractual services	4,086	2,818
Supplies and materials	10,774	1,115
Business and travel expenses	1,619	410
Capital expenditures	-	-
Other expenses	-	-
Total Wastewater Field	**$ 253,093**	**$ 171,353**
Wastewater I&I		
Personnel services	$ 564,969	$ 537,092
Contractual services	73,624	78,343
Supplies and materials	82,411	94,606
Business and travel expenses	922	954
Capital expenditures	-	-
Other expenses	2,474	2,394
Total Wastewater I&I	**$ 724,400**	**$ 713,389**
Wastewater Maintenance		
Personnel services	$ 505,723	$ 444,806
Contractual services	80,665	113,734
Supplies and materials	224,783	196,373
Business and travel expenses	992	1,406
Capital expenditures	-	-
Other expenses	26,292	20,021
Total Wastewater Maintenance	**$ 838,455**	**$ 776,340**
Wastewater Pumps		
Personnel services	$ 770,126	$ 753,098
Contractual services	477,754	507,019
Supplies and materials	431,311	243,716
Business and travel expenses	4,328	1,858
Capital expenditures	-	111,044
Other expenses	1,576	2,207
Total Wastewater Pumps	**$ 1,685,095**	**$ 1,618,942**
Instrumentation & Electrical		
Personnel services	$ 929,137	$ 562,958
Contractual services	134,074	151,403
Supplies and materials	165,786	164,889
Business and travel expenses	21,902	27,985
Capital expenditures	-	43,670
Other expenses	-	65
Total Electrical	**$ 1,250,899**	**$ 950,970**
Total Operating Expenses Excluding Depreciation	**$ 22,774,466**	**$ 20,909,090**
Commission Wide Totals		
Personnel services	**$ 11,987,759**	**$ 10,847,409**
Contractual services	**6,777,744**	**6,560,438**
Supplies and materials	**2,176,364**	**1,769,048**
Business and travel expenses	**310,861**	**294,374**
Capital expenditures	**896,079**	**848,149**
Other expenses	**625,659**	**589,672**
Total Operating Expenses Excluding Depreciation	**$ 22,774,466**	**$ 20,909,090**

Asset management is an essential component of good governance in both the public and private sectors, and should be aligned to, and integrated with, a utility's strategic, operational and financial planning. For utilities that manage large asset holdings, a well-structured, practical asset management framework can assist in providing clarity for stakeholders as to the linkages between asset levels and the outcomes expected of the utility, and thus aid decisions on asset management. The main message is to ensure utilities have a disciplined approach to match their investment in assets to program requirements, and to plan for asset replacement in a strategic way, which accords with the Utility's capital budgeting framework where applicable. An efficient and optimal asset base is, for most utilities, an integral component of their accrual-based financial framework. The use of assets can have a considerable cost attached, and it is important therefore, that they are managed both efficiently and effectively.

Asset Management
Program

MOUNT PLEASANT WATERWORKS
CLEAN WATER

SCHEDULE OF CAPITAL ASSET BY UTILITY, FUNCTION AND TYPE

AS OF JUNE 30, 2017

Utility	Function	Type	Gross Asset Value	Depreciation	Book Value
Water	Distribution	Water Mains	$ 107,970,751	$ 29,655,607	$ 78,315,144
		Meters	3,769,559	1,512,723	2,256,836
		Storage	7,803,316	3,180,077	4,623,239
		High Service PS	1,316,417	567,628	748,789
		Dispensing Stations	85,204	54,600	30,604
		Children Fountain	9,973	2,575	7,398
		Distribution Total	**120,955,220**	**34,973,210**	**85,982,010**
	Treatment	RO Plants	10,478,915	5,668,354	4,810,561
		Treatment Total	**10,478,915**	**5,668,354**	**4,810,561**
	Supply	CWS	17,904,447	8,598,758	9,305,689
		Wells	5,438,827	2,763,891	2,674,936
		Supply Storage	153,245	57,588	95,657
		Supply Total	**23,496,519**	**11,420,237**	**12,076,282**
	General	Light Equipment	614,421	440,387	174,034
		Heavy Equipment	337,757	211,772	125,985
		General Total	**952,178**	**652,159**	**300,019**
	Water Total		**$ 155,882,832**	**$ 52,713,960**	**$ 103,168,872**
Wastewater	Collections	Gravity Lines	$ 125,696,171	$ 36,460,876	$ 89,235,295
		Pump Stations	30,790,146	10,150,025	20,640,121
		Force Mains	19,282,277	3,348,275	15,934,002
		Collection Total	**175,768,594**	**49,959,176**	**125,809,418**
	Treatment	Wastewater Plants	77,777,964	23,400,557	54,377,407
		Outfall	4,089,714	1,854,114	2,235,600
		Re-Use	214,171	73,232	140,939
		Treatment Total	**82,081,849**	**25,327,903**	**56,753,946**
	General	Heavy Equipment	162,168	93,286	68,882
		Light Equipment	216,702	66,760	149,942
		General Total	**378,870**	**160,046**	**218,824**
	Wastewater Total		**$ 258,229,313**	**$ 75,447,125**	**$ 182,782,188**
Admin		Centers	$ 12,602,607	$ 3,139,822	9,462,785
		Computers	5,386,036	3,572,148	1,813,888
		Equipment	986,808	510,352	476,456
		Heavy Equipment	120,870	5,457	115,413
		Furniture & Fixtures	244,417	173,034	71,383
		Generators	2,456,552	1,532,549	924,003
		Laboratory	22,722	17,635	5,087
		Vehicles	4,632,925	2,165,720	2,467,205
	Admin Total		**$ 26,452,937**	**$ 11,116,717**	**$ 15,336,220**
	Total Capital Assets		**$ 440,565,082**	**$ 139,277,801**	**$ 301,287,280**
	Construction-in-progress		31,495,626	-	31,495,626
	Grand Total		**$ 472,060,708**	**$ 139,277,801**	**$ 332,782,906**

MOUNT PLEASANT WATERWORKS

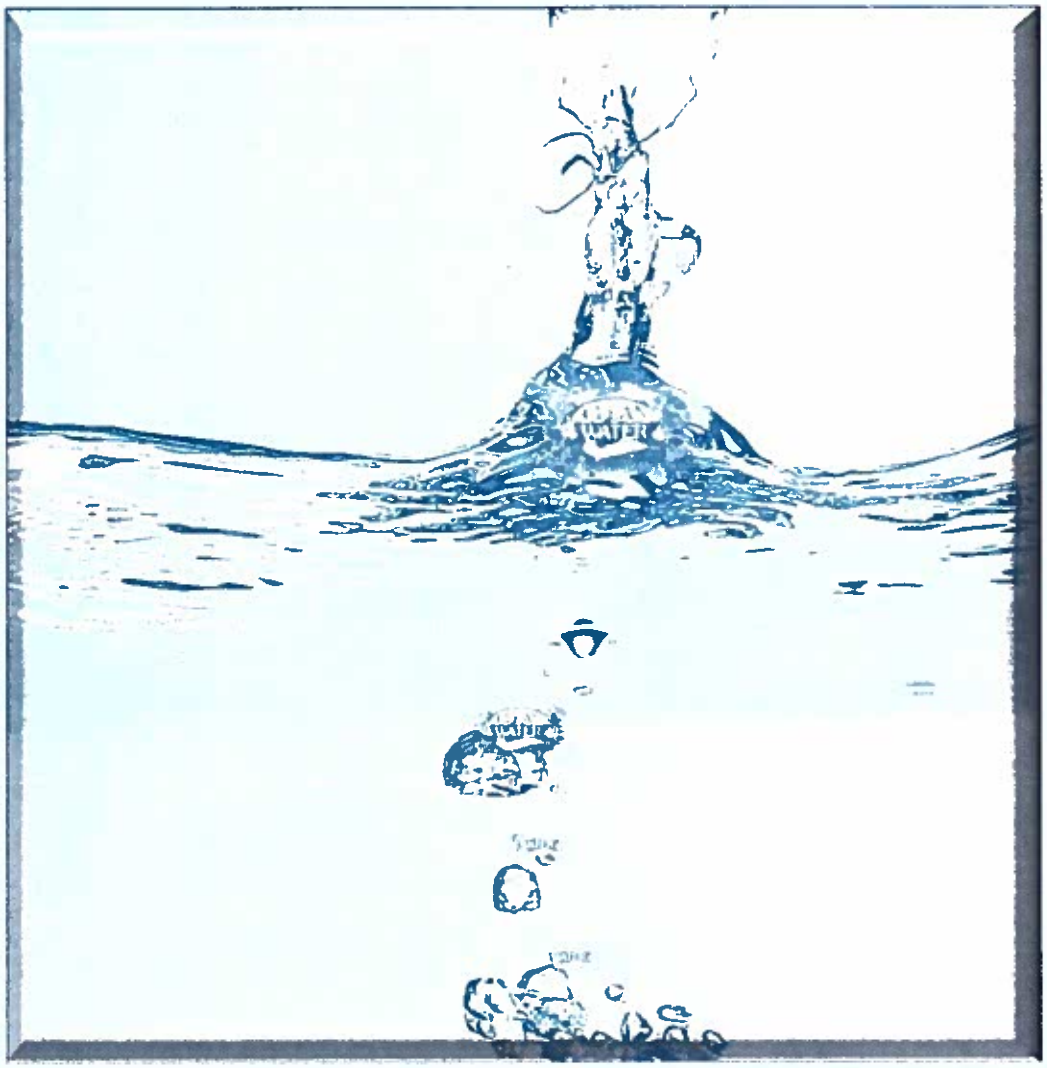
CLEAN WATER

Statistical Information

(Unaudited)

MOUNT PLEASANT WATERWORKS

CLEAN WATER



Slogan – SUSTAIN LIFE

Statistical Section

(Unaudited)

The objectives of statistical section information are to provide the financial statement user with additional historical perspective, context and details to assist in using the information in the financial statements, notes to the financial statements, and required and other supplementary information to understand and assess a government's economic condition.

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Present how financial performance and well-being have changed over time.		
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Sources: Unless otherwise noted, the information in these schedules were derived from the Comprehensive Annual Financial Report for the relevant years.

MOUNT PLEASANT WATERWORKS

NET POSITION BY COMPONENT

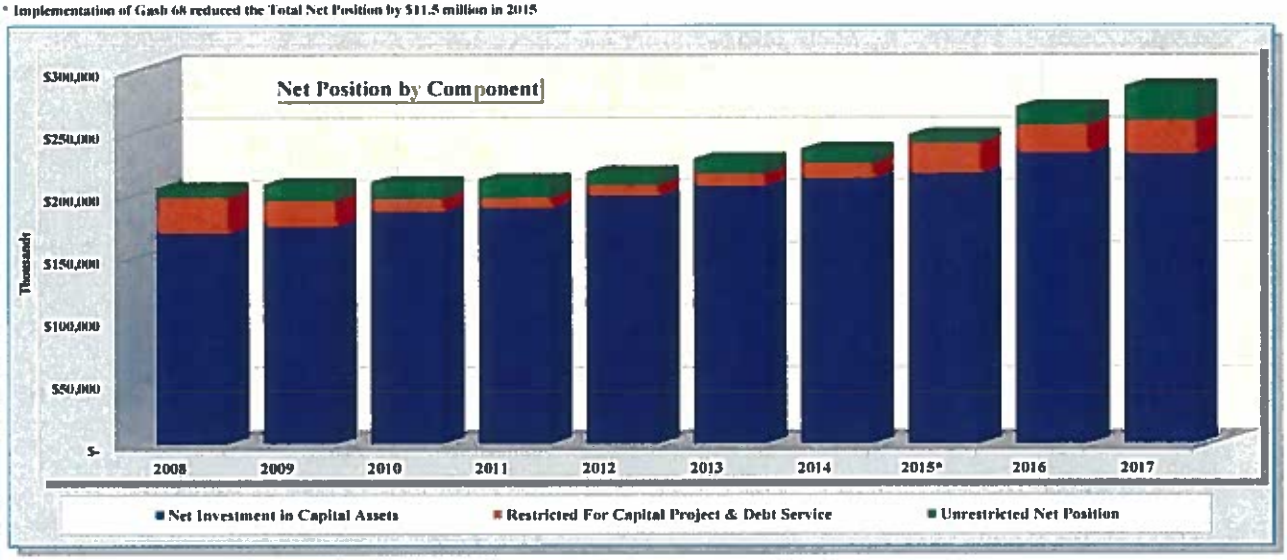
Last Ten Fiscal Years

TABLE 1

In Thousands

	Restated 2008	Restated 2009	2010	2011	2012	Restated 2013	2014	2015*	2016	2017
Net Investment in Capital Assets	$ 168,107	$ 173,690	$ 185,338	$ 187,998	$ 197,673	$ 205,687	$ 211,648	$ 216,011	$ 232,296	**$ 231,801**
Restricted for:										
Capital projects	26,537	18,490	9,062	6,759	8,044	9,354	11,589	23,101	21,425	**25,306**
Debt service	2,180	2,172	1,538	1,557	858	886	831	1,185	1,061	**1,390**
Total Restricted	28,716	20,661	10,600	8,315	8,902	10,239	12,420	24,286	22,486	**26,695**
Subtotal	196,823	194,351	195,939	196,313	206,574	215,926	224,068	240,298	254,782	**258,497**
Unrestricted Net Position	7,461	13,026	13,085	15,109	10,660	11,880	11,519	6,621	14,688	**27,278**
Total Net Position	$ 204,284	$ 207,377	$ 209,024	$ 211,422	$ 217,235	$ 227,806	$ 235,587	$ 246,918	$ 269,470	**$ 285,775**

* Implementation of Gasb 68 reduced the Total Net Position by $11.5 million in 2015



MOUNT PLEASANT WATERWORKS
REVENUES AND EXPENSES

TABLE 2

LAST TEN FISCAL YEARS

In Thousand

	Restated 2008	Restated 2009	2010	2011	Restated 2012	Restated 2013	2014	2015*	2016	2017
Operating revenues:										
Total water revenue	11,989	11,083	12,106	13,766	14,008	14,086	14,746	16,899	19,245	21,265
Total wastewater revenue	11,052	11,178	12,065	12,648	13,601	14,306	15,747	17,538	19,511	21,648
Other fees and charges	1,516	1,382	1,349	1,346	1,385	1,576	2,086	2,418	2,531	2,385
Total operating revenues	24,558	23,642	25,519	27,759	28,995	29,969	32,579	36,856	41,287	45,298
Operating expenses before depreciation										
Personnel services	8,770	8,855	8,274	8,552	8,293	8,719	8,665	9,605	10,601	11,988
Contractual services	4,938	4,897	4,769	4,811	5,253	5,663	5,760	5,914	6,807	6,778
Supplies and materials	1,944	1,875	1,629	1,671	1,538	1,567	1,724	1,743	1,769	2,176
Education and travel	323	258	111	206	175	239	267	271	294	311
Repair & maintenance (capital budget)	839	1,108	981	1,032	790	1,378	2,404	1,155	848	896
Other expenses	409	541	431	476	495	477	536	531	590	626
Total operating expenses before depreciation	17,223	17,534	16,196	16,748	16,544	18,043	19,355	19,218	20,909	22,774
Operating income before depreciation	7,335	6,108	9,324	11,011	12,451	11,926	13,224	17,638	20,378	22,524
Depreciation and amortization	8,777	9,451	10,181	10,435	10,988	10,375	11,273	11,398	13,301	16,150
Operating income (loss)	(1,443)	(3,343)	(857)	576	1,463	1,551	1,952	6,240	7,076	6,374
Non-operating income/(expense)	(1,330)	(1,903)	(1,858)	(1,686)	(1,329)	(425)	(463)	(652)	(995)	(1,996)
Increase (decrease) in net position, before capital contributions	(2,772)	(5,246)	(2,715)	(1,110)	134	1,126	1,489	5,588	6,081	4,379
Capital contributions.	11,480	8,338	4,362	3,508	6,162	8,962	6,292	17,282	16,471	11,926
Increase in net position	$ 8,707	$ 3,093	$ 1,647	$ 2,398	$ 6,297	$ 10,088	$ 7,781	$ 22,870	$ 22,552	$ 16,305

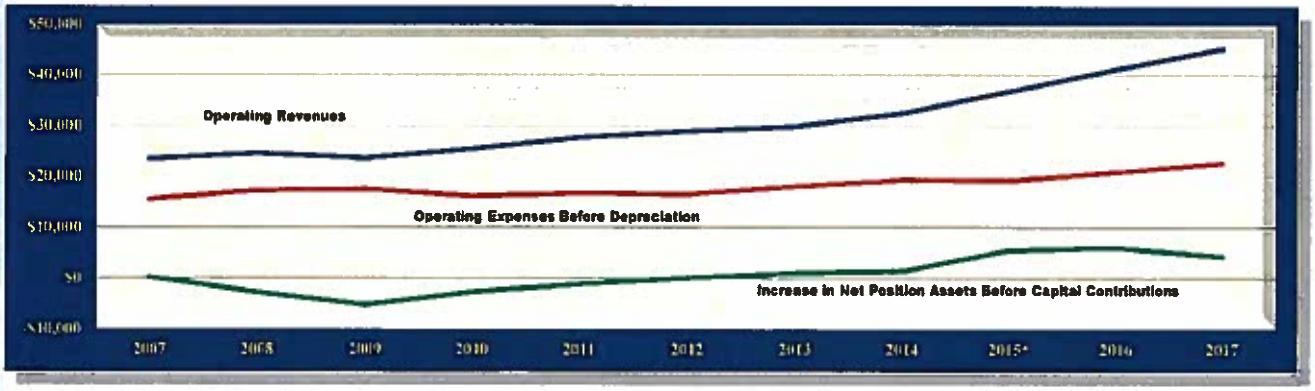


TABLE 3

MOUNT PLEASANT WATERWORKS
TEN LARGEST CUSTOMERS
Last Ten Fiscal Years

Customer	2008	2009	2010 [1]	2011	2012	2013	2014	2015	2016	2017
Town of Mount Pleasant	-	-	393,327	284,622	271,819	260,284	283,435	334,226	324,847	413,245
Charleston County School District	102,163	106,690	180,253	213,719	179,928	227,919	217,366	260,764	312,018	361,085
S C State Ports Authority [2]	77,716	-	-	-	-	261,146	128,258	194,996	258,275	326,448
Harbor Pointe Apartment	172,509	172,880	172,283	190,588	189,335	187,719	200,198	231,277	251,373	261,567
East Cooper Regional Medical Center	101,227	101,671	221,156	260,574	262,603	267,586	212,604	254,929	236,173	254,442
Hibben Ferry Apartments LLC	120,888	123,022	126,928	140,671	151,578	161,699	178,208	196,181	214,604	252,081
The Franke Home	-	95,676	181,016	268,806	191,171	228,911	226,766	226,634	304,503	211,968
Mount Pleasant Hospital (Roper)	-	-	-	-	-	-	-	-	-	187,140
Brothers Property Management	-	-	-	129,391	121,851	127,690	182,439	165,035	-	185,665
Five Star Quality Care (Palms)	-	-	-	-		134,407	134,850	147,451	150,391	156,443
Montclair Assoc Limited	120,347	112,477	115,523	102,635	130,045	131,464	134,733	162,213	164,777	-
The Meridian Owners Association, Inc	-	-	96,605	-	-	-	-	-	146,389	-
BNP/ Paces Watch LLC	103,966	105,031	129,636	120,276	134,683	-	-	-	-	-
East Bridge Town Lofts HOA	94,533	118,252	-	105,890	106,086	-	-	-	-	-
Snee Farms Lakes	87,391	82,845	84,974	-	-	-	-	-	-	-
Runaway Bay Apartments	87,494	83,981	-	-	-	-	-	-	-	-
Totals	$ 1,068,234	$ 1,102,525	$ 1,701,701	$ 1,817,172	$ 1,739,099	$ 1,988,826	$ 1,898,857	$ 2,173,707	$ 2,363,350	$ 2,610,084
Total Operating Revenue *	$ 24,557,621	$ 23,642,327	$ 25,519,169	$ 27,759,081	$ 28,994,570	$ 29,968,904	$ 32,579,431	$ 36,855,524	$ 41,286,937	$ 45,298,281
Percent Top Ten to Total	4.35%	4.66%	6.67%	6.55%	6.00%	6.64%	5.83%	5.90%	5.72%	5.76%

Revenue includes volumetric (water, irrigation and wastewater) sales, base facility charges and other operating revenues.

[1] Effective beginning Fiscal Year 2010 includes Irrigation revenue

[2] SC State Ports Authority is primarily a wastewater customer and was not previous listed until FY11

[3] East Cooper Hospital and Mount Pleasant Hospital were constructed in FY2010

MOUNT PLEASANT WATERWORKS

TEN LARGEST CUSTOMERS

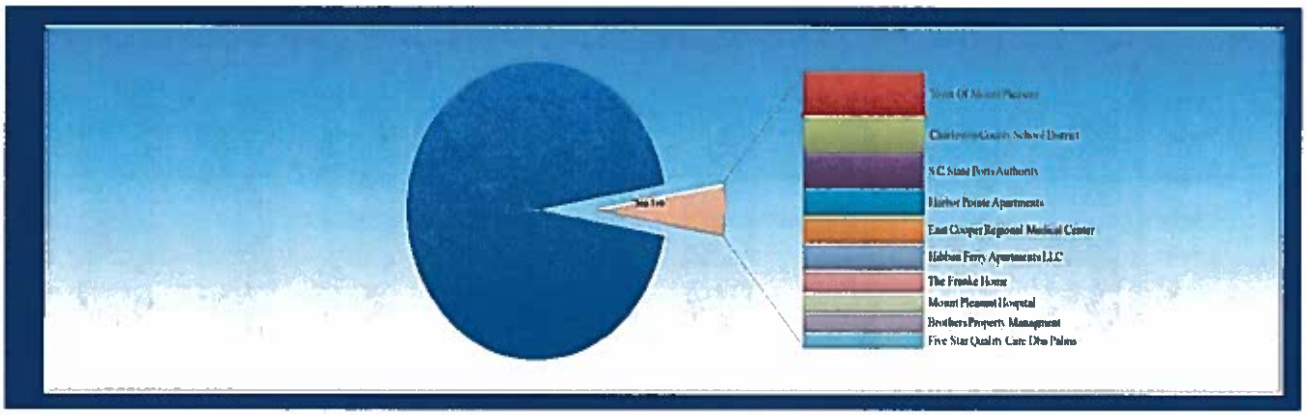
FISCAL YEAR 2017

TABLE 3a

Customer	Water Gallons	Irrigation Gallons	Water Revenues	Irrigation Revenues	Total Water Revenues	Wastewater Revenues	Total Revenues	Percent of Total Revenue
Town Of Mount Pleasant	6,674,400	39,457,600	$ 45,181	$ 311,019	$ 356,200	$ 57,045	$ 413,245	0.91%
Charleston County School District	13,849,000	10,267,000	$ 91,149	$ 138,020	$ 229,169	$ 131,917	$ 361,085	0.80%
S C State Ports Authority	11,188,600	0	$ 61,963	$ -	$ 61,963	$ 264,485	$ 326,448	0.72%
Harbor Pointe Apartments	16,197,400	0	$ 103,483	$ 516	$ 103,999	$ 157,568	$ 261,567	0.58%
East Cooper Regional Medical Center	7,486,600	10,963,200	$ 45,453	$ 143,149	$ 188,602	$ 65,840	$ 254,442	0.56%
Hibben Ferry Apartments LLC	15,234,100	1,295,500	$ 95,452	$ 11,714	$ 107,167	$ 144,914	$ 252,081	0.56%
The Franke Home	12,485,000	2,056,900	$ 79,038	$ 22,178	$ 101,216	$ 110,752	$ 211,968	0.47%
Mount Pleasant Hospital	11,721,000	0	$ 77,060	$ -	$ 77,060	$ 110,080	$ 187,140	0.41%
Brothers Property Managment	7,693,100	5,179,200	$ 44,704	$ 76,510	$ 121,214	$ 64,451	$ 185,665	0.41%
Five Star Quality Care Dba Palms	7,734,200	3,704,900	$ 46,142	$ 42,162	$ 88,304	$ 68,139	$ 156,443	0.35%
Totals	110,263,400	72,924,300	$ 689,624	$ 745,269	$ 1,434,893	$ 1,175,190	$ 2,610,084	5.76%
Total Operating Revenue			$ 18,054,478	$ 4,455,684	$ 22,510,162	$ 22,788,119	$ 45,298,281	
Percent of Revenue for the Ten Largest Customers			3.82%	16.73%	6.37%	5.16%	5.76%	

Notes:

1. Water and irrigation consumed is in gallons
2. Revenue includes volumetric, twater, irrigation and wastewater (sales, basic facility charges and other operating revenues
3. SC State Ports Authority is primarily a wastewater



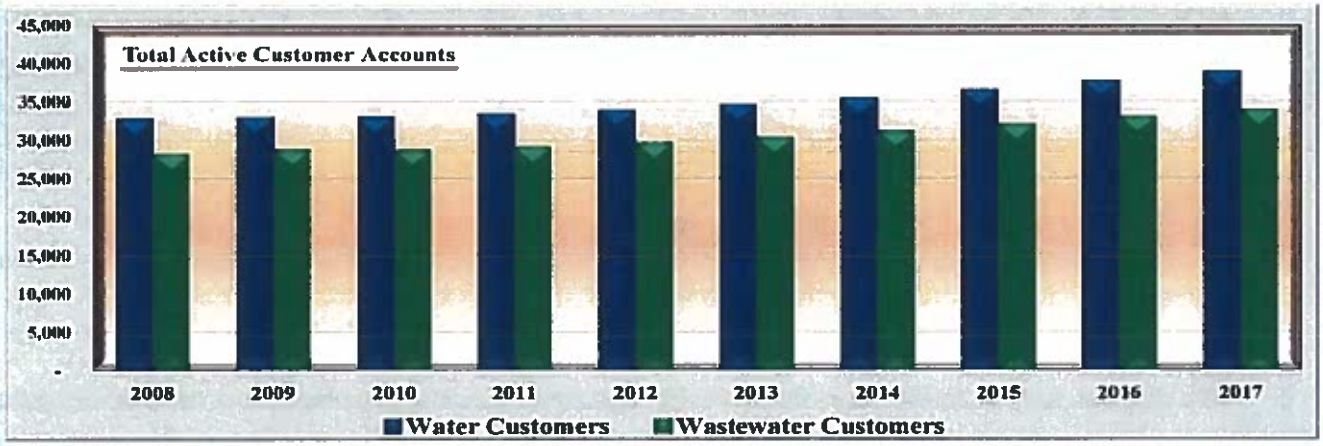
MOUNT PLEASANT WATERWORKS

CUSTOMER ACCOUNTS

LAST TEN FISCAL YEARS

TABLE 4

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Water:											
Active Accounts	Residential	27,420	27,959	27,909	28,198	28,616	29,272	30,070	30,944	31,901	**32,735**
	Commercial	2,396	2,028	2,173	2,209	2,283	2,334	2,382	2,365	2,402	**2,452**
	Irrigation	2,831	2,428	2,781	2,809	2,836	2,838	2,848	3,013	3,266	**3,547**
	Total	32,647	32,415	32,863	33,216	33,735	34,444	35,300	36,322	37,569	**38,734**
Average Gallons per month	Residential - Water	5,284	4,896	4,959	5,064	5,036	4,748	4,534	4,695	4,638	**4,632**
	Residential - Irrigation	7,041	4,796	4,981	5,921	6,149	4,887	3,647	4,661	4,814	**5,452**
	Commercial - Water	19,882	22,211	21,236	21,669	20,945	21,305	21,299	22,769	22,737	**23,101**
	Commercial - Irrigation	27,338	22,610	25,534	30,741	29,201	27,694	19,468	20,982	22,891	**24,687**
Average Monthly Bill	Residential - Water	$ 18.84	$ 17.99	$ 19.83	$ 20.17	$ 21.07	$ 21.04	$ 21.78	$ 25.11	$ 26.88	$ **28.15**
	Residential - Irrigation	34.21	25.26	29.10	34.06	37.01	31.53	26.15	35.16	38.12	**44.47**
	Commercial - Water	67.66	76.39	79.92	81.32	82.75	88.26	95.01	107.62	112.54	**120.49**
	Commercial - Irrigation	129.45	113.37	141.82	169.31	169.12	168.90	130.13	146.27	163.22	**185.16**
	* REU's Per Account (Residential 1:1, Commercial 1:2.5)										
Wastewater:											
Active Accounts	Residential	26,163	26,776	26,739	27,081	27,566	28,224	29,030	29,894	30,867	**31,698**
	Commercial	1,892	1,884	1,880	1,915	1,972	2,012	2,043	2,029	2,059	**2,097**
	Total	28,055	28,660	28,619	28,996	29,538	30,236	31,073	31,923	32,926	**33,795**
Average Gallons per month	Residential	5,275	4,881	4,956	5,066	5,047	4,753	4,531	4,701	4,640	**4,637**
	Commercial	24,116	23,172	23,737	24,269	23,587	24,488	24,199	25,910	26,095	**26,414**
Average Monthly Bill	Residential	$ 26.21	$ 25.39	$ 27.98	$ 28.13	$ 29.70	$ 29.97	$ 31.17	$ 35.03	$ 36.74	$ **38.34**
	Commercial	121.63	120.46	134.05	136.60	139.91	151.86	161.80	179.24	185.31	**197.71**
	* REU's Per Account (Residential 1:1, Commercial 1:2.5)										



MOUNT PLEASANT WATERWORKS

TABLE 5

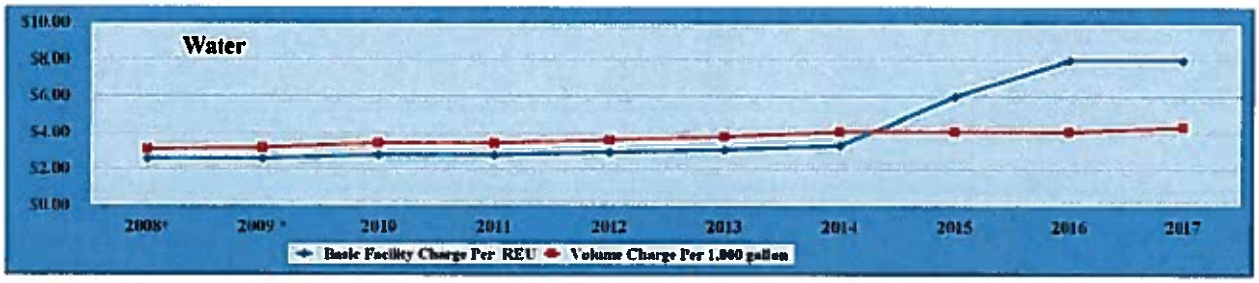
RATE HISTORY

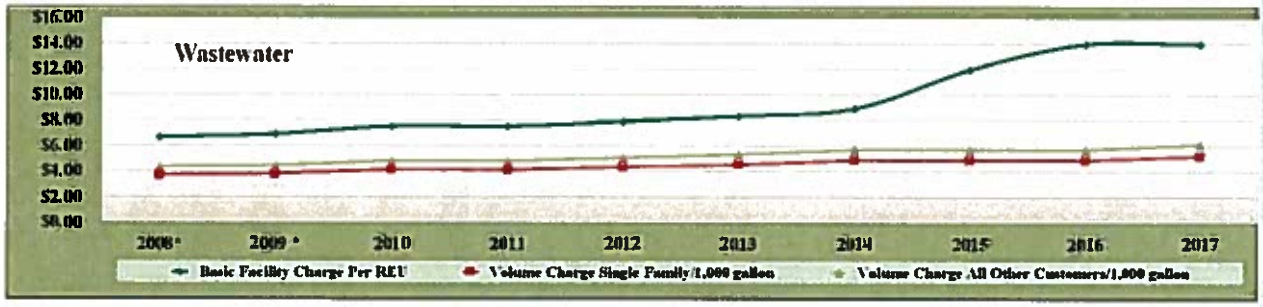
LAST TEN FISCAL YEARS

	2008*	2009 *	2010	2011	2012	2013	2014	2015	2016	2017
Water										
Basic Facility Charge Per REU	$2.57	$2.57	$2.80	$2.80	$2.94	$3.09	$3.33	$6.00	$8.00	$8.00
Volume Charge Per 1,000 gallon	$3.08	$3.15	$3.43	$3.43	$3.60	$3.78	$4.07	$4.07	$4.07	$4.35
Irrigation										
Basic Facility Charge Per REU	$2.57	$2.57	$2.80	$2.80	$2.94	$3.09	$3.33	$6.00	$8.00	$8.00
Volume Charge Per 1,000 gallon	$4.50	$4.73	$5.28	$5.28	$5.54	$5.82	$6.26	$6.26	$6.26	$6.69
Wastewater										
Basic Facility Charge Per REU	$6.69	$6.94	$7.56	$7.56	$7.94	$8.34	$8.97	$12.00	$14.00	$14.00
Volume Charge Single Family/1,000 gallon	$3.70	$3.78	$4.12	$4.12	$4.33	$4.55	$4.90	$4.90	$4.90	$5.25
Volume Charge All Other Customers/1,000 gallon	$4.35	$4.45	$4.85	$4.85	$5.09	$5.35	$5.76	$5.76	$5.76	$6.16
Impact Fees										
Water Impact Fees	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,070	$2,142
Wastewater Impact Fees	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,658	$4,821

REU = Residential Equivalent Unit

* Rate Increase Effective January 1





MOUNT PLEASANT WATERWORKS
DEBT HISTORY
LAST TEN FISCAL YEARS

TABLE 6

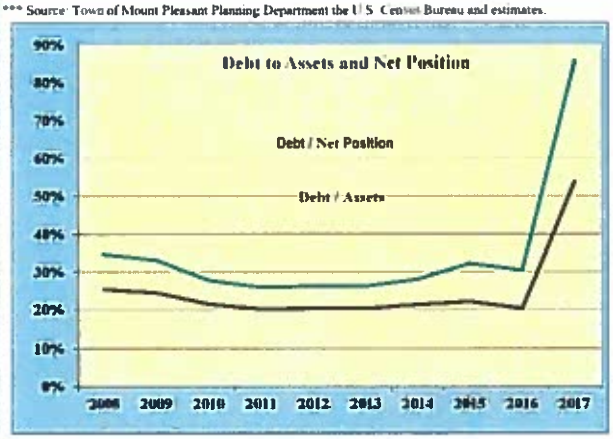
In Thousand

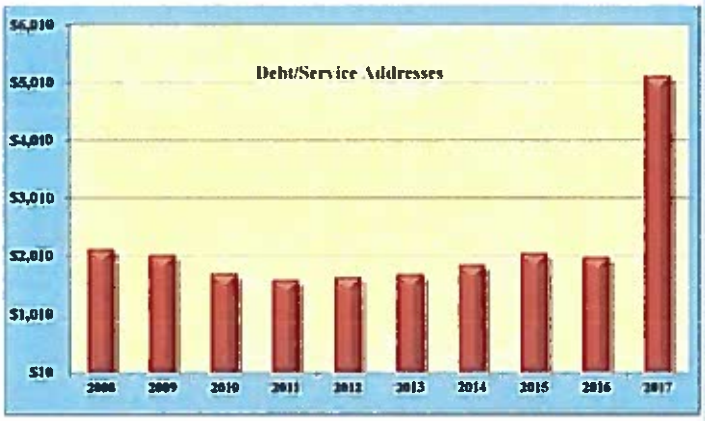
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenue Bonds*	$ 53,460	$ 50,905	$ 48,422	$ 45,711	$ 42,895	$ 39,744	$ 35,798	$ 12,907	$ 10,406	$ 128,261
State Revolving Loan	17,298	17,740	9,573	9,152	8,698	14,953	25,642	32,363	35,798	43,010
Bank Loan	-	-	-	-	5,396	5,081	4,759	30,684	28,996	27,514
Total Debt	$ 70,758	$ 68,645	$ 57,995	$ 54,863	$ 56,989	$ 59,778	$ 66,198	$ 75,954	$ 75,200	$ 198,785
Percentage Change	-0.7%	-3.0%	-15.5%	-5.4%	3.9%	4.9%	10.7%	14.7%	13.6%	161.7%
Ratios - Debt to:										
Operating revenue	288%	290%	227%	198%	197%	199%	203%	233%	204%	439%
Operating expenses before depreciation	411%	391%	359%	328%	344%	331%	342%	392%	391%	873%
Assets	25%	24%	21%	20%	20%	20%	21%	22%	20%	54%
Net Position	35%	33%	28%	26%	26%	26%	28%	32%	30%	86%
Debt Per Service Address **	$ 2,110	$ 2,009	$ 1,685	$ 1,578	$ 1,621	$ 1,672	$ 1,832	$ 2,041	$ 1,970	$ 5,099
Personal Income (In thousands)	$ 2,169,126	$ 2,398,000	$ 2,587,185	$ 2,849,881	$ 2,719,488	$ 2,933,075	$ 3,060,550	$ 3,060,550	$ 3,454,753	$ 3,709,456
Debt as a % Personal Income ***	3.3%	2.9%	2.2%	1.9%	2.1%	2.0%	2.2%	2.5%	2.2%	5.4%

* Debt balances include premiums and discounts.

** Service addresses represent active and inactive addresses with one or more accounts.

*** Source: Town of Mount Pleasant Planning Department the U.S. Census Bureau and estimates.





MOUNT PLEASANT WATERWORKS

DEBT SERVICE COVERAGE

LAST TEN FISCAL YEARS

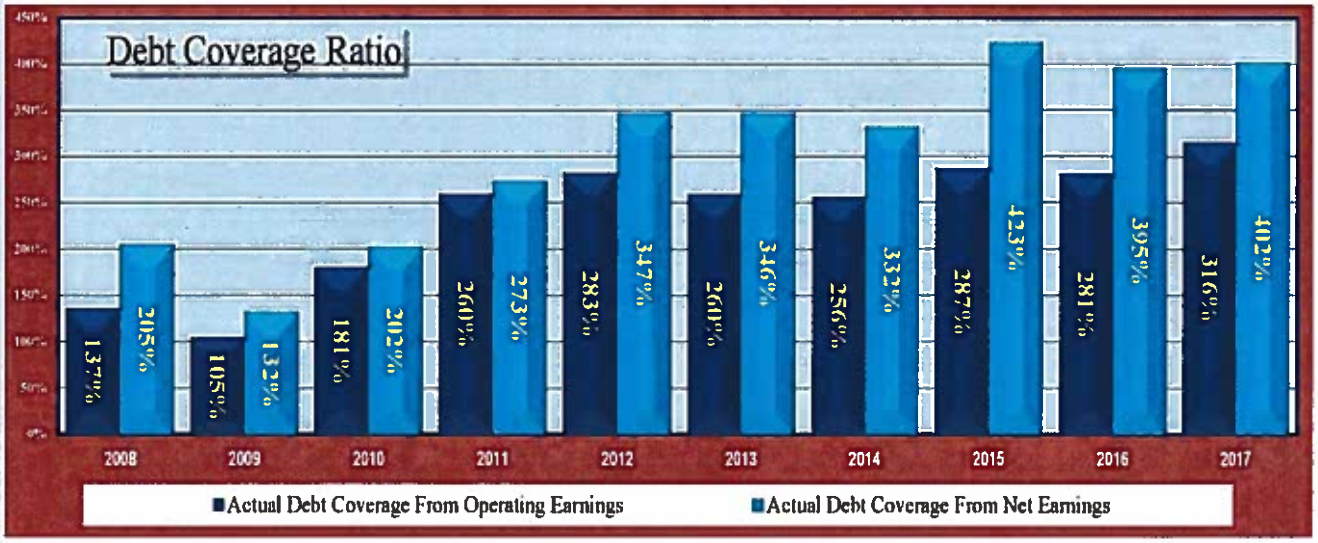
TABLE 7

In Thousand

	2008	2009	2010	2011	2012	2013	2014 (REVISED)	2015	2016	2017
Revenues and receipts from operation of system	$ 30,604	$ 25,964	$ 26,935	$ 29,937	$ 33,839	$ 36,049	$ 36,612	$ 45,104	$ 49,680	$ 51,641
Expenses of operating and maintaining the system	17,223	17,534	16,196	16,748	16,544	18,043	19,355	19,218	20,909	22,774
Net earnings	$ 13,381	$ 8,431	$ 10,740	$ 13,189	$ 17,295	$ 18,006	$ 17,257	$ 25,886	$ 28,770	$ 28,867
Total debt service	$ 6,530	$ 6,402	$ 5,318	$ 4,826	$ 4,989	$ 5,198	$ 5,199	$ 6,116	$ 7,288	$ 7,188
Debt service coverage from:										
Net earnings (120%)	205%	132%	202%	273%	347%	346%	332%	423%	395%	402%
Net operating earnings (100%)	137%	105%	181%	260%	283%	260%	256%	287%	281%	316%

Notes:

1. Net earnings and debt coverage service are computed based on definitions contained in the Commission's Bond Ordinances.
2. "Revenues of the system" are all revenues from operation of the system except grants, customer deposits, developer contributions and special assessments.
3. "Expenses of operating and maintaining the system" exclude operating expenses, thus excluding depreciation, gain (loss) on disposals, interest and amortization.
4. Debt service coverage equals net earnings divided by principal and interest. Coverage requirement is a minimum of 100% without impact fees (net operating earnings) and 120% with impact fees (net earnings).



MOUNT PLEASANT WATERWORKS

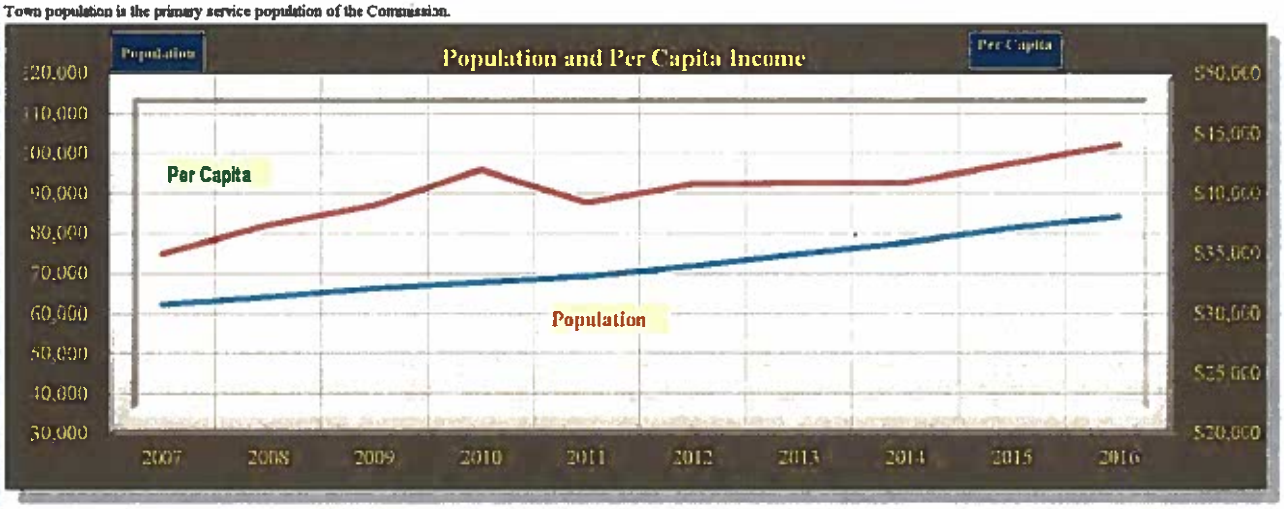
DEMOGRAPHIC AND ECONOMIC DATA

TABLE 8

LAST TEN CALENDAR YEARS

Town of Mount Pleasant *	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Population	62,059	64,148	66,287	67,843	69,357	71,875	74,885	77,667	81,317	84,170
Per Capita Income	$ 34,953	$ 37,382	$ 39,030	$ 42,007	$ 39,210	$ 40,608	$ 40,870	$ 40,870	$ 42,485	$ 44,071
Median Age	36.6	35.9	37.7	37.7	39.1	39.1	39.1	39.1	39.1	39.2
Unemployment Rate	3.1%	3.5%	6.3%	5.4%	6.4%	5.5%	5.1%	3.4%	3.3%	3.6%
Personal Income (in thousands)	$ 2,169,126	$ 2,398,000	$ 2,587,185	$ 2,849,881	$ 2,719,488	$ 2,933,075	$ 3,060,550	$ 3,174,250	$ 3,454,753	$ 3,709,456

* Source: Town of Mount Pleasant Planning Department the U.S. Census Bureau and estimates.
Town population is the primary service population of the Commission.



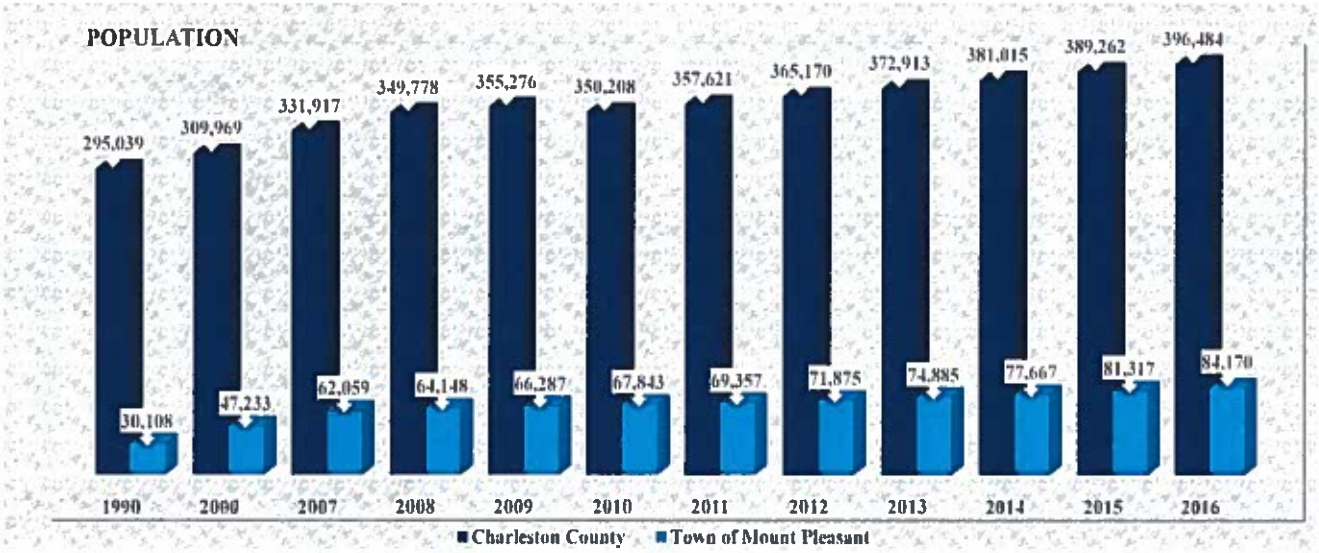
MOUNT PLEASANT WATERWORKS

LOCAL, REGIONAL, AND NATIONAL DEMOGRAPHIC DATA

TABLE 9

		1990	2000	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Town of Mount Pleasant	Population	30,108	47,233	62,059	64,148	66,287	67,843	69,357	71,875	74,885	77,667	81,317	84,170
	Percent Change		56.9%	2.6%	3.4%	3.3%	2.3%	2.2%	3.6%	4.2%	3.7%	4.7%	3.5%
Charleston County	Population	295,039	309,969	331,917	349,778	355,276	350,208	357,621	365,170	372,913	381,015	389,262	396,484
	Percent Change		5.1%	0.5%	5.4%	1.6%	-1.4%	2.1%	2.1%	2.1%	2.2%	4.4%	4.1%
MSA*	Population	506,875	549,033	616,499	649,781	659,191	664,688	681,632	697,497	712,081	727,689	744,526	761,155
	Percent Change		8.3%	-0.2%	5.4%	1.4%	0.8%	2.6%	2.3%	2.1%	2.2%	4.6%	4.6%
South Carolina	Population	3,486,703	4,023,570	4,424,232	4,503,280	4,561,242	4,625,360	4,673,509	4,723,417	4,771,929	4,832,482	4,896,146	4,961,119
	Percent Change		15.4%	2.0%	1.8%	1.3%	1.4%	1.0%	1.1%	1.0%	1.3%	2.6%	2.7%
United States	Population	248,807,000	281,421,906	299,398,484	304,059,724	309,928,902	308,747,716	311,582,564	313,873,685	316,128,839	318,857,056	321,418,820	323,127,513
	Percent Change		16.9%	1.0%	1.6%	1.9%	-0.4%	0.9%	0.7%	0.7%	0.9%	1.7%	1.3%

*MSA-The Charleston Metropolitan Statistical Area (comprising Charleston, Berkeley, and Dorchester Counties) - Source U.S. Census Bureau



MOUNT PLEASANT WATERWORKS

Table 10

PRINCIPAL EMPLOYERS - Town of Mount Pleasant

Current Year and Nine Years Ago

Employer	2017	Rank	Percent Total Employment	2008	Rank	Percent Total Employment
Charleston County School District	1,202	1	2.91%			
East Cooper Regional Medical Center	887	2	2.15%	675	1	1.93%
Harris Teeter	651	3	1.58%			
Town of Mount Pleasant	594	4	1.44%	556	2	1.59%
Walmart	450	5	1.09%	350	3	1.00%
Roper St. Francis Mount Pleasant Hospital	450	5	1.09%			
Publix	432	6	1.05%	300	4	0.86%
Mediterranean Shipping Company	350	7	0.85%	225	8	0.64%
Sandpiper Retirement Community	300	8	0.73%	225	7	0.64%
Vibra Hospital	266	9	0.64%			
Motley Rice, LLC	250	10	0.61%	300	5	0.86%
Franke as Seaside	250	10	0.61%	250	6	0.72%
Whole Foods				200	9	0.57%
Agent Owned Realty Co				175	10	0.50%
Total **	6,082		12.83%	3,256		9.33%

Source: Charleston Metro Chamber of Commerce, Town of Mount Pleasant and Survey by Mount Pleasant Waterworks
** These numbers are estimated based on the best information provided at the time. They are subject to change*
*** Estimated employed in the town: 41,340 for 2017 and 34,900 for 2008*

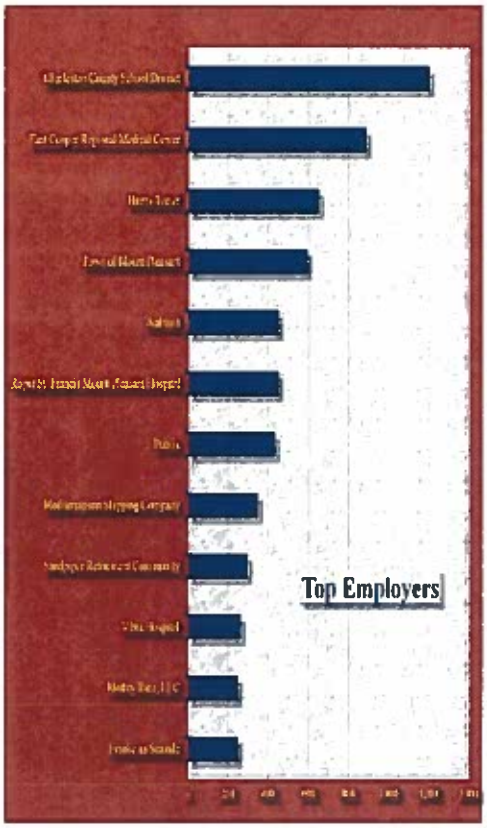


Table 11

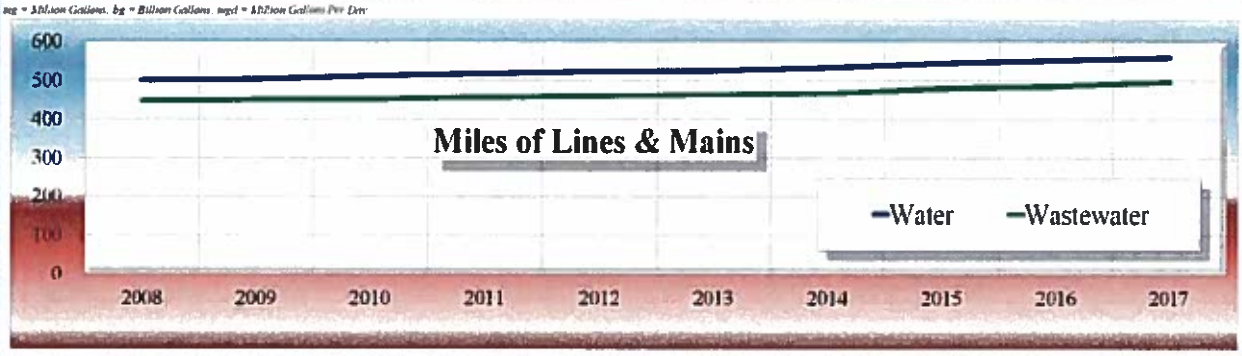
MOUNT PLEASANT WATERWORKS

Operating & Capital Indicators

LAST TEN FISCAL YEARS

Utility	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Water										
Capital Assets										
Total miles of water mains	502	505	513	520	525	526	535	547	555	561
Number of ground storage tanks	8	8	8	8	8	8	8	8	8	8
Number of elevated storage tanks	1	1	1	1	1	1	1	1	1	1
Number of hydrants	3,151	3,252	3,286	3,309	3,355	3,411	3,468	3,607	3,680	3,775
Number of water treatment plants	4	4	4	4	4	4	4	4	4	4
Aquifer storage recovery capacity (mg)	130	130	130	130	130	130	130	130	130	130
Water source - capacity:										
Groundwater - six deep wells (mgd)	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.72
Purchased surface water from CWS (mgd)	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Total Capacity (mgd)	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**	**16.22**
Wastewater										
Capital Assets										
Total miles of wastewater mains & lines	448	451	453	458	461	466	468	482	488	497
Number of wastewater pump stations	153	157	157	157	158	159	157	158	160	161
Number of wastewater treatment plants	2	2	2	2	2	2	2	2	2	2
Treatment Capacity										
Center Street Wastewater Plant (mgd)	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Rifle Range Road Wastewater Plant (mgd)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total Capacity (mgd)	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**	**9.70**
Annual Capacity (bg)	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54
Total Annual Wastewater Treatment (bg)	2.34	2.56	2.62	2.31	2.44	2.56	2.72	2.81	3.09	2.95
Average Daily Flow (mgd)	6.55	7.00	6.50	6.35	6.70	7.02	6.39	7.70	8.47	8.08
Percent of Capacity Utilized	**68%**	**72%**	**67%**	**68%**	**69%**	**72%**	**66%**	**79%**	**87%**	**83%**

mg = Million Gallons, bg = Billion Gallons, mgd = Million Gallons Per Day



MOUNT PLEASANT WATERWORKS

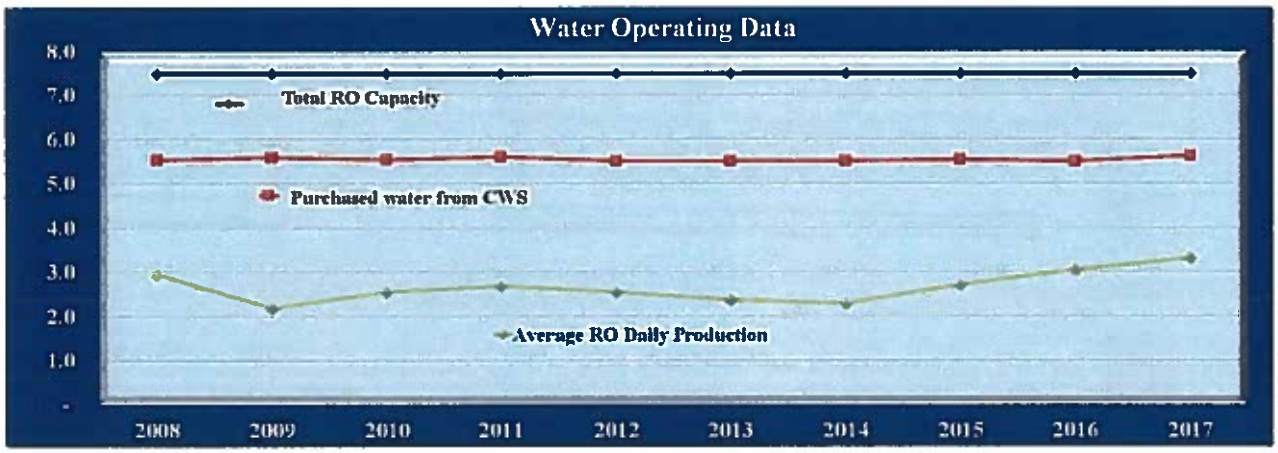
TABLE 12

WATER FACILITIES OPERATIONS

LAST TEN FISCAL YEARS

Water Utility	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Customers										
Number residential water customers	27,420	27,959	27,909	28,198	28,616	29,272	30,070	30,944	31,901	**32,735**
Number commercial water customers	2,396	2,028	2,173	2,209	2,283	2,334	2,382	2,365	2,402	**2,452**
Number irrigation customers	2,831	2,828	2,781	2,809	2,836	2,838	2,848	3,013	3,266	**3,547**
Total number of water customers	32,647	32,815	32,863	33,216	33,735	34,444	35,300	36,322	37,569	**38,734**
Total Annual Gallons & Dollars Billed										
Total Annual Gallons Billed (mg)	2,708	2,485	2,521	2,638	2,666	2,579	2,470	2,651	2,736	**2,900**
Total Annual Dollars Billed (million)	$ 11.71	$ 10.78	$ 11.95	$ 13.60	$ 13.77	$ 13.74	$ 14.33	$ 16.42	$ 18.72	**$ 20.81**
Actual supplied water (millions of gallons)										
Reverse Osmosis (RO), from well/aquifer	1,075	800	951	982	932	867	838	999	1,112	**1,208**
Purchased water from CWS	2,019	2,036	2,017	2,045	2,010	2,008	2,009	2,017	2,004	**2,054**
Total water supplied (mg)	3,094	2,836	2,948	3,027	2,942	2,866	2,847	3,008	3,116	**3,262**
Average Daily Supply (Consumption)	*8.5*	*7.8*	*8.1*	*8.3*	*8.0*	*7.9*	*7.8*	*8.2*	*8.5*	**8.9**
RO treatment plants, millions of gallons per day capacity										
Charles H. Hankins RO Plant No. 1	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	**1.27**
William L. Golightly RO Plant No. 2	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	**1.66**
Robert S. Bell, Jr., RO Plant No. 3	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	3.16	**3.16**
RO Plant No. 4	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	**1.40**
Total RO Capacity with 10% bleed	7.49	7.49	7.49	7.49	7.49	7.49	7.49	7.49	7.49	**7.49**
Average RO Daily Production	2.95	2.19	2.55	2.69	2.55	2.37	2.29	2.71	3.05	**3.31**

mg = Million Gallons, bg = Billion Gallons



MOUNT PLEASANT WATERWORKS

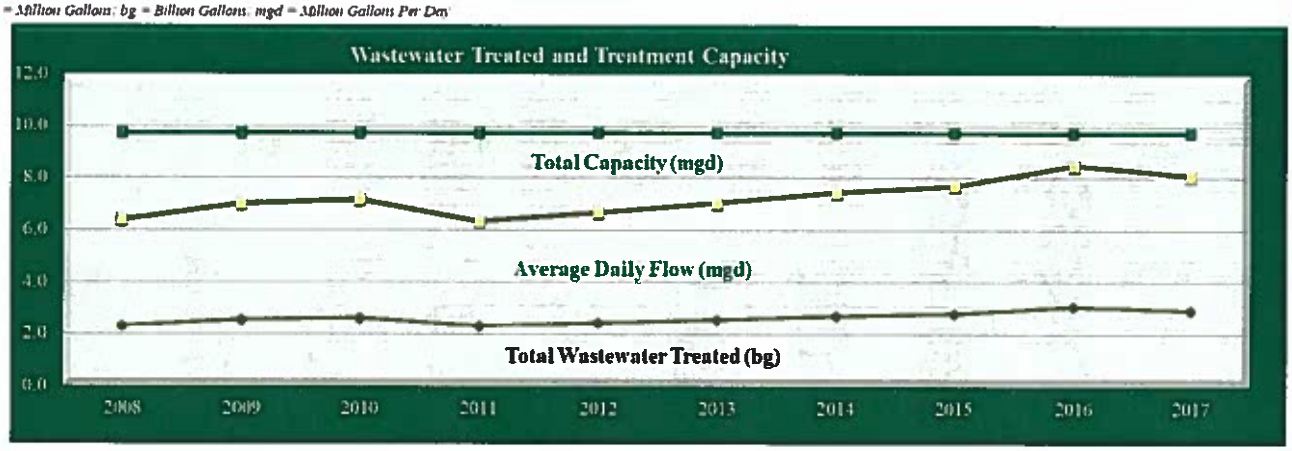
TABLE 13

WASTEWATER FACILITIES OPERATIONS

LAST TEN FISCAL YEARS

Wastewater Utility	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Customers										
Number of residential wastewater customers	26,163	26,776	26,739	27,081	27,566	28,224	29,030	29,894	30,867	31,698
Number of commercial wastewater customers	1,892	1,884	1,880	1,915	1,972	2,012	2,043	2,029	2,059	2,097
Total number of wastewater customers	27,545	28,055	28,619	28,996	29,538	30,236	31,073	31,923	32,926	33,795
Total Annual Gallons & Dollars Billed										
Total Annual Gallons Billed (bg)	2.20	2.09	2.12	2.19	2.20	2.17	2.15	2.28	2.33	2.43
Total Annual Dollars Billed (millions)	$ 10.92	$ 11.01	$ 11.98	$ 12.53	$ 13.44	$ 14.07	$ 15.48	$ 17.54	$ 19.51	$ 21.65
Treatment Capacity										
Center Street Wastewater Plant (mgd)	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Rifle Range Road Wastewater Plant (mgd)	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Total Capacity (mgd)	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70
Annual Capacity (bg)	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54
Total Annual Wastewater Treatment (bg)	2.34	2.56	2.62	2.31	2.44	2.57	2.72	2.81	3.09	2.95
Average Daily Flow (mgd)	6.41	7.01	7.18	6.33	6.68	7.04	7.44	7.70	8.47	8.08
Percent of Capacity Utilized	68%	72%	67%	65%	63%	72%	66%	79%	87%	83%

mg = Million Gallons; bg = Billion Gallons; mgd = Million Gallons Per Day

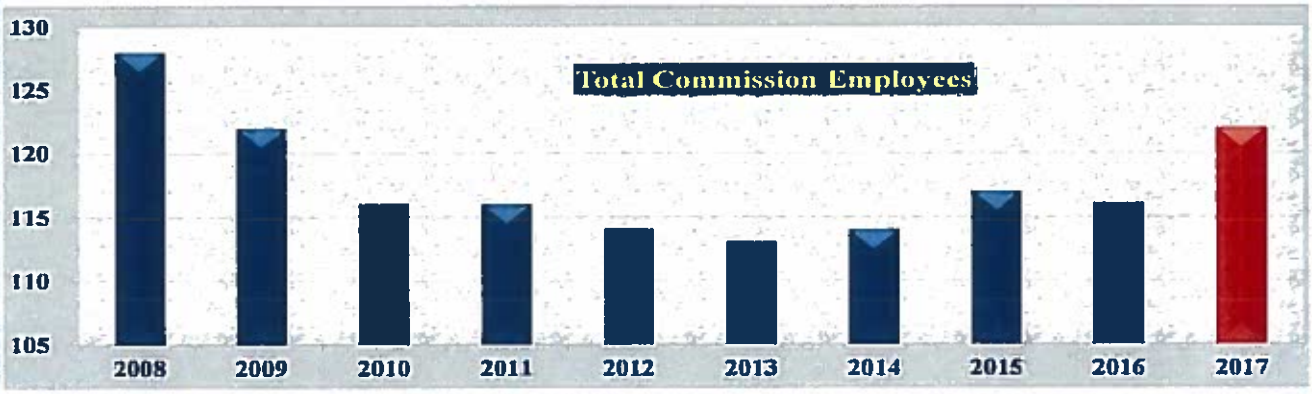


MOUNT PLEASANT WATERWORKS
EMPLOYEES
LAST TEN FISCAL YEARS

TABLE 14

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Water									
Water Operations	6	6	5	4	5	5	5	5	5
Water Maintenance	12	12	11	11	8	8	7	8	6
Water Quality	5	5	5	4	5	5	5	5	5
Meter Reading	4	4	4	4	5	4	4	4	4
Site Restoration	5	5	4	3	3	4	4	4	4
Wastewater									
Wastewater Operations	7	7	7	7	7	8	8	8	8
Wastewater Maintenance	22	22	22	22	22	22	23	23	21
Electrical	5	5	4	4	4	4	4	4	5
Environmental Quality & Safety									
Safety	2	2	2	2	2	2	2	2	2
Laboratory	4	4	4	4	4	4	4	4	4
Dispatch	3	3	3	3	3	3	3	3	2
CMMS	-	1	1	1	1	1	1	1	1
Facilities Service	2	2	2	2	2	2	2	2	2
Special Programs									1
Engineering	9	10	10	12	12	9	9	9	13
Administration									
Executive Administration	3	3	3	3	3	2	2	2	2
Human Resources	3	2	2	2	2	2	2	3	2
Finance & Accounting	7	6	6	6	6	5	5	5	5
Purchasing & Inventory	3	3	3	3	3	3	3	3	3
Billing	3	3	3	3	3	3	3	3	3
Customer Service	13	9	7	8	7	10	11	11	11
Management Information Systems	8	8	8	8	7	7	7	8	7
AMR Installers	2	-	-	-	-	-	-	-	
Total	**128**	**122**	**116**	**116**	**114**	**113**	**114**	**117**	**116**

New Organizational Structure	2017
Field Services	
Field Services Administration	1
Water Quality	5
Water Lines	6
Site Restoration	4
Wastewater Field Supervision	2
Wastewater Maintenance	12
Wastewater Pumps	8
Instrumentation & Electric	8
Plant Operations	
Operations Administration	1
Water Plant Operations	4
Wastewater Plant Operations	7
Laboratory	5
Technical Services	
Technical Services Administration	2
IT and Records	4
Asset Management	2
Dispatch	2
Facilities	2
Safety & Security	1
Engineering	15
Administration	
Executive Administration	2
Human Resources	3
Finance & Accounting	5
Purchasing & Inventory	3
Customer Communication (Service)	10
Billing	3
Smart Meters	5
	122



Best Places to Work in South Carolina Award

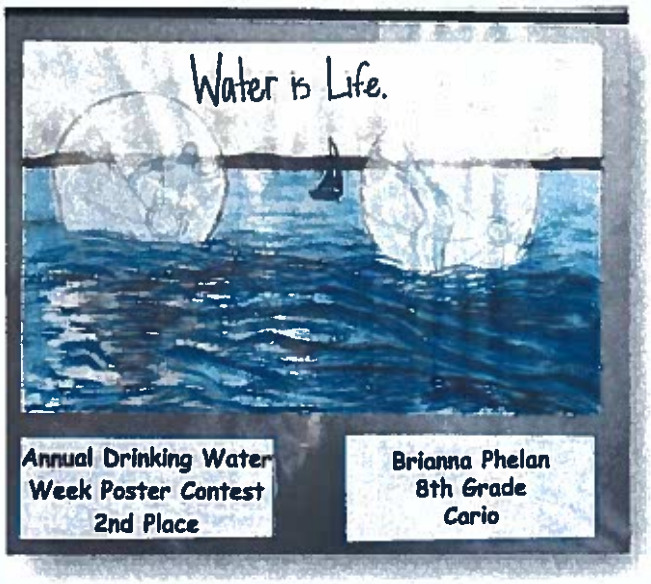
Mount Pleasant Waterworks, for the second year in a row, was recently named as one of the Best Places to Work in South Carolina. The Best Places to Work program, created by SC Biz News, the South Carolina Chamber of Commerce and Best Companies Group, was designed to identify, recognize, and honor employers in the state that benefit the state's economy, workforce, and businesses.

In order to qualify for this award, an extensive two-part survey process was conducted. The first part consisted of evaluating our company's workplace policies, practices, philosophy, systems, and demographics. The second part consisted of an employee survey to measure employee opinions. The combined scores determined the top companies and the final rankings

Seventy companies from across the state were recognized, and Mount Pleasant Waterworks ranked in the top 16 of South Carolina employers for 2017, moving up 8 places on the company rankings list from 2016.

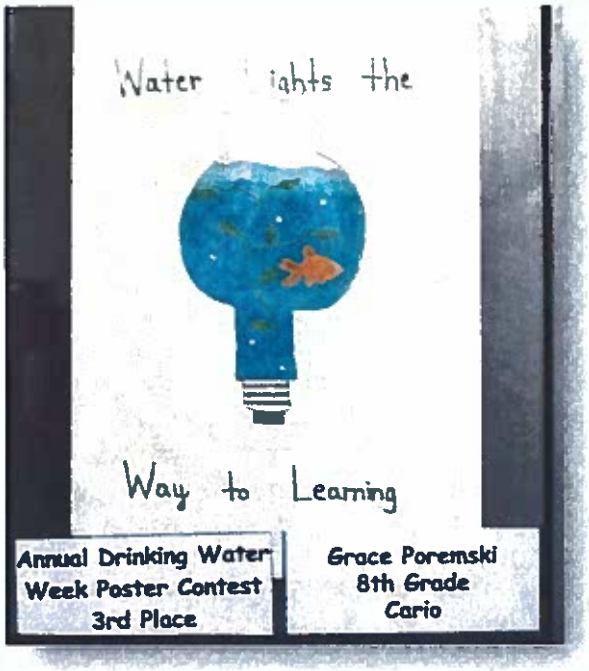
MOUNT PLEASANT WATERWORKS CLEAN WATER

Poster Contest 2017 Second and Third Place Winners



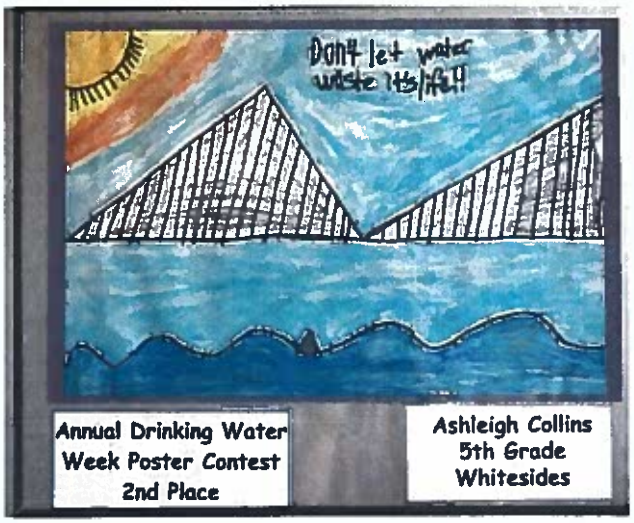
Annual Drinking Water Week Poster Contest 2nd Place

Brianna Phelan
8th Grade
Cario



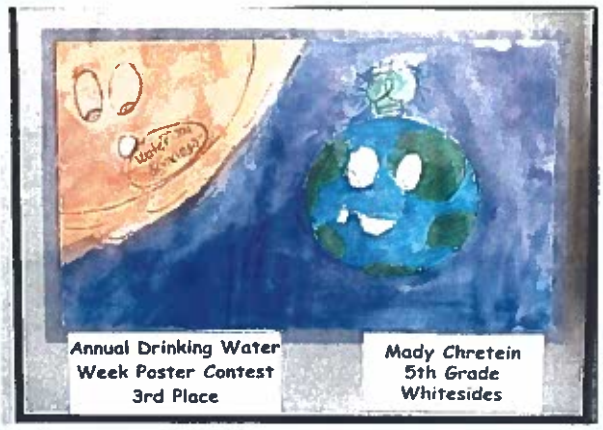
Annual Drinking Water Week Poster Contest 3rd Place

Grace Poremski
8th Grade
Cario



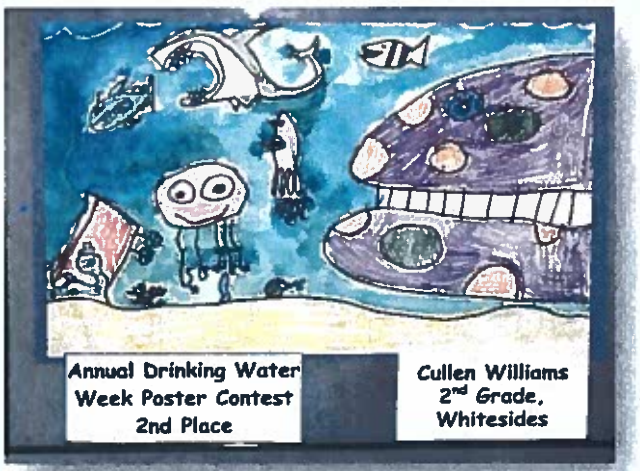
Annual Drinking Water Week Poster Contest 2nd Place

Ashleigh Collins
5th Grade
Whitesides



Annual Drinking Water Week Poster Contest 3rd Place

Mady Chretein
5th Grade
Whitesides



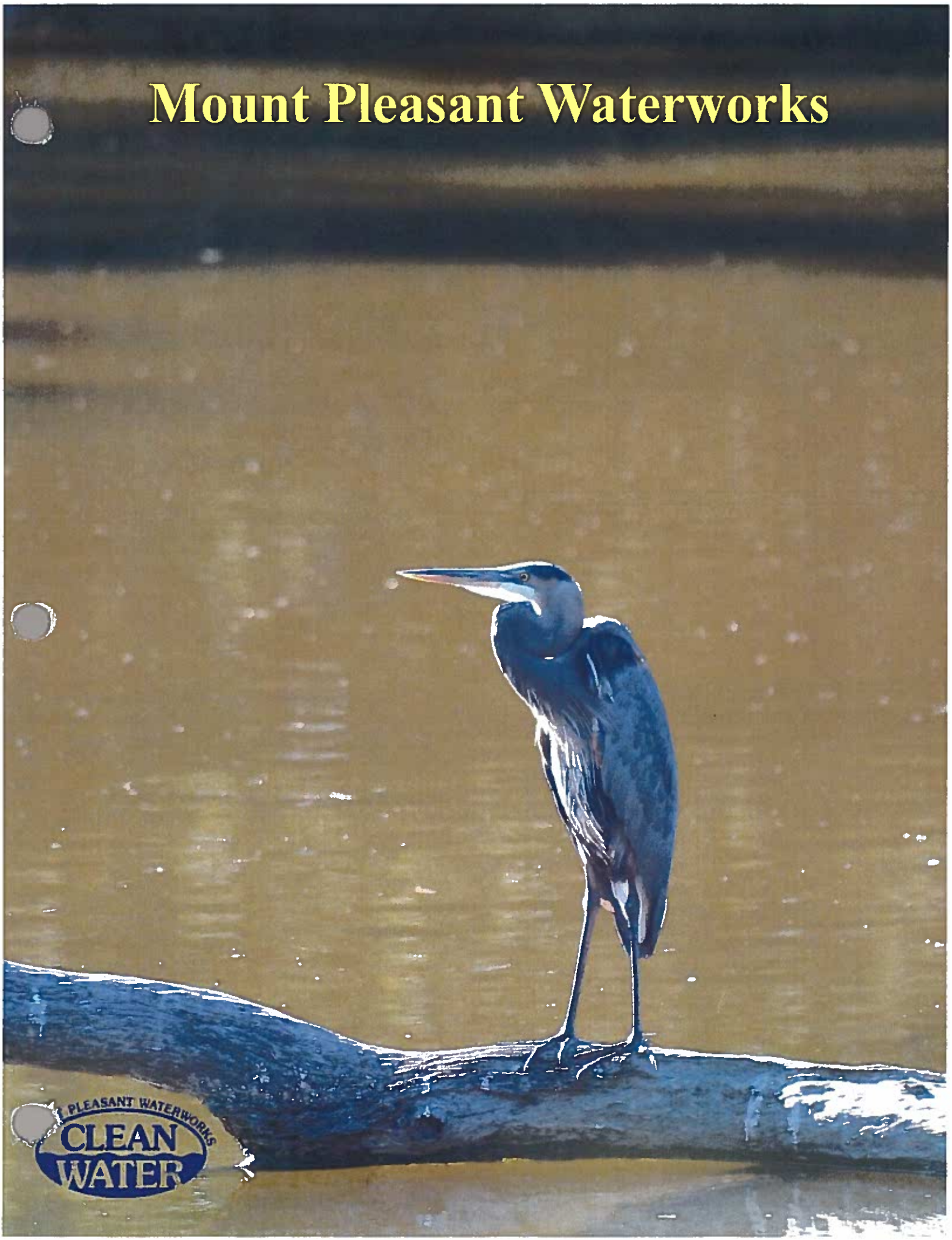
Annual Drinking Water Week Poster Contest 2nd Place

Cullen Williams
2nd Grade,
Whitesides

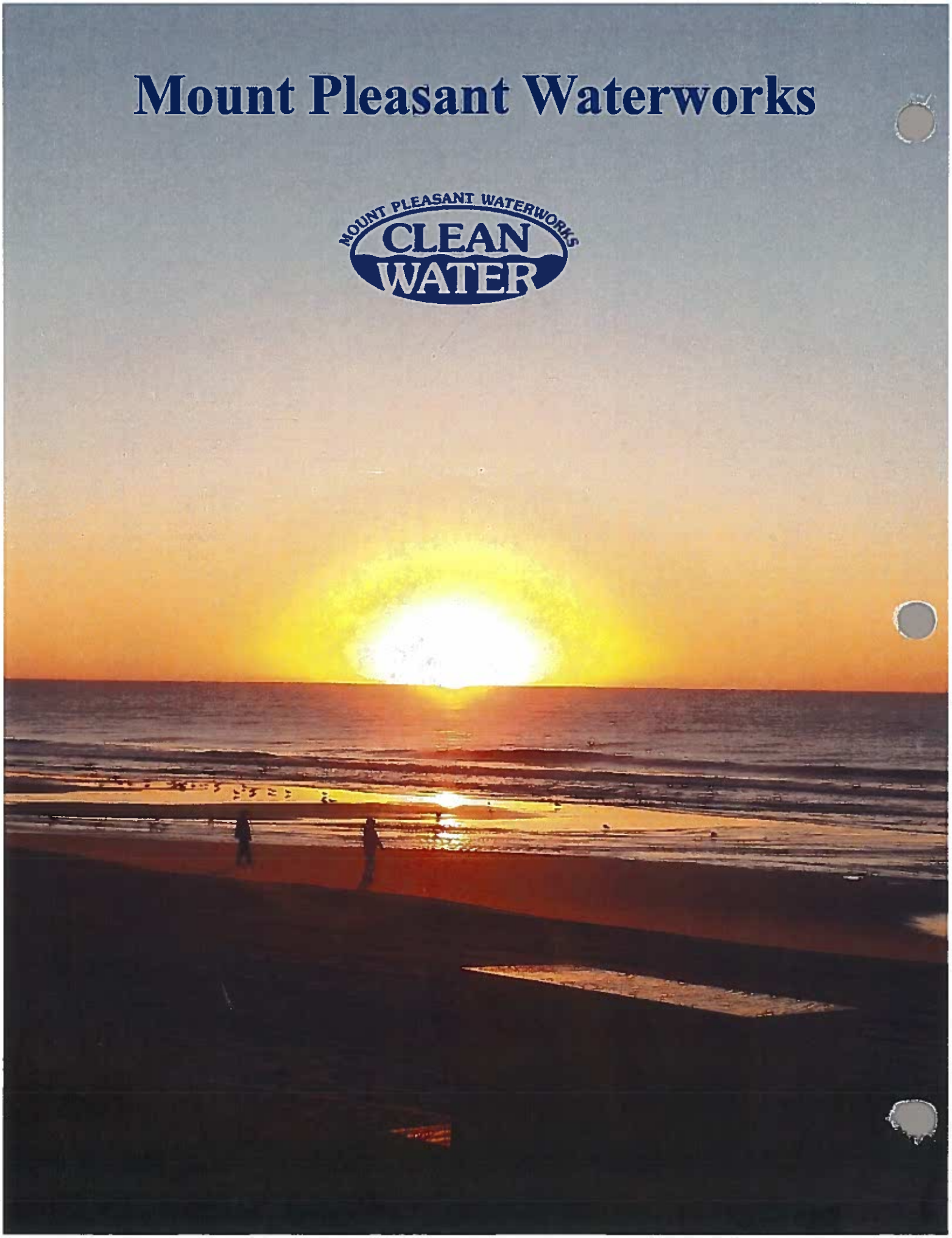
Annual Drinking Water Week Poster Contest 3rd Place

Roxie Ciesar
2nd Grade
Whitesides

Mount Pleasant Waterworks



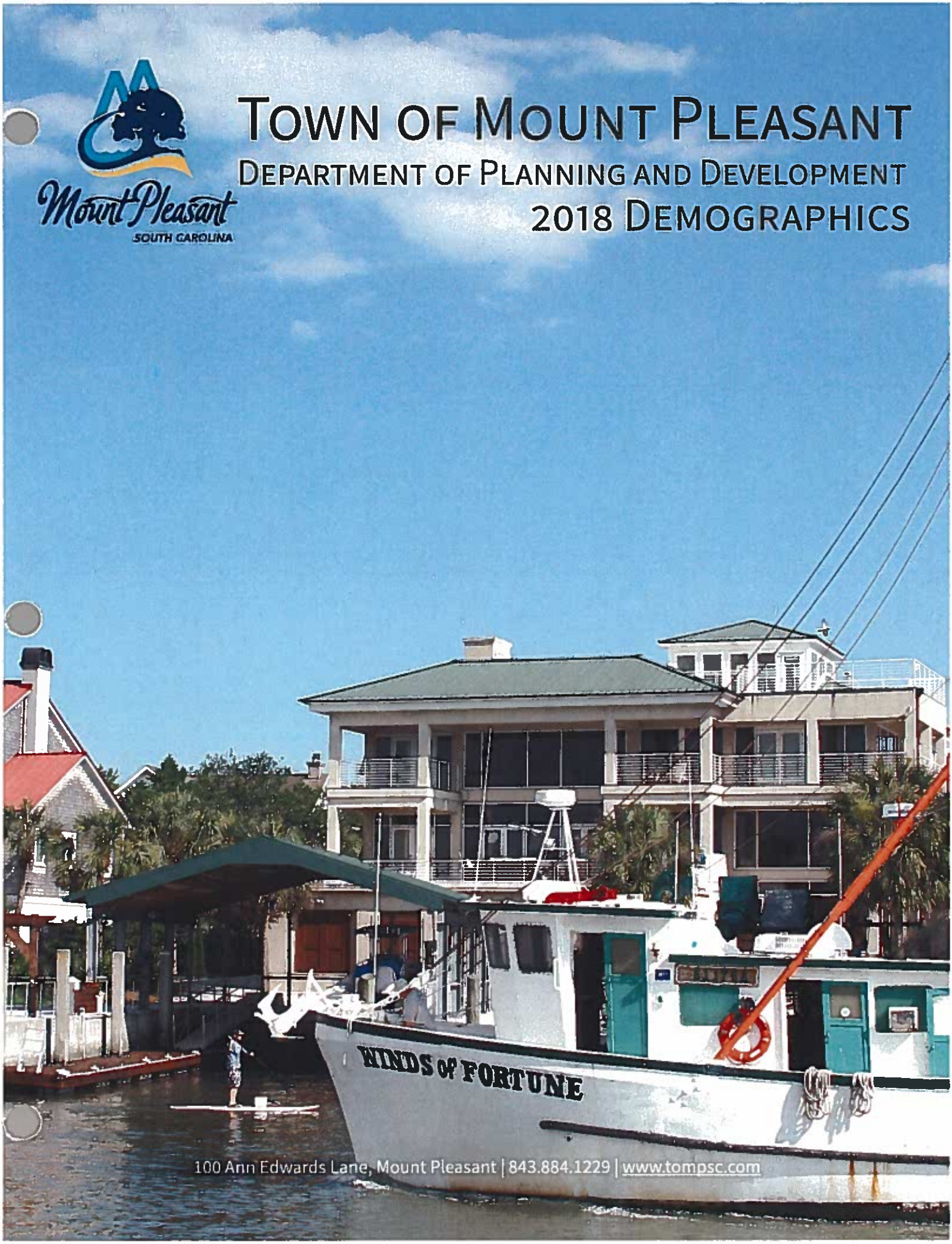
Mount Pleasant Waterworks



Town of Mount Pleasant

Department of Planning and Development

2018 Demographics



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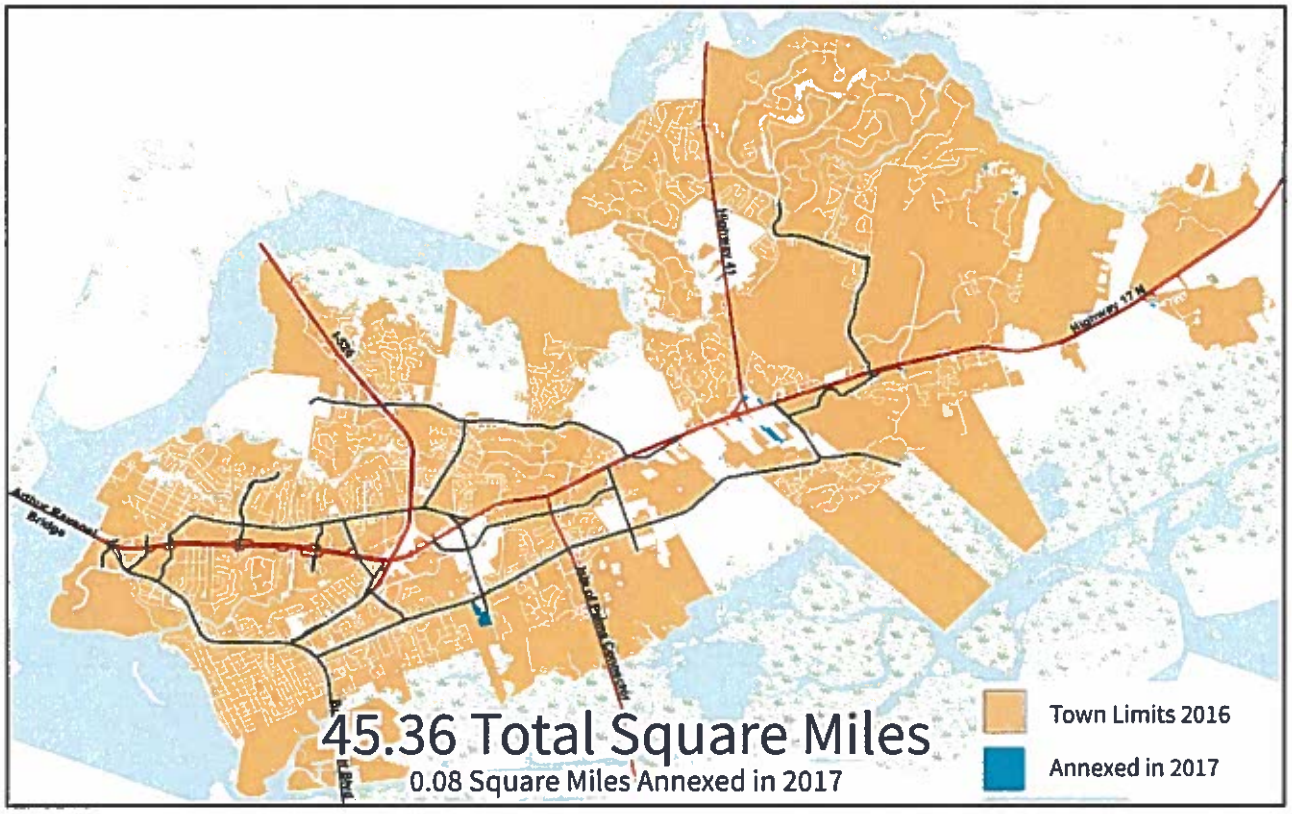
2017 Review



Population

= 10,000 people

2017 Estimate* 85,044

2015 Estimate* 78,988

2010 Census 67,843

*based on number of dwelling units receiving a Certificate of Occupancy times average people per household

Estimated Per Capita Income

Year	Mount Pleasant	Charleston County	South Carolina	United States
1990	$18,931	$16,673	$13,276	$19,572
2000	$30,823	$21,393	$18,795	$21,587
2010	$39,347	$27,831	$22,128	$26,059
2016	$46,622	$33,700	$25,521	$29,829

Source: US Census Bureau, 2016 American Community Survey Estimates

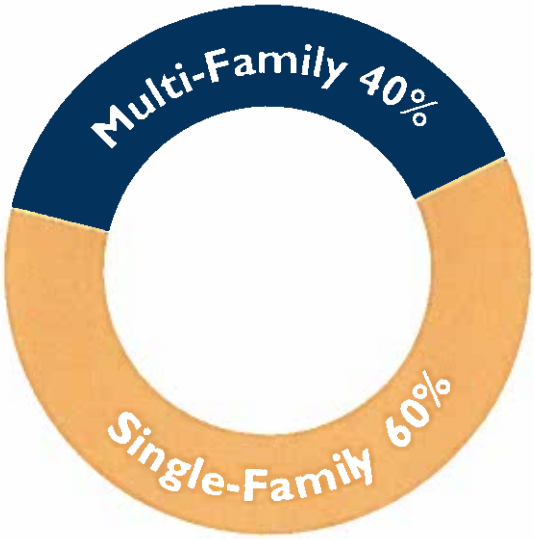
Educational Attainment

	Mount Pleasant	Charleston County	South Carolina
Persons Aged 25+	54,963	266,019	3,269,424
No GED	2.2%	9.8%	14.0%
High School Graduate	13.2%	21.7%	29.5%
Associates Degree	7.2%	8.1%	9.1%
Bachelors Degree	38.4%	26.5%	16.9%
Graduate or Professional Degree	20.9%	14.6%	9.6%

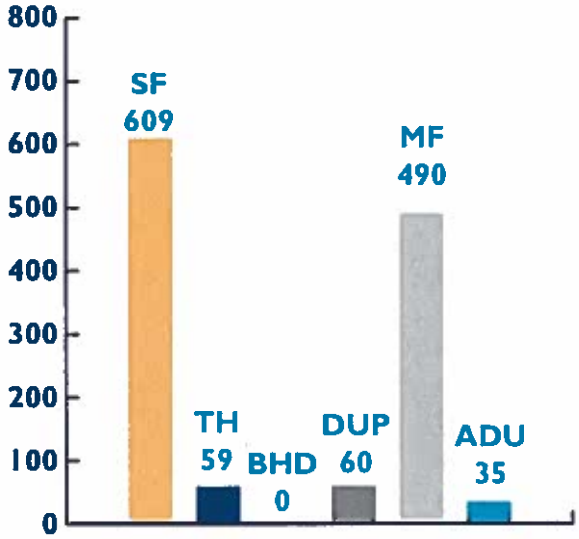
Source: US Census Bureau—2016 American Community Survey Estimates

2017 Review

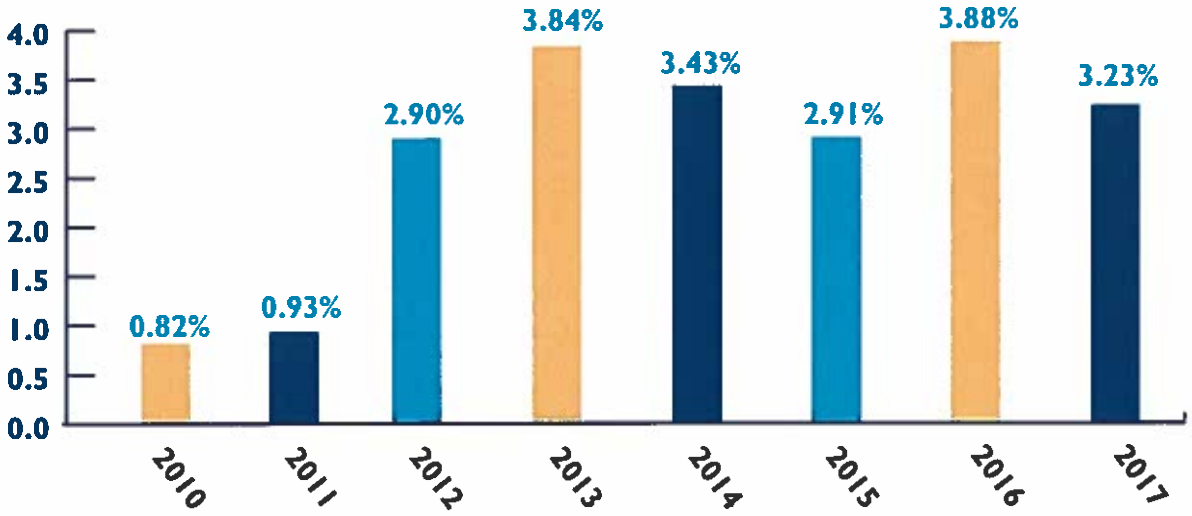
Ratio of Housing Stock



Residential Building Permits



Annual Growth Rate - Dwelling Units



Annual Growth Rate - Dwelling Units				
based on number of dwelling units (DU) receiving a Certificate of Occupancy (does not include annexations)				
Year	**# DU as of Jan 1**	**# DU as of Dec 31**	**Increase in DU**	**Growth Rate**
1997	16,182	16,990	808	4.99%
1998	16,990	17,744	754	4.44%
1999	17,744	19,056	1,312	7.39%
2000	19,056	21,674	2,618	13.74%
2001	21,674	23,198	1,524	7.03%
2002	23,198	24,456	1,258	5.42%
2003	24,456	25,384	928	3.79%
2004	25,384	26,173	789	3.11%
2005	26,173	27,186	1,013	3.87%
2006	27,186	28,365	1,179	4.34%
2007	28,365	29,108	743	2.62%
2008	29,108	29,618	510	1.75%
2009	29,618	30,100	482	1.63%
2010*	30,632	30,882	250	0.82%
2011	30,882	31,169	287	0.93%
2012	31,169	32,072	903	2.90%
2013	32,072	33,304	1,232	3.84%
2014	33,304	34,446	1,142	3.43%
2015	34,446	35,449	1,003	2.91%
2016	35,449	36,826	1,377	3.88%
2017	36,826	38,026	1,200	3.26%

Annual Growth Rate - Population				
*based on estimated population***				
Year	**Population as of Jan 1**	**Population as of Dec 31**	**Increase in Population**	**Growth Rate**
2007	62,509	64,147	1,638	2.62%
2008	64,147	65,271	1,124	1.75%
2009	65,271	66,333	1,062	1.63%
2010*	67,743	68,341	598	0.88%
2011	68,341	69,048	707	1.03%
2012	69,048	71,088	2,040	2.95%
2013	71,088	73,915	2,827	3.98%
2014	73,915	76,612	2,697	3.65%
2015	76,612	78,988	2,376	3.10%
2016	78,988	82,215	3,227	4.09%
2017	82,215	85,044	2,829	3.44%

***** July 2016 Census Population Estimate= 84,170. Note that the discrepancy in the Town estimate and the Census estimate is likely due to the following factors: The U.S. Census calculates population using data on births, deaths, and domestic and international migration whereas the Town estimate is based on a simplified calculation method using the average number of people per household from the 2010 Census multiplied by the number of dwelling units within the Town limits.***

PERMITTED DWELLING UNITS - CALENDAR YEAR

NUMBER OF DWELLING UNITS PERMITTED ANNUALLY (Excludes ADU)

YEAR	SF	TH	**BHD	DUP	MF	TOTAL	RATIO OF SF/MF % SF	% MF
2000	1104	64	0	72	317	1,557	75%	25%
2001	743	30	0	106	361	1,240	62%	38%
2002	864	62	0	0	55	981	94%	6%
2003	822	102	0	0	16	940	98%	2%
2004	917	45	0	0	47	1,009	95%	5%
2005	711	192	0	0	358	1,261	72%	28%
2006	600	228	0	0	158	986	84%	16%
2007	294	57	0	0	8	359	98%	2%
2008	156	62	0	0	293	511	43%	57%
2009	124	38	0	0	5	167	97%	3%
2010	177	46	0	0	0	223	100%	0%
2011	229	29	0	0	513	771	33%	67%
2012	409	67	0	0	595	1071	44%	56%
2013	644	125	0	0	372	1141	67%	33%
2014	622	89	0	4	596	1311	54%	46%
2015	721	136	52	0	235	1144	79%	21%
2016	677	212	24	0	703	1616	56%	44%
2017	**609**	**59**	**0**	**60**	**490**	**1218**	**60%**	**40%**

Starting in 2017 duplexes count as single family units

NUMBER OF DWELLING UNITS PERMITTED MONTHLY - 2017

MONTH	SF	TH	**BHD	DUP	MF	ADU	TOTAL	Senior Living Indep	Dep
January	45	4	0	0	0	4	53	0	130
February	45	6	0	0	0	5	56	72	0
March	67	28	0	0	0	6	101	73	0
April	73	3	0	0	0	7	83	0	125
May	95	0	0	0	390	2	487	80	80
June	52	0	0	9	0	2	63	0	0
July	34	0	0	34	0	2	70	8	0
August	64	0	0	0	0	1	65	0	0
September	38	7	0	0	0	2	47	0	0
October	30	2	0	0	0	1	33	0	0
November	34	0	0	2	0	2	38	0	0
December	**32**	**9**	**0**	**15**	**100**	**1**	**157**	**0**	**0**
TOTAL	**609**	**59**	**0**	**60**	**490**	**35**	**1,253**	**233**	**335**

****Big House Dwelling**

Ratio of Housing Stock by Unit Type - 2017						
	Single-Family Detached	Single-Family Attached	Single-Family Total	Multi-Family Condos	Multi-Family Apartments	Multi-Family Total
Units Built & Under Construction	64.55%	7.47%	72.01%	11.47%	16.52%	27.99%
Total Approved Units (includes Built & UC units)	65.01%	8.17%	73.18%	11.19%	15.63%	26.82%

COMMERCIAL PERMITS - FISCAL YEAR			
Year	*Commercial New Construction*	*Commercial Repairs / Additions*	*Total*
FY 04-05	34	273	307
FY 05-06	70	217	287
FY 06-07	72	254	326
FY07-08	30	244	274
FY08-09	18	183	201
FY 09-10	18	164	182
FY 10-11	17	167	184
FY 11-12	25	226	251
FY 12-13	26	245	271
FY 13-14	45	275	320
FY 14-15	45	231	276
FY 15-16	49	219	268
FY 16-17	25	253	278
FY 17-18	4	128	132

Community Profile

Demographics			
Sex & Age	2000	2010	2015*
Total Population	47,609	67,843	74,952
Male	47.9%	48.1%	48.1%
Female	52.1%	51.9%	51.9%
Median Age	35.9	39.1	39.2
% Population 18 years and under	25.8%	24.1%	23.9%
% Population 65 years and over	10.0%	12.2%	14.2%
Households			
Total Housing Units	20,197	30,674	32,133
Average Household Size	2.47	2.43	2.48
Average Family Size	2.99	2.99	3.05
Race			
Total Population	47,609	67,843	74,952
One Race	99.2%	98.9%	98.5%
White	90.2%	91.3%	91.7%
Black or African American	7.3%	5.1%	4.6%
American Indian & Alaska Native	0.2%	0.2%	0.1%
Asian	1.2%	1.6%	2.0%
Some other race	0.4%	0.6%	0.1%
Social Characteristics			
Housing Characteristics			
Total Housing Units	20,197	30,674	32,133
Occupied Housing Units	19,025	27,742	30,007
Owner-occupied	74.0%	72.6%	71.4%
Renter-occupied	26.0%	27.4%	28.6%
Vacant Housing Units	1,172	2,932	2,126
Avg. Household Size - Owner-occupied	2.61	2.55	2.59
Avg. Household Size - Renter-occupied	2.05	2.1	2.21

Educational Attainment	2000	2010	2015*
Population 25 years and over	32,430	46,641	52,567
High School Graduate (or equivalent)	14.1%	12.0%	12.9%
Associate Degree	7.7%	7.9%	6.8%
Bachelor's Degree	33.7%	39.7%	37.8%
Graduate or Professional Degree	18.9%	23.5%	21.0%
High School Graduate or higher	94.0%	97.6%	97.6%
Percent bachelor's degree or higher	52.6%	63.2%	58.8%
Place of Birth			
Total Population	47,386	68,112	74,952
Native (U.S.)	95.7%	97.1%	94.7%
Foreign Born	4.3%	2.9%	5.3%
Economic Characteristics			
Employment			
Population 16 years and over	36,578	53,187	58,724
In labor force	69.9%	74.3%	69.9%
Civilian labor force	69.1%	74.1%	69.3%
Employed	67.5%	69.0%	65.6%
Unemployed	1.5%	5.1%	3.6%
Armed Forces	0.9%	0.2%	0.6%
Not in labor force	30.1%	25.7%	30.1%
Commuting to Work			
Workers 16 years and over	24,136	36,307	38,178
Mean Travel Time to Work (minutes)	22.9	20.8	22.1
Income			
Median Household Income	$61,054	$70,363	$77,638
Median Family Income	$71,165	$86,463	$102,068
Per Capita Income	$30,823	$39,347	$44,071
% Families below poverty level	3.2%	5.3%	5.0%
% Individuals below poverty level	5.0%	8.0%	7.4%
Median Home Value - Owner-occupied	$185,500	$334,800	$372,000
Median Monthly Gross Rent	$838	$1,212	$1,299

Source: American Community Survey.

*2015 survey data is estimated by the U.S. Census Bureau

Housing

Since **2013** the Town Building Inspections Division has been accredited by the **International Accreditation Service (IAS)** for its strong commitment to community, quality, and efficiency.

	2000	2010	2015*
Housing Trends			
Number of Dwelling Units	20,197	30,674	32,133
Population per Household	2.47	2.43	2.48
Median House Value (MHV)	$185,500	$334, 800	$372,000
Percentage Change (MHV)	+91%	+80%	+11%
Income Trends			
Median Household Income	$61, 054	$70,635	$77,638
Percentage Change	+58%	+16%	+9%
Rent Trends			
Median Rent	$838	$1,212	$1,299
Percentage Change	+56%	+45%	+7%
Vacancy Trends			
Vacant Housing Units	1,172	2,932	2,126
Vacant seasonal, occasional use, or recreational units	157	927	N/A
Homeowner Vacancy rate	1.5%	3.1%	1.7%
Rental Vacancy Rate	8.7%	10.3%	5.7%

Source: American Community Survey.

*2015 survey data is estimated by the U.S. Census Bureau

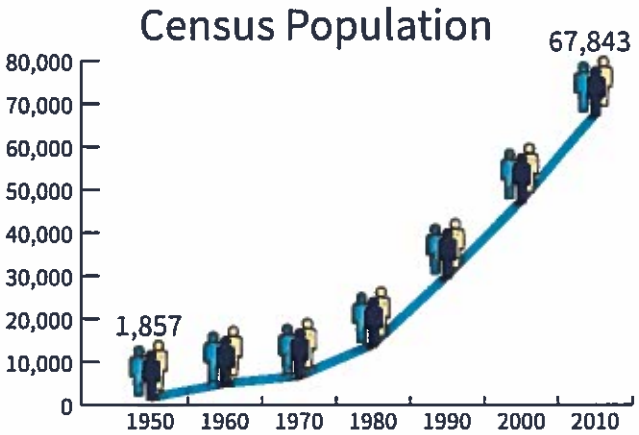
Population

Decennial Census

Year	Population	Percentage Change
1950	1,857	-
1960	5,116	175.5%
1970	6,879	34.5%
1980	14,209	106.6%
1990	30,108	111.9%
2000	47,609	58.1%
2010	67,843	42.5%

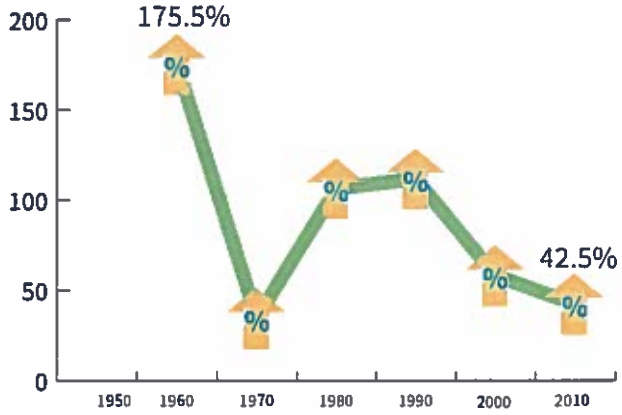
Source: US Census Bureau

Census Population



Source: US Census Bureau

Percentage Change



Source: US Census Bureau

EDUCATION

8 Elementary Schools

4 Middle Schools

2 High Schools

Town of Mount Pleasant Public Enrollment by School							
Elementary Schools	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Belle Hall	781	769	692	704	704	704	760
James B. Edwards	700	637	561	613	673	676	630
Jennie Moore	725	750	709	801	1,129	1,128	1,161
Laurel Hill Primary	1,143	1,114	1,075	1,079	1,004	1,019	665
Mount Pleasant Academy	500	537	517	561	568	576	613
Mamie Whitesides	642	658	595	695	691	721	726
Charles Pinckney	1,100	1,161	1,164	1,296	1,141	1,067	774
Carolina Park	-	-	-	-	-	-	683
Middle Schools							
Laing	517	604	605	769	1105	1,199	1,261
Moultrie	879	891	896	797	779	835	793
Thomas C. Cario	1,376	1,357	1,353	1,313	1,237	1,222	1,195
East Cooper Montessori (1st to 8th)	196	259	250	264	300	352	376
High School							
Wando	3,100	3,565	3,579	3,860	4,060	4,068	3,984
Oceanside	-	-	-	-	-	-	530

Source: Charleston County School District

1 Higher Education

Trident Technical College—Mount Pleasant Campus

In 2011, Trident Technical College, a two-year public technical college, opened its doors in Mount Pleasant. Programs include Associate Degrees in Arts, Science, and General Business; and Certificates in Business, Computer Aided Design, Customer Service, and Microcomputer Expert User.

EMPLOYMENT

Unemployment Rate		
Year	Town	State
1990	1.9%	4.7%
1995	2.0%	5.1%
2000	1.3%	3.6%
2005	2.3%	6.7%
2010	5.1%	11.2%
2015	3.3%	5.5%
2016	2.8%	3.9%

Source: SC Department of Commerce; US Census Bureau; US Department of Labor

National Unemployment Rate for 2017

4.4%

Town Unemployment Rate for 2017

2.8%

Regional Job & Market Forecast

The 2018 – 2019 Economic Forecast for the Charleston region indicates continued strong growth across the region. The national, state and local economies are all expected to grow over the next 18 to 24 months, with national GDP growth projected at some of the strongest rates in years. Locally, the region continues to grow and attract major industry, particularly in the Advanced Manufacturing, Logistics and Transportation and IT sectors. Additionally, the area's major economic engines continue to grow and expand. The Economic Outlook Board does not foresee anything on the horizon to slow the job and population growth fueling the local region's economy for the next two years.

The Port of Charleston will experience a strong increase in container volumes as global markets expand and in anticipation of the deepening of the Charleston Harbor and the expansion of the Panama Canal. The number of automobiles shipped through the port will remain steady for 2018 before expanding in 2019 as the Volvo plant in Berkeley County begins production.

The region's real estate market will continue to expand, although not at the rate needed to accommodate population growth. The region needs an average of 7,500 new housing units added each year to accommodate the growing population. Strong anti-growth sentiment across the region must be balanced with the need for housing at income levels that will help stem the rising cost of housing across the region. Rising housing costs are pricing many out of the market and becoming an employee retention issue for area employers. The result is compounding the problem of filling a workforce pipeline, as well as adding congestion to overburdened transportation corridors each day as residents are forced to commute longer distances to and from work because they cannot afford to live near jobs. There is growing awareness of the linkage between these three issues – congestion, jobs and housing. Now the region's challenge is implementing solutions to solve them.

Source: *2018-2019 Economic Outlook Forecast: Charleston Metro Chamber of Commerce*

Neighborhood Profile

*Units built refers to the number of units under construction and completed by December 31, 2017

Single Family Homes

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Annie Laura Lane (Hurd Subdivision)	12	12	R-3	29466
Avian Park	25	25	R-1	29464
Back Bay Village	58	57	R-1	29464
Baytree	23	23	R-3	29464
Bayview Acres	150	150	R-1	29464
Bees Crossing	0	90	R-4	29429
Belle Hall	1013	1126	PD	29464
Bennett (near Rifle Range and Bowman)	8	12	R-1	29464
Boatyard	10	11	R-1	29464
Braemore	29	31	R-1	29464
Brickyard Plantation	825	828	PD	29466
Bridlewood	25	25	R-1	29464
Brookgreen Meadows	148	150	R-1/R-2 /R-3	29464
Bulls Bay	3	51	RC-3	29429
Cadberry	8	8	R-1	29464
Candlewood	124	124	R-2	29464
Cardinal Hill	10	25	PD	29466
Carol Oaks	46	46	RPH	29466
Carolina Park	711	1400	PD	29466
Carriage Hill Landing	30	30	PD	29466
Cassina Heights	56	56	R-1	29464
Cassina Plantation	34	34	PD/R-1	29464
Center Lakes	75	75	PD	29464
Central Mount Pleasant	9	419	PD	29464
Chadbury Village	87	87	PD	29466
Charleston National	687	777	PD	29466
Chelsea Park	114	114	PD	29464

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Coleman Walk	0	44	R4	29464
Cooper Estates	313	313	R-1/R-3	29464
Coopers Landing	80	80	R-1	29464
Coopers Point	23	23	R-1	29464
Copahee Landing	26	27	PD	29466
Covington at Park West	5	30	R-1	29466
Creekside	164	164	R-1	29464
Crown Pointe	79	79	PD	29466
Commonwealth	80	81	R R / RC-1	29466
Darrell Creek	234	291	RR /R-1	29466
Daybreak	13	20	R-1	29464
Dunes West	1784	1857	PD/R-1	29466
Earl's Court	21	26	AB	29464
East Crossing	67	67	PD	29466
Fairway Place	36	36	PD	29464
Fiddlers Marsh	63	63	R-2	29464
Fourth Ave	0	6	PD	29464
Fox Pond	82	82	R - 3 / RPH	29464
Foxchase	4	4	R-1	29464
Freeman	19	19	R-1	29464
Fulton	19	31	PD	29466
Glen Lake	107	107	R-2	29464
Goblet	0	28	R-1	29464
Greenhill	161	200	R-2	29464
Gregorie Ferry Enclave	18	18	RPH	29466
Groves	196	196	R-1	29464
Groves Manor	13	13	R-1	29464
Hamlet Square	40	40	PD	29464
Hamlin Plantation	601	610	PD	29466
Harborgate Shores	270	270	R-2	29464

Neighborhood Profile

*Units built refers to the number of units under construction and completed by December 31, 2017

Single Family Homes

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Harbor Watch	54	67	PD	29464
Hamlin Oaks	12	15	R-4	29466
Heritage	101	101	R-1	29464
Hermitage	56	56	R-1	29464
Heron Point	64	64	R-2	29464
Hickory Shadows	127	127	R-3	29464
Hidden Cove	247	247	R-1	29464
Hilliardville	10	11	R-1	29429
Hidden Lakes	225	225	PD	29464
Hobcaw Creek Plantation	257	257	R-1	29464
Hobcaw Point	373	373	R-1	29464
Home Farm	14	14	R-1	29464
Horlbeck Creek	83	83	PD	29466
I'On	752	762	PD	29464
Ivy Hall	251	251	PD	29466
Lakeshore	79	82	PD	29464
Landings Run	62	62	R-1	29464
Laurel Grove	76	76	RPH	29466
Laurel Lakes	66	69	R-3	29464
Lazy Acres	9	9	R-1	29464
Liberty Hill Farm	0	264	CL	29464
Lieben Park	102	102	PD	29466
Longpoint	681	697	PD	29464
Magnolia Village	53	53	R-4	29466
Mallard Lakes	85	85	R-3	29464
Marsh Harbor	90	90	PD	29464
Mathis Ferry Place	0	7	R2	29464
McAdams Court	11	11	RPH	29466
Molasses Creek	142	145	R-1	29464
Moores Landing	0	60	PD-CD	29466
Moss Park	38	38	R-1	29464
Moultrie Park at Belle Hall	24	24	RPH	29464

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
New Parrish Village	24	24	RPH	29464
North Point	57	57	PD	29464
Oak Park	39	39	R-2	29464
Oakhaven	229	229	R-1/R-3	29464
The Oaks	28	53	R-2	29464
Old Georgetown Crossing	19	19	RPH	29464
Farm at Old Georgetown	0	31	PD	29466
Old Mount Pleasant	1630	1729	R-1/R-2 /R-3	29464
Old Village Landing	103	114	PD	29464
Olde Park	101	114	R-1	29464
On the Harbor	14	21	R-1	29464
Oyster Point	241	474	CL	29466
Parish Place	144	144	R-2	29464
Park West	1903	2059	PD	29466
Patriots Province	87	87	PD	29464
Pepper Plantation	24	40	PD	29466
Phillips Community	2	2	CC	29466
Phillips Creek	0	33	CC	29466
Phillips Manor	23	23	PRH	29466
Phillips Park	22	22	RPH	29464
Pinckney Place	29	30	PD	29464
Pirates Cove	45	45	RPH	29464
Pleasant Pines	37	37	R-1	29464
Point Pleasant	130	130	R-2	29464
Pointe at Primus	0	72	PD	29466
Porchers Preserve	52	56	PD	29466
Quail Hollow	105	105	PD	29466
Queen's Row	30	30	RPH	29464

Neighborhood Profile

*Units built refers to the number of units under construction and completed by December 31, 2017

Single Family Homes

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Queen's Court	22	22	R-3	29464
Raven's Run (ALL)	84	92	R-1	29466
Remley's Point	146	150	R-1	29464
Rice Planters Point	19	19	R-1	29464
Rifle Range Road	84	118	CC /R-1	
River Reach	20	23	R-1	29464
RT Country Club	620	800	PD	29466
Rivertowne (includes Planters Pointe)	973	1250	PD	29466
River Watch	24	29	R-1	29464
Rosemead	98	98	R-2	29464
Salt Grass Pointe	42	42	R-2	29464
Scott's Creek	67	71	R-1	29464
Sea Island Crossing	16	18	PD	29464
Sea Island Hamlet	0	12	R1	29464
Seaside Farms	504	509	PD	29464
Seaside Farms Proper	12	71	PD	29464
Shellpoint	91	102	R-2	29464
Shem Creek Area	27	27	R-1/R-2	29464
Shem Drive	12	12	AB	29464
Shemwood I	110	110	R-1/R-2	29464
Shemwood II	107	107	R-3	29464
Simmons Point	35	35	PD	29464
Six Mile (in Town limits)	34	34	CC	29466
Snee Farm	1020	1020	R-1/PD RPH	29464
Snee Farm Village	0	42	PD	29464

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Somerset Oaks	27	27	RPH	29466
Somerset Point	52	52	R-1	29464
Sunchaser	16	16	CC	29466
Stratton on the Sound	46	148	R-2	29466
Sullivan's Pointe	21	21	AB	29464
Sweetgrass	254	254	PD	29464
Sweetgrass Village	33	33	RPH	29466
Tidal Walk	118	119	PD	29464
Tupelo	304	313	PD	29466
Village	21	21	R-1	29464
Village Park	10	12	NC	29464
Village at Carol Oaks	0	3	RPH	29466
Village at Heron Lake	33	33	RPH	29464
Wakendaw	403	403	R-1	29464
Wakendaw Place	21	27	R-2	29464
Wando East	95	95	R-1	29464
Wando Farms	10	14	PD	29466
Wando Lakes	96	96	R-1	29464
Wando Park Blvd - Haven	4	4	PD	29464
Warrick Oaks	12	12	NC	29464
Watermark	139	156	PD	29464
Waters Edge	161	161	PD	29466
West Point	122	122	PD	29466
Wexford Park	20	20	PD	29466
Wharf Indigo	16	16	R-1	29464
White Hall Terrace	91	104	R-1	29466

Neighborhood Profile

Townhomes

*Units built refers to the number of units under construction and completed by December 31, 2017

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Baytree	212	212	TH	29464
Beaumont	110	110	PD	29464
Bowman Park	36	37	PD	29464
Carolina Park	76	100	PD	29466
Carolina Walk	49	49	PD	29464
Cottingham	39	39	TH	29464
Cove Inlet	146	146	TH	29464
Dunes West	216	455	PD	29466
Eastwood	33	33	TH	29464
Etiwan Pointe	107	118	PD	29464
Hamlin Park	103	103	PD	29466
Hamlin Plantation	275	277	PD	29466
Heritage Village	150	150	TH	29464
Hickory Shadows	25	25	TH	29464
Hunters Run (Wando East)	59	59	MF	29464
Hunters Trace	60	60	MF	29464
Lake Hunter Commons	56	56	MF	29464
Liberty Hill Farm	0	66	CL	29466
Marais at Seaside Farms	106	106	PD	26464
Marsh Pointe	50	50	TH	29464
Myrtle Acres	14	14	MF	29464
Oyster Point	76	118	CL	29466
Oyster Point Townhouses	92	98	CL	29466
Park West	342	545	PD	29466
Phillips Park	3	3	TH	29464
Reserve at Wando East	39	39	MF	29464

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Sandpiper Point	61	61	PD	29464
Sea Island Hamlet	0	12	R1	29464
Village at Carol Oaks	32	38	TH	29466
Vincent Drive Mixed Use	0	8	AB	29464
Village Park	2		NC	29464
Wando East	171	171	MF	29464
Wando Park two family dwellings	4	4	PD	29464
Whitesides Park at Myrick Rd	13	13	TH	29464
Waterway Arms	64	64	TH	29464

Neighborhood Profile

*Units built refers to the number of units under construction and completed by December 31, 2017

Multi-Family Condo Units

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
218 Venning	4	4	R-2	29464
656 Coleman	45	54	PD	29464
Bay Club	162	162	MF	29464
Baytree Commons	6	6	MF	29464
One Belle Hall	59	59	PD	29464
Cambridge Lakes	108	108	MF	29464
Dunes West	469	520	PD	29466
East Bridge Town Lofts	200	200	PD	29464
Etiwan Point	52	52	PD	29464
Fairmont	48	48	MF	29464
Greystone	50	50	PD	29464
Hibben Ferry II	64	64	MF	29464
Lansing East	20	20	MF	29464
Legends, The	200	200	PD	29466
Long Grove Condos	272	272	PD	29464
Marsh Grass	16	16	MF	29464
Marsh Harbor	7	7	MF	29464
Meadows	36	36	RTH	29464
Meridian	328	328	R-1	29466
Montclair	240	240	PD	29464
Parkwest		886	PD	29466
Tennyson Quads	49			
Planter's Place	36	36	MF	29464
Remington Forest	62	62	PD	29464
Renaissance	100	100	PD	29464
Retreat Charleston National	97	154	PD	29466

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Sandpiper Point	59	59	PD	29464
Sawyers Landing	15	17	AB	29464
Sea Gull Villas	10	10	MF	29464
Shelmore Village	41	41	AB	29464
Simmons Point	56	56	PD	29464
Snee Farms Lakes	148	148	MF	29464
South Hampton Pointe	240	240	PD	29464
Tides	175	175	PD	29466
Ventura Villas Condos	160	160	RTH	29464
Village Creek	132	132	MF	29464
Waterford	52	52	RTH	29464
Winward Point	24	24	PD	29464
Woodscape	24	24	MF	29464

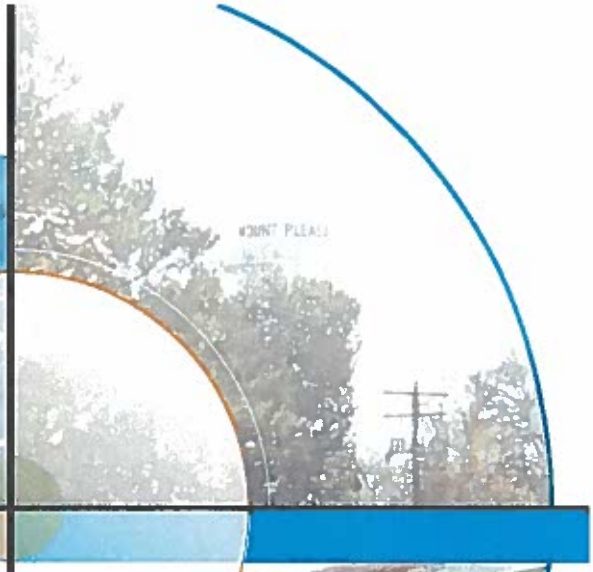
Neighborhood Profile

*Units built refers to the number of units under construction and completed by December 31, 2017

Multi-Family Apartment Units

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Alexan	240	240	PD	29464
Anchorage	128	128	MF	29464
Atlantic	0	224	AB	29464
Boulevard	425	430	AB	29464
Bridgeside	324	573	PD	29464
Carolina Park	250	530	PD	29466
Central Mount Pleasant	442	405	PD	29464
Crickentree	132	132	MF	29464
Edgewater Plantation	360	360	PD	29464
Edmund Jenkins Homes	27	27	R-2	29464
Gregory Ferry Landing	240	240	PD	29466
Harbour Pointe	358	358	PD	29464
Hibben Ferry	304	304	MF	29464
Indigo Square	438	456	PD	29464
Oyster Park	269	269	AB	29464
Oakleaf	108	108	MF	29464
Paces Watch	232	232	MF	29464
Parish Place	127	127	MF	29464
Preserve at Belle Hall	85	85	PD	29464
Rivers Walk	348	348	R-1	29464
Riverwood	108	108	MF	29464
Riveria at Seaside Farms	252	252	PD	29464
Runaway Bay	208	208	MF	29464
Shemwood II	56	56	MF	29464
Six Mile Apartments	56	56	MF	29464
Snee Farm Village	0	12	PD	29464

Subdivision	Units Built *	Units Approved	Zoning	Zip Code
Somerby	33	46	PD	29466
Thickett	120	120	MF	29464
Von Kolnitz at Mathis Ferry	58	58	MF	29464
Watermark	244	274	PD	29464
Whilden St.	12	12	R-2	29464
Woodfield	258	258	PD	29464



Mount Pleasant Waterworks

COMPREHENSIVE UTILITY MASTER PLAN

Five Year Update

Revised Final Report

JANUARY 2016

CDM Smith

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Abbreviations

Acronym	Definition
AACE	American Association of Cost Engineers
ADD	average day demand
ASR	aquifer storage and recovery
Center St WWTP	Center Street Wastewater Treatment Plant
CIP	Capital Improvements Program
CWS	Charleston Water System
ENR CCI	Engineering News – Record Construction Cost Index
EPS	extended period simulation
fps	feet per second
ft	feet
GIS	Geographical Information Systems
gpd	gallons per day
gpd/REU	gallons per day per REU
gpm	gallons per minute
HDPE	high density polyethylene
I/I	infiltration/inflow
MDD	maximum day demand
MG	million gallons
mgd	million gallons per day
MPW	Mount Pleasant Waterworks
PE	polyethylene pipe
PHD	Peak Hour Demand
PS	pump station
psi	pounds per square inch
PVC	polyvinyl chloride
RAS	return activated sludge
RCP	reinforced concrete pipe
REU	residential equivalency unit
Rifle Range Rd WWTP	Rifle Range Road Wastewater Treatment Plant
RO	reverse osmosis
SCADA	Supervisory Control and Data Acquisition
SCDHEC	South Carolina Department of Health & Environmental Control

SSOs	sanitary sewer overflows
TDH	total dynamic head
Town	Town of Mount Pleasant
VFD	variable frequency drive
WTP	Water Treatment Plant

Executive Summary

E.1 Introduction

Mount Pleasant Waterworks (MPW) provides water and wastewater service to a population of over 73,000 within the Town of Mount Pleasant (Town) and other unincorporated areas of Charleston County. In 2010, CDM Smith and MPW completed a comprehensive utility master plan that standardized the utility planning and design criteria and consolidated the planning efforts for water source and treatment, water distribution and transmission, wastewater treatment, wastewater collection, and reuse/reclaimed water. MPW subsequently commissioned CDM Smith to develop a 5-year update to the 2010 Master Plan including an updated short- and long-term coordinated capital improvement plan.

This 2015 Comprehensive Utility Master Plan update is coordinated with the *Town of Mount Pleasant Comprehensive Plan 2009-2019 - 2014 Update* (2014 Comprehensive Plan Update) and addresses changes to land use planning within the past five years. Updated recommendations for improvements to source water and treatment, water distribution and transmission, wastewater treatment, and wastewater collection and conveyance system are provided for near-term projected growth (approximately 5-years), mid-term projected growth (approximately 10-years), and buildout of the service area. The conclusions and recommendations from the 2010 Master Plan regarding reuse/reclaimed water have not changed since the previous analysis, and therefore, are not discussed in this report.

The following is a brief description of the methods, evaluation, and results of the master planning efforts conducted for this study. A more detailed description of the information provided herein can be found in the report sections that follow.

E.2 Water Demand and Wastewater Flow Projections

MPW uses residential equivalency units (REUs) as a basis to determine current and future water demands and wastewater flows. An REU is defined as a unit of development (residential, commercial, industrial, or other type) which is equivalent to the average water usage or wastewater flow for a typical residential customer.

E.2.1 Future REU Projections

REU projections were developed based on future land use in the 2014 Comprehensive Plan Update. The most significant change to the land use plan is the extension of the Town's planning area to include additional unincorporated areas of Charleston County east of Guerins Bridge Road to Steed Creek Road (**Figure ES-1**). The REU projections assume that the MPW service area will also be expanded to match the Town's planning area boundary. The projected future additional REUs based on the 2014 land use plan are approximately 15 percent greater than the REUs estimated in the 2010

Master Plan. A total of approximately 65,600 REUs are projected at buildout. Of these, the expanded portion of the service area accounts for approximately 2,600 REUs.

Figure ES-1. MPW Service Area

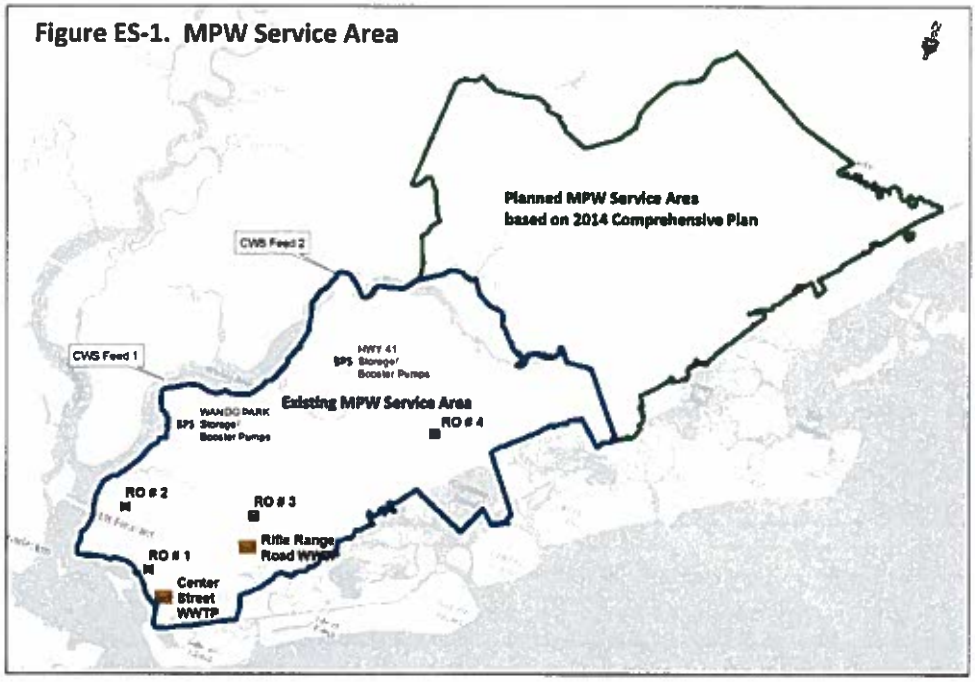
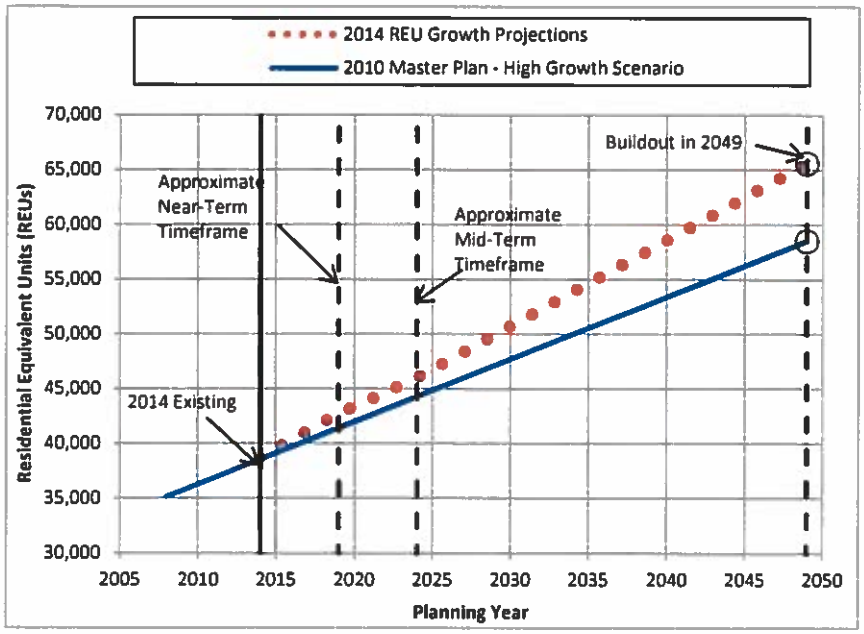


Figure ES-2 presents the projected REU growth trend through buildout, as compared with the projections in the 2010 Master Plan. Based on MPW's planned development information, growth is assumed to be 2.0 percent per year for existing through near-term planning period; 1.5 percent per year for near-term through mid-term planning period; and 1.4 percent per year for mid-term through buildout planning period. It is assumed the MPW service area will be extended to the area east of Guerins Bridge Road between mid-term and buildout. **Figure ES-3** shows the general areas that are expected to develop in the near-term and mid-term.

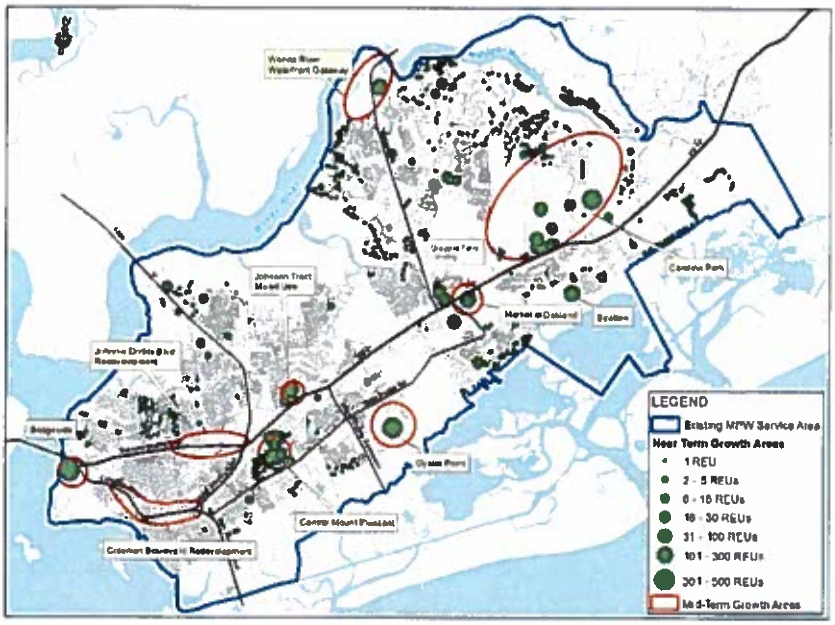
Figure ES-2. Future REU Projections



E.2.2 REU Usage Factors

A standard usage factor (gallons/REU) is applied to the number of REUs to develop water demand and wastewater flow projections, and to calculate impact fees, basic facility charges and excessive-use tiers. Based on review of recent historical customer REU data, water billing data, water production data, and wastewater flow data, a common value of 220 gpd/REU is recommended for use in developing water demand and wastewater flow projections for this master plan update. This value is a conservative estimate of the characteristics of demand on MPW's system over a 7-year historical period including both wet and dry years. A value of 300 gpd/REU is currently used to determine impact fees and volumetric rates.

Figure ES-3. Areas of Development for Near-Term and Mid-Term



E.2.3 Water Demand and Wastewater Flow Projections

Figure ES-2 presents REU projections for potable water customers. In addition, some water users will have separate irrigation meters. A review of historical REU data indicates that irrigation REUs comprise approximately 9 percent of the total allocated water REUs. It is assumed that irrigation REUs will remain at the same percentage of overall water use in the future. The projected average day water demand was calculated by applying the standard usage factor of 220 gpd/REU to the future water and irrigation REUs (**Table ES-1**). Maximum day water demands were determined by applying a peaking factor of 1.6 to the average demands.

Table ES-1. Water Demand Projections

Planning Period	Approximate Year	Water REUs	Irrigation REUs	Average Day Demand [1] (mgd)	Maximum Day Demand [2] (mgd)
Existing Actual	2014	38,629	3,981	8.0	11.6
Near-Term	2019	42,650	4,218	10.3	16.5
Mid-Term	2024	45,946	4,544	11.1	17.8
Buildout	2049	65,591	6,487	15.9	25.4

1) Existing ADD is based on actual water usage. ADD for near-term, mid-term and buildout based on a demand factor of 220 gpd/REU.
2) Existing MDD is based on actual water usage. MDD for near-term, mid-term and buildout based on MDD:ADD peaking factor of 1.6.

Projected average annual wastewater flow was calculated by applying the standard usage factor of 220 gpd/REU to the future wastewater REUs (**Table ES-2**). Peak wastewater flows were estimated by applying a peaking factor of 3.65 to the average wastewater flow projections. Wastewater REUs for near-term and mid-term are approximately 95 percent of the water REUs to reflect customers who receive water service, but are still on septic systems for wastewater as well as other water use that is not returned to the sewer. By buildout, it is assumed that all existing water customers that are currently on septic systems will receive both water and wastewater service from MPW. It is assumed future development within the planning area will receive both water and wastewater service from MPW, with exception of the following:

- It is assumed that MPW will not extend wastewater service to areas north of the Wando River that are zoned for rural conservation less than 1 unit per 3 acres.
- It is assumed that MPW will not extend wastewater service to the extended planning area east of Guerins Bridge Road.

Table ES-2. Wastewater Flow Projections

Planning Period	Approximate Year	Wastewater REUs	Average Annual Flow [1] (mgd)	Peak Flow [2] (mgd)
Existing Actual	2014	37,067	7.4	--
Near-Term	2019	41,088	9.0	32.9
Mid-Term	2024	44,384	9.8	35.8
Buildout	2049	62,857	13.8	50.4

1) Existing annual average flow is based on flow records at Rifle Range Road and Center Street wastewater treatment plants. Annual average flow for near-term, mid-term and buildout based on a flow factor of 220 gpd/REU.
2) Peak flow for near-term, mid-term and buildout based on a peaking factor of 3.65.

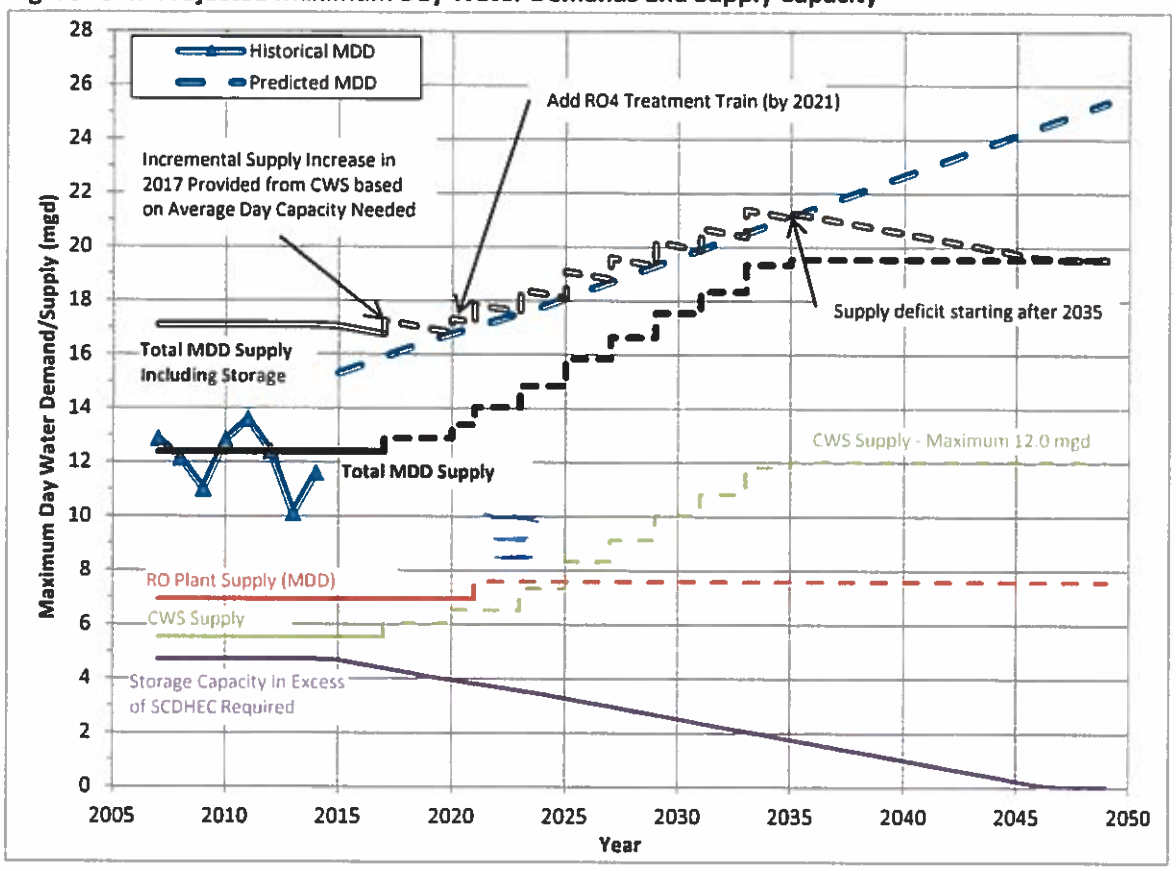
E.3 Water Supply and Treatment

MPW's current water supply sources consist of four reverse osmosis (RO) treatment plants, three aquifer storage and recovery (ASR) wells, and two supply feeds from the Charleston Water System (CWS), with a combined average day water supply of 9.9 mgd and a maximum day water supply of 12.4 mgd. In addition, the volume of the eight ground-level storage facilities and one elevated storage facility in the water system currently exceeds ½ of the maximum day demand, which is the minimum storage volume that is required by the South Carolina Department of Health and Environmental Control (SCDHEC). The storage volume in excess of the SCDHEC requirement is available to supplement water supply for maximum day demand given that demands on subsequent days are lower to allow for recharge of the storage facilities.

A comparison of the projected water demands and existing water supply sources indicates that the average day water supply capacity of the four RO plants and contracted supply of 5.5 mgd from CWS is not adequate to meet the projected average day demands through near-term. Therefore, additional supply capacity is needed to meet projected demands. The maximum supply capacity of the four RO plants and contracted supply of 5.5 mgd from CWS in addition to system storage capacity (in excess of the SCDHEC requirements) is adequate to meet the maximum day demands through near-term. However additional supply capacity is needed for projected maximum day demands before mid-term.

It is assumed that additional average day water supply capacity will be provided through CWS and that the maximum supply from the existing CWS feeds is 12.0 mgd (without additional improvements to the CWS system). An additional purchase of 0.5 mgd from CWS is recommended by near-term. A second purchase increase of 1.3 mgd from CWS and planned addition of another treatment train to RO Plant No. 4 is recommended in by mid-term to increase average and maximum day supply capacity. Between mid-term and buildout, a stepped increase in water supply from CWS is recommended (approximately 1 mgd every other year) to keep pace with maximum day demands (**Figure ES-4**). Assuming a maximum supply from the existing CWS feeds of 12.0 mgd, adequate water supply will be available for average day demand conditions through buildout. However, as shown in Figure ES-4, water supply will be inadequate to meet maximum day demands past 2035. Implementation of additional CWS feed(s) to increase water supply from Sullivan's Island and/or Remley's Point were considered as part of the water distribution and transmission system evaluation.

Figure ES-4. Projected Maximum Day Water Demands and Supply Capacity



E.4 Water Distribution and Transmission System Evaluation

Hydraulic analyses were conducted using MPW's InfoWater hydraulic model to evaluate the adequacy of the existing water distribution and transmission system to meet existing and projected maximum day demands. For this master planning effort, the existing hydraulic model used for the 2010 Master Plan was updated and verified with water system SCADA data for a 3-day maximum demand period in June 2014. Extended period hydraulic model simulations were run with maximum day demands (which include peak hour demands) for near-term, mid-term, and buildout planning periods. Model results were evaluated against the evaluation criteria developed for the 2010 Master Plan.

E.4.1 Current Service Area

Results of the hydraulic evaluation indicate the existing water infrastructure is adequately sized to meet water transmission and storage needs through the mid-term planning period. Therefore, no infrastructure improvements are recommended for the near-term or mid-term planning periods.

The hydraulic evaluation for the buildout planning period identified water supply, pressure, and headloss deficiencies in the existing water distribution and transmission system by buildout. Based on information provided by MPW and CWS, three options for additional water supply were evaluated. A hydraulic analysis was performed for the two options involving additional water supply from CWS to identify the appropriate operational and infrastructure improvements required to resolve the system deficiencies to meet buildout demands. Improvements were developed consistent with the design criteria presented in the 2010 Master Plan. Recommended improvements within the current service area for the buildout planning period include approximately 5.9 miles of 12-inch to 24-inch diameter water mains and a third CWS water supply feed from Sullivan's Island with a capacity of 1.8 mgd, as listed in **Table ES-3.**

Table ES-3. Summary of Water System Buildout Improvements for the Current Service Area

CIP ID[1]	Location/Description	Approximate Length (feet)	Diameter (inches)
1	New parallel water main along I-526, Seacoast Pkwy, Bell Hall Pkwy and Long Point Rd from Wando Park Storage Tank to Whipple Rd to improve transmission from CWS Feed No. 1 at Daniel Island	14,300	24
3	New parallel water main along Ben Sawyer Boulevard from Tolers Cove Dr to Rifle Range Rd to improve transmission from the new CWS Feed at Sullivan's Island	7,800	12
6*	New water main crossing Wando River at the end of Cape Island Drive to improve pressures and fire flow and create looping for water quality and redundancy	2,600	12
7	New water main on Mathis Ferry Rd from I-526 to Von Kolnitz Rd to complete a pipe loop and improve transmission from CWS Feed No. 1 at Daniel Island to Mathis Ferry Rd	1,300	12
8*	New water main, connection, and meter to establish 3rd water supply feed from CWS via Sullivan's Island	5,200	16

1) See Figure 4-9 for location of improvements; project numbers with an asterisk correspond to recommendations in the 2010 Master Plan.

E.4.2 Extended Service Area

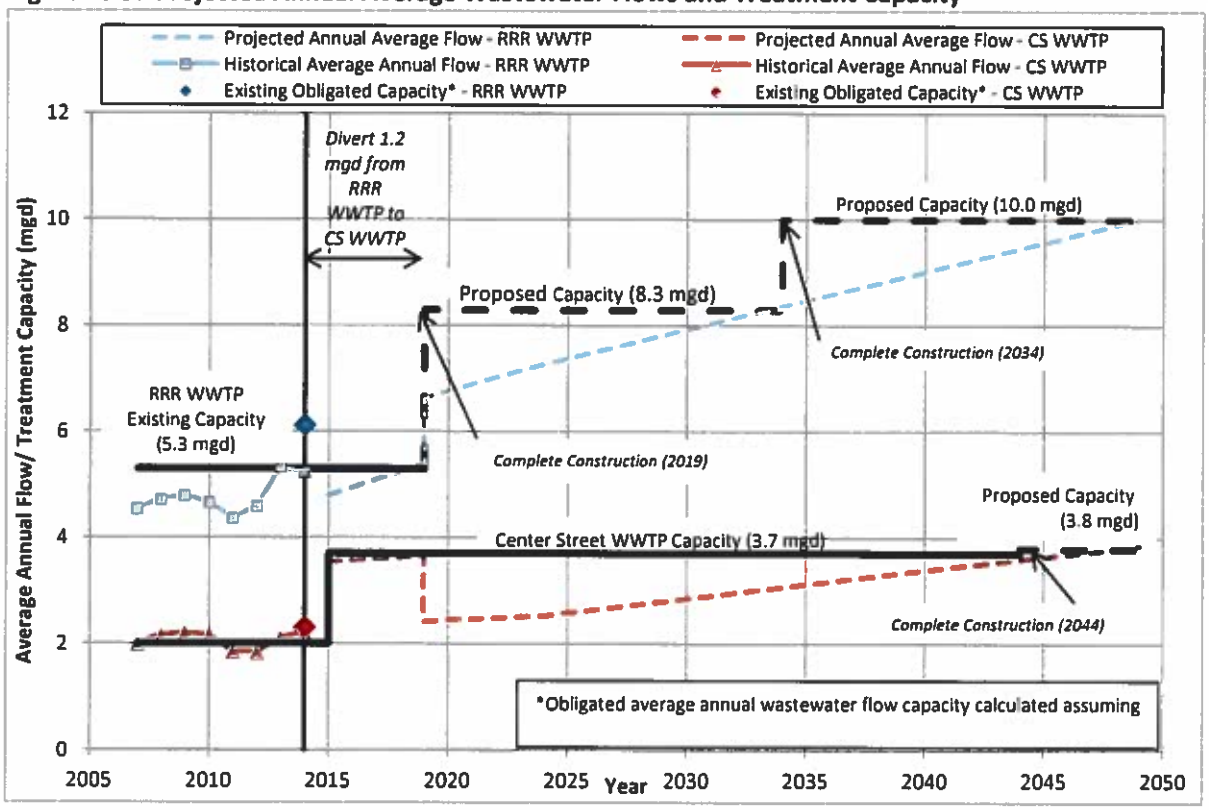
The projected buildout maximum day demand for the areas north and east of the Wando River that are not currently served by MPW is 1.1 mgd. Additional line extensions, water supply, and water transmission improvements beyond those recommended for the current service area are required to provide water service to the extended service area. To provide water service to the Woodville area and Cat Island, approximately 5.1 miles of 8-inch diameter water line extension is recommended. To provide service to the extended service area east of Guerins Bridge Road, an additional 23 miles of 12-inch diameter water line extension, 1,000-gpm booster pump station, and hydropneumatic pump are recommended. Recommended transmission improvements from CWS Feed No. 3 to the extended service area include 3.2 miles of 12-inch and 20-inch diameter water line along Rifle Range Road and Highway 17 and upsizing Project 3 (see Table ES-3) from 12-inch diameter to 16-inch diameter.

E.5 Wastewater Treatment

MPW owns and operates two wastewater treatment plants: the Center Street Wastewater Treatment Plant (Center St WWTP) and the Rifle Range Road Wastewater Treatment Plant (Rifle Range Rd WWTP). Center St WWTP has a permitted capacity of 3.7 mgd. However, the current treatment capacity is limited to 2.0 mgd due to clarifier capacity. MPW is completing work to improve the hydraulic capacity of the Center St WWTP up to the permitted capacity. Improvements at Center St WWTP are expected to be complete in spring of 2015. Rifle Range Rd WWTP has a permitted capacity of 6.0 mgd, with a current treatment capacity of approximately 5.3 mgd (based on capacity of the return activated sludge (RAS) pumping). The combined treatment capacity of both plants, once improvements at Center St WWTP are complete, is 9.0 mgd. MPW has the ability to distribute a portion of the flow between the two treatment plants by diverting flow on Rifle Range Road just east of Oak Haven Boulevard.

Figure ES-5 presents a wastewater treatment capacity schedule for the individual WWTPs. The obligated capacity (including all existing REUs plus engineering entry REUs) for Rifle Range Rd WWTP based on the service area currently exceeds the treatment and permitted capacity. Therefore, once upgrades at Center St WWTP are completed, it is recommended that approximately 1.2 mgd of flow be diverted from the Rifle Range Rd service area to the Center St WWTP. Proposed treatment capacity improvements up to 8.3 mgd at Rifle Range Rd should be completed by 2019, at which time all flow from the Rifle Range Rd service area can be treated at the Rifle Range Rd WWTP. A subsequent upgrade to 10.0 mgd at Rifle Range Rd WWTP is recommended by 2034 and upgrade to 3.8 mgd at Center St WWTP is recommended by 2044 to provide treatment capacity for projected buildout wastewater flows.

Figure ES-5. Projected Annual Average Wastewater Flows and Treatment Capacity



E.6 Wastewater Collection and Conveyance System

Hydraulic analyses were conducted using MPW's InfoSWMM hydraulic model to evaluate the adequacy of the existing wastewater collection system to convey projected peak wastewater flows. For this master planning effort, the existing hydraulic model used for the 2010 Master Plan was updated and verified with pump station and WWTP SCADA data, as available, for a dry-weather period in June 2014.

The model was run with projected average dry-weather wastewater flows and peak wet-weather flows (based on a peaking factor of 3.65) for four planning periods: existing, near-term, mid-term, and buildout. The collection system capacity was analyzed based on the evaluation criteria developed for the 2010 Master Plan. The capacity analysis identified system deficiencies including overflows in multiple locations throughout the collection system for dry-weather flows in the buildout planning period and for peak wet-weather flows in existing, near-term, mid-term, and buildout planning periods.

Additional hydraulic modeling analyses were conducted to identify the appropriate infrastructure improvements required to resolve the deficiencies, consistent with the design criteria presented in the 2010 Master Plan. Although improvements are required in all of the wastewater service areas, the majority of the improvements are located in the Rifle Range Road WWTP areas (**Table ES-4**). A summary of the phased improvements within the current service is given in Table ES-4. Individual projects are listed in Table 6-5 in Section 6 of this report.

Table ES-4. Summary of Wastewater System Improvements for the Current Service Area

Phase	Service Area	Pump Station Projects (#)	Force Main Projects		Gravity Line Projects	
			# of Projects	Approximate Length (ft)	# of Projects	Approximate Length (ft)
Near-Term	Center Street WWTP	1	--	--	--	--
	Rifle Range WWTP	9	4	23,800	--	--
Mid-Term	Rifle Range WWTP	2	2	14,000	--	--
Buildout	Center St WWTP	2	1	3,400	1	3,900
	Rifle Range WWTP Area	17	10	39,700	1	1,000
	Total	**31**	**17**	**80,900**	**2**	**4,900**

For the purpose of this study, it was assumed that the wastewater collection system would extend to the Woodville area by buildout. In addition to the projects listed in Table ES-4, two projects were added to extend wastewater service to the Woodville area including: 1) construction of a new pump station, and 2) construction of approximately 5,900 feet of new force main to convey flow from the new Woodville pump station to combine with the force main from PS 120.

E.7 Combined Capital Improvements Program

A combined Capital Improvement Program (CIP) was developed for implementing the recommended improvements including hydraulic capacity and treatment-related improvements for water

distribution and transmission, water source and treatment, wastewater collection and conveyance, and wastewater treatment. The CIP does not include potential capital projects required to correct structural or maintenance related deficiencies. These projects may be added at a future date to complete the coordinated, comprehensive CIP.

The CIP is prioritized into the following phases for planning purposes:

- Phase 1 – Near-Term; (0-5 years)
- Phase 2 – Mid-Term; (5-10 years)
- Phase 3 – Buildout; (10-35 years)
- Extended Service Area – Buildout (10-35 years). Includes projects to serve potential new customers outside of MPW's current service area.

In general, the timing of Phase 1 and 2 improvements are better defined than buildout improvements. The prioritization of buildout projects depends on development timing and these improvements should be re-assessed in future master planning efforts as more specific development plans are available. The total cost of combined Phase 1 through Phase 3 CIP projects presented in Table ES-5 is $195.3 million.

Table ES-5. Capital Improvement Program Summary

Improvement Type	Estimated Capital Cost (in millions of dollars)			
	Phase 1 (Near-Term; 0-5 years)	Phase 2 (Mid-Term; 5-10 years)	Phase 3 (Buildout; 10-35 years)	Extended Service Area (Buildout)
WATER SUPPLY AND TREATMENT				
RO Plant Upgrades	--	$0.7	--	--
Additional Water Supply from CWS	$0.7	$2.0	$14.3	$1.7
WATER SUPPLY AND TREATMENT SUBTOTAL	*$0.7*	*$2.7*	*$14.3*	*$1.7*
WATER DISTRIBUTION SYSTEM				
Water Main Improvements	--	--	$10.9	$20.2
New Booster Pump Station & Hydropneumatic Tank	--	--	--	$1.5
WATER DISTRIBUTION SYSTEM SUBTOTAL	--	--	*$10.9*	*$21.8*
WASTEWATER TREATMENT				
Rifle Range Road WWTP Upgrades	$50.8	$29.9	$53.5	--
WASTEWATER COLLECTION SYSTEM				
Pump Station Improvements	$2.0	$1.1	$3.4	$0.5
Force Main Improvements	$4.7	$7.6	$13.3	$1.1
Gravity Line Improvements	--	--	$0.4	--
WASTEWATER COLLECTION SYSTEM SUBTOTAL	*$6.7*	*$8.7*	*$17.1*	*$1.6*
TOTAL ESTIMATED CAPITAL COST	**$58.2**	**$41.3**	**$95.8**	**$25.1**

Section 1
Introduction

1.1 Background and Objectives

Mount Pleasant Waterworks (MPW) provides water and wastewater service to a population of over 73,000 within the Town of Mount Pleasant (Town) and other unincorporated areas of Charleston County. MPW's service area is generally bounded by the Cooper River to the southwest, the Wando River and Guerin Creek to the north and west, and the Intercoastal Waterway to the east, as shown in **Figure 1-1**.

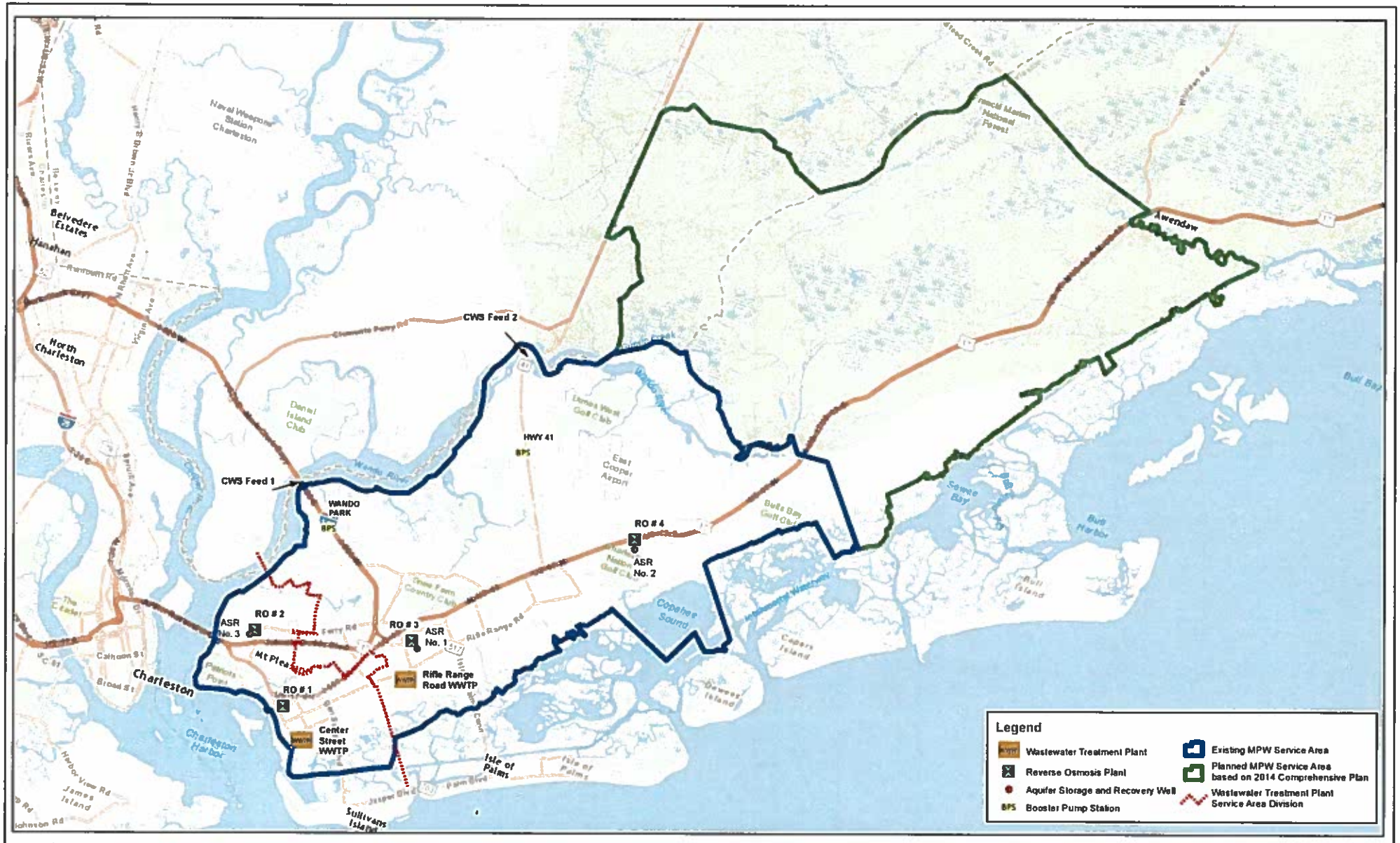
MPW began operations of a water distribution system in 1935. In 2014, the water distribution system averaged 8.0 million gallons per day (mgd). The system has an average day water supply capacity of 11.0 mgd provided by four reverse osmosis treatment plants and two feeds from Charleston Water System (CWS) (Figure 1-1). Additional supply capacity for maximum day demands is available from three aquifer storage and recovery wells (Figure 1-1). Approximately 520 miles of water pipe, 12 million gallons of storage, and 6 pump stations are operated and maintained by MPW.

The wastewater collection system began operation in 1942. In 2014 average daily wastewater flow was 7.4 mgd with a permitted capacity of 9.7 mgd between two wastewater treatment plants: Center Street and Rifle Range Road (Figure 1-1). Due to the relatively flat terrain in the Mount Pleasant area, the wastewater collection system is constructed with gravity collector lines in addition to a network of pumps and force mains to convey wastewater flow to the treatment plants. Approximately 460 miles of pipe and 158 pump stations are operated and maintained by MPW.

In 2010, CDM Smith and MPW completed a comprehensive utility master plan that consolidated the planning efforts for water source and treatment, water distribution and transmission, wastewater treatment, wastewater collection, and reuse/reclaimed water. The objectives for the *2010 Comprehensive Utility Master Plan* (2010 Master Plan) were to:

- Standardize the planning criteria and coordinate planning data with the Town of Mount Pleasant and Charleston County Comprehensive Land Plans.
- Develop uniform design criteria to guide the facility planning.
- Develop coordinated and comprehensive master plans for each asset class (including water source and treatment, water distribution and transmission, wastewater treatment, wastewater collection, and reuse/reclaimed water).
- Develop near-term, mid-term, and build-out coordinated capital improvement plans.

The objective of this master planning effort is to develop a 5-year update to the 2010 Master Plan including an updated short- and long-term (5-year, 10-year, and buildout) coordinated capital improvement plan.



MPW Service Area

Figure 1-1

CDM Smith

This 2015 Comprehensive Utility Master Plan update is coordinated with the *Town of Mount Pleasant Comprehensive Plan 2009-2019 - 2014 Update* (2014 Comprehensive Plan Update) and addresses changes to land use planning within the past five years. The most significant change to the land use plan is the extension of the Town's planning area to include additional unincorporated areas of Charleston County east of Guerins Bridge Road to Steed Creek Road. Considerations for extending water and wastewater service to this additional area are discussed in this report.

This 5-year update builds upon the planning and design criteria and improvement alternatives developed in the 2010 Master Plan report. Background on development of the hydraulic models, evaluation criteria, standardized design criteria, and construction cost assumptions were presented in the 2010 Master Plan report. The conclusions and recommendations from the 2010 Master Plan regarding reuse/reclaimed water have not changed since the previous analysis, and therefore, are not discussed in this report.

1.2 Report Format

The remainder of this report is organized into the following sections:

Section 2 – Water Demand and Wastewater Flow Projections

Section 3 - Water Supply and Treatment

Section 4 – Water Distribution and Transmission System Evaluation

Section 5 – Wastewater Treatment

Section 6 – Wastewater Collection and Conveyance System Evaluation

Section 7 - Combined Capital Improvement Program

Section 2

Water Demand and Wastewater Flow Projections

MPW uses residential equivalency units (REUs) as a basis to determine current and future water demands and wastewater flows. An REU is defined as a unit of development (residential, commercial, industrial, or other type) which is equivalent to the average water usage or wastewater flow for a typical residential customer. A standard usage factor (gallons/REU) is applied to the number of REUs to develop water demand and wastewater flow projections, and to calculate impact fees, basic facility charges and excessive-use tiers. This section provides a discussion of historical water demands and wastewater flows used to develop a recommended standard usage value for future REU assignments. Future REU projections for the near-term (approximately 5 years), mid-term (approximately 10 years), and buildout (long-term) planning periods are also discussed followed by presentation of the corresponding water demand and wastewater flow projections that are used in this master plan update.

2.1 Water Demand Factors

Water demand factors were evaluated from billing data, which can be analyzed by customer type (residential vs. commercial), and from water production data, which accounts for the total water supplied to the distribution system including non-billed usage.

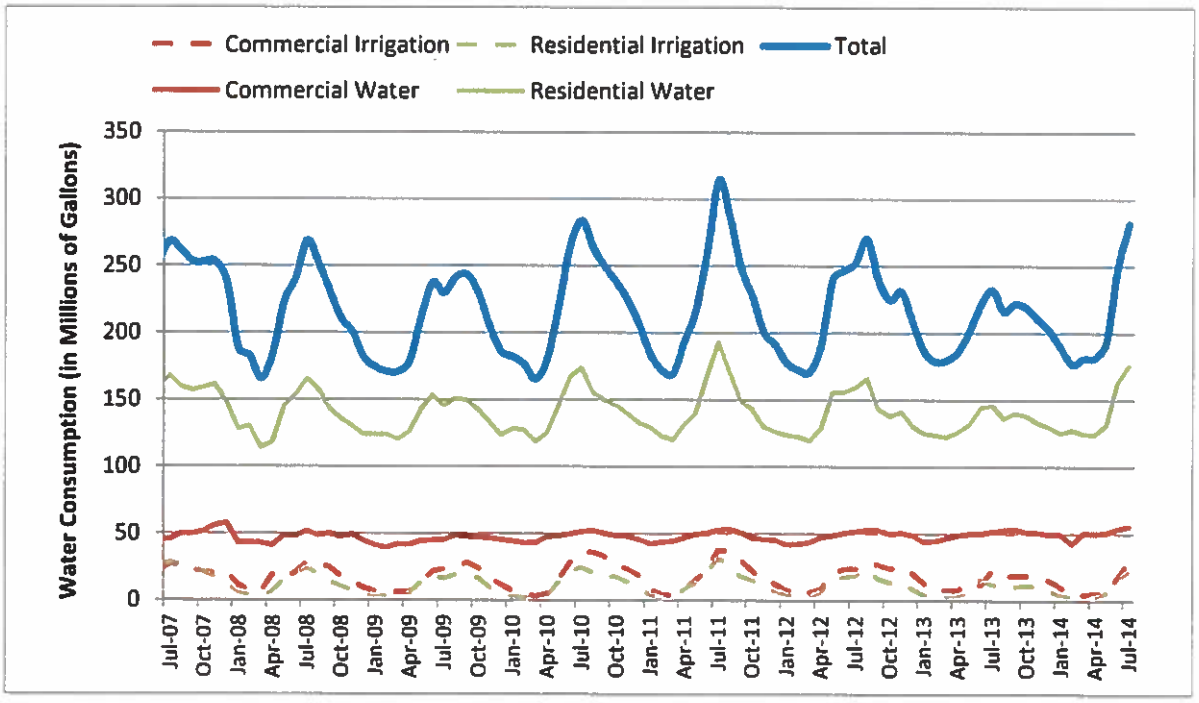
2.1.1 Water Billing Data

Monthly water billing records from 2007 through 2014 were analyzed to compare water use among residential and commercial customers for water and irrigation meters. Historical water usage was also correlated with precipitation data. **Figure 2-1** shows monthly water consumption trends for the past 7 years. Water consumption trends indicate:

- The annual average water consumption has remained consistent over the past 7 years. As expected, peak consumption is highest during the driest year (2011) and lowest during the wettest year (2013).
- Residential water meters have higher seasonal usage than commercial meters.
- Metered use from irrigation-only meters (including both residential and commercial irrigation meters) is approximately 10 percent of the total water consumption.

Historical consumption in each category was also compared with the number of REUs for the respective customer accounts, as listed in **Table 2-1**. Each residential water account is assigned one REU. All irrigation meters sized 1-inch diameter or less are also assigned one REU. Irrigation meters greater than 1-inch diameter are assigned a greater number of REUs, proportional to the meter size. A standard factor of 300 gallons per day per REU (gpd/REU) is used to determine the number of REUs allocated to commercial water accounts.

Figure 2-1. Historical Monthly Water Consumption (from Billing Records)



MPW compiled data comparing the number of REUs allocated to commercial customers versus the billed water consumption of those customers in 2013. Assuming one REU is equivalent to 300 gpd average consumption, approximately 700 commercial customers used less than their allocated REUs in 2013 and approximately 90 customers used more than their allocated REUs in 2013. The difference between the allocated and calculated REUs for each customer account was summed, resulting in a net of approximately 4,400 REUs that are allocated to commercial accounts, but are "unused". It is assumed that the number of unused REUs is consistent over the past seven years. Therefore, 4,400 REUs were subtracted from the total allocated commercial REUs for the analysis presented in Table 2-1.

In general, the billed consumption per REU for residential water accounts is within 10 percent of the billed consumption per allocated REU for commercial water accounts, and has remained consistent over the past 7 years. However, the average usage per commercial REU increases from 148 gpd/REU to 255 gpd/REU once the number of commercial REUs are adjusted. The billed consumption for irrigation REUs is also higher than residential water REUs. Consumption per REU for irrigation accounts increases during dry years and decreases during wet years.

2.1.2 Water Production

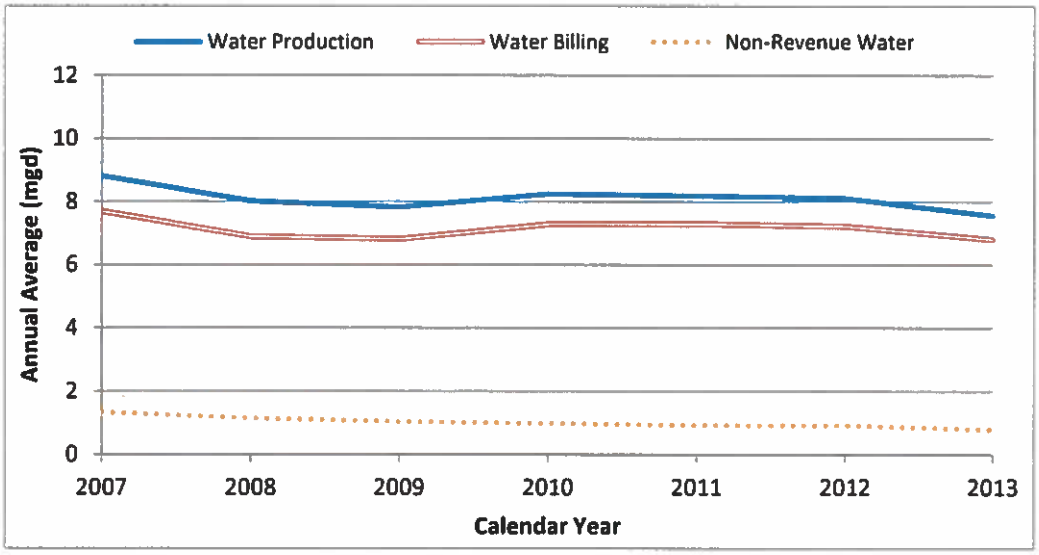
Water production was used to determine the water demand factor per REU for this master plan update to account for sizing of water distribution infrastructure and water production capacity. **Figure 2-2** shows a comparison of annual average water consumption from billing data versus combined water production from the water treatment plants and water supplied from Charleston Water System (CWS). The difference between water production and consumption, referred to as non-revenue water, is approximately 10 percent of the total water production and has decreased from 15 percent since 2007.

Table 2-1. Billed Water Consumption with Adjusted Commercial REUs

	Residential			Commercial				Irrigation			Total		
Calendar Year [1]	Average Billed [2] (mgd)	REUs	Unit Demand Factor (gpd/REU)	Average Billed [2] (mgd)	Allocated REUs [3]	Adjusted REUs [4]	Unit Demand Factor [5] (gpd/REU)	Average Billed [2] (mgd)	REUs	Unit Demand Factor (gpd/REU)	Average Billed [2] (mgd)	REUs	Unit Demand Factor (gpd/REU)
2010	4.7	27,921	167	1.6	10,392	5,992	260	1.0	3,816	272	7.3	37,729	193
2011	4.7	28,245	167	1.6	10,480	6,080	256	1.0	3,830	267	7.3	38,155	191
2012	4.6	28,664	161	1.6	10,690	6,290	252	1.0	3,872	258	7.2	38,826	185
2013	4.4	29,325	149	1.6	11,111	6,711	241	0.7	3,882	190	6.7	39,918	168

1) Table has been shortened to years 2010 through 2013 for simplicity.
2) Average water consumption from monthly billing records. Does not include non-revenue water usage.
3) Allocated commercial REUs are based on the REUs in the customer billing database.
4) The allocated commercial water REUs were adjusted down by 4,400 to account for unused commercial REUs based on recent billing data.
5) Commercial unit demand factor is calculated using the adjusted REUs.

Figure 2-2. Historical Annual Average Water Production and Billing



When considering water production, both residential and commercial water REUs and irrigation REUs were combined together and compared with total water production to determine a single water demand factor (**Table 2-2**). Since 2007, MPW's average day demand (ADD) unit factor has ranged from 188 to 228 gpd/REU, with an average of 209 gpd/REU. The 90th percentile value over this period is 222 gpd/REU, i.e. 90 percent of the ADD unit demand factors since 2007 have been less than 222 gpd/REU.

Table 2-2. Water Demand Factors

Calendar Year [1]	ADD [2] (mgd)	Adjusted Water REUs [3]	Irrigation REUs	Total REUs [4]	ADD Unit Demand (gpd/REU)
2010	8.2	33,913	3,816	37,729	218
2011	8.2	34,325	3,830	38,155	214
2012	8.0	34,954	3,872	38,826	205
2013	7.5	36,036	3,882	39,918	188

1) Table has been shortened to years 2010 through 2013 for simplicity.
2) Average day demand from combined RO plant flow and water supply from CWS
3) The allocated water REUs were adjusted down by 4,400 to account for unused commercial REUs (see Table 2-1).
4) Total REUs = water REUs plus irrigation REUs

2.2 Wastewater Flow Factors

The average monthly wastewater flow based on records at the Rifle Range Road and Center Street wastewater treatment plants for 2007 through 2014 is shown in **Figure 2-3**. Historically, the wastewater REUs comprise approximately 95 percent of the water REUs since some customers in the service area receive water from MPW, but are on septic systems for wastewater. The commercial wastewater REUs were adjusted similar to the water REUs. Of the 4,400 unused commercial water REUs, 4,300 are also allocated to the wastewater system. Therefore, 4,300 REUs were subtracted from the total allocated wastewater REUs. **Table 2-3** lists the average annual wastewater flow, REUs, and unit flow factor. Since 2007, flow factors range from 190 to 215 gpd/REU for average wastewater flow conditions, with an average of 202 gpd/REU. The 90th percentile value over this period is 213 gpd/REU.

Figure 2-3. Historical Monthly Wastewater Flow

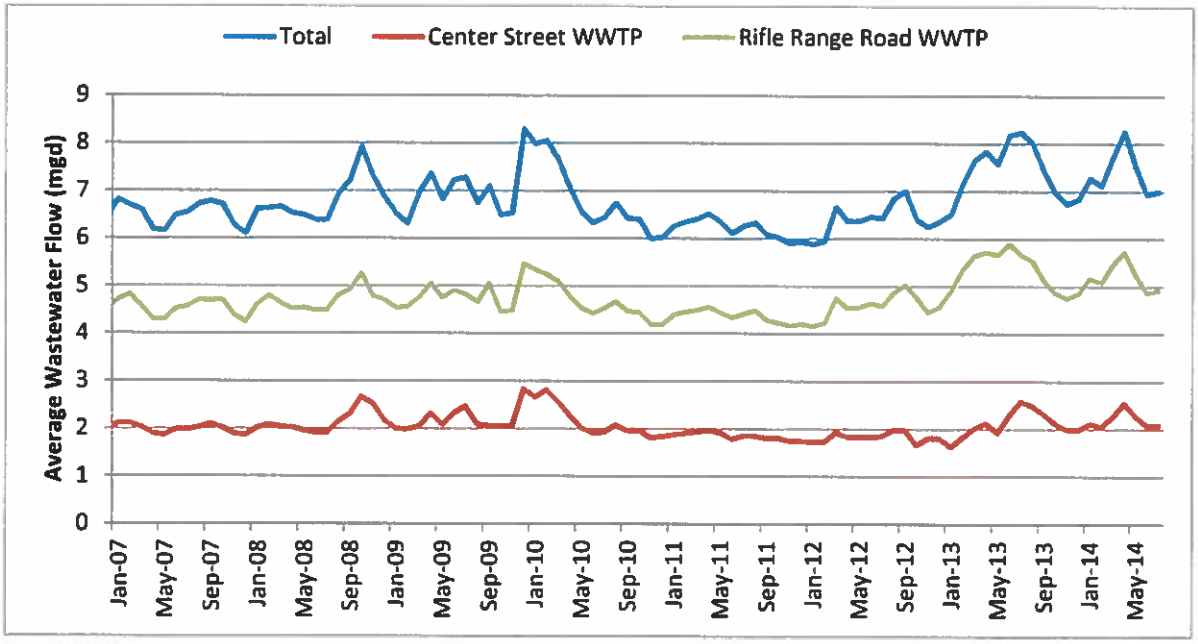


Table 2-3. Wastewater Flow Factors

Calendar Year [1]	Average Annual Flow [2] (mgd)	Allocated Wastewater REUs [3]	Adjusted Wastewater REUs [4]	Unit Flow Factor (gpd/REU)
2010	6.8	36,361	32,061	212
2011	6.2	36,880	32,580	190
2012	6.4	37,625	33,325	192
2013	7.4	38,663	34,363	215

1) Table has been shortened to years 2010 through 2013 for simplicity.
2) Total average annual flow based on flow records at Rifle Range Road and Center Street wastewater treatment plants.
3) Total allocated wastewater REUs based on billing data.
4) The allocated wastewater REUs were adjusted down by 4,300 to account for unused commercial REUs.

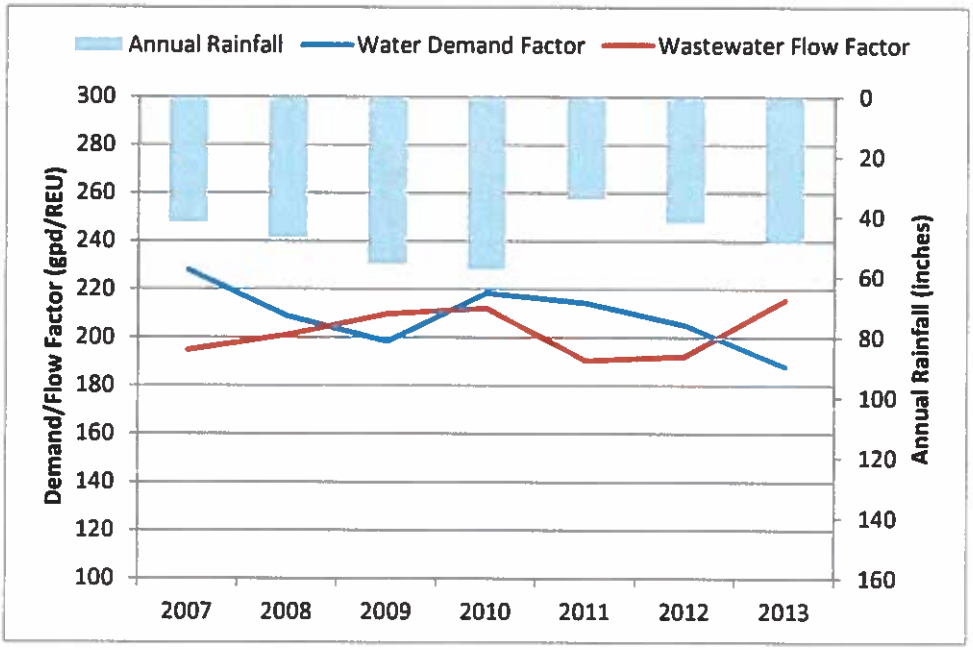
2.3 REU Assignment Recommendations

The 2010 Master Plan used a water demand factor of 215 gpd/REU and wastewater flow factor of 205 gpd/REU to develop the system-wide Capital Improvement Plan. However, MPW currently uses a common factor of 300 gpd/REU to determine both water and wastewater impact fees and rate calculations.

Figure 2-4 provides a comparison of water demand factors and wastewater factors since 2007, assuming the commercial REUs are adjusted as given in Tables 2-2 and 2-3. Typically, wastewater factors are slightly less than water demand factors. For 2011, the driest year since 2007, the wastewater flow factor is 89 percent of the water demand factor. However, as shown in Figure 2-4, the wastewater factors are highest during years with more rainfall. This is indicative of reduced irrigation water use (which is not returned to the wastewater system) and higher infiltration/inflow (I/I) into the wastewater system during wet years.

Since the historical water and wastewater factors are similar, a common value of 220 gpd/REU is recommended for future REU assignments. This value is a conservative estimate of the characteristics of demand on MPW's system over a 7-year historical period including both wet and dry years.

Figure 2-4. Historical Annual Water Demand, Wastewater Flow, and Rainfall



2.4 Future REU Projections

The water and wastewater evaluations conducted for this master plan update evaluate near-term, mid-term, and buildout planning periods. REU projections are used to estimate water demand and wastewater flows.

As part of the 2010 Master Plan, growth projections were developed based on both population forecasts for the Town from a McKibben Demographic Research study (low growth scenario) and future land use provided in the Town of Mount Pleasant 2009-2019 Comprehensive Plan (high growth

scenario). The high growth scenario based on future land use was ultimately used to identify potential improvements to the water and wastewater systems.

The future REU projections have been updated from the 2010 projections to reflect changes to the future land use in the 2014 Comprehensive Plan Update. In addition, the Town has expanded its planning area to include areas of Charleston County east of Guerins Bridge Road to Steed Creek Road, as shown on **Figure 2-5**. The projections assume that the MPW service area will also be expanded to match the Town's planning area boundary.

A similar methodology to that used for the 2010 Master Plan was used to update the growth projections based on future land use. The overall REUs estimated based on the future land use of the water service planning area were used to determine overall growth of the system.

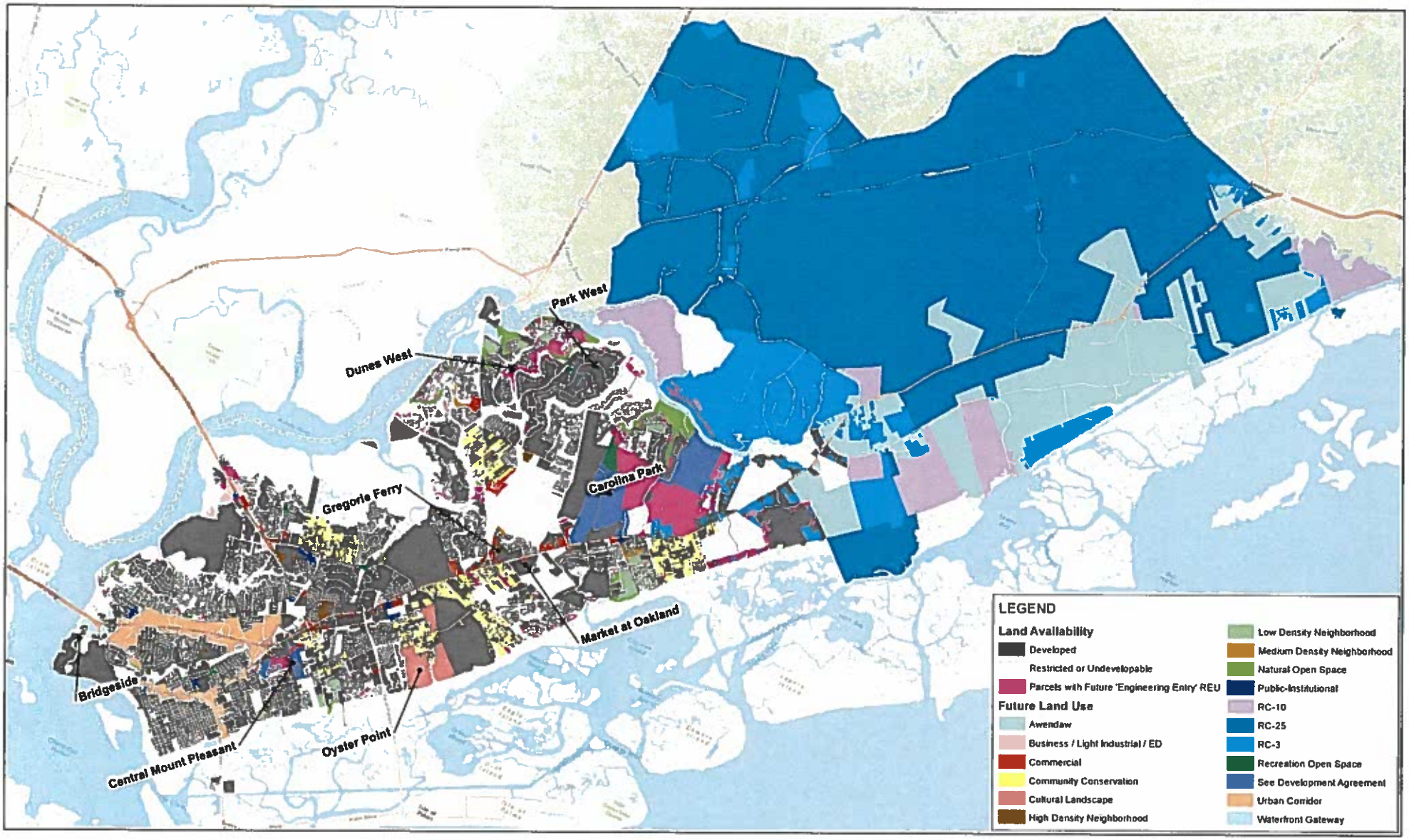
Figure 2-6 shows the future land use and land availability reflected in the 2014 Comprehensive Plan Update. It was assumed that all developable land would be built-out to the maximum use specified in the 2014 Comprehensive Plan Update. Developed, undevelopable, and restricted properties were assumed to remain as-is with the exception of the "urban corridor" land use. Areas within this corridor are expected to be redeveloped to a higher density based on the 2014 Comprehensive Plan and zoning.

The projections also account for some specific developments, most of which were identified in the 2010 Master Plan, but are not currently fully developed (based on 2014 REUs within those properties). "Engineering entry" REUs are also included in the projections. Engineering entry REUs are assigned to a development after the impact fees have been paid in order for MPW to account for capacity allocated to the development. The engineering entry REUs are converted to active REUs once the development is completed and begins using MPW's water/wastewater service. **Table 2-4** shows how the total number of future REUs were determined for buildout conditions and presents a comparison of the 2010 and 2014 REU projections.

The projected future additional REUs based on the 2014 land use plan are approximately 15 percent greater than the REUs estimated in the 2010 Master Plan. Approximately 27,000 future REUs will be added to the service area by buildout. Of these, the expanded portion of the service area accounts for approximately 2,600 REUs at buildout.

A total of 65,591 REUs are projected at buildout for the entire planning area including the additional service area east of Guerins Bridge Road to Steed Creek Road. The total existing REUs in 2014 (38,629 REUs adjusted for unused commercial REUs) are similar to those projected in the 2010 Master Plan (38,545 REUs projected for 2014 adjusted for unused commercial REUs), indicating that growth over the past 7 years has followed the trend projected in the 2010 Master Plan. Based on MPW's planned development information, the following growth rates are assumed for each planning period:

- **Existing to near-term planning period** – Growth is assumed to be 2.0 percent per year.
- **Near-term to mid-term planning period** – Growth is assumed to be 1.5 percent per year.
- **Mid-term to buildout planning period** – Growth is assumed to be 1.3 percent per year in the current service area, with a buildout year of 2049 (consistent with the 2010 Master Plan). It is assumed MPW will extend service to the area east of Guerins Bridge Road between mid-term and buildout, which will increase the growth rate to 1.4 percent per year.



Future Land Use and Land Availability

Figure 2-6

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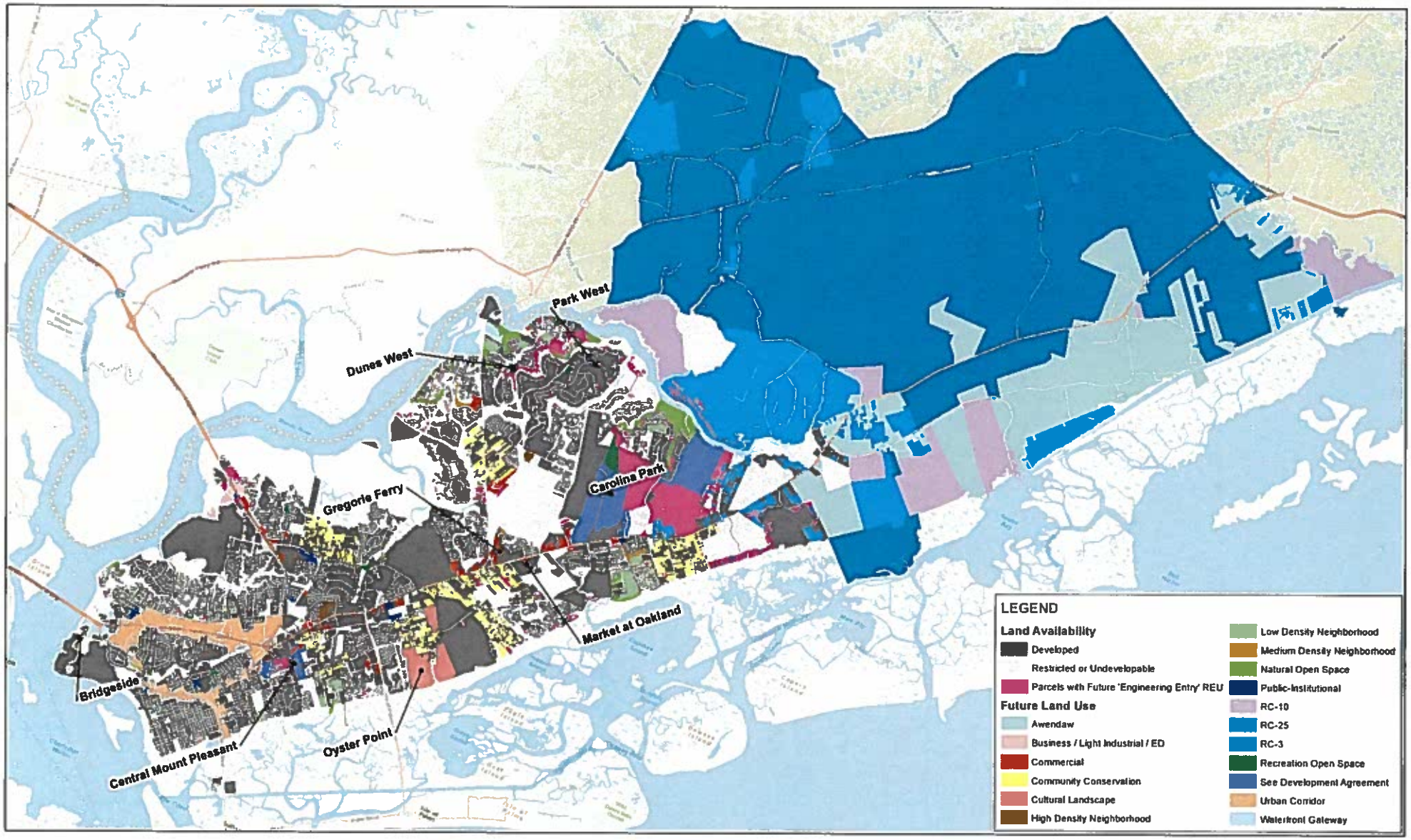

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Future Land Use and Land Availability

Figure 2-6

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Table 2-4. Comparison of 2010 REU Projections and Updated 2014 REU Projections

	2010 REU Projections[1]			2014 REU Projections[2]			
Description	Acres	REU/ Acre	Future Additional REUs[3]	Acres	REU/ Acre[4]	Future Additional REUs[3]	Notes
Engineering Entries							
Parcels with future 'Engineering Entry' REUs	1,499	n/a	2,207	1,370	n/a	1,125	Not including Carolina Park
Urban Corridor Redevelopment							
Coleman & Ben Sawyer Boulevards	224	16.0	2,456	224	16.0	2,418	Based on zoning of max density for residential between 16-20 units/acre
Johnnie Dodds Boulevard	600	12.0	4,002	600	12.0	4,042	Based on estimate used for 2010 Master Plan
Chuck Dawley Boulevard	52	6.5	185	52	16.0	725	Updated based on zoning of max density for residential between 16-20 units/acre
Urban Corridor Redevelopment Subtotal	*876*		*6,643*	*876*		*7,185*	
Developable Parcels (outside of Urban Corridor)							
Specific Developments[5]							
Carolina Park	1,621	n/a	3,037	1,723	n/a	2,676	Total estimated wastewater flow of 911,200 gpd = 3,037 REUs
Market at Oakland Plantation	74	n/a	385	74	n/a	355	Total 676,000 sq ft of office & retail space
Gregorie Ferry Landing	15	n/a	259	21	n/a	129	Total 232 condominium units & 40,000 sq. ft. of commercial/retail space
Bridgeside	46	n/a	1,018	46	n/a	1,014	Total 180,000 sq ft office; 120,000 sq ft retail; 30,000 sq ft restaurant; 565 residential units; 700 hotel rooms
Central Mount Pleasant	n/a	n/a	0	83	n/a	835	391 single family units; 25 townhomes; 419 apartments approved
Other Developable Parcels by Landuse							
Business / Light Industrial / ED	134	2.0	249	139	2.0	130	REU/Acre based on existing development (parcels <5 acres)
Commercial	266	4.6	1,076	227	4.6	833	REU/Acre based on existing development (parcels <5 acres)
Community Preservation	1208	1.3	1,072	1,127	3.0	3,000	REU/Acre revised based on 2014 zoning density
Cultural Landscape	350	0.0	0	417	3.0	1,317	REU/Acre revised based on 2014 zoning density
High Density Neighborhood	59	8.6	494	59	9.0	412	REU/Acre revised based on 2014 zoning density
Low Density Neighborhood	851	3.0	2,108	1,011	3.0	2,022	REU/Acre revised based on 2014 zoning density
Medium Density Neighborhood	92	6.5	584	85	6.0	294	REU/Acre revised based on 2014 zoning density
Natural Open Space	667	0.0	0	555	0.0	0	No new development
Public-Institutional	101	1.3	123	51	1.3	61	REU/Acre based on existing development (parcels <5 acres)
Recreation Open Space	40	0.0	0	21	0.0	0	No new development
Rural Conservation	1254	0.6	727	n/a	n/a	0	Landuse not applicable for 2014 update
Rural Conservation - 3	2453	0.3	818	3,458	0.3	1,153	REU/Acre based on zoning 1 unit/3 acres
Rural Conservation - 10[6]	698	0.1	70	752	0.1	80	REU/Acre based on zoning 1 unit/10 acres
Rural Conservation - 25[6]	361	0.04	14	502	0.04	21	REU/Acre based on zoning 1 unit/25 acres
Waterfront Gateway	209	12.0	2,496	n/a	n/a	0	Landuse categorized by Cooper River and Wando River for 2014 update
Waterfront Gateway - Cooper River	n/a	n/a	0	45	12.0	571	REU/Acre revised based on 2014 zoning density
Waterfront Gateway - Wando River	n/a	n/a	0	174	6.0	1,114	REU/Acre revised based on 2014 zoning density
Developable Parcels Subtotal	*10,500*		*14,530*	*10,571*		*16,019*	
Additional Service Area for 2014 Master Plan[7]							
Rural Conservation - 3	n/a	n/a	0	2,877	0.3	920	REU/Acre based on zoning 1 unit/3 acres
Rural Conservation - 10	n/a	n/a	0	2,298	0.1	245	REU/Acre based on zoning 1 unit/10 acres
Rural Conservation - 25	n/a	n/a	0	34,440	0.04	1,468	REU/Acre based on zoning 1 unit/25 acres
Additional Service Area Subtotal	*n/a*		*0*	*39,614*		*2,633*	
GRAND TOTAL	**12,875**		**23,381**	**52,432**		**26,962**	

1) 2010 REU projections based on Future Land Use from 2009-2019 Comprehensive Plan
2) 2014 REU projections based on Future Land Use from 2014 Comprehensive Plan Update
3) Future Additional REUs = Acreage multiplied by REU/acre minus any existing REUs within the specified parcels plus an increase of 5 percent to account for uncertainty in future projections.
4) For values in RED, the REU/ acre density has changed since the 2010 Comprehensive Utility Master Plan based on updated 2014 zoning density
5) Development within Park West, Dunes West, and Oyster Point neighborhoods are accounted for under Engineering Entries and within the developable parcels by landuse.
6) It is assumed that MPW will not extend wastewater serivce to areas located north of the Wando River and areas east of Guerins Bridge Road that are zoned for rural conservation-10 and rural conservation-25.
7) It is assumed that MPW will extend water service to the additional service area, but not wastewater service.

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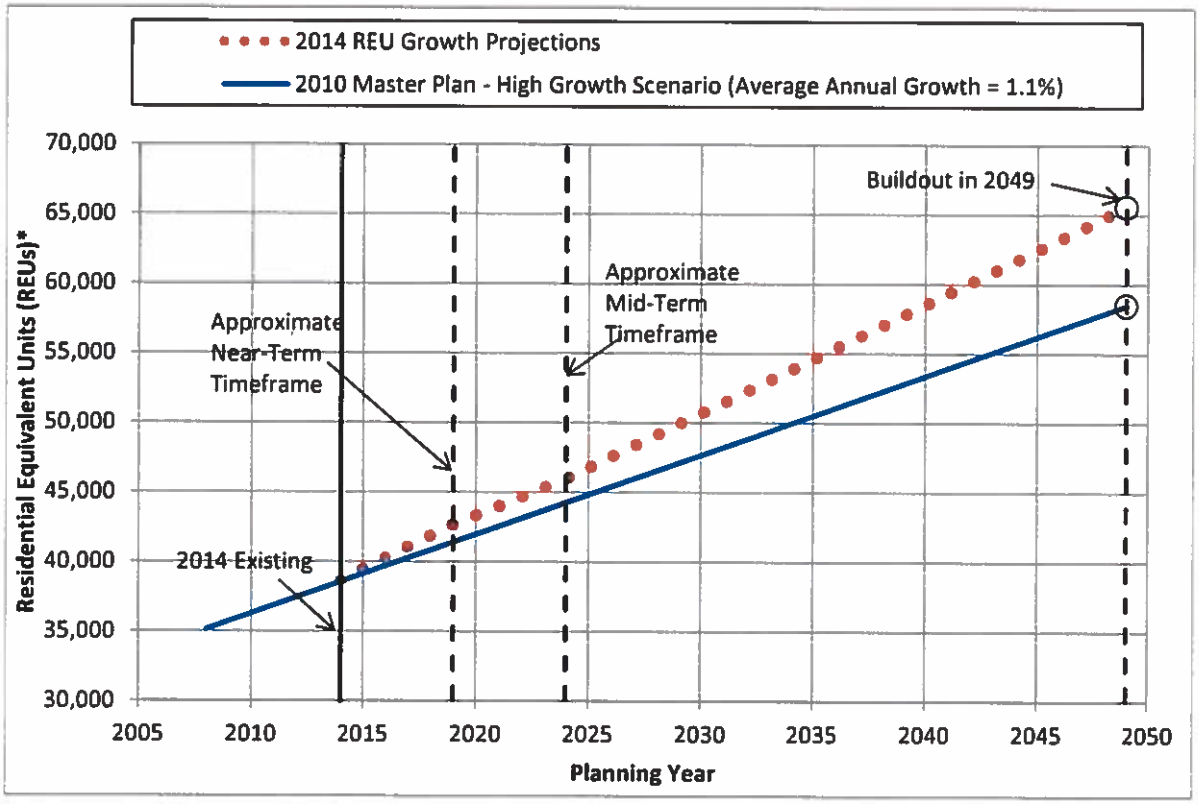
Figure 2-7 presents the projected REU growth trend through buildout. **Table 2-5** summarizes the REU projections for each planning period. The water REUs in Table 2-5 correspond to the REU projections in Table 2-4 and Figure 2-7. In addition, some water users will have separate irrigation meters. A review of historical REU data indicates that irrigation REUs comprise approximately 9 percent of the total allocated water REUs. It is assumed that irrigation REUs will remain at the same percentage of overall water use in the future. The projected irrigation REUs in Table 2-7, along with projected water REUs, will be used in the calculation of future water demands.

Figure 2-7. MPW Service Area Future REU Projections



* Note: 2010 High growth scenario and 2014 existing REUs adjusted down by 4,400 to account for unused commercial REUs.

Table 2-5. Summary of REU Projections

Planning Period	Approximate Year	Projected REUs		
		Water	Irrigation	Wastewater
Existing[1]	2014	38,629	3,981	37,067
Near-Term	2019	42,650	4,218	41,088
Mid-Term	2024	45,946	4,544	44,384
Buildout	2049	65,591	6,487	62,857

1) The existing allocated water REUs were adjusted down by 4,400 to account for unused commercial REUs. The existing allocated wastewater REUs were adjusted down by 4,300 to account for unused commercial REUs. Existing REUs do not include engineering entries.

The wastewater REUs for recent years comprise approximately 95 percent of the water REUs. The difference can be attributed to customers who receive water service, but are still on septic systems for wastewater as well as other water use that is not returned to the sewer. It is assumed that the number of existing water customers on septic will remain relatively unchanged for the near-term and mid-term planning periods. However, by buildout all existing water customers that are currently on septic systems will receive both water and wastewater service from MPW. It was also assumed that all future development within the service area planning boundary will receive both water and wastewater service from MPW, with the exception of the following areas:

- It is assumed that MPW will not extend wastewater service to areas north of the Wando River that are zoned for rural conservation less than 1 unit per 3 acres.
- It is assumed that MPW will not extend wastewater service to the additional planning area east of Guerins Bridge Road.

2.5 Allocation of Future REUs

The projected REUs for the near-term and mid-term planning scenarios are assigned to specific areas based on discussions with MPW and the Town of Mount Pleasant Planning and Development department about the probable timing and location of future development in the service area. **Figure 2-8** shows the general areas that are expected to develop in the near-term and mid-term. **Figure 2-9** shows locations of projected REU growth between existing and buildout for water REUs.

2.5.1 Near-Term Planning Period

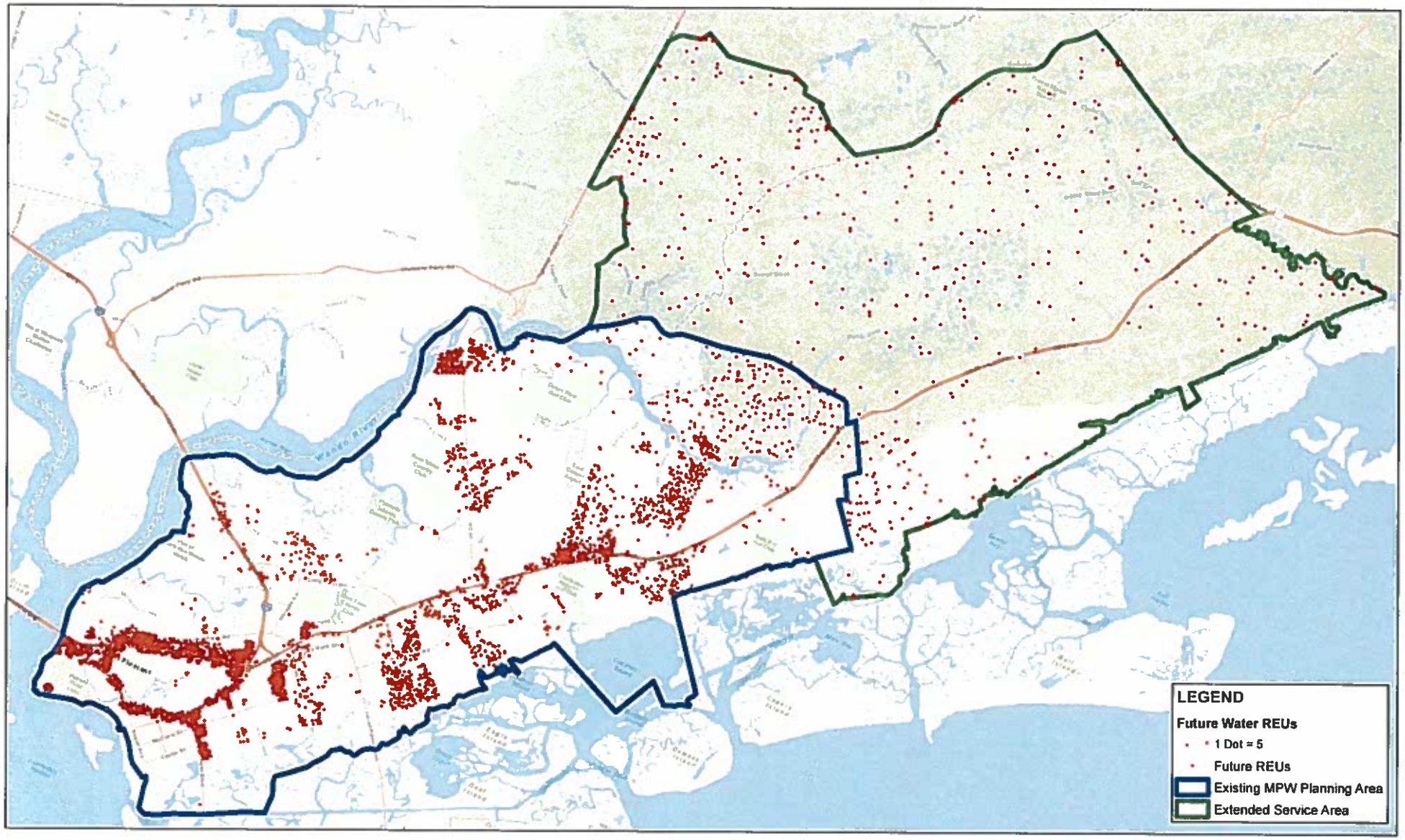
The following assumptions are used in allocating the future REUs for the near-term planning period:

- All existing engineering entries will be converted to active REUs by the near-term.
- The Gregorie Ferry Landing and Stratton by the Sound developments will be 100 percent completed.
- The Market at Oakland Plantation will be approximately 75 percent built-out.
- Carolina Park will be approximately 25 percent built-out.
- The following development projects will be completed to approximately 50 percent of buildout in the near-term: Bridgeside, Central Mount Pleasant, Oyster Point, Johnson Tract mixed-use development.
- Development within the Wando River Waterfront Gateway area will occur (to approximately 25 percent of buildout).

2.5.2 Mid-Term Planning Period

The following assumptions are used in allocating the future REUs for the mid-term planning period:

- The following development projects will be 100 percent completed by mid-term: Market at Oakland Plantation, Central Mount Pleasant, Oyster Point, Johnson Tract mixed-use development.
- Carolina Park and Bridgeside development will be approximately 75 percent built-out.
- Development within the Wando River Waterfront Gateway area will continue (to approximately 50 percent of buildout).
- Some redevelopment along Johnnie Dodds Boulevard and Coleman Boulevard will occur.



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Town of Mount Pleasant Areas of Development
by Buildout Planning Period

Figure 2-9

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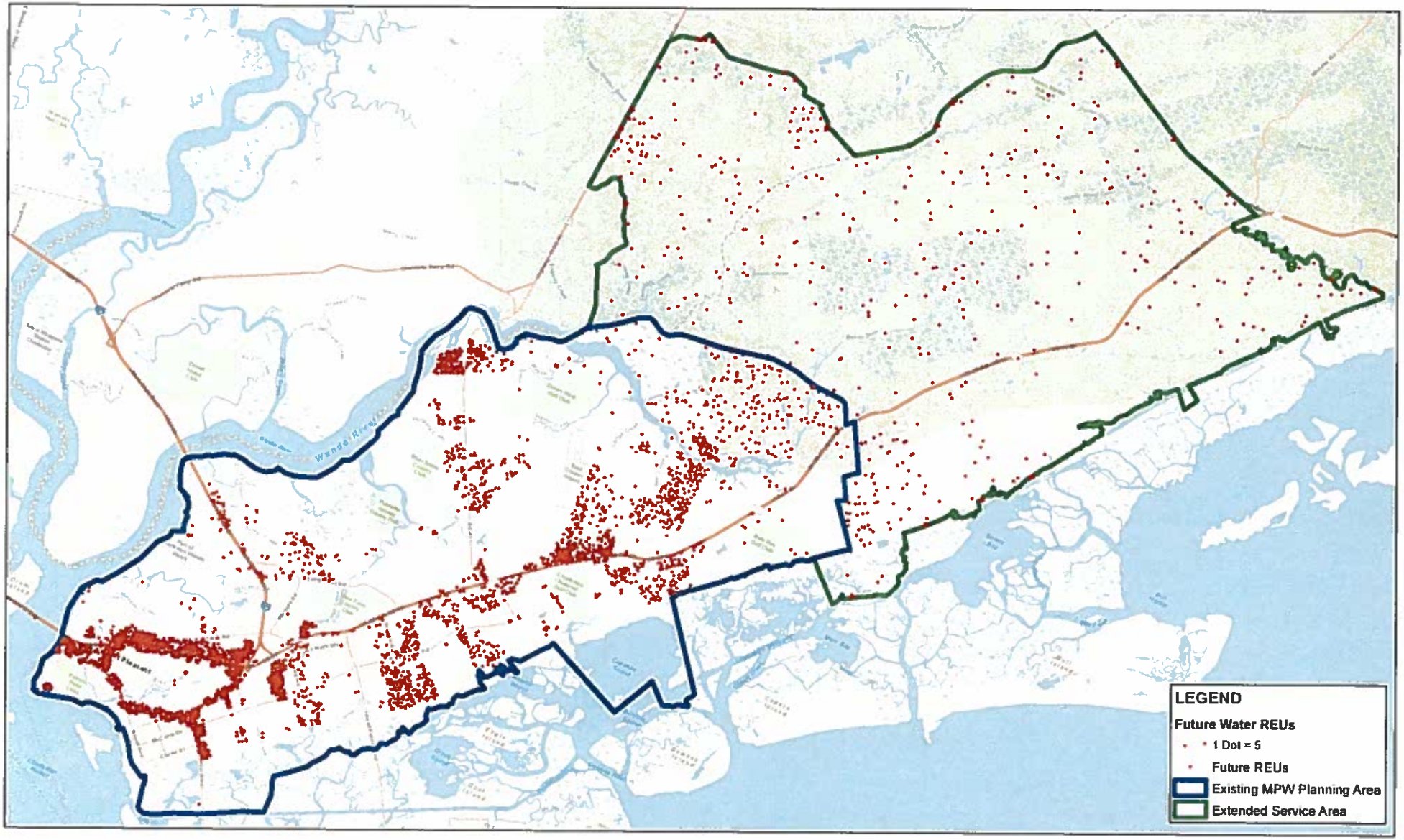

Town of Mount Pleasant Areas of Development
by Buildout Planning Period

Figure 2-9

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2.6 Water Demand Projections

Projected average day water demand is calculated by applying the water demand factor of 220 gpd/REU to the future REUs. To determine projected maximum day demand (MDD), a peaking factor of 1.6 is applied to the average day demand. This peaking factor represents the 90th percentile historical value from 2007 through 2013 and is the same as the MDD:ADD peaking factor used in the 2010 Master Plan. **Table 2-6** summarizes the water demand projections for near-term, mid-term, and buildout planning periods.

Table 2-6. Water Demand Projections

Planning Period	Approximate Year	Average Day Demand [1] (mgd)	Maximum Day Demand [2] (mgd)
Existing Actual	2014	8.0	11.6
Near-Term	2019	10.3	16.5
Mid-Term	2024	11.1	17.8
Buildout	2049	15.9	25.4

1) Existing ADD is based on actual water usage. ADD for near-term, mid-term and buildout based on a demand factor of 220 gpd/REU.
2) Existing MDD is based on actual water usage. MDD for near-term, mid-term and buildout based on MDD:ADD peaking factor of 1.6.

2.7 Wastewater Flow Projections

Similar to the water demands, the projected average annual wastewater flow is calculated by applying the wastewater flow factor of 220 gpd/REU to the future REUs. Peak wet weather wastewater flow is estimated by applying a peaking factor of 3.65, which is the same peaking factor used in the 2010 Master Plan. The development of this peaking factor is discussed in Section 8 of the 2010 Master Plan. For this analysis, a peaking factor of 3.65 results in a peak unit flow per REU of approximately 800 gpd/REU, which is slightly greater than the State design criteria of 300 gpd/REU x 2.5 peaking factor = 750 gpd/REU. **Table 2-7** summarizes the wastewater flow projections for near-term, mid-term, and buildout planning periods.

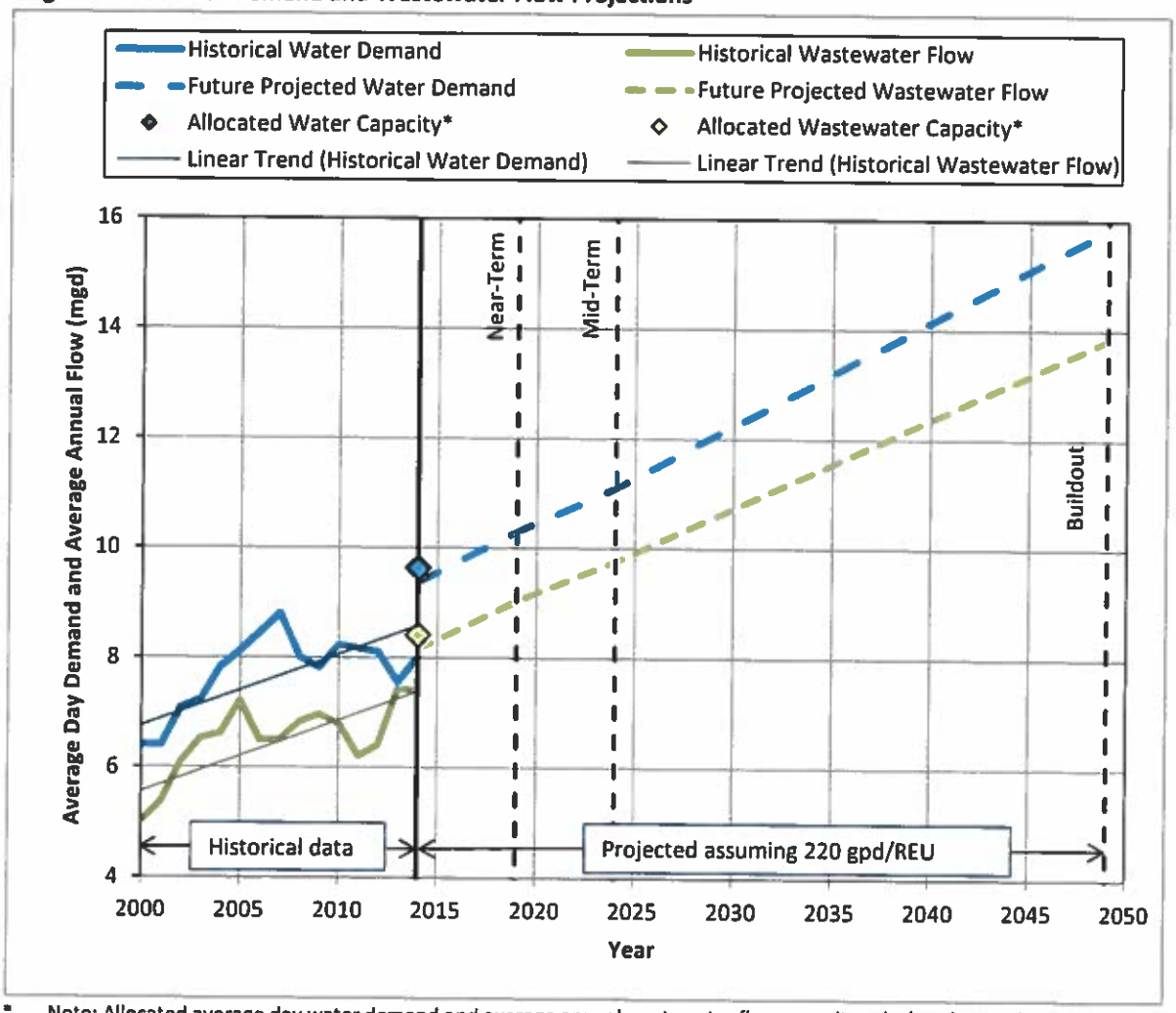
Table 2-7. Wastewater Flow Projections

Planning Period	Approximate Year	Average Annual Flow [1] (mgd)	Peak Flow [2] (mgd)
Existing Actual	2014	7.4	--
Near-Term	2019	9.0	32.9
Mid-Term	2024	9.8	35.8
Buildout	2049	13.8	50.4

1) Existing annual average flow is based on flow records at Rifle Range Road and Center Street wastewater treatment plants. Annual average flow for near-term, mid-term and buildout based on a flow factor of 220 gpd/REU.
2) Peak flow for near-term, mid-term and buildout based on a peaking factor of 3.65.

The historical and projected average day water demand and average annual wastewater flow projections are shown in **Figure 2-10**.

Figure 2-10. Water Demand and Wastewater Flow Projections



* Note: Allocated average day water demand and average annual wastewater flow capacity calculated assuming 220 gpd/REU. Allocated capacity includes all existing REUs plus engineering entry REUs.

Section 3
Water Supply and Treatment

The evaluation of MPW's water supply and treatment needs for existing conditions through the buildout planning period is presented in this section. This evaluation is a 5-year update to the water supply and treatment recommendations provided in Section 5 of the 2010 Master Plan, and is based on updated supply and demand projections. The tasks performed as part of this effort include identifying the existing water supply capacity, assessing the need for future water supply, and evaluating opportunities to provide additional water supply.

3.1 Existing Water Supply Capacity

MPW's water supply sources consist of four reverse osmosis (RO) treatment plants, three aquifer storage and recovery (ASR) wells, and two supply feeds from the Charleston Water System (CWS), as shown on Figure 1-1 in Section 1. The capacity of each water supply source is listed in **Table 3-1**, followed by a brief description of each water supply source.

Table 3-1. MPW Water Supply Sources

Source[1]	Capacity [million gallons per day (mgd)]	
	Existing Average Day Supply[2]	Existing Maximum Day Supply[3]
RO Plant No. 1	0.74	1.15
RO Plant No. 2	1.10	1.72
RO Plant No. 3	1.83	2.88
RO Plant No. 4	0.73	1.15
SUBTOTAL	**4.40**	**6.90**
CWS Feed No. 1 (Daniel Island)	3.00	3.00
CWS Feed No. 2 (Highway 41)	2.50	2.50
TOTAL	**9.90**	**12.40**

1) See Figure 1-1 for the source locations.
2) RO plant capacities are scaled to a combined maximum of 4.4 mgd for Average Day Demand based on USGS Report 2007-5126.
3) MPW also has the capability to use ASR wells located at RO Plants No. 2, 3, and 4, which can provide up to approximately 0.20 mgd supply at each plant during periods of high demand. However, ASR capability is not currently being used.

The RO plants treat groundwater from the Middendorf Aquifer and distribute the finished water to the distribution system utilizing high service pumps. Based on the 2007 USGS Report *Hydrology and Simulation of Groundwater Flow near Mount Pleasant, South Carolina*, a maximum of 5.5 mgd can be withdrawn from the aquifer during average annual conditions in order to maintain adequate aquifer levels. The RO plants have a concentrate reject of approximately 20 percent, resulting in a combined finished water capacity of 4.4 mgd that can be delivered to the distribution system on an average day basis.

The three ASR wells tap the Santee Limestone Aquifer. The ASR wells can be injected with finished water from RO Plant Nos. 2, 3 and 4 during periods of low demand. MPW has the capability to withdrawal water from the ASRs during periods of high demand and distribute it into the distribution system. However, this capability is not being used at this time. The ASR capacity is not reflected in the water supply sources given in Table 3-1. Additional information about the ASRs can be found in the March 2008 *Aquifer Storage and Recovery Master Plan*.

MPW has an agreement with CWS to receive finished water at two feed points located along the northern boundary of MPW's service area. Both feeds are served by CWS's Hanahan Water Treatment Plant. CWS currently supplies MPW with water at a fixed rate of 3.0 mgd from CWS Feed No. 1 at Daniel Island and 2.5 mgd from CWS Feed No. 2 at Highway 41. Under the agreement with CWS, MPW may purchase additional withdrawals in increments of 100,000 gallons up to 12 mgd as needed over the next 20 years. The agreement also allows MPW to exceed the contractual water usage up to 1.26 times the normal operating flow for a period of up to 72 hours.

The average day water supply capacity from the RO plants and CWS feed points is 9.9 mgd. The maximum day water supply capacity from the RO plants and CWS feed points is 12.4 mgd, without considering the allowable 72-hour exceedance from CWS.

3.2 Water Storage Capacity

MPW has eight ground-level storage facilities and one elevated storage facility, for a total storage capacity of 12.3 million gallons (MG). The volume of storage within the existing water system currently exceeds ½ of the maximum day demand, which is the minimum storage volume that is required by the South Carolina Department of Health and Environmental Control (SCDHEC). Section 4 of this report provides additional details on existing system storage and storage volume requirements.

The storage volume in excess of the SCDHEC requirement is available to supplement water supply for maximum day demand given that demands on subsequent days are lower to allow for recharge of the storage facilities. Although storage was not considered for maximum day supply in the 2010 Master Plan, for the purpose of this evaluation, the storage volume in excess of the SCDHEC requirement is considered as additional supply capacity for maximum day demands to allow MPW to delay treatment upgrades and additional water supply purchases from CWS. In addition, as a back-up to supply from storage, MPW could use the allowable 72-hour exceedance to obtain additional water from CWS for the maximum day demand.

Based on the calculated maximum day demand (assuming 220 gpd/REU), MPW has excess storage of 4.8 MG beyond the SCDHEC requirement. In addition to the RO plants and CWS feed points, this brings the current maximum day water supply capacity to 17.2 mgd. As demands increase in the future, the excess storage volume available to supplement water supply on a maximum day decreases.

3.3 Future Water Demands and Supply

A comparison of the projected water demands and existing water supply capacity is presented in **Table 3-2.** The average day water supply capacity of the four RO plants and contracted supply of 5.5 mgd from CWS is not adequate to meet the projected average day demands through near-term. Therefore, additional supply capacity is needed to meet projected demands. The maximum supply capacity of the four RO plants and contracted supply of 5.5 mgd from CWS in addition to system storage capacity (in excess of the SCDHEC requirements) is adequate to meet the maximum day demands through near-term. However additional supply capacity is needed for projected maximum day demands before mid-term.

Table 3-2. Projected Water Demands and Existing Supply Capacity

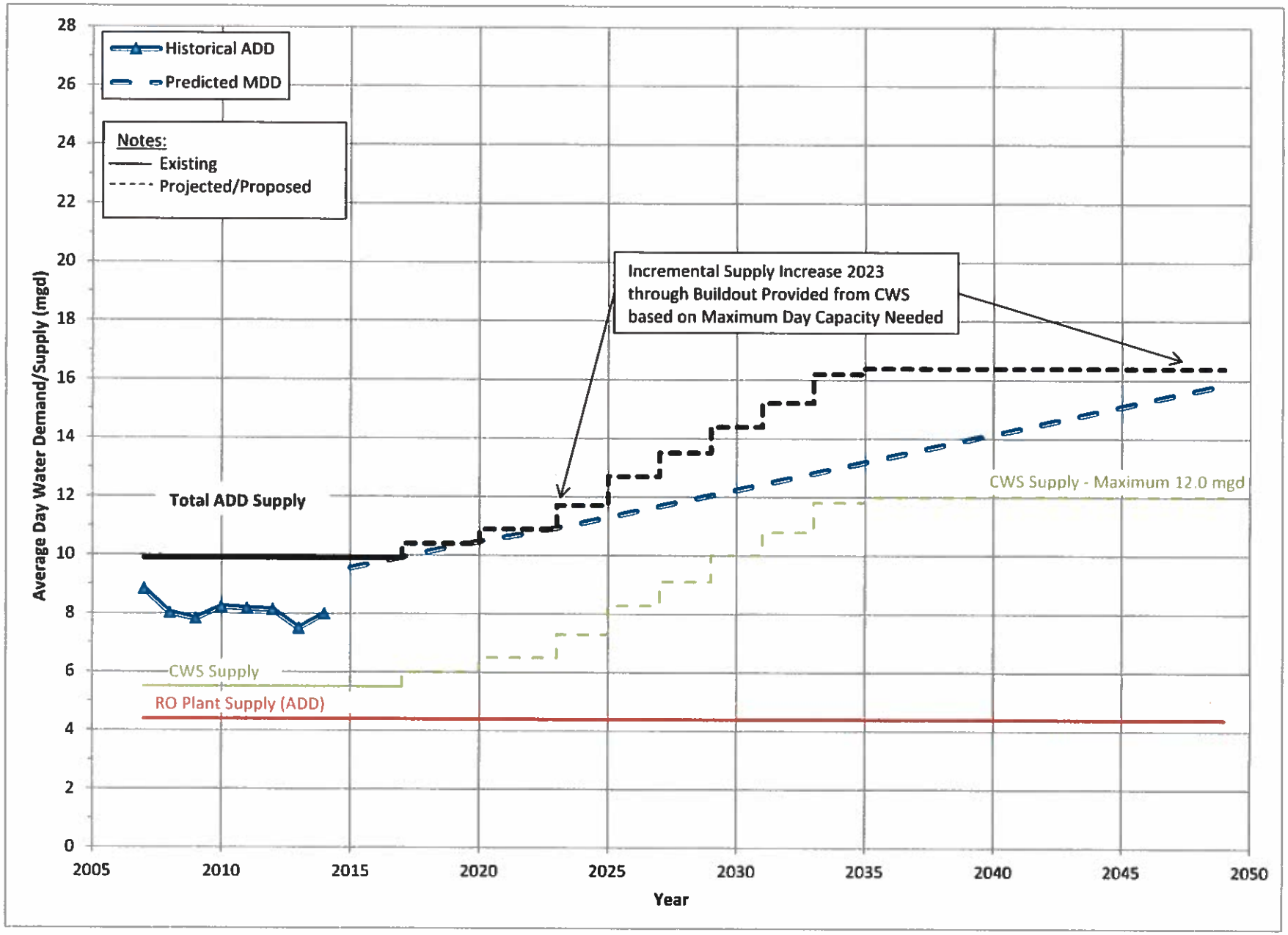
Planning Period	Approx. Year	Average Day Demand/Supply (mgd)		Maximum Day Demand/Supply (mgd)			
		Projected ADD	Existing Supply Capacity [1]	Projected MDD	Existing Supply Capacity [1]	Available Storage Capacity [2]	Total Supply Capacity
Existing [3]	2014	8.0	9.9	11.6	12.4	4.8	17.2
Near-Term	2019	10.3	9.9	16.5	12.4	4.1	16.5
Mid-Term	2024	11.1	9.9	17.8	12.4	3.4	15.8
Buildout	2049	15.9	9.9	25.4	12.4	0.0	12.4

1) See Table 3-1 for existing average day and maximum day supply capacity.
2) Total existing storage volume is 12.3 MG. Available storage for maximum day supply is assumed to be the existing storage volume minus the SCDHEC storage requirement of 1/2 maximum day demand.
3) Existing average day demand and maximum day demand is based on actual water usage.

Figures 3-1 and 3-2 present the average day and maximum day historical and projected water supply versus demand schedule from 2007 through buildout. The first increase in water supply is recommended by 2017 to increase average day supply, as shown in Figure 3-1. It is assumed that all additional average day water supply capacity will be provided through CWS. Therefore, additional purchase from CWS is recommended by 2017. A second purchase increase from CWS is recommended in by 2020 to increase average day supply capacity to meet projected demands. MPW is planning to add another treatment train to RO Plant No. 4, which will increase the maximum day supply capacity by approximately 0.6 mgd by 2021, although average day supply capacity remains fixed based on aquifer limitations. After 2023, a stepped increase in water supply from CWS is recommended (approximately 1 mgd every other year) to keep pace with maximum day demands, as shown in Figure 3-2. Assuming a maximum supply from the existing CWS feeds of 12.0 mgd, adequate water supply will be available for average day demand conditions through buildout. However, as shown in Figure 3-2, water supply will be inadequate to meet maximum day demands past 2035.

Based on discussions with CWS, the water supply available to MPW is limited to 7 mgd at Feed No. 1 (Daniel Island) and 5 mgd at Feed No. 2 (Highway 41). If improvements are made to the CWS distribution system, Feed No. 1 may be increased up to 10 mgd, however Feed No. 2 is limited by the capacity of the 30-inch diameter pipe crossing the Wando River and downstream transmission mains. To supply additional water, the implementation of a CWS feed from Sullivan's Island and a feed from

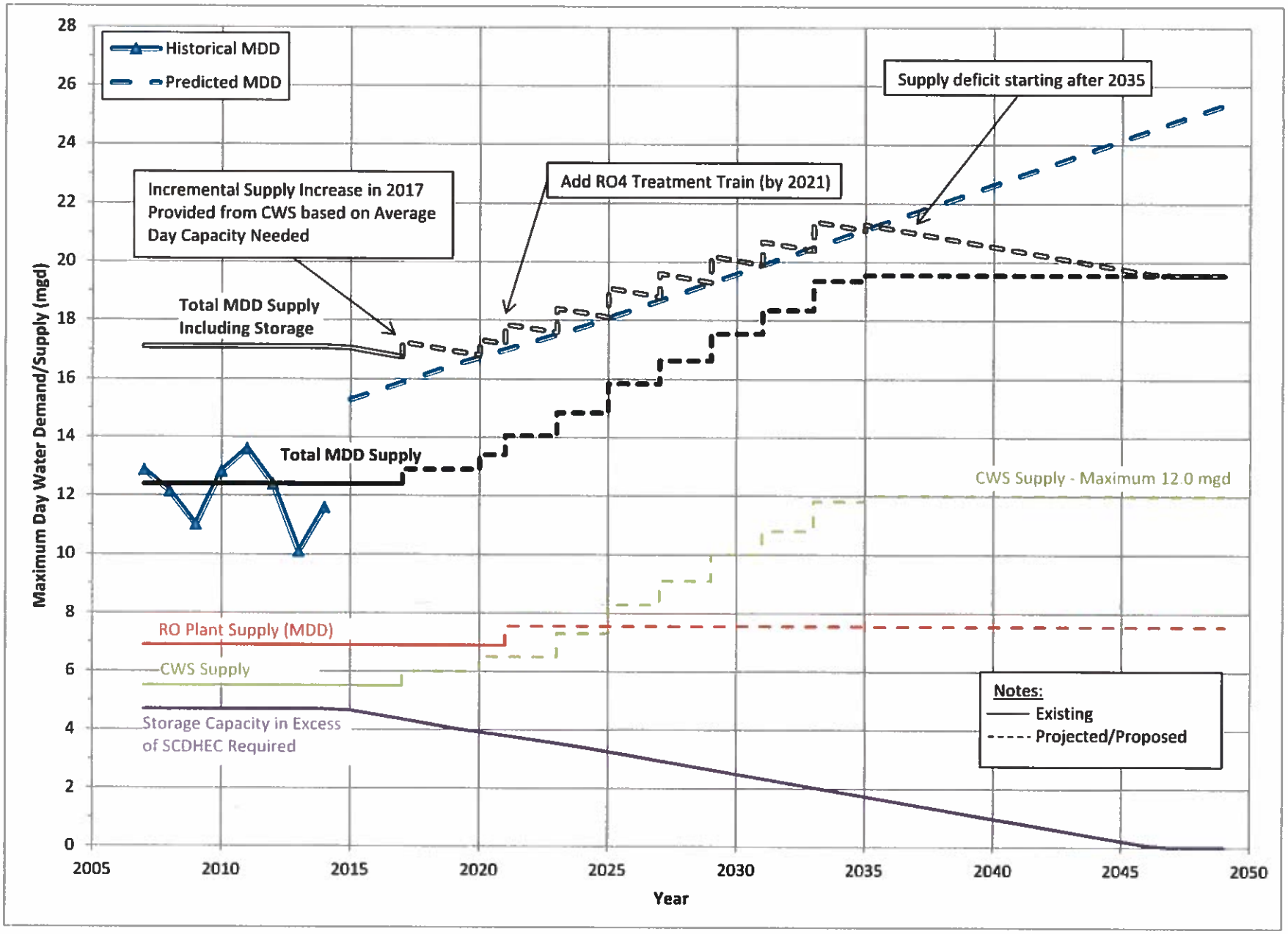
Remley's Point was considered as part of the water distribution and transmission system evaluation. A description of how these additional feeds could be utilized and the associated benefits can be found in Section 4.



MPW Projected Average Day Water Demands and Supply Capacity

CDM Smith

Figure 3-1



MPW Projected Maximum Day Water Demands and Supply Capacity

CDM Smith

Figure 3-2

Section 4

Water Distribution and Transmission System Evaluation

CDM Smith was tasked with conducting a hydraulic model evaluation of MPW's water distribution and transmission system. This evaluation is a 5-year update to the water distribution and transmission system recommendations provided in Section 6 of the 2010 Master Plan, and is based on revised demand projections and implementation of system infrastructure improvements. The tasks performed as part of this effort include:

- Updating and verifying the existing hydraulic model since the 2010 Master Plan
- Evaluating the existing water system under existing and projected demands
- Identifying deficiencies in the water system based on the evaluation criteria
- Recommending infrastructure and operational improvements to address deficiencies.

A discussion of the hydraulic model evaluation and recommended improvements follows.

4.1 Existing Water System

MPW provides potable water to approximately 33,500 accounts within and around the Town of Mount Pleasant. The water system generally consists of the following:

- Water Supply: Four reverse osmosis (RO) plants, three aquifer storage and recovery (ASR) wells, and two Charleston Water System (CWS) feeds, for a total water supply capacity of 9.9 million gallons per day (mgd) or 6,880 gallons per minute (gpm) during average day demand and 12.4 mgd or 8,610 gpm during maximum day demand, as discussed in Section 3.
- Water System Storage: Eight ground-level storage facilities and one elevated storage facility, for a total storage capacity of 12.3 million gallons (MG), see **Table 4-1**.
- Pumping Facilities: Four high-service pump stations and two booster pump stations, see Table 4-1.
- Pipe Infrastructure: 522 miles of water main ranging from 1 to 30 inches in diameter, constructed primarily of polyvinyl chloride (PVC) and ductile iron, with some asbestos cement, cast iron, high-density polyethylene, and polyethylene used in some areas.

Table 4-1. Summary of Finished Water Storage and Pumping Facilities

Facility[1]	Pumping				Storage	
	Description	Number of Pumps	Design Capacity per Pump (gpm)	VFDs[2]	Description	Total Volume (MG)
RO Plant No. 1	High Service Pump Station	1	280	No	Ground Tanks (2)	1.0
		2	900	No		
RO Plant No. 2	High Service Pump Station	3	1,200	Yes	Ground Tanks (2)	2.3
					Elevated Tank	0.5
RO Plant No. 3	High Service Pump Station	2	1,200	Yes	Ground Tank	2.0
		2	2,000	Yes		
RO Plant No. 4	High Service Pump Station	1	750	Yes	Ground Tank	2.0
		2	900	Yes		
Wando Park	Booster Pump Station	2	4,000	Yes	Ground Tank	2.5
Highway 41	Booster Pump Station	2	1,500	Yes	Ground Tank	2.0
					TOTAL	**12.3**

1) See Figure 4-2 for a map showing the locations of the pumping facilities.
2) Variable Frequency Drives (VFDs)

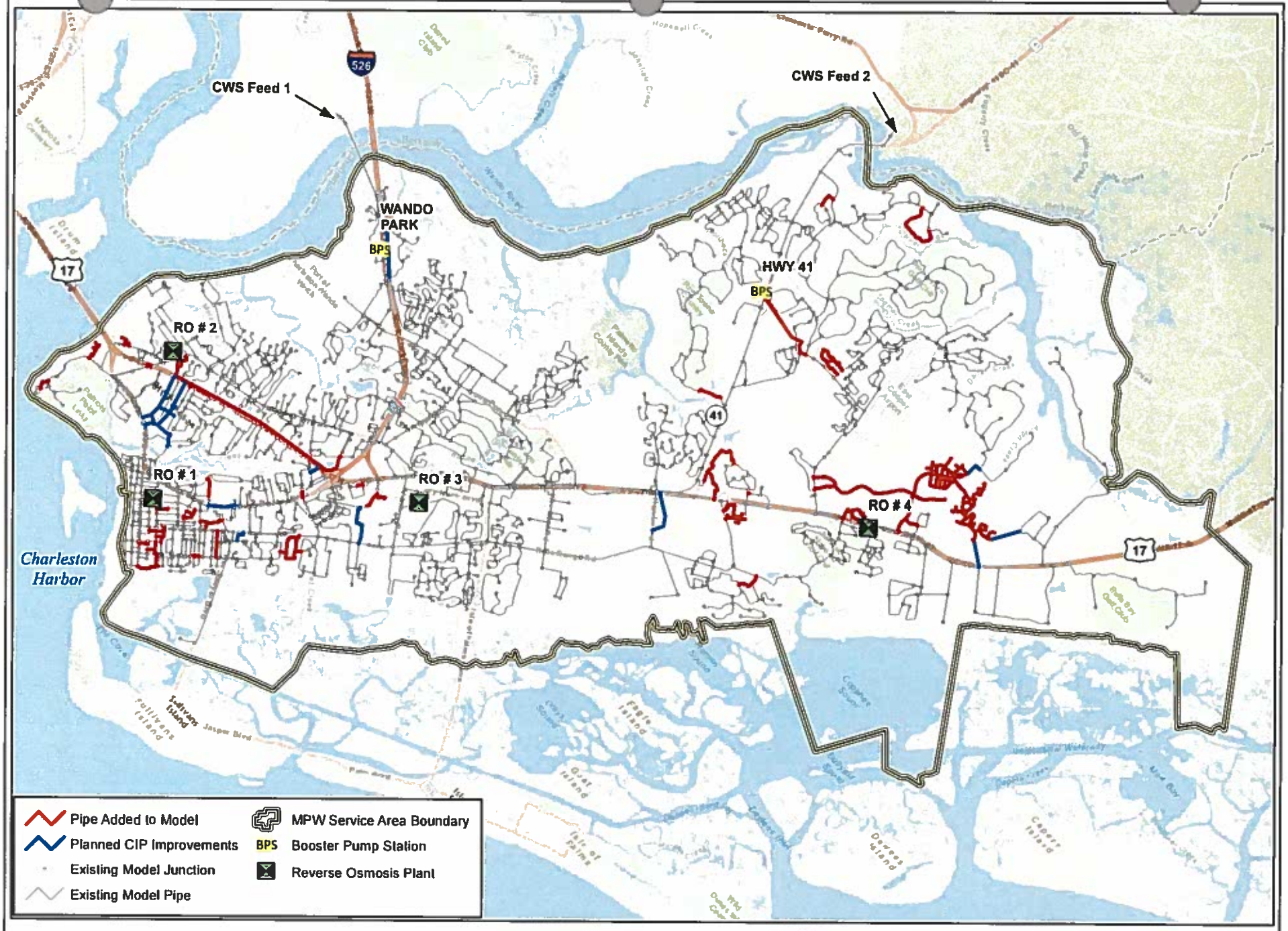
4.2 Model Update and Verification

MPW first developed a hydraulic model of the water distribution system in 1993 and has updated and recalibrated the model during subsequent master planning efforts. As part of the 2010 Master Plan, CDM Smith converted the existing water distribution system hydraulic model to Innovyze InfoWater model software, updated the model with recently constructed infrastructure, and verified the model results with supervisory control and data acquisition (SCADA) data from a maximum day demand period in June 2008 over a 24-hour extended period simulation (EPS).

For this master planning effort, the model was again updated with new infrastructure constructed since the 2010 Master Plan and verified against SCADA data over a 3-day maximum demand period in June 2014. Based on a review of previous model calibration and verification efforts, it was determined by MPW that a full calibration based on field data was not necessary for this evaluation.

4.2.1 Model Updates

CDM Smith updated the modeled pipes based on geographic information system (GIS) information provided by MPW. Existing pipes added to the model are shown in red on **Figure 4-1** and listed by diameter in **Table 4-2**. The majority of water pipes constructed since the 2010 Master Plan include the following:



Water Model Updates since the 2010 Comprehensive Utility Master Plan

Figure 4-1

CDM Smith

- New 16-inch diameter transmission main along Highway 17
- New 8-inch through 16-inch diameter pipes in Carolina Park
- New 8-inch through 12-inch diameter pipes in the Gregorie Ferry Landing and Oakland Plantation areas
- New 16-inch diameter water main from Highway 41 booster pump station to Park West Blvd
- Miscellaneous small sections of pipe in the RO Plant No. 1 and RO Plant No. 2 areas.

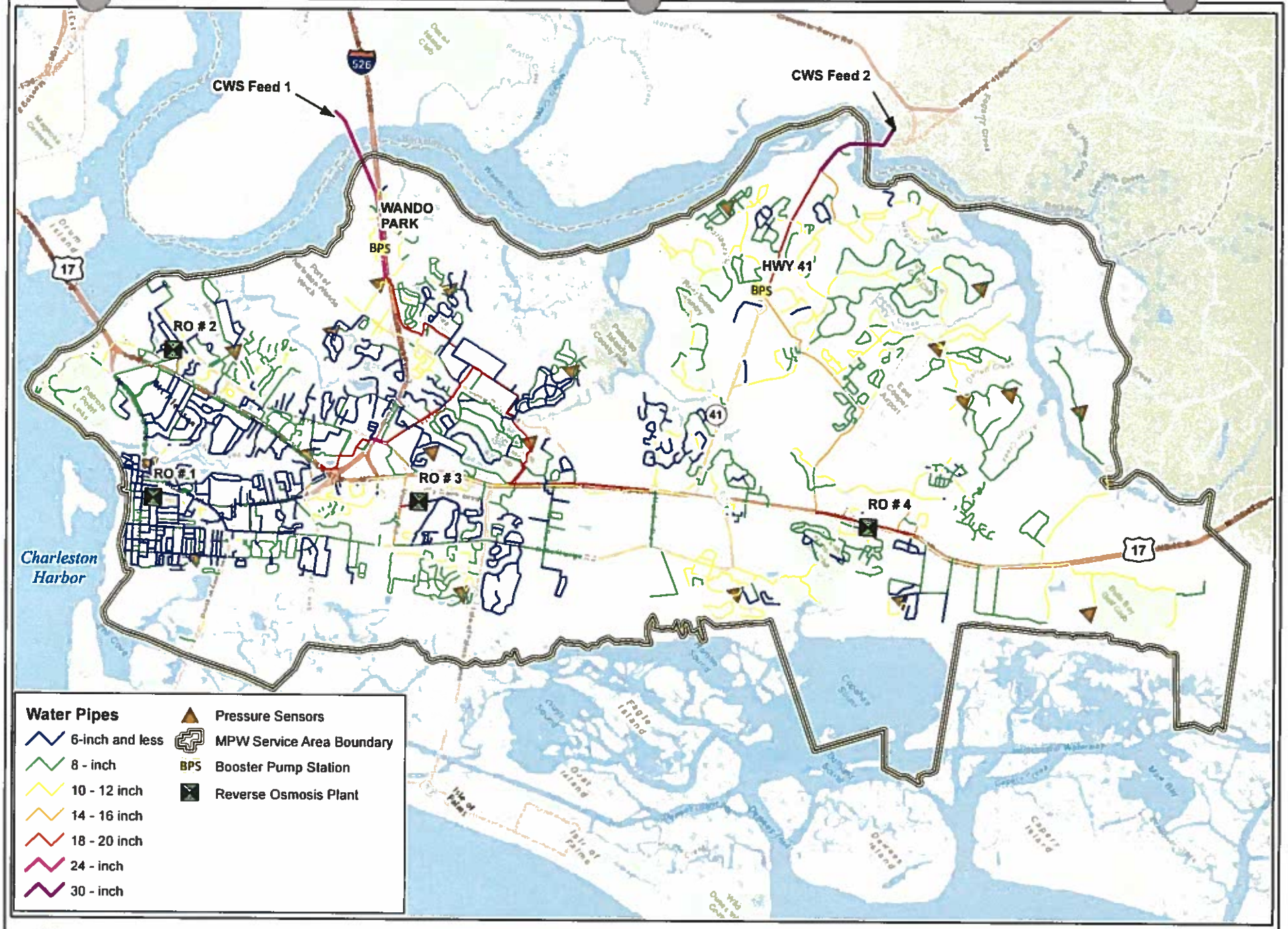
Table 4-2. Summary of Pipes Added to Model (since the 2010 Master Plan)

Diameter (inches)	Modeled Pipe Length (ft)
2	86
4	51
6	12,919
8	41,416
10	20,166
12	29,152
16	21,469
18	609
20	1,939
TOTAL	**127,807**

Planned improvements that are included in MPW's budget within the next 5 years and are in the planning, design, or construction phase are included as part of the near-term planning period and are shown in blue on Figure 4-1.

In addition to the infrastructure updates, CDM Smith re-allocated water demands in the model based on MPW's GIS customer database for 2014. The existing REUs for each customer account were assigned to the nearest node in the model. A demand factor of 220 gpd REU was applied to determine the average day demand, and a peaking factor of 1.6 was applied to the average day demand to determine maximum day demand. A description of the demands can be found in Section 2 of this report. The system-wide diurnal demand hydrograph developed for in previous modeling efforts was applied to all demand nodes for this evaluation.

The final version of the existing system model includes two CWS feeds, four RO plants and associated high-service pump stations, two booster pump stations, six ground storage tanks, one elevated storage tank, and approximately 363 miles of 2- to 30-inch diameter transmission and distribution mains. **Figure 4-2** shows the modeled water system infrastructure.



Modeled Water System Infrastructure

Figure 4-2

CDM Smith

4.2.2 Model Verification

MPW provided CDM Smith with water system SCADA data for June 2014. Based on a review of available flow data, the maximum demand period for the year occurred from June 18 through 20. Therefore, the verification analysis was performed for a 72-hour EPS using the Wednesday, June 18 through Friday, June 20, 2014 SCADA data. For verification purposes, the following assumptions and inputs were applied to the model:

- Demand: The total system demand was adjusted in the model using a global factor.
- CWS Feed Points: The CWS feed points were modeled as fixed-grade reservoirs followed by a flow control valve so that the flow into the MPW system is constant. The control valve at CWS Feed No. 1 (Daniel Island) was set to a constant 3.0 mgd and the control valve at CWS Feed No. 2 (Highway 41) was set to a constant 2.5 mgd.
- Storage Tanks: The initial tank water levels were obtained from SCADA data and input into the model. The fill valves for the Wando Park and Highway 41 ground storage tanks were set to simulate a tank filling rate to match tank levels observed from SCADA data during the filling cycle.
- Pumps: The operational data of the high-service pumps at the RO plants and booster pumps were input in the model based on SCADA data. Operational data included on/off status and relative speed for pumps with VFDs. For RO Plant Nos. 2, 3, and 4 high service pumps, the model controls were set to a target pressure downstream of the pumps based on SCADA and input from MPW.

The verification model was run and results compared to the SCADA data. The model appears to reflect the existing system within reasonable accuracy based on the following results:

- Pumps: The model-simulated flows and discharge pressures at each of the high service and booster pump stations followed a similar pattern as the SCADA data. Modeled pump station discharge pressures were generally within 3 psi of the SCADA field pressures. **Figure A-1** in Appendix A shows a comparison of the pump station flow and discharge pressures generated by the model for the four RO plant high-service pump stations. **Figure A-2** in Appendix A shows a comparison of the pump station flow and discharge pressures generated by the model for the Wando Park and Highway 41 booster pump stations.
- Storage Tanks: In general, model-simulated water levels in the storage tanks were within 2 feet of the field data and followed a similar pattern as the SCADA data. **Figure A-3** in Appendix A shows a comparison of the model and SCADA tank water levels for the Wando Park ground storage tank, Highway 41 ground storage tank, and RO Plant No. 2 elevated storage tank. It should be noted that water level comparisons were not made for the other storage facilities since they are pumped out of, not into, and were therefore modeled as fixed-head reservoirs.
- Pressure Sensors: MPW collects SCADA from 20 remote pressure sensors throughout the water system to monitor system pressures at locations shown on Figure 4-2. **Figure A-4** in Appendix A shows a comparison of the pressures between the SCADA and model for 16 of the pressure sensors. The remaining four pressure sensors either did not have SCADA data available for the verification period, or were noted to have inaccurate pressure readings based on discussions with MPW staff. The model generally simulated the pressures within 3 psi of the SCADA data and followed a similar pattern of pressure fluctuation throughout the day.

4.3 Hydraulic Evaluation Approach and Criteria

CDM Smith conducted hydraulic model evaluations to assess the adequacy of the existing water system. A description of the modeling approach and evaluation criteria follows.

4.3.1 Modeling Approach

Hydraulic model simulations of the existing water distribution infrastructure were run with existing, near-term, mid-term, and buildout projected maximum day demands to assess the adequacy of the existing water system to meet existing and future demands. Extended period hydraulic model simulations were run with maximum day demands applied to the system-wide diurnal demand hydrograph to simulate peak hour demands. Simulations were run for a duration of 72-hours to determine if tanks are able to fill during nighttime hours under maximum day demands. Maximum day demands plus fire flow demand were also simulated in the hydraulic model to determine the adequacy of the available fire flow.

The model results were compared to the evaluation criteria developed for the water system, described in Section 4.3.2. The inability of system components to adhere to the evaluation criteria was considered a deficiency and the potential need for an infrastructure and/or operational improvement was assessed.

The hydraulic modeling evaluation was also based on the following assumptions:

- Planned Improvements: It is assumed that the water pipe improvements that are included in MPW's budget within the next 5 years and are in the planning, design, or construction phase are completed and in service by the near-term planning period. Figure 4-1 shows the location of the 5-year planned improvements (in blue) based on information provided by MPW. These improvements are not included in the CIP presented in Section 7 of this report.
- Water Main Extensions: Water main extensions were added to the model in the buildout scenario to allocate demands in areas of the system that are not currently served, but are within the current service area around Carolina Park and in the Woodville and Cat Island area. The water main extensions are the same as those recommended in the 2010 Master Plan. It is assumed that the Carolina Park water distribution pipes will be built by the developer and are based on information from the engineering and planning firm Seamon Whiteside & Associates used in the 2010 Master Plan.
- Water Supply: As discussed in Section 3, the following water supply sources are available for maximum day demands:
  - Four RO plants (6.9 mgd MDD, 4.4 mgd ADD)
  - Two CWS feeds (current contract at 5.5 mgd total)
  - System storage in excess of the SCDHEC required volume (currently 4.8 MG available for MDD only; available storage volume decreases as future demands increase)

  Section 3 also provides recommendations for increasing the water supply to meet future projected demands.
- Operations: The operational controls for the high service pumps, booster pumps, and flow control valves at the CWS feeds are set in the model to simulate water supply from the appropriate sources, as recommended for each planning period. In general, for current

operations of the water system, the CWS feeds are set to supply a constant flow equal to the contractual water supply, the RO plant high service pumps are operated as needed to meet demand, and the booster pumps at Wando Park and Highway 41 are used as needed in the mornings during irrigation season. It should be noted that the existing water system evaluations include only the two existing CWS feed points at Highway 41 and Daniel Island (not the two additional proposed CWS feeds from Sullivan's Island and Remley's Point; these feeds are evaluated as improvements discussed in Section 4.5)

4.3.2 General Evaluation Criteria

As part of the 2010 Master Plan, minimum and maximum water system evaluation criteria were developed based on a combination of regulatory requirements, industry standards, and MPW and CDM Smith experience. The evaluation criteria are not intended to serve as design criteria, but rather to serve as triggers for identifying the potential need for infrastructure and/or operational improvements. For example, a water main may be designed for a maximum velocity of 5 feet per second (fps), but the evaluation criteria for velocity may not trigger the need for an improvement until velocities reach 10 fps. The evaluation criteria used to assess the existing water system includes system pressure, water main velocity, water main headloss, available fire flow, and system storage. **Table 4-3** summarizes the evaluation criteria for each parameter.

Table 4-3. Summary of Evaluation Criteria

Parameter	Condition	Evaluation Criteria
Pressure	Minimum	30 psi for Average, Maximum, and Peak Hour Demand, with desirable average pressures of at least 50 to 60 psi
		20 psi for Fire Flow
	Maximum	100 psi
Velocity	Maximum	10 fps, with less than 5 fps desirable
Headloss	Maximum	10 feet/1,000 feet for pipes < 24-inch diameter
		3 feet/1,000 feet for pipes ≥ 24-inch diameter
Fire Flow	Minimum	1,000 gpm desirable
		500 gpm minimum on dead ends and cul-de-sacs
Storage[1]	Minimum	Equalization, Fire Protection, and Emergency
		South Carolina Department of Health and Environmental Control (SCDHEC) [61-58]

1) Requirement based on whichever criterion is greater.

4.4 Existing Water System Hydraulic Evaluation Results

CDM Smith conducted 72-hour extended period hydraulic model simulations of the existing water system under MDD (which include peak hour demands) for near-term, mid-term, and buildout planning periods. The existing condition scenario is based on the verification analysis for June 2014. The model results were assessed for each scenario using the evaluation criteria presented in Table 4-3. A discussion of the model evaluation results follows.

4.4.1 Water Supply

Over the course of the planning periods, the modeled water supply from the two CWS feed points is increased to meet demands throughout the system. The maximum day supply amounts simulated in the model at each of the CWS feeds are listed in **Table 4-4.** In addition, for the near-term and mid-term planning periods, a portion of the storage volume at RO Plant Nos. 2, 3, and 4, and the Wando Park and Highway 41 storage facilities are used to supplement maximum day water supply. As discussed in section 3, MPW is limited in the amount of water it can obtain from CWS at the two existing feeds. The supply capacity through Feed No. 1 at Daniel Island is limited to 7.0 mgd; if improvements are made to the CWS distribution system this feed could supply MPW with up to 10 mgd. The supply capacity through Feed No. 2 at Highway 41 is limited to 5 mgd. Therefore, by buildout, additional feeds are needed from CWS to address MPW's water supply as well as additional improvements within the distribution system to convey the required water supply from CWS.

Table 4-4. Modeled Maximum Day Supply from CWS Feeds

Model Scenario	CWS Feed No. 1 (Daniel Island) (mgd)	CWS Feed No. 2 (Highway 41) (mgd)
Existing	3.0	2.5
Near-Term	3.0	3.0
Mid-Term	4.0	3.3
Buildout[1]	16.8	

1) Combined supply from CWS for projected buildout demands within the existing service area is 16.8 mgd. The projected demands for the extended service area east of Guerins Bridge Road require an additional supply of 1.1 mgd from CWS. The contribution of water being supplied from each CWS feed at buildout is given in Table 4-7 with the recommended improvements.

4.4.2 Water Transmission

Table 4-5 summarizes the hydraulic evaluation results for pressure, velocity, headloss, and fire flow for existing conditions (no system improvements), for near-term, mid-term, and buildout planning periods. In general, model simulation results indicate that there are no pressure, velocity, headloss, or fire flow deficiencies for existing conditions or the near-term and mid-term planning periods. Therefore, the existing water infrastructure is adequate to meet water transmission needs through the mid-term planning period. Results are discussed in the following paragraphs.

Table 4-5. Summary of Pressure, Velocity, Headloss, and Fire Flow Model Results with No System Improvements

Parameter[1]	Evaluation Criteria	Unit	Model Scenario[2]			
			Existing[3]	Near-Term	Mid-Term	Buildout
Pressure	Minimum	psi	54	51	47	18
	Average	psi	65	63	61	44
	Maximum	psi	75	78	77	75
Velocity	Maximum	fps	4.0	5.7	6.0	7.8
Headloss for D < 24"	Maximum	ft/1,000ft	5.1	8.2	8.3	24.3
Headloss for D >= 24"	Maximum	ft/1,000ft	1.1	1.2	1.8	4.8
Fire Flow	Minimum	gpm	>500	>500	>500	N/A[4]

1) See Table 4-3 for a description of the evaluation criteria.
2) Results are based on a 72-hour EPS under maximum day demand conditions, which includes peak hour demand.
3) Values obtained from verification analysis, described in Section 4.2.
4) Fire flow was not considered for buildout since the system did not pass the other minimum criteria.

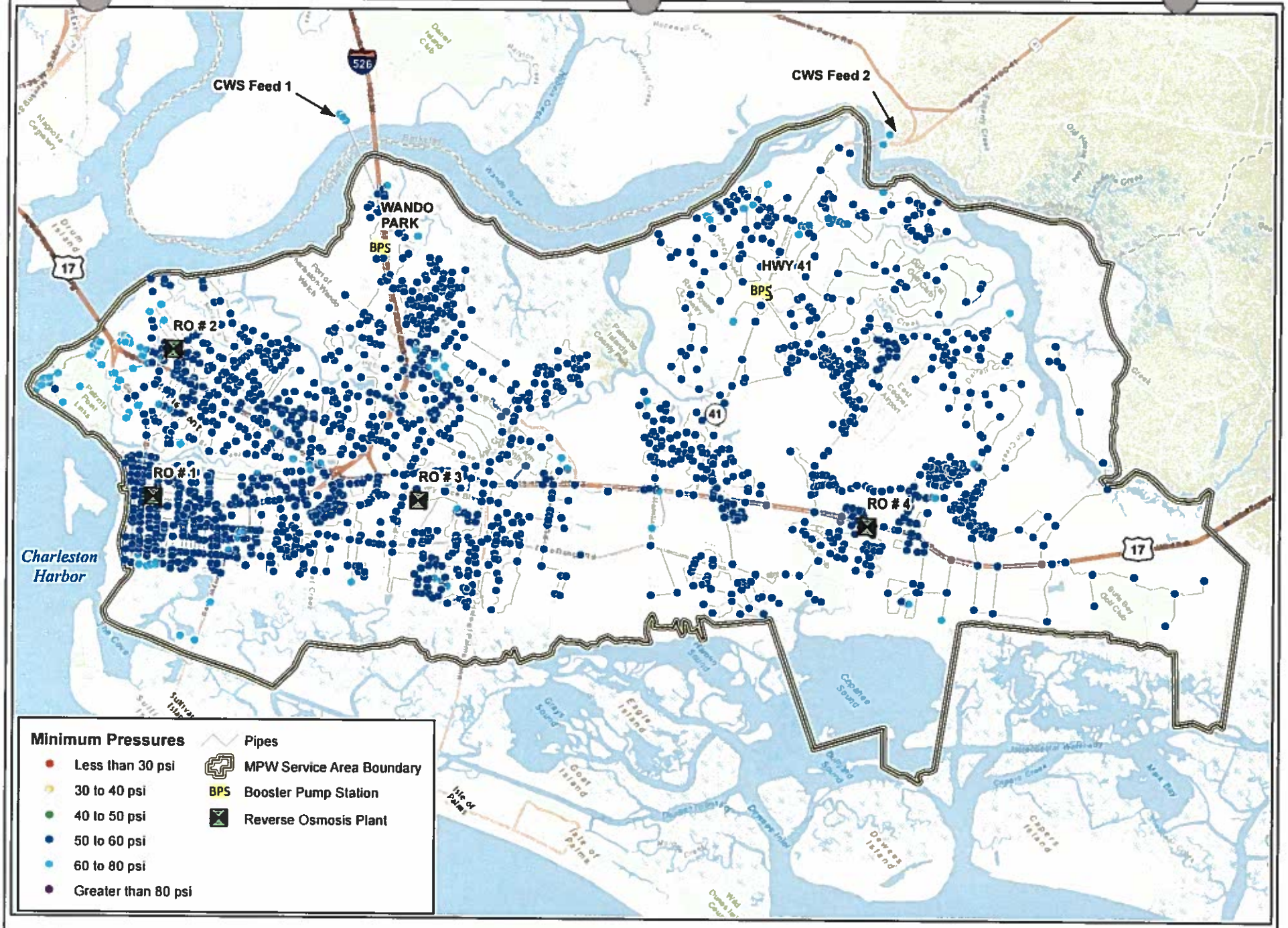
Pressure

Figures 4-3 and 4-4 present the minimum system pressures simulated at each model junction during the peak hour demand for the near-term and mid-term planning periods. Minimum pressures range from 47 to 60 psi throughout the majority of the system for each scenario. The lowest pressures are observed near RO Plant No. 2, RO Plant No. 4, and along Highway 17 in the mid-term planning period. Average daily pressures for maximum day demands range from 54 to 70 psi and maximum pressures are less than 77 psi, as shown in Table 4-5. Therefore, the existing infrastructure is adequate to satisfy the minimum and maximum pressure criteria, as well as the average desirable pressures for near-term, and mid-term MDDs.

Figure 4-5 presents the minimum system pressures during the peak hour demand for the buildout planning period. System pressures less than the minimum criteria of 30 psi are observed throughout the majority of the system. Pressures of 30 to 50 psi are observed in the western portions of the system, closest to the Daniel Island CWS feed. Average daily pressures for maximum day demands range from 35 to 68 psi and maximum pressures are less than 75 psi, as shown in Table 4-5. The low pressures generally indicate that the existing water system infrastructure is inadequate to satisfy the minimum pressure criteria and desirable average pressure criteria under the projected buildout scenario.

Velocity

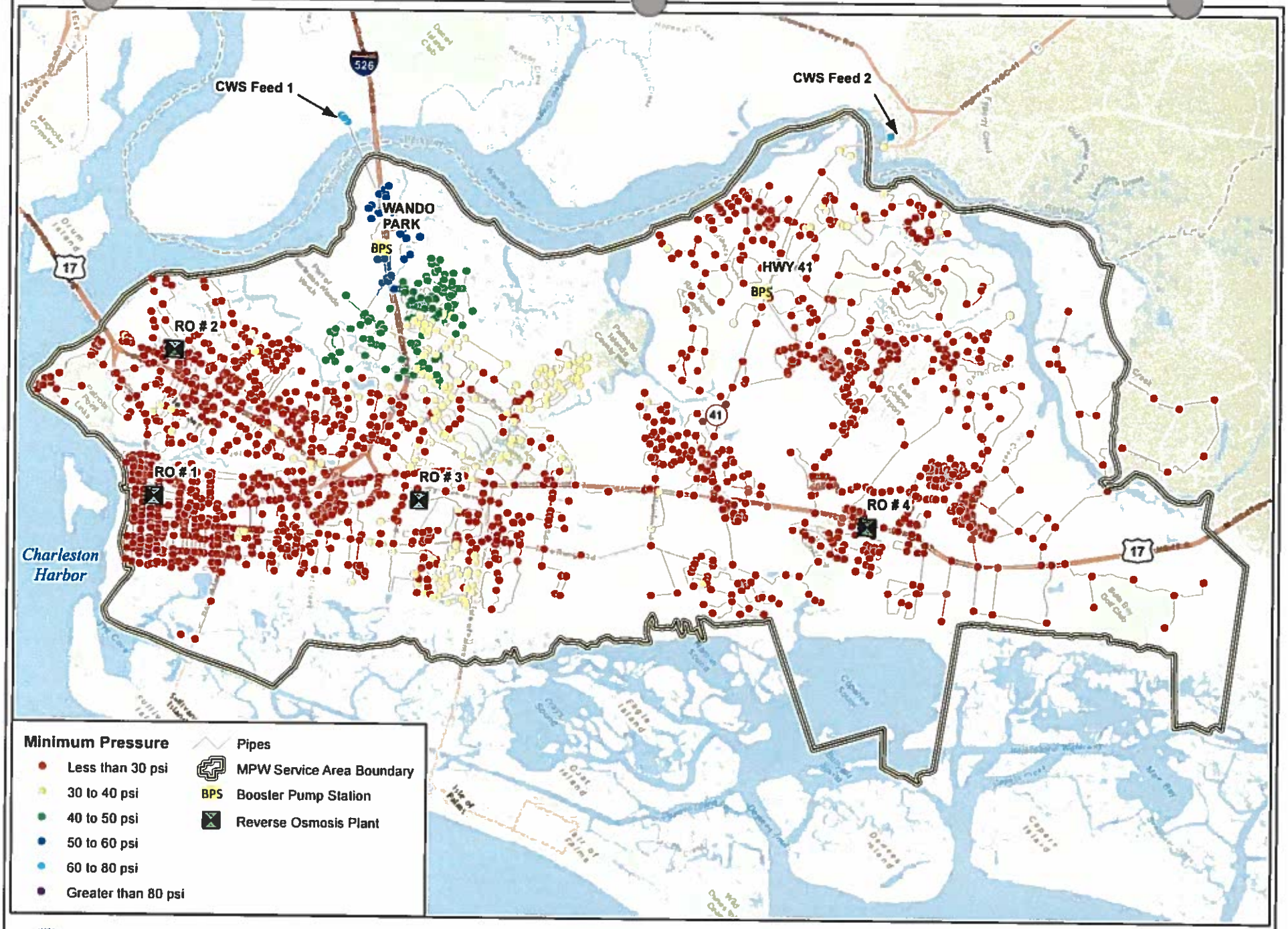
Maximum velocities are 5 fps or less for both the mid-term and near-term planning periods, except for two small segments near pump stations that are less than 10 fps. The majority of the pipe velocities in both planning periods are less than 2 fps. Maximum velocities for the buildout planning period are less than 10 fps, with the majority of the pipe velocities less than 5 fps (**Figure B-1** in Appendix B). Therefore, the existing infrastructure is adequate to satisfy the maximum velocity criteria through buildout.



Near Term (No Improvements) - Minimum Pressures

Figure 4-3

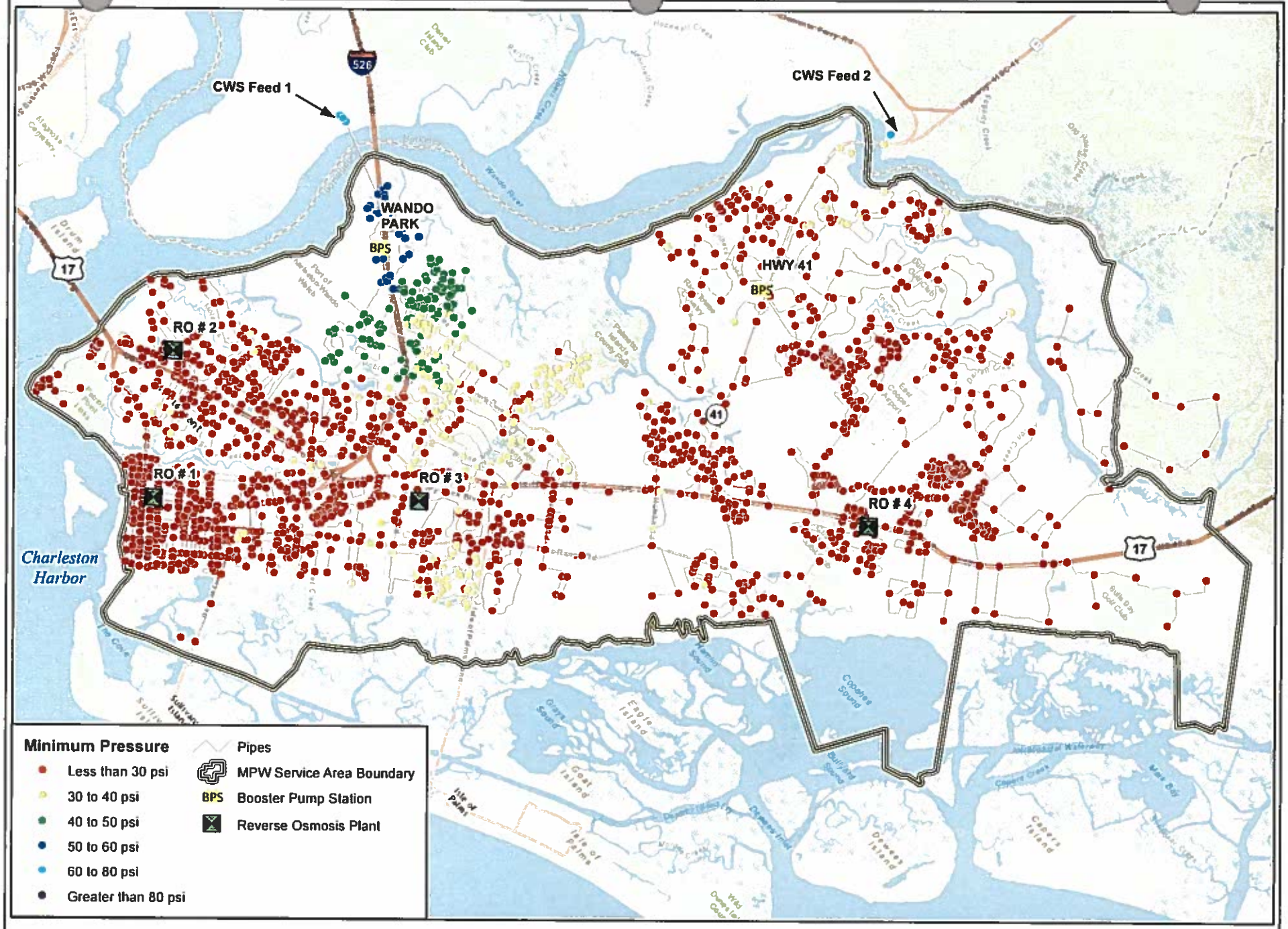
CDM Smith



Buildout (No Improvements) - Minimum Pressures

Figure 4-5

CDM Smith



Buildout (No Improvements) - Minimum Pressures

Figure 4-5

CDM Smith

Headloss

For the near-term and mid-term planning periods, maximum headloss is less than 10 ft/1,000 ft for all pipes less than 24 inches in diameter and less than 3 ft/1,000 ft for all pipes 24 inches in diameter and larger.

Figure B-2 in Appendix B presents the maximum headloss simulated for each modeled pipe for the buildout planning period. Headloss greater than 5 ft/1,000 ft is predicted in the main transmission lines from the CWS feed No. 1 at Daniel Island. Since this feed provides the majority of MPW's water supply by buildout, the headloss indicates that the capacity of the existing transmission infrastructure from the CWS feed No. 1 into MPW's system is limited.

Fire Flow

Figure B-3 in Appendix B presents the available fire flow rates simulated at each model junction under existing conditions with maximum day demands. In most areas, the available fire flows are greater than 1,500 gpm. Fire flows less than 1,000 gpm were observed on some dead end lines and cul-de-sacs. However, the model simulations predict an available fire flow greater than 500 gpm in all areas. Similar fire flow results were observed for the near-term and mid-term planning periods. Therefore, the existing infrastructure is adequate to satisfy the minimum allowable fire flow criteria through mid-term. Since the existing system cannot adequately meet maximum day pressure under the projected buildout demands, a fire flow analysis was not conducted for the buildout scenario.

4.4.3 Storage Evaluation

Storage Volume

A summary of the estimated system-wide total storage volume requirement is presented in **Table 4-6**. MPW currently has 12.3 MG of storage, which adequately meets all the storage criteria through mid-term and is slightly less than the SCDHEC total buildout storage requirement. However, the SCDHEC requirement may be reduced since the source and treatment facilities have auxiliary power to supplement peak demands.

Storage Effectiveness

Figures B-4 through B-7 in Appendix B show the storage tank usage for existing, near-term, mid-term, and buildout maximum day demands, respectively, at the Wando Park ground storage tank, Highway 41 ground storage tank, and RO Plant No. 2 elevated storage tank. It should be noted that for near-term and mid-term planning periods, the Wando Park and Highway 41 storage is used to supplement maximum day water supply; therefore, the tanks are not filled on the maximum day.

The Wando Park and Highway 41 tanks are controlled by pumps and fill valves and operate effectively for all future planning periods. The 0.5 MG elevated tank at RO Plant No. 2 is the only elevated storage within MPW's water system. SCADA data indicates that the elevated tank uses approximately 40 percent of the volume (approximately 10 foot turnover) for demand equalization on a maximum day. However, as demands in the system change, the hydraulic grade line near RO Plant No. 2 fluctuates. By buildout, without improvements the elevated tank completely drains. Even with recommended transmission improvements in buildout, the elevated tank still empties during the peak hour demand period. However, the tank remains hydraulically effective during average demand conditions. The effectiveness of the elevated tank should be re-evaluated in the future as demands increase in the vicinity of RO Plant No. 2.

Table 4-6. Summary of Storage Evaluation Results

Storage Evaluation Criteria	Planning Period[1]			
	Existing	Near-Term	Mid-Term	Buildout[6]
SCDHEC Requirement[2]				
(Peak Flow + Fire Flow) x 2 hours (MG)	*1.9*	*2.5*	*2.7*	*3.6*
½ MDD (MG)	*5.8*	*8.2*	*8.9*	*12.7*
SCDHEC Total Requirement (MG)	5.8	8.2	8.9	12.7
Equalization + Fire Protection + Emergency Storage (0% of ADD)				
Equalization Storage[3] (MG)	*1.0*	*1.5*	*1.6*	*2.3*
Fire Protection Storage[4] (MG)	*0.6*	*0.6*	*0.6*	*0.6*
Emergency Storage[5] (MG)	*0.0*	*0.0*	*0.0*	*0.0*
Total Storage Requirement (MG)	1.6	2.1	2.2	2.9
Equalization + Fire Protection + Emergency Storage (25% of ADD)				
Equalization Storage[3] (MG)	*1.0*	*1.5*	*1.6*	*2.3*
Fire Protection Storage[4] (MG)	*0.6*	*0.6*	*0.6*	*0.6*
Emergency Storage[5] (MG)	*2.0*	*2.6*	*2.8*	*4.0*
Total Storage Requirement (MG)	3.6	4.7	5.0	6.9
Equalization + Fire Protection + Emergency Storage (50% of ADD)				
Equalization Storage[3] (MG)	*1.0*	*1.5*	*1.6*	*2.3*
Fire Protection Storage[4] (MG)	*0.6*	*0.6*	*0.6*	*0.6*
Emergency Storage[5] (MG)	*4.0*	*5.2*	*5.6*	*7.9*
Total Storage Requirement (MG)	5.6	7.3	7.8	10.8

1) Total existing storage is 12.3 MG
2) SCDHEC system-wide storage requirement is the greater of [(Peak Hour Flow + Fire Flow) x 2 hour duration] versus ½ of MDD.
3) Equalization Storage = 9% of MDD based on *2010 Master Plan*
4) Fire Protection Storage = 3,500 gpm for 3 hr duration
5) Emergency Storage = % of ADD as noted
6) Buildout storage requirements are calculated based on projected demands for the existing service area plus the extended service area east of Guerins Bridge Road.

Additional Elevated Storage Evaluation

MPW has also reported spikes in system pressures during existing overnight periods of low demand when the hydraulic grade of the system is higher and the RO Plant No. 2 elevated tank fills completely. Without any other elevated storage and with a constant water supply into the system from CWS that exceeds the overnight demands, there is a surge in system pressure. CDM Smith evaluated the addition of a new elevated tank in the vicinity of RO Plant No. 1 to help address the pressure surge. MPW indicated that a new tank with a volume of approximately 0.2 to 0.3 MG should be considered. Hydraulic model simulations were run with February 2014 (minimum month) demands with an additional new 0.3 MG elevated tank. However, since the RO Plant No. 2 elevated tank and the new

elevated tank are located in the same vicinity, they operate similarly and both are locked out (i.e. system hydraulic grade exceeds the tank high water level) during low demand periods. In addition, as the hydraulic grade of the system changes in the future, the elevated storage will be less effective during peak demand periods. Therefore, a new elevated tank in the vicinity of RO Plant No. 1 is not recommended to address pressure surge during low demands. It is recommended that a surge analysis be performed to consider the benefits of installing a surge valve at the RO Plan No. 2 ground storage tank to eliminate pressure surge when the elevated tank becomes full and/or opening the fill valves to store excess water supplied from CWS in the Wando Park and Highway 41 ground storage tanks.

4.4.4 Operational Evaluation

The hydraulic model was used to evaluate the operations of the water distribution and transmission system. The following operational recommendations are outlined to assist MPW with maintaining desirable system pressures, balancing water supply from the reverse osmosis (RO) treatment plants vs. the Charleston Water System (CWS) feedpoints, and maximizing water quality. These operation recommendations are provided for existing, near-term (5-year), and mid-term (10-year) planning periods:

- CWS Feeds: Maintain constant water supply feed from the CWS feedpoints to maximize the amount of water supplied by CWS at the contractual limit. If the CWS supply exceeds system demands during overnight low demand periods, it is recommended that water supplied through the flow control valve(s) from CWS be reduced, if possible, or alternately open the fill valves on the Wando Park and Highway 41 ground storage tanks to store excess water supplied from CWS.

- RO Plants: Operate one large pump at RO Plant No. 1 during daytime hours (approximately 5 a.m. to 10 p.m.) for average day demands; operate one large pump continuously during maximum day demands to maximize the supply capacity at RO Plant No. 1. Operate the variable speed pumps at RO Plant Nos. 2, 3, and 4 based on a pressure set point in the range of 60 psi to 65 psi. In general, this results in operation of one large pump at each RO Plant during average day demands and two pumps during peak hours for maximum day demands.

- Storage/Re-pump Facilities: Operate the booster pumps at the Wando Park and Highway 41 storage/re-pump facilities in the morning hours when demands are highest (approximately 6 a.m. to 11 a.m.) to boost system pressures and re-fill the tanks over the remainder of the day. It is recommended that approximately one third of the tank volume be turned over each day, with the remaining two thirds of the volume reserved for fire protection and emergency storage. During lower demand periods, the storage tanks can be filled to a lower level to reduce the tank volume and decrease water age in the tanks.

Additional system improvements and water supply feeds are required for the buildout scenario; therefore, operations of the system at buildout will be dependent on the implemented improvements. Although modeled operations at buildout are generally the same as the other planning periods, the buildout operations are not specifically discussed in this section.

4.5 Improvements Evaluation

The existing water infrastructure is adequate to meet water transmission and storage needs through the mid-term planning period. However, the available 12 mgd water supply through CWS Feed No. 1 and CWS Feed No. 2 will not meet the demands projected past 2035 and pressure and headloss deficiencies are predicted in the existing water system for the buildout planning period (Section 4.4.2). In order to address MPW's water supply and infrastructure at buildout, three options were evaluated, as defined in **Table 4-7**:

- **Option 1** – Existing CWS feeds limited to 12 mgd with 7 mgd from Feed No. 1 and 5 mgd from Feed No. 2; additional supply provided from non-CWS sources.
- **Option 2** – Option 1 plus new CWS feeds at Sullivan's Island (Feed No. 3) and Remley's Point (Feed No. 4) for a total CWS supply up to 17.9 mgd.
- **Option 3** – Option 1 with increase in flow at Feed No. 1 from 7 to 10 mgd plus new feed at Sullivan's Island (Feed No. 3) for a total CWS supply up to 17.9 mgd.

In addition, MPW's planning area has been extended beyond the current service area to maintain consistency with the Town's 2014 Comprehensive Plan Update. The extended service area includes projected growth east of Guerins Bridge Road to Steed Creek Road. The major infrastructure required to extend service to areas north and east of the Wando River that are not currently served by MPW is included as a separate analysis. For each option, the supply required for the current service area is identified with an "A" designation (e.g. Option 1A) and with a "B" designation with the inclusion of the extended service area (e.g. Option 1B).

Table 4-7. Maximum Day Supply from CWS Feeds at Buildout

Buildout Model Scenario[1]	CWS Feed No. 1 (Daniel Island) (mgd)	CWS Feed No. 2 (Highway 41) (mgd)	New CWS Feed No. 3 (Sullivan's Island) (mgd)	New CWS Feed No. 4 (Remley's Point) (mgd)	Total CWS Supply (mgd)	Projected Deficit (mgd)
Option 1A	7.0	5.0	--	--	12.0	4.8
Option 1B	7.0	5.0	--	--	12.0	5.9
Option 2A	7.0	5.0	1.8	3.0	16.8	--
Option 2B	7.0	5.0	2.9	3.0	17.9	--
Option 3A	10.0	5.0	1.8	--	16.8	--
Option 3B	10.0	5.0	2.9	--	17.9	--

1) A = Current Service Area, B = Current Service Area plus Extended Service Area

The pressure at the point of delivery for each of the feeds was provided by CWS and is defined in **Table 4-8**.

Table 4-8. Pressure Provided by CWS at Point of Delivery for Feeds

CWS Feed	Delivery Pressure (psi)
CWS Feed No. 1 [1]	86
CWS Feed No. 2 [2]	78
CWS Feed No. 3 [3]	70
CWS Feed No. 4 [4]	79

1) Based on email from Curtis Denman to Mark Cline, August 28, 2015, 3:30 p.m.: 86 psi upstream of meter at 10 mgd.
2) Based on email from Curtis Denman to Mark Cline, August 28, 2015, 3:30 p.m.: 78 psi upstream of existing 10x2 meter, 68 psi downstream after 10 psi meter loss
3) Based on email from Curtis Denman to Mark Cline, August 25, 2015, 1:08 p.m.: 70 psi upstream of meter, >60 psi downstream of meter.
4) Based on email from Curtis Denman to Mark Cline, August 28, 2015, 4:29 p.m.: 79 psi at Remley Point Boat Landing

CDM Smith conducted hydraulic modeling analyses to identify the appropriate operational and infrastructure improvements required to resolve system deficiencies. The hydraulic analysis under buildout conditions was based on the following assumptions:

- The improvement alternatives identified as part of the 2010 Master Plan were used as a basis for the infrastructure improvements recommended as part of this evaluation. Where necessary, the 2010 recommendations have been modified based on the updated demand projections and hydraulic evaluation results.
- The pressures at the point of delivery for the CWS Feeds were modeled using the values provided in Table 4-8.
- Where new water mains are required to resolve water system deficiencies, the design criteria discussed in Section 3 of the 2010 Master Plan were utilized. It is assumed that water mains will be located along major roads or within existing rights-of-way.
- It is assumed that the water pipe improvements that are included in MPW's budget within the next 5 years and are in the planning, design, or construction phase are completed and in service by the near-term planning period (see Figure 4-1).
- It is assumed that water main extensions within Carolina Park will be built by the developer and therefore are not included as MPW capital improvement projects.

4.5.1 Option 1

Option 1 supplements MPW's RO Plant supply of 7.5 mgd with 7.0 mgd from CWS Feed No. 1 and 5.0 mgd from CWS Feed No. 2. A new 4.8-mgd water source will be required to satisfy MPW's projected buildout maximum day demand of 24.3 mgd for the current service area (Option 1A); a new 5.9-mgd water source will be required if the extended service area north/east of the Wando River is included under buildout conditions (Option 1B).

MPW has a permitted groundwater average and maximum withdrawal of 5.5 mgd and 9.0 mgd, respectively. The permitted groundwater withdrawal includes both process and finished water. The average and maximum available finished water are 4.4 mgd and 7.5 mgd, respectively, assuming 20 percent brine reject water from the RO treatment process.

Based on discussions with MPW, it is our understanding that it is unlikely that an increase in the permitted groundwater withdrawal will be approved; hence, additional groundwater is not available as a source. With Option 1, MPW will need to consider a new surface water supply to supplement the MPW and CWS supplies. The evaluation of a new surface water supply is not included in the scope of this Master Plan, therefore, Option 1 was not considered further in this study.

4.5.2 Option 2

Water Supply

Option 2 supplements the MPW and CWS supplies in Option 1 with an additional 3 mgd from a new CWS Feed No. 4 at Remley's Point. However, to satisfy the projected buildout maximum day demands for the current service area, 1.8 mgd will also be required from CWS Feed No. 3 through Sullivan's Island (Option 2A); 2.9 mgd will be required with the extended service area (Option 2B).

Water Transmission

Results of the hydraulic analysis indicate that the existing water infrastructure is inadequate to meet water transmission needs for Option 2 under buildout conditions. Improvements are required to provide adequate transmission for the available flow from CWS Feed Nos. 1, 3, and 4.

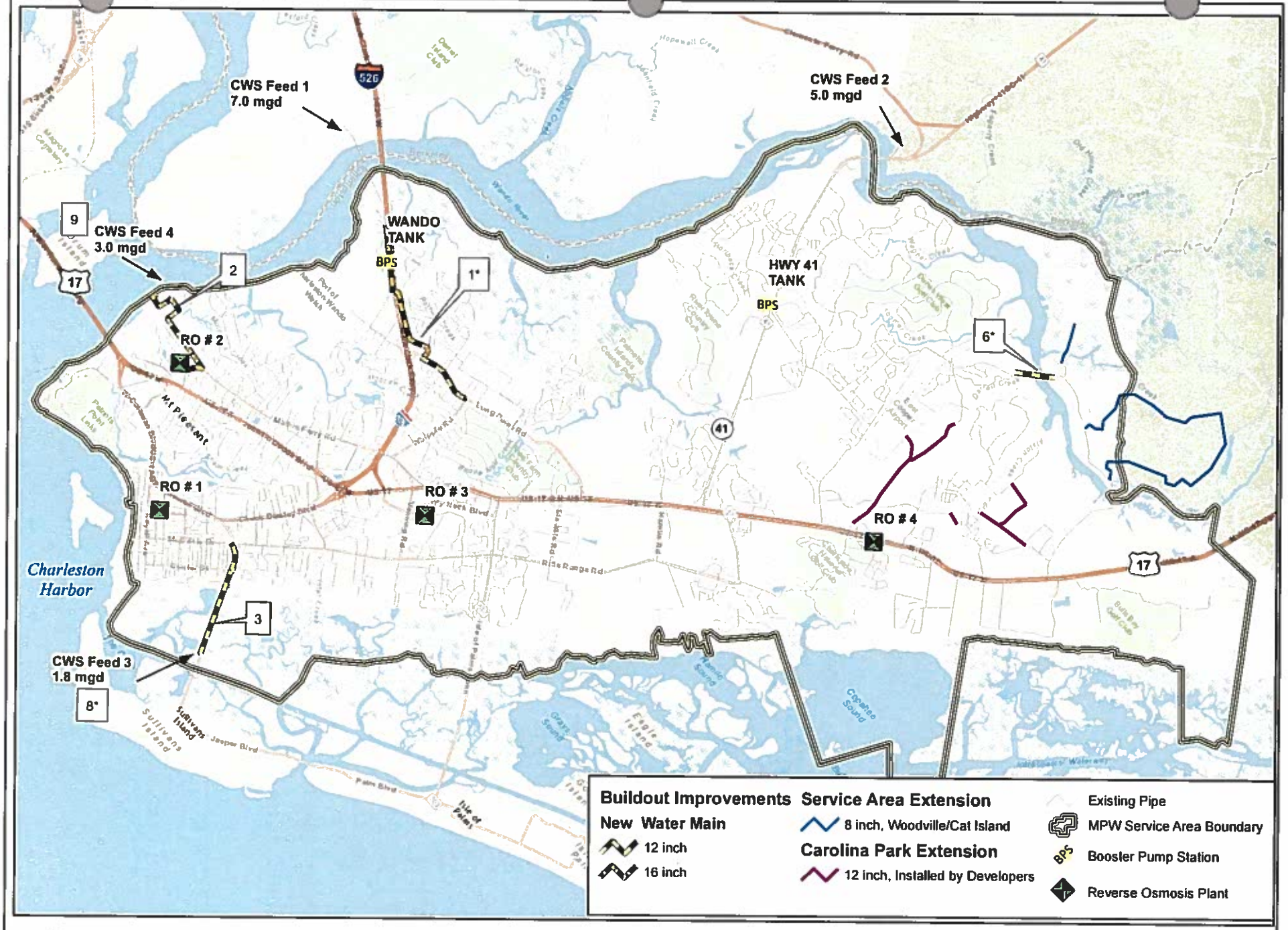
Option 2A - Current Service Area Improvements

The recommended infrastructure improvements for the current service area are presented in **Table 4-9** and **Figure 4-6.** Project numbers with an asterisk correspond to projects recommended in the 2010 Master Plan.

Table 4-9. Option 2A - Summary of Recommended Buildout Improvements for the Current Service Area

CIP ID[1]	Location	Improvement Type	Approximate Length (feet)	Diameter (inches)
1*	I-526, Seacoast Pkwy, Bell Hall Pkwy, Long Point Rd	Water Main	14,300	16
2	Remley's Point, 5th Ave, 2nd St, 3rd Ave, 3rd St, 5th Ave, Mathis Ferry Rd	Water Main	9,200	16
3	Ben Sawyer Blvd	Water Main	7,800	12
6*	Wando River Crossing	Water Main	2,600	12
8*	CWS Feed No. 3 Sullivan's Island (up to connection at Tolers Cove Dr)	Connection, Water Main, Meter	5,200	16
9	CWS Feed No. 4 Remley's Point (up to boat landing)	Connection, Water Main, Meter	7,800	20

1) Refer to Figure 4-6 for location of improvements; project numbers with an asterisk correspond to recommendations in the 2010 Master Plan.



Option 2A
Improvement Recommendations

Figure 4-6

CDM Smith

Significant growth is projected to occur in the southwestern portion of the system along the Johnnie Dodds Boulevard and Coleman/ Ben Sawyer Boulevard urban corridors. Much of the future demand in this area will be supplied through CWS Feed No. 1 at Daniel Island and Feed No. 4 at Remley's Point.

Hydraulic model results indicate that the capacity of the 24-inch/20-inch diameter main from CWS Feed No. 1 is inadequate to convey the projected supply of 7.0 mgd to meet demands and maintain minimum pressures in the southwest portion of the system. To improve transmission from CWS Feed No. 1, installation of the following improvement is recommended:

- Project 1 - Approximately 14,300 feet of new parallel 16-inch diameter main from the Wando River crossing at Eighty Oak Avenue to Whipple Road, along I-526, Seacoast Parkway, Belle Hall Parkway, and Long Point Road.

To establish the fourth CWS water supply feed at Remley's Point, the following improvements are recommended:

- Project 9 – Approximately 7,800 feet of new 20-inch diameter main and a new meter is required to implement the CWS feed from the CWS system on Daniel Island across the Wando River to Remley's Point boat landing (infrastructure recommendations and costs provided by CWS).
- Project 2 – Approximately 9,200 feet of 16-inch diameter main from Remley's Point boat landing along 5th Avenue, 2nd Street, 3rd Avenue, 3rd Street, and 5th Avenue, continuing southwest onto Mathis Ferry Road, connecting to the existing 16-inch diameter main on Walt Miller Street.

To establish the third CWS water supply feed from Sullivan's Island, the following improvements are recommended:

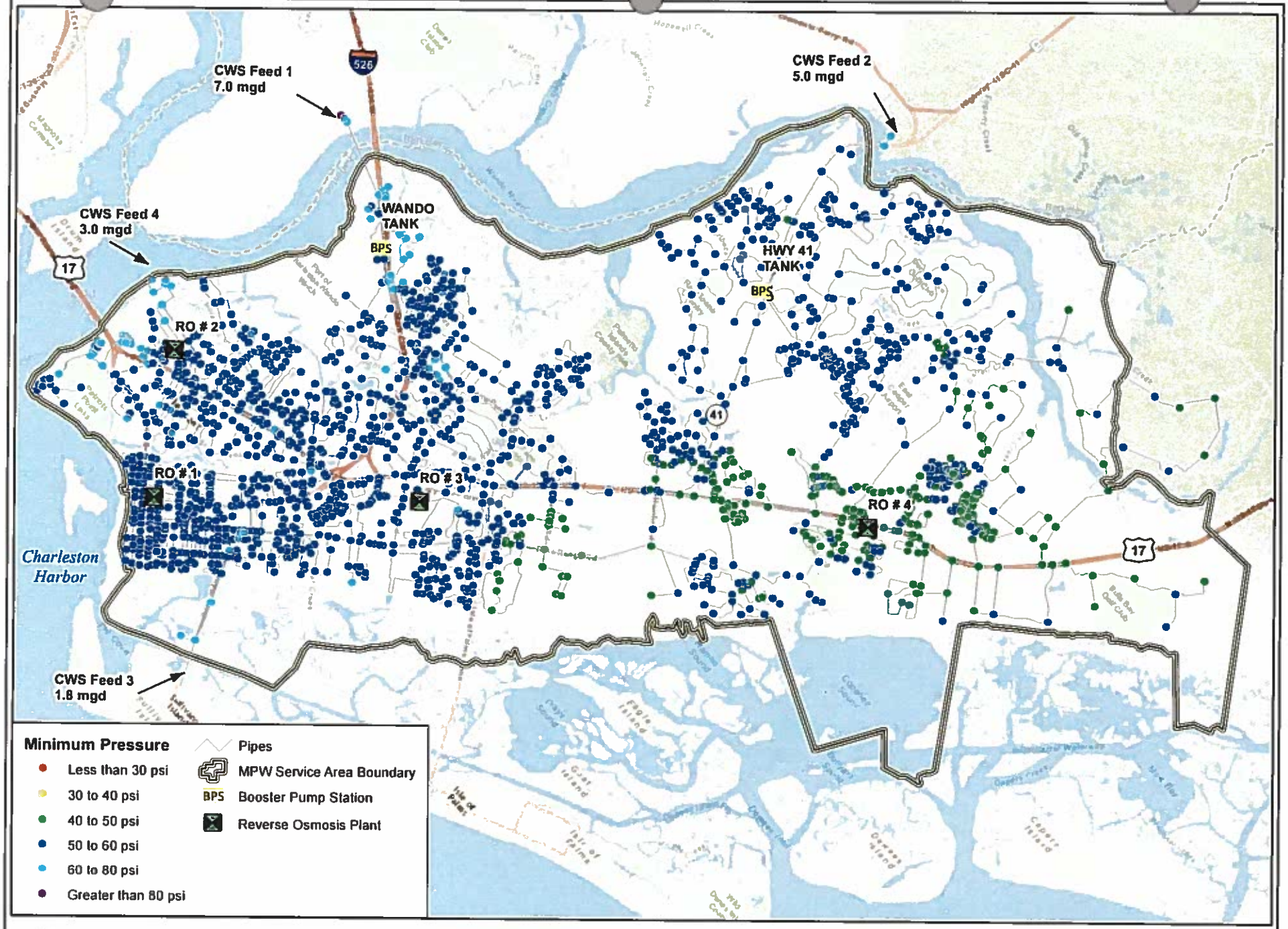
- Project 8 - Approximately 5,200 feet of 16-inch diameter main and a new meter is required to implement the CWS feed from Sullivan's Island. The water main extends from Middle Street on Sullivan's Island across the waterway to the existing MPW-owned 12-inch diameter water main at Tolers Cove Drive (infrastructure recommendations and costs provided by CWS).
- Project 3 - Approximately 7,800 feet of 12-inch diameter main paralleling the existing 12-inch pipe on Ben Sawyer Boulevard from Tolers Cove Drive to the 12-inch main at Rifle Range Road. This pipe improves transmission from the CWS feed into the MPW transmission system.

To improve pressures and fire flow and create looping for water quality and redundancy purposes, and serve future growth in the northern portion of the system north of Wando River, the following improvement is recommended:

- Project 6 – Approximately 2,600 feet of new 12-inch diameter main crossing the Wando River between Beckenham Drive and Cape Island Drive.

The minimum system pressures predicted by the hydraulic model with the implementation of the improvements listed in Table 4-9 are shown on **Figure 4-7**. As shown in this figure, implementing the recommended improvement projects for the current service area increases the minimum pressures at buildout to acceptable levels throughout the water system.

The resulting maximum head losses, maximum velocities, and fire flow after implementing the recommended improvements are presented in **Figures C-1** through **C-3** in Appendix C.



Option 2A - Minimum Pressures

Figure 4-7

CDM Smith

Option 2B - Extended Service Area Improvements

The recommended infrastructure improvements for the extended service area are presented in **Table 4-10** and **Figure 4-8.** These improvements are required in addition to the improvements identified for Option 2A in Table 4-9 with the exception of Project 3 which needs upsized from 12-inch to 16-inch for the additional supply from CWS Feed No. 3 at Sullivan's Island.

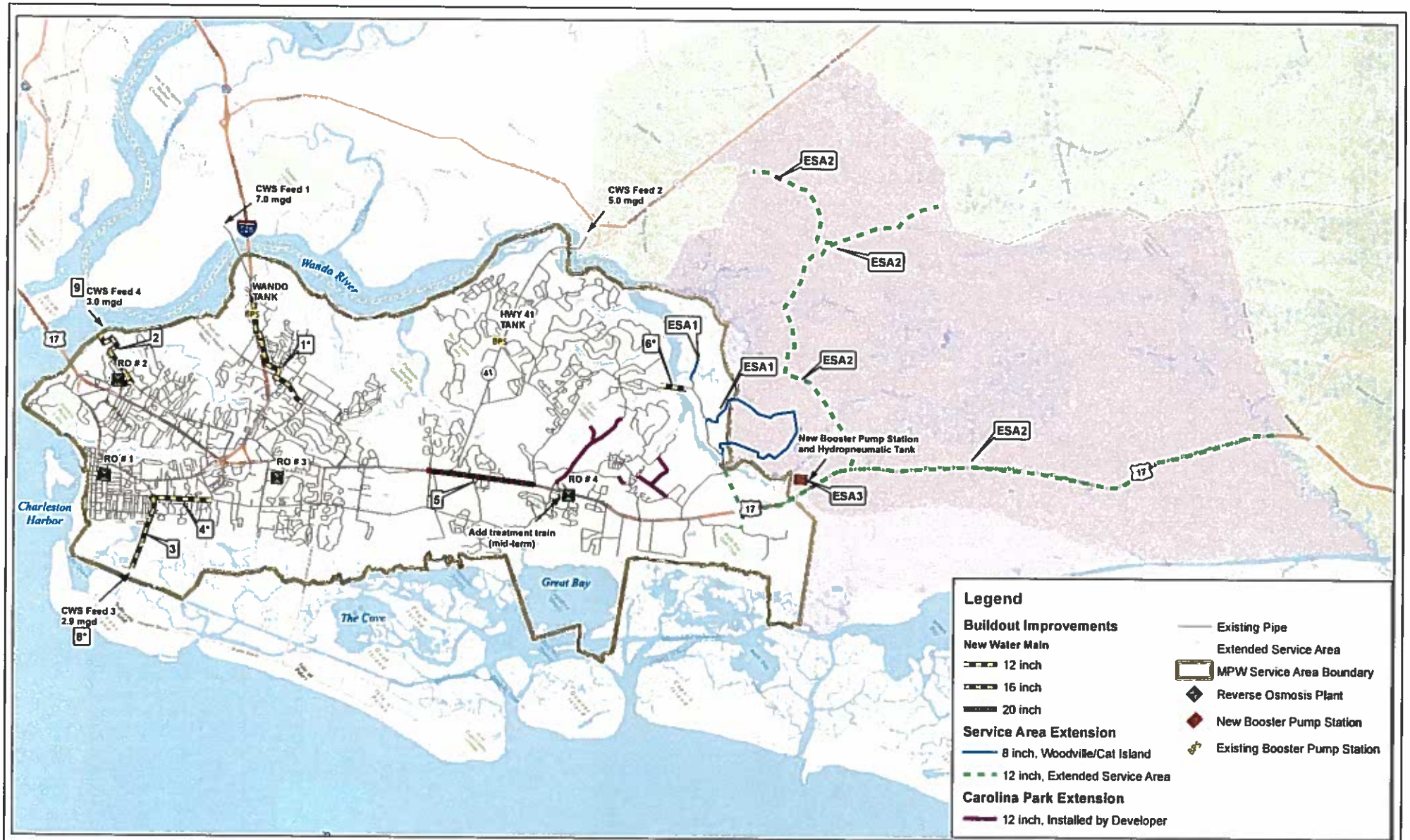
Table 4-10. Option 2B - Summary of Recommended Buildout Transmission Improvements for the Extended Service Area in addition to Option 2A Improvements

CIP ID[1]	Location	Improvement Type	Approximate Length (feet)	Diameter (inches)
3[2]	Ben Sawyer Blvd	Water Main	7,800	16
4*	Rifle Range Rd	Water Main	6,100	12
5	Highway 17	Water Main	10,800	20
ESA1	Woodville Area and Cat Island	Water Main	27,000	8
ESA2	East of Guerins Bridge Road	Water Main	123,000	12
ESA3	Booster Pump Station (1,000 gpm at 130 feet TDH) with VFDs and hydro-pneumatic tank	Pump Station	n/a	n/a

1) Refer to Figure 4-8 for location of improvements; project numbers with an asterisk correspond to recommendations in the 2010 Master Plan. Option 2A Improvements are provided in Table 4-9.
2) Project 3 is the same as presented in Option 2A, except the pipe diameter is upsized from 12 inches to 16 inches

An additional 1.1 mgd water supply from CWS Feed No. 3 at Sullivan's Island is required under this scenario to extend service to areas north and east of the Wando River that are not currently served by MPW. The following improvements are recommended to provide transmission from Feed No. 3 to the extended service area:

- Project 3 – Approximately 7,800 feet of 16-inch diameter main paralleling the existing 12-inch pipe on Ben Sawyer Boulevard from Tolers Cove Drive to Rifle Range Road. This pipe improves transmission from the CWS feed into the MPW transmission system.
- Project 4 - Approximately 6,100 feet of 12-inch diameter main on Rifle Range Road from Ben Sawyer Boulevard to the existing 12-inch diameter main at Bowman Road. This pipe improves transmission from the CWS feed at Sullivan's Island to the east.
- Project 5 – Approximately 10,800 feet of 20-inch diameter main on Highway 17 from the existing 20-inch diameter main at Hamlin Road to the existing 20-inch diameter main at Park West Boulevard to eliminate a 12-inch bottleneck and improve transmission to the extended service area.



Option 2B
Improvement Recommendations

Figure 4-8

CDM Smith

The major infrastructure required to provide water service within the extended service area includes the following:

- Woodville Area and Cat Island (Project ESA1) - Approximately 27,000 linear feet of new 8-inch diameter water mains along existing roadways.
- East of Guerins Bridge Road (Project ESA2) – Approximately 123,000 linear feet of new 12-inch diameter water mains along existing roadways.
- Booster Pump Station (Project ESA3) – Due to the higher elevations at the extremities of the extended service area, a 1,000-gallons per minute (gpm) booster pump station (with total dynamic head (TDH) of 130 feet) is recommended to maintain adequate pressures. The extended service area has relatively low, sparsely distributed demands over a large area due to the low development density recommended in the 2014 Comprehensive Plan Update. Because of potential water age issues, an elevated tank within the extended service area is not recommended. Instead, the booster pumps should operate with variable frequency drives (VFDs) and a hydro-pneumatic tank is also recommended to help maintain system pressures during low demand periods and improve booster pump operations.

The minimum system pressures with the implementation of the improvements listed in Table 4-10 predicted by the hydraulic model are shown on **Figure C-4** in Appendix C.

Storage

The storage tank operations for Options 2A and 2B are similar. **Figure C-5** in Appendix C illustrates the storage tank usage over a 72-hour extended period simulation under maximum day buildout conditions for both Options 2A and 2B. Results indicate that the existing storage facilities are hydraulically-effective for buildout conditions. Additional storage is not required.

4.5.3 Option 3

Water Supply

Option 3 eliminates CWS Feed No. 4 at Remley's Point from Option 2 and increases the available flow from CWS Feed No. 1 to 10 mgd. To satisfy the projected buildout maximum day demands for the current service area, an additional 1.8 mgd will be required from CWS Feed No. 3 through Sullivan's Island (Option 3A); 2.9 mgd will be required to serve the extended service area (Option 3B).

Water Transmission

Results of the hydraulic analysis indicate that the existing water infrastructure is inadequate to meet water transmission needs for Option 3 under buildout conditions. Improvements are required to provide adequate transmission for the available flow from CWS Feed Nos. 1 and 3.

Option 3A - Current Service Area Improvements

The recommended infrastructure improvements for the current service area are presented in **Table 4-11** and **Figure 4-9.** Project numbers with an asterisk correspond to projects recommended in the 2010 Master Plan.

Table 4-11. Option 3A - Summary of Recommended Buildout Improvements for the Current Service Area

CIP ID[1]	Location	Improvement Type	Approximate Length (feet)	Diameter (inches)
1*	I-526, Seacoast Pkwy, Bell Hall Pkwy, Long Point Rd	Water Main	14,300	24
3	Ben Sawyer Blvd	Water Main	7,800	12
6*	Wando River Crossing	Water Main	2,600	12
7	Mathis Ferry Road	Water Main	1,300	12
8*	CWS Feed No. 3 Sullivan's Island (up to connection at Tolers Cove Dr)	Connection, Water Main, Meter	5,200	16

1) Refer to Figure 4-9 for location of improvements; project numbers with an asterisk correspond to recommendations in the 2010 Master Plan.

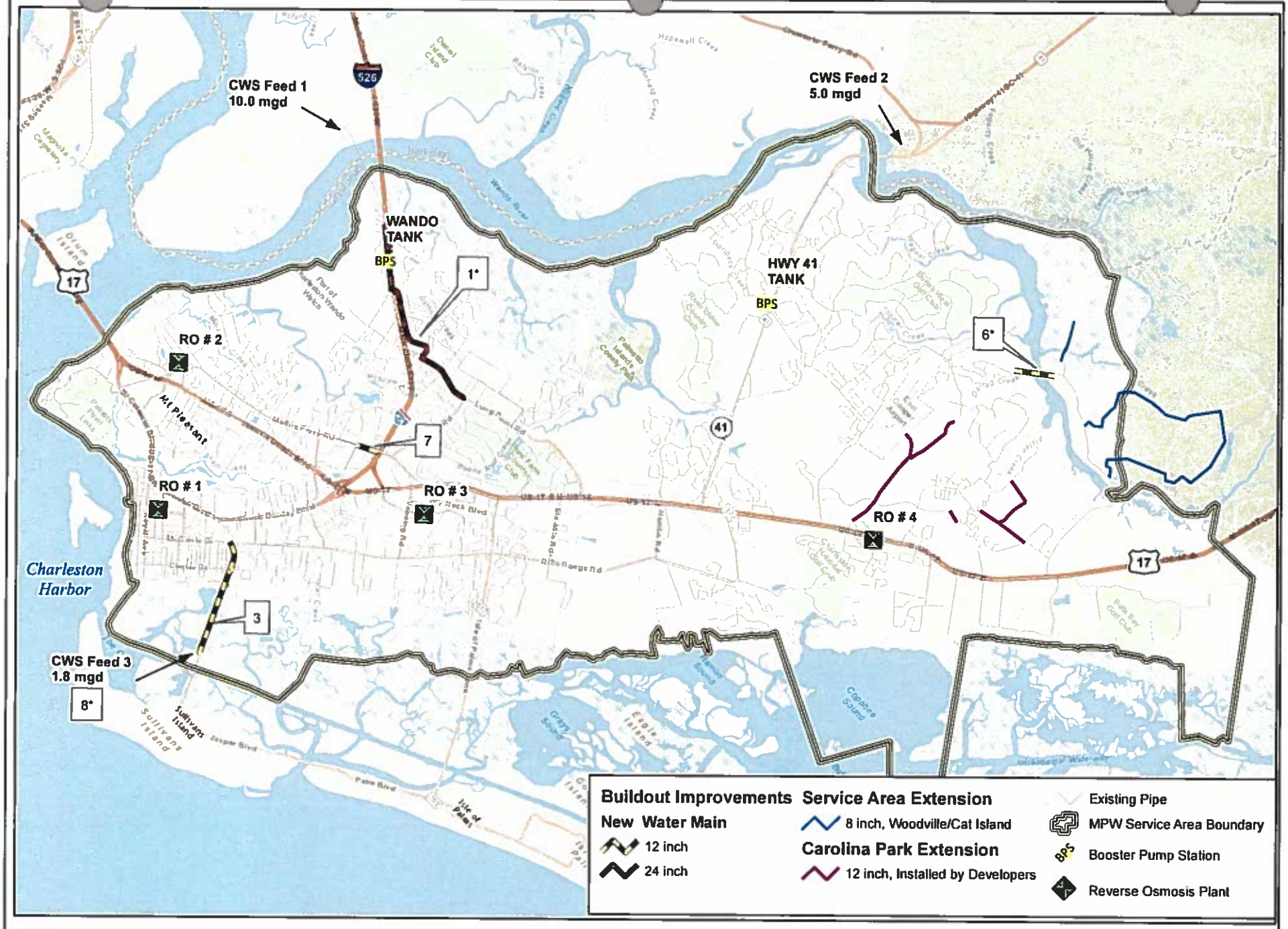
Option 3A improvements are similar to the recommended improvements for Option 2A with the exception of project 1 and 7.

- Project 1 - Hydraulic model results indicate that additional conveyance capacity is required to supply the projected 10.0 mgd from CWS Feed No. 1. Project 1 identified in Option 2A is recommended to be upsized from a 16-inch diameter pipe to a 24-inch diameter pipe to increase the transmission capacity from CWS Feed No. 1.
- Project 7 – Approximately 1,300 feet of 12-inch diameter main on Mathis Ferry Rd from the existing 24-inch diameter main at I-526 to the existing 12-inch diameter main at Von Kolnitz Road to complete a pipe loop and improve transmission from CWS Feed No. 1 to Mathis Ferry Road.

Implementing the recommended improvement projects listed in Table 4-11 increases the minimum pressures at buildout throughout the water system to acceptable levels as shown on **Figure 4-10.** The resulting maximum head losses, maximum velocities, and fire flow after implementing the recommended improvements are presented in **Figures C-6** through **C-8** in Appendix C.

Option 3B - Extended Service Area Improvements

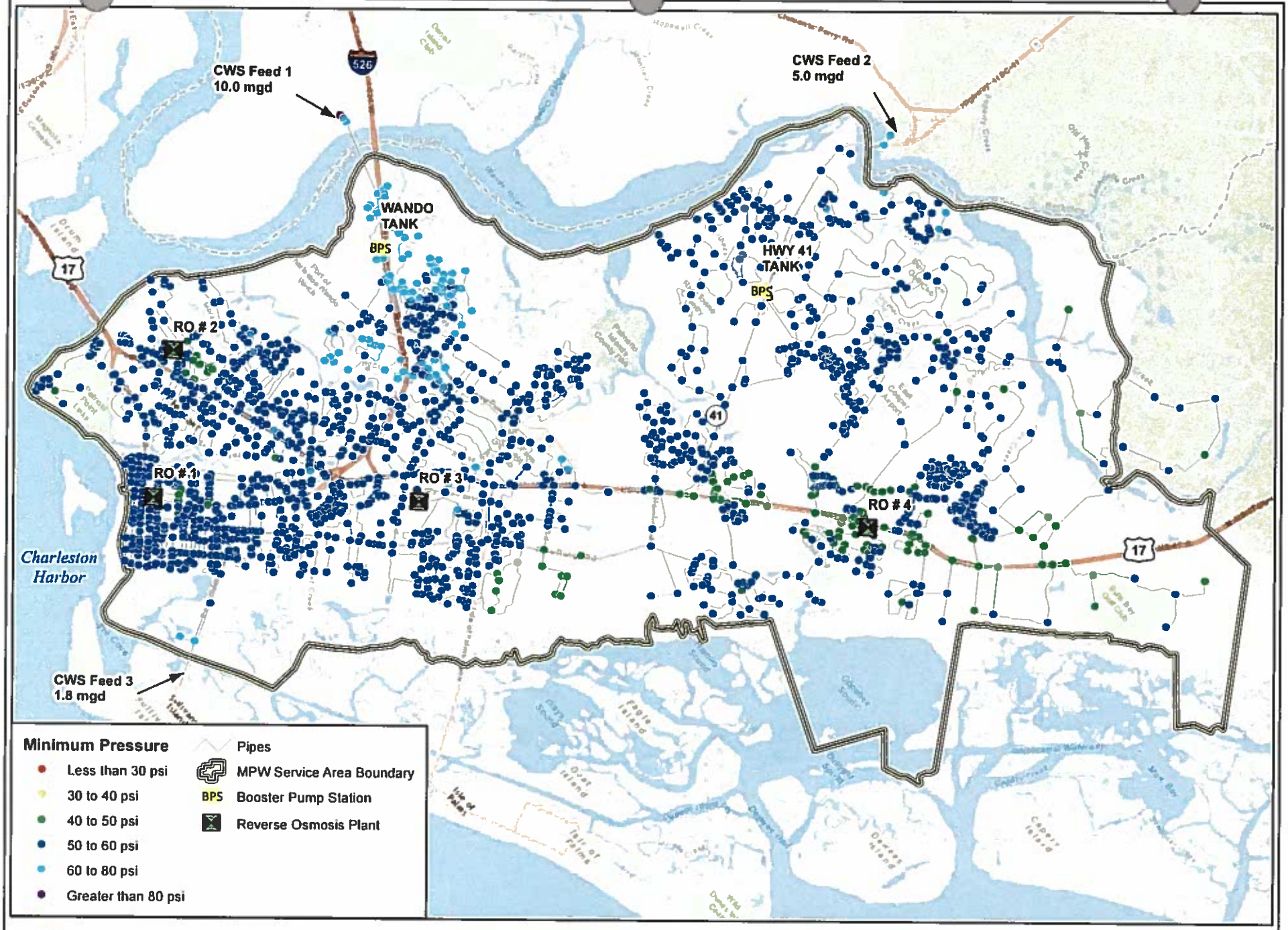
The recommended infrastructure improvements for the extended service area for Option 3B are presented in **Table 4-12** and **Figure 4-11;** these improvements are required in addition to the improvements identified for Option 3A in Table 4-11 with the exception of Project 3 which needs to be upsized from 12-inch to 16-inch diameter to convey additional supply from CWS Feed No. 3 at Sullivan's Island.



Option 3A
Improvement Recommendations

Figure 4-9

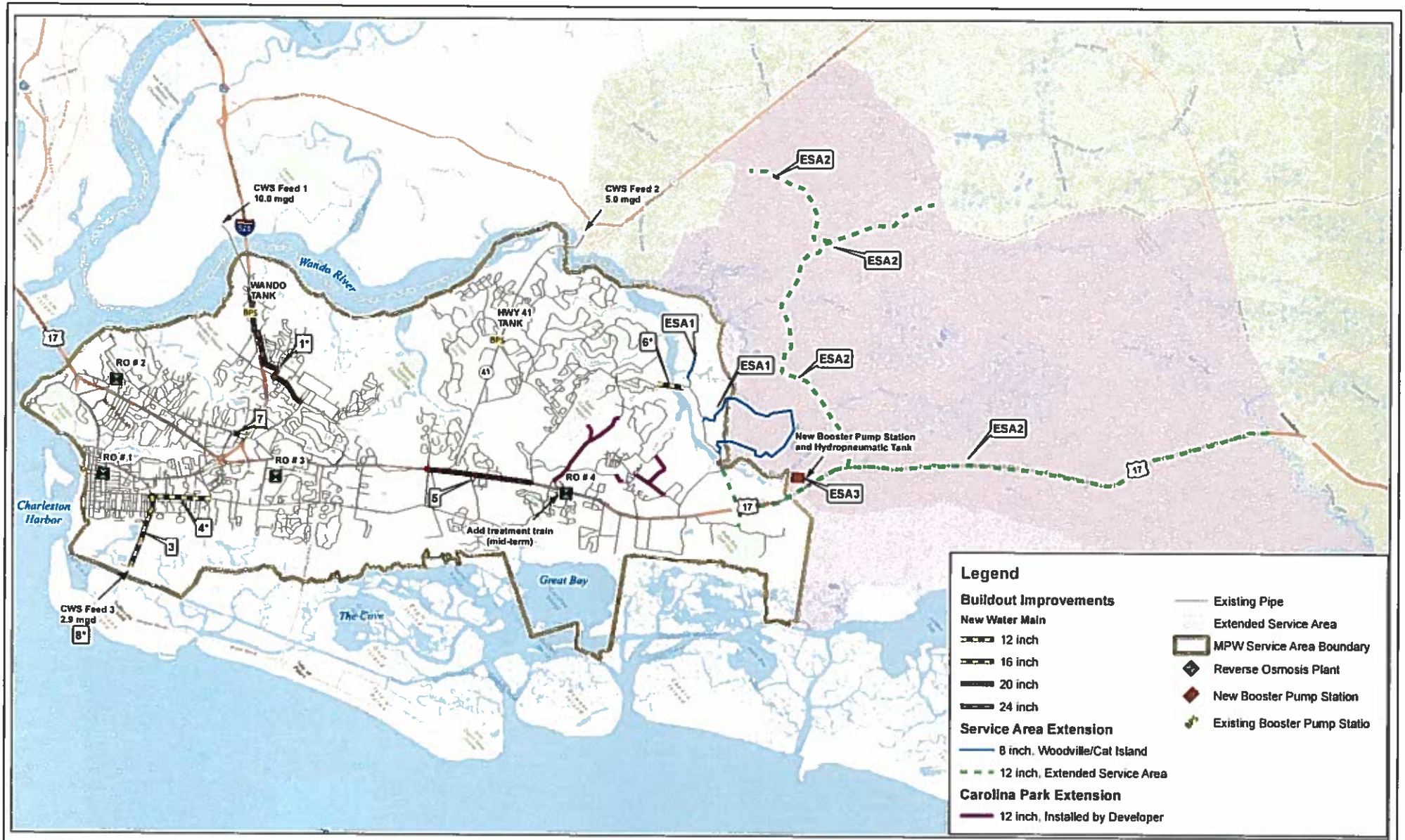
CDM Smith



Option 3A - Minimum Pressures

Figure 4-10

CDM Smith



Option 3B
Improvement Recommendations

Figure 4-11

CDM Smith

Table 4-12. Option 3B - Summary of Recommended Buildout Transmission Improvements for the Extended Service Area in addition to Option 3A Improvements

CIP ID[1]	Location	Improvement Type	Approximate Length (feet)	Diameter (inches)
3[2]	Ben Sawyer Blvd	Water Main	7,800	16
4*	Rifle Range Rd	Water Main	6,100	12
5	Highway 17	Water Main	10,800	20
ESA1	Woodville Area and Cat Island	Water Main	27,000	8
ESA2	East of Guerins Bridge Road	Water Main	123,000	12
ESA3	Booster Pump Station (1,000 gpm at 130 feet TDH) with VFDs and hydro-pneumatic tank	Pump Station	n/a	n/a

1) Refer to Figure 4-11 for location of improvements; project numbers with an asterisk correspond to recommendations in the 2010 Master Plan. Option 3A Improvements are provided in Table 4-11.
2) Project 3 is the same as presented in Option 3A, except the pipe is upsized from 12-inch to 16-inch.

The additional improvements for the extended service area in Option 3B are the same as the extended service area improvements described under Option 2B. The minimum system pressures with the implementation of these improvements predicted by the hydraulic model are shown in **Figure C-9** in Appendix C.

Storage

The storage tank operations for Options 3A and 3B are similar. **Figure C-10** in Appendix C illustrates the storage tank usage over a 72-hour extended period simulation under maximum day buildout conditions for both Options 3A and 3B. The Wando Park and Highway 41 tanks are controlled by pumps and fill valves and operate effectively under buildout conditions. The 0.5-million-gallon (MG) elevated tank at RO Plant No. 2 is the only elevated storage within MPW's water system. As demands in the system increase the hydraulic grade line near RO Plant No. 2 fluctuates without an additional water supply feed in the vicinity. Even with recommended transmission improvements under buildout conditions, the elevated tank still empties during the peak hour demand period. However, the tank remains hydraulically effective during average demand conditions. The effectiveness of the elevated tank should be re-evaluated in the future as demands increase in the vicinity of RO Plant No. 2.

4.5.4 Cost Estimates

The planning-level opinion of probable construct cost was estimated based on the assumptions and standardized unit costs developed previously and described in Section 4 and Appendix B of the 2010 Master Plan and recent cost estimates provided by MPW and CWS. The cost for CWS Feed No. 3. (Project 8) was developed by CWS and assumes that CWS will construct the feed from Middle Street on Sullivan's Island across the waterway to the existing MPW-owned 12-inch diameter main at Tolers Cove Drive. The cost for CWS Feed No. 4 at Remley's Point (Project 9) was developed by CWS and assumes that CWS will construct the feed from the CWS water system on Daniel Island to the boat landing at Remley's Point. MPW's cost share for these two additional feeds are included in the cost estimate. For Option 3A and 3B, it is assumed that the cost of any improvements to the CWS system

that are necessary to provide 10 mgd at the Feed No. 1 will be paid for by CWS and are not included in this cost estimate.

The estimated costs for Options 2A, 2B, 3A, and 3B are presented in **Table 4-13**. Due to the costs of installing the new feed at Remley's Point, Option 2 is significantly more expensive than implementing improvements in the existing system to provide 10 mgd at CWS Feed No. 1. Therefore, Option 3 is recommended as the preferred alternative for additional water supply from CWS to meet the buildout demands of MPW's water distribution and transmission system.

4.6 Conclusions and Recommendations

CDM Smith conducted hydraulic model analyses to evaluate the adequacy of the existing water distribution and transmission system to meet existing and projected maximum day demands. Based on the results of the modeling analyses, the existing water distribution and transmission system is adequately sized to meet existing and projected water demands through the mid-term planning period. Therefore, no pipe infrastructure improvements are recommended for the near-term or mid-term planning periods. However, several operational recommendations are provided to assist MPW with continuing to maintain desirable system pressures, balance water supply from the reverse osmosis (RO) treatment plants vs. the Charleston Water System (CWS) feedpoints, and maximize water quality.

A hydraulic model analysis of the maximum day demands for the buildout planning period identified water supply deficiencies and pressure deficiencies in the existing water distribution and transmission system by buildout. Based on information provided by MPW and CWS, three options for additional water supply were evaluated. A hydraulic analysis was performed for the two options involving additional water supply from CWS to identify the appropriate operational and infrastructure improvements required to resolve the system deficiencies to meet buildout demands. Based on this analysis and the costs provided in Table 4-13, Option 3 was selected as the preferred alternative. Recommended improvements under Option 3 for the current service area include 5.9 miles of 12-inch to 24-inch diameter water main improvements and a third CWS feed from Sullivan's Island with a capacity of 1.8 mgd.

Additional line extensions, water supply, and water transmission improvements beyond those recommended for the current service area are required to provide water service to the extended service area. To provide water service to the Woodville area and Cat Island, approximately 5.1 miles of 8-inch diameter water line extension is recommended. To provide service to the extended service area east of Guerins Bridge Road, an additional 23 miles of 12-inch diameter water line extension, 1,000-gpm booster pump station and hydropneumatic pump are recommended. Recommended transmission improvements from CWS Feed No. 3 to the extended service area include 3.2 miles of 12-inch and 20-inch diameter water line and upsizing one of the current system improvement projects (1.5 miles) from 12-inch diameter to 16-inch diameter.

Costs for the recommended improvements are included in the Capital Improvements Program in Section 7. It is anticipated that most of the cost to extend service to customers outside of MPW's current service area would be paid for by developers. In addition, MPW should be cognizant of opportunities to implement improvements at reduced costs, such as in conjunction with road repair construction, repaving, and other utility construction/rehabilitation/repair.

Table 4-13: Cost Estimates for Improvement Recommendations

CIP ID[1]	Location	Improvement Type	Option 2A - Current Service Area	Option 2B - Extended Service Area	Option 3A - Current Service Area	Option 3B- Extended Service Area
			Estimated Capital Cost[2] ($)	Estimated Capital Cost[2] ($)	Estimated Capital Cost[2] ($)	Estimated Capital Cost[2] ($)
1*	I-526, Seacoast Pkwy, Bell Hall Pkwy, Long Point Rd	Water Main	$2,590,000	$2,590,000	$5,300,000	$5,300,000
2	Remley's Point, 5th Avenue, 2nd Street, 3rd Avenue, 3rd Street, 5th Avenue, Mathis Ferry Road	Water Main	$1,660,000	$1,660,000		
3	Ben Sawyer Boulevard	Water Main	$860,000	$1,410,000	$860,000	$1,410,000
4*	Rifle Range Road	Water Main		$690,000		$690,000
5	Highway 17	Water Main		$3,180,000		$3,180,000
6*	Wando River Crossing	Water Main	$930,000	$930,000	$930,000	$930,000
7	Mathis Ferry Road	Water Main			$150,000	$150,000
8*	CWS Feed No 3 Sullivan's Island[3]	Water Main and Meter	$3,620,000	$3,620,000	$3,620,000	$3,620,000
9	CWS Feed No 4 Remley's Point[4]	Water Main and Meter	$9,040,000	$9,040,000		
ESA1	Woodville Area and Cat Island	Water Main		$1,980,000		$1,980,000
ESA2	East of Guerins Bridge Road	Water Main		$13,820,000		$13,820,000
ESA3	Booster Pump Station	Booster Pump Station		$1,530,000		$1,530,000
TOTALS			$18,700,000	$40,450,000	$10,860,000	$32,610,000

Notes :

1. Refer to Figure 4-6 for Option 2A improvement locations, Figure 4-8 for Option 2B improvement locations, Figure 4-9 for Option 3A improvement locations, and Figure 4-11 for Option 3B improvement locations.

2. Estimated capital costs for water distribution projects include a 30% construction contingency and a 25% engineering/legal/administration contingency. Costs are in 2014 dollars without escalation.

3. Costs for establishing a new CWS Feed at Sullivan's Island were developed and provided by CWS. The total project cost is $6.66 million; cost listed in Table 4-13 is MPW's share of the project. It is assumed that the remainder of the project cost will be paid by CWS.

4. Costs for establishing a new CWS Feed at Remley's Point were developed and provided by CWS. The total project cost is $9.04 million (including all infrastructure up to the tie-in with MPW's system at the boat landing); cost listed in Table 4-13 is MPW's share of the project. It is assumed that the remainder of the project cost will be paid by CWS.

Section 5

Wastewater Treatment

The evaluation of MPW's wastewater treatment needs for existing conditions through the buildout planning period is presented in this section. This evaluation is a 5-year update to the wastewater treatment recommendations provided in Section 7 of the 2010 Master Plan report, and is based on updated flow projections. Below is a description of the existing wastewater treatment facilities followed by a discussion of capacity planning requirements, permitted treatment capacity needs, and future hydraulic capacity needs.

5.1 Wastewater Treatment Facilities

MPW owns and operates two wastewater treatment plants: the Center Street Wastewater Treatment Plant (Center St WWTP) and the Rifle Range Road Wastewater Treatment Plant (Rifle Range Rd WWTP). The locations and service areas of the two plants are shown on Figure 1-1 in Section 1. Center St WWTP has a permitted capacity of 3.7 mgd. However, the current treatment capacity is limited to 2.0 mgd due to clarifier capacity. MPW is completing work to improve the hydraulic capacity of the Center St WWTP up to the permitted capacity. Improvements at Center St WWTP are expected to be complete in spring of 2015.

Rifle Range Rd WWTP has a permitted capacity of 6.0 mgd. Due to limitations with some of the treatment processes, Rifle Range Rd WWTP currently has a treatment capacity of approximately 5.3 mgd (based on capacity of the return activated sludge (RAS) pumping).

The combined treatment capacity of both plants, once improvements at Center St WWTP are complete, is 9.0 mgd. MPW has the ability to distribute a portion of the flow between the two treatment plants by diverting flow on Rifle Range Road just east of Oak Haven Boulevard. The two plants discharge treated effluent into a combined outfall, which discharges 4,700 feet into the Charleston Harbor in the Rebellion Reach Channel for maximum dilution. The outfall has an assimilative capacity of 17 mgd.

5.2 Future Wastewater Flows and Treatment Capacity

A comparison of the projected average annual wastewater flows and existing treatment capacity is presented in **Table 5-1** by treatment plant service area. The existing obligated flows in Table 5-1 include all permitted or obligated REUs and are therefore higher than the actual existing wastewater flow. The Center St WWTP has adequate capacity for the projected wastewater flows through mid-term; however, the Rifle Range Rd WWTP does not have adequate treatment capacity for the existing obligated flows. As discussed above, MPW has the ability to divert a portion of the flow from Rifle Range Rd WWTP to Center St WWTP. Considering the combined treatment capacity of both plants, MPW only has adequate capacity for the total projected wastewater flows until near-term, by which time additional treatment capacity at Rifle Range Rd WWTP is needed.

Table 5-1. Projected Wastewater Flows and Existing Treatment Capacity

Planning Period	Approx. Year	Annual Average Flow (mgd)			Existing Treatment Capacity (mgd)		
		Center St WWTP	Rifle Range Rd WWTP	Total	Center St WWTP [1]	Rifle Range Rd WWTP [2]	Total
Existing Actual [3]	2014	2.2	5.2	7.4	3.7	5.3	9.0
Existing Obligated [4]	2014	2.3	6.1	8.4	3.7	5.3	9.0
Near-Term	2019	2.4	6.6	9.0	3.7	5.3	9.0
Mid-Term	2024	2.5	7.3	9.8	3.7	5.3	9.0
Buildout	2049	3.8	10.0	13.8	3.7	5.3	9.0

1) Existing treatment capacity for Center St WWTP is 3.7 mgd after current upgrade is completed.
2) Existing treatment capacity for Rifle Range Rd WWTP is 5.3 mgd based on RAS pumping; permitted capacity is 6.0 mgd.
3) Existing average annual wastewater flow based on flow records at Rifle Range Rd and Center St WWTPs.
4) Obligated average annual wastewater flow calculated assuming 220 gpd/REU; includes all existing REUs plus engineering entry REUs.

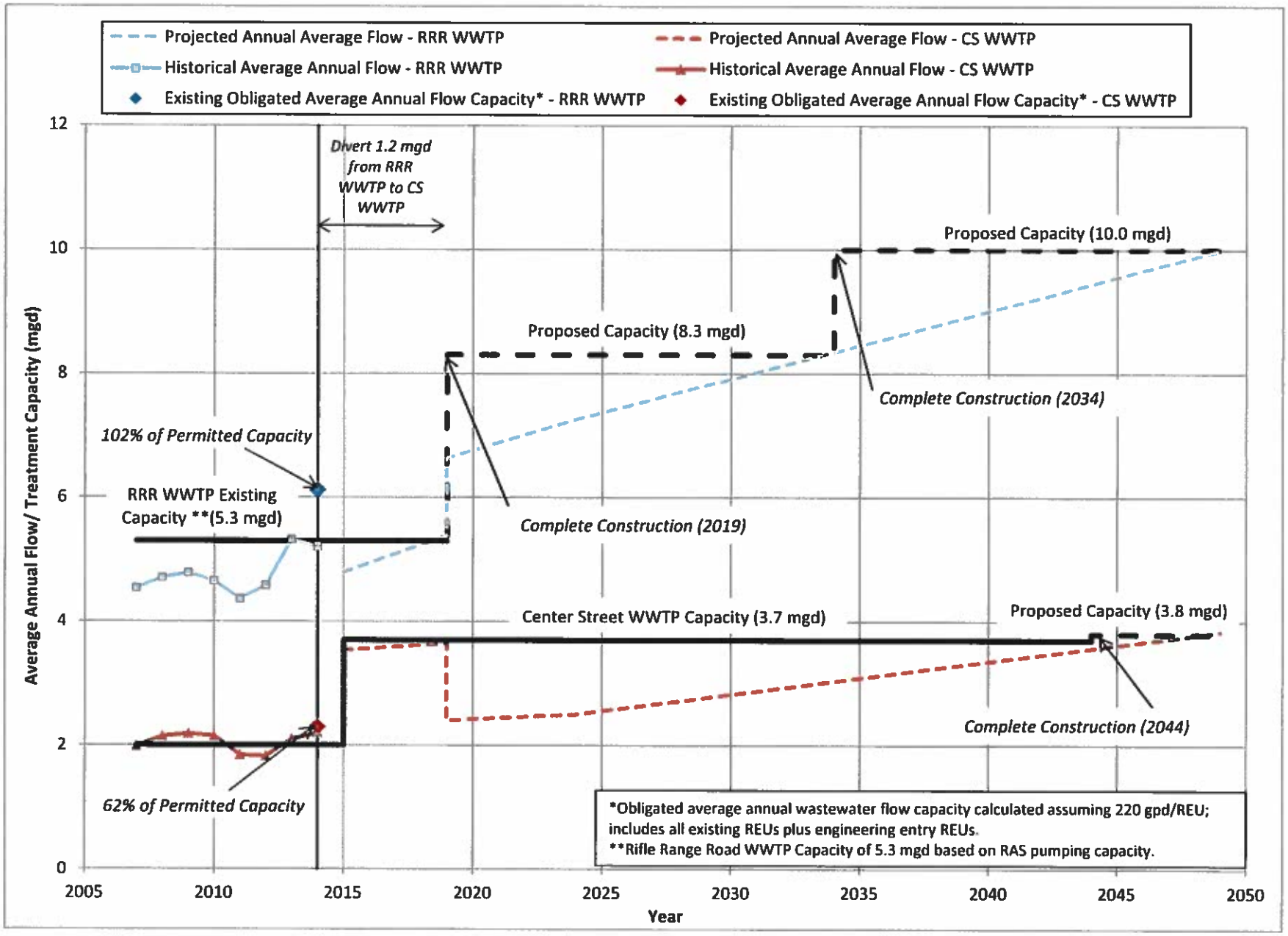
Figure 5-1 presents a wastewater treatment capacity schedule for the individual WWTPs. **Figure 5-2** presents a similar treatment capacity schedule for the total combined wastewater flows. The obligated capacity for Rifle Range Rd WWTP based on the service area currently exceeds the treatment and permitted capacity. Therefore, once upgrades at Center St WWTP are completed, it is recommended that approximately 1.2 mgd of flow be diverted from the Rifle Range Rd service area to the Center St WWTP, as shown on Figure 5-1. Proposed treatment capacity improvements up to 8.3 mgd at Rifle Range Rd should be completed by 2019, at which time all flow from the Rifle Range Rd service area can be treated at the Rifle Range Rd WWTP. A subsequent upgrade to 10.0 mgd at Rifle Range Rd WWTP is recommended by 2034 and upgrade to 3.8 mgd at Center St WWTP is recommended by 2044 to provide treatment capacity for projected buildout wastewater flows.

5.3 Analysis of Future Hydraulic Capacity

Although average annual flows are used to determine permitted treatment capacity, a plant must also be able to handle peaks in the wastewater flows caused by infiltration and inflow and hourly fluctuations throughout the day. Peak wet-weather flows that are projected at the WWTPs if all improvements are made as recommended based on results of the hydraulic modeling (presented in Section 6) are given in **Table 5-2.**

Table 5-2. Projected Peak Flows at the WWTPs

Planning Period	Approx. Year	Peak Wet-Weather Flow (mgd)		
		Center St WWTP	Rifle Range Rd WWTP	Total
Near-Term	2019	9.1	23.1	32.2
Mid-Term	2024	9.4	25.1	34.5
Buildout	2049	13.8	34.9	48.7



MPW Projected Annual Average Wastewater Flows and Treatment Capacity by WWTP

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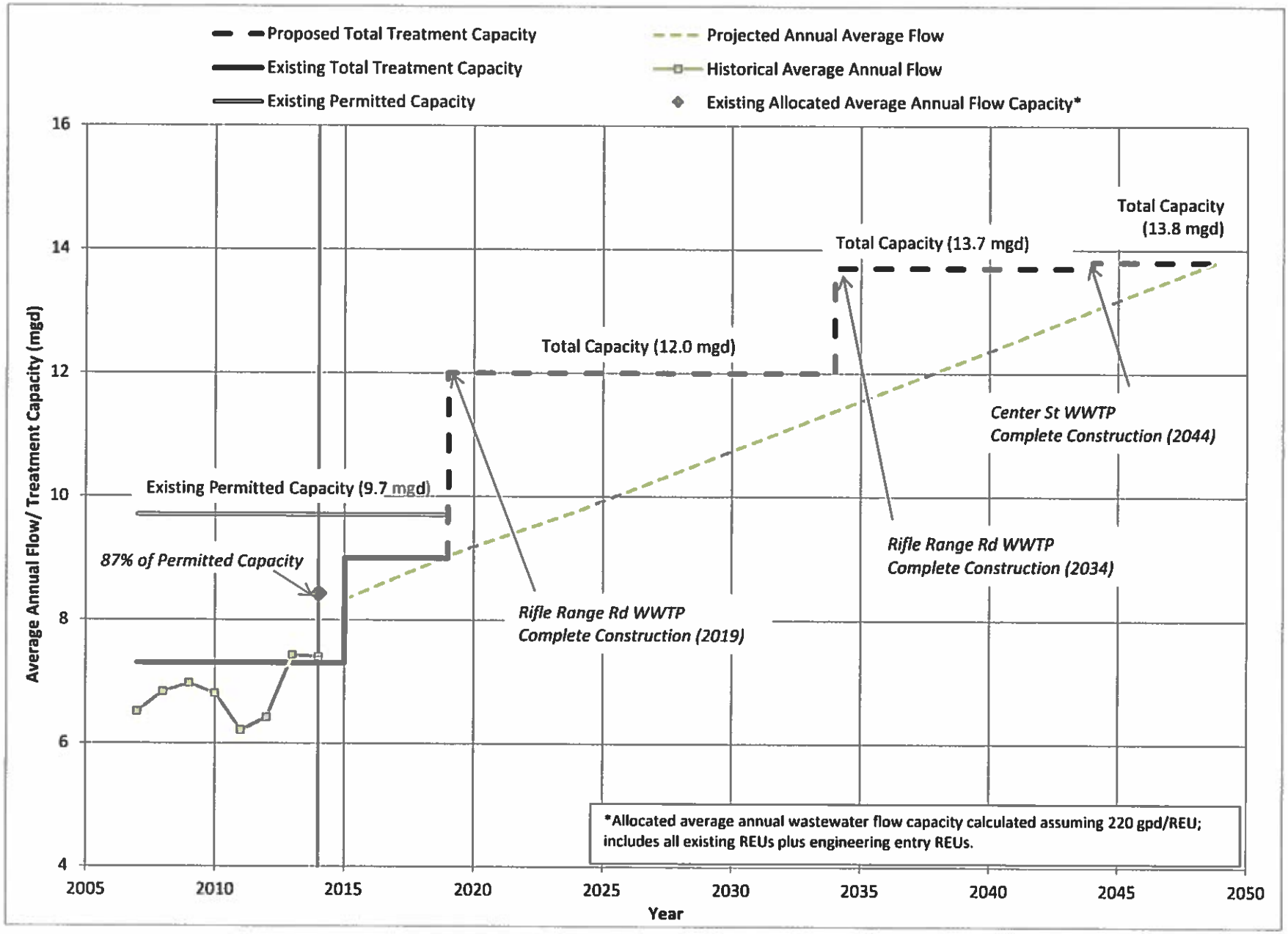
Figure 5-1



MPW Projected Annual Average Wastewater Flows and Total Treatment Capacity

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Figure 5-2

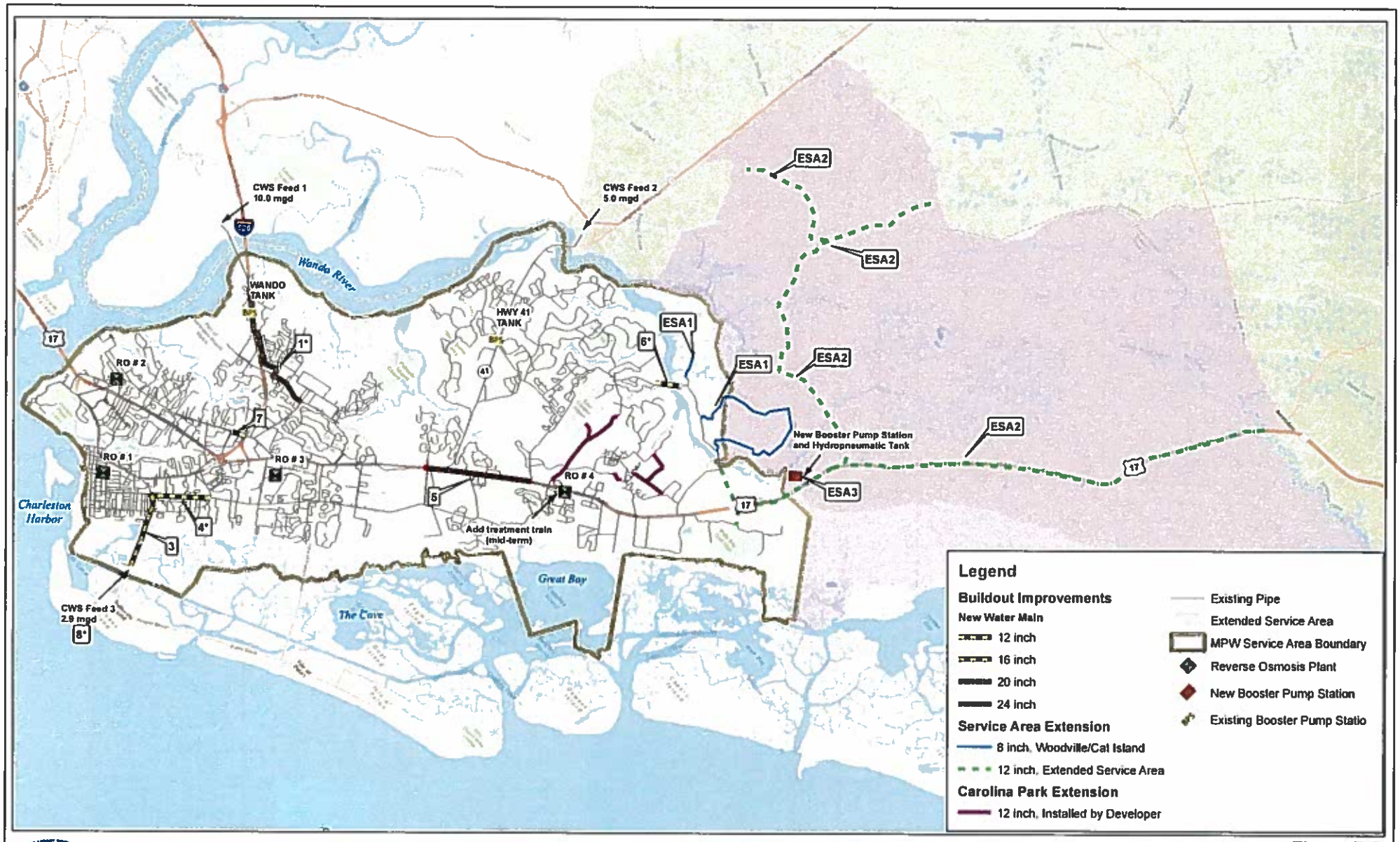
Table 7-3. Extended Service Area Buildout Capital Improvements Program

Project ID [1]	Improvement Type	Service Area	Improvement Description	Estimated Capital Cost ($) [2]
BUILDOUT EXTENDED SERVICE AREA WATER SUPPLY PROJECTS				
CWS Feed	Water supply purchase	n/a	Additional water purchases from CWS (1.1 mgd)	$1,700,000
			BUILDOUT EXTENDED SERVICE AREA WATER SUPPLY BUILDOUT PROJECTS	**$1,700,000**
BUILDOUT EXTENDED SERVICE AREA WATER DISTRIBUTION SYSTEM PROJECTS				
3	New water main	Ben Sawyer Blvd[3]	Construct 7,800 LF of new parallel 16-inch water main along Ben Sawyer Blvd from Tolers Cover Dr to Rifle Range Rd	$550,000
4	New water main	Rifle Range Rd	Construct 6,100 LF of new parallel 12-inch water main along Rifle Range Rd from Ben Sawyer Blvd to Bowman Rd	$690,000
5	New water main	Highway 17	Construct 10,800 LF of new parallel 20-inch water main along Highway 17 from Hamilon Rd to Park West Blvd	$3,180,000
ESA1	New water main	Woodville/ Cat Island	Construct approx. 27,000 LF of new 8-inch water mains to serve the Woodville area and Cat Island	$1,980,000
ESA2	New water main	East of Guerins Bridge Rd	Construct approx. 123,000 LF of new 12-inch water mains to serve the areas east of Guerins Bridge Rd	$13,820,000
ESA3	New booster pump station & hydropneumatic tank	East of Guerins Bridge Rd	New booster pump station with VFDs and hydropneumatic tank - design point 1,000 gpm @ 130 ft TDH	$1,530,000
			EXTENDED SERVICE AREA WATER DISTRIBUTION SYSTEM PROJECTS	**$21,800,000**
BUILDOUT EXTENDED SERVICE AREA WASTEWATER COLLECTION SYSTEM PROJECTS				
Woodville	New wastewater pump station	Woodville	New Woodville station - design point 390 gpm @ 165 ft TDH	$530,000
	New wastewater force main	Woodville	Construct 5,900 LF of new 6-inch force main from the new Woodville PS to the manifold force main along Chandler Rd	$1,090,000
			EXTENDED SERVICE AREA WASTEWATER COLLECTION SYSTEM PROJECTS	**$1,600,000**
			EXTENDED SERVICE AREA TOTAL ESTIMATED CAPITAL COST	**$25,100,000**

(1) Project IDs are identified on Figure 7-1 for wastewater collection system improvements and Figure 7-2 for water distribution system improvements. Project IDs with an asterisk (*) correspond to projects recommended in the 2010 Master Plan. Pipe extensions in Carolina Park shown on Figure 7-2 are assumed to be installed by the developer and are not included in the water main costs.

(2) Estimated capital costs for water distribution and wastewater collection projects include a 30% construction contingency and a 25% engineering/legal/administration contingency. Water treatment costs provided by MPW. Wastewater treatment costs provided by Black & Veatch. Costs are in 2014 dollars without escalation.

(3) The cost presented in Table 7-3 for Project 3 is the difference in cost between installing a 16-inch pipe ($1,400,000) and a 12-inch pipe ($860,000 as noted in Table 7-2).



Option 3B
Improvement Recommendations

Figure 7-2

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7.3.2 Extended Service Area

Extended service area projects are for major infrastructure to extend service to areas north and east of the Wando River that are not currently served by MPW.

- An additional 1.1 mgd water supply purchase from CWS is needed for the extended service area.
- Wastewater infrastructure for the extended service area includes a pump station and force main for the Woodville area (Figure 7-1).
- Water infrastructure for the extended service area includes: 12-inch transmission mains along existing roadways and a new booster pump station with hydropneumatic tank to serve areas of Charleston County east of Guerins Bridge Road to Steed Creek Road; 8-inch water mains for the Woodville area and Cat Island; and additional transmission improvements from CWS Feed No. 3. to the extended service area including 3.2 miles of 12-inch and 20-inch diameter water line and upsizing Project 3 along Ben Sawyer Boulevard from 12-inch diameter to 16-inch diameter (Figure 7-2).

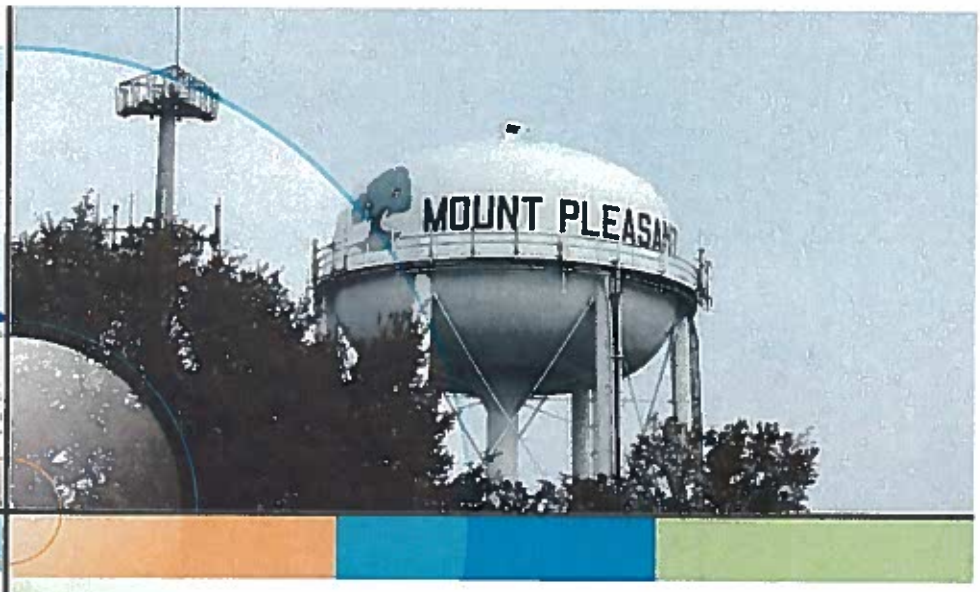
The total estimated cost of the extended service area CIP projects is $25.1 million. However, it is expected that some or all of this cost will be paid for by customers in the areas to which service is being extended, instead of through existing customer rates and fees.

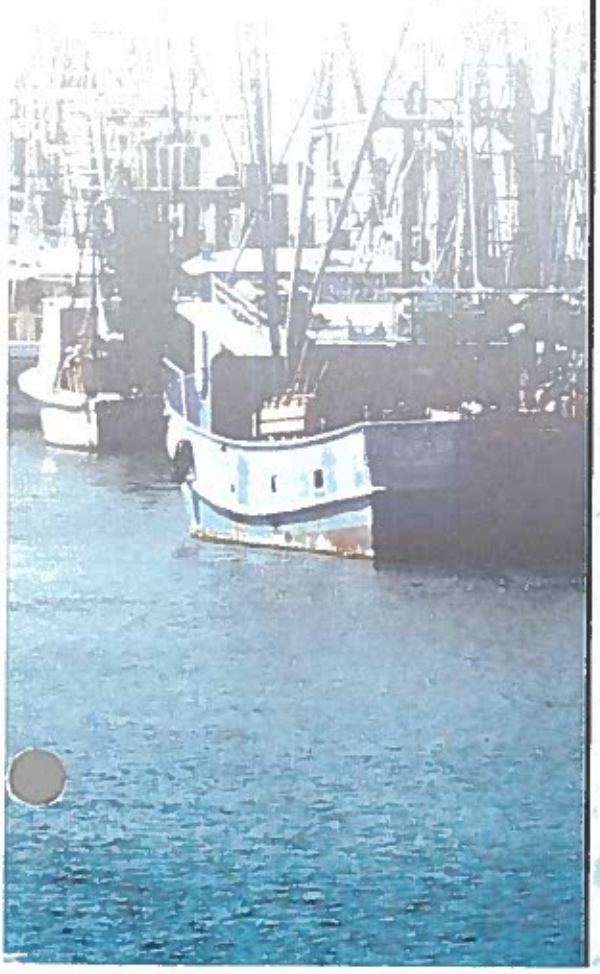
7.4 Summary

The total cost of combined Phase 1 through Phase 3 CIP projects presented in Tables 7-1 through 7-3 is $195.3 million. This includes water distribution and transmission, water source and treatment, wastewater collection and conveyance, and wastewater treatment for the existing service area. The majority of the total CIP cost is for upgrades at the Rifle Range Rd WWTP. Of the remaining projects, most are recommended in Phase 3 as the system nears buildout. The total cost for the water distribution and wastewater collection projects to serve buildout of the Extended Service Area presented in Table 7-3 is $25.1 million. A summary of the CIP costs by improvement type and phase is presented in **Table 7-4**.

Table 7-4. Capital Improvement Program Summary

Improvement Type	Estimated Capital Cost (in millions of dollars)			
	Phase 1 (Near-Term; 0-5 years)	Phase 2 (Mid-Term; 5-10 years)	Phase 3 (Buildout; 10-35 years)	Extended Service Area (Buildout)
WATER SUPPLY AND TREATMENT				
RO Plant Upgrades	--	$0.7	--	--
Additional Water Supply from CWS	$0.7	$2.0	$14.3	$1.7
WATER SUPPLY AND TREATMENT SUBTOTAL	*$0.7*	*$2.7*	*$14.3*	*$1.7*
WATER DISTRIBUTION SYSTEM				
Water Main Improvements	--	--	$10.9	$20.2
New Booster Pump Station & Hydropneumatic Tank	--	--	--	$1.5
WATER DISTRIBUTION SYSTEM SUBTOTAL	--	--	*$10.9*	*$21.8*
WASTEWATER TREATMENT				
Rifle Range Road WWTP Upgrades	$50.8	$29.9	$53.5	--
WASTEWATER COLLECTION SYSTEM				
Pump Station Improvements	$2.0	$1.1	$3.4	$0.5
Force Main Improvements	$4.7	$7.6	$13.3	$1.1
Gravity Line Improvements	--	--	$0.4	--
WASTEWATER COLLECTION SYSTEM SUBTOTAL	*$6.7*	*$8.7*	*$17.1*	*$1.6*
TOTAL ESTIMATED CAPITAL COST	**$58.2**	**$41.3**	**$95.8**	**$25.1**





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- An upgrade to the 8-inch diameter force main from Wando Plantation Way to Park West Blvd (project P1B*) is also recommended in Phase 2. Table 7-1 includes cost for replacement with 12-inch diameter force main; however, since this force main was recently installed, this project could be constructed as a smaller diameter parallel force main to reduce capital cost.
- Upgrades are recommended for PS 156 and 153 (projects RP110 and RP120) to address model predicted overflows in the Carolina Park area. It should be noted that project RP110 is recommended assuming that projected upstream flow from the Carolina Park development will be routed through PS 156. If additional pump stations are constructed in the vicinity as part of development in Carolina Park, this project should be re-evaluated.
- An increase in average and maximum day water supply is needed by mid-term. Phase 2 water supply projects include a planned additional treatment train at RO Plant No. 4 and purchase of an additional 1.3 mgd in water supply capacity from CWS.

The total estimated cost of the Phase 2 CIP projects is $41.3 million.

7.3 Buildout CIP

The buildout CIP projects are divided into two phases. Phase 3 projects listed in **Table 7-2** are recommended to address predicted deficiencies in the buildout planning period within the existing service area. Extended service area projects listed in **Table 7-3** are recommended for the major infrastructure to extend service to areas that are not currently served by MPW. Wastewater collection system buildout projects are shown in orange on Figure 7-1. Water distribution system buildout projects are shown on **Figure 7-2**. The buildout projects are grouped by asset class and listed in order of project ID number (versus a listing in order of priority like the 10-year CIP). Specific project timing and prioritization will be primarily dependent on the timing of development. The buildout projects should be re-evaluated as development occurs and as part of future master plan updates.

7.3.1 Phase 3

Table 7-2 presents the buildout CIP projects for Phase 3.

- Phase 3 water supply projects include an additional 9.5 mgd of water supply purchases from CWS, for a total supply of 16.8 mgd.
- Phase 3 water distribution system projects include a new water main along I-526 from the CWS Feed No. 1 to convey the additional water supply and address pressure deficiencies in the central portion of the system, a new water main along Mathis Ferry Road to complete a loop and improve transmission from CWS Feed No. 1 to Mathis Ferry Road, a new water main crossing Wando River to Paradise Island to improve redundancy and fire flow, a new water main and meter to implement a third CWS water supply feed from Sullivan's Island and a new water main along Ben Sawyer Boulevard to convey the additional water supply from the new CWS feed at Sullivan's Island.
- Phase 3 wastewater treatment projects include an additional upgrade of Rifle Range Rd WWTP to a treatment capacity of 10.0 mgd.
- Phase 3 wastewater collection system projects include upgrades to 19 pump stations, 11 force main projects, and two gravity line upgrade projects.

The total estimated cost of the Phase 3 CIP projects is $95.8 million.

Table 7-2. Buildout Capital Improvements Program

Project ID [1]	Improvement Type	Service Area	Improvement Description	Estimated Capital Cost ($) [2]
PHASE 3 - BUILDOUT WATER SUPPLY PROJECTS				
CWS Feed	Water supply purchase	n/a	Additional water purchases from CWS (9.5 mgd)	$14,300,000
			PHASE 3 BUILDOUT WATER SUPPLY BUILDOUT PROJECTS	**$14,300,000**
PHASE 3 - BUILDOUT WATER DISTRIBUTION SYSTEM PROJECTS				
1	New water main	I-526	Construct 14,300 LF of new parallel 24-inch water main along I-526, Seacoast Pkwy, Bell Hall Pkwy and Long Point Rd from Wando Park Storage Tank to Whipple Rd	$5,300,000
3	New water main	Ben Sawyer Blvd[3]	Construct 7,800 LF of new parallel 12-inch water main along Ben Sawyer Boulevard from Tolers Cove Dr to Rifle Range Rd	$860,000
6*	New water main	Wando River Crossing	Construct 2,600 LF of 12-inch water main crossing the Wando River	$930,000
7	New water main	Mathis Ferry Rd	Construct 1,300 LF of 12-inch water main on Mathis Ferry Rd from I-526 to Von Kolnitz Rd	$150,000
8*	New connection, water main, and meter	CWS Feed No 3[4]	Construct 5,200 LF of 16-inch water main and meter to implement a third CWS water supply feed from Sullivan's Island	$3,620,000
			PHASE 3 BUILDOUT WATER DISTRIBUTION SYSTEM PROJECTS	**$10,900,000**
PHASE 3 - WASTEWATER TREATMENT PROJECTS				
RRR WWTP_2	Wastewater treatment upgrade	Rifle Range Rd	Upgrade treatment capacity at the Rifle Range Rd WWTP to 10.0 mgd	$53,500,000
			PHASE 3 BUILDOUT WASTEWATER TREATMENT PROJECTS	**$53,500,000**
PHASE 3 - BUILDOUT WASTEWATER COLLECTION SYSTEM PROJECTS				
CS1*	Gravity line upgrade	Center St	Upsize 300 LF of existing 8-inch gravity line with 12-inch pipe downstream of PS 13 force main discharge	$70,000
CS100	Wastewater pump station upgrade	Center St	Upgrade pumps at PS 28 - new design point 510 gpm @ 145 ft TDH	$110,000
L1*	Wastewater pump station upgrade	Center St	Upgrade pumps at PS 15 - new design point 450 gpm @ 100 ft TDH	$110,000
C3*	Wastewater force main upgrade	Coleman Blvd	Upsize 3,400 LF of existing 12-inch force main with 18-inch pipe from PS 30 to Mill Street	$1,570,000
P19*	Wastewater pump station upgrade	Labor Camp	Upgrade pumps at PS 132 - new design point 220 gpm @ 140 ft TDH	$110,000
P9*	Wastewater pump station upgrade	Labor Camp	Upgrade PS 105 - new design point 650 gpm @ 130 ft TDH	$110,000
LC6*	Wastewater pump station upgrade	Labor Camp	Upgrade pumps at PS 84 - new design point 160 gpm @ 140 ft TDH	$110,000
LC12*	Wastewater force main upgrade	Labor Camp	Upsize 1,400 LF of existing 20-inch force main with 24-inch pipe from PS 126 to Venning Road	$900,000
LC13*	Wastewater pump station upgrade	Labor Camp	Upgrade pumps at PS 83 - new design point 270 gpm @ 100 ft TDH	$110,000
LC100	Wastewater pump station upgrade	Labor Camp	Upgrade pumps at PS 110 - new design point 180 gpm @ 100 ft TDH	$110,000
RP130	New wastewater force main	Park West	Reroute PS 87 by constructing 4,500 LF of new 6-inch force main from PS 87 to the new force main along US 17 (RP100); abandon the existing PS 87 force main	$740,000
LC2A*	Wastewater pump station upgrade	Park West	Upgrade pumps at PS 143 - new design point 115 gpm @ 100 ft TDH	$110,000
LC2B*	Wastewater force main upgrade	Park West	Upsize 930 LF of existing 4-inch force main with 6-inch pipe along US 17 from Sewee Preserve Road to Chandler Road	$150,000
LC9*	Wastewater pump station upgrade	Park West	Upgrade pumps at PS 115 - new design point 300 gpm @ 70 ft TDH	$110,000
RP140	Wastewater pump station upgrade	Park West	Upgrade PS 87 - new design point 260 gpm @ 155 ft TDH	$350,000
RP150	Wastewater pump station upgrade	Park West	Upgrade pumps at PS 120 - new design point 180 gpm @ 160 ft TDH	$110,000
RP160	New wastewater force main	Park West	Construct 6,200 LF of new 8, 10, and 12-inch force main along US 17 from Carolina Park Blvd to the gravity line upstream of PS 119; divert flow from Carolina Park (PS 153, 156, CP5, 157) and PS 75 to the new RP160 force main	$1,240,000
RP170	Wastewater pump station upgrade	Park West	Upgrade pumps at PS 139 - new design point 40 gpm at 165 ft TDH	$110,000
P1A*	Wastewater force main upgrade	Rifle Range Rd	Upsize 12,300 LF of existing 12-inch force main with 16-inch pipe, or construct new parallel 12-inch force main from Park West Blvd to Hwy 17 [3]	$5,190,000

Table 7-2. Buildout Capital Improvements Program (continued)

Project ID [1]	Improvement Type	Service Area	Improvement Description	Estimated Capital Cost ($) [2]
P1C_2*	Wastewater force main upgrade	Rifle Range Rd	Upsize 1,300 LF of existing 8-inch force main with 12-inch pipe from Grassy Marsh Drive to project P1C_1*	$270,000
RRR3*	Wastewater pump station upgrade	Rifle Range Rd	Upgrade PS 49 - new design point 105 gpm @ 180 ft TDH	$140,000
RRR5*	Wastewater pump station upgrade	Rifle Range Rd	Upgrade pumps at PS 82 - new design point 330 gpm @ 110 ft TDH	$110,000
RRR130	Wastewater force main upgrade	Rifle Range Rd	Upsize 1,900 LF of existing 6-inch force main with 8-inch pipe from PS 144 to Harper's Ferry Way	$334,000
RRR140	Wastewater force main upgrade	Rifle Range Rd	Upsize 3,900 LF of existing 8-inch force main with 10-inch and 12-inch pipe from PS 125 to the manifold with PS 111	$800,000
RRR150	Wastewater pump station upgrade	Rifle Range Rd	Upgrade pumps at PS 6 - new design point 575 gpm @ 60 ft TDH	$110,000
RRR160	Gravity line upgrade	Rifle Range Rd	Upsize 1,000 LF of existing 8-inch gravity line with 10-inch pipe from PS 49 force main discharge to PS 136	$340,000
RRR170	Wastewater force main upgrade	Rifle Range Rd	Upsize 3,700 LF of existing 4-inch force main with 6-inch pipe from PS 82 to the Rifle Range Rd manifold force main	$600,000
RRR180	Wastewater pump station upgrade	Rifle Range Rd	Upgrade pumps at PS 10 - new design point 145 gpm @ 90 ft TDH	$110,000
RRR190	Wastewater pump station upgrade	Rifle Range Rd	Upgrade pumps at PS 141 - new design point 40 gpm @ 120 ft TDH	$110,000
VK100	Wastewater pump station upgrade	Von Kolnitz	Upgrade pumps at PS 77 - new design point 280 gpm @ 90 ft TDH	$110,000
W1*	Wastewater pump station upgrade	Whipple Rd	Upgrade PS 102 - new design point 815 gpm @ 120 ft TDH	$1,100,000
W120	New wastewater force main	Whipple Rd	Construct 3,600 LF of new 16-inch force main along Whipple Road from Long Point Road to PS 47	$1,510,000
			PHASE 3 BUILDOUT WASTEWATER COLLECTION SYSTEM PROJECTS	**$17,100,000**
			PHASE 3 TOTAL ESTIMATED CAPITAL COST	**$95,800,000**

(1) Project IDs are identified on Figure 7-1 for wastewater collection system improvements and Figure 7-2 for water distribution system improvements. Project IDs with an asterisk (*) correspond to projects recommended in the 2010 Master Plan. Pipe extensions in Carolina Park shown on Figure 7-2 are assumed to be installed by the developer and are not included in the water main costs.

(2) Estimated capital costs for water distribution and wastewater collection projects include a 30% construction contingency and a 25% engineering/legal/administration contingency. Water treatment costs provided by MPW. Wastewater treatment costs provided by Black & Veatch. Costs are in 2014 dollars without escalation.

(3) For the extended service area, Project 3 will need to be upsized from 12-inch to 16-inch to convey the additional water supply from CWS Feed No 3 at Sullivan's Island. Refer to Table 7-3 for additional cost if upsizing to 16-inch.

(4) Costs for establishing a new CWS Feed at Sullivan's Island were developed and provided by CWS. The total project cost is $6.66 million; cost listed in Table 7-2 is MPW's share of the project. It is assumed that the remainder of the project cost will be paid by CWS.

Mount Pleasant Waterworks
Water Supply Master Plan

Technical Memorandum No. 6 –
Water System Analysis

May 2018

Final

CDM Smith

Technical Memorandum 6

Water System Analysis

6.1 Introduction

This technical memorandum (TM) presents an evaluation of the level of service provided within the Mount Pleasant Waterworks (MPW) water distribution system under several different water supply scenarios developed as part of the Water Supply Master Plan. Improvements to resolve any distribution system deficiencies are also discussed.

6.2 Modeling Approach and Evaluation Criteria

Hydraulic model evaluations were conducted to assess the adequacy of the existing water system under the following scenarios.

Scenario 1 – Seasonal operations of up to two additional aquifer storage recovery (ASR) wells to provide additional water supply for 10-year projected demands.

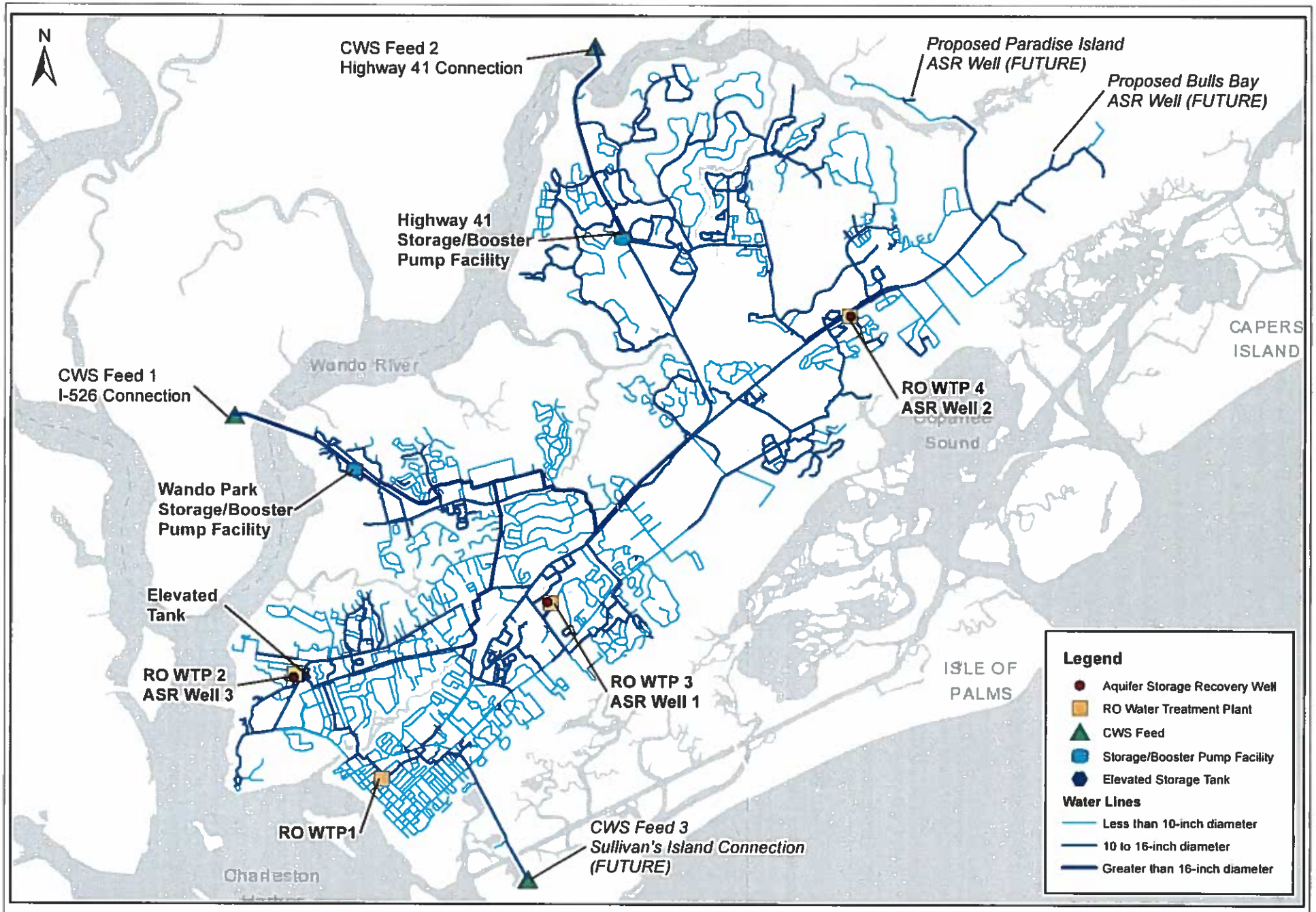
Scenario 2 – System operations with the Charleston Water System (CWS) Feed No. 1 at Daniel Island/Wando Park/Interstate 526 (I-526 connection) offline for the 10-year projected seasonal and maximum day demand conditions.

Scenario 3 – System operations with each of the water supply sources offline during the 10-year projected maximum day demand conditions. Only one water supply source is assumed to be offline at a time.

6.2.1 Hydraulic Model and Demands

Analyses were run with MPW's existing water distribution system model which utilizes Innovyze InfoWater hydraulic modeling software. The model was updated and verified as part of the 2015 Comprehensive Utility Master Plan Update (CUMP) and includes water supply from CWS and MPW's four existing reverse osmosis (RO) water treatment plants (WTPs), high-service pumps associated with the RO WTPs, two ground storage tank and booster pump stations, one elevated storage tank, and approximately 363 miles of 2- to 30-inch diameter transmission and distribution mains (**Figure 6-1**).

Scenarios 1 through 3 were evaluated with projected 10-year demands, corresponding to 2027, as given in **Table 6-1**. The development of demand projections is discussed in TM3. Demands were updated in the hydraulic model by applying a scaling factor to adjust the demand nodes from the projected mid-term scenario in the 2015 CUMP to the 10-year demands given in Table 6-1.



CDM Smith

Figure 6-1
Modeled Water Distribution System and Water Supply Sources

Table 6-1. 10-Year Seasonal Demand Projections for Water System Evaluation*

Seasonal Condition	Demand (mgd)
Average Day Demand (ADD)	11.68
Maximum Day Demand (MDD)	18.71
Winter	10.34
Summer	15.16
Shoulder	12.63

*Note: 2027 demands based on linear interpolation of 2025 and 2030 projections presented in Table 3.5 of Mount Pleasant Waterworks Water Supply Master Plan, Technical Memorandum No. 3, Water Demand and Production, dated August 24, 2017.

Extended period simulations (EPS) were run with the target seasonal demands applied to a system-wide diurnal demand hydrograph to simulate fluctuation in demands including peak hour and determine if tanks can fill during nighttime hours under maximum day demands. Simulations were run for a duration of 72 hours so the model reaches equilibrium. Maximum day demands plus fire flow demand were also simulated in the hydraulic model to determine the adequacy of the available fire flow under each scenario.

6.2.2 Water Supply Operational Approach

The following assumptions were used when evaluating the water supply scenarios. These assumptions are based on discussions with MPW staff about the preferred approach for system operations.

CWS Feed No. 1 and 2

It is assumed that the current combined contracted water purchase amount of 6.0 million gallons per day (mgd) from CWS Feed No. 1 (I-526 connection) and CWS Feed No. 2 (Highway 41 connection) will not increase for the 10-year scenarios. Under the existing contract, the 6.0-mgd supply amount can be adjusted between the two feed points. However, based on information provided by MPW, the maximum supply from CWS Feed No. 2 is 5.0 mgd due to hydraulic limitations in the CWS system. CWS Feeds No. 1 and 2 provide the baseline water supply for MPW's system.

CWS Feed No. 3

It is assumed that MPW will construct the third feed from CWS at the Sullivan's Island connection within the 10-year timeframe. This feed will be a wholesale water purchase for emergency or short-term supply only. Based on information provided by MPW, the maximum capacity of CWS Feed No. 3 is 2.25 mgd.

RO WTP Operations

The four existing RO WTPs supplement water supply into MPW's system (in addition to the CWS baseline supply). It is assumed that improvements will be made at RO WTP Nos. 3 and 4 within the 10-year timeframe to increase capacity per TM2. For the Scenario 3 evaluation of reliability under maximum day demand conditions, the capacity of the RO WTPs is assumed to be the maximum at build-out as given in TM2 Table 2-2. For all other scenarios, the capacity of the RO WTPs is assumed to be the average at build-out as given in TM2 Table 2-2.

For typical operations under demand conditions less than the maximum capacity, it is assumed that all RO WTPs operate at reduced capacity instead of taking one of the plants offline. The high service pumps at the RO WTPs are operated to maintain a pressure setpoint in the distribution system directly downstream of the pump discharge.

ASR Well Operations

ASR Well Nos. 1, 2, and 3 are all assumed to be in operation for the 10-year scenarios. The recharge rate of each ASR Well is assumed to be 200 gallons per minute (gpm). The recovery rate from each ASR well is assumed to be 350 gpm, starting in 2018. The ASR well supply is pumped via the high service pumps at the RO WTPs. The hydraulic model results report the total flow pumped from each RO WTP, including ASR recovery amounts.

ASR wells are used to supplement the water supply from CWS feeds and RO WTPs when the capacity of those supplies is exceeded. For this evaluation, unless otherwise noted, ASR recharge was assumed during average, winter, and shoulder seasons. ASR recovery was assumed during summer and maximum day conditions.

Excess Storage

The existing ground storage facilities and elevated storage tank have a combined nominal storage capacity of 12.0 million gallons (MG). Storage tank volumes are listed in Table 2-4 in TM2. This volume of storage exceeds one-half of the maximum day demand, which is the minimum storage volume that is required by the South Carolina Department of Health and Environmental Control (SCDHEC). For the 10-year projected demand condition, MPW's storage volume exceeds the SCDHEC requirement by 2.6 MG. The excess storage could provide up to 2.6 mgd of additional supply on a maximum day only. However, based on discussions with MPW staff, the storage used for supply should be limited to approximately 10 percent of the total storage capacity, which is approximately 1.2 mgd. The excess storage supply is only used for scenarios where the demands exceed the combined capacity of the CWS feeds, RO WTPs, and ASR wells.

6.2.3 General Evaluation Criteria

Table 6-2 lists the evaluation criteria used to assess the existing water system and serve as triggers for identifying the potential need for infrastructure improvements. The evaluation criteria were developed as part of the 2010 and 2015 CUMPs.

Table 6-2. Summary of Evaluation Criteria

Parameter	Condition	Evaluation Criteria
Pressure	Minimum	30 psi for Average, Maximum, and Peak Hour Demand, with desirable average pressures of at least 50 to 60 psi
		20 psi for Fire Flow
	Maximum	100 psi
Velocity	Maximum	10 fps, with less than 5 fps desirable
Headloss	Maximum	10 feet/1,000 feet for pipes < 24-inch diameter
		3 feet/1,000 feet for pipes ≥ 24-inch diameter
Fire Flow	Minimum	1,000 gpm desirable
		500 gpm minimum on dead ends and cul-de-sacs

*Requirement based on whichever criterion is greater.

6.3 System Analysis

The following sections describe the results of the hydraulic model analysis of Scenarios 1 through 3 with projected 10-year demands. For each scenario, a table and charts are presented to summarize the water supply capacity and modeled water supply used from each source.

6.3.1 Scenario 1

Scenario 1 includes construction and operation of one new ASR well adjacent to the existing 12-inch waterline in the Bulls Bay area (see Figure 6-1). It is assumed that the maximum recovery from the well is 900 gpm and the recharge rate is 350 gpm. The well is assumed to pump directly to the distribution system without any above-ground storage. One new ASR well makes up the deficit in supply to meet the 10-year maximum day demands.

A second location considered for a potential ASR well is at Paradise Island near Eden Road and Paradise Island Drive. Hydraulically, the Bulls Bay location is preferred since no additional transmission improvements are required to convey water to or from the well. To utilize 900 gpm from the Paradise Island location, upsizing of 8-inch waterlines or additional pipe looping across the Wando River would be required.

Table 6-3 summarizes the maximum supply capacity of each water source along with the modeled water supply used from each source for each demand condition under Scenario 1. **Figure 6-2** includes plots showing the utilization of each water supply source over 24-hours of the EPS model simulation. Results are summarized in the following paragraphs.

Average Day, Winter, and Shoulder Season Demands

The existing water supply sources (two CWS feeds and four RO WTPs) can meet 10-year projected average day, winter, and shoulder seasonal demands. The existing water distribution infrastructure is also sufficient to convey water to meet system demands and recharge the ASR wells under these demand conditions. The system pressures range from approximately 57 to 78 psi, velocities are generally below 5 feet per second (fps), and headloss is generally less than 3 feet per 1,000 feet. Figure A-1 in Appendix A shows pressures for average day demand conditions.

Summer Season Demands

Water supply from the new Bulls Bay ASR well is needed, in addition to the existing water supply sources (two CWS feeds, four RO WTPs, three ASR wells), to meet summer seasonal demands. The existing water distribution infrastructure is sufficient to convey water to meet summer demands and maintain system pressures in the range of approximately 55 to 76 psi, velocities generally below 5 fps, and headloss generally below 3 feet per 1,000 feet.

Table 6-3. Summary of Scenario 1 – Seasonal Operation of New ASR Well

Water Supply Source		Max Supply Capacity[1] (gpm)	Modeled Supply for 10-year Projected Demands[2] (gpm)				
			ADD	Winter	Shoulder	Summer	MDD
CWS	Feed No. 1 (I-526)	2,083	2,083	2,083	2,083	2,083	2,083
	Feed No. 2 (Highway 41)	2,083	2,083	2,083	2,083	2,083	2,083
	Feed No. 3 (Sullivan's Island)	1,563	0	0	0	0	673
	Total	**5,729**	**4,166**	**4,166**	**4,166**	**4,166**	**4,839**
RO WTP & ASR Recovery	RO WTP No. 1	824	734	514	743	785	814
	RO WTP No. 2	1,236	947	983	1,184	1,477	1,620
	ASR Well 3 Recovery[3]	350	0	0	0		
	RO WTP No. 3	2,240	2,123	1,516	2,282	2,186	2,249
	ASR Well 1 Recovery[4]	350	0	0	0		
	RO WTP No. 4	1,392	1,095	911	1,356	1,192	1,872
	ASR Well 2 Recovery[5]	350	0	0	0		
	New Bulls Bay ASR Well	900	0	0	0	700	900
	Total	**7,642**	**4,899**	**3,923**	**5,565**	**6,339**	**7,456**
ASR Recharge	ASR Well 1	-200	-200	-200	-200	0	0
	ASR Well 2	-200	-200	-200	-200	0	0
	ASR Well 3	-200	-200	-200	-200	0	0
	New Bulls Bay ASR Well	-350	-350	-350	-350	0	0
	Total	**-950**	**-950**	**-950**	**-950**	**0**	**0**
Storage/ Booster Pump Facilities[6]	Wando Park	490	0	0	0	0	360
	Highway 41	350	0	0	0	0	321
	Total	**840**	**0**	**0**	**0**	**0**	**681**

1. RO WTP capacity is assumed to be the average build-out capacity, as given in TM2 (based on finished water fluoride goal of 0.6 mg/L).
2. Modeled supply is based on average over a 24-hour simulation period.
3. ASR Well No. 3 supply is pumped via the high service pumps at RO WTP 2. Model results report total flow pumped from the RO WTP 2 high service pump station.
4. ASR Well No. 1 supply is pumped via the high service pumps at RO WTP 3. Model results report total flow pumped from the RO WTP 3 high service pump station.
5. ASR Well No. 2 supply is pumped via the high service pumps at RO WTP 4. Model results report total flow pumped from the RO WTP 4 high service pump station.
6. Water supply from storage in excess of the SCDHEC requirements at the Wando Park and Highway 41 facilities. Additional storage supply is pumped from the RO WTP ground tanks. Water supply from storage is not refilled on a maximum day.

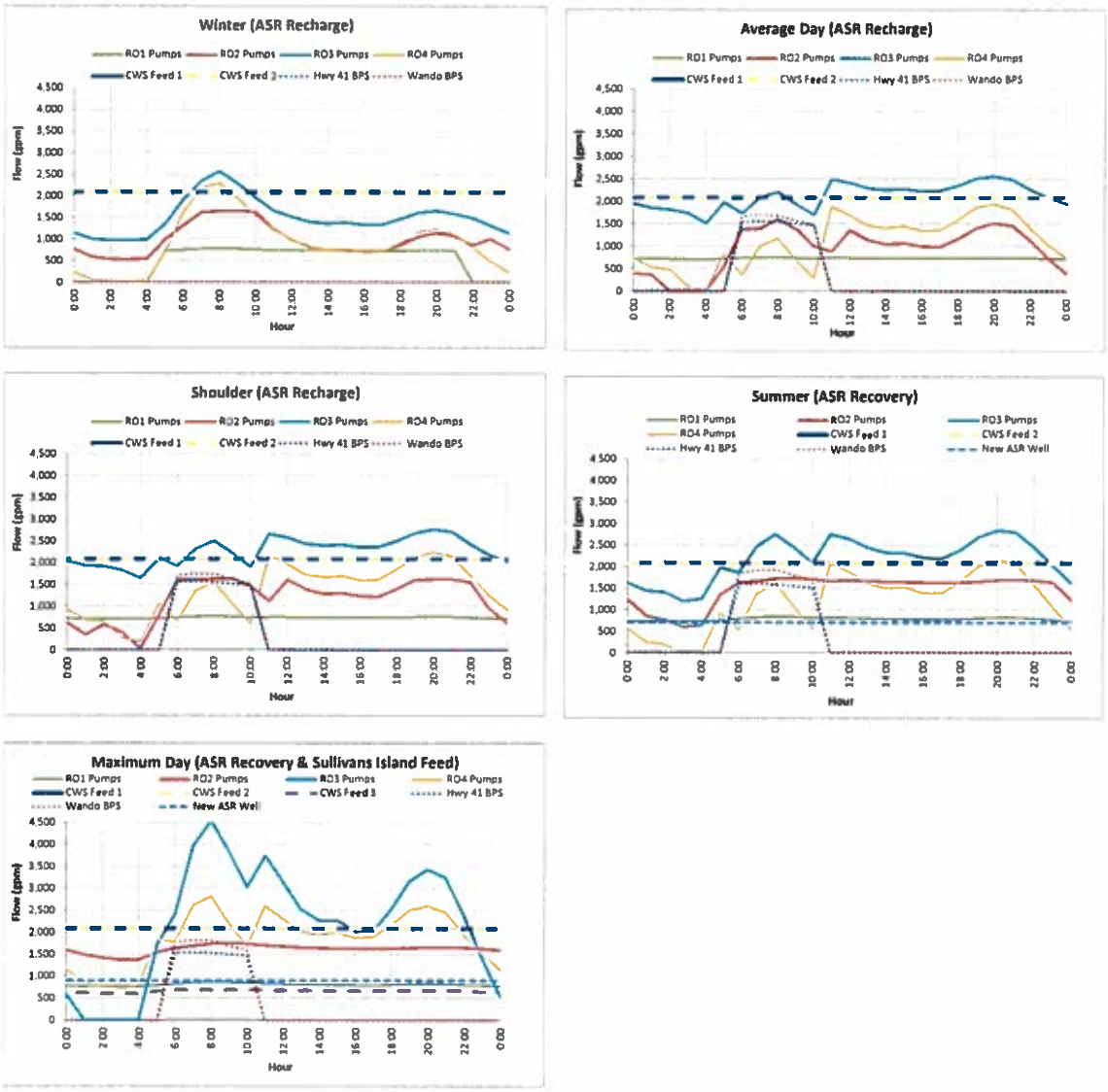


Figure 6-2. Scenario 1 Model-Simulated Pump Flows

Maximum Day Demands

To meet the projected 10-year maximum day demands in the system, additional water supply is needed from the new Bulls Bay ASR well, the CWS Feed No. 3 at Sullivan's Island, and from excess storage capacity at the Highway 41 ground storage, Wando ground storage, and RO WTP No. 2 and No. 4 ground storage. The modeled amount of water purchased at the Sullivan's Island CWS connection on a maximum day is approximately 1.0 mgd. The total amount of excess storage used for water supply (and not refilled) on a maximum day is approximately 1.2 mgd, or 10 percent of the total system storage volume.

The existing water distribution infrastructure is sufficient to convey water to meet maximum day demands. The system pressures range from approximately 53 to 76 psi, velocities are generally less than 5 fps, and headloss is generally less than 3 ft/1,000 ft. Figure A-2 in Appendix A shows pressures for maximum day demand conditions. Available fire flow under Scenario 1 maximum day demand conditions is shown in Figure A-3 in Appendix A. Scenario 1 fire flow is similar to existing fire flow available in the system (existing fire flow is presented in Figure B-3 in Appendix B of the 2015 CUMP Report). Under peak-hour conditions, the model is simulating all of the pumps operating at RO WTP No. 4. Peak hour pumping rate from each source, as simulated in the model, is shown in the plots in Figure 6-2. MPW should confirm that the maximum pumping rate can be achieved with the existing pumps.

6.3.2 Scenario 2

Scenario 2 evaluates system operations with the CWS Feed No. 1 at I-526 offline for the 10-year projected seasonal demand conditions. With the CWS Feed No. 1 offline, it is assumed that a maximum of 5.0 mgd can be supplied from the CWS Feed No. 2 at Highway 41. This scenario also includes construction and operation of the new ASR well at Bulls Bay.

Table 6-4 summarizes the maximum supply capacity of each water source along with the modeled water supply used from each source for each demand condition under Scenario 2. **Figure 6-3** includes plots showing the utilization of each water supply source over 24 hours of the EPS model simulation. Results are summarized in the following paragraphs. Maximum day demand with CWS Feed No. 1 offline is the same as presented in Scenario 3 (Section 6.3.3), and therefore is not included in Table 6-4 or Figure 6-3.

Average Day, Winter, and Shoulder Season Demands

The existing water supply sources (one CWS feed and four RO WTPs) can meet 10-year projected average day, winter, and shoulder seasonal demands with CWS Feed No. 1 offline. The existing water distribution infrastructure is also sufficient to convey water to meet system demands under these conditions. The ASR wells can all be recharged under winter demand conditions. For average day conditions all but the new Bulls Bay ASR can be recharged. For shoulder season demands, none of the ASR wells are recharged due to limited supply with CWS Feed No. 1 out of service. The system pressures range from approximately 55 to 78 psi, velocities are generally less than 5 fps, and headloss is generally less than 3 ft/1,000 ft. Figure A-4 in Appendix A shows pressures for average day demand conditions.

Table 6-4. Summary of Scenario 2 – CWS Feed No. 1 Offline

Water Supply Source		Maximum Supply Capacity[1] (gpm)	Modeled Supply for 10-year Projected Demands[2] (gpm)			
			ADD	Winter	Shoulder	Summer
CWS[3]	Feed No. 1 (I-526)	0	0	0	0	0
	Feed No. 2 (Highway 41)	3,472	3,107	3,000	3,162	3,256
	Feed No. 3 (Sullivan's Island)	1,563	0	0	0	694
	Total	**5,035**	**3,107**	**3,000**	**3,162**	**3,949**
RO WTP & ASR Recovery	RO WTP No. 1	824	806	538	816	818
	RO WTP No. 2	1,236	1,221	1,117	1,197	1,348
	ASR Well 3 Recovery[4]	350	0	0	0	
	RO WTP No. 3	2,240	2,223	2,159	2,231	2,486
	ASR Well 1 Recovery[5]	350	0	0	0	
	RO WTP No. 4	1,392	1,337	1,284	1,339	1,184
	ASR Well 2 Recovery[6]	350	0	0	0	
	New Bulls Bay ASR Well	900	0	0	0	700
	Total	**7,642**	**5,586**	**5,099**	**5,583**	**6,536**
ASR Recharge	ASR Well 1	-200	-200	-200	0	0
	ASR Well 2	-200	-200	-200	0	0
	ASR Well 3	-200	-200	-200	0	0
	New Bulls Bay ASR Well	-350	0	-350	0	0
	Total	**-950**	**-600**	**-950**	**0**	**0**
Storage/ Booster Pump Facilities[7]	Wando Park	490	0	0	0	0
	Highway 41	350	0	0	0	0
	Total	**840**	**0**	**0**	**0**	**0**

1. RO WTP capacity is assumed to be the average build-out capacity, as given in TM2 (based on finished water fluoride goal of 0.6 mg/L).
2. Modeled supply is based on average over a 24-hour simulation period.
3. CWS Feed No. 2 is limited to a maximum of 5.0 mgd.
4. ASR Well No. 3 supply is pumped via the high service pumps at RO WTP 2. Model results report total flow pumped from the RO WTP 2 high service pump station.
5. ASR Well No. 1 supply is pumped via the high service pumps at RO WTP 3. Model results report total flow pumped from the RO WTP 3 high service pump station.
6. ASR Well No. 2 supply is pumped via the high service pumps at RO WTP 4. Model results report total flow pumped from the RO WTP 4 high service pump station.
7. Water supply from storage in excess of the SCDHEC requirements at the Wando Park and Highway 41 facilities is not used from ADD, winter, shoulder, or summer demands.

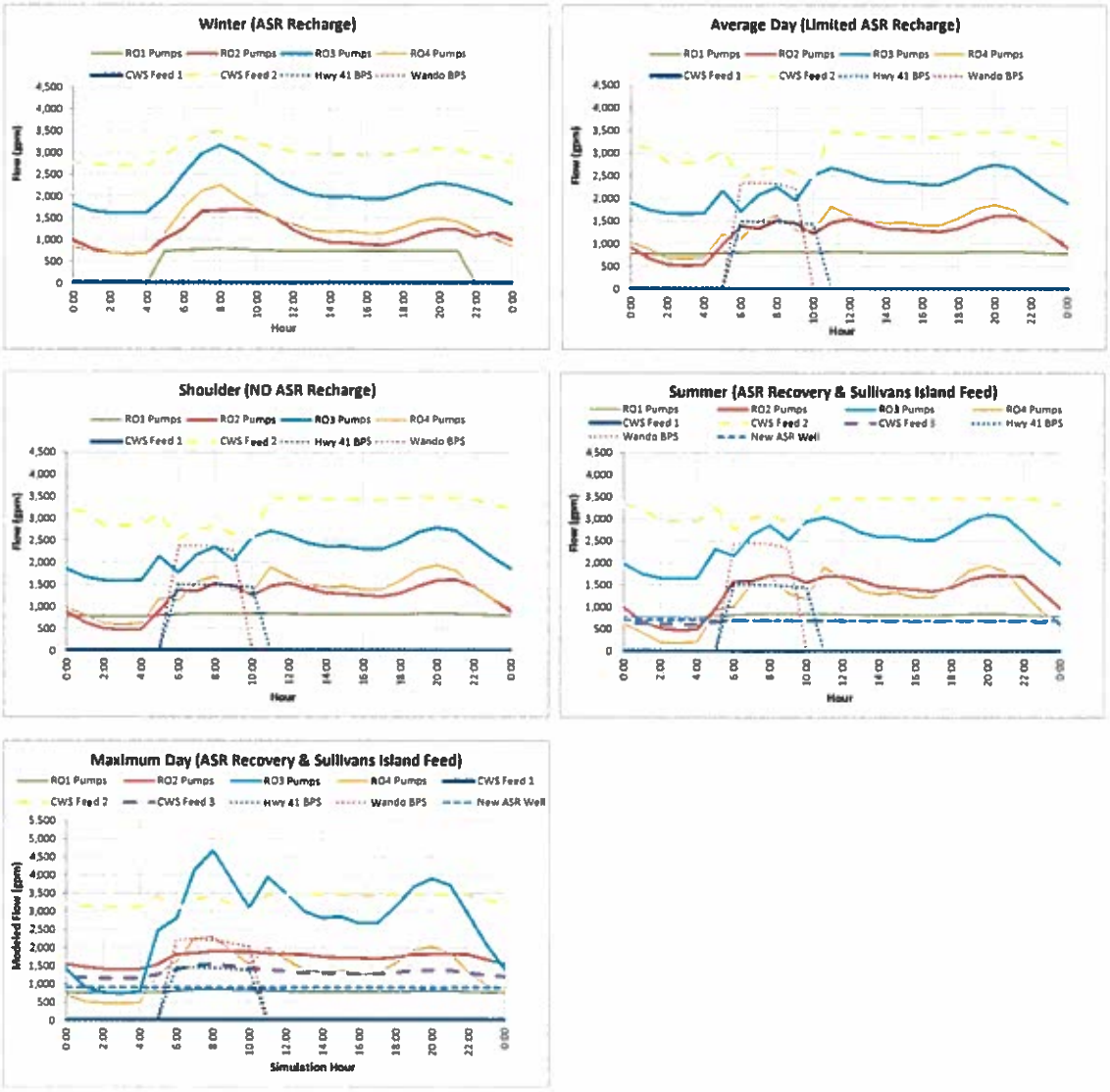


Figure 6-3. Scenario 2 Model-Simulated Pump Flows

Summer Season Demands

Water supply from the new Bulls Bay ASR well and the CWS Feed No. 3 at Sullivan's Island is needed, in addition to the existing water supply sources to meet summer seasonal demands with CWS Feed No. 1 offline. The modeled amount of water purchased at the Sullivan's Island CWS connection for summer seasonal demand is approximately 1.0 mgd. The existing water distribution infrastructure is sufficient to convey water to meet summer demands and maintain system pressures in the range of approximately 54 to 78 psi, velocities are generally less than 5 fps, and headloss is generally less than 3 ft/1,000 ft.

Maximum Day Demands

See Scenario 3 results in Section 6.3.3.

6.3.3 Scenario 3

Scenario 3 evaluates system operations and reliability under 10-year maximum day demand conditions with a water supply source offline (RO WTPs, CWS feeds, storage facilities). Only one water supply source is assumed to be offline at a time. The evaluation of Scenario 3 assumes supply of 900 gpm from the new ASR well at Bulls Bay. Scenario 3 results can be compared with Scenario 1 maximum day demand results, which describe water supply and system operations with all water supply sources on-line.

Table 6-5 summarizes the maximum supply capacity of each water source along with the modeled water supply used from each source for maximum day demand conditions. The supply capacity of the RO WTPs for maximum day demand is assumed to be the maximum at build-out as given in TM2 Table 2-2. **Figure 6-4** includes plots showing the utilization of each water supply source over 24 hours of the EPS model simulation.

Under peak-hour conditions, the model is simulating most of the high service pumps operating at RO WTP Nos. 2, 3, and 4 when they are online to meet peak demands (i.e. there is no standby pump). Peak hour pumping rate from each source, as simulated in the model, is shown in the plots in Figure 6-4. MPW should confirm that the maximum pumping rate can be achieved with the existing pumps.

Results are summarized in the following paragraphs. In general, fire flow for all of the reliability simulations with recommended improvements is similar to the existing available fire flow and meets the criteria in Table 6-2.

RO WTP No. 1 Offline

The deficit in maximum day water supply with RO WTP No. 1 offline can be met with the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at the Highway 41 and Wando Park facilities; and approximately 1.3 mgd supply from CWS Feed No. 3 at Sullivan's Island. No additional transmission improvements are required for 10-year maximum day demands. Resulting system pressures are approximately 52 to 78 psi (see Figure A-5 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

Table 6-5. Summary of Scenario 3 – Reliability with Water Supply Sources Offline

Water Supply Source		Maximum Supply Capacity[1] (gpm)	Modeled Supply for 10-year Maximum Day Demands[2] (gpm)							
			RO WTP 1 Offline	RO WTP 2 Offline[8]	RO WTP 3 Offline[9]	RO WTP 4 Offline[8]	CWS Feed 1 Offline[8]	CWS Feed 2 Offline	Wando Park Storage Offline	Hwy 41 Storage Offline
CWS[3]	Feed No. 1 (I-526)	4,167	2,083	2,083	2,083	2,083	0	4,167	2,083	2,083
	Feed No. 2 (Highway 41)		2,083	2,083	2,083	2,080	3,335	0	2,083	2,083
	Feed No. 3 (Sullivan's Island)	1,563	916	1,381	1,369	1,170	1,318	0	833	843
	Total	**5,729**	**5,082**	**5,547**	**5,535**	**5,333**	**4,652**	**4,167**	**4,999**	**5,009**
RO WTP & ASR Recovery	RO WTP No. 1	1,000	0	824	901	772	795	807	889	808
	RO WTP No. 2	1,500	1,683	0	1,929	1,261	1,713	1,573	1,695	1,603
	ASR Well 3 Recovery[4]	350								
	RO WTP No. 3	2,728	2,733	3,240	0	3,115	2,776	2,082	2,250	2,238
	ASR Well 1 Recovery[5]	350								
	RO WTP No. 4	1,688	1,895	1,780	2,078	0	1,389	2,000	1,896	2,035
	ASR Well 2 Recovery[6]	350								
	New Bulls Bay ASR Well	900	900	900	900	900	900	900	900	900
	New Paradise Island ASR Well	900	0	0	900	900	0	900	0	0
	Total	**9,766**	**7,211**	**6,744**	**6,708**	**6,948**	**7,574**	**8,262**	**7,629**	**7,584**
Storage/ Booster Pump Facilities[7]	Wando Park	490	361	362	397	367	443	204	0	364
	Highway 41	350	321	321	327	341	301	332	322	0
	Total	**840**	**683**	**684**	**723**	**708**	**745**	**537**	**322**	**364**

1. RO WTP capacity is assumed to be the maximum build-out capacity, as given in TM2 (based on finished water fluoride goal of 1.2 mg/L).
2. Modeled supply is based on average over a 24-hour simulation period.
3. Assumed maximum combined capacity of CWS Feed No. 1 and Feed No. 2 is 6.0 mgd (4,167 gpm). Feed No. 2 is limited to a maximum of 5.0 mgd; Feed No. 1 can supply up to 6.0 mgd for the 10-year scenario.
4. ASR Well No. 3 supply is pumped via the high service pumps at RO WTP 2. Model results report total flow pumped from the RO WTP 2 high service pump station.
5. ASR Well No. 1 supply is pumped via the high service pumps at RO WTP 3. Model results report total flow pumped from the RO WTP 3 high service pump station.
6. ASR Well No. 2 supply is pumped via the high service pumps at RO WTP 4. Model results report total flow pumped from the RO WTP 4 high service pump station.
7. Water supply from storage in excess of the SCDHEC requirements at the Wando Park and Highway 41 facilities. Additional storage supply is pumped from the RO WTP ground tanks. Water supply from storage is not refilled on a maximum day.
8. Pumped flow at RO WTP 3 exceeds combined WTP and ASR capacity. Additional capacity assumed to be provided by storage at RO WTP 3.
9. Pumped flow at RO WTP 2 and RO WTP 4 exceeds combined WTP and ASR capacity at each location. Additional capacity assumed to be provided by storage at RO WTP 2 and RO WTP 4.

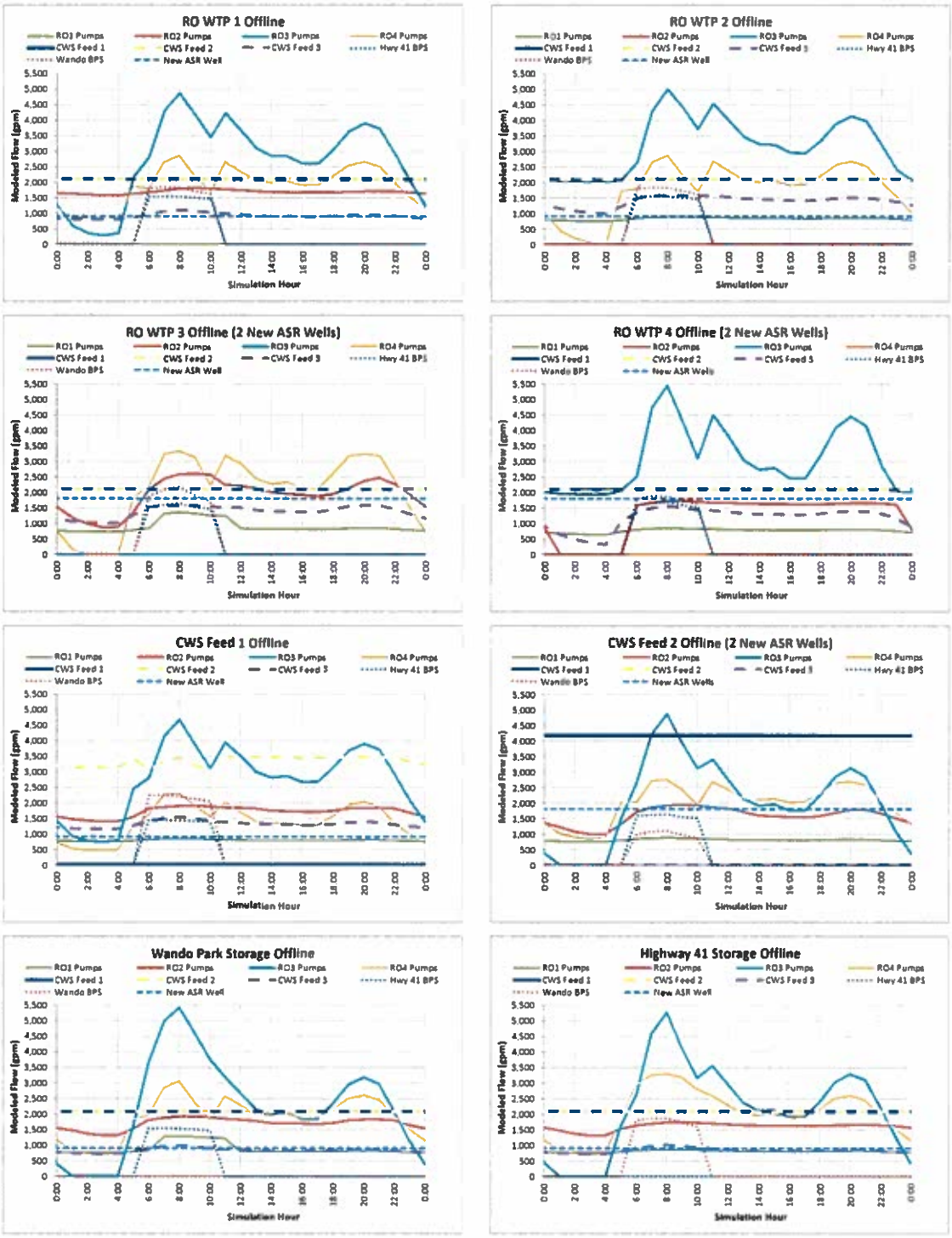


Figure 6-4. Scenario 3 Model-Simulated Pump Flows

RO WTP No. 2 Offline

The deficit in maximum day water supply with RO WTP No. 2 offline can be met with the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at RO WTP No. 3, Highway 41, and Wando Park; and approximately 2.0 mgd supply from CWS Feed No. 3 at Sullivan's Island. Once CWS Feed No. 3 flows exceed 1.4 mgd, the following transmission improvement is recommended, as shown on **Figure 6-5**:

- **Project 3** - Approximately 7,800 feet of 16-inch diameter main paralleling the existing 12-inch pipe on Ben Sawyer Boulevard from Tolers Cover Drive to the 12-inch main at Rifle Range Road. This pipe improves transmission from the CWS Feed No. 3 into the MPW transmission system and is needed once CWS flows at this location exceed approximately 1.4 mgd.

This improvement corresponds with Project 3 recommended in the 2015 CUMP. With the Project 3 improvement, system pressures are approximately 51 to 77 psi (see Figure A-6 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

RO WTP No. 3 Offline

The deficit in maximum day water supply with RO WTP No. 3 offline can be met with the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at RO WTP No. 2, RO WTP No. 4, Highway 41, and Wando Park; approximately 2.0 mgd supply from CWS Feed No. 3 at Sullivan's Island; and a second new ASR well at Paradise Island (see Figure 6-5). The new Paradise Island ASR well improves water supply to the northern portion of the system and is assumed to have a recovery rate of 900 gpm.

Several transmission improvements are recommended to maintain an adequate level of service to customers with RO WTP No. 3 offline. RO WTP No. 3 is the most critical water supply source since it requires the most additional infrastructure to account for the supply deficit if it is offline. The scenario with RO WTP No. 3 offline required the same improvement (Project 3) that is required with RO WTP No. 2 offline as well as the following improvements recommended in the 2015 CUMP and shown on Figure 6-5:

- **Project 5** – Approximately 10,800 feet of 20-inch diameter main on Highway 17 from the existing 20-inch diameter main at Hamlin Road to the existing 20-inch diameter main at Park West Boulevard. This pipe eliminates a 12-inch bottleneck and improves system pressures along Highway 41.

- **Project 6** – Approximately 2,600 feet of new 12-inch diameter main crossing the Wando River between Beckenham Drive and Cape Island Drive. This pipe increases the transmission capacity from Paradise Island so that up to 900 gpm can be conveyed from the new Paradise Island ASR well.

With the recommended improvement projects, system pressures are approximately 50 to 79 psi (see Figure A-7 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

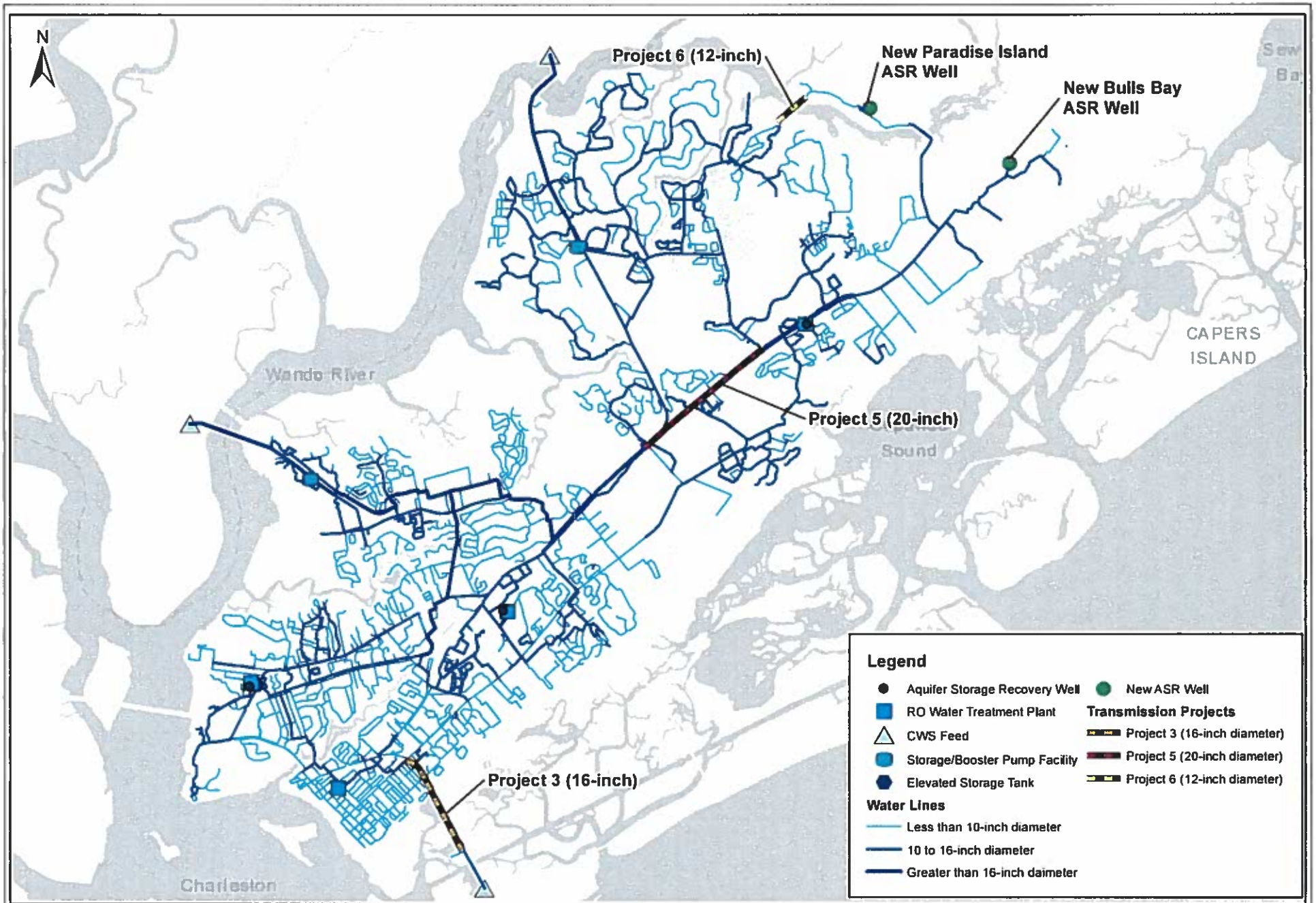


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Figure 6-5
Water System Improvement Projects

RO WTP No. 4 Offline

The deficit in maximum day water supply with RO WTP No. 4 offline can be met with the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at RO WTP No. 3, Highway 41, and Wando Park; approximately 1.7 mgd supply from CWS Feed No. 3 at Sullivan's Island; and a second new ASR well at Paradise Island (Figure 6-5). The new Paradise Island ASR well improves water supply to the northern portion of the system and is assumed to have a recovery rate of 900 gpm.

Transmission improvement Projects 3 and 6, described in the previous section, are recommended to maintain an adequate level of service to customers with RO WTP No. 4 offline (Figure 6-5). Project 3 is recommended since the CWS Feed No. 3 flow is greater than 1.4 mgd. Project 6 is recommended to improve transmission so that up to 900 gpm can be conveyed from the new Paradise Island ASR well. With the recommended improvement projects, system pressures are approximately 51 to 84 psi (see Figure A-8 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

CWS Feed No. 1 Offline

For maximum day demand conditions with CWS Feed No. 1 offline, water is provided from the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at RO WTP No. 3, Highway 41, and Wando Park; and approximately 1.9 mgd supply from CWS Feed No. 3 at Sullivan's Island. As discussed in Scenario 2, it is assumed that a maximum of 5.0 mgd can be supplied from the CWS Feed No. 2 at Highway 41 when CWS Feed No. 1 is offline.

Transmission improvement Project 3 is recommended to improve pressures into the MPW system since flow from CWS Feed No. 3 exceeds 1.4 mgd (Figure 6-5). With the Project 3 improvement, system pressures are approximately 54 to 78 psi (see Figure A-9 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

CWS Feed No. 2 Offline

For maximum day demand conditions with CWS Feed No. 2 offline, water is provided from the other existing CWS, ASR, and RO WTP supplies; new Bulls Bay ASR; use of excess storage at Highway 41 and Wando Park; and a second new ASR well at Paradise Island. It is assumed that a maximum of 6.0 mgd (current contract amount) is supplied from the CWS Feed No. 1 at I-526 when CWS Feed No. 2 is offline. Supply from CWS Feed No. 3 is not needed for this scenario.

Project 6 is recommended to improve transmission so that up to 900 gpm can be conveyed from the new Paradise Island ASR well (Figure 6-5). With the Project 6 improvement, system pressures are approximately 54 to 80 psi (see Figure A-10 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

Storage/Booster Pump Facilities Offline

Results for water supplies during maximum day demand conditions with either the Wando Park storage/booster pump facility or the Highway 41 storage/booster pump facility offline are similar to Scenario 1 maximum day results, since the amount of supply provided by excess storage in either of these storage tanks is relatively small (approximately 0.5 mgd). However, the peak-hour pumping rate from RO WTP No. 3 and No. 4, as shown in Figure 6-4, is higher since booster pumping from storage is not available to meet peak-hour demands.

No additional transmission improvements are required for 10-year maximum day demands with either of the storage/booster pump facilities offline. Resulting system pressures are approximately 53 to 77 psi (see Figures A-11 and A-12 in Appendix A). Velocities are generally less than 5 fps, and headloss is generally less than 4 ft/1,000 ft.

6.4 Summary and Recommended Improvements

In summary, the following improvements are recommended to maintain the existing level of service to customers for water supply Scenarios 1, 2, and 3 with 10-year projected demands:

- **New ASR Well at Bulls Bay** – new ASR well adjacent to the existing 12-inch waterline in the Bulls Bay area with a recovery rate of 900 gpm and the recharge rate of 350 gpm.
- **New ASR Well at Paradise Island** – new ASR well near Eden Road and Paradise Island Drive with a recovery rate of 900 gpm and the recharge rate of 350 gpm.
- **Project 3** - Approximately 7,800 feet of 16-inch diameter main paralleling the existing 12-inch pipe on Ben Sawyer Boulevard from Tolers Cover Drive to the 12-inch main at Rifle Range Road. This pipe improves transmission from the CWS Feed No. 3 into the MPW transmission system and is needed once CWS flows at this location exceed approximately 1.4 mgd.
- **Project 5** – Approximately 10,800 feet of 20-inch diameter main on Highway 17 from the existing 20-inch diameter main at Hamlin Road to the existing 20-inch diameter main at Park West Boulevard. This pipe eliminates a 12-inch bottleneck and improves system pressures along Highway 41.
- **Project 6** – Approximately 2,600 feet of new 12-inch diameter main crossing the Wando River between Beckenham Drive and Cape Island Drive. This pipe increases the transmission capacity from Paradise Island so that up to 900 gpm can be conveyed from the new Paradise Island ASR well.

These projects are shown on Figure 6-5. **Table 6-6** summarizes the improvements and additional water supplies that are recommended to address each Scenario and demand condition. The costs for recommended improvements are provided in a separate TM to be prepared by Carollo Engineers.

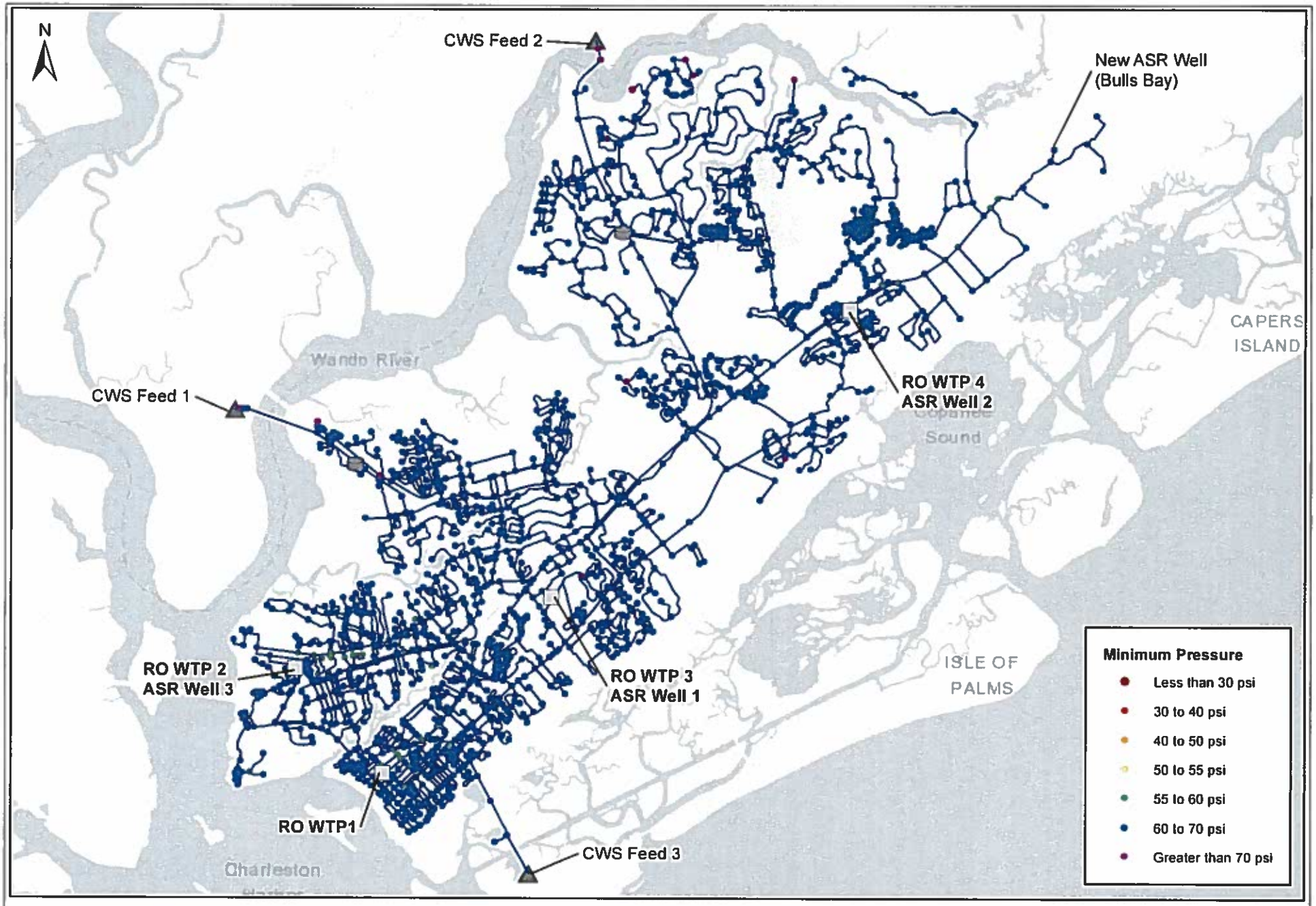
Although no pumping improvements are recommended based on the hydraulic modeling analysis, MPW should confirm that the modeled pumping rate during peak hours can be achieved with the existing pumps.

Table 6-6. Recommended New Water Supplies and Transmission Improvement Projects by Scenario

		New Water Supplies			Transmission Projects[3]		
Scenario/ Description	Demand Condition[1]	Bulls Bay ASR Well[2]	Paradise Island ASR Well[2]	Wholesale Purchase CWS Feed No. 3	Project 3	Project 5	Project 6
Scenario 1 Bulls Bay ASR	ADD						
	Winter						
	Shoulder						
	Summer	X					
	MDD	X		X			
Scenario 2 CWS Feed No. 1 Offline	ADD						
	Winter						
	Shoulder						
	Summer	X		X			
	MDD	X		X			
Scenario 3a – RO WTP 1 Offline	MDD	X		X			
Scenario 3b – RO WTP 2 Offline	MDD	X		X	X		
Scenario 3c – RO WTP 3 Offline	MDD	X	X	X	X	X	X
Scenario 3d – RO WTP 4 Offline	MDD	X	X	X	X		X
Scenario 3e – CWS Feed No. 1 Offline	MDD	X		X	X		
Scenario 3f – CWS Feed No. 2 Offline	MDD	X	X				X
Scenario 3g – Wando Park Storage Offline	MDD	X		X			
Scenario 3h – Highway 41 Storage Offline	MDD	X		X			

1. ADD = Average Day Demand; MDD = Maximum Day Demand. See Table 6-1 for 10-year demand projections.
2. Proposed location of new ASR wells shown on Figure 6-5.
3. See Figure 6-5 for transmission projects. Project numbers correspond with projects recommended in the 2015 CUMP.

Appendix A

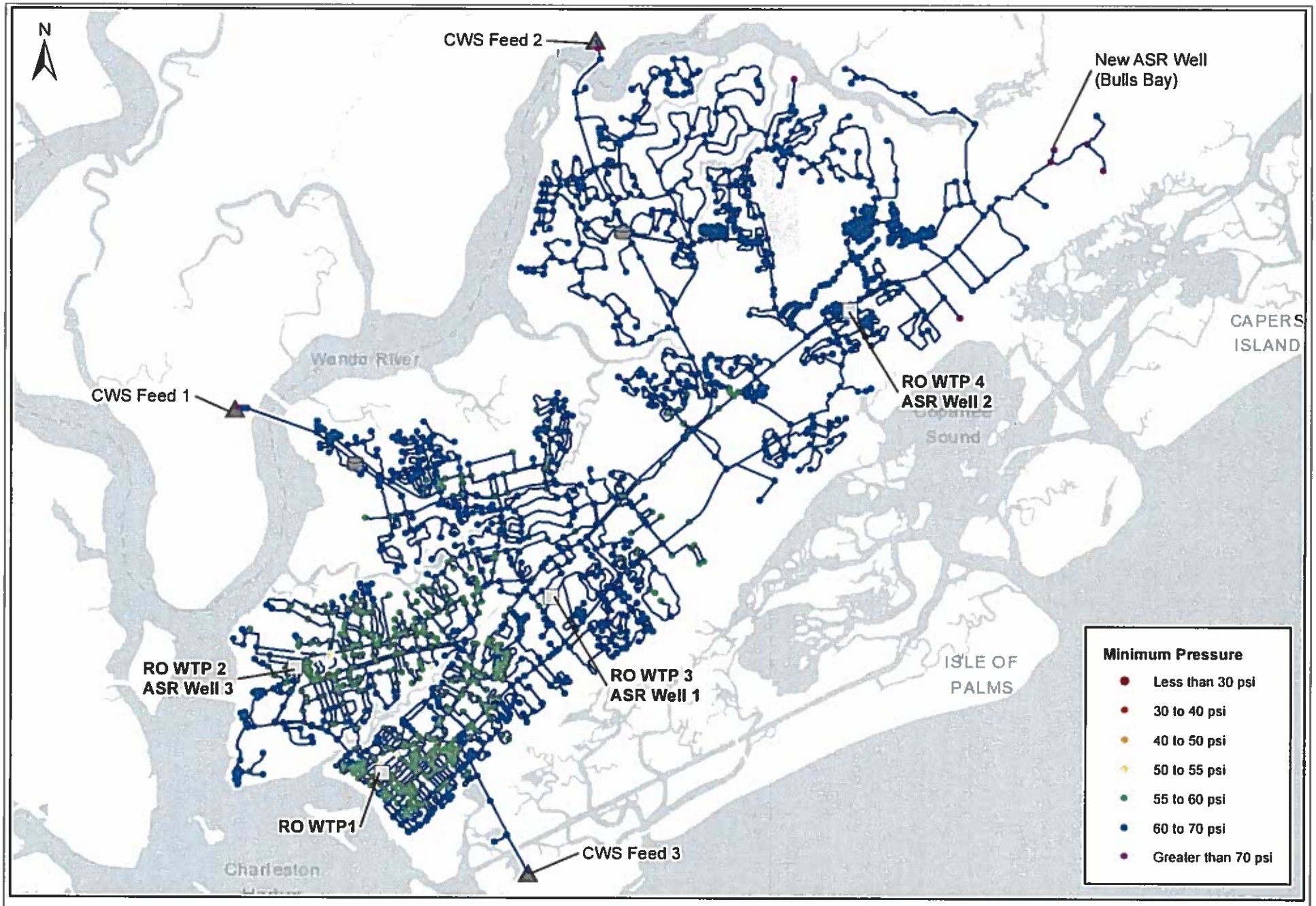


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-1
Scenario 1 Projected 10-Year Average Day Demand
With New Bulls Bay ASR Well

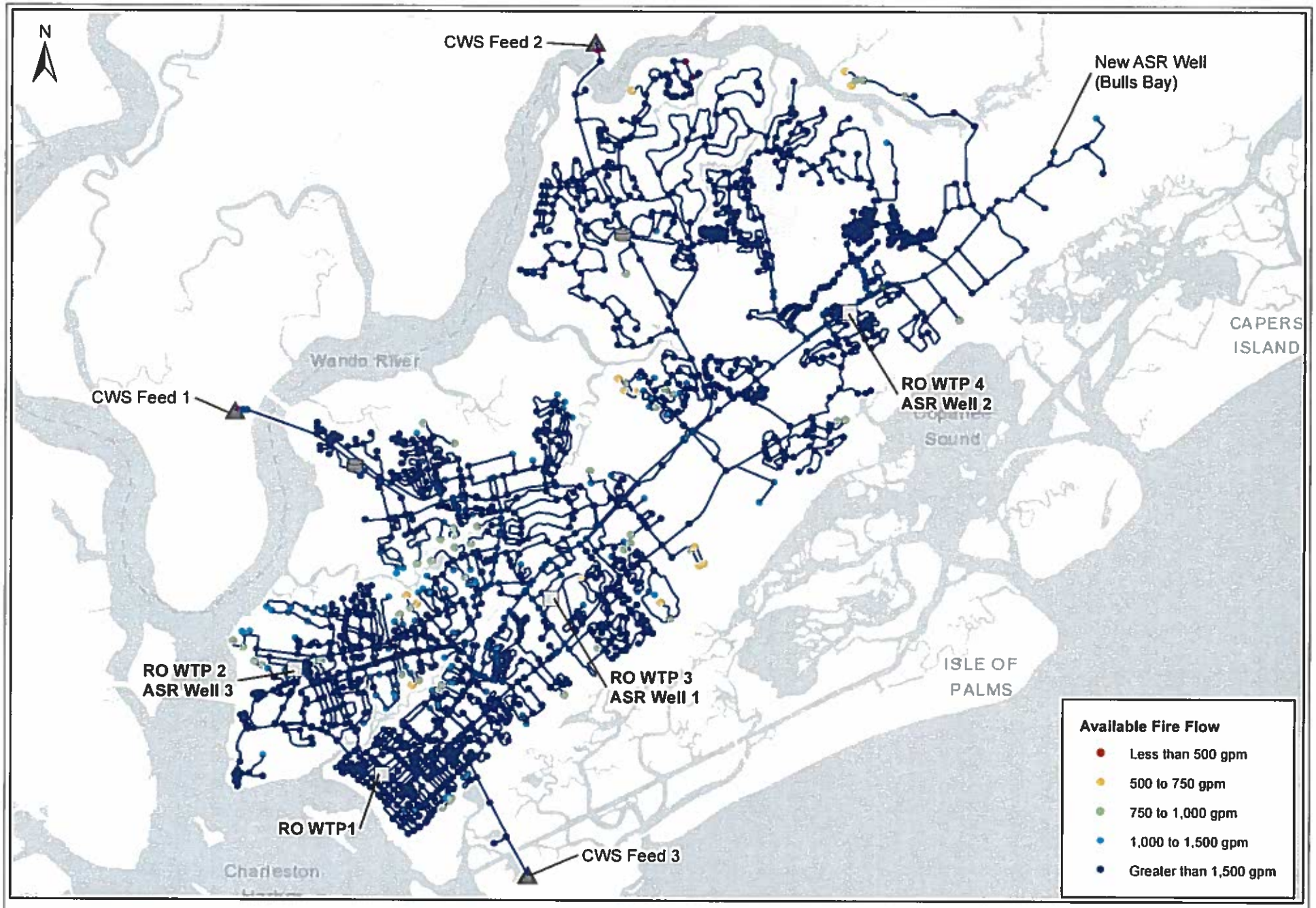


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-2
Scenario 1 Projected 10-Year Maximum Day Demand With New Bulls Bay ASR Well

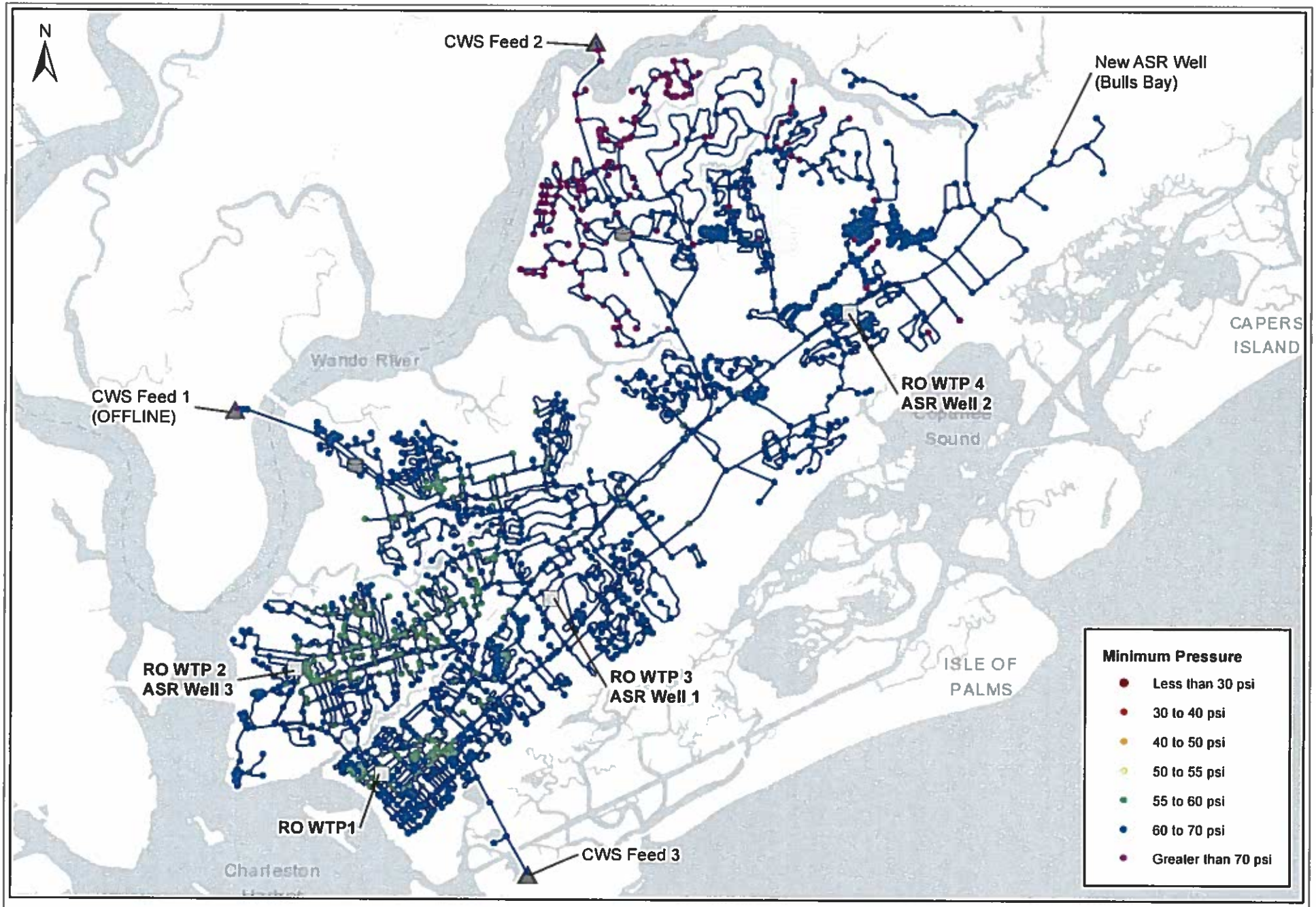


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-3
Scenario 1 Projected 10-Year Maximum Day Demand Available Fire Flow

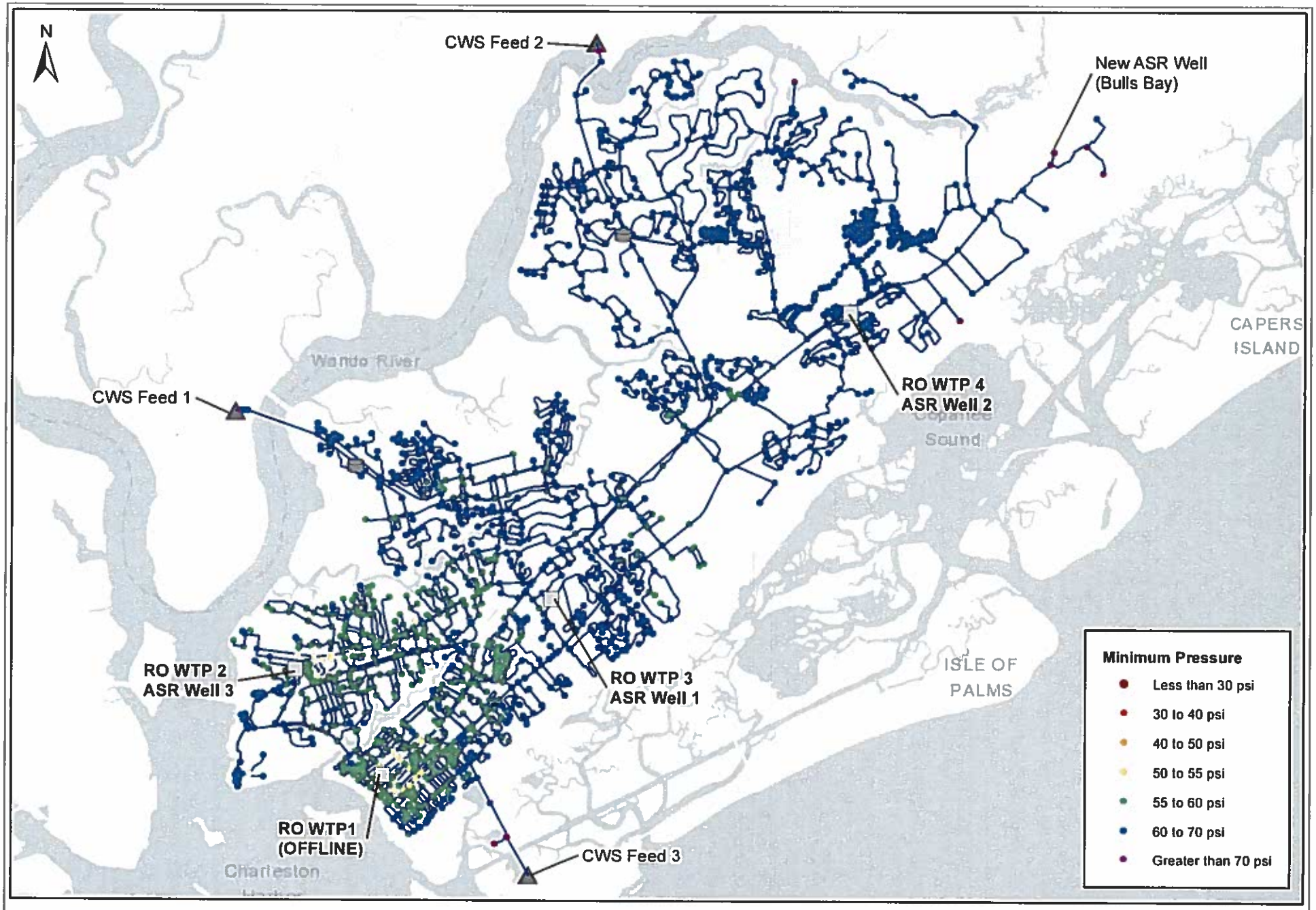


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-4
Scenario 2 Projected 10-Year Average Day Demand With CWS Feed No. 1 Offline

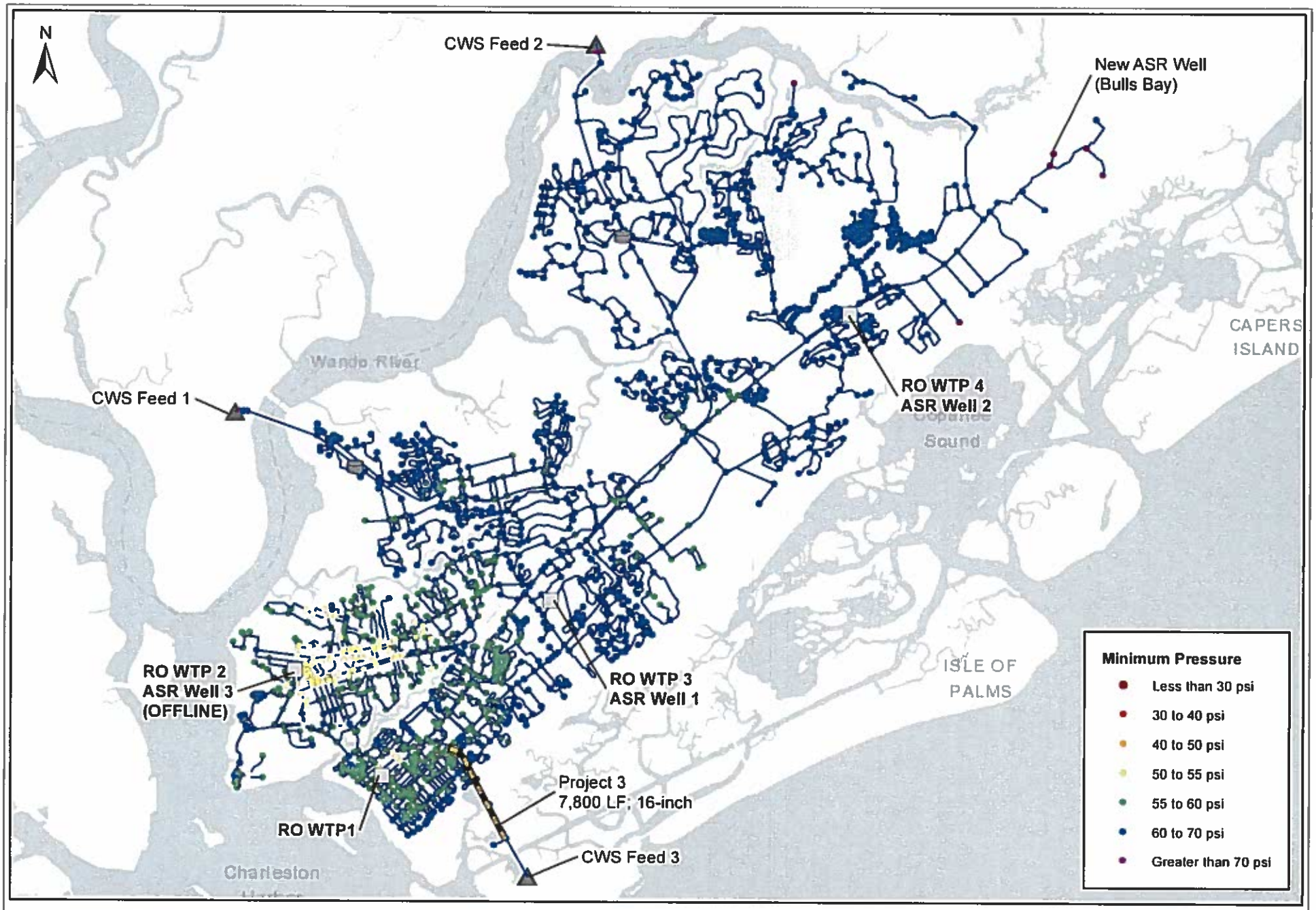


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-5
Scenario 3a Projected 10-Year Maximum Day Demand
With RO WTP No. 1 Offline

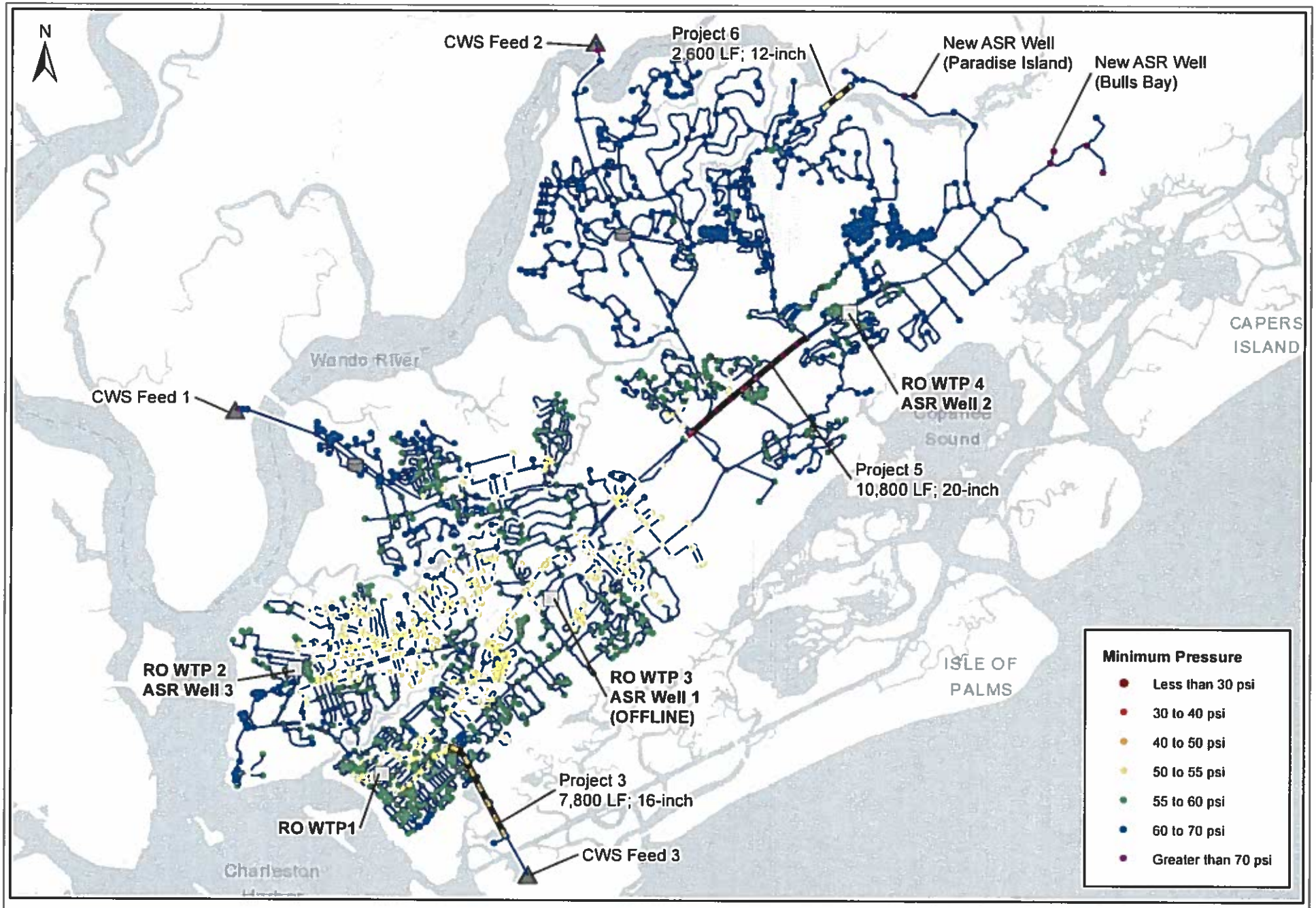


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-6
Scenario 3b Projected 10-Year Maximum Day Demand
With RO WTP No. 2 Offline

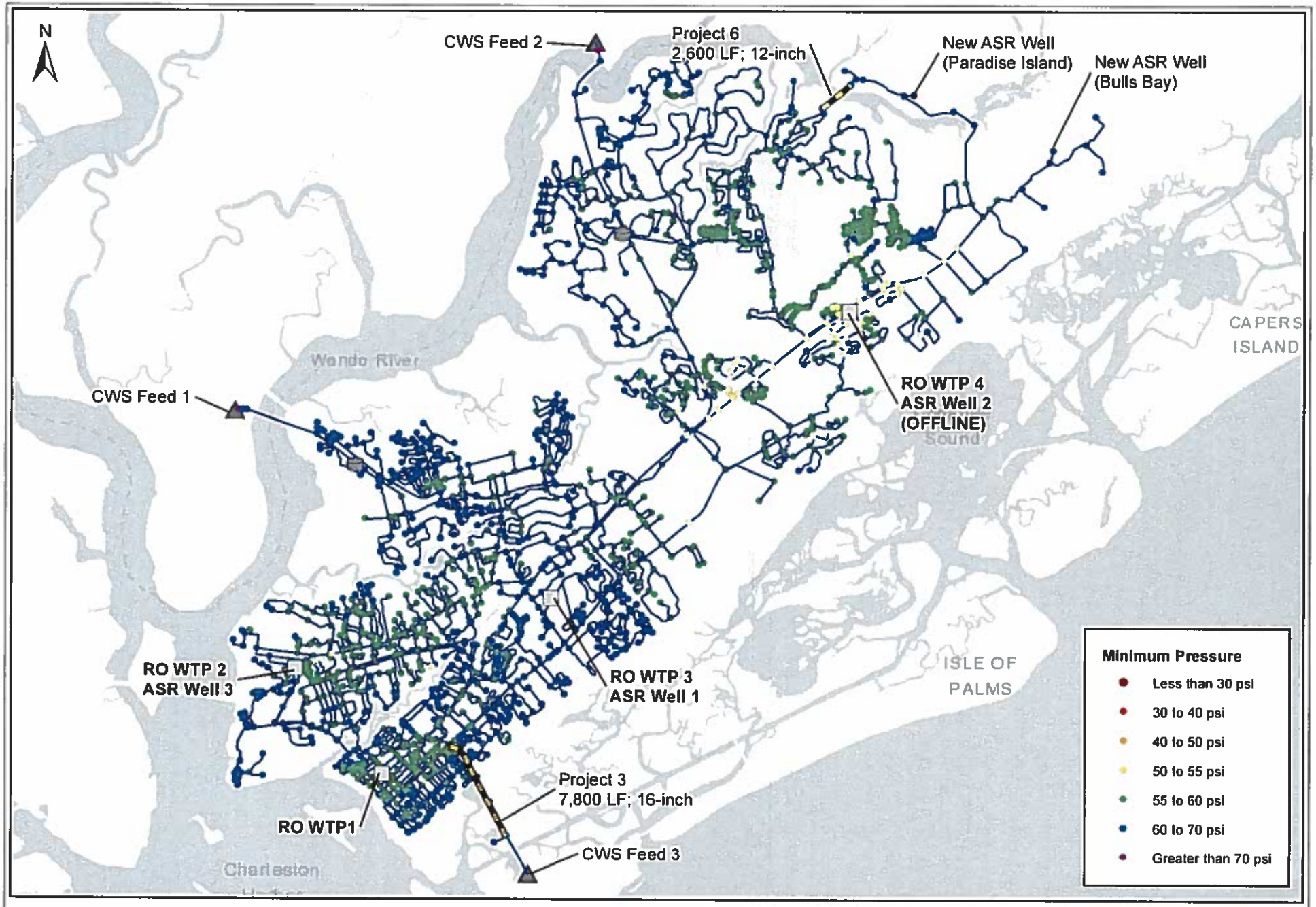


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-7
Scenario 3c Projected 10-Year Maximum Day Demand With RO WTP No. 3 Offline

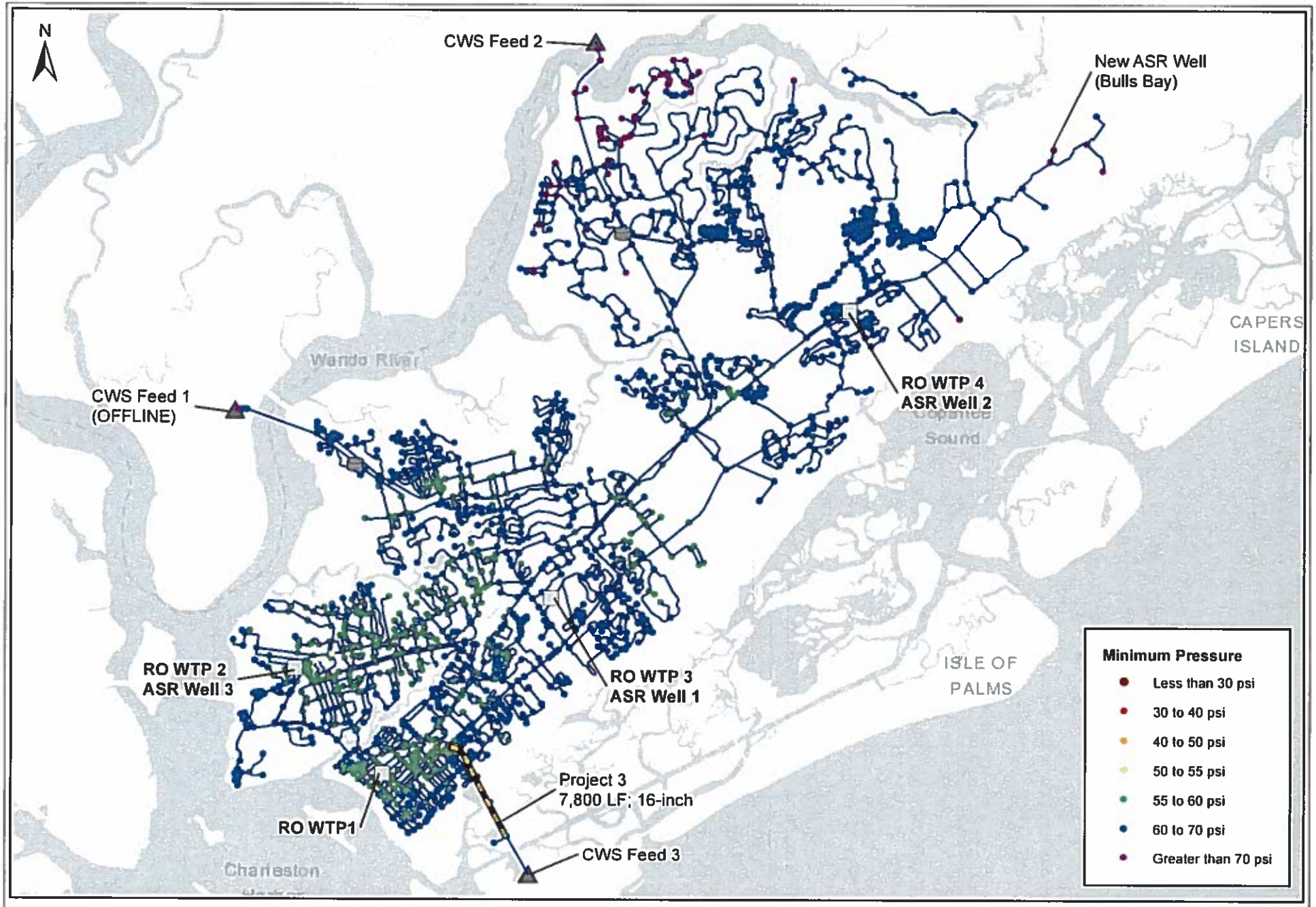


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-8
Scenario 3d Projected 10-Year Maximum Day Demand
With RO WTP No. 4 Offline

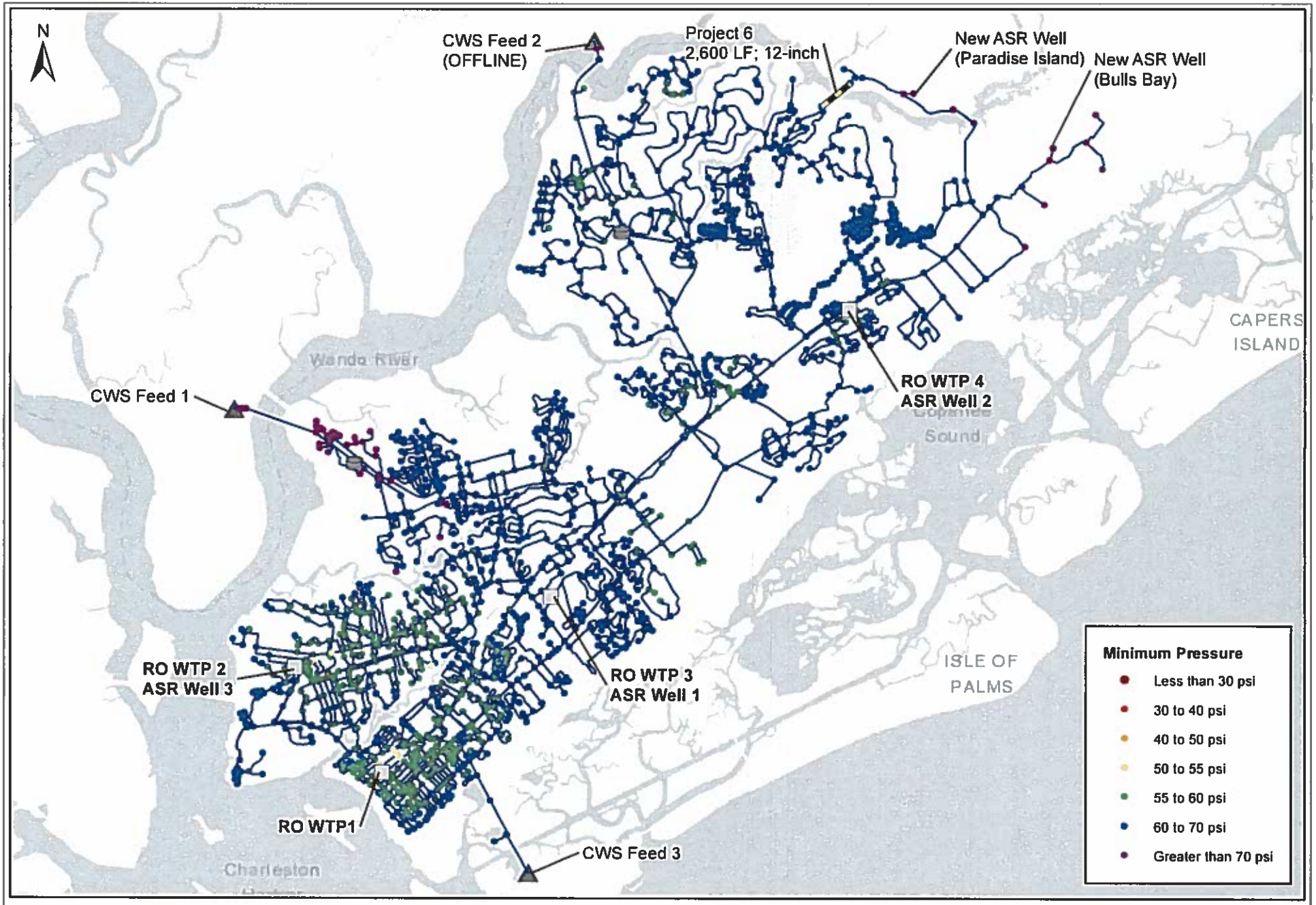


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

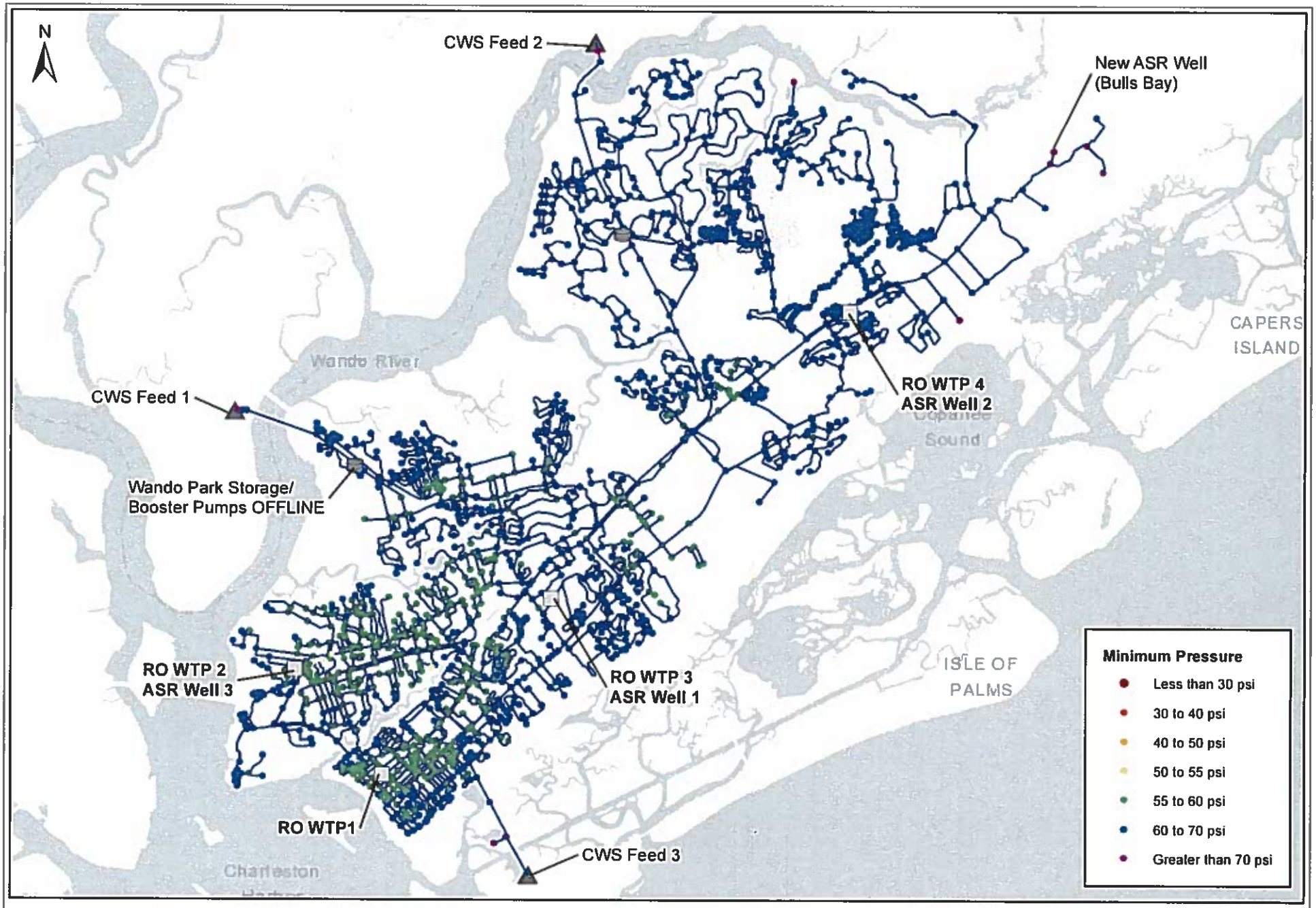
Figure A-9
Scenario 3e Projected 10-Year Maximum Day Demand
With CWS Feed No. 1 Offline



CDM Smith

CLEAN WATER

Figure A-10
Scenario 3f Projected 10-Year Maximum Day Demand
With CWS Feed No. 2 Offline

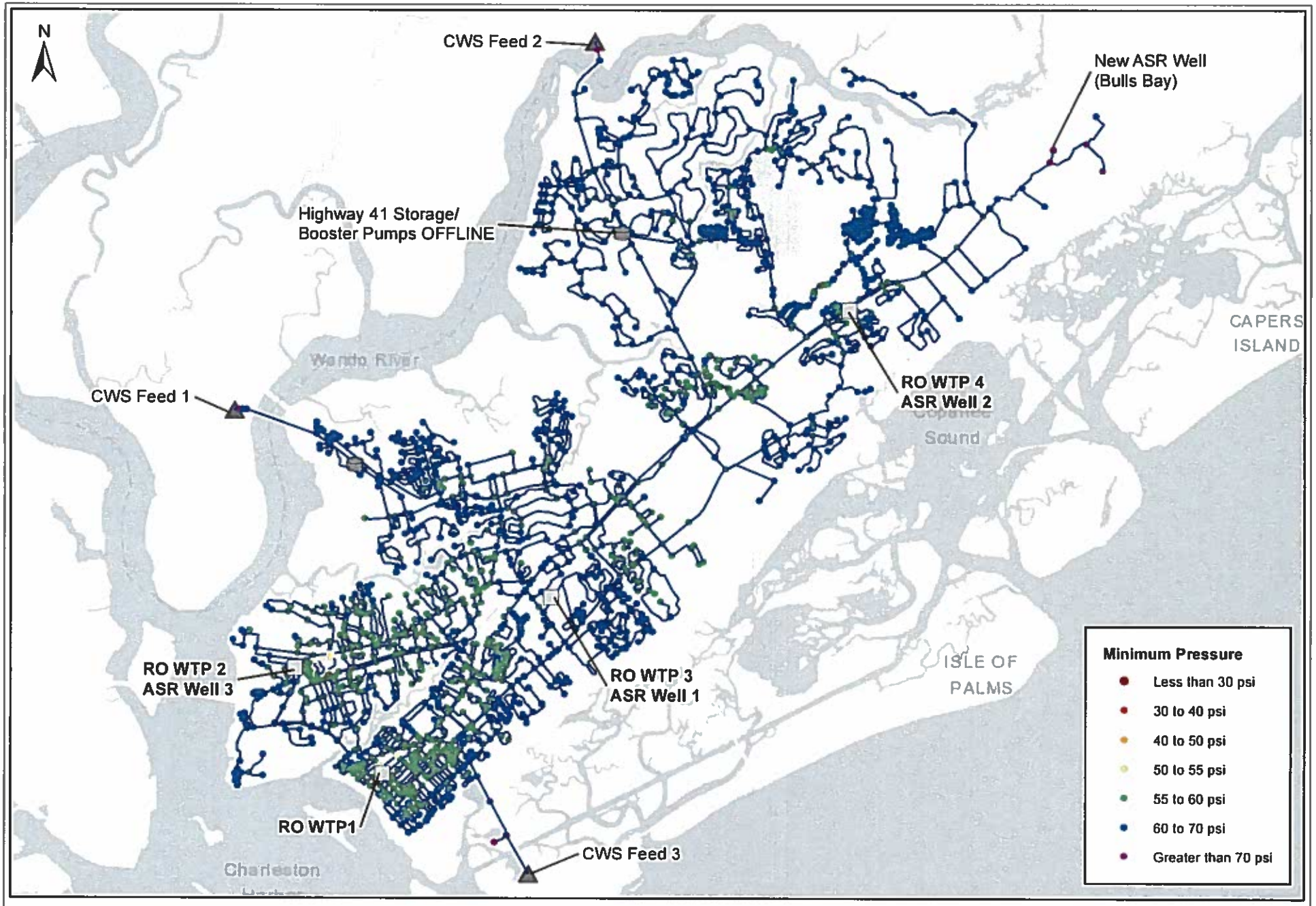


CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-11
Scenario 3g Projected 10-Year Maximum Day Demand
With Wando Park Storage/Booster Pump Facility Offline



CDM Smith

CLEAN WATER

0 0.5 1 2 3 4 Miles

Figure A-12
Scenario 3h Projected 10-Year Maximum Day Demand
With Highway 41 Storage/Booster Pump Facility Offline

Chapter 7

CAPITAL IMPROVEMENT PLAN

7.1 Introduction

The purpose of this chapter is to present a Capital Improvement Plan (CIP) developed from analyses presented in previous chapters of this Water Supply Master Plan (WSMP).

7.1.1 Capital Project Asset Classes and Types

Mount Pleasant Waterworks (MPW) CIP is separated into multiple asset classes. The WSMP updates the three water infrastructure classes:

- Supply and Storage: Charleston Water System (CWS), wells, raw water transmission mains, storage and associated booster pump stations.
- Water Treatment: Reverse Osmosis (RO) Water Treatment Plants (WTP) and associated concentrate disposal infrastructure.
- Distribution: Distribution system piping.

The WSMP recommends new and revised project in two asset classes: Supply and Storage and Water Treatment. MPW has separately adjusted timing of Distribution projects whose timing are related to Supply and Storage, or Water Treatment projects.

Projects are divided into two categories for funding:

- Extension and Expansion (E&E): Expand infrastructure to accommodate more water demand.
- Renewal and Replacement (R&R): Replacement of aging infrastructure and renewal of facilities to meet current level of service goals.

Projects may be a combination of E&E and R&R categories (for example 50 percent E&E and 50 percent R&R).

7.1.2 Capital Planning Periods

Consistent with MPW budgeting, the following Planning Periods were considered:

- 2019 – 2020
- 2021 – 2028
- 2028 and after (long-term)

Project timing was developed from the technical analyses considering financial and staff resources. Projects to be completed in 2019 and 2020 are funded in the upcoming biennium. Note, projects started in 2017-2018 are currently funded and therefore not considered as part of the CIP. Projects after 2021 are planned, but not funded.

7.2 Cost Estimating Assumptions

7.2.1 Cost Estimate Level

The CIP cost estimates presented in this chapter are American Academy of Cost Engineers (AACE) Class 4 estimates. Class 4 estimates are budget level estimates. Actual costs may vary from these estimates by -30 percent to +50 percent. These costs were determined based on MPW's and Carollo Engineers, Inc. (Carollo's) perception of current conditions at the project locations.

7.2.2 Current (October 2017) Dollar Costs

All costs are in October 2017 dollars. No inflation rate is applied to the CIP. This allows MPW staff to directly inflate the CIP as warranted in the future. The Engineering New Report (ENR) U.S. 20-City Construction Cost Index for October 2017 is 10,817. The estimates are subject to change as the project design matures. Cost of labor, materials, and equipment may vary in the future.

Note also that costs in Chapter 5 were inflated for evaluation purposes; therefore, they do not match the CIP costs presented in this Chapter.

7.2.3 Cost Factors

The CIP cost estimates were based on construction costs that are inflated using cost factors in Table 7.1. Where referencing a more detailed cost estimate, general cost factors were not applied.

Project scope contingency adjustment factors were applied based on the type of cost estimate. A 15 percent contingency was applied for project cost estimates developed from an existing design. Contingency of 20 percent was applied for project cost estimates based on a preliminary design. A 30 percent contingency was applied for project costs developed from planning level cost estimates.

A 20 percent engineering/planning cost factor for the planning and design of the project was applied to all E&E and major R&R projects.

Table 7.1 Cost Factors

Adjustment Factors	Description	Factor
Contingency	Costs that may occur due to uncertainty in project scope and conditions.	15% - 30%
Engineering/Planning	Cost for planning and design of project	20%

7.3 Supply and Storage CIP

The WSMP updated the future supply strategy to incorporate greater use of MPW's Deep Well (Middendorf Aquifer) supplies and expansion of Aquifer Storage and Recovery (ASR). The resulting E&E and R&R CIP projects needed to implement this strategy are presented below. In addition to the CIP projects, operations and maintenance (O&M) projects recommended as part of the condition assessment documented in Chapter 4 are summarized to provide a comprehensive cost summary.

7.3.1 E&E Projects

Development of new supplies is required to meet growing system demand. These include development of new ASR wells and additional CWS capacity purchases. Supply E&E projects are summarized in Table 7.2. Project timing is presented along with estimated costs. Details on each project are provided below.

7.3.1.1 WSP1802: ASR Well No. 4

Construct ASR Well No. 4 near the Bulls Bay area. ASR Well No. 4 project will include drilling a test well, design, development of the well site, completion of a permanent well, construction of a well building, installation of a well pump, disinfection system, and instrumentation and controls. Note, a portion of the ASR Well No. 4 (WSP1802) initial costs were funded as part of 2017-2018 bond issues and are not included in the presented CIP cost. Cost estimates were based on a preliminary design and include a 20 percent contingency.

7.3.1.2 2020-400-009: ASR Well No. 5

Construct ASR Well No. 5 near the Paradise Island area. ASR Well No. 5 project will include drilling a test well, design, development of the well site, completion of a permanent well, construction of a well building, installation of a well pump, disinfection system, and instrumentation and controls.

ASR Well No. 5 will be developed several years after ASR Well No. 4, currently in the 2024-2025 timeframe, to allow staff to incorporate lessons learned from ASR Well No. 4 operation and construction of related distribution system improvements. Cost estimates were based on a preliminary design and include a 20 percent contingency.

7.3.1.3 WSP1709: CWS Sullivan Island Connection

The CWS Sullivan Island Connection provides up to 2.25 million gallons per day (mgd) of potable supply, as agreed upon in the 2016 wholesale water supply contract between MPW and CWS.[1] The project constructs the supply feed, instrumentation and controls. A new 12-inch transmission main will be constructed adjacent to Ben Sawyer Boulevard to connect CWS Sullivan Island and MPW water systems. Note, costs represent MPW portion of the capital project.

Terms of the CWS Sullivan Island Connection (WSP1709) project development costs were agreed to by MPW and Charleston Public Works (CPW) as part of the 2016 wholesale water supply contract. Costs shown here represent MPW's expected capital costs, as estimated by the MPW, with CPW sharing additional project costs in accordance with the 2016 Agreement.

7.3.1.4 2036-400-003: CWS Capacity Purchases

Purchase of an additional 8.0 mgd CWS capacity at the existing Points of Delivery (POD) are planned starting in 2030 (long-term). Presented costs represent the Contract Capacity charges (capital buy-in) based on the 2016 wholesale water supply contract Tier 1 and Tier 2 rates for the existing POD No. 1 and No. 2. The Annual Capital Facility charges are considered separate R&R items (2019-400-030 and 2017-400-028).

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[1] Wholesale Water Supply, Treatment, and Transmission Services Contract by and between Commissioners of Public Works of the City of Charleston, SC and Commissioners of Public Works of the Town of Mount Pleasant, SC. October 25, 2016.

Table 7.2 Supply and Storage E&E Projects

Project Number	Project Name	Total CIP Cost (2017$)	Funding Type	Timing
WSP1802	ASR Well No. 4 Bulls Bay	$3,741,000(1)	EE W	2018 to 2019
WSP1709	CWS Sullivan Island Connection	$5,880,000(2)	2017A	2020 to 2021
2020-400-009	ASR Well No. 5 Bulls Bay	$4,128,000	EE W	2024 to 2025
2036-400-003(3)	CWS Capacity Purchases - ADD	$15,352,000	EE W	Long-term
2036-400-003.1(3)	CWS Capacity Purchases - MDD	$8,857,000	EE W	Long-term

Notes:
(1) The initial portion of the project was funded in the 2017-2018 Bond Issue.
(2) Cost represents MPW portion of the capital project.
(3) Costs based on the 2016 wholesale water supply contract Capacity Charge Tier 1 and Tier 2 rates for the existing POD No. 1 and No. 2.
(4) ADD: Average Day Demand MDD: Maximum Day Demand.

7.3.2 R&R Projects

R&R projects maintain existing supplies and treatment infrastructure. Major R&R projects are summarized in Table 7.3 and regular maintenance projects are summarized in Table 7.4. Project timing is presented along with estimated costs. These projects include replacement of existing deep wells and major capital charges associated with CWS supply. Timing of R&R projects is dictated by infrastructure reaching the end of its useful life, financial resources, staff resources, and technical considerations. R&R projects are detailed below.

7.3.2.1 2019-400-025: Replacement of Deep Well 2

Deep Well No. 2 experienced corrosion related failure in 2017 and full replacement has been recommended to maintain reliable water supply from RO WTP No. 2. The Deep Well No. 2 replacement includes siting and drilling the new well on the existing site, installation of a new well pump, well house, and upgrades to electrical, instrumentation, and controls. Replacement well design is budgeted for 2019 with construction occurring in 2020. Cost estimates are based on the costs for Deep Well 5 design and construction and include a 15 percent contingency.

7.3.2.2 2017-400-008: Asset Management - Supply and Storage (FY21-49)

MPW's asset management program was established to address infrastructure as it reaches the end of its useful life. MPW staff prioritize projects each biennium based on best available information. These projects are incorporated into the budget as regular R&R projects, where the 2018-2019 projects are presented in Section 7.3.2.10.

7.3.2.3 2019-400-030: CWS Annual Capital Outlay (FY19-20)

A Capital Improvement Charge is paid annually to CPW for MPW's portion of improvements to the CWS. CIP costs are estimated by MPW based on the information provided by CPW. 2019-400-030 includes the Fiscal Year 2019 and 2020 charges. Additional charges are included in CIP project 2017-400-28.

Table 7.3 Supply and Storage Major R&R Projects

Project Number	Project Name	Total CIP Cost (2017$)	Funding Type	Timing
2019-400-025	Replacement of Deep Well 2	$4,579,000	2017A	2019 to 2020
2017-400-008	Asset Management - Supply and Storage (FY21-49)	$2,165,000	RR	2021 to 2028
2019-400-030	CWS Annual Capital Outlay (FY19-20)	$1,793,000 ($896,500/year)	RR	2019 to 2020
2017-400-028	CWS Annual Capital Outlay (FY21-49)	$5,650,000 ($706,250/year)	RR	2021 to 2028
2029-400-026	Deep Well 4 AC Pipeline Replacement	$3,730,000(1)	RR	Long-term
2032-400-004	Deep Well No. 6 Replacement	$4,579,000	RR	Long-term
2027-400-004	Deep Well No. 3 Replacement	$4,579,000	RR	2027 to 2028
2030-400-002	Deep Well No. 4 Replacement	$4,579,000	RR	Long-term
WSP1705	Deep Well No. 5 Replacement	$4,152,000	RR	2017 to 2021

Notes:
(1) Costs were based on Technical Memorandum (TM) No. 3 Reverse Osmosis WTP No. 3 Capacity Evaluation (Carollo 2017).

7.3.2.4 2017-400-028: CWS Annual Capital Outlay (FY21-49)

A Capital Improvement Charge is paid annually to CPW for MPW's portion of improvements to the CWS. CIP costs are estimated by MPW based on information provided by CPW. Costs through 2023 are based on CPW detailed 6-year CIP and then estimates are based on CPW's long-term planning. Costs should be revised as revised or new information is provided by CPW.

7.3.2.5 2029-400-026: Deep Well 4 AC Pipeline Replacement

Deep Well No. 4 asbestos cement (AC) 16-inch transmission main from the well to RO WTP No. 3 has reached the end of its useful life. The 5,800 foot water main will be rehabilitated by installing a cure-in-place pipe (CIPP) liner system. Project costs were based on Technical Memorandum (TM) No. 3 Reverse Osmosis WTP No. 3 Capacity Evaluation (Carollo 2017). A planning level contingency of 30 percent was included for this cost estimate.

7.3.2.6 2032-400-004: Deep Well No. 6 Replacement

Deep Well No. 6 is anticipated to reach the end of its useful life in by 2024 and require full well replacement. The Deep Well No. 6 replacement includes siting and drilling a new well on the existing site, installation of a new well pump, well house, and upgrades to electrical, instrumentation, and controls. Cost estimates are based on the costs for Deep Well No. 5 design and construction and include a 15 percent contingency.

7.3.2.7 2027-400-004: Deep Well No. 3 Replacement

Deep Well No. 3 is anticipated to reach the end of its useful life by 2034 and will require full well replacement. The Deep Well No. 3 replacement includes siting and drilling a new well on the existing site, installation of a new well pump, well house, and upgrades to electrical, instrumentation, and controls. Due to the importance of Well 3, Staff have moved up the well reconstruction to reduce the risk of failure, with design occurring in 2027 and construction occurring in 2028. Cost estimates are based on the costs for Deep Well No. 5 design and construction and include a 15 percent contingency.

7.3.2.8 2030-400-002: Deep Well No. 4 Replacement

Deep Well No. 4 is anticipated to reach the end of its useful life in by 2034 and require full well replacement. The Deep Well No. 4 replacement includes siting and drilling a new well on the existing site, installation of a new well pump, well house, and upgrades to electrical, instrumentation, and controls. Cost estimates are based on the costs for Deep Well No. 5 design and construction and include a 15 percent contingency.

7.3.2.9 WSP1705: Deep Well 5 Replacement

Deep Well No. 5 failed in 2008 and requires full well replacement. The Deep Well No. 5 replacement costs includes siting and drilling anew well, installation of a new well pump, well house, and upgrades to electrical, instrumentation, and controls. Replacement well design is in progress and not included in project costs. Project cost estimates are based on the Engineers Opinion of Probable Cost that include a 15 percent contingency.

7.3.2.10 Supply and Storage Regular R&R Projects

Regular Supply and Storage R&R Projects are presented in Table 7.4. These projects address regular maintenance projects that are funded through the CIP, rather than the operating budget. Regular maintenance costs were estimated by MPW and address items identified in the Chapter 4 Condition Assessment. The remaining maintenance items from Chapter 4 not addressed by these projects are summarized in Section 7.3.3.

7.3.3 O&M Projects

Chapter 4 identified O&M projects based on the existing condition of facilities. The vast majority of these projects were small (<$10,000) and are anticipated to be completed using MPW's operating funds, not CIP funds. To provide a comprehensive accounting of project costs identified in the CIP, these operating budget projects are summarized in Table 7.5. Timing of projects are based on anticipated remaining useful life of infrastructure.

Table 7.4 Supply and Storage Regular R&R Projects

Project Number	Project Name	Total CIP Cost (2017$)	Funding Type	Timing
2018-2000-001	300HP Deep Well Motor Purchase	$28,000	RR	2019 to 2019
2018-800-005	ASR #1 VFD Upgrade	$15,000	RR	2019 to 2019
2018-800-008	WTP #2 Elevated Tank Maintenance	$249,000	RR	2019 to 2019
2018-800-009	Groundwater Monitoring Equipment - Deep Well & ASR Improvements	$20,000	RR	2019 to 2019
2018-800-010	Deep Well Motor Enclosure	$249,000	RR	2019 to 2019
2019-800-014	Ground Storage Tank Rehab	$25,000	RR	2019 to 2020
2019-800-015	Booster Pump Station Rehab	$20,000	RR	2019 to 2020
2019-800-016	Deep Well Rehab	$25,000	RR	2019 to 2019
2019-800-017	Existing ASR Well Evaluation	$10,000	RR	2019 to 2019
2020-900-029	Aquifer Storage and Recovery Automation	$100,000	RR	2020 to 2020
2021-800-003	Ground Storage Tank Rehab (FY21-49)	$100,000	RR	2021 to 2028
2021-800-004	Booster Pump Station Rehab (FY21-49)	$80,000	RR	2021 to 2028
2021-800-005	Deep Well Rehab (FY21-49)	$70,000	RR	2021 to 2028
2022-800-001	Existing ASR Well Evaluation (FY22-49)	$20,000	RR	2022 to 2025
2023-400-004	Deep Well Assessment	$987,000	RR	2023 to 2024
WTR1803	Deep Well #6 Electrical Upgrade	$95,000	RR	2019 to 2019

Notes:
(1) VFD: Variable Frequency Drive.

Table 7.5 Recommended Operating Budget Projects Summary

Location	0-2 Years		2-5 Years		5-10 Years	
	Number of Projects	Estimated Project Cost ($)	Number of Projects	Estimated Project Cost ($)	Number of Projects	Estimated Project Cost ($)
Charleston Water System Supply	3	$770,000	0	$0	0	$0
Wando Park Associated Facilities	10	$18,500	4	$13,000	1	$500
Highway 41 Associated Facilities	3	$61,000	3	$12,000	0	$0
Total[1]	16	$849,500	7	$25,000	1	$500

Notes:
(1) Project to be completed using operating funds, not the CIP.

7.4 Water Treatment CIP

When compared to MPW's 2015 Comprehensive Utility Master Plan, this WSMP relies more heavily on MPW's RO WTPs to increase production water through 2030, thereby offsetting purchases from CWS. To aid in meeting peak summer demands, RO WTP 3 and RO WTP 4 capacity will be expanded. To maintain reliability, the RO WTP plants will require regular R&R. The resulting E&E and R&R CIP projects needed to maintain and expand capacity are presented below. In addition to the CIP projects, O&M projects recommended as part of the Condition Assessment documented in Chapter 4 are summarized to provide a comprehensive cost summary.

7.4.1 E&E Projects

Major Water Treatment E&E projects are summarized in Table 7.6. Project timing is presented along with estimated costs. Project timing considers financial resources, staff resources, and technical considerations. Details on major projects are provided below.

7.4.1.1 2034-400-004 RO 4 Expansion

Expansion of the existing RO Treatment Plant 4 will increase plant nameplate capacity from an existing capacity from 1.15 mgd to 2.43 mgd. These flowrates are based on blending RO permeate and raw groundwater up to a fluoride concentration of 1.2 milligrams per liter (mg/L). A third RO train will be added to facility. The existing Deep Well No. 6 motor size will be increased from 250 horsepower (hp) to 350 hp to provide supply for the three (3) RO trains. Plant electrical modifications will also be needed to accommodate the larger deep well motor and third RO train. Cost estimates are based on TM No. 4 Reverse Osmosis WTP No. 4 Production and Distribution Capacity Evaluation (Carollo 2018). Project cost estimates include a 20 percent contingency.

7.4.1.2 2025-400-007 RO Plant 3 Expansion

RO Plant 3 expansion to increase the nameplate capacity of RO Plant 3 from a maximum capacity of 3.17 mgd to 3.93 mgd. These flowrates are based on blending RO permeate and raw groundwater up to a fluoride concentration of 1.2 milligrams per liter (mg/L). This will require changes to the existing hybrid membrane array and larger membrane feed pumps. Project cost estimates include a 20 percent contingency.

7.4.1.3 2035-400-007 RO 4 Concentrate Disposal Line

Concentrate from RO WTP No. 4 is currently transported off-site via MPW's sewer system. The available capacity in the sewers downstream of RO WTP No. 4 may not be sufficient to accommodate the additional RO concentrate that would be generated when a third RO train is added. Installing a new disposal pipeline to transport concentrate off-site is recommended. The disposal pipeline would be separate from MPW's sewer system. Installing a separate concentrate disposal line would reduce the flow entering MPW's sewer system and allow the sewer's capacity to be utilized by another user. The new pipeline would discharge the concentrate to a near-by body of water. Cost estimates are based on TM No. 4 Reverse Osmosis WTP No. 4 Production and Distribution Capacity Evaluation (Carollo 2018). Project cost estimates include a 20 percent contingency.

Table 7.6 Water Treatment E&E CIP Projects

Project Number	Project Name	Total CIP Cost (2018$)	Funding Type	Timing
2034-400-006	RO 4 Expansion	$5,514,000	EE W	Long-term
2025-400-007	RO Plant 3 Expansion	$4,436,000	EE W	2023 to 2024
2035-400-007	RO 4 Concentrate Disposal Line	$9,073,000	RR	Long-term

7.4.2 R&R Projects

Major Water Treatment R&R projects are summarized in Table 7.7 and regular R&R projects are summarized in Table 7.8. Project timing is presented along with estimated costs. Timing of R&R projects is dictated by infrastructure reaching the end of its useful life, financial resources, staff resources, and technical considerations. Major R&R projects are detailed below.

Table 7.7 Water Treatment Major R&R Projects

Project Number	Project Name	Total CIP Cost(2018$)	Funding Type	Timing
2017-400-010	Asset Management - Water Treatment (FY21-49)	$1,025,000	RR	2022 to 2028
2021-800-002	Membrane Replacement (FY21-49)	$2,520,000	RR	2021 to 2025; Long-term

7.4.2.1 2017-400-010 Asset Management - Water Treatment (FY21-49)

Asset management program was established to address infrastructure as it reaches the end of its useful life. MPW staff prioritize projects each biennium based on best available information. These projects are incorporated into the budget as regular R&R projects, where the 2018-2019 projects are presented in Section 7.4.2.3.

7.4.2.2 2021-800-002 Membrane Replacement (FY21-49)

Regular costs associated with membrane element replace at each of MPW's RO WTP's. Membrane elements are assumed to be replaced every 10 years at each plant. Costs for membrane replacement were developed as part of preliminary design for RO WTP expansion and include a 20 percent contingency. A 10 percent engineering cost factor was used for this project to account for material selection costs when replacing membranes.

7.4.2.3 Water Treatment Regular R&R Projects

Regular Water Treatment R&R Projects are presented in Table 7.8. These projects address regular maintenance projects that are funded through the CIP, rather than the operating budget. Regular maintenance costs were estimated by MPW and address items identified in the Chapter 4 Condition Assessment. The remaining maintenance items from Chapter 4 not addressed by these projects are summarized in Section 7.4.3.

Table 7.8 Water Treatment Regular R&R Projects

Project Number	Project Name	Total CIP Cost (2017$)	Funding Type	Timing
2017-800-001	Replacement NH3 scales at WTP 1-4	$30,000	RR	2019 to 2019
2017-800-002	WTP #1-4 CIP Improvements	$25,000	RR	2019 to 2019
2018-800-006	Ground Storage Tanks - Chemical Feed Improvements	$75,000	RR	2019 to 2019
2018-800-007	WTP 1-4 Pipe Improvement Project	$15,000	RR	2019 to 2019
2019-800-012	RO Plant Interior/Exterior Rehab	$50,000	RR	2019 to 2020
2021-800-001	RO Plant Interior/Exterior Maintenance (FY21-49)	$150,000	RR	2021 to 2026
2019-800-013	Membrane Replacement(2)	$546,000	RR	2019 to 2019
2019-900-023	RO Train Conductivity Transmitter Replacement	$34,000	RR	2019 to 2019
2019-900-024	Water Electrical Equipment Arc Flash Compliance	$329,000	RR	2019 to 2019
2019-900-026	Water VFD Replacement	$196,000	RR	2019 to 2019
2020-900-030	CAT5 to Fiber Optic Cable conversion at High Service Pump Stations	$20,000	RR	2020 to 2020
WTR1802	Disinfection Improvements at RO Plants(1)	$713,000	RR	2019 to 2019

Notes:
(1) Project partially funded in 2018. Project awarded for $2,344,000.
(2) Cost estimate based on replacement of membranes at RO WTP 2 and 3. Cost estimates based on preliminary designs and include a 20 percent contingency and a 10 percent engineering cost factor for selection of membranes.

7.4.3 O&M Projects

Chapter 4 identified O&M projects based on the existing condition of facilities. The vast majority of these projects were small (<$10,000) and are anticipated to be completed using MPW's operating funds, not the Capital Improvement Plan. To provide a comprehensive accounting of project costs identified in the WSMP, these operating budget projects are summarized in Table 7.9. Timing of projects are based on anticipated remaining useful life of infrastructure.

Table 7.9 Recommended O&M Project Summary

Location	0-2 Years		2-5 Years		5-10 Years	
	Number of Projects	Estimated Project Cost ($)	Number of Projects	Estimated Project Cost ($)	Number of Projects	Estimated Project Cost ($)
RO WTP No. 1 Associated Facilities	12	$56,800	6	$19,250	7	$269,000
RO WTP No. 2 Associated Facilities	10	$67,300	12	$229,750	5	$106,500
RO WTP No. 3 Associated Facilities	23	$360,400	17	$792,700	7	$199,500
RO WTP No. 4 Associated Facilities	9	$41,200	10	$65,000	3	$16,500
Total(1)	42	$468,900	39	$1,087,450	15	$322,500

Notes:
(1) Project to be completed using operating funds, not the CIP.

7.5 CIP Summary

MPW's complete CIP is presented in Table 7.10. Projects are listed in individual years for 2019 through 2028. Projects after 2028 are not scheduled to individual years; therefore, they are shown as a single combined long-term total. As previously discussed, all costs are in current (October 2017) dollars. The 10-year CIP cost for Supply & Storage projects is $38,760,000 and Water Treatment CIP cost is $7,938,000. The total 10-year CIP cost is $46,698,000 or $4.67 million per year. Long-term Supply & Storage project costs are $37,097,000 and Water Treatment long-term costs are $16,813,000 for a total long-term CIP cost of $53,910,000 or $2.57 million per year.

Table 7.10 MPW CIP Summary

Project		Total CIP Cost Estimate	CIP Phasing												Fund	Project Type	
			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	10-year (2019-2028)	Long term (2029-2049)		I&E	R&R
Supply & Storage		**$75,857,000**	**$5,914,000**	**$7,743,000**	**$8,699,000**	**$1,381,000**	**$1,894,000**	**$1,784,000**	**$4,417,000**	**$770,000**	**$1,402,000**	**$4,756,000**	**$38,760,000**	**$37,097,000**			
2017-400-008	Asset Management - Supply and Storage (FY21-49)	$2,165,000	--	--	$273,000	$272,000	$272,000	$271,000	$270,000	$270,000	$269,000	$268,000	$2,165,000	--	RR	0%	100%
2017-400-028	CWS Annual Capital Outlay (FY21-49)	$5,650,000	--	--	$1,042,000	$1,089,000	$1,068,000	$493,000	$491,000	$490,000	$489,000	$488,000	$5,650,000	--	RR	0%	100%
2018-2000-001	300HP Deep Well Motor Purchase	$28,000	$28,000	--	--	--	--	--	--	--	--	--	$28,000	--	RR	0%	100%
2018-800-005	ASR #1 VFD Upgrade	$15,000	$15,000	--	--	--	--	--	--	--	--	--	$15,000	--	RR	0%	100%
2018-800-008	WTP #2 Elevated Tank Maintenance	$249,000	$249,000	--	--	--	--	--	--	--	--	--	$249,000	--	RR	0%	100%
2018-800-009	Groundwater Monitoring Equipment - Deep Well & ASR Improvements	$20,000	$20,000	--	--	--	--	--	--	--	--	--	$20,000	--	RR	0%	100%
2018-800-010	Deep Well Motor Enclosure	$249,000	$249,000	--	--	--	--	--	--	--	--	--	$	--	RR	0%	100%
2019-400-025	Replacement of Deep Well 2	$4,579,000	$599,000	$3,980,000	--	--	--	--	--	--	--	--	$4,579,000	--	2017A	0%	100%
2029-400-026	Deep Well 4 AC Pipeline Replacement	$3,730,000	--	--	--	--	--	--	--	--	--	--	--	$3,730,000	RR	0%	100%
2019-400-030	CWS Annual Capital Outlay (FY19-20)	$1,793,000	$848,000	$945,000	--	--	--	--	--	--	--	--	$1,793,000	--	RR	0%	100%
2019-800-014	Ground Storage Tank Rehab	$25,000	$20,000	$5,000	--	--	--	--	--	--	--	--	$25,000	--	RR	0%	100%
2019-800-015	Booster Pump Station Rehab	$20,000	$15,000	$5,000	--	--	--	--	--	--	--	--	$20,000	--	RR	0%	100%
2019-800-016	Deep Well Rehab	$25,000	$25,000	--	--	--	--	--	--	--	--	--	$25,000	--	RR	0%	100%
2019-800-017	Existing ASR Well Evaluation	$10,000	$10,000	--	--	--	--	--	--	--	--	--	$10,000	--	RR	0%	100%
2020-400-009	ASR Well No. 5	$4,128,000	--	--	--	--	--	$517,000	$3,611,000	--	--	--	$4,128,000	--	EE W	100%	0%
2020-900-029	Aquifer Storage and Recovery Automation	$100,000	--	$100,000	--	--	--	--	--	--	--	--	$100,000	--	RR	0%	100%
2021-800-003	Ground Storage Tank Rehab (FY21-49)	$100,000	--	--	$20,000	$5,000	$20,000	$5,000	$20,000	$5,000	$20,000	$5,000	$100,000	--	RR	0%	100%
2021-800-004	Booster Pump Station Rehab (FY21-49)	$80,000	--	--	$15,000	$5,000	$15,000	$5,000	$15,000	$5,000	$15,000	$5,000	$80,000	--	RR	0%	100%
2021-800-005	Deep Well Rehab (FY21-49)	$70,000	--	--	$25,000	--	$25,000	--	--	--	$10,000	$10,000	$70,000	--	RR	0%	100%
2022-800-001	Existing ASR Well Evaluation (FY22-49)	$20,000	--	--	--	$10,000	--	--	$10,000	--	--	--	$20,000	--	RR	0%	100%
2036-400-003	CWS Capacity Purchases - ADD	$15,352,000	--	--	--	--	--	--	--	--	--	--	--	$15,352,000	EE W	100%	0%
2036-400-003.1	CWS Capacity Purchases - MDD	$8,857,000	--	--	--	--	--	--	--	--	--	--	--	$8,857,000	EE W	100%	0%
2023-400-004	Deep Well Assessment	$987,000	--	--	--	--	$494,000	$493,000	--	--	--	--	$987,000	--	RR	0%	100%
2032-400-004	Deep Well No. 6 Replacement	$4,579,000	--	--	--	--	--	--	--	--	--	--	--	$4,579,000	RR	0%	100%
2027-400-004	Deep Well No. 3 Replacement	$4,579,000	--	--	--	--	--	--	--	--	$599,000	$3,980,000	$4,579,000	--	RR	0%	100%
2030-400-002	Deep Well No. 4 Replacement	$4,579,000	--	--	--	--	--	--	--	--	--	--	--	$4,579,000	RR	0%	100%
WSP1705	Deep Well 5 Replacement	$4,152,000	--	--	$4,152,000	--	--	--	--	--	--	--	$4,152,000	--	RR	0%	100%
WSP1709	CWS Sullivan Island Connection	$5,880,000	--	$2,708,000	$3,172,000	--	--	--	--	--	--	--	$5,880,000	--	2017A	100%	0%

Table 7.10 MPW CIP Summary (continued)

Project		Total CIP Cost Estimate	CIP Phasing												Fund	Project Type	
			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	10-year (2019-2028)	Long-term (2029-2049)		E&E	R&R
WSP1802	ASR Well No. 4	$3,741,000	$3,741,000	--	--	--	--	--	--	--	--	--	$3,741,000	--	EEW	0%	100%
WTR1803	Deep Well #6 Electrical Upgrade	$95,000	$95,000	--	--	--	--	--	--	--	--	--	$95,000	--	RR	0%	100%
Treatment		**$24,751,000**	**$1,988,000**	**$45,000**	**$25,000**	**$223,000**	**$1,800,000**	**$3,197,000**	**$25,000**	**$270,000**	**$183,000**	**$182,000**	**$7,938,000**	**$16,813,000**			
2017-400-010	Asset Management - Water Treatment (FY21-49)	$1,025,000	--	--	--	$198,000	--	$217,000	--	$245,000	$183,000	$182,000	$1,025,000	--	RR	0%	100%
2017-800-001	Replacement NH3 scales at WTP 1-4	$30,000	$30,000	--	--	--	--	--	--	--	--	--	$30,000	--	RR	0%	100%
2017-800-002	WTP #1-4 CIP Improvements	$25,000	$25,000	--	--	--	--	--	--	--	--	--	$25,000	--	RR	0%	100%
2018-800-006	Ground Storage Tanks - Chemical Feed Improvements	$75,000	$75,000	--	--	--	--	--	--	--	--	--	$75,000	--	RR	0%	100%
2018-800-007	WTP 1-4 Pipe Improvement Project	$15,000	$15,000	--	--	--	--	--	--	--	--	--	$15,000	--	RR	0%	100%
2019-800-012	RO Plant Interior/Exterior Rehab	$50,000	$25,000	$25,000	--	--	--	--	--	--	--	--	$50,000	--	RR	0%	100%
2019-800-013	Membrane Replacement	$546,000	$546,000	--	--	--	--	--	--	--	--	--	$546,000	--	RR	0%	100%
2019-900-023	RO Train Conductivity Transmitter Replacement	$34,000	$34,000	--	--	--	--	--	--	--	--	--	$34,000	--	RR	0%	100%
2019-900-024	Water Electrical Equipment Arc Flash Compliance	$329,000	$329,000	--	--	--	--	--	--	--	--	--	$329,000	--	RR	0%	100%
2019-900-026	Water VFD Replacement	$196,000	$196,000	--	--	--	--	--	--	--	--	--	$196,000	--	RR	0%	100%
2020-900-030	CAT5 to Fiber Optic Cable conversion at High Service Pump Stations	$20,000	--	$20,000	--	--	--	--	--	--	--	--	$20,000	--	RR	0%	100%
2021-800-001	RO Plant Interior/Exterior Maintenance (FY21-49)	$150,000	--	--	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	--	--	$150,000	--	RR	0%	100%
2021-800-002	Membrane Replacement (FY21-49)	$2,520,000	--	--	--	--	$294,000	--	--	--	--	--	$294,000	$2,226,000	RR	0%	100%
2034-400-006	RO 4 Expansion	$5,514,000	--	--	--	--	--	--	--	--	--	--	--	$5,514,000	EEW	100%	0%
2025-400-007	RO Plant 3 Expansion	$4,436,000	--	--	--	--	$1,481,000	$2,955,000	--	--	--	--	$4,436,000	--	EEW	100%	0%
2035-400-007	RO 4 Concentrate Disposal Line	$9,073,000	--	--	--	--	--	--	--	--	--	--	--	$9,073,000	RR	0%	100%
WTR1802	Disinfection Improvements at RO Plants	$713,000	$713,000	--	--	--	--	--	--	--	--	--	$713,000	--	RR	0%	100%
CIP Total			**$7,902,000**	**$7,788,000**	**$8,724,000**	**$1,604,000**	**$3,694,000**	**$4,981,000**	**$4,442,000**	**$1,040,000**	**$1,585,000**	**$4,938,000**	**$46,698,000**	**$53,910,000**	--	**$44,167,000**	**$56,451,000**
Annual Cost	--		**$7,902,000**	**$7,788,000**	**$8,724,000**	**$1,604,000**	**$3,694,000**	**$4,981,000**	**$4,442,000**	**$1,040,000**	**$1,585,000**	**$4,938,000**	**$4,670,000**	**$2,567,000**	--	**$1,425,000**	**$1,821,000**

Mount Pleasant Waterworks

WATER SUPPLY MASTER PLAN

FINAL | July 2018

MOUNT PLEASANT WATERWORKS
WATER SUPPLY MASTER PLAN

FINAL | July 2018

SOUTH CAROLINA
CAROLLO ENGINEERS,INC
No. 2285
CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 22426
THOMAS F. SEACORD

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Abbreviations

AACE	American Academy of Cost Engineers
AC	Asbestos Cement
ADD	Average Day Demand
ASR	Aquifer Storage and Recovery
bls	below land surface
Carollo	Carollo Engineers, Inc.
CIP	Capital Improvement Plan
CIPP	Cure-In-Place Pipe
CPW	Charleston Public Works
CUMP	Comprehensive Utility Master Plan
CWS	Charleston Water Supply
DIP	Ductile Iron Pipe
E&E	Extension and Expansion
ENR	Engineering New Report
gpd/REU	gallons per day per REU
gpm	gallons per minute
HDD	horizontal directional drilling
hp	horsepower
MDD	Maximum Day Demand
MG	Million Gallons
mgd	million gallons per day
mg/L	milligrams per liter
MinDD	Minimum Day Demand
MinMD	Minimum Month Demand
MPW	Mount Pleasant Waterworks
O&M	Operations and Maintenance
POD	Points of Delivery
REU	Residential Equivalency Unit
RO	Reverse Osmosis
R&R	Renewal and Replacement
TDH	Total Dynamic Head
TM	Technical Memorandum
UPS	Uninterruptible Power Supply
USGS	United States Geological Survey
VFD	Variable Frequency Drive
WSMP	Water Supply Master Plan
WTP	Water Treatment Plants

EXECUTIVE SUMMARY

Purpose

The purpose of the 2018 Mount Pleasant Waterworks (MPW) Water Supply Master Plan (WSMP) is to develop a water supply strategy that considers reliability and resiliency. The strategy identifies water supply opportunities for obtaining additional and adequate water supplies for the planning period. These opportunities can be developed into the future using a combination of factors including operational flexibility, cost effectiveness, and long-term reliability and redundancy. The WSMP is a supplement to the 2015 Comprehensive Utility Master Plan (CUMP) (CDM Smith 2015).

Water supply "reliability" refers to the ability of the water supply system to consistently meet production needs (i.e., demands) under a variety of conditions that involve loss of supply sources and/or infrastructure. To provide water supply reliability and protect against loss of infrastructure a combination of approaches were considered:

1. Maintenance Best Practices
2. Redundant Equipment
3. Supply Diversification
4. Excess Supply Capacity

An evaluation of maintenance best practices and equipment redundancy is presented in Chapter 4, and an evaluation of supply diversification and excess supply capacity is presented in Chapter 5.

Demand Projections

Demand projections are based upon best estimates of customer growth and water use. The 2015 CUMP developed future water demand projections for the near-term, mid-term, and buildout planning periods. The WSMP uses these demand projections to evaluate future supply needs. MPW was projected to grow considerably:

- Annual water use is anticipated to double from 2014 to 2049.
- Future Maximum Day Demand (MDD) is anticipated to be 60 percent higher than average annual water use.

MDDs are typically driven by irrigation and other outdoor water uses. MPW's supplies must be able to meet the future MDDs, requiring extensive supply infrastructure.

Existing Supplies

MPW receives water supply from groundwater wells and treated surface water from the Charleston Water System (CWS), as shown in Figure ES.1. MPW groundwater is supplied from six (6) deep wells from the Middendorf Aquifer that are treated at four (4) reverse osmosis (RO) water treatment plants (WTPs). Additionally, MPW operates three (3) aquifer storage and recovery (ASR) wells that store water during the winter and recover water during the summer to meet peak demands.

Existing Supply Reliability

A condition assessment to evaluate the reliability of MPW's existing water supplies was performed. The assessment included an on-site inspection of the major components of MPW's water supply system, including: deep wells, storage tanks, pump stations, and water treatment plants. Following the evaluation, each component was scored in four categories: condition, capacity, performance, and reliability and redundancy. MPW's supply infrastructure is generally well maintained with adequate capacity and acceptable performance, with the exception of RO WTPs No. 2, No. 3, and No. 4. Reliability and redundancy was the most common category found to require improvement. The WSMP summarizes the priority and cost of various condition and reliability improvements projects that were identified for MPW's water supply facilities.

Future Supplies

CWS can provide sufficient future supplies as demonstrated in the 2015 CUMP. However, as MPW's reliance on CWS increases, there is a corresponding decrease in MPW's supply diversification. Consequently, this would increase the severity of a loss of service. In particular, the loss of CWS Point of Delivery No. 1 (Daniel Island) would have great impacts because it is anticipated to supply a large portion of MPW's future supply. Therefore, to meet MPW's water supply reliability goal, multiple cost-effective and reliable future supply options were considered:

- CWS,
- Deep Wells/RO WTPs, and
- ASR.

Water supplies are evaluated against future supply needs during (1) annual demands; and (2) the MDD.

Annual Supply Strategy

Future annual supply will continue to be from CWS and the deep wells/RO WTPs, where ASR is available to meet summer demands. To determine the quantity and timing of these supplies, two supply options were considered:

- Option 1 - Buy CWS Later/Increase Deep Well Withdrawals
- Option 2 - Buy CWS Now/Delay Increase in Deep Well Withdrawals

Option 1 – Buy CWS Later/Increase Deep Well Withdrawals is recommended as the preferred annual supply strategy to provide reliability, operational flexibility, and cost-effectiveness. In the next ten (10) years, the major projects for the strategy include:

- Increased use of Deep Wells.
- Expanding RO WTPs No. 3 and No. 4.
- Replacement of Deep Wells 2, 3, 4, and 5.
- Membrane Element Replacement at Plants 1 and 2. Membrane replacement at Plants 3 and 4 are included with the plant expansion projects.

- Develop an ASR Well in the Northern portion of MPW's transmission system. A second Northern ASR Well has been delayed beyond 10-years to collect information needed to optimize ASR system operations and complete related distribution system improvements.
- Construct CWS Delivery Point No. 3 (Sullivan's Island) to improve reliability of the CWS supplies.

This annual supply strategy was used as a basis to determine additional supplies needed to meet the MDDs.

MDD Supply Strategy

Meeting future MDD requires additional supply beyond the annual supply strategy.
No additional projects are required beyond the Annual Supply Strategy Option 1 within the next 10-years to meet the MDD. The MDD supply strategy for after this period was left open-ended to allow MPW to take advantage of cost-effective opportunities that arise in the intervening period. Therefore, MPW may implement a single or combination of the following supplies long-term:

- Purchase additional CWS Baseload from the existing Points of Delivery beyond the Annual Supply Strategy;
- Purchase up to 2.25 million gallons per day (mgd) CWS Wholesale from Sullivan's Island Point of Delivery;
- Construct a total of five (5) ASR Wells; three (3) additional ASR Wells beyond the two (2) currently planned; and
- Develop additional deep wells and related RO WTP capacity.

To increase CWS reliability, it is recommended the MPW participate in projects that can increase the reliability of CWS transmission to MPW's points of delivery.

Capital Improvement Plan

MPW's Capital Improvement Plan (CIP) is separated into multiple asset classes. The WSMP updates the three (3) water infrastructure classes:

- Supply and Storage: CWS, wells, raw water transmission mains, storage, and associated booster pump stations.
- Water Treatment: RO WTPs and associated concentrate disposal infrastructure.
- Distribution: Distribution system piping.

The CIP cost estimates presented in this executive summary are budget level estimates, defined by American Academy of Cost Engineers (AACE) Class 4 estimates. Actual costs may vary from these estimates by -30 percent to +50 percent. These costs were determined based on MPW's and Carollo's perception of current conditions at the project locations. All costs are in October 2017 dollars.

Project timing was developed by MPW Staff from the technical analyses considering financial and staff resources. Projects are listed in individual years for 2019 through 2028. Projects after 2028 are not scheduled to individual years; therefore, they are shown as a single combined long-term total.

The total 10-year CIP cost is $46,698,000 or $4.67 million per year, including:

- Supply & Storage 10-year CIP of $38,760,000 and
- Water Treatment 10-year CIP of $7,938,000.

Total long-term CIP cost of $53,910,000 or $2.57 million per year, including:

- Supply & Storage long-term CIP of $37,097,000 and
- Water Treatment long-term CIP of $16,813,000.

No additional distribution costs were identified; however, project timing was adjusted to align with supply and storage CIP projects.

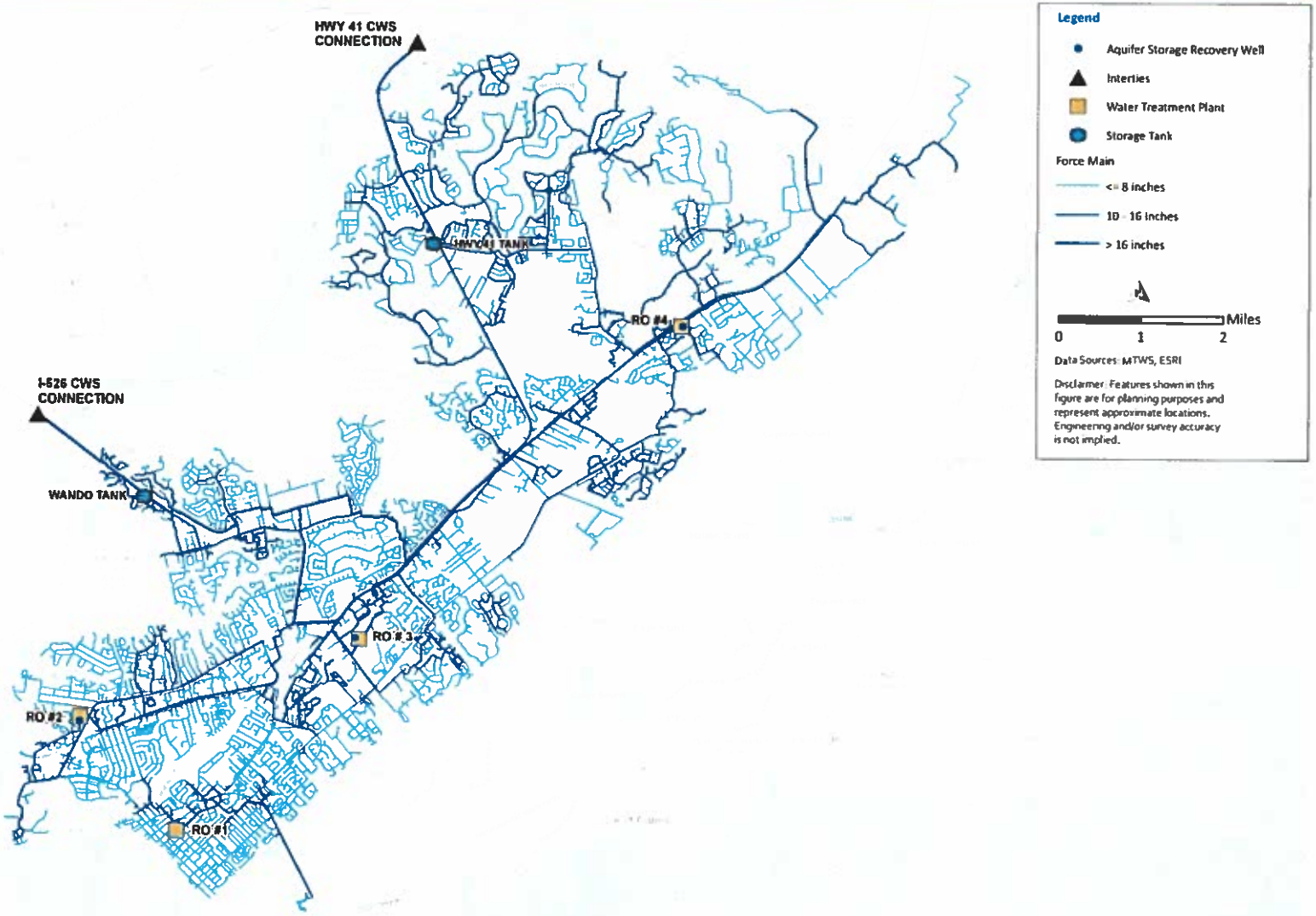

Figure ES.1 Water Supply Map

Chapter 1

INTRODUCTION

1.1 Purpose

The purpose of the 2018 Mount Pleasant Waterworks (MPW) Water Supply Master Plan (WSMP) is to develop a water supply strategy that considers reliability and resiliency. The strategy identifies water supply opportunities associated with obtaining additional supplies and overall adequate water supply for the planning period. These opportunities will be developed using a combination of factors including operational flexibility, cost effectiveness, and long-term reliability and redundancy. The WSMP is a supplement to the 2015 Comprehensive Utility Master Plan (CUMP) (CDM Smith 2015).

1.2 Background

MPW provides water to over 85,000 people within the Town of Mount Pleasant and other unincorporated areas of Charleston County. Groundwater wells have been used as a water supply source since MPW began operating in 1935. Today's wells are in deep aquifers and require advanced treatment (reverse osmosis) to remove salinity. MPW also purchases treated wholesale water from the City of Charleston's water system (CWS). MPW operates three Aquifer Storage and Recovery (ASR) wells that store excess supply during the winter and withdraw the stored water during the summer.

The 2015 CUMP identified wholesale water from CWS as the preferred source of future supplies. Supplies are anticipated to be purchased in blocks as demand increases. This Water Supply Master Plan considers alternatives to reduce or delay the purchase of CWS supplies, including reuse and conservation, seawater desalination, increased capacity from the existing system, and expanding ASR. To aid in the evaluation of supply alternatives, the WSMP includes detailed evaluation of seasonal demand, supply reliability, and supply resiliency.

1.3 Planning Period

The WSMP evaluates future water use from 2017 through 2049 using demand projections from the 2015 CUMP. The last full calendar year of data available during the WSMP evaluation was from 2016, and is used as the existing condition.

To support the Capital Improvement Program, analyses used three planning horizons:

- Short-term (0 to 4 years) from 2017 through 2020.
- Mid-term (5 to 10 years) from 2021 through 2026.
- Long-term (11 to 22 years) from 2027 through 2049.

The Water Supply Strategy establishes supply deficiencies and improvements for each planning horizon. Further, hydraulic modeling is used to evaluate the distribution system capacity for the short-term and mid-term planning horizons. The CUMP long-term distribution system analyses were considered adequate for this far planning horizon; therefore, additional hydraulic modeling was not conducted.

1.4 Chapter Review

Chapter 1 – Introduction documents the purpose of the WSMP and provides system background.

Chapter 2 – Existing Water System summarizes and characterizes water sources and related infrastructure.

Chapter 3 – Water Demand and Production projects seasonal water demands through 2049 using the 2015 CUMP projections and establishes daily diurnal patterns for each season.

Chapter 4 – Existing Water Supply Reliability Assessment considers supply reliability based on South Carolina State Primary Drinking Water Regulations and MPW level of service goals.

Chapter 5 – Future Water Supply Alternatives analyzes future water supply alternatives to provide resiliency and reduce or delay future supply improvements.

Chapter 6 – Water System Analysis evaluates future water supply alternatives through hydraulic modeling.

Chapter 7 – Recommended Capital Improvement Plan documents the water supply strategy, including conceptual project costs, timing, and permitting.

Chapter 2

EXISTING WATER SYSTEM

2.1 Introduction

The purpose of the 2018 Mount Pleasant Waterworks (MPW) Water Supply Master Plan (WSMP) is to develop a water supply strategy that considers reliability, resiliency, and increases expected in future water demand. This requires an understanding of the existing water system. The purpose of this chapter is to document existing water supply sources, and associated infrastructure in order to provide an overview of resource utilization and treatment capacities. Doing so will facilitate the identification of existing water supply system liabilities, and will allow different alternatives to be evaluated against the existing system.

2.2 Previous Water System Master Plans

Recent Comprehensive Utility Master Plans (CUMPs) document the City's overall system and identifies system deficiencies and improvements to supply customers until build-out (2049). The two most recent CUMPs include:

1. 2010 CUMP[1] - consolidated the planning efforts for water source and treatment, water distribution and transmission, wastewater treatment, wastewater collection, and reuse/reclaimed water.
2. 2015 CUMP[2] - provided a five-year update to the 2010 Master Plan including an updated short- and long-term (5-year, 10-year, and buildout) coordinated capital improvement plan.

2.3 Existing Water Supply Sources

MPW receives water supply from groundwater wells and treated surface water from the Charleston Water System. MPW groundwater is supplied from six (6) deep wells from the Middendorf Aquifer that are treated at four (4) reverse osmosis (RO) water treatment plants (WTPs). Additionally, MPW operates three (3) aquifer storage and recovery (ASR) wells that store water during the winter and recover water during the summer to meet peak demands.

[1] CDM. Mount Pleasant Waterworks Comprehensive Utility Master Plan Report. 2010.
[2] CDM Smith. Mount Pleasant Waterworks Comprehensive Utility Master Plan Five Year Update. 2015.

2.3.1 Deep Well Supply

The Middendorf Aquifer wells are located approximately 1,500 to 2,000 feet below land surface (bls), and are referred to as the deep wells. Currently, MPW operates five (5) deep wells that yield in total 6,200 gallons per minute (gpm) (8.9 million gallons per day [mgd]). A sixth deep well (DW#5) has failed and a replacement well is under design and expected to be constructed in 2018. The addition of a sixth well is expected to increase this capacity to over 7,200 gpm (10.4 mgd), however, the deep wells are not continuously operated and they are not always operated at their maximum capacity. Table 2.1 provides a detailed summary of the well construction, pump details, pump test results, and typical operating conditions.

MPW and the United States Geological Survey (USGS) collaborated on a 2007 study to predict future groundwater elevations in the Middendorf Aquifer for various groundwater pumping scenarios[3, 4]. Based upon this work, an annual average groundwater yield of 6.65 mgd was predicted to result in a minimum groundwater elevation of -356 ft (NGVD 29) in the year 2030 for the Mount Pleasant area. Extracting groundwater from lower elevations is feasible and commonly practiced, but requires additional energy to pump the water to the surface. A groundwater yield of 6.65 mgd does not directly match MPW's current operating practices, however, the USGS is currently updating the study, and revisions are anticipated to be completed in early 2018.

Raw water from the deep wells is treated at four (4) RO plants operated by MPW that are described in the next section.

2.3.2 Reverse Osmosis Treatment Plants

Groundwater from the Middendorf Aquifer is brackish and RO membranes at MPW's four (4) RO WTPs, remove the dissolved salts from the water. The RO WTPs recover approximately 80 percent of the raw water supplied to the RO membranes as finished water. The WTPs operated by MPW vary in size, and the finished water flow produced from each plant currently ranges between 800 – 1,760 gpm. Presently, the four (4) RO WTPs can produce a combined total of 4,700 gpm of finished water. Plant modifications to facilitate the blending of raw groundwater with RO membrane permeate are expected to be completed by 2018. These modifications will increase the finished water flows to a maximum of 5,600 gpm. Studies from 2017 found that expanding WTP No. 3 and No. 4 would further increase the maximum finished water flow to 6,900 gpm[5,6]. Currently, the finished water is disinfected using calcium hypochlorite. A capital improvement project to replace the calcium hypochlorite system with a sodium hypochlorite system is expected to be complete by 2019. Disinfected water from the RO WTPs is stored in ground storage tanks until high service pumps introduce the water to the distribution system. Table 2.2 provides a detailed summary of the RO WTPs capacities, equipment, and typical operating conditions.

Pump curves for the RO WTPs' membrane feed pumps are included in Appendix A.

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[3] Mount Pleasant Waterworks 2010 Comprehensive Utility Master Plan, CDM-Smith, April 2010.
[4] USGS. 2007. Hydrogeology and Simulation of Ground-Water Flow near Mount Pleasant, South Carolina – Predevelopment, 2004, and Predicted Scenarios for 2030. USGS SIR 2007-5126.
[5] Carollo Engineers, Inc. RO WTP No. 3 Capacity Evaluation, April 2017.
[6] Carollo Engineers, Inc. RO WTP No. 4 Production and Distribution Capacity Evaluation, 2017 (Draft).

2.3.3 Charleston Water System

Charleston Water System (CWS) supplies treated water from the Hanahan Water Treatment Plant at two feeds located along the northern boundary of MPW's service area, as shown in Figure 2.1. MPW receives the CWS supplies at a fixed rate of 3.0 mgd from CWS Feed No. 1 at Daniel Island/Wando Park (I-526 CWS Connection) and 2.5 mgd from CWS Feed No. 2 at Highway 41 (HWY 41 CWS Connection). MPW and CWS are developing a third point of connection and emergency feed via a horizontal directional drilling (HDD) main from a CWS Main on Sullivan's Island.

Under the agreement with CWS, MPW may purchase additional withdrawals in increments of 100,000 gallons up to 12 mgd as needed over the next 20 years. The agreement also allows MPW to exceed the contractual water usage up to 1.26 times the normal operating flow for a period of up to 72 hours.

Table 2.1 Deep Wells

Description	Units	Deep Well 1	2	3	4	5[2]	6
Year Installed	--	2007	1969	1971	1984	2018	1974
Surface Elevation	ft msl	25	22	4	19	15	26
Well Depth	ft bls	1918	1993	1950[1]	1960	1988	1834
Screen Placement							
Length (total)	ft	70	80	85	100	108	82
First Screen	ft bls	1820 - 1860	1800 - 1850	1575 - 1580	1754 - 1784	1774 - 1820	1709 - 1742
Second Screen	ft bls	1870 - 1880	1940 - 1960	1704 - 1736	1820 - 1840	1876 - 1912	1757 - 1771
Third Screen	ft bls	1888 - 1908	1976 - 1986	1740 - 1756	1855 - 1890	1952 - 1978	1805 - 1840
Fourth Screen	ft bls	--	--	1824 - 1848	1940 - 1955	--	--
Fifth Screen	ft bls	--	--	1854 - 1862	--	--	--
Material	--	Stainless Steel	Unknown	Stainless Steel	Stainless Steel	316L Stainless Steel	Unknown
Water Elevation							
Static	ft bls	118	102	93	118	TBD[3]	89
Pumping (flow rate)	ft bls (gpm)	220 (490)	161 (500)	247 (625)	170 (680)	TBD[3]	154 (570)
Pumping (flow rate)	ft bls (gpm)	287 (980)	199 (1000)	386 (1260)	225 (1250)	TBD[3]	211 (1150)
Pumping (flow rate)	ft bls (gpm)	--	248 (1530)	--	--	TBD[3]	--
Pump Bowl Elevation (top)	ft bls	500	500	500	500	TBD[3]	400
Surface Casing							
Depth	ft bls	81	Unknown	51	80	80	56
Diameter	inches	26	Unknown	22	24	26	20
Material	--	Steel	Unknown	Unknown	Unknown	Steel	Unknown

Table 2.1 Deep Wells (continued)

		Deep Well					
Description	Units	1	2	3	4	52	6
Intermediate Casing							
Depth	ft bls	1800	1600	1580	1720	1765	1570
Diameter	inches	18	16	16	16	20	16
Material	--	Steel	Unknown	Unknown	Unknown	316L Stainless Steel	Unknown
Production Casing							
Depth	ft bls	1918	Unknown	1870	1960	1988	
Diameter	inches	10	Unknown	8	8	12	8
Material	--	Steel	Unknown	Unknown	Unknown	316L Stainless Steel	Unknown
Motor Size	hp	300	350	250	300	300	250
Manufacturer	--	FlowServe	Goulds	FlowServe	FlowServe	TBD[3]	FlowServe
Model	--	12EHM	13CHC	14EJH	14EJH	TBD[3]	12ENL
No. of Stages	No.	11	8	7	7	TBD[3]	10
Type: Vertical Turbine							
Drive	--	VFD	VFD	VFD	VFD	VFD	VFD
Well Discharge Pressure	psig	70	60	70	70	TBD[3]	60
Emergency Power	--	Yes	Yes	Yes	Yes	No	Yes

Notes:
(1) The finished Depth of Deep Well 3 is 1950 ft bls. During construction, a test bore was drilled to a depth of 2141 ft bls.
(2) Information presented is based on the design of the Deep Well 5 replacement well. This well is currently under design and scheduled for completion in 2018.
(3) TBD = To be determined. Well performance will not be known until the well is constructed and tested.

Table 2.2 Treatment Facilities

Description	Units	Location			
		RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4
Date Constructed	--	1991	1991	1991	2003
Raw Water Source	--	Deep Well 1	Deep Well 2	Deep Well 3, 4, and 5[1]	Deep Well 6
Water Production					
Current					
Minimum	gpm	400	400	440	450
Maximum	gpm	800	1200	1760	900
Planned[2]					
Minimum[3]	gpm	412	412	453	464
Average[3]	gpm	824	1236	1813	928
Maximum[3]	gpm	1000	1500	2200	928
At Max Build-Out[4]					
Minimum	gpm			560	464
Average	gpm			2240	1392
Maximum	gpm			2728	1688
RO Trains					
No. of Trains	--	2	3	4	2
No. of Trains (at Build-Out)	--	2	3	4	3
Configuration	--	Hybrid	Hybrid	Hybrid	Interstage Booster Pump

Table 2.2 Treatment Facilities (continued)

		Location			
Description	Units	RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4
RO Feed Pump No. 1					
Status	--	Service	Service	Service	Service
Manufacturer	--	Goulds	Goulds	Goulds	Afton
Model	--	3410	3410	3410	MPV
Size	hp	200	200	300	100
RO Feed Pump No. 2					
Status	--	Reliability	Reliability	Reliability	Service
Manufacturer	--	Goulds	Goulds	Goulds	Afton
Model	--	3410	3410	3410	MPV
Size	hp	200	200	300	100
Emergency Power					
Standby Generator Size	KW	600[5]	900[6]	600[7]	600[6]

Notes:
(1) In 2017 MPW plugged and abandoned Deep Well 5. A replacement Deep Well 5 is planned to be constructed in 2018.
(2) Plant modifications to enable groundwater blending at each of MPW's RO WTP's is scheduled to be completed by Nov 2017.
(3) Planned Minimum and Average flows based on a finished water fluoride goal of 0.6 mg/L of fluoride. Planned Maximum flow based on a finished water fluoride goal of 1.2 mg/L.
(4) Max-build out at RO WTP No. 3 assumes the membrane feed pumps will be replaced, and the existing RO membranes will be replaced with high surface area RO membranes. Max-build out at RO WTP No. 4 assumes a third RO train will be added.
(5) Standby Generator provides power to the RO WTP, Deep Well, and High Service Pump Station.
(6) Standby Generator provides power to the RO WTP, Deep Well, High Service Pump Station, and ASR Well.
(7) Standby Generator provides power to the RO WTP, High Service Pump Station, and ASR Well. Existing generator lacks capacity to provide power to Deep Well 5.

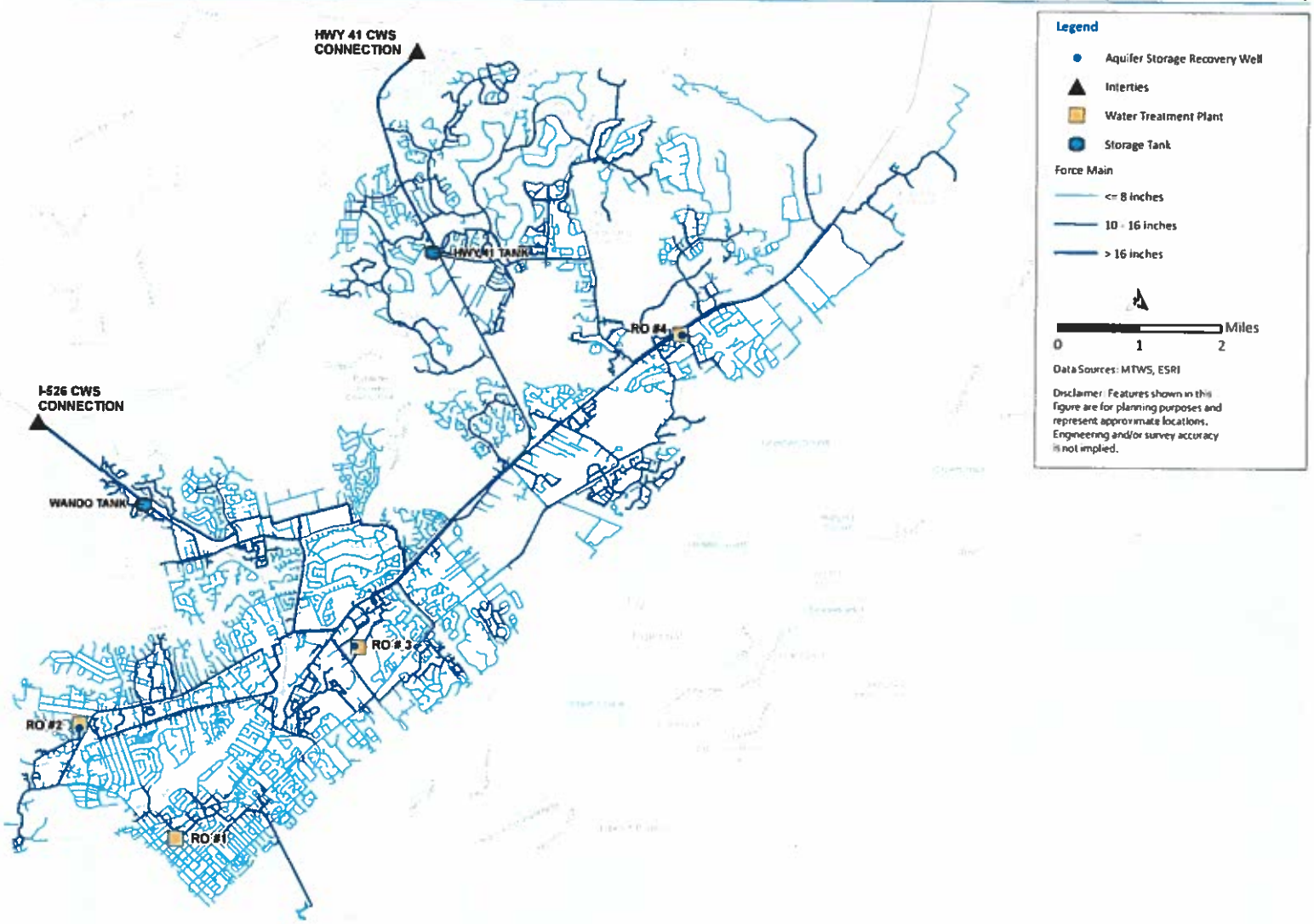


Figure 2.1 Water Supply Map

2.3.4 Aquifer Storage and Recovery

MPW uses three (3) ASR wells to store finished water during periods of low demand and recover finished water during periods of high water demand. Unlike the deep wells, the ASR wells are relatively shallow with screened intervals between 250 feet to 430 feet bls in the Santee Limestone Aquifer. Recovered water is pumped into the ground storage tanks, mixed with chlorinated water from the RO WTPs and distributed into the distribution system. The ASR system does not have a separate chlorination system. Currently, ASR Well No. 1 and No. 2 are operational; ASR Well No. 3 is inactive. Table 2.3 provides a detailed summary of the ASR wells. Recovery capacity from the three wells is between 1,075 gpm to 1,275 gpm.

Operations staff track the volume and quality (e.g., conductivity, and turbidity) of recovered water to determine when stored water has been depleted. Typically, MPW recovers approximately 80 percent of injected water from the ASR wells (e.g., for every 10 million gallons (MG) stored, 8 MG is recovered). Additional information about the ASRs can be found in the March 2008 *Aquifer Storage and Recovery Master Plan*.

2.4 Storage Facilities

MPW has seven (7) operational ground-level storage facilities and one operational elevated storage facility that provide a combined nominal storage capacity of 12.0 MG. Ground storage tanks are co-located at the RO treatment plants and pumped to the distribution via high service pumps. Two (2) ground storage tanks at Wando Park and Highway 41 are boosted into the system by onsite pump stations. The system's sole operational elevated tank is located at WTP No. 2. Storage facilities are summarized in Table 2.4 by location, where WTPs No. 1 and No. 2 have multiple storage tanks.

2.5 Pump Stations

MPW has six (6) pump stations to boost water from ground storage tanks to the distribution system, as discussed above. Pump stations associated with the RO treatment plants are referred to as High Service Pump Stations, and pump stations in the distribution system are referred to as booster pump stations. Table 2.5 provides a detailed summary of the pump stations. The majority of pumps are equipped with variable frequency drives to allow MPW to vary the flow from the pump stations. There are multiple pumps at each pump station, and the pumps run in rotation. The pump stations do not have pumps that operate purely on a standby, or redundant basis. Only one pump at High Service Pump Stations associated with RO Treatment Plants 1, 2, and 4 is needed to meet typical demands. Thus, the loss of a high-service pump does not impact the system during typical demand periods. However, multiple pumps are operated at the High Service Pump Stations during periods of high demand. The loss of a pump during a high demand period requires an increase in the pumping rate at other locations to compensate for the lost pump.

Pump curves for the pump stations' pumps are included in Appendix B.

2.6 Existing Distribution System

MPW has over 558 miles of distribution main ranging from 1-inch to 36-inches, as presented in Table 2.6. The majority of the piping in the distribution system is 6-inch and 8-inch PVC pipe. Large diameter mains (greater than 16-inches) are generally ductile iron pipe (DIP) or HDPE. The majority of the system was constructed in the 1990s and 2000s as summarized in Table 2.7.

Table 2.3 Aquifer Storage and Recovery Wells

		Aquifer Storage and Recovery Wells		
Description	Units	1	2	3
Location	--	RO WTP No. 3	RO WTP No. 4	RO WTP No. 2
Service Status	--	Operational	Operational	Inactive
Native Groundwater TDS	mg/L	2400	1700	3000
Year Installed	--	1995[1]	1995	2006
Surface Elevation	ft msl	16	26	20
Well Depth	ft bls	393	370	427
Screen Placement				
Length (total)	ft	107	125	117
First Screen	ft bls	285 - 391	245 - 370	310 - 427
Material	--	Open Borehole	Open Borehole	Open Limestone
Water Elevation				
Static	ft bls	34	32	50
Specific Capacity	gpm/ft	2.5	5	2.5
Design Recharge Capacity	gpm	250 - 300	425 - 475	250 - 300[2]
Design Recovery Capacity	gpm	300 - 350	475 - 575	300 - 350[2]
Surface Casing				
Depth	ft bls	~40	40	92
Diameter	inches	24	24	24
Material	--	Steel	Steel	Steel

Table 2.3 Aquifer Storage and Recovery Wells (continued)

		Aquifer Storage and Recovery Wells		
Description	Units	1	2	3
Intermediate Casing				
Depth	ft bls	285	245	310
Diameter	inches	17.4	17.4	17.4
Material	--	PVC	PVC	PVC
Production Casing				
Depth	ft bls	393	370	427
Diameter	inches	15	15	17
Material	--	Open Borehole	Open Borehole	Open Limestone
Motor Size	hp	30	15	30
Manufacturer	--	Centralift	Grundfos	Goulds
Model	--	WH350	230-S-150-B	6M304
No. of Stages	No.	--	--	3
Type:	--	Submersible	Submersible	Submersible
Emergency Power	--	Yes	Yes	Yes

Notes:
(1) ASR Well 1 was initially completed in 1995. The well was redeveloped in 1996.
(2) Construction and Testing of the Santee Limestone Aquifer ASR Test Well (CH2M, 2007), reports that the hydraulic properties of ASR Well 3 would perform similar to ASR Well 1.

Table 2.4 Storage Facilities

Description	Units	Location					
		WTP No. 1	WTP No. 2	WTP No. 3	WTP No. 4	Wando Park	Highway 41
Storage Tank							
Type	--	Ground	Ground	Ground	Ground	Ground	Ground
Volume	MG	0.5	2.0	2.0	2.0	2.5	2.0
Service Status	--	Operational	Operational	Operational	Operational	Operational	Operational
Finished Floor Elevation	ft msl			19.00		13.00	11.00
Overflow Elevation	ft msl			49.58		42.08	39.92
Operating Levels (above floor)[1]	ft	2.5 - 10		29.3 - 11.0	9 - 29		
Storage Tank							
Type	--	Ground	Ground				
Volume	MG	0.5	0.3				
Service Status	--	Operational	Out of Service[2]				
Finished Floor Elevation	ft msl		--				
Overflow Elevation	ft msl		--				
Operating Levels	ft		--				
Storage Tank							
Type	--	Elevated	Elevated				
Volume	MG	--	0.5				
Service Status	--	Out of Service	Operational				
Low Water Level	ft msl	--	150.5				
Overflow Elevation	ft msl	--	180.5				
Operating Levels	ft	--					

Notes:
(1) Elevations between low level alarm and high level alarm.
(2) The 0.3 MG ground storage tank at RO WTP No. 2 is not in service. MPW intends to demo this storage tank at a future date.

Table 2.5 Pump Stations

Description	Units	Location					
		RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4	Wando Park	Highway 41
Pump Station Type	--	High Service	High Service	High Service	High Service	Booster Pump	Booster Pump
No. of Pumps	--	3	3	4	3	2	2
Pump No. 1							
Manufacturer	--	Crane	Cornell Pump Co.	Goulds	Cornell Pump Co.	Cornell Pump Co.	Cornell Pump Co.
Model	--	13570-Beta	5RB-75-4		4HH-00	8H-CC 250-4	5HH 100-4
Size	hp	25	75	100	50	250	100
Design Capacity	gpm	280	1200	1200	900	4000	1500
Type	--	Horiz., Close CPLD., End Suction	Horiz., Close CPLD., End Suction		Centrifugal, End Suction	Horiz., Close CPLD., End Suction	Horiz., Close CPLD., End Suction
Drive	--		VFD	VFD	VFD	VFD	VFD
Pump No. 2							
Manufacturer	--	Cornell Pump Co.	Cornell Pump Co.	Goulds	Cornell Pump Co.	Cornell Pump Co.	Cornell Pump Co.
Model	--	4HH-CC 50-4	5RB-75-4		4HH-CC	8H-CC 250-4	5HH 100-4
Size	hp	50	75	100	50	250	100
Design Capacity	gpm	900	1200	1200	900	4000	1500
Type	--	Horiz., Close CPLD., End Suction	Horiz., Close CPLD., End Suction		Centrifugal, Close CPLD., End Suction	Horiz., Close CPLD., End Suction	Horiz., Close CPLD., End Suction
Drive	--	VFD	VFD	VFD	VFD	VFD	VFD

Table 2.5 Pump Stations (continued)

		Location					
Description	Units	RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4	Wando Park	Highway 41
Pump No. 3							
Manufacturer	--	Cornell Pump Co.	Cornell Pump Co.	Goulds	Goulds		
Model	--	4HH-CO	5RB-CC	3410M	3656		
Size	hp	50	75	150	50		
Design Capacity	gpm	900	1200	2000	750		
Type	--	Horiz., Close CPLD., End Suction	Horiz., Close CPLD., End Suction	Centrifugal, double suction	Centrifugal, End Suction		
Drive	--	VFD	VFD	VFD	VFD		
Pump No. 4							
Manufacturer	--			Goulds			
Model	--			3410M			
Size	hp			150			
Design Capacity	gpm			2000			
Type	--			Centrifugal, double suction			
Drive	--			VFD			
Emergency Power	--						
Standby Generator Size	KW	600[1]	900[2]	600[3]	600[2]	--[4]	300[2]

Notes:
(1) Standby Generator provides power to the RO WTP, Deep Well, and High Service Pump Station.
(2) Standby Generator provides power to the RO WTP, Deep Well, High Service Pump Station, and ASR Well.
(3) Standby Generator provides power to the RO WTP, High Service Pump Station, and ASR Well. Generator does not provide power to the Deep Well.
(4) There is not a standby generator at this site. There is a concrete pad and transfer switch capable of supporting a 900 KW generator.

Table 2.6 Distribution Pipe Diameters and Materials

Diameter (Inches)	Asbestos Cement (AC)	Brass	Cast Iron (CI)	Copper	Ductile Iron Pipe (DIP)	Galvanized Steel (GS)	HDPE	POLY	PVC	Total
1	250							449	388	1,086
1.25						102			612	714
1.5							39	90	129	258
2		14	0	585	42	2,942	1,778	4,063	96,204	105,628
2.25						14,381			605	14,986
2.5									1,318	1,318
3	232				573		1,070		159,080	160,955
4	7,121				9,408		119		92,623	109,270
6	7,430		34,837		45,467		4,658		588,600	680,992
8	5,493		14,494		45,730		21,287		1,002,552	1,089,556
10	5,997				14,372		4,583		285,309	310,261
12	16,056				25,575		10,291		277,717	329,638
14					730		421		4,079	5,230
16					32,047		307		28,900	61,255
18					6,859				534	7,393
20					46,117		1,415		6,929	54,461
24					6,132		363			6,495
28							4,929			4,929
30					4,002					4,002
36					254		2,133			2,387
Total	**42,579**	**14**	**49,332**	**585**	**237,307**	**17,425**	**53,391**	**4,602**	**2,545,579**	**2,950,813**

Table 2.7 Pipe Installation Decade

Installation Decade	Pipe (ft)	Portion of System (%)
1950	2,279	0%
1960	118,525	4%
1970	315,514	11%
1980	336,805	11%
1990	969,493	33%
2000	924,371	31%
2010	282,115	10%
Unknown	1,711	0%
Grand Total	**2,950,813**	

Chapter 3

WATER DEMAND AND PRODUCTION

3.1 Introduction

Mount Pleasant Waterworks (MPW) water supplies have the flexibility to vary throughout the year, while meeting annual limits. Seasonal water demands have been established to aid in water supply planning. Based on water use, three seasons were evaluated: winter, summer, and shoulder seasons. Long-term seasonal demand projections were established based on historical water use data and the Comprehensive Utility Management Plan (CUMP) demand projections.

3.2 CUMP Demand Projections

The 2015 CUMP developed future water demand projections for the near-term, mid-term, and buildout planning periods. Projections developed residential equivalency units (REUs), average day demands (ADD), and maximum day demands (MDD). This section summarized the approach, planning factors, and projections from the 2015 CUMP. These projections will serve as the foundation for the development of long-term seasonal projections as part of the Water Supply Master Plan (WSMP).

3.2.1 Approach

The 2015 CUMP approach to demand projections is: "MPW uses REUs as a basis to determine current and future water demands. An REU is defined as a unit of development (residential, commercial, industrial, or other type) which is equivalent to the average water usage or wastewater flow for a typical residential customer. A standard usage factor (gallons/REU) is applied to the number of REUs to develop water demand and wastewater flow projections, and to calculate impact fees, basic facility charges and excessive-use tiers. (CDM Smith 2015)." A standard factor of 300 gallons per day per REU (gpd/REU) was used to convert commercial water use to REUs.

3.2.2 ADD Unit Demand Factor (gpd/REU)

Historical ADD Unit demand in terms of gpd/REU was generated by comparing Historical ADD from 2010 through 2013 with an estimate of the number of REUs for the respective customer accounts. The 2015 CUMP reported that "since 2007, MPW's average day demand (ADD) unit factor has ranged from 188 to 228 gpd/REU, with an average of 209 gpd/REU." To select a final value, the historical water and wastewater factors were compared and a common value of 220 gpd/REU was recommended.

Note, non-billed usage is reflected in the ADD Unit demand factor.

3.2.3 Long-term Projections

Water demand projections in the 2015 CUMP determined for near-term (2019), mid-term (2024), and buildout (2049) planning periods. Demographic growth projections were used to develop future REU projections, which were used to estimate water demand.

The overall REUs estimated was based on "the future land use of the water service planning area were used to determine overall growth of the system. It was assumed that all developable land would be built-out to the maximum use specified in the 2014 Comprehensive Plan Update. Developed, undevelopable, and restricted properties were assumed to remain as-is with the exception of the "urban corridor" land use. Areas within this corridor are expected to be redeveloped to a higher density based on the 2014 Comprehensive Plan and zoning... The projections also account for some specific developments, most of which were identified in the 2010 Master Plan, but are not currently fully developed (based on 2014 REUs within those properties)" (CDM Smith 2015).

"Based on MPW's planned development information, the following growth rates are assumed for each planning period:

- **Existing to near-term planning period** – Growth is assumed to be 2.0 percent per year.
- **Near-term to mid-term planning period** – Growth is assumed to be 1.5 percent per year.
- **Mid-term to buildout planning period** – Growth is assumed to be 1.3 percent per year in the current service area, with a buildout year of 2049 It is assumed MPW will extend service to the area east of Guerins Bridge Road between mid-term and buildout, which will increase the growth rate to 1.4 percent per year" (CDM Smith 2015).

Table 3.1 summarizes the REU projections for each planning period. Irrigation customers, those with separate irrigation meters, comprised approximately 9 percent of the existing total allocated water REUs. It was assumed that "irrigation REUs will remain at the same percentage of overall water use in the future" (CDM Smith 2015).

Table 3.1 Summary of REU Projections

Planning Period	Approximate Year	Water	Irrigation
Existing[1]	2014	38,629	3,981
Near-Term	2019	42,650	4,218
Mid-Term	2024	45,946	4,544
Buildout	2049	65,591	6,487

Note:
(1) The existing allocated water REUs were adjusted down by 4,400 to account for unused commercial REUs. Existing REUs do not include engineering entities.

3.2.4 Water Use Projections

Table 3.2 summarizes the water demand projections for the ADD and MDD for the CUMP planning periods. Projected average day water demand was calculated by "applying the water demand factor of 220 gpd/REU to the future REUs. To determine projected MDD, a peaking factor of 1.6 is applied to the ADD. This peaking factor represents the 90th percentile historical value from 2007 through 2013 and is the same as the MDD:ADD peaking factor used in the 2010 Master Plan" (CDM Smith 2015).

Table 3.2 Water Demand Projections

Planning Period	Approximate Year	Average Day Demand (1) (mgd)	Maximum Day Demand (2) (mgd)
Existing Actual	2014	8.0	11.6
Near-Term	2019	10.3	16.5
Mid-Term	2024	11.1	17.8
Buildout	2049	15.9	25.4

Notes:
(1) Existing ADD is based on actual water usage. ADD for near-term, mid-term and buildout based on a demand factor of 220 gpd/REU.
(2) Existing MDD is based on actual water usage. MDD for near-term, mid-term and buildout based on MDD:ADD peaking factor of 1.6.

3.3 Seasonal Water Demand

To aid in water supply planning, seasonal water demands were established for winter, shoulder, and summer seasons. Seasons were established based on historical water use data. Future seasonal demands were projected by applying seasonal demand factors to the existing CUMP ADD demand projections.

3.3.1 Historical Seasonal Water Use

Historical water use patterns were evaluated using monthly billing (water use) data. Figure 3.1 provides monthly water use from 2007 through 2016. Monthly water use is relatively consistent from year to year, with the most variation occurring in the July, August, and September.

Note, water use data is collected on a fiscal year (July through June).

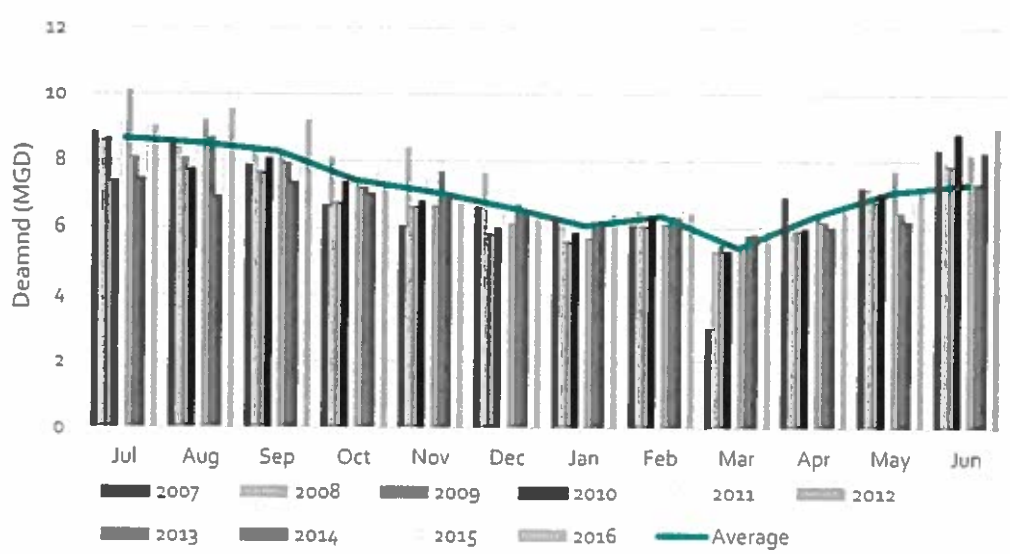


Figure 3.1 Monthly Water Demand

Average monthly demands were evaluated to establish each season (winter, shoulder, and summer), which is shown in Table 3.3. The winter season (January through April) was defined as those with less than 90 percent of the average annual water use. The shoulder season (October through December, May) was defined as months within 10 percent of the average annual water use. December was on the border of the shoulder/winter seasons. MPW staff indicated that winter operations have historically started after the first of the each year; therefore, December was maintained as part of the shoulder season. The summer season (June through September) was defined as months with greater than 110 percent of the average annual average water use.

Table 3.3 Months per Season

Month	Average Use (mgd)	Average Monthly/Average Annual Use (%)	Season
July	8.67	123%	Summer
August	9.46	121%	Summer
September	8.05	114%	Summer
October	7.68	105%	Shoulder
November	6.81	96%	Shoulder
December	6.73	92%	Shoulder
January	6.05	86%	Winter
February	5.76	81%	Winter
March	5.89	81%	Winter
April	6.14	87%	Winter
May	7.30	100%	Shoulder
June	8.11	115%	Summer

3.3.2 Seasonal Water Use Factors

To project future seasonal demands, a seasonal use factor was applied to the CUMP demand projection. Seasonal peaking factors, defined as maximum monthly water use per season divided by the average annual water use, were determined for 2007 through 2016. As statistical analysis of the monthly data showed, there was relatively little variation within a season; with the average, median, 75th percentile, and 90th percentile all within five (5) percent in all seasons. MPW directed that the seasonal peaking factor be based on the 75th percentile statistic, which was consistent with prior internal planning. The 75th percentile peaking factors are in shown in Table 3.4.

Table 3.4 Seasonal Peaking Factors

Statistic	PF Winter	PF Summer	PF Shoulder
75th Percentile	0.89	1.30	1.08

3.3.3 Seasonal Long-term Projections

Long-term seasonal demand projections as shown in Table 3.5 and Figure 3.2, which document the projected ADD, MDD and seasonal demands through 2049. Consistent with the seasonal peaking factors, winter and shoulder season demands are within 10 percent of the ADD. Monthly summer peak demands are approximately 30 percent greater than the ADD. The MDD, which is representative of the single largest daily demand in the summer, is 60 percent greater than the ADD. These seasonal demand projections will be used to analyze alternative sources of supplies in subsequent work.

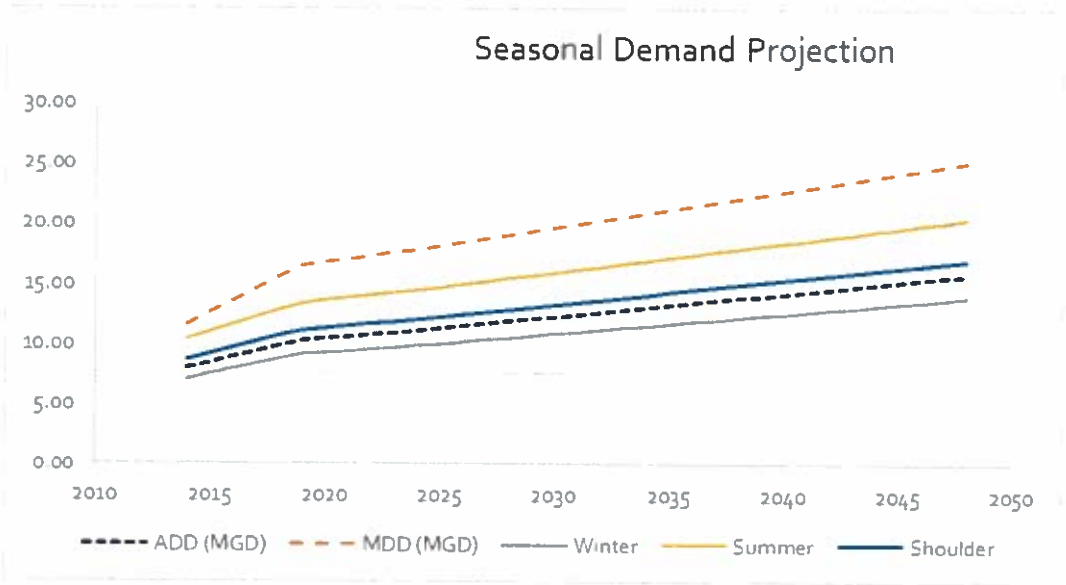


Figure 3.2 Long-term Seasonal Water Demand Projections

Table 3.5 Seasonal Demand Projections

Approximate Year (mgd)	ADD (mgd)	MDD (mgd)	Winter (mgd)	Summer (mgd)	Shoulder (mgd)
2017	9.38	14.54	8.30	12.18	10.15
2018	9.84	15.52	8.71	12.78	10.65
2019	10.30	16.50	9.12	13.37	11.14
2020	10.46	16.76	9.26	13.58	11.32
2021	10.62	17.02	9.40	13.79	11.49
2022	10.78	17.28	9.54	14.00	11.66
2023	10.94	17.54	9.69	14.20	11.84
2024	11.10	17.80	9.83	14.41	12.01
2025	11.29	18.10	10.00	14.66	12.22
2030	12.25	19.62	10.85	15.91	13.26
2035	13.21	21.14	11.70	17.15	14.29
2049	15.90	25.40	14.08	20.64	17.20

3.4 Seasonal Supply Production

Historical production data were evaluated to identify trends in seasonal water use. Production was considered for the deep wells, Charleston Water Supply (CWS) supplies, and the aquifer storage and recovery (ASR) system.

3.4.1 Deep Well Supply and Production

Monthly and seasonal deep well production data were evaluated for trends. Monthly production records were available from 2014 through June 2017, which are shown in Figure 3.3. MPW staff rotated the use of individual wells, where use was comparable over the period as shown in Figure 3.4. Note, production records are recorded on a calendar year. Total production from deep wells averaged 3.71 mgd, as presented in Table 3.6.

In recent years, MPW has withdrawn notably less than the 8.60 mgd of groundwater needed to run all their RO WTPs at their existing capacity. Due to the structure of their supply contract with CWS, MPW operates the deep well supply for peaking. Generally, MPW relies the heaviest on their deep well supply to meet demands during the summer months.

Note, MPW daily production varies within a month and week in response to increased demands from irrigation schedules and weekend water use.

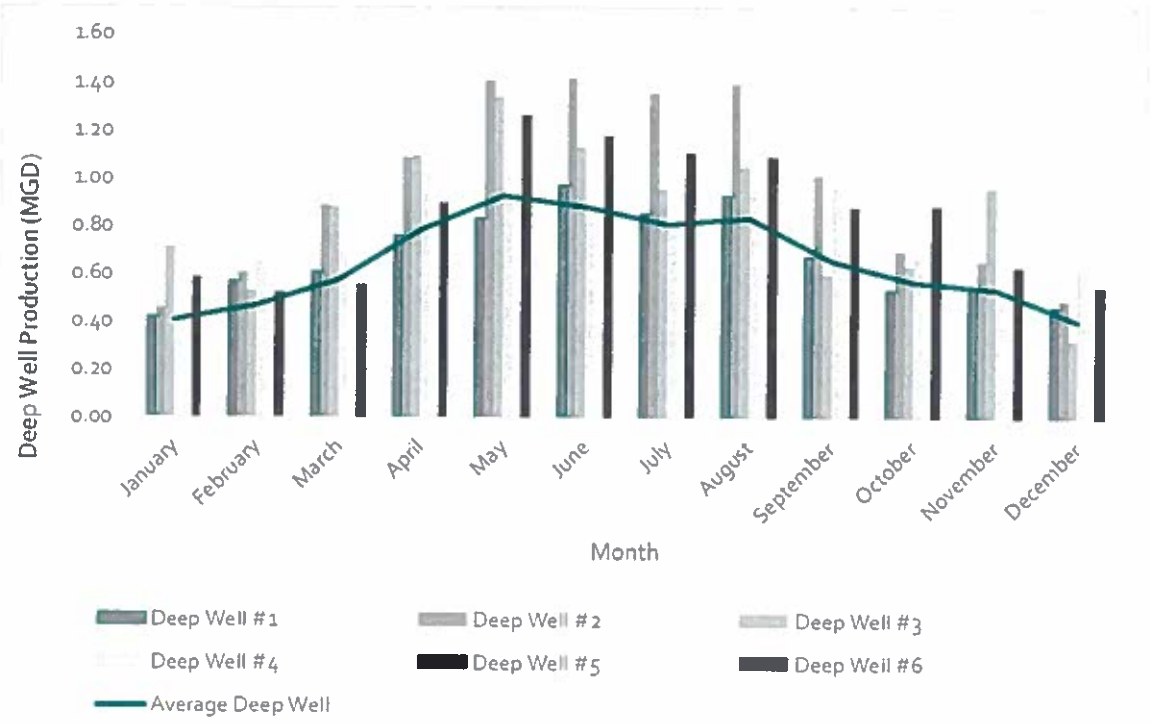


Figure 3.3 Monthly Deep Well Production

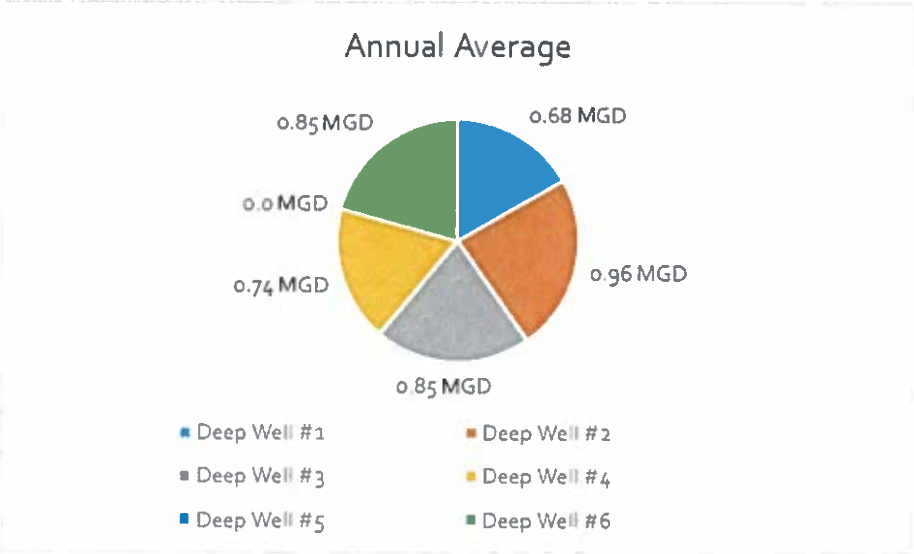


Figure 3.4 Deep Well Average Annual Production

Table 3.6 Deep Well Seasonal Production

Season	Total Deep Well (mgd)	Percent (%) of Well Capacity [1]
Summer	4.47	52%
Winter	3.12	36%
Shoulder	3.60	42%
Annual Average	3.71	43%

Notes:

(1) Percent capacity based on the groundwater required to run MPW's RO WTPs at their existing capacity without blending: 8.35 mgd. Blending to a fluoride concentration of 0.6 mg/L would require a total of 8.60 mgd of groundwater. Blending to a fluoride concentration of 1.2 mg/L would require a total of 10.07 mgd.

Groundwater from the Middendorf Aquifer is brackish and RO membranes at MPW's four (4) RO Water Treatment Plants (WTPs) remove the dissolved salts from the water. Presently, the four (4) RO WTPs can produce a combined total of 6.7 mgd (4,700 gpm) of finished water on average. In 2018, the current blending project is anticipated to increase capacity to 8.4 mgd (5,800 gpm) by allowing blending. WTPs treat a single well (RO1 treats Well #1, RO2 treats Well#2, RO4 treats #6), except RO3 that treats Wells #3, #4, and #5. Disinfected water from the RO WTPs is stored in ground storage tanks or stored seasonally in the ASR system.

Finished water production from the RO WTPs were evaluated for trends. Monthly production records were available from 2014 through June 2017. A total of 3.01 mgd of finished water was produced, as presented in Table 3.7. RO WTP #3 produced the most finished water, as shown in Figure 3.5.

The RO WTPs recover approximately 81 percent of the deep well water supplied to the RO membranes as finished water, as presented in Table 3.7.[1]This recovery rate is consistent with MPW's historical average and is typical for the WTPs treatment processes. The percent of deep well water recovered was found to vary by approximately 5 percent throughout the year. From a

[1] The 81% recovery accounts for the water loss resulting from the RO operation and bypass of a small volume of finished water around the RO process for blending.

planning perspective, this variation is not significant. However, MPW may investigate this further to better understand deep well and plant operations.

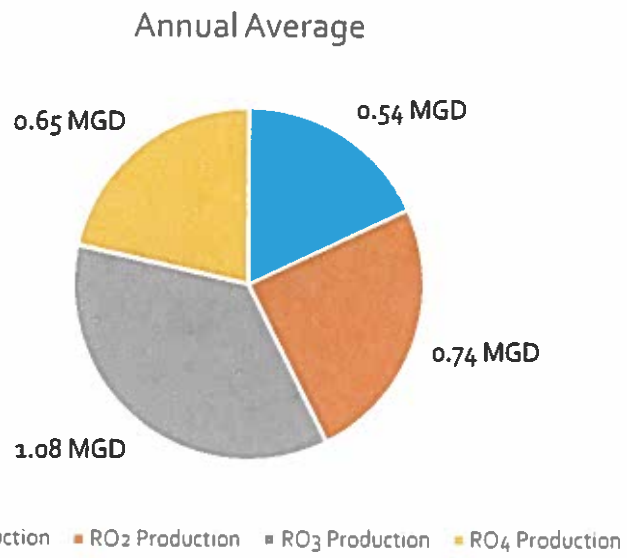


Figure 3.5 Finished Water Average Annual Production

Table 3.7 Finished Water Seasonal Production

Season	Total Finished Water (mgd)	Percent (%) of Raw Water Recovered
Summer	3.77	84%
Winter	2.37	76%
Shoulder	2.87	80%
Annual Average	3.01	81%

3.4.2 CWS Production

In addition to the deep well supplies, 5.5 million gallons per day (mgd) of constant CWS supplies were purchased from 2014 through April 2017, when it was increased to 6.0 mgd. This represents about 60 percent of the total supply for MPW. As a constant supply, there is no seasonality to the supply.

3.4.3 ASR Production

MPW's ASR wells store finished water during periods of low demand and recover finished water during periods of high water demand. Historical ASR #1 and ASR #2 average monthly recharge and recovery rates are presented in Table 3.8. ASR wells generally recharged from February through May and recovered from June through September. Overall, the Wells recovered near the 80 percent goal set for the system. Historically, recovery of ASR water was pumped near continuously at approximately 200 gallons per minute (gpm) (0.28 mgd) to 250 gpm (0.38 mgd). In 2017, MPW is testing recovery rates up to 350 gpm.

Due to the recovery inefficiencies, the ASR has a net loss of production; however, it provides valuable peaking during summer months.

Table 3.8 Historical Average Monthly ASR Recharge and Recovery

Season	Month	ASR Well #1 Recharge (mgd) (2)	ASR Well #1 Recovery (mgd) (1)	ASR Well #2 Recharge (mgd) (2)	ASR Well #2 Recovery (mgd) (2)
Summer	July	0.00	0.22	0.00	0.19
Summer	August	0.00	0.30	0.00	0.21
Summer	September	0.00	0.11	0.00	0.04
Shoulder	October	0.00	0.00	0.00	0.00
Shoulder	November	0.02	0.00	0.00	0.00
Shoulder	December	0.01	0.00	0.00	0.00
Winter	January	0.01	0.00	0.03	0.00
Winter	February	0.21	0.00	0.30	0.00
Winter	March	0.36	0.00	0.39	0.00
Winter	April	0.28	0.00	0.13	0.00
Shoulder	May	0.15	0.01	0.00	0.05
Summer	June	0.01	0.15	0.00	0.20

Notes:
(2) ASR #1 data based on 2014 – June 2017 data.
(3) ASR Well #2 data based on 2014 data.

3.4.4 Seasonal Supply Summary

MPW receives finished supplies from its RO WTPs, ASR wells, and CWS. A comparison of the average seasonal supply from each source is shown in Figure 3.6. The RO WTPs and ASR system production is varied throughout the year to provide increased supply during the summer, where CWS provides constant supply throughout the year. From 2014 through June 2017, approximately 65 percent of supplies were from CWS and 35 percent from the RO WTPs. The use of deep well sources can substantially increase in the future to maximize production from the RO WTPs. The ASR system has a small overall impact on the production; however, it provides valuable peaking supply during the summer.

Figure 3.6 Historical Seasonal Production Summary

Chapter 4

EXISTING WATER SUPPLY RELIABILITY ASSESSMENT

4.1 Introduction

Water is supplied to the Mount Pleasant Waterworks (MPW) from two sources: groundwater wells, and the Charleston Water System (CWS). Mount Pleasant Waterworks (MPW) has set a goal to provide reliable water to its customers. Water supply reliability is based upon, but not limited to the following sections of the South Carolina State Primary Drinking Water Regulations R.61-58:

- R.61-58.B(70)
- R.61-58.2.B(1)(b)
- R.61-58.2.C
- R.61.58.2.D(2)
- R.61-58.2.E
- R.61-58.4.B(1)(c)(i)
- R.61-58.4.B(1)(i)
- R.61-58.4.B(2)
- R.61-58.4.C(1)(a)
- R.61-58.5

These regulatory standards will serve as a minimum standard required for reliability, concerning both the quantity of physical supply and the operation and maintenance (O&M) of the water system. Because of the potential temporary loss of CWS source water, reliability was expanded to include other, non-regulatory factors:

1. Provide supply capacity to meet the Maximum Day Demand with the largest source out of service, which at this time is the CWS supply feed No. 1 (Daniel Island). This criteria exceeds SC regulations and is evaluated in Chapter 5.
2. Maintaining proper functioning infrastructure to continue safe and reliable operation of the water system; limiting the probability and duration of supply outages and other disruptions.

A condition assessment was performed to evaluate the proper functioning of major components of MPW's water supply system, including:

- Deep Wells.
- Aquifer Storage and Recovery (ASR) Wells.
- Storage Tanks.
- Pump Stations.
- Water Treatment Plants.

The structures, mechanical systems, and electrical and control systems associated with the components listed above were assessed based on an on-site inspection and review of operation and maintenance records. Each assessment included an evaluation in four categories. These categories and their general definitions are:

- Condition: the appearance, quality, and/or working order of the system or component.
- Capacity: the ability of a component to produce (or convey) a desired quantity.
- Performance: the ability to satisfactorily execute the desired function.
- Reliability/Redundancy: consistent performance and the presence of critical component duplication.

Condition assessment forms were used as an aide in evaluating the major components of MPW's water supply system. The forms completed during the condition assessment are included in Appendix C.

MPW's ability to meet future average day demand (ADD) and maximum day demand (MDD) were not evaluated during the condition assessment. Strategies to meet the Town of Mount Pleasant's future ADD and MDD through build-out (~2049) are evaluated in Chapter 5.

4.2 Objectives

The goal of this assessment is to:

- Document the existing condition.
- Discuss any ongoing issues.
- Identify opportunities to improve the major components of MPW's water supply system.

This assessment will establish a record of known issues and recommended improvements to meet reliability goals now and into the future.

4.3 Reliability of the Charleston Water System Supply

CWS supplies treated water to MPW from the Hanahan Water Treatment Plant. Raw water is supplied to the Hanahan WTP from the Bushy Park Reservoir and the Edisto River, and treated water is supplied to MPW through two feeds located along the northern boundary of MPW's service area. CWS Point of Delivery No. 1 is located on Daniel Island, and CWS Point of Delivery No. 2 is located in Cainhoy near Highway 41. Two water mains cross under the Cooper River from the Charleston peninsula and supply the two Points of Delivery which have a collective supply capacity of up to 15 mgd.[1] The supply volume is transferable between CWS Point of Delivery Nos. 1 and 2, however, due to capacity limitations, the full 15 mgd may not be transferred through a single point of delivery. A new Point of Delivery (No. 3) from Sullivan's Island is currently under consideration and development but will have a limited supply of only 2.25 mgd. This point of delivery will be unaffected by the Cooper River crossings. Therefore, constructing this new point of delivery will marginally increase the reliability of the CWS supply.

CWS has planned system improvements prior to 2025 that will provide a third crossing under the Cooper River. This improvement project will greatly improve the reliability of the CWS supply system to CWS Point of Delivery Nos. 1 and 2.

[1] Wholesale Water Supply, Treatment, and Transmission Services Contract by and between Commissioners of Public Works of the City of Charleston, SC and Commissioners of Public Works of the Town of Mount Pleasant, SC. October 25, 2016.

The CWS Points of Delivery were not inspected during the condition assessment. CWS is required to maintain an asset management inventory and maintenance plan in accordance with the wholesale water supply contract with MPW. Based upon this inventory and performance history, MPW staff believes the infrastructure supplying water to Point of Delivery Nos. 1 and 2 are in good condition. However, recently one point of delivery was temporarily offline due to planned maintenance of a CWS water main, which is permissible in accordance with the wholesale water supply contract with 30 days' notice.

Assessment

Condition: Neutral

- Not evaluated. MPW Staff indicated there are no known issues with the CWS Point of Delivery Nos. 1 and 2.

Capacity: Positive

- CWS Point of Delivery Nos. 1 and 2 currently supply MPW with a total of 6.0 mgd of treated water. The 6.0 mgd of water can be shifted, or split between Point of Delivery Nos. 1 and 2.
- Currently, MPW's contractually purchased capacity is 6.0 mgd. As MPW's demands increase, additional water from CWS may be purchased over the next 20-years under their current agreement. Up to 15 mgd of water, transferrable or split between the CWS Point of Delivery Nos. 1 and 2, may be purchased in increments of 100,000 gallons.

Performance: Neutral

- Other than periodic scheduled outages that are permissible with 30 days' notice, there have been no known performance issues with the CWS supply to Point of Delivery Nos. 1 and 2 with respect to quantity of water supplied.
- CWS continues to meet all regulated primary and secondary treatment standards at the points of delivery to Mount Pleasant.

Reliability/Redundancy: Negative

- The CWS system has historically been reliable; however, unlike its own supplies, MPW does not have control over the reliability of the CWS system.
- The proposed Point of Delivery No. 3 will have limited capacity, and will not be able to compensate the loss of either or both CWS Point of Delivery Nos. 1 or 2. Also, per the terms of the wholesale water supply contract the contract capacity from Point of Delivery Nos. 1 or 2 is not transferrable to Point of Delivery No. 3, and vice versa.
- CWS Supply at any point of delivery may be interrupted with 30 days' notice per the terms of the wholesale water supply contract with MPW. This type of interruption can be compensated for currently provided that the interruption occurs in off-peak seasons, or allows for the transfer of water from Point of Delivery Nos. 1 or 2 to the other.
- Because CWS provides treated surface water to MPW, the quality of water is influenced by other dischargers upstream of the Bushy Park Reservoir and Edisto River. Additionally, because of organic material native to the surface water that is treated at the Hanahan WTP, chloramines are required for disinfection, which results in MPW's need to take additional measures to control residual and address possible nitrification within their distributions system. While CWS meets all regulated primary and secondary treatment standards, emerging contaminants resulting from upstream dischargers and

water quality issues that may result from nitrification pose a reliability concern with regard to MPW's ability to provide satisfactory water quality to their customers.
Per the terms of wholesale water supply contract, exclusive of the events referenced below, MPW may not exceed its daily total Contract Capacity by more than 2 percent over a Contract Day or by more than 1 percent over three consecutive Contract Months without being required to purchase additional capacity from CWS:

- MPW is afforded the grace periods for the following events that would preclude being forced to purchase additional capacity from CWS:
  - A catastrophic emergency, which affords MPW a grace period of 30 consecutive days; or
  - Renewal, replacement, and/or repair activities by MPW, which affords MPW a grace period of 7 cumulative calendar days within a contract year.
- Exceeding the daily contract capacity in these events only results in being charged for the additional water based upon the current water rates.
- In the face of a supply outage during peak months, the terms and conditions of MPW's wholesale water supply contract with CWS can make MPW's ability to control costs difficult.

Improvement Opportunities

- Continue to develop the Point of Delivery No. 3 through Sullivan's Island to provide MPW added system wide supply reliability. In the event of an interruption in CWS supply, MPW should seek to re-negotiate transferability of supply volume between Point of Delivery Nos. 1 and 2 and Point of Delivery No. 3.
- Amend the contract with CWS to require the water purchased from CWS to meet certain water quality parameters:
  - pH.
  - Chlorine residual.
  - TOC/DOC.
  - Hardness.
- Work with CWS to expedite the construction of a redundant pipeline across the Cooper River to improve the reliability of CWS Point of Delivery Nos. 1 and 2.
  Evaluate opportunities to improve water quality:
  - In concert with CWS, MPW should:
    - Advocate source control for dischargers upstream in the Bushy Park Reservoir and Edisto River Watersheds.[2]
    - Evaluate advanced treatment that may address emergency contaminants and disinfection byproduct control.
  - Evaluate nitrification control options that result from chloramination, including:
    - Water storage tank holding time, stratification and mixing.
    - Disinfection booster stations.
    - Free chlorine burnouts.
    - Distribution main flushing.

[2] CWS is planning on funding a "Source Water Manager" position during calendar year 2018. MPW may wish to work with CWS to coproduce objectives and a scope for this position. In addition, MPW may wish to form a committee or partnership with CWS to advocate for the watersheds.

4.4 Reliability of the Middendorf Aquifer Supply

The Middendorf Aquifer is located 1500-ft to 2000-ft below land surface (bls) and is MPW's source of groundwater. Currently, MPW operates five deep wells that pump water from the Middendorf Aquifer. A sixth deep well is currently under design and anticipated to be operational in 2018. The sixth deep well will replace an older well whose casings failed and was subsequently abandoned.

Following the completion of the sixth deep well, the combined pumping capacity of MPW's wells is expected to be over 7,200 gallons per minute (gpm) (10.4 mgd). This yield is slightly less than the 10.5 mgd pumping scenario investigated by the United States Geological Survey (USGS) in a 2007 study.[3,4] For that scenario, the study predicted a minimum groundwater elevation of -549 ft (NGVD 29). Pumping groundwater from that elevation is feasible, but energy intensive and rarely practiced. However, the USGS study is currently being updated, and revisions are anticipated to be complete by 2018. Following the completion of the revised study, MPW should implement operational practices after considering the predictions made in the revised study.

The following presents an assessment of the condition and reliability of MPW's Middendorf Aquifer supply facilities. This information will subsequently be used to identify projects necessary to maintain or improve reliability and, in Chapter 5, be used to assess MPW's ability to meet their water supply goals into the future. Middendorf Aquifer Supply Facilities include:

- RO WTP No. 1 / Deep Well No. 1.
- RO WTP No. 2 / Deep Well No. 2.
- RO WTP No. 3 / Deep Well Nos. 3, and 4. (And, starting in 2018, Deep Well No. 5.)
- RO WTP No. 4 / Deep Well No. 6.

4.4.1 RO WTP No. 1

4.4.1.1 Deep Well No. 1 Summary

Deep Well No. 1 is the sole raw water source for RO WTP No. 1. The well was constructed in 2007, and was installed as a replacement for an older deep well at the same location. The total depth of the well is 1918 ft bls. Groundwater is pumped from the well using a vertical turbine pump equipped with a 300 HP motor. The well's discharge flange sits atop a concrete pedestal, and an asphalt-shingled, wooden-framed canopy protects the wellhead from the sun and the elements. Table 4.1 presents general information regarding Deep Well No. 1.

Deep Well No. 1 does not have a PVC drop tube that is dedicated for a level transmitter. Installing a dedicated drop tube will help prevent hang-ups when making water level measurements, and will allow a water level transmitter to be permanently installed, providing continuous water level measurements necessary to assess the condition of the pump and well.

[3] Mount Pleasant Waterworks 2010 Comprehensive Utility Master Plan, CDM-Smith, April 2010.
[4] United States Geological Survey (USGS). 2007. Hydrogeology and Simulation of Ground-Water Flow near Mount Pleasant, South Carolina – Predevelopment, 2004, and Predicted Scenarios for 2030. USGS SIR 2007-5126.

Table 4.1 Middendorf Aquifer Deep Well No. 1 Summary

	Deep Well No. 1
Pump Capacity	1,250 gpm @ 660 ft TDH
Year Constructed	2007
Age of Pump	9 years
Standby Power Source	600 KW Generator[1]
Year of Last Inspection	???
Condition	Neutral

Note:
(1) Stationary generator shared with all RO WTP No. 1 facilities.

4.4.1.2 Deep Well No. 1 - Groundwater Well

Deep Well No. 1 was constructed with three steel casings: a 26-inch diameter conductor casing set to a depth of 81 ft bls, an 18-inch diameter outer casing set to a depth of 1,800 ft bls, and a 10-inch diameter inner casing set to a depth of 1,918-ft. The 10-inch casing is 268 ft long, and 150 ft of the 10-inch casing is located inside the 18 inch casing. The 10-inch casing includes 65 feet of 30 slot screen (i.e., the slots on the screen have a width opening of 30-thousandths of an inch). The well screens are located at depths of 1,795-1,800 ft bls, 1,820-1,860 ft bls, 1,870-1,880 ft bls, and 1,908-1,918 ft bls. The well screens are open to the Middendorf Aquifer.

Assessment

Condition: Positive

- There are no significant known issues with Deep Well No. 1.

Capacity: Positive

- The well is capable of supplying sufficient groundwater to RO WTP No. 1 to meet the Plant's existing requirements. The well also appears capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). The well is adequately sized to deliver the 1,250 gpm flow for which its pump is rated.

Performance: Neutral

- The well's performance adequately met the requirements of RO WTP No. 1.

Reliability/Redundancy: Neutral

- RO WTP No. 1 does not have a redundant raw water supply. However, the well's performance has been reliable.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Recommend installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
  - Furthermore, periodic review of data collected from the level transmitter is recommended.
- TV the well the next time the pump is removed.

4.4.1.3 Deep Well No. 1 - Well Head Facilities

Well head facilities at Deep Well No. 1 consist of: a motor-driven vertical turbine pump, piping and valves, and an open-walled canopy. The well's pump bowl assembly has 11 stages and is located approximately 500 ft bls. Power is supplied to the pump bowls from a 300 HP motor. A check valve near the discharge flange provides protection from backflow and possible contamination from entering the well. A 1-inch PVC line continuously supplies the line shaft bearings with clean water. This water keeps the bearings pre-lubricated, and avoids the potential of dry running them before they become flooded with pumped water after the pump is turned on. A pair of butterfly valves operate in concert to either direct flow from the well to RO WTP No. 1, or to a flush line. The flush line transports flow to the Center Street Waste Water Treatment Plant where it is blended with effluent and discharged into the Charleston Harbor. Otherwise, raw water is supplied to the plant through a 10-inch pipe that runs underground.

Assessment

Condition: Neutral

- There are no significant known issues with the well head facilities at Deep Well No. 1.

Capacity: Positive

- The well is capable of supplying sufficient groundwater to RO WTP No. 1 to meet the Plant's existing requirements. The well also appears capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). The well and its pump are rated at 1,250 gpm at 660-ft Total Dynamic Head (TDH).

Performance: Neutral

- The well's performance has been adequate to meet the requirements of RO WTP No. 1.

Reliability/Redundancy: Neutral

- RO WTP No. 1 does not have a redundant raw water supply. MPW does not store spare parts for the well pump.
- Spare 300 HP motor is available.
- Standby power is available.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- The coating on the base of the pump is chipping away. Recommend monitoring the condition of the coating on the pump and discharge piping at regular intervals, and recoating as necessary to prevent corrosion.
- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings, in additional to the spare 300 HP motor currently stored.

4.4.1.4 Deep Well No. 1 - Power Supply

The Deep Well No. 1 pump motor and disconnect are located outside at the RO WTP No. 1 Facility. The variable frequency drive (VFD) for this motor is located inside the Electrical Room of RO WTP No. 1. The facility was installed in 1991 and most electrical equipment is approximately

26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.
- Deep Well No. 1 pump motor termination box is not rated for the environment and has some corrosion.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional load would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and automatic transfer switches (ATS) are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.

- The estimated cost to complete the electrical improvement opportunities identified in this section is $45,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.1.5 Deep Well No. 1 - Control System

Deep Well No. 1 is at RO WTP No. 1 and the controls are incorporated into the control system for that RO Plant.

Assessment

Because RO WTP No. 1 and Deep Well No. 1 share a common control system, refer to RO WTP No. 1 control system assessment narrative.

4.4.1.6 Groundwater Supply Transmission Pipeline

Deep Well No. 1 and RO WTP No. 1 are co-located on the same property. An above-ground valve and piping network direct the raw water from the well to either the WTP, or to a flush line. When the raw water is directed toward the WTP, approximately 220 ft of 10-inch diameter pipe that runs underground conveys the raw water to the WTP. Table 4.2 summarizes the groundwater supply transmission piping for RO WTP No. 1.

Table 4.2 RO WTP No. 1 Groundwater Supply Transmission Piping Summary

Pipe Location	Length (ft)	Diameter (inches)	Material	Year Installed	Previous Breaks? (Y or N)
From Deep Well No. 1 to RO WTP No. 1	220	10	PVC	1992	N

Assessment

Condition: Neutral

- No negative observations regarding the condition of the pipe or ancillary equipment were observed during the site visit. In general, the pipeline appears to be in good condition relative to the age of the facility.

Capacity: Positive

- The pipeline has adequate capacity for existing and planned demands. Following the completion of the groundwater blending project, the maximum raw water flowrate will be 1,200 gpm. The velocity at that flowrate will be 5 ft/sec, which is within the range commonly thought to be acceptable in general water industry practice.

Performance: Positive

- There are no known performance issues.

Reliability/Redundancy: Neutral

- The transmission pipeline has functioned reliably, however, it does not provide any redundancy since the pipeline is the only raw water supply source for RO WTP No. 1.

Improvement Opportunities

- Include the following activities on a preventative maintenance schedule:
  - Monitor corrosion on the above ground valves and pipe. Recoat as necessary.
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.4.1.7 Cartridge Filters

Two cartridge filter housings at RO WTP No. 1 pre-filter the raw water flow before it enters the RO vessels. They are responsible for removing particles large enough to foul the membrane surfaces or plug the feed water channel of the membranes.

Assessment

Condition: Neutral

- Minor corrosion is present on one of the cartridge filter's flanges, and associated flange coupling adapter.

Capacity: Positive

- The housings have adequate capacity for existing and planned demands. They have an individual capacity of 700 gpm, and a combined capacity of 1,400 gpm.

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- MPW monitors the performance of the cartridge filters by measuring the silt density index on a monthly basis. MPW also replaces the cartridge filters on an annual basis as a precaution to protect the RO membranes. These practices demonstrate and help ensure the reliable performance of the cartridge filters.
- The cartridge filters can be isolated allowing the plant to remain in operation while one cartridge filter is offline. Although both cartridge filters are typically in operation simultaneously, the ability to isolate a cartridge filter increases the reliability and redundancy of the system.

Improvement Opportunities

Monitor corrosion, replace ancillary equipment as necessary.

4.4.1.8 Membrane Feed Pumps

There are two membrane feed pumps at RO WTP No. 1. They are arranged in a duty / stand-by configuration. The membrane feed pumps supply the pressure needed to force water through the RO membranes removing the dissolved salts from the feed water.

Assessment

Condition: Neutral

- Minor defects were observed, including: paint chipping on both pumps and a small amount of oil below the coupling on pump 2.

Capacity: Positive

- The pumps have adequate capacity for existing and planned demands. The pump rating is 870 gpm at 467 TDH (with one-pump running).

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- The membrane feed pumps are arranged in a duty / stand-by configuration. This arrangement meets the State's requirements for pump station reliability and redundancy since one pump can remain in operation while maintenance is performed on the other. Spare parts are not stored by MPW, however, spare parts are commercially available.

Improvement Opportunities

- The paint is chipping away at some locations on the pumps. Recommend continuing the practice of monitoring the condition of the pump's coating at regular intervals, and re-painting as necessary to prevent corrosion.

4.4.1.9 RO Trains

There are two RO trains at RO WTP No. 1. Both trains are two-stage, single-pass, and use a hybrid membrane array to balance the flux through the 8 vessels in the first stage with the 4 vessels in the second stage. The plant can operate either train individually or both trains simultaneously.

Assessment

Condition: Neutral

- The membrane elements were replaced in 2013. The design life expectancy of a membrane is ten years. For planning purposes, MPW may consider replacing the membrane elements in 2023. Membrane replacement will reduce energy use, and improve permeate water quality.

Capacity: Neutral

- The RO trains have a capacity of 400 gpm per train (800 gpm total capacity) and the membrane condition is such that the membrane feed pumps can increase speed to maintain this flow rate.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability / Redundancy: Neutral

- RO Trains are not redundant. Redundant trains are not required by the State, however, loss of a single train would result in a 50 percent decrease in the production capacity.
- Spare parts (e.g., membranes) are not stored on site, however, they are commercially available.
- In 2013, the membrane elements were replaced. Their performance to date has been satisfactory, and any degradation in performance over time has not been sufficient to warrant performing a membrane clean-in-place. The RO trains and their supporting equipment have proven reliable.

Improvement Opportunities

- Continue daily monitoring of the pressure drop across the membranes, and weekly monitoring of the conductivity. Perform a clean-in-place of the membranes when warranted based upon these data.
  Calibrate the pressure transmitters to ensure their accuracy.

4.4.1.10 Pretreatment Chemical - Scale Inhibitor Storage and Feed System

Scale inhibitor is added to the raw water to prevent the formation of mineral scale on the RO membranes as well as piping and ancillary equipment. Scale inhibitor is delivered to the WTP in 55-gallon drums. Subsequently, the scale inhibitor is transferred via a drum pump to a day tank that supplies a chemical metering pump. From the metering pump, the scale inhibitor is injected into the raw water pipeline through an injection quill. A static mixer downstream of the injection quill disperses the scale inhibitor.

Assessment

Condition: Negative

- The drum pump at RO WTP No. 1 is no longer operational. The pump should be rebuilt or replaced.
- Minor corrosion is visible on the day tank's support stand.

Capacity: Positive

- The day tank volume is 100 gallons, which provides 1200 hours of storage at the maximum flow for WTP No. 1. This size is adequate for the facility.
- The chemical metering pump is sized to provide 4.9 gpd and has a turndown of 20:1. At the maximum WTP flow and dose, the metering pump will operate at 40 percent of its rated capacity. This size is adequate for the facility.

Performance: Neutral

- Drum pump does not function although operations staff makes accommodations to transfer chemical to the day tank.
- Scale inhibitor is consistently delivered at the proper dose.
- The static mixer produces a head loss that is greater than other models of static mixers that are available. The current static mixer produces a head loss of 2.5 psi at a flow of 1,000 gpm. This headloss is high compared to the headloss that would occur from other static mixers that are available.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore dosing if a pump or motor fails.
- The system operates reliably.

Improvement Opportunities

- Rebuild or replace the drum pump.
- Replace the static mixer. Currently, there is a large pressure drop across the mixer. Replacing it with one that has a lower pressure drop will reduce operational expenses by reducing the amount of energy required for groundwater pumping.
- Monitor corrosion on the day tank's support structure. Remove corrosion and provide a protective coating if corrosion becomes excessive.

4.4.1.11 Post Treatment Chemical - Calcium Hypochlorite Storage and Feed System

Solid tablets of calcium hypochlorite are dissolved onsite to produce a source of chlorine for the finished water. The calcium hypochlorite is dissolved by a finished water side stream, and the flow rate of the side stream is controlled by a valve. The chlorinated solution produced is returned to the finished water main line by a solution feed pump.

Assessment

Condition: Negative

- The calcium hypochlorite system requires frequent maintenance.

Capacity: Negative

- The state requires liquid chlorine systems to be able to feed a dose up to 5 mg/L. Performance literature from the manufacturer states that the system can deliver up to 2.5 lbs/hr of chlorine which is equal to a dose of 5 mg/L at maximum plant flow, however, MPW has difficulty maintaining residual.

Performance: Negative

- MPW experiences difficulty maintaining a chlorine residual.

Reliability/Redundancy: Negative

- Maintenance frequently needs to be performed on this system. At a minimum, the system needs an acid bath bi-annually to remove scale.
- The bearings on the solution feed pump experience periodic failure.
- The control boards generally last for only one year.
- A shelf spare solution feed pump and motor is maintained by MPW.
- Even when the equipment is functioning, MPW has difficulty maintaining residual.

Improvement Opportunities

- In 2018, MPW will replace the calcium hypochlorite system with a 12.5 percent sodium hypochlorite system. The system will be sized to deliver a maximum of 5 mg/L of chlorine in accordance with the State's requirements.

4.4.1.12 Post Treatment Chemical - Anhydrous Ammonia Storage and Feed System

Anhydrous ammonia is added to the finished water to react with chlorine and form monochloramine. Monochloramine is a residual disinfectant that guards against the reemergence of pathogens in the finished water while reducing the potential to form chlorinated disinfection byproducts. Anhydrous ammonia is delivered to the WTP in 150-lb gas cylinders. An ammoniator system is used to mix the ammonia with a finished water side stream, and the resulting ammonia solution is diffused into the finished water main line through the use of an injector. Tank scales are used to monitor the amount of ammonia remaining in each cylinder.

Assessment

Condition: Negative

- The injection point for the ammonia solution is located underground inside of a manhole. Sand and soil are accumulating inside the manhole burying the injector. In addition, the tank scales have not been calibrated recently and some corrosion is present on the face of the scales. A Capital Improvement Plan (CIP) project to replace and or repair the existing scales was recently requested by MPW.

Capacity: Positive

- Two (2) 150-lb gas cylinders of ammonia can be connected to the ammoniator at a time. This capacity is sufficient for this size WTP, and will provide 50 days of storage at maximum plant flow and maximum dose (i.e., dose based upon a 4:1 chlorine to ammonia ratio).
- One (1) 14 lb per day ammoniator is installed and operates at 43 percent of its capacity to meet the dose requirements at maximum flow and maximum dose.

Performance: Neutral

- No performance issues were reported. However, the tank scales have not been calibrated recently. The scales should be calibrated to ensure the ammonia system is delivering the proper dose.

Reliability/Redundancy: Neutral

- The system operates reliably, however, the ammoniator system is not redundant, and MPW does not have spare parts.
- The system operates reliably.

Improvement Opportunities

- Calibrate tank scales an on annual basis.
- Remove the soil that is burying the injector from the manhole.
- Purchase spare parts required for replacement/repairs.
- Monitor corrosion on the face of the scales. Replace scales if corrosion creates an unstable platform for the cylinders.

4.4.1.13 Post Treatment Chemical - Calcium Chloride Storage and Feed System

Calcium chloride is added to the finished water for hardness adjustment and corrosion control. Tanker trucks deliver calcium chloride to the WTP. An outdoor tank stores the calcium chloride offloaded from the trucks. From the storage tanks, the calcium chloride drains by gravity to a day tank that supplies a chemical metering pump. From the metering pump, calcium chloride is injected into the finished water pipeline through an injection quill.

Assessment

Condition: Neutral

- Erosion and/or another process have worn away concrete at the base of the bulk storage tank leaving the aggregate exposed.
- Very minor corrosion is visible on the day tank's support stand.

Capacity: Positive

- The bulk storage tank's volume is 6,000 gal. This volume will provide 58 days of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The day storage tank's volume is 180 gal, which provides 42 hours of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The chemical metering pump can pump up to 11.4 gallons per hour (gph) and has a turndown of 40:1. At the maximum WTP flow and dose, the metering pump will operate at 38 percent of its rated capacity. This size is adequate for the facility.

Performance: Neutral

- Calcium Chloride is consistently delivered at the proper dose. No performance issues have been reported.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore operations if a pump or motor fails.
- The system operates reliably, however, the injection quill requires periodic acid washes to remove scale that otherwise clogs the quill.

Improvement Opportunities

- Monitor erosion in the secondary containment area of the bulk storage tank, and corrosion on the tank stand.

4.4.1.14 RO WTP No. 1 - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources and the demand-based redundancy between the multiple pumps, there is little or no other

redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $70,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.1.15 RO WTP No. 1 - Control System

This control system was originally built and installed by Hydranautics in approximately 1992. The system hardware and software has upgraded with the last 5-years and uses an Allen-Bradley CompactLogix type of Programmable Logic Controller (PLC) interfaced over an Ethernet network to a Personal Computer (PC) Based Trihedral VTSCADA Application for monitoring and control. The instrumentation and devices used are connected to the PLC by hardwired I/O to the main cabinet.

Assessment

Condition: Positive

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Cabinet penetrations from previously abandoned pilot devices on the back of the panel are covered by a metal plate to preserve and protect the integrity of the enclosure.

Capacity: Positive

- PLC I/O:
  - 40 Analog Inputs.
  - 16 Analog Outputs.
  - 64 Digital Inputs.
  - 32 Relay Outputs.
- SCADA tags:
  - 5,000 tag count.

- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Positive

- The hardware and software platforms of the control system are satisfactory.

Reliability/Redundancy: Neutral

- There is no redundancy in the architecture of the control system. The hardware and software are modern and serviceable by the manufacturer or third party providers. In addition, MPW maintains an inventory of spare parts.

Improvement Opportunities

- Consider replacing the membrane elements in 2023. The membranes elements will be ten years old at that point and may be approaching the end of their design life expectancy.
- Use cable glands for network cables penetrations in the main control panel. This provides both a seal for the cabinet and strain relief for the cable.
- Replace the concentrate pump starter/control panels within 10-years. The panel has some evidence of corrosion and many of the components are 20+ years old.
- Install bypass switches on the network rack UPS. This allows for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS need to be taken out of service.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.[5]

4.4.1.16 RO WTP No. 1 - Treatment Plant Structure(s)

There are five structures located at RO WTP No. 1: three treatment plant buildings, one bulk chemical storage area, and one concentrate pump station.[6] The buildings include: the RO building, the calcium hypochlorite chemical feed building, the anhydrous ammonia chemical feed building, and the high service pump station. The condition of these buildings and other structures vary widely.

Assessment

Condition: Varies

- RO Building: Neutral. Some cracking over doorway lintels indicates that reinforcement may not have been installed. Coatings on roof deck require attention in some areas. Address leakage at seams of, or replace rain gutters.
- Calcium Hypochlorite Chemical Feed Building: Negative. A large crack in the concrete slab indicates structural issues for the building.
- Anhydrous Ammonia Chemical Feed Building: Negative. The exterior trim needs painting, minor to mid-size cracks around doors and windows, and a leak in the roof where ammonia is stored.
- Bulk Chemical Storage Area: Neutral. The calcium chloride storage area shows no signs of settling and is in fair condition. The sulfuric acid bulk chemical storage area is no

[5] MPW plans to start collecting VFD data once the existing VFDs are replaced.
[6] The ground storage tank and high service pump station will be addressed separately later in this Chapter.

longer in use and will be demolished as part of the Disinfection Conversion Project (2018).

Improvement Opportunities

- Perform an annual assessment that documents the condition of each facility to identify any areas that experience accelerated deterioration.
- Monitor cracks above doorway lintels at RO WTP No. 1 building and fill existing cracks. Repair coating on roof decking.
- Address leakage at seams of, or replace rain gutters.
- Repair coating on roof decking.
- Demolish calcium hypochlorite building after the disinfection conversion project is completed in 2018.
- Repair roof in the anhydrous ammonia building.

4.4.1.17 RO WTP No. 1 - Assessment Summary

Major facilities associated with the pumping and treatment of groundwater at RO WTP No. 1 include: Deep Well No. 1, a raw water transmission pipeline, the RO production facility, a bulk chemical storage area, the calcium hypochlorite chemical feed building, and the anhydrous ammonia chemical feed building. The structure of these facilities, and the mechanical equipment and associated power and control systems they house were assessed. The assessment evaluated the general fields of: condition, capacity, performance, and reliability and redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.3.

The majority of RO WTP No. 1's facilities, mechanical equipment, power, and control systems received a Neutral or Positive rating. In general, RO WTP No. 1 and its associated facilities are able to function sufficiently to meet their intended purpose. The facilities also generally appear capable of meeting the increase in maximum demands that will be experienced following the completion of the groundwater blending project. However, a few Negative ratings were assigned that MPW should plan to address.

Areas that received a Negative rating in one or more field include:

- Deep Well No. 1 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs. MPW does, however, have a CIP to replace the VFDs.
- Scale Inhibitor Storage & Feed System:
  - Negative rating was associated with the drum pump that does not function.
- Calcium Hypochlorite Storage & Feed System:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to difficulty in maintaining a chlorine residual with this system, and the frequent maintenance required. This system will be replaced by the summer of 2018 with a new 12.5 percent sodium hypochlorite storage and feed system.
- Anhydrous Ammonia Storage & Feed System:
  - Negative rating in the condition field due to soil accumulation that has buried the ammonia injection point located inside a manhole.

- RO WTP No. 1 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs.
- RO WTP No. 1 – Treatment Plant Structures:
  - Negative rating in the condition field due to the current state of the Anhydrous Ammonia Chemical Feed Building, and Calcium Hypochlorite Chemical Feed Building. The Anhydrous Ammonia Building's exterior trim should be repainted, there are cracks around doors and windows, and a leak in the roof where the ammonia is stored.

Table 4.3 RO WTP No. 1 Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
Deep Well No. 1 - Groundwater Well	POSITIVE	POSITIVE	NEUTRAL	NEUTRAL
Deep Well No. 1 - Wellhead Facilities	NEUTRAL	POSITIVE	NEUTRAL	NEUTRAL
Deep Well No. 1 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
Groundwater Transmission Pipeline	NEUTRAL	POSITIVE	POSITIVE	NEUTRAL
Cartridge Filters	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
Membrane Feed Pumps	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
RO Trains	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Scale Inhibitor Storage & Feed System	NEGATIVE	POSITIVE	NEUTRAL	POSITIVE
Calcium Hypochlorite Storage & Feed System	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Anhydrous Ammonia Storage & Feed System	NEGATIVE	POSITIVE	NEUTRAL	NEUTRAL
Calcium Chloride Storage & Feed System	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
RO WTP No. 1 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 1 - Control System	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
RO WTP No. 1 - Treatment Plant Structures	NEUTRAL(1)	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

Note:
(1) Represents an average rating of the multiple structures present at RO WTP No. 1.

4.4.2 RO WTP No. 2

4.4.2.1 Deep Well No. 2

Deep Well No. 2 is the sole raw water source for RO WTP No. 2. The well was constructed in 1969. The total depth of the well is 1,993 ft bls. Groundwater is lifted from the well using a

vertical turbine pump equipped with a 350 HP motor. The well's discharge flange sits atop a concrete pedestal, and an asphalt-shingled, wooden-framed canopy protects the wellhead from the sun and the elements. Table 4.4 presents general information regarding Deep Well No. 2.

Deep Well No. 2 does not have a PVC drop tube that is dedicated for a level transmitter. Installing a dedicated drop tube will help prevent hang-ups when making water level measurements, and will allow a water level transmitter to be permanently installed and continuous water level measurements made.

Table 4.4 Middendorf Aquifer Deep Well No. 2 Summary

	Deep Well No. 2
Pump Capacity	1560 gpm @ 700 ft TDH
Year Constructed	1969
Age of Pump	12
Standby Power Source	900 KW Generator(1)
Year of Last Inspection	2017
Condition	Neutral

Notes:
(1) Stationary generator shared with all RO WTP No. 2 facilities.

4.4.2.2 Deep Well No. 2 - Groundwater Well

Deep Well No. 2 was constructed with three steel casings, however the diameter and depths of these casings is currently unknown. The well screens are located at depths of 1,800-1,850 ft bls, 1,940-1,960 ft bls, and 1,976-1,986 ft bls. The well screens are open to the Middendorf aquifer.

Assessment

Condition: Negative

- In October 2017, Deep Well No. 2 produced rusted column pipe material. The column pipe and pump bowls were subsequently pulled and the casing and column pipe were heavily corroded. Deep Well No. 2 has not operated since.

Capacity: Negative

- Prior to October 2017, the well was capable of supplying sufficient groundwater to RO WTP No. 2 to meet the Plant's existing requirements. The well also appeared capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). The existing well and its pump were rated at 1,560 gpm at 700 ft TDH. Although the existing Deep Well No. 2 is not operating and may require replacement, the replacement well is expected to supply sufficient groundwater to meet the Plant's requirements.

Performance: Negative

- Prior to October 2017, the well's performance was adequate to meet the requirements of RO WTP No. 2. The well also appeared capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). Although the existing Deep Well No. 2 is not operating and may require replacement, the replacement well is expected to supply sufficient groundwater to meet the Plant's requirements.

Reliability/Redundancy: Negative

- RO WTP No. 2 does not have a redundant raw water supply. However, the design life of a deep well is 50-100 years (depending on the materials used in well construction). The existing Deep Well No. 2 was constructed in 1969 and is 48-years old. Although the existing Deep Well No. 2 is not currently operating and may require replacement, the replacement well is expected to provide a reliable, long-term supply.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Construct a replacement Deep Well No. 2.
- Recommend installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
  - Furthermore, periodic review of data collected from the level transmitter is recommended.
- TV the well the next time the pump is removed.

4.4.2.3 Deep Well No. 2 - Well Head Facilities

Well head facilities at Deep Well No. 2 consist of: a motor-driven vertical turbine pump, piping and valves, and an open-walled canopy. The well's pump bowl assembly has 7 stages and is located approximately 500 ft bls. Power is supplied to the pump bowls from a 350 HP motor. A check valve near the discharge flange provides protection from backflow and possible contamination from entering the well. A 1-inch diameter PVC line continuously supplies the line shaft bearings with clean water. This water keeps the bearings pre-lubricated, and avoids the potential of dry running them before they become flooded with pumped water after the pump is turned on. A pair of butterfly valves operate in concert to either direct flow from the well to RO WTP No. 2, or to a flush line. The flush line transports flow to a nearby pond. Otherwise, raw water is supplied to the plant through a 12-inch pipe that runs underground.

Assessment

Condition: Negative

- In October 2017, Deep Well No. 2 produced rusted column pipe material. The column pipe and pump bowls were subsequently pulled and the casing and column pipe were heavily corroded. Deep Well No. 2 has not operated since.

Capacity: Negative

- Prior to October 2017, the well was capable of supplying sufficient groundwater to RO WTP No. 2 to meet the Plant's existing requirements. The well also appeared capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). The existing well and its pump were rated at 1,560 gpm at 700 ft TDH. Although the existing Deep Well No. 2 is not operating and may require replacement, the replacement well is expected to supply sufficient groundwater to meet the Plant's requirements.

Performance: Negative

- Prior to October 2017, the well's performance was adequate to meet the requirements of RO WTP No. 2. In October 2017, Deep Well No. 2 produced rusted column pipe material. Deep Well No. 2 has not operated since and may require replacement.

Reliability/Redundancy: Negative

- RO WTP No. 2 does not have a redundant raw water supply. However, the design life of a deep well is 50-100 years (depending on the materials used in well construction). The existing Deep Well No. 2 was constructed in 1969 and is 48-years old. Although the existing Deep Well No. 2 may require replacement, the replacement well is expected to provide a reliable, long-term supply.
- Standby power is available.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Deep Well No. 2 may require replacement. Either construct a replacement Deep Well No. 2, or rehabilitate the existing Deep Well No. 2 to return it to service.
- The coating on the base of the pump is chipping away. Recommend monitoring the condition of the coating on the pump and discharge piping at regular intervals, and recoating as necessary to prevent corrosion.
- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings, in additional to the spare 350 HP motor currently stored.

4.4.2.4 Deep Well No. 2 - Power Supply

The Deep Well No. 2 pump motor and disconnect are located outside at the RO WTP No. 2 facility. The VFD for this motor is located inside the Electrical Room of RO WTP No. 2. The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.
- Deep Well No. 2 pump motor termination box is not rated for the environment and has some corrosion.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional load would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

4.4.2.5 Deep Well No. 2 - Control System

Deep Well No. 2 is at RO WTP No. 2 and the controls are incorporated into the control system for that RO Plant.

Assessment

Because RO WTP No. 2 and Deep Well No. 2 share a common control system, refer to RO WTP No. 2 control system assessment narrative.

4.4.2.6 Groundwater Supply Transmission Pipeline

Deep Well No. 2 and RO WTP No. 2 are co-located on the same property. An above-ground valve and piping network direct the raw water from the well to either the WTP, or to a flush line. When the raw water is directed toward the WTP, approximately 215 ft of 10-inch diameter pipe that runs underground conveys the raw water to the WTP. Table 4.5 summarizes the groundwater supply transmission piping for RO WTP No. 2.

Table 4.5 RO WTP No. 2 Groundwater Supply Transmission Piping Summary

Pipe Location	Length (ft)	Diameter (inches)	Material	Year Installed	Previous Breaks? (Y or N)
From Deep Well No. 2 to RO WTP No. 2	215	12	DIP	1992	N

Assessment

Condition: Neutral

- No negative observations were made during the site visit, and MPW operation's staff did not provide any negative comments regarding the pipeline.

Capacity: Positive

- The pipeline has adequate capacity for existing and planned demands. Following the completion of the groundwater blending project, the maximum raw water flowrate will be 1,800 gpm. The velocity at that flowrate will be 5 ft/sec, which is within the range commonly thought to be acceptable in general water industry practice.

Performance: Positive

- There are no known performance issues.

Reliability/Redundancy: Neutral

- Neutral. The transmission pipeline has functioned reliably, however, it does not provide any redundancy since the pipeline is the only raw water supply source for RO WTP No. 2.

Improvement Opportunities

- Include the following activities on a preventative maintenance schedule:
  - Monitor corrosion on the above ground valves and pipe. Recoat as necessary.
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.4.2.7 Cartridge Filters

Two cartridge filter housings at RO WTP No. 2 pre-filter the raw water flow before it enters the RO vessels. They are responsible for removing particles large enough to foul the membrane surfaces or plug the feed water channel of the membranes.

Assessment

Condition: Positive

- No negative observations were made during the site visit.

Capacity: Positive

- The housings have adequate capacity for existing and planned demands. They have an individual capacity of 1,040 gpm, and a combined capacity of 2,080 gpm.

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- MPW monitors the performance of the cartridge filters by measuring the silt density index on a monthly basis. MPW also replaces the cartridge filters on an annual basis as a

precaution to protect the RO membranes. These practices demonstrate and help ensure the reliable performance of the cartridge filters.

- The cartridge filters can be isolated allowing the plant to remain in operation while one cartridge filter is offline. Although both cartridge filters are typically in operation simultaneously, the ability to isolate a cartridge filter increases the reliability and redundancy of the system.

Improvement Opportunities

- None.

4.4.2.8 Membrane Feed Pumps

There are two membrane feed pumps at RO WTP No. 2. They are arranged in a duty / stand-by configuration. The membrane feed pumps supply the pressure needed to force water through the RO membranes removing the dissolved salts from the feed water.

Assessment

Condition: Positive

- No deficiencies were noted.

Capacity: Positive

- The pumps have adequate capacity for existing and planned demands. The pump rating is 1,300 gpm at 437 TDH (with one-pump running).

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- The membrane feed pumps are arranged in a duty / stand-by configuration. This arrangement meets the State's requirements for pump station reliability and redundancy since one pump can remain in operation while maintenance is performed on the other.
- Spare parts are not stored by MPW, however, spare parts are commercially available.

Improvement Opportunities

- None.

4.4.2.9 RO Trains

There are three RO trains at RO WTP No. 2. The trains are two-stage, single-pass, and use a hybrid membrane array to balance the flux through the 8 vessels in the first stage with the 4 vessels in the second stage. The plant can operate the trains individually or run the trains in any combination simultaneously.

Assessment

Condition: Neutral

- The membrane elements were replaced in 2007. The design life expectancy of a membrane is ten years, and the elements may be approaching the end of their useful life. For planning purposes, MPW may consider replacing the membrane elements within the next few years. Membrane replacement will reduce energy use, and improve permeate water quality.

Capacity: Neutral

- The RO trains have a capacity of 400 gpm per train (1,200 gpm total capacity) and the membrane condition is such that the membrane feed pumps can increase speed to maintain this flow rate.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability / Redundancy: Neutral

- RO Trains are not redundant. Redundant trains are not required by the State, however, loss of a single train would result in a 33 percent decrease in the production capacity.
- Spare parts (e.g., membranes) are not stored on site, however, they are commercially available.
- Around 2007, the membrane elements were replaced. Their performance to date has been satisfactory, and any degradation in performance over time has not been sufficient to warrant performing a membrane clean-in-place. The RO trains and their supporting equipment have proven reliable.

Improvement Opportunities

- Continue daily monitoring of the pressure drop across the membranes, and weekly monitoring of the conductivity. Perform a clean-in-place of the membranes when warranted based upon these data.
- Calibrate the pressure transmitters to ensure their accuracy.
- Plan on replacing the membrane elements within the next few years. The membrane elements are ten years old- which is their design life expectancy- and may require replacement within the next few years.

4.4.2.10 Pretreatment Chemical - Scale Inhibitor Storage and Feed System

Scale inhibitor is added to the raw water to prevent the formation of mineral scale on the RO membranes as well as piping and ancillary equipment. Scale inhibitor is delivered to the WTP in 55-gallon drums. Subsequently, the scale inhibitor is transferred via a drum pump to a day tank that supplies a chemical metering pump. From the metering pump, the scale inhibitor is injected into the raw water pipeline through an injection quill. A static mixer downstream of the injection quill disperses the scale inhibitor.

Assessment

Condition: Neutral

- The condition of the scale inhibitor storage and feed system is satisfactory. However, one of the rollers on the peristaltic pump's roller assembly was making a screeching noise during the site visit.

Capacity: Neutral

- The day tank volume is 100 gallons, which provides 799 hours of storage at the maximum flow for WTP No. 2. This size is adequate for the facility.
- The chemical metering pump is sized to provide 4.9 gpd and has a turndown of 20:1. At the maximum WTP flow and dose, the metering pump will operate at 60 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Scale inhibitor is consistently delivered at the proper dose.
- The static mixer produces a head loss that is greater than other models of static mixers that are available. The current static mixer produces a head loss of 2.5 psi at a flow of 1,000 gpm. This headloss is high compared to the headloss that would occur from other static mixers that are available.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore dosing if a pump or motor fails. The system operates reliably.

Improvement Opportunities

- Replace the roller assembly on the peristaltic pump.
- Replace the static mixer. Currently, there is a large pressure drop across the mixer. Replacing it with one that has a lower pressure drop will reduce operational expenses by reducing the amount of energy required for groundwater pumping.
- Monitor corrosion on the day tank's support structure. Remove corrosion and provide a protective coating if corrosion becomes excessive.

4.4.2.11 Post Treatment Chemical - Calcium Hypochlorite Storage and Feed System

Solid tablets of calcium hypochlorite are dissolved onsite to produce a source of chlorine for the finished water. The calcium hypochlorite is dissolved by a finished water side stream, and the flow rate of the side stream is controlled by a valve. The chlorinated solution produced is returned to the finished water main line by a solution feed pump.

Assessment

Condition: Negative

- The calcium hypochlorite system requires frequent maintenance, and MPW experiences difficulty in maintaining a chlorine residual.

Capacity: Negative

- The state requires liquid chlorine systems to be able to feed a dose up to 5 mg/L. Performance literature from the manufacturer states that the system can deliver up to 2.5 lbs/hr of chlorine which is equal to a dose of 3.3 mg/L at maximum plant flow, however, MPW has difficulty maintaining residual.

Performance: Negative

- MPW experiences difficulty maintaining a chlorine residual.

Reliability/Redundancy: Negative

- Maintenance frequently needs to be performed on this system.
- The system needs an acid bath bi-annually to remove scale.
- The bearings on the solution feed pump experience periodic failure.
- The control boards generally last for only one year.
- A shelf spare solution feed pump and motor is maintained by MPW.

- Even when the equipment is functioning, MPW has difficulty maintaining residual.

Improvement Opportunities

- In 2018, MPW will replace the calcium hypochlorite system with a 12.5 percent sodium hypochlorite system. The system will be sized to deliver a maximum of 5 mg/L of chlorine in accordance with the State's requirements.

4.4.2.12 Post Treatment Chemical - Anhydrous Ammonia Storage and Feed System

Anhydrous ammonia is added to the finished water to react with chlorine and form monochloramine. Monochloramine is a residual disinfectant that guards against the reemergence of pathogens in the finished water while reducing the potential to form chlorinated disinfection byproducts. Anhydrous ammonia is delivered to the WTP in 150-lb gas cylinders. An ammoniator system is used to mix the ammonia with a finished water side stream, and the resulting ammonia solution is diffused into the finished water main line through the use of an injector. Tank scales are used to monitor the amount of ammonia remaining in each cylinder.

Assessment

Condition: Negative

- The injection point for the ammonia solution is located underground inside of a manhole. Sand and soil are accumulating inside the manhole burying the injector. In addition, the tanks scales have not been calibrated recently and some corrosion is present on the face of the scales. A CIP project to replace and or repair the existing scales was recently requested by MPW.

Capacity: Positive

- Two (2) 150-lb gas cylinders of ammonia can be connected to the ammoniator at a time. This capacity is sufficient for this size WTP, and will provide 33 days of storage at maximum plant flow and maximum dose (i.e., dose based upon a 4:1 chlorine to ammonia ratio).
- One (1) 14 lb per day ammoniator is installed and operates at 64 percent of its capacity to meet the dose requirements at maximum flow and maximum dose.

Performance: Neutral

- No performance issues were reported. However, the tank scales have not been calibrated recently. The scales should be calibrated to ensure the ammonia system is delivering the proper dose.

Reliability/Redundancy: Neutral

- The system operates reliably, however, the ammoniator system is not redundant, and MPW does not have spare parts.
- The system operates reliably.

Improvement Opportunities

- Calibrate tank scales an on annual basis.
- Remove the soil that is burying the injector from the manhole.
- Purchase spare parts required for replacement/repairs.
- Monitor corrosion on the face of the scales. Replace scales if corrosion creates an unstable platform for the cylinders.

4.4.2.13 Post Treatment Chemical - Calcium Chloride Storage and Feed System

Calcium chloride is added to the finished water for hardness adjustment and corrosion control. Tanker trucks deliver calcium chloride to the WTP in bulk. An outdoor tank stores the calcium chloride offloaded from the trucks. From the storage tanks, the calcium chloride drains by gravity to a day tank that supplies a chemical metering pump. From the metering pump, the calcium chloride is injected into the finished water pipeline through an injection quill.

Assessment

Condition: Neutral

- Erosion and/or another process have worn away concrete at the base of the bulk storage tank leaving the aggregate exposed.
- Very minor corrosion is visible on the day tank's support stand.
- A small amount of oil had pooled beneath the peristaltic pump and suggests that the pump is leaking oil.

Capacity: Positive

- The bulk storage tank's volume is 6,000 gal. This volume will provide 39 days of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The day storage tank's volume is 180 gal, which provides 28 hours of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The chemical metering pump can pump up to 11.4 gph and has a turndown of 40:1. At the maximum WTP flow and dose, the metering pump will operate at 57 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Calcium Chloride is consistently delivered at the proper dose. No performance issues have been reported.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore operations if a pump or motor fails.
- The system operates reliably, however, the injection quill requires periodic acid washes to remove scale that otherwise clogs the quill.

Improvement Opportunities

- Monitor erosion in the secondary containment area of the bulk storage tank, and corrosion on the tank stand.
- Verify if the oil that pooled beneath the peristaltic pump is from an oil leak.

4.4.2.14 RO WTP No. 2 - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources and the demand-based redundancy between the multiple pumps, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

- The estimated cost to complete the electrical improvement opportunities identified in this section is $70,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.2.15 RO WTP No. 2 - Control System

This control system was originally built and installed by Hydranautics in approximately 1992. The system PLC hardware is still the original equipment and uses an Allen-Bradley SLC type of PLC interfaced over an Ethernet network to a PC Based Trihedral VTSCADA Application for monitoring and control. The software has upgraded with the last 5-years. The instrumentation and devices used are connected to the PLC by hardwired I/O to the main cabinet.

Assessment

Condition: Positive

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Cabinet penetrations from previously abandoned pilot devices on the back of the panel are covered by a metal plate to preserve and protect the integrity of the enclosure.

Capacity: Neutral

- PLC I/O:
  - 40 Analog Inputs.
  - 20 Analog Outputs.
  - 64 Digital Inputs.
  - 48 Relay Outputs.
- SCADA tags:
  - 5,000 tag count.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Negative.

- The life cycle of the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued. The software platform of the HMI system is modern and reliable.

Reliability/Redundancy: Neutral.

- There is no redundancy in the architecture of the control system. The hardware is serviceable but migration to newer technology is recommended. The software is modern and serviceable by the manufacturer or third party providers.

Improvement Opportunities

- Replacement of PLC hardware is recommended within 5-years.[7]
- Replacement of 24V DC power supply in main control panel.[8]
- Replace the concentrate pump starter/control panels within 10-years. The panel has some evidence of corrosion and many of the components are 20+ years old.

[7] A CIP project that includes PLC hardware replacement should be completed by Dec 2017.
[8] A CIP project that includes replacing the 24V DC power supply should be completed by Dec 2017.

- Install bypass switches on the network rack UPS. This allows for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS need to be taken out of service.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.4.2.16 RO WTP No. 2 - Treatment Plant Structure(s)

There are five treatment plant related structures located at RO WTP No. 2.[9] These include: the RO building, the calcium hypochlorite chemical feed building, the anhydrous ammonia chemical feed building, a bulk chemical storage area, and a concentrate pump station. The structures are generally in good condition, however, the chemical storage area requires rehabilitation.

Assessment

Condition: Varies

- RO Production Facility: Neutral. The architectural metal siding on the north side of the facility is damaged, and coatings on the roof deck are peeling off. Address leakage at seams of, or replace rain gutters.
- Calcium Hypochlorite Chemical Feed Building: Positive. No negative observations were made during the site visit.
- Anhydrous Ammonia Chemical Feed Building: Positive. No negative observations were made during the site visit.
- Bulk Chemical Storage Area: Negative. The acid and caustic soda storage areas that are no longer in use should be demolished.
- Concentrate Pump Station: Positive. No negative observations were made during the site visit.

Improvement Opportunities

- Perform an annual assessment that documents the condition of each facility to identify any areas that experience accelerated deterioration.
- For the RO Production Facility:
  - Repair the architectural metal siding on the north side of the building.
  - Re-coat the roof decking.
  - Address leakage at seams of, or replace rain gutters.
  - Determine the source of, and repair the leaks above the restroom and electrical rooms.
- Bulk Chemical Storage Area:
  - Demolish the acid and caustic soda storage areas that are no longer in use.
- Demolish calcium hypochlorite building after the disinfection conversion project is completed in 2018.

4.4.2.17 RO WTP No. 2 - Assessment Summary

Major facilities associated with the pumping and treatment of groundwater at RO WTP No. 2 include: Deep Well No. 2, a raw water transmission pipeline, the RO production facility, a bulk chemical storage area, the calcium hypochlorite chemical feed building, and the anhydrous

[9] The ground storage tank and high service pump station will be addressed separately later in this Chapter.

ammonia chemical feed building. The structure of these facilities, and the mechanical equipment and associated power and control systems they house were assessed. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.6.

Table 4.6 RO WTP No. 2 Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
Deep Well No. 2 - Groundwater Well	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Deep Well No. 2 - Wellhead Facilities	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Deep Well No. 2 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
Groundwater Transmission Pipeline	NEUTRAL	POSITIVE	POSITIVE	NEUTRAL
Cartridge Filters	POSITIVE	POSITIVE	POSITIVE	POSITIVE
Membrane Feed Pumps	POSITIVE	POSITIVE	POSITIVE	POSITIVE
RO Trains	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Scale Inhibitor Storage & Feed System	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
Calcium Hypochlorite Storage & Feed System	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Anhydrous Ammonia Storage & Feed System	NEGATIVE	POSITIVE	NEUTRAL	NEUTRAL
Calcium Chloride Storage & Feed System	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
RO WTP No. 2 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 2 - Control System	POSITIVE	NEUTRAL	NEGATIVE	NEUTRAL
RO WTP No. 2 - Treatment Plant Structures	NEUTRAL(1)	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

Notes:
(1) Represents an average rating of the multiple structures present at RO WTP No. 2.

The majority of RO WTP No. 2's facilities, mechanical equipment, power, and control systems received a Neutral or Positive rating. In general, RO WTP No. 2 and its associated facilities are able to function sufficiently to meet their intended purpose. The facilities also generally appear capable of meeting the increase in maximum demands that will be experienced following the completion of the groundwater blending project. However, a few Negative ratings were assigned that MPW should plan to address.

Areas that received a Negative rating in one or more field include:

- Deep Well No. 2 – Groundwater Well:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to Deep Well No. 2 being out of service due to casing and column pipe corrosion.
- Deep Well No. 2 – Well Head Facilities:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to Deep Well No. 2 being out of service due to casing and column pipe corrosion.
- Deep Well No. 2 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs.
- Calcium Hypochlorite Storage & Feed System:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to difficulty in maintaining a chlorine residual with this system, and the frequent maintenance required. This system will be replaced by the summer of 2018 with a new 12.5 percent sodium hypochlorite storage and feed system.
- Anhydrous Ammonia Storage & Feed System:
  - Negative rating in the condition field due to soil accumulation that has buried the ammonia injection point located inside a manhole.
- RO WTP No. 2 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs.
- RO WTP No. 2 – Control System:
  - Negative rating in the performance field due to PLC hardware being in the "Active Mature" status (as identified by the manufacturer). PLC support and replacement parts are still available but are soon to be discontinued.

4.4.3 RO WTP No. 3

4.4.3.1 Deep Wells No. 3, 4, and 5 Summary

Deep Wells No. 3 and 4 supply raw water to RO WTP No. 3, however, construction of an additional Deep Well is planned to be completed in 2018. The well will be named Deep Well No. 5 and installed as a replacement for an older well whose casings failed and was subsequently abandoned. Table 4.7 presents general information regarding Deep Well Nos. 3, 4, and 5.

Table 4.7 Middendorf Aquifer Deep Well No. 3, 4 and 5 Summary

	Deep Well No. 3	Deep Well No. 4	Deep Well No. 5 (1)
Pump Capacity	1,200 gpm @ 618 ft TDH	1,100 gpm @ 750 ft TDH	1,000 gpm
Year Constructed	1971	1984	2018
Age of Pump	2008	2006	NA
Standby Power Source	275 KW Generator(2)	350 KW Generator(2)	Generator(3)
Year of Last Inspection	2008	1993	NA
Condition	Negative	Neutral	NA

Notes:

(1) Information presented is based on the design of the Deep Well No. 5 replacement well. This well is currently under design and scheduled for completion in 2018.

(2) Portable generator.

(3) Stationary generator shared with RO WTP No. 3.

Deep Well No. 3 was constructed in 1971. The total depth of the well is 1,950 ft bls. Groundwater is lifted from the well using a vertical turbine pump equipped with a 250 HP motor. The well's discharge flange sits atop a concrete pedestal, and an asphalt-shingled, wooden-framed canopy protects the wellhead from the sun and the elements.

Deep Well No. 4 was constructed in 1984. The total depth of the well is 1,960 ft bls. Groundwater is lifted from the well using a vertical turbine pump equipped with a 300 HP motor. The well's discharge flange sits atop a concrete pedestal, and an asphalt-shingled, wooden-framed canopy protects the wellhead from the sun and the elements.

Deep Well No. 3 does not have a PVC drop tube that is dedicated for a level transmitter. Deep Well No. 4 does have a PVC drop tube for a level transmitter, but does not have a level transmitter. Installing a dedicated drop tube in Deep Well No. 3 will help prevent hang-ups when making water level measurements. Installing a level transmitter inside the drop tubes will allow a water level transmitter to be permanently installed, providing continuous water level measurements necessary to assess the condition of the pump and well.

4.4.3.2 Deep Well No. 3 - Groundwater Well

Deep Well No. 3 was constructed with three steel casings: a 22-inch diameter conductor casing set to a depth of 51 ft bls, a 16-inch diameter outer casing set to a depth of 1,580 ft bls, and an 8-inch diameter inner casing set to a depth of 1,870 ft bls. The 8-inch casing is 340-ft long, and 62-ft of the 8-inch casing is located inside the 16-inch casing. The 8-inch casing includes 85-feet of screen. The well screens are located at depths of 1,575-1,580 ft bls, 1,704-1,736 ft bls, 1,740-1,756 ft bls, 1,824-1,848 ft bls, and 1,854-1,862 ft bls. The well screens are open to the Middendorf Aquifer.

Assessment

Condition: Neutral

- There are no significant known issues with Deep Well No. 3. However, Deep Well No. 3 was constructed in 1971 and is 47-years old. The design life expectancy of a deep well is often between 50-100 years (depending on materials used in construction). Deep Well No. 3 may be approaching the end of its design life and may require replacement within the next five years.

Capacity: Neutral

- When Deep Well No. 3 is operating alone, the well does not have the capacity to meet the maximum raw water flow requirements of RO WTP No. 3. The well is adequately sized to deliver the 1,200-gpm flow for which its pump is rated.

Performance: Neutral

- The well performs adequately, and can be operated with other wells to meet the requirements of RO WTP No. 3.

Reliability/Redundancy: Neutral

- The well's performance has been reliable, and having two deep wells supply water to RO WTP No. 3 does offer some redundancy although both wells are required to operate simultaneously to allow all RO trains at the WTP to operate at full production capacity.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Plan on replacing Deep Well No. 3 within the next 2-5 years. Deep Well No. 3 is 46-years old and may be approaching the end of its 50-year design life expectancy.
- Recommend installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
  - Furthermore, periodic review of data collected from the level transmitter is recommended.
- TV the well the next time the pump is removed.

4.4.3.3 Deep Well No. 3 - Well Head Facilities

Well head facilities at Deep Well No. 3 consist of: a motor-driven vertical turbine pump, piping and valves, and an open-walled canopy. The well's pump bowl assembly has 6 stages and is located approximately 500 ft bls. Power is supplied to the pump bowls from a 250 HP motor. A check valve near the discharge flange provides protection from backflow and possible contamination from entering the well. A 1-inch diameter PVC line continuously supplies the line shaft bearings with clean water. This water keeps the bearings pre-lubricated, and avoids the potential of dry running them before they become flooded with pumped water after the pump is turned on. A pair of butterfly valves operate in concert to either direct flow from the well to RO WTP No. 3, or to a flush line. The flush line transports flow to a ditch that drains offsite. Otherwise, raw water is supplied to the plant through a series of 16-inch diameter pipes that run underground.

Assessment

Condition: Negative

- The pump bowls and column pipe require replacement. They are scheduled to be replaced during fall/winter of 2017.

Capacity: Neutral

- When Deep Well No. 3 is operating alone, the well does not have the capacity to meet the maximum raw water flow requirements of RO WTP No. 3.

Performance: Neutral

- The well performs adequately, and can be operated with other wells, to meet the requirements of RO WTP No. 3. Note that groundwater flow from Deep Wells No. 3, 4, and 5 will be needed to meet the maximum capacity of RO WTP No. 3, (i.e., all RO trains running with maximum groundwater blending).

Reliability/Redundancy: Neutral

- The well's performance is generally reliable, and having two deep wells supply water to RO WTP No. 3 does offer some redundancy although both wells are required to operate simultaneously to allow all RO trains at the WTP to operate at full production capacity.
- Standby power is available.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Replace the pump bowls and line shaft bearings.

- The coating on the base of the pump is chipping away. Recommend monitoring the condition of the coating on the pump and discharge piping at regular intervals, and recoating as necessary to prevent corrosion.
- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings, in additional to the spare 250 HP motor currently stored.

4.4.3.4 Deep Well No. 3 - Power Supply

The Deep Well 3 facility was installed in 1992 and most electrical equipment is approximately 25 years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Neutral

- The electrical equipment appears to be in good condition overall, except for the generator which has some corrosion.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional load would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.

- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.
- Recommend replacing portable generator with a new stationary standby generator.
- Recommend replacing generator manual transfer switch (MTS) with a new generator ATS.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $140,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.3.5 Deep Well No. 3 - Control System

This site uses a Micrologix PLC connected to the main SCADA system over a cellular radio. The deep well pump is the only equipment at the site.

Assessment

Condition: Neutral

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Components inside were clean and free of any dust buildup indicating a good seal around the enclosure.

Capacity: Neutral

- PLC I/O:
  - 6 Analog Inputs.
  - 4 Analog Outputs.
  - 20 Digital Inputs.
  - 6 Digital Outputs.
- The I/O capacity cannot be expanded, however there is existing spare I/O points that can be utilized.

Performance: Neutral

- The Micrologix PLC is a low end controller that is very capable for the application.

Reliability/Redundancy: Neutral

- There are manual pilot controls on the motor control center (MCC) starter for the motor that can be used in lieu of the PLC.

Improvement Opportunities

- Remove the coaxial cabling that runs to the abandoned radio antenna.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.4.3.6 Deep Well No. 4 - Groundwater Well

Deep Well No. 4 was constructed with three steel casings: a 24-inch diameter conductor casing set to a depth of 80 ft bls, a 16-inch diameter outer casing set to a depth of 1,720 ft bls, and an

8-inch diameter inner casing set to a depth of 1,960 ft bls. The 8-inch casing is 320-ft long, and 80-ft of the 8-inch casing is located inside the 16-inch casing. The 8-inch casing includes 100 ft of screen. The well screens are located at depths of 1,754-1,784 ft bls, 1,820-1,840 ft bls, 1,855-1,890 ft bls, and 1,940-1,955 ft bls. The well screens are open to the Middendorf Aquifer.

Assessment

Condition: Neutral

- There are no significant known issues with Deep Well No. 4.

Capacity: Neutral

- When Deep Well No. 4 is operating alone, the well does not have the capacity to meet the maximum raw water flow requirements of RO WTP No. 3. The well is adequately sized to deliver the 1,100-gpm flow for which its pump is rated.

Performance: Neutral

- The well performs adequately, and can be operated with other wells, to meet the requirements of RO WTP No. 3.

Reliability/Redundancy: Neutral

- The well's performance has been reliable, and having two deep wells supply water to RO WTP No. 3 does offer some redundancy. However, both wells are required to operate simultaneously to allow all the RO trains at the WTP to operate at full production capacity.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Recommend installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
  - Furthermore, periodic review of data collected from the level transmitter is recommended.
- TV the well the next time the pump is removed.

4.4.3.7 Deep Well No. 4 - Well Head Facilities

Well head facilities at Deep Well No. 4 consist of: a motor-driven vertical turbine pump, piping and valves, and an open-walled canopy that covers the well. In addition, there is a small building that houses electrical and control equipment co-located with the Deep Well. The well's pump bowl assembly has seven stages and is located approximately 500 ft bls. Power is supplied to the pump bowls from a 300 HP motor. A check valve near the discharge flange provides protection from backflow and possible contamination from entering the well. A 1-inch diameter PVC line continuously supplies the line shaft bearings with clean water. This water keeps the bearings pre-lubricated, and avoids the potential of dry running them before they become flooded with pumped water after the pump is turned on. A pair of butterfly valves operate in concert to either direct flow from the well to RO WTP No. 3, or to a flush line. The flush line transports flow to a ditch that transports the flow offsite. Otherwise, raw water is supplied to the plant through a series of ten, 16-inch diameter pipes that run underground.

Assessment

Condition: Negative

- The building that houses the deep well's electrical and control system is currently divided into two rooms. The room that houses the VFD is relatively small, and the VFD installation violates National Electrical Code (NEC) working depth requirements. In addition, personnel could become trapped in the room when the VFD enclosure door is open.

Capacity: Neutral

- When Deep Well No. 4 is operating alone, the well does not have the capacity to meet the maximum raw water flow requirements of RO WTP No. 3.

Performance: Neutral

- The well performs adequately, and can be operated with other wells, to meet the requirements of RO WTP No. 3. Note that groundwater flow from Deep Wells No. 3, 4, and 5 will be needed to meet the maximum capacity of RO WTP No. 3, (i.e., all RO trains running with maximum groundwater blending).

Reliability/Redundancy: Neutral

- The well's performance is generally reliable, and having two deep wells supply water to RO WTP No. 3 does offer some redundancy although both wells are required to operate simultaneously to allow all RO trains at the WTP to operate at full production capacity.
- Standby power is available.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- The coating on the base of the pump is chipping away. Recommend monitoring the condition of the coating on the pump and discharge piping at regular intervals, and recoating as necessary to prevent corrosion.
- A security fence wraps around the deep well property to guard against unauthorized access to the site. A section of this fence was hit by a truck and is leaning. Repair the fence to restore site security.
- The building that houses the deep well's electrical and control system is divided into two rooms. However, the room that the electrical cabinets are in is small and does not meet NEC requirements. Also, the VFD face to exterior wall does not meet NEC requirements either. Remove the dividing wall, and relocate VFDs to meet NEC requirements.
- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings, in additional to the spare 300 HP motor currently stored.

4.4.3.8 Deep Well No. 4 - Power Supply

The Deep Well 4 facility was installed in 1992 and most electrical equipment is approximately 25 years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall, except for the generator which has some corrosion.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional load would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The dividing wall in the electrical room precludes the VFD installation from meeting NEC working depth requirements and presents a reliability and safety concern.
  The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
  Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources a, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.
- Recommend replacing portable generator with a new stationary standby generator.
- Recommend replacing generator MTS with a new generator ATS.
- Full-Voltage bypass is not used. VFD presents a safety concern due to insufficient working depth and due to personnel being trapped in corner of room when the door is

open. This violates NEC working depth requirements. VFD also presents a reliability concern due to its age. Highly recommend replacing with a new 18-pulse VFD with input and output reactors, without bypass and removing wall to combine into one room. A new, larger heating, ventilation, and air conditioning (HVAC) unit will also likely be needed.

- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $228,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible. The estimate does not include costs for demolition of an internal wall, and a new HVAC unit.

4.4.3.9 Deep Well No. 4 - Control System

This site uses a Micrologix PLC connected to the main SCADA system over a cellular radio. The deep well pump is the only equipment at the site.

Assessment

Condition: Neutral

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Components inside were clean and free of any dust buildup indicating a good seal around the enclosure.

Capacity: Neutral

- PLC I/O:
  - 6 Analog Inputs.
  - 4 Analog Outputs.
  - 9 Digital Inputs.
  - 10 Digital Outputs.
- The I/O capacity cannot be expanded, however there is existing spare I/O points that can be utilized.

Performance: Neutral

- The Micrologix PLC is a low end controller that is very capable for the application.

Reliability/Redundancy: Neutral

- There are manual pilot controls on the MCC/Starter for the motor that can be used in lieu of the PLC.

Improvement Opportunities

- Remove the coaxial cabling that runs to the abandoned radio antenna.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.4.3.10 Deep Well No. 5 - Groundwater Well

Deep Well No. 5 was constructed in 1975. In 2008, MPW stopped operating the well after it began producing sand and what appears to be corroded casing material. Subsequently, Deep Well No. 5 was abandoned. Construction for a replacement Deep Well No. 5 is scheduled for 2018. The replacement well will be co-located at RO WTP No. 3. Similar to the other deep wells, the replacement Deep Well No. 5 will also pump water from the Middendorf Aquifer.

Assessment

Condition: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Capacity: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Performance: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Reliability/Redundancy: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Improvement Opportunities

- Construct a replacement Deep Well No. 5.

4.4.3.11 Deep Well No. 5 - Well Head Facilities

Construction for a replacement Deep Well No. 5 is scheduled for 2018. The replacement well will be co-located at RO WTP No. 3, and will have new well head facilities.

Assessment

Condition: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Capacity: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Performance: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Reliability/Redundancy: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Improvement Opportunities

- Construct a replacement Deep Well No. 5.

4.4.3.12 Deep Well No. 5 - Power Supply

Construction for a replacement Deep Well No. 5 is scheduled for 2018. The replacement well will be co-located at RO WTP No. 3, and will have a new power supply, likely involving an upgrade to the electrical service and system at RO WTP No. 3.

Assessment

Condition: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Capacity: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Performance: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Reliability/Redundancy: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Improvement Opportunities

- Construct a replacement Deep Well No. 5.

4.4.3.13 Deep Well No. 5 - Control System

Construction for a replacement Deep Well No. 5 is scheduled for 2018. The replacement well will be co-located at RO WTP No. 3, and will have a new control system that communicates with the primary control system at RO WTP No. 3.

Assessment

Condition: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Capacity: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Performance: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Reliability/Redundancy: Negative

- The existing Deep Well No. 5 is abandoned. A replacement deep well is scheduled to be constructed in 2018.

Improvement Opportunities

- Construct a replacement Deep Well No. 5.

4.4.3.14 Groundwater Supply Transmission Pipeline

Deep Wells No. 3 and 4 are the only deep wells that are not co-located on the same property as the RO WTP that they supply water to. In addition, the deep wells themselves are also geographically separated from each other. Both deep wells have above-ground valve and piping networks that direct the raw water from the well to either RO WTP No. 3, or to a flush line. For Deep Well No. 3, when the raw water is directed toward the WTP, approximately 2.1-miles of underground pipe conveys the raw water to the WTP. Approximately 1.5-miles of underground pipe conveys water from Deep Well No. 4 to RO WTP No. 3.

Deep Well No. 5 will be constructed on the same property as RO WTP No. 3. Approximately 120 ft of pipe will be installed to connect the Deep Well No. 5 with the RO WTP No. 3. Table 4.8 presents general information regarding Deep Well Nos. 3, 4, and 5. The groundwater supply transmission piping for RO WTP No. 3 is summarized in Table 4.9.

Table 4.8 Middendorf Aquifer Deep Well No. 3, 4, and 5 Summary

	Deep Well No. 3	Deep Well No. 4	Deep Well No. 5(1)
Pump Capacity	1,200 gpm @ 618 ft TDH	1,100 gpm @ 750 ft TDH	1,000 gpm
Year Constructed	1971	1984	2018
Age of Pump	2008	2006	NA
Standby Power Source	275 KW Generator(2)	350 KW Generator(2)	Generator(3)
Year of Last Inspection	2008	1993	NA
Condition	Negative	Neutral	NA

Notes:
(1) Information presented is based on the design of the Deep Well No. 5 replacement well. This well is currently under design and scheduled for completion in 2018.
(2) Portable generator.
(3) Stationary generator shared with RO WTP No. 3.

Table 4.9 RO WTP No. 3 Groundwater Supply Transmission Piping Summary

Pipe Location	Length (ft)	Diameter (inches)	Material	Year Installed	Previous Breaks (Y or N)
Deep Well No. 3 to HWY 17	3,240	16	PVC	1993	N
HWY 17 to Montclair Dr	2,740	16	PVC	1993	N
Montclair Dr to Hungryneck Blvd	1,720	16	PVC / DIP	1993, 1998, 2014	N
Hungryneck Blvd to Waterfront Dr	1,410	16	PVC	1993	N
Waterfront Dr to Labor Camp Rd	560	16	PVC	1993	N
Labor Camp Rd to RO Plant 3	1,350	16	PVC	1993	N
Deep Well No. 4 to Whipple Rd	710	10	PVC	1992	N
Whipple Rd to Mathis Ferry Rd	830	12	AC	1976	N
Mathis Ferry RD to HWY 17	2,860	12	AC	1973	N
HWY 17 to Venning Rd 12	670	12	PVC	2006	N
Venning Rd to Labor Camp Rd	2,040	12	AC	1973	Y
Labor Camp Rd to RO Plant 3	1,060	16	PVC	1992	N

Assessment

Condition: Varies

- From Deep Well No. 3: Neutral. MPW operations staff did not make any negative comments regarding the pipeline. The pipeline appears to be in good condition relative to its age.
- From Deep Well No. 4: Negative. Transmission piping from Deep Well No. 4 mainly consists of asbestos cement (AC) pipe that was installed in the 1970's. The life expectancy of AC pipe is 50 years without preventative maintenance. Several unexplained main breaks in the AC pipe have occurred. Given the pipeline's age and history of breaks, the pipeline may become increasingly problematic in future years unless preventative maintenance is performed.

Capacity: Positive

- From Deep Well No. 3: Positive. The pipeline has adequate capacity for existing and planned demands. Following the completion of the groundwater blending project, the maximum raw water flowrate will be approximately 1,200 gpm. The velocity at that flowrate will be 2 ft/sec, which is within the range commonly thought to be acceptable in general water industry practice.
- From Deep Well No. 4: Positive. The pipeline has adequate capacity for existing and planned demands. Following the completion of the groundwater blending project, the maximum raw water flowrate will be approximately 1,000 gpm. The velocity at that flowrate will be 4 ft/sec, which is within the range commonly thought to be acceptable in general water industry practice.

Performance: Varies

- From Deep Well No. 3: Neutral. There are no known performance issues.

- From Deep Well No. 4: Negative. Generally, the pipeline is capable of filling its role. However, occasional line breaks detract from the overall performance of the pipeline.

Reliability/Redundancy: Varies

- From Deep Well No. 3: Neutral. The transmission pipeline has functioned reliably, however, it does not have any redundancy.
- From Deep Well No. 4: Negative. Several unexplained main breaks in this pipeline have occurred. Given the pipeline's age, it may be approaching the end of its useful life unless preventative maintenance is performed. The pipeline does not have any redundancy.

Improvement Opportunities

- Entirely replace or line the AC pipeline from Deep Well No. 4 with cured-in-place pipe (CIPP).

4.4.3.15 Cartridge Filters

Two cartridge filter housings at RO WTP No. 3 pre-filter the raw water flow before it enters the RO vessels. They are responsible for removing particles large enough to foul the membrane surfaces or plug the feed water channel of the membranes.

Assessment

Condition: Positive

- No negative observations were made during the site visit.

Capacity: Positive

- The housings have adequate capacity for existing and planned demands. They have an individual capacity of 1,700 gpm, and a combined capacity 3,400 gpm.

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- MPW monitors the performance of the cartridge filters by measuring the silt density index on a monthly basis. MPW also replaces the cartridge filters on an annual basis as a precaution to protect the RO membranes. These practices demonstrate and help ensure the reliable performance of the cartridge filters.
- The cartridge filters can be isolated allowing the plant to remain in operation while one cartridge filter is offline. Although both cartridge filters are typically in operation simultaneously, the ability to isolate a cartridge filter increases the reliability and redundancy of the system.

Improvement Opportunities

- None.

4.4.3.16 Membrane Feed Pumps

There are two membrane feed pumps at RO WTP No. 3. They are arranged in a duty / stand-by configuration. The membrane feed pumps supply the pressure needed to force water through the RO membranes removing the dissolved salts from the feed water.

Assessment

Condition: Neutral

- A small amount of oil below the couplings on both pumps was observed.

Capacity: Negative

- The pump rating is 2,200 gpm at 327 ft (with one-pump running), however, pumps appear to operate to the far right of their rated pump curve. At this operating point, if the membranes are new, the pump may be operating at a low enough speed that they will be operating outside their rated pump curve and cavitation may be possible. As the membranes foul, there is less operational room available for increasing the pump speed to maintain RO production flow at a higher flow rate.

Performance: Negative

- Cavitation noise has been observed.
- The pumps operate too far to the right of their pump curve and depending on the condition of the membranes, these pumps may not be able to meet the hydraulic requirements required to meet the maximum flow and maximum head condition.

Reliability/Redundancy: Positive

- The membrane feed pumps are arranged in a duty / stand-by configuration. This arrangement meets the State's requirements for pump station reliability and redundancy since one pump can remain in operation while maintenance is performed on the other.
- Spare parts are not stored by MPW, however, spare parts are commercially available.

Improvement Opportunities

- Verify that the amount of oil below the couplings is from normal operations.
- After Deep Well No. 5 is constructed and its maximum flow rate is established through pump testing:
  - If Deep Well No. 5 produces flow sufficient to consider increasing capacity at RO WTP 3, consider pump replacement in concert with an RO plant expansion.
  - If Deep Well No. 5 only produces flow required to meet the current WTP capacity, consider either adjusting the pressure set point at the suction of the membrane feed pumps or replacing the pumps to achieve a better operating point.

4.4.3.17 RO Trains

There are four RO trains at RO WTP No. 3. The trains are two-stage, single-pass, and use a hybrid membrane array to balance the flux through the 11 vessels in the first stage with the 5 vessels in the second stage. The plant can operate the trains individually or run the trains in any combination simultaneously.

Assessment

Condition: Neutral

- The membrane elements were replaced around 2005. The design life expectancy of a membrane is ten years, and the elements may be approaching the end of their useful life. For planning purposes, MPW may consider replacing the membrane elements

within the next few years. Membrane replacement will reduce energy use, and improve permeate water quality.

Capacity: Neutral

- The RO trains have a capacity of 440 gpm per train (1,760 gpm total capacity). The membrane condition may determine how much flow can be produced when all four trains are operating due to the limitations of the membrane feed pumps.

Performance: Negative

- The differential pressure in the trains at RO WTP No. 3 have increased to the point where a clean-in-place may be warranted.

Reliability / Redundancy: Neutral

- Around 2005, the membrane elements were replaced. Their performance to date has been satisfactory, although the differential pressure across both stages of the RO train may warrant either performing a clean-in-place or replacing the membranes. Otherwise, the RO trains and their supporting equipment have proven reliable.

Improvement Opportunities

- In 2018, after Deep Well No. 5 is constructed and tested, and the capacity is known, in concert with determining if RO WTP No. 3 should be expanded and if the membrane feed pumps should be replaced, either:
  - Perform a clean-in-place of the membranes to address the increase in differential pressure.
  - Replace the membranes as part of an RO plant expansion project.
- Calibrate the pressure transmitters to ensure their accuracy.
- Plan on replacing the membrane elements within the next few years. The membrane elements are twelve years old. Their design life expectancy is only 10-years, and they may require replacement within the next few years.

4.4.3.18 Pretreatment Chemical - Scale Inhibitor Storage and Feed System

Scale inhibitor is added to the raw water to prevent the formation of mineral scale on the RO membranes as well as piping and ancillary equipment. Scale inhibitor is delivered to the WTP in 55-gallon drums. Subsequently, the scale inhibitor is transferred via a drum pump to a day tank that supplies a chemical metering pump. From the metering pump, the scale inhibitor is injected into the raw water pipeline through an injection quill. A static mixer downstream of the injection quill disperses the scale inhibitor.

Assessment

Condition: Positive

- The condition of the scale inhibitor storage and feed system is satisfactory.

Capacity: Positive

- The day tank volume is 100 gallons, which provides 545 hours of storage at the maximum flow for WTP No. 3. This size is adequate for the facility.
- The chemical metering pump is sized to provide 4.9 gpd and has a turndown of 20:1. At the maximum WTP flow and dose, the metering pump will operate at 27 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Scale inhibitor is consistently delivered at the proper dose.
- The static mixer produces a head loss that is greater than other models of static mixers that are available. The current static mixer produces a head loss of 2.5 psi at a flow of 1,000 gpm. This headloss is high compared to the headloss that would occur from other static mixers that are available.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore dosing if a pump or motor fails. The system operates reliably.

Improvement Opportunities

- Replace the static mixer. Currently, there is a large pressure drop across the mixer. Replacing it with one that has a lower pressure drop will reduce operational expenses by reducing the amount of energy required for groundwater pumping.
- Monitor corrosion on the day tank's support structure. Remove corrosion and provide a protective coating if corrosion becomes excessive.

4.4.3.19 Post Treatment Chemical - Calcium Hypochlorite Storage and Feed System

Solid tablets of calcium hypochlorite are dissolved onsite to produce a source of chlorine for the finished water. The calcium hypochlorite is dissolved by a finished water side stream, and the flow rate of the side stream is controlled by a valve. The chlorinated solution produced is returned to the finished water main line by a solution feed pump.

Assessment

Condition: Negative

- The calcium hypochlorite system requires frequent maintenance, and MPW experiences difficulty in maintaining a chlorine residual.

Capacity: Negative

- The state requires liquid chlorine systems to be able to feed a dose up to 5 mg/L. Performance literature from the manufacturer states that the system can deliver up to 2.5 lbs/hr of chlorine which is equal to a dose of 2.3 mg/L at maximum plant flow, however, MPW has difficulty maintaining residual.

Performance: Negative

- MPW experiences difficulty maintaining a chlorine residual.

Reliability/Redundancy: Negative

- Maintenance frequently needs to be performed on this system. At a minimum, the system needs an acid bath bi-annually to remove scale.
- The bearings on the solution feed pump experience periodic failure.
- The control boards generally last for only one year.
- A shelf spare solution feed pump and motor is maintained by MPW.
- Even when the equipment is functioning, MPW has difficulty maintaining residual.

Improvement Opportunities

- In 2018, MPW will replace the calcium hypochlorite system with a sodium hypochlorite system. The system will be sized to deliver a maximum of 5 mg/L of chlorine in accordance with the State's requirements.

4.4.3.20 Post Treatment Chemical - Anhydrous Ammonia Storage and Feed System

Anhydrous ammonia is added to the finished water to react with chlorine and form monochloramine. Monochloramine is a residual disinfectant that guards against the reemergence of pathogens in the finished water while reducing the potential to form chlorinated. Anhydrous ammonia is delivered to the WTP in 150-lb gas cylinders. An ammoniator system is used to mix the ammonia with a finished water side stream, and the resulting ammonia solution is diffused into the finished water main line through the use of an injector. Tank scales are used to monitor the amount of ammonia remaining in each cylinder.

Assessment

Condition: Neutral

- The tank scales have not been calibrated recently and some corrosion is present on the face of the scales. A CIP project to replace and or repair the existing scales was recently requested by MPW.

Capacity: Positive

- Two (2) 150-lb gas cylinders of ammonia can be connected to the ammoniator at a time. This capacity is sufficient for this size WTP, and will provide 18 days of storage at maximum plant flow and maximum dose (i.e., dose based upon a 4:1 chlorine to ammonia ratio).
- One (1) 14 lb per day ammoniator is installed and operates at 55 percent of its capacity to meet the dose requirements at maximum flow and maximum dose.

Performance: Neutral

- No performance issues were reported. However, the tank scales have not been calibrated recently. The scales should be calibrated to ensure the ammonia system is delivering the proper dose.

Reliability/Redundancy: Neutral

- The system operates reliably, however, the ammoniator system is not redundant and MPW does not have spare parts.
- The system operates reliably.

Improvement Opportunities

- Calibrate tank scales an on annual basis.
- Purchase spare parts required for replacement/repairs.
- Monitor corrosion on the face of the scales. Replace scales if corrosion creates an unstable platform for the cylinders.

4.4.3.21 Post Treatment Chemical - Calcium Chloride Storage and Feed System

Calcium chloride is added to the finished water for hardness adjustment and corrosion control. Tanker trucks deliver calcium chloride to the WTP. An outdoor tank stores the calcium chloride offloaded from the trucks. From the storage tanks, the calcium chloride drains by gravity to a day tank that supplies a chemical metering pump. From the metering pump, calcium chloride is injected into the finished water pipeline through an injection quill.

Assessment

Condition: Neutral

- Erosion and/or another process have worn away concrete at the base of the bulk storage tank leaving the aggregate exposed. Very minor corrosion is visible on the day tank's support stand.

Capacity: Neutral

- The bulk storage tank's volume is 6,000 gal. This volume will provide 26 days of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The day storage tank's volume is 180 gal, which provides 19 hours of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The chemical metering pump can pump up to 11.4 gph and has a turndown of 40:1. At the maximum WTP flow and dose, the metering pump will operate at 83 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Calcium Chloride is consistently delivered at the proper dose. No performance issues have been reported.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore operations if a pump or motor fails.
- The system operates reliably, however, the injection quill requires periodic acid washes to remove scale that otherwise clogs the quill.

Improvement Opportunities

- Monitor erosion in the secondary containment area of the bulk storage tank, and corrosion on the tank stand.

4.4.3.22 RO WTP No. 3 - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Negative

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.
- Note that the switchboard only has space for one smaller frame size breaker to be added, thus limiting the expansion capability of this switchboard. The switchboard is 2500 A and could accommodate additional loads but there is not much space to add them and additional vertical sections cannot be added in this room due to space limitations. This lack of spare space could lead to the switchboard having to be replaced during an expansion/upgrade.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources and the demand-based redundancy between the multiple pumps, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.
- Plant voiced a concern with having generator auxiliary power feed in panel dedicated to instrument power. Don't want the possibility of tripping entire panelboard in the event that panelboard main breaker trips due to generator auxiliary power overload. Recommend moving generator power feed to a different panelboard and revise panelboard schedules.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.

- Remove or re-label all unused equipment.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $90,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.3.23 RO WTP No. 3 - Control System

This control system was originally built and installed by Hydranautics in approximately 1992. The system PLC hardware is still the original equipment and uses an Allen-Bradley SLC type of PLC interfaced over an Ethernet network to a PC Based Trihedral VTSCADA Application for monitoring and control. The SCADA software has upgraded with the last 5-years. The instrumentation and devices used are connected to the PLC by hardwired I/O to the main cabinet.

Assessment

Condition: Positive

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Cabinet penetrations from previously abandoned pilot devices on the back of the panel are covered by a metal plate to preserve and protect the integrity of the enclosure.

Capacity: Neutral

- PLC I/O:
  - 51 Analog Inputs.
  - 20 Analog Outputs.
  - 96 Digital Inputs.
  - 48 Relay Outputs.
- SCADA tags:
  - 5,000 tag count.
- The system is limited to the spare capacity of the existing PLC I/O cards.

Performance: Neutral

- The life cycle of the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued. The software platform of the HMI system is modern and reliable.

Reliability/Redundancy: Neutral

- There is no redundancy in the architecture of the control system. The hardware is serviceable but migration to newer technology is recommended. The software is modern and serviceable by the manufacturer or third party providers.

Improvement Opportunities

- The life cycle for the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. Replacement is recommended within 5-years.[10]
- Replacement of 24V DC power supply in main control panel.
- Label and route the wiring on the left side of the main control panel in wireways.
- Replace the concentrate pump starter/control panels within 10 years. The panel has some evidence of corrosion and many of the components are 20+ years old.
- Install bypass switches on the network rack UPS. This allows for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS need to be taken out of service.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.4.3.24 RO WTP No. 3 - Treatment Plant Structure(s)

There are five treatment plant related structures at RO WTP No. 3.[11] These include: the RO building, the high service pump station which houses the calcium hypochlorite chemical feed building, the anhydrous ammonia chemical feed building, a concentrate pump station, and a bulk chemical storage area. The structures are generally in good condition, however, the chemical storage area requires rehabilitation.

Assessment

Condition: Varies

- RO Building: Neutral. The rain gutters are leaking and are beyond repair. There are signs of roof leakage through the drop ceilings in the control room and electrical room. Also, the floor in the calcium chloride room has damage from a chemical spill.
- Calcium Hypochlorite Chemical Feed (housed within the High Service Pump Station): Neutral. The roof insulation in the High Service Pump Station is coming loose.
- Anhydrous Ammonia Chemical Feed Building: Positive. No negative observations were made during the site visit.
- Concentrate Pump Station: Neutral. A hornet nest was present during the site visit.
- Bulk Chemical Storage Area: Negative. The acid and caustic soda storage areas that are no longer in use should be demolished. The acid containment area has worn, and aggregate is visible. The calcium chloride storage area is in good shape.

Improvement Opportunities

- Perform an annual assessment that documents the condition of each facility to identify any areas that experience accelerated deterioration.
- For the RO Production Facility:
  - Replace roof gutters.
  - Determine the source of, and repair the leaks above the control and electrical rooms.

[10] Currently, MPW has a project to replace the PLC hardware by Mar 2018.

[11] The ground storage tank and high service pump station will be addressed separately later in this Chapter.

- High Service Pump Station:
  - Monitor roof insulation. Re-install if the insulation becomes too loose.
- Bulk Chemical Storage Area:
  - Demolish the acid and caustic soda storage areas that are no longer in use.
- Concentrate Pump Station:
  - Remove hornet nest.

4.4.3.25 RO WTP No. 3 - Assessment Summary

Major facilities associated with the pumping and treatment of groundwater at RO WTP No. 3 include: Deep Wells No. 3, 4, and 5, raw water transmission pipelines, the RO production facility, a bulk chemical storage area, the calcium hypochlorite chemical feed, and the anhydrous ammonia chemical feed building. The structure of these facilities, and the mechanical equipment and associated power and control systems they house were assessed. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.10.

The majority of RO WTP No. 3's facilities, mechanical equipment, power, and control systems received a Neutral or Positive rating. RO WTP No. 3 and its associated facilities are not currently able to function sufficiently to meet their intended purpose due to the failure of Deep Well No. 5, which is scheduled for replacement in 2018. Replacing Deep Well No. 5 will allow MPW to meet the increase in water demand following the completion of the groundwater blending project. Additionally, a few Negative ratings were assigned to the WTP during the assessment that MPW should plan to address.

Areas that received a Negative rating in one or more field include:

- Deep Well No. 3 – Wellhead Facilities:
  - Negative rating in the condition field due to the pump bowl and line shaft bearings requiring replacement (schedule for fall/winter 2017).
- Deep Well No. 3 – Power Supply:
  - Negative rating in the reliability fields due to concerns regarding the age of the electrical equipment, especially the VFDs. Also, electrical interlocks are needed wherever load-sized disconnects or transfer switches are utilized on VFDs or RVSS starters.
- Deep Well No. 4 – Wellhead Facilities:
  - Negative rating in the condition field due to the divider wall in the building that houses the deep well's electrical and control systems. The divider wall creates a small room which houses the VFD, and the VFD installation violates NEC working depth requirements.
- Deep Well No. 4 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs. The VFD installation does not meet NEC requirements and this further presents both a reliability and a safety concern.
- Deep Well No. 5:
  - This well is currently abandoned and will be replaced in 2018.

- Groundwater Transmission Pipeline:
  - Negative ratings in the condition, performance, and reliability / redundancy fields due to several unexplained main breaks that have occurred. The AC portion of the transmission piping from Deep Well No. 4 is nearing the end of its 50-year life expectancy. Preventative maintenance that includes CIPP will restore the life expectancy.
- Membrane Feed Pumps:
  - Negative ratings in the fields of capacity and performance were associated with the fact that these pumps operate to the far right of their rated pump curve. When Deep Well No. 5 is available and the plant may return to its maximum flow, this pump may not perform adequately based upon the membrane condition. MPW may consider either (1) replacing these pumps, or (2) adjusting the set point used to control the discharge pressure at each groundwater well. This decision can be made when the capacity of Deep Well No. 5 is established in 2018.
- RO Trains:
  - A negative rating in the field of performance was assessed based upon the high differential pressure seen in the membrane train. MPW should consider either performing a clean-in-place or replacing the membranes. This decision may be differed until after the capacity of Deep Well No. 5 is established in 2018 and a decision is made regarding expanding the plant and/or replacing the membrane feed pumps.
- Calcium Hypochlorite Storage & Feed System:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to difficulty in maintaining a chlorine residual with this system, and the frequent maintenance required. This system will be replaced by the summer of 2018 with a new 12.5 percent sodium hypochlorite storage and feed system.
- RO WTP No. 3 – Power Supply:
  - Negative rating in the capacity field due to the need to perform an electrical capacity analysis of the complete electrical distribution system before any proposed expansions or upgrade involving load increases could begin. Also, the switchboard only has space for one smaller frame size breaker to be added, thus limiting the expansion capability of the switchboard.
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs. Also, electrical interlocks are needed wherever load-sized disconnects or transfer switches are utilized on VFDs or RVSS starters. Lastly, moving the generator power feed to a different panelboard and revising the panelboard schedules is recommended. This will avoid the possibility of tripping the entire panelboard in the event that panelboard main breaker trips due to generator auxiliary power overload.

Table 4.10 RO WTP No. 3 Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
Deep Well No. 3 - Groundwater Well	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 3 - Wellhead Facilities	NEGATIVE	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 3 - Power Supply	NEUTRAL	NEUTRAL	POSITIVE	NEGATIVE
Deep Well No. 3 - Control System	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 4 - Groundwater Well	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 4 - Wellhead Facilities	NEGATIVE	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 4 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
Deep Well No. 4 - Control System	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Deep Well No. 5 - Groundwater Well	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Deep Well No. 5 - Wellhead Facilities	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Deep Well No. 5 - Power Supply	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Deep Well No. 5 - Control System	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Groundwater Transmission Pipeline	NEGATIVE	POSITIVE	NEGATIVE	NEGATIVE
Cartridge Filters	POSITIVE	POSITIVE	POSITIVE	POSITIVE
Membrane Feed Pumps	NEUTRAL	NEGATIVE	NEGATIVE	POSITIVE
RO Trains	NEUTRAL	NEUTRAL	NEGATIVE	NEUTRAL
Scale Inhibitor Storage & Feed System	POSITIVE	POSITIVE	POSITIVE	POSITIVE
Calcium Hypochlorite Storage & Feed System	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Anhydrous Ammonia Storage & Feed System	NEUTRAL	POSITIVE	NEUTRAL	NEUTRAL
Calcium Chloride Storage & Feed System	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
RO WTP No. 3 - Power Supply	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
RO WTP No. 3 - Control System	POSITIVE	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3 - Treatment Plant Structures	NEUTRAL(1)	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

Note:
(1) Represents an average rating of the multiple structures present at RO WTP No. 3.

4.4.4 RO WTP No. 4

4.4.4.1 Deep Well No. 6 Summary

Deep Well No. 6 is the sole raw water source for RO WTP No. 4. The well was constructed in 1974. The total depth of the well is 1,834 ft bls. Groundwater is lifter from the well using a vertical turbine pump equipped with a 300 HP motor. The well's discharge flange sits atop a concrete pedestal, and an asphalt-shingled, wooden-framed canopy protects the wellhead from the sun and the elements. Table 4.11 presents general information regarding Deep Well No. 6.

Deep Well No. 6 does have a PVC drop tube that is dedicated for a level transmitter. Installing a water level transmitter in the drop tube will allow water level measurements to be made continuously.

Table 4.11 Middendorf Aquifer Deep Well No. 6 Summary

	Deep Well No. 6
Pump Capacity	1,600 gpm at 480 TDH
Year Constructed	1974
Age of Pump[1]	1 year
Standby Power Source	600 KW Generator[2]
Year of Last Inspection	2016
Condition	Neutral

Notes:
(1) Pump was installed in 2016.
(2) Stationary generator shared with all RO WTP No. 4 facilities.

4.4.4.2 Deep Well No. 6 - Groundwater Well

Deep Well No. 6 was constructed with three steel casings: a 20-inch diameter conductor casing set to a depth of 56 ft bls, an 16-inch diameter outer casing set to a depth of 1,570 ft bls, and a 8-inch diameter inner casing set to a depth of 1,834 ft. The 8-inch casing includes 82-feet of screen. The well screens are open to the Middendorf Aquifer and are located at depths of 1,709-1,742 ft bls, 1,757-1,771 ft bls, and 1,805-1,840 ft bls.

Assessment

Condition: Positive

- There are no significant known issues with Deep Well No. 6. However, Deep Well No. 6 was constructed in 1974 and is 43-years old. The design life expectancy of a deep well is often between 50-100 years (depending on materials used in construction). Deep Well No. 6 may be approaching the end of its design life and may require replacement within the next ten years.
- There are no significant known issues with Deep Well No. 6.

Capacity: Positive

- The well is capable of supplying sufficient groundwater to RO WTP No. 4 to meet the plant's existing requirements. The well also appears capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). Lastly, the well also appears capable of meeting future groundwater requirements that would be imposed following the

installation of a third RO train. The well is adequately sized to deliver the 1,600 gpm flow for which its pump is rated.

Performance: Neutral

- The well's performance has met the requirements of RO WTP No. 6.

Reliability/Redundancy: Neutral

- RO WTP No. 6 does not have a redundant raw water supply. However, the well has performed reliably.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Plan on replacing Deep Well No. 6 within the next 5-10 years. Deep Well No. 6 is 43-years old and may be approaching the end of its 50-year design life expectancy.
- Recommend installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
  - Furthermore, periodic review of data collected from the level transmitter is recommended.
- TV the well the next time the pump is removed.

4.4.4.3 Deep Well No. 6 - Well Head Facilities

Well head facilities at Deep Well No. 6 consist of: a motor-driven vertical turbine pump, piping and valves, and an open-walled canopy. The well's pump bowl assembly has 10 stages and is located approximately 400 ft bls. Power is supplied to the pump bowls from a 250 HP motor. A check valve near the discharge flange provides protection from backflow and possible contamination from entering the well. A 1-inch diameter PVC line continuously supplies the line shaft bearings with clean water. This water keeps the bearings pre-lubricated, and avoids the potential of dry running them before they become flooded with pumped water after the pump is turned on. A pair of butterfly valves operates in concert to either direct flow from the well to RO WTP No. 4, or to a flush line. The flush line transports flow to a pond on an adjacent property. Otherwise, raw water is supplied to the plant through a 14-inch pipe that runs underground.

Assessment

Condition: Neutral

- The pump and motor make excessive noise.

Capacity: Positive

- The well is capable of supplying sufficient groundwater to RO WTP No. 4 to meet the Plant's existing requirements. The well also appears capable of supplying sufficient groundwater to the plant to meet the increased flow required following the completion of the groundwater blending project (2017). Lastly, the well also appears capable of meeting future groundwater requirements that would be imposed following the installation of a third RO train. The well and its pump are rated at 1,600-gpm at 480-ft TDH.

Performance: Positive

- The well head facilities' have met the requirements of RO WTP No. 6.

Reliability/Redundancy: Neutral

- RO WTP No. 6 does not have a redundant raw water supply. However, the well has performed reliably.
- Standby power is available.
- MPW's ability to meet the State's criteria for redundancy of groundwater wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Include the following activities on a preventative maintenance schedule:
  - Monitor the condition of the pump's coating at regular intervals, and recoating as necessary to prevent corrosion.
- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings, in additional to the spare 250 HP motor currently stored.

4.4.4.4 Deep Well No. 6 - Power Supply

Deep Well No. 6 is located in a dedicated building (with separate process and electrical rooms) at the RO WTP No. 4 Facility. The Deep Well No. 6 building equipment is supplied from the RO WTP No. 4 Electrical Room. The facility was installed in 2003 and most electrical equipment is approximately 14-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional load would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- VFD Feeder and motor conductors are grossly undersized (using a combination of #4/0 American wire gauge (AWG) and 250 kcmil conductors) which presents a serious electrical hazard, NEC code violation, safety hazard, and reliability concern.
- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.

- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.
- Lots of equipment enclosures are no longer being used and wires were simply spliced within the enclosures rather than removing the enclosures that are no longer being used and re-routing the circuits. The current state of the wiring and enclosures is cause for much confusion and would present much difficulty in trouble-shooting, maintenance and repair.

Improvement Opportunities

- URGENT! VFD Feeder and motor conductors are grossly undersized (using a combination of #4/0 AWG and 250 kcmil conductors) which presents a serious electrical hazard, NEC code violation, safety hazard, and reliability concern. Immediate replacement with a completely new drive system enclosure (18-pulse VFD with input and output reactors) and new properly-sized wiring to the drive and to the motor is recommended. The Altivar 61 drive unit and components may be kept as a shelf-spare for other facilities.
- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment. Existing enclosures for 480V disconnect, Well Pump Breaker, Panel "A'", Well Pump Starter (RVAT), wireway, and j-boxes all need to be removed. Conduits should be removed where not needed, holes plugged, and conduits re-routed where needed and sized correctly. All unused wiring should be removed. New conductors should be re-run all the way from Panel EW to their respective loads, instead of the splices that are currently used in the make-shift j-boxes. May also want to add a new wireway to transition conduits between rooms. Also need to add a 480V service disconnect or panelboard for the incoming service for the building.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $43,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.4.5 Deep Well No. 6 - Control System

Deep Well 6 is at RO WTP No. 4 and the controls are incorporated into the control system for that RO Plant.

Assessment

Because RO WTP No. 4 and Deep Well No. 6 share a common control system, refer to RO WTP No. 4 control system assessment narrative.

4.4.4.6 Groundwater Supply Transmission Pipeline

Deep Well No. 6 and RO WTP No. 4 are co-located on the same property. An above-ground valve and piping network direct the raw water from the well to either the WTP, or to a flush line. When the raw water is directed toward the WTP, approximately 180 ft of 12-14-inch diameter pipe that runs underground conveys the raw water to the WTP. Table 4.12 provides an overview of the groundwater supply transmission pipeline for RO WTP No. 4.

Table 4.12 RO WTP No. 4 Groundwater Supply Transmission Piping Summary

Pipe Location	Length (ft)	Diameter (inches)	Material	Year Installed	Previous Breaks? (Y or N)
First pipe run from Deep Well No. 6 to RO WTP No. 4	47'	12	PVC	2002	N
Second pipe run from Deep Well No. 6 to RO WTP No. 4	143'	14	PVC	2002	N

Assessment

Condition: Neutral

- No negative observations regarding the condition of the pipe or ancillary equipment were observed during the site visit.

Capacity: Positive

- The pipeline has adequate capacity for existing and planned demands. The maximum flow rate following the completion of the groundwater blending project, and the addition of a third RO train will be 1,988 gpm. The velocity through the smallest diameter transmission line, (i.e., 12-inches), will be 5.6 ft/sec, which is within the range commonly thought to be acceptable in general water industry practice.

Performance: Positive

- There are no known performance issues.

Reliability/Redundancy: Neutral

- The transmission pipeline has functioned reliably, however, it does not provide any redundancy since the pipeline is the only raw water supply source for RO WTP No. 4.

Improvement Opportunities

- Include the following activities on a preventative maintenance schedule:
  - Monitor corrosion on the above ground valves and pipe. Recoat as necessary.
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.4.4.7 Cartridge Filters

Two cartridge filter housings at RO WTP No. 4 pre-filter the raw water flow before it enters the RO vessels. They are responsible for removing particles large enough to foul the membrane surfaces or plug the feed water channel of the membranes.

Assessment

Condition: Positive

- No negative observations were made during the site visit.

Capacity: Positive

- The housings have adequate capacity for existing and planned demands. They have an individual capacity of 600 gpm, and a combined capacity of 1,200 gpm.

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- MPW monitors the performance of the cartridge filters by measuring the silt density index on a monthly basis. MPW also replaces the cartridge filters on an annual basis as a precaution to protect the RO membranes. These practices demonstrate and help ensure the reliable performance of the cartridge filters.
- The cartridge filters can be isolated allowing the plant to remain in operation while one cartridge filter is offline. Although both cartridge filters are typically in operation simultaneously, the ability to isolate a cartridge filter increases the reliability and redundancy of the system.

Improvement Opportunities

- None.

4.4.4.8 Membrane Feed Pumps

There are two membrane feed pumps at RO WTP No. 4. Each feed pump is dedicated to a single RO train. The membrane feed pumps supply the pressure needed to force water through the RO membranes removing the dissolved salts from the feed water.

Assessment

Condition: Positive

- No deficiencies were noted.

Capacity: Positive

- The pumps have adequate capacity for existing and planned demands. The pump rating is 563 gpm at 258 ft per pump.

Performance: Positive

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Neutral

- Each RO train has a dedicated feed pump. The failure of a single pump will reduce the plant capacity by the flow achieved by that train. This configuration is different than RO WTPs 1, 2 and 3 where the pump stations are designed separately and conform to the

State's requirements for pump station redundancy. Here at WTP No. 4, the pumps are treated as part of the RO treatment train, which reduces the overall reliability of the plant's ability to produce its rated capacity. MPW's ability to meet the State's criteria for water supply reliability will be assessed further in Chapter 5 of this report.

- Spare parts are not stored by MPW, however, spare parts are commercially available.

Improvement Opportunities

- Consider storing spare parts for the pump, including spare pump bowls and line shaft bearings and a spare 100 HP motor.

4.4.4.9 RO Trains

There are two RO trains at RO WTP No. 4. The trains are two-stage, single-pass, and use a hybrid membrane array to balance the flux through the 10 vessels in the first stage with the 5 vessels in the second stage. The plant can operate the trains individually or run the trains in any combination simultaneously.

Assessment

Condition: Neutral

- The membrane elements were replaced in 2013. The design life expectancy of a membrane is ten years. For planning purposes, MPW may consider replacing the membrane elements in 2023. Membrane replacement will reduce energy use, and improve permeate water quality.

Capacity: Neutral

- The RO trains have a capacity of 450 gpm per train (900 gpm total capacity) and the membrane condition is such that the membrane feed pumps can increase speed to maintain this flow rate.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability / Redundancy: Neutral

- RO Trains are not redundant. Redundant trains are not required by the State, however, loss of a single train would result in a 50 percent decrease in the production capacity.
- Spare parts (e.g., membranes) are not stored on site, however, they are commercially available.
- The membrane elements were installed in 2013. Their performance to date has been satisfactory, and any degradation in performance over time has not been sufficient to warrant performing a membrane clean-in-place. The RO trains and their supporting equipment have proven reliable.

Improvement Opportunities

- Consider replacing the membrane elements in 2023. The membrane elements will be ten years old at that point and may be approaching the end of their design life expectancy. Membrane replacement will reduce energy use, and improve permeate water quality.

- Continue daily monitoring of the pressure drop across the membranes, and weekly monitoring of the conductivity. Perform a clean-in-place of the membranes when warranted based upon these data.
- Calibrate the pressure transmitters to ensure their accuracy.

4.4.4.10 Pretreatment Chemical - Scale Inhibitor Storage and Feed System

Scale inhibitor is added to the raw water to prevent the formation of mineral scale on the RO membranes as well as piping and ancillary equipment. Scale inhibitor is delivered to the WTP in 55-gallon drums. Subsequently, the scale inhibitor is transferred via a drum pump to a day tank that supplies a chemical metering pump. From the metering pump, the scale inhibitor is injected into the raw water pipeline through an injection quill. A static mixer downstream of the injection quill disperses the scale inhibitor.

Assessment

Condition: Positive

- The condition of the scale inhibitor storage and feed system is satisfactory.

Capacity: Positive

- The day tank volume is 80 gallons, which provides 853 hours of storage at the maximum flow for WTP No. 2. This size is adequate for the facility.
- The chemical metering pump is sized to provide 4.9 gpd and has a turndown of 20:1. At the maximum WTP flow and dose, the metering pump will operate at 45 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Scale inhibitor is consistently delivered at the proper dose.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW redundancy to quickly restore dosing if a pump or motor fails. The system operates reliably.

Improvement Opportunities

- Monitor corrosion on the day tank's support structure. Remove corrosion and provide a protective coating if corrosion becomes excessive.

4.4.4.11 Post Treatment Chemical - Calcium Hypochlorite Storage and Feed System

Solid tablets of calcium hypochlorite are dissolved onsite to produce a source of chlorine for the finished water. The calcium hypochlorite is dissolved by a finished water side stream, and the flow rate of the side stream is controlled by a valve. The chlorinated solution produced is returned to the finished water main line by a solution feed pump.

Assessment

Condition: Negative

- The calcium hypochlorite system requires frequent maintenance, and MPW experiences difficulty in maintaining a chlorine residual.

Capacity: Negative

- Performance literature from the manufacturer states that the system can deliver up to 2.5 lbs/hr of chlorine which is equal to a dose of 4.4 mg/L at maximum plant flow, however, MPW has difficulty maintaining residual.

Performance: Negative

- MPW experiences difficulty maintaining a chlorine residual.

Reliability/Redundancy: Negative

- Maintenance frequently needs to be performed on this system.
- The system needs an acid bath bi-annually to remove scale.
- The bearings on the solution feed pump experience periodic failure.
- The control boards generally last for only one year.
- A shelf spare solution feed pump and motor is maintained by MPW.
- Even when the equipment is functioning, MPW has difficulty maintaining residual.

Improvement Opportunities

- In 2018, MPW will replace the calcium hypochlorite system with a sodium hypochlorite system. The system will be sized to deliver a maximum of 5 mg/L of chlorine in accordance with the State's requirements.

4.4.4.12 Post Treatment Chemical - Anhydrous Ammonia Storage and Feed System

Anhydrous ammonia is added to the finished water to react with chlorine and form monochloramine. Monochloramine is a residual disinfectant that guards against the reemergence of pathogens in the finished water while reducing the potential to form chlorinated. Anhydrous ammonia is delivered to the WTP in 150-lb gas cylinders. An ammoniator system is used to mix the ammonia with a finished water side stream, and the resulting ammonia solution is diffused into the finished water main line through the use of an injector. Tank scales are used to monitor the amount of ammonia remaining in each cylinder.

Assessment

Condition: Neutral

- The tanks scales have not been calibrated recently and some corrosion is present on the face of the scales. A CIP project to replace and or repair the existing scales was recently requested by MPW.

Capacity: Neutral

- Two (2) 150-lb gas cylinders of ammonia can be connected to the ammoniator at a time. This capacity is sufficient for this size WTP, and will provide 30 days of storage at maximum plant flow and maximum dose (i.e., dose based upon a 4:1 chlorine to ammonia ratio).
- One (1) 28 lb per day ammoniator is installed and operates at 28 percent of its capacity to meet the dose requirements at maximum flow and maximum dose.

Performance: Neutral

- No performance issues were reported. However, the tank scales have not been calibrated recently. The scales should be calibrated to ensure the ammonia system is delivering the proper dose.

Reliability/Redundancy: Neutral

- The system operates reliably, however, the ammoniator system is not redundant, and MPW does not have spare parts.
- The system operates reliably.

Improvement Opportunities

- Calibrate tank scales an on annual basis.
- Purchase spare parts required for replacement/repairs.
- Monitor corrosion on the face of the scales. Replace scales if corrosion creates an unstable platform for the cylinders.

4.4.4.13 Post Treatment Chemical - Calcium Chloride Storage and Feed System

Calcium chloride is added to the finished water for hardness adjustment and corrosion control. Tanker trucks deliver calcium chloride to the WTP. An outdoor tank stores the calcium chloride offloaded from the trucks. From the storage tanks, the calcium chloride is transferred to a day tank by a transfer pump. The day tank supplies a chemical metering pump which injects calcium chloride into the finished water pipeline through an injection quill.

Assessment

Condition: Neutral

- The coating on the chemical transfer pump is degrading and rust is present.

Capacity: Positive

- The bulk storage tank's volume is 4,000 gal. This volume will provide 34 days of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The day storage tank's volume is 180 gal, which provides 74 hours of storage at the maximum plant flow and maximum dose. This size is adequate for the facility.
- The chemical metering pump can pump up to 11.4 gph and has a turndown of 40:1. At the maximum WTP flow and dose, the metering pump will operate at 42 percent of its rated capacity. This size is adequate for the facility.

Performance: Positive

- Calcium Chloride is consistently delivered at the proper dose. No performance issues have been reported.

Reliability/Redundancy: Positive

- Metering pumps for each chemical are standardized throughout MPW's four RO WTPs, and MPW maintains an inventory of spare parts and pumps for each type of metering pump and motor in use. This inventory meets the State's criteria for chemical feed system redundancy and allows MPW to quickly restore operations if a pump or motor fails.
- The system operates reliably, however, the injection quill requires periodic acid washes to remove scale that otherwise clogs the quill.

Improvement Opportunities

- Maintain a spare chemical transfer pump. The existing pump's coating is degrading and starting to rust.

4.4.4.14 RO WTP No. 4 - Power Supply

The facility was installed in 2003 and most electrical equipment is approximately 14-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Electrical interlocks are needed wherever load-side disconnects or transfer switches are utilized on VFDs or RVSS Starters.
- Other than the redundancy between the utility and generator sources and the demand-based redundancy between the multiple pump trains, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what redundancy is required.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.

- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $39,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.4.4.15 RO WTP No. 4 - Control System

This control system uses an Allen-Bradley CompactLogix type of PLC interfaced over an Ethernet network to a PC Based Trihedral VTSCADA Application for monitoring and control. Both the PLC and SCADA applications have been upgraded within the last 5-years and are modern, reliable technologies for the application.

Each RO Train has a cabinet with a CompactLogix remote I/O chassis for instruments and devices local to that train. It is connected over Ethernet on the SCADA network to PLC A.

The instrumentation and devices used are connected to the PLC by hardwired I/O. The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Cabinet penetrations from previously abandoned pilot devices on the back of the panel are covered by a metal plate to preserve and protect the integrity of the enclosure.

Assessment

Condition: Positive

- The internal cabinet power and signal wiring was overall found to be well organized and labeled with wire way covers in place. Cabinet penetrations from previously abandoned pilot devices on the back of the panel are covered by a metal plate to preserve and protect the integrity of the enclosure.

Capacity: Positive

- PLC I/O:
  - 40 Analog Inputs.
  - 16 Analog Outputs.
  - 64 Digital Inputs.
  - 32 Relay Outputs.
- SCADA tags:
  - 5,000 tag count.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Positive.

- The hardware and software platforms of the control system are satisfactory.

Reliability/Redundancy: Neutral.

- There is no redundancy in the architecture of the control system. The hardware and software are both modern and serviceable. Because the PLC I/O network is also on the SCADA network, this leaves it susceptible to unnecessary broadcast storms or excessive and unnecessary network traffic that could degrade or cause catastrophic failure.

Improvement Opportunities

- Separate the CompactLogix remote I/O network traffic onto a separate physical Ethernet network.
- The network connection to the High service pump station is copper CAT5 media. This is very close to the physical limitations of CAT5, which may cause reduced speeds and is susceptible to surges, particularly lightning. Replacing this with a fiber media is recommended.
- Install bypass switches on the network rack UPS. This allows for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS need to be taken out of service.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.4.4.16 RO WTP No. 4 - Treatment Plant Structure(s)

There are three treatment plant related structures at RO WTP No. 4.[12] These include: the RO production facility (which, unlike the other WTPs, also houses the calcium hypochlorite and anhydrous ammonia feed systems), a concentrate pump station, and a bulk chemical storage area. The structures are generally in good condition.

Assessment

Condition: Varies

- RO Production Facility: Positive. No negative observations were made during the site visit.
- Concentrate Pump Station: Positive. No negative observations were made during the site visit.
- Bulk Chemical Storage Area: Negative. The grate over the sump in the secondary containment area cannot support the weight of someone stepping on it. The grate should be replaced with one that can support the weight of someone working on it. The storage area is otherwise in good condition.

Improvement Opportunities

- Perform an annual assessment that documents the condition of each facility to identify any areas that experience accelerated deterioration.
- Calcium Chloride Bulk Storage Area:
  - Replace the grate that covers the sump with a grate that can support body weight.

4.4.4.17 RO WTP No. 4 - Assessment Summary

Major facilities associated with the pumping and treatment of groundwater at RO WTP No. 4 includes: Deep Well No. 6, a raw water transmission pipeline, the RO production facility, and a bulk chemical storage area. The structure of these facilities, and the mechanical equipment and associated power and control systems they house were assessed. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.13.

[12] The ground storage tank and high service pump station will be addressed separately later in this Chapter.

The majority of RO WTP No. 4's facilities, mechanical equipment, power, and control systems received a Neutral or Positive rating. In general, RO WTP No. 4 and its associated facilities are able to function sufficiently to meet their intended purpose. The facilities also generally appear capable of meeting the increase in maximum demands that will be experienced following the completion of the groundwater blending project. However, a few Negative ratings were assigned that MPW should plan to address.

Table 4.13 RO WTP No. 4 Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
Deep Well No. 6 - Groundwater Well	POSITIVE	POSITIVE	NEUTRAL	NEUTRAL
Deep Well No. 6 - Wellhead Facilities	NEUTRAL	POSITIVE	POSITIVE	NEUTRAL
Deep Well No. 6 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
Groundwater Transmission Pipeline	NEUTRAL	POSITIVE	POSITIVE	NEUTRAL
Cartridge Filters	POSITIVE	POSITIVE	POSITIVE	POSITIVE
Membrane Feed Pumps	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
RO Trains	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Scale Inhibitor Storage & Feed System	POSITIVE	POSITIVE	POSITIVE	POSITIVE
Calcium Hypochlorite Storage & Feed System	NEGATIVE	NEGATIVE	NEGATIVE	NEGATIVE
Anhydrous Ammonia Storage & Feed System	NEUTRAL	POSITIVE	NEUTRAL	NEUTRAL
Calcium Chloride Storage & Feed System	NEUTRAL	POSITIVE	POSITIVE	POSITIVE
RO WTP No. 4 - Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 4 - Control System	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
RO WTP No. 4 - Treatment Plant Structures	NEUTRAL(1)	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

Notes:
(1) Represents an average rating of the multiple structures present at RO WTP No. 4.

Areas that received a Negative rating in one or more field include:

- Deep Well No. 6 – Power Supply:
  - Negative rating in the reliability field due to multiple concerns including:
    - Feeder and motor conductors are grossly undersized. The undersized conductors are a serious NEC code violation, safety hazard, and reliability concern.
    - The age of the electrical equipment, especially the VFDs.
    - Electrical interlocks are needed wherever load-sized disconnects or transfer switches are utilized on VFDs or RVSS starters.

    - Several equipment enclosures are no longer used for the purpose that they were initially installed. Wires were spliced within the enclosures instead of removing the enclosures and re-routing the circuits. The current state of the wiring and enclosures is cause for much confusion and would present difficulty in trouble shooting maintenance and repair.
- Calcium Hypochlorite Storage & Feed System:
  - Negative ratings in the fields of condition, capacity, performance, and reliability due to difficulty in maintaining a chlorine residual with this system, and the frequent maintenance requirements. This system will be replaced by the summer of 2018 with a new 12.5 percent sodium hypochlorite storage and feed system.
- RO WTP No. 4 – Power Supply:
  - Negative rating in the reliability field due to concerns regarding the age of the electrical equipment, especially the VFDs. Also, electrical interlocks are needed wherever load-sized disconnects of transfer switches are utilized on VFDs or RVSS starters.
- RO WTP No. 4 – Treatment Plant Structures:
  - Negative rating in the condition field due to the grate that covers the entrance to the sump in the secondary containment area. This grate cannot support the weight of someone stepping on it. Serious injury could result from someone stepping onto the grate and subsequently falling into the sump. The grate should be replaced with one that can support the weight of someone walking on it.

4.5 Reliability of Existing Aquifer Storage Recovery Wells

MPW uses aquifer storage and recovery (ASR) wells to store finished water in the Santee Limestone Aquifer. Water is stored in the aquifer during periods of low demand, and recovered during periods of high demand. This practice helps MPW to offset the water production infrastructure (e.g., treatment plants) and increasing the daily Contract Capacity with Charleston CWS to meet the maximum day demand.

Unlike the Middendorf Aquifer deep wells, the ASR wells are relatively shallow, and due to the consolidated rock formation in which they are finished, they are constructed with open hole intervals between 250 feet and 430 feet bls. Currently, two of the three ASR wells owned by MPW are operational. Table 4.14 provides a summary of the ASR Wells.

Table 4.14 ASR Well Summary

	ASR Well No. 1 (@ RO WTP No. 3)	ASR Well No. 2 (@ RO WTP No. 4)	ASR Well No. 3 (@ RO WTP No. 2)
Recovery Capacity(1)	350 gpm	350 gpm	350 gpm
Recharge Capacity(2)	200 gpm	200 gpm	200 gpm
Year Constructed	1995(3)	1995	2006
Age of Pump	Unknown	Unknown	Unknown
Standby Power Source	600 KW Generator(4)	600 KW Generator(5)	900 KW Generator(6)
Year of Last Inspection	Unknown	Unknown	Unknown
Condition	Neutral	Neutral	Negative

Notes:
(1) Value reported is the recovery rate currently practiced. Other values for the recovery capacities very widely: 300-350 gpm for ASR Well No. 1[13], 475-575 gpm for ASR Well No. 2[14], 300-350 gpm for ASR Well No. 3[15], 0.2 mgd (140 gpm) for all three ASR Wells[16].
(2) Value reported is recharge rate currently practiced. Greater rates may be possible.
(3) ASR Well No. 1 was initially completed in 1995. The well was redeveloped in 1996.
(4) Stationary generator shared with all RO WTP No. 3 facilities.
(5) Stationary generator shared with all RO WTP No. 4 facilities.
(6) Stationary generator shared with all RO WTP No. 2 facilities.

4.5.1.1 ASR Well No. 1 (at RO WTP No. 3)

ASR Well No. 1 was constructed with two casings: a 24-inch diameter steel conductor casing set to an approximate depth of 40 ft bls, and a 17-inch diameter PVC casing set to a depth of 285 ft. A 15-inch diameter open borehole was drilled to a final depth of 399 ft bls, however approximately seven feet of the borehole collapsed. Subsequent measurements indicate that the borehole has stabilized at a depth of approximately 391 ft.

Well head facilities at ASR Well No. 1 consist of: a submersible pump, and an above ground network of piping and valves. The distribution system is the source of recharge water. Recovered water is pumped into the ground storage tank, and mixed with chlorinated water from the distribution system. The ASR well does not have a separate chlorination system. However, a separate chlorination system for the ASR well could be constructed. This system could be created by installing a flow measuring device on the well's recovery pipe, and having a flow paced metering pump dose a source of chlorine (e.g., sodium hypochlorite) and an ammoniator dose ammonia into the recovered water before it flows into the ground storage tank.

Assessment

Condition: Neutral

- The well and associated components appear to be in good condition. However, drainage from a ground storage tank comes to the ASR pad and there are signs of sediment accumulation as a result of the drainage.

[13] Aquifer Storage Recovery Phase II: Installation and Testing of ASR 1 at the RO3 Plant Site, CH2M Hill, August 1997.
[14] Aquifer Storage Recovery Phase II: Installation and Testing of ASR 2 at the Morgan's Point Facility, CH2M Hill, August 1997.
[15] Construction and Testing of the Santee Limestone Aquifer ASR Test Well (CH2M, 2007), reports that the hydraulic properties of ASR Well 3 would perform similar to ASR Well 1.
[16] Mount Pleasant Waterworks 2010 Comprehensive Utility Master Plan, CDM-Smith, April 2010.

Capacity: Neutral

- It is suspected that ASR well recharge and recovery capacity are approximately equal to those seen at the completion of construction, although the well is not directly equipped to measure flow rate, which must instead be approximated using a flow totalizer. At the completion of construction the well was rated to recharge at a rate between 250 to 300 gpm and recover at a rate between 300 to 350 gpm. Currently, MPW estimates that the recharge and recovery rates are 200 gpm and 350 gpm, respectively.
- The capacity of the well, at approximately 200 gpm recharge and 350 gpm recovery, is moderate when compared to other ASR wells operating in South Carolina, such as those operating in Hilton Head with recharge and recovery capacities of approximately 1,000 gpm or more. In many respects the capacity of a well is limited by local hydrogeology and comparisons to wells outside of MPW's service area are not totally comparable. However, MPW's ASR wells were the first constructed in the State of South Carolina and some of the first in the water industry. The practice of ASR well construction and operation has advanced such that the capacity may be improved. Concepts for improving ASR capacity and performance are presented in Appendix D.

Performance: Neutral

- Since they were installed, MPW's ASR wells operate at an approximate recovery of 85 percent. This means that 85 percent of the recharge water is available for recovery and 15 percent of the recharge water is lost to the aquifer. ASR industry practice has advanced since the wells were first installed. It is now common practice to maintain a "buffer zone" of water, approximately equal to the volume of water stored annually. The "buffer zone" practice is one that could improve annual ASR recovery and should be investigated further. Refer to Appendix D for other operational concepts that may be employed to improve the ASR well's performance through operational practice.

Reliability/Redundancy: Neutral

- ASR Well No. 1 does not have a redundant well that can be used to inject or recover stored water. However, aside from the initial collapse of unstable borehole after construction, the well has remained reliable.
- MPW does not store a spare well pump for their ASR wells which is consistent with State requirements for groundwater wells, but not for pump stations.
- Standby power is available through the stationary generator at RO WTP No. 3.
- MPW's ability to meet the State's criteria for redundancy of storage and supply wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Refer to Appendix D for recommended improvement areas related to operational practice that include:
  - Installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
    - Furthermore, periodic review of data collected from the level transmitter is recommended.
  - Installation of a magnetic flow meter to automatically record the flow of water recharged and recovered. This will assist MPW with tracking performance and recovery.

  - Installation of a conductivity analyzer to record the quality of water that is recharged and recovered. This will assist MPW with tracking performance and recovery.
- Considering storing a spare well pump and/or manufacturer recommended spare parts.
- TV the well the next time the pump is removed.

4.5.1.2 ASR Well No. 2 (at RO WTP No. 4)

ASR Well No. 2 was constructed with two casings: a 24-inch diameter steel conductor casing set to an approximate depth of 40 ft bls, and a 17-inch diameter PVC casing set to a depth of 245-ft. A 15-inch diameter open borehole was drilled to a final depth of 370 ft bls.

Well head facilities at ASR Well No. 2 consist of: a submersible pump, and an above ground network of piping and valves. The distribution system is the source of recharge water. Recovered water is pumped into the ground storage tank, mixed with chlorinated water from the distribution system. The ASR well does not have a separate chlorination system. However, a separate chlorination system for the ASR well could be constructed. This system could be created by installing a flow measuring device on the well's recovery pipe, and having a flow paced metering pump dose a source of chlorine (e.g., sodium hypochlorite) and an ammoniator dose ammonia into the recovered water before it flows into the ground storage tank.

Assessment

Condition: Neutral

- The well and associated components appear to be in good condition.

Capacity: Neutral

- It is suspected that ASR well recharge and recovery capacity have decreased from the design value, although the well is not directly equipped to measure flow rate, which must instead be approximated using a flow totalizer. At the completion of construction the well was rated to recharge at a rate between 425 to 475 gpm and recover at a rate between 425 to 475 gpm. Currently, MPW estimates that the recharge and recovery rates are 200 gpm and 350 gpm, respectively.
- The current capacity of the well, at approximately 200 gpm recharge and 350 gpm recovery, is moderate, when compared to other ASR wells operating in South Carolina, such as those operating in Hilton Head with recharge and recovery capacities of approximately 1,000 gpm or more. In many respects the capacity of a well is limited by local hydrogeology and comparisons to wells outside of MPW's service area are not totally comparable. However, MPW's ASR wells were the first constructed in the State of South Carolina and some of the first in the water industry. The practice of ASR well construction and operation has advanced such that the capacity may be improved. Concepts for improving ASR capacity and performance are presented in Appendix D.

Performance: Neutral

- Since they were installed, MPW's ASR wells operate at an approximate recovery of 85 percent. This means that 85 percent of the recharge water is available for recovery and 15 percent of the recharge water is lost to the aquifer. ASR industry practice has advanced since the wells were first installed. It is now common practice to maintain a "buffer zone" of water, approximately equal to the volume of water stored annually. The "buffer zone" practice is one that could improve annual ASR recovery and should be

investigated further. Refer to Appendix D for other operational concepts that may be employed to improve the ASR well's performance through operational practice.

Reliability/Redundancy: Neutral

- ASR Well No. 2 does not have a redundant well that can be used to inject or recover stored water.
- The capacity of ASR Well No. 2 is estimated to have deteriorated since it was constructed and some changes to operational practice may improve the reliability of its performance.
- Standby power is available through the stationary generator at RO WTP No. 4.
- MPW does not store a spare well pump for their ASR wells which is consistent with State requirements for groundwater wells, but not for pump stations.
- MPW's ability to meet the State's criteria for redundancy of storage and supply wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Refer to Appendix D for recommended improvement areas related to operational practice that include:
  - Installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
    - Furthermore, periodic review of data collected from the level transmitter is recommended.
  - Installation of a magnetic flow meter to automatically record the flow of water recharged and recovered. This will assist MPW with tracking performance and recovery.
  - Installation of a conductivity analyzer to record the quality of water that is recharged and recovered. This will assist MPW with tracking performance and recovery.
- Considering storing a spare well pump and/or manufacturer recommended spare parts.
- TV the well the next time the pump is removed.

4.5.1.3 ASR Well No. 3 (at RO WTP No. 2)

ASR Well No. 3 was constructed with two casings: a 24-inch diameter steel conductor casing set to a depth of 92 ft bls, and a 17-inch diameter PVC casing set to a depth of 310-ft. A 17-inch diameter open borehole was drilled to a final depth of 427 ft bls.

Well head facilities at ASR Well No. 3 consist of: a submersible pump, and an above ground network of piping and valves. The distribution system is the source of recharge water. Recovered water is pumped into the ground storage tank, mixed with chlorinated water from the distribution system. The ASR well does not have a separate chlorination system. However, a separate chlorination system for the ASR well could be constructed. This system could be created by installing a flow measuring device on the well's recovery pipe, and having a flow paced metering pump dose a source of chlorine (e.g., sodium hypochlorite) and an ammoniator dose ammonia into the recovered water before it flows into the ground storage tank.

Assessment

Condition: Neutral

- The well and associated components appear to be in good condition.

Capacity: Neutral

- Historically, the well's capacity has been low. ASR Well No. 3 is not currently operating.

Performance: Neutral

- ASR Well No. 3 is not currently operating.

Reliability/Redundancy: Neutral

- ASR Well No. 3 is not currently operating.
- Standby power is available through the stationary generator at RO WTP No. 2.
- MPW does not store a spare well pump for their ASR wells which is consistent with State requirements for groundwater wells, but not for pump stations.
- MPW's ability to meet the State's criteria for redundancy of storage and supply wells will be assessed further in Chapter 5 of this report.

Improvement Opportunities

- Evaluate ASR Well No. 3's performance by performing pump testing, and consider reactivating ASR Well No. 3.
- Refer to Appendix D for recommended improvement areas related to operational practice that include:
  - Installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:
    - Furthermore, periodic review of data collected from the level transmitter is recommended.
  - Installation of a magnetic flow meter to automatically record the flow of water recharged and recovered. This will assist MPW with tracking performance and recovery.
  - Installation of a conductivity analyzer to record the quality of water that is recharged and recovered. This will assist MPW with tracking performance and recovery.
- Considering storing a spare well pump and/or manufacturer recommended spare parts.
- TV the well the next time the pump is removed.

4.5.1.4 ASR Wells - Assessment Summary

Major facilities associated with the ASR Wells include: ASR Wells 1, 2 and 3 and their surface facilities. Power and control systems are associated with the RO WTPs at which each well is located and these facilities are assessed elsewhere in this Chapter. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.15.

All of the ASR facilities received a Neutral rating. In general, the ASR facilities are able to function sufficiently to meet their intended purpose although some operational improvements have been identified that may improve performance and capacity, and include:

- Refer to Appendix D for recommended improvement areas related to operational practice that include:
  - Installation of a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity over time:

    - Furthermore, periodic review of data collected from the level transmitter is recommended.
  - Installation of a magnetic flow meter to automatically record the flow of water recharged and recovered. This will assist MPW with tracking performance and recovery.
  - Installation of a conductivity analyzer to record the quality of water that is recharged and recovered. This will assist MPW with tracking performance and recovery.
- Additionally, MPW should perform a pump test on ASR Well 3 to assess its performance.

Table 4.15 ASR Wells Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
ASR Well No. 1	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
ASR Well No. 2	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
ASR Well No. 3	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL

4.6 Reliability of Existing Storage Facilities

MPW operates seven (7) ground-level water storage facilities and one (1) elevated water storage facility. These facilities provide a combined nominal storage capacity of 12.0 MG. Table 4.15 provides a summary of the water storage tanks. These storage tanks were evaluated during the condition assessment, and those findings are summarized in Table 4.16. There are two additional storage facilities that are both out-of-service: a 0.3 MG ground storage tank at WTP No. 2, and an elevated storage tank at WTP No. 1. MPW has plans to demolish the 0.3 MG ground storage tank at RO WTP No. 2. The elevated tank at RO WTP No. 1 is currently a source of revenue (i.e., cellular service), although it needs to be assessed structurally. The cellular services that lease space on the existing tower are working to develop a replica tank to replace the existing structure.

Table 4.16 Water Storage Tank Summary

	RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4	Wando Park	Highway 41
Type	Ground	Ground / Elevated	Ground	Ground	Ground	Ground
No. of Tanks	2	2	1	1	1	1
Total Volume (MG)	1.0	2.3	2.0	2.0	2.5	2.0
Material	Concrete	Concrete / Steel	Concrete	Concrete	Concrete	Concrete
Year Constructed	1992	1991 / 1988	1991	1992	2006	2000
Last Inspected	2013	2013	2013	2013	2014	2013
Condition	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

4.6.1.1 RO WTP No. 1 Storage Tanks

Assessment

Condition: Neutral

- RO WTP No. 1 Ground Storage Tank No. 1: Neutral. The outer coating of the storage tank is cracking and flaking off in spots, discoloration on the tank's surface indicates the presence of biological growth, calcification on the tank may indicate the seepage of water through the tank, and there is a transverse crack on one of the tank's supports.
- RO WTP No. 1 Ground Storage Tank No. 2: Neutral. The outer coating of the storage tank is cracking and flaking off in spots, and discoloration on the tank's surface indicates the presence of biological growth.

Capacity: Neutral

- No issues regarding the capacity of RO WTP No. 1's storage tanks were mentioned by MPW's operations staff.

Performance: Neutral

- No issues regarding the performance of RO WTP No. 1's storage tanks were mentioned by MPW's operations staff.

Reliability/Redundancy: Neutral

- The storage tanks operate reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Monitor the deterioration of the outer coating and biological growth on the storage tanks. Pressure-wash the tanks as necessary to prevent excessive build-up of biological growth. Re-coat areas where the outer coating has flaked off.
- Conduct a structural evaluation of the transverse crack on Ground Storage Tank No. 1. Fill the crack to prevent moisture from entering the crack.
- Perform an annual assessment that documents the condition of each tank and to identify areas that experience accelerated in deterioration.
- Inspect the interior of the tanks at least every 5-years.

4.6.1.2 RO WTP No. 2 Storage Tanks

Assessment

Condition: Neutral

- RO WTP No. 2 Ground Storage Tank: Neutral. Minor cracks on north side of the tank. No evidence of leakage.
- RO WTP No. 2 Elevated Storage Tank: Neutral. The elevated storage tank was not visually inspected. No issues regarding the condition of the storage tank were mentioned by MPW's operations staff.

Capacity: Neutral

- No issues regarding the capacity of RO WTP No. 2's storage tanks were mentioned by MPW's operations staff.

Performance: Neutral

- No issues regarding the performance of RO WTP No. 2's storage tanks were mentioned by MPW's operations staff.

Reliability/Redundancy: Neutral

- The storage tanks operate reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Monitor the existing cracks on the ground storage tank. Schedule maintenance if cracks grow or leakage becomes excessive.
- Perform an annual assessment that documents the condition of each tank and to identify areas that experience accelerated in deterioration.
- Inspect the interior of the tanks at least every 5-years.

4.6.1.3 RO WTP No. 3 Storage Tank

Assessment

Condition: Neutral

- Evidence of tank leakage observed on the east side of tank - i.e., bubbling of coating.

Capacity: Neutral

- No issues regarding the capacity of RO WTP No. 3's storage tank was mentioned by MPW's operations staff.

Performance: Neutral

- No issues regarding the performance of RO WTP No. 3's storage tank was mentioned by MPW's operations staff.

Reliability/Redundancy: Neutral

- The storage tank is operating reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Monitor the coating for signs of accelerated leakage. Schedule maintenance if cracks grow or leakage becomes excessive.
- Perform an annual assessment that documents the condition of each tank and to identify areas that experience accelerated in deterioration.
- Inspect the interior of the tank at least every 5-years.

4.6.1.4 RO WTP No. 4 Storage Tank

Assessment

Condition: Neutral

- No splash pad on overflow. Signs of leakage around overflow link seal.

Capacity: Neutral

- No issues regarding the capacity of RO WTP No. 4's storage tank was mentioned by MPW's operations staff.

Performance: Neutral

- No issues regarding the performance of RO WTP No. 4's storage tank was mentioned by MPW's operations staff.

Reliability/Redundancy: Neutral

- The storage tank is operating reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Install a splash pad for the tank's overflow to prevent damage to structure in the event of an overflow condition.
- Monitor leakage in the area around the overflow link seal. Schedule maintenance if leakage becomes excessive.
- Perform an annual assessment that documents the condition of each tank and to identify areas that experience accelerated in deterioration.
- Inspect the interior of the tank at least every 5-years.

4.6.1.5 Wando Park Storage Tank

Assessment

Condition: Neutral

- Minor cracks are present in the surface coating, and the surface coating has peeled away in some spots. This might be evidence of a minor leak at the base of the tank.
- No splash pad was found near tank overflow.

Capacity: Neutral

- No issues regarding the capacity of Wando Park's storage tank was mentioned by MPW's operations staff.

Performance: Neutral

- No issues regarding the performance of Wando Park's storage tank was mentioned by MPW's operations staff.

Reliability/Redundancy: Neutral

- The storage tank is operating reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Install a splash pad for the tank's overflow to prevent damage to structure in the event of an overflow condition.

- Monitor areas where the surface coating has peeled away, and where minor cracks are present. Schedule maintenance if cracks grow or leakage becomes excessive.
- Perform an annual assessment that documents the degradation of the tank to allow degradation monitoring, and identifying any areas that experience accelerations in degradation.
- Inspect the interior of the tank at least every 5-years.

4.6.1.6 Highway 41 Storage Tank

Assessment

Condition: Neutral

- There are minor signs of cracking around the entire base of the tank, and signs of leakage on the east side.

Capacity: Neutral

- No issues regarding the capacity of the Highway 41 Storage Tank was mentioned by MPW's operations staff.

Performance: Negative

- MPW's operations staff mentioned that temperature stratification occurs in the ground storage tank, and that difficulties they've encountered with maintaining a chlorine residual may be related to the poor mixing that occurs in the tank.

Reliability/Redundancy: Neutral

- The storage tank is operating reliably.
- Chapter 5 of this report will evaluate MPW's overall storage capacity and their ability to meet the State's requirements for overall storage capacity and ability to meet peak flows.

Improvement Opportunities

- Perform a study to evaluate alternatives to improve mixing and maintenance of chlorine residual after water is stored in the Highway 41 storage tank.
- Perform an annual assessment that documents the condition of each tank and to identify areas that experience accelerated in deterioration.
- Inspect the interior of the tank at least every 5-years.

4.6.1.7 Storage Facilities - Assessment Summary

Storage facilities were assessed to determine their condition. Power and control systems are associated with the RO WTPs or booster pump station at which each storage tank is located and these facilities are assessed elsewhere in this Chapter. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.17.

Table 4.17 Water Storage Facility Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
RO WTP No. 1 Storage Tanks	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 2 Storage Tanks	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3 Storage Tank	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 4 Storage Tank	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Wando Park Storage Tank	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
HWY 41 Storage Tank	NEUTRAL	NEUTRAL	NEGATIVE	NEUTRAL

The majority of the storage facilities received a Neutral rating. In general, the storage facilities are able to function sufficiently to meet their intended purpose although, one facility received a Negative rating based upon its performance:

- Highway 41 Storage Tank:
  - MPW's operations staff mentioned that temperature stratification occurs in the ground storage tank, and that difficulties they've encountered with maintaining a chlorine residual may be related to the poor mixing that occurs in the tank. MPW should perform an evaluation of alternatives to improve mixing and maintenance of chlorine residual.

4.7 Reliability of Existing Pump Station Facilities

MPW operates four high-service pump stations and two booster pump stations. One high-service pump station is co-located with each RO WTP as well as one or more storage tanks. Similarly, one booster pump station is co-located with each CWS Point of Delivery and storage tank. The six pump stations boost water from the storage tanks to the distribution system. An overview of the pump stations is provided in Table 4.18. The pump stations were evaluated during the condition assessment, and those findings are summarized in Table 4.19 in section 4.7.1.47 *Pump Station Facilities - Assessment Summary*.

There are multiple pumps at each pump station of varying size, and the pumps run in rotation. The pump stations do not have pumps that operate purely on a standby, or redundant basis. Only one pump at the high service pump stations associated with RO Treatment Plants No. 1, 2, and 4 is needed to meet average day demands. However, multiple pumps are operated at the High Service Pump Stations during periods of maximum day or peak hour demand. To meet system pressure requirements, the loss of a pump during a high demand period requires an increase in the pumping rate at other locations to compensate for a pump failure.

The booster pump stations at HWY 41 and Wando Park were constructed with future expansion in mind and these facilities can accommodate the installation of an additional pump. The RO WTP high service pump stations are built out and modifications would be required to increase their peak pumping capacity.

Table 4.18 Pump Station Summary

	RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4	Wando Park	Highway 41
Capacity (gpm)	1. 400 gpm @ 120 TDH 2. 900 gpm @ 120 TDH 3. 400 gpm @ 400 gpm	1. 1,200 gpm 2. 1,200 gpm 3. 1,200 gpm	1. 1,200 gpm 2. 1,200 gpm 3. 2,000 gpm 4. 2,000 gpm	1. 900 gpm 2. 900 gpm 3. 750 gpm	1. 3,200 gpm 2. 3,200 gpm	1. 1,500 gpm @ 200 2. 1,500 gpm @ 200
Year Constructed	1991	1991	1991	2003	2006	2000
Age of Pumps	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Standby Power Source	600 KW Generator(1)	900 KW Generator(1)	600 KW Generator(1)	600 KW Generator(1)	None(2)	300 KW Generator
Year of Last Inspection	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Condition	Negative	Negative	Negative	Negative	Negative	Neutral

Notes:

(1) Stationary generator shared with all facilities at the RO WTP.

(2) The Wando Park Booster Pump Station does not have a standby generator. There is a concrete pad and transfer switch capable of supporting a 900 KW generator.

4.7.1.1 RO WTP No. 1 High Service Pump Station - Mechanical Facilities

The high service pump station at RO WTP No. 1 pumps water from the two ground storage tanks to the distribution system. Mechanical equipment at the pump station consists of two, 50 HP pumps, one, 25 HP pump, and a 4-inch Cla-Val control valve that recirculates water to the pump suction if the discharge is over-pressurized. A window-mounted HVAC unit provides climate control for the pump station.

Assessment

Condition: Neutral

- There was a small amount of oil underneath pump No. 1, and minor corrosion near the pump outlet. Minor corrosion was also present at the suction end of Pump No. 2. No negative observations were made regarding Pump No. 3.
- As opposed to the high service pump stations at RO WTPs No. 2 and No. 4, this high service pump station uses FVNR starts located in the main control panel rather than VFDs. Therefore, as opposed to the Condition of at RO WTPs No. 2 and No. 4, there does not appear to be an NEC clearance violation at this location.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 – 400 gpm at 120 ft TDH.
  - Pump No. 2 – 900 gpm at 120 ft TDH.
  - Pump No. 3 – 400 gpm at 120 ft TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Neutral

- The pump station's performance has been reliable.
- Standby power is available through the stationary generator at RO WTP No. 1.
- MPW does not store spare pump parts, although they are commercially available.
- Although the pump station does not have a redundant pump, the loss of a pump can be compensated for by increased pumping at another pump station. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Verify that the oil beneath Pump No. 1 is from normal operations, and not from a leak.
- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Monitor corrosion on the above ground valves and pipe. Recoat as necessary.

- Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.2 RO WTP No. 1 High Service Pump Station - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Neutral

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Resolve NEC working depth violation at each VFD. The building should have been larger to properly accommodate all the equipment while still maintaining the NEC required working depth in front of the VFDs.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

4.7.1.3 RO WTP No. 1 High Service Pump Station - Control System

This control system uses an Allen-Bradley SLC type of PLC interfaced over an Ethernet network to a PC Based Trihedral VTSCADA Application for monitoring and control. The SCADA application has been upgraded within the last 5-years and is a modern, reliable technology for the application. There are pilot devices on the front of the control panel for manual control of the pumps.

Assessment

Condition: Negative

- The Cabinet is showing signs of rust and corrosion. The internal wiring is disorganized and not properly routed within the enclosure. Excess wire and cable lengths result in coils of the wire at the bottom of the enclosure creating both a housekeeping and potential electrical noise issue. The wireless access point is resting on other equipment and not secured in place.

Capacity: Neutral

- PLC I/O:
  - 8 Analog Inputs.
  - 8 Analog Outputs.
  - 32 Digital Inputs.
  - 16 Relay Outputs.

Performance: Neutral

- The life cycle of the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued. The software platform of the HMI system is modern and reliable.

Reliability/Redundancy: Negative

- There is no redundancy in the architecture of the control system. The hardware is serviceable but migration to newer technology is recommended. The software is modern and serviceable by the manufacturer or third party providers.

Improvement Opportunities

- This cabinet in its entirety should be replaced within 5-10 years. Execution of this project should include migrating to the MPW's standard CompactLogix PLC platform.
- The wireless access point should be converted to a version that uses ruggedized industrial IP67/NEMA 4X housing that can be mounted external to the cabinet. The unit should also be capable of having multiple external antenna attachments to better control and limit the wireless coverage to only desired areas.

4.7.1.4 RO WTP No. 1 High Service Pump Station - Structure

The high service pump station houses three pumps that boost water from the WTP's two ground storage tanks to the distribution system.

Assessment

Condition: Neutral

- The exterior of the building needs repainting.

Improvement Opportunities

- Repaint the exterior of the building.

4.7.1.5 RO WTP No. 2 High Service Pump Station - Mechanical Facilities

The high service pump station at RO WTP No. 2 pumps water from the one ground storage tank at the Plant to the distribution system. Mechanical equipment at the pump station consists of three 75 HP pumps, and a 4-inch Cla-Val control valve that recirculates water to the pump suction if the discharge is over-pressurized. A window-mounted HVAC unit provides climate control for the pump station.

Assessment

Condition: Positive

- No negative observations were made.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 – Design capacity of 1200 gpm @ unknown TDH.
  - Pump No. 2 – Design capacity of 1200 gpm @ unknown TDH.
  - Pump No. 3 – Design capacity of 1200 gpm @ unknown TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Neutral

- The pump station's performance has been reliable.
- Standby power is available through the stationary generator at RO WTP No. 2.
- MPW does not store spare pump parts, although they are commercially available.
- Although the pump station does not have a redundant pump, the loss of a pump can be compensated for by increased pumping at another pump station. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.6 RO WTP No. 2 High Service Pump Station - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Negative

- The electrical equipment appears to be in good condition overall.
- Position of electrical equipment relative to mechanical equipment appears to violate NEC requirements for clearance in front of electrical cabinets.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Resolve NEC working depth violation at each VFD. The building should have been larger to properly accommodate all the equipment while still maintaining the NEC required working depth in front of the VFDs.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

4.7.1.7 RO WTP No. 2 High Service Pump Station - Control System

This control system uses an Allen-Bradley SLC type of PLC interfaced over an Ethernet network to the RO WTP No. 2 SCADA application for monitoring and control. The SCADA assessment was considered as part of the RO WTP No. 2 Control System assessment, this evaluation only considers the PLC Cabinet and related components.

Assessment

Condition: Neutral

- The condition of the cabinet is satisfactory. All wires are labeled, properly routed, and generally well organized. The cabinet is in an environmentally controlled room.

Capacity: Neutral

- PLC I/O:
  - 40 Analog Inputs.
  - 20 Analog Outputs.
  - 64 Digital Inputs.
  - 48 Relay Outputs.
- SCADA tags:
  - 5,000 tag count.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Neutral

- The life cycle of the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued.

Reliability/Redundancy: Negative

- There are pilot devices on the front of the control panel for manual control of the pumps if the PLC were to fail.
- Exposed 480 Volt, 3-Phase AC wiring is a maintenance and safety concern. While the NEC allows this installation, extra precaution and Personal Protective Equipment (PPE) should be worn by any personnel working in the cabinet in compliance with (NFPA) 70E.

Improvement Opportunities

- Replace PLC hardware within 5 years. Install new PLC in a cabinet physically separate from the existing panel to separate the power distribution components for increased safety and easier maintenance.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.7.1.8 RO WTP No. 2 High Service Pump Station - Structure

The high service pump station houses three pumps that boost water from the WTP's ground storage tank to the distribution system.

Assessment

Condition: Neutral

- Coatings on the exterior of the facility are peeling off.

Improvement Opportunities

- Recoat the exterior of the building.

4.7.1.9 RO WTP No. 3 High Service Pump Station - Mechanical Facilities

The high service pump station at RO WTP No. 3 pumps water from the Plant's only ground storage tank to the distribution system. Mechanical equipment at the pump station consists of two 100 HP pumps, and two 150 HP pumps. The pump station's HVAC system consists of eleven (11) motorized dampers, five (5) exhaust fans, and four (4) unit heaters.

Assessment

Condition: Positive

- No negative observations were made.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 - 900 gpm @ unknown TDH.
  - Pump No. 2 - 900 gpm @ unknown TDH.
  - Pump No. 3 - 2,000 gpm @ unknown TDH.
  - Pump No. 4 - 2,000 gpm @ unknown TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Neutral

- The pump station's performance has been reliable.
- Standby power is available through the stationary generator at RO WTP No. 3.
- MPW does not store spare pump parts, although they are commercially available.
- Although the pump station does not have a redundant pump, the loss of a pump can be compensated for by increased pumping at another pump station. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.10 RO WTP No. 3 High Service Pump Station - Power Supply

The facility was installed in 1991 and most electrical equipment is approximately 26-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Negative

- The electrical equipment is located in a non-climate controlled building with louvers that are allowing the entry of corrosive gases, such as hydrogen sulfide (H2S). Electrical equipment is showing the signs of wear due to heat and corrosion.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what all redundancy is needed and where it is needed.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Remove or re-label all unused equipment.
- VFD enclosures have minor to excessive corrosion and the VFDs are nearing the end of their product life cycle. Due to the nearby source of hydrogen sulfide gas, we recommend enclosing this area as an Electrical Room with its own HVAC system and Positive Pressurization Unit (PPU) and removing louvers from this portion of the building. Recommend replacing the entire VFD cabinets (18-pulse VFD with input and output reactors). Recommend disconnecting bypass cables between MCC and new VFDs.

- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- Recommend replacing dry-type transformers soon. The transformers are non-ventilated type and are running very hot. Presents both safety and reliability concerns.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $129,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible. This estimate does not include the cost of constructing a new electrical room, or installing a new HVAC and PPU system.

4.7.1.11 RO WTP No. 3 High Service Pump Station - Control System

This control system uses an Allen-Bradley SLC type of PLC interfaced over an Ethernet network to a PC Based Trihedral VTSCADA Application for monitoring and control. The SCADA application has been upgraded within the last 5 years and is a modern, reliable technology for the application. There are pilot devices on the front of the control panel for manual control of the pumps. A wireless access point is installed inside the control panel.

Assessment

Condition: Negative

- Rust and corrosion are present on the cabinet. The internal wiring is disorganized and not properly routed within the enclosure. Excess wire and cable lengths are coiled together at the bottom of the enclosure. These coils are not organized and create a troubleshooting and potential electrical noise issue. The wireless access point is resting on other equipment, and is not secured in place.

Capacity: Neutral

- PLC I/O:
  - 8 Analog Inputs.
  - 8 Analog Outputs.
  - 32 Digital Inputs.
  - 16 Relay Outputs.

Performance: Neutral

- The life cycle of the PLC hardware is currently in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued. The software platform of the HMI system is modern and reliable.

Reliability/Redundancy: Neutral

- There is no redundancy in the architecture of the control system. The hardware is serviceable but migration to newer technology is recommended. The software is modern and serviceable by the manufacturer or third party providers.

Improvement Opportunities

- The entire cabinet should be replaced within 5-10 years. Execution of this project would include migrating to the MPW's standard CompactLogix PLC platform.
- The wireless access point should be converted to a ruggedized version with industrial IP67/NEMA 4X housing that can be externally mounted to the cabinet. Multiple external antenna should also be attached to the unit to improve the control of the wireless coverage, and limit the coverage to only desired areas.

- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.7.1.12 RO WTP No. 3 High Service Pump Station - Structure

The high service pump station houses four pumps that boost water from the WTP's ground storage tank to the distribution system.

Assessment

Condition: Neutral

- There are some signs that the roof insulation is coming loose.

Improvement Opportunities

- Monitor the roof insulation. Re-apply adhesive, or re-install the insulation as necessary.
- Create an Electrical Room with its own HVAC system and PPU.

4.7.1.13 RO WTP No. 4 High Service Pump Station - Mechanical Facilities

The high service pump station at RO WTP No. 4 pumps water from the Plant's only ground storage tank to the distribution system. Mechanical equipment at the pump station consists of three, 50 HP pumps, and a 4-inch Cla-Val control valve that recirculates water to the pump suction if the discharge is over-pressurized. A window-mounted HVAC unit provides climate control for the pump station.

Assessment

Condition: Neutral

- Overall, the mechanical equipment appears to be in good condition.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 - 1,500 gpm @ unknown TDH.
  - Pump No. 2 - 1,500 gpm @ unknown TDH.
  - Pump No. 3 - 750 gpm @ unknown TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Neutral

- The pump station's performance has been reliable.
- Standby power is available through the stationary generator at RO WTP No. 4.
- MPW does not store spare pump parts, although they are commercially available.
- Although the pump station does not have a redundant pump, the loss of a pump can be compensated for by increased pumping at another pump station. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to

compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.14 RO WTP No. 4 High Service Pump Station - Power Supply

The facility was installed in 2003 and most electrical equipment is approximately 14-years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Negative

- The electrical equipment appears to be in good condition overall.
- Position of electrical equipment relative to mechanical equipment appears to violate NEC requirements for clearance in front of electrical cabinets.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what all redundancy is needed and where it is needed.
- A 40 HP VFD is being used to drive a 50 HP motor. Recommend replacing with a new 50 HP VFD.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Resolve NEC working depth violation at each VFD. The building should have been larger to properly accommodate all the equipment while still maintaining the NEC required working depth in front of the VFDs.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- The estimated cost to complete the electrical improvement opportunities identified in this section is $20,000. This includes cost for equipment and installation, and utilizing existing cables and conduits where possible.

4.7.1.15 RO WTP No. 4 High Service Pump Station - Control System

This control system uses an Allen-Bradley CompactLogix type of PLC interfaced over an Ethernet network to the RO WTP No. 4 SCADA application for monitoring and control. The PLC has been upgraded within the last 5-years and is a modern, reliable technology for the application.

Assessment

Condition: Positive

- The fiberglass enclosure and all components were in good condition. All components were installed new within the last 5-years. Wiring was labeled and neatly organized.

Capacity: Positive

- PLC I/O:
  - 40 Analog Inputs.
  - 16 Analog Outputs.
  - 64 Digital Inputs.
  - 32 Relay Outputs.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Positive.

- The hardware and software platforms of the control system are satisfactory.

Reliability/Redundancy: Neutral.

- There is no redundancy in the control system. The copper media used for the network connection is susceptible to line surges.

Improvement Opportunities

- The network connection to the High service pump station is copper CAT5 media. This is very close to the physical limitations of CAT5, which may cause reduced speeds or loss of connectivity. Replacing this with a fiber media is recommended.
- The copper CAT5 media for the network connection is routed outdoors between the main RO building and the High Service Pump building, leaving it susceptible to electrical surges, particularly nearby lighting strikes. It is recommended to install surge suppressors on the network cable near where it enters each building.
- Install a permanent shelf for the Uninterruptible Power Supply (UPS). The current unit is unsecured and resting on top of the control panel.
- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.7.1.16 RO WTP No. 4 High Service Pump Station - Structure

The high service pump station houses three pumps that boost water from the WTP's ground storage tank to the distribution system.

Assessment

Condition: Neutral

- The coating on the exterior of the facility requires repair.

Improvement Opportunities

- Recoat the exterior of the building.

4.7.1.17 Wando Park Booster Pump Station - Mechanical Facilities

The Wando Park Booster Pump Station pumps water from the station's 2.5 MG ground storage tank to the distribution system. Major mechanical equipment at the pump station includes two 250 HP pumps. Additionally, there is a 2-ton hoist inside the pump station. Two HVAC package units provide adequate heating and cooling for the pump station.

Assessment

Condition: Negative

- The line that lubricates the mechanic seal on Pump No. 1 has a crack in it and is leaking.
- The chain that is associated with the hoist is rusted. The hoist itself is, however, in good condition.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 – 3200 gpm @ unknown TDH.
  - Pump No. 2 – 3200 gpm @ unknown TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Negative

- The line that lubricates the mechanic seal on Pump No. 1 has failed twice in the past 10 years. Otherwise the pump station's performance has been reliable.
- Standby power is not available at this location.
- MPW does not store spare pump parts, although they are commercially available.
- Only one pump is needed in order to meet current peak demands. Although the pumps alternate in operation, and the station does not have a pump designated as spare, the station has redundancy since demand can be met by operating a single pump. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Replace the lubrication line on Pump No. 1.
- Replace the chain on the hoist.
- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.18 Wando Park Booster Pump Station - Power Supply

The facility was installed in 2006 and most electrical equipment is approximately 11 years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Positive

- The electrical equipment appears to be in good condition overall.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Negative

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are

the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.

- Other than the redundancy between the utility and generator sources, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what all redundancy is needed and where it is needed.

Improvement Opportunities

- Update all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.
- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

4.7.1.19 Wando Park Booster Pump Station - Control System

This control system uses an Allen-Bradley CompactLogix type of PLC interfaced over radio to the central Wastewater SCADA application for monitoring and control. There is a Cla-Val standalone valve controller mounted adjacent to the cabinet.

Assessment

Condition: Positive

- The enclosure and all components were in good condition. All components were installed new within the last 5-10 years. Wiring was labeled and neatly organized.

Capacity: Positive:

- PLC I/O:
  - 16 Analog Inputs.
  - 4 Analog Outputs.
  - 32 Digital Inputs.
  - 8 Relay Outputs.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Positive.

- The hardware and software platforms of the control system are satisfactory.

Reliability/Redundancy: Neutral

- There are pilot devices on the front of the control panel for manual control of the pumps.

Improvement Opportunities

- Install a permanent shelf for the UPS supplying the control panel.

- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.7.1.20 Wando Park Booster Pump Station - Structure

Assessment

Condition: Neutral

- A mushroom, approximately 12-inches in diameter, is growing on the ceiling of the pump station. This may indicate a roof leak.

Improvement Opportunities

- Inspect the roof of the pump station for a leak.
- Inspect the plenum above the ceiling for presence of biological growth.

4.7.1.21 Highway 41 Booster Pump Station - Mechanical Facilities

The Highway 41 Booster Pump Station pumps water from the station's 2.0 MG ground storage tank to the distribution system. Major mechanical equipment at the pump station includes two 100 HP pumps. Additionally, there is a 1-ton hoist inside the pump station. A package HVAC unit provides adequate heating and cooling for the pump station.

Assessment

Condition: Positive

- No negative observations made.

Capacity: Neutral

- An analysis of MPW's ability to meet state requirements for maintaining distribution pressures from this and other high service pump stations and booster pump stations is presented in Chapter 5 of this report.
- The individual capacity of each pump is:
  - Pump No. 1 – 1,500 gpm at 200 ft TDH.
  - Pump No. 2 – 1,500 gpm at 200 ft TDH.

Performance: Neutral

- Adequate to meet the requirements of the existing facility.

Reliability/Redundancy: Positive

- The pump station has performed reliably.
- Standby power is available through a stationary generator.
- MPW does not store spare pump parts, although they are commercially available.
- Only one pump is needed in order to meet current demands.
- Although the station does not have a pump designated as spare, the station has redundancy since demand can be met by operating a single pump. This appears to be consistent with State requirements that do not require that each pump station have a standby (i.e., redundant pump), but should a single pump be unavailable, the entire pump station (i.e., pump or booster pump station network) should be able to compensate to meet peak hour flows. MPW's overall ability to meet maximum day and peak hour pumping will be evaluated/verified in Chapter 5 of this report.

Improvement Opportunities

- Consider storing manufacturer recommended spare pump parts.
- Include the following activities on a preventative maintenance schedule:
  - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.

4.7.1.22 Highway 41 Booster Pump Station - Power Supply

The facility was installed in 2000 and most electrical equipment is approximately 17 years old. Refer to the electrical equipment condition equipment forms for equipment locations, details, and assessments.

Assessment

Condition: Neutral

- The electrical equipment appears to be in good condition overall.
- Generator block heater has excessive corrosion and needs to be replaced.
- Generator exhaust silencer has excessive corrosion. Need to make sure that it does not allow water ingress into the generator.
- Generator ATS HMI screen is sun fading. Need to add UV protection/sun screen.

Capacity: Neutral

- The electrical system capacity is sufficient for the current operating loads. Any proposed expansions or upgrades involving additional loads would require an electrical capacity analysis of the complete electrical distribution system. At a minimum, new feeders would be required to any loads that are increased in size. Note that the main electrical distribution system for this facility is either at or near capacity and is not likely able to accommodate significant additional load.

Performance: Positive

- The electrical equipment is operating and meeting facility demands. All controls, indicators, and interlocks appear to be operating according to their design.

Reliability/Redundancy: Neutral

- The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability. Motors, generators, and ATS are the next level of concern. Most other electrical equipment is less of a reliability concern. All electrical equipment needs to be regularly inspected and maintained.
- Other than the redundancy between the utility and generator sources a, there is little or no other redundancy for each service. Some pump services have bypass starters, but these are not utilized. Prior to the modification of existing equipment or the purchasing of new equipment, there likely needs to be a discussion and consensus on what all redundancy is needed and where it is needed.

Improvement Opportunities

- Revise all 1-lines and schematics to match the existing installation. Some equipment may warrant having a 1-line posted at the enclosure.

- Ensure that all electrical equipment has lamacoid nameplates matching the equipment tags shown on the 1-lines.
- Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a printed revised schedule for each panelboard.
- Perform an arc flash study and add arc flash labels to all applicable equipment. This is a potential electrical safety concern/code violation.
- Recommend replacing any and all VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- Recommend that all motors driven by VFDs be specified as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- Repair or replace generator block heater.
- Ensure that generator exhaust silencer does not allow water ingress.
- Add UV protection/sun screen for the generator ATS HMI screen.

4.7.1.23 Highway 41 Booster Pump Station - Control System

This control system uses an Allen-Bradley CompactLogix type of PLC interfaced over radio to the central Wastewater SCADA application for monitoring and control. There is a Cla-Val standalone valve controller mounted adjacent to the cabinet.

Assessment

Condition: Positive

- The enclosure and all components were in good condition. All internal components were installed new within the last 5-10 years. Wiring was labeled and neatly organized.

Capacity: Positive:

- PLC I/O:
  - 16 Analog Inputs.
  - 4 Analog Outputs.
  - 32 Digital Inputs.
  - 8 Relay Outputs.
- The I/O capacity can be expanded by Ethernet RIO nodes as needed to meet future requirements.

Performance: Positive.

- The hardware and software platforms of the control system are satisfactory.

Reliability/Redundancy: Neutral

- There are pilot devices on the front of the control panel for manual control of the pumps.

Improvement Opportunities

- Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.7.1.24 Highway 41 Booster Pump Station - Structure Assessment

Condition: Neutral

- Corrosion is present on the floor of the chlorine room.

Improvement Opportunities

- Repair the flooring in the chlorine room.

4.7.1.25 Pump Station Facilities - Assessment Summary

Major facilities associated with the MPW's pump station facilities include: high service pump stations at RO WTP No. 1, 2, 3 and 4 and booster pump stations at CWS connections 1 and 2: i.e., Wando Park (via Daniel Island) and Highway 41, respectively. The structure of these facilities, and the mechanical equipment and associated power and control systems they house were assessed. The assessment evaluated the general fields of: condition, capacity, performance, and reliability / redundancy. Each field was assigned a rating of Positive, Neutral, or Negative. A summary of the assessment is presented in Table 4.19.

Table 4.19 Existing Pump Station Facility Assessment Summary

Pump Station	Condition	Capacity	Performance	Reliability / Redundancy
RO WTP No. 1 High Service Pump Station – Mechanical Facilities	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 1 High Service Pump Station – Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEUTRAL
RO WTP No. 1 High Service Pump Station – Control System	NEGATIVE	NEUTRAL	NEUTRAL	NEGATIVE
RO WTP No. 1 High Service Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
RO WTP No. 2 High Service Pump Station – Mechanical Facilities	POSITIVE	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 2 High Service Pump Station – Power Supply	NEGATIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 2 High Service Pump Station – Control System	NEUTRAL	NEUTRAL	NEUTRAL	NEGATIVE
RO WTP No. 2 High Service Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
RO WTP No. 3 High Service Pump Station – Mechanical Facilities	POSITIVE	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3 High Service Pump Station – Power Supply	NEGATIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 3 High Service Pump Station – Control System	NEGATIVE	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3 High Service Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
RO WTP No. 4 High Service Pump Station – Mechanical Facilities	NATURAL	NEUTRAL	NEUTRAL	NEUTRAL

Table 4.19 Existing Pump Station Facility Assessment Summary (continued)

Pump Station	Condition	Capacity	Performance	Reliability / Redundancy
RO WTP No. 4 High Service Pump Station – Power Supply	NEGATIVE	NEUTRAL	POSITIVE	NEGATIVE
RO WTP No. 4 High Service Pump Station – Control System	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
RO WTP No. 4 High Service Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
Wando Park Booster Pump Station – Mechanical Facilities	NEGATIVE	NEUTRAL	NEUTRAL	NEGATIVE
Wando Park Booster Pump Station – Power Supply	POSITIVE	NEUTRAL	POSITIVE	NEUTRAL
Wando Park Booster Pump Station – Control System	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
Wando Park Booster Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
Highway 41 Booster Pump Station – Mechanical Facilities	POSITIVE	NEUTRAL	NEUTRAL	POSITIVE
Highway 41 Booster Pump Station – Power Supply	NEUTRAL	NEUTRAL	POSITIVE	NEUTRAL
Highway 41 Booster Pump Station – Control System	POSITIVE	POSITIVE	POSITIVE	NEUTRAL
Highway 41 Booster Pump Station – Structure	NEUTRAL	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE

The majority of pump station facilities, mechanical equipment, power, and control systems received a Neutral or Positive rating. In general, the pump station facilities are able to function sufficiently to meet their intended purpose. However, a few Negative ratings were assigned that MPW should plan to address.

Areas that received a Negative rating in one or more field include:

- RO WTP No. 1 High Service Pump Station:
  - Negative rating in the Condition field due to:
    - Position of electrical equipment relative to mechanical equipment appears to violate NEC requirements for clearance in front of electrical cabinets.
    - Condition of the control cabinet warrants replacement.
  - Negative rating in the reliability field due to:
    - Lacks redundancy in the control system architecture.
- RO WTP No. 2 High Service Pump Station:
  - Negative rating in the Condition field due to:
    - Position of electrical equipment relative to mechanical equipment appears to violate NEC requirements for clearance in front of electrical cabinets.
  - Negative rating in the reliability field due to:
    - The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability.

        - Control cabinet has exposed 480 VAC wires.
- RO WTP No. 3 High Service Pump Station:
    - Negative rating in the condition field due to:
        - Exposure of the electrical equipment to a corrosive environment. The electrical and control equipment shows signs of significant corrosion.
        - Control cabinet is disorganized making troubleshooting difficult.
    - Negative rating in the reliability field due to:
        - The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability.
- RO WTP No. 4 High Service Pump Station:
    - Negative rating in the Condition field due to:
        - Position of electrical equipment relative to mechanical equipment appears to violate NEC requirements for clearance in front of electrical cabinets.
    - Negative rating in the reliability field due to:
        - The age of the electrical equipment has the propensity to create reliability issues. Outdated VFDs that are out of production and that are no longer available or serviced are the main cause of concern in regard to reliability.
- Wando Park Booster Pump Station:
    - Negative rating in the Condition field due to:
        - Leak in seal water line.
    - Negative rating in the reliability field due to:
        - Lack of standby power.
        - Leak in seal water line.

4.8 Summary

A condition assessment to evaluate the reliability of MPW's existing water supplies was performed. The assessment included an on-site inspection of the major components of MPW's water supply system, including: deep wells, storage tanks, pump stations, and water treatment plants. The structures, mechanical systems, and electrical and control system associated with those components were assessed. Following the evaluation, each component was scored in four categories: condition, capacity, performance, and reliability and redundancy. Positive, neutral, or negative scores were assigned to each category. Table 4.20 summarizes the priority and cost of various condition and reliability improvements projects that were identified for MPW's water supply facilities. Cost summaries are further broken down in Appendix E. The cost summaries do not include projects that would expand MPW's water supply portfolio (e.g., expanding the RO WTPs, and the creation of new ASR wells). A detailed evaluation of alternatives to expand MPW's water supply portfolio is presented in Chapter 5.

Table 4.21 summarizes the existing water supply reliability assessments. Components receiving a negative score identify opportunities for MPW to increase the reliability of their existing water supplies, and meet their reliability standard.

Table 4.20 Water Supply Condition and Reliability Improvement Projects

4.8.1 Charleston Water System Supply

4.8.1.1 0 – 2 Years

Evaluate opportunities to improve water quality, including:

- In concert with CWS, advocate source control for dischargers upstream in the Bushy Park Reservoir and Edisto River Watersheds, and evaluate advanced treatment that may address emergency contaminants and disinfection byproduct control.
- Evaluate nitrification control options that result from chloramination within MPW's distribution system.
- Implementation of a nitrification control option based on the findings of the evaluation.

Estimated cost: $770,000.

4.8.1.2 0 – 5 Years

- To improve the reliability of the CWS supply at Point of Delivery Nos. 1 and 2, work with CWS to expedite the construction of a redundant pipeline across the Cooper River.
- To improve the reliable supply of water from CWS, work with Charleston CPW to develop and construct the third point of delivery from Sullivan's Island. In the event of an emergency or scheduled replacement/repair events, attempt to renegotiate wholesale water supply contract terms with CWS to allow some degree of transferability in the supply of water from Point of Delivery Nos. 1 and 2 with Point of Delivery No. 3.

Estimated cost: $4,000,000. *(Note: The estimated cost presented represents MPW's portion of the cost to construct the third point of delivery from Sullivan's Island. The estimated cost does not include the construction of a redundant pipeline across the Cooper River.)*

4.8.2 RO WTP No. 1 Associated Facilities

4.8.2.1 0 – 2 Years

- Deep Well No. 1
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
- RO WTP No. 1
  - Mechanical
    - Continue to monitor RO train data necessary to assess the need for membrane replacement.
    - Replace the drum pump associated with the scale inhibitor storage and feed system at RO WTP No. 1. The drum pump is no longer operational.
    - Replace the existing calcium hypochlorite system with a sodium hypochlorite system (scheduled for 2018).
    - Purchase ammoniator system spare parts.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.2 RO WTP No. 1 Associated Facilities (continued)

4.8.2.2 4.8.2.1 0 — 2 Years (continued)

- Remove soil that has accumulated around the ammonia solution injection quill.
- Electrical
  - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
    - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
    - Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a revised schedule for each panelboard.
  - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
  - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
  - Remove or re-label all unused electrical equipment.
- Structural
  - Seal cracks above door lintels.
  - Address leakage at seams of, or replace rain gutters.

- Anhydrous Ammonia Chemical Feed Building
  - Structural
    - Repaint the exterior trim.
    - Repair leak in the roof.
    - Monitor the cracks around doors and windows. Repair cracks as necessary.
- RO WTP No. 1 Ground Storage Tank No. 1
  - Structural
    - Conduct a structural evaluation of the transverse crack present on one of the tank's ribs. Fill the crack to prevent moisture from entering the crack.
- RO WTP No. 1 High Service Pump Station
  - Mechanical
    - Verify that the oil pooling beneath Pump No. 1 is from normal operations, and not from a leak.
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, pipes, and tank scales. Recoat as necessary.
    - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
    - Calibrate pressure transmitters annually.
    - Calibrate the anhydrous ammonia tank scales annually.
  - Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.2.3 Estimated cost: $686,017.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.2 RO WTP No. 1 Associated Facilities (continued)

4.8.2.4 2 – 5 Years

- Deep Well No. 1
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Update spare parts inventory for all deep well pumps.
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
- RO WTP No. 1
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Install cable glands for network cable penetrations in the main control panel. This provides both a seal for the cabinet and strain relief for the cable.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
- Ground Storage Tank No. 1
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- Ground Storage Tank No. 2
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- RO WTP No. 1 High Service Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

Estimated cost: $144,250.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.2 RO WTP No. 1 Associated Facilities (continued)

4.8.2.5 5 – 10 Years

- Deep Well No. 1
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 1
  - Mechanical
    - Replace the membrane elements. The membrane elements were installed in 2013, and will be ten years old in 2023. The design life expectancy of a membrane is ten years, and membrane replacement will reduce energy use, and improve permeate water quality.
  - Controls
    - Replace the concentrate pump starter/control panel. The panel has some evidence of corrosion and many of the components are 20+ years old.
    - Install bypass switches on the network rack UPS. This will allow for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS needs to be taken out of service.
  - Structural
    - Re-coat the roof decking.
- Calcium Hypochlorite Chemical Feed Building
  - Structural
    - Demolish structure.
- RO WTP No. 1 High Service Pump Station
  - Controls
    - Replace the control system cabinet in its entirety, and migrate to the MPW's standard CompactLogix PLC platform.
    - Convert the wireless access point to a version that uses ruggedized industrial IP67/NEMA 4X housing that can be mounted external to the cabinet. The unit should also be capable of having multiple external antenna attachments to better control and limit the wireless coverage to only desired areas.
  - Structural
    - Recoat building exterior.

4.8.2.6 Estimated cost: $389,800.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.3 RO WTP No. 2 Associated Facilities

4.8.3.1 0 – 2 Years

- Deep Well No. 2
  - Mechanical
    - Construct a replacement Deep Well No. 2. The existing Deep Well No. 2 was constructed in 1969. The design life expectancy of the Deep Well is 50-years. Deep Well No. 2 will be 50-years old in 2019. Deep Well No. 2 began producing rusted column pipe material in 2017.
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
- RO WTP No. 2
  - Mechanical
    - Replace the membrane elements. The membrane elements were installed in 2013, and will be ten years old in 2023. The design life expectancy of a membrane is ten years, and membrane replacement will reduce energy use, and improve permeate water quality.
    - Continue to monitor RO train data necessary to assess the need for membrane replacement.
    - Replace the existing calcium hypochlorite system with a sodium hypochlorite system (scheduled for 2018).
    - Purchase ammoniator system spare parts.
    - Remove soil that has accumulated around the ammonia solution injection quill.
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update all panelboard schedules to match the actual loads served. Remove outdated panelboard schedules and replace with a revised schedule for each panelboard.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
    - Remove or re-label all unused electrical equipment.
  - Structural
    - Repair the architectural metal siding on the north side of the building.
    - Address leakage at seams of, or replace rain gutters.
    - Determine the source of, and repair the leaks above the restroom and electrical rooms.
- ASR Well No. 3
  - Mechanical
    - Evaluate the well's historical performance, and consider reactivating the well.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.3 RO WTP No. 2 Associated Facilities (continued)

4.8.3.2 4.8.3.1 0 – 2 Years (continued)

- RO WTP No. 2 High Service Pump Station
  - Mechanical
    - Continue to monitor RO train data necessary to assess the need for membrane replacement.
  - Controls
    - Eliminate the exposed 480 Volt, 3-phase AC wiring in the PLC cabinet. The NEC allows this installation, but extra precaution is warranted and PPE should be worn by any personnel working in the cabinet in compliance with NFPA 70E. It is a maintenance and safety concern.
- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, pipes, and tank scales. Recoat as necessary.
    - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
    - Calibrate pressure transmitters annually.
    - Calibrate the anhydrous ammonia tank scales annually.
    - Monitor the accumulation of soil around chemical injection quills that are located underground (e.g., the ammonia solution injection point).
  - Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.3.3 Estimated cost: $5,878,317.

4.8.3.4 2 – 5 Years

- Deep Well No. 2
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Update spare parts inventory for all deep well pumps.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
- RO WTP No. 2
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Replace the PLC hardware. Existing PLC hardware is in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued.
    - Replace the 24V DC power supply in the main control panel.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
  - Structural
    - Re-coat the roof decking.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.3 RO WTP No. 2 Associated Facilities (continued)

4.8.3.5 4.8.3.2 2 – 5 Years (continued)

- ASR Well No. 3
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Install a magnetic flow meter for automatic data collection.
    - Install an electric conductivity analyzer to monitor for changes in the specific conductivity of the well.
- Update spare parts inventory for all ASR well pumps.
- Ground Storage Tank
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- RO WTP No. 2 High Service Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Replace the PLC hardware. Install new PLC cabinet physical separate from the existing panel to separate power distribution components for increased safety and easier maintenance.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.8.3.6 Estimated cost: $319,750.

4.8.3.7 5 – 10 Years

- Deep Well No. 2
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 2
  - Controls
    - Replace the concentrate pump starter/control panel. The panel has some evidence of corrosion and many of the components are 20+ years old.
    - Install bypass switches on the network rack UPS. This will allow for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS needs to be taken out of service.
- ASR Well No. 3
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 2 High Service Pump Station
  - Structural
    - Recoat building exterior.

4.8.3.8 Estimated cost: $106,500.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.4 RO WTP No. 3 Associated Facilities

4.8.4.1 0 – 2 Years

- Deep Well No. 3
  - Mechanical
    - Replace the pump bowls and line shaft bearings.
  - Electrical
    - Replace portable generator with a stationary standby generator.
    - Replace generator MTS with a new generator ATS.
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
    - Remove or re-label all unused equipment.
  - Controls
    - Remove the coaxial cable that runs to the abandoned radio antenna.
- Deep Well No. 4
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
    - Remove the wall that divides the building that houses the deep well's electrical and control system into two rooms. This dividing wall precludes the VFD installation from meeting NEC working depth requirements.
      - Existing VFD also presents a reliability concern due to its age. Replace with a new 18-pulse VFD with input & output reactors, without bypass.
      - Following the removal of the dividing wall, a new, larger HVAC unit will also likely be needed.
    - Remove or re-label all unused equipment.
  - Controls
    - Remove the coaxial cable that runs to the abandoned radio antenna.
  - Structural
    - Repair the perimeter fence that wraps around the deep well property to guard against unauthorized access to the site.
- Deep Well No. 5
  - Structural
    - Construct a replacement Deep Well No. 5.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.4 RO WTP No. 3 Associated Facilities (continued)

4.8.4.2 4.8.4.1 0 – 2 Years (continued)

- RO WTP No. 3
  - Mechanical
    - Replace the membrane elements. The membrane elements were installed in 2013, and will be ten years old in 2023. The design life expectancy of a membrane is ten years, and membrane replacement will reduce energy use, and improve permeate water quality.
    - Continue to monitor RO train data necessary to assess the need for membrane replacement.
    - Replace the existing calcium hypochlorite system with a sodium hypochlorite system (scheduled for 2018).
    - Purchase ammoniator system spare parts.
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Move generator power feed to a different panelboard and revise panelboard schedules. The generator auxiliary power feed in panel dedicated to instrument power. Don't want the possibility of tripping entire panelboard in the event that panelboard main breaker trips due to generator auxiliary power overload.
  - Controls
    - Label and route the wiring on the left side of the main control panel in wireways.
  - Structural
    - Determine the source of, and repair the leaks above the control and electrical rooms.
    - Address leakage at seams of, or replace rain gutters.
- RO WTP No. 3 High Service Pump Station
  - Electrical
    - Replace dry-type transformers.
    - Create a separate electrical room within the pump station with its own HVAC system and PPU. Exclude/remove louvers from this room.
      - Replace existing VFD cabinets (18-pulse VFD with input and output reactors).
      - Disconnect bypass cables between MCC and new VFDs.
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Remove or re-label all unused electrical equipment.
- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, pipes, and tank scales. Recoat as necessary.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.4 RO WTP No. 3 Associated Facilities (continued)

4.8.4.3 4.8.4.1 0 – 2 Years (continued)

- Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
- Calibrate pressure transmitters annually.
- Calibrate the anhydrous ammonia tank scales annually.

- Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.4.4 Estimated cost: $6,396,917.

4.8.4.5 2 – 5 Years

- Groundwater Supply Transmission Pipeline
  - Mechanical
    - Replace or line the AC pipeline from Deep Well No. 4 with cured-in-place pipe (CIPP).
- Deep Well No. 3
  - Mechanical
    - Construct a replacement Deep Well No. 3. The existing Deep Well No. 3 was constructed in 1971. The design life expectancy of the Deep Well is 50-years. Deep Well No. 2 will be 50-years old in 2021.
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Update spare parts inventory for all deep well pumps.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Replace the PLC hardware. Existing PLC hardware is in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
- Deep Well No. 4
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Update spare parts inventory for all deep well pumps.
  - Electrical
    - Replace portable generator with a stationary standby generator.
    - Replace generator MTS with a new generator ATS.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.4 RO WTP No. 3 Associated Facilities (continued)

4.8.4.6 4.8.4.2 2 – 5 Years (continued)

- RO WTP No. 3
  - Mechanical
    - After Deep Well No. 5 is constructed and its maximum flow rate is established through pump testing:
      - If Deep Well No. 5 produces flow sufficient to consider increasing capacity at RO WTP No. 3, consider membrane feed pump replacement in concert with an RO plant expansion.
      - If Deep Well No. 5 only produces flow required to meet the current WTP capacity, consider either adjusting the pressure set point at the suction of the membrane feed pumps or replacing the pumps to achieve a better operating point.
      - Perform a membrane CIP if the membrane elements won't be replaced in the near future.
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Replace the PLC hardware. Existing PLC hardware is in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued.
    - Replace the 24V DC power supply in the main control panel.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
- ASR Well No. 1
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Install a magnetic flow meter for automatic data collection.
    - Install an electric conductivity analyzer to monitor for changes in the specific conductivity of the well.
    - Update spare parts inventory for all ASR well pumps.
- Ground Storage Tank
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- RO WTP No. 3 High Service Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.

4.8.4.7 Estimated cost: $9,642,700.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.4 RO WTP No. 3 Associated Facilities (continued)

4.8.4.8 5 – 10 Years

- Deep Well No. 3
  - Structural
    - TV the well the next time the pump is removed.
- Deep Well No. 4
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 3
  - Controls
    - Replace the concentrate pump starter/control panel. The panel has some evidence of corrosion and many of the components are 20+ years old.
    - Install bypass switches on the network rack UPS. This will allow for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS needs to be taken out of service.
- ASR Well No. 1
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 3 High Service Pump Station
  - Controls
    - Replace the PLC hardware. Existing PLC hardware is in the "Active Mature" status, as identified by the manufacturer. PLC support and replacement parts are still available but are soon to be discontinued.
    - Wireless access point should be converted to a ruggedized version with industrial IP67/NEMA 4X housing that can be externally mounted to the cabinet.
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
  - Structural
    - Perform maintenance to maintain roof insulation.

4.8.4.9 Estimated cost: $204,500.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.5 RO WTP No. 4 Associated Facilities

4.8.5.1 URGENT

- Deep Well No. 6
  - Electrical
    - VFD Feeder and motor conductors are dangerously undersized (using a combination of #4/0 AWG and 250 kcmil conductors) which presents a serious electrical hazard, NEC code violation, safety hazard and reliability concern. Immediate replacement with a completely new drive system enclosure (18-pulse VFD with input and output reactors) and new properly-sized wiring to the drive and to the motor is recommended.
      - The existing Altivar 61 drive unit and components can be retained as a shelf-spare for other facilities.
- RO WTP No. 4
  - Structural
    - Replace the grate that covers the sump located within the secondary containment structure of the calcium chloride bulk storage area. The existing grate cannot support the weight of someone stepping on it. Serious injury could result from someone stepping onto the grate and subsequently falling into the sump. The grate should be replaced with one that can support the weight of someone walking on it.

4.8.5.2 Estimated cost: $61,000.

4.8.5.3 0 – 2 Years

- Deep Well No. 6
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope shall include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Install electrical interlocks wherever load-side disconnects or transfer switches are utilized on VFDs or reduced voltage soft starters (RVSS).
    - Remove or re-label all unused equipment. Existing enclosures for 480V disconnect, Well Pump Breaker, Panel "A'", Well Pump Starter (RVAT), wireway, and j-boxes all need to be removed. Conduits should be removed where not needed, holes plugged, and conduits re-routed where needed and sized correctly. All unused wiring should be removed. New conductors should be re-run all the way from Panel EW to their respective loads, instead of the splices that are currently used in the make-shift j-boxes. May also want to add a new wireway to transition conduits between rooms.
    - Add a 480V service disconnect or panelboard for the incoming service for the building.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.5 RO WTP No. 4 Associated Facilities (continued)

4.8.5.4 4.8.5.2 0 – 2 Years (continued)

- RO WTP No. 4
  - Mechanical
    - Continue to monitor RO train data necessary to assess the need for membrane replacement.
    - Replace the existing calcium hypochlorite system with a sodium hypochlorite system (scheduled for 2018).
    - Purchase ammoniator system spare parts.
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope shall include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
    - Remove or re-label all unused electrical equipment.
  - Controls
    - Separate the CompactLogix remote I/O network traffic onto a separate physical Ethernet network.
    - Replace the copper CAT5 media network connection with a fiber media connection. The existing connection is close to the physical limitations of CAT5, which may cause reduced speeds and is susceptible to surges, particularly lightning.
- Ground Storage Tank
  - Structural
    - Install a splash pad for the tank's overflow to prevent damage to structure in the event of an overflow condition.
- RO WTP No. 4 High Service Pump Station
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment.
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
  - Controls
    - Install surge suppressors on the copper CAT5 media for the network connection routed between the main RO building and the High Service Pump Station near where it enters each building.
    - Replace the copper CAT5 media network connection to the High Service Pump Station with a fiber media.
    - Install a permanent shelf for the UPS. The current unit is unsecured and resting on top of the control panel.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.5 RO WTP No. 4 Associated Facilities (continued)

4.8.5.5 4.8.5.2 0 – 2 Years (continued)

- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, pipes, and tank scales. Recoat as necessary.
    - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
    - Calibrate pressure transmitters annually.
    - Calibrate the anhydrous ammonia tank scales annually.
  - Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.5.6 Estimated cost: $704,517.

4.8.5.7 2 – 5 Years

- Deep Well No. 6
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Update spare parts inventory for all deep well pumps.
- RO WTP No. 4
  - Mechanical
    - Update spare parts inventory to include a shelf spare calcium chloride transfer pump.
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
- ASR Well No. 2
  - Mechanical
    - Install a level transmitter to monitor changes in the well's static and pumping water level, recharge rate, and specific capacity.
    - Install a magnetic flow meter for automatic data collection.
    - Install an electric conductivity analyzer to monitor for changes in the specific conductivity of the well.
    - Update spare parts inventory for all ASR well pumps.
- Ground Storage Tank
  - Structural
    - Inspect the interior of the tank at least every 5-years.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.5 RO WTP No. 4 Associated Facilities (continued)

4.8.5.8 4.8.5.3 2 – 5 Years (continued)

- RO WTP No. 4 High Service Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
    - Re-locate VFD location to bring working depth requirements into compliance with NEC.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

4.8.5.9 Estimated cost: $144,000.

4.8.5.10 5 – 10 Years

- Deep Well No. 6
  - Mechanical
    - Construct a replacement Deep Well No. 6. The existing Deep Well No. 6 was constructed in 1974. The design life expectancy of the Deep Well is 50-years. Deep Well No. 6 will be 50-years old in 2024.
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 4
  - Mechanical
    - Replace the membrane elements. The membrane elements were installed in 2013, and will be ten years old in 2023. The design life expectancy of a membrane is ten years, and membrane replacement will reduce energy use, and improve permeate water quality.
  - Controls
    - Install bypass switches on the network rack UPS. This will allow for a simple uninterrupted transition of the equipment in the rack to the utility power source if the UPS needs to be taken out of service.
- ASR Well No. 2
  - Structural
    - TV the well the next time the pump is removed.
- RO WTP No. 4 High Service Pump Station
  - Structural
    - Recoat building exterior.

4.8.5.11 Estimated cost: $5,147,500.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.6 Wando Park Associated Facilities (continued)

4.8.5.12 0 – 2 Years

- Storage Tank
  - Structural
    - Install a splash pad for the tank's overflow to prevent damage to structure in the event of an overflow condition.
    - Monitor cracking around the base of the tank, including the cracks that were repaired in 2013.
- Wando Park Booster Pump Station
  - Mechanical
    - Replace the lubrication line on Pump No. 1. It is currently cracked and leaking.
  - Electrical
    - Add UV protection/sun screen for the generator ATS HMI screen.
    - Ensure generator exhaust silencer does not allow water ingress.
    - Repair or replace generator block heater.
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.
  - Controls
    - Install a permanent shelf for the UPS.
  - Structural
    - Inspect the roof of the pump station for a leak.
    - Inspect the plenum above the ceiling for the presence of biological growth.
- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, and pipes. Recoat as necessary.
    - Calibrate pressure transmitters annually.
    - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
  - Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.5.13 Estimated cost: $29,650.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.6 Wando Park Associated Facilities (continued)

4.8.5.14 2 – 5 Years

- Storage Tank
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- Wando Park Booster Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.
  - Structural
    - Repair flooring in the chlorine room.

Estimated cost: $13,000.

4.8.5.15 5 – 10 Years

- Wando Booster Service Pump Station
  - Mechanical
    - Replace the rusty chain on the hoist prior to its next use.

Estimated cost: $500.

4.8.6 Highway 41 Associated Facilities

4.8.6.1 0 – 2 Years

- Storage Tank
  - Mechanical
    - Perform a tracer study to determine if stratification is occurring in the ground storage tank, and resulting in poor mixing. Evaluate and implement alternatives, including: mixers, circulation pumps, chloramine boost station, or tank cycling.
- Highway 41 Booster Pump Station
  - Electrical
    - Perform an arc flash study and add arc flash labels to all applicable equipment. Arc flash study scope should also include:
      - Update all electrical 1-lines and schematics to match the existing installation. Post 1-lines at enclosures as warranted.
      - Update panelboard schedules to match the actual loads served. Remove outdated panelboard schedules.
    - Install lamacoid nameplates that match the equipment tags shown on the 1-lines on all electrical equipment.

Table 4.20 Water Supply Assessment Summary (continued)

4.8.7 Highway 41 Associated Facilities (continued)

4.8.6.2 4.8.7.1 0 – 2 Years

- All Facilities
  - Establish a preventative maintenance schedule, and include the following items:
    - Monitor corrosion on pumps, motors, valves, and pipes. Recoat as necessary.
    - Calibrate pressure transmitters annually.
    - Exercise isolation valves and other seldom used equipment to ensure their performance and maintain their functionality.
  - Perform annual assessments that document the condition of each facility to identify any areas that experience accelerated deterioration.

4.8.6.3 Estimated cost: $72,150.

4.8.6.4 2 – 5 Years

- Storage Tank
  - Structural
    - Inspect the interior of the tank at least every 5-years.
- Highway 41 Booster Pump Station
  - Mechanical
    - Update spare parts inventory for pump manufacturer's recommended spare parts.
  - Electrical
    - Replace VFDs that are older than the two most recent production models, since VFDs present the most likely reliability concern for each pump service.
    - Specify VFD driven motors as inverter-duty rated, with Class F insulation, at a minimum, while maintaining Class B Temperature Rise.
  - Controls
    - Collect and monitor VFD data including motor current and pump speed to help evaluate pump and motor condition for maintenance purposes.

Estimated cost: $12,000.

4.8.6.5 5 – 10 Years

- None.

Table 4.21 Existing Water Supply Reliability Assessment Summary

Supply Source	Condition	Capacity	Performance	Reliability / Redundancy
CWS Point of Delivery No. 1 (Wando Park)	NEUTRAL	POSITIVE	NEUTRAL	NEGATIVE(1)
CWS Point of Delivery No. 2 (Highway 41)	NEUTRAL	POSITIVE	NEUTRAL	NEGATIVE(1)
RO WTP No. 1	NEUTRAL	NEUTRAL	NEGATIVE(2)	NEUTRAL
RO WTP No. 1 GST	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 1 HSPS	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 2	NEGATIVE(3)	NEUTRAL	NEGATIVE(2)	NEUTRAL
RO WTP No. 2 GST	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 2 HSPS	NEUTRAL	NEUTRAL	NEUTRAL	NEGATIVE(4)
ASR Well No. 3 (at RO WTP No. 2)	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3[4]	NEUTRAL	NEGATIVE(5,6)	NEGATIVE(2)	NEGATIVE(5,7)
RO WTP No. 3 GST	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 3 HSPS	NEGATIVE(8)	NEUTRAL	NEUTRAL	NEGATIVE(8)
ASR Well No. 1 (at RO WTP No. 3)	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 4	NEUTRAL	NEUTRAL	NEGATIVE(2)	NEGATIVE(9)
RO WTP No. 4 GST	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
RO WTP No. 4 HSPS	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
ASR Well No. 2 (at RO WTP No. 4)	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Wando Park GST	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL
Wando Park BPS	NEGATIVE(10)	NEUTRAL	NEUTRAL	NEGATIVE(10)
Highway 41 GST	NEUTRAL	NEUTRAL	NEGATIVE(11)	NEUTRAL
Highway 41 BPS	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL

Notes:

(1) Negative rating due to the reliability of the CWS system being outside of MPW's control, and the lack of redundancy.
(2) Negative rating due to inadequate performance of disinfection systems at maintaining residual in accordance with the State's requirements. This is scheduled to be addressed in 2018 as part of a Disinfection Conversion Project.
(3) Negative rating due to the condition of Deep Well No. 2. Deep Well No. 2 produced rusted casing material in October 2017 and has not operated since.
(4) Negative rating due to reliability and safety concerns related to the power supply, and exposed wiring in the controls cabinet.
(5) Negative rating due to the lack of adequate well water supply, which will be addressed in 2018 with the replacement of Deep Well No. 5.
(6) Negative rating due to the hydraulic capacity of the membrane feed pumps.
(7) Negative rating due to the reliability of the power supply at Deep Wells 3 and 4.
(8) Negative rating due to the lack of a dedicated electrical room with its own HVAC system. This is resulting in excess wear on the electrical equipment from heat and corrosion.
(9) Negative rating due to the reliability concerns regarding the power supply at Deep Well 6.
(10) Negative rating due to the leak in the seal water line that may impact the reliability of the pump's operation.
(11) Negative rating due to MPW's ability to maintain chlorine residual after water is stored in the HW 41 GST.

Chapter 5

FUTURE WATER SUPPLY ALTERNATIVES

5.1 Introduction

Future Water Supply opportunities were evaluated to identify a portfolio of water supplies adequate to meet (seasonal) average day demand (ADD) and maximum day demand (MDD) through build-out. These opportunities were evaluated using a combination of factors including reliability, operational flexibility, and cost effectiveness. This evaluation builds on the 2015 Comprehensive Utility Master Plan (CUMP) (CDM Smith 2015).

The 2015 CUMP identified wholesale water from CWS as the preferred source of future supplies. Supplies were anticipated to be purchased in blocks of constant annual supply, referred to as baseload, as demand increases. This chapter considers additional alternative sources of supply to replace or delay the purchase of CWS supplies, including reuse and conservation, seawater desalination, increased capacity from the existing system, and expanding ASR. Specific combinations of supply sources, referred to as Alternatives, were further evaluated to determine a preferred strategy to meet ADD and MDD through build-out (~2049). The selected alternatives will be simulated in MPW's hydraulic model to evaluate the level of service in the distribution system and identify any potential transmission improvements to resolve issues (i.e., subjection of Chapter 6). Conceptual costs are calculated to aid in Capital Improvement Project (CIP) planning.

5.2 Reliability

Water Supply Reliability refers to the ability of the water supply system to consistently meet production needs (i.e., demands) under a variety of conditions that involve loss of supply sources and/or infrastructure. To provide water supply reliability and protect against loss of infrastructure a combination of approaches should be considered, including:

1. Maintenance Best Practices (Chapter 4)
2. Redundant Equipment (Chapter 4)
3. Supply Diversification (Chapter 5)
4. Excess Supply Capacity (Chapter 5)

Maintenance Best Practices and equipment redundancy are evaluated in detail in Chapter 4. Supply diversification and excess supply capacity are evaluated in this Chapter.

As presented in Chapter 4, DHEC provides general regulatory criteria for water system infrastructure reliability. These regulatory standards serve as a minimum standard required for reliability, concerning both the quantity of physical supply and the operation and maintenance (O&M) of the water system. Maintenance Best Practices and redundant equipment were evaluated to maintain proper functioning infrastructure to continue safe and reliable operation of the water system; limiting the probability and duration of supply outages and other disruptions.

DHEC's regulatory standards do not directly address supply capacity required considering MPW's diverse supply mix. Therefore, because of the potential temporary loss of CWS source water (i.e., MPW's largest single source), MPW expanded reliability to be defined as:

> *Provide supply capacity to meet the Maximum Day Demand with the largest source out of service, which at this time is the CWS Point of Delivery No. 1 (the I-526 Point of Delivery from Daniel Island). This criteria exceeds SC regulations.*

The following sections evaluate future supply needs seasonally and during the MDD for both normal conditions and considering MPW's reliability goal.

5.3 Future Supply Needs

Existing water supplies are evaluated herein against future supply needs during (1) seasonal ADD; and (2) the MDD[1]. The impact of MPW's reliability goal on overall water supply source capacity required is quantified. The future water supply needs that are identified define the quantity and timing of the water supply required.

5.3.1 Existing Supplies

The future supply needs consider MPW's existing supply sources, as presented in Table 5.1. The existing sources of supply include[2]:

- Charleston Water System (CWS) supplies are, by contract, a baseload source of supply, which can be taken from either of two existing points of delivery. MPW is currently contracted for 6 mgd of supply, which can be increased up to 15 mgd.
- Deep Wells and the RO WTPs are operated year round, with higher use in the summer to meet peak demands. The reported 6.92 mgd quantity reflects the treated water available from the RO WTP processes, which includes an approximate 20 percent water loss of raw water during the treatment process.
- MPW uses three (3) Aquifer Storage and Recovery (ASR) wells to store finished water during periods of low demand and recover finished water during periods of high water demand. The ASR wells provide 1 mgd of recovered water (supply) during the summer. Approximately 80 percent of the water stored is recoverable. The remaining 20 percent of the stored water is used to maintain a buffer zone between the finished water stored in the aquifer and the native groundwater.
- MPW has seven (7) operational ground-level storage facilities and one operational elevated storage facility that provide a combined nominal storage capacity of 12.0 MG. Storage in excess of DHEC requirements may be used to meet the MDD.

[1] Refer to Chapter 3 for additional background on seasonal ADD and MDD flows.
[2] Refer to Chapter 2 for additional background on MPW's existing water supply infrastructure.

Table 5.1 Existing Water Supply Sources

Alternative	Description	Quantity	Usage to Meet System Demands
CWS	Charleston Water System (CWS) supplies treated water from the Hanahan Water Treatment Plant at two points of delivery along the northern boundary of MPW's service area.	6 mgd	Constant daily flow.
Deep Wells / RO WTP	Six (6) Middendorf Aquifer wells, referred to as Deep Wells, are located approximately 1,500 to 2,000 feet below land surface (bls). Deep Wells are treated at four (4) Reverse Osmosis Water Treatment Plants (RO WTPs).	6.92 mgd	As needed.
Aquifer Storage and Recovery (ASR)	MPW operates three (3) aquifer storage and recovery (ASR) wells that store water during the winter and recover water during the summer to meet peak demands.	1 mgd	Water stored in the Winter. Water recovered in the Summer.
Excess Storage	Water Storage in excess of DHEC requirements as documented in the 2015 CUMP.	4.6 MG	MDD only.

5.3.2 Seasonal Demands

MPW water use has three distinct seasons: winter, shoulder, and summer seasons. Seasons were established based on historical water use data, as presented in Chapter 3. Future seasonal demands were projected by applying seasonal peak monthly demand factors to the existing 2015 CUMP ADD demand projections.

Seasonal water demands were analyzed to more accurately evaluate the utilization of MPW's water supply sources, thereby helping to manage supply needs and ultimately capital costs associated with future supply infrastructure. To determine future supply needs on a seasonal basis, CWS and Deep Wells were compared against future build-out demands, as presented in Figure 5.1. The 6.2 mgd to 9.1 mgd supply deficit represents the range of future supplies needed to meet seasonal supply demands. The actual quantity of supply developed will depend on the type and usage of the supply (i.e., baseload (CWS) vs. peaking supplies).

Note, existing ASR and excess storage were not considered in the seasonal ADD analysis, as they have not historically been used to meet the seasonal ADD.

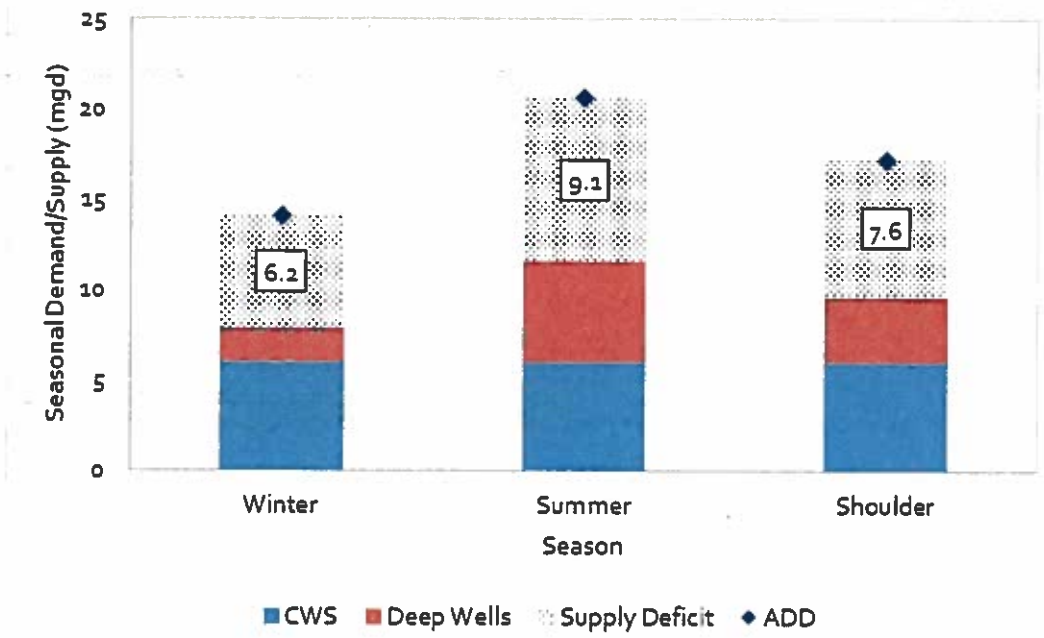


Figure 5.1 Additional seasonal supply needed at build-out ADD

5.3.3 MDD

The 2015 CUMP found that meeting future MDD will require additional supplies beyond that needed on an annual or seasonal basis. As presented in Chapter 2, MDD is approximately 25 percent higher than peak monthly use. MPW primarily uses their RO WTPs and CWS supply to meet MDD, as well as ASR and storage in excess of DHEC requirements. As presented in Figure 5.2, when future demands increase, excess storage decreases resulting in less available MDD supply.

Figure 5.3 presents a comparison of existing MDD supply against future demands. A total of 11.5 mgd of MDD supplies will be needed by build-out. This exceeds the seasonal demand deficit, largely due to decreasing available storage. Additionally, peak supply needs increase at a faster rate than ADD supply needs due to the decreasing ability to use storage to meet MDD.

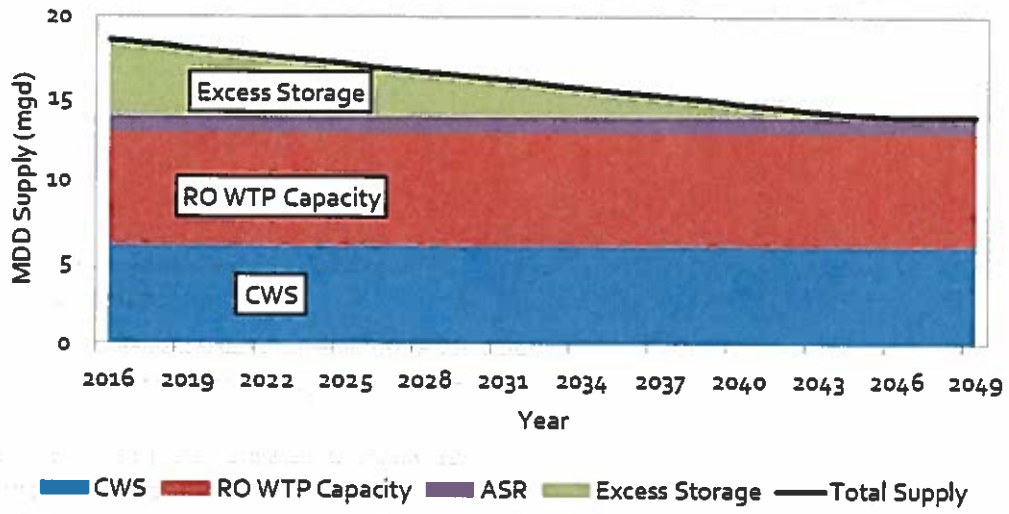


Figure 5.2 Existing supply MDD capacity through build-out

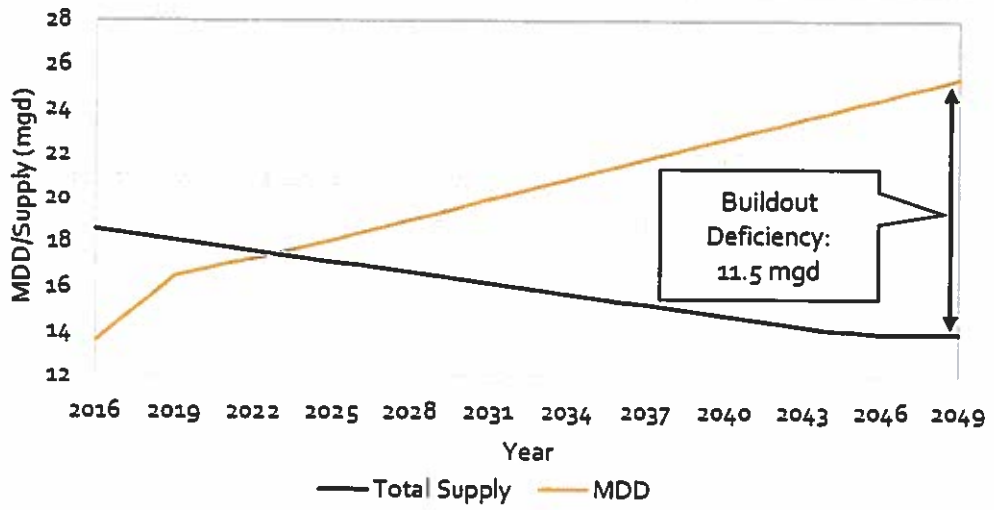


Figure 5.3 MDD supply excess/deficit through build-out

5.4 Future Water Supply Feasibility

CWS can provide sufficient future supplies as demonstrated in the 2015 CUMP. However, as MPW's reliance on CWS increases, there is a corresponding decrease in MPW's supply diversification. Consequently, this would increase the severity of a loss of service from MPW. In particular, the loss of CWS Point of Delivery No. 1 (Daniel Island) would have great impacts because it is anticipated to supply a large portion of MPW's future supply. Therefore, to meet MPW's water supply reliability goal, additional potential water supplies should be considered as alternatives or in addition to CWS:

- Additional RO Supply Capacity
- ASR Wells
- Conservation
- Reclaimed Water System
- Indirect Potable Reuse
- Seawater Desalination

Implementation of these supply sources may provide resiliency and reduce or delay future CWS supply improvements. The feasibility of a potential water supply source to meet MPW's future water supply needs are considered in the following sections.

5.4.1 Charleston CWS

As presented in Chapter 4, CWS has generally provided MPW a dependable supply of potable water. MPW's current (2016) contract with Charleston Public Works (CPW) provides for up to a total of 17.25 mgd of baseload supply (i.e., 11.25 mgd beyond the existing 6 mgd). This supply can be taken from three points of delivery, as presented in the Table 5.2. Up to 15 mgd of purchased baseload supply can be taken from either the existing Point of Delivery No. 1 (located on Daniel Island) or Point of Delivery No. 2 (located in Cainhoy near HWY 41). MPW and CPW have agreed on constructing Point of Delivery No. 3 (located on Sullivan's Island) that is anticipated to be online in 2020. Unlike the existing Points of Delivery, the Sullivan's Island Point of Delivery's 2.25 mgd supply can be taken as either baseload or as needed using CWS's municipal wholesale (wholesale) rate. Wholesale purchases will allow MPW to use this delivery point as a peaking source; however, wholesale water purchases are more expensive than the baseload supply contract. Furthermore, the Sullivan's Island Point of Delivery would provide some supply redundancy because it originates from a separate area of the CWS transmission system.

Table 5.2 CWS Wholesale Water Supply Sources

CWS Location	CWS Transmission System	Maximum Physical Capacity	Maximum Contractual Capacity	Supply timing
Point of Delivery No. 1 (Daniel Island)	Cainhoy/Daniel Island	10 mgd	15 mgd	Baseload
Point of Delivery No. 2 (Cainhoy, near HWY 41)	Cainhoy/Daniel Island	5 mgd	15 mgd	Baseload
Point of Delivery No. 3 (Sullivan's Island Point of Delivery)	Sullivan's Island	2.25 mgd (Available ~2020)	2.25 mgd	Baseload or Wholesale (as-needed)

As presented in Chapter 4, two water mains cross under the Cooper River from the Charleston peninsula and supply Point of Delivery No. 1 (on Daniel Island), and Point of Delivery No. 2 (in Cainhoy, near HWY 41). The two points of delivery have a combined supply capacity of up to 15 mgd. The supply volume is transferable between CWS Delivery Points No. 1 and 2, however, due to capacity limitations, the full 15 mgd may not be transferred through a single delivery point. CWS has planned system improvements prior to 2025 that will provide a third crossing under the Cooper River. This improvement project is recommended as it will improve the reliability of the CWS supply delivered to MPW.

The 2015 CUMP indicates that additional CWS supply capacity is available to meet annual demands through build-out. Figure 5.4 demonstrates that a total of 13.5 mgd (i.e., 6 mgd existing / 7.5 mgd future) of baseload CWS supply can be used to meet the build-out seasonal demand conditions. However, as the baseload from CWS increases, the RO WTPs utilization becomes minimal in the winter, which may result in operational challenges associated with the prolonged off-line/storage at these facilities.

Note, due to the additional costs, the use of wholesale supplies from the Sullivan's Island Point of Delivery (i.e., Point of Delivery No. 3) are limited to meeting the MDD.

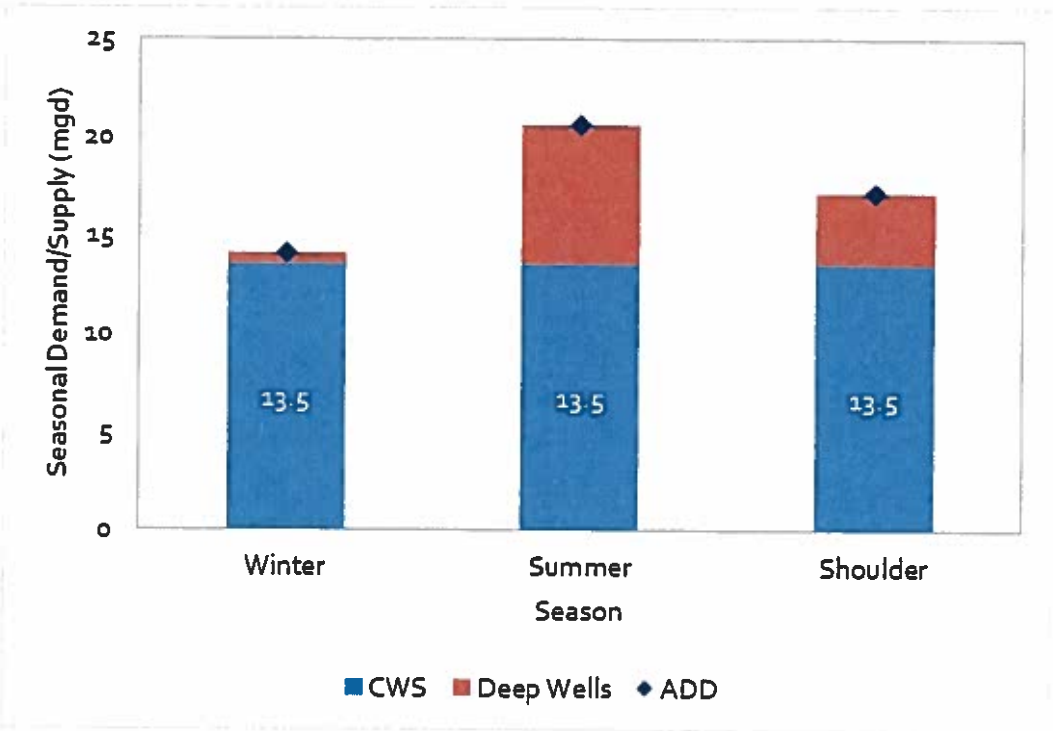


Figure 5.4 Seasonal ADD supply with 13.5 mgd CWS baseload at build-out

5.4.2 Deep Well / RO WTP Supply

5.4.2.1 Deep Well Pumping

MPW and the United States Geological Survey (USGS) collaborated on a 2007 study to address concerns from users of the Middendorf aquifer[3,4]. As presented in Table 5.3, based upon this work, an annual average groundwater yield of 5.56 mgd would result in groundwater elevations between -68 and -150 ft (NGVD 29). Table 5.3 also shows recent USGS modeling results that evaluate the effect of increased pumping on aquifer drawdown. The models predict increased pumping will lower groundwater elevations. Consequently, groundwater pumping costs will increase for MPW. However, it is not uncommon for utilities to pump groundwater from such elevations. Although, initial evaluation of the USGS data indicate that drawdown will increase, no major infrastructure improvements will be needed due to the additional aquifer drawdown. Minor changes, such as increased chemical storage, may be needed to maintain the current operations and maintenance (O&M) practices of the RO WTP's with increased use, but are not required.

[3] Mount Pleasant Waterworks 2010 Comprehensive Utility Master Plan, CDM-Smith, April 2010.
[4] USGS. 2007. Hydrogeology and Simulation of Ground-Water Flow near Mount Pleasant, South Carolina – Predevelopment, 2004, and Predicted Scenarios for 2030. USGS SIR 2007-5126.

Table 5.3 Impact of Increased Pumping on Aquifer Drawdown

Groundwater Study	Annual Average Yield (mgd)	Range of Groundwater Levels in Wells (ft)	Potential Annual Average Finished Water (mgd)
Existing (2007 Study)	5.56	-68 to -150	4.45
USGS 2017 Scenario 1	8.6	-221 to -295	6.88
USGS 2017 Scenario 4	10.1	-243 to -357	8.08
Permitted	10.52	Unknown	8.40

5.4.2.2 RO WTP Capacity

Groundwater from the Middendorf Aquifer is brackish and RO membranes at MPW's four (4) RO WTPs remove the dissolved salts from the water. The RO WTPs recover approximately 80 percent of the raw water supplied to the RO membranes as finished water. The WTPs operated by MPW vary in capacity, as presented in Table 5.4. When plant modifications to facilitate the blending of raw groundwater with RO membrane permeate are completed in 2018, the RO WTP finished water capacity during normal conditions will be 6.92 mgd[5]. However, studies from 2017 found that expanding WTP No. 3 and No. 4 could further increase capacity to 8.20 mgd[6].

Based upon a build-out RO WTP capacity of 8.20 mgd and the current CWS contract capacity of 6 mgd, Figure 5.5 presents the seasonal demand deficit that must still be addressed through additional supplies. These additional supplies may include additional CWS contract capacity or the other supply alternatives presented later in this chapter.

[5] "Normal conditions" refer to a goal finished water fluoride concentration of 0.6 mg/L. Increasing the blending flow rate (i.e., groundwater bypassing RO treatment) would increase the RO WTP capacity and the fluoride concentration in the finished water. A finished water fluoride concentration goal of 1.2 mg/L would increase the combined RO WTP finished water capacity to 8.39 mgd.

[6] Based upon a finished water fluoride concentration goal of 0.6 mg/L. The overall RO WTP finished water capacity could be increased to 9.97 mgd if the fluoride goal was increased to 1.2 mg/L.

Table 5.4 RO WTP Capacity

Description	RO WTP No. 1	RO WTP No. 2	RO WTP No. 3	RO WTP No. 4	Total
Raw Water Source	Deep Well 1	Deep Well 2	Deep Wells 3, 4, and 5	Deep Well 6	
Water Production					
Average (mgd)(1)	1.19	1.78	2.61	1.34	6.92
Maximum (mgd)(1,2)	1.44	2.16	3.17	1.62	8.39
Water Production with Improvements					
Average (mgd)(3,4)	"	"	3.23	2.00	8.20
Maximum (mgd)(2,3,4)	"	"	3.93	2.43	9.96

Notes:
(1) Plant modifications to enable groundwater blending at each of MPW's RO WTP's is scheduled to be completed by 2018.
(2) Average flows based on a finished water fluoride concentration goal of 0.6 mg/L. Maximum flow based on a finished water fluoride concentration goal of 1.2 mg/L.
(3) Max-build out at RO WTP No. 3 assumes the membrane feed pumps will be replaced, and the existing RO membranes will be replaced with high surface area RO membranes per Carollo Engineers, Inc. RO WTP No. 3 Capacity Evaluation, April 2017.
(4) Max-build out at RO WTP No. 4 assumes a third RO train will be added per Carollo Engineers, Inc. RO WTP No. 4 Production and Distribution Capacity Evaluation, 2017 (Draft)

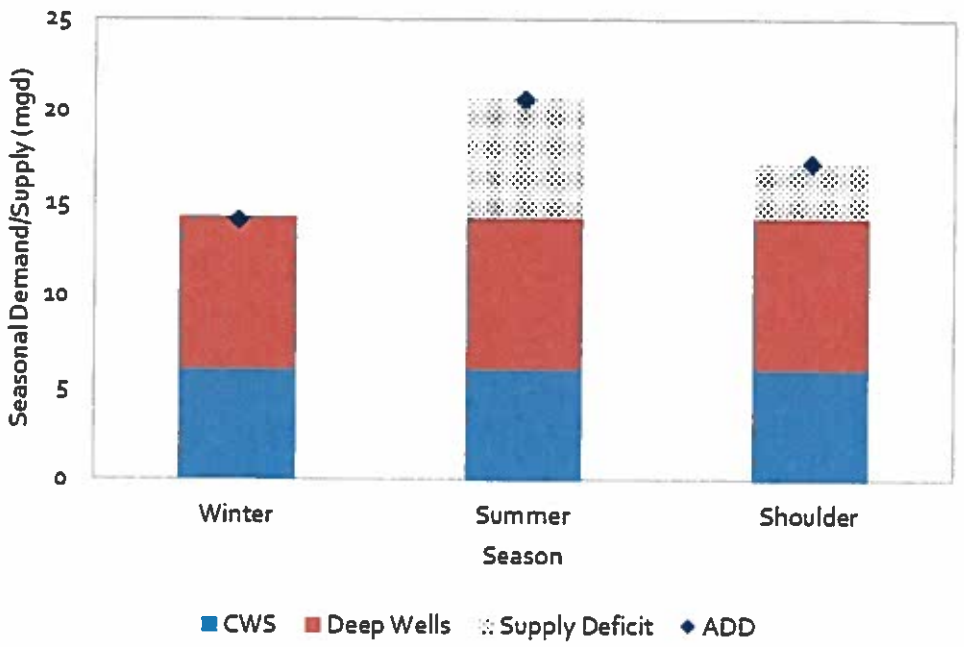


Figure 5.5 Seasonal ADD supply deficit with 8.20 mgd RO WTP capacity at build-out

5.4.3 Water Conservation

Water Conservation activities reduce demands through active behavioral and passive savings from water saving fixtures and appliances. Reduced water demands result in less supply needed in the future. There are many potential best management practices (BMP) for water conservation that can address both continuous and peak or irrigation reductions. A large body of literature is available on water conservation BMPs, including the US Environmental Protection Program (EPA) WaterSense Program. MPW has already implemented two effective BMPs: (1) water rates to encourage conservation; and (2) public education. The impact of these BMPs is already reflected in the historical water use rates. Two additional BMPs types are considered in this study: (3) every-other-day water ordinance; and (4) water efficient fixtures.

5.4.3.1 Every-other-day watering ordinance

MPW does not have an official water ordinance; however, water use data show that a majority of customers irrigate on Monday, Wednesday and Fridays. Enacting an every-other-day watering ordinance would shift irrigation and reduce peak hour demand by ~ 15 percent. However, it would result in little reduction in daily flow (2% to 5%). For a reliability standpoint, changes to irrigation practices is considered to provide marginal increased reliability because it is reliant on customer behavior.

5.4.3.2 Water Efficient Fixtures

Installation of water-efficient fixtures and appliances is a cost-effective method of reducing demands. Potential fixtures and appliances are presented in Table 5.5, which also provides typical annual water savings, cost savings per gallon saved, and lifespan of the fixture/appliances. For a reliability standpoint, fixture/appliance replacements provide good reliability and will remain in use for one to three decades before replacement is required.

The largest opportunities for water savings are in older buildings, which are more likely to have high water use fixtures/appliances. The International Plumbing code requires water-efficient fixtures on all new buildings; therefore, there are limited opportunities for improving water-efficiency for new construction.

MPW can incentivize the installation of water-efficient fixtures bv providing rebates. Rebates typically represent a fraction of the total cost and are intended to encourage customers to purchase more water-efficient fixtures/appliances when the need arises.

5.4.3.3 Water Conservation Potential

MPW has implemented two effective water conservation BMPs through its water rates and public education program. Enacting an every-other-day watering ordinance would likely reduce peak hour demand by as much as 15 percent and may result in a small reduction in daily flow (2 percent to 5 percent). Given the relatively new residential and commercial development in Town of Mount Pleasant (majority built since 1990), installation of water efficient fixtures via rebates is anticipated to only provide a limited quantity of supply reduction. It is recommended that MPW continue its existing BMPs and consider expanding its program as part of a comprehensive supply strategy.

Since water conservation is anticipated to provide limited overall demand reduction, it was not considered a feasible source of future supply and is not considered further.

Table 5.5 Water Conservation Measures

BMP Type	Saving per Method (gal/yr)	Cost per fixture/appliance ($)	Cost per gallon saved ($/gal)	Lifespan (years)
High Efficiency Toilet	4,015	$200	$18.2	20
Urinal	4,680	$350-$750	$27-$58	30
Clothes Washer	6,935	$400 to $1000	$21 - $52	12 to 14
Showerhead	1,200	$50	$15.2	10 to 20
Faucet retrofit	570	$4	$2.6	11 to 20
Pre-rinse Spray Valve	7,000	$75	$3.9	5

5.4.4 Indirect Potable Reuse

As a new ADD/MDD supply source, indirect potable reuse for MPW might consist of the injection of highly-treated wastewater into the Middendorf Aquifer near MPW's wastewater treatment plants. After a period of months, years or decades, the injected water could travel to potable water wells and be withdrawn for potable use. The injected water could potentially offset additional withdrawals from the existing (or future) deep wells and reduce aquifer drawdown. Therefore, indirect potable reuse could reduce the energy needed for groundwater pumping. This may improve the cost of the deep well supply, which will otherwise increase as a result of the effect of drawdown at the higher aquifer pumping rates presented previously in Table 5.3.

South Carolina specific regulations have not been established for indirect potable reuse, which provides notable uncertainty in both the cost and implementation schedule for this option. However, California indirect potable reuse regulations require "full advanced treatment", which requires treating wastewater through microfiltration, RO, and advanced oxidation processes. Given this amount of treatment, its cost and permitting uncertainties, indirect potable reuse was not considered to be a feasible future supply source at this time. Indirect potable reuse should be reevaluated again as part of future updates to this water supply master plan once South Carolina specific regulations have been established.

5.4.5 Seawater Desalination

Seawater Desalination has been implemented worldwide using a variety of treatment approaches to create potable supply from seawater. Seawater is approximately 16 times more saline than the Middendorf Aquifer and therefore requires more treatment and electrical power than MPW's existing sources. As a new ADD/MDD supply source for MPW, a major benefit of seawater desalination is the ability to tailor new supplies to the quantity and timing needed. Additionally, seawater sources are drought proof, unaffected by other regional withdrawals, and have excellent reliability when treatment systems are well design and operated. The largest traditional challenge for desalination are the high capital and operational (energy) costs for treatment (i.e., typically more than 2 to 5 times that of traditional water supply alternatives), as well as the environmental impacts of the intake type and disposal of treatment residuals. While brine disposal issues are fairly straight forward to resolve, depending upon the intake type chosen, permitting may be difficult and uncertain – thereby making it difficult for engineers to accurately predict the cost and schedule of implementing a seawater desalination supply source. Given the high costs and uncertainties regarding the predictability of project cost and schedule, seawater desalination was not considered to be a feasible future supply source at this time.

5.4.6 ASR Wells

MPW has three (3) Aquifer Storage and Recovery (ASR) wells, two of which (ASR1 and ASR2) are used to meet summer ADD/MDD. The two operating wells store excess treated water during the winter and shoulder months when supply from CWS meets most or all of MPW's water demands. MPW follows the common practice of recovering a majority of the water injected into an ASR well, but not all of it. The unrecovered treated water is left underground to act as a buffer zone between the treated water and the native groundwater. Currently, MPW recovers approximately 80 percent to 85 percent of water stored in the ASR wells while the remainder is used to create the buffer zone.

An evaluation of existing and potential future ASR well operation and usage is presented in Appendix D. A summary of these findings is presented below.

5.4.6.1 Existing ASR Wells

MPW has operated their existing ASR wells to provide summer supply since 1997. Historically, water has been recovered at a constant rate during the summer until stored water is exhausted. MPW tracks both volume and quality of water recovered to determine when the stored water is exhausted.

Based upon the findings presented in Appendix D, the existing ASR wells can support variable and higher injection/recovery rates than currently operated:

- Recovery rate of approximately 300 to 500 gpm
- Injection rates of approximately 200 to 300 gpm
- The wells can support varying recovery rates, rather than the historically constant operation.

Controlled testing on the ASR wells is, however, recommended to determine how the ASR wells will perform under higher and variable injection and recovery rates.

MPW does not operate ASR3 because 1) native water-quality conditions require establishing a large buffer zone between recoverable water and the native groundwater, and 2) the water system demands near ASR3 are easily met by other sources of water. ARS3 is operational, meaning that it can be put into service relatively quickly. However, developing a buffer zone and recoverable storage zone at ASR3 will require more time and investment of treated water.

Existing wells can be improved by:

- Replacing well pumps/motors to increase recovery rates.
- Incorporate variable speed drive (VFD) and controls to allow variable recovery rates.

5.4.6.2 Northern ASR Wells (Future)

MPW may expand ASR system via the construction of two (or more) new ASR wells in the northern part of their system to provide summer supplies. These wells are expected to reduce water age and improve water quality in the winter in the nearby distribution system.

Like the existing wells, the Santee/Black Mingo aquifer was considered the most viable formation for ASR future operation. Based upon the analysis presented in Appendix D, the Peedee Aquifer or the Black Creek Aquifer were not considered feasible for potential ASR development. While the Middendorf Aquifer may support ASR wells, it was not considered feasible due to the capital cost of the wells (similar to deep wells) when compared to the Santee/Black Mingo well construction cost.

The Santee/Black Mingo aquifer conceptual injection volumes and rates near Awendaw/Paradise Island were estimated based on an initial ASR report by CH2MHill in the proposed region. Previous ASR test wells in this area indicate that the aquifer is more transmissive than at the existing ASR1 and ASR2 sites. Specific capacity of test wells was much higher (5.8 to 6.3 gpm/ft) in the northern part of the MPW service area, and chloride and TDS concentrations of the native groundwater were lower than at existing ASR well sites. Table 5.6 lists conceptual injection volumes, injection rates, and production rates for proposed northern ASR wells.

Table 5.6 Northern ASR Conceptual Parameters

Average Specific Capacity (gpm/ft)(1)	Conceptual Injection Rates (gpm)(2)	Maximum Conceptual Recovery Rates (gpm)
6.1	350	900

Notes:
(1) Test well Data from the Santee Limestone Water supply/ Aquifer Storage Recovery Investigation Report by CH2MHill 1994.
(2) Based on known specific capacities.

5.4.6.3 Distribution Improvements

Two potential northern ASR Well sites were evaluated in MPW's hydraulic model. ASR operations were modeled as recharge for ADD, winter, and shoulder seasons; recovery for summer demand and MDD scenarios. Model simulations were run for the 10-year planning horizon using extended period simulations (EPS).

New ASR wells were modeled at the following locations, as shown in Chapter 6:

- Adjacent to the existing 12-inch waterline in the Bulls Bay area and
- Adjacent to an 8-inch waterline near Paradise Island.

Hydraulically, the Bulls Bay location is preferred as no transmission improvements are required. To utilize the full 900 gpm, the Paradise Island location would require upsizing of some 8-inch waterline and/or looping across Wando River (2015 CUMP Project #6). The 2015 CUMP Project #6 is anticipated to cost $1M in 2017 dollars.

5.4.7 Reclaimed Water System

New or existing ADD/MDD may be off-set by expanding MPW's reclaimed water practice. Evaluation for a reclaimed water system for the MPW was first completed in 1993 and then updated by CDM Smith in 2004 and 2008 respectively. The evaluation determined that implementation of a reclaimed water system would be technically feasible and not cost prohibitive as reclaimed piping construction is similar to that of potable water. In order to implement and develop a reclaimed water system, MPW would require three to five years to update its policies/procedures and subsequently construct the reclaimed water system infrastructure.

The 1993 Master Plan investigated a wide range of water supply alternatives from reuse to water purchases from CWS. The 1993 Master Plan recommended that a limited urban reuse system be implemented targeting areas such as the Patriot's Point Golf Course, adjacent commercial properties; properties adjacent to Rifle Ranger Road WWTP (RRRWWTP), and golf courses/single family homes in the Snee Farm area.

The 2004 CDM Reuse Master Plan update evaluated four reuse scenarios, primarily for irrigation with the potential for additional industrial or non-potable urban use. Scenarios 1A, capable 0.62 mgd, included distribution piping costs from the RRRWWTP, inspection/rehabilitation for force main along SR 41, plant modifications, and golf course connections (i.e., at Rivertown, Dunes West, Snee Farms). Scenario 1B is the same with the addition of Charleston National golf course and would provide 0.87 mgd. Scenarios 2A and 2B are the same as scenario 1 with the addition of residential connections surrounding the golf courses and would be able to serve 1.72 and 1.94 mgd, respectively. As presented in Table 5.7, the total construction costs range from $7.65 million to $31.53 million depending on the scenario and from $3.83-$5.76 in equivalent cost per 1000 gallons.

Table 5.7 Updated costs associated with 2004 CDM Reuse Master Plan Update

2017 Updated Costs	Scenario			
	1A	1B	2A	2B
2004 Total Reclaimed Water ADF (million gallons)	0.62	0.87	1.71	1.94
Total Construction Cost (million $)	$7.65	$9.07	$21.52	$31.53

Notes:
(1) Test well Data from the Santee Limestone Water supply/ Aquifer Storage Recovery Investigation Report by CH2MHill 1994
(2) Assumption using 3.5% inflation rate
(3) Information taken from Rifle Range Road WWTP Reuse Master Plan Update completed by CDM Smith in 2004
(4) Average Daily Flow assumed to be the same Notes:

Additionally, the 2008 CDM report distinguished 3 major subdivisions that could also be served reclaimed water. They were considered good candidates due to the proximity of the subdivision to the RRRWWTP (reducing conveyance costs), and the anticipated quality for the plant's effluent following possible upgrades. As presented in Table 5.8, inflated total project costs to construct approximately 49,200 linear feet of additional piping would be $2,145,861 and anticipated costs per gallon would be $6.5.

Table 5.8 Updated Costs associated with building reclaimed water infrastructure

Item	Costs ($)
RRR Distribution Mains Construction	$307,099
Central Mount Pleasant Construction	$835,693
Watermark Construction	$231,537
Scotts Creek Construction	$56,245
Subtotal	**$1,430,575**
25% Engineering	$357,643
25% Contingency	$357,643
Total Capital Costs	**$2,145,861**
Financing Costs	$459,215
Par Bond Amount	$2,605,075
Debt Services	$208,927
O&M	$31,566
Total Annual Costs	**$240,493**
Average Daily Flow (gpd)	100,720
Cost per 1000 gallons	**$6.5**

Notes:
(1) All costs in 2017 dollars.
(2) Information taken from Draft Feasibility Study for Reclaimed Water System to serve three Rifle Range Road Subdivisions completed by CDM Smith in 2008
(3) Average Daily Flow assumed to be the same.

Reclaimed water is a proven supply source that can be cost effective in the right conditions. MPW has previously chosen not to implement a large-scale reclaimed water system, which speaks to the political, economic, and technical challenges of implementing a reclaimed water system in an existing built environment. Given these challenges and the cost-effectiveness of other supplies, expanded water reuse was not considered further as a future supply source.

5.4.8 Future Water Supply Summary

A summary of future water supply sources is presented in Table 5.9. Feasible future water supplies are CWS, Deep Wells/RO WTPs, and ASR. These sources provide cost-effective and reliable supplies as presented in Figure 5.6, compared to the other supply alternatives, these supply sources provide cost-effective and reliable supply options. Water conservation is recommended, but is not anticipated to provide sufficient supply to be considered in future analyses. Indirect potable use and seawater desalination were not considered feasible sources at this time due to the uncertainties in being able predict the cost and schedule for implementing these supplies due to a lack of regulatory support or criteria. Reuse for irrigation on a larger scale was also not considered cost-effective due to the costs creating a new reclaimed water distribution system in existing developments. However, reuse is recommended where allowed by state regulation and cost-effective – still, it is not considered as part of this evaluation.

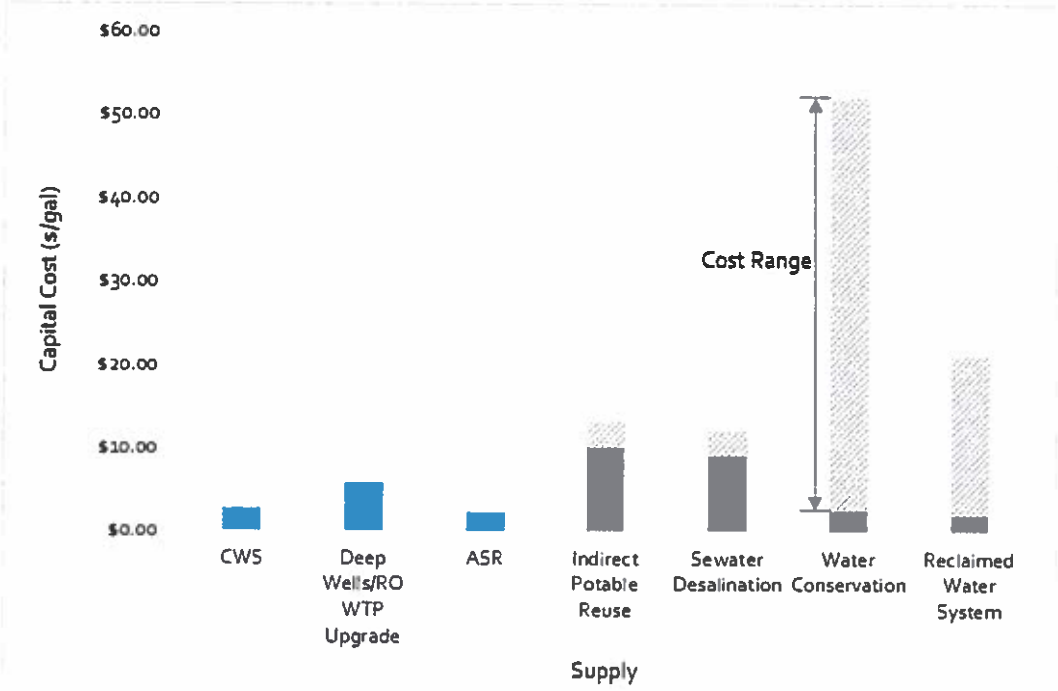


Figure 5.6 Future Supply Option Conceptual Costs

Table 5.9 Potential Future Water Supply Sources

Water Supply	Description	Quantity	Capital Costs	Reliability	Limitation	Feasible
CWS	Charleston Water System (CWS) supplies treated water from the Hanahan Water Treatment Plant at two Points of Delivery located along the northern boundary of MPW's service area.	1 to 11.75 mgd	$2.65/gal	Good	Water quality issues & single Cooper River crossing.	Yes
Deep Wells / RO WTP Upgrade	Five (5) Middendorf Aquifer wells, referred to as Deep Wells, are located approximately 1,500 to 2,000 feet below land surface (bls). Deep Wells are treated at four (4) Reverse Osmosis (RO) Water Treatment Plants.	Up to 8.2 mgd Treated Annual Supply Additional 1.2 mgd treated MDD supply*	$5.60/gal	Good	Increased pumping cost from increased aquifer yield.	Yes
ASR	ASR wells that store water during the winter and recover water during the summer to meet peak demands.	1.3 mgd per well during MDD*	$2.30/gal	Excellent	None.	Yes
Indirect Potable Reuse	Injection of highly treated wastewater into the Middendorf aquifer to offset potable water withdrawals.	1 to 10 mgd	$10 to $13/gal	Excellent	Expensive. Permitting questions makes it difficult to predict cost and implementation schedule.	No

Table 5.9 Potential Future Water Supply Sources (continued)

Water Supply	Description	Quantity	Capital Costs	Reliability	Limitation	Feasible
Seawater Desalination	Saltwater Desalination uses advanced treatment to create potable supply from seawater.	1 to 12 mgd	$9 to $12/gal	Excellent	Expensive. Permitting questions makes it difficult to predict cost and implementation schedule.	No
Water Conservation	Water Conservation activities reduce demands through active behavioral and passive water saving fixtures and appliances.	<1 mgd during ADD <1 mgd to 2 mgd during MDD	$2.6 to $52/gal	Marginal to Good	Limited quantity. Relies on customer behavior.	Yes. Not considered as a supply due to limited quantity.
Reclaimed Water System	Highly treated wastewater is used to meet irrigation demands.	1 to 10 mgd during MDD	$2-$21/gal	Good	Expensive to implement. Reclaimed water system has similar reliability concerns as a potable system.	No

5.5 Annual Water Supply Alternatives

5.5.1 Supply Options

Future annual ADD supply will continue to be from CWS and the deep wells/RO WTPs. To determine the quantity and timing of these supplies, two supply options were considered:

- Option 1 - Buy CWS Later.
- Option 2 - Buy CWS Now.

The water supply options were sized to meet future seasonal demands; however, the annual ADD is used to present the Options graphically for simplicity.

In addition to CWS Baseload supplies, MPW plans to construct the CWS Point of Delivery No. 3 (Sullivan's Island Point of Delivery) and two ASR wells in the northern portion of the system to aid in system operation:

- As presented in section 5.4.1, the Sullivan's Island Point of Delivery will be constructed, but is not anticipated to be used as a source of annual supply.
- As presented in section 5.4.4, each ASR wells is anticipated to supply 1.3 mgd (900 gpm) during the summer from water that is stored in the winter and shoulder months. Additionally, the wells are expected to reduce water age and improve water quality in the winter. Since ASR wells do not provide supply on an average day, they are not included in the ADD supply analysis presented below.
- The losses associated with ASR operation are included in the ADD calculations.

5.5.1.1 Option 1 – Buy CWS Later

Option 1 - Buy CWS Later supply annual usage is presented in Figure 5.7, which includes:

- Increased average use of RO WTPs beyond the existing 4.45 mgd production level, where groundwater pumping increases to approximately the 8.5 mgd deep well withdrawal scenario evaluated by the USGS[7].
- Maintain CWS supplies at the current level of 6 mgd through the next 10 years period.
- Increase CWS baseload after 10-year period to up to 11 mgd at build-out.

Option 1 does not require supply improvements until 2025, when peak month water use requires the WTP 3 and WTP 4 upgrades. An additional 5 mgd of CWS baseload will be purchased by 2049. Option 1 – Buy CWS Later relies more heavily on existing RO WTPs than Option 2. Future CWS supplies are needed to meet future summer demands; however, their baseload supply must also be used during winter and shoulder months. Consequently, average RO WTP use is reduced in the build-out timeframe.

5.5.1.2 Option 2 – Buy CWS Now

Option 2 - Buy CWS Now annual supply usage is presented in Figure 5.8, which includes:

- Maintain average use of RO WTPs at current levels, where no additional drawdown is anticipated in the Middendorf Aquifer.
- Purchase additional CWS supplies up to 11 mgd at build-out, with majority of purchases in the next 20 years.

[7] RO WTP operation results in 20 percent loss of groundwater pumped.

- Additional deep well withdrawals and WTP 3 and 4 upgrades after 2040.

Option 2 frontloads purchases on CWS supplies to limit drawdowns of the Middendorf Aquifer. Additionally, it limits MPWs risk of the CWS capital cost increasing at future years.

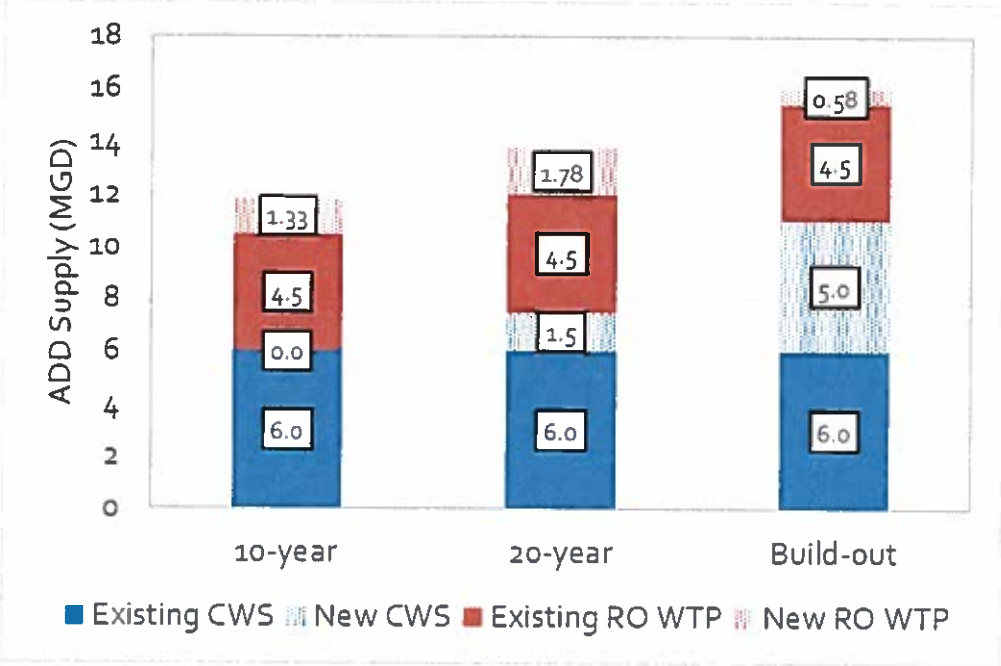


Figure 5.7 Future Supply Option 1 to meet Annual Average Day Demand – Buy CWS Later

Figure 5.8 Future Supply Option 2 to meet Annual Average Day Demand – Buy CWS Now

5.5.2 Seasonal Supply Reliability

As demands increase, the existing supply sources will be less able to reliably meet demands. As previously discussed, MPW has established a goal of meeting future demands with the largest source, CWS Point of Delivery No. 1 (Daniel Island), out-of-service. During emergency conditions when CWS Point of Delivery No. 1 is out of service, MPW has the following supply sources:

- CWS capacity of 5 mgd from CWS Point of Delivery No. 2 (Hwy 41).
- Existing RO WTP capacity of 6.92 mgd, which will require deep well withdrawals near the 8.5 mgd level considered by USGS.
- The future CWS Sullivan's Island Point of Delivery will provide an additional 2.25 mgd of reliable supply from the CWS.
- Future WTP 3 and WTP 4 upgrades can increase available supply to 8.2 mgd, which would require deep well pumping of 10.2 mgd – close to MPW's groundwater withdrawal permit of 10.59 mgd.

Note, ASR wells are not considered reliable on an annual timescale, as there is a period in the fall where a well may have limited stored water to use.

Currently, there are two CWS reliability limitations: the Cainhoy / Daniel Island Water Transmission System and the distribution system from Daniel Island to MPW. There are two transmission mains to Daniel Island that are part of the Cainhoy / Daniel Island Water Transmission System. Both of those mains can supply water to Points of Delivery 1 and 2; however, the loss of the larger 40-inch main would severely decrease the supply to both Points of Delivery. CWS has identified a future CIP project to add a third transmission main across the Cooper River to provide additional transmission reliability. Additionally, disruption in the distribution system on Daniel Island or the crossing from Points of Delivery (I-526 and HW 41) to the MPW service area may result in supply limitations for either Point of Delivery. Increased distribution reliability would require upsized and/or parallel crossings.

As presented in Figure 5.9, MPW exceeds the capacity required to reliably meet their ADD through the 20-year scenario using the planned Sullivan's Island Point of Delivery and RO WTP upgrades. However, by build-out, MPW will need to develop approximately 0.5 mgd of additional ADD supply. No project is currently envisioned to provide this supply; however, the most likely source is from future repair or replacement activities that increase reliable capacity of existing supplies.

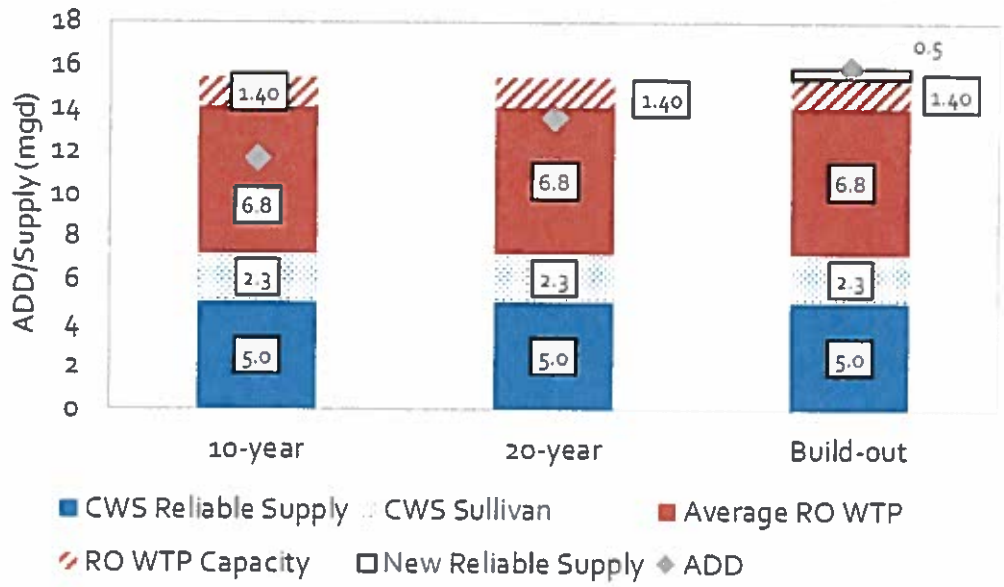


Figure 5.9 Annual Reliable Supply Capacity with Improvements

5.5.3 Annual Costs

The choice of Option 2 – Buy CWS Now or Option 1 – Buy CWS Later may impact the overall cost of supply for MPW. CWS escalates it capital and O&M costs based on the Hardy-Whitman Index for Public Utility Construction Costs. The Hardy-Whitman index has grown at rate greater than the more general ENR 20-City Index over the last decade. Historically, the cost for ASR and RO WTP projects more closely follow the ENR index than Hardy-Whitman; therefore, the timing of CWS purchase may have an impact on overall costs.

Costs for Option 1 and Option 2 were calculated for both capital and O&M costs, as presented in the following tables.

5.5.3.1 ASR Unit Costs

ASR annual costs reflect both capital and O&M costs, as presented in Table 5.10. ASR Capital Costs include the cost of drilling and equipping the ASR wells. ASR wells are typically 200 feet or less; therefore, they are notably less expensive than new deep wells. ASR capital costs are estimated at $3,000,000, which includes the well, well pumps, well building, disinfection system, and appurtenances. It is assumed that $1M of distribution system improvement was needed to support new ASR wells, except for the Bulls Bay location, these costs are based on hydraulic modeling conducted for the proposed Paradise Island location. All costs are in 2017-dollars. An annual inflation rate of 3.2 percent was assumed to produce estimates for future years.

ASR O&M costs are based on the energy required for ASR well pumping and value of water lost during storage. ASR recovery rate assumed to be 80 percent, (i.e., for every 100-gallons of water stored, 80 gallons can be recovered):

- Assumed energy cost of $0.10/kWhr in 2017, with an annual inflation rate of 3 percent.

- The value of the unrecoverable water is based on MPW's Tier 1 Water Volumetric Rate (currently $4.57/1000-gal). Future volumetric rates were inflated by 3.2 percent, which was calculated based on a regression analysis of MPW's water rates from 2002 - 2017.
- The cost of the lost water during storage exceeds the cost for ASR well pumping.

Table 5.10 ASR Costs

Item	Cost Type	Cost	Notes
Aquifer Storage and Recovery Well Construction	Capital	$3,000,000	Each well.
Distribution System Improvements	Capital	$1,000,000	Each Well. Not required for Bulls Bay area. Cost based on improvements needed for Paradise Island area.
Cost of water "lost" to ASR	O&M	$0.91 per 1000-gal	Per 1000-gallons of water recovered from an ASR well.(1)
ASR Pump Energy (for existing ASR Wells 1 and 2)	O&M	$0.07 per 1000-gal	$8,299 Annually, for recovering 1 MG of stored water per day for 122 days.(2)
ASR Pump Energy (future ASR wells in MPW's northern distribution area)	O&M	$0.10 per 1000-gal	$32,859 Annually, for recovering 2.6 MG of stored water per day for 122 days.(3)

Notes:

(1) Assumes an ASR recovery rate of 80%. Based on MPW's volumetric customer rate of $4.57 per 1000-gallons.

(2) Energy cost based on the assumption that the top of the pump bowls are 120-feet below ground, and the water surface elevation in the ASR wells is also 120-feet below ground. Most likely, this is a conservative estimate that over-estimates the cost.

(3) Energy cost based on the assumption that the top of the pump bowls are 120-feet below ground, the water surface elevation in the ASR wells is also 120-feet below ground, and the ASR wells are pumping into the distribution system at 50 psig. Most likely, these are conservative estimates that over-estimate the cost.

5.5.3.2 RO Unit Costs

RO WTP costs are based on capital costs to increase capacity and for future O&M, as presented in Table 5.11. O&M includes both operation and infrastructure renewal costs. Renewal projects were scheduled based on the typical useful life of deep wells and RO WTP infrastructure. These replacement costs exceed the costs to increase the capacity of the RO WTPs over the planning period. As many factors influence useful life, it is recommended MPW track asset condition and update the cost estimate as required. All costs are in 2017-dollars.

RO Capital Costs include the cost of expanding RO WTP No. 3, RO WTP No. 4, and the High Service Pump Station at RO WTP No. 4. Carollo's technical memorandum titled "Reverse Osmosis WTP No. 3 Capacity Evaluation" from April 2017 reports the cost of expanding RO WTP No. 3 as $4,249,939 (2017 dollars). A capital cost estimate produced by Carollo in September 2017 estimates the cost of expanding RO WTP No. 4 as $7,121,439 (2017 dollars, and includes the cost of the high service pump station upgrades). An annual inflation rate of 3.2 percent was assumed to produce estimates for future years.

RO O&M Costs considered energy, chemicals, and infrastructure renewal, including:

- Energy required for deep well pumping, and membrane feed and booster pumps. Assumed energy cost of $0.10/kWhr.
- Chemicals, including: caustic soda ($0.71/gallon), scale inhibitor ($1.01/lb.), calcium chloride ($0.17/lb.), and ammonia ($1.70/lb.).

- Membrane Clean in Place ($2000/year).
- Membrane Element Replacement ($600/each membrane):
  - Assumes Plant 1's elements will be replaced in 2023, and every 10-years thereafter.
  - Assumes Plant 2's elements will be replaced in 2019, and every 10-years thereafter.
  - Assumes Plants 3 and 4 won't have their elements replaced prior to expanding those plants (in 2028), and every 10-years thereafter.
- Deep well replacement ($5,000,000/each) and scheduled based on a 50-year useful life. Due to O&M difficulties, Deep Well 2 and 5 are scheduled for replacement in 2019 and 2018, respectively:
  - Assumes Deep Well 5 will be replaced in 2018.
  - Assumes Deep Well 2 will be replaced in 2019.
  - Assumes Deep Well 3 will be replaced in 2021.
  - Assumes Deep Well 6 will be replaced in 2024.
  - Assumes Deep Well 4 will be replaced in 2034.

An annual inflation rate of 3% is assumed for all RO O&M costs.

Table 5.11 RO Costs

Item	Cost Type	Cost	Notes
Membrane Element Replacement		$646,800	Estimate includes materials and labor to replace all elements at MPW's four (4) RO WTPs.
Deep Well Replacement		$5,000,000	Each.
Deep Well Electricity (Existing)	O&M	$0.18	$294,112 Annually, for 5.5 mgd of groundwater pumping. Producing 4.4 mgd of finished water.(1,2,3)
Deep Well Electricity (8.6 mgd Groundwater)	O&M	$0.20	$512,025 Annually, for 8.6 mgd of groundwater pumping. Producing 6.92 mgd of finished water.(1,2,4)
Deep Well Electricity (10.2 mgd Groundwater)	O&M	$0.23	$672,635 Annually, for 10.2 mgd of groundwater pumping. Producing 8.1 mgd of finished water.(1,5)
RO O&M Costs	O&M	$0.44	Per 1000-gallons.(1,6)

Notes:
(1) Cost per 1000-gallons of finished water.
(2) Based on predicted groundwater levels from USGS groundwater modeling.
(3) The 2015 CUMP assumed 4.4 mgd as the average day supply from the RO WTPS.
(4) 6.92 mgd of finished water represents running all RO WTPs at their existing capacity, and blending groundwater to a finished water fluoride goal of 0.6 mg/L.
(5) 10.20 mgd of finished water represents running RO WTPs 1 and 2 at their existing capacity, running RO WTPs 3 and 4 at their expanded capacity, and blending groundwater to a finished water fluoride goal of 0.6 mg/L.
(6) Includes cost for groundwater pumping, chemicals, and RO feed and booster pump energy.

5.5.3.3 CWS Unit Costs

CWS supply costs, as presented in Table 5.12, include capital costs to construct transmission improvements, Capital Buy-In Charge to for baseload supplies (i.e., "Contract Capacity"), annual capital improvements costs, and volumetric costs.

CWS capital costs include the Capital Buy-In Charge for both the Water Treatment System and the Water Transmission System. Per the 2016 Contract, the Water Treatment system Capital Buy-In Charge is $2,480,902 and the Water Transmission System Capital Buy-In Charges are differentiated by point of delivery and total supply:

- Points of Delivery Nos. 1 and 2 Tier 1: $2,867,688 per 1.0 mgd from 6.0 mgd up to 12.00 mgd.
- Points of Delivery Nos. 1 and 2 Tier 2: $3,374,565 per 1.0 mgd from 12.00 mgd up to 15.00 mgd.
- Point of Delivery No. 3 (Sullivan's Island), $4,516,308 per 1.0 mgd up to 2.25 mgd.

Capital Buy-In Costs escalate each year according to their Reproduction Cost Less Depreciation (RCLD) value. When calculating the RCLD value of an asset, CPW uses the Handy-Whitman Index of Public Utility Construction Cost to determine the reproduction value. CPW then uses a condition percentage schedule (e.g., Iowa Cost Curves), which takes into account asset age, serviceability, and estimated condition to establish a fair RCLD value. The RCLD for the Water Treatment System was assumed to increase at a rate of 3.2 percent. The RCLD for the Water Transmission System was assumed to increase at a rate of 4.0 percent.

CWS O&M Costs include the Capital Improvement Charge and CWS Volumetric Rate. For 2017, the Capital Improvement Charge is $166,667/mgd ($1,000,000 / 6-mgd) and assumed to increase at an annual rate of 4.6 percent. For 2017, the CWS Volumetric Rate is $0.75/1000-gallons. The CWS Volumetric Rate is composed of three components: 1) An operations and maintenance expense assumed to increase at an annual rate of 4.6 percent, 2) Depreciation on MPW's allocated share of General Plant Assets which is also assumed to increase at an annual rate of 4.6 percent, and 3) Return on MPW's allocation of General Plant Assets which is assumed to increase at an annual rate of 3.2 percent. Therefore, the 2017 Municipal Wholesale Volumetric Rate is $0.75 per 1,000 gallon and assumed to increase at an annual rate of approximately 4.6 percent.

As previously discussed, Municipal Wholesale Volumetric Rate is much higher than baseload volumetric costs at $2.86 per 1,000 gallon, but does not require the Buy-In or Capital Improvement Charges. Municipal Wholesale Volumetric Rate was also assumed to increase at an annual rate of approximately 4.6 percent.

Table 5.12 CWS Costs

Item	Cost Type	Cost	Notes
Capital Buy-In Charge for Water Treatment System	Capital	$2,480,902 per 1.0 mgd.	2016 Contract value
Capital Buy-In Charge for Water Transmission System, Tier 1	Capital	$2,867,688 per 1.0 mgd.	2016 Contract value. Points of Delivery Nos. 1 and 2, per 1.0 mgd from 6.0 mgd up to 12.00 mgd.
Capital Buy-In Charge for Water Transmission System, Tier 2	Capital	$3,374,565 per 1.0 mgd.	2016 Contract value. Points of Delivery Nos. 1 and 2, per 1.0 mgd from 12.00 mgd up to 15.00 mgd.
Capital Buy-In Charge for Water Transmission System for Point of Delivery No. 3	Capital	$4,516,308 per 1.0 mgd.	2016 Contract value. Point of Delivery No. 3, per 1.0 mgd up to 2.25 mgd.
Construction Costs for Point of Delivery No. 3(1)	Capital	$4,000,000	Construction Costs for need.
Capital Improvement Charge (aka "CIP Payment")	O&M	$166 per 1,000 gallons	Based upon 2017 annual cost, per 1,000 gallons of purchased capacity.
Purchased Capacity Volumetric Rate	O&M	$0.75 per 1,000 gallons	2016 Contract value
Municipal Wholesale Volumetric Rate	O&M	$2.86 per 1,000 gallons	2016 Contract value

Notes:
(1) MPW and CPW will share the cost of the directional drilling equally. Other costs will be shared: CPW at 45 percent, and MPW at 55 percent. MPW's estimated share of all costs is $4,000,000.

5.5.3.4 Annual Option Costs

The capital and O&M costs for Option 1 and Option 2 to supply the ADD were calculated based on the supply needed to meet future demands through build-out and costs summarized in the above sections. Costs considered the timing of supply to account for the differences in inflation rates between the supply elements. The Net Present Value (NPV) of the costs, which adjusts all costs to today's dollars assuming a 3.2 percent inflation rate, was calculated to allow direct comparison of the Options. The resulting NPV costs are summarized in Table 5.13. The Table divides costs by capital and O&M for CWS and MPW controlled supplies (i.e., RO WTP and ASR). Detailed costs tables are presented in Appendix A

Option 1 – Buy CWS Later requires approximately $7.39M per year of supply related costs over the planning period, which is approximately $0.68M per year less than Option 2 - Buy Now. The savings in Option 1 are due to cost savings from operating MPWs RO WTP and ASR supplies instead of CWS during earlier years. Option 1 – Buy CWS Later capital costs are anticipated to be approximately $1M higher NPV cost than Option 2 due to the delay purchasing additional CWS supplies, and the associated effect of the Handy-Whitman Index inflation rate that is associated with the CWS contract, which is higher than the standard ENR 20-City average inflation.

Table 5.13 Net Present Value of ADD Costs

Cost Component	Option 1 - Buy CWS Later ($M)	Option 2 - Buy CWS Now ($M)	Difference (Buy Now minus Buy Later) ($M)
CWS Capital	$34.6	$33.6	-$1.0
CWS O&M	$127.6	$148.4	$20.8
RO WTP + ASR Capital	$18.4	$28.7	$10.4
RO WTP + ASR O&M	$63.3	$55.7	-$7.6
Total ($ NPV)	**$243.8**	**$266.4**	**$22.6**
Annual Total ($ NPV)	**$7.39**	**$8.07**	**$0.68**

5.5.4 Annual Supply Strategy

Option 1 – Buy CWS Later is recommended as MPW's preferred annual supply strategy to provide reliability, operational flexibility, and cost-effectiveness. In the next ten years, the major projects for the strategy includes:

- Increased use of Deep Wells resulting in drawdown of the Middendorf Aquifer and associated increased energy costs.
- Expanding RO WTPs 3 and 4.
- Replacement of Deep Wells 2, 3, 5, and 6.
- Membrane Element Replacement at Plants 1, and 2.
- Develop an ASR well in the Northern portion of MPW's transmission system.
- Construct CWS Delivery Point No. 3 (Sullivan's Island) to improve reliability of the CWS supplies.

This annual supply strategy was used as a basis to determine additional supplies needed to meet the MDD, presented in the next section.

5.6 MDD Water Supply Alternatives

5.6.1 MDD Supply Options

Additional MDD supplies are required beyond the ADD supply strategy recommended above (i.e., Option 1 – Buy CWS Later). Based on the feasible future supplies, three approaches were considered:

- Option A - CWS Wholesale: Purchase CWS Wholesale supply from Sullivan's Island Point of Delivery on an as-needed basis.
- Option B – CWS Baseload: Purchase additional CWS Baseload that will be used year-round.
- Option C- Additional ASR Wells: Develop additional ASR wells to store water in the winter and shoulder seasons, and recover the water in the summer.

Each of these MDD supply strategies consider adding supply capacity beyond that required for the ADD supply strategy recommended (i.e., Option 1 – Buy CWS Later), sufficient to meet the peak summer monthly demands, which is approximately 25 percent more than the ADD.

Absent consideration of MPW's reliability criteria, Figure 5.10 demonstrates that an additional 2.5 mgd of future MDD supply is required beyond that required to meet the ADD. Figure 5.10 also indicates that the recommended ADD supply strategy provides sufficient MDD supply through 2034 (i.e., still without considering reliability criteria). Additional information on the three options to meet the MDD from 2035 to build-out is presented in the following sections.

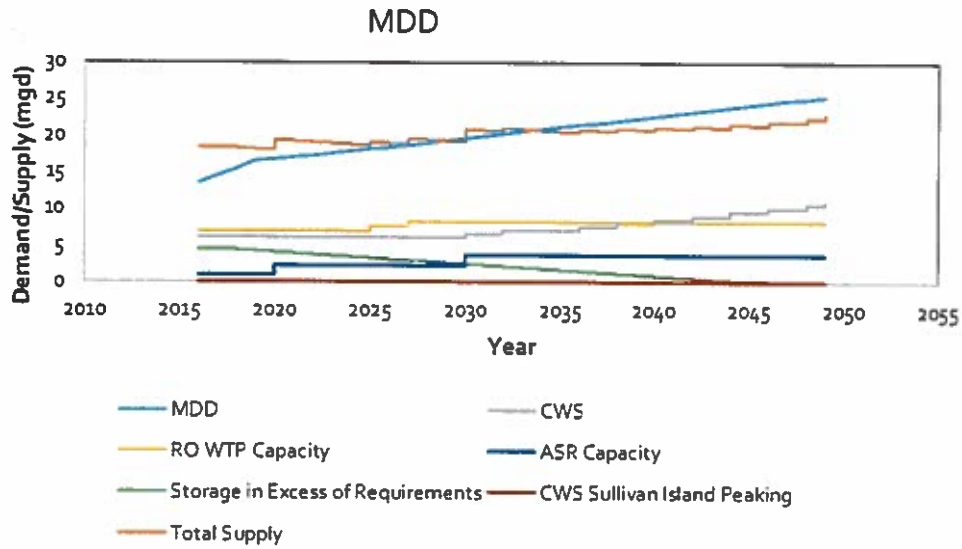


Figure 5.10 MDD supply deficit with the planned ADD supply strategy

5.6.1.1 Option A - CWS Wholesale

The CWS Point of Delivery No. 3 - Sullivan's Island Point of Delivery allows up to 2.25 mgd of baseload or wholesale water to be purchased on an as-needed basis. Capital fees paid by MPW vary depending upon MPW's decision to purchase water from this connection on a baseload or wholesale basis. Wholesale purchases will allow MPW to meet only peak summer demands; however, the cost of water is more expensive than the baseload option. CWS Wholesale can only provide 2.25 of the 2.5 mgd needed MDD supply, as presented in Figure 5.11. The data presented in Figure 5.11 demonstrates that the use of the CWS Wholesale will provide sufficient capacity through 2045 (25+ years) without additional MDD specific capital projects. After 2045, MPW would need to develop approximately 0.25 mgd of additional MDD supply beyond the currently available CWS Wholesale capacity.

Importantly, CWS Wholesale may also be used to enhance operations during peak demand periods. Hydraulic modeling found that meeting the 10-year MDD will require utilization of some of the 'excess' storage capacity in the storage tanks located at RO2, RO4, and CWS Point of Delivery Nos. 1 and 2. Using Point of Delivery No. 3 (at Sullivan's Island) to deliver 1 mgd (700 gpm) of CWS Wholesale water would reduce the total storage pumped (and not refilled) for the max day from approximately 2.4 mgd (20 percent of total storage) to 1.2 mgd (10 percent of total storage). Reducing the volume of water pumped from storage grants MPW Staff additional flexibility in operating the system.

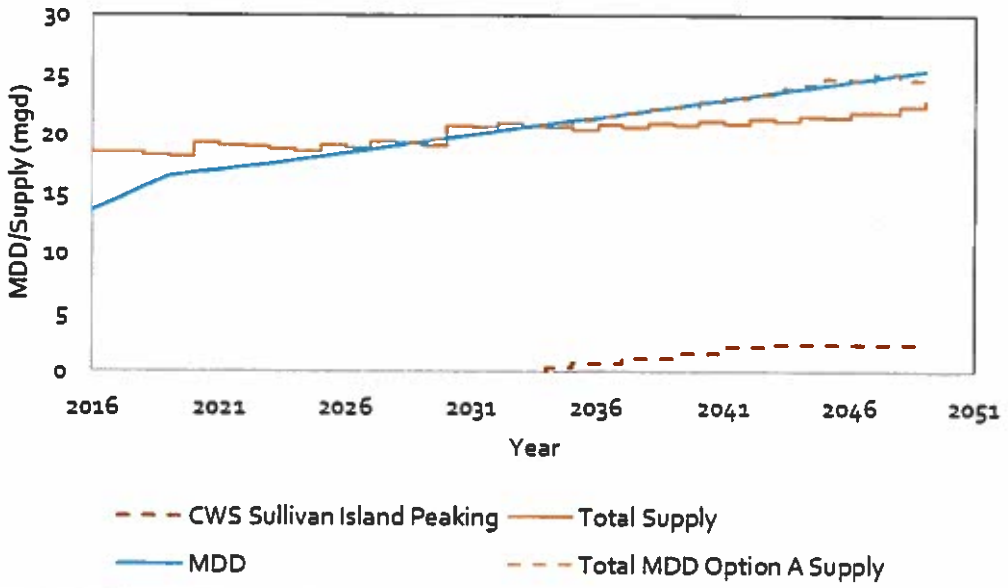


Figure 5.11 Future MDD supply with Sullivan's Island Point of Delivery wholesale supply

5.6.1.2 Option B - CWS Baseload

Additional CWS Baseload supply can be used to address future MDD and is consistent with the 2015 CUMP. Through build-out, MPW would need 13.5 mgd of total CWS supply to meet the MDD, an increase of 7.5 mgd from the existing contract and 3.5 mgd more than ADD Option 1, as presented in Figure 5.12. As a baseload supply, MPW would receive the additional CWS supply all year. Therefore, as the CWS baseload supply increases, deep well/RO WTP use will decrease, particularly in the winter season, likely resulting in several RO WTPs only being used in the summer season.

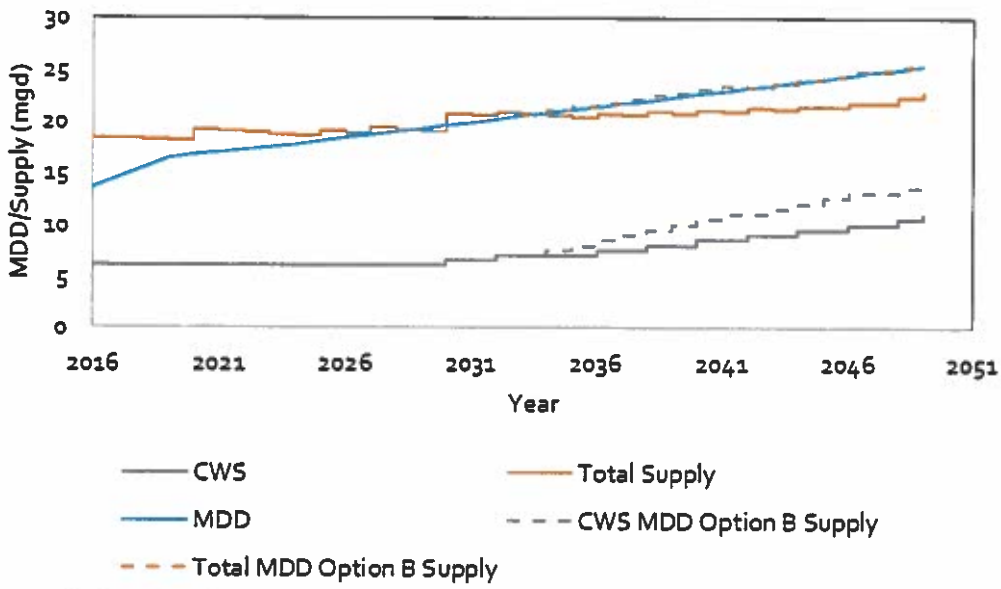


Figure 5.12 Future MDD supply with additional CWS Baseload

5.6.1.3 Option C- Additional ASR Wells

Additional ASR wells can be used to meet MDD supplies through build-out. Based on an ASR recovery (i.e., production) capacity of 1.3 mgd identified in Appendix D, a total of five (5) new ASR wells need to be developed in addition to the existing ASR wells. The initial two ASR wells would be develop as currently planned in 2020 and 2030. Then three additional wells would be needed in 2033, 2041, and 2046, as presented in Figure 5.13. MPW staff were concerned that there may not be sufficient land available to site the three additional ASR wells; therefore, this Option should be further evaluated in future water supply master plan updates to determine its feasibility. A major advantage of ASR wells is they provide additional reliable supplies, which is discussed further in the next section.

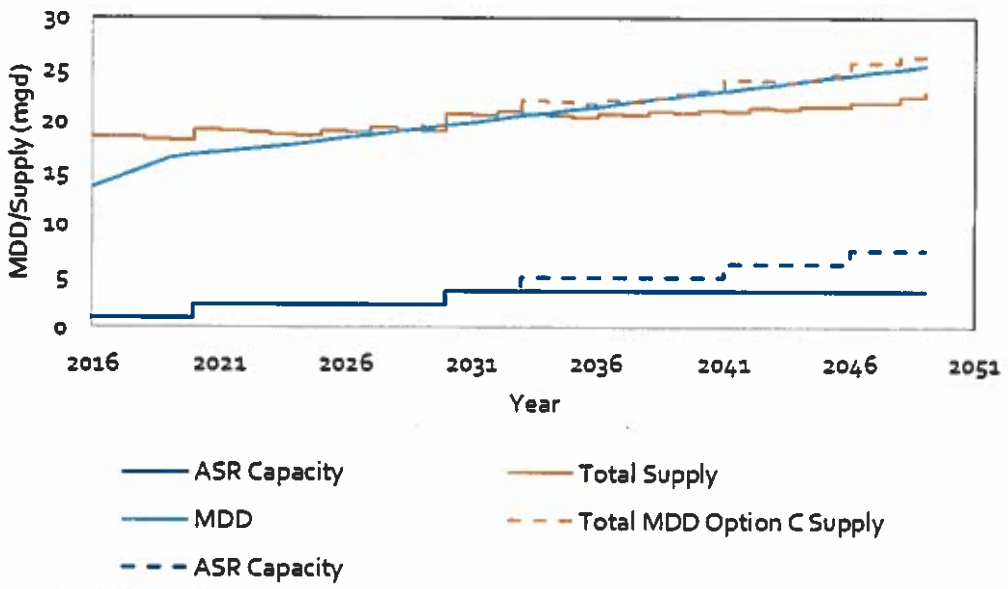


Figure 5.13 Future MDD supply with new ASR wells

5.6.2 MDD Supply Reliability

Providing MDD supply reliability becomes more challenging in the future as MPW relies more heavily on the CWS and storage decreases. As presented previously, MPW has established a water supply reliability goal of meeting future MDD with the largest source, CWS Point of Delivery No. 1 (Daniel Island), out-of-service. While meeting this goal during the MDD addresses MPW's water supply reliability, the available water supply resources must still be evaluated to determine the best approach. During emergency conditions when CWS Point of Delivery No. 1 is out of service, MPW can use the following supply sources:

- CWS Point of Delivery No. 2 (Cainhoy, near Hwy 41) with a capacity of 5 mgd.
- CWS Point of Delivery No. 3 (Sullivan's Island) with a capacity of 2.25 mgd.
- Existing RO WTP capacity of 6.92 mgd, which will require deep well withdrawals near the 8.5 mgd level evaluated by USGS.
- Future RO WTP 3 and RO WTP 4 upgrades can increase RO WTP available supply by 1.3 mgd to 8.2 mgd.
- Operating all RO WTPs at maximum capacity can provide 1.76 mgd additional capacity by allowing higher fluoride concentrations (1.2 mg/L). These fluoride concentrations are well within drinking water regulatory standards; however, MPW policy is to only operate RO WTPs at maximum capacity during emergency conditions.
- Excess storage: 4 MG of excess storage currently available and declining to 0 MG by build-out.
- Existing ASR wells recovery capacity of 1 mgd.
- Two new Northern ASR wells with a recovery capacity of 2.6 mgd.
- Additionally, MPW can enact voluntary or mandatory water restrictions and other measured to reduce demand during emergency conditions.

MDD Options A and B that rely on additional CWS supplies will not provide additional supply reliability beyond the planned reliable supplies presented above. These supplies can meet the MDD though the next 20 years as presented in Figure 5.14. As excess storage decreases and demands increase, MPW will need to operate their RO WTP at maximum capacity during the MDD if CWS Delivery Point No. 1 is offline. This increases the RO WTP maximum capacity by 1.76 mgd, as shown in the 20-year and build-out scenarios. By build-out, MPW will have an approximate supply deficit of 4.6 mgd during the MDD.

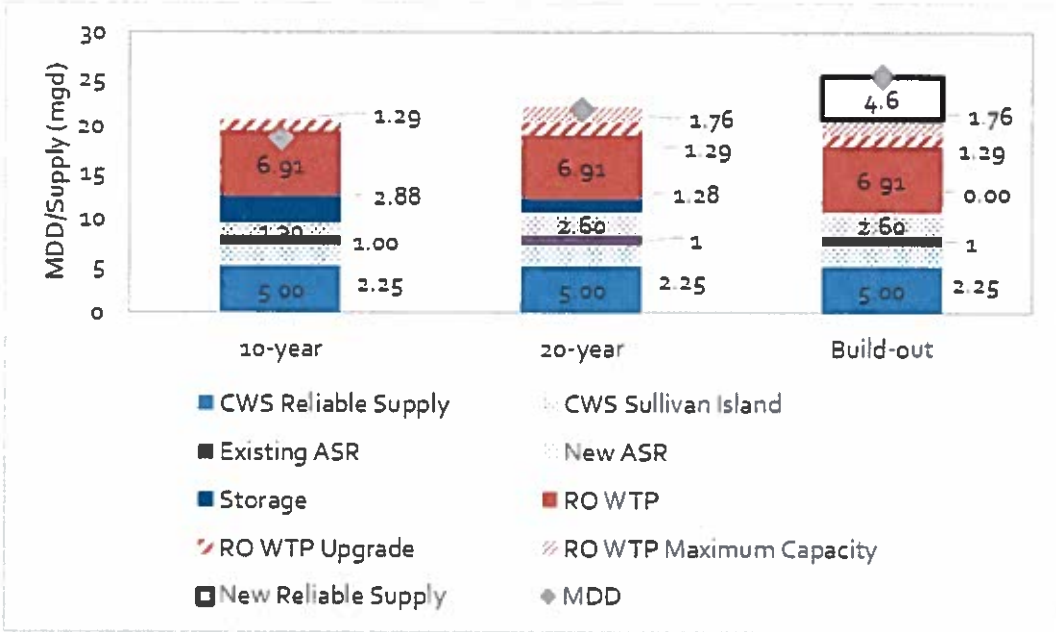


Figure 5.14 Reliable MDD supply portfolio with planned Seasonal improvements

MDD Option C would develop a total of five (5) new ASR wells through build-out. This would provide a total of 4.9 mgd of capacity from the ASR system, as presented in Figure 5.15. The additional reliable supply would reduce the reliability deficit from 4.6 mgd to 0.7 mgd at buildout.

There are several potential MDD supply reliability improvement projects that can enable MPW to meet future MDD reliably:

- Construct additional ASR wells beyond the two currently planned.
- Develop additional deep wells and related RO WTP capacity.
- Increased capacity from CWS Points of Delivery. This requires upsized and/or parallel river crossings.

While specific projects for supply improvements that address MDD reliability are not required for the next 20 years, based upon the data presented in Figure 5.14, the MDD costs presented in the next section are anticipated to be sufficient to meet MPW's MDD reliability goal for the next 20 years.

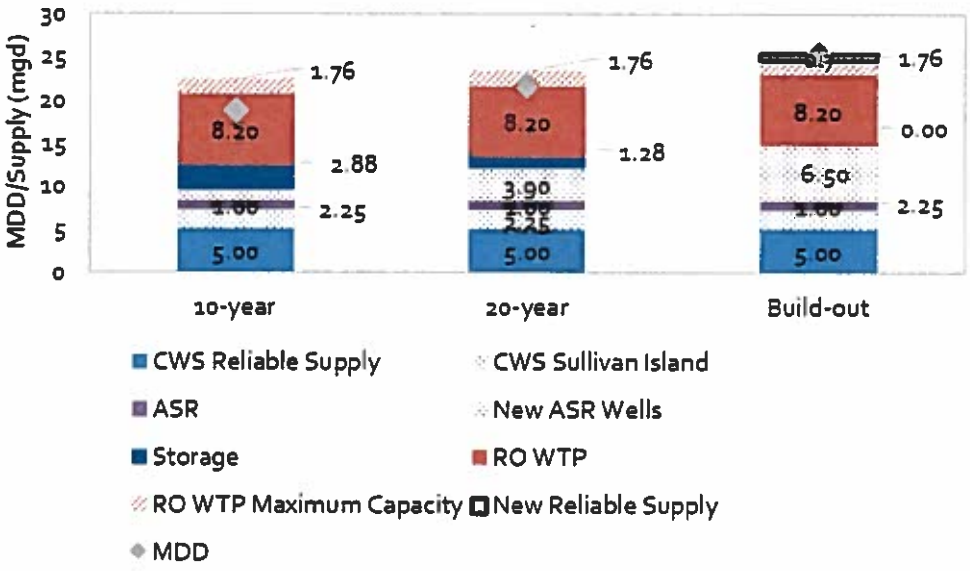


Figure 5.15 Reliable MDD supply portfolio for Option C

5.6.3 MDD Supply Costs

The MDD options presented in this Chapter provide an envelope of future water supply possibilities. The NPV cost for MDD supply options was calculated using the information and methodology presented previously for the ADD supply alternatives analysis, and are presented in Table 5.13. An ADD supply perspective was required for several reasons:

1. ADD supply represents the overall average supply cost and selecting the ADD supply cost first, before considering MDD, helps to control overall supply costs in general.
2. Since additional CWS Baseload require year-long purchase and will decrease the overall use of the RO WTPs, which can affect the ADD supply strategy selected.

Based upon the data presented in Table 5.14, like ADD Supply Option 1, purchasing annual CWS Baseload (Option B) was found to be the most expensive MDD supply option. However, purchasing CWS Wholesale (Option A) is estimated to be 0.8 mgd per year less costly than CWS Baseload supplies over the entire planning period. Option C – Additional ASR Wells has a slightly greater cost ($0.2M per year) than Option A - CWS Wholesale, but provides greater supply reliability.

Table 5.14 Net Present Value of ADD Costs

Cost Component	Option A - CWS Wholesale ($M)	Option B - CWS Baseload ($M)	Option C – Additional ASR Wells ($M)
CWS Capital	$37.7	$53.9	$34.6
CWS O&M	$131.3	$147.4	$128.9
RO WTP + ASR Capital	$18.4	$18.4	$30.4
RO WTP + ASR O&M	$62.7	$57.7	$65.4
Total NPV ($)	**$250.1**	**$277.4**	**$259.2**
Annual Total	**$7.58**	**$8.40**	**$7.86**

5.6.4 MDD Supply Strategy

The ADD supply strategy that defers additional CWS purchases (Option 1) and increases the use of MPW's deep well/RO WTP supplies meets MPW's MDD for the next 20-years. In addition, no additional projects are required within the next 10-years to meet the MDD with Option 1. The MDD supply strategy for build-out was left open-ended to allow MPW to take advantage of cost-effective opportunities that arise in the intervening period. Therefore, MPW may implement a combination of:

- Purchase of a total of 13 mgd of CWS Baseload; an additional 2 mgd from the Annual Supply Strategy.
- Purchase up to 2.25 mgd of CWS Wholesale from Sullivan's Island Point of Delivery.
- Construct a total of five (5) ASR Wells; three (3) additional ASR wells beyond the two currently planned.
- Develop additional deep wells and related RO WTP capacity.

To increase reliability, it is recommended the MPW participate in projects that can increase the reliability of the existing points of delivery.

Option B – CWS Baseload was selected to provide adequate budget for future MDD water supply projects. However, MPW will continue to seek cost-effective, reliable MDD supplies from all sources, such as ASR wells.

Chapter 6

WATER SYSTEM ANALYSIS

6.1 Introduction

To better understand the impact of future supplies on the level of service in the distribution system, Mount Pleasant Waterworks (MPW) contracted with CDMSmith to perform Water System Analyses. The analyses considered water distribution system under several different water supply scenarios using MPW's water hydraulic model:

Scenario 1 – Seasonal operations of up to two additional aquifer storage recovery (ASR) wells to provide additional water supply for 10-year projected demands.

Scenario 2 – System operations with the Charleston Water System (CWS) Feed No. 1 at Daniel Island/Wando Park/Interstate 526 (I-526 connection) offline for the 10-year projected seasonal and maximum day demand conditions.

Scenario 3 – System operations with each of the water supply sources offline during the 10-year projected maximum day demand conditions. Only one water supply source is assumed to be offline at a time.

Improvements to resolve any distribution system deficiencies were identified for each Scenario. These included:

- **New ASR Well at Bulls Bay** – new ASR well adjacent to the existing 12-inch waterline in the Bulls Bay area with a recovery rate of 900 gallons per minute (gpm) and a recharge rate of 350 gpm.
- **New ASR Well at Paradise Island** – new ASR well near Eden Road and Paradise Island Drive with a recovery rate of 900 gpm and a recharge rate of 350 gpm.
- **Project 3** – Approximately 7,800 feet of 16-inch diameter main paralleling the existing 12-inch pipe on Ben Sawyer Boulevard from Tolers Cover Drive to the 12-inch main at Rifle Range Road. This pipe improves transmission from the CWS Feed No. 3 into the MPW transmission system and is needed once CWS flows at this location exceed approximately 1.4 million gallons per day (mgd).
- **Project 5** – Approximately 10,800 feet of 20-inch diameter main on Highway 17 from the existing 20-inch diameter main at Hamlin Road to the existing 20-inch diameter main at Park West Boulevard. This pipe eliminates a 12-inch bottleneck and improves system pressures along Highway 41.
- **Project 6** – Approximately 2,600 feet of new 12-inch diameter main crossing the Wando River between Beckenham Drive and Cape Island Drive. This pipe increases the transmission capacity from Paradise Island so that up to 900 gpm can be conveyed from the new Paradise Island ASR well.

These projects have been incorporated in MPW's Capital Improvement Plan – Distribution Asset Class. Note, the Distribution Asset Class is not included in Chapter 7 Capital Improvement Plan, as it is outside the scope of this Plan.

Additional information on the modeling analysis and mapping of the recommended improvements are presented in the following pages, which contain CDMSmith's Technical Memorandum 6 – Water System Analysis and associated appendices.

Maintenance schedule to preserve the integrity and efficient operation of water conveyance systems (R.61-113 E.2.j.3)

Mount Pleasant Waterworks (MPW) ensures the preservation, integrity, and efficient operation of the water conveyance system by referencing American Water Works Association, South Carolina Department of Health and Environmental Control (SCDHEC), and other industry best management practices and standards. MPW utilizes a computer maintenance management system (CMMS) to track preventative maintenance and corrective maintenance work orders.

Information provided to SCDHEC in the sanitary survey including information on the cross-connection program, valve and hydrant maintenance program, flushing program, leak detection and repair, sampling plan, and source water protection plan together help preserve the integrity of the conveyance system. Laboratory data is collected throughout the treatment and distribution system and is stored in a laboratory information management system database and analyzed daily to optimize operations.

Statement of Beneficial Use
(R.61-113, E.j.4)

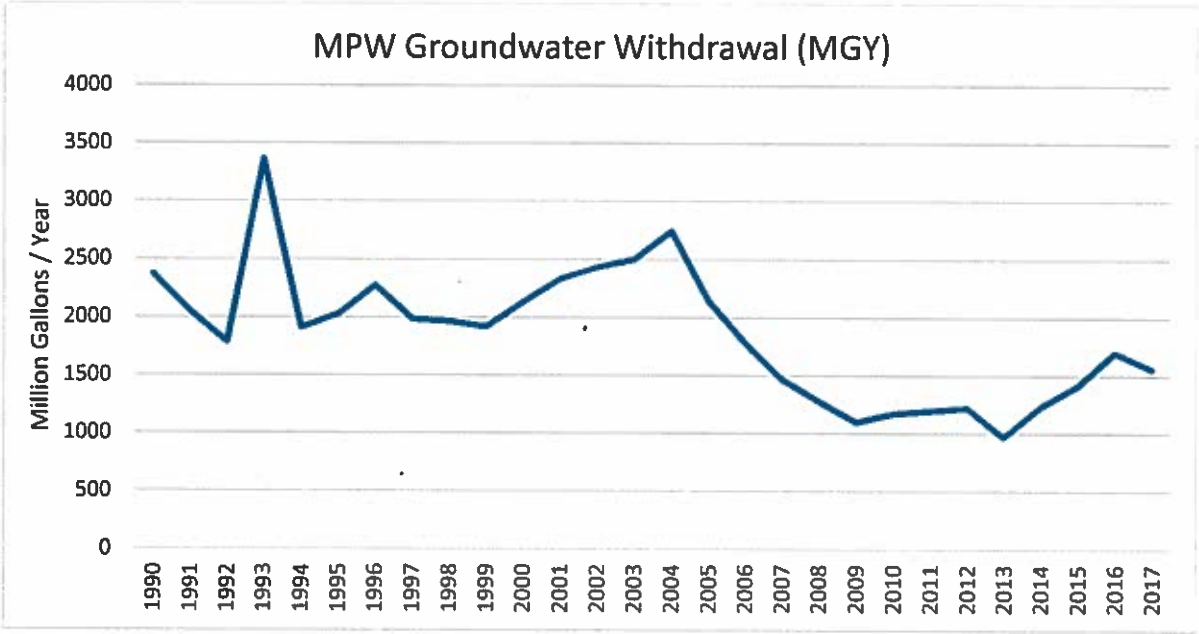
Reducing Mount Pleasant Waterworks' (MPW) groundwater withdrawal to 1350 mg/y will result in MPW **NOT** meeting current water demands for the 90,000 customers who solely rely on MPW for their daily water needs.

Therefore, the beneficial use of groundwater is:

- to meet the domestic needs of these 90,000 residents and commercial businesses;
- to support economic development within MPW's service area;
- to provide public health and safety protection through clean safe water service; and
- to provide fire protection in MPW's service area.

Historical Water Information
(R.61-113, E.j.4)

Mount Pleasant Waterworks (MPW) has enclosed water withdrawal data from 1990-2017 (27 years). During this period a maximum of 3369 MGY was pumped in 1993 and a minimum value of 971 MGY was pumped in 2013. The maximum withdrawal over the last 10 years occurred in 2017 with a total withdrawal of 1700 MGY.



Permit # 10WS006
Current Withdrawal Permit Limit: **3953 MGY**

SCDHEC Water Use Report

Year	Million Gallons
2007	1468.576
2008	1279
2009	1097.16
2010	1172.05
2011	1196.1
2012	1221.4
2013	970.61
2014	1233.8
2015	1413.05
2016	1700.04
2017	1559.31

sourceid	1990	1991	1992	1993	1994	2011	2012	2013	2014	2015	2016	2017
10WS006G01	0	0	0	120.568	446.782	259.2	278.5	253.8	305.7	312.62	293.12	337.56
10WS006G02	378.248	392.6	0	553.117	489.173	358.3	329.9	245.53	251.6	304.95	396.38	292.2
10WS006G03	187.432		0	339.53	3	198.3	232.8	160.68	210.2	233	272.92	267.35
10WS006G04	0	0	0	52.924	442.944	227.6	188.3	159.2	245.2	264.73	380.63	290.35
10WS006G05	315.408	264.087	0	410.77	529.784	152.7	191.9	151.4	221.1	297.75	356.99	371.85
10WS006G06	0	0	0	0	0	0	0	0	0	0	0	0
10WS006G07	1492.936	1394.291	1787.979	1368.266	0	0	0	0	0	0	0	
10WS006G08				524.06	0							
Total	2374.024	2050.978	1787.979	3369.235	1911.683	1196.1	1221.4	970.61	1233.8	1413.05	1700.04	1559.31

Availability of alternative water sources.
(R.61-113,E.I.)

Since 1966 Mount Pleasant Waterworks (MPW) has been evaluating new water sources. As technology, demand and environmental/sustainability conditions have evolved so has MPW's pursuit of water sources. This includes not only looking at new sources but ways to augment our water supply with such things as reuse and aquifer storage and recovery.

Below is a listing of some of the reports generated from our desire to sustain the natural water resources available to us.

Groundwater:
As Mount Pleasant was settled the geography limited access to surface water. Therefore, MPW has evaluated the feasibility of thee aquifers; Santee, Black Creek and Middendorf.

1954	38 surficial wells used until contaminated by hurricane Hugo
1966	*Middendorf Aquifer Groundwater Resource Model for the Trident Area*; Synesis Environmental Inc.
1988	*Preliminary Engineering Report Mount Pleasant Groundwater Supply System;* CH2M Hill
	Feasibility of Groundwater Supply Development from the Black Creek Aquifer Mount Pleasant, South Carolina; CH2M Hill
2005	*Mount Pleasant Waterworks Groundwater Treatment Study Technical Memorandum No. 1 Water Supply Alternatives: Black Creek Aquifer*, Carollo Engineers

Surface Water:

As technologies changed and construction methods evolved MPW began to evaluate joint use surface water alternatives. These evaluations resulted in MPW's conjunctive use of surface water provided by Charleston Water System.

1983	East Cooper Water Supply Planning Study Groundwater Supply Alternatives; Enright Associates Inc.
1992	*Santee Cooper Regional Water System Lake Moultrie Pilot Study*; Hobbs Upchurch and Associates P.A.
1994	*Evaluation of Surface Water Supply Alternatives*; Camp Dresser & McKee Inc.
1995	Entered into 30-yr surface water purchase contract with Charleston Water System
2016	Renewal/Extension of surface water purchase contract with Charleston Water System

Aquifer Storage and Recovery:

In an effort to meet peak summer demands while alleviating large groundwater withdrawal swings from winter to summer, MPW evaluated and implemented the use of three ASR wells in the Santee Limestone aquifer. MPW also tested the feasibility of using the Middendorf aquifer at Deep Well 6 for ASR.

1994	*Santee Limestone Water Supply/Aquifer Storage Recovery Investigation*; CH2M Hill
1997	Aquifer Storage Recovery Installation and Testing Morgan's Point Facility; CH2M Hill
	Aquifer Storage Recovery Deep Well 6 at Morgan's Point Facility; CH2M Hill
	Aquifer Storage Recovery Management and Operation Plan; CH2M Hill
2007	Construction and Testing of the Santee Limestone Aquifer ASR Test Well; CH2M Hill
2017	ASR Conceptual Injection Rates and Storage Volumes Technical Memorandum; Groundwater Management Associates

Reuse:

Other efforts to conserve and protect our water resources, MPW has studied the feasibility of reuse. Although not viable on a large scale, MPW has initiated local reuse programs on its two wastewater treatment plants and neighboring recreational facilities.

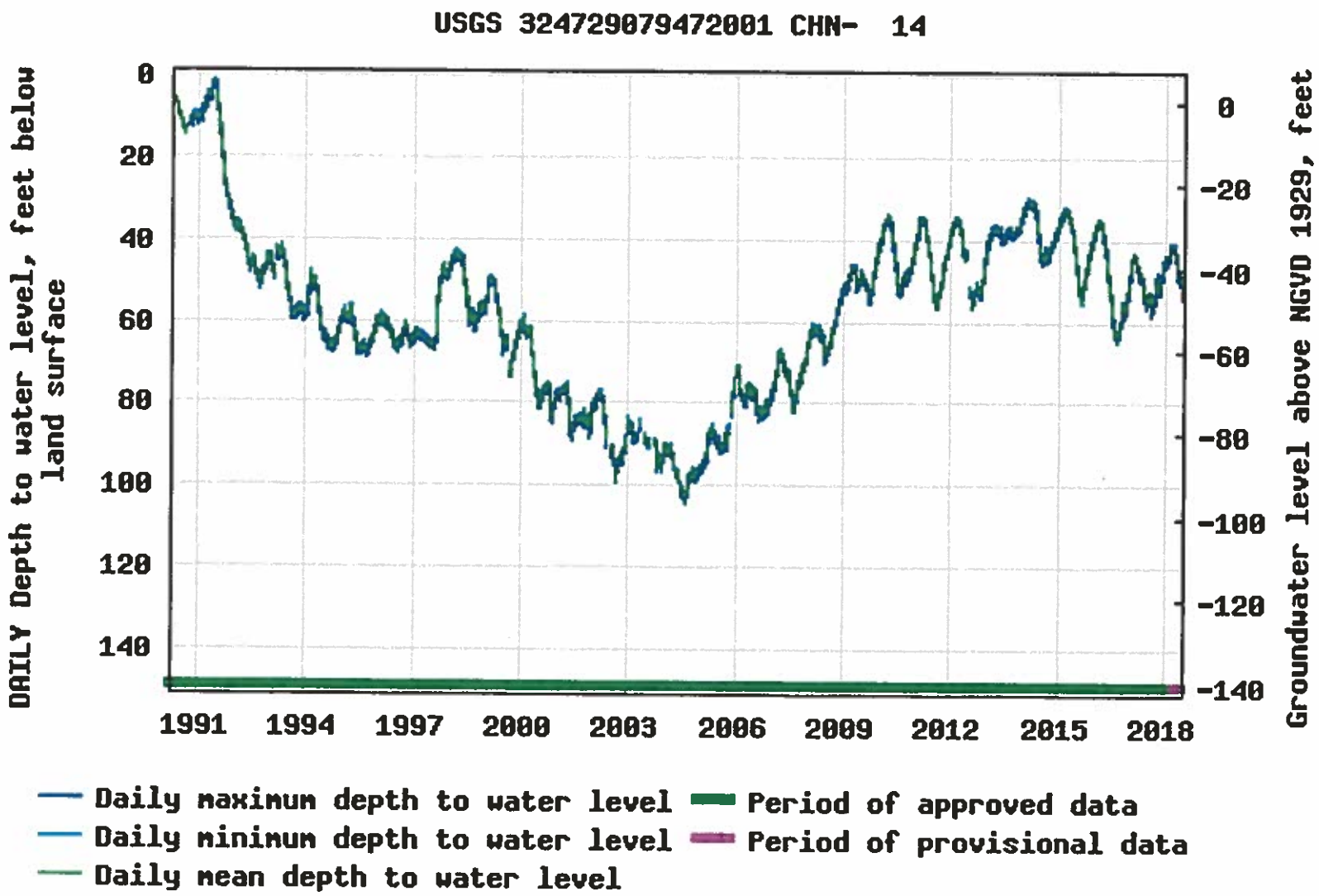
1993	Mount Pleasant Waterworks and Sewer Commission Reuse Mater Plan; Camp Dresser & McKee Inc.
2004	*Rifle Range Road WWTP Reuse Master Plan Update*; Camp Dresser & McKee Inc.
2008	*Draft Feasibility Study for a Reclaimed Water System to serve three Rifle Range Road Subdivisions;* Camp Dresser & McKee Inc.
2010	*Comprehensive Utility Master Plan*, Section 9 – Reuse/Reclaimed Water System; Camp Dresser & McKee Inc.

Anticipated adverse effect on other users, including public supply
(R.61-113.E.2.m.)

MPW has been monitoring the groundwater levels in the CHN-14 monitoring well since 1990. See attached graph. Over the last 27 years, MPW has withdrawn 52 billion gallons of water from the Charleston Aquifer, see attached table. Over those years the lowest level measured in CHN-14 was 105 feet below grade. At that point MPW had withdrawn about 34 billion gallons of water in the previous 16 years. From what we understand, there have been no reported or documented adverse impacts on the aquifer or other users. Water levels in CHN-14 are now at 50 feet below grade and have stayed in that range over the last 9 years.

MPW has contracted with the USGS to provide groundwater modeling for MPW long range utilization of the Charleston Aquifer. Based on this scientific model, we been assured the aquifer can respond to our maximum permitted withdrawal, without depletion. The preliminary unpublished model results indicate the drawdowns will level off at about 400 feet below grade, which is at least 1000 feet above the confining unit of the Charleston Aquifer. A copy of the model results is included in our reply.

No adverse impacts were presented in the Trident Capacity Use Area Groundwater Evaluation. What the Department has said there are *potential* adverse impacts, we would agree, however the modeling work done by USGS for MPW has estimated the aquifer has the capacity to yield our maximum withdrawal without excessive drawdown.


USGS 324729079472001 CHN- 14
DAILY Depth to water level, feet below land surface
0
20
40
60
80
100
120
140
Groundwater level above NGVD 1929, feet
0
-20
-40
-60
-80
-100
-120
-140
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
Daily maximum depth to water level
Daily minimum depth to water level
Daily mean depth to water level
Period of approved data
Period of provisional data

MPW Historical Groundwater Withdrawals (mg/y)

sourceid	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
10WS006G01	0	0	0	120.568	446.782	489.796	272.47	0	0	3.25	69.94	240.1	262.8	283.697	454.202
10WS006G02	378.248	392.6	0	553.117	489.173	612.316	670.856	463.02	412.552	386.02	630.66	687.9	659.3	694.6	733.611
10WS006G03	187.432		0	339.53	3	51.451	420.78	338.88	473.571	405.82	445.04	469	532.4	491.03	491.213
10WS006G04	0	0	0	52.924	442.944	397.167	286.689	306.39	241.209	390.561	421.79	306.3	271	290.021	324.142
10WS006G05	315.408	264.087	0	410.77	529.784	479.146	399.057	396.72	422.971	357.14	301.23	293.1	330.4	409.496	332.142
10WS006G06	0	0	0	0	0	0	227.07	479.71	414.568	375.833	263.39	336.35	377.3	334.619	409.261
10WS006G07	1492.936	1394.291	1787.979	1368.266	0										
10WS006G08				524.06	0										
Total	2374.024	2050.978	1787.979	3369.235	1911.683	2029.876	2276.922	1984.72	1964.871	1918.624	2132.05	2332.75	2433.2	2503.463	2744.571

2166.8912 ten year average

21668.912 ten year total

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
													27	
508.652	474.4	414.7	269.7	235.08	267.28	259.2	278.5	253.8	305.7	312.62	293.12	337.56		
650.706	528.62	522.1	466.3	399.1	378.06	358.3	329.9	245.53	251.6	304.95	396.38	292.2		
269.325	54.1	98.8	185.2	215.14	207.36	198.3	232.8	160.68	210.2	233	272.92	267.35		
213.303	174.06	0.476	0	202.04	256.45	227.6	188.3	159.2	245.2	264.73	380.63	290.35		
351.532	293.91	256.9	239.8	30.1	62.9	152.7	191.9	151.4	221.1	297.75	356.99	371.85		
155.188	257.69	175.6	118	9.6	0	0	0	0	0	0	0	0		
0		0	0	6.1	0	0	0	0	0	0	0			
													52,057.5	total
2148.706	1782.78	1468.576	1279	1097.16	1172.05	1196.1	1221.4	970.61	1233.8	1413.05	1700.04	1559.31	1,859.2	average
				1992.226	ten year average							1308.295	1,915.2	median
				19922.26	ten year total							10466.36		8 year total

Permitted effluent discharges in accordance with a valid NPDES Discharge Permit (R61-113,E.n)

Mount Pleasant Waterworks (MPW) is authorized through the National Pollutant Discharge Elimination System (NPDES) to discharge to the Charleston Harbor and Wando River through surface water discharge permits. NPDES Permit Number SC0040771 discharges to the Charleston Harbor and includes Center Street WWTP, Rifle Range Road WWTP, Reverse Osmosis Water Treatment Plant #1 and Reverse Osmosis Water Treatment Plant #3. Reverse Osmosis Water Treatment Plant #4 discharges into the collection system that is treated by the Rifle Range Road WWTP. Reverse Osmosis Treatment Plant #2 discharges directly into the Wando River authorized by NPDES Permit Number SC0043273. Both permits are attached for your review.

Surface Water Discharge Permit

In Accordance With the
National Pollutant Discharge Elimination System (NPDES)

This NPDES Permit Certifies That

Mount Pleasant Waterworks
Water Treatment Plant #2

has been granted permission to discharge treated wastewater from a water treatment facility located at

333 Seventh Avenue, Mount Pleasant
Mount Pleasant, SC 29465
(Charleston County)

to receiving waters named

Wando River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, III, IV and V hereof. This permit is issued in accordance with the provisions of the Pollution Control Act of South Carolina (S.C. Code Sections 48-1-10 et seq., 1976), Regulation 61-9 and with the provisions of the Federal Clean Water Act (PL 92-500), as amended, 33 U.S.C. 1251 et seq., the "Act."

Jeffrey P. deBessonet, P.E., Director
Water Facilities Permitting Division
Bureau of Water

Issued: July 22, 2011 **Expires:** August 31, 2016

Effective: September 1, 2011 **Permit No.:** SC0043273

D H E C
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

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PART I. Definitions

Any term not defined in this Part has the definition stated in the South Carolina Pollution Control Act (PCA) or in "Water Pollution Control Permits", R.61-9 or its normal meaning.

A. The "Act", or CWA shall refer to the Clean Water Act (Formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, and Pub. L. 97-117, 33 U.S.C. 1251 et seq. Specific references to sections within the CWA will be according to Pub. L. 92-500 notation.

B. The "arithmetic mean" of any set of values is the summation of the individual values divided by the number of individual values.

C. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

D. A "composite sample" shall be defined as one of the following four types:

1. An influent or effluent portion collected continuously over a specified period of time at a rate proportional to the flow.

2. A combination of not less than 8 influent or effluent grab samples collected at regular (equal) intervals over a specified period of time and composited by increasing the volume of each aliquot in proportion to flow. If continuous flow measurement is not used to composite in proportion to flow, the following method will be used: An instantaneous flow measurement should be taken each time a grab sample is collected. At the end of the sampling period, the instantaneous flow measurements should be summed to obtain a total flow. The instantaneous flow measurement can then be divided by the total flow to determine the percentage of each grab sample to be combined. These combined samples form the composite sample.

3. A combination of not less than 8 influent or effluent grab samples of equal volume but at variable time intervals that are inversely proportional to the volume of the flow. In other words, the time interval between aliquots is reduced as the volume of flow increases.

4. If the effluent flow varies by less than 15 percent, a combination of not less than 8 influent or effluent grab samples of constant (equal) volume collected at regular (equal) time intervals over a specified period of time. (This method maybe used with prior Department approval.)

All samples shall be properly preserved in accordance with Part II.J.4. Continuous flow or the sum of instantaneous flows measured and averaged for the specified compositing time period shall be used with composite results to calculate mass.

E. "Daily discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of

measurement, the daily discharge is calculated as the average measurement of the pollutant over the day.

F. "Daily maximum" is the highest average value recorded of samples collected on any single day during the calendar month.

G. "Daily minimum" is the lowest average value recorded of samples collected on any single day during the calendar month.

H. The "Department" or "DHEC" shall refer to the South Carolina Department of Health and Environmental Control.

I. The "geometric mean" of any set of values is the Nth root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

J. A "grab sample" is an individual, discrete or single influent or effluent portion of at least 100 milliliters collected at a time representative of the discharge and over a period not exceeding 15 minutes and retained separately for analysis.

K. The "instantaneous maximum or minimum" is the highest or lowest value recorded of all samples collected during the calendar month.

L. The "monthly average", other than for fecal coliform and enterococci, is the arithmetic mean of all samples collected in a calendar month period. The monthly average for fecal coliform and enterococci bacteria is the geometric mean of all samples collected in a calendar month period. The monthly average loading is the arithmetic average of all daily discharges made during the month.

M. "POTW" means a treatment works as defined by section 212 of the Clean Water Act, which is owned by a state or municipality (as defined by section 502[4] of the CWA). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature or a regional entity composed of tow (2) or more municipalities or parts thereof. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality, as defined in section 502(4) of the CWA, which has jurisdiction over the Indirect Discharges to and the discharge from such a treatment works.

N. "Practical Quantitation Limit (PQL)" is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. It is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specific sample weights, volumes, and processing steps have been followed. It is also referred to as the reporting limit.

O. "Privately owned treatment works" means any device or system which both is used to treat wastes from any facility whose operator is not the operator of the treatment works and is not a POTW.

P. "Quarter" is defined as the first three calendar months beginning with the month that this permit becomes effective (unless otherwise specified in this permit) and each group of three calendar months thereafter.

Q. "Quarterly average" is the arithmetic mean of all samples collected in a quarter.

R. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

S. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

T. "Weekly average", is the arithmetic mean of all the samples collected during a one-week period. For self-monitoring purposes, weekly periods in a calendar month are defined as three (3) consecutive seven-day intervals starting with the first day of the calendar month and a fourth interval containing seven (7) days plus those days beyond the 28th day in a calendar month. The value to be reported is the single highest of the four (4) weekly averages computed during a calendar month. The weekly average loading is the arithmetic average of all daily discharges made during the week.

Legend (See Effluent Limitations and Monitoring Requirements)

Abbreviation	Meaning/Definition	Abbreviation	Meaning/Definition
BOD_5	5-Day Biochemical Oxygen Demand	24 Hr C	24 Hour Composite
TSS	Total Suspended Solids	Cont.	Continuous
DO	Dissolved Oxygen	Cal	Calculated
TRC	Total Residual Chlorine	Eff.	Effluent
NH_3-N	Ammonia Nitrogen	Inst	Instantaneous

PART II. Standard Conditions

A. Duty to comply

The permittee must comply with all conditions of the permit. Any permit noncompliance constitutes a violation of the Clean Water Act and the Pollution Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. The Department's approval of wastewater facility Plans and Specifications does not relieve the permittee of responsibility to meet permit limits.

1. a. The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for water plant sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions or standards for water plant sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

   b. It is the responsibility of the permittee to have a treatment facility that will meet the final effluent limitations of this permit. The approval of plans and specifications by the Department does not relieve the permittee of responsibility for compliance.

2. Failure to comply with permit conditions or the provisions of this permit may subject the permittee to civil penalties under S.C. Code Section 48-1-330 or criminal sanctions under S.C. Code Section 48-1-320. Sanctions for violations of the Federal Clean Water Act may be imposed in accordance with the provisions of 40 CFR Part 122.41(a)(2) and (3).

3. A person who violates any provision of this permit, a term, condition or schedule of compliance contained within a valid NPDES permit, or the State law is subject to the actions defined in the State law.

B. Duty to reapply

1. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. Any POTW with a current effective permit shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department. (The Department shall not grant permission for applications to be submitted later than the expiration date of the existing permit)

2. If a privately owned treatment works as defined in Part I.N, wishes to continue an activity regulated by this permit after the expiration date of this permit, the privately owned treatment works must apply for and obtain a new permit. A privately owned treatment works with a currently effective permit shall submit a new application 180 days before the existing permit expires, unless permission for a later date has been granted by the Department. The Department may not grant permission for applications to be submitted later than the expiration date of the existing permit.

C. Need to halt or reduce activity not a defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or water plant sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper operation and maintenance

1. The permittee shall at all times properly operate and maintain in good working order and operate as efficiently as possible all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes effective performance based on design facility removals, adequate funding, adequate operator staffing and training and also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Power Failures.

   In order to maintain compliance with effluent limitations and prohibitions of this permit, the permittee shall either:

   a. provide an alternative power source sufficient to operate the wastewater control facilities;

   b. or have a plan of operation which will halt, reduce, or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

3. The permittee shall develop and maintain at the facility a complete Operations and Maintenance Manual for the waste treatment facility's portion of the water plant and/or land application system for the water plant residuals. The manual shall be made available for on-site review during normal working hours. The manual shall contain operation and maintenance instructions for all equipment and appurtenances associated with the waste treatment facilities and land application system. The manual shall contain a general description of: the treatment process(es), the operational procedures to meet the requirements of (E)(1) above, and the corrective action to be taken should operating difficulties be encountered.

4. The permittee shall provide for the performance of daily treatment facility inspections by a certified operator of the appropriate grade as specified in Part V. The inspections shall include, but should not necessarily be limited to, areas which require visual observation to determine efficient operation and for which immediate corrective measures can be taken using the O & M manual as a guide. All inspections shall be recorded and shall include the date, time, and name of the person making the inspection, corrective measures taken, and routine equipment maintenance, repair, or replacement performed. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

5. A roster of operators associated with the facility's operation and their certification grades shall be submitted to the DHEC/Bureau of Water/Water Pollution Control Division. For existing facilities,

this roster shall be submitted within thirty (30) days of the effective date of this permit. For new facilities, this roster must be submitted prior to placing the facility into operation. Additionally, any changes in operator or operators (including their certification grades) shall be submitted to the Department as they occur.

F. Permit actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

G. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege nor does it authorize any injury to persons or property or invasion of other private rights, or any infringement of State or local law or regulations.

H. Duty to provide information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

I. Inspection and entry

The permittee shall allow the Department, or an authorized representative (including an authorized contractor acting as a representative of the Department), upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act and Pollution Control Act, any substances or parameters at any location.

J. Monitoring and records

1. a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b. Flow Measurements

Where primary flow meters are required, appropriate flow measurement devices and methods consistent with accepted scientific practices shall be present and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of not greater than 10 percent from the true discharge rates throughout the range of expected discharge volumes. The primary flow device, where required, must be accessible to the use of a continuous flow recorder.

c. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

2. Except for records of monitoring information required by this permit related to the permittee's water plant sludge use and disposal activities, which shall be retained for a period of at least five years, the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

3. Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

4. a. Analyses for required monitoring must be conducted according to test procedures approved under 40 CFR Part 136 or, in the case of water plant sludge use or disposal specified in R.61-9.503, unless other test procedures have been specified in the permit

b. Unless addressed elsewhere in this permit, the permittee shall use a sufficiently sensitive analytical method for each sample that achieves a value below the derived permit limit stated in Part III. If more than one method of analysis is approved for use, the Department recommends for reasonable potential determinations that the permittee use the method having the lowest practical quantitation limit (PQL) unless otherwise specified in Part V of the permit. For the purposes of reporting analytical data on the Discharge Monitoring Report (DMR):

(1) Analytical results below the PQL from methods available in 40 CFR 136 or otherwise specified in the permit shall be reported as zero (0), provided the PQL is below the value specified in Part V and the result is also below the PQL. Zero (0) shall also be used to average results which are below the PQL. When zero (0) is reported or used to average results, the permittee shall report, in the "Comment Section" or in an attachment to the DMR,

the analytical method used, the PQL achieved, and the number of times results below the PQL were reported as zero (0).

(2) Analytical results above the PQL from methods available in 40 CFR 136 or otherwise specified in the permit shall be reported as the value achieved, even if the PQL is below the value specified in Part V. When averaging results using a value containing a < the average shall be calculated using the value and reported as < the average of all results collected.

3. (a) Mass value for a pollutant collected using a grab sample shall be calculated using the 24-hour totalized flow for the day the sample was collected (if available) or the instantaneous flow at the time of the sample and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate. Grab samples should be collected at a time representative of the discharge.

(b) Mass value for a pollutant collected using a composite sample shall be calculated using the 24-hour totalized flow measured for the day the sample was collected and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate.

5. The PCA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment provided by the Clean Water Act is also by imprisonment of not more than 4 years.

K. Signatory requirement

1. All applications, reports, or information submitted to the Department shall be signed and certified.

a. Applications. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or

(b) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency or public facility: By either a principal executive officer, mayor, or other duly authorized employee or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(a) The chief executive officer of the agency, or

(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator, Region IV, EPA).

b. All reports required by permits, and other information requested by the Department, shall be signed by a person described in Part II.K.1.a of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in Part II.K.1.a of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

(3) The written authorization is submitted to the Department.

c. Changes to authorization. If an authorization under Part II.K.1.b of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part II.K.1.b of this section must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under Part II.K.1.a or b of this section shall make the following certification: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. The PCA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $25,000 per violation, or by imprisonment for not more than two years per violation, or by both.

L. Reporting requirements

1. Planned changes

The permittee shall give written notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in R 61-9.122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Part II.L.8 of this section.

c. The alteration or addition results in a significant change in the permittee's water plant sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan (included in the NPDES permit directly or by reference);

2. Anticipated noncompliance

The permittee shall give advance notice to DHEC/Bureau of Water/Water Pollution Control Division of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is not transferable to any person except after notice to DHEC/Bureau of Water/NPDES Administration Section. The Department may require modification or revocation and reissuance of the permit to change the name of permittee and incorporate such other requirements as may be necessary under the Pollution Control Act and the Clean Water Act. (See section 122.61; in some cases, modification or revocation and reissuance is mandatory.)

a. Transfers by modification. Except as provided in paragraph (b) of this section, a permit may be transferred by the permittee to a new permittee only if the permit has been modified or revoked and reissued (under R.61-9.122.62(e)(2)), or a minor modification made (under R.61-9.122.63(d)), to identify the new permittee and incorporate such other requirements as may be necessary under CWA, provided the new permittee is a viable wastewater system owner in accordance with R.61-9.600.

b. Other transfers. As an alternative to transfers under paragraph (a) of this section, any NPDES permit may be transferred to a new permittee, provided the new permittee is a viable wastewater system owner in accordance with R.61-9.600, if:

(1) The current permittee notifies the Department at least 30 days in advance of the proposed transfer date in Part II.L.3.b(2) of this section;

(2) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them, and the new owner meets the viability requirements of R.61-9.600; and

(3) Permits are non-transferable except with prior consent of the Department. A modification under this subparagraph may also be a minor modification under section 122.63.

4. Monitoring reports

Monitoring results shall be reported at the intervals specified in the permit.

a. Monitoring results (with the exception of any Annual Reporting requirements under section 503.18, section 503.28, section 503.48 or section 504.18) must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Department for reporting results of monitoring of water plant sludge use or disposal practices.

(1) Effluent Monitoring:

Effluent monitoring results obtained at the required frequency shall be reported on a Discharge Monitoring Report Form (EPA Form 3320-1). The DMR is due postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Discharge Monitoring Reports (DMRs) shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data Management Section
2600 Bull Street
Columbia, South Carolina 29201

(2) Groundwater Monitoring:

Groundwater monitoring results obtained at the required frequency shall be reported on a Groundwater Monitoring Report Form (DHEC 2110) postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Groundwater Monitoring Report Form (DHEC 2110) shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Monitoring, Assessment and Protection Division
Groundwater Quality Section
2600 Bull Street
Columbia, South Carolina 29201

(3) Water Plant Sludge, Biosolids and/or Soil Monitoring:

Water plant sludge, biosolids and/or soil monitoring results obtained at the required frequency shall be reported in a laboratory format postmarked no later than the 28th day of the month following the end of the monitoring period. Two copies of these results shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Water Pollution Enforcement Section
2600 Bull Street
Columbia, South Carolina 29201

(4) All other reports required by this permit shall be submitted at the frequency specified elsewhere in the permit to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Water Pollution Enforcement Section
2600 Bull Street
Columbia, South Carolina 29201

b. If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136 or, in the case of water plant sludge use or disposal, approved under 40 CFR Part 136 unless otherwise specified in R.61-9.503, R.61-9.504, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or water plant sludge reporting form specified by the Department.

c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Department in the permit.

5. Twenty-four hour reporting

a. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally to local DHEC office within 24 hours from the time the permittee becomes aware of the circumstances. During normal working hours call:

County	EQC Region	Phone No.
Berkeley, Charleston, Dorchester	Region 7 – Charleston EQC Office	843-953-0150

After-hour reporting should be made to the 24-Hour Emergency Response telephone number 803-253-6488 or 1-888-481-0125 outside of the Columbia area.

A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; and, if the noncompliance has not been corrected, the anticipated time it is expected to continue and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

b. The following shall be included as information which must be reported within 24 hours under this paragraph.

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit. (See R.61-9.122.41(L)(6)(ii)(A).

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Department in the permit to be reported within 24 hours (See R 61-9.122.44(g)). If the permit contains maximum limitations for any of the pollutants listed below, a violation of the maximum limitations shall be reported orally to the DHEC/Bureau of Water/Water Pollution Control Division within 24 hours or the next business day.

(i) Total Residual Chlorine (TRC)

c. The Department may waive the written report on a case-by-case basis for reports under Part II.L.5.b of this section if the oral report has been received within 24 hours.

6. Other noncompliance.

The permittee shall report all instances of noncompliance not reported under Part II.L.4 and 5 of this section and Part IV at the time monitoring reports are submitted. The reports shall contain the information listed in Part II.L.5 of this section.

7. Other information.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

8. Domestic treatment works

Note: No new introduction of pollutants into the water plant effluent treatment facility (WPETF) from an indirect discharger which would be subject to sections 301 or 306 of CWA if it were directly discharging those pollutants are permitted (See Part V. F)

All permittees must provide adequate notice to the Department of the following:

(1) Any substantial change in the volume or character of pollutants being introduced into that WPETF by a source introducing pollutants into the WPETF at the time of issuance of the permit, and

(2) For purposes of this paragraph, adequate notice shall include information on:

(i) The quality and quantity of effluent introduced into the WPETF, and

(ii) Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the WPETF.

M. Bypass

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Part II.M.2 and 3 of this section.

2. Notice.

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible, at least ten days before the date of the bypass to DHEC/Bureau of Water/Water Facilities Permitting Division.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II(L)(5) of this permit (24-hour reporting).

3. Prohibition of bypass

   a. Bypass is prohibited, and the Department may take enforcement action against a permittee for bypass, unless:

      (1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

      (2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

      (3) The permittee submitted notices as required under Part II.M.2 of this section.

   b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in Part II.M.3.a of this section.

N. Upset

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Part II.N.2 of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

b. The permitted facility was at the time being properly operated; and
c. The permittee submitted notice of the upset as required in Part II.L.5.b(2) of this section.
d. The permittee complied with any remedial measures required under Part II.D of this section.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

O. Misrepresentation of Information

1. Any person making application for a NPDES discharge permit or filing any record, report, or other document pursuant to a regulation of the Department, shall certify that all information contained in such document is true. All application facts certified to by the applicant shall be considered valid conditions of the permit issued pursuant to the application.

2. Any person who knowingly makes any false statement, representation, or certification in any application, record, report, or other documents filed with the Department pursuant to the State law, and the rules and regulations pursuant to that law, shall be deemed to have violated a permit condition and shall be subject to the penalties provided for pursuant to 48-1-320 or 48-1-330.

Modification date: October 1, 2015

Signature:

New Permit Modification

Part III. Limitations and Monitoring Requirements

A. Effluent Limitations and Monitoring Requirements

1. **FINAL LIMITS**: During the period beginning on effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial number 001. Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS					MONITORING REQUIREMENTS		
	Pounds per Day		Other Units					
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	---	---	MR MGD	MR MGD	---	2 month	Estimate[1]	Effluent
PH	---	---	MR Standard Units			2 month	Grab	Effluent

[1] The permittee shall maintain at the permitted facility a record of the method(s) used in "estimating" the discharge flow, i.e., pump curves, production charts, water use records, etc. Records of any necessary calibrations must also be kept. Permittee shall make this information available for on-site review during normal working hours.

Part III. Limitations and Monitoring Requirements

Old permit requirements

A. Effluent Limitations and Monitoring Requirements

1. **FINAL LIMITS**: During the period beginning on effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial number 001. Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS					MONITORING REQUIREMENTS		
	Pounds per Day		Other Units					
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	MR MGD	MR MGD	—	2/month	Estimate[1]	Effluent
PH	—	—	MR Standard Units			Daily	Grab	Effluent

1. The permittee shall maintain at the permitted facility a record of the method(s) used in "estimating" the discharge flow, i.e., pump curves, production charts, water use records, etc. Records of any necessary calibrations must also be kept. Permittee shall make this information available for on-site review during normal working hours.

B. Whole Effluent Toxicity Limitations and Monitoring Requirements

Not applicable to this permit.

C. Groundwater Requirements

Not applicable to this permit.

D. Water Plant Sludge Disposal Requirements

Not applicable to this permit.

E. Land Application Requirements

Not applicable to this permit.

F. Instream Biological Assessment

Not applicable to this permit.

Part IV. Schedule of Compliance

A. Schedule(s)

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedules:

   Not applicable to this permit.

2. The permittee shall achieve compliance with the Whole Effluent Toxicity limitations specified for discharges in accordance with the following schedules:

   Not applicable to this permit.

3. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date

Part V. Other Requirements

A. Effluent Limitations and Monitoring Requirements

1. There shall be no discharge of floating solids or visible foam in other than trace amounts, nor shall the effluent cause a visible sheen on the receiving waters.

2. a. Effluent samples taken in compliance with the monitoring requirements specified in Part III, shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

   b. Influent samples taken in compliance with the monitoring requirements specified in Part III, shall be taken at the following location(s): nearest accessible point prior to any primary treatment unit (e.g. after the bar screen and before primary treatment).

3. Samples shall be collected in accordance with Part I.

4. MR = Monitor and Report only.

B. Effluent Toxicity Limitations and Monitoring Requirements

Not applicable to this permit.

C. Groundwater Requirements

Not applicable to this permit.

D. Water Plant Sludge Disposal Requirements

1. Water Plant Sludge Use and Disposal

   a. The Permittee shall take all reasonable steps to minimize or prevent any discharge or water plant sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

   b. This permit may be modified to address any standard for water plant sludge use or disposal, or practice not currently limited in this permit.

   c. No person shall use or dispose of water plant sludge through any practice for which requirements are established except in accordance with a permit issued by the Department. Any water plant sludge disposal permits issued by the Department will remain in effect and all conditions and requirements will apply.

      1. Compliance with the standards (40 CFR Part 503 and R.61-9.503) should have been achieved by February 19,1994, and this condition continues to be in effect.

2. When compliance with the standard required construction of new pollution control facilities, compliance with the standards (40 CFR Part 503 and R.61-9.503) should have been achieved by February 19, 1995, and this condition continues to be in effect.

3. All other requirements for the frequency of monitoring, record keeping, and reporting identified in 40 CFR Part 503 or R.61-9.503, was effective on July 20, 1993 and continue to be in effect.

d. 1. The permittee must obtain prior Departmental approval of planned changes in the facility when the alteration or addition results in a significant change in the permittee's water plant sludge use or disposal practices, and such alteration, addition or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

2. The water plant sludge disposal permit may be modified or revoked and reissued if there are material and substantial alterations or additions to the permitted facility or activity (including a change or changes in the permittee's water plant sludge use or disposal practice) which occurred after the permit issuance which justify the application of permit conditions which are different from or absent in the existing permit.

e. The water plant sludge disposal permit may be terminated if there is a change in any condition that requires either a temporary or permanent reduction or elimination of any discharge or water plant sludge use or disposal practice controlled by the permit.

f. Periodic inspections will be conducted by Department authorized representatives to ensure compliance with State regulations and permit stipulations. Any necessary modification to this permit may be based upon these evaluations.

g. Records of monitoring required by the permits related to water plant sludge use and disposal activities must be kept at least five (5) years.

h. Water plant sludge monitoring procedures shall be those specified in 1) 40 CFR Part 503; 2) 40 CFR Part 136; or 3) other procedures specified in the water plant sludge permit (in that order of "preference" depending on the availability and applicability of a particular method at the time the water plant sludge permit is issued).

i. The permittee must provide water plant sludge monitoring results on a form(s) approved by the Department.

j. The permittee shall submit the results of all water plant sludge monitoring if done more frequently than required by the water plant sludge permit. The permittee may be required to maintain specific records at the facility and on request may also be required to furnish them to the Department.

k. The permittee should note that under 40 CFR 122.44(*l*), the "anti-backsliding" provision applies only to surface water dischargers. The "anti-backsliding" provision does not apply to water plant sludge use and disposal activities.

2. Odor Control Requirements

The permittee shall use best management practices normally associated with the proper operation and maintenance of a water plant sludge wastewater treatment site, any water plant sludge storage or lagoon areas, transportation of water plant sludges, and all individual activities permitted under R.61-9.503 to ensure that an undesirable level of odor does not exist.

a. The permittee is required to prepare an odor abatement plan for the water plant sludge treatment sites, any water plant sludge storage or lagoon areas, and land application or surface disposal sites. The plan must include the following topics:

(1) Operation and maintenance practices which are used to eliminate or minimize undesirable odor levels in the form of best management practices for odor control.

(2) Use of treatment processes for the reduction of undesirable odors;

(3) Use of setbacks.

(4) Contingency plans and methods to address odor problems for the different type of disposal/application methods used.

b. Unless otherwise requested, prior to issuance of a new or expanded land application disposal permit (either NPDES or ND), the Department may review the odor abatement plan for compliance with this Part (503.50). The Department may require changes to the plan as appropriate.

c. No permittee may cause, allow, or permit emission into the ambient air of any substance or combinations of substances in quantities that an undesirable level of odor is determined to result unless preventative measures of the type set out below are taken to abate or control the emission to the satisfaction of the Department. When an odor problem comes to the attention of the Department through field surveillance or specific complaints, the Department may determine, in accordance with section 48-1-120 of the Pollution Control Act, if the odor is at an undesirable level by considering the character and degree of injury or interference to:

(1) The health or welfare of the people;
(2) Plant, animal, freshwater aquatic, or marine life;
(3) Property; or
(4) Enjoyment of life or use of affected property.

d. After determining that an undesirable level of odor exists, the Department may require:

(1) the permittee to submit a corrective action plan to address the odor problem,
(2) remediation of the undesirable level of odor within a reasonable timeframe, and
(3) in an order, specific methods to address the problem.

e. In accordance with R.61-9.503.50(e), if the permittee fails to control or abate the odor problems addressed in this section within the specified timeframe, the Department may revoke

disposal/application activities associated with the site or the specific aspect of the water plant sludge management program.

E. Land Application

Not applicable to this permit.

F. Pretreatment

1. No indirect discharges regulated under 40 CFR Part 403 or R61-9.403 are permitted to this facility, therefore no specific pretreatment requirements shall apply.

G. Additional Operational Requirements

1. The water plant effluent treatment facility is assigned an operator classification in the Permit to operate for the facility. The facility must comply with these permit conditions.

2. For parameters with a sample frequency of once per month or greater, the Permittee shall monitor (at least one sample) consistent with conditions established by this Permit on the second (2nd) Tuesday of every calendar month, unless otherwise approved by the Department. (For example; with a once per week (01/07) sampling frequency, the permittee shall monitor one weekly sample on the day of the week noted during the monthly DMR reporting period.)

   For parameters with a sampling frequency of less than once per month (if any), the permittee shall monitor these parameters on specific date noted above on any of the months during the appropriate reporting period unless otherwise approved by the Department. (For example, with a once per quarter (1/90) sampling frequency, the permittee may monitor on the day of the week noted in either the first, second or third month in the quarterly reporting period.)

   For parameters requiring multiple samples for a single test the Permittee may collect the samples on any date during the reporting period, unless otherwise approved by the Department. The permittee must notify the Department of the planned sampling dates upon request.

   In accordance with R.61-9.122.41(j)(1)(iii), the Department may waive compliance with the permit requirement for a specific sampling event for extenuating circumstances. Additional monitoring, as necessary to meet the frequency requirements of this Permit (Part III.A., III.B., and III.C., if applicable) shall be performed by the Permittee.

3. For the parameters listed that are not quantifiable using EPA-approved analytical methods, the practical quantitation limit (PQL) using the analytical method shall be considered as being in compliance with the limit provided. In cases where the limit is not quantifiable using EPA approved analytical methods, appropriate biological monitoring requirements are incorporated into the permit.

5. Unless authorized elsewhere in this Permit, the permittee must meet the following requirements concerning maintenance chemicals. Maintenance chemicals shall be defined as any man-induced additives to the waste streams.

a. The discharge, in detectable amounts, of any of the one hundred and twenty-six priority pollutants is prohibited, if the pollutants are present due to the use of maintenance chemicals.

b. Slimicides, algicides and biocides are to be used in accordance with registration requirements of the Federal Insecticides, Fungicide and Rodenticide Act.

c. The use of maintenance chemicals containing bis(tributyltin) oxide is prohibited unless written approval is obtained from SCDHEC.

d. Any maintenance chemicals added to the above referenced waste streams must degrade rapidly, either due to hydrolytic decomposition or biodegradation.

e. Discharges of maintenance chemicals added to waste streams must be limited to concentrations which protect indigenous aquatic populations in the receiving stream.

f. The permittee must keep sufficient documentation on-site that would show that the above requirements are being met. The information shall be made available for on-site review by Department personnel during normal working hours.

g. The occurrence of instream problems may necessitate the submittal of chemical additive data and permit modification to include additional monitoring and limitations.

H. Wastewater Design Flow

a. For the purposes of identification of the treatment capacity (under R.61-67.300.A.8), the design flow(s) is 0.5 MGD.

b. For NPDES billing (under R.61-30.2.b), the "actual flow" limit for this wastewater treatment facility shall be identified as the design flow of 0.5 MGD.

National Pollutant Discharge Elimination System Permit

(for Discharge to Surface Waters)

This NPDES Permit Authorizes

Mount Pleasant Water Works

Center Street WWTP & Rifle Range Road WWTP

RO WTP #1 & RO WTP #3

to discharge from a facility located at

Center Street (Outfall 001) and Rifle Range Road (Outfall 002)
RO-WTP#1 (Outfall 003) and RO-WTP#3 (Outfall 004)
Town of Mount. Pleasant
(Charleston County)

to receiving waters named

Charleston Harbor

in accordance with limitations, monitoring requirements and other conditions set forth herein. This permit is issued in accordance with the provisions of the Pollution Control Act of South Carolina (S.C. Code Sections 48-1-10 *et seq.*, 1976), Regulation 61-9 and with the provisions of the Federal Clean Water Act (PL 92-500), as amended, 33 U.S.C. 1251 *et seq.*, the "Act."

Jeffrey P. deBessonet, P.E., Director
Water Facilities Permitting Division

Issue Date: June 29, 2018

Expiration Date[1]: July 31, 2023

Effective Date: August 1, 2018

Permit No.: **SC0040771**

[1] This permit will continue to be in effect beyond the expiration date if a complete timely re-application is received pursuant to Regulation 61-9.122.6 and signed per Regulation 61-9.122.22.

dhec

SC Department of Health and Environmental Control

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PART I. Definitions

Any term not defined in this Part has the definition stated in the South Carolina Pollution Control Act (PCA) or in "Water Pollution Control Permits", R.61-9 or its normal meaning.

A. The "Act", or CWA shall refer to the Clean Water Act (Formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, and Pub. L. 97-117, 33 U.S.C. 1251 et seq. Specific references to sections within the CWA will be according to Pub. L. 92-500 notation.

B. The "arithmetic mean" of any set of values is the summation of the individual values divided by the number of individual values.

C. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

D. A "composite sample" shall be defined as one of the following four types:

1. An influent or effluent portion collected continuously over a specified period of time at a rate proportional to the flow.

2. A combination of not less than 8 influent or effluent grab samples collected at regular (equal) intervals over a specified period of time and composited by increasing the volume of each aliquot in proportion to flow. If continuous flow measurement is not used to composite in proportion to flow, the following method will be used: An instantaneous flow measurement should be taken each time a grab sample is collected. At the end of the sampling period, the instantaneous flow measurements should be summed to obtain a total flow. The instantaneous flow measurement can then be divided by the total flow to determine the percentage of each grab sample to be combined. These combined samples form the composite sample.

3. A combination of not less than 8 influent or effluent grab samples of equal volume but at variable time intervals that are inversely proportional to the volume of the flow. In other words, the time interval between aliquots is reduced as the volume of flow increases.

4. If the effluent flow varies by less than 15 percent, a combination of not less than 8 influent or effluent grab samples of constant (equal) volume collected at regular (equal) time intervals over a specified period of time. (This method maybe used with prior Department approval.)

   All samples shall be properly preserved in accordance with Part II.J.4. Continuous flow or the sum of instantaneous flows measured and averaged for the specified compositing time period shall be used with composite results to calculate mass.

E. "Daily discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the day.

F. "Daily maximum" other than for bacterial indicators (i.e. fecal coliform, E. coli and enterococci) is the highest average value recorded of samples collected on any single day during the calendar month. Daily average for bacterial indicators means the highest arithmetic average of bacterial samples collected for each bacterial indicator species (i.e. fecal coliform, E. coli and/or enterococci) in any 24 hour period during a calendar month.

G. "Daily minimum" is the lowest average value recorded of samples collected on any single day during the calendar month.

H. The "Department" or "DHEC" shall refer to the South Carolina Department of Health and Environmental Control.

I. The "geometric mean" of any set of values is the Nth root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

J. A "grab sample" is an individual, discrete or single influent or effluent portion of at least 100 milliliters collected at a time representative of the discharge and over a period not exceeding 15 minutes and retained separately for analysis.

K. The "instantaneous maximum or minimum" is the highest or lowest value recorded of all samples collected during the calendar month.

L. The "monthly average", other than for fecal coliform, E. coli and enterococci, is the arithmetic mean of all samples collected in a calendar month period. Monthly average (for bacterial indicators only) means the calendar month (i.e., 28 days, 29 days, 30 days, or 31 days) geometric mean of all bacterial samples collected [for each of the bacterial indicator species (i.e., E. coli, enterococcus, and/or fecal coliform)] during that calendar month. The monthly average loading is the arithmetic average of all daily discharges made during the month.

M. "POTW" means a treatment works as defined by section 212 of the Clean Water Act, which is owned by a state or municipality (as defined by section 502[4] of the CWA). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature or a regional entity composed of two (2) or more municipalities or parts thereof. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality, as defined in section 502(4) of the CWA, which has jurisdiction over the Indirect Discharges to and the discharge from such a treatment works.

N. "Practical Quantitation Limit (PQL)" is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. It is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specific sample weights, volumes, and processing steps have been followed. It is also referred to as the reporting limit.

O. "Privately owned treatment works" means any device or system which both is used to treat wastes from any facility whose operator is not the operator of the treatment works and is not a POTW.

P. "Quarter" is defined as the first three calendar months beginning with the month that this permit becomes effective (unless otherwise specified in this permit) and each group of three calendar months thereafter.

Q. "Quarterly average" is the arithmetic mean of all samples collected in a quarter.

R. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

S. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

T. "Weekly average", is the arithmetic mean of all the samples collected during a one-week period. For self-monitoring purposes, weekly periods in a calendar month are defined as three (3) consecutive seven-day intervals starting with the first day of the calendar month and a fourth interval containing seven (7) days plus those days beyond the 28th day in a calendar month. The value to be reported is the single highest of the four (4) weekly averages computed during a calendar month. The weekly average loading is the arithmetic average of all daily discharges made during the week.

U. ."Ultimate Oxygen Demand" (UOD) is the oxygen consumed by aquatic microbes in metabolizing the remaining organic and nitrogenous matter in the effluent from the permittee's wastewater treatment plant. This demand is expressed in pounds per day and is calculated by multiplying the effluent biochemical oxygen demand (BOD_5) concentration by the F-ratio and adding that to 4.57 times the effluent ammonia (NH_3-N) concentration and multiplying the sum by the flow and the constant 8.34. The UOD loading is the arithmetic average of all individual loading determinations made during the sampling period.

$$U.O.D.(lbs/day) = [\{CBOD_5(mg/l) * F\text{-}ratio\} + \{NH_3\text{-}N(mg/l) * 4.57\}] * Flow(MGD) * 8.34$$
$$F\text{-}ratio = 3.18$$

Legend (See Effluent Limitations and Monitoring Requirements)

Abbreviation	Meaning/Definition	Abbreviation	Meaning/Definition
BOD_5	5-Day Biochemical Oxygen Demand	24 Hr C	24 Hour Composite
TSS	Total Suspended Solids	Cont.	Continuous
DO	Dissolved Oxygen	Cal	Calculated
TRC	Total Residual Chlorine	Eff.	Effluent
NH_3-N	Ammonia Nitrogen	Inst	Instantaneous

PART II. Standard Conditions

A. Duty to comply

The permittee must comply with all conditions of the permit. Any permit noncompliance constitutes a violation of the Clean Water Act and the Pollution Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. The Department's approval of wastewater facility Plans and Specifications does not relieve the permittee of responsibility to meet permit limits.

1. a. The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

   b. It is the responsibility of the permittee to have a treatment facility that will meet the final effluent limitations of this permit. The approval of plans and specifications by the Department does not relieve the permittee of responsibility for compliance.

2. Failure to comply with permit conditions or the provisions of this permit may subject the permittee to civil penalties under S.C. Code Section 48-1-330 or criminal sanctions under S.C. Code Section 48-1-320. Sanctions for violations of the Federal Clean Water Act may be imposed in accordance with the provisions of 40 CFR Part 122.41(a)(2) and (3).

3. A person who violates any provision of this permit, a term, condition or schedule of compliance contained within a valid NPDES permit, or the State law is subject to the actions defined in the State law.

B. Duty to reapply

1. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. Any POTW with a current effective permit shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department. (The Department shall not grant permission for applications to be submitted later than the expiration date of the existing permit)

2. If a privately owned treatment works as defined in Part I.N, wishes to continue an activity regulated by this permit after the expiration date of this permit, the privately owned treatment works must apply for and obtain a new permit. A privately owned treatment works with a currently effective permit shall submit a new application 180 days before the existing permit expires, unless permission for a later date has been granted by the Department. The Department may not grant permission for applications to be submitted later than the expiration date of the existing permit.

C. Need to halt or reduce activity not a defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper operation and maintenance

1. The permittee shall at all times properly operate and maintain in good working order and operate as efficiently as possible all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes effective performance based on design facility removals, adequate funding, adequate operator staffing and training and also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Power Failures.

   In order to maintain compliance with effluent limitations and prohibitions of this permit, the permittee shall either:

   a. provide an alternative power source sufficient to operate the wastewater control facilities;

   b. or have a plan of operation which will halt, reduce, or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

3. The permittee shall develop and maintain at the facility a complete Operations and Maintenance Manual for the waste treatment facilities and/or land application system. The manual shall be made available for on-site review during normal working hours. The manual shall contain operation and maintenance instructions for all equipment and appurtenances associated with the waste treatment facilities and land application system. The manual shall contain a general description of: the treatment process(es), the operational procedures to meet the requirements of (E)(1) above, and the corrective action to be taken should operating difficulties be encountered.

4. The permittee shall provide for the performance of daily treatment facility inspections by a certified operator of the appropriate grade as specified in Part V. The inspections shall include, but should not necessarily be limited to, areas which require visual observation to determine efficient operation and for which immediate corrective measures can be taken using the O & M manual as a guide. All inspections shall be recorded and shall include the date, time, and name of the person making the inspection, corrective measures taken, and routine equipment maintenance, repair, or replacement performed. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

5. A roster of operators associated with the facility's operation and their certification grades shall be submitted to the DHEC/Bureau of Water/Water Pollution Control Division. For existing facilities, this roster shall be submitted within thirty (30) days of the effective date of this permit. For new facilities, this roster must be submitted prior to placing the facility into operation. Additionally, any changes in operator or operators (including their certification grades) shall be submitted to the Department as they occur.

6. Wastewater Sewer Systems

a. Purpose. This section establishes rules for governing the operation and maintenance of wastewater sewer systems, including gravity or pressure interceptor sewers. It is the purpose of this section to establish standards for the management of sewer systems to prevent and/or minimize system failures that would lead to public health or environmental impacts.

b. Applicability. This section applies to all sewer systems that have been or would be subject to a DHEC construction permit under Regulation 61-67 and whose owner owns or operates the wastewater treatment system to which the sewer discharges.

c. General requirements. The permittee must:

(1) Properly manage, operate, and maintain at all times all parts of its sewer system(s), to include maintaining contractual operation agreements to provide services, if appropriate;

(2) Provide adequate capacity to convey base flows and peak flows for all parts of the sewer system or, if capital improvements are necessary to meet this standard, develop a schedule of short and long term improvements;

(3) Take all reasonable steps to stop and mitigate the impact of releases of wastewater to the environment; and

(4) Notify the Department within 30 days of a proposed change in ownership of a sewer system.

F. Permit actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

G. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege nor does it authorize any injury to persons or property or invasion of other private rights, or any infringement of State or local law or regulations.

H. Duty to provide information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

I. Inspection and entry

The permittee shall allow the Department, or an authorized representative (including an authorized contractor acting as a representative of the Department), upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act and Pollution Control Act, any substances or parameters at any location.

J. Monitoring and records

1. a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

   b. Flow Measurements

   Where primary flow meters are required, appropriate flow measurement devices and methods consistent with accepted scientific practices shall be present and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of not greater than 10 percent from the true discharge rates throughout the range of expected discharge volumes. The primary flow device, where required, must be accessible to the use of a continuous flow recorder.

   c. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

2. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by R.61-9.503 or R.61-9.504), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

3. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were performed;
   d. The individual(s) who performed the analyses;
   e. The analytical techniques or methods used; and
   f. The results of such analyses.

4. a. Analyses for required monitoring must be conducted according to test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal specified in R.61-9.503, unless other test procedures have been specified in the permit

b. Unless addressed elsewhere in this permit, the permittee shall use a sufficiently sensitive analytical method for each sample that achieves a value below the derived permit limit stated in Part III. For the purposes of reporting analytical data on the Discharge Monitoring Report (DMR):

(1) Analytical results below the PQL from methods available in 40 CFR 136 or otherwise specified in the permit shall be reported as zero (0), provided the PQL is below the value specified in Part V.G.5 and the result is also below the PQL. Zero (0) shall also be used to average results which are below the PQL. When zero (0) is reported or used to average results, the permittee shall report, in the "Comment Section" or in an attachment to the DMR, the analytical method used, the PQL achieved, and the number of times results below the PQL were reported as zero (0).

(2) Analytical results above the PQL from methods available in 40 CFR 136 or otherwise specified in the permit shall be reported as the value achieved, even if the PQL is below the value specified in Part V.G.5. When averaging results using a value containing a < the average shall be calculated using the value and reported as < the average of all results collected.

3. (a) Mass value for a pollutant collected using a grab sample shall be calculated using the 24-hour totalized flow for the day the sample was collected (if available) or the instantaneous flow at the time of the sample and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate. Grab samples should be collected at a time representative of the discharge.

(b) Mass value for a pollutant collected using a composite sample shall be calculated using the 24-hour totalized flow measured for the day the sample was collected and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate.

5. The PCA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment provided by the Clean Water Act is also by imprisonment of not more than 4 years.

K. Signatory requirement

1. All applications, reports, or information submitted to the Department shall be signed and certified.

a. Applications. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or

(b) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency or public facility: By either a principal executive officer, mayor, or other duly authorized employee or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(a) The chief executive officer of the agency, or

(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator, Region IV, EPA).

b. All reports required by permits, and other information requested by the Department, shall be signed by a person described in Part II.K.1.a of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in Part II.K.1.a of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

(3) The written authorization is submitted to the Department.

c. Changes to authorization. If an authorization under Part II.K.1.b of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part II.K.1.b of this section must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under Part II.K.1.a or b of this section shall make the following certification: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. The PCA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $25,000 per violation, or by imprisonment for not more than two years per violation, or by both.

L. Reporting requirements

1. Planned changes

The permittee shall give written notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in R 61-9.122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Part II.L.8 of this section.

c. The alteration or addition results in a significant change in the permittee's sewage sludge or industrial sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan (included in the NPDES permit directly or by reference);

2. Anticipated noncompliance

The permittee shall give advance notice to DHEC/Bureau of Water/Water Pollution Control Division of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is not transferable to any person except after notice to DHEC/Bureau of Water/NPDES Administration Section. The Department may require modification or revocation and reissuance of the permit to change the name of permittee and incorporate such other requirements as may be necessary under the Pollution Control Act and the Clean Water Act. (See section 122.61; in some cases, modification or revocation and reissuance is mandatory.)

a. Transfers by modification. Except as provided in paragraph b of this section, a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued (under R.61-9.122.62(e)(2)), or a minor modification made (under R.61-9.122.63(d)), to identify the new permittee and incorporate such other requirements as may be necessary under CWA.

b. Other transfers. As an alternative to transfers under paragraph a of this section, any NPDES permit may be transferred to a new permittee if:

(1) The current permittee notifies the Department at least 30 days in advance of the proposed transfer date in Part II.L.3.b(2) of this section;

(2) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

(3) Permits are non-transferable except with prior consent of the Department. A modification under this subparagraph may also be a minor modification under section 122.63.

4. Monitoring reports

Monitoring results shall be reported at the intervals specified in the permit. Monitoring periods are calculated beginning with the permit effective date, unless otherwise stated elsewhere in this permit. If the permit is modified, the effective date of the modification is used to begin calculation of the monitoring period for those items that are part of the modification unless otherwise stated elsewhere in this permit.

a. Monitoring results (with the exception of any Annual Reporting requirements under section 503.18, section 503.28, section 503.48 or section 504.18) must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Department for reporting results of monitoring of sludge use or disposal practices.

(1) Effluent Monitoring:

Until final approval of DHEC's designated electronic DMR system, effluent monitoring results obtained at the required frequency shall be reported on a Discharge Monitoring Report Form (EPA Form 3320-1). The DMR is due postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Discharge Monitoring Reports (DMRs) shall be submitted to:

S.C, Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data & Records Management Section
2600 Bull Street
Columbia, South Carolina 29201

Once DHEC notifies the permittee that the electronic DMR system is operational, the permittee will be required to use the electronic DMR system beginning the monitoring period following the notification. Completed electronic DMRs must be received no later than 11:59 PM on the 28th day of the month following the end of the monitoring period.

(2) Groundwater Monitoring:

Groundwater monitoring results obtained at the required frequency shall be reported on a Groundwater Monitoring Report Form (DHEC 2110) or the format the analyzing laboratory utilizes, postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Groundwater Monitoring Report Form (DHEC 2110) shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data & Records Management Section
2600 Bull Street
Columbia, South Carolina 29201

(3) Sludge Monitoring:

Sludge monitoring results obtained at the required frequency shall be reported in a laboratory format postmarked no later than the 28th day of the month following the end of the monitoring period. Two copies of these results shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data & Records Management Section
2600 Bull Street
Columbia, South Carolina 29201

(4) All other reports required by this permit shall be submitted at the frequency specified elsewhere in the permit to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data & Records Management Section
2600 Bull Street
Columbia, South Carolina 29201

b. If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal, approved under 40 CFR Part 136 unless otherwise specified in R.61-9.503, R.61-9.504, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the Department.

c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Department in the permit.

5. Twenty-four hour reporting

a. The permittee/system owner (or applicable representative) (hereafter permittee/system owner) shall report any non-compliance that meets the criteria in Part II.L.5.b. Any information shall be provided orally or electronically to the local DHEC office as soon as possible but no later than 24 hours from the time the permittee/system owner becomes aware of the circumstances. During normal working hours (8:30 AM - 5:00 PM Eastern Standard Time) call the appropriate regional office in the table below.

County	DHEC Region	Phone No.
Berkeley, Charleston, Dorchester	Low Country Region BEHS Charleston	843-953-0150

* After hour reporting should be made to the 24-hour Emergency Response telephone number 1-888-481-0125.

A written submission (using DHEC Form 3685 or submission with equivalent information) shall also be provided to DHEC within 5 days of the time the permittee/system owner becomes aware of the circumstances. The written submission must be sent to the Water Pollution Control Division at the address in Part II.L.4.a(4) of the permit or faxed to 803-898-4215. (Note: Upon notification of availability of a Department electronic reporting system, the written submission shall be made through the electronic system.) The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has

not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

b. The following shall be included as information which must be reported within 24 hours under this paragraph.

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit. (See R.61-9.122.44(g)).

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed below (See R 61-9.122.44(g)):

I. TRC

(4) Any non-compliance which may endanger human health or the environment.

(5) Any spill or release that reaches the surface waters of the State.

(6) Any spill or release that exceeds an estimated 500 gallons.

[Note: When investigating a potential release due to a problem with a pump station, the investigation should include an evaluation of upstream manholes.]

c. The Department may waive the written report on a case-by-case basis for reports under Part II.L.5.b of this section if the oral report has been received within 24 hours.

6. Other noncompliance.

The permittee shall report all instances of noncompliance not reported under Part II.L.4 and 5 of this section and Part IV at the time monitoring reports are submitted. The reports shall contain the information listed in Part II.L.5 of this section.

7. Other information.

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

8. Domestic treatment works

All POTWs must provide adequate notice to the Department of the following:

(1) Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to sections 301 or 306 of CWA if it were directly discharging those pollutants; and

(2) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(3) For purposes of this paragraph, adequate notice shall include information on:

(i) The quality and quantity of effluent introduced into the POTW, and

(ii) Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

M. Bypass

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Part II.M.2 and 3 of this section.

2. Notice.

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible, at least ten days before the date of the bypass to DHEC/Bureau of Water/Water Facilities Permitting Division.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II(L)(5) of this permit (24-hour reporting).

3. Prohibition of bypass

   a. Bypass is prohibited, and the Department may take enforcement action against a permittee for bypass, unless:

      (1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

      (2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

      (3) The permittee submitted notices as required under Part II.M.2 of this section.

   b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in Part II.M.3.a of this section.

N. Upset

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Part II.N.2 of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;
   b. The permitted facility was at the time being properly operated; and
   c. The permittee submitted notice of the upset as required in Part II.L.5.b(2) of this section.
   d. The permittee complied with any remedial measures required under Part II.D of this section.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

O. Misrepresentation of Information

1. Any person making application for a NPDES discharge permit or filing any record, report, or other document pursuant to a regulation of the Department, shall certify that all information contained in such document is true. All application facts certified to by the applicant shall be considered valid conditions of the permit issued pursuant to the application.

2. Any person who knowingly makes any false statement, representation, or certification in any application, record, report, or other documents filed with the Department pursuant to the State law, and the rules and regulations pursuant to that law, shall be deemed to have violated a permit condition and shall be subject to the penalties provided for pursuant to 48-1-320 or 48-1-330.

Part III. Limitations and Monitoring Requirements

A. Effluent Limitations and Monitoring Requirements

1. **Final Limits – Outfall 001** During the period beginning on effective date of this permit and lasting through an Approval to Place into Operation at 10.6 MGD issued for this facility or the expiration date, whichever occurs earlier, the permittee is authorized to discharge from outfall serial number **001** (Center Street WWTP into combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 3.7MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	Daily	Cont.	Eff.
$CBOD_5$	771	1157	—	25 mg/l*	37.5 mg/l*	—	1/Week	24 Hr C	Eff.
TSS	926	1389	—	30 mg/l	45 mg/l	—	1/Week	24 Hr C	Eff.
NH_3-N	MR	MR	—	MR mg/l	MR mg/l	—	1/Week	24 Hr C	Eff.
TRC	30.86	—	46.29	1.0 mg/l	—	1.5 mg/l	1/Week	Grab	Eff.
DO	—	—	—	1.0 mg/l Minimum at all times			5/Week	Grab	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			5/Week	Grab	Eff.
$CBOD_5$ (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—
TSS (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—

* Maximum allowable concentration limits so long as UOD limits are not exceeded.
** See Part V.H.

2. **Final Limits – Outfall 001** During the period beginning on an Approval to Place into Operation at 10.6 MGD issued for this facility and lasting through expiration date, the permittee is authorized to discharge from outfall serial number **001** (Center Street WWTP into combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 3.7MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	Daily	Cont.	Eff.
$CBOD_5$	771	1157	—	25 mg/l*	37.5 mg/l*	—	1/Week	24 Hr C	Eff.
TSS	926	1389	—	30 mg/l	45 mg/l	—	1/Week	24 Hr C	Eff.
NH_3-N (Mar. – Oct.)	617	926	—	20 mg/l*	30 mg/l*	—	1/Week	24 Hr C	Eff.
NH_3-N (Nov. – Feb.)	MR	MR	—	MR mg/l	MR mg/l	—	1/Week	24 Hr C	Eff.
TRC	30.86	—	46.29	1.0 mg/l	—	1.5 mg/l	1/Week	Grab	Eff.
DO	—	—	—	1.0 mg/l Minimum at all times			5/Week	Grab	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			5/Week	Grab	Eff.
$CBOD_5$ (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—
TSS (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—

* Maximum allowable concentration limits so long as UOD limits are not exceeded.
** See Part V.H.

3. **Final Limits – Outfall 002** During the period beginning on effective date of this permit and lasting through an Approval to Place into Operation at 10.6 MGD issued for this facility or the expiration date, whichever occurs earlier, the permittee is authorized to discharge from outfall serial number **002** (Rifle Range Road WWTP into the combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 6.0MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	Daily	Cont.	Eff.
$CBOD_5$	1251	1877	—	25 mg/l*	37.5 mg/l*	—	1/Week	24 Hr C	Eff.
TSS	1501	2252	—	30 mg/l	45 mg/l	—	1/Week	24 Hr C	Eff.
NH_3-N	MR	MR	—	MR mg/l	MR mg/l	—	1/Week	24 Hr C	Eff.
TRC	50.04	—	75.06	1.0 mg/l	—	1.5 mg/l	3/Week	Grab	Eff.
DO	—	—	—	1.0 mg/l Minimum at all times			5/Week	Grab	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			5/Week	Grab	Eff.
$CBOD_5$ (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—
TSS (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—

* Maximum allowable concentration limits so long as UOD limits are not exceeded.
** See Part V.H.

4. **Final Limits – Outfall 002** During the period beginning on an Approval to Place into Operation at 10.6 MGD issued for this facility and lasting through expiration date, the permittee is authorized to discharge from outfall serial number **002** (Rifle Range Road WWTP into the combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 10.6 MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	Daily	Cont.	Eff.
$CBOD_5$	2210	3315	—	25 mg/l*	37.5 mg/l*	—	3/Week	24 Hr C	Eff.
TSS	2652	3978	—	30 mg/l	45 mg/l	—	3/Week	24 Hr C	Eff.
NH_3-N (Mar. – Oct.)	1768	2652	—	20 mg/l*	30 mg/l*	—	3/Week	24 Hr C	Eff.
NH_3-N (Nov. – Feb.)	MR	MR	—	MR mg/l	MR mg/l	—	3/Week	24 Hr C	Eff.
TRC	88.4	—	132.6	1.0 mg/l	—	1.5 mg/l	3/Week	Grab	Eff.
DO	—	—	—	1.0 mg/l Minimum at all times			5/Week	Grab	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			5/Week	Grab	Eff.
$CBOD_5$ (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—
TSS (% Removal)**	—	—	—	85% (Minimum)	—	—	1/Month	Calc.	—

* Maximum allowable concentration limits so long as UOD limits are not exceeded.

** See Part V.H.

5. **Final Limits – Outfall 003** During the period beginning on effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 003 (Mt. Pleasant/WTP #1 into the combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 0.25MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	2/Month	Cont.	Eff.
$CBOD_5$	MR	MR	—	MR mg/l	MR mg/l	—	1/Month	24 Hr C	Eff.
TSS	42	63	—	20 mg/l	40 mg/l	—	1/Month	24 Hr C	Eff.
NH_3-N	MR	MR	—	MR mg/l	MR mg/l	—	1/Month	24 Hr C	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			2/Month	Grab	Eff.

6. **Final Limits – Outfall 004**: During the period beginning on effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 004 (Mt. Pleasant/WTP #3 into the combined outfall 005). Such discharge shall be limited and monitored by the permittee as specified below:

Following limits are based on the average design flow of: 0.67MGD									
EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow	—	—	—	MR MGD	MR MGD	—	2/Month	Cont.	Eff.
$CBOD_5$	MR	MR	—	MR mg/l	MR mg/l	—	1/Month	24 Hr C	Eff.
TSS	112	168	—	20 mg/l	40 mg/l	—	1/Month	24 Hr C	Eff.
NH_3-N	MR	MR	—	MR mg/l	MR mg/l	—	1/Month	24 Hr C	Eff.
pH	—	—	—	6.0 – 9.0 Standard Units			2/Month	Grab	Eff.

7. **Final Limits – Outfall 005**: During the period beginning on effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 005 (Combined outfall pipe discharges directly into Charleston Harbor). Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
UOD (Mar – Oct)	11,415	17,123	—	—	—	—	1/Month	Calculated*	Eff.
UOD (Nov – Feb)	15,111	22,667	—	—	—	—	1/Month	Calculated*	Eff.

* See Part I.U and Part III.A.12 & 13

8. **Final Limits - Outfall 006**: During the period beginning on the effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 006 (This is a spray irrigation site at the Joe Gawrych Baseball Complex). Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow*	—	—	—	0.0349 MGD	0.0349 MGD	—	Daily	Cont.	Eff.

* Samples shall be taken after final treatment but prior to actual application to the land. Flow - metering locations for the three land application sites will be established for compliance verification.

9. **Final Limits - Outfall 007**: During the period beginning on the effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 007 (This is a spray irrigation site at the Edward D. Duffy Baseball Complex). Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow*	—	—	—	0.0342 MGD	0.0342 MGD	—	Daily	Cont.	Eff.

* Samples shall be taken after final treatment but prior to actual application to the land. Flow - metering locations for the three land application sites will be established for compliance verification.

10. **Final Limits - Outfall 008**: During the period beginning on the effective date of this permit and lasting through until the expiration date, the permittee is authorized to discharge from outfall serial number 008 (This is a spray irrigation site at the Commission's Operations Center). Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS		
	Pounds per Day			Other Units					
	Monthly Average	Weekly Average	Daily Maximum	Monthly Average	Weekly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Flow*	—	—	—	0.0121 MGD	0.0121 MGD	—	Daily	Cont.	Eff.

* Samples shall be taken after final treatment but prior to actual application to the land. Flow - metering locations for the three land application sites will be established for compliance verification.

11 **FINAL LIMITS:** During the period beginning on the effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial number **001 and 002**. Such discharge shall be limited and monitored by the permittee as specified below:

If each Enterococci daily maximum (as defined by R.61-68.B.29) during a calendar month reporting period is **less than or equal to** 501 MPN/100 ml **or** the provisions of R.61-68.E.14(c)(12), included as "Bacteria Supplemental Data Sheet" at the end of Part V of this permit, were **not** met, then the following limits apply:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS		
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type	Sample Point
Enterococci (MPN/100ml)	35	501	3/Week	Grab	Effluent

Otherwise report "Conditional Monitoring-Not Required" on the Discharge Monitoring Report (DMR) form for this portion (Part III.A.11) of the permit, and report all Enterococci data for this monitoring period in 10 below.

12. **FINAL LIMITS:** During the period beginning on the effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial number **001 and 002**. Such discharge shall be limited and monitored by the permittee as specified below:

If any Enterococci daily maximum (as defined by R.61-68.B.29) during a calendar month reporting period is **greater than** 501 MPN/100 ml **AND** in each instance the provisions of R.61-68.E.14(c)(12), included as "Bacteria Supplemental Data Sheet" at the end of Part V of this permit, **WERE** met, then the following limits apply:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS		
	Monthly Average	Individual Sample Maximum	Measurement Frequency	Sample Type	Sample Point
Enterococci (MPN/100ml)	35	800*	3/Week	Grab	Effluent

* For this reporting period only.

Otherwise, report "Conditional Monitoring-Not Required" on the Discharge Monitoring Report (DMR) form for this portion (Part III.A.12) of the permit, and report all Enterococci data for this monitoring period in 11 above. In addition, if data is reported in item 104, the "Bacteria Supplemental Data Sheet" contained in Part V of this permit **must** be attached to the Discharge Monitoring Report (DMR) and signed by the authorized DMR representative, documenting compliance with the provisions of R.61-68.E.14(c)(12). If this attachment is not included with the DMR submittal, the permittee may **not** use this portion (Part III.A.12) for reporting Enterococci data.

a **Note for 11 and 12 above:** Sample results reported should include all data collected for this monitoring period including any additional Enterococci samples that might be collected under the provisions of R.61-68.E.14(c)(12).

b **Note for 11 and 12 above:** Provided the facility meets the new limits and satisfactory disinfection performance, the permit may be modified and the measurement frequency could be reduced after a one-year period subject to a standard NPDES permit modification per R61-9.

13. Samples taken in compliance with the monitoring requirements specified above in Part III.A.1, Part III.A.2, Part III.A.3, Part III.A.4, A.5, A.6 shall be taken at the following locations: nearest accessible point after final treatment but prior to actual discharge into the combined outfall pipe.

    Samples taken for Part III.A.8, Part III.A.9 and Part III.A.10 shall be taken after final treatment but prior to actual application to the land. Flow metering locations for the three land application sites will be established for compliance verification.

14. The UOD limit (for outfall 005 – combined discharge) The Compliance Value for UOD shall be determined by the following listed equation: (see Part I.T for calculating UOD)

$$UOD_{combined} = UOD_1 + UOD_2 + UOD_3 + UOD_4$$

1). UOD_1 shall mean the calculated UOD loading from Center Street WWTP by using equation listed in Part I.U.

2). UOD_2 shall mean the calculated UOD loading from Rifle Range Road WWTP by using equation listed in Part I.U.

3). UOD_3 shall mean the calculated UOD loading from WTP#1 by using equation listed in Part I.U.

4). UOD_4 shall mean the calculated UOD loading from WTP#3 by using equation listed in Part I.U.

B. Whole Effluent Toxicity Limitations and Monitoring Requirements

Final Limits

1. During the period beginning on the modification date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall **001** (Center Street WWTP).

Such discharge shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
Mysidopsis bahia ***Chronic*** Whole Effluent Toxicity @ CTC= 1%	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
	25%	40%	1/year	24 hrs comps.

See Part V.B. for additional toxicity reporting requirements.
MR = Monitor and Report.

The following notes apply only to valid tests. For invalid tests see Part V.B. The % fecundity effect is not used below when inadequate control fecundity occurs (egg production by less than 50% of females). Inadequate control fecundity alone does not invalidate the toxicity test.

Note 1: The overall % effect is defined as the larger of the % survival effect, the % growth effect or the % fecundity effect from DMR Attachment Form 3883 (11/2010).

Note 2: If only one test is conducted during a month, the monthly average and daily maximum are each equal to the overall % effect.

Note 3: If more than one test is conducted during a month, the monthly average is the arithmetic mean of the overall % effect values of all tests conducted during the month.

Note 4: The monthly average to be reported on the DMR is the highest monthly average for any month during the monitoring period. There is no averaging of data from tests from one month to another.

Note 5: The daily maximum to be reported on the DMR is the highest of the % survival effect, % growth effect or % fecundity effect of all tests conducted during the monitoring period.

Note 6: When a sample is collected in one month and the test is completed in the next month, the overall % effect applies to the month in which the sample was collected.

Note 7: Tests must be separated by at least 7 days (from the time the first sample is collected to start one test until the time the first sample is collected to start a different test). There is no restriction on when a new test may begin following a failed or invalid test.

Note 8: For any split sample:
a. Determine the % survival effect, % growth effect and % fecundity effect values separately for each test.
b. Determine the arithmetic mean of the % survival effects, of the % growth effects and of the % fecundity effects for all tests.
c. The monthly average and daily maximum shall be the higher of the % effect values from (b) above.
d. For the purposes of reporting, split samples are reported as an individual sample regardless of the number of times it is split. All laboratories used shall be identified on the DMR attachment and each test shall be reported individually on DMR Attachment Form DHEC 3883 (11/2010).

a. Samples used to demonstrate compliance with the discharge limitations and monitoring requirements specified above shall be taken at or near the final point-of-discharge but prior to mixing with the receiving waters or other waste streams.

2. During the period beginning on the modification date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall **002** (Rifle Range Road WWTP):

Such discharge shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
Mysidopsisgh bahia ***Chronic*** Whole Effluent Toxicity @ CTC= 1%	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
	25%	40%	1/year	24 hrs comps.

See Part V.B. for additional toxicity reporting requirements.
MR = Monitor and Report.

The following notes apply only to valid tests. For invalid tests see Part V.B. The % fecundity effect is not used below when inadequate control fecundity occurs (egg production by less than 50% of females). Inadequate control fecundity alone does not invalidate the toxicity test.

Note 1: The overall % effect is defined as the larger of the % survival effect, the % growth effect or the % fecundity effect from DMR Attachment Form 3883 (11/2010).

Note 2: If only one test is conducted during a month, the monthly average and daily maximum are each equal to the overall % effect.

Note 3: If more than one test is conducted during a month, the monthly average is the arithmetic mean of the overall % effect values of all tests conducted during the month.

Note 4: The monthly average to be reported on the DMR is the highest monthly average for any month during the monitoring period. There is no averaging of data from tests from one month to another.

Note 5: The daily maximum to be reported on the DMR is the highest of the % survival effect, % growth effect or % fecundity effect of all tests conducted during the monitoring period.

Note 6: When a sample is collected in one month and the test is completed in the next month, the overall % effect applies to the month in which the sample was collected.

Note 7: Tests must be separated by at least 7 days (from the time the first sample is collected to start one test until the time the first sample is collected to start a different test). There is no restriction on when a new test may begin following a failed or invalid test.

Note 8: For any split sample:

a. Determine the % survival effect, % growth effect and % fecundity effect values separately for each test.
b. Determine the arithmetic mean of the % survival effects, of the % growth effects and of the % fecundity effects for all tests.
c. The monthly average and daily maximum shall be the higher of the % effect values from (b) above.
d. For the purposes of reporting, split samples are reported as an individual sample regardless of the number of times it is split. All laboratories used shall be identified on the DMR attachment and each test shall be reported individually on DMR Attachment Form DHEC 3883 (11/2010).

a. Samples used to demonstrate compliance with the discharge limitations and monitoring requirements specified above shall be taken at or near the final point-of-discharge but prior to mixing with the receiving waters or other waste streams.

C. Groundwater Requirements

1. Groundwater Monitoring Requirements

a. Each of the five (5) groundwater monitoring wells (as reported in the past) shall be sampled by the permittee as specified below:

Parameter	Measurement Frequency	Sample Method
Ammonia (NH_3)	Semi-Annually	Pump or Bailer Method
Nitrate (N)	Semi-Annually	Pump or Bailer Method
Field pH	Semi-Annually	Pump or Bailer Method
TDS	Semi-Annually	Pump or Bailer Method
Field Specific Conductance	Semi-Annually	Pump or Bailer Method
Depth to Groundwater (Report within 0.01 feet)	Semi-Annually	Tape
Groundwater Elevation (Report within 0.01 feet above mean sea level)	Semi-Annually	Tape

b. For purposes of Groundwater Monitoring, the following measurement frequency table shall be utilized:

Measurement Frequency	Sampling Period	Reporting Deadline
Quarterly (Samples must be taken at least 60 days apart.)	January 1st – March 31st	April 28th
	April 1st – June 30th	July 28th
	July 1st – September 30th	October 28th
	October 1st – December 31st	January 28th
Semi-Annually	January 1st – March 31st	April 28th
	July 1st – September 30th	October 28th
Annually	October 1st – December 31st	January 28th

c. All well are to yield representative samples of the aquifer. Should groundwater elevation drop to a level below a well for two consecutive sampling events, it must reinstalled as per R61-71.

d. Sample collection methods shall be in accordance with EPA publication SESDPROC 301-R2, dated October 28, 2011.

e. All groundwater monitoring wells must be properly maintained at all times and are to yield a representative sample of the aquifer. If the groundwater elevation drops to a level that prevents the collection of a sample for two consecutive sampling periods, then this well shall be considered as "rendered unusable." In accordance with Regulation 61-71, any monitoring well which is destroyed, rendered unusable, or abandoned, shall be reported to the Department, and shall be properly abandoned, revitalized, or replaced. The permittee shall revitalize or replace the dry well within six months after recording the second dry sampling period.

f. In accordance with R.61-9.505.5(d), "If a deleterious impact to the groundwaters of the State from the permitted use or disposal practices is documented through groundwater monitoring levels exceeding the standards set forth in R.61-68 or a significant adverse trend occurs, then it will be the obligation of the permittee as directed by the Department to conduct an investigation to determine the vertical and horizontal extent of groundwater impact. The Department may require remediation of the groundwater to within acceptable levels for groundwater as set forth in R.61-68."

D. Sludge Disposal Requirements

1. Sludge Transportation and Disposal

1). Sludge solids will be removed from both Center Street WWTP (Plant #1) & Rifle Range Road WWTP (Plant #2) and transported to the Berkeley County Landfill (#091001-1102) and/or Chambers-Oakridge Landfill (#182400-1101) under the following conditions:

a. All containers for sludge collection and transportation shall be structurally sound in every respect and shall be so constructed as to prevent leakage or spillage of any kind while in the process of pumping, storage, or transit.

b. The total volume of waste transported shall not exceed available capacity at the Landfill site per year.

c. The hauling of sludge may be temporarily suspended or permanently revoked when, in the opinion of the South Carolina Department of Health and Environmental Control or any of its authorized representatives, the Permittee has failed to comply with the permitting, hauling, transportation, or disposal requirements of these guidelines.

d. To the extent provided by the law, the Permittee is responsible for the handling, transportation, and disposal of all sludge from the various source(s) transported to the approved disposal site. This responsibility includes, but is not limited to spills, accidents, unauthorized leaks, or other hazards which may occur.

2. Letter of Approval

The sludge removal and transportation letter permit issued by SCDHEC Water Facilities Permitting Division, dated September 23, 2002, shall be incorporated into and become an enforceable part of this permit. All conditions included in the letter permit shall be a requirement of this NPDES permit.

E. Land Application Requirements (Effluent)

The treated wastewater is to be spray irrigated onto the Joe Gawrych Baseball Complex, Edward D. Duffy Baseball Complex, and Commission's Operations Center spray field. The acreages and application rates at each site shall be as follows:

1. Joe Gawrych Baseball Complex* - A maximum of 2.0 inches/week on 4.5 acres of spray site for a maximum of 34,910 gallons per day.

2. Edward D. Duffy Baseball Complex* - A maximum of 2.0 inches/week on 4.42 acres of spray field for a total of 34,289 gallons per day.

3. Commission's Operations Center* - A maximum of 2.0 inches/week on 1.57 acres of spray field for a total of 12,179 gallons per day.

* These spray sites are for an as-needed basis only and will not increase the overall permitting capacity of the Mt. Pleasant system.

F. Instream Biological Assessment

Not applicable to this permit.

Part IV. Schedule of Compliance

A. Schedule(s)

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedules:

   Not applicable to this permit.

2. The permittee shall achieve compliance with the Whole Effluent Toxicity limitations specified for discharges in accordance with the following schedules:

   Not applicable to this permit.

3. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date

Part V. Other Requirements

A. Effluent Limitations and Monitoring Requirements

1. There shall be no discharge of floating solids or visible foam in other than trace amounts, nor shall the effluent cause a visible sheen on the receiving waters.

2. a. Effluent samples taken in compliance with the monitoring requirements specified in Part III, shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

   b. Influent samples taken in compliance with the monitoring requirements specified in Part III, shall be taken at the following location(s): nearest accessible point prior to any primary treatment unit (e.g. after the bar screen and before primary treatment).

3. Samples shall be collected in accordance with Part I.

4. MR = Monitor and Report only.

B. Effluent Toxicity Limitations and Monitoring Requirements

1. For the requirements identified in Part III.B.1 & B.2:

   a. A *Mysidopsis bahia* survival, growth and fecundity chronic toxicity test shall be conducted at the frequency stated in Part III.B, Effluent Toxicity Limitations and Monitoring Requirements, using the chronic test concentration (CTC) of 1% and the following test concentrations: 0% (control), 0.1%, 0.3%, 1%, 3.1 and 100% effluent. The permittee may add additional test concentrations without prior authorization from the Department provided that the test begins with at least 8 vessels each containing 5 organisms per concentration and all data is used to determine permit compliance. The effluent's salinity may be adjusted to 20 to 30 parts per thousand (ppt) by the addition of salts before the test is performed. The effluent shall not be diluted to achieve a lower salinity.

   b. The test shall be conducted using EPA Method 1007.0 in accordance with "Short-Term Methods for Estimating Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms," EPA/821/R-02/014 (October 2002).

   c. The permittee shall use the linear interpolation method described in "Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms," EPA/821/R-02/014 (October 2002), Appendix L to estimate the percent effect on survival, growth and fecundity at the CTC according to the equations in d below.

   d. The linear interpolation estimate of percent effect is $\left(1 - \frac{M_{CTC}}{M_1}\right) * 100$ if the CTC is a tested concentration. Otherwise, it is

$$\left(1 - \frac{M_j - \frac{M_{j+1} - M_j}{C_{j+1} - C_j} * C_j + \frac{M_{j+1} - M_j}{C_{j+1} - C_j} * CTC}{M_1}\right) * 100 .$$

e. A test shall be invalidated if any part of Method 1007.0 is not followed or if the laboratory is not certified at the time the test is conducted.

f. All valid toxicity test results shall be submitted on the DHEC Form 3883 (11/2010) entitled "DMR Attachment for Toxicity Test Results" in accordance with Part II.L.4. In addition, results from all invalid tests must be appended to DMRs, including lab control data. The permittee has sole responsibility for scheduling toxicity tests so as to ensure there is sufficient opportunity to complete and report the required number of valid test results for each monitoring period.

g. The permittee is responsible for reporting a valid test during each monitoring period. However, the Department acknowledges that invalid tests may occur. All of the following conditions must be satisfied for the permittee to be in compliance with Whole Effluent Toxicity (WET) testing requirements for a particular monitoring period when a valid test was not obtained.

   (1) A minimum of five (5) tests have been conducted which were invalid in accordance with Part V.B.1.d above;

   (2) The data and results of all invalid tests are attached to the DMR;

   (3) At least one additional State-certified laboratory was used after two (2) consecutive invalid tests were determined by the first laboratory. The name(s) and lab certification number(s) of the additional lab(s) shall be reported in the comment section of the DMR; and

   (4) A valid test was reported during each of the previous three reporting periods.

   If these conditions are satisfied, the permittee may enter "H" in the appropriate boxes on the toxicity DMR and add the statement to the Comment Section of the DMR that "H indicates invalid tests."

h. This permit may be modified based on new information that supports a modification in accordance with Regulation 61-9.122.62 and Regulation 61-68.D.

C. Groundwater Requirements

Not applicable to this permit

D. Sludge Disposal Requirements

1. Class I sludge management facilities (includes but is not limited to all facilities with pretreatment programs, Publicly Owned Treatment Works (Facility) with a design flow rate equal to or greater than 1 Million gallons per day, and Facility's that serve 10,000 people or more) shall submit the following to EPA Region 7 (Attn: Water Enforcement Branch, EPA Region 7, 11201 Renner Boulevard, Lenexa, KS 66219) with a duplicate copy to the Department:

   a. The information in 40 CFR Part 503.17(a) except the information in 503.17(a)(3)(ii), 503.17(a)(4)(ii) and 503.17(a)(5)(ii), for the appropriate requirements on February 19 of each year.

   b. The information in 40 CFR Part 503.17(a)(5)(ii)(A) through (a)(5)(ii)(G) on February 19 of each year when ninety (90) percent or more of any of the cumulative pollutant loading rates in Table 2 of 503.13 is reached at a site.

The requirements to send information to EPA Region 7 will remain in effect until the State of South Carolina is delegated the sludge program under 40 CFR Part 123 or 40 CFR Part 501. The permittee is also required to send a copy of the information to the Department under the requirements of R.61-9.503.

c. Until such time as a specific federal sludge disposal permit is issued under the provisions of 40 CFR Part 503, the direct enforceability (§ 503.3(b)) of the sludge standards requires that the permittee shall not use or dispose of sewage sludge through practice for which requirements are established in 40 CFR Part 503, except in accordance with those requirements. If the Department includes State sludge permit requirements under R.61-9.503, the conditions of that permit shall apply in addition to any requirements under 40 CFR Part 503.

2. a. The permittee must obtain prior Departmental approval of planned changes in the facility when the alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

   b. The sludge disposal permit may be modified or revoked and reissued if there are material and substantial alterations or additions to the permitted facility or activity (including a change or changes in the permittee's sludge use or disposal practice) which occurred after the permit issuance which justify the application of permit conditions which are different from or absent in the existing permit.

3. The sludge disposal permit may be terminated if there is a change in any condition that requires either a temporary or permanent reduction or elimination of any discharge or sludge use or disposal practice controlled by the permit.

4. Periodic inspections will be conducted by Department authorized representatives to ensure compliance with State regulations and permit stipulations. Any necessary modification to this permit may be based upon these evaluations.

5. Records of monitoring required by the permits related to sludge use and disposal activities must be kept at least five (5) years (or longer as required by 40 CFR Part 503 or R.61-9.503).

6. Sludge monitoring procedures shall be those specified in 1) R.61-9.503; 2) 40 CFR Part 503; 3) 40 CFR Part 136; or 4) other procedures specified in the sludge permit (in that order of "preference" depending on the availability and applicability of a particular method at the time the sludge permit is issued).

7. The permittee shall submit the results of <u>all</u> sludge monitoring if done more frequently than required by the sludge permit. The permittee may be required to maintain specific records at the facility and on request may also be required to furnish them to the Department.

8. Odor Control Requirements

   The permittee shall use best management practices normally associated with the proper operation and maintenance of a sludge wastewater treatment site, any sludge storage or lagoon areas, transportation of sludges, and all individual activities permitted under R.61-9.503 to ensure that an undesirable level of odor does not exist.

   a. The permittee is required to prepare an odor abatement plan for the sewage sludge treatment sites, any sludge storage or lagoon areas, and land application or surface disposal sites. It must be noted this state regulation that went into effect on June 27, 2003, and continues in effect, required permittees that land-

apply sludge to prepare the plan by December 24, 2003. Otherwise, the permittee had until June 27, 2004 to prepare the plan and this requirement remains in effect. The plan must have included the following topics:

(1) Operation and maintenance practices which are used to eliminate or minimize undesirable odor levels in the form of best management practices for odor control.

(2) Use of treatment processes for the reduction of undesirable odors;

(3) Use of setbacks.

(4) Contingency plans and methods to address odor problems for the different type of disposal/application methods used.

b. Unless otherwise requested, prior to issuance of a new or expanded land application disposal permit (either NPDES or ND), the Department may review the odor abatement plan for compliance with this Part (503.50). The Department may require changes to the plan as appropriate.

c. No permittee may cause, allow, or permit emission into the ambient air of any substance or combinations of substances in quantities that an undesirable level of odor is determined to result unless preventative measures of the type set out below are taken to abate or control the emission to the satisfaction of the Department. When an odor problem comes to the attention of the Department through field surveillance or specific complaints, the Department may determine, in accordance with section 48-1-120 of the Pollution Control Act, if the odor is at an undesirable level by considering the character and degree of injury or interference to:

(1) The health or welfare of the people;
(2) Plant, animal, freshwater aquatic, or marine life;
(3) Property; or
(4) Enjoyment of life or use of affected property.

d. After determining that an undesirable level of odor exists, the Department may require:

(1) the permittee to submit a corrective action plan to address the odor problem,
(2) remediation of the undesirable level of odor within a reasonable timeframe, and
(3) in an order, specific methods to address the problem.

e. In accordance with R.61-9.503.50(e), if the permittee fails to control or abate the odor problems addressed in this section within the specified timeframe, the Department may revoke disposal/application activities associated with the site or the specific aspect of the sludge management program.

E. Land Application

The three spray-fields listed in Part III.E shall be utilized on an as-needed basis only. No spraying shall occur during normal business operation hours when the general public may come in contact with the treated effluent being sprayed.

F. Pretreatment

1. Pretreatment Regulations and Program Requirements

a. All industrial users which discharge wastewater into the Permittee's system are required to comply with pretreatment provisions of the Act, as set forth in the General Pretreatment Regulations, 40 CFR Part 403, promulgated thereunder, the approved State Pretreatment Program (R.61-9.403), and the permittee's approved pretreatment program.

b. This permit shall be modified, or alternatively revoked and reissued, to incorporate an approved POTW Pretreatment Program.

c. Any application for authority to revise categorical pretreatment Standards to reflect POTW removal of pollutants in accordance with the requirements of 40 CFR 403.7 must be submitted to the Department at the time of application for POTW pretreatment program approval or at the time of permit expiration and reissuance thereafter.

2. Prohibited Discharges

In accordance with 24 S.C. Reg. Ann. §61-9.403, the Permittee shall prohibit in its sewer use ordinance and pretreatment program regulations (if a pretreatment program is approved by the Department) the discharge of pollutant(s) into its treatment works by any non-domestic source(s), if such pollutant(s) may inhibit or interfere with the operation or performance of the works. Further, the Permittee shall prohibit in its sewer use ordinance and pretreatment program regulations (if a pretreatment program is approved by the Department) the introduction of the following pollutants into its treatment works:

a. Pollutant(s) which create a fire or explosion hazard in the POTW, including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21.

b. Pollutant(s) which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges.

c. Solid or viscous pollutant(s) in amounts which will cause obstruction to the flow in the POTW resulting in interference.

d. Any pollutant, including oxygen demanding pollutants, (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

e. Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW Treatment Plant exceeds 40°C (104°F) unless the Department, upon request of the POTW, approves alternate temperature limits.

f. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through.

g. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems.

h. Any trucked or hauled pollutants, except at discharge points designated by the POTW.

Upon development of specific limits for these pollutant categories, either in an approved POTW Pretreatment Program or otherwise, such limits shall be deemed prohibitions for the purpose of Section 307(d) of the Act and shall be enforceable in lieu of the general prohibitions set forth above.

G. Additional Operational Requirements

1. The wastewater treatment plant is assigned a classification of Group IV-B (Biological) in the Permit to Construct which is issued by the Department. This classification corresponds to an operator with a grade of A.

2. The wastewater treatment plant is assigned a Reliability Classification of Class III, in accordance with Section 67.400 "Reliability Classifications" of the Standards for Wastewater Facility Construction: R.61-67.

3. For parameters with a sample frequency of once per month or greater, the Permittee shall monitor (at least one sample) consistent with conditions established by this Permit on the first (1st) Wednesday of every calendar month, unless otherwise approved by the Department. (For example; with a once per week (01/07) sampling frequency, the permittee shall monitor one weekly sample on the day of the week noted during the monthly DMR reporting period.)

   For parameters with a sampling frequency of less than once per month (if any), the permittee shall monitor these parameters on specific date noted above on any of the months during the appropriate reporting period unless otherwise approved by the Department. (For example, with a once per quarter (1/90) sampling frequency, the permittee may monitor on the day of the week noted in either the first, second or third month in the quarterly reporting period.)

   For parameters requiring multiple samples for a single test the Permittee may collect the samples on any date during the reporting period, unless otherwise approved by the Department. The permittee must notify the Department of the planned sampling dates upon request.

   In accordance with R.61-9.122.41(j)(1)(iii), the Department may waive compliance with the permit requirement for a specific sampling event for extenuating circumstances. Additional monitoring, as necessary to meet the frequency requirements of this Permit (Part III.A., III.B., and III.C., if applicable) shall be performed by the Permittee.

4. [Reserved]

5. For purposes of reporting, the Permittee shall use the reporting threshold equivalent to the PQL listed below and conduct analyses in accordance with the method specified below:

Parameter	Analytical Method	PQL
Total Residual Chlorine	①	0.050 mg/l

① The Permittee must use a suitable analytical method (40 CFR Part 136 approved) from a SCDHEC certified laboratory with a PQL equal to or lower than the PQL listed above. If the permittee is using a PQL below the PQL listed above, then for purposes of reporting, the lower PQL shall be used in accordance with Part II.J.4.b.

H. Secondary Treatment - Percent Removal (BOD_5, $CBOD_5$ and TSS)

1. In accordance with R.61-9.133.102,103 and 105, the 30 day average percent removal for BOD_5, $CBOD_5$ (if applicable) and TSS have been identified in Part III.A, "Effluent Limitations and Monitoring Requirements". For purposes of reporting the 30-day average percent removal for BOD_5, $CBOD_5$ (if applicable) and TSS across the treatment plant, the permittee shall conduct influent and effluent sampling for BOD_5, $CBOD_5$ (if applicable) and TSS during a 30-day reporting as follows:

   Influent Sampling:
   - At a minimum during any 30-day reporting period, collect grab or composite influent sample(s) at a frequency identified in Part III.A. The procedure to collect a composite sample shall be in accordance with Part I.D and a grab sample shall be in accordance with Part I.I.
   - If only one influent sample is collected during any 30-day reporting period (provided this meets the minimum frequency specified in Part III.A), then that sample shall be considered as the 30-day average influent concentration for a given parameter.
   - If more than one influent samples are collected during the 30-day reporting period, then all individual values for a given parameter shall be averaged to determine the 30-day average influent concentration.

   Effluent Sampling:
   - Effluent data collected for permit compliance can be used, provided sufficient samples are collected to meet the frequency specified in Part III.A.
   - If more than one effluent samples are collected during the 30-day reporting period, then all individual values for a given parameter shall be averaged to determine the 30-day average effluent concentration.

   Percent Removal Determination:
   - Determine the 30-day average percent removal for a given parameter using the formula below:

$$\textit{30-day average percent removal} = \frac{C_{influent} - C_{effluent}}{C_{influent}} \times 100$$

   where:
   $C_{influent}$ = Average of all influent samples collected during the 30-day reporting period in (mg/l).
   $C_{effluent}$ = Average of all effluent samples collected during the 30-day reporting period in (mg/l).

2. The Department may substitute either a lower percent removal requirement or a mass loading limit for the percent removal requirements set forth in section 133.102(a)(3), section 133.102(a)(4)(iii), section 133.102(b)(3), section 133.105(a)(3), section 133.105(b)(3) and section 133.105(e)(1)(iii) provided that the permittee satisfactorily demonstrates that:

   (a) The treatment works is consistently meeting, or will consistently meet, its permit effluent concentration limits but its percent removal requirements cannot be met due to less concentrated influent wastewater,

   (b) To meet the percent removal requirements, the treatment works would have to achieve significantly more stringent limitations than would otherwise be required by the concentration-based standard. In accordance with R.61-9.133.101(j), "Significantly more stringent limitation" means BOD_5 and TSS limitations necessary to meet the percent removal requirements of at least 5 mg/l more stringent than the otherwise applicable concentration-based limitations (e.g., less than 25 mg/l in the case of the secondary treatment limits for BOD5 and TSS), or the percent removal limitations in section 133.102 and

section 133.105, if such limits would, by themselves, force significant construction or other significant capital expenditure.

(c) The less concentrated influent wastewater is not the result of excessive I/I. The determination of whether the less concentrated wastewater is the result of excessive I/I will use the definition of excessive I/I in 40 CFR 35.2005(b)(16) plus the additional criterion that inflow is non-excessive if the total flow to the POTW (i.e., wastewater plus inflow plus infiltration) is less than 275 gallons per capita per day.

I. Wastewater Design Flow

a. For the purposes of identification of the treatment capacity (under R.61-67.300.A.8) and for a determination of whether or not a POTW is required to develop a pretreatment program (under R.61-9.403.a), the design flow(s) is 14.3 MGD (CS = 3.7 MGD + RRR = 10.6 MGD).

b. For NPDES billing (under R.61-30.B(2)(b)), the "actual flow" limit for this wastewater treatment facility shall be identified as the design flow of 14.3 MGD.

BACTERIA SUPPLEMENTAL DATA SHEET

MONITORING PERIOD

YEAR MO DAY			YEAR MO DAY
FROM		TO	

Select the current daily maximum limit	☐ 349 MPN/100 ml (E.coli) ☐ 104 MPN/100 ml (Enterococci) ☐ 501 MPN/100 ml (Enterococci) ☐ 43 MPN/100 ml (Fecal coliform)

1. Report data and sample time for daily maximum bacteria value greater than the permitted limitation.

Sample Result (MPN/100 ml) §	Sample Date (mm/dd/yyyy)	Sample Time (24 Hr. Format)	Parameter
	/ /	: hrs	☐ E.coli ☐ Enterococci ☐ Fecal coliform

§ Sample result above must be less than or equal to 800 MPN/100 ml for E. coli and Enterococci or less than or equal to 200 MPN/100 ml for Fecal Coliform to use this form.

2. Two additional bacterial samples collected within 48 hours of the original sample result (of item #1) that exceeded the daily maximum limitation.

Sample Number	Sample Result (MPN/100 ml)	Sample Date (mm/dd/yyyy)	Sample Time (24 Hr. Format)	Parameter
1.		/ /	: hrs	☐ E.coli ☐ Enterococci ☐ Fecal coliform
2.		/ /	: hrs	☐ E.coli ☐ Enterococci ☐ Fecal coliform

The two additional sample results in item #2, do not exceed the daily maximum bacteria limits in the permit and were collected within 48-hours of the original sample result of item #1.

☐ Yes ☐ No*

3. Report the total number of bacterial samples collected in the previous twelve months: _____
(If requested, this data must be provided to the Department to verify this information)

4. Choose one of the following:

a. ☐ The number from item #3 above is less than 120; and no more than one (1) bacterial sample exceeded the daily maximum limit in the previous twelve (12) months, and that value is identifed in item #1 above.

b. ☐ The number in item #3 above is 120 samples or more, and no more than four (4) individual bacterial samples exceeded the daily maximum limit in the previous twelve (12) months, and those values were:

Sample Number	Sample Result (MPN/100 ml)	Sample Date (mm/dd/yyyy)	Parameter
1.	Same as Item #1 above	Same as Item #1 above	Same as Item #1 above
2.		/ /	☐ E.coli ☐ Enterococci ☐ Fecal coliform
3.		/ /	☐ E.coli ☐ Enterococci ☐ Fecal coliform
4.		/ /	☐ E.coli ☐ Enterococci ☐ Fecal coliform

c. ☐ Neither (a) **nor** (b) above is true*.

5. The following statements are true:
   a. The disinfection equipment and wastewater solids handling system were fully functional and operating during this monitoring period.
   b. There is neither an existing Consent Order nor Adminstrative Order is associated with the facility's operation of this disinfection system.
   c. The laboratory data included with this report is sufficiently sensitive to accurately represent the effluent bacteria concentrations. No values for the monitoring period were reported as ">" greater than.

* If you check any of the starred boxes or if statements 5(a), (b) or (c) are not true, you cannot use this form.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Name: _____

Signature: _____ Date: _____

Note: The bacteria supplemental data sheets are required only in the event the permittee reports bacteria data under Part III.A.12.

RATIONALE

Permitting Engineer: Weijia Hu
Name of Facility: Mt. Pleasant Waterworks/RRR-CS WWTP
NPDES Permit No.: SC0040771

Date: April 26, 2018

Facility Rating: ☒ Major ☐ Minor

☐ Issuance (New) ☒ Reissuance ☐ Modification ☐ Expansion of existing facility

Facility Description (include SIC code): 4952(SIC)
Facility Location: 1619 Rifle Range Road, Mount Pleasant, SC 29464, South Carolina.
County: Charleston
Watershed: Select One

Permit based on NPDES Permit Application: 2A
Application Received Date: 09/01/2012

If this application is for a new or expansion of an existing facility, is the anti-degradation assessment completed, per the requirements of R.61-68.D: N/A

Number of Outfalls: 1
For Outfall 005 Effluent Comprised of: Domestic WW

Receiving Water: Charleston Harbor
Receiving Water Classification (see R.61-68 for receiving water uses): Salt Water (SB)

Discharge to Impaired Waters: Yes (see State 303(d) list for impaired waters: DO)

Has coordination with Shellfish Sanitation on SFH or SA/SB waters for existing uses been conducted? Yes

Is the discharge to a waterbody or for a parameter listed in an approved TMDL? Yes
If Yes, list the parameter(s) for which the TMDL is written and the waterbody segments impacted: DO

Does any discharge have the potential to affect a threatened or endangered species? No

Enter the appropriate Design Flow: (Q_d) (MGD): 14.3

EPA review of the draft permit is required if any box below is checked (Mark all that apply)

☒ Major permits (POTW 1.0 MGD or more)
☐ Minor permits (Private facility with average discharge 0.5 MGD or greater)
☐ Permits with discharges which may adversely affect the waters of another State (Coordination with the other State is also required)
List State and name of waterbody(ies) that reach affected state: NA
☐ Permits with site-specific limits for any parameter(s)
List parameters with site-specific limits:
☐ Priority permits
☐ Modification(s) to any permit listed above or a modification that changes a permit to put it into one of the above categories (where it previously was not)
☐ Modification to any permit where the schedule of compliance interim dates are extended more than once

Stream Data from Wasteload Allocation dated (04/23/2018)

Receiving Stream Flow Data:

7Q10 at discharge point (Q_{7Q10})	12600.000 cfs	8129.032 mgd
Average Annual Flow at discharge point (AAF_d)	18200.000 cfs	11741.935 mgd

This outfall does not have the potential to affect an existing or proposed surface water drinking water source or any state-approved source water protection area (SWPA). Additional information on source water protection is provided in sections II.B and G of this rationale.

Map showing the SW P area and the discharge point included: No

7Q10 at source water protection area boundary (Q_{7Q10i})	N/A cfs	N/A mgd
Average Annual Flow at source water protection area boundary (AAF_i)	N/A cfs	N/A mgd

Data from Discharge Monitoring Reports (DMRs) and NPDES permit application (including all subsequent data presented) from 10/01/2013 – 03/31/2013 has been used to evaluate permit limitations.

I. GENERAL INFORMATION

A. The effluent from this facility may be subject to the requirements of any of the following regulations: R.61-68, R.61-69, R.61-9.122, 124, 125, 129, 133, and 403; 40 CFR Part 136; Subchapter N (40 CFR Parts 400 through 402 and 404 through 471); and R.61-9.503, 504 and 505..

B. Authority: This permit is written in accordance with applicable laws and regulations including, but not limited to, Regulation 61-9, Regulation 61-68, Pollution Control Act and Clean Water Act.

C. Under R.61-9.124.8 (Fact Sheet), a fact sheet shall be prepared for every draft permit for a major NPDES facility or activity, for every Class I sludge management facility, for every NPDES draft permit that incorporates a variance or requires an explanation under section 124.56(b), and for every draft permit which the Department finds is the subject of wide-spread public interest or raises major issues. The Rationale will be included as an attachment to the Fact Sheet prepared under this regulation.

D. The conclusions noted in the Rationale establish proposed effluent limitations and permit requirements addressed in R.61-9.122.43 (Establishing Permit Conditions), R.61-9.122.44 (Establishing Limitations, Standards and other permit conditions) and other appropriate sections of R.61-9.

II. RATIONALE GUIDANCE PROCEDURES

A. The receiving waterbody 7Q10, annual average flow or other critical flow condition at the discharge point, and 7Q10, annual average flow, or other critical flow condition for source water protection are determined by the SCDHEC's Wasteload Allocation Section. The 7Q10, Annual Average Flow or other critical flow conditions are based on information published or verified by the USGS, an estimate extrapolation from published or verified USGS data or from data provided by the permittee.These flows may be adjusted by the Wasteload Allocation Section to account for existing water withdrawals that impact the flow. The 7Q10 (or 30Q5 if provided by the applicant), annual average flow at the discharge point, or other critical flow condition or 7Q10 (or 30Q5 if provided by the applicant), annual average flow or other critical flow condition for source water protection for a proposed or existing surface water drinking water intake will be used to determine dilution factors, as appropriate, in accordance with R.61-68.C.4.a & 4.b for aquatic life, human health, and organoleptic effects respectively.

B. Water and organism consumption, drinking water MCLs data will be evaluated as human health values when calculating dilution factors. "The Department may, after Notice of Intent included in a notice of a proposed NPDES permit in accordance with Regulation 61-9.124.10, determine that drinking water MCLs or W/O shall not apply to discharges to those waterbodies where there is: no potential to affect an existing or proposed drinking water source and no state-approved source water protection area. For permitting purposes, a proposed drinking water source is one for which a complete permit application, including plans and specifications for the intake, is on file with the Department at the time of consideration of an NPDES permit application for a discharge that will affect or has the potential to affect the drinking water source." See R.61-68.E.14.c.(5).

The Department will implement this protection in NPDES permits using the source water protection program already developed for the drinking water program. A source water protection program was developed originally in 1999 to define the source water protection areas for each drinking water intake. The program was designed to identify source water protection areas (SWPAs) to aid drinking water systems in identifying sources of potential contamination that could affect their intakes. In September 2009, this program was modified to redefine the SWPAs as smaller, more manageable areas. The revised document developed in September 2009 is entitled "South Carolina Drinking Water Source Assessment and Protection Program." For the purposes of NPDES permitting, the SWPA referred to in Regulation 61-68.E.14.c(5) is the Primary Protection Area defined in the revised assessment and protection document. More information regarding the use of these protection areas is provided later in this rationale with the discussion of the procedure for establishing permit limits in Section G.2

C. Application of numeric criteria to protect human health: If separate numeric criteria are given for organism consumption, water and organism consumption (W/O), and drinking water Maximum Contaminant Levels

(MCLs), they shall be applied as appropriate. The most stringent of the criteria shall be applied to protect the existing and classified uses of the waters of the State. See R.61-68.E.14.b.(1).

D. Numeric criteria have been established in R.61-68 based on organoleptic data (prevention of undesirable taste and odor). For those substances which have aquatic life and/or human health numeric criteria and organoleptic numeric criteria, the most stringent of the three shall be used for derivation of permit effluent limitations. See R.61-68.E.13.

E. Sampling Frequency: Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. Monitoring results must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in the permit (R.61-9.122.41). Typically requirements to report monitoring results shall be established on a case-by-case basis with a frequency dependent on the nature and effect of the discharge but in no case less than once a year (R.61-9.122.44)

F. Compliance Schedules:

1. A person issued an NPDES permit by the Department who is not in compliance with applicable effluent standards and limitations or other requirements contained therein at the time the permit is issued, shall be required to achieve compliance within a period of time as set forth by the Department, with effluent standards and limitations, with water quality standards, or with specific requirements or conditions set by the Department. The Department shall require compliance with terms and conditions of the permit in the shortest reasonable period of time as determined thereby or within a time schedule for compliance which shall be specified in the issued permit.

2. If a time schedule for compliance specified in an NPDES permit which is established by the Department, exceeds nine (9) months, the time schedule shall provide for interim dates of achievement for compliance with certain applicable terms and conditions of the permit. (R.61-9.122.47)

G. Procedure for establishing effluent limitations:

1. Effluent limits (mass and concentration) for Five day Biochemical Oxygen Demand (BOD_5), Ultimate Oxygen Demand (UOD), Dissolved Oxygen (DO), Total Ammonia Nitrogen (as N), and Nutrients are established by the WLA Section, with consideration given to technology-based limitations.

a. Five day Biochemical Oxygen Demand BOD_5, Ultimate Oxygen Demand (UOD), Dissolved Oxygen (DO):

Effluent limits for conventional oxygen demanding constituents (BOD_5, UOD and DO) are established to protect in-stream water quality and uses, while utilizing a portion of the assimilative capacity of the receiving water. The ability of a water body to assimilate oxygen-demanding substances is a function of its physical and chemical characteristics above and below the discharge point. Various mathematical techniques, called models, have been developed to estimate this capacity. The Department follows the procedures as outlined in the "State/EPA Region IV Agreement on the Development of Wasteload Allocations/Total Maximum Daily Loads and NPDES Permit Limitations" dated October 30, 1991 (as updated) for determining the assimilative capacity of a given water body. Mathematical models such as QUAL2E and QUAL2E-UNCAS are used in accordance with "Enhanced Stream Water Quality Models QUAL2E and QUAL2E-UNCAS: Documentation and Users Manual" (EPA/600/3-87/007; dated May 1987) as updated. BOD_5 limit based on the Wasteload Allocation is considered to be the monthly average limit. The weekly average limit is established by multiplying the monthly average limit by 1.50. This multiplier (1.50) is equal to the ratio between weekly average and monthly average BOD_5 limits for secondary treatment (R.61-9.133.102). For facilities subject to secondary treatment regulation the BOD_5 limits will be in accordance with Regulation R.61-9.133.102. These parameters will be identified in Part III of this rationale when they are applicable to the permit.

b. Total Ammonia Nitrogen (as N):

Ammonia limitations based on oxygen demand will be determined from modeling information as described above. These values will be used as monthly average derived limits and a weekly average will be determined by multiplying the monthly average derived limit by 1.50. These values will be compared with the ammonia water quality criteria for protection of aquatic life from Regulation 61-68, as shown below. The more stringent of the limitations will be imposed. Calculations for aquatic life criteria and other wasteload recommendations will be shown later in Part III of this rationale when ammonia is a pollutant of concern.

The following ammonia water quality limits are calculated using the references listed below:

Hampson, B.L., 1977. Relationship between total ammonia and free ammonia in terrestrial and ocean waters. J. Cons. int. Explor. Mer. 37(2): 117-122.

Hydroscience, 1971. Simplified Mathematical Modeling of Water Quality. Report prepared for EPA. 127 pp.

U.S. EPA, 1999. Update of Ambient Water Quality Criteria for Ammonia. EPA-822-R-99-014. Washington, DC. 147 pp.

U.S. EPA, 1989. Ambient Water Quality Criteria for Ammonia (Saltwater). EPA 440/5-88-004. Washington, DC. 59 pp.

Whitfield, M., 1974. The hydrolysis of ammonium ions in sea water—a theoretical study. J. Mar. Biol. Ass. U.K. 54: 565-580.

The thirty-day (monthly) average, and weekly average limits for Total Ammonia Nitrogen (as N) are calculated using the following equations:

Determining the Criterion Concentration:

Step 1: Calculate the molal ionic strength of the receiving water using Equation 3 from Hampson (1977):

$$I = 19.9273*S/(1000 - 1.005109*S)$$

Where S = salinity (g/kg or ppt)

Step 2: Calculate the negative log of the hydrolysis constant using the regression equation for Model B from the Appendix in Hampson (1977):

$$pK_a^S = 9.245 + 0.116*I.$$

Step 3: Calculate the percent un-ionized ammonia using the equation for FREAM3 in the seawater subroutine of Hampson's program:

$$\% \text{ UIA} = \text{FREAM3} = 100/[1 + 10\text{^}(pK_a^S + 0.0324*(298 - T) + 0.0415*P/T - pH)]$$

where T = temperature (K),
P = pressure (atm) = 1 atm (U.S. EPA, 1989)
pH = receiving water pH.

Step 4: Calculate the total ammonia CMC and CCC using the un-ionized ammonia CMC = 0.233 mg/L and CCC = 0.035 mg/L (U.S. EPA, 1989, p. 27) and the calculated % UIA:

total ammonia CMC (mg/L) = 0.233*100/% UIA, and

total ammonia CCC (mg/L) = 0.035*100/% UIA.

Step 5: Convert the total ammonia values to total ammonia nitrogen by multiplying by 14/17 (U.S. EPA, 1999, p. 107):

total ammonia nitrogen (mg N/L) = total ammonia (mg/L) * 14/17

Step 6: Calculate the discharge concentrations protecting against acute and chronic toxicity in the receiving water using the following equation. Simplified Mathematical Modeling (SMM) is used to estimate dilution (Hydroscience, 1971). The SMM equations are provided in the State/EPA Wasteload Allocation Agreement. The tidal river case (Case 1) is used here. The equation for the initial concentration of a non-conservative constituent is:

$$C_0 = \frac{25.5758 Q_d C_d}{AU\sqrt{1 + 4KE/U^2}}$$

where C_0 = initial concentration (mg N/L)
Q_d = discharge flow (MGD)
C_d = discharge concentration (mg/L)
A = channel cross section area (ft^2)
U = freshwater velocity (mi/day)
K = decay rate coefficient (1/day)
E = dispersion coefficient (mi^2/day)
25.5758= units conversion factor.

The equation is solved for the allowable discharge concentration, C_d, assuming values for the other parameters.

The most restrictive of either limits calculated to protect aquatic life or oxygen demand will be used. See Part III for description of the controlling limit.

Note: For receiving stream flow data, see table provided earlier.

c. Discharges of Nutrients:

In order to protect and maintain lakes and other waters of the State, consideration is given to the control of nutrients reaching the waters of the State. Therefore, in accordance with regulation R.61-68.E.11, the Department controls the nutrients as prescribed below. Nutrient limitations will be determined from the best available information and/or modeling performed by the Wasteload Allocation Section to meet these water quality standards.

i. Discharges of nutrients from all sources, including point and nonpoint, to waters of the State shall be prohibited or limited if the discharge would result in or if the waters experience growths of microscopic or macroscopic vegetation such that the water quality standards would be violated or the existing or classified uses of the waters would be impaired. Loading of nutrients shall be addressed on an individual basis as necessary to ensure compliance with the narrative and numeric criteria.

ii. Numeric nutrient criteria for lakes are based on an ecoregional approach which takes into account the geographic location of the lakes within the State and are listed below. These numeric criteria are applicable to lakes of 40 acres or more. Lakes of less than 40 acres will continue to be protected by the narrative criteria.

1. For the Blue Ridge Mountains ecoregion of the State, total phosphorus shall not exceed 0.02 mg/l, chlorophyll *a* shall not exceed 10 ug/l, and total nitrogen shall not exceed 0.35 mg/l.

2. For the Piedmont and Southeastern Plains ecoregions of the State, total phosphorus shall not exceed 0.06 mg/l, chlorophyll *a* shall not exceed 40 ug/l, and total nitrogen shall not exceed 1.50 mg/l.

3. For the Middle Atlantic Coastal Plains ecoregion of the State, total phosphorus shall not exceed 0.09 mg/l, chlorophyll *a* shall not exceed 40 ug/l, and total nitrogen shall not exceed 1.50 mg/l.

iii. In evaluating the effects of nutrients upon the quality of lakes and other waters of the State, the Department may consider, but not be limited to, such factors as the hydrology and morphometry of the waterbody, the existing and projected trophic state, characteristics of the loadings, and other control mechanisms in order to protect the existing and classified uses of the waters.

iv. The Department shall take appropriate action, to include, but not limited to: establishing numeric effluent limitations in permits, establishing Total Maximum Daily Loads, establishing waste load allocations, and establishing load allocations for nutrients to ensure that the lakes attain and maintain the above narrative and numeric criteria and other applicable water quality standards.

v. The criteria specific to lakes shall be applicable to all portions of the lake. For this purpose, the Department shall define the applicable area to be that area covered when measured at full pool elevation.

2. Effluent concentration limits (C_{efflim}) for pollutants other than the parameters listed in G.1 a-c above are established using the following procedures:

Following information to be used (where applicable) for establishing effluent concentration limits:

Q_{7Q10}	7Q10 of the receiving stream at the discharge point in mgd.
AAF_d	Stream Average Annual Flow (AAF) at the discharge point in mgd.
Q_{7Q10i}	7Q10 for the receiving stream at water treatment plant (WTP) intake downstream of the discharge in mgd.
AAF_i	Stream Average Annual Flow at water treatment plant (WTP) intake downstream of the discharge in mgd.
Q_d	Design Wastewater Treatment Plant Flow in mgd

a. Determine dilution factors:
The following information is to be used (where applicable) for establishing effluent concentration limits:

DF_1: Dilution factor based on 7Q10 of the receiving stream at the discharge point (Q_{7Q10}). This dilution factor is used to determine the derived limits for protection of the following aquatic life and human health concerns for the reasons indicated:

i. Aquatic Life (see R.61-68.C.4.a(1)). Protection of aquatic life on a short-term basis is needed at the point where aquatic organisms become exposed to the discharge.

ii. Human Health – Organism Consumption for parameters identified as non-carcinogens per R.61-68.C.4.b(1). Protection for human health on a short-term basis for consumption of aquatic organisms is needed at the point the aquatic organisms become exposed to the discharge.

$$DF_1 = \left(\frac{Q_{7Q10} + Q_d}{Q_d} \right)$$

DF_2: Dilution factor, at the discharge point, based on the Average Annual Flow of the receiving stream at the discharge point (AAF_d). This dilution factor is used to determine the derived limits for protection of the following aquatic life, human health and organoleptic concerns for the reasons indicated:

i. Human Health – Organism Consumption for parameters identified as carcinogens per R.61-68.C.4.b(1). Protection for human health on a long-term basis to prevent cancer due to consumption of aquatic organisms is needed at the point the aquatic organisms become exposed to the discharge.

ii. Organoleptic effects per R.61-68.C.4.b(1). Protection for taste and odor issues related to the discharge is needed at the point where the discharge enters the stream.

$$DF_2 = \left(\frac{AAF_d + Q_d}{Q_d} \right)$$

DF_3: Dilution factor based on the 7Q10 at the source water protection area boundary for protection of a proposed or existing water intake downstream of the discharge (Q_{7Q10i}). This dilution factor is used to determine the derived limits for protection of the following human health concerns for the reasons indicated:

i. Human Health – Water and Organism (W/O) Consumption for parameters identified as non-carcinogens per R.61-68.C.4.b(1) and E.14.c(5) to protect for short-term health effects when the discharge has the potential to affect a surface water drinking water intake. Protection of human health relative to drinking the water from the waterbody and consuming aquatic organisms from the same waterbody is provided by this criterion, but drinking the water withdrawn from the waterbody may require a higher level of protection in terms of applicable dilution than consumption of organisms.

ii. Human Health - Drinking Water Maximum Contaminant Level (MCL) for parameters identified as non-carcinogens per R.61-68.C.4.b(1) and E.14.c(5) to protect for short-term health effects when the discharge has the potential to affect a surface water drinking water intake. Protection of human health relative to drinking the water from the waterbody after conventional treatment per R.61-68.G is provided by this criterion

$$DF_3 = \left(\frac{Q_{7Q10i} + Q_d}{Q_d} \right)$$

DF_4: This dilution factor is based on the Average Annual Flow or other critical flow condition (AAF_i) for protection of a proposed or existing surface water drinking water intake that the discharge has the potential to affect. This dilution factor is used to determine the derived limits for protection of the following human health concerns for the reasons indicated:

i. Human Health–Water and Organism Consumption for parameters identified as carcinogens per R.61-68.C.4.b(1) and E.14.c(5) to protect for long-term health effects due to cancer when the discharge has the potential to affect a surface water drinking water intake. Protection of human health relative to drinking the water from the waterbody and consuming aquatic organisms from the same waterbody is provided by this criterion, but drinking the water withdrawn from the waterbody may require a higher level of protection in terms of applicable dilution than consumption of organisms.

ii. Human Health - Drinking Water Maximum Contaminant Level (MCL) for parameters identified as carcinogens per R.61-68.C.4.b(1) and E.14.c(5) to protect for long-term health effects due to cancer when the discharge has the potential to affect a surface water drinking water intake. Protection of human health relative to drinking the water from the waterbody after conventional treatment per R.61-68.G is provided by this criterion.

$$DF_4 = \left(\frac{AAF_i + Q_d}{Q_d} \right)$$

For both DF_3 and DF_4, to satisfy the mixing zone requirements of R.61-68.C.10(a) for both W/O and MCL criteria, the Department will use the following flows to determine dilution:

1. The following applies to discharges and intakes in flowing rivers:

   a. Where the discharge is within the SWPA (15 river miles) of the intake, the flow at the 15-river mile boundary of the tributary with the largest applicable critical flow will be used.

   b. Where the discharge is outside the SWPA (15 river miles) of the intake, the applicable critical flow at the intake will be used.

2. When the discharge is either in the tributary to a lake or in a lake and the intake is in the same lake that does not behave as a run-of- river impoundment*, the flow is determined using the sum of the applicable critical flows of all tributaries entering the lake.

3. The following applies when both the discharge and the intake are in a lake arm that behaves as a run-of-river impoundment*:

   a. Where the discharge is within the SWPA (15-mile buffer which may include both lake and river miles) of the intake, the flow at the 15-mile boundary of the tributary with the largest applicable critical flow will be used.

   b. Where the discharge is outside the SWPA (15-mile buffer which may include both lake and river miles) of the intake, the applicable critical flow at the intake will be used.

4. Where the discharge is in the arm of a lake and the intake is in the upper reach of another arm of the lake, no protection of W/O or MCL criteria is needed because the discharge does not have the potential to affect the intake,

5. If the discharge has the potential to affect multiple intakes, the SWPA of the intake closest to the discharge will be protected. However, the permittee may be required to provide notification to all potentially affected intakes.

6. When the discharge is in a tidally influenced waterbody, the flow may be determined on a case-by-case basis and the 7Q10 and AAF for source water protection will be specified [and may not use the 15 mile buffer listed above]. The determination of the source water protection area will be made using available data and taking into consideration tidal conditions.

*** Run-of-river impoundment is defined as a lake or reservoir (or arm of a lake or reservoir) that is narrow and/or shallow offering little dilution or delay in contaminant flow toward an intake.**

Dilution Factors (using formulas above):

DF_1	569.5
DF_2	822.1
DF_3, if applicable	NA
DF_4, if applicable	NA

b. Determine monthly average derived limits using the following procedures:

WQS_{al} Saltwater Standard (based on an established criteria or other published data per R.61-68), for protection of Aquatic Life; may be a CCC or CMC as defined below

WQS_{org} Saltwater Standard (based on an established criteria or other published data per R.61-68), for protection of Human Health – Organism Consumption

WQS_{wo} Saltwater Standard (based on an established criteria or other published data per R.61-68), for protection of Human Health – Water & Organism Consumption.

WQS_{mcl} Saltwater Standard (based on an established criteria or other published data per R.61-68), for Drinking Water MCL (Maximum Contaminant Level).

WQS_{ol}: Saltwater Standard (based on an established criteria or other published data per R.61-68), based on Organoleptic Data.

C_{aqlife} Concentration limit derived from aquatic life data

C_{HH} Concentration limit derived from human health data as determined from organism (C_{org}), water/organism (C_{wo})and MCL (C_{mcl}) data

C_b The background concentration of the concerned parameter in mg/l is typically determined from ambient monitoring data or data provided by applicant. If the waterbody to which the discharge flows is not on the 303(d) list, the 90th percentile of ambient monitoring data for aquatic life protection for the parameters identified in the Appendix (Water Quality Numeric Criteria) to Regulation 61-68 from the last 3 years, or whatever is available if less than 3 years, will typically be used. If the waterbody to which the discharge flows is not on the 303(d) list, the median value of ambient monitoring data for human health protection for the parameters identified in the Appendix (Water Quality Numeric Criteria) to Regulation 61-68 from the last 3 years, or whatever is available if less than 3 years, will typically be used. The background concentration is assumed to be zero (0) in the absence of actual data based on Departmental guidance and EPA recommendation.

C_{ol} Concentration limit derived from organoleptic data

i. Determine the derived limit for protection of Aquatic Life (C_{aqlife})

1. The following guidelines apply to determining aquatic life limits using this basic equation:

$$C_{aqlife} = (DF_1 \times WQS_{al}) - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

a Typically, the Criterion Maximum Concentration (CMC) is applied as a daily maximum derived limit and the Criterion Continuous Concentration (CCC) is applied as a monthly average derived limit, after consideration of dilution and background concentrations. Exceptions exist based on EPA criteria and are indicated for specific parameters. The CMC and CCC for specific metals will be adjusted using the procedures in 60 FR 22229, "Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance-Revision of Metals Criteria," May 4, 1995 and the "Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria," Oct. 1, 1993 and applied as a daily maximum and monthly average, respectively, after consideration of dilution and background concentrations. For specific metals, this calculation is explained in detail later in this rationale.

monthly average = C_{aqlife} using CCC as WQS_{al}
daily maximum = C_{aqlife} using CMC as WQS_{al}

b. If only a CMC exists for a particular parameter, the daily maximum derived permit limit will be set using that value, after consideration of dilution and background concentrations. If no other values (e.g., human health) exist for that parameter on which to base a monthly average limit and the discharge is continuous, the monthly average will be set equal to the daily maximum to satisfy Regulation 61-9.122.45(d). In no case shall the monthly average limit be set higher than the daily maximum limit. If only a CCC is given, it will be used as a monthly average derived limit and the daily maximum derived limit will be two (2) times the value obtained for the monthly average based on a simplified statistical procedure for determining permit limits recommended in Section 5.4.2 of the US EPA's "Technical Support Document for Water Quality-based Toxics Control", EPA/505/2-90-001, March 1991 (hereafter known as the TSD).

If a CCC exists and no CMC exists and no other acute or chronic data exists, the aquatic life limits are

monthly average = C_{aqlife} using CCC as WQS_{al}
daily maximum = 2 x C_{aqlife}

If a CMC and no CCC exists, and no other acute or chronic data exists, the aquatic life limits are

monthly average = C_{aqlife} using CMC as WQS_{al}
daily maximum = C_{aqlife} using CMC as WQS_{al}

c. If only an acute toxicity effect concentration for a number of species for a particular pollutant is given as an LC_{50}, the lowest concentration should be divided by an acute-to-chronic ratio (ACR) of 10 and a sensitivity factor of 3.3, for an acceptable instream concentration in order to protect against chronic toxicity effects (from R.61-68.E.16.a(1)). Other acute toxicity data will be handled similarly. The value obtained from this calculation will be used as a monthly average derived limit after consideration of dilution and background concentrations. The daily maximum will be two (2) times the value obtained for the monthly average based on a simplified statistical procedure for determining permit limits recommended in Section 5.4.2 of the TSD considering an assumed coefficient of variation (CV) of 0.6 and 95th percentile occurrence probability.

monthly average = C_{aqlife} using other data as WQS_{al}
daily maximum = 2 x C_{aqlife}

d. If a chronic toxicity effect concentration for a number of species for a particular pollutant is given as a no observed effect concentration (NOEC), the lowest concentration should be divided by a sensitivity factor of 3.3 in order to protect against chronic toxicity to the most sensitive species (from R.61-68.E.16.a(2)). Other chronic toxicity data will be handled similarly. The value obtained from this calculation will be used as a monthly average derived limit after consideration of dilution and background concentrations. The daily maximum will be two (2) times the value obtained for the monthly average based on a simplified statistical procedure for determining permit limits recommended in Section 5.4.2 of the TSD considering an assumed coefficient of variation (CV) of 0.6 and 95th percentile occurrence probability.

monthly average = C_{aqlife} using other data as WQS_{al}
daily maximum = 2 x C_{aqlife}

e. If both acute and chronic data are available for a particular pollutant, monthly average derived limits will be calculated as in (c) and (d) above for each acute and chronic, respectively. The more stringent of the monthly average derived limits will be the monthly average derived limit used after consideration of dilution and background concentrations. The daily maximum will be two (2) times the value obtained for the monthly average based on a simplified statistical procedure for determining permit limits recommended in Section 5.4.2 of the TSD considering an assumed coefficient of variation (CV) of 0.6 and 95th percentile occurrence probability.

monthly average = C_{aqlife} using other data as WQS_{al}
daily maximum = 2 x C_{aqlife}

2. Consider the background concentration (C_b) of the parameter of concern. If the background concentration is equal to or greater than the applicable standard (*WQS*, as defined above) for the parameter of concern, then the derived concentration limit (C_{aqlife}) for that parameter is established equal to the standard (*WQS*) so that no additional amount of that pollutant is added to the waterbody. An exception exists where the naturally occurring instream concentration for a substance is higher than the derived permit effluent limitation. In those situations, the Department may establish permit effluent limitations (C_{efflim}) at a level higher than the derived limit, but no higher than the natural background concentration (i.e. a "rise above background" limit). In such cases, the Department may require biological instream monitoring and/or whole effluent toxicity (WET) testing (R.61-68.E.14.c(2)).

   If C_b is not based on naturally occurring concentrations and

   $$C_b \geq WQS$$

   Then

   $$C_{aqlife} = WQS.$$

   If C_b is based on naturally occurring concentrations and

   $$C_b \geq WQS$$

   Then

   $$C_{aqlife} < C_{eff\ lim} \leq C_b.$$

3. So that metals in saltwater may be expressed in terms of total recoverable metal as required by R.61-9.122.45(c), the saltwater CCC and CMC will be used in the calculation of limits for all other parameters not included in paragraph 2 above. Monthly average derived limits (C_{aqlife}) for aquatic life protection are calculated as follows:

   $$C_{aqlife} = (DF_1 \times WQS_{al}) - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

4. Where a Water Effects Ratio (WER) is used to adjust a criterion, derived limits for the adjusted aquatic life criterion ($C_{aqlife\text{-}adj}$) are calculated as follows. The WER is a type of site-specific permit effluent limit (as allowed by R.61-68.E.14.c(7)) derived using a ratio determined from EPA methodology. Both DHEC and EPA must approve the WER prior to implementation. See EPA's 1994 "Interim Guidance on the Determination and Use of Water-Effect Ratios (WERs) for Metals." The approved WER will be shown in the water quality spreadsheets on the Data sheet. The revised aquatic life value will be shown with the WER, hardness and dissolved metals adjustments, as appropriate, in the aquatic life columns on the Pollutant spreadsheet.

   a. For metals identified in #3 above, revise the equation for S as follows:

      S = [CCC or CMC (adjusted for hardness)] x WER

   Follow the remaining calculations in #2 above to get an adjusted C_{aqlife} value that will be used to determine derived limits:

   monthly average = $C_{aqlife\text{-}adj}$ based on CCC
   daily maximum = $C_{aqlife\text{-}adj}$ based on CMC

b. For other parameters, use the appropriate equation in #1 above to derive an adjusted C_{aqlife} value. The monthly average will be calculated as follows using the appropriate WQS_{al} and the daily maximum calculated using the appropriate equations in #1 above.

$$C_{aqlife-adj} = (DF_1 \times WQS_{al} \times WER) - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

5. Where the Recalculation Procedure is used to adjust a criterion, derived limits for the adjusted aquatic life criterion ($C_{aqlife-adj}$) are calculated as follows. The Recalculation Procedure is intended to cause a site-specific criterion to appropriately differ from the State-adopted national aquatic life criterion if justified by demonstrated pertinent toxicological differences between the aquatic species that occur at the site and those that were used in the derivation of the criterion. It is important to note that the site (the portion of the waterbody or watershed being affected) must be clearly defined. This procedure is used to develop site-specific criteria in accordance with R.61-68.C.12. Both DHEC and EPA must approve the recalculated criterion prior to implementation.

   The approved recalculated aquatic life criteria (*SS*-CCC and *SS*-CMC, as appropriate) will be shown adjusted for hardness on the Data spreadsheet. The additional dissolved metals adjustments, as appropriate, will be shown in the aquatic life columns on the Pollutant spreadsheet. If the parameter being adjusted is one of the metals in #2 above, SS will include all the appropriate metals adjustments.

$$C_{aqlife-adj} = (DF_1 \times SS - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

   monthly average = $C_{aqlife-adj}$ based on CCC
   daily maximum = $C_{aqlife-adj}$ based on CMC

6. Where a WER and recalculation procedure are combined to adjust a criterion, derived limits ($C_{aqlife-adj}$) for aquatic life protection are calculated by combining the calculations in #3 and #4.

$$C_{aqlife-adj} = (DF_1 \times SS \times WER) - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

   monthly average = $C_{aqlife-adj}$ based on CCC
   daily maximum = $C_{aqlife-adj}$ based on CMC

7. Other scientifically defensible methods for developing site-specific aquatic life effluent limits or site-specific criterion may be used on a case-by-case basis.

ii. Determine derived limit for protection of Human Health

1. The following guidelines apply to determining human health limits:

   a. The human health criterion given by Regulation 61-68 will be applied as a monthly average derived limit after consideration of dilution and background concentrations (C_{HH-avg}). Exceptions exist based on EPA criteria and are indicated for specific parameters. No limits on human health based on water and organism consumption or drinking water MCLs will be imposed if there is no potential to affect a drinking water intake or source water protection area (i.e., if there is no intake downstream of the discharge).

   b. The daily maximum permit limit will be determined from the monthly average derived value from (a) above and a multiplier (*M*) determined using a statistical procedure recommended in Section 5.5 using average = 95th percentile from Table 5-3 in the TSD. The permitted or proposed number of samples per month (n) is used with the coefficient of variation (CV) to determine *M*. CV is assumed to be 0.6 as a default value if information is not known.

$$M = \frac{e^{(Z_m\sigma - 0.5\sigma^2)}}{e^{(Z_a\sigma_n - 0.5\sigma_n^2)}}$$

where:

$$\sigma_n^2 = \ln\left(\frac{CV^2}{n} + 1\right)$$

$$\sigma^2 = \ln\left(CV^2 + 1\right)$$

CV = coefficient of variation of the effluent concentration. For a data set where n>10, the CV is calculated as standard deviation divided by mean for the data set being evaluated. For data set where n<10, the CV is estimated to equal 0.6. For less than 10 items of data, the uncertainty in the CV is too large to calculate a standard deviation or mean with sufficient confidence.n = the number of effluent samples per month, (where frequency is less than 1/month, n =1)

z_m = the percentile exceedance probability for the daily maximum permit limit (=2.326 for 99th percentile basis)

z_a = the percentile exceedance probability for the monthly average permit limit (=1.645 for 95th percentile basis)

$C_{HH\text{-}max} = M * C_{HH\text{-}avg}$

2. Consider the background concentration (C_b) of the parameter of concern. If the background concentration is equal to or greater than the applicable standard (WQS, as defined above) for the parameter of concern, then the derived concentration limit (C_{HHe}) for that parameter and for the protection of that standard is established equal to the standard (WQS). An exception exists where the naturally occurring instream concentration for a substance is higher than the derived permit effluent limitation. In those situations, the Department may establish permit effluent limitations (C_{efflim}) at a level higher than the derived limit, but no higher than the natural background concentration (i.e. a "rise above background" limit). In such cases, the Department may require biological instream monitoring and/or whole effluent toxicity (WET) testing (See R.61-68.E.14.c(3)).

   If C_b is not based on naturally occurring concentrations and

   $$C_b \geq WQS$$

   Then, generally,

   $$C_{HH} = WQS.$$

   If C_b is based on naturally occurring concentrations and

   $$C_b \geq WQS$$

   Then, generally,

   $$C_{HH} < C_{eff\ lim} \leq C_b.$$

3. Human Health – Organism Consumption (C_{org}).

   a. For Carcinogens
   The Monthly Average is calculated as follows:

   $$C_{org} = (DF_2 \times WQS_{org}) - \left\{C_b \times \left(\frac{AAF_d}{Q_d}\right)\right\}$$

The Daily Maximum is calculated as

$$C_{org\text{-}max} = M * C_{org}$$

b. For Non-carcinogens
The Monthly Average is calculated as follows:

$$C_{org} = (DF_1 \times WQS_{org}) - \left\{ C_b \times \left(\frac{Q_{7Q10}}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$$C_{org\text{-}max} = M * C_{org}$$

4. Human Health – Water and Organism Consumption (C_{wo})

a. For Carcinogens
The Monthly Average is calculated as follows:

$$C_{wo} = (DF_2 \times WQS_{wo}) - \left\{ C_b \times \left(\frac{AAF_i}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$$C_{wo\text{-}max} = M * C_{wo}$$

b. For Non-carcinogens
The Monthly Average is calculated as follows:

$$C_{wo} = (DF_1 \times WQS_{wo}) - \left\{ C_b \times \left(\frac{Q_{7Q10i}}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$$C_{wo\text{-}max} = M * C_{wo}$$

5. Human Health – Drinking Water Maximum Contaminant Level (MCL) (C_{mcl}).

a. For Carcinogens
The Monthly Average is calculated as follows:

$$C_{mcl} = (DF_4 \times WQS_{mcl}) - \left\{ C_b \times \left(\frac{AAF_i}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$$C_{mcl\text{-}max} = M * C_{mcl}$$

b. For Non-carcinogens
The Monthly Average is calculated as follows:

$$C_{mcl} = (DF_3 \times WQS_{mcl}) - \left\{ C_b \times \left(\frac{Q_{7Q10i}}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$$C_{mcl\text{-}max} = M * C_{mcl}$$

6. Human Health - Organoleptic criteria (C_{ol}).

The Monthly Average is calculated as follows:

$$C_{ol} = (DF_2 \times WQS_{ol}) - \left\{ C_b \times \left(\frac{AAF_d}{Q_d} \right) \right\}$$

The Daily Maximum is calculated as

$C_{ol\text{-}max} = M * C_{ol}$

iii. Parameters given in a wasteload allocation for oxygen-demanding pollutants and nutrients will be limited as

monthly average = C_{wla}
weekly average = 1.50 x C_{wla} (for POTW)
daily maximum = 1.50 x C_{wla} (for private facilities)

c. Determine most stringent of applicable water quality data using the monthly average derived limits determined or calculated above:

monthly average C_{efflim} = minimum of derived monthly averages (C_{aqlife}, C_{org}, C_{wo}, C_{mcl}, C_{ol}, C_{wla})
daily maximum C_{efflim} = minimum of derived daily maximums (C_{aqlife}, $C_{org\text{-}max}$, $C_{wo\text{-}max}$, $C_{mcl\text{-}max}$, $C_{ol\text{-}max}$, $C_{wla\text{-}max}$)

d. Determine whether the discharge causes, has the reasonable potential to cause or contributes to a water quality violation

Regulation 61-9.122.44(d)(1)(i) states: "Limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Department determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality."

When determining whether a discharge causes, has the reasonable potential to cause or contributes to an instream excursion, the Department will use procedures which account for controls on point and nonpoint sources of pollution, the variability of the pollutant in the effluent, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and, where appropriate, the dilution of the effluent in the receiving water (R.61-9.122.44(d)(1)(ii)).

Based on the above statements, there are three scenarios when limitations are required, as follows:

i. When data provided by the permit applicant indicates discharge values greater than the proposed limitation derived above, that discharge may <u>cause</u> an excursion above a narrative or numeric water quality criterion.

ii. A discharge will be determined to <u>contribute</u> to an excursion of a water quality criterion when the waterbody is impaired (e.g., on the 303(d) list) for the parameter of concern and that parameter is also being discharged.

iii. <u>Reasonable potential to cause</u> a water quality violation is determined using the following information:

Chapter 3 of the TSD provides information for determining the need for permit limits based on the regulatory statements above. A statistical procedure is also presented in Chapter 3 for use in determining reasonable potential from effluent data. "National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-Based Effluent Limitations Set Below Analytical Detection/Quantitation Level" draft dated March 22, 1994, offers recommendations on how to interpret data below detection capabilities to make a reasonable potential analysis.

All pollutants given in a wasteload allocation or an effluent limitation guideline will be limited in the permit.

When effluent data consists of non-quantifiable/non-detectable values or when no effluent data is available, other factors and information are considered to determine reasonable potential. In situations where a pollutant is known to be present in the wastestream (due to production data or other information), we know it is being discharged and has the potential to impact even though it may not be quantifiable. The fact that it is present will be enough information to say reasonable potential exists for that pollutant. Therefore, a reasonable potential decision is based on various data and information, and not just non-quantifiable/non-detectable data. Consideration is given to existing data, dilution in the stream, type of receiving water, designated use, type of industry/wastestream, ambient data, history of compliance, and history of toxic impact. If any source of information indicates reasonable potential to cause, or contribute to an exceedance of the water quality standard, a water quality limit will be developed.

Note: The result of the following calculations may indicate that reasonable potential does not exist. However, as stated above, other information may "override" this numerical determination to justify the need for a limit.

1. The procedure for determining reasonable potential from actual effluent data is explained in Box 3-2 on page 53 of the TSD. Multiplying factors are determined from Table 3-2 at a 95% confidence level and 95% probability in Section 3.3.2. The following describes the procedures used for determining reasonable potential for chemical-specific parameters, under certain circumstances.

Step 1: Data Analysis: The statistical calculations involved in the "Reasonable Potential" analysis require discrete numerical data. The following describes how the effluent data will be used in determining reasonable potential.

Actual analytical results should be used whenever possible. Results less than detection and quantification should be used as follows:

a. If the permittee reports results below the practical quantitation limit (PQL) (as defined by the permit), then the reported "less than PQL" value for a given sample is assumed to be zero.

b. If the permittee uses a detection/quantification level that is **greater** than the PQL, then the reported "less than" value for a given sample is assumed to be a discrete value equal to the detection/quantification level used by the permittee.

c. If the reported data consists of both discrete and non-discrete values and/or the data is reported using varying detection/quantification levels, then a combination of the above two approaches is used, or the data is evaluated in a manner that is most appropriate for that data set.

Note: For information on the acceptable analytical methods and practical quantitation limits (PQL) please refer to NPDES permit application supplement "Practical Quantitation Limits (PQL) and Acceptable Analytical Methods" dated July 2001

Step 2: Using data from the permit application, other data supplied by the applicant and/or Discharge Monitoring Report (DMR) data, determine the total number of observations (n) for a particular set of effluent data and determine the highest value (C_{max}) from that data set. For the monthly average comparison, the data set will include monthly average results and n will be the number of months in which they sampled in the time period being evaluated. When there is also a daily maximum comparison, the data set will include daily maximum results and n will be the total number of samples in the time period being evaluated. Individual results may not necessarily be used in the calculation

Step 3: Determine the coefficient of variation (*CV*) for the data set. For a data set where $n>10$, the *CV* is calculated as standard deviation divided by mean for the data set being evaluated. For data set where $n<10$, the *CV* is estimated to equal 0.6. For less than 10 items of data, the uncertainty in the *CV* is too large to calculate a standard deviation or mean with sufficient confidence.

$$CV = 0.6 \quad \text{for} \quad n < 10$$

$$CV = \frac{\sigma}{\mu} \quad \text{for} \quad n > 10$$

where: σ = Standard Deviation of the samples
μ = Mean of the samples

Step 4: Determine the appropriate multiplying factor (*MF*) from either Table 3-2 or using the formulae in Section 3.3.2 of the TSD.

a. Determine the percentile represented by the highest concentration in the sample data.

$$p_n = (1 - Confidence\ Level)^{1/n}$$

where: p_n = Percentile represented by the highest concentration in the data
n = number of samples
Confidence Level = 0.95 i.e. 95%

b. Determine the multiplying factor (*MF*), which is the relationship between the percentile described above (C_p) and the selected upper bound of the lognormal effluent distribution, which in this case will be the 95th percentile (C_{95}).

$$MF = \frac{C_{95}}{C_p} = \frac{e^{(Z_{95}\sigma + 0.5\sigma^2)}}{e^{(Z_p\sigma + 0.5\sigma^2)}}$$

where: Z_{95} is the standardized Z-score for the 95th percentile of the standardized normal distribution = 1.645

Z_p is the standardized Z-score for the pth percentile of the standardized normal distribution.(determined in (b) above)

Note: The values of Z-scores are listed in tables for the normal distribution. If using Microsoft® Excel, this can be calculated using the NORMSINV function.

$$\sigma^2 = \ln(CV^2 + 1)$$

$$\sigma = \sqrt{\ln(CV^2 + 1)}$$

Step 5: Multiply the highest value from the data set (C_{max}) by the multiplying factor (*MF*) determined in Step 4 to obtain the maximum receiving water concentration (*RWC*).

$$RWC = C_{max} \times MF$$

Step 6: *RWC* ≤ Derived monthly average limit (C_{leffim}) implies that a reasonable potential does not exist.

RWC > Derived monthly average limit (C_{effim}) implies that a reasonable potential exists.

H. Other considerations

1. When the derived permit effluent limitation based on aquatic life numeric criteria is below the practical quantitation limit for a substance, the derived permit effluent limitation shall include an accompanying statement in the permit that the practical quantitation limit using approved analytical methods shall be considered as being in compliance with the limit. Appropriate biological monitoring requirements shall be incorporated into the permit to determine compliance with appropriate water quality standards. (R.61-68.E.14.c(2))

2. When the derived permit effluent limitation based on human health numeric criteria is below the practical quantitation limit for a substance, the derived permit effluent limitation shall include an accompanying statement in the permit that the practical quantitation limit using approved analytical methods shall be considered as being in compliance with the limit. (R.61-68.E.14.c(3)).

   Note 1: The effluent concentration limits determined above may not necessarily be the NPDES permit limit. NPDES Permit limits are determined after a reasonable potential analysis is conducted using these derived limits and also after evaluating other issues (e.g. anti-backsliding, categorical standards).

   Note 2: Mass limitations may be required in certain circumstances. When mass limits are calculated the formula to be used is as follows:

   *Mass (lb/day) = Flow (mgd) * Concentration (mg/l) * 8.34*

3. Fecal Coliform and Enterococci (if applicable): Effluent Limits for Fecal Coliform and Enterococci (if applicable) are established in accordance with Regulation R.61-68.E.14.c.9. See Part III below for specific limits. To protect Class SA, SB and SFH waters, the limits for Enterococci (if applicable) are subject to EPA Region IV's conditional approval concerning implementation dated October 7, 2004.

4. pH and DO: In accordance with Reg. 61-68.G.11, 12 & 13 the in-stream DO and pH requirements are as follows:

Stream Classification	pH Requirement	D.O. Requirement
Shellfish Harvesting Waters (SFH)	Shall not vary more than 3/10 of a pH unit above or below that of effluent-free waters in the same geological area having a similar total salinity, alkalinity and temperature, but not lower than 6.5 or above 8.5	Daily average not less than 5.0 mg/l with a low of 4.0 mg/l
Class SA, and Class SB	Shall not vary more than one-half of a pH unit above or below that of effluent-free waters in the same geological area having a similar total salinity, alkalinity and temperature, but not lower than 6.5 or above 8.5	Daily average not less than 5.0 mg/l with a low of 4.0 mg/l
Class SB	Shall not vary more than one-half of a pH unit above or below that of effluent-free waters in the same geological area having a similar total salinity, alkalinity and temperature, but not lower than 6.5 or above 8.5	Not less than 4.0 mg/l

5. The calculations for the assessment of effluent limits has been compiled using a Microsoft Excel spreadsheet. This spreadsheet is attached for documentation of individual calculations. The limits noted in Part III reflect the most restrictive conditions that apply.

6. The wasteload allocation (WLA) completed by the Wasteload Allocation Section is incorporated into this rationale by reference. A copy of the WLA is attached.

III. PERMIT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall 005-Combined outfall line to Charleston Harbor
This facility has 4 internal outfalls and 1 common outfall (discharges to receiving stream).

Outfall 001 - Center Street WWTP (Outfall 001, 3.7 mgd) discharges to outfall 005
Outfall 002 – Rifle Range Road WWTP (Outfall 002, 6 mgd & 10.6 mgd) discharges to outfall 005
Outfall 003 – RO WTP#1 (Outfall 003, 0.25 mgd) discharges to outfall 005
Outfall 004 – RO WTP#3 (Outfall 004, 0.67 mgd) discharges to outfall 005
Outfall 005 – Common Outfall discharges to Charleston Harbor

The Preliminary Engineering Report – Rifle Range Road WWTP Improvements has been submitted with NPDES permit application to address what was proposed to comply with the requirement of the Department's February 16, 2017 letter/Wasteload Allocation for the RRR WWTP's expansion to 10.6 mgd from 6.0 mgd. The PER has been reviewed and we found it acceptable.

- The sampling locations for Enterococci, Total Residual Chlorine (TRC), Dissolved Oxygen (DO) and pH have been moved from outfall 005 to the Center Street WWTP and Rifle Range Road WWTP.
- Each outfall calculates its own UOD and totalized to a final UOD. The compliance point for this totalized UOD will be at the outfall 005 (outfall 005 discharges to Charleston Harbor).
- The chronic toxicity test at CTC of 1% with once per year sampling frequency were included for the outfall 001, 002 and acute toxicity test at ATC of 1% with once per year sampling frequency were include for the outfall 003 & 004.

Biological Assessment (if applicable): Not applicable

Whole Effluent Toxicity:
Permittee requested Mixing Zone and Completed Mixing Zone NPDES Application Supplement: Yes

Existing WET monitoring:
Previous permit limits (effective 10/014/2013):

At outfall 001 (Center Street WWTP):
Chronic Toxicity at CTC = 1% (25% - 40%, 5 serial dilutions)
Chronic Toxicity Testing frequency: 1/year

At outfall 002 (Rifle Range Road WWTP):
Chronic Toxicity at CTC = 1% (25% - 40%, 5 serial dilutions)
Chronic Toxicity Testing frequency: 1/year

At outfall 003 (RO WTP #1):
Acute Toxicity at ATC = 1% (pass/fail)
Chronic Toxicity Testing frequency: 1/year

At outfall 004 (RO WTP #3):
Acute Toxicity at ATC = 1% (pass/fail)
Chronic Toxicity Testing frequency: 1/year

Note: The facility has a common pipe (outfall 005) with a diffuser placed into the Charleston Harbor. The original dye study and CORMIX2 modeling study for this facility has been conducted on March 29, 1999. Based on the 2013 Charleston Harbor, Cooper, Ashley and Wando River Dissolved Oxygen TMDL, the tidal dilution developed for this facility's discharge is 12,600 cfs.

Based on the mixing zone report (CORMIX model), Chronic toxicity test at 1% was established for outfall 001 & 002, Acute toxicity test at 1% was established for outfall 003 & 004 in the existing permit.

Reasonable potential determination:

The following procedure to evaluate reasonable potential has been used.

Step 1: Determine the coefficient of variation (*CV*) for the data set. For a data set where $n>10$, the *CV* is calculated as standard deviation divided by mean. For data set where $n<10$, the *CV* is estimated to equal 0.6. For less than 10 items of data, the uncertainty in the *CV* is too large to calculate a standard deviation or mean with sufficient confidence. The CVs have been determined for each data set (see attached spreadsheet).

Step 2: Determine the appropriate multiplying factor (*MF*) from either Table 3-2 or using the formulae in Section 3.3.2. (EPA Using the procedures outlined in the EPa Technical Support Document for Water Quality-based Toxics Control, Box 3-2, page 53. The MFs have been determined for each data set (see attached spreadsheet).

Step 3: Multiply the highest reported value of percent effect or reproduction from the data set by the multiplying factor (*MF*) determined in Step 2 to obtain the maximum possible percent effect value Cmax

Cmax = *MF* * highest reported value of percent effect or reproduction

Repeat this procedure to calculate all Cmax for each data set.

Step 4: Using Cmax to against permit limits 25% (monthly average) and 40% (Daily maximum).

If Cmax < 25% or 40%, implies that a reasonable potential does not exist
If Cmax ≥ *25% or 40%*, implies that a reasonable potential exists

DMR data (10/01/2013 – 01/31/2018) has been utilized in the reasonable potential analysis, 17 quarterly chronic toxicity testing results have been collected for outfall 001, 002 and 17 quarterly acute toxicity testing results have been collected for 003 and 004.

Conclusion: Based the review of the historical toxicity test data and considering this facility's peculiar outfalls setting and vast dilution available in the receiving stream (Charleston Harbor), acute toxicity test at ATC of 1% for outfall 003 & 004 would be no longer needed. The chronic test at CTC of 1% at once per year sample frequency will remain in the permit for outfall 001 & 002.

At outfall 001 (Center Street WWTP):
Chronic Toxicity at CTC = 1% (Mysidopsis Bahia, 25% - 40%, 5 serial dilutions)
Chronic Toxicity Testing frequency: 1/year

At outfall 002 (Rifle Range Road WWTP):
Chronic Toxicity at CTC = 1% (2 Mysidopsis Bahia, 5% - 40%, 5 serial dilutions)
Chronic Toxicity Testing frequency: 1/year

Ultimate Oxygen Demand (UOD) (outfall 005):

1. Previous Permit Limits (effective 10/01/2013)

   Mar. – Oct.
   Monthly average: 11,415 lbs/day
   Weekly Average: 17,123 lbs/day

   Nov. – Feb.:
   Monthly average: 15,111 lbs/day
   Weekly Average: 22,667 lbs/day

2. NPDES Application: (No. Of UOD analyses: ---) NA

3. DMR Data: The highest monthly UOD was reported in: 4059 lbs/day

4. Wasteload Allocation: Based on Charleston TMDL (2013), the critical period UOD load this facility is11,415 lbs/d and seasonal UOD is 15,111 lbs/d (see following table for detail)

Charleston TMDL Calculator

Critical Limits Scenario March thru October

Discharge	NPDES	Location	Flow	CBOD5		F-ratio	CBODu		Ammonia		UOD	DO
Name	Permit No.	waterbody	MGD	mg/L	lbs/day		mg/L	lbs/day	mg/L	lbs/day	lbs/day	mg/L
Mount Pleasant/CS	SC0040771	Harbor	3.7	30	926	3.18	95	2,944	10	309	4,354	1
Mount Pleasant/RR	SC0040771	Harbor	6	30	1,501	3.18	95	4,774	10	500	7,061	1
Total =			9.7								11,415	

Seasonal Limits Scenario November thru February

Discharge	NPDES	Location	Flow	CBOD5		F-ratio	CBODu		Ammonia		UOD	DO
Name	Permit No.	waterbody	MGD	mg/L	lbs/day		mg/L	lbs/day	mg/L	lbs/day	lbs/day	mg/L
Mount Pleasant/CS	SC0040771	Harbor	3.7	30	926	3.18	95	2,944	20	617	5,764	1
Mount Pleasant/RR	SC0040771	Harbor	6	30	1,501	3.18	95	4,774	20	1,001	9,347	1
Total =			9.7								15,111	

5. Other information: The (f) ratio for $CBOD_5$ is shown on the wasteload allocation and it is 3.18.

   UOD is the oxygen consumed by aquatic microbes in metabolizing the remaining organic and nitrogenous matter in the effluent from the permittee's wastewater treatment plant. This demand is expressed in pounds per day and is calculated by multiplying the effluent biochemical oxygen demand (BOD_5) concentration by f-ratio and adding that to 4.57 times the effluent ammonia (NH_3-N) concentration and multiplying the sum by the NPDES permitted flow and the constant 8.34.

   $$U.O.D.(lbs/day) = [\{BOD_5(mg/l) * (f\text{-}ratio)\} + \{NH_3\text{-}N(mg/l) * 4.57\}] * Flow(MGD) * 8.34$$

6. Conclusion: Based on the WLA, UOD limits (outfall 005) will be as follows:
   Mar. – Oct.
   Monthly average: 11,415 lbs/day
   Weekly Average: 17,123 lbs/day
   Nov. – Feb.:
   Monthly average: 15,111 lbs/day
   Weekly Average: 22,667 lbs/day

Flow (001+002+003+004):

1. Previous permit limits (effective 10/01/2013):
   Monthly average: MR MGD
   Weekly average: MR MGD

2. NPDES Application (2A): (No. of flow analyses: 365)
   Long Term Average Value: 4.86 MGD
   Maximum Daily Value: 9.09 MGD
3. DMR Data: The highest flow was reported in: 11 mgd
4. Water Quality Data: Not applicable.
5. Categorical Limitation: Not applicable
6. Other information: None
7. Detection Limit: Not applicable.
8. Proposed Flow Conditions (Monthly/Weekly Average): MR (total design flow = 15.22 MGD = 10.6+3.7+.25+.67)

9. Conclusion: Based on the use of a MR for flow, in addition to mass limits for conventional pollutants, mass limitations for toxic pollutants (e.g. TRC and metals) will be specified for monthly average and daily maximum based on the design flow noted on the effluent limits page of the permit. In addition a condition in Part V. has been added to identify the design flow for the purposes of identification of the treatment capacity (under R.61-67.300.A.8); for a determination of whether or not a POTW is required to develop a pretreatment program (under R.61-9.403.a) and for the annual NPDES fees (under R.61-30.2.b).

Five Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$):

1. Previous permit limits (effective 10/01/2013):

   Center Street WWTP (outfall 001):
   Monthly average: 25 mg/l*
   Weekly average: 37.5 mg/l
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

   Rifle Range Road WWTP (outfall 002):
   Monthly average: 25 mg/l*
   Weekly average: 37.5 mg/l
   Sampling frequency: 3/Week
   Sampling Type: 24 hr. Comps.

   RO WTP#1 (outfall 003):
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 1/Month
   Sampling Type: 24 hr. Comps.

   RO WTP#3 (outfall 004):
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 1/Month
   Sampling Type: 24 hr. Comps.

* Maximum concentration limit provided while UOD limits cannot be exceeded.

2. NPDES Application (2A): (total No. of $CBOD_5$ measurements analyses: 157)
   Long Term Average Value: 4.0 mg/l
   Maximum Daily Value: 12 mg/l
3. DMR Data: The highest BOD_5 was reported in Value: 15 mg/l
4. Water Quality Data: Not applicable.
5. Secondary Limitation: In accordance with R.61-9.133.102, 103 or 105.
   30-day average not to exceed 30 mg/l
   7-day average not to exceed 45 mg/l
   30-day average percent removal not to be less than 85 percent
6. Other information: NA
7. Detection Limit: Not applicable.
8. Proposed CBOD5 Limitation: Based on Waste Load Allocation dated 03/09/2018.
   Monthly Average: 25 mg/l
9. Conclusion: Based on the review of historical data, the monitoring frequency of CBOD5 for RRRWWTP can be reduced for the existing flow of 6.0 mgd. For the expansion of 10.6 mgd, the monitoring frequency will remain at three per week until we have sampling data to demonstrate the facility's consistent compliance and no reasonable potential is evaluated at 10.6 mgd. CBOD5 limits would be as follows.

Center Street WWTP (outfall 001):
Monthly average: 25 mg/l*
Weekly average: 37.5 mg/l
Sampling frequency: 1/Week
Sampling Type: 24 hr. Comps.

Rifle Range Road WWTP (outfall 002) @6.0 MGD:
Monthly average: 25 mg/l*
Weekly average: 37.5 mg/l*
Sampling frequency: 1/Week
Sampling Type: 24 hr. Comps.

Rifle Range Road WWTP (outfall 002) @10.6 MGD:
Monthly average: 25 mg/l*
Weekly average: 37.5 mg/l*
Sampling frequency: 3/Week
Sampling Type: 24 hr. Comps.

RO WTP#1 (outfall 003):
Monthly average: MR mg/l
Weekly average: MR mg/l
Sampling frequency: 1/Month
Sampling Type: 24 hr. Comps.

RO WTP#3 (outfall 004):
Monthly average: MR mg/l
Weekly average: MR mg/l
Sampling frequency: 1/Month
Sampling Type: 24 hr. Comps.

* Maximum allowable CBOD5 concentration provided while UOD limits cannot be exceeded.

Total Suspended Solids (TSS):

1. Previous permit limits (effective 10/01/2013):

Center Street WWTP (outfall 001):
Monthly average: 30 mg/l
Weekly average: 45 mg/l
Sampling frequency: 1/Week
Sampling Type: 24 hr. Comps.

Rifle Range Road WWTP (outfall 002):
Monthly average: 30 mg/l
Weekly average: 45 mg/l
Sampling frequency: 3/Week
Sampling Type: 24 hr. Comps.

RO WTP#1 (outfall 003):
Monthly average: 20 mg/l
Weekly average: 40 mg/l
Sampling frequency: 1/Month
Sampling Type: 24 hr. Comps.

RO WTP#3 (outfall 004):
Monthly average: 20 mg/l
Weekly average: 40 mg/l
Sampling frequency: 1/Month
Sampling Type: 24 hr. Comps.

2. NPDES Application (2A): (No. of TSS analyses: 157)
   Long Term Average Value: 6.0 mg/l
   Maximum Daily Value: 12 mg/l

3. DMR Data: The highest TSS was reported in: 24 mg/l
4. Water Quality Data: Not applicable.

5. Secondary Limitation: In accordance with R.61-9.133.102, 103 or 105.
   30-day average not to exceed 30 mg/l
   7-day average not to exceed 45 mg/l
   30-day average percent removal not to be less than 85 percent

6. Other information: NA

7. Detection Limit: 0.50 mg/l

8. Proposed TSS Limits:
   Monthly Average: 30 mg/l
   Weekly Average: 45 mg/l

9. Conclusion: Based on the review of historical data, the monitoring frequency of TSS for RRRWWTP could be reduced for the existing flow of 6.0 mgd. For the expansion of 10.6 mgd, the monitoring frequency will remain at three per week until we have sampling data to demonstrate the facility's consistent compliance and reasonable potential is evaluated at 10.6 mgd. TSS limits would be as follows.

   Center Street WWTP (outfall 001):
   Monthly average: 30 mg/l
   Weekly average: 45 mg/l
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

   Rifle Range Road WWTP (outfall 002) @6.0 MGD:
   Monthly average: 30 mg/l
   Weekly average: 45 mg/l
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

   Rifle Range Road WWTP (outfall 002) @10.6 MGD:
   Monthly average: 30 mg/l
   Weekly average: 45 mg/l
   Sampling frequency: 3/Week
   Sampling Type: 24 hr. Comps.

   RO WTP#1 (outfall 003):
   Monthly average: 20 mg/l
   Weekly average: 40 mg/l
   Sampling frequency: 1/Month
   Sampling Type: 24 hr. Comps.

   RO WTP#3 (outfall 004):
   Monthly average: 20 mg/l
   Weekly average: 40 mg/l
   Sampling frequency: 1/Month
   Sampling Type: 24 hr. Comps.

Total Ammonia Nitrogen (as N):

1. Previous permit limits (effective 10/01/2013):
   a. Center Street WWTP (outfall 001):
      (March – October):
      Monthly average: 20 mg/l*
      Weekly average: 30 mg/l*
      Sampling frequency: 1/Week
      Sampling Type: 24 hr. Comps.
      (November – February):
      Monthly average: MR mg/l
      Weekly average: MR mg/l
      Sampling frequency: 1/Week
      Sampling Type: 24 hr. Comps.

   b. Rifle Range Road WWTP (outfall 002):
      (March – October):
      Monthly average: 20 mg/l*
      Weekly average: 30 mg/l*
      Sampling frequency: 3/Week
      Sampling Type: 24 hr. Comps.
      (November – February):
      Monthly average: MR mg/l
      Weekly average: MR mg/l
      Sampling frequency: 3/Week
      Sampling Type: 24 hr. Comps.

   c. RO WTP#1 (outfall 003):
      Monthly average: MR mg/l
      Weekly average: MR mg/l
      Sampling frequency: 1/Month
      Sampling Type: 24 hr. Comps.

   d. RO WTP#3 (outfall 004):
      Monthly average: MR mg/l
      Weekly average: MR mg/l
      Sampling frequency: 1/Month
      Sampling Type: 24 hr. Comps.

* Maximum allowable ammonia concentration provided while UOD limits cannot be exceeded.

2. NPDES Application (2A): (No. of Total Ammonia Nitrogen (as N) analyses: 157)
   Long Term Average Value: 0.2 mg/l
   Maximum Daily Value: 3.0 mg/l
3. DMR Data: The highest Total Ammonia Nitrogen (as N) was reported in: 1.4 mg/l (CS WWTP), 1.0 mg/l (RRR WWTP) since May 1, 2015
4. Water Quality Data: Not applicable
5. Secondary Limitation: Not applicable
6. Other information: We have reviewed permittee's request for a modification for all NH3-N sampling to be monitor and report (MR). We have reviewed the request and found that at the existing combined design flows, the monthly average NH3-N concentration that would violate the monthly average UOD limitation (critical period, assuming CBOD5 at the PQL) is approximately 30 mg/l. Based on recent monitoring data, there is no reasonable potential for the permittee to exceed 30 mg/l at the existing combined design flows. Therefore, we will revise the monthly and weekly average NH3-N limits at the existing design flows during the critical period to MR.

   However, at the expanded combined design flows, the monthly average NH3-N concentration that would violate the

monthly average UOD limitation (critical period, assuming CBOD5 at the PQL) is approximately 20 mg/l. Data from the existing facility cannot be used to evaluate reasonable potential for the future upgraded facility. Therefore, we will include monthly and weekly average NH3-N concentration limits at the expanded design flows during the critical period of 20 mg/l and 30 mg/l, respectively (along with corresponding mass limitations).

7. Detection Limit: 0.050 mg/l. (EPA Method 350.2, 350.3 or 350.1)

8. Proposed Total Ammonia Nitrogen (as N) Limitation: Based on Waste Load Allocation,
   a. Critical limitation based on chronic toxicity:
      Monthly Average: 434.8 mg/l

9. Conclusion: Based on the review of historical data, the monitoring frequency of NH3-N for RRRWWTP could be reduced for the existing flow of 6.0 mgd. For the expansion of 10.6 mgd, the monitoring frequency will remain at three (3) per week until we have sampling data to demonstrate the consistent compliance and reasonable potential be evaluated at 10.6 mgd. NH3-N limits would be as follows.

Center Street WWTP (outfall 001):

a. Center Street WWTP (outfall 001) when RRR@6.0 mgd:
   Monthly average: MR mg/l*
   Weekly average: mg/l*
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

b. Center Street WWTP (outfall 001) when RRR@10.6 mgd:
   (March – October):
   Monthly average: 20 mg/l*
   Weekly average: 30 mg/l*
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.
   (November – February):
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

b. Rifle Range Road WWTP (outfall 002)@6.0 MGD:
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 1/Week
   Sampling Type: 24 hr. Comps.

Rifle Range Road WWTP (outfall 002) @10.6 MGD:
   (March – October):
   Monthly average: 20 mg/l*
   Weekly average: 30 mg/l*
   Sampling frequency: 3/Week
   Sampling Type: 24 hr. Comps.
   (November – February):
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 3/Week
   Sampling Type: 24 hr. Comps.

c. RO WTP#1 (outfall 003):
   Monthly average: MR mg/l
   Weekly average: MR mg/l
   Sampling frequency: 1/Month
   Sampling Type: 24 hr. Comps.

d. RO WTP#3 (outfall 004):
Monthly average: MR mg/l
Weekly average: MR mg/l
Sampling frequency: 1/Month
Sampling Type: 24 hr. Comps.

* Maximum allowable ammonia concentration provided while UOD limits cannot be exceeded.

Enterococci (Outfall 001 & 002):

1. Previous permit limits (effective 10/01/2013):
   Monthly Average: 35/100 ml
   Daily Maximum: 501/100 ml
   Sampling frequency: 3/week
   Sampling Type: Grab.
2. NPDES Application (2A): (No. of Enterococci analyses: 157)
   Highest Monthly Average: 4/100 ml
   Highest Daily Maximum: 41/100ml
3. DMR Data:
   Highest Monthly Average Value: 22/100 ml
   Highest Weekly Average Value: 439/100
4. Categorical Limitation: none
5. Other Information: The revisions to the Water Classifications & Standards (R.61-68) and Classified Waters (R.61-69) were approved by USEPA on February 28, 2013. Subsection R.61-68.E.14.c(12) includes the provisions and acceptable allowance for meeting the daily maximum bacterial limits. These revisions (the bacteriological standard for the nearest surface water body), in accordance with R.61-9.505.45(i)(9), have been incorporated in this draft permit and including a supplemental data sheet in Part V to address the provisions of R.61-68.E.14.c(12).
6. Detection Limit: 1/100 ml
7. Proposed Enterococci limits (if applicable):
   Enterococci for outfall 001 & 002:
   Monthly Average: 35/100 ml
   Daily Maximum: 501/100 ml
8. Conclusion: Enterococci Limitations will be as follows:
   Enterococci for outfall 001 & 002:
   Monthly Average: 35/100 ml
   Daily Maximum: 501/100 ml
   Sampling frequency: 3/week
   Sampling Type: Grab.

Total Residual Chlorine (TRC) (Outfall 001 & 002):

1. Previous permit limits (effective 10/01/2013):
   Center Street WWTP (outfall 001):
   Monthly average: 1.0 mg/l
   Weekly average: 1.5 mg/l
   Sampling frequency: 1/Week
   Sampling Type: Grab
   Rifle Range Road WWTP (outfall 002):
   Monthly average: 1.0 mg/l
   Weekly average: 1.5 mg/l
   Sampling frequency: 3/Week
   Sampling Type: Grab

2. Governing Water Quality Criterion: Water Classifications and Standards (R.61-68).

3. Other Information:
   NPDES Application (2A): (total No. of TRC measurements: 260)
   Monthly Average Value: 0.80 mg/l
   Maximum Daily Value: 1.14 mg/l
   DMR Data: The highest TRC was reported in: 1.4 mg/l
   Proposed TRC Limitation: Monthly Average: 1.0 mg/l, Weekly Average: 1.5 mg/l
   Note: Based on the review of historical data, the facility has consistently met TRC concentration limits with compliance of Enterococci. Mount Pleasant Water Works request for a higher Total Residual Chlorine (TRC) limits from 1.0 mg/l (monthly average) and 1.5 mg/l (daily maximum) to 2.0 mg/l (monthly average) and 3.0 mg/l (daily maximum) is not justified due to anti-backsliding/anti-degradation rules.

4. Cause, Reasonable Potential to Cause or Contribute to excursions of either Aquatic Life Criteria, based on Water Classifications and Standards R.61-68.

5. Effluent Guidelines Limitations: See R.61-9.133 (Not applicable to this parameter)

6. Conclusion: Based on the review of historical data, the facility has consistently met TRC concentration limits with compliance of Enterococci. The request for a higher Total Residual Chlorine (TRC) limits from 1.0 mg/l (monthly average) and 1.5 mg/l (daily maximum) to 2.0 mg/l (monthly average) and 3.0 mg/l (daily maximum) is not justified due to anti-backsliding/anti-degradation rules.

   Note that based on the available dilution at this discharge location (Charleston Harbor) and travel time in the common outfall 005, we will consider to review a future study on TRC decay in the common pipe (005) to establish the reasonable TRC limits (for both concentration and mass limits). Until such study is reviewed and approved by the Department. the existing TRC limits (include mass limits) will remain the same in the previous permit.
   Outfall 001 and 002:
   Monthly average: 1.0 mg/l
   Daily maximum: 1.5 mg/l
   Sampling Frequency: outfall 001: 1/week, outfall 002: 3/week
   Sample type: Grab

Dissolved Oxygen (DO) outfall 001 and 002:

1. Previous Permit Limits (effective 10/01/2013): 1.0 mg/l
2. NPDES Application (2A): (total No. of DO analyses: 259)
   Long Term Average Value: 4.0 mg/l
   Maximum Daily Value: 6.4 mg/l
3. DMR Data: The lowest DO was reported in: 2.2 mg/l
3. Water Quality Data: Effluent Limits for D.O. are established in accordance with Reg. 61-68.G.11, 12 & 13. For Class Salt Water this value is not less than 4.0 mg/l
4. Site Specific D.O. Standards applicable to Receiving Waters; See (R.61-69): No
6. Secondary Limitation: Not applicable.
7. Other information: NA
8. Detection Limit: Not applicable.
9. Proposed DO Limitations: 1.0 mg/l. Based on Waste Load Allocation dated (03/09/2018)
10. Conclusion: The previous DO limits will remain in the permit.
    Outfall 001 & 002:
    Minimum: 1.0 mg/l
    Sampling frequency: 5/week
    Sampling Type: Grab

pH:

1. Previous Permit Limits (effective 10/01/2013):
   6.0 ~ 8.5 standard units
   Sampling frequency: Daily

Sampling Type: Grab

2. NPDES Application (2A): (No. of pH analyses: ---)
   Long Term Average Value: 6.4 standard units.
   Maximum Daily Value: 7.2 standard units.
3. DMR Data: The highest and lowest pH was reported in: 8.5/6.1 s.u.
4. Water Quality Data: Effluent Limits for pH are established in accordance with Reg. 61-68.G.11, 12 & 13. For Class Salt Water this value is 6.5 – 8.5 standard units.
5. Site Specific pH. Standards applicable to Receiving Waters; See (R.61-69): No
6. Secondary Limitation: 6.0 - 9.0 standard units. [R.61-9.133.102(c)]
7. Other information: NA
8. Detection Limit: Not applicable
9. Proposed pH Limitations: 6.0 – 9.0 standard units

10. Conclusion: Based on Secondary treatment requirement (R.61-9.133.102(c)) and due to vast amount dilution is available in the Harbor, pH limits will be as follows for all four outfalls.
    6.0 ~ 9.0 standard units
    Sampling frequency: @Outfall 001 & 002: 5/week
    @Outfall 003 & 004: 2/Month
    Sampling Type: Grab

CBOD5 and TSS remoal:

1. Previous Permit Limits (effective 10/01/2013):
   Monthly average: 85%
   Sampling Frequency: 1/Month

2. CBOD5 and TSS removal will remain at 85%

Other Parameters: In addition to the parameters listed above, the remaining parameters listed in the NPDES Application Form 2A, Part D "Expanded Effluent Testing Data" have been evaluated for a reasonable potential to cause or contribute to an exceedance of the water quality standards. The evaluation showed no reasonable potential for such an exceedance. Therefore monitoring requirement for these parameters will not be included in the permit.

Other Relevant Factor; Available geologic and hydrologic information on the aquifer (R.61 – 113.F.1.k)

Over the years, MPW has evaluated alternative water supplies, cooperated with USGS in development and funding of several groundwater flow models beginning in 1996, provided continuing funding of monitoring well CHN-14, implemented Aquifer Storage and Recovery, enacted Tiered conservation rates, and pushed for Capacity Use and the Groundwater Use and Reporting Act of 2000.

The Trident Area Groundwater Management Plan denotes that permit renewals will consider the best available information on the geologic and hydrogeologic characteristics of the aquifer and groundwater withdrawals of the area to protect against or abate unreasonable, or potentially unreasonable, adverse effects on the aquifer and water users. MPW would like to put forth the following USGS scientific investigation reports to use when reviewing the Groundwater Management Strategies. The scientific investigation reports are listed below and the purpose and key findings of each report noted on the following pages.

1996 *Ground-Water Hydrology, Historical Water Use, and Simulated Ground-Water Flow in Cretaceous-Age Coastal Plain Aquifers Near Charleston and Florence, South Carolina*; Water-Investigations Report 96-4050, USGS

2007 *Hydrogeology and Simulation of Ground-Water Flow near Mount Pleasant, South Carolina – Predevelopment, 2004 and Predicted Scenarios for 2030*; Scientific Investigation Report 2007-5126, USGS

2009 *Simulation of Reclaimed-Water Injection and Pumping Scenarios and Particle-Tracking Analysis near Mount Pleasant, South Carolina*; USGS, Scientific investigations Report 2009-5185

2017 *Simulation of Groundwater Flow and Pumping Scenarios for 1900-2050 near Mount Pleasant, South Carolina*; Scientific Investigation Report 2017-5128, USGS

Ground-Water Hydrology, Historical Water Use, and Simulated Ground-Water Flow in Cretaceous-Age Coastal Plain Aquifers Near Charleston and Florence, South Carolina; Water-Investigations Report 96-4050, USGS

Purpose: 1) Describe hydrogeologic framework for Cretaceous aquifer
2) Develop, calibrate and apply a quasi-three-dimensional digital model to simulate groundwater water flow
3) Evaluate groundwater use scenarios for Charleston area.

Finding: A groundwater use model scenario included ending all well withdrawal for Mount Pleasant in 1994 – 2015 with produced a gradual recovery and low water level of 16 ft. in 2015.

This shows the aquifer will rebound and the withdrawals have minimal impact on the aquifers storativity.

Hydrogeology and Simulation of Ground-Water Flow near Mount Pleasant, South Carolina – Predevelopment, 2004 and Predicted Scenarios for 2030; Scientific Investigation Report 2007-5126, USGS

Purpose: 1) Update 1996 model with 2004 water use and groundwater flow
2) Incorporate well data (flow, water level and quality) from Black Creek test well, drilled by MPW
3) Simulate predictive water-management scenarios to the year 2030 for Middendorf aquifer.

Finding: Water budget indicates that lateral flow provides predominant flow to wells. (92%)

This finding shows that minimal amounts of the water withdrawn from the aquifer is coming from storage.

Simulation of Reclaimed-Water Injection and Pumping Scenarios and Particle-Tracking Analysis near Mount Pleasant, South Carolina; USGS, Scientific investigations Report 2009-5185

Purpose: 1) Update 2004 model to determine the effects of recent water use
2) determine effects on groundwater level with potential use of reclaimed water injection
3) Simulate predictive water-management scenarios to the year 2050 for Middendorf aquifer.

Finding: Particle tracking from three injection wells (5,300 to 9,200-ft from the existing wells) will travel to the production wells in 18 to 256 years.

This shows the movement of water within the aquifer is relatively slow and therefore any potential change in water quality characteristics can be identified and tracked in enough time to initiate any remediation efforts.

Simulation of Groundwater Flow and Pumping Scenarios for 1900-2050 near Mount Pleasant, South Carolina; Scientific Investigation Report 2017-5128, USGS

Purpose:

1) Update 2008 model to determine the effects of recent water use including groundwater use data located in the North Carolina, South Carolina and Georgia Coastal Plain physiographic province

2) Use of parameter estimation to update the hydraulic conductivity and storage properties

3) Simulate predictive water-management scenarios to the year 2050 for Middendorf aquifer.

Finding:

1) The recovery of groundwater levels in the area also is evident in Berkeley County where the long-term downward trend for an observation well has been eliminated; the trend can be attributed to reduced pumping.

2) At maximum capacity of 10.16 MGD, CHN-14 and BRK-431 show groundwater level declines of 116 and 41-ft, respectively. (MPW decline to -359)

3) Water budget indicates that lateral flow provides predominant flow to wells. (95%)

Findings from this report continue to confirm the ability for the aquifer to rebound and that drawdown will reach an equilibrium.

Preliminary unpublished work with USGS (In provisional state - not in release by USGS)*

Purpose: 1) Simulated seven additional predictive scenarios

2) Run scenario to equilibrium

3) Particle tracking and travel times for four potential injection wells

Finding: 1) Withdrawal of 12.34MGD reaches equilibrium of drawdown at an imaginary well located in Mount Pleasant at -302ft in 2100 and only drops another 21ft over 600 years.

2) Reuse injection of 2MGD at each wastewater treatment plant reduces drawdown from a range of 43 to 94ft at MPW wells.

3) Particle tracking from injection wells at wastewater plants to production wells range from approximately 6 to 27.

*This information was presented by USGS to MPW and SCDHEC in preliminary unpublished form via conference call and PowerPoint at a meeting held at MPW on June 19, 2018.