TOWN OF KILL DEVIL HILLS

Land Where Flight Began

MEMORANDUM January 26, 2022

TO: Mayor and Board of Commissioners

FROM: Debora P. Diáz, Town Manager

REF: New Business

1. 2022 Water System Master Plan Update (Attached NB-1)

The 10-year update to the Town's Water System Master Plan has been completed by American Engineering and Dewberry. Both firms collaborated in 2017 on the detailed engineering report and system modeling utilized for successful planning and installation of the elevated water tank behind the Fire Station. Public Services Director Steve Albright's accompanying memorandum highlights the Plan, which evaluates our water system, provides a recommended 10-year Capital Improvement Plan (CIP), and discusses rates.

Pete Burkhimer, PE, and Patrick Lewis, PE, plan to attend this meeting and report their findings to the Board. Staff recommends the Board of Commissioners adopt the Water System Master Plan Update as presented. If approved, Plan implementation will begin with recommendations in the 2022-2023 fiscal year budget.

A motion is in order.

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January 26, 2022

Memorandum

To: Debora P. Diaz, Town Manager

From: Stephen F. Albright, Public Services Director SA

Subject: **Water System Master Plan Update**

Please find the attached Water System Master Plan update co-authored by American Engineering and Dewberry. These firms worked together in 2017 on the detailed engineering report and system model utilized to determine the size and configuration of the recently completed elevated water tank behind the Fire Station at 1634 N. Croatan Highway. Based on their familiarity with the system and successful completion of these improvements, we worked with them again to complete the 10-year update of the Town's Water System Master Plan. This plan had been completed in 2002 (Wooten Company) and in 2012 (GHD Consulting).

The Plan provides a detailed analysis of all aspects of the Town Water System including:

- Water quantity analysis including population projections, usage trends and contractual capacity limitations
- Water quality analysis including testing and EPA requirements
- Capital Improvement Plan to guide the next decades worth of necessary improvements and budget decisions
- Rate and fee analysis to guide future rate and fee decisions

Pete Burkhimer, PE and Patrick Lewis, PE plan on attending the meeting and presenting their findings and recommendations to the Board of Commissioners.

Staff recommends the Board of Commissioners adopt the Water System Master Plan Update as presented. Implementation will begin with the recommendations in the upcoming fiscal year budget.

Town of Kill Devil Hills

Water System Master Plan

January 2022

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APPENDICES

Appendix A – Condition Assessment

1. EXECUTIVE SUMMARY

1.1 GENERAL

In 2020, the Town of Kill Devil Hills (KDH, Town) contracted American Engineering and Dewberry Engineers, Inc (American/Dewberry) to complete an update to the Town's Water System Master Plan (WSMP). The previous WSMP was completed in 2012 by GHD Consulting Engineers, PLLC, and is being updated to reflect the current water pumping, storage, chlorine addition, and distribution system. This WSMP will focus on the following:

- Evaluate current and future demands of the Town
- Evaluate Dare County source water quantity and quality
- Perform condition assessment on the Town's existing assets
- Update the Town's Capital Improvements Plan
- Evaluate and update the Town's rates and fees
- Complete a report summarizing the above

1.2 SYSTEM SUMMARY

The Town of Kill Devil Hills owns and operates a comprehensive water distribution system that provides clean drinking water to its customers. Raw water is treated by Dare County (County) through the County's two water treatment plants (WTP): the 5 million gallons per day (MGD) Skyco Plant and the 5 MGD North Reverse Osmosis (NRO) Plant. Dare County provides treated water from these plants to Kill Devil Hills. Water enters the Town through metered connections at the Town's two pump station facilities: Eighth Street and Old Town Hall.

The Eighth Street facility houses three (3) 1,200 gallon per minute (gpm) pumps, a 0.25 million gallon (MG) elevated storage tank (EST), and two ground storage tanks (GST) with 0.7 MG in total capacity. The Old Town Hall (OTH) facility houses three 1,600 gpm pumps, a 0.40 MG EST, and a 0.5 MG GST. The Town owns approximately 80 miles of pipe ranging from 2 to 16 inches in diameter. Waterline materials primarily consist of polyvinyl chloride (PVC, 75.4% of total system), asbestos cement (AC, 21.6% of total system), ductile iron (DI, 2.6% of total system), and high-density polyethylene (HDPE, 0.4% of total system) pipes. The Town is undergoing a concerted, multi-year effort to replace all asbestos cement pipes in the system (further discussed in **Section 7**). Further details on the Town's water distribution system are provided in **Section 3**.

1.3 DEMAND REQUIREMENTS

The water demands in the Town of Kill Devils Hills are highly dependent on the tourist population in the Town. Based on 2020 certified resident population estimates, the permanent population is slightly over 7,300, but during the summer months, the population can increase to 40,000 according to the 2020 Land Use Plan.

The Town's water consumption varies with the seasonal population surges. Based on the *2012 Water System Master Plan* report, peak season was assumed to be the months of March through November, while the off season was assumed to be November through March. According to meter data recorded at the Eighth Street and OTH facilities from 2015-2019, the average daily demand (ADD) during the off season is 0.80 million gallons per day (MGD), and the ADD during the peak seasons is 1.22 MGD. The maximum daily demand MDD during the off season is 1.44 MGD and the MDD during the peak season is 2.23 MGD. Further demand and consumption data are provided in **Section 4**.

1.4 WATER SUPPLY

Treated water is provided to the Town by Dare County. The Town has an agreement with Dare County for the County to provide up to 3.0 MGD of drinking water. The Town typically requires less than half this amount of water, with the average daily demand (ADD) from 2015 through 2019 being 1.11 MGD. The maximum daily demand recorded during this period is 2.23 MGD. **Table 1-1** summarizes the Town's consumption.

At both the Eighth Street and Old Town Hall facility, the Town boosts the chlorine residual from the water that is received from Dare County. Prior to the 2017 upgrades to the Skyco WTP, the Town had historical problems managing disinfectant byproducts (DBPs) such as trihalomethanes (THMs). Since the upgrades to the Skyco WTP, the Town's water quality has been excellent, meeting the quality requirements set by the Environmental Protection Agency, and the North Carolina Department of Environmental Quality, Public Water Supply Section.

Table 1-1: Kill Devil Hills Consumption Summary (2015-2019)

	ADD (Year)	MDD (Year)	ADD (Peak Season)	MDD (Peak Season)	ADD (Off Season)	MDD (Off Season)
Eighth Street	0.55	1.41	0.61	1.42	0.40	0.99
Old Town Hall	0.56	1.37	0.62	1.37	0.41	1.12
Kill Devil Hills Total	1.11	2.23	1.22	2.23	0.80	1.44

Note: All units MG
Data is based on daily meter reading from the Eighth Street and Old Town Hall facilities

1.5 WATER DISTRIBUTION SYSTEM REQUIREMENTS

1.5.1. Hydraulic Model

A hydraulic model of the Town's water distribution system was not completed as a part of this report; however, a hydraulic model was built and calibrated as part of the Old Town Hall Elevated Storage Tank Replacement Preliminary Engineering Report (PER) (American/Dewberry, 2017) and the results of this model are summarized in **Section 6**.

1.5.2. Condition Assessment

American/Dewberry performed an onsite condition assessment for the Town's above-ground facilities at the Eighth Street and Old Town Hall pump stations. This includes an assessment of the mechanical, site, electrical, structural, and architectural features of each facility. This assessment does not include evaluations of the elevated or ground storage tanks as the Town regularly contracts specialty inspection companies to maintain and inspect their storage tanks. Recommendations are provided to improve the functionality and operational lifetime of each facility. Budgetary cost estimates for these recommendations are provided to guide the Town in completing the repairs. This condition assessment is provided in **Appendix A**.

Underground facilities such as the distribution pipe network are difficult to assess and were not included in this assessment. The Town has continued to implement a plan to replace all AC pipes within the system over the coming years.

1.6 CAPITAL IMPROVEMENT PLAN

A 10-year capital improvement plan (CIP) was developed to guide the Town through the planning period. A list of projects was developed during a CIP Workshop between the Town, American, and Dewberry. Projects include upgrades to both the Eighth Street and Old Town Hall facilities, a continuation of the AC pipe replacement project, and other miscellaneous improvements to the water system.

1.7 RATES AND FEES

In order to ensure that the Town can fund all expenditures associated with the water system, a rates and fees analysis was completed. The water system's future expenditures were calculated by evaluating water usage data over the past several years to predict future water usage within the system. The rates and fees needed to fund all expenditures were determined using the calculated future rates of water usage.

The Town has expressed interest in continuing the annual 4% rate increase that it has adopted. This will provide sufficient funding for the operations and maintenance costs and the capital expenditures on most years and allow the Town to maintain a positive fund balance. Several additional annual rate increase structures are analyzed to provide a comparison.

2 STUDY OVERVIEW

2.1 OVERVIEW

Dewberry Engineers, Inc is subcontracted by American Engineering on behalf of the Town of Kill Devil Hills, North Carolina to develop a 10-year water system master plan and associated rate study for the Town's water system. The Town most recently completed a water system master plan in 2012 authored by GHD Consulting Engineers, PLLC. This document provides an update on the previous report based on the current requirements of the Town.

The Town wishes to update the 2012 WSMP for the planning period of 2022 through 2032. This effort will focus on the following aspects:

- Evaluate current and future demands of the Town
- Evaluate Dare County source water quantity and quality
- Perform condition assessment on the Town's existing assets
- Update the Town's Capital Improvements Plan
- Evaluate and update the Town's rates and fees
- Complete a report summarizing the above

2.2 PAST STUDIES AND EVALUATIONS

American/Dewberry relied on past studies in the preparation of this report. These studies include the following:

- Town of Kill Devil Hills Water System Master Plan, GHD Consulting Engineers, PLLC, March 2012
- Town of Kill Devil Hills, NC Old Town Hall Elevated Storage Tank Replacement Preliminary Engineering Report, Dewberry Engineers, Inc & American Engineering, September 2017
- Town of Kill Devil Hills CAMA Land Use Plan Update, Holland Consulting Planners, August 2020

3 SYSTEM DESCRIPTION

3.1 GENERAL

Kill Devil Hills is located in Dare County, North Carolina on the Outer Banks, situated between the towns of Kitty Hawk and Nags Head. The Town is a coastal beach community with a large focus on tourism, attracting many thousands of visitors annually. Due to the large tourist population during the summer months, the water system has been designed to support this larger seasonal population, rather than the year-round, permanent population. The Town occupies approximately 6 square miles of land.

3.2 EXISTING WATER SYSTEM

The Town owns and operates the water distribution system that serves commercial and residential customers within the Town. The Town's existing water system can be seen in **Figure 3-1**. Potable water is provided by Dare County from two (2) 5.0 million gallon per day groundwater treatment plants, the Skyco Nanofiltration and Ion Exchange Water Plant (Skyco) and the North Reverse Osmosis Water Plant (NRO). Under the current agreement between the Town and Dare County, the Town may purchase up to 3.0 MGD of potable water from the County. Potable water is supplied through the Dare County Transmission Main to two metered connections located at the Town's two booster pump stations at Eighth Street and Old Town Hall. The Dare County Transmission Main can be seen in **Figure 3-2**.

The Eighth Street facility was the site for the Town's original water treatment plant, built-in 1963. It was converted into a booster pump station in the 1980s. The facility has one 200,000-gal cast-in-place concrete ground storage tank (GST), one 500,000-gal cast-in-place concrete GST, and a 250,000-gal welded steel, multi-legged elevated storage tank (EST). Water is delivered from Dare County into the GSTs. The facility receives water from Dare County into the two GSTs. Three 1,200 gpm, 75-hp vertical turbine pumps operate automatically to maintain the level in the EST by pumping water from the GSTs. The facility also houses a chlorine gas feed system for boosting the chlorine residual prior to distributing it to the Town's customers.

The Old Town Hall facility was built in 1983 as an addition to the fire station maintenance building. The facility has a recently rehabilitated 500,000-gal prestressed concrete GST and a recently constructed 400,000-gal welded-steel pedesphere EST. The facility receives water from Dare County into the GST. Three 1,600 gpm, 100-hp pumps automatically operate to maintain the level in the EST by pumping from the GST. Similar to Eighth Street, the facility also houses a chlorine gas feed system for boosting the chlorine residual. The Eighth Street and OTH facilities are summarized in **Table 3-1.** The location of the Town's water facilities and Dare County connection points can be seen in **Figure 3-1**.

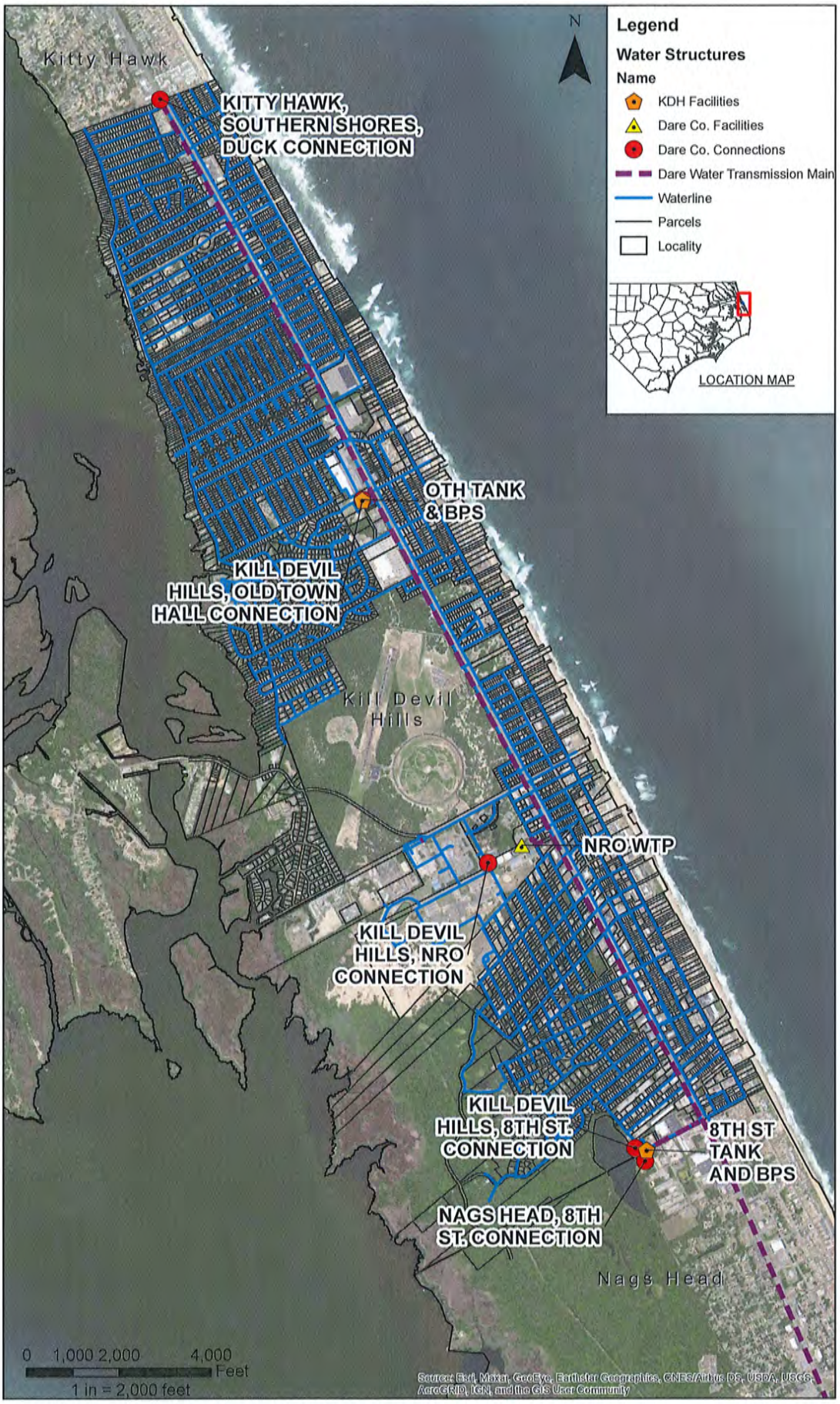

FIGURE 3-1: Existing Kill Devil Hills Water System

FIGURE 3-2: Dare County Transmission Main

Table 3-1: Existing Facilities Summary

PARAMETER	VALUE
EIGHTH STREET TANK AND PUMP STATION	
Number of pumps, Duty / Standby	2 / 1
Type	Vertical Turbine
Make / Model	American Turbine / 12-H-150
Pump Rated Flow, gpm / Head, feet	1200 / 175
Motor Horsepower, each	75
Ground Storage Tanks, concrete	0.20 and 0.50 MG
Elevated Storage Tank, multi-legged	0.25 MG
OLD TOWN HALL TANK AND PUMP STATION	
Number of pumps, Duty / Standby	2 / 1
Type	Horizontal Split Case
Make / Model	Paco / 29-60161
Pump Rated Flow, gpm / Head, feet	1600 / 165
Motor Horsepower, each	100
Ground Storage Tank, prestressed concrete	0.50 MG
Elevated Storage Tank, pedesphere	0.40 MG

The Town's water distribution system was originally constructed in the 1960s and contains asbestos cement (AC), ductile iron (DI), polyvinyl chloride (PVC), and high-density polyethylene (HDPE) pipe. The AC pipe is the oldest in the system, and since 2002 the Town has been continuously replacing the pipe with a long-term goal of replacing all AC pipe in the system. The Town owns approximately 422,000 linear feet (LF) of water piping. Pipe size ranges from 2" for small service connections and minor mains to 16" for larger transmission mains. **Table 3-2** and **Table 3-3** and provide data on the existing distribution system, including pipe size and material. See **Figure 3-3** for a map of all existing pipes colored by diameter. See **Figure 3-4** for a map of all existing pipes colored by material.

Table 3-2: Distribution System Materials

Pipe Diameter	Material	Length (LF)	Percent of Total System Length
2-16	PVC	315,140	75.4%
2-16	DI	10,898	2.6%
3-10	AC	90,280	21.6%
16	HDPE	1,670	0.4%
Total		**417,988**	**100%**

Table 3-3: Distribution System Inventory

Pipe Diameter	Material	Length (LF)	Percent of Total System Length
16	PVC	32,106	7.7%
	DI	695	<1%
	HDPE	1,670	0.4%
12	PVC	799	0.2%
	DI	0	0%
	AC	0	0%
10	PVC	3,048	0.7%
	DI	155	<1%
	AC	1,121	0.3%
8	PVC	74,610	17.9%
	DI	1,287	0.3%
	AC	21,255	5.1%
6	PVC	130,794	31.3%
	DI	8,518	2.0%
	AC	55,438	13.3%
4	PVC	6,181	1.5%
	DI	159	<1%
	AC	11,842	2.8%
3	PVC	0	0%
	DI	0	0%
	AC	624	0.2%
2	PVC	67,602	16.2%
	DI	84	<1%
	AC	0	0%
Total		**417,988**	**100%**

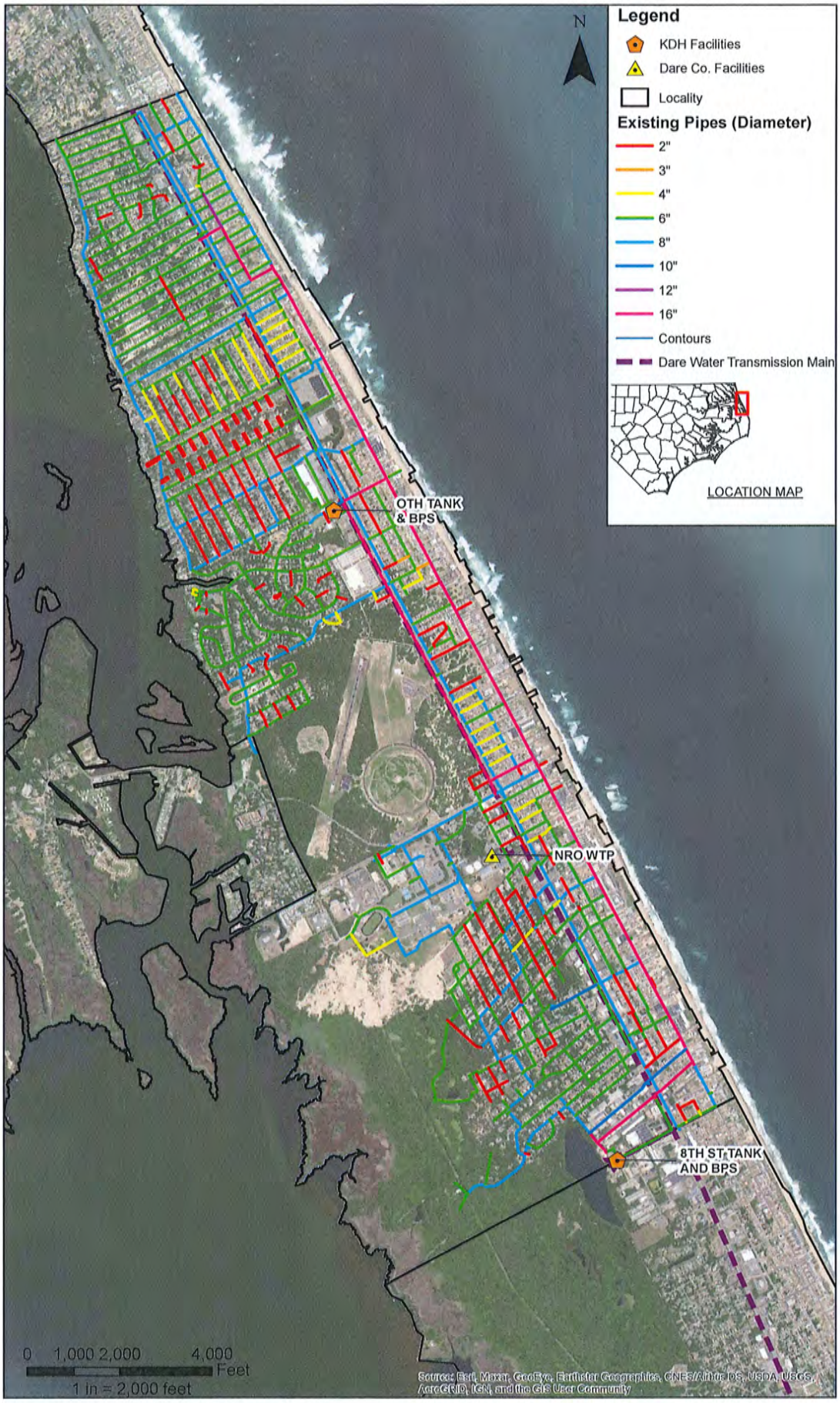

FIGURE 3-3: Existing Waterline Diameter

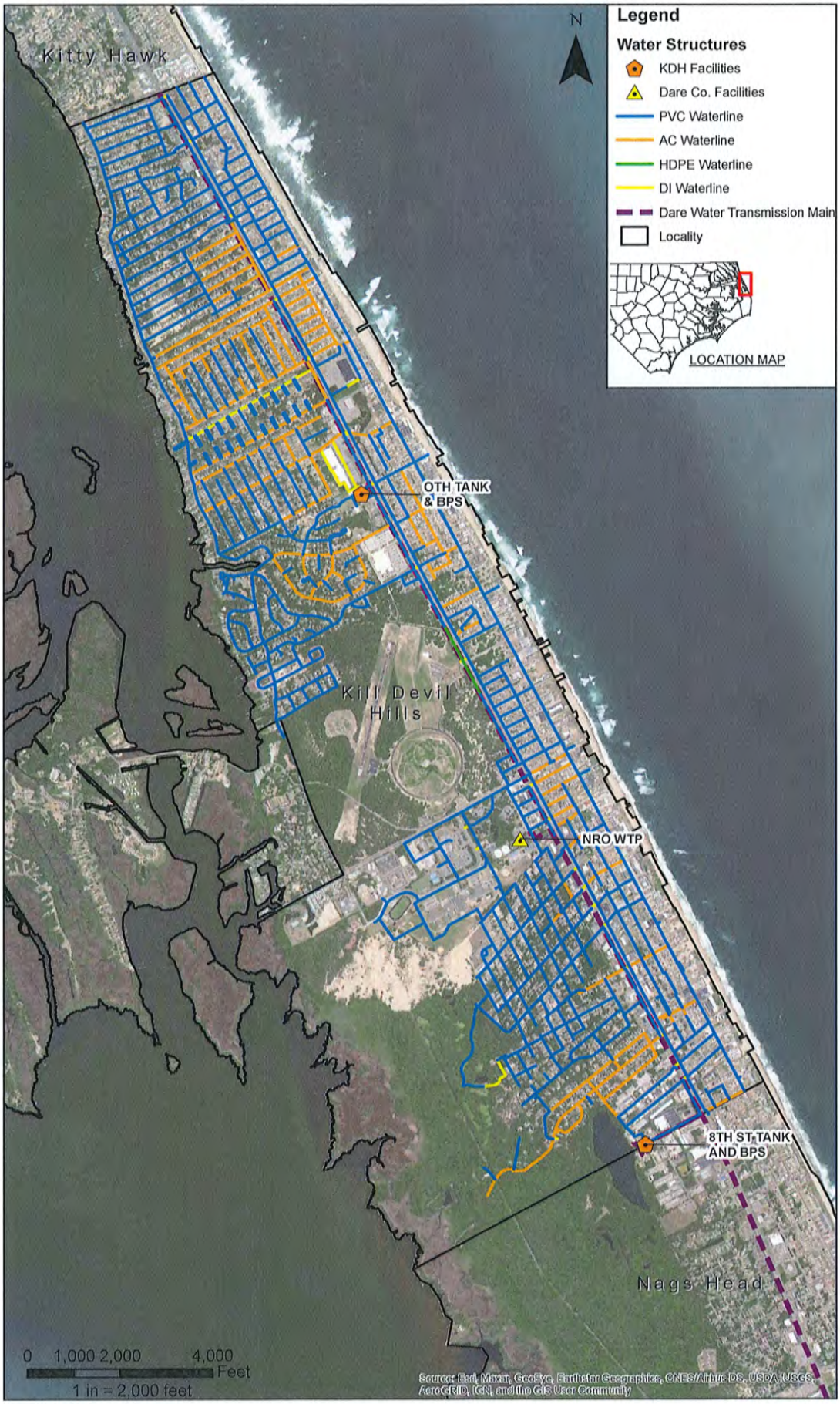

FIGURE 3-4: Existing Waterline Material

The Town uses an automated meter reading and billings system initially installed in the 1980s. Since then, the Town continues to upgrade their meter reading equipment and software. In the last eight years they have transitioned from Sensus to Badger meters in conjunction with Beacon software which offers advanced technology. This is a drive by reading system with the capabilities of leak detection. The meters are read every three months and processed for quarterly billing.

Treated water entering the Town's system is metered at the Eighth Street and OTH facilities. The yearly volume purchased between 2010 and 2019 ranged from a high of 460 MG in 2010 to a low of 400 MG in 2017. In 2019, the quarterly volume purchased ranged from 61 MG in the first quarter to 141 MG in the third quarter. This represents a typical trend of the Town purchasing (and consuming) higher volumes of water during the summer months when tourism peaks. The total volume of water purchased in 2019 was 403 MG.

During 2019, the Town sold a total of 361 MG to customers, with quarterly sales ranging from a low of 55 MG in the first quarter to a high of 137 MG in the third.

In 2003, the American Water Works Association (AWWA) abandoned the use of the term "unaccounted-for water" because all volumes of water supplied within a distribution system go toward beneficial consumption or wasteful loss. The industry-standard term is now "non-revenue water" (NRW) which includes the sum of water loss and any authorized, unbilled consumption that occurs in the distribution system. The NRW is commonly calculated as the difference between water purchased or produced and water billed. For the calendar year 2019, the Town's non-revenue water was 42 MG. This difference is due primarily to fire department usage, flushing, and other non-revenue water such as leakage. Fire department usage for 2019 is 0.125 MG, leaving most of the difference as system leakage or other losses. A summary of the Town's water consumption and NRW can be seen in **Table 3-4**.

Table 3-4: Kill Devil Hills Purchased Water and Consumption

Year	Total Water Billed to Customers (MG)	Total Water Purchased from Dare County (MG)	Non-Revenue Water (MG)
2015	363	439	76
2016	347	419	72
2017	337	400	63
2018	346	407	61
2019	361	403	42

NRW can be a combination of many different factors including leakage, unmetered public use, unregistered consumers, flushing, or other uses. The decrease in the Town's NRW is likely due to the replacement of older pipes in the system, and improved metering. In 2003, the AWWA also abandoned the use of a percent of system input volume to measure water loss performance in favor of a suite of key performance indicators for water loss as outlined in the AWWA's Manual: *Water Audits and Loss Control Programs* (M36). A free Water Audit Software is available from AWWA to assist utilities to develop programs to manage all water loss components in distribution systems.

4 EXISTING AND FUTURE SERVICE REQUIREMENTS

4.1 POPULATION PROJECTIONS

Population projections for the Town have been drawn from the 2012 WSMP and the 2020 Land Use Plan. The projection provided in the 2012 WSMP estimates the population in 2020 as 8,647, and the population in 2030 as 10,014. Due to the significant population changes during the summer months, a population projection specifically during the peak season was included in the projections. These projections are shown in **Table 4-1**.

Table 4-1: 2012 WSMP Projected Population

Year	Permanent Population	Peak Seasonal Total Population
2016	8,018	48,018
2017	8,171	48,171
2018	8,327	48,327
2019	8,485	48,485
2020	8,647	48,647
2021	8,775	48,775
2022	8,904	48,904
2023	9,036	49,036
2024	9,170	49,170
2025	9,305	49,305
2026	9,443	49,443
2027	9,582	49,582
2028	9,724	49,724
2029	9,868	49,868
2030	10,014	50,014
2031	10,162	50,162

The Town updated its Land Use Plan in 2020. The Land Use Plan includes more up-to-date population projections through 2050, with much lower growth rates than those seen in the 2012 WSMP. The plan projects the Town's permanent population to be 7,172 in 2030. This is only a slight increase of the Town's estimated 2020 population of 7,012. There is a significant decrease in the population projected when compared to the 2012 report, with a much slower rate of growth.

Like with the 2012 projections, season population estimates are included in the Land Use Plan. The 2020 estimated peak season population is 37,668. The projected peak season population in 2030 is estimated to be 42,208. The population projections from the 2020 Land Use Plan can be seen in **Table 4-2**.

Table 4-2: 2020 Land Use Plan Projected Population

Year	Permanent Population	Peak Seasonal Total Population
2016	6,948	35,852
2020	7,012	37,668
2025	7,092	39,938
2030	7,172	42,208
2035	7,265	44,485

It should be noted that the 2020 certified population estimate from the State of North Carolina lists the population as 7,378, higher than the estimate provided by the 2020 Land Use Plan, but lower than the 2012 WSMP. For the purposes of demand projections within this report, the population projections from these sources were combined to provide a population estimate that is more accurate to the Town's actual rate of growth. The Town's population in 2016 was set to match that of the 2020 Land Use Plan, and a multiplier was applied to the projected population to create a growth rate similar to that of the 2012 WSMP while having more accurate current population values. The Town's projected population using this method is shown in **Table 4-3**.

Table 4-3: Average Projected Population

Year	2012 WSMP Permanent Population	Land Use Plan Permanent Population	Average Permanent Population	Peak Seasonal Total Population
2016	8,018	6,948	6,948	42,900
2017	8,171	6,964	7,119	43,300
2018	8,327	6,980	7,293	43,700
2019	8,485	6,996	7,333	43,900
2020	8,647	7,012	7,656	44,500
2021	8,775	7,028	7,962	45,000
2022	8,904	7,044	8,201	45,400
2023	9,036	7,060	8,365	45,800
2024	9,170	7,076	8,490	46,100
2025	9,305	7,092	8,617	46,500
2026	9,443	7,108	8,746	46,800
2027	9,582	7,124	8,877	47,200
2028	9,724	7,140	9,010	47,500
2029	9,868	7,156	9,145	47,900
2030	10,014	7,172	9,282	48,200
2031	10,162	7,188	9,421	48,600

Using this method, the permanent population in 2020 is estimated to be 7,656, slightly higher than the certified population estimate. This higher population will allow for demand projections to be more conservative and help the Town to be prepared for larger populations. A comparison between the 2012 WSMP, the 2020 Land Use Plan and this 2021 estimate can be seen in Figure 4-1 and Figure 4-2.

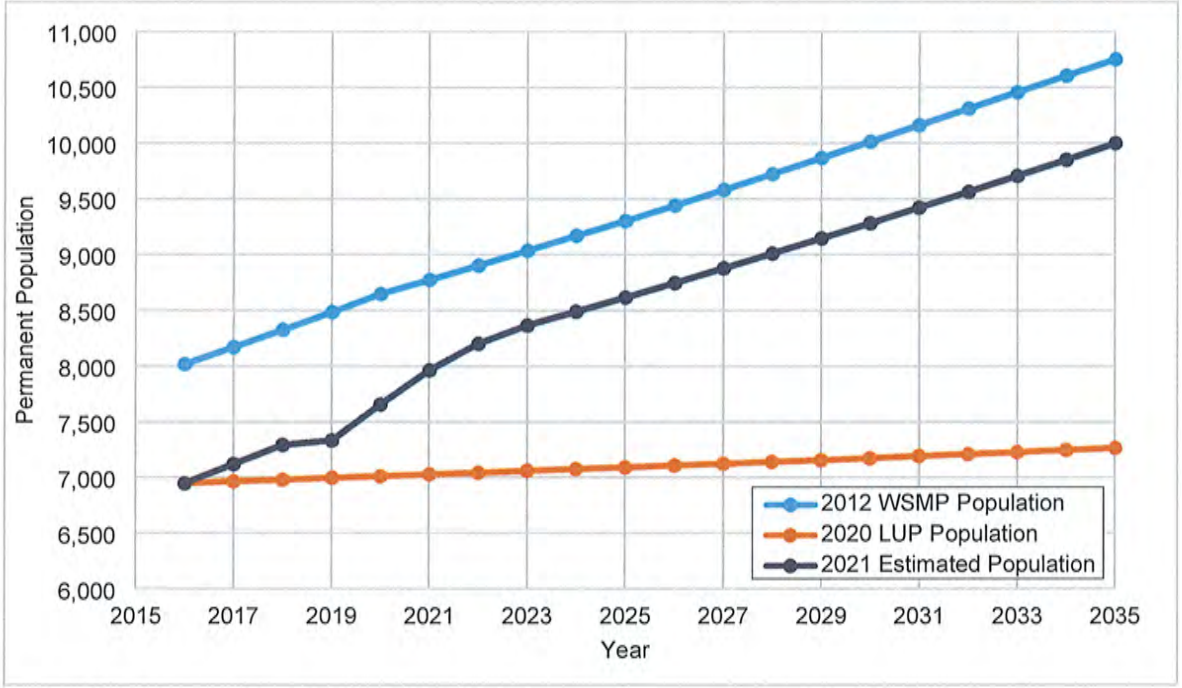

Figure 4-1: Permanent Population Estimates

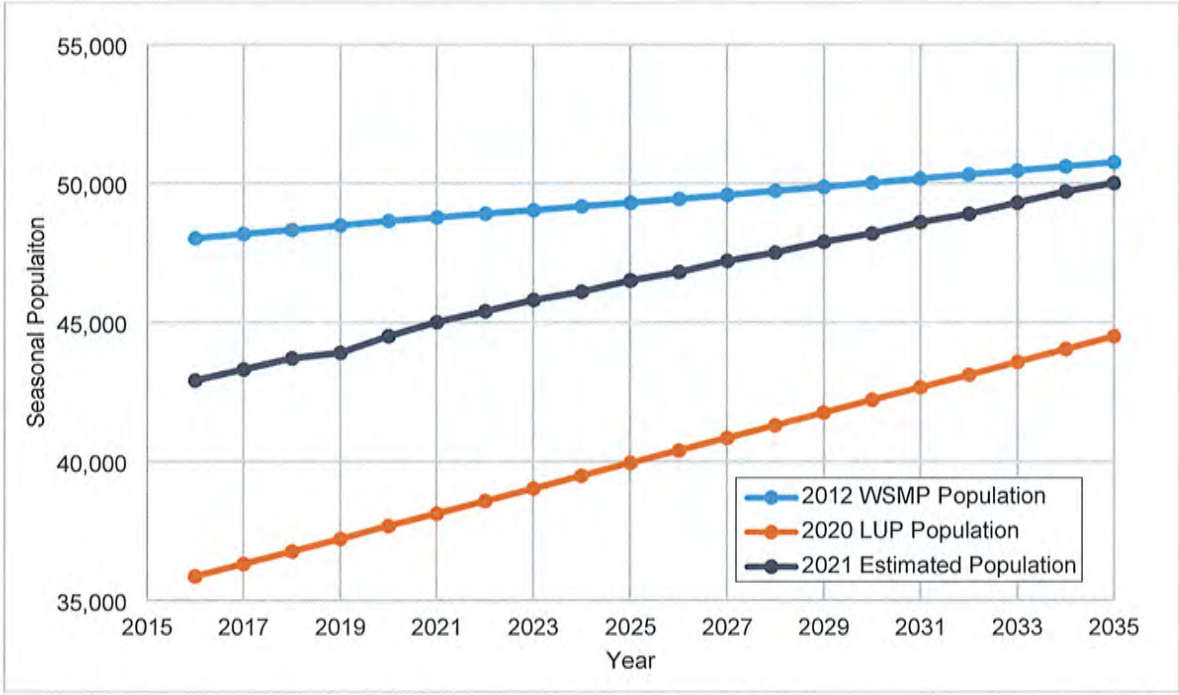

Figure 4-2: Seasonal Population Estimates

4.2 EXISTING WATER DEMAND

The existing demands were generated based on five years of data from January 2015 to December 2019. Monthly water meter data was provided by the Town and monthly flow reports were provided by Dare County and were summarized based on the following:

- Average daily demand (ADD), averaged over each year
- Maximum daily demand (MDD)
- ADD, averaged over peak season
- MDD, peak season
- ADD, averaged over off season
- MDD, off season

Based on the *2012 Water System Master Plan* report, peak season was assumed to be the months of March through November, while the off season was assumed to be November through April. **Figure 4-3** displays the Town's water use from calendar year 2015 through 2019.

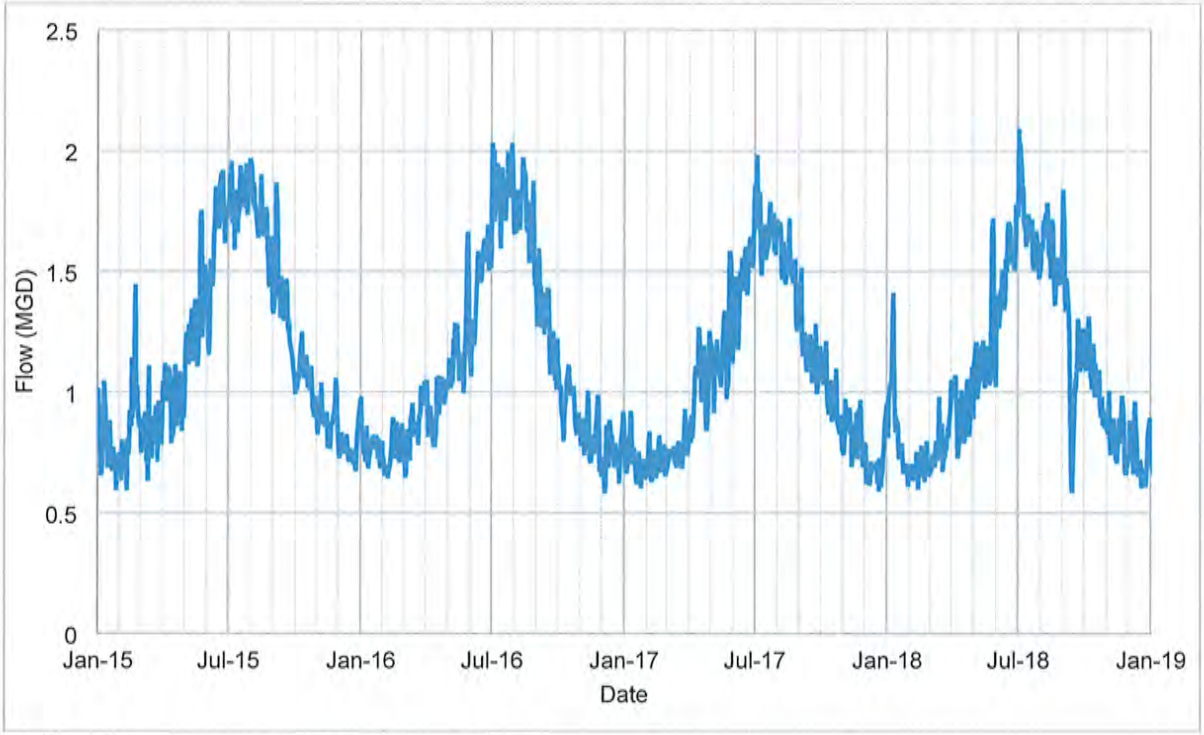

Figure 4-3: Water KDH System Use (2015-2019)

Water usage remains consistent from year to year, with much higher usage during the peak months. During the peak season, the highest flows are approximately 2.0 MGD. During the off seasons, the lowest flow is approximately 0.6 MGD. **Table 4-4** provides a demand breakdown by facility for the full year, peak season, and off season from 2015-2019.

It should also be noted that, due to the effects of COVID-19, the breadth of the Season increased in 2020 and 2021, as residents of the northeastern US found spring and fall vacations at the Outer Banks a viable option to, for example, Caribbean destinations. In these years, rental occupancies and roadway traffic made November population similar to September and March population similar to May. These trends seem likely to continue to some extent. While not increasing ADD or MDD, they will likely increase the yearly volume of water purchased.

Table 4-4: Kill Devil Hills Consumption Data (2015-2019)

	ADD (Year)	MDD (Year)	ADD (Peak Season)	MDD (Peak Season)	ADD (Off Season)	MDD (Off Season)
Eighth Street[1]	0.55	1.41	0.61	1.41	0.40	0.99
Old Town Hall[1]	0.56	1.37	0.62	1.37	0.41	1.12
KDH Supply Total	1.11	2.23	1.22	2.23	0.80	1.44
KDH Demand[2]	0.97	1.94	1.09	2.19	0.67	1.35

Note: All units MG
(1) Based on OTH and Eighth Street daily meter readings;
(2) Based on meter data provided by the Town of Kill Devil Hills

Consumption does not favor either of the pump station facilities, with each supplying similar flow to the Town. Future demand is not significantly higher than the demand in the existing system and remains below the 3.0 MGD supply agreement with Dare County. A per-capita demand value was calculated using the ADD during the peak and off seasons of 2020. The 2020 peak season ADD is 1.26 MG and the off season ADD is 0.74 MG. Using the 2020 peak seasonal population estimates, the peak season per-capita demand is 28.2 gallons per day (gpd). Using the 2020 permanent resident population estimates, the off season per capita demand is 97.2 gpd.

4.3 FUTURE WATER DEMAND

Using the 2020 per-capita demand values and the population projections from the calculated future population values, future demand values are calculated. **Table 4-5** shows the projected ADD and MDD for the peak and off seasons. ADD was calculated by multiplying the per-capita demand by the projected population from the Land Use Plan. MDD was calculated by applying a peaking factor of 1.76 to the peak season ADD values and a peaking factor of 1.42 to the off season ADD values. The peaking factor was calculated by dividing the 2020 MDD by ADD.

Table 4-5: Kill Devil Hills Future Demand

Year	ADD (MGD) (Peak Season)	MDD (MGD) (Peak Season)	ADD (MGD) (Off Season)	MDD (MGD) (Off Season)
2020	1.26	2.22	0.74	1.05
2021	1.27	2.24	0.77	1.10
2022	1.28	2.26	0.80	1.13
2023	1.29	2.28	0.81	1.15
2024	1.30	2.29	0.83	1.17
2025	1.31	2.31	0.84	1.19
2026	1.32	2.33	0.85	1.21
2027	1.33	2.35	0.86	1.22
2028	1.34	2.36	0.88	1.24
2029	1.35	2.38	0.89	1.26
2030	1.36	2.40	0.90	1.28
2031	1.37	2.42	0.92	1.30

In 2031, the ADD and MDD of the off season are projected to be 0.92 MGD and 1.72 MGD, respectively. The ADD and MDD of the peak season are projected to be 1.37 MGD and 2.58 MGD, respectively. Peak season MDD estimates through 2031 remain below the Town's purchase limit of 3.0 MGD, however as

demand continues to increase, peak season MDD for years beyond the planning period may surpass the purchase limit. These projected demand values are shown in **Figure 4-4**.

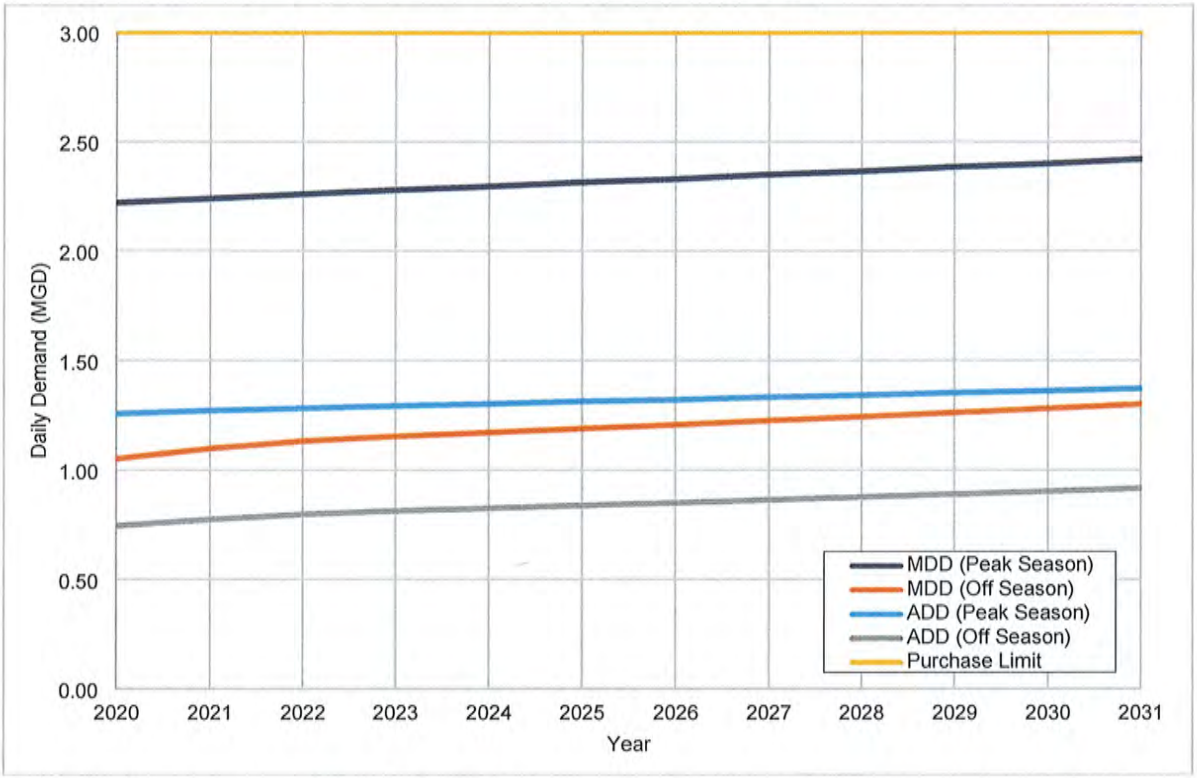

Figure 4-4: Future ADD and MDD

5 WATER SUPPLY

5.1 GENERAL

The Dare County Water Department is the supplier of all potable water to the Town of Kill Devil Hills, as well as surrounding localities. The County supplies water at two connection points to the Town's distribution system.

The Town has the ability to purchase up to 3.0 MGD of potable water from Dare County per the terms of the agreement between the County and the Town. The Town does not currently face any water quantity issues. Per the 2019 Kill Devil Hills Local Water Supply Plan, the Town requires an average of 1.0 MGD, with a maximum day demand of 2.2 MGD. While the Town may face increased demand in the future, it is not currently nearing the contractual purchase limits to its supply, nor are future demands projected to increase beyond the purchase limits.

The Town is subject to compliance with state and federal requirements for potable water. The Town does not currently face water quality issues. Dare County provides treatment for raw water in the Skyco and NRO plants, which is then pumped to the Town of Kill Devil Hills and other localities. The Town boosts the chlorine residual at the Eighth Street and Old Town Hall facilities through chlorine gas injection before water pumped into the distribution system. The levels of chlorine residuals, disinfection byproducts, lead and copper, and other constituent levels in distributed water are monitored by the Town to ensure they stay within acceptable levels.

5.2 WATER QUANTITY

Dare County operates several wells as the raw water source for the Skyco and NRO WTPs. The Skyco Plant is located on the nearby Roanoke Island. The plant draws raw water from 10 wells which is then treated through nanofiltration followed by sodium hypochlorite disinfection. Potable water is then pumped into the distribution system via the Dare County Transmission Main. The Skyco Plant is rated for 5.0 MGD. The NRO Plant is located centrally within the Town of Kill Devil Hills, on Mustian St. The plant draws raw water from 14 wells which is treated primarily through reverse osmosis followed by sodium hypochlorite disinfection. After treatment, potable water is pumped into the Dare County Water Transmission main for distribution. The NRO Plant is rated for 5.0 MGD, making the total forward flow rate of the two Dare County plants 10.0 MGD. **Table 5-1** provides details on each of the WTPs.

Table 5-2 provides details on Dare County's high service pump stations located at each WTP. The Town of Kill Devil Hills purchases water exclusively from the County, with up to 3.0 MGD available. It is written in the contract between the County and the towns of Kill Devil Hills and Nags Head that if the Dare County facilities have exceeded 90% for two (2) consecutive days and the towns exceed their allocations, the towns must pay to install additional treatment trains.

Table 5-1: Dare County Water Treatment Plant Information

WTP	Source	Treatment Process	Production Capacity (MGD)	Distribution Capacity (MGD)
Skyco WTP	10 wells	Nanofiltration for removing constituents	5.0[1]	6.0
NRO WTP	14 wells	Reverse osmosis to remove TDS and granular ferric hydroxide to remove arsenic	5.0	8.0
		Total	**10.0**	**14.0**

(1) According to the Dare County 2019 Local Water Supply Plan. The Dare County treatment facilities website lists the Skyco WTP capacity as 6.0 MGD (https://www.darenc.com/departments/water-department/facilities).

Table 5-2: Dare County Pump Station Information

PARAMETER	VALUE
Skyco WTP High Service Pump Station	
Number of pumps, Duty / Standby	1 / 1
Type	Horizontal Split Case
Make / Model	Ingersoll-Rand / 10x8x13 HOC II
Pump Rated Flow, gpm / Head, feet	4000 / 94
Motor Horsepower, each	125
NRO WTP High Service Pump Station	
Number of pumps, Duty / Standby	2 / 1
Type	Horizontal Split Case
Make / Model	Crane Deming / 5060
Pump Rated Flow, gpm / Head, feet	2800 / 54
Motor Horsepower, each	60

Between 2014 and 2019, the average daily production of Dare County varied from 5 and 7 MGD, with a maximum daily production of 12.4 MGD, which occurred in 2018. The average daily demand of the Town of Kill Devil Hills during the same period is approximately 1.1 MGD, with a maximum daily demand of 2.1 MGD, which also occurred in 2018. The MDD of the town is approximately 17% of the maximum daily production of the County from 2014 to 2019. The 2.1 MGD MDD of the town also remains below the contractual 3.0 MGD of water provided by Dare County to the Town. **Table 5-3** compares the water production of Dare County and the water demand of the Town from 2014 to 2019. **Figure 5-1** compares the monthly production of the County with the monthly consumption of the Town from 2016 to 2019 graphically. The Town's purchase limit of 3.0 MGD is also displayed. While the WTPs have exceeded 90% capacity on max days, the Town has not exceeded the purchase limit and is not required to pay for additional treatment trains. As long as the seasonal population does not increase drastically, the Town's consumption will continue to remain below the limits and will not be a concern. At the current rate of population growth, the Town should remain within the 3.0 MGD limit for the planning period.

Table 5-3: Dare County Production and Kill Devil Hills Demand Comparison

	Dare County		Town of Kill Devil Hills	
	Average Day Production (MGD)	Maximum Day Production (MGD)	Average Day Demand (MGD)	Maximum Day Demand (MGD)
2019	6.8	12.2	1.1	2.2
2018	6.7	12.4	1.2	2.1
2017	5.4	9.7	1.1	2.0
2016	5.6	10.2	1.1	2.0
2015	N/A*	N/A*	1.2	2.0
2014	6.5	N/A*	1.2	2.1

** Data not provided*

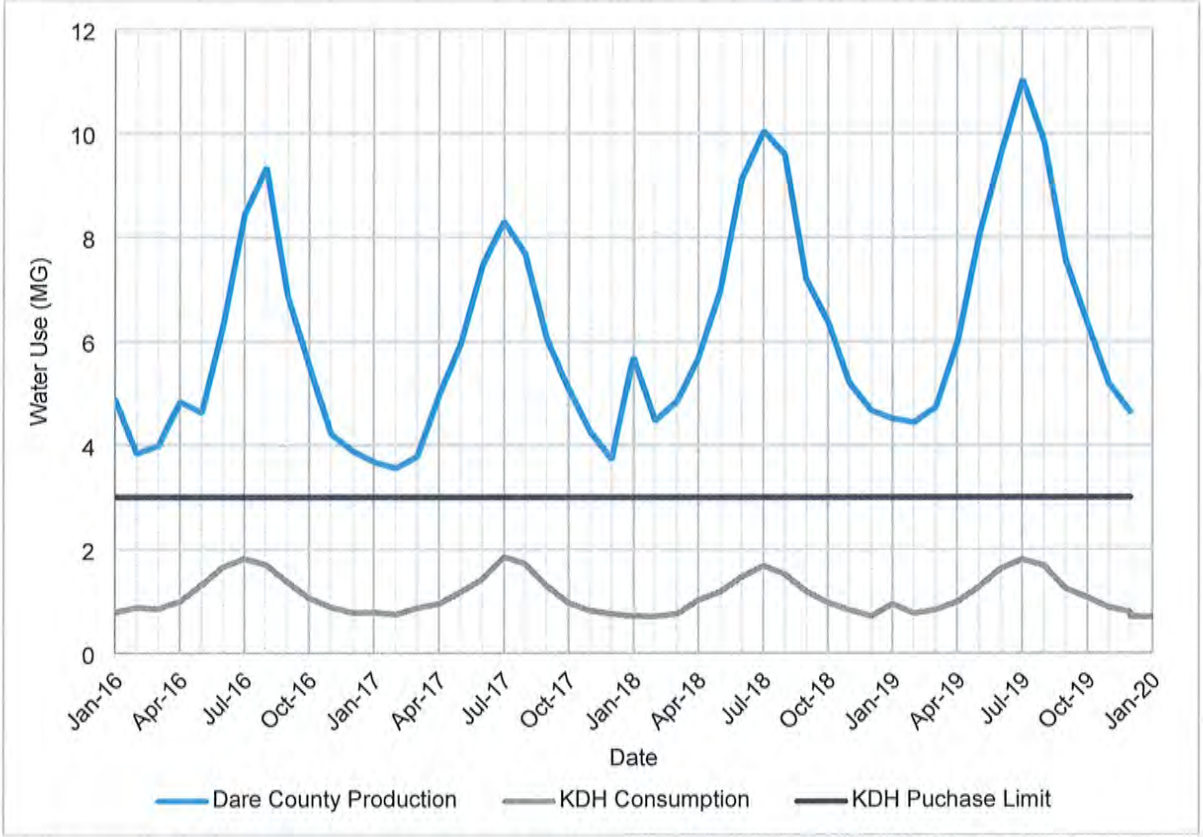

Figure 5-1: Dare County Monthly Production and Kill Devil Hills Monthly Demand Comparison

All community water systems must submit a local water supply plan (LWSP) every five years and update it yearly. The LWSP includes basic system information, water uses data, water supply source data, and wastewater information. The LWSP also includes population projection and demand data used for estimating the Town's future water usage. The Town submits an LSWP annually.

5.3 WATER QUALITY

The analysis of the Town's water quality included a comparison of water quality at the Dare County plants and within the Town's system with regulatory requirements, including any groundwater constituents, disinfection residuals, disinfection by-products (DBP), and lead and copper. This review focused on both primary and secondary contaminants in the water. Primary contaminants are contaminants that pose a risk to human health and are federally regulated and defined in the National Primary Drinking Water Standards by the Environmental Protection Agency (EPA). Primary contaminants are reviewed against the Maximum Contaminant Levels (MCL) set by the EPA. Secondary contaminants are contaminants that do not pose a health risk but may have other concerns such as aesthetics. In North Carolina, the North Carolina Department of Environmental Quality, Public Water Section (PWS) governs the recommended MCLs for the secondary contaminants and enforces quality standards. PWS has set enforceable MCL for iron and manganese at 0.30 mg/L and 0.05 mg/L, respectively.

Raw water initially undergoes treatment at either the Skyco or NRO plants before being pumped into the County's water transmission mains and ultimately into the Town's water distribution system. See **Table 5-1** for information on treatment processes at the WTPs. Dare County monitors the quality of finished water at each of the WTPs. The results of this monitoring can be seen in **Table 5-4**.

Table 5-4: NRO and Skyco WTP Distributed Water Quality

Parameter	NRO	Skyco	MCL
P-Alkalinity as $CaCO_3$, mg/l	0	0	N/A
Total Alkalinity $CaCO_3$, mg/l	20	104	N/A
Bicarbonate as HCO_3, mg/l	24	85	N/A
Carbonate as CO_3, mg/l	0	0	N/A
Hydroxide as OH, mg/l	0	0	N/A
Total Hardness as $CaCO_3$, mg/l	4	96	150[1]
Calcium Hardness as $CaCO_3$, mg/l	2	80	N/A
Magnesium as $CaCO_3$, mg/l	2	16	N/A
Color, C. U. (Color Units)	0	13	15[1]
Silica as SiO_2, mg/l	1	13	N/A
Conductivity as µS/cm	506	406	N/A
Iron, Fe mg/l	0.000	0.120	0.300[1]
Manganese, Mn mg/l	0.007	0.053	0.050[1]
Phosphate as PO_4, mg/l	0.89	1.23	5.00[1]
Chloride as CL_2, mg/l	150	110	250[1]
Fluoride, F mg/l	0.71	0.70	0.70-1.00 [1] 4.00 [2]
Nitrate as NO_3, mg/l	0.01	0.40	10.00[2]
Zinc, Zn, mg/l	0.320	0.410	5.000[1]
Chlorine (free CL_2), mg/l	0.69	0.28	0.20[3] 4.00[2]
Corrosiveness	-2.71	-0.43	N/A
pH	7.6	7.6	6.5 - 8.5[4]
pHs	10	8	N/A
Total Dissolved Solids, mg/l	255	308	500[1]
Sulfate as SO_4, mg/l	1	0	250[1]
Salinity, part per thousand (ppt)	0	191	N/A
Temperature as F°, Fahrenheit	71	73	N/A

(1) Recommended Max
(2) Mandatory Max
(3) Mandatory Min
(4) Mandatory Range

Source: Dare County Website Water Facilities (https://www.darenc.com/departments/water-department/facilities)

5.3.1 Chlorine Treatment and Disinfection Residuals

For systems using groundwater sources, PWS requires that treated water maintain a minimum free chlorine residual of 0.20 mg/L. Filtered water is disinfected with chlorine at the Skyco and NRO plants, before being pumped into the transmission main, and again at the Town's Eighth Street and OTH facilities. **Table 5-5** shows the average chlorine dosage data for the two facilities.

Table 5-5: Kill Devil Hills Average Chlorine Dosage (2015-2019)

Facility	Average Cl2 Used (mg/L)	Average Daily Cl2 Dosage (gpd)	Average Distributed Cl2 (mg/L)
Old Town Hall	1.81	0.40	1.06
Eighth Street	2.42	0.54	1.07

The Town measures the free chlorine concentration at each of the facilities daily to ensure the residual chlorine remains above acceptable levels. **Table 5-6** provides a summary of the free chlorine values at each facility from 2015-2019. **Figure 5-2** shows the free chlorine concentrations and **Figure 5-3** shows a 7-day running average of the free chlorine concentrations at the Eighth Street and OTH facilities from 2015-2019. As seen in both figures, free chlorine at the facilities typically remains above 0.20 mg/L. The Town typically records free chlorine levels between 1.0 and 1.2 mg/L, with averages of 1.06 and 1.07 mg/L recorded at the Eighth Street and OTH facilities, respectively. It appears that there are monitoring or recording errors, as on some days the Chlorine level drops to 0, as seen in **Figure 5-2**. According to the SCADA data provided by the Town, flow is recorded as 0 on the same days, signaling that the facility is offline or there are errors. The lowest non-zero chlorine concentration recorded is 0.34 mg/L, recorded at the Eighth Street facility.

Table 5-6: Free Chlorine Concentration Summary (2015-2019)

Facility	Average Free Chlorine (mg/L)	Maximum Free Chlorine (mg/L)	Minimum Free Chlorine (mg/L)
Old Town Hall	1.06	1.43	0.49
Eighth Street	1.07	1.52	0.34

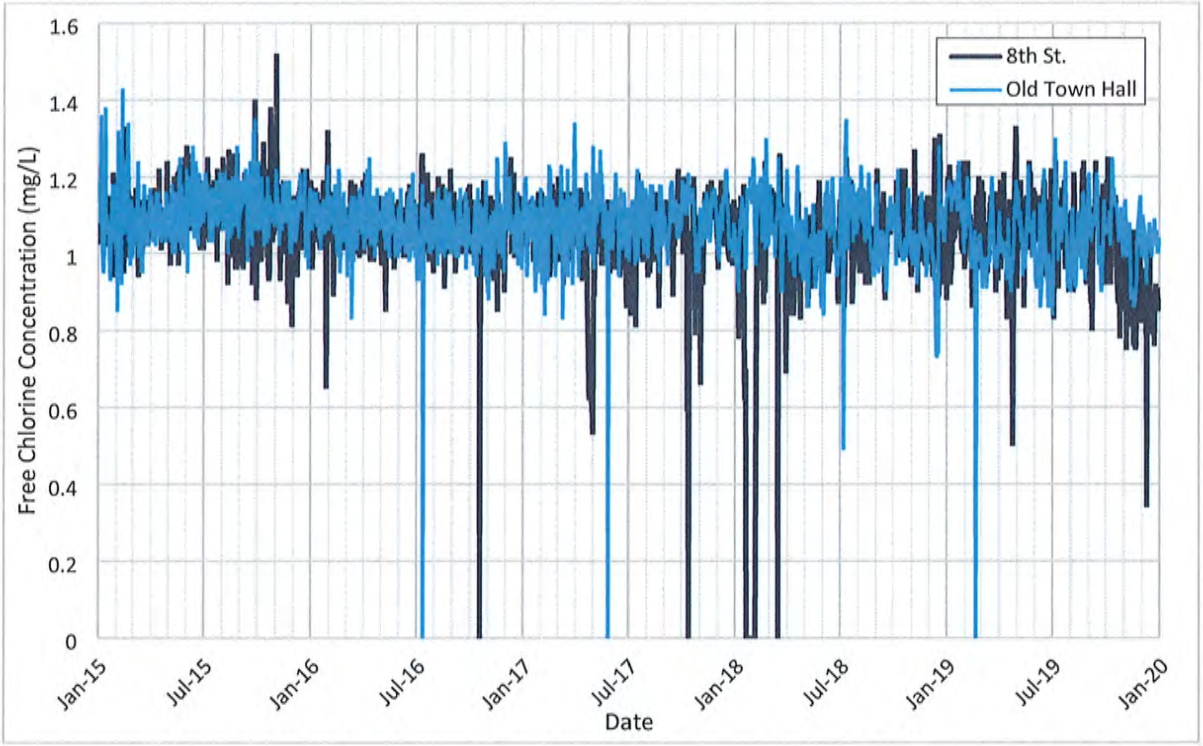

Figure 5-2: Free Chlorine Concentration

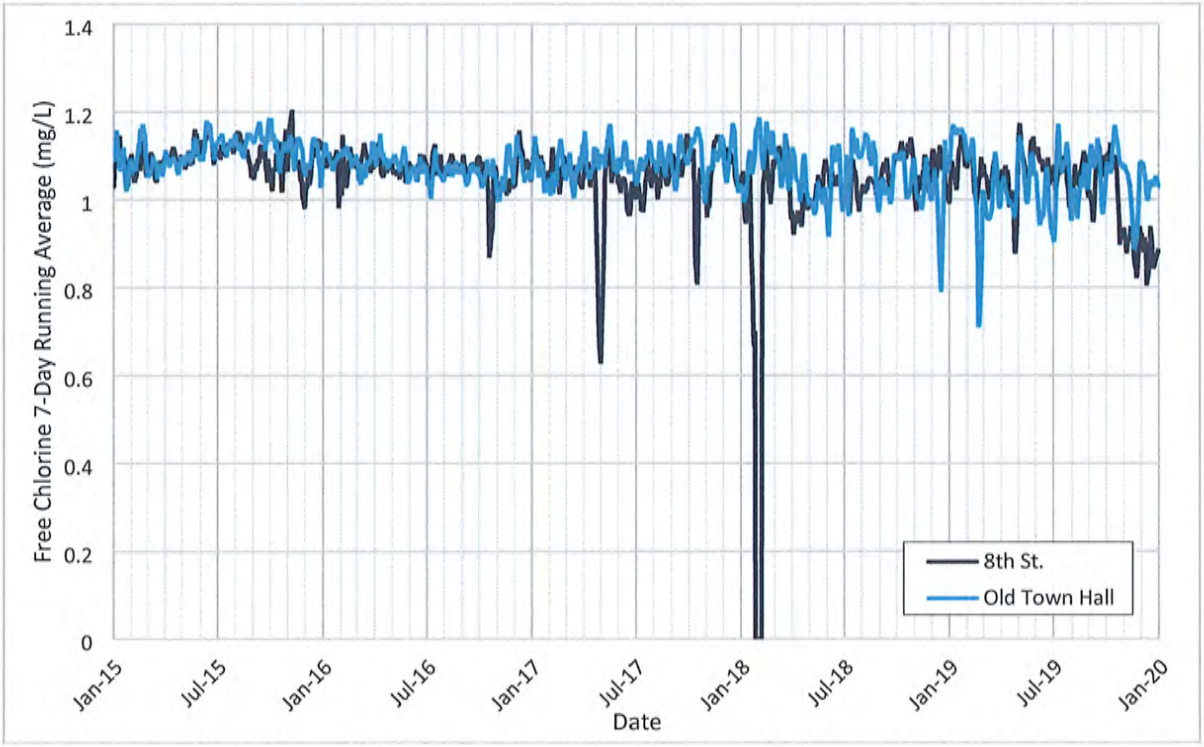

Figure 5-3: Free Chlorine Concentration Running Average

5.3.2 Disinfection Byproducts

Disinfection byproducts are produced through the reactions of chlorine with naturally occurring organic matter present in water. DBPs can potentially be harmful to human health, so the EPA sets MCLs for disinfection byproducts through the Disinfectants and Disinfection Byproducts Rules (DBPR). The Town of Kill Devil Hills must comply with Stage 2 DBPR. The DBPs that are restricted through these rules include total trihalomethanes (TTHM) with an MCL of 0.08 mg/L and 5 haloacetic acids (HAA5) with an MCL of 0.06 mg/L.

Disinfection by-products are measured for compliance through running annual averages (RAAs) under Stage 1 DBPRs, and locational running annual averages (LRAAs) under Stage 2 DBPRs. The RAA is calculated as an average of samples taken at each monitoring location throughout the Town's water system. The LRAA is calculated separately for each sampling location across the Town's system. The Town typically samples at various locations throughout the system, including:

- 406 Arch St.
- 528 Parkwood Dr.
- 500 West Eighth Street
- 1634 N Croatan Hwy.

Data for each of these sampling sites were provided for analysis. For 500 West Eighth Street and 1634 N Croatan Hwy., data from 2015-2017 was provided. Due to the nanofiltration upgrade to the Skyco WTP, the Town qualified for reduced disinfection byproducts monitoring, allowing for fewer samples to be taken and these sampling locations were removed in 2018. For 406 Arch St. and 528 Parkwood Dr. data from 2015-2019 was provided, with additional 2020 data from 528 Parkwood Dr.

The disinfection byproduct data for the sampling locations for the Town's water distribution system are presented in **Figure 5-4** through **Figure 5-7**. Each figure displays the DBP concentrations at all sampling locations, with **Figure 5-5** and **Figure 5-7** showing the LRAA for each of the locations. The figures also display the MCL as set by the EPA and the recommended levels of each DBP, incorporating a 20% safety factor. Sampling locations are shown on a map in **Figure 5-8**.

The maximum TTHM measurement of 0.08 mg/L was recorded at 528 Parkwood Dr. in September 2015, reaching the MCL of TTHM. However, since 2015 TTHM measurements at this location have been consistently below the recommended levels. In September of 2016, TTHM level of 0.074 mg/L was measured at 500 W Eighth Street While not above the MCL, this is above the recommended level. Elevated TTHM levels were likely caused by treated water from Skyco WTP, and concentration maximums and averages have decreased to acceptable levels since the aforementioned upgrade. Despite the high TTHM measurements, there have been no violations of the Stage 2 DBPR, as the LRAA of TTHM has remained below the MCL for all sampling locations from 2015-2019.

The maximum HAA5 measurement of 0.017 mg/L occurred at 500 W Eighth Street in June 2016 and is safely below both the MCL of 0.06 mg/L and the recommended level. The LRAA of HAA5 at each of the sampling locations consistently remained below the MCL and recommended levels. There are no violations of the Stage 2 DBPR for HAA5 concentration.

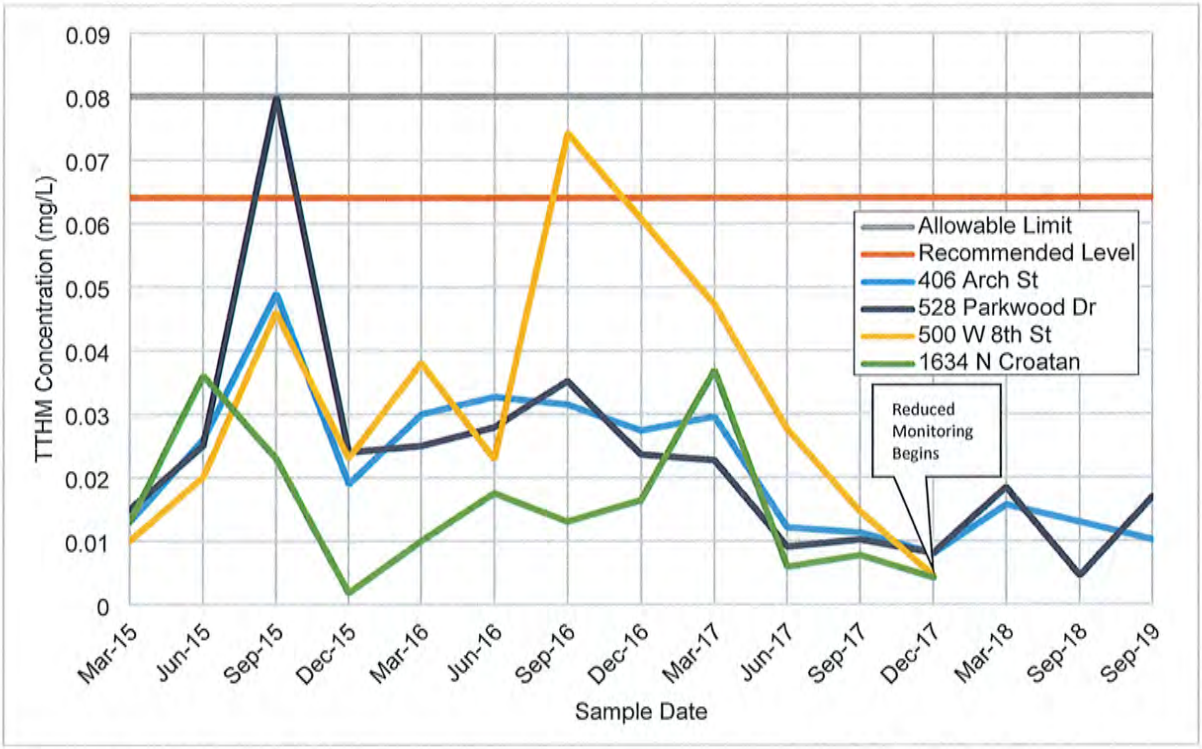

Figure 5-4: TTHM Concentration

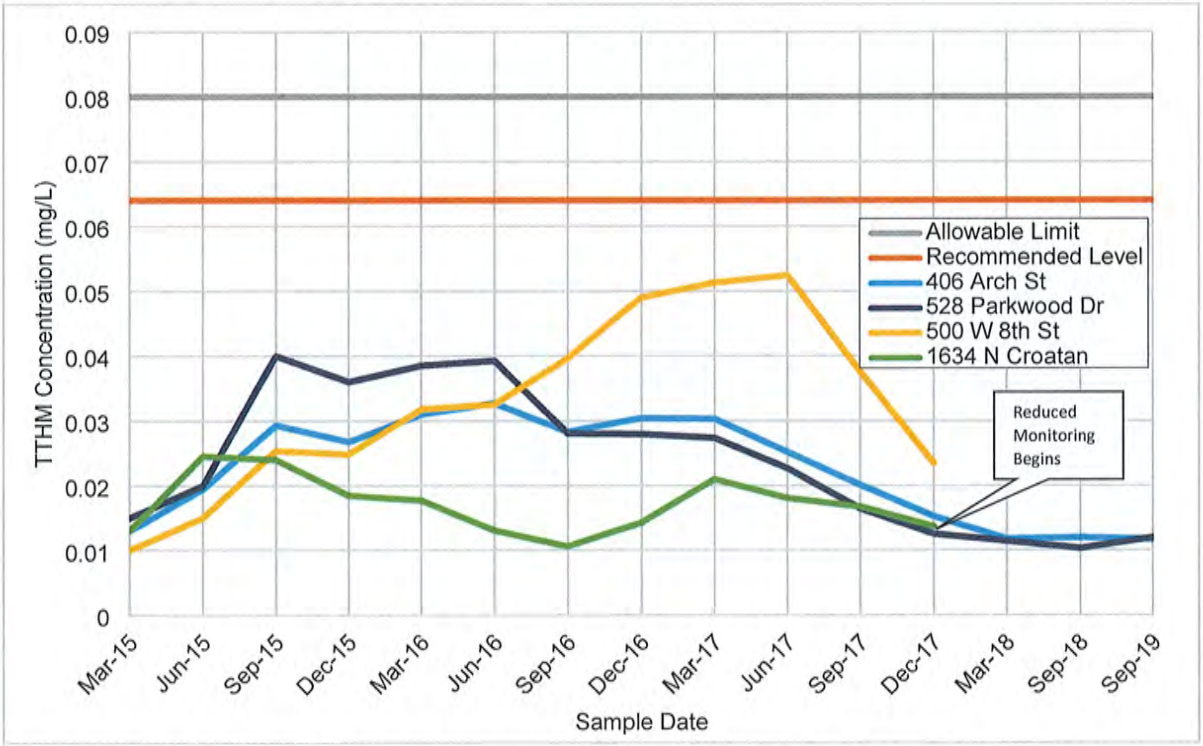

Figure 5-5: TTHM Concentration Locational Running Annual Average

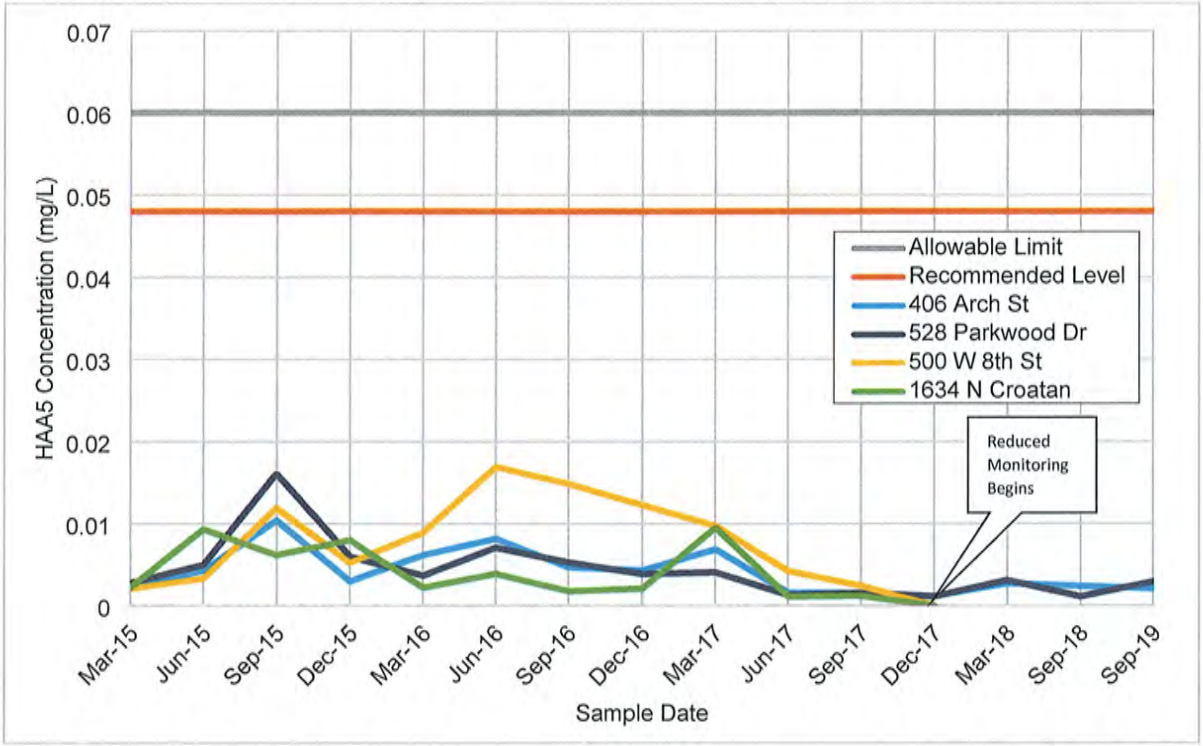

Figure 5-6: HAA5 Concentration

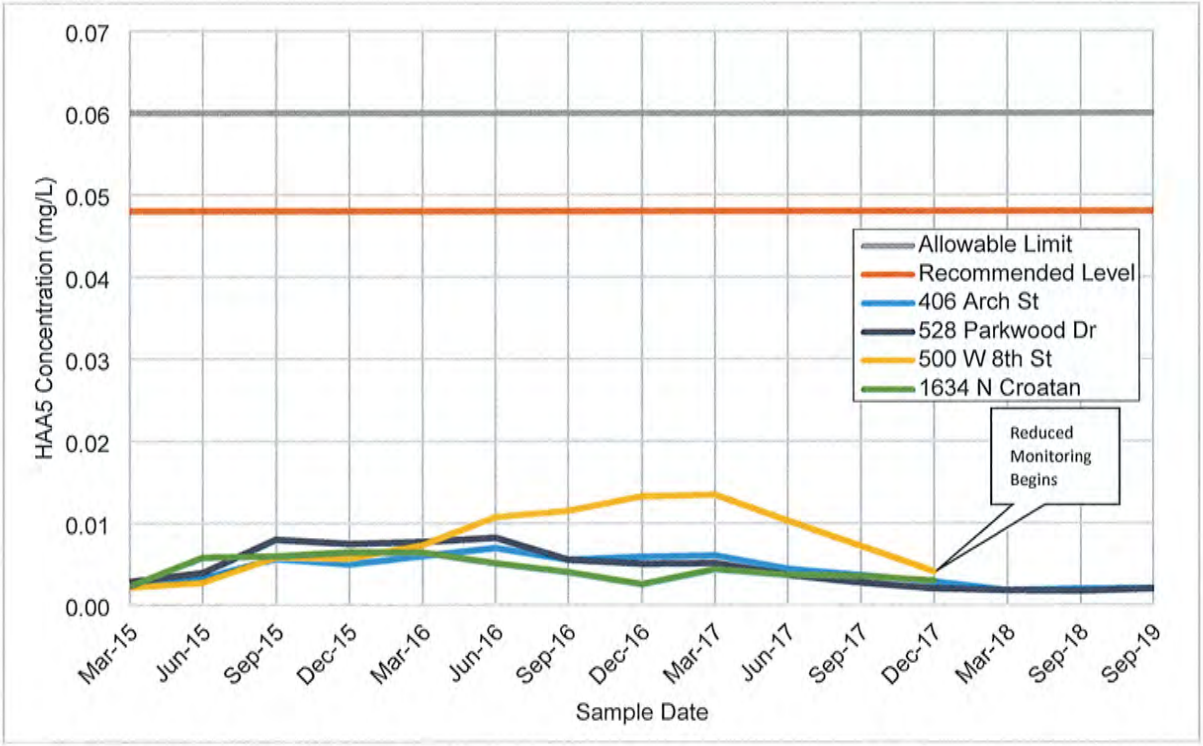

Figure 5-7: HAA5 Concentration Locational Running Annual Average

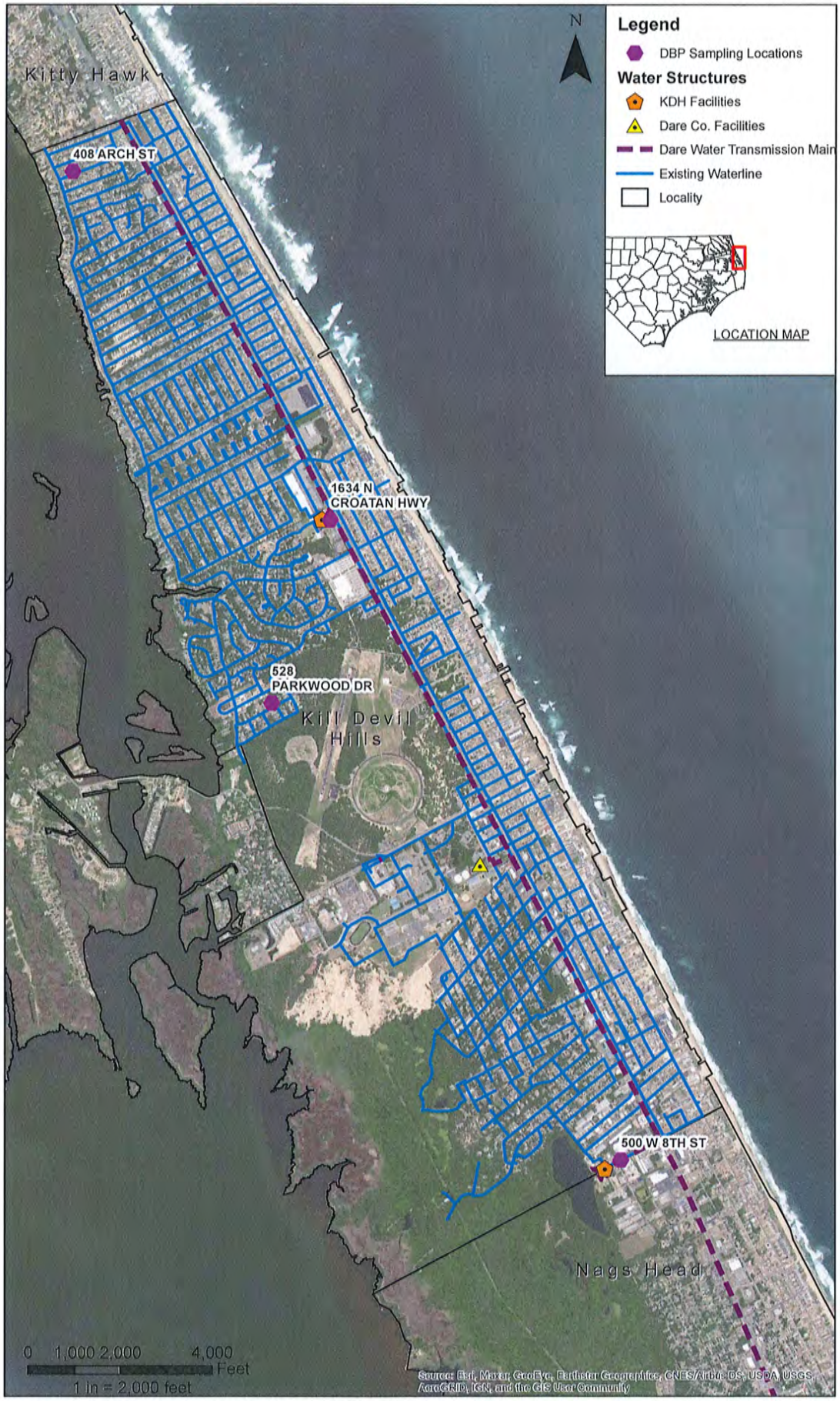

FIGURE 5-8: Disinfection By-Products Sampling Locations

5.3.3 Lead and Copper

Lead and copper primarily enter water distributions systems through pipes and plumbing materials. Both have been shown to cause health problems in humans ranging from stomach distress to brain damage, according to the EPA. Lead and copper in drinking water are regulated by the EPA through the Lead and Copper Rule (LCR). The LCR requires that lead levels in drinking water remain below the action level of 15 parts per billion (ppb) (0.015 mg/L) and that copper levels remain below the action level of 1.3 parts per million (ppm) (1.3 mg/L). If the 90th percentile values for either lead or copper concentration exceed the action level, the Town must take actions to control corrosion. If the 90th percentile value for lead concentration exceeds the action level, localities must also inform customers of the potential danger and steps to take to protect themselves.

The Town's lead and copper levels are both consistently below the action levels set by the LCR. The maximum lead concentrations recorded by the Town are 0.033 mg/L and 0.028 mg/L in April and May 2018, respectively. These individual values are above the action level for lead, but action only needs to be taken when the 90th percentile values rise above the action level. All other recorded values are below the action level. The 90th percentile value for lead remains at 0 mg/L for all data provided. The Town's maximum copper concentration is 0.496 mg/L, recorded in April 2018. This maximum is below the action level for copper. The highest 90th percentile value for copper is 0.31 mg/L, which occurred in 2012. This is below the action level for copper concentration. No additional action needs to be taken to protect customers from lead or copper in the Town's water.

5.4 SUMMARY

The following is a summary of the findings from the water quantity and water quality reviews:

- The contractual agreement between Dare County and the Town to provide 3.0 MGD of potable water is sufficient to serve the Town for the foreseeable future.
- A comparison of Dare County finished water with EPA and PWS standards shows that the County's WTPs are producing water that meets regulatory standards.
- Chlorine residuals at the Town's facilities are acceptable.
- TTHM concentration has exceeded the recommended levels in the past, however since the Skyco WTP upgrade TTHM concentrations have remained below the MCL and recommended levels.
- HAA5 concentrations are consistently below the MCL and recommended levels.
- Lead and copper concentrations are below the MCL.

5.5 RECOMMENDATIONS

The Town does not face any notable problems with the water quantity or quality. Provided the Town continues to be proactive in treating and monitoring finished water, little additional needs to be done to maintain high quality water. The following is a list of recommendations that the Town may take to ensure the long-term reliability of the water system:

- Stay aware of factors that may increase water demand/decrease water supply such as environmental factors or population growth rates.
- Continue to monitor water quality for contaminants and take action if contaminant levels rise above MCLs.

6 WATER DISTRIBUTION SYSTEM

6.1 GENERAL

This section addresses the Town of Kill Devils Hills's water distribution system and provides analyses of various portions of the system. These analyses include a hydraulic model and storage analysis completed as part of a previous PER and a condition assessment of the Town's above-ground facilities.

The condition of buried piping is not evaluated as a part of this study; however, the Town maintains a program to replace all the asbestos cement piping in the system. AC pipe is the oldest in the system and the most likely to be in poor condition.

6.2 HYDRAULIC MODEL

A calibrated hydraulic model of the Town's water system was developed as part of the Old Town Hall Elevated Storage Tank Replacement Preliminary Engineering Report (PER), completed by Dewberry and American Engineering in 2017. The following section summarizes the results of this model.

6.2.1 System Pressures

Minimum pressures were modeled assuming the initial tank levels were close to the bottom of the tank. Maximum pressures were modeled assuming the initial tank levels were at overflow level. **Table 6-1** summarizes the existing system pressure characteristics. As seen in **Table 6-1**, minimum system pressures did not drop below 43 psi and maximum system pressures did not exceed 67 psi. **Figure 6-1** displays the minimum and maximum system pressures for the existing system.

Table 6-1: System Pressure

SYSTEM PRESSURE
Minimum: 43 psi
Average: 60 psi
Maximum: 67 psi

The modeled pressures are within the normal operating range of water distribution systems. The low pressures modeled would not likely be observed as the Town typically operates the system well above the bottom of the elevated storage tanks. Currently, the OTH tank and Eighth Street tank operate at the same hydraulic grade line (HGL). This allows the Town to evenly distribute flow between the two tanks.

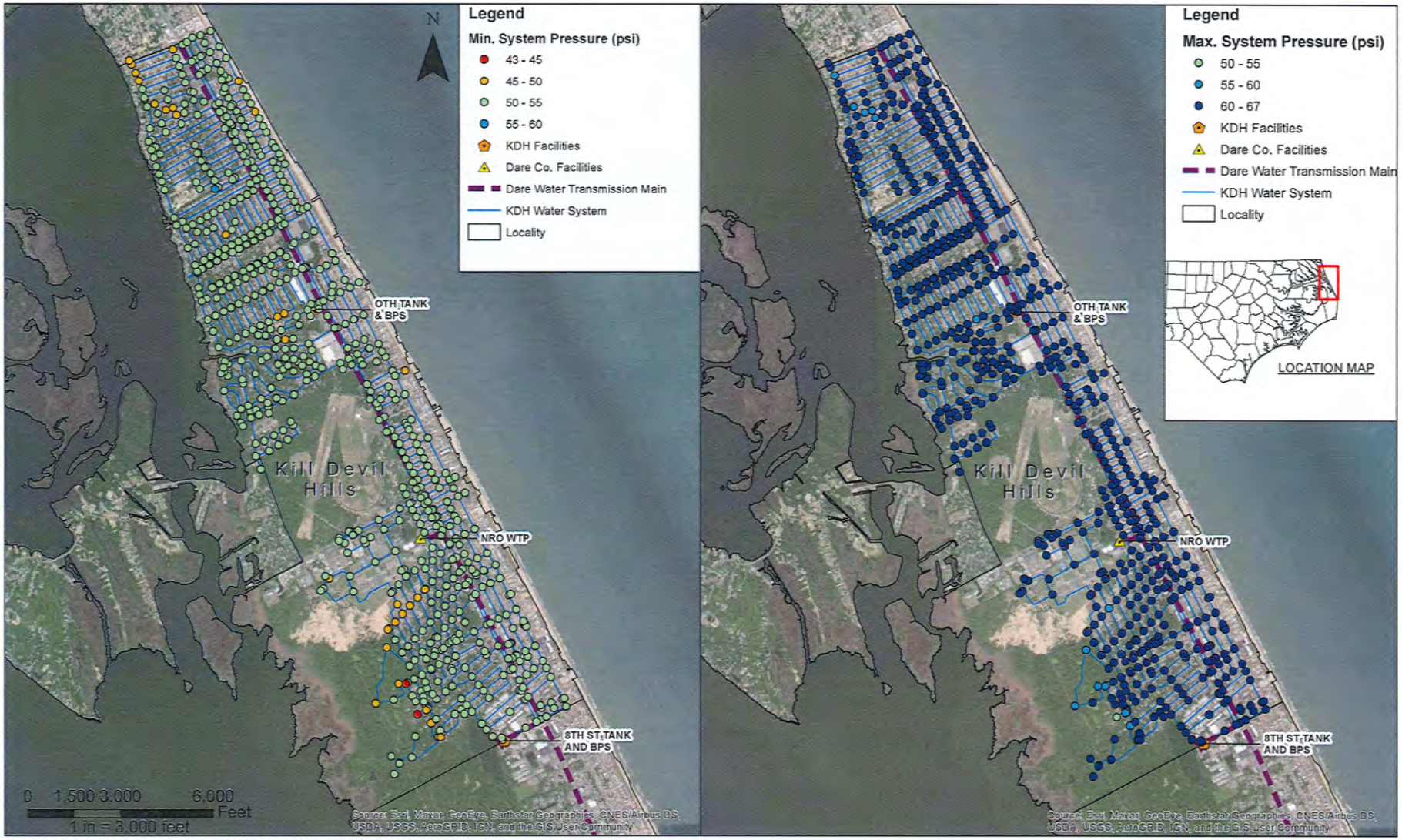

FIGURE 6-1: Minimum and Maximum System Pressures

6.2.2 Fire Flow Analysis

Over the past several years, the Town has undertaken capital improvement projects to make the system have higher water storage capacity, improve the flow of water between northern and southern ends of the system, and thereby improve system fireflows. Projects included addition of a 0.4 MG EST and construction of 16-inch water mains to improve system function.

Several scenarios were run simulating various fire flow scenarios. One scenario evaluates the instantaneous available fire flow throughout the water system. Instantaneous fire flow is a simple snapshot in time, based on the existing hydraulics of the system. The instantaneous available fire flow can be seen below in **Figure 6-2**.

Another scenario is an extended period scenario with a fire occurring at a single point in the system. A 5,000 gpm point demand was located on a node in two locations: the Outer Banks Beach Club Condominiums and at the northernmost end of the system. The scenario was run for 4 hours to see if the existing system had the capacity to meet the demand of a fire of that duration. The north end location was shown to be the more difficult location to provide 4-hr fire flow for, due to its location further from the ESTs. **Figure 6-3** shows the tank levels for the Old Town Hall and Eighth Street elevated tanks during a 4-hr fire flow at the north end simulation location. Due to its central location within the system, the OTH tank is more critical for fire protection.

The model indicates one limiting factor is the amount of flow received from Dare County. In the event of an extensive fire, the Town's emergency protocol is implemented; Dare County emergency staff are contacted and, if necessary, additional pumping capacity from the NRO or Skyco WTPs can be provided to the Town by Dare County.

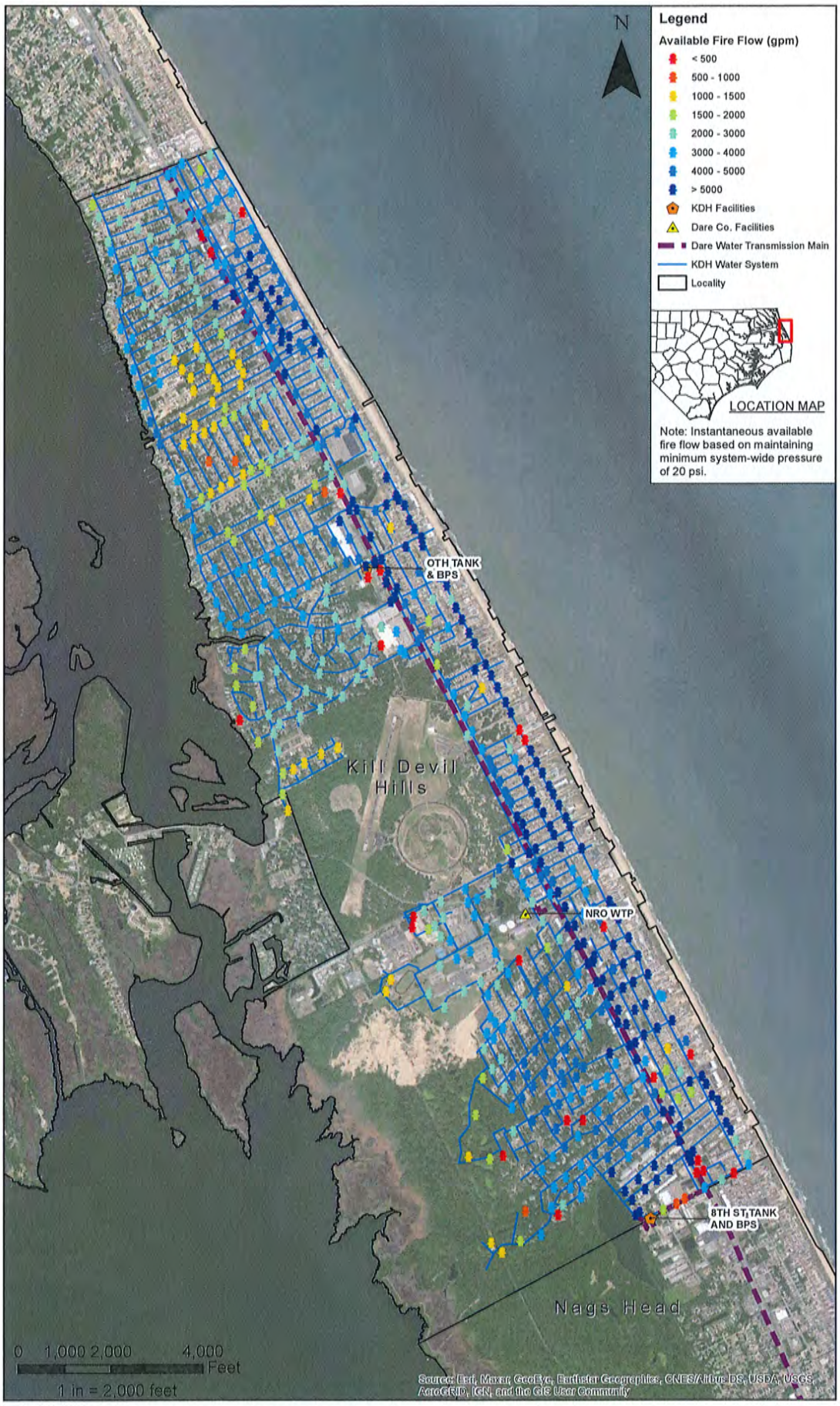

FIGURE 6-2: Instantaneous Available Fire Flow

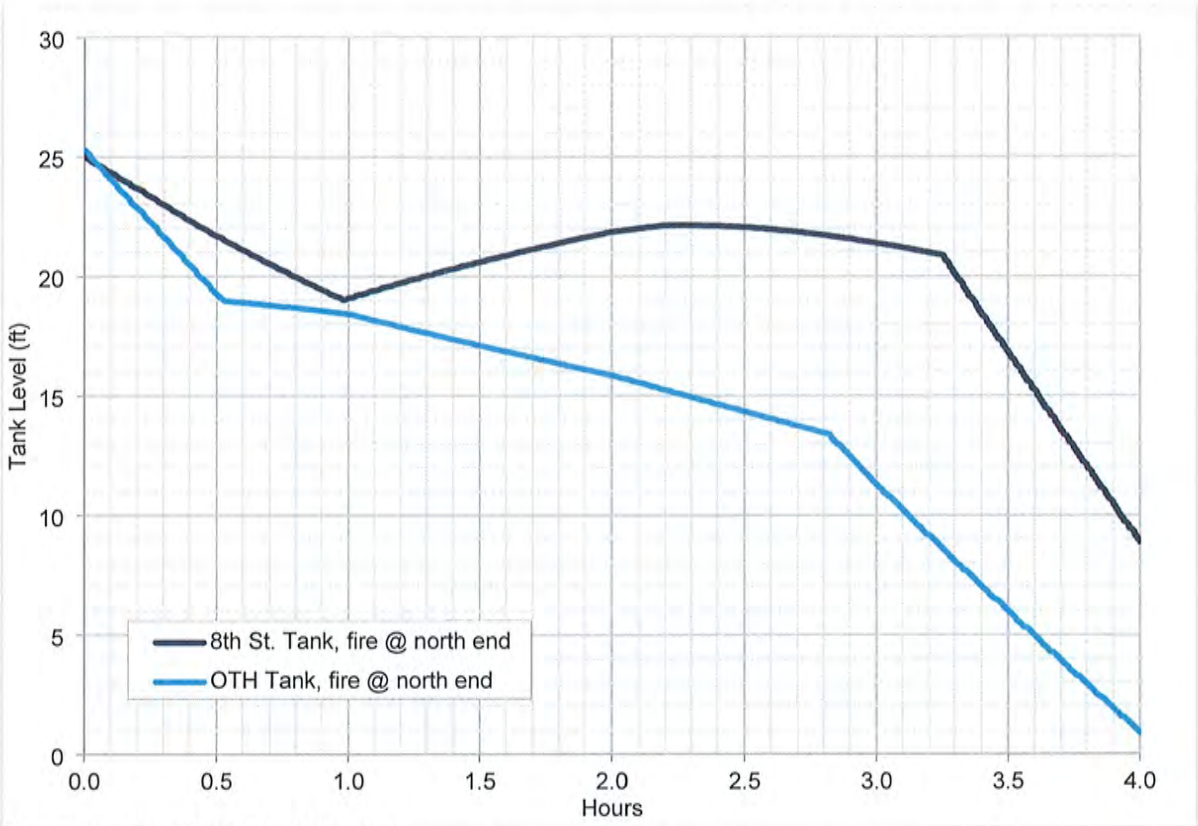

Figure 6-3: 4-hr Fire Flow Tank Levels

6.2.3 Water Age Analysis

The water age analysis was run as a 30-day (720-hour) scenario evaluating the water age starting from the Dare County System to the end consumer in the Town. The average day demand, off season, was used as it represents the least amount of demand on the Town's system, and therefore the highest potential water age. **Table 6-2** shows the average water age in the Old Town Hall elevated tank and within the Town's distribution system. The average water age in the Old Town Hall tank is 69.1 hours and the average water age in the system is 76.5 hours. Water age throughout the system can be seen in **Figure 6-4**.

Table 6-2: Average Water Age

Location	Average Age (hr)
OTH Elevated Storage Tank	69.1
System	76.5

Limiting the water age within a system helps to mitigate the formation of DBPs. Recent improvements to the Skyco WTP replaced the ion exchange system with a nanofiltration system. With this improvement, the formation of DBPs has significantly decreased due to the increased removal of natural organic matter in the water. The decrease in DBPs further ensures that the water age will not result in DBP formation issues within the Town's water system.

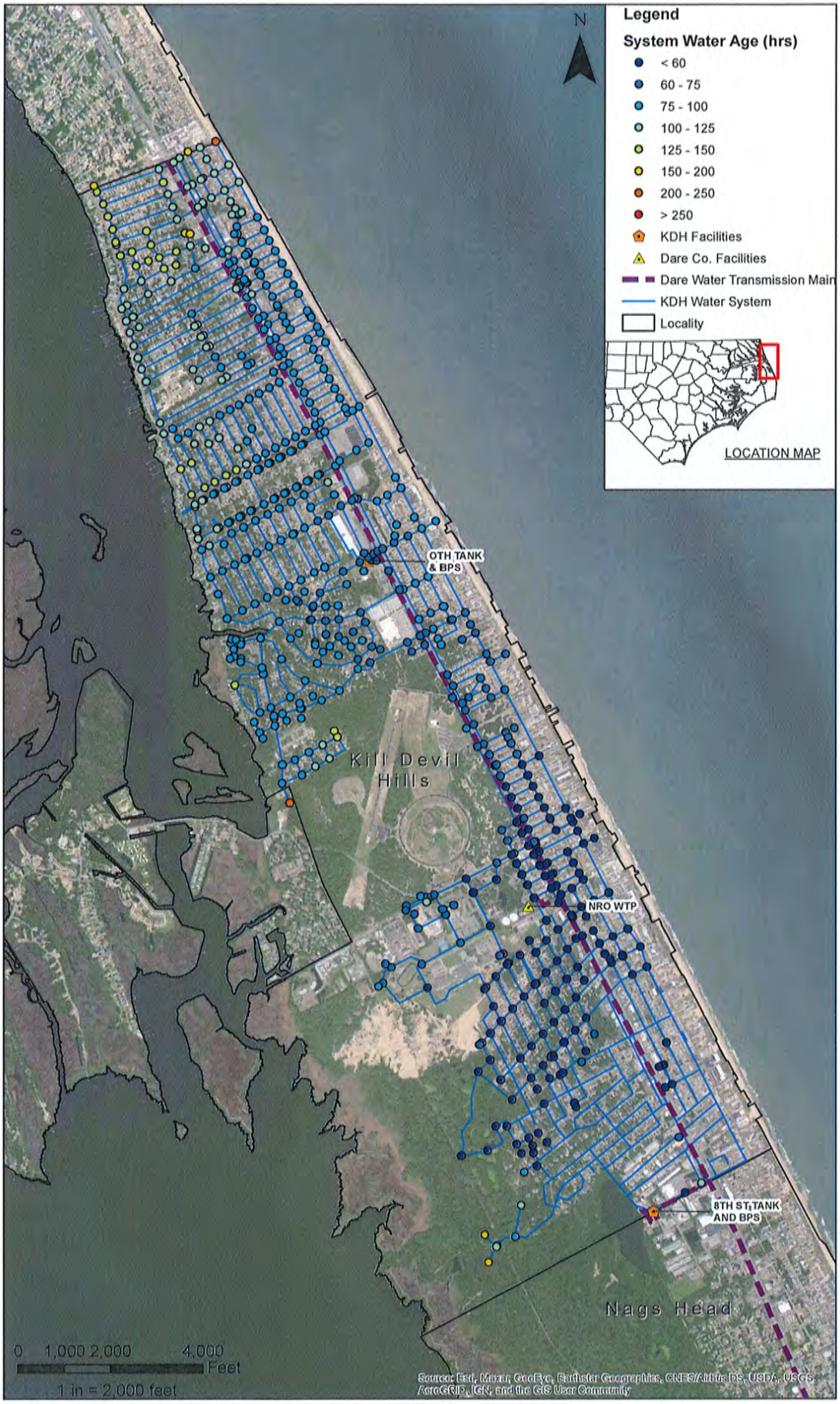

FIGURE 6-4: System Water Age

6.3 STORAGE EVALUATIONS

The North Carolina Department of Environmental Quality Rules Governing Public Water Systems requires a minimum system storage volume equal to one-half of the average annual daily flow. KDH currently has 1.85 MG of available storage between the three ground storage tanks and two elevated tanks. Current peak season ADD is 1.26 MG, projected to 1.44 MG by 2031. Under the current recommendations, the system has more than adequate storage to meet the requirements according to the NCDEQ recommendations.

When evaluating water storage, both equalization and fire flow storage are totaled to determine the minimum required storage. For the KDH system, the fire flow goal is 5,000 gpm for four (4) hours which requires 1.2 MG of water storage to serve the fire flow demand over the required period. Equalization storage is needed for a system to meet daily peak domestic demands and should be equal to approximately 1/3 of the maximum day demand over a 24-hour period per *AWWA Manual of Water Supply Practices M31*. Based on the 2017 Old Town Hall Elevated Storage Tank Replacement Preliminary Engineering Report (Dewberry), the future maximum daily demand during the peak season for KDH was estimated to be 1.83 MGD based upon demand through 2017. Based on the recommended equalization storage and fire storage required, the total recommended storage per AWWA standards was 1.81 MG. However, more recent data as of 2019 indicates that peak daily demands have reached 2.23 MGD.

As shown in **Table 6-3**, the total storage volume of the Town's existing water system is 1.85 MG. Based on current and projected demand, recommended system storage values are provided. The Town currently has long-term plans to increase the overall system storage by adding a second ground storage tank at Old Town Hall, to provide both additional storage and system redundancy, and replacing the Eighth Street EST with a larger EST. These improvements will allow the Town to meet the projected storage requirements.

Table 6-3: Water System Storage Volume

	Existing Storage	Recommended Equalization Storage (1)	Fire Storage	Total Recommended Storage (2)
2017	1.85	0.61	1.2	1.81
2021	1.85	0.74	1.2	1.94
2031	1.85	0.88	1.2	2.08

Note: All units MG.
(1) Equalization storage equal to 1/3 MDD, 1.83 MGD.
(2) Per AWWA M31.

6.4 EXISTING CONDITION OF ABOVE-GROUND FACILITIES

A condition assessment of the existing above-ground facilities owned by the Town was completed as a part of this WSMP. This assessment does not include an assessment of the ground storage tanks or elevated storage tanks. This condition assessment is included in **Appendix A**.

6.5 RECOMMENDATIONS

The following is a list of recommendations that the Town may take to ensure the long-term reliability of the water system:

- Complete the recommended improvements listed in the condition assessment included in **Appendix A**.
- Continue replacement of the AC pipe. Pipe replacement projects should incorporate valves and hydrants necessary to support the operation and maintenance of the system.

7 CAPITAL IMPROVEMENT PROGRAM

7.1 GENERAL

The Capital Improvement Program (CIP) includes a listing of capital projects to be performed over the next ten years. The program is designed to address both the condition and capacity of the existing facilities as well as prepare the Town for future growth. The intent of the CIP is to provide a plan for the Town to use for the next 10 years to address deficiencies, improve resiliency, and plan for growth. The CIP is intended to be flexible to provide the Town guidance, knowing that plans change and that emergencies arise that may require funds to be diverted. The CIP is then used to inform and develop the rate analysis presented in **Section 8**.

7.2 CIP WORKSHOP

Before finalizing the CIP, the Town and representatives from American and Dewberry held a CIP Workshop. The purpose of the workshop was to identify system improvements and projects for the development of the CIP. The Town benefits from having an existing system that is fully developed and robust with few critical projects necessary for redundancy or to replace failing infrastructure. The majority of capital projects identified were related to the Eighth Street and Old Town Hall facilities. The projects identified during the CIP Workshop are listed and described below.

7.2.1 Eighth Street CIP Projects

The following projects were identified to be completed over the 10-year planning period at the Eighth Street facility.

7.2.1.1 Isolation Valve and Check Valve Replacement

Each pump discharge at the Eighth Street pump station has an 8" check valve and an 8" gate valve on the discharge. These valves are aging and should be replaced in kind with new valves.

7.2.1.2 Yard Valve Replacement

The yard valves and hydrants throughout the Eighth Street facility are aging and should be replaced with new valves. Valves to be replaced under this project include the tank isolation valves.

7.2.1.3 Altitude Valve Vault Rehabilitation

The altitude valve vault for the elevated tank is showing wear and is beginning to deteriorate. To extend the operational life of the vault, it should be cleaned and recoated or completely abandoned/demolished. In addition, the 10" altitude valve in the vault is not used and is in poor condition. The valve should be evaluated to determine if it serves any purpose not considered. If it is determined that the valve is unnecessary, it should be removed so that any further deterioration does not negatively impact the performance of the elevated tank fill/discharge line.

7.2.1.4 Vertical Turbine Pump Cans Camera Inspection

The pump cans of the three vertical turbine pumps in the Eighth Street pump station should be inspected to ensure they are in good condition.

7.2.1.5 Maintenance Yard - Systems

Town staff has expressed interest in constructing a maintenance building similar to those used by the Town's Department of Public Works located on Bermuda Bay Blvd. This building would be located on the empty field immediately north of the Eighth Street facility and would include space for vehicle storage and maintenance as well as spare parts and equipment.

7.2.1.6 Building Renovation - Plant

Most of the second story of the pump station building is currently unused and can be converted into office space and a break area for operations personnel. While the exterior is in good condition, the interior is aging and could use a renovation to modernize the building including the laboratory.

7.2.1.7 Motor Control Center (MCC) Replacement

The existing MCC in the Eighth Street pump station retains components of the original MCC installed when the facility was constructed. To ensure the long-term reliability of the facility, the MCC should be replaced with modern technology. This is not an urgent upgrade and is not recommended to be completed within the 10-year planning period. However, the Town should plan for this eventual upgrade. It is recommended to replace the MCC when the variable frequency drives for the pumps are next replaced, in approximately 15 years.

7.2.2 Old Town Hall CIP Projects

7.2.2.1 New Swing Check Valves (Pump No. 1 and No. 2)

The two (2) older pumps (Pump No. 1 and No. 2) at the Old Town Hall Booster Station each have a flow control valve on the down stream side of the pump. Previously, this was used to prevent water hammer upon pump start up. However, the recent Old Town Hall Elevated Tank Replacement and Booster Station Upgrade installed soft starts on each of the pump motors and a third pump was added with a swing check valve. The installation of the soft starts renders the flow control valves unnecessary. The aging 8" flow control valves on the discharge of the two older pumps in the Old Town Hall pump station should be replaced with new 8" check valves identical to the check valve downstream of Pump No. 3.

7.2.2.2 Impeller Inspections and Replacement (Pump No. 1 and No. 2)

The impellers of the older two pumps (Pump No. 1 and No. 2) at the Old Town Hall pump station should be inspected to ensure that they are operating without damage. If the impellers are in poor condition, they should be replaced. To estimate the cost of this CIP project, it was assumed that both impellers would be replaced in-kind, along with the shaft, bearings, mechanical seals, and wear rings. This project should be coupled with the installation of the new 8" swing check valves on Pump No. 1 and No. 2 to minimize downtime of the station.

7.2.2.3 Ground Storage Tank Inspection

To ensure that the existing ground storage tank is in good condition, it should be inspected and any faults addressed. The tank inspection consists of an exterior inspection and an unmanned underwater vehicle (UUV) interior inspection.

7.2.2.4 Recoat Ground Storage Tank

To preserve the ground storage tank it should be periodically recoated. This CIP project includes both an interior and exterior recoating of the existing GST.

7.2.2.5 New 0.5 MG Ground Storage Tank

To provide system redundancy and increase the Town's water storage capacity, an additional 0.5 MG concrete GST will be constructed at the Old Town Hall facility. This tank could be located just southeast of the existing GST and would allow the Town to take one tank offline for maintenance while still retaining storage volume at the facility. The cost estimate for this CIP project includes the tank itself, as well as the necessary yard piping and miscellaneous improvements to the facility necessary to operate the tank.

7.2.2.6 New Generator and ATS

The existing generator at the Old Town Hall facility should be replaced to ensure the facility has reliable power during outages.

7.2.3 Water Distribution System CIP Projects

7.2.3.1 New Administration Building Generator

The existing diesel generator at the water system administration building is old and in need of replacement.

7.2.3.2 Water Meter Replacement

The Town has an ongoing effort to replace the aging water meters throughout the system. The remaining meters scheduled for replacement in Year 2 will allow for more accurate meter reading and billing by the Town.

7.2.3.3 Asbestos Cement Pipe Replacement

The Town has an ongoing program to replace the aging AC pipe throughout the system. This project will continue throughout the planning period. More details on this program are provided below.

7.2.3.4 Hydrant and Valve Replacement

The AC pipe replacement program will address many of the older hydrants and valves as the old pipe is replaced with new. However, in the areas of the Town where pipe is not replaced, periodic projects should be conducted for replaceing older hydrants and valves throughout the water system to ensure functionality of the valves and hydrants.

7.3 CIP PROJECT PHASING

7.3.1 Asbestos Cement Pipe Replacement Program

The Town has been proactively replacing AC pipe for a number of years. The impetus for replacement of AC pipe is not a health hazard, but instead, it is known to weaken as a material as it ages leading to breaks and leaks. At the previous iteration of this WSMP, 109,000 linear feet of AC pipe was identified. As noted in **Section 3.2**, the Town has just over 90,000 linear feet of AC pipe remaining in the system, accounting for just over 20% of the system by pipe material. These projects are typically coupled with street and drainage improvement projects in order to limit the disturbance to existing neighborhoods. There are no specific areas of AC pipe experiencing capacity or serious conditions problems so the projects can be performed in any order in coordination with street and drainage projects.

The Town has historically budgeted $1.4 million to complete an AC pipe replacement project approximately every two years. This has allowed the Town to plan and budget accordingly for these improvements and not overextend the Town's personnel resources required to complete these projects. For the purposes of this WSMP, the Town wishes to continue with this trend to perform a project every two years with the exception of several projects already planned for the first few years of the WSMP's period of study. Based on the current uncertainty in the construction market, it is recommended that the Town budget $2.0 million in 2021 dollars for each replacement project moving forward. **Table 7-1** summarizes the current, future, and total costs estimated for AC pipe replacement.

Table 7-1: Asbestos Replacement Program

Fiscal Year	Project Cost, 2021 Cost	Future Worth	Notes
2021-22	$ 1,300,000	$ 1,300,000	1
2022-23	$ 700,000	$ 700,000	1
2023-24	$ 900,000	$ 900,000	1
2024-25			
2025-26	$ 2,000,000	$ 2,252,000	2
2026-27			
2027-28	$ 2,000,000	$ 2,389,000	2
2028-29			
2029-30	$ 2,000,000	$ 2,534,000	2
2030-31			
2031-32	$ 2,000,000	$ 2,688,000	2
Total AC Pipe Replacement	**$ 10,900,000**		

1. Projects currently in development
2. Future costs based on 3% escalation per year

7.3.2 Short-Term Above-Ground Facility Improvements

Short-term CIP improvements are focused on improving the immediate functionality of the facilities and replacing any dysfunctional or aging elements. The Town has been proactive throughout the previous planning period, so the projects described here are also proactive and will help the Town keep the water system in good overall condition and ensure that nothing fails. It is recommended that pump inspections at both facilities occur within the next several years, as well as the check valve replacement at Old Town Hall and the gate and check valve replacement at Eighth Street. These projects should be completed over 2 years with the Old Town Hall projects being completed on one and the Eighth Street projects being completed on another. The generator replacements at both the Old Town Hall facility and the water administration building should also be completed soon due to the criticality of the generators. **Table 7-2** lists the short-term projects and provides a budgetary cost estimate for each.

Table 7-2: Short-Term CIP Projects

Facility	Improvement	Budgetary Cost Estimate
Eighth Street	New Isolation Valves and Check Valves	$43,000
Eighth Street	Vertical Turbine Pump Cans Camera Inspection	$20,000
Old Town Hall	New Swing Check Valves	$26,000
Old Town Hall	Impeller Inspections and Replacement	$62,000
Old Town Hall	New Generator & ATS	$206,000
Water Admin Building	New Generator & ATS	$30,000

7.3.3 Long-Term Above-Ground Facility Improvements

Many of the improvements listed in **Section 7.2** are intended to be implemented within two to ten years. The proposed years for these projects to take place are based on discussions held during and after the CIP Workshop. **Table 7-3** lists the long-term projects along with budgetary costs and fiscal year of the improvement.

Table 7-3: Long-Term CIP Projects

Facility	Improvement	Year	Budgetary Cost Estimate
Eighth Street	Maintenance Yard	2024-25	$2,250,000
Eighth Street	Building Renovation	2025-26	$300,000
Eighth Street	Yard Valve Replacement	2028-29	$148,000
Eighth Street	Concrete Vault Altitude Valve	2028-29	$50,000
Old Town Hall	Recoat Ground Storage Tank	2028-29	$153,000
Old Town Hall	New 0.5 MG Ground Storage Tank	2030-31	$1,500,000
Old Town Hall	Ground Storage Tank Inspection	2031-32	$11,000

7.4 CAPITAL IMPROVEMENT PLAN

The capital projects to be included in the CIP are presented below in **Table 7-4**. Costs in this table are presented as future costs and escalated 3-percent per year.

Table 7-4: Future Capital Improvement Program Project Costs

Year from projection	0	1	2	3	4	5	6	7	8	9	10	Beyond 2032
Fiscal Year	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	
Eighth Street New Isolation Valves and Check Valves			$43,000									
Eighth Street Yard Valve Replacement								$148,000				
Eighth Street Concrete Vault Altitude Valve								$50,000				
Eighth Street Vertical Turbine Pump Cans Camera Inspection			$20,000									
Eighth Street Building Renovation					$300,000							
Eighth Street Maintenance Yard				$2,250,000								
Eighth Street MCC Replacement												$347,000
Old Town Hall New Swing Check Valves		$26,000										
Old Town Hall Impeller Inspections and Replacement		$62,000										
Old Town Hall Ground Tank Inspection											$11,000	
Old Town Hall Paint Ground Tank								$153,000				
Old Town Hall New 0.5 MG Ground Tank										$1,500,000		
Old Town Hall New Generator & ATS		$206,000										
Water Admin Building New Generator & ATS		$30,000										
Water Meter Replacement			$750,000									
AC Pipe Replacement	$1,300,000	$700,000	$900,000		$2,252,000		$2,389,000		$2,534,000		$2,688,000	$2,769,000
Hydrant and Valve Replacement						$250,000				$250,000		
Annual Total	**$1,300,000**	**$1,024,000**	**$1,713,000**	**$2,250,000**	**$2,552,000**	**$250,000**	**$2,389,000**	**$351,000**	**$2,534,000**	**$1,750,000**	**$2,699,000**	

8 RATES AND FEES

8.1 INTRODUCTION AND APPROACH

Municipal water systems within North Carolina are required by state law to be financially self-sufficient. Municipalities must be able to adequately cover all annual operating and maintenance costs, CIP costs, and pay any debt obligations through rates and fees charged to consumers. Dewberry and American Engineers collected expense and revenue data from the Town to evaluate the current rates and fees and outline a strategy to fund the water system throughout the planning period. The following sections detail the Town's various costs incurred and revenue raised by the water system.

8.2 OPERATIONS AND MAINTENANCE COSTS

O&M costs include all day-to-day operating costs of the water system and any routine maintenance performed on the water system. Actual cost data from 2020 and cost data from 2021 projected by the Town were examined and used to project the future O&M costs for the Town. O&M costs are categorized into administrative, personnel, and operations costs. 2020 and projected 2021 O&M costs are provided in **Table 8-1**, sorted into these three categories.

Table 8-1: Water System O&M Costs

	Actual 2019-20	Projected 2020-21
Administrative		
Legal Services	$ 7,740	$ 11,000
Travel & Training - Attorney	$ -	$ 500
Personnel		
Salaries - Full Time	$ 809,785	$ 869,524
FICA Expense	$ 59,747	$ 66,518
Funding for Health Plan	$ 189,022	$ 216,805
Retirement	$ 73,304	$ 88,256
5% 401K Nonlaw Emp Retirement	$ 37,262	$ 43,477
Operations		
Professional Services	$ 595	$ 7,500
Engineering Services	$ 700	$ 4,000
Audit	$ 5,145	$ 8,470
Postage	$ 13,743	$ 18,000
Telephone	$ 6,379	$ 10,000
Utilities	$ 43,441	$ 61,200
Travel & Training	$ 2,556	$ 12,000
M & R - Building & Grounds	$ 64,643	$ 29,500
M & R - Plants	$ 53,485	$ 20,110
M & R - System	$ 82,811	$ 96,000
M & R - Hydrants	$ 5,486	$ 8,100
M & R - Storm	$ 5,236	$ -
Outside Maintenance & Repair	$ 11,402	$ 25,800
Fleet Maintenance	$ 4,191	$ 6,500
Insurance Claims	$ 8,620	$ -
Communications	$ 3,109	$ 3,050

	Actual 2019-20	Projected 2020-21
Maintenance Contracts	$ 28,458	$ 33,770
Printing	$ 3,391	$ 4,500
Equipment Rental	$ -	$ 1,500
Copier Lease	$ 1,636	$ 2,485
Tuition Reimbursement	$ -	$ 1,500
Advertising	$ 362	$ 1,000
Vehicle Fuel	$ 8,957	$ 8,000
Supplies & Materials	$ 17,444	$ 16,500
Chemicals	$ 8,843	$ 8,500
Uniforms	$ 5,392	$ 9,425
Contracted Services	$ 8,164	$ 18,620
Contracted Service - Water Billing	$ 4,298	$ 6,000
Treated Water Cost	$ 791,801	$ 900,000
Dues & Subscriptions	$ 5,823	$ 7,009
General Insurance	$ 60,638	$ 60,638
Retiree Health Insurance	$ 58,214	$ 62,426
Workers Compensation	$ 14,164	$ 14,278
Misc - Special Events	$ 671	$ 700
Misc - Wellness Program	$ -	$ 3,750
Tank Mixer Loan Repayment	$ 2,813	$ 2,813
General Fund Admin Cost Allocation	$ 413,290	$ 437,727
Annual O&M Cost	**$ 2,922,761**	**$ 3,207,451**

O&M costs were projected through the end of the planning period based on estimated rates of escalation. The projected annual O&M costs are shown in **Table 8-2**.

Table 8-2: Projected Annual O&M Costs

Fiscal Year	2022-23	2023-24	2024-25	2025-26	2026-27
Annual O&M Cost	$3,407,786	$3,509,870	$3,615,017	$3,723,319	$3,834,869
Fiscal Year	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**
Annual O&M Cost	$3,949,766	$4,068,110	$4,190,004	$4,315,555	$4,444,872

8.3 EXISTING DEBT

The Town has generated sufficient revenue through rates and fees to provide for all O&M costs and fund the previous CIP costs from the past planning period without incurring much debt. The only debt accrued by the Town is from a tank mixer. The Town puts $2,813 annually towards paying off this loan.

8.4 CAPITAL IMPROVEMENT PLAN

Yearly Capital Improvement Plan project costs were developed along with the CIP in **Section 7** for the 10-year planning period. The CIP includes the Town's ongoing effort to replace all the AC pipe within the system, new water meters, as well as rehabilitation and replacement of existing assets at the Old Town Hall and Eighth Street facilities and the proposed maintenance garage at Eighth Street.

CIP costs vary from year to year due to the priority of each CIP project and the bi-yearly cost allocation for the AC pipe replacement program. The annual costs for the CIP projects through the planning period are presented in **Table 8-3**.

Table 8-3: CIP Annual Costs

Fiscal Year	2022-23	2023-24	2024-25	2025-26	2026-27
Annual CIP Total	$1,024,000	$1,713,000	$2,250,000	$2,552,000	$250,000
Fiscal Year	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**
Annual CIP Total	$2,389,000	$351,000	$2,534,000	$1,750,000	$2,699,000

8.5 REVENUE REQUIREMENTS

Water system revenue is required to provide sufficient funding for the following:

- O&M Costs
- Debt Payments
- Capital Expenditures

The projected annual costs of each of these items as well as the total annual cost is summarized in **Table 8-4**.

Table 8-4: Projected Annual Water System Expenditures

Fiscal Year	2022-23	2023-24	2024-25	2025-26	2026-27
O&M Costs	$3,407,786	$3,509,870	$3,615,017	$3,723,319	$3,834,869
Debt Service	$2,813	$2,813	$2,813	$2,813	$2,813
Capital Expenditures	$1,024,000	$1,713,000	$2,250,000	$2,552,000	$250,000
Total Annual Costs	**$4,434,599**	**$5,225,683**	**$5,867,830**	**$6,278,132**	**$4,087,682**
Fiscal Year	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**
O&M Costs	$3,949,766	$4,068,110	$4,190,004	$4,315,555	$4,444,872
Debt Service	$2,813	$2,813	$2,813	$2,813	$2,813
Capital Expenditures	$2,389,000	$351,000	$2,534,000	$1,750,000	$2,699,000
Total Annual Costs	**$6,341,579**	**$4,421,923**	**$6,726,817**	**$6,068,368**	**$7,146,685**

Annual water system expenditures range from $6.9 million in 2022-23 to $9.7 million in 2030-31. Due to the varying capital expenditures from year to year, the total annual costs do not increase every year but follow a general upward trend based on the annually increasing O&M costs.

The Town generates revenue through two primary means: rates and fees. Total annual revenue should be sufficient to cover the total annual costs of the water system. If insufficient revenue is raised on any year, the Town will need to fund the water system using reserve funds. Rate revenue is the revenue raised through rates charged to water system consumers based on water usage. Fee revenue is revenue from other sources such as system development fees, utilities penalties, and connections fees. Revenue raised by fees over the past three fiscal years is shown in **Table 8-5**.

Table 8-5: Revenue from Fees

Fiscal Year	2017-18	2018-19	2019-20	2020-21
Taps & Connections	$ 82,590	$ 88,645	$ 69,599	$ 65,417
Utilities Penalties & Interest	$ 33,876	$ 35,633	$ 29,200	$ 13,170
System Development Fees	$ 622,000	$ 579,100	$ 308,200	$ 369,800
Interest Income	$ 129,592	$ 157,875	$ 143,351	$ 38,987
Miscellaneous Revenues	$ 46,075	$ 39,107	$ 15,929	$ 29,788
Debt Repayment from WW Fund	$ 18,750	$ 18,750	$ 18,750	$ 18,750
Total Annual Fee Revenue	**$ 932,883**	**$ 919,111**	**$ 585,029**	**$ 535,912**

The primary sources of fee revenue are system development fees (SDF), and interest income. System development fees, or hookup fees, are charged to new connections in the water system to make up for the cost of the connection and increased capacity of the water system. Interest income is revenue earned on the Unrestricted Net Assets of the system and functions as reserve funds. In the 2019-20 fiscal year, SDFs were significantly lower than in prior years, likely due to the effects of COVID-19 on the economy. Current trends, however, show increased development in the Town, so SDF revenue may increase in the future. Offsetting the lower fee revenue in 2019-20, additional funding was provided through grants from the Dare County COVID-19 fund, and the Department of Transportation (DOT). This revenue is summarized in **Table 8-6**.

Table 8-6: Additional FY 2019-20 and 2020-21 Revenue

Fiscal Year	2019-20	2020-21
DOT Grant	$ 295,060	$ 319,819
Dare County COVID-19 Grant	$ 4,424	$ 6,369
Total	**$ 299,484**	**$ 326,188**
Total (inc. fee revenue)	**$ 884,512**	**$ 862,100**

Using historic data, projections for the Town's fee revenue were created. These projections assume that no further grants are provided to the Town, and that system development fees will return to a level similar to those before the COIVD-19 pandemic. To provide a conservative estimate, most fees were held constant over the planning period, but could realistically be higher due to inflation. The development of future fee revenue is discussed in more detail in **Section 8.6**. Projected fee revenue is shown in **Table 8-7**.

Table 8-7: Projected Fee Revenue

Fiscal Year	2022-23	2023-24	2024-25	2025-26	2026-27
Taps & Connections	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000
Utilities Penalties & Interest	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
System Development Fees	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000
Interest Income	$ 50,000	$ 51,500	$ 53,045	$ 54,636	$ 56,275
Miscellaneous Revenues	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000
Debt Repayment from WW Fund	$ 18,750	$ 18,750	$ 18,750	$ 18,750	$ 18,750
Total	**$ 593,750**	**$ 595,250**	**$ 596,795**	**$ 598,386**	**$ 600,025**
Fiscal Year	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**
Taps & Connections	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000
Utilities Penalties & Interest	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
System Development Fees	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000
Interest Income	$ 57,964	$ 59,703	$ 61,494	$ 63,339	$ 65,239
Miscellaneous Revenues	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000
Debt Repayment from WW Fund	$ 18,750	$ 18,750	$ 18,750	$ 18,750	$ 18,750
Total	**$ 601,714**	**$ 603,453**	**$ 605,244**	**$ 607,089**	**$ 608,989**

The remainder of the water system's budget is provided by rates charged to consumers for water usage. **Table 8-8** presents the rate revenue required each fiscal year to pay for all costs incurred by the water system. The Town increases rates by a standard amount each year to pay for these increasing costs. Several annual rate increase options are provided and analyzed in **Section 8.7**.

Table 8-8: Revenue to be Raised by Rates

Fiscal Year	Annual Costs	Fee Revenue	Revenue to be Raised by Rates
2022-23	$ 4,434,599	$ 593,750	$ 3,840,849
2023-24	$ 5,225,683	$ 595,250	$ 4,630,433
2024-25	$ 5,867,830	$ 596,795	$ 5,271,035
2025-26	$ 6,278,132	$ 598,386	$ 5,679,745
2026-27	$ 4,087,682	$ 600,025	$ 3,487,657
2027-28	$ 6,341,579	$ 601,714	$ 5,739,865
2028-29	$ 4,421,923	$ 603,453	$ 3,818,470
2029-30	$ 6,726,817	$ 605,244	$ 6,121,573
2030-31	$ 6,068,368	$ 607,089	$ 5,461,279
2031-32	$ 7,146,685	$ 608,989	$ 6,537,697

8.6 RATE STRUCTURE TO RAISE REVENUES

The rate structure employed by the Town as of July 1, 2021, is shown in **Table 8-9** and **Table 8-10**. The rate structure is comprised of a minimum charge for the first 5,000 gallons used and increasing commodity rates for usage beyond 6,000 gallons. Rates are slightly higher for out-of-town customers.

Table 8-9: Current Rates for the First 5,000 Gallons

Meter Size	Minimum Charge for the First 5,000 Gallons
3/4"	$72.00
1"	$131.00
1-1/2"	$302.00
2"	$561.00
3"	$1,078.00
4" and Larger	$2,044.00
3/4" Out-of-Town	$89.00

Table 8-10: Commodity Rates for Usage above 5,000 Gallons (per 1,000 gallons over minimum)

Gallonage	KDH System Commodity Rate	Out-of-Town Commodity Rate
6,000 – 40,000	$8.00	$8.50
41,000 – 250,000	$8.50	$9.00
251,000 – 1,000,000	$9.00	$9.50
1,001,000 and over	$9.50	$10.00

Revenue from rates makes up the bulk of the water system's budget, while fee revenue makes up a relatively small portion. The Town currently raises rates by 4% each fiscal year to offset the rising costs associated with inflation and the operations and maintenance of the water system. The Town has expressed interest

in continuing to implement a 4% rate increase each year. Additionally, 2% yearly increase and 6% yearly increases were evaluated as a sensitivity analysis.

Under a 2% rate increase per fiscal year, the revenue of the water system varies from $4.2 million in the 2022-23 fiscal year to $5.0 million in the 2031-32 fiscal year. With a 4% annual rate increase, revenue varies from $4.3 million to $6.2 million. With a 6% annual rate increase, revenue varies from $4.5 million to $7.6 million. Rate revenue from fiscal year 2022-23 through 2031-32 with 2%, 4%, and 6% annual increases are shown in **Table 8-11**.

Table 8-11: Rate Revenue with 2%, 4%, and 6% Annual Increase

Fiscal Year	Rate Revenue with 2% Annual Increase	Rate Revenue with 4% Annual Increase	Rate Revenue with 6% Annual Increase
2022-23	$ 4,177,299	$ 4,342,720	$ 4,511,354
2023-24	$ 4,260,845	$ 4,516,429	$ 4,782,035
2024-25	$ 4,346,061	$ 4,697,086	$ 5,068,957
2025-26	$ 4,432,983	$ 4,884,970	$ 5,373,095
2026-27	$ 4,521,642	$ 5,080,368	$ 5,695,480
2027-28	$ 4,612,075	$ 5,283,583	$ 6,037,209
2028-29	$ 4,704,317	$ 5,494,927	$ 6,399,442
2029-30	$ 4,798,403	$ 5,714,724	$ 6,783,408
2030-31	$ 4,894,371	$ 5,943,313	$ 7,190,413
2031-32	$ 4,992,259	$ 6,181,045	$ 7,621,838

8.7 FEES

There are two fees that the Town charges water customers which need to be evaluated as part of this Water System Master Plan update because they are directly related to the system's assets. One is the System Development Fee (SDF) that is charged to customers upon initial connection to the system. The second is a tap fee and is intended to recover the cost of purchase and installation of a meter for a customer.

As should be noted from the rate structure and revenues discussion in **Section 8.6**, these fees are currently a relatively small component of the revenues generated by the system. The development rate for the next 10-year period is expected to be either the same or slightly below the current development rate, which means that these fees are expected to remain a relatively small component of the revenues generated by system in this period.

8.7.1 System Development Fee

The SDF is the larger of the two fees. It is a charge or assessment for service imposed with respect to new development to fund costs of capital improvements necessitated by and attributable to such new development and to recoup costs of existing facilities which serve such new development. The current SDF schedule is set based on the meter sizes allowed within the Town's water system, and is shown in **Table 8-12**.

Table 8-12: 2021-22 Town of Kill Devil Hills SDF Schedule

METER SIZE	SDF
5/8"	$4,000.00
1"	$6,900.00
1-1/2"	$10,500.00
2"	$13,900.00
3"	$20,300.00
4"	$27,600.00
6"	$41,800.00

Per the schedule, the current SDF in the Town for a residential 5/8-inch meter is $4,000. This fee is based on a three-bedroom residential structure. For a comparison, **Table 8-13** shows the SDF charged in coastal communities near the Town.

Table 8-13: SDF in Coastal Communities near Town of Kill Devil Hills

COMMUNITY	SDF
Town of Nags Head	$787.00
Dare County	$2,512.00
Town of Kill Devil Hills	$4,000.00
Town of Manteo	$4,700.00
Currituck County SOBW	$7,297.00

Improvements conducted in years prior to this study have been made to address capacity and redundancy concerns within the system. In addition, the Town is undertaking a program to replace water system infrastructure that is nearing or is past its useful life. An example of this is the replacement of the existing AC water mains, which are past their useful life, with other pipe materials, mainly PVC pipe. The replacement programs are forecast to continue beyond the period covered by this study.

The SDF is calculated by determining the overall value of the assets within the system, factoring in their current replacement cost and remaining useful life. This value is then distributed across the system to determine the fee a new customer would need to pay, based on the meter size of the new connection, as their 'fair share' of the capital costs to develop the existing system to the point where the customer can actually connect.

Since the last Water System Master Plan Update was completed in 2012, the overall value of the water system infrastructure has increased from approximately $26 million to $37 million. Even after allowing for inflation of asset value, this is a clear demonstration that the replacement projects the Town has completed in recent years have increased the value of the assets, specifically as assets with limited or no remaining useful life (AC water main piping) are being replaced with new assets (PVC water main piping) and these assets are within the very early part of their full useful life. Based on the significant increase in the value of the system's assets, it is clear that an increase of the SDF is warranted so that new customers can pay their 'fair share' of the existing system's capabilities.

Based on the analysis of SDF for the Town, it is recommended that the SDF be increased to $6,000 for a 5/8-inch meter connection. **Table 8-14** shows the recommended increases in SDF for other meter sizes allowed within the Town's water system.

Table 8-14: Recommended SDF for Town of Kill Devil Hills Water System

METER SIZE	SDF
5/8"	$6,000.00
1"	$10,400.00
1-1/2"	$15,800.00
2"	$20,900.00
3"	$30,500.00
4"	$41,400.00
6"	$62,700.00

The water supply is currently adequate to meet the Town's needs and is forecast to remain that way over the next 10 years. It is not expected that there will be a need to increase the Town's water supply, and as such, no costs for doing so need to be factored into the SDF at this time. Per NCGS 162A, Article 8, the Public Water and Sewer System Development Fee Act, adopted by the General Assembly in its 2017 session (House Bill 436), this SDF will be reviewed in 5 years. Should the need to increase the town's water supply above the contractual limit be imminent or should another factor such as long-lasting inflationary economic conditions (which can cause the value of the system and capital costs to significantly increase) occur prior to the required 5-year review, the Town could further evaluate the SDF at that time.

8.7.2 Tap Fee

The second fee that the Town charges is a tap fee. As stated earlier, this fee is intended to recover the cost of purchase and installation of a meter for a customer. For the Town, this fee is a very small portion of the revenue stream. The current fee schedule for tap fees within the Town is show in **Table 8-15**.

Table 8-15: 2021-2011 Town of Kill Devil Hills Tap Fee Schedule

METER SIZE	TAP FEE
5/8"	$1,145.00
1"	$1,460.00
1-1/2"	$3,945.00**
2"	$4,315.00**
3" and up	***

** Additional fees apply if a Road Bore is needed
*** Cost (materials, labor, equipment, engineering, etc.)

Based on information provided by the Town, this schedule appears at this time to recover the costs associated with a customer's meter installation. Meter and installation costs should be reviewed yearly, and if the cost of the meter or installation increase significantly, the tap fees should be adjusted accordingly based on those increases.

8.8 RESERVES AND CASH FLOWS

Cash flow through the water system budget will vary depending on the rate structure implemented by the Town over the planning period. A cash flow analysis is provided for each of the rate structures: 2%, 4%, and 6% annual rate increases. Also included in the cash flow analysis is the water system's current total fund balance of $7.8 million. This amount varies from year to year based largely on the Town's capital improvements but has remained around $8 million since 2018. The reserve fund is necessary for the Town

to have adequate funding for any unexpected expenses or to meet short-term financial needs. The fund is also used to pay for larger CIP projects that cannot be funded by the year's revenue alone.

8.8.1 2% Annual Rate Increase

Should the Town adopt a 2% annual rate increase, the water system's cash flow is shown in **Table 8-16**.

Table 8-16: Water System Cash Flow with 2% Annual Rate Increase

Fiscal Year	Annual Water System Expenses	Revenue from Rates and Fees	Cash Flow	Cumulative Balance	Cumulative Balance with Fund Balance
2022-23	$ 4,434,599	$ 4,771,049	$ 336,450	$ 336,450	$ 8,483,099
2023-24	$ 5,225,683	$ 4,856,095	$ (369,589)	$ (33,139)	$ 8,113,511
2024-25	$ 5,867,830	$ 4,942,856	$ (924,974)	$ (958,113)	$ 7,188,537
2025-26	$ 6,278,132	$ 5,031,369	$ (1,246,763)	$ (2,204,876)	$ 5,941,774
2026-27	$ 4,087,682	$ 5,121,668	$ 1,033,986	$ (1,170,890)	$ 6,975,759
2027-28	$ 6,341,579	$ 5,213,789	$ (1,127,790)	$ (2,298,680)	$ 5,847,969
2028-29	$ 4,421,923	$ 5,307,769	$ 885,846	$ (1,412,834)	$ 6,733,816
2029-30	$ 6,726,817	$ 5,403,647	$ (1,323,170)	$ (2,736,004)	$ 5,410,645
2030-31	$ 6,068,368	$ 5,501,460	$ (566,908)	$ (3,302,913)	$ 4,843,737
2031-32	$ 7,146,685	$ 5,601,247	$ (1,545,438)	$ (4,848,351)	$ 3,298,299

As seen in the "Cumulative Balance" column of **Table 8-16**, starting in FY 2023-24 the water system will run a deficit that will continue throughout the planning period. The water system's current fund balance would ensure that the water system does not go into debt during the planning period. However, the fund will be significantly drained by FY 2031-32. **Figure 8-1** shows the water system's cumulative balance both with and without the current fund balance. **Figure 8-2** shows the yearly expenses and revenue of the water system with a 2% annual rate increase. The cash flow of the water system would trend negatively, with the fund balance decreasing most years during the planning period. Revenue from rates and fees is only sufficient to cover water system expenses in years when CIP costs are very low. A significant fund balance would need to be used to pay for most CIP projects and the fund balance would decrease from roughly $8.4 million to $3.3 million through the planning period.

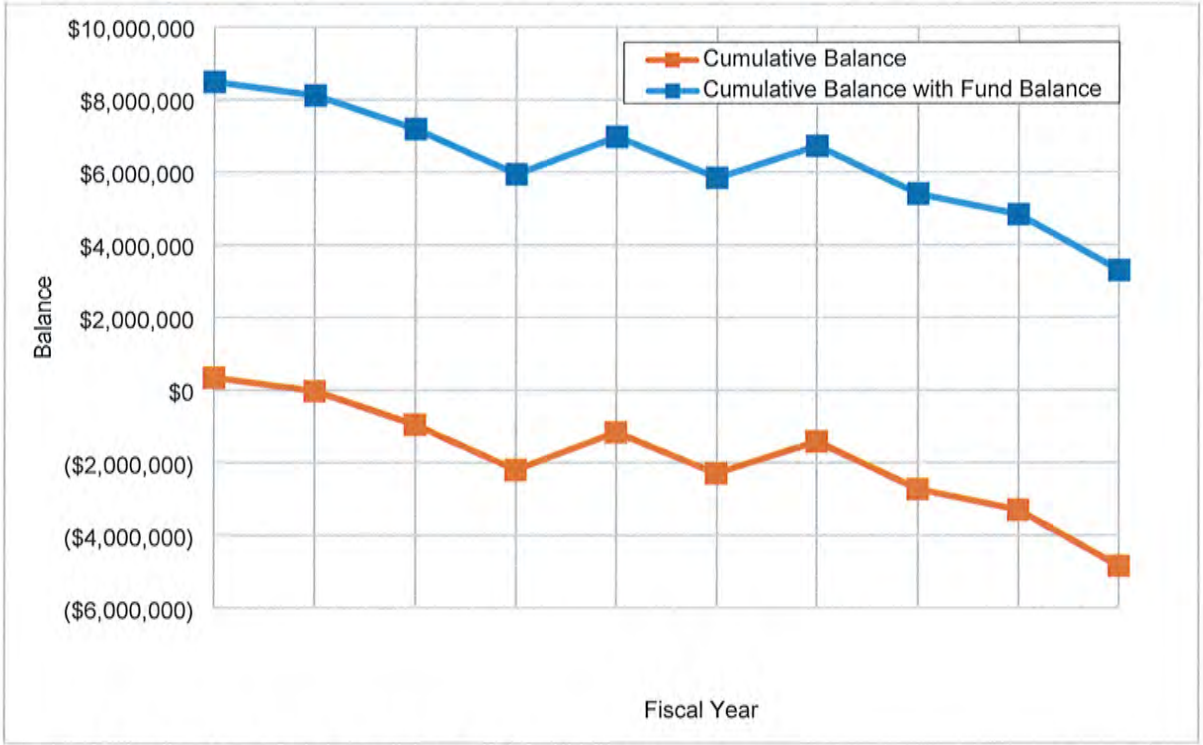

Figure 8-1: Yearly Cumulative Balance, 2% Yearly Rate Increase

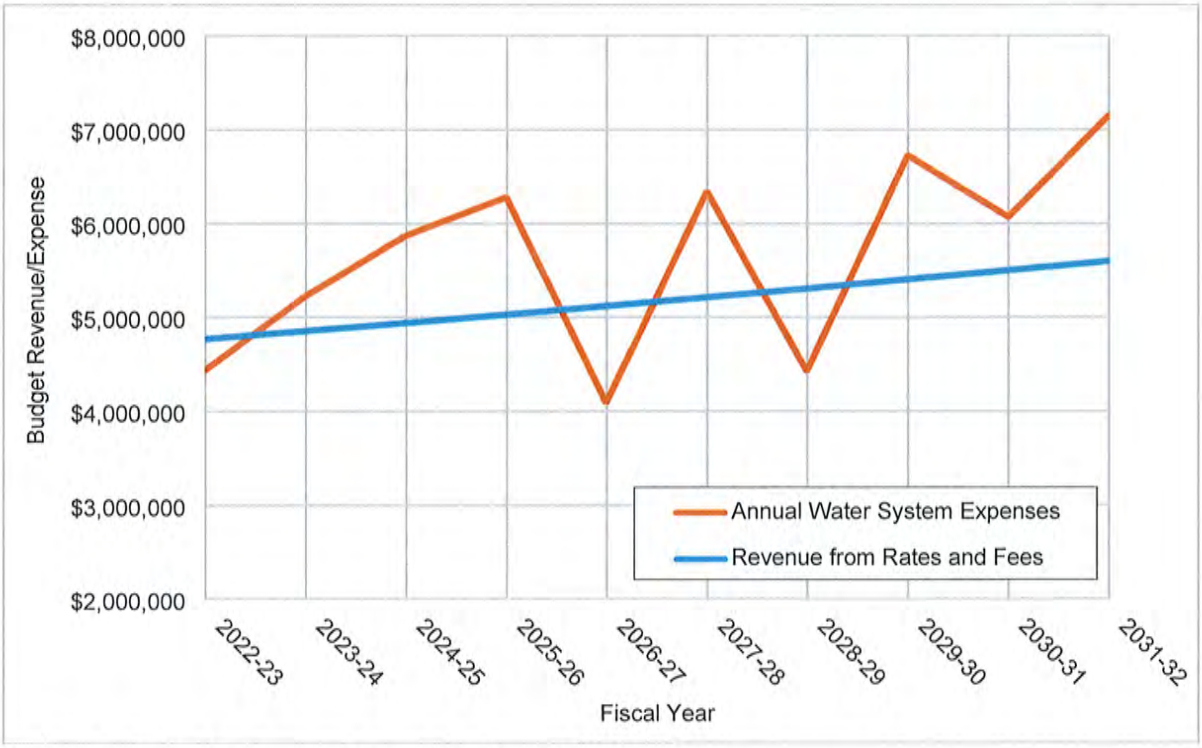

Figure 8-2: Yearly Expenses and Revenue, 2% Yearly Rate Increase

8.8.2 6% Annual Rate Increase

If the Town chooses to adopt a larger 6% annual rate increase, the water system's cash flow is presented in **Table 8-17**.

Table 8-17: Water System Cash Flow with 6% Annual Rate Increase

Fiscal Year	Water System Expenses	Revenue from Rates and Fees	Cash Flow	Cumulative Balance	Cumulative Balance with Fund Balance
2022-23	$ 4,434,599	$ 5,105,104	$ 670,505	$ 670,505	$ 8,817,155
2023-24	$ 5,225,683	$ 5,377,285	$ 151,602	$ 822,107	$ 8,968,757
2024-25	$ 5,867,830	$ 5,665,752	$ (202,078)	$ 620,029	$ 8,766,679
2025-26	$ 6,278,132	$ 5,971,481	$ (306,651)	$ 313,379	$ 8,460,028
2026-27	$ 4,087,682	$ 6,295,506	$ 2,207,824	$ 2,521,202	$10,667,852
2027-28	$ 6,341,579	$ 6,638,923	$ 297,344	$ 2,818,546	$10,965,196
2028-29	$ 4,421,923	$ 7,002,894	$ 2,580,972	$ 5,399,518	$13,546,167
2029-30	$ 6,726,817	$ 7,388,652	$ 661,835	$ 6,061,353	$14,208,002
2030-31	$ 6,068,368	$ 7,797,501	$ 1,729,133	$ 7,790,486	$15,937,136
2031-32	$ 7,146,685	$ 8,230,826	$ 1,084,141	$ 8,874,627	$17,021,277

The cumulative balance of the water system would increase in most years throughout the planning period and in the few years where cumulative balance decreases, it difference would be minor. The water system's fund balance would nearly double from FY 2022-23 to FY 2031-32. The cumulative balance of the water system with and without the current fund balance is shown in **Figure 8-3**. Annual expenses and revenue of the water system with a 6% annual rate increase is shown in **Figure 8-4**. Cash flow would trend toward a significant increase in the fund balance of the water system. With a 6% annual rate increase, the Town would rarely need to use the fund balance to fund CIP projects, as the larger rate increase would allow for full payment of these projects using the revenue. A 6% annual increase, however, is significantly larger than the Town's current 4% annual rate increase and would result in much higher charges to consumers within the water system.

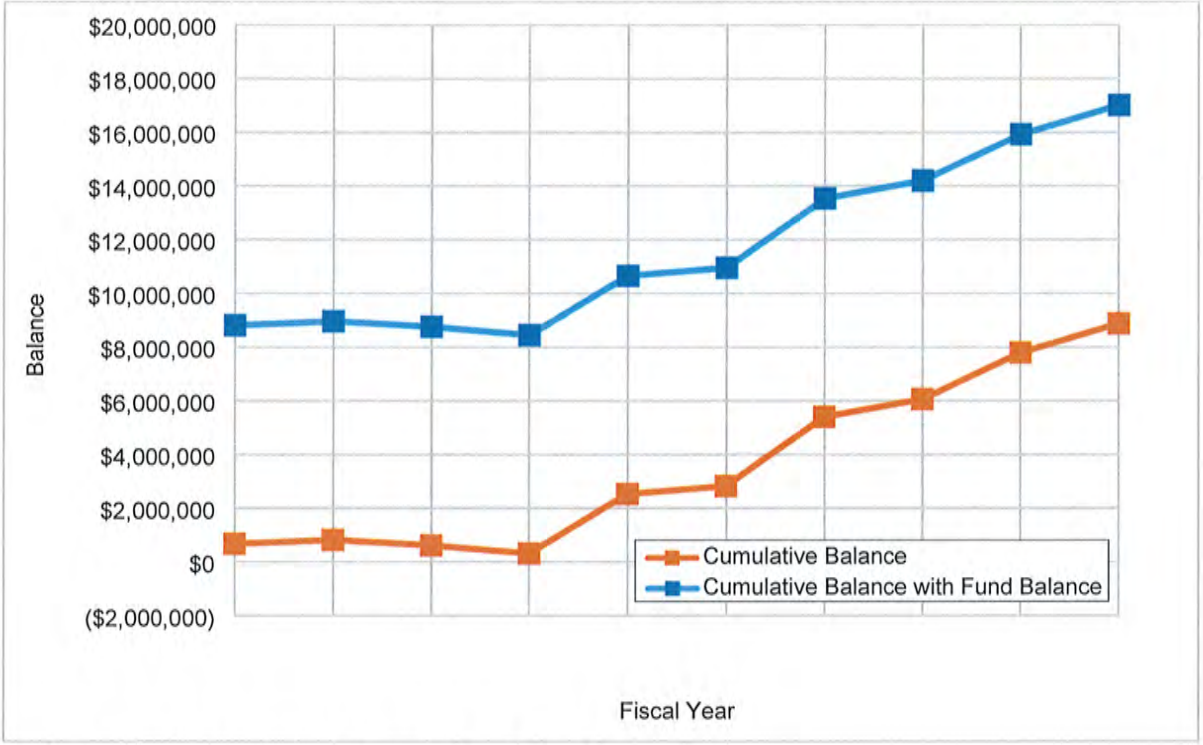

Figure 8-3: Yearly Cumulative Balance, 6% Yearly Rate Increase

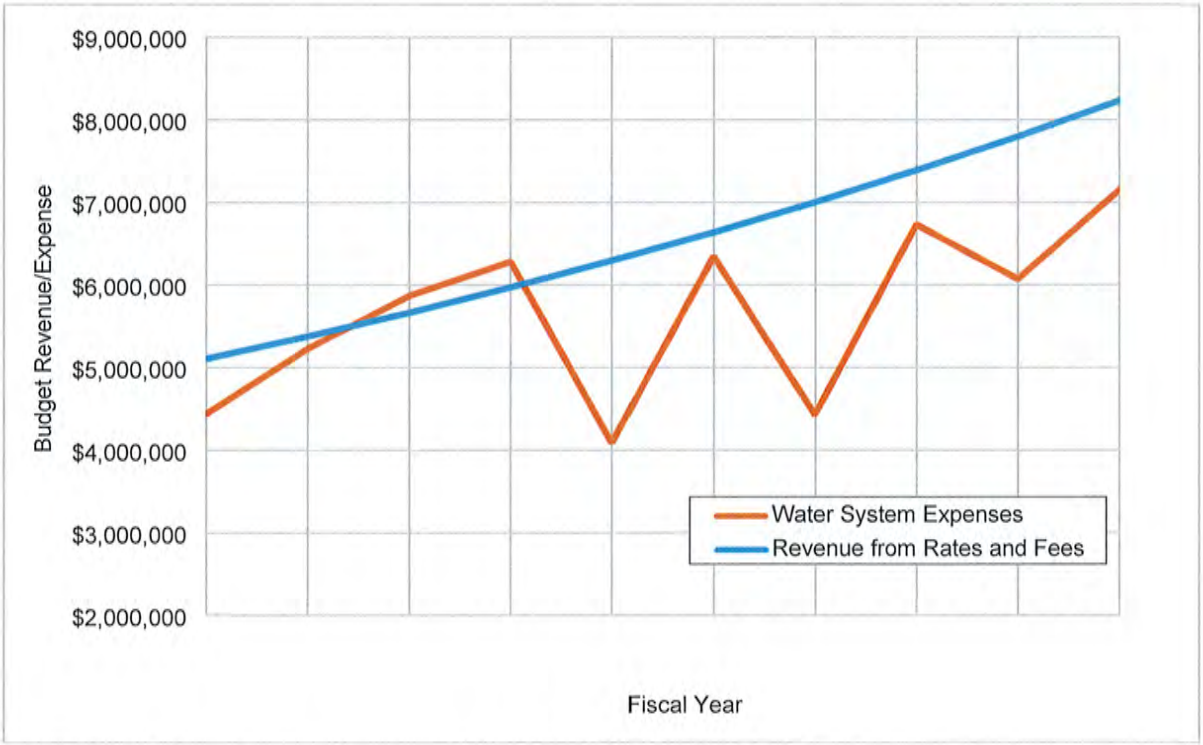

Figure 8-4: Yearly Expenses and Revenue, 6% Yearly Rate Increase

8.8.3 4% Annual Rate Increase

If the Town continues to implement a 4% annual rate increase, the water system's cash flow can be seen in **Table 8-18**.

Table 8-18: Water System Cash Flow with 4% Annual Rate Increase

Fiscal Year	Water System Expenses	Revenue from Rates and Fees	Cash Flow	Cumulative Balance	Cumulative Balance with Fund Balance
2022-23	$ 4,434,599	$ 4,936,470	$ 501,871	$ 501,871	$ 8,648,521
2023-24	$ 5,225,683	$ 5,111,679	$ (114,004)	$ 387,867	$ 8,534,517
2024-25	$ 5,867,830	$ 5,293,881	$ (573,949)	$ (186,082)	$ 7,960,568
2025-26	$ 6,278,132	$ 5,483,356	$ (794,776)	$ (980,858)	$ 7,165,792
2026-27	$ 4,087,682	$ 5,680,394	$ 1,592,712	$ 611,854	$ 8,758,504
2027-28	$ 6,341,579	$ 5,885,297	$ (456,282)	$ 155,572	$ 8,302,221
2028-29	$ 4,421,923	$ 6,098,379	$ 1,676,456	$ 1,832,028	$ 9,978,678
2029-30	$ 6,726,817	$ 6,319,967	$ (406,850)	$ 1,425,178	$ 9,571,828
2030-31	$ 6,068,368	$ 6,550,401	$ 482,033	$ 1,907,211	$ 10,053,861
2031-32	$ 7,146,685	$ 6,790,034	$ (356,652)	$ 1,550,560	$ 9,697,209

A 4% annual increase to rates provides a more balanced revenue to the water system and allows for the Town to pay for the CIP projects while keeping the fund balance relatively consistent. The cumulative balance of the water system with and without the current fund balance is shown in **Figure 8-5**. Annual expenses and revenue of the water system with a 4% annual rate increase are shown in **Figure 8-6**. The cash flow of the water system will vary significantly from year to year due to the varying capital expenditures. Revenue from rates and fees alone will be sufficient to pay for CIP projects on years with fewer expensive projects, but use of the fund balance will be required on years with larger projects, such as the Eighth Street maintenance yard. The decrease in fund balance caused during these years will be temporary, as in years with fewer CIP expenses the fund balance will be restored. Under the 4% annual increase, the fund balance is projected to increase from roughly $8.6 million to $9.7 million by the end of the planning period.

The 4% annual rate increase currently employed by the Town is sufficient to generate revenue over the planning period to pay for water system O&M costs and capital expenses without significantly increasing charges to consumers.

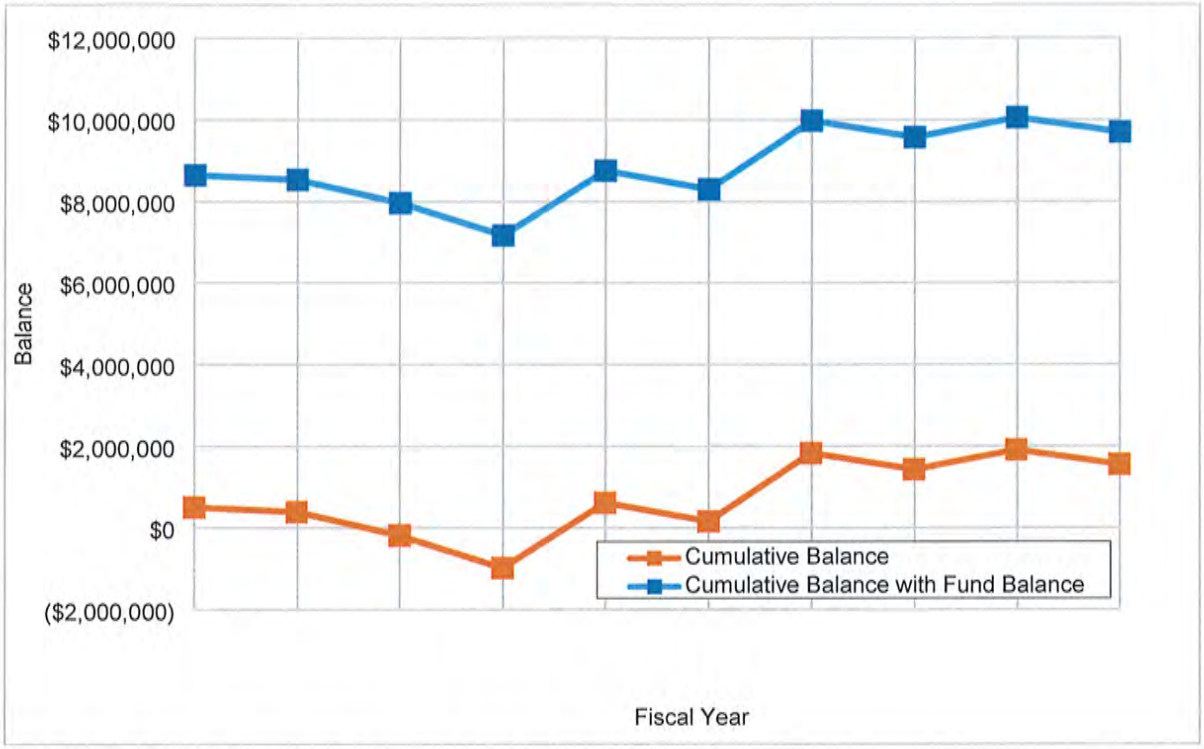

Figure 8-5: Yearly Cumulative Balance, 4% Yearly Rate Increase

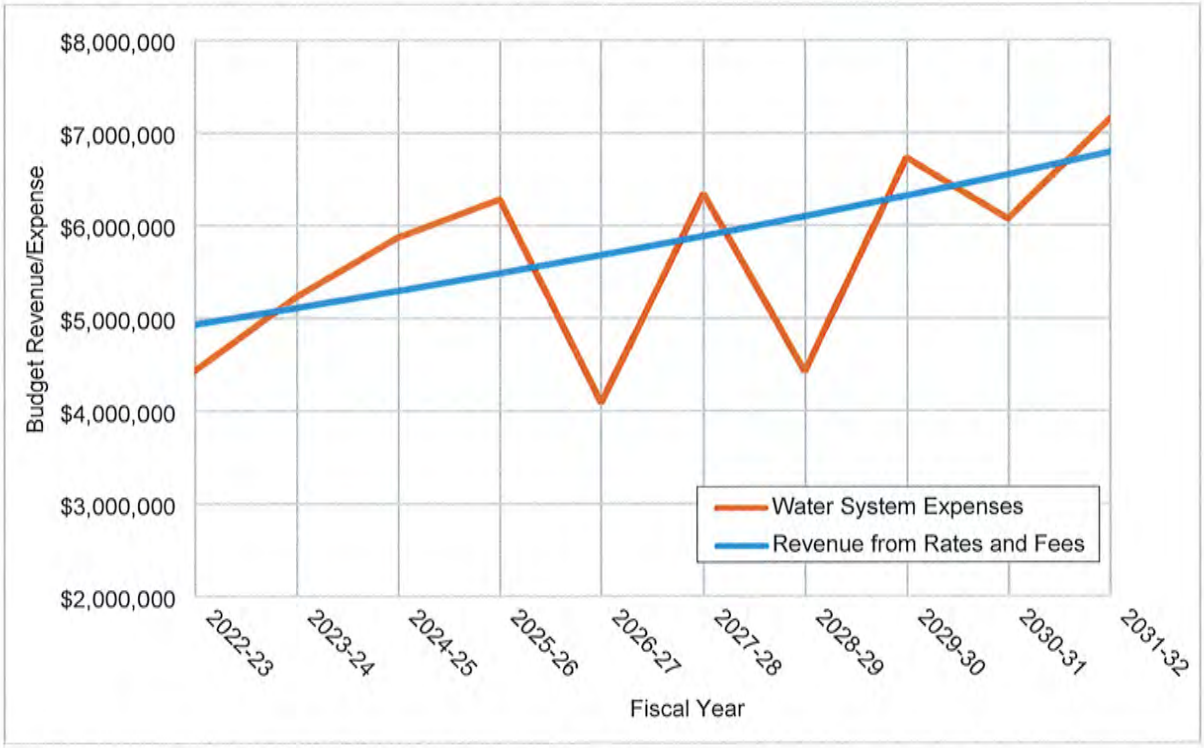

Figure 8-6: Yearly Expenses and Revenue, 4% Yearly Rate Increase

8.9 CONCLUSIONS AND RECOMMENDATIONS

The Town continues to do an excellent job of managing both the infrastructure and finances of the water system. The water system is currently in good financial condition and benefits from being largely built out with many redundancies and few weaknesses. There are no imminently critical infrastructure projects required for the operation of the water system within the next 10 years which allows the Town to continue with the AC pipe replacement projects and for budgeting for larger capital projects such as the Eighth Street maintenance yard. As described previously, the water system has very little debt and a stable fund balance, allowing for flexibility moving into and beyond the next planning period.

It is recommended that the Town continue with the 4% annual water usage rate increase that it has been using in recent years. This would allow for sufficient funds to meet yearly O&M costs and capital expenditures while maintaining slight overall increase in the fund balance. Should the current period of high inflation persist beyond the next 2-3 years, the Town may wish to revisit the usage rate analysis in order to ensure stability moving forward. It is recommended that the Town increase the SDF rates in accordance with Table 8-14 in order to provide a means for new customers to pay for their 'fair share' of the existing system which allows for them to have a connection. These recommended fees and rates will allow the Town to continue paying for capital projects outright (without the need to finance them through borrowing) which benefits the Town greatly by avoiding system debt.

Appendix A – Condition Assessment

Date: January 17, 2022

To: Steve Albright, Public Services Director, Town of Kill Devil Hills

Pete Burkhimer, PE, Senior Consultant, American Engineers

From: Brett Heim, PE

Subject: Kill Devil Hills Water System Master Plan Condition Assessment

1. GENERAL SUMMARY

On January 5, 2021, Dewberry Engineers conducted a site visit to analyze the condition of the two (2) water booster pump stations in the Town of Kill Devil Hills. The condition assessment was centered specifically around the Old Town Hall (OTH) and the Eighth Street booster pump stations; it did not include assessment of the onsite storage. The interior, exterior and site of the Old Town Hall and Eighth Street pump stations were evaluated with the purpose of reviewing the condition of the pump stations and to detect any problems or deficiencies. The disciplines of site/civil, structural, architectural, process mechanical, building mechanical, and electrical are included in this review. Engineers involved in each discipline were present at the site visit. The remainder of the system is described in paragraphs below within this summary.

Under each discipline, recommendations for improvements to the two facilities have been provided. In addition, a planning level cost estimate is provided for each improvement in the structural, process mechanical, and building mechanical sections. These cost estimates do not include any engineering fees associated with the improvements.

The Old Town Hall (OTH) facility houses three (3) 1,600 gallon per minute (gpm) pumps, a 0.40 million gallon (MG) elevated storage tank (EST), and a 0.5 MG ground storage tank (GST).

The Eighth Street facility houses three (3) 1,200 gpm pumps, a 0.25 MG EST, and two GSTs with 0.7 MG in total capacity.

The Town owns approximately 80 miles of water main pipe ranging from 2 to 16 inches in diameter. Water main materials primarily consist of polyvinyl chloride (PVC, 75.4% of total system), asbestos cement (AC, 21.6% of total system), ductile iron (DI, 2.6% of total system), and high-density polyethylene (HDPE, 0.4% of total system) pipes. There are many inline valves and fire hydrants located within the system. Currently, the Town is undergoing a concerted, multi-year effort to replace all asbestos cement pipes in the system. When these pipes are replaced, existing valves and hydrants on those mains are also being replaced. Due to this replacement program, water main infrastructure within the system is either within its useful life and functioning properly or is forecast for replacement, and no additional assessment is being conducted under this condition assessment.

The Town is also currently undergoing a meter replacement project. Software upgrades related to meters and their operation are also being upgraded with this replacement program. As such, no additional assessment of meters or software is being conducted under this condition assessment.

2. OLD TOWN HALL PUMP STATION

2.1. SUMMARY

The Old Town Hall Pump Station is an addition constructed in the 1980s to an existing building used by the fire department, located on the west side of N Croatan Hwy., across from E 2nd St. The single-story addition consists of the pump room, chlorine room, office/lab, and restroom with shower. The pump station process equipment is held in the large main pump room with the office/lab to the side and the restroom and storage space near the back. Chemical process equipment is stored in the chlorine room, a separate room accessed from the outside. A prestressed concrete ground storage tank and a recently constructed welded steel pedesphere elevated storage tank sit in the yard behind the pump station. The pump station was recently upgraded to include a third pump, new valves, new fittings, and other upgrades. Dewberry was provided with the original pump station as-built construction drawings prepared by Miller Williams & Works and dated September 1984.

2.2. SITE / CIVIL

Landscaping

The front of the pump station consists of a gravel driveway with a concrete sidewalk and small patches of grass next to the building (Figure 1). Behind the pump station is a grass yard with the generator, valve vaults, the elevated storage tank and the ground storage tank (Figure 2). Grass is somewhat patchy but does not require landscaping work.

Figure 1 – Building Front

Figure 2 – Tanks and Yard

Fencing

The front of the building and driveway is surrounded by a 6' chain-link fence. The fence appears rusted in some areas but is otherwise in good condition. The back yard of the pump station is surrounded by a 6' tall chain-link fence with barbed wire on top.

Pump Station Site Recommendations

- Continue performing maintenance on lawns and grasses on-site.

2.3. STRUCTURAL

Structural Evaluation

A visual structural evaluation was completed to review the structural condition of the pump station. It should be noted that this type of visual structural evaluation is limited in nature because many of the structural elements were inaccessible or were not visible (such as the foundation). Destructive methods were not used to observe hidden conditions. Materials and geotechnical testing and structural capacity analysis were outside the scope of this evaluation. For the purposes of this report, the side of the pump station facing the existing water tanks will be considered the north side of the building.

General Structural Description

The pump station is a one-story building that was constructed as an addition to an existing building. The pump station has an outside plan dimension of 34'-0" in the north-south direction and an outside plan dimension of 39'-4" in the east-west direction. According to the as-built drawings, the building roof structure consists of prefabricated wood trusses spaced at approximately 24 inches on center and spanning in the north-south direction. Due to the presence of drywall ceiling, the wood trusses could not be observed. The trusses are supported by loadbearing 8-inch CMU walls with a bearing height of 12'-0" above the finished floor. According to the as-built drawings, the CMU walls are supported on 2'-0" wide continuous concrete wall footings. The 8-inch CMU walls were not specified to be reinforced on the as-built drawings. A steel beam supporting a trolley hoist spans in the north-south direction of the building and is centered over three pumps and is supported on the exterior CMU walls. The as-built drawings specify that it is a W8x24 beam. The trolley hoist states that it has a 4,000 lb capacity, but a 1,700 lb maximum lift capacity is stenciled on the side of the beam. Based on calculations performed by Dewberry, the 1,700 lb maximum capacity restriction is correct. The building floor slab is 4 inches thick and has two pipe trenches approximately 2'-0" deep running in the north-south direction. The west trench is 2'-6" wide and the east trench is 2'-0" wide. In 2018, the north end of both trenches was enlarged to approximately 5'-3" by 6'-0". All of pipe trenches are covered with open floor grating.

Observed Structural Condition of Pump Station

As noted previously, the condition of the existing wood roof trusses could not be observed due the presence of a hard drywall ceiling. However, no significant deflection, cracking, or water damage was observed in the ceiling which indicates the trusses are likely performing well. The as-built drawings do not indicate any type of hurricane ties at the truss bearing on the 8-inch CMU walls. Hurricane ties provide a mechanical connection to prevent wind uplift failure during a high wind event. This could be a potential failure point for the building roof structure during a major hurricane event if hurricane ties or similar are not present.

The exterior 8-inch CMU walls have a significant amount of cracking, mostly located in the mortar joints (Figure 3 and Figure 4). The stair step crack seen in Figure 3 is often associated with differential foundation settlement. The stair step crack width was observed to be uniform throughout the whole stair step crack extents. With differential settlement, the crack width should get larger as the crack gets further from the ground due to rotation of the settling wall segment. It is Dewberry's opinion that these cracks are likely caused by thermal expansion and contraction forces and lack of vertical control joints in the wall. It is standard practice to place vertical control joints in CMU walls at approximately 30 to 40 feet on center to control this type of thermal related cracking. As noted previously, the as-built drawings do not indicate any reinforcing in the CMU walls. It should be noted that these unreinforced exterior masonry walls are likely insufficient to resist the maximum hurricane wind loads as prescribed by the current North Carolina State Building Code and that the initial building was built in the 1960s. There are no requirements in the State Building Code to retrofit existing structures and when the building reaches the end of its useful life, a new code-compliant structure is recommended.

No evidence of foundation settlement was observed. The existing floor slab appears to be in good condition with only minor hairline cracking observed. This type of cracking is typically related to thermal expansion and contraction and is not currently a structural concern.

Figure 3 – Mortar Cracking in Exterior Wall at Southwest Building Corner

Figure 4 – Mortar Cracking on North Exterior Wall

Structural Recommendations

Deficiency Repairs - In the event that cracks worsen, or it becomes evident that the existing facility will be maintained beyond its useful life, the following repairs should be considered:

- For the cracks in the exterior 8-inch CMU walls, remove the cracked mortar and repoint the mortar joints - $1,500
- Thermal cracking will likely continue to occur in the exterior walls unless vertical control joints are installed. Install one vertical control joint at the approximate midpoint in the north, south, and west walls. The joints will require saw cutting the CMU block and installation of control gasket and elastomeric sealant on both the exterior and interior face of the joint - $6,000

Potential Resiliency Improvement Repairs:

- Even though the existing roof truss bearings and existing CMU walls are likely not adequate for resisting current building code prescribed hurricane force wind loads, the building code does not require existing buildings to be improved or reinforced unless major modifications and/or additions are made to the building. That said, the Town of Kill Devil Hills may wish to improve the resiliency of the building to withstand a major hurricane event with the following
    - For the truss bearings, partially remove the existing ceiling in order to install code-compliant hurricane anchors securing the trusses to the CMU wall below - $8,000
    - For reinforcing the CMU walls to withstand current building code wind loads, this would likely involve one of three options – $40,000
        - Breaking out the interior face shells of the CMU and installing reinforcing bars
        - Adding steel straps to the inside face of the CMU
        - Temporarily shoring the roof and constructing a new reinforced CMU wall

2.4. ARCHITECTURAL

General Architectural Description

The walls are painted, load bearing CMU block on a concrete footing. Trusses with a twelve-foot high bearing support a split slope membrane roof, which was replaced in 2020. The floor is a concrete slab with carpet in the office. The chlorine room, office, and storage all have vinyl flooring. The pump room ceiling appears to be a treated plywood panel and trim.

Observed Condition of the Pump Station Exterior

The original windows have been replaced and the exterior has been coated along with the windows caulked (Figure 5).

Figure 5 – Metal Fascia & CMU Block

The roof has been replaced in the last year and exhibits no signs of distress or wear. Roof fascia trim and wood soffit trim were replaced in 2021 along with the exterior coating repairs.

Replacing the existing wood doors and frames with hollow metal would provide materials that match noted improvements in durability and longevity.

Observed Condition of the Pump Station Interior

While the interior side of the exterior block has been repainted in the pump room, efflorescence is still present, likely due to the exposure of the exterior walls.

Due to the age of the building, the vinyl flooring in the office should be removed entirely and the hole in the chorine room ceiling should be repaired. The building interior was repainted in 2020.

All exposed concrete floors should be sealed with a protective floor coating.

Office casework exhibits signs of distress (Figure 6). Replacing with laminated cabinets and a solid surface counter and stainless sink provides durable, easy to clean finishes that suit the environment. Replace sink faucet with a new gooseneck fixture. Painting the dark stained wood window trim would update the appearance and brighten the room. Replacing the existing worn carpet and vinyl sheet flooring with new luxury vinyl tile flooring would provide a modern and durable finish.

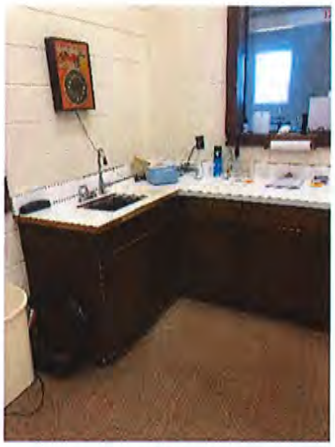

Figure 6 – Office Casework

The steel rails in the chlorine room have surface rust and need to be sanded, prepped, and painted with a high-performance coating.

Restroom fixtures should be replaced for more efficient fixtures including the mop sink. Toilet accessories such as a wall mounted soap dispenser and paper towel dispenser should be provided for ease of use. The baseboard heater should be replaced for a more efficient radiant heater. The restroom has a hole in the drywall ceiling that needs to be repaired.

2.5. PROCESS MECHANICAL

Observed Condition in Pump Room

The pump room houses all pumps and related electrical fixtures, piping, and valves. Three (3) pumps are housed in the room, with piping from both the inlet and discharge running in a pipe chase below the floor (Figure 7 and Figure 8). The existing pumps are PACO model 29-60161 horizontally mounted pumps with 100-hp motors. Each of the three (3) existing pumps is rated for 1,600 gpm at 165 ft of head however, it should be noted that the newer third pump was installed in 2020 and has been seen to have a higher firm pumping rate of 2,200 gpm at 165 ft of head. All piping appeared to be in very good condition with only very minor rusting and no leaking. Overall, the pump room process equipment is in very good condition and there are no notable improvements to be made.

Figure 7 – Pump Room

Figure 8 – Pump Room

Observed Condition in Chemical Room

Chemical equipment is housed in a separate room attached to the pump station (Figure 9). Chlorine gas is stored in racks just inside the room and all chemical process equipment for the chlorine gas system is operated in this room. The room has a gas detector and a fan/louver ventilation system.

Figure 9 – Chemical Room and Chlorine Gas System

A new chlorine gas detector was installed and interlocked with a visible and audible alarm to alert any personnel of a gas leak on April 21, 2021 (Figure 10). The gas detector is linked to the fan and louvers so that in the event of a gas leak the fan will activate and the louvers will open. In addition, all chemical process piping was replaced (Figure 11).

Figure 10 – Chlorine Gas Detector

Figure 11 – Chlorine Gas Piping

The chlorine feed system has not reached the end of its useful life however, once it does, the Town should consider replacing it. An evaluation of both gaseous chlorine and liquid Sodium Hypochlorite (NaOCl) systems should be considered. Safety of materials, operations considerations, available space, and costs should all be considered in this evaluation.

Observed Condition of Pump Station Wet Well

There is a small wet well on the pump station site in the back yard that all wastewater from the pump station is routed to. Town personnel noted that the wet well sees very little flow but is necessary for the wastewater flow from the OTH pump station to reach the onsite septic system. The wet well is in poor condition and should either be rehabilitated (Figure 12) or bypassed so that the flow from the pump station can be sent directly to the septic system.

Figure 12 – Wet Well Interior

Process Mechanical Recommendations:

- Interlock chlorine gas detector with ventilation system - $50,000
- Rehabilitate sanitary sewer wet well - $20,000

2.6. BUILDING MECHANICAL

Observed Condition of the Pump Room

The pump room is ventilated by a roof-mounted fan and three (3) floor level louvers on the wall near the pump area and another louver on the wall in the back of the room near the hot water heater (Figure 13 and Figure 14). The fan and all louvers in the pump room are in good condition. The pump room is heated by two (2) unit heaters in the corners to the left of the entry door (Figure 15). Both were functional and effective but had minor cosmetic damage. The heaters do not need to be replaced.

Figure 13 – Pump Room Louvers

Figure 14 – Pump Room Ventilation Fan

A hot water heater is positioned near a mop sink in the back of the room (Figure 16).

Figure 15 – Pump Room Heater

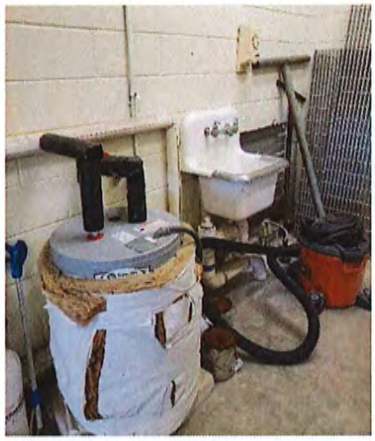

Figure 16– Hot Water Heater & Sink

Past the sink and hot water heater there is a small bathroom (Figure 17). The fixtures in the bathroom are functional but visibly aged.

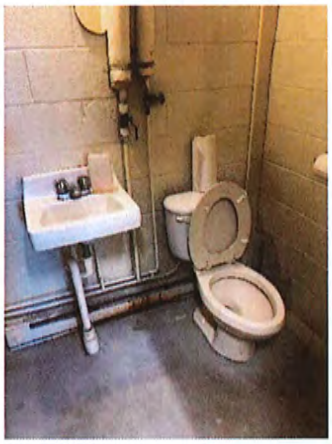

Figure 17 – Toilet and Sink

Observed Condition in the Office

A small office/lab room is attached to the pump room. It houses a computer, some electrical equipment, lab equipment, and counterspace. The office also has a sink on one of the desks with two (2) faucets (Figure 18). One of the faucets is non-functional and should be removed. The office has a single unit heater (Figure 19). The heater appeared to be in good condition and was functioning at the time of this assessment.

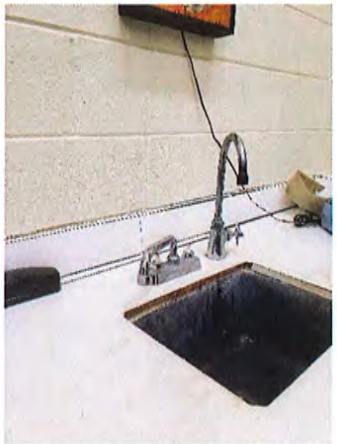

Figure 18 – Office/Lab Sink

Figure 19 – Office/Lab Heater

Observed Condition in the Chemical Room

For ventilation, the chemical room has a fan/louver system with the fan on the roof and louvers on the wall at ground level (Figure 20). The louvers were replaced in 2021 and the ventilation system is set to turn on when the light switch is turned on. The ventilation system is also linked to the gas detection system and will activate if a chlorine leak occurs.

The chemical room has a single heater mounted on the wall (Figure 21). The heater was functional at the time of this assessment and appears to be in good condition aside from some minor rust.

Figure 20 – Chemical Room Louvers

Figure 21 – Chemical Room Heater

Building Mechanical Recommendations:

- Remove broken faucet in office/lab - $250

2.7. ELECTRICAL / INSTRUMENTATION & CONTROLS

General Electrical Description

The Old Town Hall PS has a single electrical utility service fed from pole-mounted transformers outside the facility. The service is 480/277 V, 3-phase, 4-wire, 600 A, routed underground from the transformers to inside the pump station building. The main electrical equipment is located in the pump room including the service entrance disconnect switch, automatic transfer switch (ATS), and the motor control center (MCC), with the pump control room containing the remote terminal unit (RTU) with the programmable logic controller (PLC). Outside is a diesel standby generator and the elevated storage tank.

Service Entrance

The service entrance disconnect switch and current transformer (CT) cabinet are located inside the pump room by the street side door. The utility meter is located on the exterior wall opposite the CT cabinet. The disconnect switch could not be safely opened; however, it appears to be in fair condition. It appears the installation of the switch was around the time of the generator and transfer switch installation as the original service entrance disconnecting means was the main breaker of the MCC. Once the service entrance disconnect switch reaches its useful life, it is recommended to replace it with a circuit breaker instead of a fused switch which provide a more robust disconnect. The disconnect switch is manufactured by Square-D and has the following ratings: 600 A, 600 V.

Automatic Transfer Switch

The ATS is located in the pump room near the bathroom and appears to be in fair condition (Figure 22 and Figure 23). The ATS is connected to the utility for normal power and the generator for emergency power, where the load side energizes the MCC. The ATS is manufactured by Generac and has the following ratings: 800 A, 480 V, 3-phase, model no.: 3596730100, serial no.: 84335. The ATS was installed in 2005. An ATS can be expected to have a 20-25-year useful life. Based on the installation date of the ATS, there are between 5 and 10 years of useful life left. It is recommended that this ATS be replaced when the generator is replaced.

Figure 22 – ATS - Exterior

Figure 23 – ATS - Interior

Generator

The generator is located outside in the corner of the property (Figure 24). The generator has a sub-base fuel storage tank that was replaced in 2019 and elevates the generator enclosure substantially. On visual inspection, the generator appears to be in poor to fair condition; however, the Town operator indicated it is functional. The visual inspection yielded the following observations of condition: the generator enclosure doors are taped shut because the doors cannot remain closed during high wind events, which has caused water intrusion and significant corrosion to the generator. Reference the interior generator picture below, the grounding bolt is badly corroded (Figure 25). The generator is manufactured by Generac with the following ratings: 275 kW, 480/277 V, 3-phase, model no.: 3414150100, serial no.: 2073912, production

date: 09/18/2003, diesel fueled. The estimated useful life of a generator is 20-25 years, so the generator is approaching the end of its estimated useful life.

Figure 24 – Generator – Exterior

Figure 25 – Generator – Interior

Motor Control Center

The MCC is located in the pump room adjacent to the service entrance disconnect (Figure 26). The MCC has a main breaker that used to be the service entrance disconnect, the main bucket could not be safely opened without de-energizing the entire station to verify that the old neutral bond was removed. The MCC contains the motor starters for the booster pumps, chlorine room exhaust fan, grinder pump, and the pump room exhaust fan, contains the circuit breakers for the unit heaters, office air conditioner, and transformer disconnect, and also contains the step-down transformer and 208/120 V panelboard. The MCC appears to be in fair condition, and the current the completion of the 2020 Old Town Hall Elevated Tank Replacement Project replaced the booster pump motor starters with new reduced voltage soft starters, as well as the pump room exhaust fan motor starter. The MCC powers the new elevated tank with a 480 V feeder.

The MCC is building original, so the installation date of 1983. The estimated useful life of an MCC varies on the device, the structures, circuit breakers, and transformer have an estimated useful life of 50 years, motor starters without solid-state devices are 35 years, and solid-state starters are approximately 20 years. All the motor starters which have not been recently replaced are at the end of their useful life. In the future, it is preferred to not install the transformer and panelboard into the MCC as it limits the amount of conduit and modifiability for all the branch loads due to the MCC construction. The MCC's 208/120 V panelboard is also missing its protective cover as can be seen in the photo below (Figure 27). This creates an unsafe working environment if breakers need to be switch on and off, but does not urgently need to be replaced. The MCC is a Model 4 manufactured by Square-D with the following ratings: 600 A, 600 A main breaker, 480/277 V, 3-phase, F.O. no.: 12-68493.

Figure 26 – MCC

Figure 27 – MCC – Panelboard

Miscellaneous Electrical

The lighting in the pump room was recently replaced with linear LED fixtures and is in good condition. The pump control room appears to still have linear fluorescent fixtures.

Based on the 1983 drawings, there doesn't appear to be a ground ring around the building or substantial grounding. Effective grounding is important for electrical safety and shock hazards, and protection for electronic devices. It is also essential if a lightning protection system is installed to provide an extremely low impedance path to the earth.

Remote Terminal Unit & Controls

The RTU is located in the control room, which is a conditioned space to protect the sensitive electronics (Figure 28). The RTU controls the pump station and connects to the Town's SCADA network. The RTU was installed by ISI Inc. in 2014 and is in good condition. The PLC located inside the RTU is a Direct Logic 205 (Figure 29). The estimate useful life an RTU is 10-15 years.

Figure 28 – RTU

Figure 29 – RTU – Interior

Electrical Recommendations

- Replace service entrance disconnect switch with a service entrance rated circuit breaker
- Replace the generator and automatic transfer switch. Provide an access platform to the generator for access to the generator
- Replace the motor starters in the MCC that have not been recently replaced. Install a cover for the internal panelboard so no live exposed parts can be incidentally touched
- Replace the control room light fixtures with LED
- Evaluate the grounding potential, if it isn't less than 2 ohms, install additional grounding

3. EIGHTH STREET PUMP STATION

3.1. SUMMARY

The Eighth Pump Station is located near the Kill Devil Hills town border with Nags Head, at the intersection of Eighth St. and Pond St. The two-story pump station building was built in the 1960s. The pump station process equipment is held in a large main room off the main hallway. An office/lab and several storage rooms are on the other side of the hallway. Chemical process equipment is stored in a separate room accessed an exterior entrance next to the main front door. A multi-leg elevated storage tank and two cast-in-place ground storage tanks are in the fenced-in yard behind the pump station. The ground storage tanks were part of a wastewater treatment plant that existed on the site. The elevated storage tank was constructed in the 1980s. Dewberry was provided with the original pump station construction drawings prepared by William F. Freeman, Inc Engineers & Architects and dated June 1963.

3.2. SITE / CIVIL

Landscaping

The front of the pump station consists of an asphalt driveway with parking directly in front of the building. Behind the building is a large fenced-in grass yard with the generator, electrical boxes, an elevated storage tank, two ground storage tanks, and the associated valve vaults. No action needs to be taken on the landscaping of this pump station.

Fencing

The back yard of the pump station is surrounded by a 6' tall chain-link fence with barbed wire on top (Figure 30). The fence is functional and is not severely bent in any area, however, in some spots the fence is rusty, and the barbed wire is sagging and bent (Figure 31). The highly rusted fence section should be replaced to maintain security around the pump station.

Figure 30 – Back Yard

Figure 31 – Rusted Fence

Pump Station Site Recommendations

- Replace rusted fence sections - $5,000

3.3. STRUCTURAL

Structural Evaluation

A visual structural evaluation was completed to review the structural condition of the pump station. It should be noted that this type of visual evaluation is limited in nature because many of the structural elements are inaccessible or are not visible (such as the foundation). Destructive methods were not used to observe hidden conditions. Materials and geotechnical testing and structural capacity analysis are outside the scope of this evaluation. For the purposes of this report, the side of the pump station facing the parking lot will be considered the south side of the building.

General Structural Description

The pump station is a partial two-story building. The one-story portion of the building has plan dimensions of approximately 44'-0" by 49'-0". The two-story portion of the building is located on the north side of the one-story area and has plan dimensions of approximately 18'-0" by 22'-0". The two-story portion of the building is a cast-in-place concrete structure and was originally a microfilter basin with a microfilter drive floor above it, but this space has subsequently been repurposed into storage areas and offices. The building roof structure consists of 6-inch-deep by 16-inch-wide precast *Flexicore* hollow core panels which also acts as the finished ceiling. The bottoms of the hollow core panels are located 9'-4" above the floor and are supported on a continuous on a cast-in-place concrete bearing beam which is located above load-bearing exterior 8-inch CMU walls around the perimeter of the building. On the one-story area, the hollow core panels are also supported on a load-bearing interior 8-inch CMU wall along the west side of the central corridor running down the approximate center of the building. The exterior walls of the one-story area consist of 8-inch CMU with a 4-inch brick veneer face and a continuous 24-inch-tall decorative precast panel band at the top of the wall. The 8-inch CMU walls were not specified to be reinforced on the original construction drawings. All of the 8-inch CMU block have a glazed finish on their interior face. The exterior walls of the two-story area are 12-inch-wide cast-in-place reinforced concrete walls for the first floor, switching to 8-inch CMU with brick veneer on the second floor. The one-story area floor consists of 7-1/2-inch-thick slab-on-grade.

In 2004 the prefabricated metal-plate-connected wood trusses with APA rated particle board sheathing were added above the original flat core plank roof at both the one-story and two-story areas. This was done to improve the building aesthetics and reduce the potential for roof leaks common to flat roofs. The roof trusses above the one-story area were detailed to create a large attic floor area. There was some discussion during the site visit about the possibility of adding office spaces at the attic floor area.

An emergency generator is located outside the west wall of the pump station.

Observed Structural Condition of Pump Station

The wood roof trusses, and sheathing appear to be in good condition and built to 2004 code. The connection of the wood trusses to the exterior walls could not be observed, so it could not be confirmed if there are hurricane type uplift anchors present. Hurricane ties provide a mechanical connection to prevent wind uplift failure during a high wind event. This could be a potential failure point for the building roof trusses during a major hurricane event if hurricane ties or similar are not present.

The hollow core panels were observed to be in good condition with no cracking or other types of distress observed. Some paint flaking was observed at one precast hollow core panel in the main pump room (Figure 32). This is most likely indicative of a previous roof leak, but it does not appear to be active now.

Figure 32 – Peeling Paint on Underside of Hollow Core Panels

The condition of the masonry walls is below average. Significant areas of mortar cracking were observed on the inside face of the CMU block, mostly at the top 2 courses of the block (Figure 33). At the exterior wall brick veneer, mortar cracking and mortar loss to the extent that re-pointing the mortar is recommended (Figure 34). According to Town staff, areas of brick veneer mortar cracking and mortar loss had been recently repaired and this completed work was observed during the site visit.(Figure 35). The mortar deterioration on the brick veneer is likely due to accelerated weathering due to the beach salt environment and mortar quality. The mortar cracking on the interior face of the 8-inch CMU is mostly likely caused by differential thermal expansion and contraction between the 8-inch CMU wall and the concrete bearing beam that was cast on top of the CMU. The reinforced concrete bearing beam would have significantly more resistance to thermal forces compared to the masonry below.

Figure 33 – Typical Mortar Cracking in Top Two Courses of 8" Glazed CMU

Figure 34 – Typical Mortar Cracking in Brick Veneer

The concrete exterior wall at the first floor level of the two-story area and the exposed concrete foundation wall around the base of the one-story area have recently received a concrete coating product (Figure 36). No issues were observed with this concrete coating.

Figure 35 – Recent Repointing Repair of Brick Veneer Mortar

Figure 36 – Recent Concrete Coating Product Applied to Exterior Concrete Wall

As noted previously, the original construction drawings do not indicate any reinforcing in the CMU walls. It should be noted that these unreinforced exterior masonry walls are likely insufficient to resist the maximum hurricane wind loads as prescribed by the current North Carolina State Building Code. There are no requirements in the State Building Code to retrofit existing structures and when the building reaches the end of its useful life, a new code-compliant structure is recommended.

No evidence of foundation settlement was observed. The existing floor slab appears to be in good condition with no evidence of significant cracking or settling.

It was observed that the emergency generator does not have a platform around it. A platform could provide easier and safer access to the generator panels.

Structural Recommendations

Deficiency Repairs:

- For the mortar cracks on the interior face of the 8" CMU walls, remove cracked mortar and repoint the mortar joints – $2,500
- For the mortar cracks and missing mortar on the exterior brick veneer, removed cracked mortar and repoint the mortar joints - $5,000

Potential Resiliency Improvement Repairs:

- Even though the existing wood roof truss bearings and existing CMU walls are likely not adequate for resisting current building code prescribed hurricane force wind loads, the building code does not require existing buildings to be improved or reinforced unless major modifications and/or additions are made to the building. That said, the Town of Kill Devil Hills may wish to improve the resiliency of the building to withstand a major hurricane event with the following
    - For the truss bearings, investigate to determine if hurricane type ties are present. If not, then install code compliant hurricane anchors securing the trusses to the walls below - $3,000
    - For reinforcing the CMU walls to withstand current building code wind loads, this would likely involve one of three options - $40,000:
        - Breaking out the interior face shells of the CMU and installing reinforcing bars
        - Adding steel straps to the inside face of the CMU
        - Temporarily shoring the roof and constructing a new reinforced CMU wall

Safety Improvements:

- Add prefabricated aluminum access platform around the generator to provide easier and safer access to the generator panels - $30,000

Addition of Offices to Existing Attic Space:

- The conversion of the existing empty attic space to office space may require reinforcing of the existing wood framed attic floor to provide a minimum live load capacity of 50 psf as required by the building code for office areas. If this project is pursued, it is recommended that a structural engineer perform an analysis of the existing attic floor to determine its live load capacity, and if required, design reinforcing details for the existing wood floor system

3.4. ARCHITECTURAL

General Architectural Description

The exterior walls are brick and CMU on a concrete footing. Horizontal precast panels accent the second-floor level with siding above on the gable ends of the roof and siding inserts below windows. The first floor consists of the microfilter basin, lab, restroom, work room, chlorinator room, pump room, and an office with an entrance under the stairs. Stairs to the second level are in the pump room.

The first floor consists of glazed block CMU walls, quarry tile floor on a concrete slab with a core plank ceiling while the second level office has wood paneled walls and acoustical ceiling tile.

Originally the second level was just an office above the basin, but a second story addition of wood trusses bearing on the first-floor walls created an unfinished walk-in attic space with an opening created in the existing exterior wall (Figure 37). The new roof ties into the second story office roof.

Figure 37 – Added joists/attic space

Observed Condition of the Pump Station Exterior

The mortar in the brick joints is releasing in numerous places. This issue is addressed in the structural portion of the report. The asphalt shingle roof does not need to be addressed.

The vinyl windows and metal trim display no signs of distress.

Metal door frames show signs of light rust. Proper preparation, rust removal, and coating will restore the frames. The main entrance and chlorinator room entrances are wood frames and doors (Figure 38). Replacing with aluminum doors and frames would provide updated durable materials.

The siding should be painted since it's an ongoing maintenance item and other wear surfaces will be painted.

Figure 38 – Entrance door

Observed Condition of the Pump Station Interior

The interior walls are glazed block CMU. The walls don't need to be addressed unless the desire is to update the color to something less dated. While a primer and high-performance coating would update the appearance, it would generate an ongoing maintenance item.

Due to the age of the building, the entire interior should be repainted, including any wood paneling remaining, panels below windows, doors, and trim. The core plank ceiling is in good condition and should be repainted.

Lab casework exhibits while in acceptable condition could use updating (Figure 39). Replacing with laminated cabinets and a solid surface counter and stainless sink provides durable, easy to clean finishes that suit the environment. The existing stove and other break room items should be relocated from the lab to the new break room location.

The handrail at the stairs does not meet the profile for accessibility requirements and should be replaced (Figure 40).

Figure 39 – Office casework

Figure 40 – Handrail

The steel rails in the chlorine room need to be sanded, prepped, and painted with a high-performance coating. While there are no signs of rust, the paint has flaked off extensively.

The restroom shower should be replaced with either a new prefabricated shower unit or a new tile shower. Removal of the existing block wall and tile finish would be required. The remaining restroom fixtures can be cleaned and remain. The baseboard heater should be replaced for a more efficient radiant heater. Toilet accessories such as a wall mounted soap dispenser and paper towel dispenser should be provided for ease of use.

Metal door frames show signs of light rust. Proper preparation, rust removal, and coating will restore the frames. Use of automotive body filler for small rust areas would eliminate the need to replace frames that would be difficult to replace in existing block walls.

The current office at the second level should be converted to a break room (Figure 41 and Figure 42). Currently the first-floor lab doubles as a makeshift breakroom. The office under the stairs and the office at the second level should be relocated to the walk-in attic space. This requires providing electrical, lighting, and most likely a small split system heating unit. The first-floor office and office entrance under the stairs should be converted to storage, leaving the wood paneled walls. The section of carpet of the room under the stair should be removed, leaving the rooms under the stair as bare concrete.

Luxury vinyl tile flooring in the break room and new relocated office would provide a modern and durable finish. The portion of remaining quarry tile in the new break room should be removed. Walls in the relocated office should receive a painted drywall finish with a drywall ceiling.

A wood stud/wood paneling wall added at the main entrance could be replaced with drywall for a durable surface. The second-floor office/break room has a wood panel finish that should be replaced with drywall to update the appearance. The wood paneling in the office converted to storage under the stairs doesn't need to be replaced.

Figure 41 – Attic space

Figure 42 – Second floor office

3.5. PROCESS MECHANICAL

Observed Condition in Pump Room

The large pump room houses most of the process equipment for this pump station including pumps, piping, and valves (Figure 43). Additionally, most of the electrical equipment is housed in this room. The pumps are roughly in the center of the room with discharge piping running along the back wall (Figure 44). The existing pumps are American Turbine model 12-H-150 vertical turbine pumps with 75-hp motors. The pumping capacity of the pump station with the 3 existing pumps is 2,400 gpm, or 1,200 gpm per pump, at 125 ft of head with two duty pumps and one standby pump. The existing pumps were recently replaced in 2021 after the time of the site visit for this condition assessment. Paint is not chipping and there is only minor rust on some of the valves. The check valves and the surge relief valve appear to have some minor leaking. These leaks do not need repair at present but should be monitored in case they worsen. No improvements to the process equipment in the pump room are recommended at this time.

Figure 43 – Pump Room

Figure 44 – Pumps

Observed Condition in Pump Station Chemical Room

The chemical system for the pump station is housed in a small room to the left to of the main door to the pump station. The active chlorine gas canisters are directly inside the room with piping of the system mounted along the wall to the left (Figure 45 and Figure 46). Excess full and empty chlorine gas canisters and stored in the room as well.

Figure 45 – Chemical Piping

Figure 46 – Chlorine Gas System

The chemical room appeared to be in poor condition. Process equipment is showing its age with some areas having significant rust and corrosion. The piping and valves appear to be in particularly poor condition (Figure 47). This equipment is scheduled to be rehabilitated the same as OTH in the spring of 2022. When the equipment reaches the end of its useful life, an evaluation of both gaseous chlorine and liquid Sodium Hypochlorite (NaOCl) systems should be considered. Safety of materials, operations considerations, available space, and costs should all be considered in this evaluation.

Figure 47 – Rusted Chemical Piping

Process Mechanical Recommendations

- Rehabilitate chemical feed system as planned in Spring 2022.
- Monitor leaky valves

3.6. BUILDING MECHANICAL

Observed Condition in the Pump Room

The pump room has a small sink in the back corner. The sink shows clear signs of aging and personnel noted that the sink does not function well. It should be either repaired or replaced to continue use.

Observed Condition in the Chemical Room

There is a safety shower and eyewash station directly outside the door to the chemical room (Figure 48). When tested, neither the shower or the eyewash station functioned properly and must be replaced. It is recommended that the new shower be freeze proof.

Figure 48 – Safety Shower

Observed Condition in the Office/Lab

The office/lab room is off the main hallway across from the pump room. It houses a computer, SCADA systems, a small kitchen, and laboratory equipment. A small bathroom is connected to the office. All plumbing fixtures in the office and lab appeared to be in good condition and personnel confirmed at all fixtures functioned properly. The office/lab is heated by a ceiling-mounted unit heater. The heater appears to be in good condition and is functioning properly.

Observed Condition in Other Rooms

A small room off the main hallway houses the hot water heater, a sink, and acts as miscellaneous storage space (Figure 49). The hot water heater appears to be in good condition and shows only minor cosmetic damage. The hot water heater should be properly insulated. The mop sink next to the hot water heater is showing signs of aging.

Heaters are situated in various rooms and hallways throughout the building (Figure 50). All heaters appear to be functional, but most have some cosmetic damage or rust. The heaters do not need to be replaced at this time however if the pump station were to be completely renovated, the heaters should be included in that renovation.

Figure 49 – Hot Water Heater and Mop Sink

Figure 50 - Heater

Building Mechanical Recommendations

- Repair pump room sink - $1,000
- Replace outdoor safety shower near chemical room – $3,000
- Refurbish bathroom - $20,000
- Insulate Hot Water Heater - $200

3.7. ELECTRICAL / INSTRUMENTATION & CONTROLS

General Electrical Description

The Eighth Street PS has a single electrical utility service fed from pole-mounted transformers outside the facility. The service is 480/277 V, 3-phase, 4-wire, 400 A, routed underground from the transformers to an equipment rack inside the fence line. The main electrical disconnect is on this equipment rack and feeds the rest of the main electrical equipment located in the pump room. The pump room contains an ATS, MCC, VFDs, and distribution equipment. The remote terminal unit (RTU) is located in the lab/control room. There is an outside diesel standby generator.

Service Entrance

The service entrance disconnect switch and CT cabinet are located outside on a wooden equipment rack (Figure 51). The utility meter is located on the same equipment rack. The service entrance disconnect switch appears to be in fair condition, with some signs of corrosion and water intrusion in the bottom of the enclosure. The disconnect is a heavy-duty fused switch manufactured by Square-D with the following ratings: 400 A, 400 A fuses, 600 V, NEMA 4 enclosure. With the enclosure located outside and near the ocean, it is strongly recommended all outdoor electrical equipment be rated NEMA 4X stainless steel for the extra protection against corrosion. It is also recommended that equipment racks be made of a more structurally sound material such as stainless steel or aluminum.

Automatic Transfer Switch

The ATS is located in the pump room against the far wall and appears to be in fair condition (Figure 52). The ATS is connected to the utility for normal power and the generator for emergency power, where the load side feeds an enclosed circuit breaker for the plant electrical distribution. The ATS has had a visual arc inside the enclosure as there is blackened burn marks near the main lugs. The visual inspection of the components did not indicate any damage. Unless the Town has knowledge of the components being recently replaced, an inspection of the ATS is suggested by an InterNational Electrical Testing Association (NETA)

inspector to verify that the components are not damaged in a way that is not outwardly-visible. The ATS is manufactured by ASCO with the following ratings: 800 A, 480 V, 3-phase, cat. no.: H7ADTSA30800N5XL, serial no.: 937828 RE, manufactured in 2013. An estimated useful life of an ATS is 20-25 years.

Figure 51 – Service Entrance Equipment Rack

Figure 52 – ATS - Interior

Generator

The generator is located outside in the corner of the property by the service entrance equipment rack (Figure 53). The generator has a sub-base fuel storage tank that elevates the generator enclosure beyond accessible height. The generator appears to be in fair condition with some corrosion and water intrusion inside the enclosure (Figure 54). The generator is manufactured by Blue Star Power Systems Inc. and has the following ratings: 150 kW, 480/277 V, 3-phase, model no.: JD150-01, serial no.: S-4762, production date: 04/2013, diesel fueled. The estimated useful life of a generator is 20-25 years.

Figure 53 – Generator - Exterior

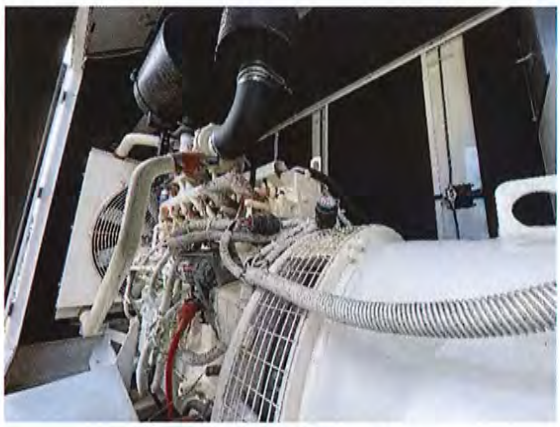

Figure 54 – Generator - Interior

Motor Control Center

The MCC at Eighth Street PS is located in the pump room and is mostly abandoned (Figure 55). The only energized buckets at the time of the inspection were the main breaker, unit heaters breaker, transformer breaker, transformer feeder breaker, and the lighting panelboard inside the MCC (Figure 56). The MCC appears to be in poor to fair condition, mostly due to its age and since the standard components for an MCC of this age are not available as spare parts. Should any maintenance be required on the interior of the MCC, non-standard modifications would be need to be made due to lack of available spare parts. The MCC is manufactured by GE with the following ratings: 600 A, 600 A main breaker, 480/277 V, 3-phase, installed in 1963. The MCC is past its estimated remaining useful life, and with most of its equipment abandoned, should be replaced and reconfigured.

Figure 55 – MCC

Figure 56 – MCC – Panelboard Transformer

Variable Frequency Drives

The pumps are operated on variable frequency drives (VFD), located inside the pump room (Figure 57). When the VFDs were installed, the existing starters in the MCC were abandoned; however, the installation was done via multiple splices in boxes and wireways. This method can lead to dangerous situations in not understanding where all the conductors are sourced from and you cannot safely isolate a single VFD to work in the common wireway. The VFDs were recently replaced in 2021 using the existing exterior enclosure (Figure 58). The VFDs are VLT Aqua Drive FC 202 with the following ratings: 75 hp, 480 V, 3-phase, cat. no.: 131H2160. The estimated useful life of a VFD is approximately 15 years. This can be affected if the drive is not air conditioned and with proper ventilation inside the enclosure.

Figure 57 – VFDs

Figure 58 – VFD – Interior

Miscellaneous Electrical

The lighting in the building appears to have been recently replaced with linear LED fixtures and is in good condition.

There doesn't appear to be a ground ring around the building or substantial grounding. Effective grounding is important for electrical safety and shock hazards, and protection for electronic devices. It is also essential if a lightning protection system is installed to provide an extremely low impedance path to Earth.

Remote Terminal Unit & Controls

The RTU is located in the lab/control room, which is a conditioned space to protect the sensitive electronics (Figure 59). The RTU controls the pump station and connects to the Town's SCADA network. The RTU was

installed by ISI Inc. in 2014 and is in good condition. The PLC located inside the RTU is a Direct Logic 205 (Figure 60). The estimate useful life an RTU is 10-15 years.

Figure 59 – RTU

Figure 60 – RTU – Interior

Electrical Recommendations

- Replace the service entrance disconnect switch with a service entrance rated circuit breaker in a NEMA 4X stainless steel enclosure
- Provide an access platform to the generator for access to the generator
- Replace the MCC lineup with a 480 V main distribution panelboard with dedicated breakers powering each VFD and the remaining 480 V equipment. Also, a dry-type step-down transformer and 208/120 V panelboard
- Evaluate the grounding potential, if it isn't less than 2 ohms, install additional grounding