

Water Facilities Plan: City of Stuart

Pretreatment and Alternative Water Supply Project

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Chapter 1.0 - Summary of Findings and Recommendations

This Water Facilities Plan was prepared for the City of Stuart to meet the requirements of the Florida Department of Environmental Protection (FDEP) State Revolving Fund (SRF) loan funding of drinking water systems. The City of Stuart is located in Martin County and provides water service to the City of Stuart and some parts of unincorporated Martin County. The City of Stuart serves an estimated 16,623 resident population within its service area with 3,950 service connections inside the City and 487 service connections outside the City limits.

The City of Stuart owns and operates a water treatment plant (WTP) with a permitted treatment capacity of 6.0 million gallons per day (mgd) that utilizes forced draft aeration, lime softening, and dual media filtration to treat surficial groundwater from their supply wells. The water wellfield is comprised of a total of 30 production wells of which 23 are active and 7 are inactive due to contamination remediation efforts. Additionally, three wells, PW-1, PW-3, and PW-5, are also currently inactive due to perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) contamination levels that exceed EPA health advisory levels (HAL).

The Environmental Protection Agency (EPA) established the Third Unregulated Contaminant Monitoring Rule {UCMR 3) in 2012 and required yearly assessment monitoring of public drinking water systems in 2013, which regulates a number of emerging contaminants of concern that have been found in water sources around the Country. The City of Stuart was required to monitor for these contaminants as a public water system (PWS) which serves more than 10,000 people since 2013. For the City of Stuart, the perfluorinated compounds (PFC's), perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid {PFOA) are the contaminants of concern which have consistently been detected above the minimum reporting level (MRL) since the rule was promulgated. Although no regulatory limits were initially established by the UCMR 3, in May 2016 EPA established a value of 0.07 ug/1, or 70 parts per trillion (ppt), as a Health Advisory Level (HAL) for the combined PFOS and PFOA levels for public drinking water systems. Since the inception of the UCMR 3, the City of Stuart's water treatment system's point of entry (POE) has historically experienced samples with PFC levels above this HAL. The HAL's provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. EPA's HAL's are non-enforceable and provide technical guidance to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination.

Although the source of PFC contamination found in the groundwater is not fully known, given the environmental sources suspected for the contribution of these contaminants, the source of measured PFCs are suspected to be either from fire-fighting foam entering groundwater, or direct contribution from wastewater reclaim application. Given elevated levels found in several supply wells within a clustered area, it is believed that a point source is the major contributor to these elevated levels.

In addition to contamination of the supply wells for the City's water treatment plant, elevated levels of PFC compounds have also been detected in an area within the City's service area called the Monterey Subdivision, consisting of approximately 146 residences within a 32.5-acre area in unincorporated Martin County on SE San Jose St, SE Tejon St, SE Cortez St, SE Madrid St, and SE Seville St. These homes are

currently on private wells that recent sampling results have shown PFC levels above the established EPA levels.

Based on the results from the sampling and technical research for PFC removal, the current treatment in use at the water treatment plant, using air stripping of the raw water to remove volatiles and other known contaminants, is not effective at removing PFC's. The City of Stuart needs to implement a pretreatment process to remove the PFOA and PFOS contaminants to well below the HAL.

The Monterey Subdivision also needs to have a new water distribution system constructed to connect to the City's public water supply to disconnect these homes from their private well systems.

Additionally, there are certain factors that are threatening the reliability and availability of the surficial aquifer. These factors include groundwater contamination, potential for salt water intrusion, and potential impacts on adjacent wetlands and other legal users. Due to the ongoing threats to the existing water supply and potential for more stringent future drinking water regulations, the City of Stuart needs to diversity its supply options by investing in an alternate water supply (AWS) and treatment system.

Although the City's surficial aquifer water supply is sufficient to meet the population and water demand forecasts under existing water quality regulations, the City's existing surficial aquifer system wells withdrawal rates are limited due to the potential for wetland impacts, potential for saltwater intrusion, and contamination in the surficial aquifer supply. Due to these reasons the City is proactively planning to phase in over a ten-year period reverse osmosis treatment utilizing the Florida Aquifer System as an alternative water source.

Based on the factors noted above, this project meets the requirements of Florida Statute 403.8532(9) which states that special consideration shall be given to "Projects that provide for the development of alternative drinking water supply projects and management techniques in areas where existing source waters are limited or threatened by saltwater intrusion, excessive drawdowns, contamination, or other problems".

The project cost for the Monterey Subdivision water distribution system, proposed pretreatment facilities, and alternative water supply reverse osmosis treatment through Phase 2 is estimated at $18,968,668. Of the total estimated cost, $779,935 is for the Monterey Subdivision water distribution system, $1,904,733 is for the pretreatment system (Phase 1) and $16,284,000 is for the alternative water supply reverse osmosis treatment through Phase 2. The City is currently requesting a $1,904,733 loan for the construction of the pretreatment system (Phase 1), a $768,375 loan for the design of the first two bid packages (Phase 2A and 2B) for the alternative water supply project, and a $779,935 construction loan for the Monterey Subdivision water distribution system. The details of capital and operation and maintenance costs for the water treatment plant improvements are shown in **Appendix A**.

The pledged revenue for debt payments are the water charges by the City of Stuart. The SRF loan will be repaid in 40 semi-annual installments.

Chapter 2.0 - Introduction

2.1 Background

The City of Stuart is located in Martin County, Florida along Florida's East coast. It is the largest of the four incorporated municipalities within Martin County and serves as the County seat. The City which is bordered by the North and South Forks of the St. Lucie River, was first settled in 1870, incorporated in 1914 and chartered in 1925. The City of Stuart is a small neighborhood community that is famous for its sport fishing and is known locally as the Sailfish Capital of the World due to its proximity to the Gulf Stream in the Atlantic Ocean. Although the residential population fluctuates with an increase in visitors during the winter months, the City's service area population was estimated to be approximately 16,623 based on US Census data with 3,950 service connections inside the City and 487 service connections outside the City limits.

The Utility Division of the Public Works Department is responsible for the overall operation of the City's water system including the treatment and distribution of water to its service area customers. The planning area, **Figure 2-1**, includes the entire service area which encompasses the majority of the City of Stuart as well as contiguous areas east to the St. Lucie River, west to the South Fork of the St. Lucie River and south to Monterey Road.

2.2 Need

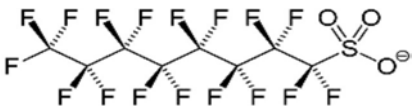
The City of Stuart (City) owns and operates a water treatment plant (WTP) with a permitted treatment capacity of 6.0 million gallons per day (mgd) that utilizes forced draft aeration, lime softening, and dual media filtration to treat surficial groundwater from their supply wells. The water wellfield is comprised of a total of 30 production wells of which 23 are active and 7 are inactive due to contamination remediation efforts. Additionally, three wells, PW-1, PW-3, and PW-5, are also currently inactive due to perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) contamination levels that exceed EPA health advisory levels (HAL). A copy of the Public Health Certification Risk and lab results of the well sampling is included under **Appendix H**.

The Environmental Protection Agency (EPA) established the Third Unregulated Contaminant Monitoring Rule (UCMR 3) in 2012 and required yearly assessment monitoring of public drinking water systems in 2013, which regulates a number of emerging contaminants of concern that have been found in water sources around the Country. The City of Stuart was required to monitor for these contaminants as a public water system (PWS) which serves more than 10,000 people since 2013. In particular for the City of Stuart, perfluorinated compounds (PFC's), perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are the contaminants of concern which have consistently been detected above the minimum reporting level (MRL) since the rule was promulgated.

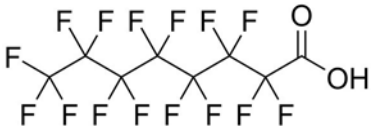


CITY OF STUART WATER FACILITIES PLAN	PLANNING & SERVICE AREA	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 2-1 & 3-1

PFOS



PFOA

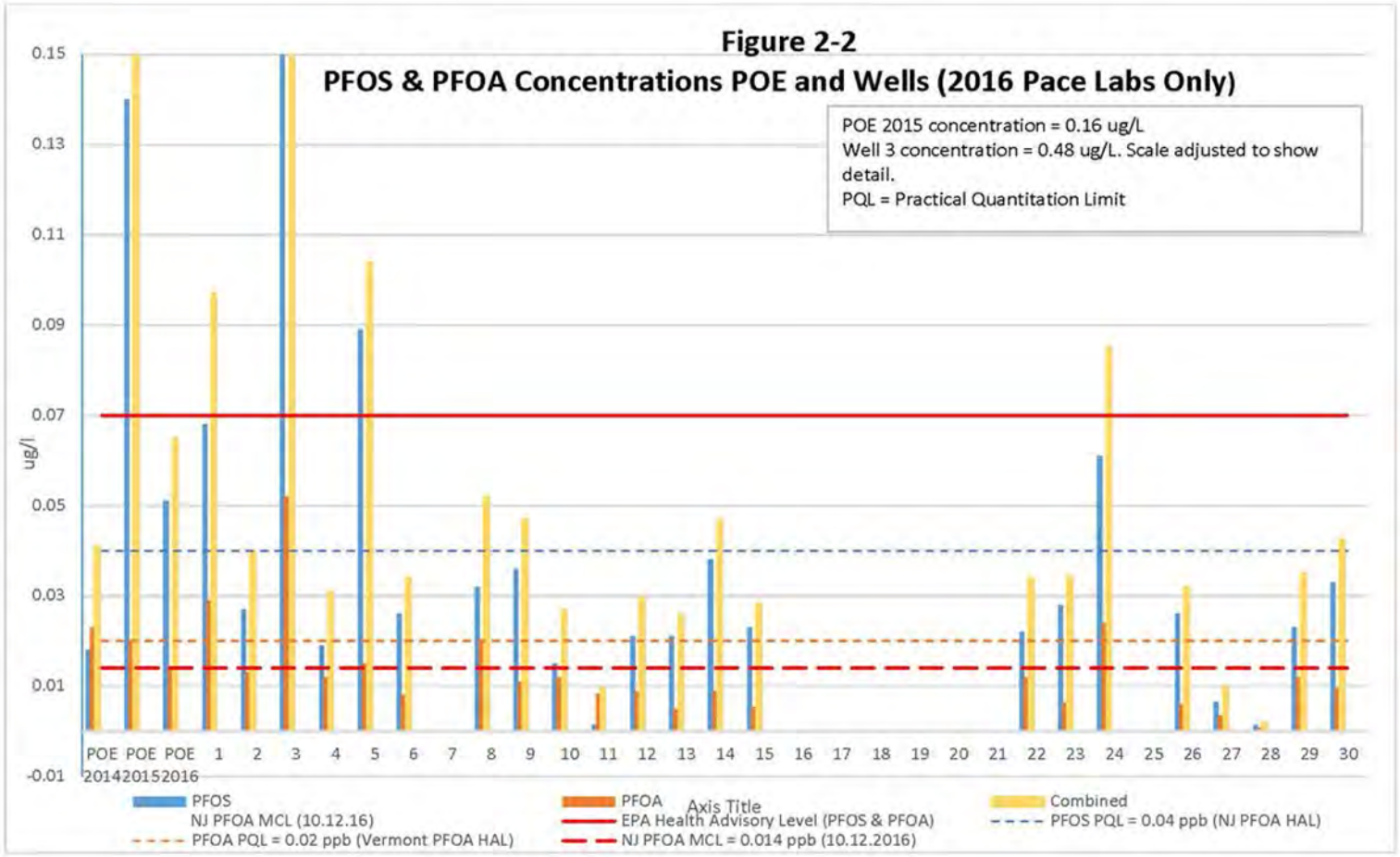


Although a provisional health advisory for PFOS/PFOA combined was set at 0.600 ug/L, or 600 parts per trillion (ppt) in 2009, in May 2016 EPA established a value of 0.07 ug/L, or 70 parts per trillion (ppt), as a Health Advisory Level (HAL) for the combined PFOS and PFOA levels for public drinking water systems. Since the inception of the UCMR 3, the City of Stuart's water treatment system's point of entry (POE) has historically experienced samples with PFC levels above this HAL. The HAL's provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. EPA's HAL's are non-enforceable and provide technical guidance to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination.

Although the source of PFC contamination found in the groundwater is not fully known, given the environmental sources suspected for the contribution of these contaminants, the source of measured PFCs are suspected to be either from a direct point source contamination using fire- fighting foam entering groundwater. Given elevated levels found in several supply wells within a clustered area, it is believed that a point source is the major contributor to these elevated levels. Refer to **Figure 2-2** illustrating the PFC (PFOA + PFOS) levels measured in each supply well and POE.

Based on the results from the sampling and technical research for PFC removal, conventional treatment currently in use at the water treatment plant of using air stripping of the raw water to remove volatiles and other known contaminants followed by lime softening and filtration is not effective at removing PFC's. For supporting information, refer to the Water Research Foundation's Web Report #4322, "Treatment Mitigation Strategies for Poly- and Perfluoralkyl Substances". Based on this information and other research, the existing treatment system provides inadequate treatment for the removal and/or reduction of PFC's in order to meet the established regulations and the City's treatment goals.

Given the PFC contaminant's concentration in the raw water, it is not anticipated that blending with other wells with lower PFC levels as a treatment method to reduce PFC levels in the finish water will be acceptable to meet the PFC removal goals. Using the 70 ppt HAL (combined PFOA and PFOS) as an upper limit for each well, an alternative treatment method will be necessary to maintain use of the groundwater wells. There is


Figure 2-2
PFOS & PFOA Concentrations POE and Wells (2016 Pace Labs Only)
POE 2015 concentration = 0.16 ug/L
Well 3 concentration = 0.48 ug/L. Scale adjusted to show detail.
PQL = Practical Quantitation Limit
ug/l
0.15
0.13
0.11
0.09
0.07
0.05
0.03
0.01
-0.01
POE POE POE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
2014 2015 2016
PFOS
PFOA
Axis Title
Combined
NJ PFOA MCL (10.12.16)
EPA Health Advisory Level (PFOS & PFOA)
PFOS PQL = 0.04 ppb (NJ PFOA HAL)
PFOA PQL = 0.02 ppb (Vermont PFOA HAL)
NJ PFOA MCL = 0.014 ppb (10.12.2016)

Also, on-going research outside of the EPA that has suggested lower allowable concentrations of PFOA, PFOS, and other PFC's is recommended. For instance, The State of New Jersey was in the process of promulgating a maximum contaminant level for PFOA of 14 ppt at the time of this report, nearly five times lower than the HAL EPA has established. If adopted, it will be the only legal limit on PFOA in the nation.

The existing groundwater supply has limitations due to challenges with other historical contaminants, including the recent presence of PFCs and some of the emerging contaminants of concern. Accordingly, the approach to the City's water supply concerns revolves around achieving compliance for the existing water source and customers as well as a sustainable supply for the future of the City.

The current water supply is derived from the surficial aquifer which has limited withdrawal capacity and is highly scrutinized by the South Florida Water Management District due to its influence on the surrounding water table. In addition, its close proximity to the surface yields it as suspect to contamination from surface application of chemicals and reclaimed water. Specifically, these contaminants include the PFCs, and others listed in **Table 2-1**.

Table 2-1 Contaminants of Concern - City of Stuart Wells

Water Quality		Unit	Influent (range)	MCL/HAL
	Parameter			
	PFC (PFOS)**	ug/l	0.046 - 2.1	-
	PFC (PFOA)**	ug/l	0.0048-0.052	-
	PFC (PFOS + PFOS) (max)	ug/l	0.050 - 2.15	0.070
>	1,4-Dioxane**	ug/l	0.130	-
>	Methyl-tert-butyl-ether	ug/l	1.800	-
>	cis-1,2-Dichloroethylene (DCE)	ug/l	0.3-42.4	70.0
>	1,2 Dichloropropane (DCP)	ug/l	1.2-39.0	-
>	1,2,3-Trichloropropane (1,2,3-TCP)*	ug/l	1.0-23.8	-
>	Trichloroethylene (TCE)	ug/l	5.00	-
>	Tetrachloroethylene (PCE)	ug/l	0.65	3.0
>	Vinyl Chloride	ug/l	0.13	1.0
>	Chlorobenzene	ug/l	0.34	-
>	Benzene	ug/l	1.30	1.0

* UCMR3 List
** UCMR3 and UCMR4 List
> Treatment currently in place

Longer term raw water supply focused on alternative water sources needs to be implemented in the future for sustainability, treatment feasibility, regulatory considerations, and financial efficiency for the City. The existing surficial aquifer is a limited source of raw water, and the City does not have any alternative water supply sources, other than interconnects with neighboring utilities. Additionally, the existing surficial aquifer has a number of existing contaminants that further limit the withdrawal capacity, and with the recent discovery of PFC contaminants, further limits the Utilities ability to meet future water system demands and drinking water standards. **Table 2-1** provides a list of current and historical known contaminants that require advanced treatment beyond conventional lime softening and filtration.

Currently, there is no known groundwater contaminant level established for PFC's that would trigger corrective cleanup actions or potential funding at the PFC levels measured in the wells. Additionally, the use of reclaim water for irrigation and continued recharge of the surficial aquifer has no regulations for these emerging contaminants. However, reclaim water quality standards are currently under review by the regulatory agencies, which may trigger monitoring and/or potential treatment for these emerging contaminants.

The short-term solution should include either replacing lost capacity from these wells with finished water from existing finish water interconnects or restore the functional use of the existing groundwater wells containing elevated PFC levels with an alternative treatment method. Restoring capacity of the raw water supply wells which contain PFC levels above the HAL, must include an advanced treatment method not currently used at the existing facility. Pilot testing using the most cost-effective, best known track record of reducing PFC's was developed and implemented in order to identify design criteria, operational experience, and capital and operating costs associated with the selected treatment option.

Based on the results from the sampling and technical research for PFC removal, the current treatment in use at the water treatment plant, using air stripping of the raw water to remove volatiles and other known contaminants, is not effective at removing PFC's. The City of Stuart needs to implement a pretreatment process to remove the PFOA and PFOS contaminants to well below the HAL. Additionally, there are certain factors that are threatening the reliability and availability of the surficial aquifer. These factors include groundwater contamination, potential for salt water intrusion, and potential impacts on adjacent wetlands and other legal users. Due to the ongoing threats to the existing water supply and potential for more stringent future drinking water regulations, the City of Stuart needs to diversity its supply options by investing in an alternate water supply (AWS) and treatment system.

In addition to contamination of the supply wells for the City's water treatment plant, elevated levels of PFC compounds have also been detected in an area within the City's

service area called the Monterey Subdivision, consisting of approximately 146 residences within a 32.5-acre area in unincorporated Martin County on SE San Jose St, SE Tejon St, SE Cortez St, SE Madrid St, and SE Seville St. . These homes are currently on private wells that recent sampling results have shown PFC levels above the established EPA levels. In conjunction with the treatment improvements planned at the City's water treatment facility, the Monterey Subdivision also needs to have a new water distribution system constructed to connect to the City's public water supply to disconnect these homes from their private well systems.

Although the City's surficial aquifer water supply is sufficient to meet the population and water demand forecasts under existing water quality regulations, the City's existing surficial aquifer system wells withdrawal rates are limited due to the potential for wetland impacts, potential for saltwater intrusion, and contamination in the surficial aquifer supply. Due to these reasons the City is proactively planning to phase in over a ten-year period reverse osmosis treatment utilizing the Florida Aquifer System as an alternative water source. This project meets the requirements of Florida Statute 403.8532(9) which states that special consideration shall be given to "Projects that provide for the development of alternative drinking water supply projects and management techniques in areas where existing source waters are limited or threatened by saltwater intrusion, excessive drawdowns, contamination, or other problems".

2.3 Scope of Study

The scope of the Water Facilities Plan is described below:

1. Inventory existing water facilities, service area characteristics, and environmental conditions.
2. Establish design needs for planning period.
3. Identify and evaluate various water system alternatives to satisfy the planning year needs.
4. Recommend the most cost-effective, environmentally sound facilities to meet the planning needs.
5. Describe, in detail, the recommended facilities and their cost.
6. Present a schedule of implementation of the recommended facilities.
7. Identify and adverse environmental impacts and propose mitigating measures.
8. Identify a source of financing and estimate the cost per household.

Chapter 3.0 - Environmental Impacts

3.1 Description of Planning Area

3.1.1 Planning/Water Service Area

The planning area and water service area are the same and as depicted in **Figure 3-1.** The planning area is bounded on the east by the St. Lucie River, on the south by Monterey Road on the west by the South Fork of the St. Lucie River and on the north by Federal Highway/US No. 1 and Baker Road.

3.1.2 Climate

Due to its proximity to the Atlantic Ocean in South Florida, the climate in the City of Stuart is humid with warm temperatures characteristic of long tropical summers and mild winters. According to climate data provided by the USDA Natural Resources Conservation Service, the average annual temperature is 83^0F. During extended periods from the month of June through the month of September, daytime temperatures often exceed 90^0F. Winters are generally short and mild with January generally the coldest month with an average daily temperature of 65^0F. The coldest day temperature recorded in Stuart in the last 30 years was 23^0F. Normally in Stuart the temperatures rarely reach freezing.

The average rainfall in Stuart is 59 inches. Approximately 60% of the total rainfall occurs during the months of June through September.

From June to September, daily thunderstorms with moderately high winds are likely to occur. The hurricane season begins in June and concludes in November and heavy rainfall and high winds can be expected during this time period.

3.1.3 Topography and Drainage

The topography in the service area ranges from sea level to 15 feet. Higher elevations can be found as you move inland from the areas located adjacent to the surrounding waters. The highest elevation in the planning area is 17 feet. **Figure 3-2** depicts the topography data for the Stuart service area. Surface water drains to adjacent waterways with the flow generally from the west to the east except in those areas adjacent to water bodies.



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CITY OF STUART WATER FACILITIES PLAN	TOPOGRAPHIC MAP	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-2

3.1.4 Geology, Soils and Physiography

Most of the planning areas terrain is flat and low lying. According to the USDA Soil Conservation Service:

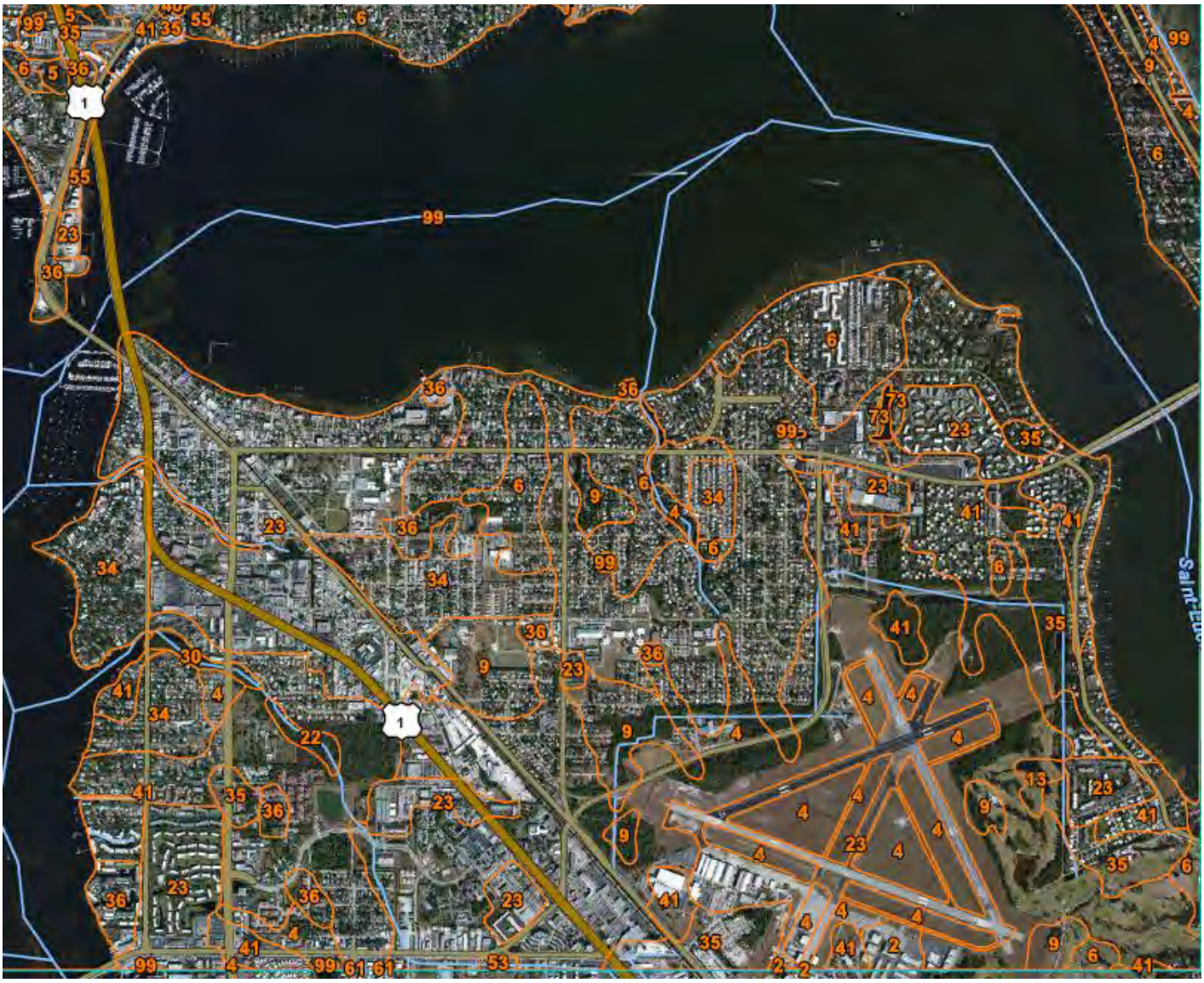
> "*The sandy flatlands, stretching westward from the coastal ridge to near Lake Okeechobee, make up the major part of the survey area. The flatlands consist mostly of flatwoods with numerous small ponds and grassy sloughs. The soils are predominantly nearly level, sandy, and wet and have a sandy subsoil that is weakly cemented with organic matter. In the south-central part of the survey area, limestone is below the soil in many places. Most areas of the flatwoods have an elevation ranging from 15 to 30 feet, but in the northwestern part elevation ranges to about 50 feet. Vegetation is mostly pine, saw palmetto, and pineland threeawn."*

The soils characteristics for the planning area, as provided from the USDA Soil Conservation Service, are illustrated in **Figure 3-3**. Throughout the planning area, nearly level to gently sloping, excessively drained soils exist. These soils are typically sandy throughout. The majority of the soils are Paola soils, 50 percent, with 30 percent St. Lucie soils and 20 percent soils of minor extent. Paola soils are excessively drained. The surface layer is gray sand about 4 inches thick, the subsurface layer is mostly white sand to a depth of 32 inches with a subsoil is also sand to a depth of about 68 inches. The substratum is a light yellowish-brown sand to a depth of 80 inches or more. St. Lucie soils are also excessively drained and consist of a surface layer of gray sand approximately 3 inches thick followed by a layer of white sand to a depth of 80 inches or more.

3.1.5 Surface and Ground Water Hydrology, Quality and Uses

3.1.5.1. Surface and Ground Water Hydrology

There are no Outstanding Florida Waters in the planning area. **Figure 3-4** illustrates the surface water features located within the planning area. The St. Lucie River is a designated Class III water body, suitable for recreation and for propagation of fish and wildlife. The Intracoastal waterway is located to the east of the planning area and serves as the marine highway for boat traffic travelling through Stuart on their way north or south.



Map Unit Symbol	Map Unit Name
2	Lawnwood and Myakka fine sands
4	Waveland and Immokalee fine sands
5	Waveland and Lawnwood fine sands, depressional
6	Paola and St. Lucie sands, 0 to 8 percent slopes
8	Palm Beach-Beaches complex, 0 to 8 percent slopes
9	Pomello sand, 0 to 5 percent slopes
13	Placid and Basinger fine sands, depressional
22	Okeelanta muck
23	Urban land
30	Bessie muck
34	St. Lucie-Paola-Urban land complex, 0 to 8 percent slopes
35	Salerno sand
36	Arents, 0 to 2 percent slopes
40	Sanibel muck
41	Jonathan sand, 0 to 5 percent slopes
50	Wulfert and Durbin mucks, tidal
53	Udorthents, 0 to 35 percent slopes
55	Basinger fine sand
61	Hobe fine sand, 0 to 5 percent slopes
63	Nettles sand
73	Samsula muck

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

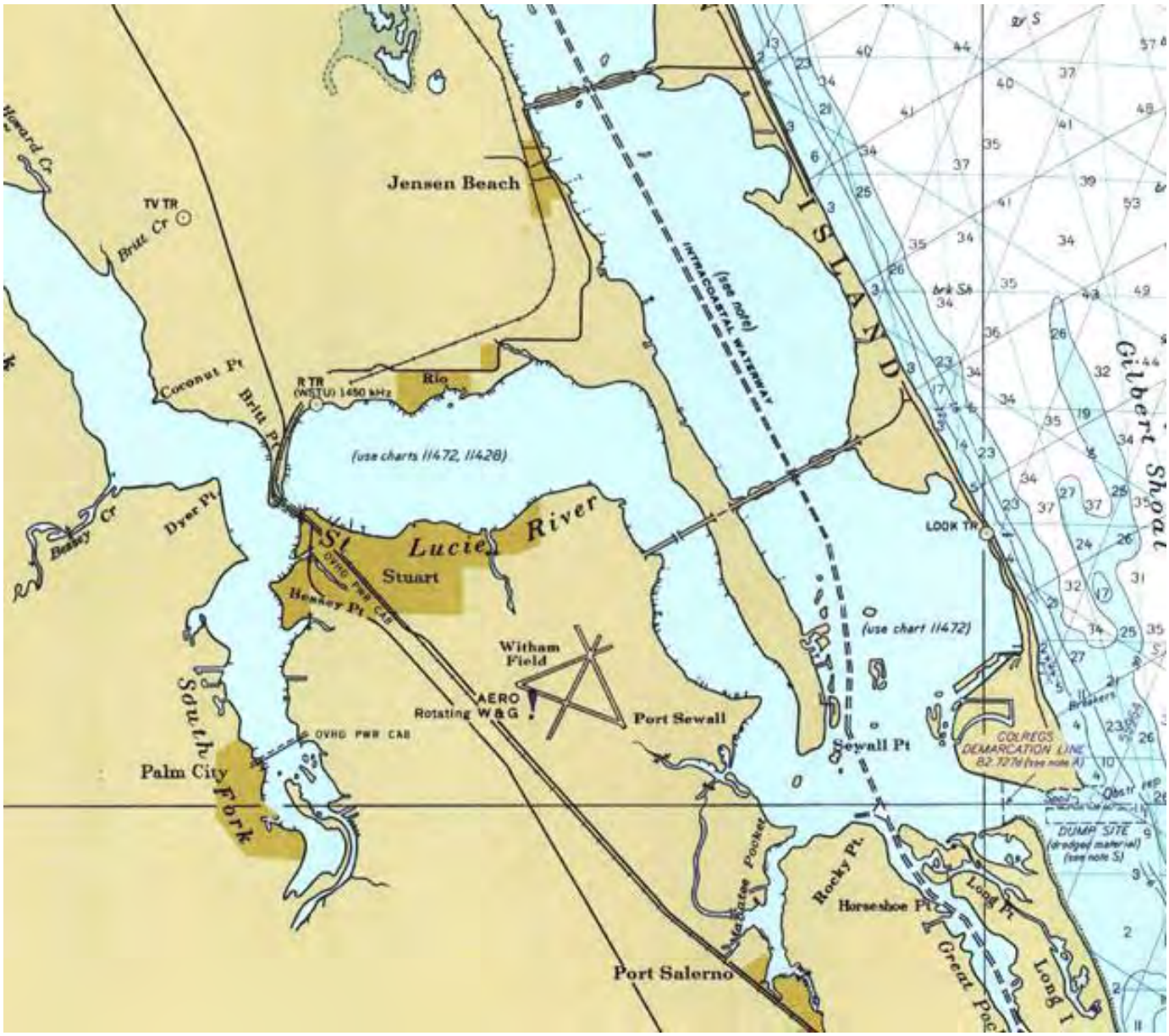
This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Martin County, Florida
Survey Area Data: Version 10, Jul 3, 2012

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 15, 2010—Mar 13, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



CITY OF STUART WATER FACILITIES PLAN	SURFACE WATER FEATURES	HOLTZ CONSULTING ENGINEERS, INC. 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-4

3.1.5.2. Surface and Ground Water Quality and Uses

The water quality in the St. Lucie River is fair and fluctuates seasonally due to releases of freshwater from Lake Okeechobee. Much of the ground water in the planning area is Class G-11 (potable water use).

3.1.6 Sourcewater Protection

The City's main potable water supply source is the surficial aquifer. All of the City's raw water supply wells withdraw from the surficial aquifer approximately 100 to 125 feet below ground surface. The production wells vary slightly in depth from approximately 105-feet to 120 feet below ground surface depending on local subsurface conditions.

The City's Comprehensive Plan references the Martin County Wellfield Protection Ordinance (Ord. No. 428, pt. 1 adopted 7-27-1993 and Ord. No. 437, pt. 2, adopted 3-8-1994) which adopted the Martin County Wellfield Protection Ordinance provisions to make Division 5 application to the City of Stuart. Additionally, the City of Stuart has developed policies within its Comprehensive Plan (Ord. No. 1893-02, pt. 1 adopted 1-27-2003 and Ord. No. 2205-2010, pt. 1 (Exh. I)) adopted 9-27-2010) related to sourcewater protection.

The proposed projects will enhance and improve the City's water supply and sourcewater protection. **Appendix B** contains a copy of the Martin County Wellfield Protection Ordinance.

3.1.7 Environmentally Sensitive Areas or Features

3.1.7.1 Wetlands

According to the U.S. Department of the Interior National Wetland Inventory Map, numerous freshwater wetlands border surface water bodies that drain the service area. **Figure 3-5** presents wetlands identified in the National Wetland Inventory. There will be no wetland impacts associated with the City of Stuart alternative water supply treatment project including the concentrate disposal main.

3.1.7.2 Environmentally Sensitive Lands

All proposed improvements will be constructed on the existing City of Stuart water treatment plant site or within the public road Right-of-Way for the concentrate disposal main. There are no environmentally sensitive lands within the project area.



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

CITY OF STUART WATER FACILITIES PLAN	NATIONAL WETLAND INVENTORY	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-5

3.1.7.3 Plant and Animal Communities (Endangered Species)

According to the Martin County Soil Survey, wildlife habitat has already been impacted with development in the urbanized areas near the coast such as the City of Stuart. The most extensive areas of good habitat are in the undeveloped rangeland and the ocean beaches which are used extensively for nesting by endangered and threatened sea turtles and the mangrove islands in the Indian River, Loxahatchee River and St. Lucie River which are valuable as rookery and roosting areas for wading birds and pelicans.

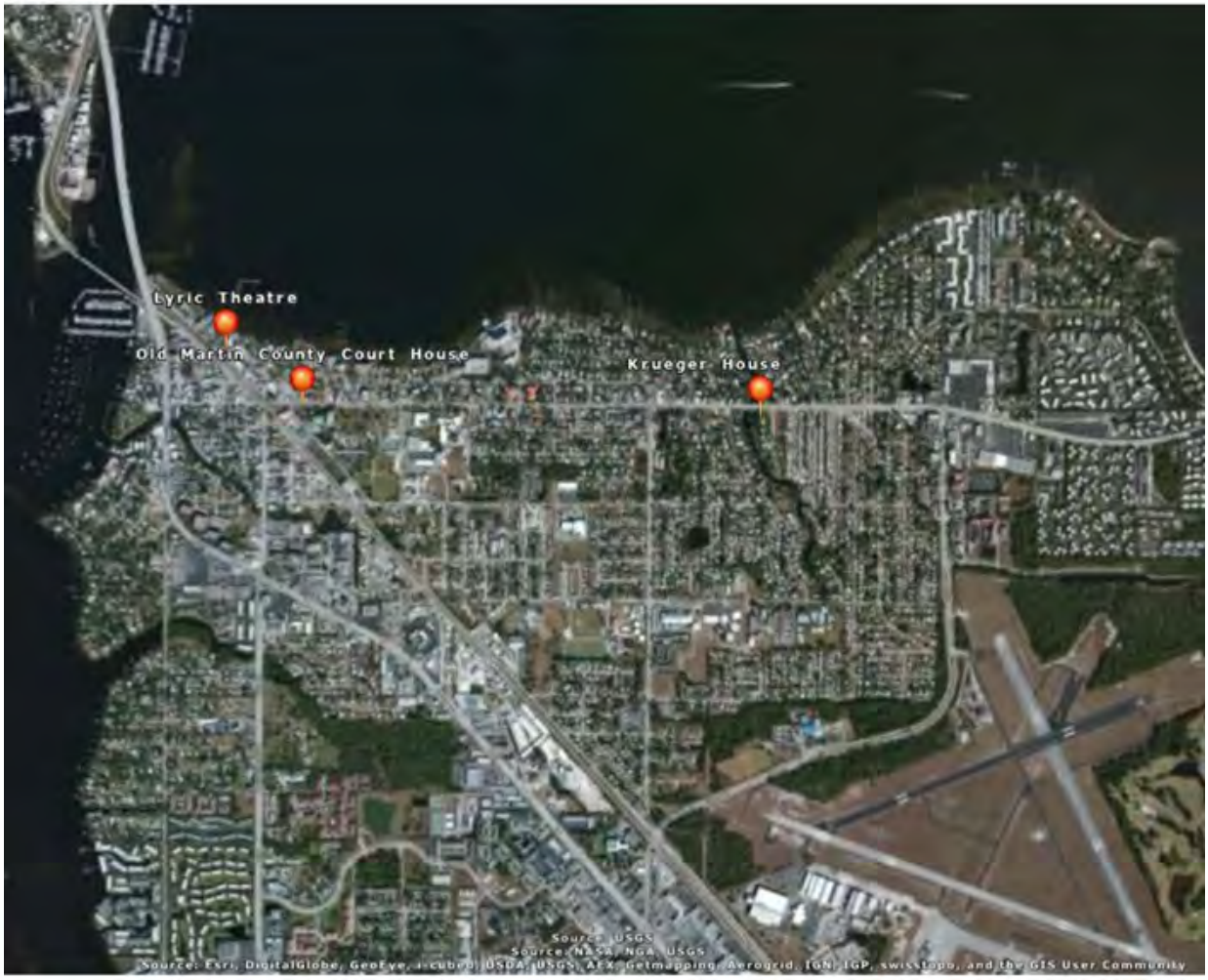
The alternative water supply project will be on the existing City of Stuart water treatment plant property and for the concentrate disposal main within the limits of public road Right-of-Ways within the heart of the downtown City of Stuart service area and therefore no endangered or threatened species of animals or vegetation will be impacted with this project.

3.1.7.4 Archaeological and Historical Sites

Figure 3-6 identifies the historical and archaeological sites recorded in the Florida Master Site File (Florida Division of Historical Resources) within the project area. As identified in the figure, the alternative water supply project will be constructed within the limits of existing City of Stuart water treatment plant property and public right-of-way for the concentrate disposal main and Monterey Subdivision water mains. Although there are structures and sites identified within the project areas, none of these projects will be impacted by the alternative water supply project.

3.1.8 Floodplain

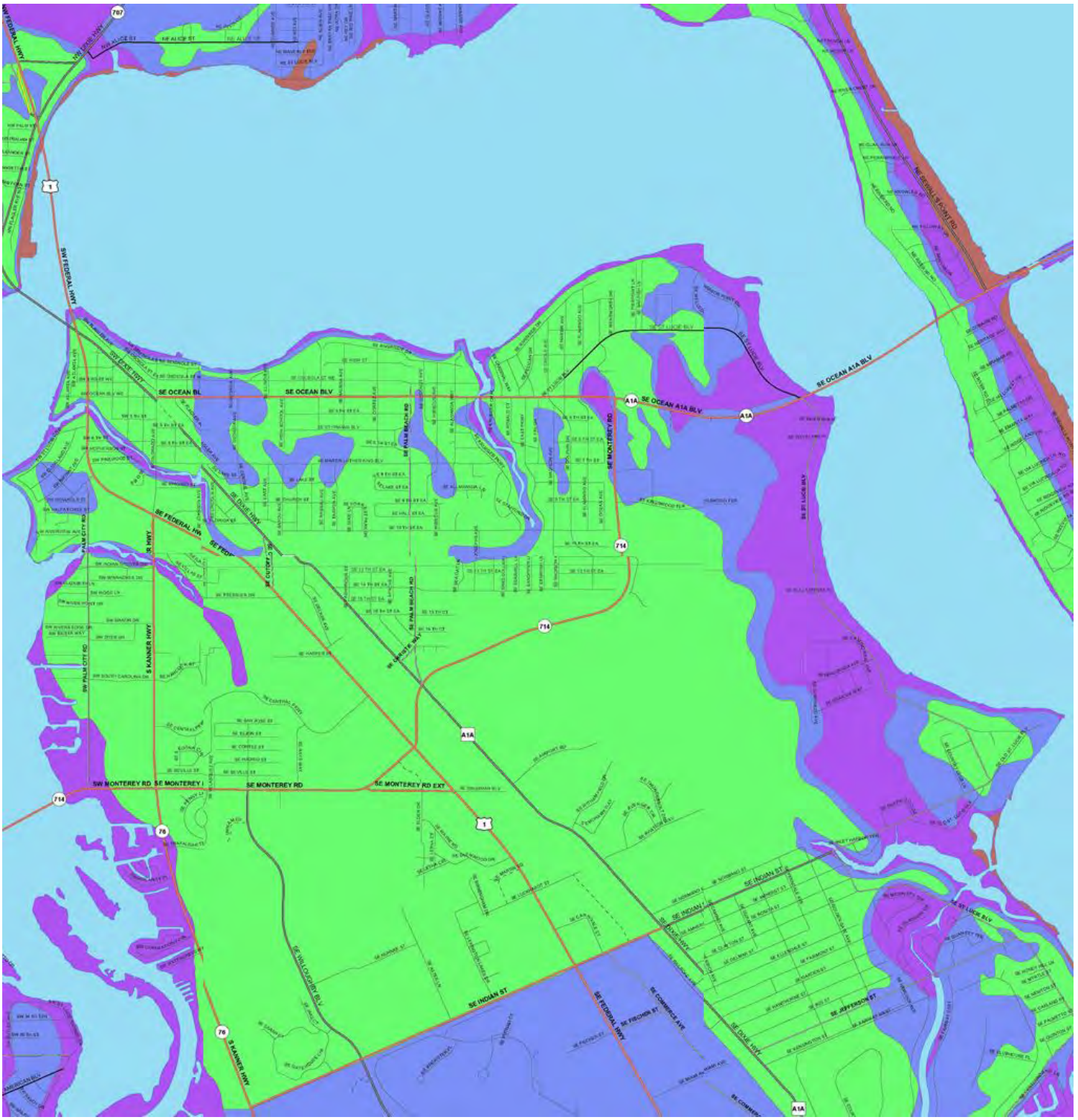
Flood zones for the water service area are presented in **Figure 3-7.** The areas in which the proposed infrastructure and treatment improvements are to be constructed are located in Zones X and AE. The Flood Insurance Rate Map (FIRM) defines Zone X as an area determined to be outside of the 0.2% annual chance floodplain. Zone AE is designed as the 100-year floodplain where base flood elevations have been determined. The construction of the City of Stuart alternative water supply project will occur on the existing water treatment plant site and within the limits of the public road Right-of-Way and will not create any impact on the existing floodplain boundaries as the surface elevation will not be altered.





May 2018

CITY OF STUART WATER FACILITIES PLAN	HISTORICAL & ARCHAEOLOGICAL SITES	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-6



FEMA_FIRMS_FINAL
Zone
- A
- AE
- AH
- VE
- X
- X500

N
W E
S

CITY OF STUART WATER FACILITIES PLAN	FLOOD ZONES	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-7

3.1.9 Air Quality

According to the Florida Department of Environmental Protection, Florida Air Quality System (FLAQS) website, the City of Stuart's water service area is an "attainment" area with respect to the National Ambient Air Quality Standards.

The construction of the City of Stuart alternative water supply project will not create any impact on the existing City of Stuart air quality.

3.2 Socio-economic Conditions

3.2.1 Population

The population of the service area is calculated using the available information from the different census tracts from the American Community Survey, 2016 estimates. Using the past history of the census tracts population and future growth estimates from Martin County and the City of Stuart planning department, a future population projection is made for the census tracts. **Table 3-1** presents the existing population of the City of Stuart in the census tracts served and the current number of water accounts.

Table 3-1: Population and Future Water Demands

Year	Total Resident Population of Water Service Area	Number of Accounts
2016	16,623	4,500

3.2.2 Land Use and Development

Future land use is established in the Comprehensive Plan for the City of Stuart and is depicted in the 2030 Future Land Use Map. Areas within the City north of the St. Lucie River consist of commercial, residential, conservation, and limited areas of industrial. The majority of the City of Stuart is south of the St. Lucie River. The central area of the City, considered downtown Stuart, is a mix of commercial, office, and residential. Heading east, the predominant land use is single-family and multi-family residential, with commercial and office uses along SE Ocean Boulevard, and interspersed areas of public and institutional uses. Along the western city limits, adjacent to the St. Lucie River, uses are predominantly single-family, with several areas of multi-family and commercial. Heading south along the U.S. 1 corridor, land uses are predominantly commercial, followed by multi-family residential, with limited areas of industrial, public, and institutional. Redevelopment, or future

development on vacant parcels, is expected to be consistent with the City's 2030 Future Land Use Map.

3.3 Water Supply, Treatment and Transmission/Distribution System

3.3.1 Description of the Existing Water System

The City of Stuart receives raw water from 30 raw water wells located throughout the City's service area and has executed an Interlocal Agreement with Martin County Utilities (MCU) for the purchase of additional potable water should this be necessary in order for the City to meet daily demands. These water sources are summarized as follows:

Raw Water Source: Surficial Aquifer. All of the City's raw water supply wells withdraw from the surficial aquifer approximately 100 to 125 feet below ground surface. The production wells vary slightly in depth from approximately 105-feet to 120 feet below ground surface depending on local subsurface conditions. Seven of the 30 supply wells have been leased to Northrop Grumman Corporation, as part of its groundwater remediation program. A map showing the location of the City's raw water wells is included as **Figure 3-8.**

In addition to the raw water wells, the City has an Interlocal Agreement with Martin County Utilities (MCU) for the purchase of additional potable water should this be necessary in order for the City to meet daily demands.

The City of Stuart's water transmission and distribution system consists of approximately 100 miles of pipe that ranges in diameter from ¾ inches to 24 inches. The material of construction includes cast iron, ductile iron, asbestos cement, and polyvinyl chloride (PVC).

The City's water transmission and distribution system is supplied by high service pumps located at the City's water treatment plant which draws from the water plant's ground storage. The City's service area for potable water is depicted in **Figure 3-1** titled City of Stuart Potable Water Service Area.



CITY OF STUART WATER FACILITIES PLAN	RAW WATER PIPELINE AND WELL LOCATIONS	**HOLTZ CONSULTING ENGINEERS, INC.** 270 SOUTH CENTRAL BLVD., SUITE 207 JUPITER, FL 33458 PH: (561) 575-2005	FIGURE 3-8

3.3.2 Present and Historical Water Usage

The City's projected per capita water demand was determined as part of the City's South Florida Water Management District (SFWMD) Water Use Permit renewal process. The estimated future per capita demand of 191 gallons per day per person (gpd/person) by 2028 is less than the current demand of 218 gpd/person. **Table 3-2** shows the future population projections along with the corresponding potable water flow demand projections through 2028.

Table 3-2: Population and Future Water Demands

Year	Population	Per Capita Usage (gallons)	Average Daily Flow	MDF Peaking Factor	Maximum Daily Flow (MGD)	Peak Hour Peaking Factor
2009	17,135	210	3.60	1.32	4.76	1.93
2010	17,428	209	3.65	1.32	4.81	1.93
2011	17,726	208	3.69	1.32	4.87	1.93
2012	18,029	207	3.73	1.32	4.93	1.93
2013	18,338	206	3.78	1.32	4.99	1.93
2014	18,651	205	3.82	1.32	5.05	1.93
2015	18,970	204	3.87	1.32	5.11	1.93
2016	19,295	203	3.92	1.32	5.17	1.93
2017	19,625	202	3.96	1.32	5.23	1.93
2018	19,960	201	4.01	1.32	5.30	1.93
2019	20,302	200	4.06	1.32	5.36	1.93
2020	20,649	199	4.11	1.32	5.42	1.93
2021	21,002	198	4.16	1.32	5.49	1.93
2022	21,361	197	4.21	1.32	5.55	1.93
2023	21,726	196	4.26	1.32	5.62	1.93
2024	22,098	195	4.31	1.32	5.69	1.93
2025	22,476	194	4.36	1.32	5.76	1.93
2026	22,860	193	4.41	1.32	5.82	1.93
2027	23,251	192	4.46	1.32	5.89	1.93
2028	23,648	191	4.52	1.32	5.96	1.93

Data Source: City of Stuart South Florida Water Management District Water Use Permit Application.

The projected daily potable water necessary to serve the City's future demands ranges from 3.6 million gallons per day (MGD) to 5.96 MGD. Based on these projections, neither the average daily demand nor the maximum daily demands are anticipated to exceed the current permitted WTP capacity of 6.0 MGD within the planning period.

3.3.3 Water Conservation

The City of Stuart adopted a 20-year Water Conservation Initiative in January 2008. Effective July 1, 2010, the City also adopted 2-day per week year-round water conservation measures to limit residential irrigation to 2 days per week and the timing of the irrigation to early morning and late evenings to mitigate the loss of water to evaporation.

The City of Stuart recently implemented the use of AquaHawk, an online water conservation and budgeting tool for customers. AquaHawk Alerting™ is an online Web portal that enables City customers to see their water usage anytime during the billing cycle. After registering and providing up-to-date contact information, customers can opt to receive a text message, e-mail, or phone call alert if their consumption indicates a potential leak or abnormal usage. To help save money and more efficiently manage water usage, customers can set thresholds for usage (e.g., 5,000 gals.). If the customer's consumption is trending to exceed or surpasses the threshold, AquaHawk will send an automatic alert. Additionally, when City of Stuart consumers are traveling, AquaHawk enables them to monitor for unauthorized water use in their homes. Consumption, rainfall, and temperature data are displayed in easy-to-understand graphs that help pinpoint when an account may be using water inefficiently such as watering a landscape during, or shortly after a rain event.



Since 2012, the City of Stuart along with partnering agencies, has been hosting an annual "Water Fest", in honor of Water Conservation Month, Earth Day, and Drinking Water Week. This free-to-the public event is to promote and educate awareness for water conservation and protecting the environment. More than 1,000 attendees come to Water Fest each year. Young and old learn together about water testing and treatment, water quality and conservation. Participants are provided with hands-on water treatment testing and sampling offered by Martin County Utilities and the City of Stuart Water Treatment Facility.



City of Stuart Annual Water Fest

3.3.4 Performance of Existing Water System

The high service pumps at the City's water treatment plant perform well and the water treatment plant is in good operating condition and has the capability to treat the projected demand permitted under the water use permit from the South Florida Water Management District.

3.3.5 Service Population and Water Demand Projection

The water demand for 2028 is developed based upon the population projection and per capita demand of 191 gallons per capita. **Table 3-2** listed above, presents the projected water demands from 2009 to 2028.

3.4 Managerial capacity

The City of Stuart Public Works Department has the responsibility and authority to operate and maintain the water system. Department staff has the capability and capacity to maintain and operate the City's water system. The City's water system is continuously operated in shifts. After hours repairs and maintenance are conducted with night and weekend utility crews.

Routine water analyses are performed by Public Works Department staff in the City's laboratory. Monitoring of the water system is accomplished with SCADA. Recently the City of Stuart implemented AquaHawk Alerting™, a meter reading system that incorporates leak detection to more accurately pinpoint the location of leaks and breaks and to allow residents to monitor water conservation and individual water usage.

Chapter 4.0 - Alternatives Analysis

4.1 General

For the pretreatment system (Phase I) as part of the City of Stuart Alternative Water Supply Project there are three viable treatment method alternatives effective at removing PFC's:

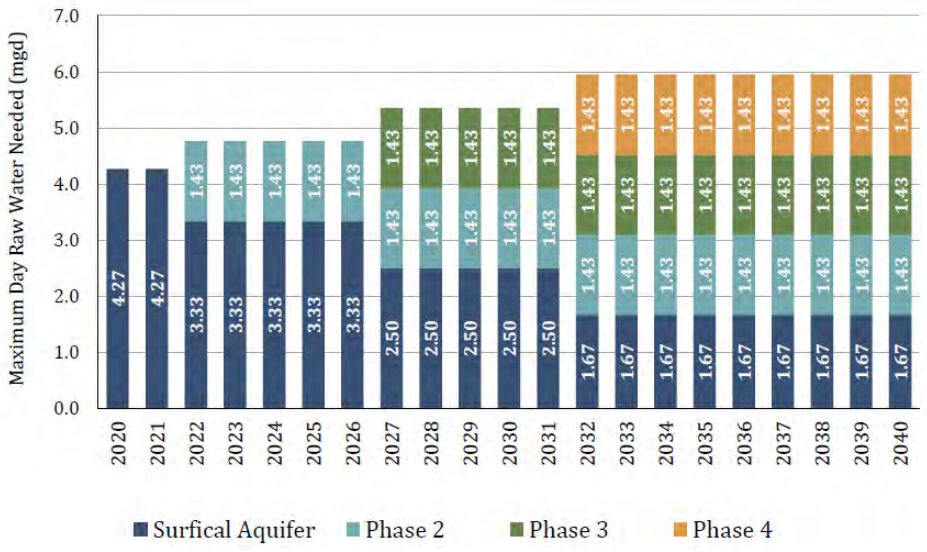
1. (An) Ion Exchange (AIX).

2. Granular activated carbon (GAC).

3. Membrane Treatment (Reverse Osmosis (RO) and Nanofiltration (NF).

Pilot testing was conducted to determine the most feasible treatment method for the removal of the PFC compounds.

The current water supply for the City of Stuart is the surficial aquifer. However, the surficial aquifer has several factors which are threatening the reliability and availability of this water source. These factors include groundwater contamination, potential for salt water intrusion, and potential impacts on adjacent wetlands and other legal users. The recommended alternative water supply is the Floridan aquifer Upper Permeable Zone. Although the current, total dissolved solids (TDS) concentration is expected to be between 3,000 – 5,000 mg/L, it is expected that the TDS concentrations will increase to approximately 6,000 mg/L after 50 years of pumping. The proper technology to treat water of this characteristics is reverse osmosis (RO). The addition of the reverse osmosis treatment to the City of Stuart will result in a reduction on surficial well withdrawals. The chart below depicts the estimated surficial well withdrawals through 2040.



For the alternative water supply and treatment systems (Phase 2) four potential alternatives utilizing reverse osmosis treatment were evaluated as a solution to the City of Stuart's water supply needs and are depicted in the table below. Cost was not a factor in the evaluation and comparison of the four alternatives.

AWS Alternatives

Alternative	Description	Disposition of Existing Lime Softening Plant	Alternative Water Supply	
			Source	Treatment Process
1	Replace lime softening plant with nanofiltration treatment and add Floridan Aquifer wells and reverse osmosis treatment	Replace with Nanofiltration WTP	Upper Floridan Aquifer (UFA)	Reverse Osmosis
2	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Upper Floridan Upper Permeable Zone) and reverse osmosis treatment	Continue Operation of Existing Lime Softening Plant	Upper Floridan Aquifer Upper Permeable Zone (UPZ)	Reverse Osmosis
3	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Upper Floridan Avon Park Permeable Zone) and reverse osmosis treatment	Continue Operation of Existing Lime Softening Plant	Upper Floridan Aquifer Avon Park Permeable Zone (APPZ)	Reverse Osmosis
4	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Lower Floridan Aquifer Uppermost Permeable Zone) and reverse osmosis treatment	Continue Operation of Existing Lime Softening Plant	Lower Floridan Aquifer Uppermost Permeable Zone (LFA)	Reverse Osmosis

For the Monterey Subdivision water main improvements there are three primary options which are:

1. No action
2. Construction of a filtration system at each individual residence
3. Construction of a new water distribution system and connect to the City's water distribution system.

4.2 Cost-effectiveness

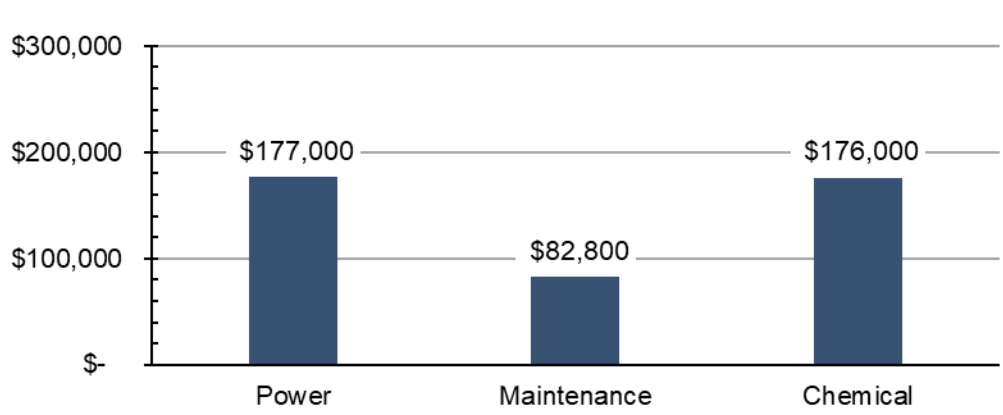
The cost effectiveness of the project was evaluated based on capital investment, and operation and maintenance costs. However, the benefit of the projects outweighs the capital costs as they provide removal of harmful contaminants and provide a reliable source and treatment of drinking water for the City and its residents. Appendix A contains a detailed cost calculation of the selected alternative.

Cost was not a factor in the evaluation and comparison of the four alternative water supply alternatives, however the capital costs for the feasible alternatives are presented below:

Alternative	Description	Evaluation	Capital Cost
1	Replace lime softening plant with nanofiltration treatment and add Floridan Aquifer wells and reverse osmosis treatment	Not feasible due to limited site space	Capital Cost not estimated, alternative not feasible
2	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Upper Floridan Upper Permeable Zone) and reverse osmosis treatment	Feasible and recommended	$16,284,000
3	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Upper Floridan Avon Park Permeable Zone) and reverse osmosis treatment	Feasible but not recommended due to raw water quality degradation over time based on groundwater hydraulic modeling results	$16,752,000

4	Continued operation of existing lime softening plant plus add Floridan Aquifer wells (completed in the Lower Floridan Aquifer Uppermost Permeable Zone) and reverse osmosis treatment	Not feasible due to poor raw water quality	Capital Cost not estimated, alternative not feasible

The finished water from the reverse osmosis facility will off-set finished water produced by the lime softening plant. Hence, the overall O&M costs for the facility will increase. However, keeping the lime softening plant as the sole means of water treatment for the City of Stuart is not a feasible option. The estimated annual O&M cost increase for the facility is presented below.



Chemical costs were developed based on preliminary chemical dosages presented in the table below, a raw water flow of 1.43 mgd and a permeate flow rate of 1.0 mgd.

Preliminary Estimate of Chemical Doses

Chemical	Unit	Dose
Sulfuric Acid	mg/L	65
Scale Inhibitor	mg/L	3.0
Corrosion Inhibitor	mg/L	5.0
Sodium Hydroxide	mg/L	40
Carbon Dioxide	mg/L	30

Maintenance costs were developed based replacement frequency experienced by facilities with similar treatment processes as well as engineering judgement. For

membrane replacement costs, it was assumed that membranes are replaced every 5 years. For cartridge filter replacement cost, it was assumed that the replacement frequency is every 6 months. These frequencies can change depending on raw water quality characteristics as well as overall system maintenance practices.

Energy costs were estimated based on a permeate flow rate of 1.0 mgd at a membrane recovery of 70%. The RO system's total energy cost was calculated based on a unit power cost of $0.10 per kilowatt-hour (kW-hr). The energy costs include power consumption for the equipment listed below:

- One (1) UFA well pump (continuous operation)
- One (1) RO membrane feed pump (continuous operation) – for this calculation an average pressure between current condition and 20-year projected condition was assumed
- One (1) clean-in-place pump (12 hours of operation every three months)
- Five (5) chemical metering pumps (continuous operation)
- One (1) degasifier blower (continuous operation)
- One (1) transfer pump (continuous operation)
- One (1) concentrate pump (continuous operation)

4.3 Pretreatment System

4.3.1 Pilot Testing

The City of Stuart's existing groundwater supply has limitations due to recent discovery of Per-Fluorinated (PFCs) and other emerging contaminants of concern in the raw water supply. Since the existing conventional treatment system does not provide adequate treatment and removal of these contaminants, pilot testing was immediately implemented to determine the most cost-effective method of treatment. Based on sampling results and technical research available at the time, the current treatment system in place using aeration, lime softening, and filtration of the raw water is not effective at removing PFC's. With that, the City actively investigated treatment methods to reduce and eliminate the PFC's in the raw water supply. A treatment investigation was conducted in late 2016, of which granular activated carbon (GAC), ion exchange (IX), and membrane treatment were determined to be the best available technologies suitable for implementation at the City's water treatment plant. A copy of the full report and the basis of design is included as **Appendix G.** The following is the evaluation of each of the treatment technologies:

4.3.1.1 Ion Exchange

Ion exchange is an exchange of ions between two electrolytes or between an electrolyte solution and a complex. Typical ion exchangers are ion exchange resins (functionalized porous or gel polymer), zeolites, montmorillonite, clay, and soil humus. Ion exchangers are either cation exchangers that exchange positively charged ions (cations) or anion exchangers that exchange negatively charged ions (anions). Typical ion exchange

systems include softeners, which replace or remove calcium (hardness) with sodium.

Ion exchange resins from different manufacturers tend to deliver varying results on PFC removal. Research indicates that fresh resin presents a higher removal efficiency than continuous regeneration approaches (Appleman, 2012). The removal efficiency is estimated to be largely based on molecular weight of the fluorine chains. The longer chains such as PFOS typically have better removal efficiency in cases where ion exchange has been shown to provide some removal of the PFC's. Generally, in the cases where ion exchange has provided some level of removal, the smaller versus larger fluorine hydrocarbon chains were removed at approximately 46% and 92%, respectively (Appleman, 2012). According to the WRF Web Report #4322, Treatment Mitigation Strategies for Poly- and Perfluoroalkyl Substances, 2016, Amberlite IRA-400 resin was found to have a higher capacity than GAC for both PFOS and PFOA removal. However, contact times for IX are much longer than typical bed volumes used for conventional IX treatment, and conventional regeneration techniques were not sufficient to regenerate the resins. Recent experience with IX piloting has been directed away from regenerating the resins and running the bed volumes to exhaustion.

Other studies have indicated waters with contaminated with PFC's that contained higher natural organic matter (NOM) were more effectively removed using IX, possibly due to the interaction between the PFC's and NOM.

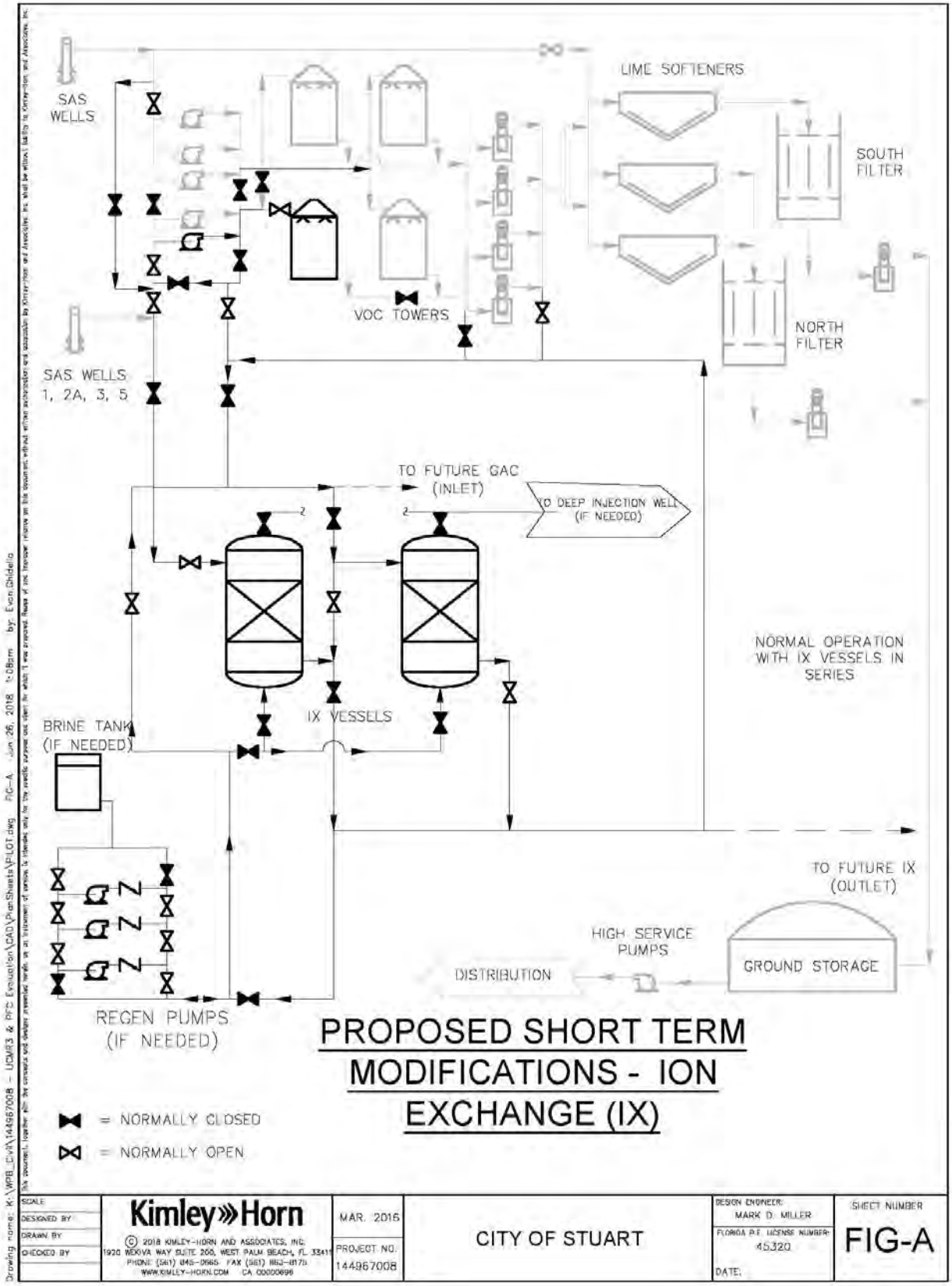
Given the research that has been conducted, ion exchange has the potential to provide removal of PFCs and should be considered on a case by case basis compared to the contaminants present and the Utility's goals. Recent advances in IX technology and recent pilot studies have shown IX resins that were originally designed to remove perchlorates from contaminated water have shown outstanding performance in removing PFC's at extended bed volume cycles down to non-detect levels. Small scale pilot testing was conducted at the conclusion of the initial final draft report, which has triggered modification of this report to include IX performance. The following process flow diagram (Figure A) is a schematic depiction of the integration of GAC into the City's existing process.

Some of the advantages of using IX include:

- Specific, yet partial removal of contaminants with select media
- Requires low operating pressures
- No hazardous chemicals required for treatment
- Much higher bed volume treatment than GAC (> 10 times)
- Regeneration not required, lowered operating costs

The disadvantages include:

- Potential to lose resin and require regular purchase of new resin
- Maintenance can be intensive with several mechanical transfer processes if resins regenerated


SAS WELLS
LIME SOFTENERS
SOUTH FILTER
NORTH FILTER
VOC TOWERS
SAS WELLS 1, 2A, 3, 5
TO FUTURE GAC (INLET)
TO DEEP INJECTION WELL (IF NEEDED)
NORMAL OPERATION WITH IX VESSELS IN SERIES
IX VESSELS
BRINE TANK (IF NEEDED)
TO FUTURE IX (OUTLET)
HIGH SERVICE PUMPS
GROUND STORAGE
DISTRIBUTION
REGEN PUMPS (IF NEEDED)
PROPOSED SHORT TERM MODIFICATIONS - ION EXCHANGE (IX)
= NORMALLY CLOSED
= NORMALLY OPEN
Kimley»Horn
CITY OF STUART
MARK D. MILLER
45320
MAR. 2016
144967008
FIG-A

Non-labor operating costs are mainly composed of ion exchange resin replacement, and regeneration cost and brine disposal cost IF the resins are regenerated. Operating costs are estimated based on average annual design flow conditions. Ion exchange resin replacement and regeneration with sodium chloride is estimated at $0.20 per 1,000 gallons of treated average flow. If regenerated resin used, brine disposal cost is estimated at $0.15 per 1,000 gallons of ion exchange treated flow, which includes pumping of spent brine directly to the City's WWTP. Both the resin supply and brine disposal costs are subject to CPI cost increases and could lead to increased operating expenses. Labor costs, power costs and other existing operating costs are not included in this estimate. The conceptual level operational cost estimates for the ion exchange system are shown in the table below.

Conceptual Level Annual AIX Operational Cost Estimate

ADD Capacity (MGD)	MDD Capacity (MGD)	Operating Costs ($ per 1,000 gallon produced)	Estimated Annual Operating Cost (0.525 MGD treated per day)
0.525	0.75	$ 0.35	$67,069

The conceptual level of capital costs estimated for ion exchange treatment construction are shown in the table below. The estimated costs are based on treating the average day demand flow rate of 0.525 MGD. The cost shown includes the ion exchange treatment systems and pre-filtration to prevent sand and silt build-up on the resins. The brine as well as the ancillary resin regeneration system, brine storage and transfer systems, and resin storage and system controls needed for full operation of the ion exchange treatment system was not included in the table of costs, since the newer generation IX resins are assumed to be run through to exhaustion of the resin when PFC levels start to breakthrouth. The table below provides a summary of the estimated costs for the ion exchange treatment alternative.

Conceptual Level AIX Capital Cost Estimate

Item	Size/Units	Quantity	Unit or Material Cost	Total Cost
General Requirements	L.S.	1	$ 50,000	$ 50,000
Site Civil (slab, site work)	L.S.	1	$ 110,000	$ 110,000
Site Mechanical (RWM piping, u/g)	L.S.	1	$ 90,000	$ 90,000

Electrical (new service, MCC, VFD's)	L.S.	1	$ 120,000	$ 120,000
12-inch FM (WTP to WWTP)	FT	5300	$ 90	$ -
DIW upgrades	L.S.	1	$ -	$ -
Process				
Ion Exchange (vessels, filters, resin)	MGD-ADD	1.00	$ 0.47	$ 470,000
Instrumentation & Controls	L.S.	1	$ 80,000	$ 80,000
Total Construction Cost				$ 920,000
Contingency	% of Const.	15%	$ 138,000	$ 138,000
Engineering Planning, Design and Permitting	% of Const.	12%	$ 126,960	$ 126,960
Total Budget				$ 1,184,960

4.3.1.2 Granular Activated Carbon

Activated carbon is commonly used adsorb natural organic compounds, taste and odor compounds, and synthetic organic chemicals in drinking water treatment. Adsorption is both the physical and chemical process of accumulating a substance at the interface between liquid and solids phases. Activated carbon is an effective adsorbent because it is a highly porous material and provides a large surface area to which contaminants may adsorb. The two main types of activated carbon used in water treatment applications are granular activated carbon (GAC) and powdered activated carbon (PAC).

Multiple carbon manufacturers and carbon bases of their carbon components have been utilized to effectively remove PFCs in water sources. The testing researched has resulted in a variance of active removal rates and bed volumes. The carbon base material, loading rates, raw water contaminants, nominal organic matter (NOM) and TOC, and granule size have all contributed to the length of run time, removal of specific contaminants and regeneration frequency. Despite the variations in these criteria, the treatment technology is overall effective at removing PFCs of concern for the City of Stuart.

In general, waters with TOC and NOM in the raw water significantly reduces the bed volumes to contaminant breakthrough. This results in more frequent regeneration and more costly operations. Relating to the City of Stuart's ground water supply, organics are going to be present and are most likely going to reduce the longevity of each carbon load. It is anticipated that the

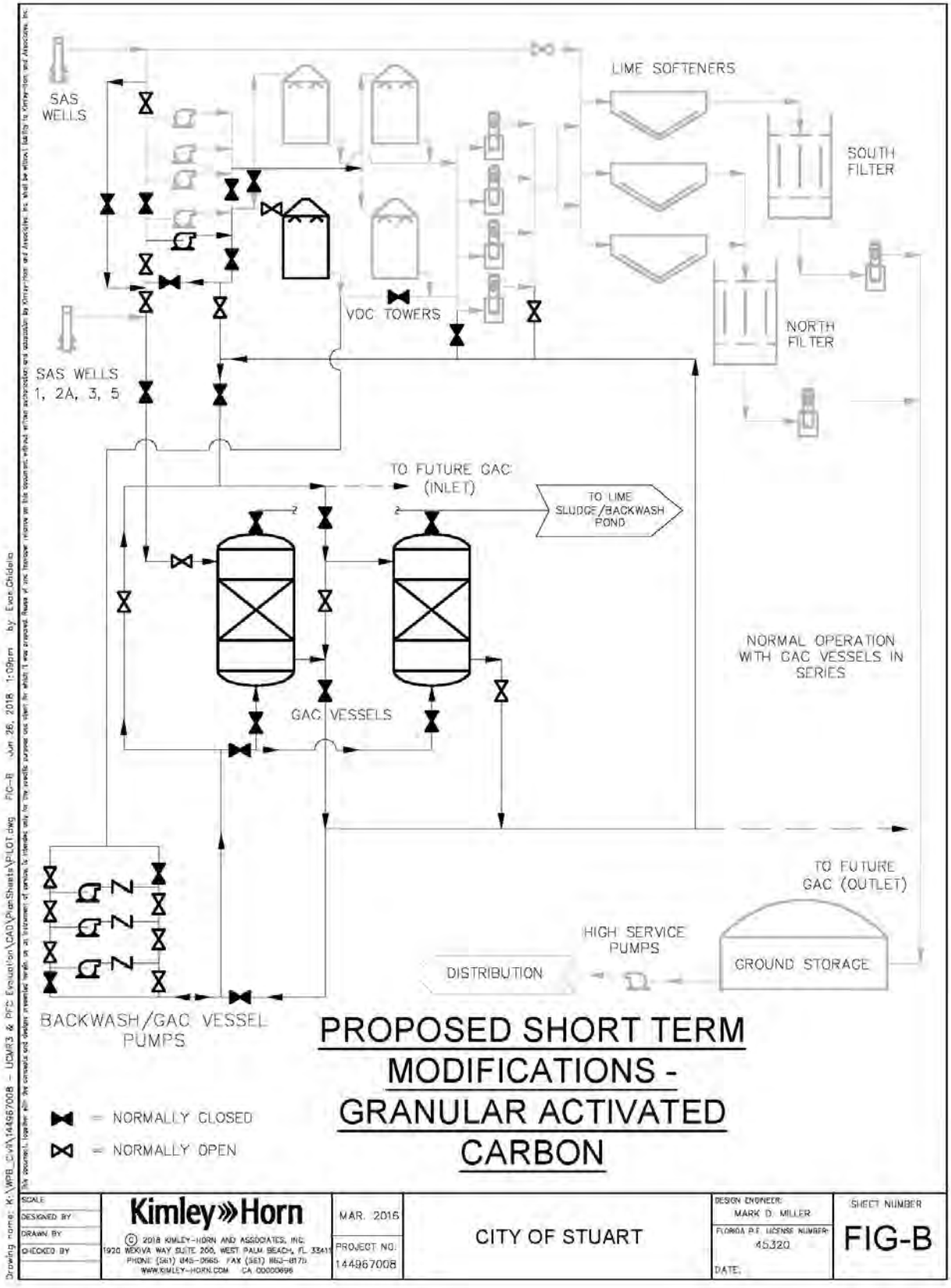
frequency of full breakthrough would be around the 10,000 bed volumes (Appleman, 2012).

At the pilot scale, small columns of GAC can be exposed to a steady stream of raw water to simulate the actual operating conditions of the Utility. Pilot testing is typically completed using 4-inch columns filled with a known quantity of GAC. As the water is processed through the GAC the water quality parameters are analyzed on the treated side of the GAC media. As the specific parameters of concern consume the GAC adsorption sites within the media, they will be identified in the treated water. This is termed as the initial breakthrough and the beginning stages of degrading removal of the specified contaminant. At this point, the carbon will become less efficient at removing the contaminant and the engineering analysis can be used to determine the percentage of breakthrough that can be allowed while maintaining compliance with the regulatory conditions. Once the GAC reaches its limit for obtaining regulatory compliance, it is considered exhausted and requires regeneration or replacement with virgin media. This process reveals the design parameters for the full-scale design and operation of the GAC treatment process and can be scaled up directly to the full- scale treatment.

At the full-scale treatment design and operation, the process is administered in the same fashion. The pressurized carbon vessels are much larger and hold from 20,000 to 40,000 pounds of GAC and require backwash cycles as the pressure buildup in the vessel typically escalates prior to the exhaustion of the carbon media. The breakthrough of the contaminants is observed similarly to the breakthrough described for the pilot scale operation. The frequency of regeneration is similar to the process observed in the pilot scale adjusted for the quantity of flow at the full-scale treatment. As noted above, the full-scale treatment and operation closely resembles the process experienced in the pilot scale treatment and operation. The following process flow diagram (Figure B) is a schematic depiction of the integration of GAC into the City's existing process.

Some of the advantages of using GAC include:

- Proven technology with numerous installations
- Requires low operating pressures
- No chemicals required for treatment
- Less maintenance than other treatment alternatives
- High percentage removal of specific contaminants
- Can be designed for full or partial removal of contaminants
- Regenerated GAC minimizes operational costs
- Capital expense for installation is low compared to other alternatives
- Allows hardness and alkalinity through for treated water stability


SAS WELLS
SAS WELLS 1, 2A, 3, 5
LIME SOFTENERS
SOUTH FILTER
NORTH FILTER
VOC TOWERS
TO FUTURE GAC (INLET)
TO LIME SLUDGE/BACKWASH POND
NORMAL OPERATION WITH GAC VESSELS IN SERIES
GAC VESSELS
TO FUTURE GAC (OUTLET)
HIGH SERVICE PUMPS
DISTRIBUTION
GROUND STORAGE
BACKWASH/GAC VESSEL PUMPS
= NORMALLY CLOSED
= NORMALLY OPEN
PROPOSED SHORT TERM MODIFICATIONS - GRANULAR ACTIVATED CARBON
Kimley»Horn
© 2018 KIMLEY-HORN AND ASSOCIATES, INC.
1920 WEKIVA WAY SUITE 200, WEST PALM BEACH, FL 33411
PHONE (561) 845-0665 FAX (561) 863-8175
WWW.KIMLEY-HORN.COM CA 00000696
MAR. 2016
PROJECT NO: 14496700B
CITY OF STUART
DESIGN ENGINEER: MARK D. MILLER
FLORIDA P.E. LICENSE NUMBER: 45320
DATE:
SHEET NUMBER
FIG-B
SCALE
DESIGNED BY
DRAWN BY
CHECKED BY

The disadvantages include:

- Spent carbon must be regenerated offsite
- GAC is consumed by hydrogen sulfide (H_2S), iron, DOC and TOC which can reduce the removal efficiency and significantly shorten the regeneration cycles, resulting in increased operating costs
- Iron can blind over the media, greatly reducing the treatment effectiveness of the GAC
- Large loading of backwash/rinse flow disposal into the onsite backwash basin for the lime softening facility
- Operational expenses may be higher than the other alternatives due to the frequent estimation of regeneration cycles

Estimated operating costs for the various treatment levels is presented in the table below for GAC treatment. Non-labor operating costs are mainly composed of the cost of GAC regeneration. Operating costs are estimated based on average annual design flow conditions. The largest contributor to the operating expenses for GAC center around the supply and regeneration of the GAC media, its transport to and from a regeneration facility, and steady replacement through each regeneration cycle. GAC regeneration costs are estimated using $1.35 per pound of GAC and a GAC consumption rate of 0.64 pounds per 1,000 gallons treated prior to breakthrough. Backwash disposal costs, labor costs, and other existing operating costs are not included in this estimate. Overall, total operating costs are estimated to be $0.58 per 1,000 gallons produced for the respective treatment level considered.

Conceptual Level Annual GAC Operational Cost Estimate

ADD Capacity (MGD)	MDD Capacity (MGD)	Operating Costs ($ per 1,000 gallon produced)	Estimated Annual Operating Cost (0.525 MGD treated per day)
0.525	0.75	$ 0.58	$111,143

The conceptual level of capital costs estimated for GAC treatment construction are shown in the table below. The estimated costs are based on treating the average day demand flow rate of 0.65 MGD. The cost shown includes the GAC treatment systems, as well as the ancillary

backwash systems and controls needed for full operation of the GAC treatment system. The table below provides a summary of the estimated costs for the GAC treatment alternative.

Conceptual Level GAC Capital Cost Estimate

Item	Size/Units	Quantity	Unit or Material Cost	Total Cost
General Requirements	L.S.	1	$ 50,000	$ 50,000
Site Civil (slab, site work)	L.S.	1	$ 80,000	$ 110,000
Site Mechanical (RWM piping, u/g)	L.S.	1	$ 80,000	$ 80,000
Electrical (new service, MCC, VFD's)	L.S.	1	$ 95,000	$ 120,000
Process				
Recirc/booster pumps	L.S.	1	$ 50,000	$ 50,000
Granular Activated Carbon (vessels, GAC, rinse pumps)	MGD-ADD	1.00	$ 0.38	$ 380,000
Instrumentation & Controls	L.S.	1	$ 80,000	$ 80,000
Total Construction Cost				$ 870,000
Contingency	% of Const.	15%	$ 130,500	$ 130,500
Engineering Planning, Design and Permitting	% of Const.	12%	$ 120,060	$ 120,060
Total Budget				$ 1,120,560

4.3.1.3 Membrane Treatment

Research suggests that membrane treatment is a viable option for removal of the contaminants listed in the UCMR 3 and the suggested contaminants in the drafted UCMR 4. However, there is no known full-scale membrane treatment system that is currently in operation and that demonstrates consistent reliable rejection of these contaminants.

Depending on the level of treatment desired and the contaminants present, nanofiltration (NF) membranes can be implemented to provide effective removal of the PFCs regulated by the UCMR 3 and UCMR 4. As with several other technologies listed within this analysis, the smaller carbon chain PFCAs such as perfluorobutanoic acid (PFBA) are more challenging to remove. Nanofiltration membranes were observed to remove greater than 90% of the PFCs in both a flow through and recycled treatment approach (Appleman, 2012).

Where more effective treatment removal is needed, brackish water reverse osmosis (RO) membranes have shown to remove greater than 90% of all the contaminants listed and greater than 95% of all contaminants listed over the molar mass of 300 g/mol (Appleman, 2012). Even with the molar mass driving most of the rejection abilities, the RO membrane is estimated to remove greater than 95% of PFBAs found in the raw water which are the smallest chain of PFCs. Therefore, membrane treatment provides the best available technology and highest removal efficiency of all the PFC's down to the smallest molecular weight than the other treatment methods. While research indicates that membrane elements appear to reject the PFBAs, PFCs and PFOAs at a high rate, it is suggested that the City pilot membrane elements to confirm the rejection rates as well as compare the performance of elements from different manufacturers.

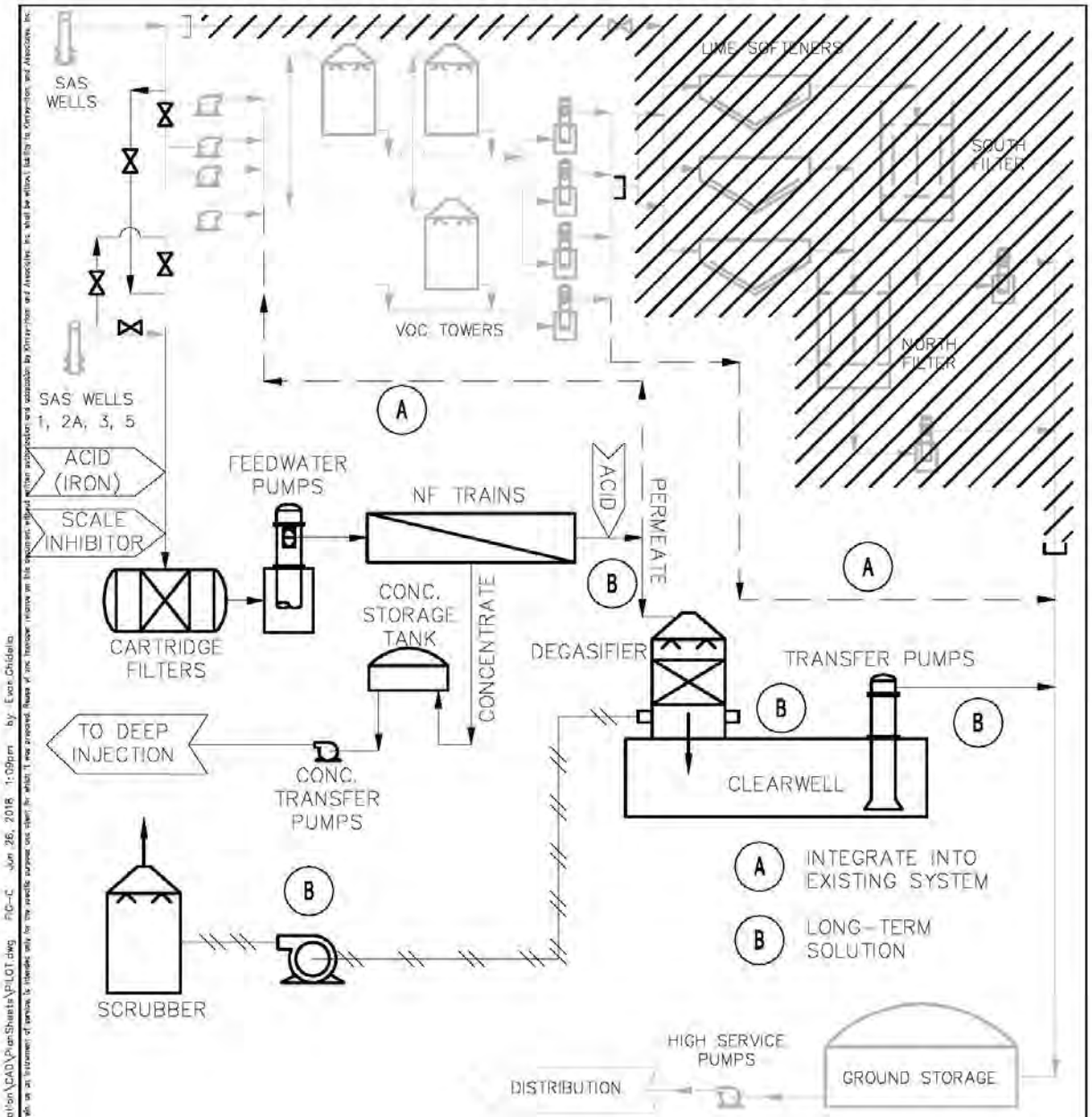
At the pilot scale, a single element testing unit can be utilized to show rejection characteristics of selected membranes. The performance can be quickly compared by simulating the projected recovery of multiple elements within the full-scale system. Typical single element pilot tests focus on the lead and tail elements of the system as well as a representative middle element within the membrane train. Samples taken from the raw feed stream, permeate and concentrate can be analyzed to monitor the respective performance from the membrane elements. If further testing is desired to simulate the full membrane train's performance and any fouling potential, a pilot scale membrane test can be initiated using 4-inch elements mocking the projected staging array. The following process flow diagram is a schematic depiction of the integration of membranes into the City's existing process.

Some of the advantages of using membrane treatment include:

- High percentage of removal of contaminants
- Continuous operation of consistent treatment quality
- Automated process controls for operators
- Lowest operating costs compared to the comparable alternatives
- Can be tested at small scale to identify the effective removal of contaminants

The disadvantages include:

- Concentrate disposal is required resulting in increased DIW usage
- Direct forcemain required to convey concentrate to DIW for disposal
- New chemicals introduced to the plant operation (acid for pH adjustment, anti-scalant for membrane process)
- Capital expense is larger than other alternatives
- Operator interaction and instrument technician required for day to day operation



PROPOSED SHORT TERM/LONG TERM MODIFICATIONS NANOFILTRATION

= NORMALLY CLOSED

= NORMALLY OPEN

SCALE	Kimley»Horn	MAR. 2015	CITY OF STUART	DESIGN ENGINEER: MARK D. MILLER	SHEET NUMBER FIG-C
DESIGNED BY	© 2018 KIMLEY-HORN AND ASSOCIATES, INC.	PROJECT NO. 144967008		FLORIDA P.E. LICENSE NUMBER: 45320	
DRAWN BY	1920 WEKIVA WAY SUITE 200, WEST PALM BEACH, FL 33411 PHONE (561) 845-0900 FAX (561) 863-8175 WWW.KIMLEY-HORN.COM CA 00000696			DATE:	
CHECKED BY					

Traditionally, membrane operational costs and concentrate disposal have been the prohibiting factor in integrating membrane treatment. Since the City's WTP currently has a deep injection well for wastewater effluent injection, the concentrate disposal expense includes repumping the concentrate down the deep well. Given that the anticipated feed pressures for this raw water quality are expected to be less than 100 psi, the non-labor operating costs are much more comparable to, if not less expensive, than other treatment technologies. For this operating expense analysis, we have calculated the power consumption using 100 psi as the feed pressure and the remaining concentrate pressure to transport the concentrate to the effluent storage and disposal site.

The non-labor operating costs are mainly composed of energy (feed pumping) cost, membrane replacement cost (5-year replacement), and concentrate disposal cost (repumping down the deep injection well). The conceptual level operating costs are estimated based on average annual design flow conditions. Membrane feed power costs are estimated using $0.12 per KWH and 100 psi net feed pressure, which results in a cost of
$0.25 per 1,000 gallons of membrane permeate produced. Concentrate disposal pumping results in a cost of $0.05 per 1,000 gallons of membrane permeate produced, which results in total membrane operational costs of $0.30 per 1,000 gallons of membrane permeate produced. Concentrate disposal is assumed to be via a pipeline to the WWTP, using residual concentrate pressure from the membrane systems. In order to provide an air gap between the membrane concentrate and the injection well, a booster pump station is necessary and the capital and operating costs are included. Membrane replacement cost is estimated at
$0.05 per 1,000 gallons of permeate produced. Labor costs, deep injection well maintenance, additional chemical costs and other existing operating costs are not included in this conceptuallevel cost estimate.

Conceptual Level Annual Membrane Operational Cost Estimate

ADD Capacity (MGD)	MDD Capacity (MGD)	Operating Costs ($ per 1,000 gallon produced)	Estimated Annual Operating Cost (0.525 MGD treated per day)
0.525	0.75	$ 0.30	$57,488

The conceptual level of capital costs estimated for membrane treatment system construction are shown in the table below. The estimated costs are based on producing the average day demand flow rate of 0.525 MGD. The cost shown includes the membrane treatment systems, as well as the ancillary cleaning system, concentrate storage and disposal systems.

Conceptual Level Membrane Capital Cost

Item	Size/Units	Quantity	Unit or Material Cost	Total Cost
General Requirements	L.S.	1	$ 50,000	$ 50,000
Site Civil (slab, site work)	L.S.	1	$ 110,000	$ 110,000
Site Mechanical (RWM piping, u/g)	L.S.	1	$ 90,000	$ 90,000
Electrical (new service, MCC, VFD's)	L.S.	1	$ 150,000	$ 150,000
12-inch FM (WTP to WWTP)	FT	5300	$ 90	$ 477,000
DIW upgrades	L.S.	1	$ 250,000	$ 250,000
Process				
Building	SQFT	8000	$ 110	$ 880,000
Membrane Treatment	MGD-ADD	1.00	$ 1.05	$ 1,050,000
Instrumentation & Controls	L.S.	1	$ 150,000	$ 150,000
Total Construction Cost				$ 3,207,000
Contingency	% of Const.	15%	$ 481,050	$ 481,050
Engineering Planning, Design and Permitting	% of Const.	12%	$ 442,566	$ 442,566
Total Budget				$ 4,130,616

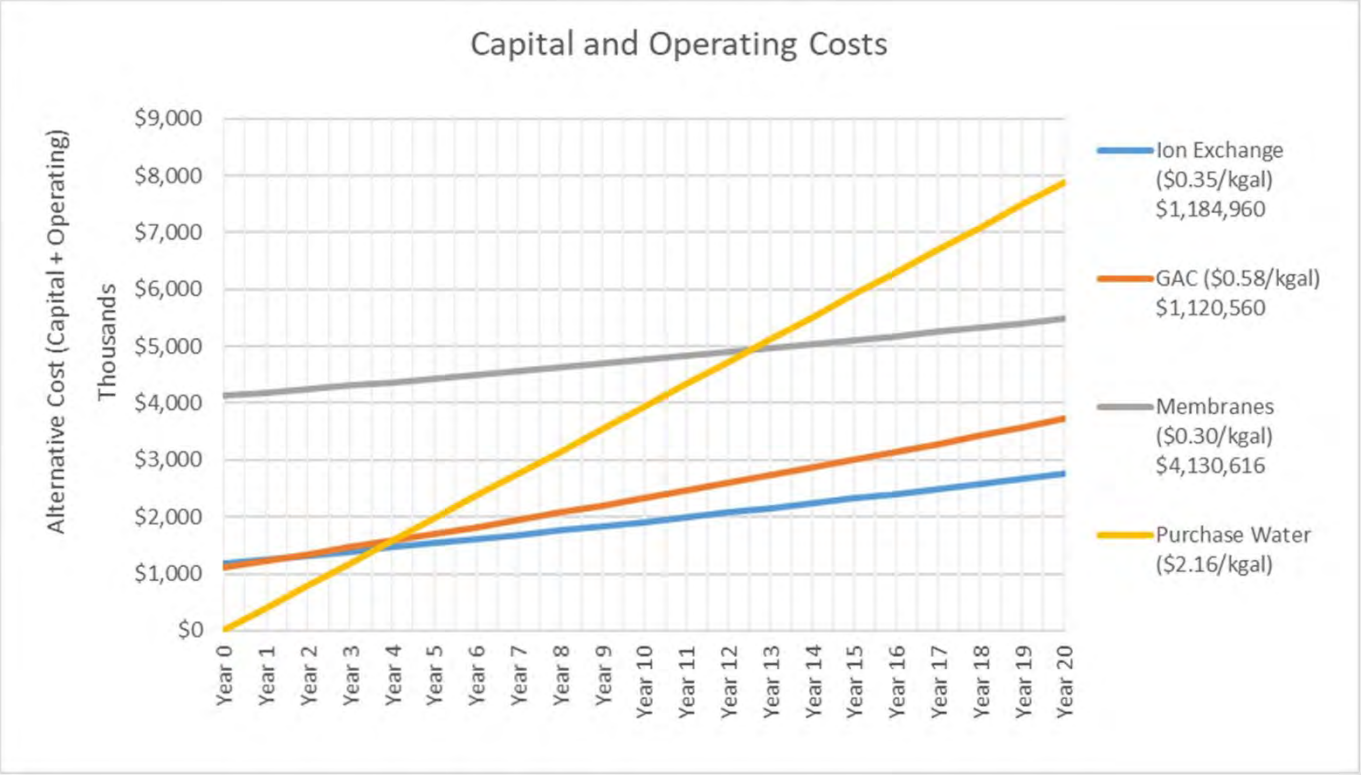
4.3.1.4 Selected Pretreatment Alternative

The three treatment alternatives considered for the Utility's WTP are each projected to remove the emerging contaminants to an acceptable level for UCMR regulatory compliance. The recommendations have been based on the ability to achieve treatment compliance for the Utility as well as capital expense and operational expense. After reviewing these categories for each alternative, this section provides a discussion of the treatment alternative selection that is recommend for short-term solution for the City's Utility.

Treatment Alternative	Capital Cost	Annual Operating Cost	20-Year NPV: Capital and Operating Cost
Ion Exchange	$1,184,960	$67,069	$2,526,335
GAC	$1,120,560	$111,143	$3,343,410
Membranes	$4,130,616	$57,488	$5,280,366
Martin County Utilities	$N/A	$394,200	$7,884,000

Based on the combination of capital and operating costs, it is recommended that the Utility pursue ion exchange (IX) treatment alternative for this facility. Although the GAC treatment alternative provides the lowest initial capital cost for the three alternatives, the operating costs for IX clearly provide a more rapid return on investment as compared to GAC. The net return on investment shows IX is the most cost-effective treatment alternative beyond 1 – 2 years of operation.

Additionally, IX provides the necessary treatment capabilities to effectively remove the emerging contaminants from the raw water supply coupled with flexibility to increase removal through increasing the media regeneration frequency. The annual operating expenses are slightly more than the membrane treatment alternative however, the capital cost differential doesn't support the short-term or even long-term (20-years) application of membrane treatment. As shown in the capital and operating costs figure, GAC provides the second most cost-effective solution for the City's treatment. Since this option will most likely be a short-term solution to the City's demand, buying water from Martin County Utilities is the most cost effective short-term solution (3 years +/-) even though the operating costs are much higher than one of the treatment options. The long-term economic differential is graphically depicted in the figure below.



Depending on the water source selected for the long-term supply for the City's potable water, the IX treatment alternative may be used for full treatment or in conjunction with another treatment alternative to achieve regulatory compliance and water quality preferences set by the City. Further analysis and testing may be completed to confirm the treatment alternatives necessary for long-term future water supplies, however, at the time of the completion of this report, IX is the best available technology for removing PFC's from this raw water and appears it will remain the most effective treatment method removing PFC's down to low non-detect levels.

4.4 Alternative Water Supply

4.4.1 Alternative #1: Replace the existing lime softening plant with nanofiltration treatment and add Floridan Aquifer wells and reverse osmosis treatment.

This alternative evaluated the use of the existing surficial aquifer wellfield with nanofiltration treatment replacing the existing lime softening plant along with a Floridan aquifer water supply and RO treatment. Nanofiltration was chosen as an alternative treatment method appropriate for treating the surficial aquifer water supply. The TDS concentration for the Floridan Aquifer Upper Permeable Zone is expected to be between 3,000 – 5,000 mg/L. It is expected that the TDS concentrations will increase to approximately 6,000 mg/L after 50 years of pumping. The proper technology to treat water of this characteristics is Reverse Osmosis (RO). However, for this alternative, the existing WTP does not have sufficient site space to construct nanofiltration treatment along with RO treatment. Consequently, the City would have to repurpose the soccer field at the 10th Street / Guy Davis Sports Complex to provide sufficient land to construct the membrane treatment facility and its ancillary facilities (i.e., backup power, degasifiers, odor control, fuel storage, chemical facilities, electrical building, etc.). City staff indicated that repurposing the soccer field at the 10th Street / Guy Davis Sports Complex is not feasible. Hence, it is recommended that this alternative is not feasible and hence was rejected.

4.4.2 Alternative #2: Continue the operation of the existing lime softening plant and add Floridan Aquifer wells (completed in the Upper Floridan Upper Permeable Zone (UPZ)) and reverse osmosis treatment.

Under this alternative the existing lime softening plant would continue to treat the surficial aquifer supply and Floridan Aquifer wells and reverse osmosis treatment would be added as an alternative water supply. The Floridan Aquifer wells would supply water from the UPZ. The proposed RO treatment facilities

would be constructed on the existing WTP site. There appears to be sufficient site space exists to support the RO treatment facility and its ancillary facilities. Hence, this alternative is deemed feasible from a space planning perspective.

Ground water modeling prepared by Grandusky, Lamb and Associates, Inc. indicates that TDS may rise from approximately 4,000 mg/L to approximately 5,000 mg/L in the UPZ over the next 20 years. Additionally, GLA indicated that TDS may rise from 6,000 mg/L to approximately 14,000 mg/L in the APPZ over the next 20 years.

The large TDS increase forecasted for the APPZ would require that the proposed electrical equipment, motors, pumps, conductors, etc. to be oversized to accommodate the expected future degradation in water quality. This would increase the construction cost of the proposed alternative water supply facility designed for the APPZ (Alternative 4.4.3 noted below) relative to an alternative water supply facility designed for the UPZ (this alternative, 4.4.2). Hence, this alternative is the most feasible and is recommended.

4.4.3 Alternative #3: Continue the operation of the existing lime softening plant and add Floridan Aquifer wells (completed in the Upper Floridan Avon Park Permeable Zone (APPZ)) and reverse osmosis treatment.

Under this alternative the existing lime softening plant would continue to treat the surficial aquifer supply and Floridan Aquifer wells and reverse osmosis treatment would be added as an alternative water supply. The Floridan Aquifer wells would supply water from the APPZ. The proposed RO treatment facilities would be constructed on the existing WTP site. There appears to be sufficient site space to support the RO treatment facility and its ancillary facilities. Hence, although this alternative is deemed feasible from a space planning perspective, given the large TDS increase forecast for the APPZ, this alternative is not recommended.

4.4.4 Alternative #4: Continue the operation of the existing lime softening plant and add Floridan Aquifer wells (completed in the Lower Floridan Aquifer (LFA) Uppermost Permeable Zone) and reverse osmosis treatment.

Under this alternative the existing lime softening plant would continue to treat the surficial aquifer supply and Floridan Aquifer wells and reverse osmosis treatment would be added as an alternative water supply. The Floridan Aquifer wells would supply water from the Lower Floridan Uppermost Permeable Zone.

The LFA has much higher operating cost, higher construction cost, and lower water quality relative to the UPZ and APPZ. Therefore, this alternative is discarded as it is not economically feasible.

4.5 Monterey Subdivision Water Main Installation

4.5.1 Alternative #1: No action

Under this alternative, all of the 146 residences will continue to have their water supply from their existing private wells systems. As this does not provide any treatment to the existing wells, and therefore does not remove any PFC contaminants, this alternative is not viable and hence was rejected.

4.5.2 Alternative #2: Construct Filtration Systems on Individual Wells

This alternative involves installing a filtration system at each of the 146 residences to provide treatment and removal of the PFC compounds. This would require the filtration systems to be installed and maintained on private property. Since these systems would be installed on private property, they would become the responsibility of the landowners to operate and maintain and not the City's, which is not feasible. Therefore, this alternative was not recommended or selected.

4.5.3 Alternative #3: Construct a water distribution system and connect to the City's system

This alternative involves installing a water distribution system within the project area and connecting each of the residences to the public water system and disconnecting their contaminated private wells for potable water usage. The mains would be constructed of 6-inch polyvinyl chloride (PVC). In addition, to connecting the homes to the public water system and disconnecting the contaminated private wells, fire protection for this community would also be provided with the addition of new fire hydrants through the project area. The route of the proposed water mains will be in the public right-of-way and will not involve any land acquisition or easements. The only approvals to obtain are for the current landowners in order to construct the water main services on the existing properties and disconnect the existing wells. There are no adverse environmental impacts expected as a result of the implementation of this alternative. This alternative was selected.

Chapter 5.0 - Selected Project

5.1 Description of Proposed Facilities

The planned improvements for the City of Stuart's pretreatment system, Monterey Subdivision water main improvements, and alternative water supply project is proposed to be constructed in multiple phases from 2018 through 2032. The flowchart below depicts the timeline and improvements under each Phase.

- **Phase 1 - 2018 - Pretreatment System**
- **Phase 1A - 2020- Monterey Subdivision Water Main Improvements**
- **Phase 2 - 2022- Well FA-1 & 1 MGD Reverse Osmosis Treatment Facility (RO Train 1)**
  - Phase 2A - Well FA-1 & Convert Injection Well to Tubing & Packer WEll
  - Phase 2B - Wellhead, Raw Water Pipeline, and Concentrate Pipeline
  - Phase 2C - 1 MGD Reverse Osmosis Treatment Plant
- **Phase 3 - 2027 - Well FA-2 & 1 MGD RO Train (RO Train 2)**
- **Phase 4 - 2032 - Well FA-2 & 1 MGD RO Train (RO Train 3)**

5.1.1 Ion Exchange Pretreatment System

The ion exchange (IX) pretreatment system will consist of modifications/replacement of the existing influent booster pumps, bag filters and four ion exchange vessels loaded with resin that has been selected to remove PFCs. The IX system is designed to treat up to 4 MGD, and will treat raw water and will



Ion Exchange Pretreatment Units

act as a pretreatment system to the VOC towers, which is also a pretreatment to the existing lime softening and filtration system. The existing raw water booster pumps will be modified to divert all, or partial (4 MGD) raw water stream to the IX system prior to entering the VOC towers which are used for stripping volatile organic compounds. The raw water booster pumps currently act as in-line booster pumps driven by variable speed VFD's, and maintain a constant suction pressure on the raw water manifold. All the supply well raw water is pumped through the VOC towers. Bag filters (10 – 50 micron size) upstream of the IX vessels will remove suspended material from the raw water to prevent blinding of the IX resin. The IX vessels (4) will be piped to allow parallel (4) or series (2) raw water feed. Initial loading of 4 different resins will operate in parallel, then once the best performing resin is selected, replace all of the resins, and place them in lead/lag series operation. Each vessel is rated for 2 MGD, allowing up to 6 MGD of treatment with one out of service in parallel mode, or 4 MGD with 2 in lead/lag series mode.

A copy of the final design plans for the pretreatment system are shown on the following pages that provide the location and schematic of the proposed improvements at the water treatment facility.

5.1.2 Reverse Osmosis Treatment Alternative Water Supply

The detailed descriptions of the proposed improvements as part of the alternative water supply project are contained in the "City of Stuart- Alternative Water Supply Technical Memorandum No. 5, 6, and 7 AWS Conceptual Design" included under **Appendix F**. The project is scheduled to be implemented in three phases (Phase 2, Phase 3, and Phase 4) constructed over a ten-year period. Phase 2 of the project will provide a reverse osmosis treatment capacity of 1.0-mgd and will be bid in three separate sub-phases (Phase 2A, 2B, and 2C) and bid packages. The conceptual implementation plan is to bid and construct Phase 2A first. Phase 2B will be bid and constructed approximately five months after Phase 2A. Phase 2C will be bid and constructed approximately a year and four months after Phase 2B. An overview of the proposed improvements for the Phase 2 improvements include the following:

1. The Upper Permeable Zone (UPZ) of the Upper Floridan Aquifer is recommended for the AWS.

2. Three UPZ wells with a capacity of 1.43 million gallons per day (mgd) each are recommended. Each well is sized to provide raw water to one reverse osmosis (RO) membrane train.

3. It is recommended that the membrane treatment plant be constructed on the WTP site. Additionally, it is recommended that the membrane building be sized to house three RO membrane trains. Each membrane train would have a finished water capacity of 1.0 mgd.

WATER TREATMENT PLANT
PER-FLUORINATED CHEMICAL TREATMENT SYSTEM

PREPARED FOR THE

CITY OF STUART

FEBRUARY 2018

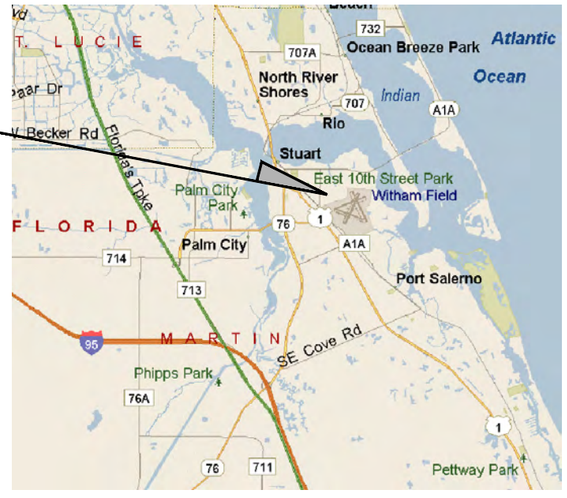
CITY COMMISSIONERS

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BECKY BRUNER	VICE MAYOR
TOM CAMPENNI	
TROY McDONALD	
EULA CLARKE	

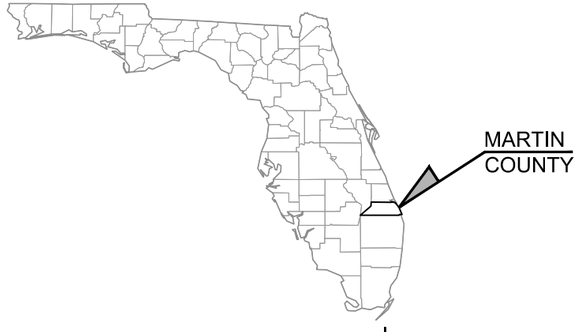
DEPARTMENT OF PUBLIC WORKS

SAMUEL T. AMERSON, P.E.	DIRECTOR
DAVID PETERS	ASSISTANT DIRECTOR

PROJECT LOCATION
CITY OF STUART WATER TREATMENT PLANT
1002 PALM BEACH ROAD
STUART, FL 34994



LOCATION MAP
N.T.S.



VICINITY MAP
N.T.S.

INDEX OF SHEETS

SHEET NO.	SHEET DESCRIPTION
G-1	COVER SHEET
C-1	WTP SITE PLAN
M-1	DEMOLITION PLAN
M-2	PROPOSED SUBGRADE PLAN
M-3	PROPOSED FLOOR PLAN
M-4	PROPOSED SECTIONS
S-1	ION EXCHANGE VESSEL PAD
D-1	CONSTRUCTION DETAILS
D-2	CONSTRUCTION DETAILS
I-0	OVERALL WATER PLANT PROCESS FLOW DIAGRAM (PFD)
I-1	PROCESS & INSTRUMENTATION DIAGRAM (P&ID) LEGEND
I-2	P&ID ION EXCHANGE SYSTEM
E-1	ELECTRICAL NOTES & LEGEND
E-2	ELECTRICAL INSTALL SITE PLAN
E-3	ELECTRICAL ROOM PLAN
E-4	DEMO ELECTRICAL ONELINE
E-5	INSTALL ELECTRICAL ONELINE
E-6	INSTRUMENT RISER DIAGRAM
E-7	VFD DETAILS
E-8	ELECTRICAL DETAILS
E-9	STANDARD LOOP DIAGRAMS
E-10	NETWORK DIAGRAM

No.	REVISIONS	DATE	BY

Kimley»Horn

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WWW.KIMLEY-HORN.COM CA 00000696

KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

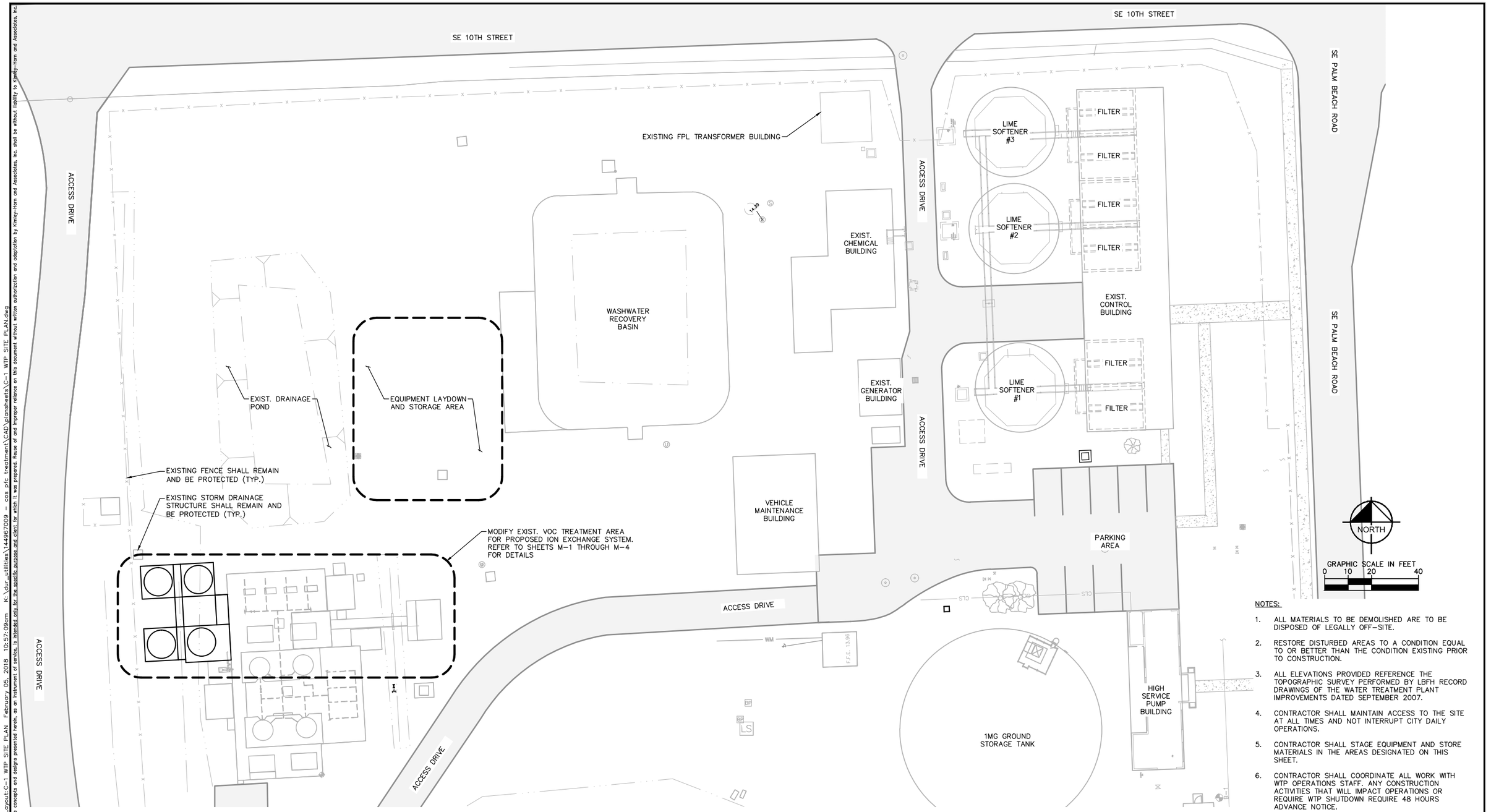
PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

COVER SHEET

SHEET NUMBER
G-1
1 OF 22

Plotted By:Black, Nick Sheet Set:PFC TREATMENT Layout:G-1 COVER SHEET February 05, 2018 10:57:01am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\G-1 COVER SHEET.dwg
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NOTES:

1. ALL MATERIALS TO BE DEMOLISHED ARE TO BE DISPOSED OF LEGALLY OFF-SITE.
2. RESTORE DISTURBED AREAS TO A CONDITION EQUAL TO OR BETTER THAN THE CONDITION EXISTING PRIOR TO CONSTRUCTION.
3. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
4. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
5. CONTRACTOR SHALL STAGE EQUIPMENT AND STORE MATERIALS IN THE AREAS DESIGNATED ON THIS SHEET.
6. CONTRACTOR SHALL COORDINATE ALL WORK WITH WTP OPERATIONS STAFF. ANY CONSTRUCTION ACTIVITIES THAT WILL IMPACT OPERATIONS OR REQUIRE WTP SHUTDOWN REQUIRE 48 HOURS ADVANCE NOTICE.

No.	REVISIONS	DATE	BY

Kimley»Horn
© 2018 KIMLEY-HORN AND ASSOCIATES, INC.
1920 WEKIVA WAY SUITE 200, WEST PALM BEACH, FL 33411
PHONE: 561-845-0665 FAX: 561-863-8175
WWW.KIMLEY-HORN.COM CA 00000696

KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM

PREPARED FOR

CITY OF STUART

MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL

MARK D. MILLER

FLORIDA LICENSE NUMBER 45320

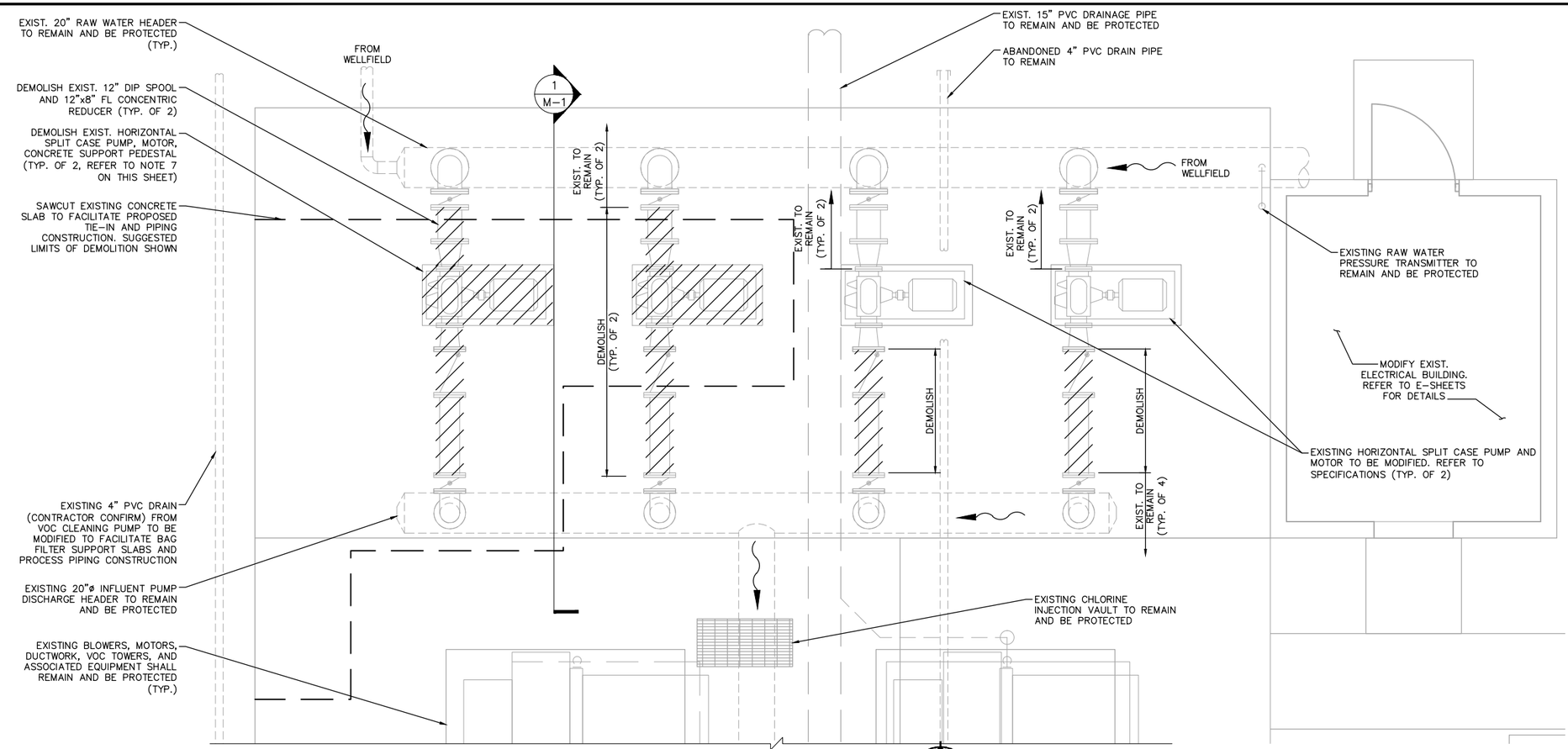
DATE: ____

WTP SITE PLAN

SHEET NUMBER C-1

2 OF 22

Plotted By:Block, Nick Sheet Set:PFC TREATMENT Layout:C-1 WTP SITE PLAN February 05, 2018 10:57:09am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\C-1 WTP SITE PLAN.dwg
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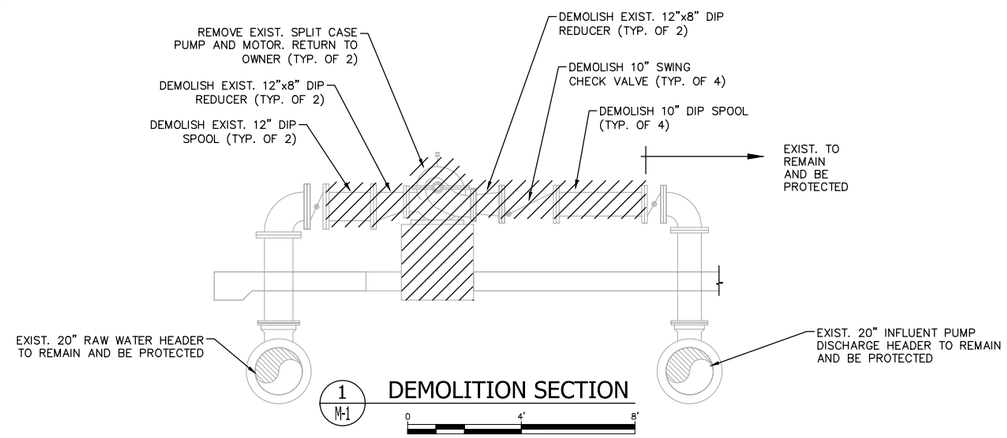
DEMOLITION PLAN

0 4' 8'

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

NOTES:

1. ALL MATERIALS TO BE DEMOLISHED ARE TO BE DISPOSED OF LEGALLY OFF-SITE.
2. RESTORE DISTURBED AREAS TO A CONDITION EQUAL TO OR BETTER THAN THE CONDITION EXISTING PRIOR TO CONSTRUCTION.
3. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
4. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
5. CONTRACTOR SHALL STAGE EQUIPMENT AND STORE MATERIALS IN THE AREAS DESIGNATED ON THIS SHEET.
6. CONTRACTOR SHALL COORDINATE ALL WORK WITH WTP OPERATIONS STAFF. ANY CONSTRUCTION ACTIVITIES THAT WILL IMPACT OPERATIONS OR REQUIRE WTP SHUTDOWN REQUIRE 48 HOURS ADVANCE NOTICE.
7. CONTRACTOR SHALL COORDINATE ALL DEMOLITION ACTIVITIES SO THAT ONLY ONE PUMP IS OUT OF SERVICE AT ANY GIVEN TIME.



1 M-1 DEMOLITION SECTION

0 4' 8'

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

Plotted By:Block, Nick Sheet Set:PFC TREATMENT Layout:M-1 DEMOLITION PLAN February 05, 2018 10:57:15am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\M-1 DEMOLITION PLAN.dwg
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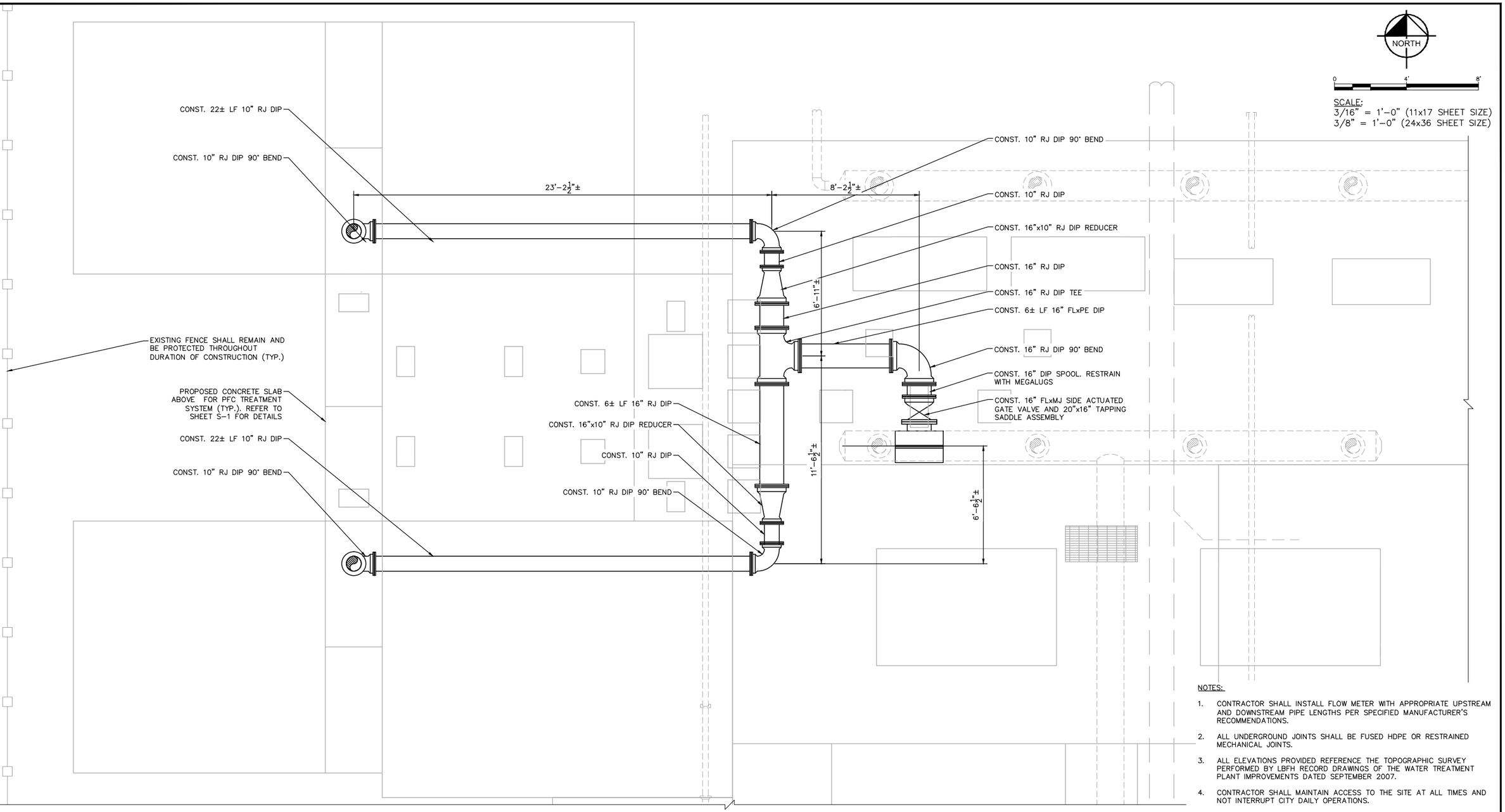
KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

DEMOLITION PLAN

SHEET NUMBER
M-1
3 OF 22



SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

NOTES:

1. CONTRACTOR SHALL INSTALL FLOW METER WITH APPROPRIATE UPSTREAM AND DOWNSTREAM PIPE LENGTHS PER SPECIFIED MANUFACTURER'S RECOMMENDATIONS.
2. ALL UNDERGROUND JOINTS SHALL BE FUSED HDPE OR RESTRAINED MECHANICAL JOINTS.
3. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
4. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
5. ALL SURFACE MOUNTED CONDUIT/PIPING SHALL HAVE ALUMINUM WALKOVER PER DETAIL 7 ON SHEET D-1.

Plotted By:Block, Nick Sheet Set:PFC TREATMENT Layout:M-2 PROPOSED SUBGRADE PLAN February 05, 2018 10:57:25am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\M-2 PROPOSED SUBGRADE PLAN.dwg
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WWW.KIMLEY-HORN.COM CA 00000696

KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

PROPOSED SUBGRADE PLAN

SHEET NUMBER
M-2
4 OF 22

EXISTING FENCE SHALL REMAIN AND BE PROTECTED

3 M-4

CONST. 10" GE TEE, BUTTERFLY VALVE, AND GROOVED PIPE CAP FOR BACKWASH OPERATIONS (TYP. OF 2)

CONST. 12'ø ION EXCHANGE VESSEL (TYP. OF 4)

CONST. ½" TAP FOR FILTER EFFLUENT PRESSURE TRANSMITTER. REFER TO DETAIL 6 ON SHEET D-1

PROPOSED VESSEL EFFLUENT PIPING (BELOW). REFER TO SHEET M-2 FOR DETAILS

1 M-4

CONST. 10" FLxGE DIP (TYP.)

CONST. 10" GExGE DIP (TYP.)

CONST. 10" GE DIP 90° BEND

CONST. 13.5± LF 10" GExGE DIP SPOOL (TYP. OF 2)

CONST. 10" GE DIP TEE (TYP. OF 2)

CONST. 10" GE DIP 90° BEND (TYP.)

CONST. 10" GE DIP 45° BEND (TYP.)

CONST. 10" FLxGE DIP (TYP.)

CONST. 10" FL DIP TEE (TYP.)

CONST. 0.5± LF 10" GE DIP SPOOL (TYP. OF 2)

CONST. ½" TAP FOR FILTER EFFLUENT PRESSURE TRANSMITTER. REFER TO DETAIL 6 ON SHEET D-1

EXISTING RAW WATER INFLUENT HEADER (BELOW). REFER TO SHEET M-2 FOR DETAILS

2 M-4

CONST. SUCTION PRESSURE GAUGE ASSEMBLY. REFER TO DETAIL ON SHEET D-2 (TYP. OF 2)

CONST. 12"x10" FL ECCENTRIC REDUCER (TYP. OF 2)

CONST. 12" FLxFL GLOBE STYLE SILENT CHECK VALVE (TYP. OF 2)

CONST. 12" LUG STYLE BUTTERFLY VALVE (TYP. OF 2)

CONST. 12"x10" FL CONCENTRIC REDUCER (TYP. OF 4)

CONST. 12" FL DIP 90° BEND, ROLL AS REQUIRED (TYP. OF 2)

CONST. 12" FL DIP TEE (TYP. OF 2)

CONST. 1" TAP FOR FLOW SWITCH (TYP. OF 2)

CONST. 2±LF 12" FL DIP SPOOL (TYP. OF 2)

CONST. 4±LF 10" FL DIP SPOOL (TYP. OF 2)

CONST. 10" FLxFL GLOBE STYLE SILENT CHECK VALVE (TYP. OF 2)

CONST. 3± LF 16" GE DIP SPOOL

CONST. ½" TAP FOR FILTER INFLUENT PRESSURE TRANSMITTER. REFER TO DETAIL 6 ON SHEET D-1

CONST. 304SST BAG FILTER (TYP. OF 2)

CONST. 10" GE DIP 90° BEND (TYP.)

CONST. 16"x10" GE DIP TEE (TYP. OF 6)

CONST. DISCHARGE PRESSURE GAUGE ASSEMBLY. REFER TO DETAIL ON SHEET D-2 (TYP. OF 2)

CONST. 6± LF 16" GE DIP SPOOL

PROPOSED VESSEL EFFLUENT PIPING (BELOW). REFER TO SHEET M-2 FOR DETAILS

CONST. 10" GE BUTTERFLY VALVE (TYP.)

CONST. 4.5± LF 10" GE DIP SPOOL (TYP. OF 2)

CONST. 10" LUG STYLE BUTTERFLY VALVE (TYP. OF 4)

EXIST. BLOWER, SUPPORT, DRAIN, DUCTWORK, VOC TOWER SHALL REMAIN AND BE PROTECTED

NORTH

0 4' 8'

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

NOTES:

1. CONTRACTOR SHALL INSTALL FLOW METER WITH APPROPRIATE UPSTREAM AND DOWNSTREAM PIPE LENGTHS PER SPECIFIED MANUFACTURER'S RECOMMENDATIONS.
2. CONTRACTOR SHALL PROVIDE AND INSTALL GROOVED PIPE COUPLINGS AND DUCTILE IRON PIPE WITH CUT GROOVES WHERE GRAPHICALLY SHOWN ON THE DRAWINGS. FLANGED PIPE CAN BE USED AS AN ALTERNATE, SEE SPECIFICATIONS.
3. ALL UNDERGROUND JOINTS SHALL BE FUSED HDPE OR RESTRAINED MECHANICAL JOINTS.
4. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
5. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
6. ALL SURFACE MOUNTED CONDUIT SHALL HAVE ALUMINUM WALKOVER PER DETAIL 7 ON SHEET D-1.

Plotted By:Black, Nick Sheet Set:PFC TREATMENT Layout:M-3 PROPOSED FLOOR PLAN February 05, 2018 10:57:34am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\M-1 ION EXCHANGE FACILITY PLAN.dwg
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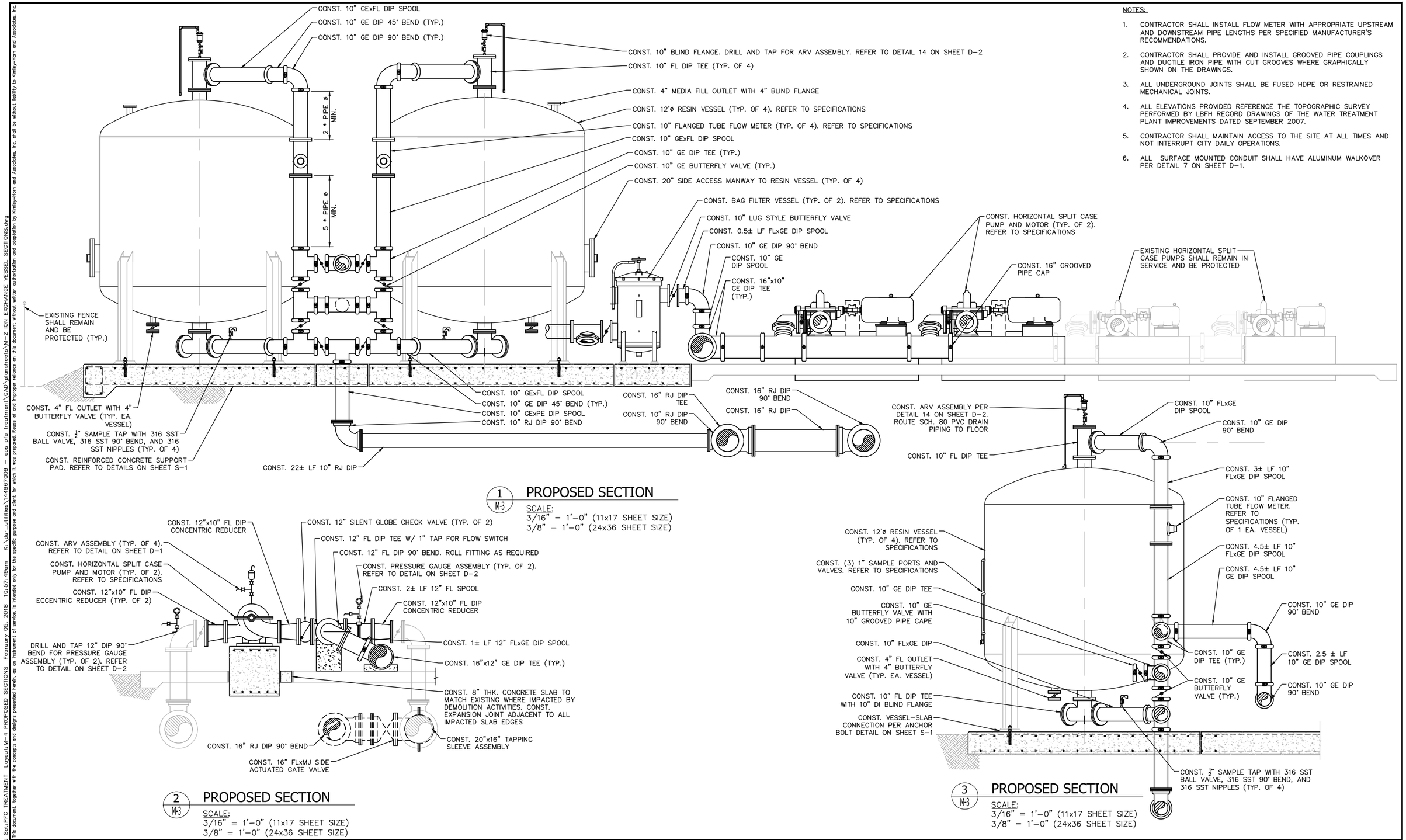
KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

PROPOSED FLOOR PLAN

SHEET NUMBER
M-3
5 OF 22



1 M-3 PROPOSED SECTION

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

2 M-3 PROPOSED SECTION

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

3 M-3 PROPOSED SECTION

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

NOTES:

1. CONTRACTOR SHALL INSTALL FLOW METER WITH APPROPRIATE UPSTREAM AND DOWNSTREAM PIPE LENGTHS PER SPECIFIED MANUFACTURER'S RECOMMENDATIONS.
2. CONTRACTOR SHALL PROVIDE AND INSTALL GROOVED PIPE COUPLINGS AND DUCTILE IRON PIPE WITH CUT GROOVES WHERE GRAPHICALLY SHOWN ON THE DRAWINGS.
3. ALL UNDERGROUND JOINTS SHALL BE FUSED HDPE OR RESTRAINED MECHANICAL JOINTS.
4. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
5. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
6. ALL SURFACE MOUNTED CONDUIT SHALL HAVE ALUMINUM WALKOVER PER DETAIL 7 ON SHEET D-1.

Plotted By:Black, Nick Sheet Set:PFC TREATMENT Layout:M-4 PROPOSED SECTIONS February 05, 2018 10:57:49am K:\dur_utilities\144967009 — cos pfc treatment\CAD\plansheets\M-2 (ON EXCHANGE VESSEL SECTIONS.dwg
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WWW.KIMLEY-HORN.COM CA 00000696

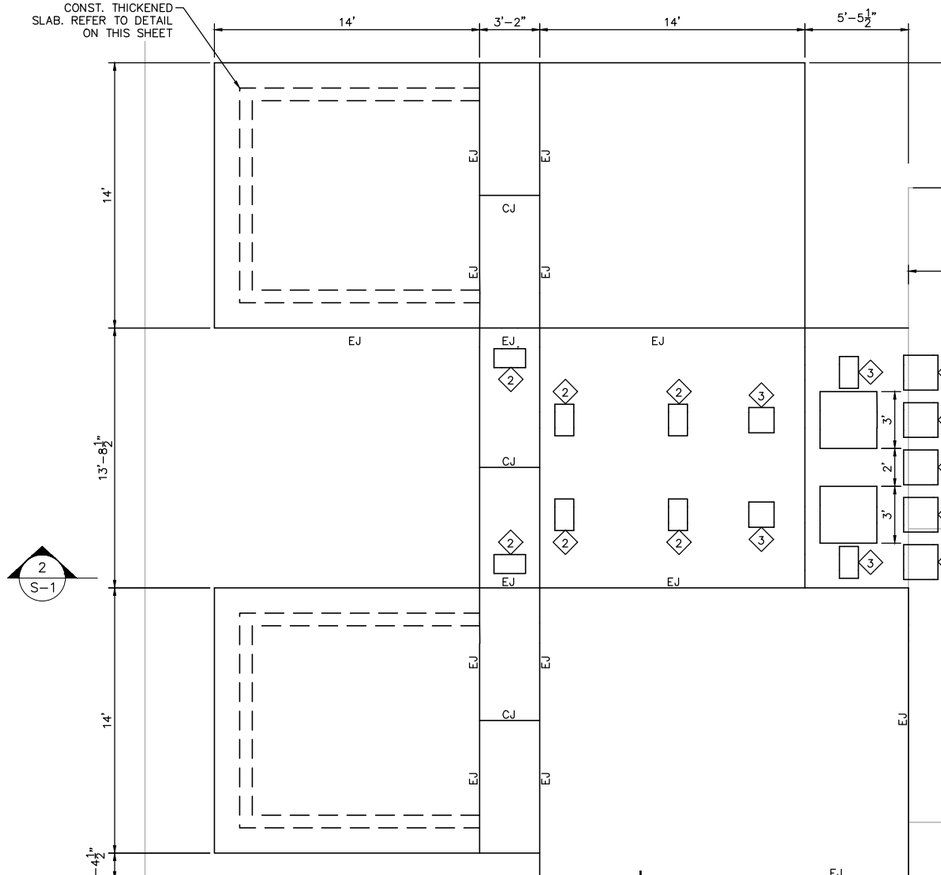
KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: _____

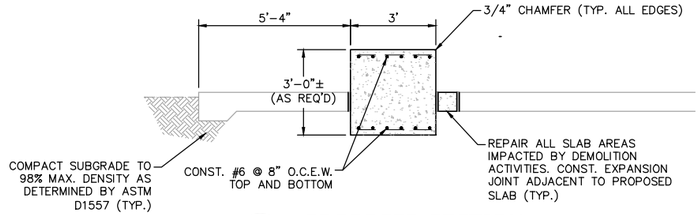
PROPOSED SECTIONS

SHEET NUMBER
M-4
6 OF 22



PLAN

SCALE:
1/8" = 1'-0" (11x17 SHEET SIZE)
1/4" = 1'-0" (24x36 SHEET SIZE)



1 S-1 PROPOSED SECTION

SCALE:
3/16" = 1'-0" (11x17 SHEET SIZE)
3/8" = 1'-0" (24x36 SHEET SIZE)

1010 GENERAL NOTES:
STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH JOB SPECIFICATIONS AND ARCHITECTURAL, MECHANICAL, ELECTRICAL, PLUMBING AND SITE DRAWINGS. CONSULT THESE DRAWINGS FOR DEPRESSIONS, AND OTHER DETAILS NOT SHOWN ON STRUCTURAL DRAWINGS.

DIMENSIONS AND CONDITIONS MUST BE VERIFIED IN THE FIELD. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH THE AFFECTED PART OF THE WORK.

1015 EXISTING STRUCTURES:
INFORMATION SHOWN FOR EXISTING STRUCTURE ON THESE DRAWINGS WAS TAKEN FROM DRAWINGS THAT WERE:

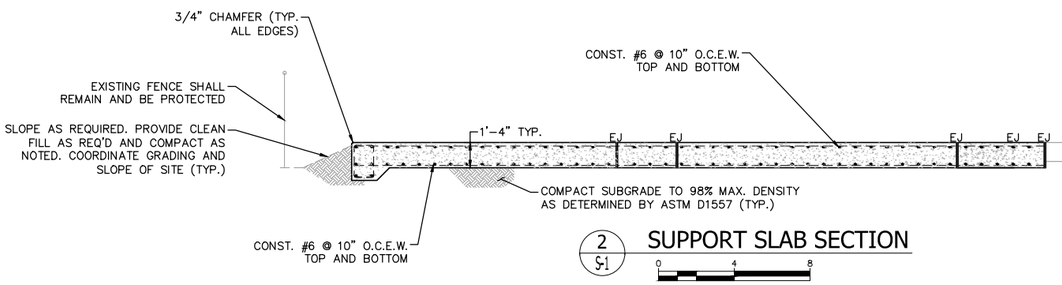
PREPARED FOR: CITY OF STUART
PREPARED BY: CH2M HILL
ENTITLED: VOC CONTAMINATION TREATMENT SYSTEM FOR THE WATER TREATMENT PLANT (SHEET 7)
DATED: JAN 1990

WORK SHOWN ON THESE PLANS ASSUMES THAT THE ORIGINAL CONSTRUCTION WAS PERFORMED IN ACCORDANCE WITH THE ABOVE INDICATED ORIGINAL DRAWINGS INCLUDING (BUT NOT LIMITED TO) DIMENSIONS, ELEVATIONS, MEMBER SIZES, MATERIALS, DETAILS, ETC. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE CONDITIONS RELATING TO THE EXISTING STRUCTURE TO NOTIFY THE ENGINEER IMMEDIATELY OF ANY DISCREPANCIES OR CONFLICTS.

1061 DESIGN LOADS:
THE STRUCTURAL SYSTEM HAS BEEN DESIGNED IN ACCORDANCE WITH THE FLORIDA BUILDING CODE, 2017 EDITION. THE FOLLOWING LOADS HAVE BEEN UTILIZED:

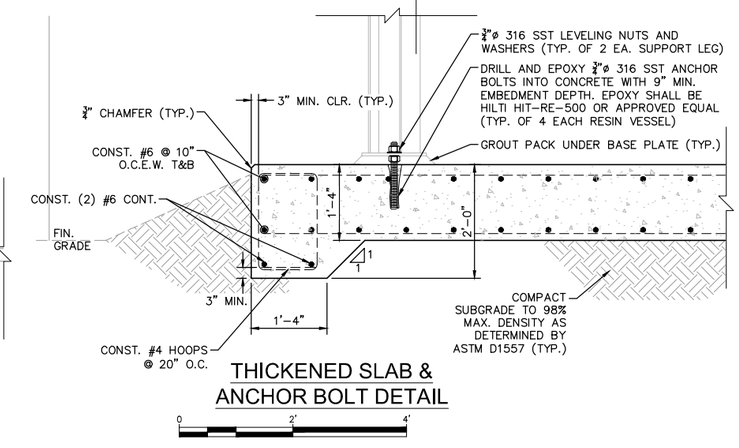
EQUIPMENT LOADS:
VESSELS: 36,500 LBS (EMPTY); 180,000 LBS (OPERATING)
WIND: ASCE 7-16
140 MPH REGION
IMPORTANCE FACTOR CAT IV = 1.15
EXPOSURE C

REPORT NO. 04-5747
PREPARED BY: ARDAMAN & ASSOCIATES, INC.
TITLED: SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING
EVALUATION: PROPOSED CITY OF STUART WTP IMPROVEMENTS; PALM BEACH ROAD AND 10TH STREET, STUART, MARTIN COUNTY, FLORIDA
DATED: AUGUST 17, 2004



2 S-1 SUPPORT SLAB SECTION

SCALE:
1/8" = 1'-0" (11x17 SHEET SIZE)
1/4" = 1'-0" (24x36 SHEET SIZE)



THICKENED SLAB & ANCHOR BOLT DETAIL

NOTES:

1. ALL ELEVATIONS PROVIDED REFERENCE THE TOPOGRAPHIC SURVEY PERFORMED BY LBFH RECORD DRAWINGS OF THE WATER TREATMENT PLANT IMPROVEMENTS DATED SEPTEMBER 2007.
2. CONTRACTOR SHALL COORDINATE PUMP PAD HEIGHT WITH INFLUENT PUMP SELECTION TO MAINTAIN DESIRED SUCTION ELEVATION
3. CONTRACTOR SHALL MAINTAIN ACCESS TO THE SITE AT ALL TIMES AND NOT INTERRUPT CITY DAILY OPERATIONS.
4. CJ = CONTRACTION JOINT – SEE DETAIL ON SHEET D-2
   EJ = EXPANSION JOINT – SEE DETAIL ON SHEET D-2
5. CONTRACTOR SHALL SECURE PROPOSED VESSELS TO SLAB PER ANCHOR BOLT DETAIL ON THIS SHEET.

No.	REVISIONS	DATE	BY

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KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

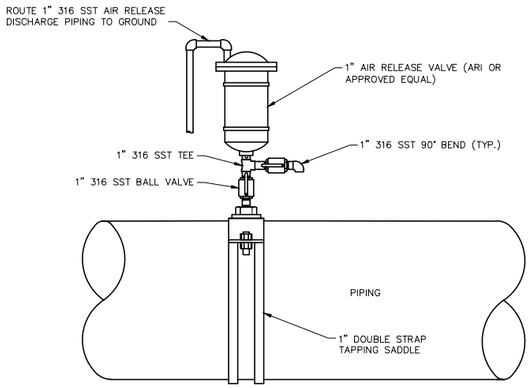
PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: _____

ION EXCHANGE VESSEL PAD

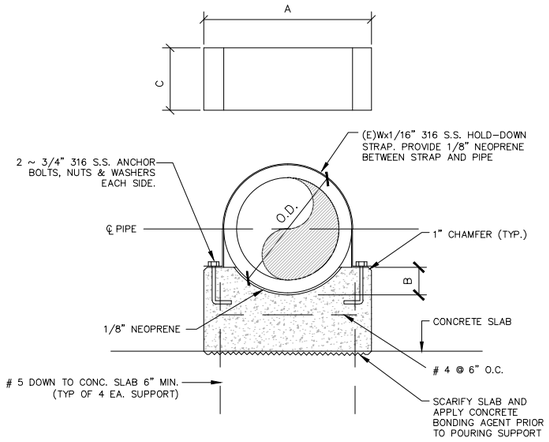
SHEET NUMBER
S-1
7 OF 22

Plotted By:Black, Nick Sheet Set:PFC TREATMENT Layout:S-1 ION EXCHANGE VESSEL PAD February 05, 2018 10:58:06am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\S-1 ION EXCHANGE VESSEL PAD.dwg
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ARV DETAIL 1

N.T.S.

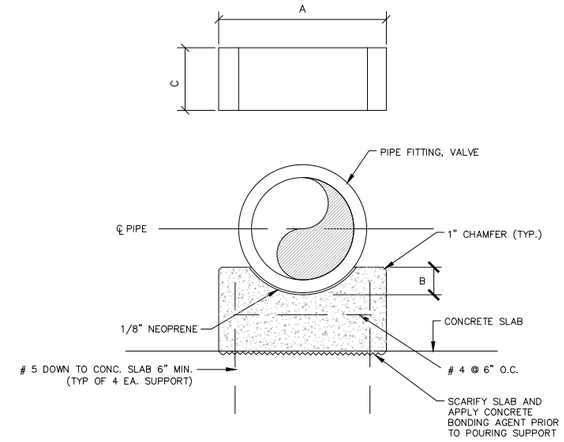


SCHEDULE

PIPE SIZE	A	B	C	E
4"	1'-2"	2"	8"	2"
6"	1'-6"	2"	8"	4"
8"	1'-8"	3"	1'-0"	4"
10"	1'-8"	3"	1'-0"	4"
12"	2'-2"	4"	1'-0"	6"
16"	2'-0"	4"	1'-0"	6"

PIPE SUPPORT TYPE 2

N.T.S.

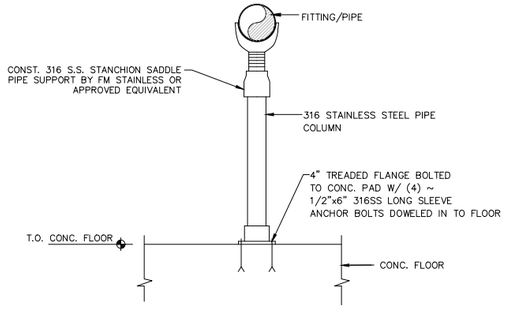


SCHEDULE

PIPE SIZE	A	B	C
4"	1'-2"	2"	8"
6"	1'-6"	2"	8"
8"	1'-8"	3"	1'-0"
10"	1'-8"	3"	1'-0"
12"	2'-0"	4"	1'-0"

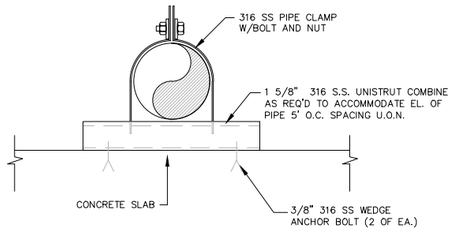
PIPE SUPPORT TYPE 3

N.T.S.



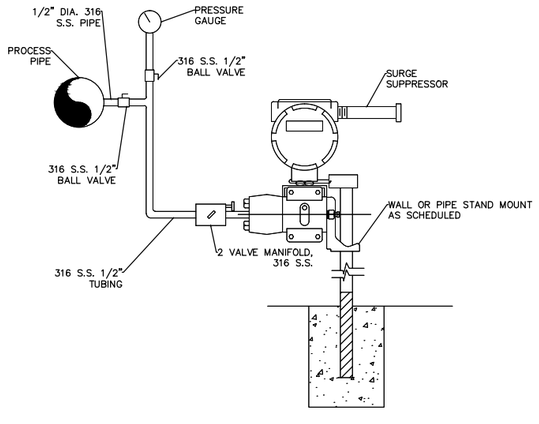
PIPE SUPPORT TYPE 4

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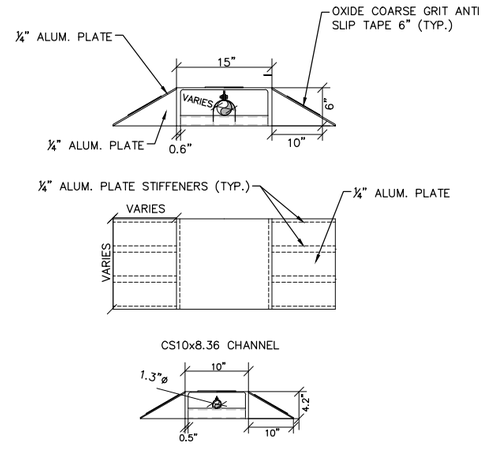
PIPE SUPPORT TYPE 5

N.T.S.



PRESSURE TRANSMITTER DETAIL 6

N.T.S.



ALUMINUM WALKOVER DETAIL 7

N.T.S.

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KHA PROJECT	144967009
DATE	FEB. 2018
SCALE	AS SHOWN
DESIGNED BY	MDM
DRAWN BY	NPB
CHECKED BY	MDM

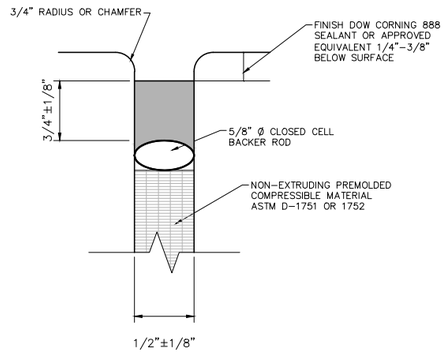
PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

CONSTRUCTION DETAILS

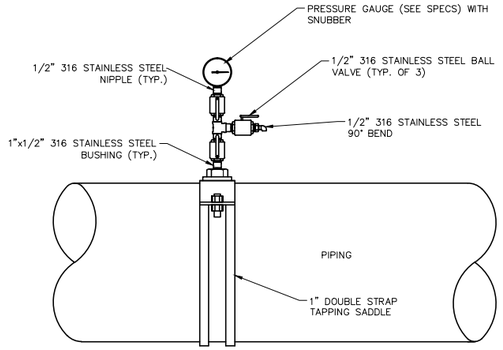
SHEET NUMBER
D-1
8 OF 22

Plotted By:Black, Nick Sheet Set:PFC TREATMENT Layout:D-1 CONSTRUCTION DETAILS February 05, 2018 10:58:13am K:\dur_utilities\144967009 — cos pfc treatment\CAD\plansheets\D-1 CONSTRUCTION DETAILS.dwg
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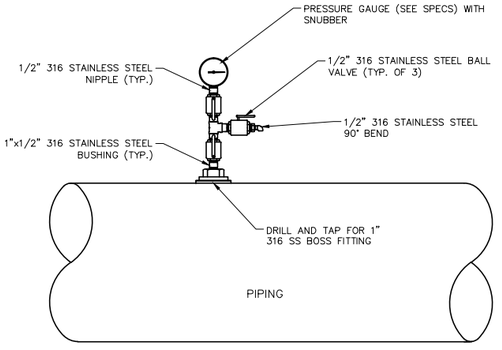
EXPANSION JOINT DETAIL 8

N.T.S.



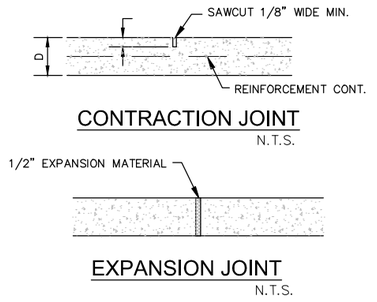
PRESSURE GAUGE DETAIL 9

N.T.S.



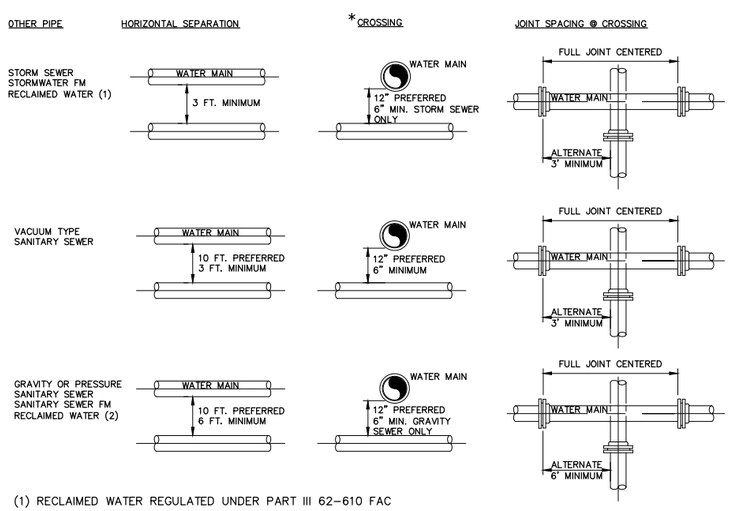
PRESSURE GAUGE DETAIL 10

N.T.S.



JOINT DETAILS 11

N.T.S.



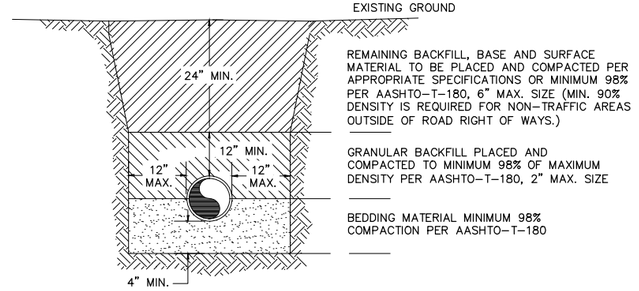
(1) RECLAIMED WATER REGULATED UNDER PART III 62-610 FAC

(2) RECLAIMED WATER NOT REGULATED UNDER PART III 62-610 FAC

* WATER MAIN SHOULD CROSS ABOVE OTHER PIPE. WHEN WATER MAIN MUST BE BELOW OTHER PIPE THE MINIMUM VERTICAL SEPARATION IS 12"

PIPE CROSSING/SEPARATION DETAIL 12

N.T.S.

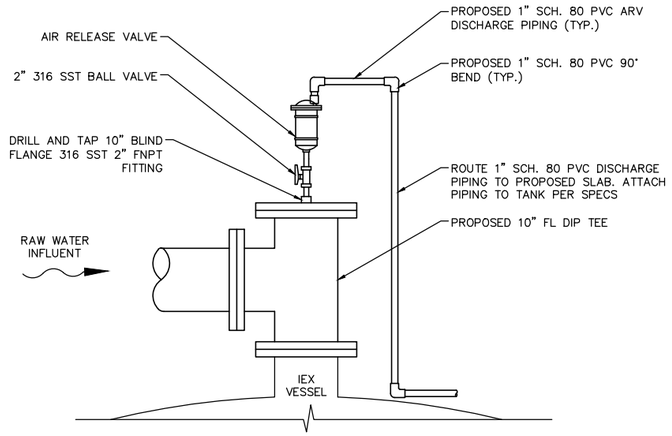


NOTES:

1. BEDDING MATERIAL SHALL CONSIST OF IN-SITU GRANULAR MATERIAL OR WASHED AND GRADED LIMEROCK 3/8"-7/8" SIZING. UNSUITABLE IN-SITU MATERIALS SUCH AS MUCK, DEBRIS AND LARGER ROCKS SHALL BE REMOVED.
2. THE PIPE SHALL BE FULLY SUPPORTED FOR ITS ENTIRE LENGTH WITH APPROPRIATE COMPACTION UNDER THE PIPE HAUNCHES.
3. THE PIPE SHALL BE PLACED IN A DRY TRENCH.
4. BACKFILL SHALL BE FREE OF UNSUITABLE MATERIAL SUCH AS LARGER ROCK, MUCK AND DEBRIS.
5. DENSITY TEST ARE REQUIRED IN ONE (1) FOOT LIFTS ABOVE PIPE AT INTERVALS OF 400 FT. MAXIMUM, OR AS DIRECTED BY S.I.D.
6. THE APPLICANT / CONTRACTOR SHALL BE RESPONSIBLE TO COMPLY WITH ALL APPLICABLE TRENCH-SAFETY LAWS AND REGULATIONS.
7. THE AFFECTED AREA SHALL BE RESTORED TO EQUAL OR BETTER CONDITION OR AS SPECIFIED IN PERMIT / CONTRACT DOCUMENTS.
8. MINIMUM COMPACTION CRITERIA SHALL BE NOTED HEREIN OR PER THE PIPE MANUFACTURERS RECOMMENDATIONS, WHICHEVER IS MORE STRINGENT.

TYPICAL TRENCH DETAIL 13

N.T.S.



ARV DETAIL 14

N.T.S.

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KHA PROJECT	144967009
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DRAWN BY	NPB
CHECKED BY	MDM

PFC TREATMENT SYSTEM

PREPARED FOR

CITY OF STUART

MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL

MARK D. MILLER

FLORIDA LICENSE NUMBER 45320

DATE: ____

CONSTRUCTION DETAILS

SHEET NUMBER D-2

9 OF 22

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FROM WELLS 1, 2A, 3, 5

VOC INFLUENT PUMPS

BAG FILTER #1

BAG FILTER #2

RESIN VESSEL #1

RESIN VESSEL #2

RESIN VESSEL #3

RESIN VESSEL #4

1MG GROUND STORAGE

1MG GROUND STORAGE

1MG GROUND STORAGE

HIGH SERVICE PUMPS

TO DISTRIBUTION

TO DISTRIBUTION

LIME SOFTENER #1

LIME SOFTENER #2

LIME SOFTENER #3

DUAL MEDIA GRAVITY FILTERS (COVERED & SCREENED)

HEADER TROUGH

HEADER TROUGH

CLEARWELL & TRANSFER PUMPS

VOC TOWERS

VOC EFFLUENT PUMPS

WASHWATER RECOVERY BASIN

SLUDGE LAGOONS

CATCH BASIN

FROM WELLS 12 & 13 STEAM

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DATE: ____

OVERALL WATER PLANT PROCESS FLOW DIAGRAM (PFD)

SHEET NUMBER

I-0

10 OF 22

VALVE SYMBOLS

- GATE
- GLOBE
- BALL
- BALL
- BUTTERFLY
- CHECK
- DIAPHRAGM
- PLUG
- NEEDLE
- SOLENOID
- 3-WAY SOLENOID (SEE DETAIL A)
- PINCH VALVE
- RELIEF AND/OR SAFETY
- 3-WAY
- 5-WAY

CONTROL VALVES/ACTUATORS

- PRESSURE REDUCING REGULATOR, SELF CONTAINED
- BACK PRESSURE REGULATOR, SELF CONTAINED
- MOTOR OPERATED BALL VALVE
- MOTOR OPERATED BALL VALVE
- MOTOR OPERATED BUTTERFLY VALVE
- MOTOR OPERATED GLOBE VALVE
- CYLINDER OR PISTON OPERATED BUTTERFLY VALVE
- DAMPER
- AIR OPERATED CONTROL VALVE w/ AIR SUPPLY AND POSITIONER
- MODULATING CONTROL VALVE
- BLAST GATE
- VACUUM RELIEF VALVE

PIPING AND EQUIPMENT SYMBOLS

- CENTRIFUGAL PUMP
- BLOWER
- POSITIVE DISPLACEMENT PUMP (W/MANUAL STROKE ADJUSTMENT)
- ROTARY COMPRESSOR OR FAN
- VERTICAL TURBINE PUMP
- MIXING TEE
- MIXER OR AGITATOR
- STATIC MIXER
- SIGHT GLASS
- LEVEL GAUGE
- FLOW SIGHT GLASS
- INJECTION SPARGER
- REDUCER
- QUICK DISCONNECT
- FLOOR DRAIN
- RUPTURE DISC
- DIAPHRAGM OR CHEMICAL SEAL
- EDUCTOR
- Y-STRAINER
- PULSATION DAMPENER
- CALIBRATION COLUMN
- VENT TO ATMOSPHERE
- MEMBRANE TREATMENT STAGE
- EXPANSION JOINT

LIST OF RELAY FUNCTIONS

- ADJUSTABLE RATIO
- EXTRACT SQUARE ROOT
- CONVERT SIGNAL RELAY (TYPICAL EXAMPLES)
  - E-VOLTAGE
  - H-HYDRAULIC
  - I-CURRENT
  - O-ELECTROMAGNETIC OR SONIC
  - P-PNEUMATIC
  - R-RESISTANCE(ELECTRICAL)

FLOW MEASUREMENT SYMBOLS

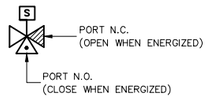
- FLOW ELEMENT(ORFICE PLATE)
- FLOW TOTALIZING UNDICATOR (TURBINE METER)
- FLOW ELEMENT(ANNUBAR)
- INSERTION TYPE MAGNETIC FLOWMETER
- MAGNETIC FLOWMETER
- INLINE FLOW INDICATOR
- INLINE FLOW INDICATOR (ROTOMETER) WITH INTEGRAL MANUAL VALVE

INSTRUMENT SYMBOLS

- PANEL MOUNTED PILOT LITE
- FIELD (LOCALLY) MOUNTED INSTRUMENT
- PANEL MOUNTED INSTRUMENT
- INACCESSIBLE PANEL MOUNTED INSTRUMENT
- FIELD MOUNTED INSTRUMENT (PLC CONTROL)
- PANEL MOUNTED INSTRUMENT (PLC CONTROL)
- FIELD MOUNTED INSTRUMENT (HMI CONTROL)
- PANEL MOUNTED INSTRUMENT (HMI CONTROL)
- INSTRUMENTS SHARING A COMMON HOUSING

LINE SYMBOLS

- PROCESS FLOW PIPING
- AIR STREAM OR PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL (OR FUTURE)
- FIBER OPTIC



DETAIL "A"
(SOLENOID VALVE OPERATION)

CONTROL SYMBOLS

- DISCRETE INPUT
- DISCRETE OUTPUT
- ANALOG INPUT
- ANALOG OUTPUT

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER (OR PAIR)		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE		READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS(2)		ALARM		
B			USERS CHOICE(3)	USERS CHOICE(3)	USERS CHOICE(3)
C	CONDUCTIVITY (ELECTRIC)			CONTROL	
D		DIFFERENTIAL			
E	VOLTAGE (E.M.F.)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FUNCTION)			
G	GAGING (DIMENSION)		GLASS (DIRECT VIEW)		
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRIC)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT(PILOT)		
M	MOISTURE OR HUMIDITY				
N	USER'S CHOICE(3)		USERS CHOICE(3)	USERS CHOICE(3)	USERS CHOICE(3)
O	OXIDE REDUCT. POTENTIAL		ORFICE (RESTRICTION)		
P	PRESSURE OR VACUUM		TEST OR SAMPLE POINT		
Q	QUANTITY OR EVENT	INTERGRATE/ TOTALIZER			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE,DAMPER, OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED(4)	UNCLASSIFIED(4)	UNCLASSIFIED(4)	UNCLASSIFIED(4)	UNCLASSIFIED(4)
Y	USERS CHOICE(3)			RELAY OR COMPUTE	
Z	POSITION			DRIVE,ACTUATE,ETC.	

1. ANY FIRST LETTER COMBINED W/ MODIFIER REPRESENTS A NEW AND SEPARATE MEASURED VARIABLE. EXAMPLES: PD=DIFFERENTIAL PRESSURE,FQ=TOTALIZED OR INTERGRATED FLOW. EXCEPTION IS MODIFIER "J" FOR MULTIPOINT SCANNING. "A" IS USED FOR ANALYTICAL VARIABLES. EXAMPLES: pH,Na,SiO~s2~S,O~s2~S,ETC. A SYMBOL OR DESCRIPTION
2. DENOTING THE FUNCTION IS SHOWN OUTSIDE THE INSTRUMENT SYMBOL. EXAMPLE: (AIT) pH
3. MEANING OF A "USER CHOICE" LETTER SHALL BE CONSISTENT THROUGHOUT A PROJECT AND SHALL BE SPECIFIED IN THE DRAWING LEGEND.
4. UNCLASSIFIED LETTER MAY HAVE A FEW DIFFERENET MEANINGS ON A PROJECT.THE MEANING SHALL BE SPECIFIED NEAR EACH INSTRUMENT SYMBOL USING THE UNCLASSIFIED LETTER.

FLOW ACRONYMS

AS – AIR SUPPLY
BAS – BLOWER AIR SUPPLY
FW – FINISH WATER
IAS – INSTRUMENT AIR SUPPLY
PB – PERMEATE BLEND
PW – POTABLE WATER
SA – SAMPLE

SPECIAL IDENTIFICATION

AX – ANALYZER TEST CONNECTION
PX – PRESSURE TEST CONNECTION
S – SAMPLE
XL – MOTOR RUNNING LIGHT
SDI – SILT DENSITY INDEX TEST FILTER HOLDER W/0.45 MICRON FILTER HOLDER
D – DRAIN
N.C. – NORMALLY CLOSED
N.O. – NORMALLY OPEN
F.C. – FAIL CLOSED
F.O. – FAIL OPEN

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MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
MARK D. MILLER
FLORIDA LICENSE NUMBER
45320
DATE: ____

PROCESS & INSTRUMENTATION DIAGRAM (P&ID) LEGEND

SHEET NUMBER
I-1
11 OF 22

Plotted By:Block, Nick Sheet Set:PFC TREATMENT Layout:I-1 PROCESS & INSTRUMENTATION DIAGRAM (P&ID) LEGEND February 05, 2018 10:58:27am K:\dur_utilities\144967009 - cos pfc treatment\CAD\plansheets\I-1 PROCESS & INSTRUMENTATION DIAGRAM (P&ID) SYMBOL LEGEND & ABBREVIATIONS.dwg
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HMI (WTP)

SUCTION PRESSURE

CONTROL POWER FAIL

PUMP RUN

PUMP FAIL

PUMP START/STOP

SPEED CONTROL

RESET

SPEED INDICATION

LOW FLOW ALARM

FILTER INFLUENT PRESSURE

FILTER EFFLUENT PRESSURE

PLC

FROM WELLS 1, 2, 4, 5

FROM WELLS 4 & 6-25

VFD

SPEED POT

HOA

TO VOC TOWERS

BFV-XX

ARV

FQI

MEDIA FILL

BACKWASH/ REGEN

SAMPLE PORTS

WASH DOWN

MEDIA FILL MANWAY

#1 #2 #3

MEDIA OUTLET

DRAIN

RESIN VESSEL #1

RESIN VESSEL #2

RESIN VESSEL #3

RESIN VESSEL #4

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FLORIDA

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FLORIDA LICENSE NUMBER 45320

DATE: ____

P&ID ION EXCHANGE SYSTEM

SHEET NUMBER

I-2

12 OF 22

ELECTRICAL LEGEND

- RACEWAY EXPOSED
- LIGHTING RACEWAY CONCEALED
- RACEWAY CONCEALED
- RACEWAY TURNED UP/DOWN
- (5) MOTOR
- TRANSFORMER
- FUSE
- CIRCUIT BREAKER
- CAPACITOR
- LIGHTNING ARRESTER
- SAFETY DISCONNECT SWITCH, HP RATED
- GROUND
- DUPLEX, 14" AFF
- [T] THERMOSTAT
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- LEVEL SWITCH, FLOAT SWITCH
- PRESSURE SWITCH
- LIMIT SWITCH
- THERMAL SWITCH
- HEATER
- (G) PILOT LIGHT
- [ETM] ELAPSED TIME METER
- SELECTOR SWITCH
- PUSH BUTTON ON-OFF SWITCH
- EQUIPMENT POWER RECEPTACLE
- $ SWITCH 48"AFF,
- $3 SWITCH 48"AFF, 3-WAY
- [J] JUNCTION BOX
- PANELBOARD, ELECTRICAL EQUIP. ENCL
- (S) SOLENOID VALVE
- [M] MOTOR OPERATED VALVE
- //// CROSS HATCH DENOTES DELETION
- [MS] MANUAL MOTOR STARTER
- RED, MAINTAINED PUSH BUTTON
- TIMING CONTACT
- FLOW SWITCH
- ENCLOSED COMBINATION STARTER
- CONTROL RELAY, MOTOR STARTER, ETC.
- (C01) DENOTES CONDUIT TAG 01
- (C01) (C02) DENOTES SEPARATE CONDUITS WITH SEPARATE WIRE
- (A-3) DENOTES PANELBOARD A, CIRCUIT 3

GENERAL ELECTRICAL NOTES

1. READ THE SPECIFICATIONS
   REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS. THERE ARE REQUIREMENTS NOTED IN THE SPECIFICATIONS WHICH ARE NOT INDICATED ON THE DRAWINGS.
2. SCHEMATIC NATURE
   PLAN VIEWS ARE SCHEMATIC IN NATURE AND MEANT TO SHOW THE SCHEMATIC ARRANGEMENT OF EQUIPMENT AND CONDUIT.
3. APPROVED SHOP DRAWINGS
   USE APPROVED SHOP DRAWINGS FOR LAY OUT OF EQUIPMENT. THE CONTRACT DOCUMENTS WILL VARY FROM THE SHOP DRAWINGS. INFORM THE ENGINEER IMMEDIATELY IF THERE ARE LAY OUT ISSUES OR INADEQUATE SPACE FOR EQUIPMENT OR CLEARANCES. LAND CONDUITS IN OPENINGS OF ENCLOSURES PER THE APPROVED SHOP DRAWINGS, DO NOT USE THE CONTRACT DRAWINGS.
4. CLEARANCES
   IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO MEET N.E.C. CLEARANCES ABOUT EQUIPMENT.
5. ROUTING
   CONDUIT ROUTING IS SCHEMATIC IN NATURE. CONDUIT ROUTING IS SHOWN FOR CLARITY ON THE CONTRACT DRAWINGS. ROUTE CONDUITS AS MAY BE REQUIRED.
6. FUTURES FACILITIES
   WHERE FUTURE FACILITIES ARE INDICATED. CONDUIT ROUTING SHALL ACCOUNT FOR SUCH FACILITIES.
7. RESPONSIBILITIES
   BIDDERS, SUPPLIERS, EQUIPMENT VENDORS, GENERAL CONTRACTOR, SUB CONTRACTORS AND OTHER SIMILAR ENTITIES ARE REQUIRED TO READ ALL THE CONTRACT DOCUMENTS INCLUDING DRAWINGS AND SPECIFICATIONS.
8. HOMERUNS
   CONTRACTOR SHALL COORDINATE HOME RUNS BETWEEN PLAN VIEWS. WHERE ANY CONDUIT IS SHOWN IN ANY PLAN VIEW IT SHALL BE INSTALLED THE ENTIRE LENGTH AS MAY BE REQUIRED.
9. SEPARATION
   MAINTAIN 12" MIN SEPARATION BETWEEN 4-20MADC SIGNAL AND ALL OTHER RACEWAYS.
10. STUB-UPS
    CONDUITS NOT TERMINATIED IN PULL BOXES SHALL BE STUBBED-UP, CAPPED AND TAGGED.

ELECTRICAL ABBREVIATIONS

AXS	AUTO TRANSFORMER STARTER
CR	CONTROL RELAY
CP	CONTROL PANEL
CPB	CONTROL PULL BOX
CR	CARD READER
CS	CONTROL STATION
CTB	CONTROL TERM. BOX
DISC	DISCONNECT SWITCH
DS	DOOR SWITCH
EN	ETHERNET
ETM	ELAPSED TIME METER
F	FUSE
FO	FIBER OPTIC
FO-E-CBL	FIBER OPTIC ETHERNET CABLE
FSA	FIELD SURGE ARRESTOR
GFI	GROUND FAULT INTERRUPTER
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
IPB	INST. PULL BOX
IPSCP	INLINE PUMP STATION CONTROL PANEL
ITB	INST. TERMINAL BOX
LA	LIGHTNING ARRESTER
LOR	LOCAL-OFF-REMOTE
M	MOTOR STARTER
MB+	MODBUS PLUS
MCC	MOTOR CONTROL CENTER
MLO	MAIN LUG ONLY
MTS	MANUAL TRANSFER SWITCH
NF	NON FUSED
N.I.C.	NOT IN CONTRACT
OCP	OPERATOR CONTROL PANEL
OHC	OPEN-HOLD-CLOSE
OHU	OVER HEAD ELEC UTILITIES
OL	OVER LOAD RELAY
PB	PUSH BUTTON
PDP	POWER DIST. PANEL
PM	POWER MONITOR
PNLBD	PANELBOARD
PPB	POWER PULL BOX
PSA	PANEL SURGE ARRESTOR
R-I/O CBL	REMOTE I/O CABLE
RDC	ROLL UP DOOR CONTROLLER
R,G,A	RED, GREEN, AMBER PILOT LIGHT
RGS	RIGID GALV. STEEL
RO	READ OUT
SA	SURGE ARRESTER
SACP	SULFURIC ACID CP
SICP	SCALE INHIBITOR CP
SS	SELECTOR SWITCH OR 316 STAINLESS STEEL
SWBD	SWITCH BOARD
TC	TIME CLOCK
TOT	TOTALIZER
TS	TEST SWITCH
VCP	VENDOR CP
VFD	VARIABLE FREQUENCY DRIVE
WP	WEATHER PROOF
WW	WIRE WAY
ZSL	POSITION SWITCH CLOSED
ZSO	POSTION SWITCH OPEN

MATERIAL SCHEDULE

LOCATION	CONDUIT	ENCLOSURE MATERIALS	ENCLOSURE NEMA RATING	FASTENERS, STRUT, THREADED ROD, ETC.	REMARKS
INTERIOR					
EXPOSED IN AIR CONDITIONED EQUIPMENT ROOMS	PVC SCHED. 80	PAINTED STEEL	1, GASKETED	GALV. STEEL	
EXPOSED IN PUMP ROOMS, EQUIPMENT ROOMS, ETC. (NOT A/C)	PVC SCHED. 80	316 SS	MODIFIED NEMA 12	316 SS	
EXTERIOR					
BELOW GRADE	PVC SCHED. 40	CONCRETE BOXES	N/A	316 SS	
ABOVE GRADE	PVC SCHED. 80	316 SS	4X	316 SS	

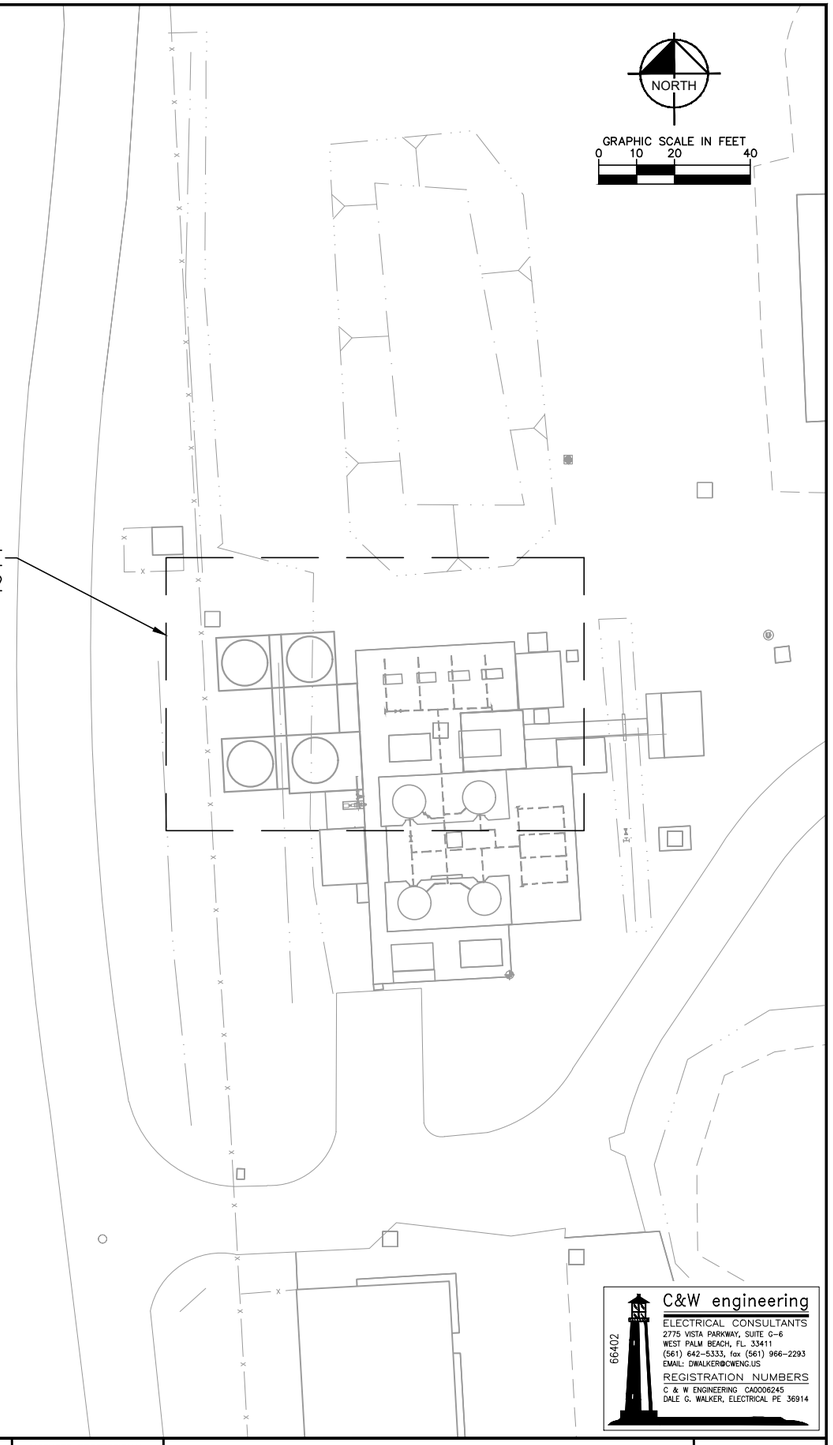
GENERAL NOTES

1. THE FOLLOWING SHALL ESTABLISH THE MINIMUM LEVEL OF QUALITY FOR MATERIALS.
2. THE FOLLOWING SHALL APPLY UNLESS OTHERWISE INDICATED BY PLANS
3. THE FOLLOWING SHALL NOT APPLY TO POWER TRANSFORMERS, LIGHT FIXTURES AND LIGHT POLES, THOSE ELEMENTS ARE NOTED OR INDICATED ELSEWHERE

LEGEND

N/A	NOT APPLICABLE
316 SS	316 STAINLESS STEEL
EMT	ELECTRICAL METALLIC TUBING, GALV. STEEL
ALUMINUM	ALUMINUM RIGID CONDUIT 6063 ALLOY, NOT ALUMINUM EMT

MATERIAL SCHEDULE



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EMAIL: DWALKER@CWENG.US
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66402

No.	REVISIONS	DATE	BY

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KHA PROJECT 144967009
DATE FEB 2018
SCALE AS SHOWN
DESIGNED BY DGW
DRAWN BY AOD
CHECKED BY DGW

PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
DALE G. WALKER
FLORIDA LICENSE NUMBER 36914
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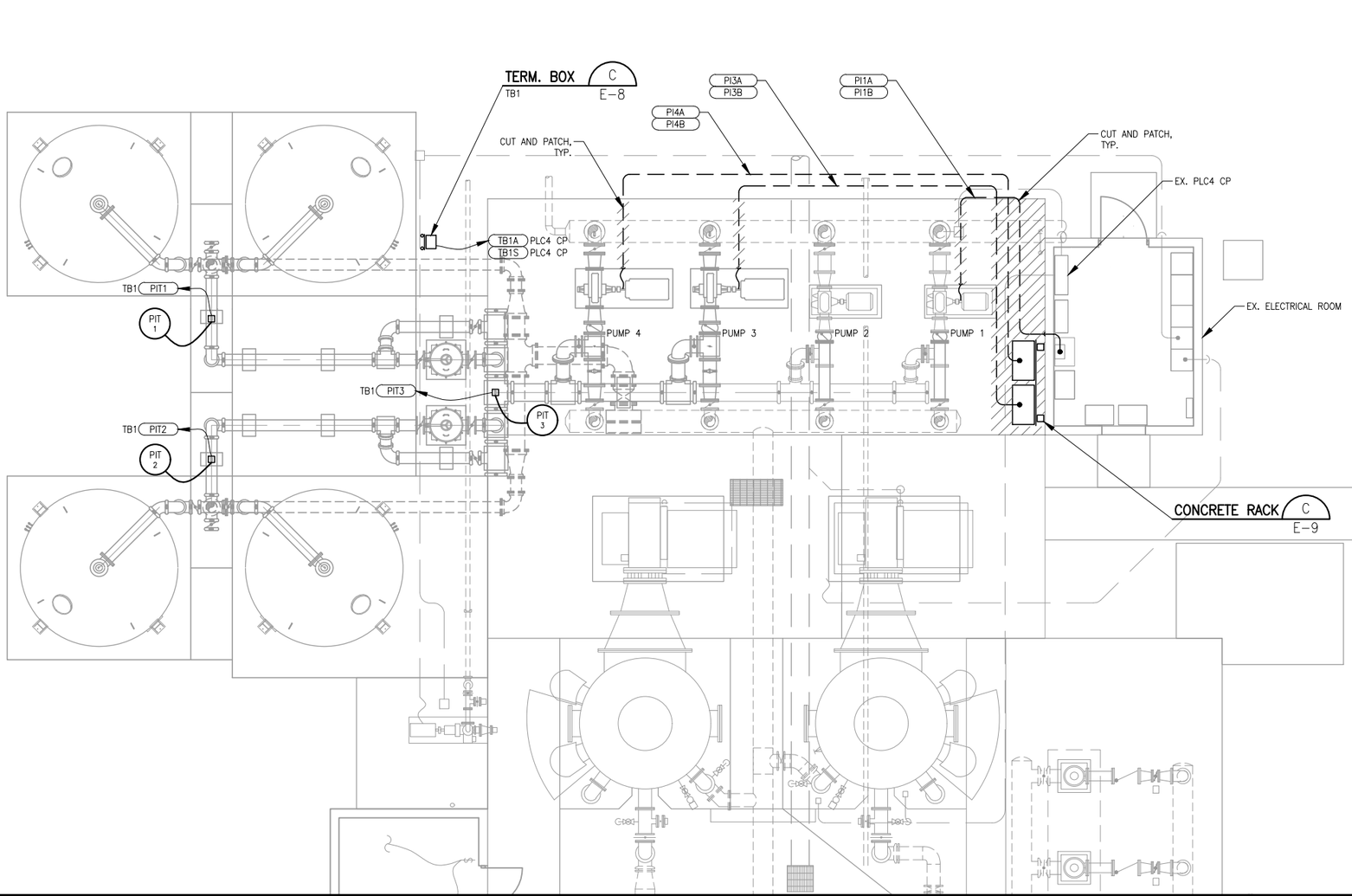
ELECTRICAL NOTES & LEGENDS

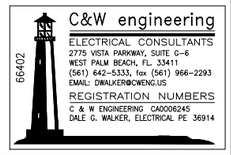
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GENERAL ELECTRICAL NOTES

1. CUT AND PATCH CONCRETE AS NEEDED TO INSTALL CONDUIT AND EQUIPMENT,





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NORTH

GRAPHIC SCALE IN FEET
0 2.5 5 10

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KHA PROJECT	144967009
DATE	FEB 2018
SCALE	AS SHOWN
DESIGNED BY	DGW
DRAWN BY	AOD
CHECKED BY	DGW

PFC TREATMENT SYSTEM

PREPARED FOR

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MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL

DALE G. WALKER

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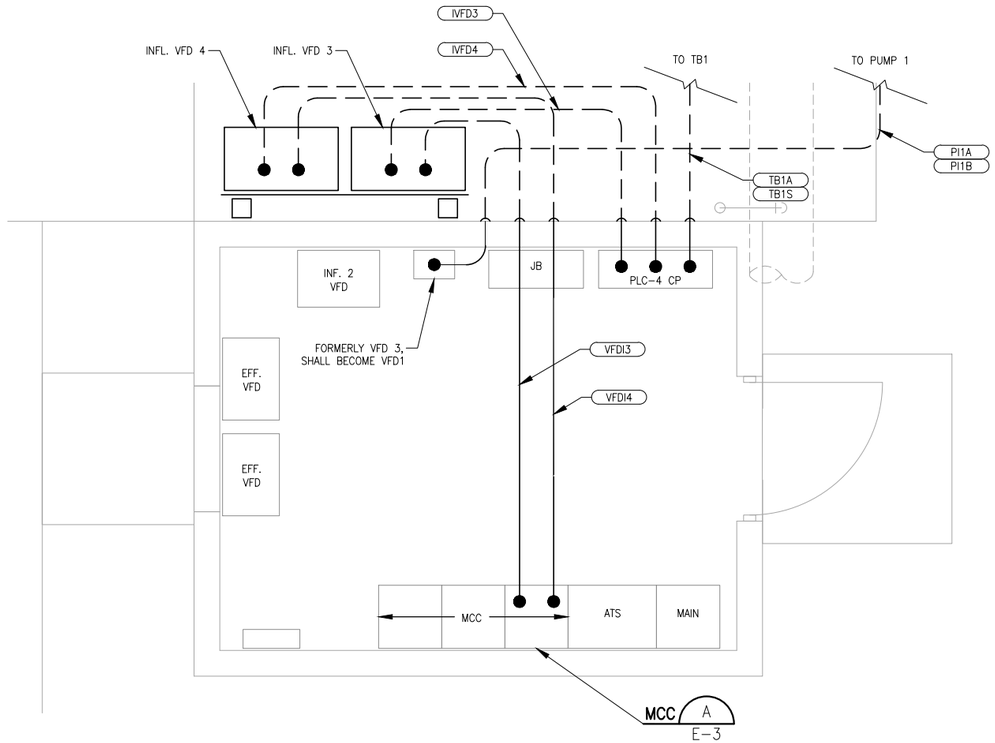
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ELECTRICAL INSTALL SITE PLAN

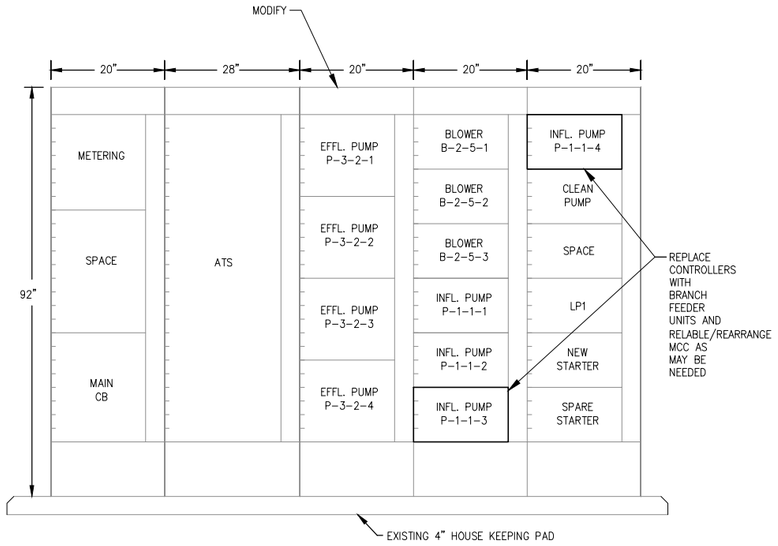
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E-2

14 OF 22



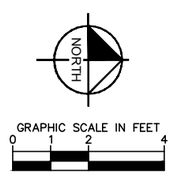
ELECTRICAL ROOM INSTALLATION PLAN



EXISTING WESTINGHOUSE 2100 SERIES MCC ELEVATION

NTS

A



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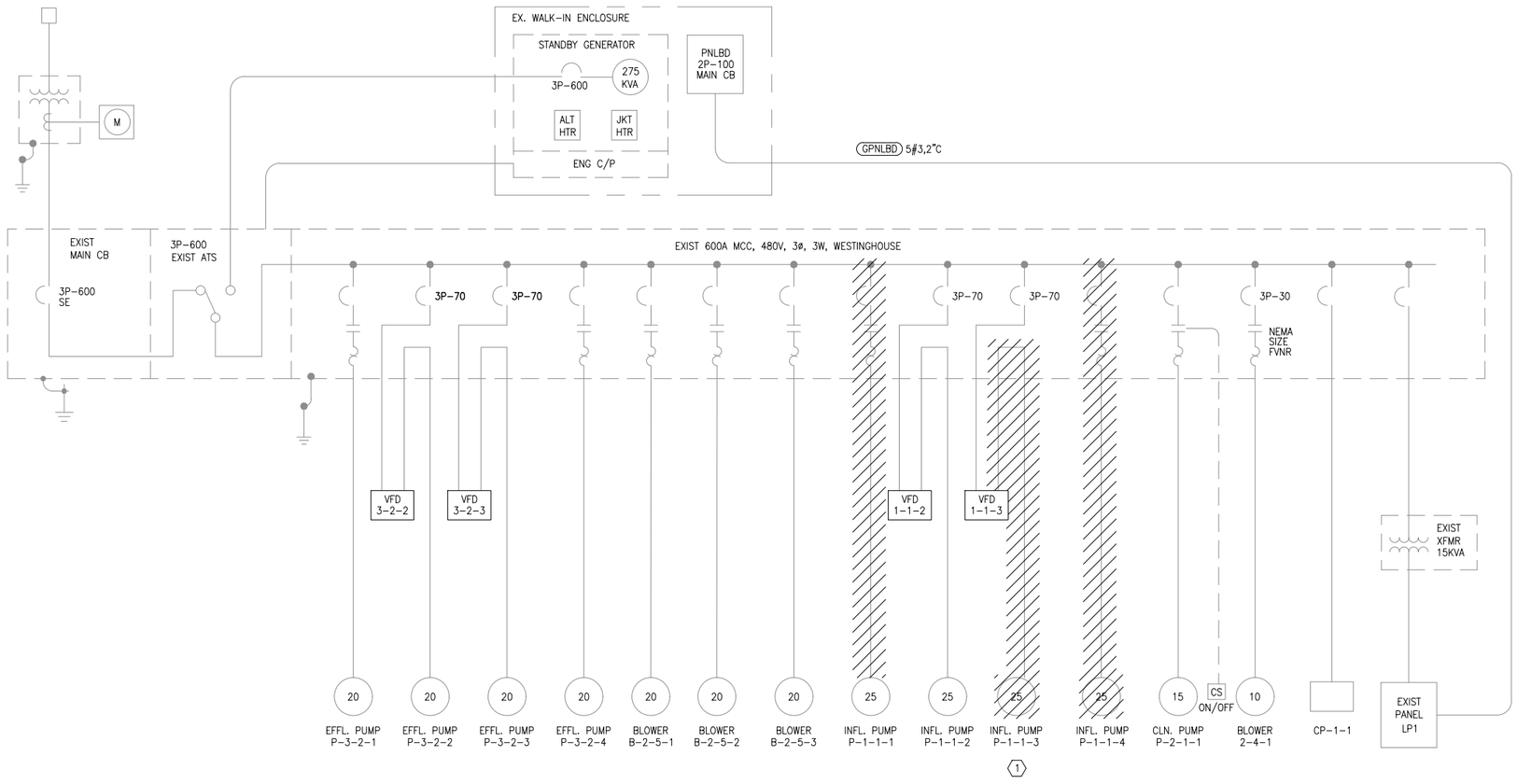
ELECTRICAL ROOM PLAN

SHEET NUMBER
E-3
15 OF 22

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SPECIFIC ELECTRICAL NOTES

(1) REUSE THE INFLUENT PUMP 3 DRIVE FOR INFLUENT PUMP 1. MOVE THE DRIVE OUTPUT FROM 3 TO 1.



DEMO ONELINE DIAGRAM

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DEMO ELECTRICAL ONELINE

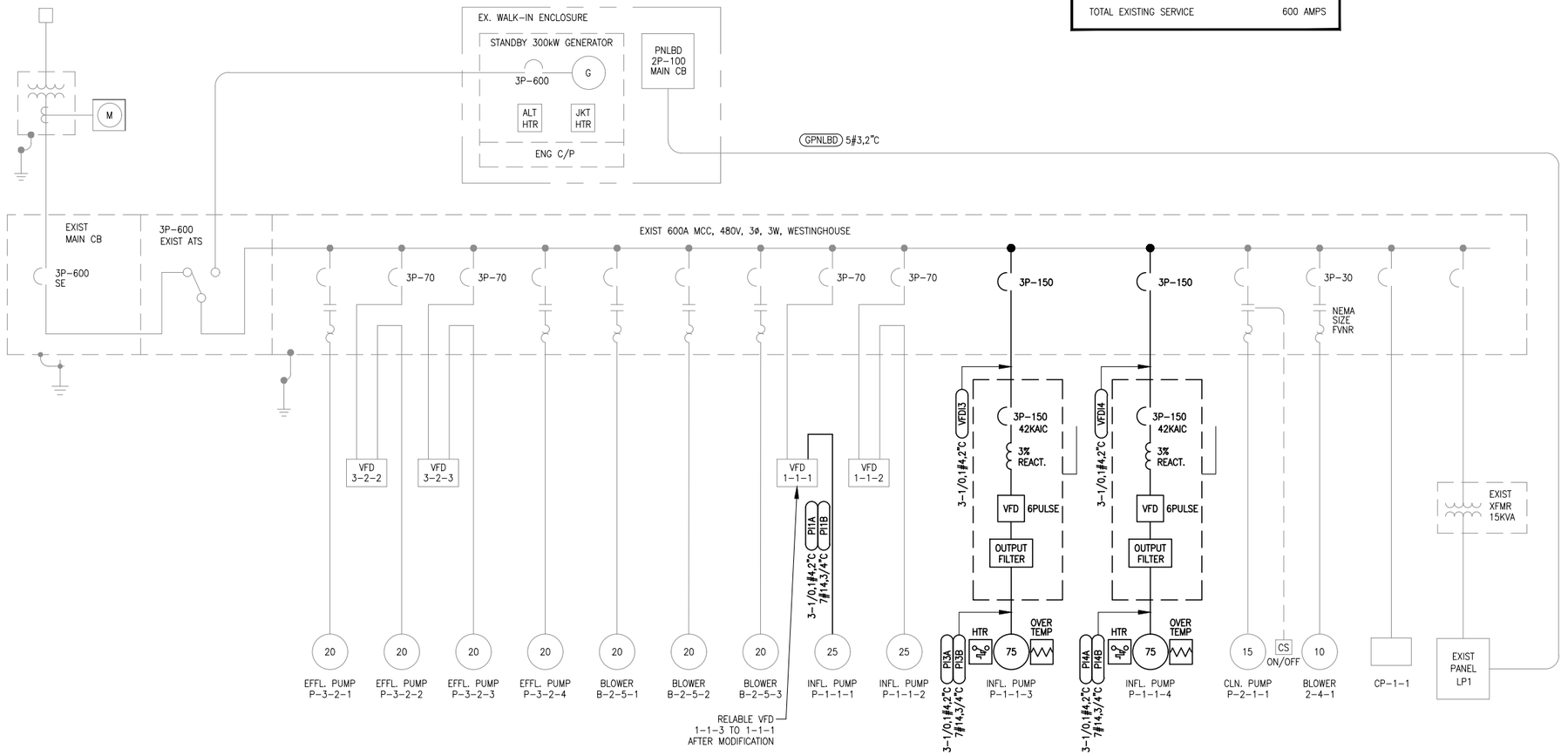
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LOAD CALCULATION

DESCRIPTION	AMPS
INFL. PUMP 1	27
INFL. PUMP 2	27
INFL. PUMP 3	96
INFL. PUMP 4, BACKUP	–
BLOWER 1	27
BLOWER 2	27
BLOWER 3	27
BLOWER 4, BACKUP	–
EFFL. PUMP 1	34
EFFL. PUMP 2	34
EFFL. PUMP 3	34
EFFL. PUMP 4, BACKUP	–
CLEANING PUMP	21
TX 1	18
NEW BLOWER	14
25% OF LARGEST MOTOR	25
TOTAL	411

TOTAL EXISTING SERVICE 600 AMPS



INSTALL ONELINE DIAGRAM

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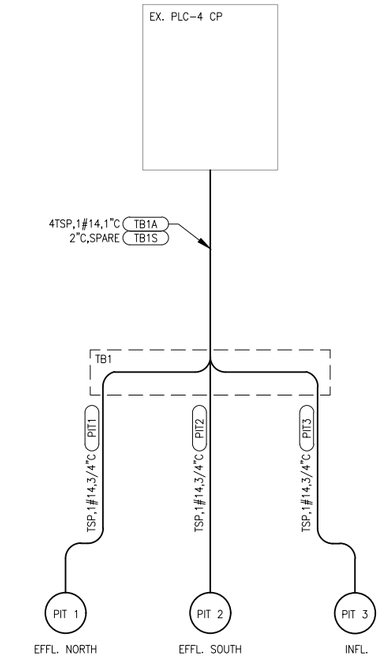
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DATE: ____

INSTALL ELECTRICAL ONELINE

SHEET NUMBER
E-5
17 OF 22

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INSTRUMENT RISER

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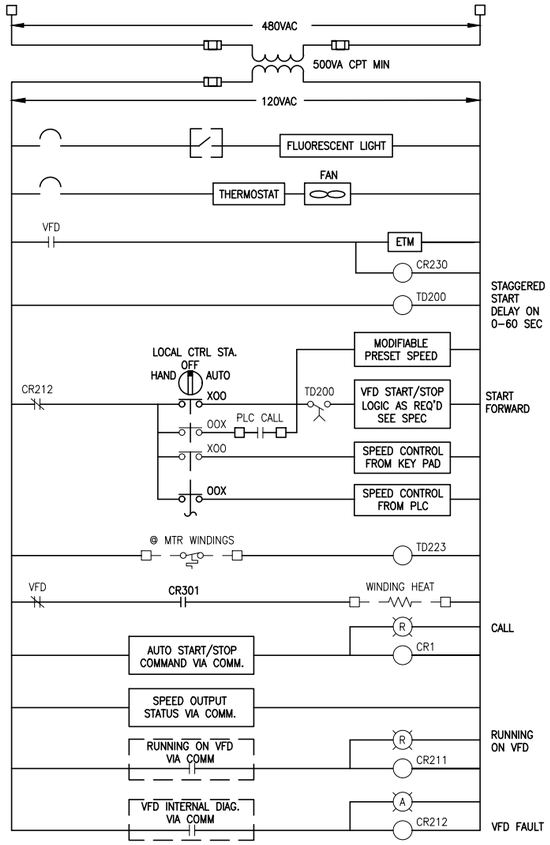
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FLORIDA LICENSE NUMBER
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DATE: ____

INSTRUMENT RISER DIAGRAM

SHEET NUMBER
E-6
18 OF 22

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PARAMETERS SENT/RECEIVED VIA NETWORK

- VFD RUN
- VFD FAULT
- VFD H-O-A, AUTO
- SPARE
- OVERTEMP
- MTR. WINDING OVERTEMP
- ENCL. INTRUSION

ANALOG INPUT PARAMETERS

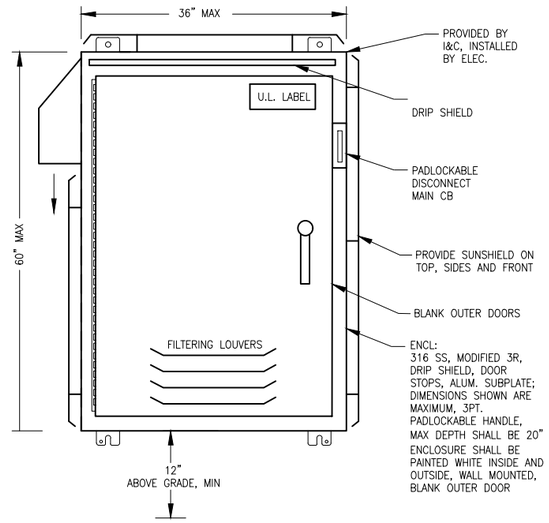
1. SPEED COMMAND

ANALOG OUTPUT PARAMETERS

1. SPEED INDICATION

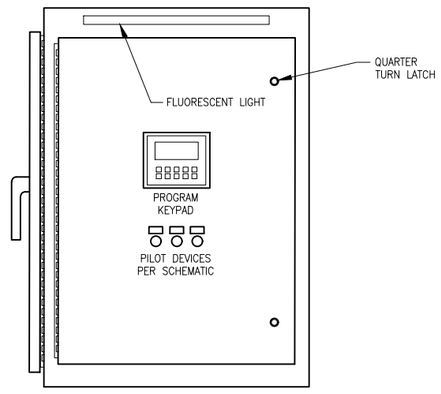
VFD SCHEMATIC

NTS



VFD OUTSIDE DETAIL

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VFD DEADFRONT DETAIL

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PFC TREATMENT SYSTEM

PREPARED FOR

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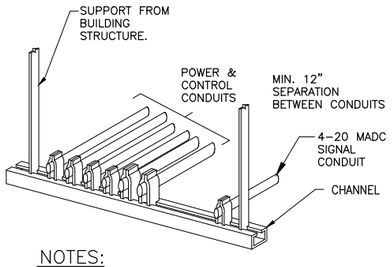
VFD DETAILS

SHEET NUMBER

E-7

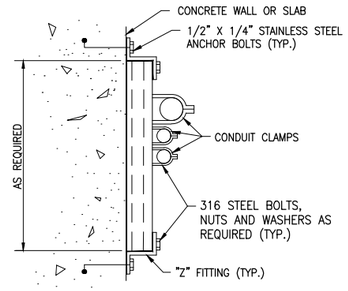
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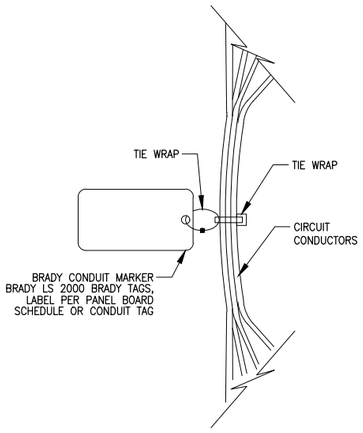


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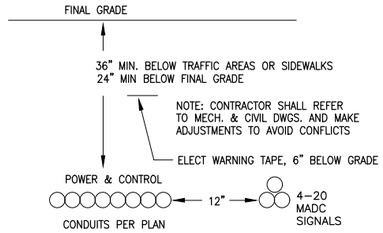
1. THIS DETAIL TYPICAL FOR BOTH VERTICAL AND HORIZONTAL MOUNTING
2. CHANNEL AND ALL SUPPORT DEVICES TO BE FIELD COATED TO MATCH.
3. CHANNELS TO BE SPACED 5' MAXIMUM.
4. ALL MATERIALS 316 SS



INSTALLATION DETAIL

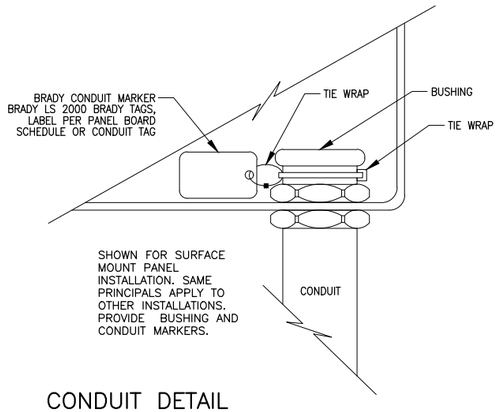


CIRCUIT MARKER

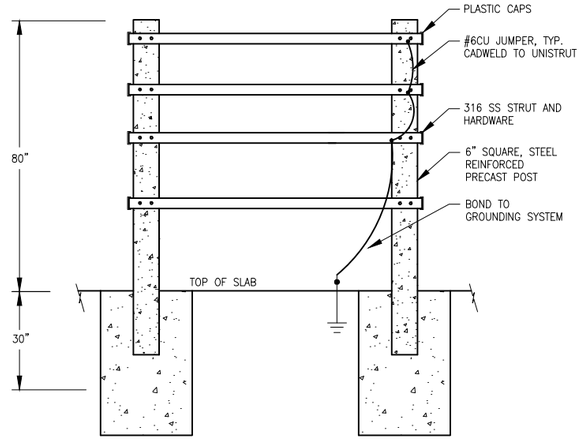


DIRECT BURIED CONDUIT

NTS, TYPICAL FOR DIRECT BURIED CONDUITS



CONDUIT DETAIL



CONCRETE RACK

B

NTS

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KHA PROJECT 144967009
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DRAWN BY AOD
CHECKED BY DGW

PFC TREATMENT SYSTEM

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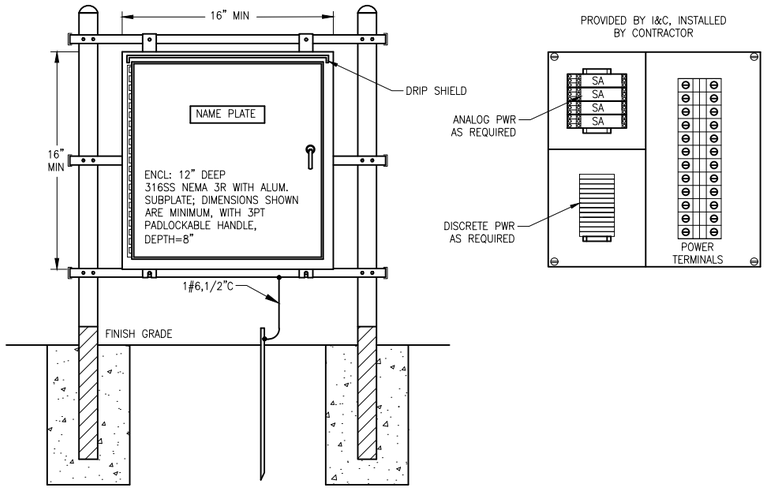
ELECTRICAL DETAILS

SHEET NUMBER
E-8
20 OF 22

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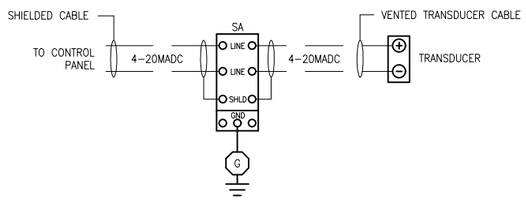
GENERAL ELECTRICAL NOTES

1. MODIFY AND REUSE THE EXISTING PLC4 CONTROL PANEL. USE THE EXISTING SPARE I/O FOR NEW ELEMENTS. MODIFY AND ADD NEW NETWORK EQUIPMENT. THE SYSTEM IS A HOT BACKUP SYSTEM. SEE THE NETWORK DIAGRAM.



FRONT VIEW

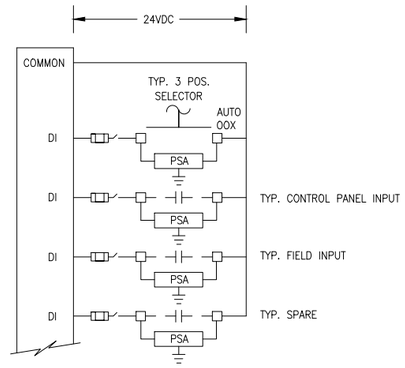
SUBPANEL LAYOUT



TERMINAL BOX DETAIL

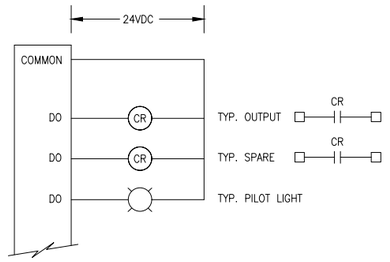
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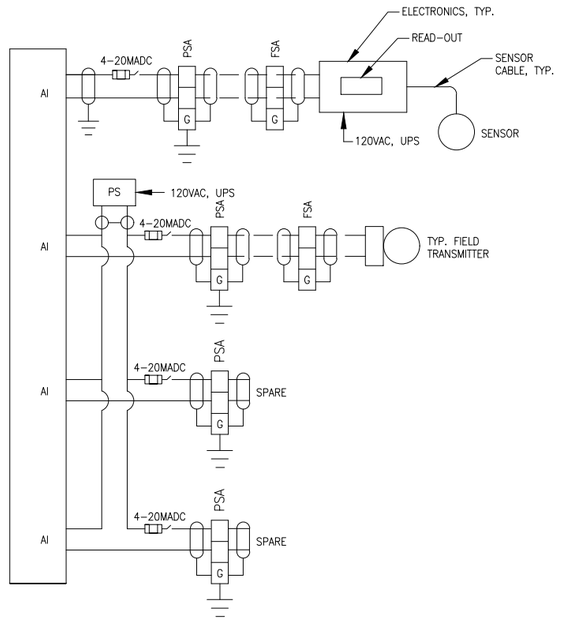
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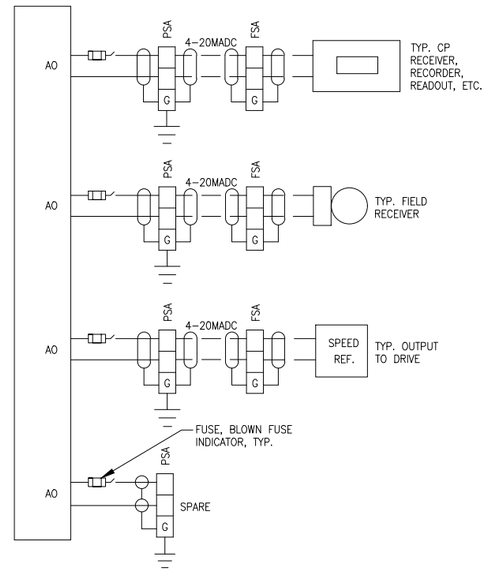
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KHA PROJECT	144967009
DATE	FEB 2018
SCALE	AS SHOWN
DESIGNED BY	DGW
DRAWN BY	AOD
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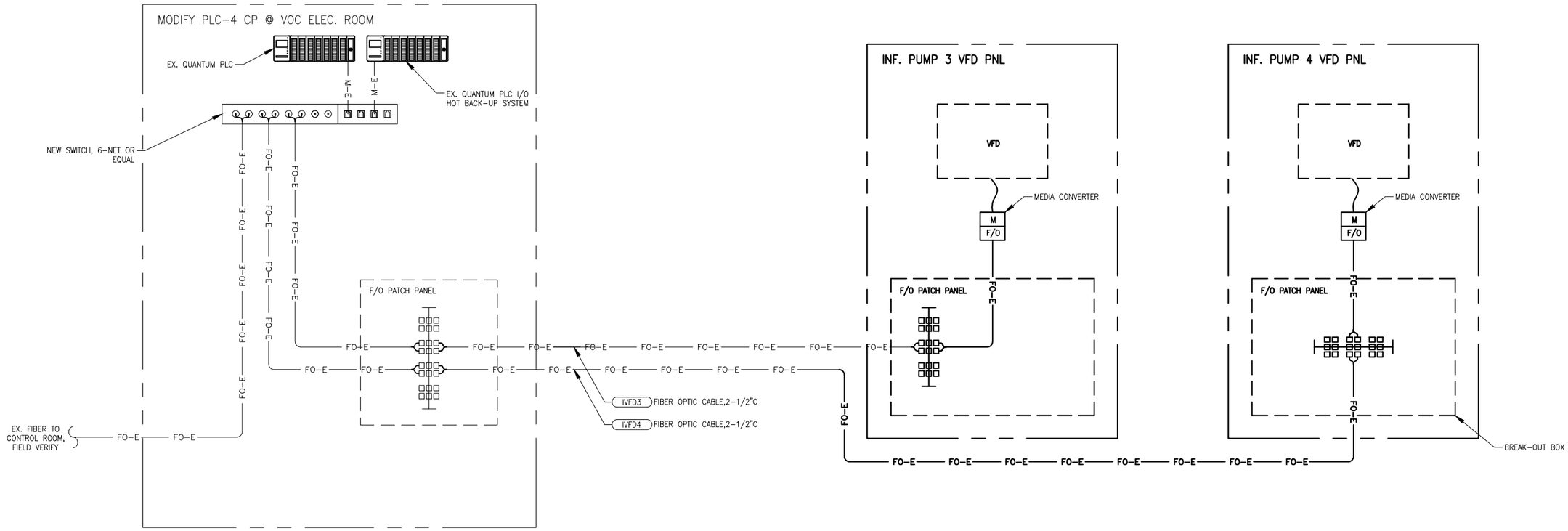
PFC TREATMENT SYSTEM
PREPARED FOR
CITY OF STUART
MARTIN COUNTY FLORIDA

LICENSED PROFESSIONAL
DALE G. WALKER
FLORIDA LICENSE NUMBER
36914
DATE: ____

STANDARD LOOP DIAGRAMS

SHEET NUMBER
E-9
21 OF 22

Plotted By:Andres Demarchi Sheet Set:PFC TREATMENT SYSTEM Layout:LOOPS February 05, 2018 05:34:25pm \\newserver-pc\new server c:\JOBS\66-KH\66402 city of stuart voc modifications\Drawings\02 Electrical Details.dwg
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SHEET NUMBER
E-10
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4. It is recommended that the three wells and RO trains be constructed in phases as follows:

- Phase 2: Well FA-1 and RO Train 1 in the year 2022
- Phase 3: Well FA-2 and RO Train 2 in the year 2027
- Phase 4: Well FA-3 and RO Train 3 in the year 2032

5. It is recommended that disposal of RO concentrate (brine) be achieved by the following:

- Convert existing Water Reclamation Facility injection well IW-2 into a tubing and packer well.
- Alternate disposal method during mechanical integrity testing would be to remove the RO Facility from service and meet the balance of water demand by increasing the output of the lime softening WTP. This operating strategy would likely only need to be implemented once every five years for a one-week duration.
- The City could also purchase finished water from Martin County to meet demand during the timeframe that the RO facility is shut down during mechanical integrity testing.

5.1.2.1 Floridan Aquifer Supply (FAS) Wells

A variety of factors were used to assess the viability of a site for the construction of a water production well. These factors included if the property is owned by the City, the zoning for the site, the method of water disposal during construction, the likelihood of public opposition to the construction, the jurisdiction responsible for permitting the site, and many others. The City indicated that the athletic field west of the City's WTP is owned by the City of Stuart. Construction of FAS wells on this site is feasible. A total of three Florida Aquifer Supply Wells each with a capacity of 1.5 mgd are proposed through Phase 4. Phase 2 will include the construction of one well, FA-1. **Figure 5-1** illustrates the proposed FAS well locations.

Table 5-1 presents certain location data for the proposed FAS wells.



Phase	Incremental Finished Water Capacity (mgd)	Year On-Line
2	1.0	2022
3	1.0	2027
4	1.0	2032

Figure 5-1: Proposed Floridan Aquifer System Well Location Map

Table 5-1: Proposed FAS Well Location Data

Parameter	FA-1	FA-2	FA-3
Latitude	27°11'18.21"N	27°11'23.84"N	27°11'12.66"N
Longitude	80°14'13.39"W	80°14'25.21"W	80°14'27.26"W
Pump Capacity	1.5 mgd	1.5 mgd	1.5 mgd
Separation Distance from Nearest FAS Well	≈ 1,180 feet	≈ 1,180 feet	≈ 1,150 feet
Year On-Line	2021	2026	2031

Maximizing well separation distance is recommended to minimize drawdown interactions between wells, potentially accelerating water quality degradation due to "up-coning" (i.e., the upward movement of water from lower depths).

Key wellfield components would be designed based on the following:

- *Piping*: Raw water transmission main will be High Density Polyethylene (HDPE).
- *Pump*: Submersible style pumps allow a lesser amount of dissolved oxygen from entering the pipe network than do surface mounted (i.e., turbine pumps with extended shaft and the motor mounted above grade) pumping equipment. Minimizing the entrance of dissolved oxygen into the pipe network is an important design goal. Therefore, submersible style pumps are recommended.
- *Wellhead*: Wellhead piping would be 316L stainless steel. Each well would be equipped with surge relief, a flushing connection for periodic sand removal and chemical injection connections for well disinfection.
- *Telemetry*: City staff requested that telemetry between the proposed wells and the WTP be fiber optic cable. This approach is feasible.
- *Controls*: The well pump will be controlled locally through the pump Local Control Panel (LCP). Each well would be equipped with a programmable logic control and be controllable remotely at the WTP.

Figure 5-2 illustrates a conceptual cross section of the wellhead.

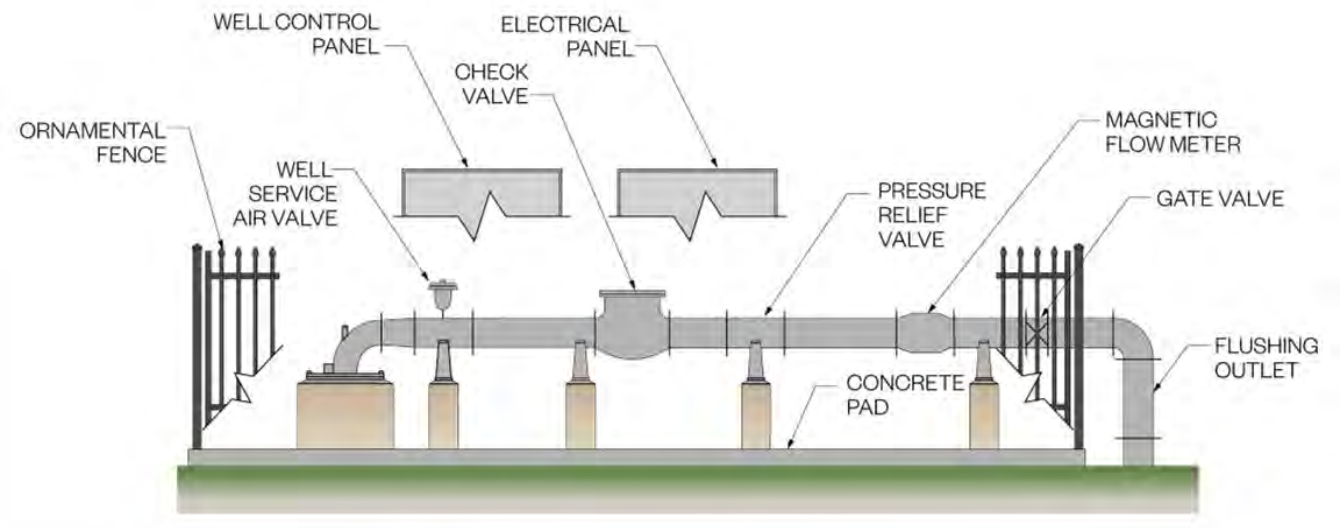


Figure 5-2: Conceptual Floridan Aquifer Wellhead Cross Section

5.1.2.2 Reverse Osmosis (RO) Treatment –Phase 2 of the design will include one RO train with a capacity of 1.0-mgd in a two-stage membrane configuration. Phase 3 and Phase 4 will each add an additional 1.0-mgd RO treatment train.

Figure 5-3 shows the conceptual process flow diagram and **Figure 5-4** shows a conceptual site plan illustrating the location of the major RO system components on the existing WTP site. There appears to be sufficient space at the existing WTP to accommodate the proposed RO facilities. It is noted that construction at the site will be highly difficult due to the limited land availability. Furthermore, the construction will be disruptive to ongoing operation of the existing WTP. These challenges can be overcome with carefully prepared design documents.

Blended (i.e., RO permeate and lime softened water) finished water quality will meet all federal and state primary and secondary drinking water quality standards, health advisory levels, and the City of Stuart aesthetic levels for hardness. Key finished water quality goals are summarized in the table below.

Parameter	Units	Value
Hardness	mg/L as $CaCO_3$	60 – 80
Alkalinity	mg/L as $CaCO_3$	>50
pH	--	7.0 – 8.5
Color	CU	<6
Chlorides	mg/L	< 100
Sodium	mg/L	< 60

Note. Water quality values are based on a blend of approximately 25% RO degasified permeate and 75% lime softened water.

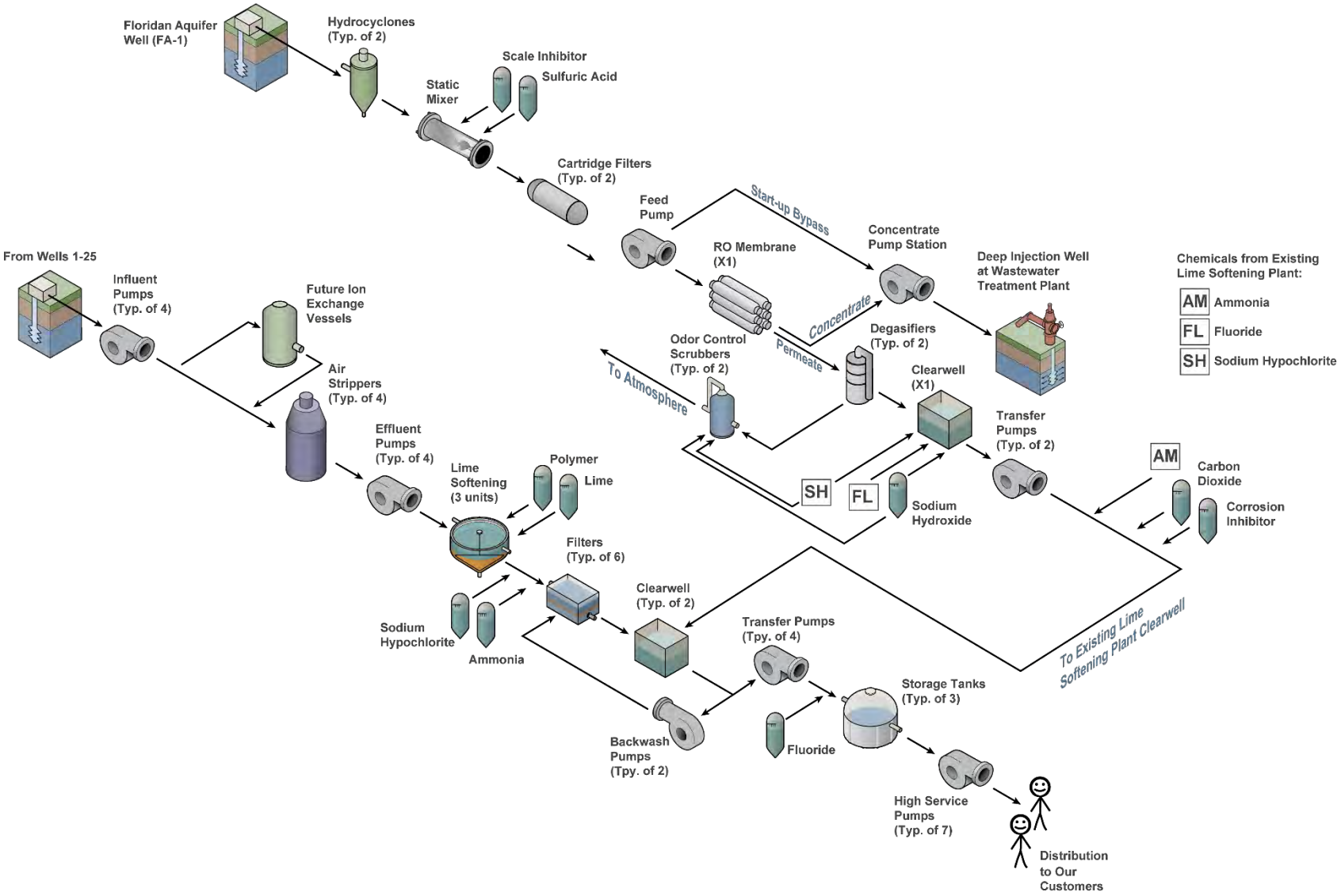


Figure 5-3: RO System Process Flow Diagram

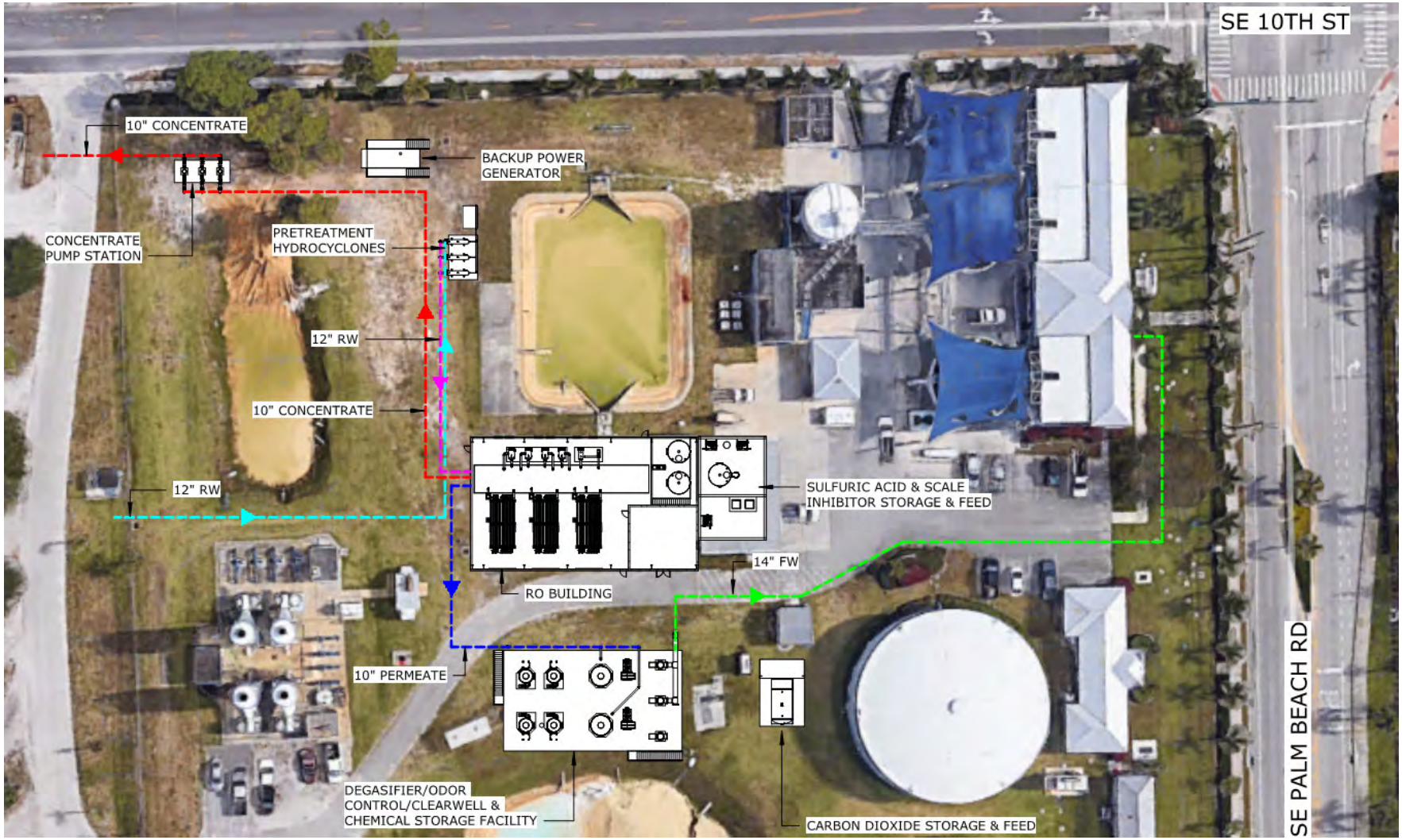


Figure 5-4: RO Conceptual Site Plan

The final composition of the blended finished water would be defined during detailed design.

Pretreatment System

Prior to RO treatment, raw water needs to be pre-treated to remove particles to protect the membranes and minimize scaling and fouling potential. Pretreatment will consist of the following:

- Hydrocyclone Sand Separators
- Chemical Pretreatment
- Cartridge Filters

These pretreatment components are described below.

Hydrocyclone Sand Separators

The use of sand cyclone separators is proposed as the first barrier for protecting the RO membranes by removing sand and silt that is occasionally produced. RO membranes are excellent for the removal of dissolved solids; however, they can be easily plugged by sand or silt. Therefore, sand separators will be installed to minimize potential fouling of the RO membrane surfaces due to particulates (i.e. sand) in the feed water. The conceptual design criteria are summarized in **Table 5-2**.

Table 5-2: Sand Cyclone Separators Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Number of Units	--	One (1) Duty One (1) Standby
Flow per Unit	gpm mgd	2,014 2.90

Chemical Pretreatment

Chemical pretreatment is required to control the formation of scale on the membrane surfaces, which will aid in maintaining the operational effectiveness and life of the membranes. The chemicals required for conditioning of the raw water upstream of the cartridge filters are sulfuric acid and scale inhibitor. Sulfuric acid is used to lower the feed water pH which reduces the membrane scaling potential. In addition, the addition of sulfuric acid inhibits oxidation of soluble iron.

Scale inhibitor is provided to condition the feed raw water and assist with the prevention of precipitation of sparingly soluble salts and silica. As the feed water becomes more concentrated, the saturation limit of soluble salts may be surpassed, and precipitation may occur on the RO membranes (scaling). Scale formation results in increased operating

costs (i.e., higher pumping pressure and increased chemical cleaning) and potentially increased salt passage. Scale inhibitors act to complex dissolved ions and increase the saturation limit of the salts. Selection of the correct scale inhibitor for a giving application is important.

The sulfuric acid system will include a bulk storage tank within a containment area while the scale inhibitor system will use totes rather than a bulk storage tank. Both systems will be equipped with day tanks, transfer pumps, metering pumps, and controls. The following general design criteria is used for sizing of chemical system components.

1. Bulk storage tanks will be sized to store a chemical volume that is contain 1.5 times a truck load or at least 30 days of average chemical usage, whichever is greater.
2. Day tanks shall provide 24-30 hours of chemical supply based upon the maximum design feed rate.
3. The firm pumping capacity of metering pumps (largest pump out of service) shall have sufficient capacity to provide the maximum design chemical dosage at the maximum flow.
4. Containment areas around the tanks will be provided. The containment areas will be sizes to contain the volume of one full bulk storage tank.

Sulfuric acid and scale inhibitor conceptual design criteria is summarized in **Table 5-3** and **5-4**.

Table 5-3: Sulfuric Acid Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Concentration	%	98
Specific Gravity		1.84
Solution Weight	lb/gal	15.05
Feed Location	--	Upstream of Cartridge Filters
Chemical Dose	mg/L	60 – 70 (1)
Bulk Storage Tank Number Storage Capacity Min. Storage Time	 -- gal day	 1 5,250 30
Day Tank Number Storage Time	 -- hr	 1 24 - 30

Description	Unit	Criteria (Phase 2)
Metering Pumps Number Type Feed Rate	 -- -- gph	 1 Mechanic/Hydraulic Diaphragm 2.0 – 2.5
Materials Tanks Piping	 --	 Carbon Steel Alloy 20

Notes.

(1) Chemical dose was calculated based on a target pH of 6.0 and preliminary membrane performance projections. Chemical dose will need to be confirmed and adjusted based on specific raw water quality characteristics.

Table 5-4: Scale Inhibitor Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Concentration	%	100
Specific Gravity	--	1.00
Solution Weight	lb/gal	8.33
Feed Location	--	Upstream of Cartridge Filters
Chemical Dose	mg/L	2- 5 (1)
Storage Totes Number Storage Capacity Min. Storage Time	 -- gal day	 2 275 30
Day Tank Number Storage Time	 -- hr	 1 24 - 30
Metering Pumps Number Type Feed Rate	 -- -- gph	 1 Solenoid 0.1 – 0.3
Materials Tanks Piping	 --	 Per manufacturer Polyvinyl Chloride (PVC)

Notes.

(1) Selection of scale inhibitor and dose will vary based on specific raw water quality characteristics and goals.

Cartridge Filters

In addition to chemical conditioning, the conditioned feed water will be filtered by 5-micron nominal pore size cartridge filters immediately before the first stage membrane feed pumps. Cartridge filters will provide additional protection by removing fine silt particles. Cartridge filters provides low cost protection for the more expensive downstream membrane system. Phase 1 will include two cartridge filters, one duty and one standby. Each cartridge filter will be sized for the treatment capacity of the RO skid. Conceptual design criteria are summarized in **Table 5-5**.

Table 5-5: Cartridge Filters Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Number of Units	--	One (1) Duty One (1) Standby
Vessel Orientation	--	Horizontal
Cartridge Rating	micron	5
Cartridge Loading Rate per 10 inch Average Loading Rate Maximum Loading Rate	 gpm/LF gpm/LF	 4 6
Flow per Vessel (@ RO 70% recovery)	gpm mgd	992 1.43
Cartridge Housing Material	--	316 stainless steel

Membrane System Bypass Valve

It is common industry practice when starting a RO plant to bypass the initial flow of raw water to waste prior to starting a RO train. There are several reasons for doing this. The initial flow of raw water is usually more turbid than normal because of oxidation of constituents such as hydrogen sulfide or biological activity that may have occurred while the system was idle. Chemical pretreatment systems, especially pH adjustment, need time to stabilize chemical dosages and pH. Time may also be needed to start the required number of well pumps and accommodate well startup protocols such as initial blowoffs. Startup bypass flow is continued until parameters such as turbidity, pH, oxidation reduction potential (ORP), flow and pressure are in acceptable ranges. Target bypass flow is usually approximately the same as the feed flow to one RO train so that transition to production is relatively “bumpless”.

A startup bypass valve is generally opened sufficiently to obtain the target flow, which is diverted to the concentrate disposal system. The “by-pass flow” is often greater than the maximum concentrate flow during operation. Consequently, the concentrate pipeline and other components must be sized to accommodate this short-term “by-pass flow”.

Alternatively, bypass flow can be directed to a detention basin. At the end of the bypass cycle, water is admitted to the initial RO train as the bypass valve slowly closes and the RO feed pump speed ramps up. It is generally not necessary to bypass water when subsequent RO trains are started. In the event of abnormal operating conditions such as power failure or raw water high pressure, the bypass valve would go to a fully open position. For this reason, it is preferable that the bypass valve actuator can open the valve without electrical power.

First Stage Feed Pumping

One dedicated RO feed pump will be provided per train. The purpose of the first stage feed pumps is to increase the pressure of the feed water to overcome the osmotic pressure, fouling, and total head losses in the system. The conceptual design criteria are summarized in **Table 5-6**.

Table 5-6: First Stage Feed Pump Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)	
		UPZ	APPZ
Number of Units	--	One dedicated per train	
Feed Flow [1]	gpm mgd	992 1.43	992 1.43
Feed Pressure	ft	430 - 480	480 - 850
Motor	HP	200	300
Pump Control	--	VFD	VFD
Materials of Construction (wetted parts)	--	316 Stainless Steel	

It is recommended that the detailed design proceed assuming that the AWS will be from the UPZ.

Second Stage (Interstage) Boost Pumps

Second stage or interstage boost pumps will be driven by energy recovery devices. Energy recovery devices recover pressure from the membrane concentrate and this energy is transferred to boost the driving pressure to the second stage. In addition to providing power savings, second stage booster helps balance the flux between the first and second stage while providing the necessary energy for proper second stage operation. A summary of the conceptual design criteria is summarized in **Table 5-7**.

Table 5-7: Second Stage Feed Pump Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)	
		UPZ	APPZ
Number of Units	--	One dedicated per train	
Feed Flow [1]	gpm mgd	495 0.71	495 0.71
Boost Pressure	ft	185	185

It is recommended that the detailed design proceed assuming that the AWS will be from the UPZ.

Reverse Osmosis Membrane Trains

Phase 1 construction of the RO facility will have a permeate production capacity of 1.0 mgd with provisions to accommodate future expansion to 3.0 mgd permeate. Therefore, the initial phase of the design will include one RO train with a capacity of 1.0 mgd in a two-stage membrane configuration. **Table 5-8** summarizes the design criteria. Membrane trains will be provided as skid mounted units by a membrane manufacturer.

Table 5-8: RO Membrane Train Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)	
		UPZ	APPZ
Number of Units	--	One train	
Feed Flow	mgd	1.43	1.43
Permeate Flow	mgd	1.00	1.00
Concentrate Flow	mgd	0.43	0.43
Number of Stages per Train	--	2	2
Average Flux [1]	gfd	11.6	11.6
Number of Elements per Train	--	196	196
Permeate Recovery	%	70	70
Feed Pressure	psi	185 - 205	210 - 370
Booster Pressure	psi	80	80
Permeate TDS	mg/L	65 – 90	50 – 380
Permeate Chlorides	mg/L	35 – 50	30 – 230

Table 5-8: RO Membrane Train Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)	
		UPZ	APPZ

Notes.
(1) Flux and pressures vary based on raw water quality as well as total membrane available area (number of elements).

It is recommended that the RO membrane train detailed design proceed assuming that the AWS will be from the UPZ.

Membrane Clean-in-Place

RO membranes are susceptible to scaling and fouling during operation, which impacts membrane performance by increasing pressure loss, reduction in permeate flow, and impacts on permeate water quality. Chemical cleanings are necessary to remove foulants and scale. The major components of the clean-in-place system include:

- Chemical tanks with immersion heaters and mixers
- Cartridge filter
- Transfer pump
- Cleaning pump

Degasification and Odor Control

Degasification is provided to condition the permeate water by removing hydrogen sulfide, carbon dioxide, and other dissolved gasses. Since the raw water entering the plant has hydrogen sulfide concentrations that could cause odor-control issues and since the WTP is located near residential neighborhoods, the proposed system will be equipped with air quality control scrubbers. The proposed degasifier and scrubber systems will be located downstream of the membrane treatment process. **Table 5-9** presents the conceptual design criteria.

Table 5-9: Degasifiers and Odor Control Scrubbers Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Degasifiers		
Number of Units	--	One (1) Duty One (1) Standby
Hydrogen Sulfide Concentration	mg/L	2.0 – 2.5
Permeate Flow per Degasifier	mgd	2.0

Table 5-9: Degasifiers and Odor Control Scrubbers Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Gas Removal Efficiency	%	95 – 98%
Tower Diameter	ft	9.0
Tower Overall Height	ft	26
Number of Blowers	--	One (1) Duty One (1) Standby
Odor Control Scrubbers		
Number of Units	--	One (1) Duty One (1) Standby
Number of Stages	--	2
Min. Removal Efficiency	%	99

Chemical Post-treatment

Chemical such as sodium hydroxide, carbon dioxide, and/or hydrated lime will be used to increase the pH level of the permeate water, adding alkalinity, and achieve a more stable and less corrosive finished water. These chemicals will be added to the RO permeate after the degasification process to increase the pH and alkalinity. Conceptual design criteria are summarized in **Table 5-10**.

Table 5-10: Post-Treatment Chemicals Conceptual Design Criteria

Description	Unit	Criteria (Phase 2)
Sodium Hydroxide		
Concentration	%	50
Specific Gravity	--	1.53
Solution Weight	lb/gal	12.76
Feed Location	--	Downstream of Degasification
Chemical Dose	mg/L	30 – 50 (1)
Bulk Storage Tank Number Storage Capacity Min. Storage Time	 -- gal day	 1 6,000 30
Day Tank Number Storage Time	 -- hr	 1 24 - 30
Metering Pumps Number Type Feed Rate	 -- -- gph	 1 Mechanic/Hydraulic Diaphragm 1.2 – 2.5
Materials Tanks Piping	 --	 Carbon Steel CPVC
Carbon Dioxide		
Concentration	%	100
Specific Gravity (2)	--	1.52
Feed Location	--	Downstream of Degasification
Chemical Dose	mg/L	25 – 30 (1)
Bulk Storage Tank Number Storage Capacity Min. Storage Time	 -- gal day	 1 2,000 30
Corrosion Inhibitor		
Concentration	%	32 - 36
Specific Gravity	--	1.03
Solution Weight	lb/gal	11.10
Feed Location	--	Downstream of Degasification
Chemical Dose	mg/L	1 - 5 (1)
Storage Totes Number Storage Capacity Min. Storage Time	 -- gal day	 2 275 30

Day Tank		
Number	--	1
Storage Time	hr	24 - 30
Metering Pumps		
Number	--	1
Type	--	Mechanic/Hydraulic Diaphragm
Feed Rate	gph	0.03 – 0.16
Materials		
Tanks	--	Per manufacturer
Piping		PVC

Notes:

(1) Chemical dose will vary based on specific raw water quality characteristics, permeate water quality and finished water quality goals.

(2) Gas specific gravity relative to air.

In addition, corrosion inhibitor will be added to reduce the corrosion potential in the distribution system. This chemical will also be added after degasification and prior to blending with lime softened water. **Table 5-10** provides a summary of corrosion inhibitor feed and storage system.

Degasifier Clearwell and Transfer Pumps

A clearwell will collect the degasified permeate. It is assumed that the RO permeate will be conveyed to the existing filter clearwell and blended with the lime softened water. Other blending options exist and will be evaluated during detailed design. If blending in the existing filter clearwell is selected during detailed design, the transfer pumps may not be needed. Hydraulic analysis during detailed design would determine if the proposed transfer pumps are needed.

Backup Power Supply

It is recommended that backup emergency power be supplied to the proposed RO membrane facility via a new stand-alone diesel engine generator with enclosure and belly tank located on a slab on-grade. The generator would be within a weatherproof sound attenuating enclosure with a belly tank below the enclosure. Personnel access stairs / platforms would be designed on both sides of the enclosure sub-base tank. Conceptual design criteria for the proposed diesel engine generator is summarized in **Table 5-11**.

Table 5-11: Emergency Diesel Engine Generator Design Criteria

Description	Criteria (Phase 2)
EPA Emission Standard	Tier 4
Estimated Maximum Running Load	500 kW / 570 kVA
Generator Size	750 kW
RPM / Voltage	1,800 rpm / 480 volts
Cooling Type	Air Cooled Radiator
Fuel Type	Diesel
Enclosure Type	Sound Attenuated

RO Treatment Facility Conceptual Layouts

The Phase 2 conceptual layout is for the construction of a 1.0 mgd RO treatment facility and the details are described on the following pages. The future Phase 3 and 4 which will each add an additional 1.0 mgd treatment train and will require the following:

Phase 3 RO Addition (1.0 mgd RO train)

1. Pre-treatment: One (1) additional cartridge filter
2. One (1) additional RO train feed pump and interstage booster pump

Phase 3 RO Addition (1.0 mgd RO train)

1. Pre-treatment:
    i. One (1) additional sand cyclone separator
    ii. One (1) additional cartridge filters
    iii. One (1) additional chemical metering pump for sulfuric acid
    iv. One (1) additional chemical metering pump for scale inhibitor
2. One (1) additional RO train feed pump and interstage booster pump
3. Post-treatment:
    i. One (1) additional degasifier and odor control scrubber
    ii. One (1) additional chemical metering pump for sodium hydroxide
    iii. One (1) additional chemical metering pump for corrosion inhibitor
    iv. One (1) additional transfer pump at degasifier clearwell
4. One (1) additional concentrate pump

Pretreatment – Sand Cyclone Separators

Conceptual layout of the sand cyclone separator pretreatment system is shown **Figure 5-5**. This layout includes the installation of two units to provide full redundancy. Space and provisions for the installation of a third unit will be provided.

RO Membrane Building

Figures 5-6A, B, and C shows the conceptual layout of the RO membrane building. The building will be a pre-engineered metal building housing the RO trains, cartridge filters, feed pumps, clean-in-place system, and electrical room. The building footprint is sized to allow phased expansion to three membrane trains (build-out condition), additional cartridge filters, and feed pumps.

Post-Treatment Facilities

The degasifier structure will be sized to accommodate the installation of two degasifiers and associated odor control scrubbers to provide full system redundancy. In addition, two vertical turbine transfer pumps will be installed on this structure with provisions for the addition of a future pump to meet build out conditions. The structure will be an elevated structure to allow the clearwell to be directly under the degasifier units. Additional space under this elevated structure will be used to house post-treatment chemicals. **Figures 5-7-A, B, C and D** show the conceptual layout of the post-treatment structure.

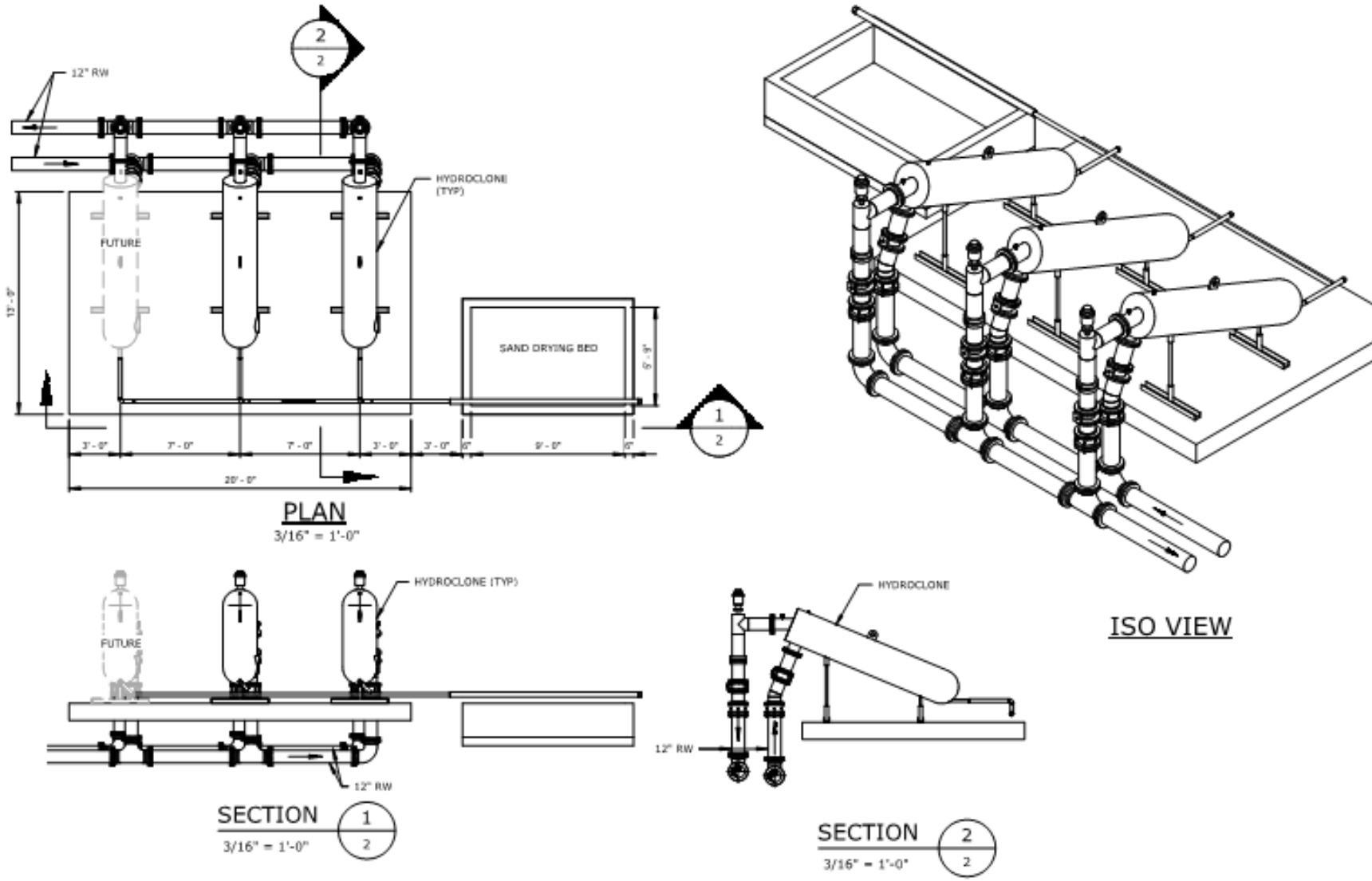
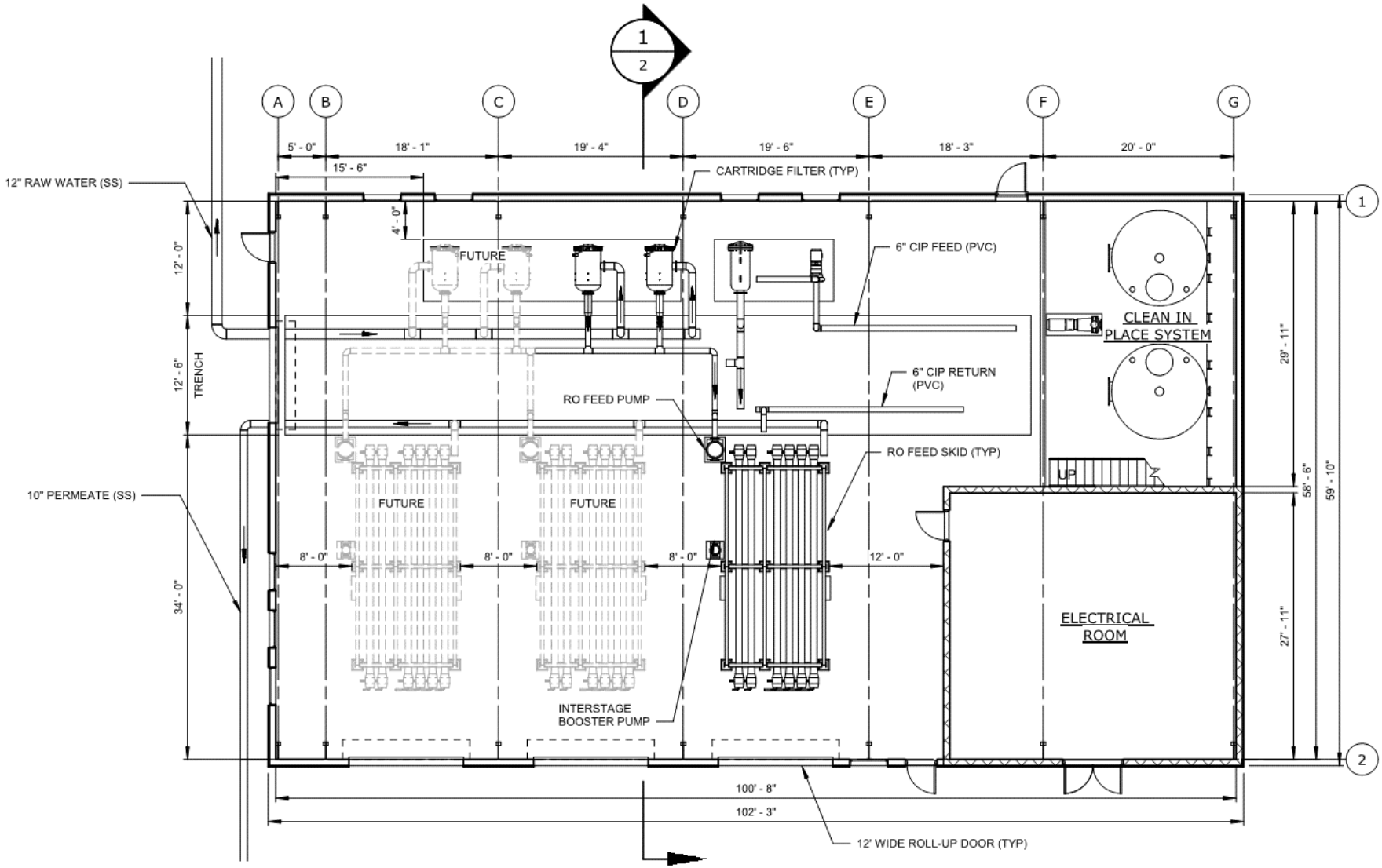


Figure 5-5: Sand Cyclone Separators Conceptual Illustration

Figure 5-6A: Membrane Building Conceptual Plan



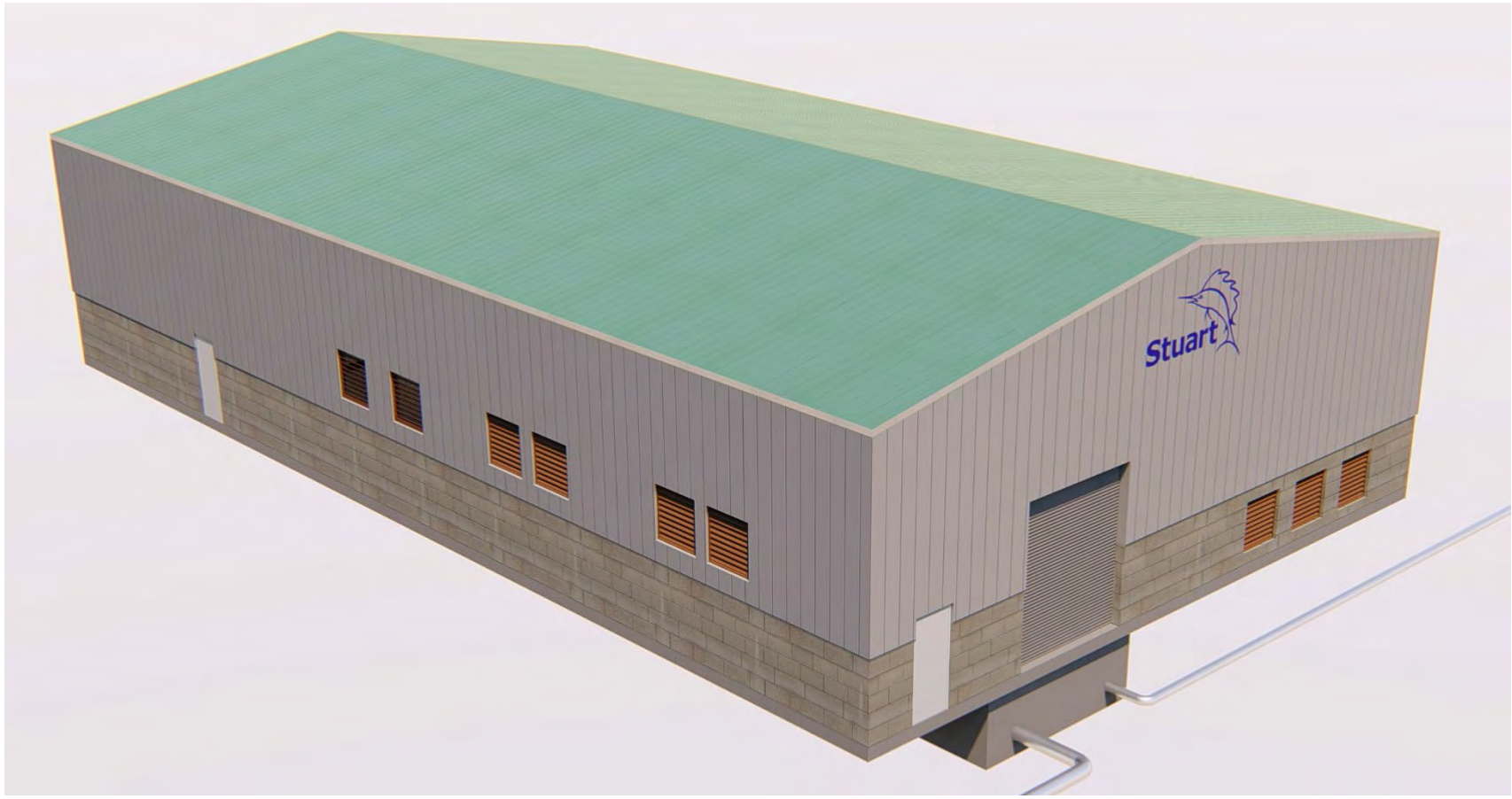


Figure 5-6B: Membrane Building Conceptual Exterior View

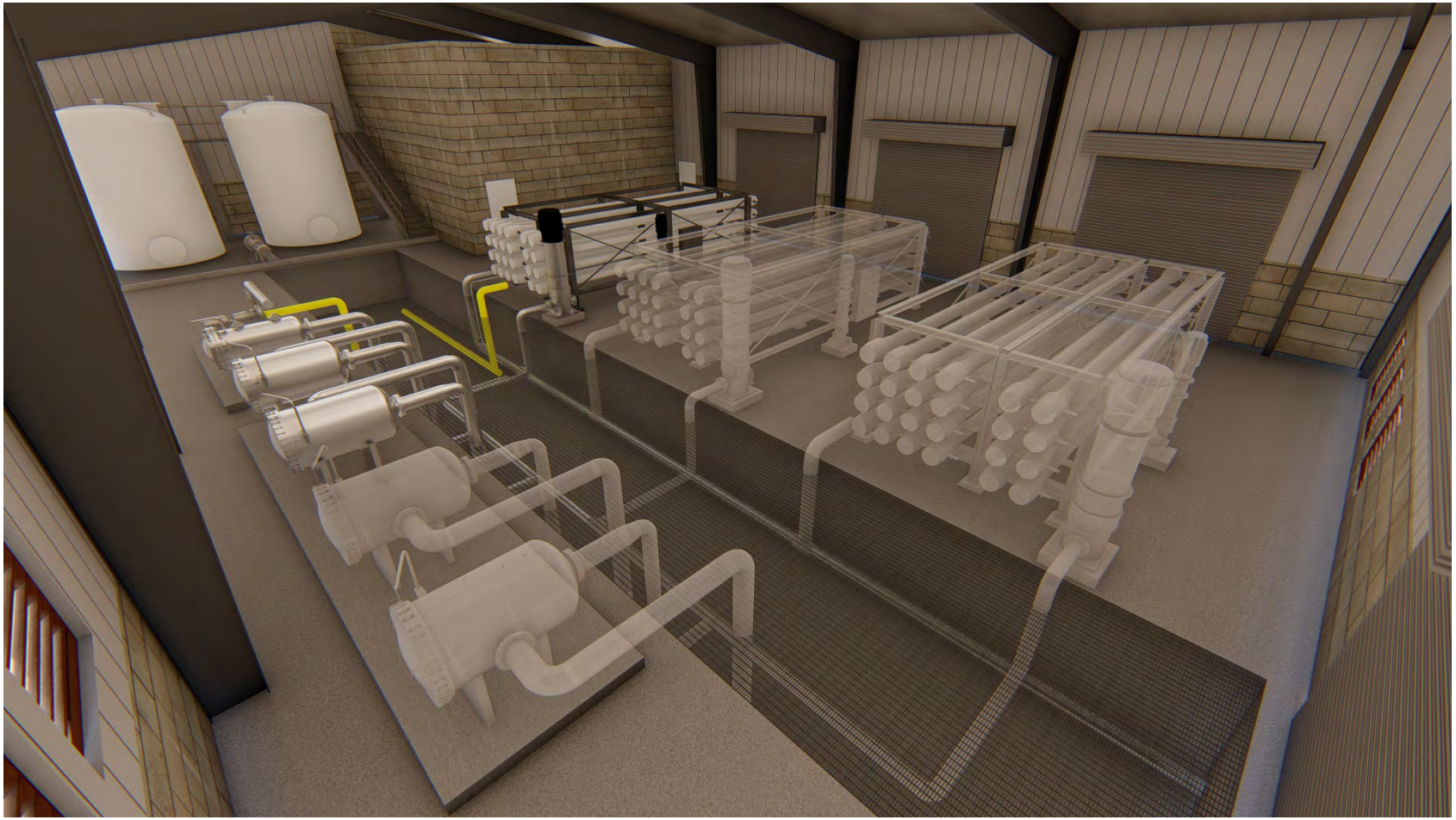


Figure 5-6C: Membrane Building Conceptual Interior View

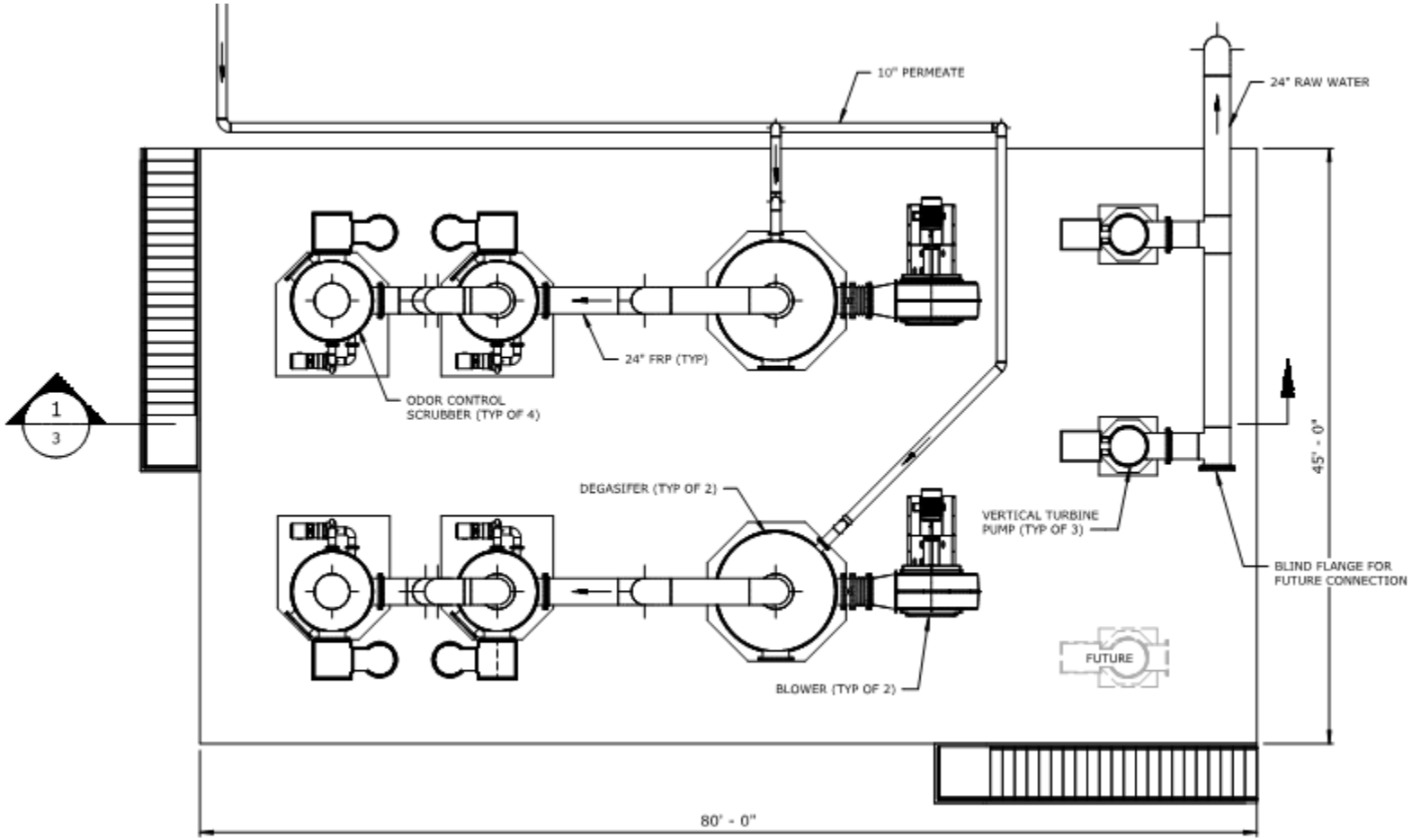


Figure 5-7A: Post-treatment Facilities Conceptual Layout – Upper Plan

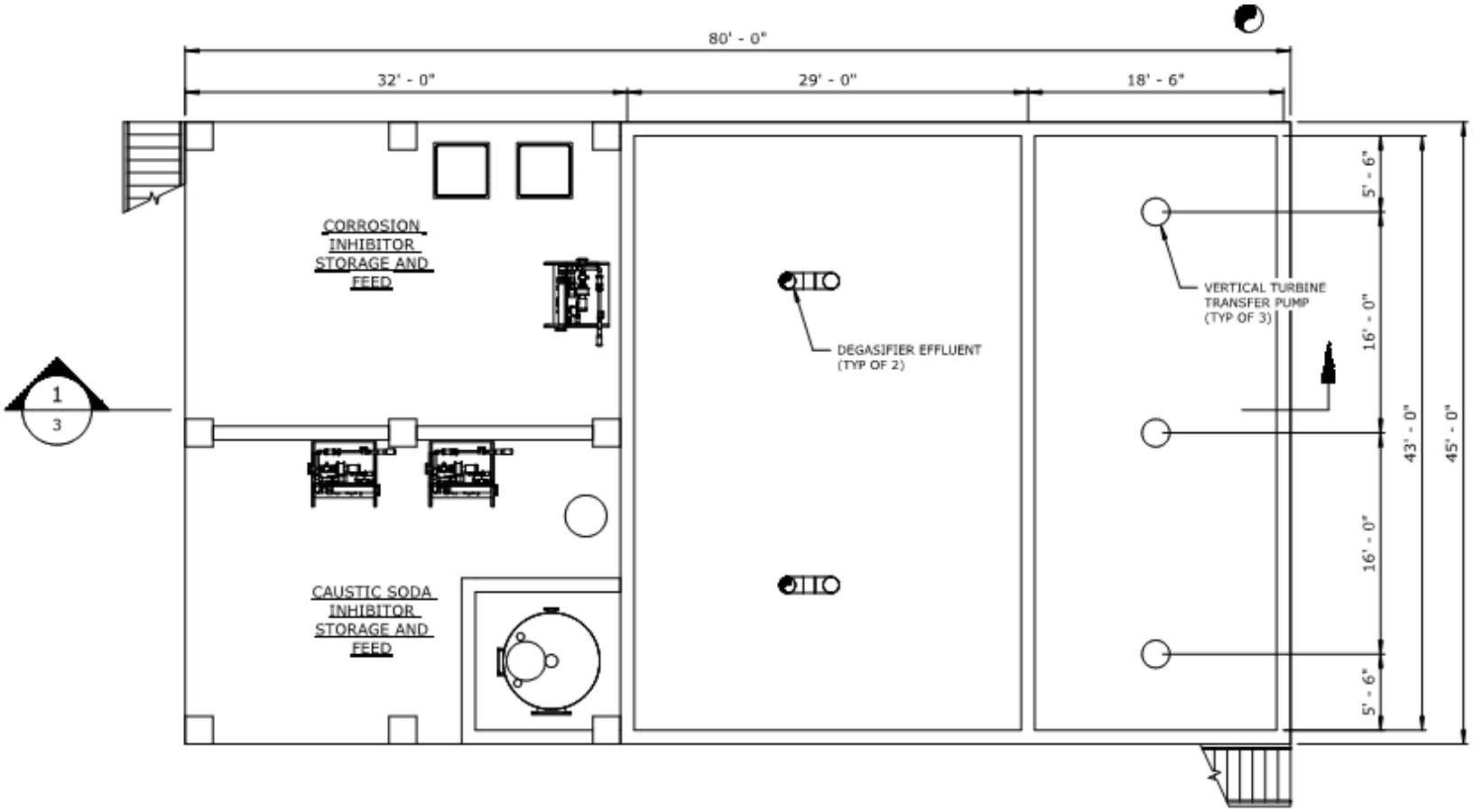


Figure 5-7B: Post-treatment Facilities Conceptual Layout – Lower Plan

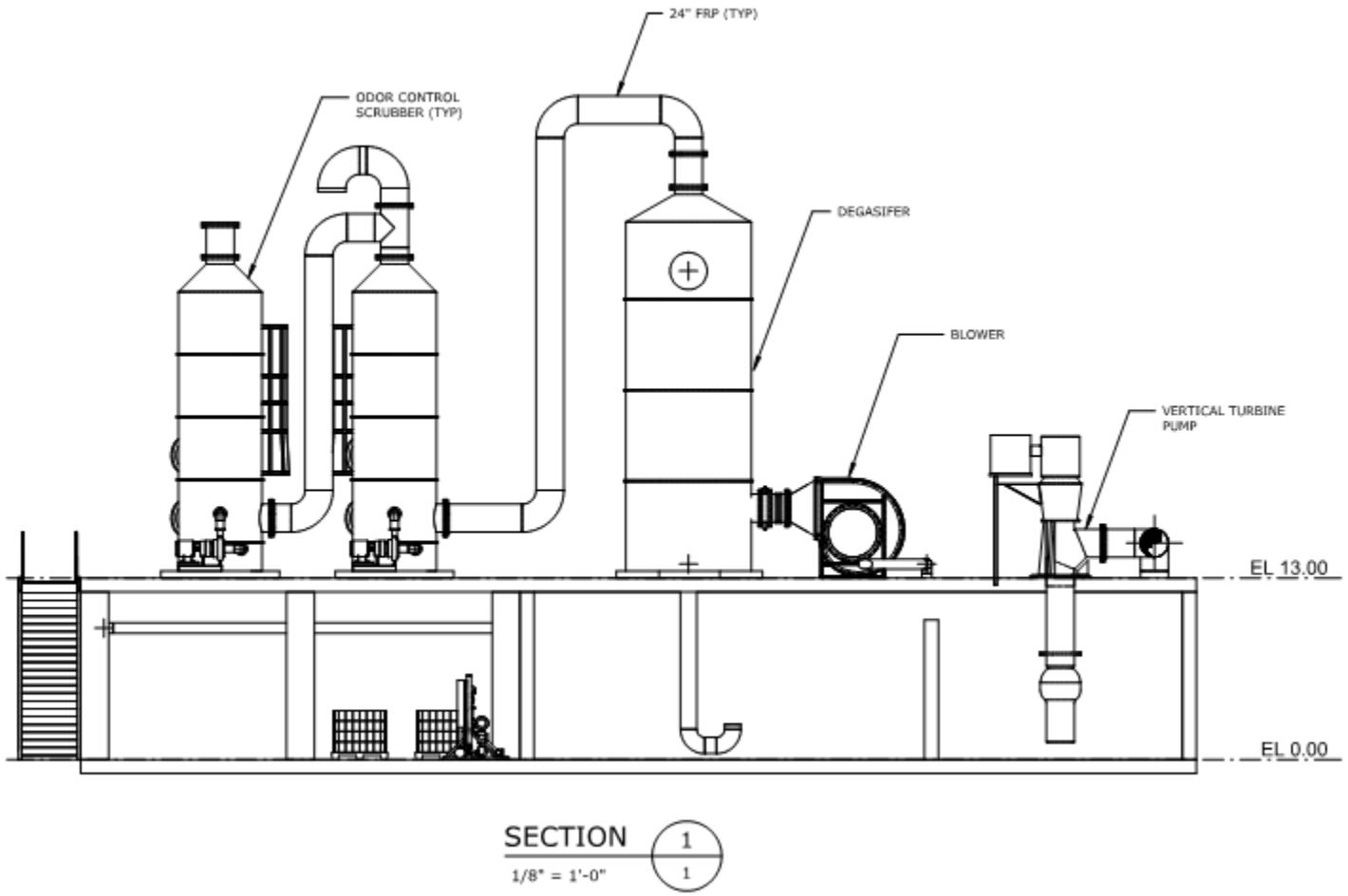


Figure 5-7C: Post-treatment Facilities Conceptual Layout – Section

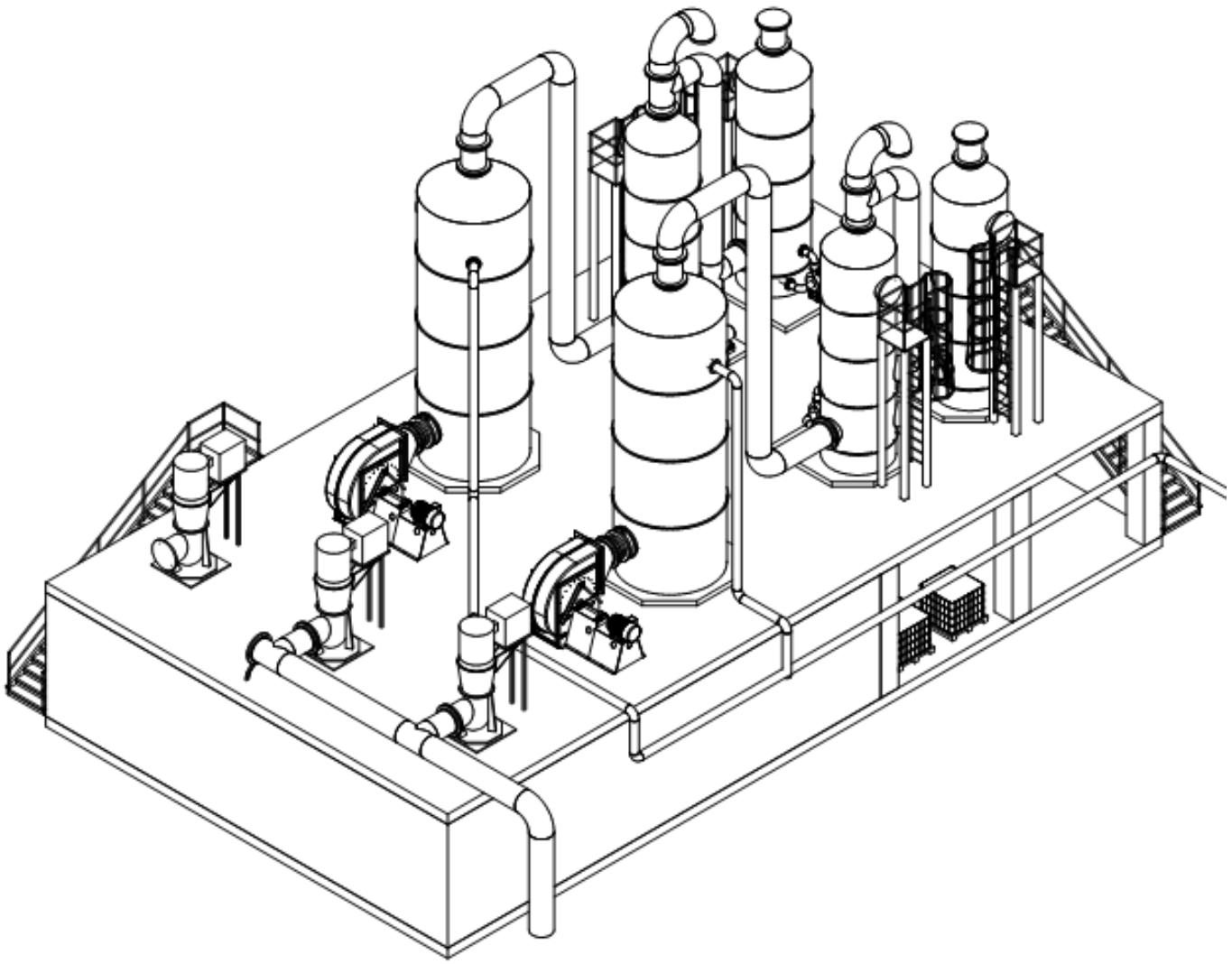


Figure 5-7D: Post-treatment Facilities Conceptual Layout – Isometric

Chemical Feed and Storage Facilities

The proposed RO system requires storage of the following chemicals:

1. Sulfuric Acid
2. Scale Inhibitor
3. Sodium Hydroxide
4. Corrosion Inhibitor
5. Carbon Dioxide

Figure 5-8 illustrates the proposed sulfuric acid and scale inhibitor storage and feed building. The sodium hydroxide and corrosion inhibitor will be stored in the space available under the odor control scrubbers (post-treatment elevated structure), as shown in **Figures 5-7B**. Carbon dioxide storage and feed equipment is illustrated in **Figure 5-9**.

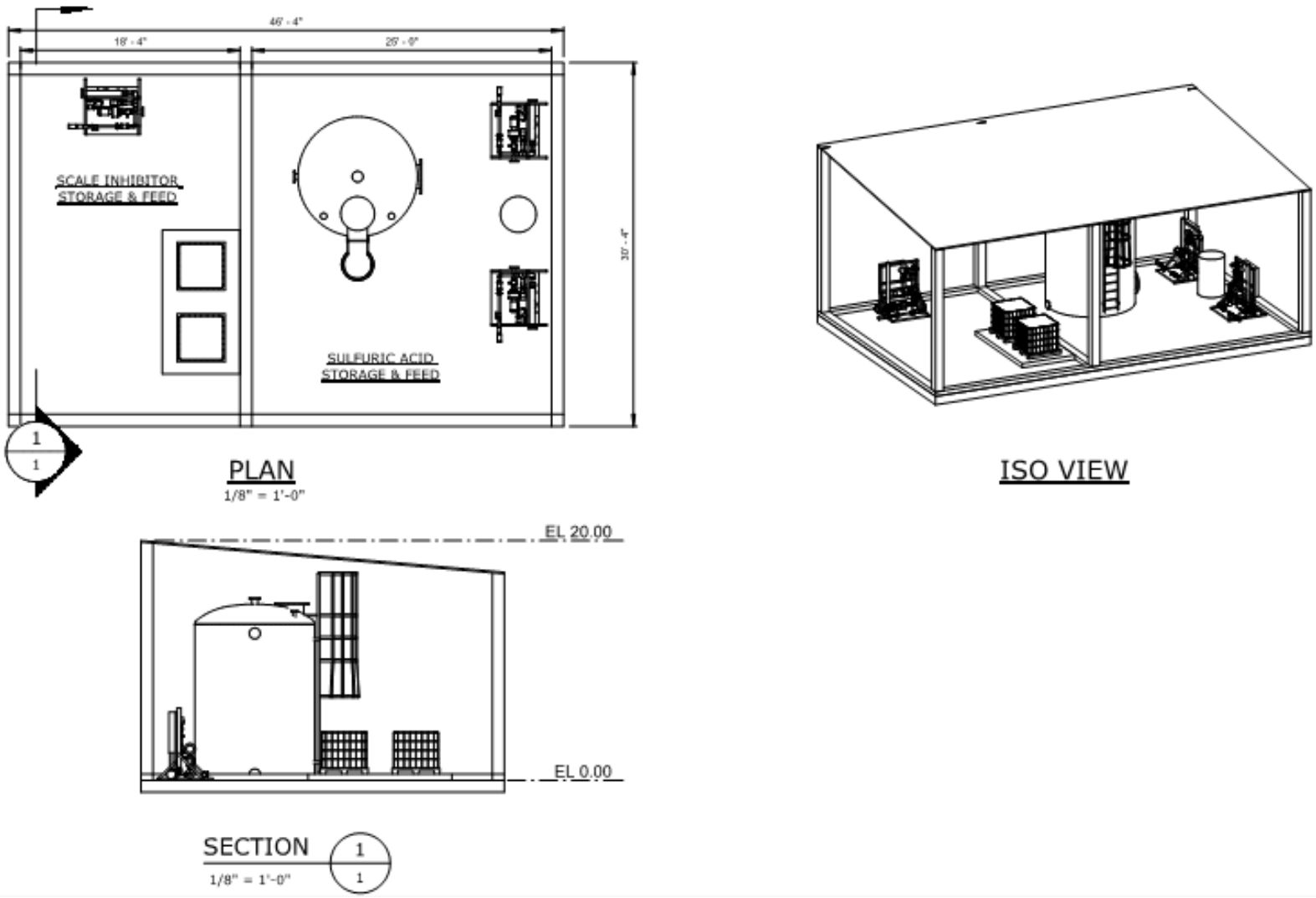
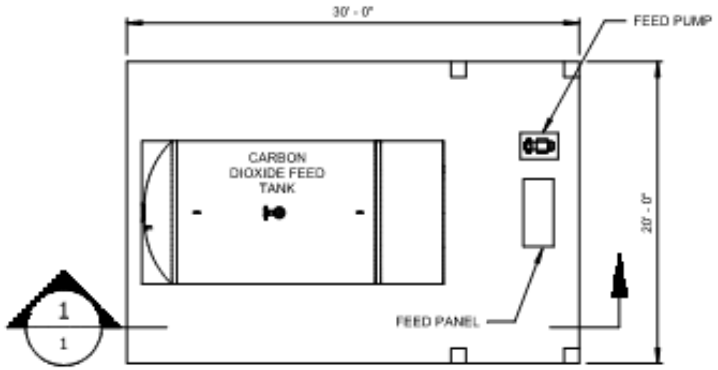
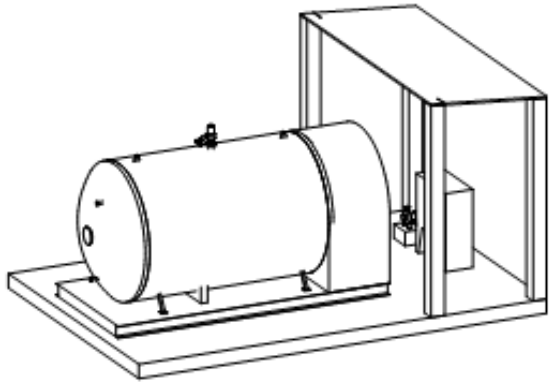


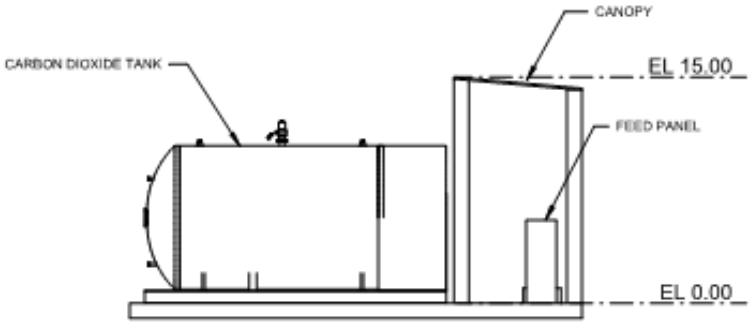
Figure 5-8: Pretreatment Chemical Building Conceptual Layout



PLAN
1/8" = 1'-0"



ISO VIEW



SECTION 1/1
1/8" = 1'-0"

Figure 5-9: Carbon Dioxide Conceptual Layout

Backup Power Supply

The proposed backup emergency power consists of a stand-alone diesel engine generator with enclosure and belly tank located on a slab on-grade. Typical layout of a backup power supply is shown in **Figure 5-10**.

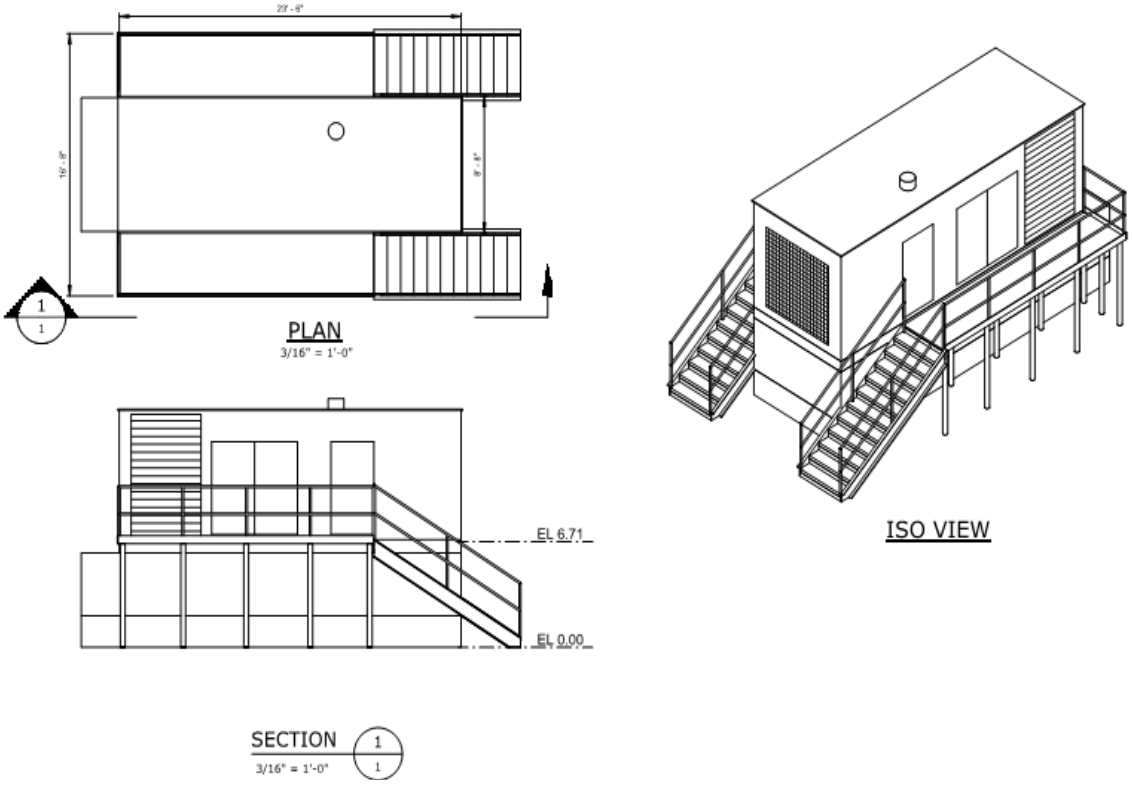


Figure 5-10: Backup Power Generator Typical Layout

5.1.2.3 Concentrate Disposal

The existing deep injection well at the water reclamation facility (WRF) will be converted to a tubing and packer well to allow it to receive RO concentrate under FDEP regulations. This will also require a 600 gpm concentrate pump station (estimated $500,000 for the construction of the concentrate pump station) and 10-inch pipeline to convey the RO concentrate from the RO facility to the existing (WRF) for disposal via the injection well. **Figure 5-11** shows the preliminary pipe route for the proposed concentrate pipeline. Additionally, the concentrate pipeline would convey the raw water from the RO facility during bypass-startup. A surge analysis will be performed during the detailed design for the project. If determined to be needed, a surge tank or other surge prevention system will be designed.



Figure 5-11: Concentrate Pipeline Conceptual Routing Plan

5.1.3 Monterey Subdivision Water Main Improvements

The design plans for the proposed water main improvements are shown on the following pages. These plans show the location and size of the proposed water mains and services, as well as the location of the newly proposed fire hydrants.

5.2 Environmental Impacts of Proposed Facilities

For both the water treatment facility improvements as well as the concentrate pipeline and Monterey Subdivision water main improvements, the short-term impacts during construction include increased noise levels, increased airborne particulates and surface run-off during rainfall on the site. Control measures will be implemented to minimize these temporary effects. The long-term impacts of the project are beneficial. The City will have a sustainable water supply for the current and future demands of the City and the residents within the Monterey Subdivision will be connected to the public water system and taken off their currently contaminated private wells.

The proposed project will not have significant adverse effects on wild and scenic rivers or on flora, fauna, threatened or endangered plant or animal species, prime agricultural lands, wetlands, undisturbed natural areas, or the socio-economic character of the area. A review of the State Historic Preservation Office database indicates that no archeological, historical or cultural sites are recorded in the area of construction.

5.3 Cost to Construct Facilities

The details of construction costs for the project are presented in **Appendix A**. The total estimated construction cost for the pretreatment system (Phase 1) is $1,904,733, and $16,284,000 for the alternative water supply reverse osmosis treatment through Phase 2. The City is currently requesting a $1,904,733 loan for the construction of the pretreatment system, $779,935 for the Monterey Subdivision water distribution system, and a $768,375 loan for the design of the first two bid packages (Phase 2A and 2B) for the alternative water supply project.

5.4 Consistency with the Comprehensive Plan

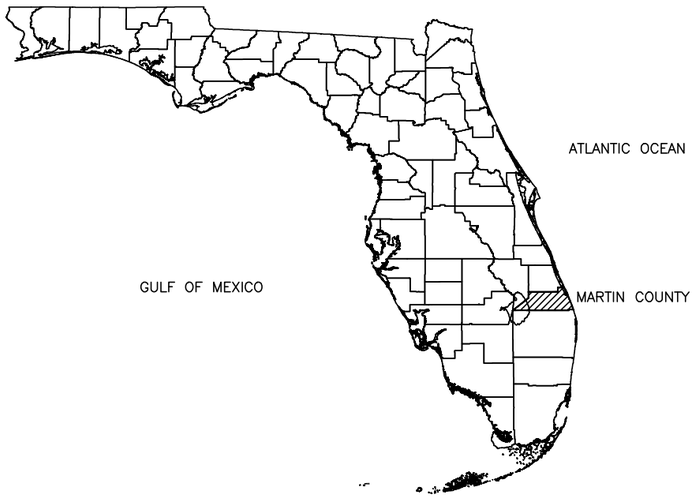
The recommendations resulting from this study are consistent with the City's Comprehensive Plan.

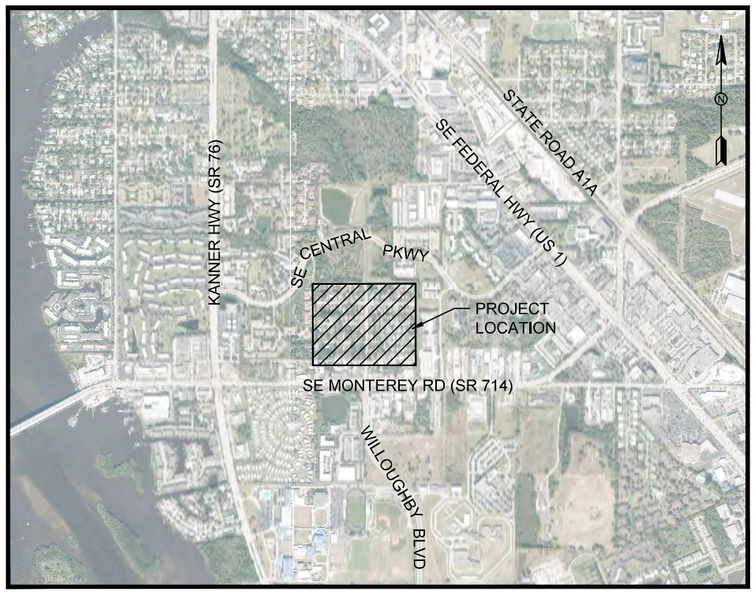
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

PREPARED FOR
CITY OF STUART

MARTIN COUNTY, FLORIDA

SECTION 09, TOWNSHIP 38S, RANGE 41E





VICINITY MAP

NTS

SHEET INDEX

SHEET No.	SHEET TITLE
G-1	COVER
G-2	LEGEND, ABBREVIATIONS, AND NOTES
G-3	KEYSHEET
C-1	SE SAN JOSE STREET WATER MAIN PLAN
C-2	SE TEJON STREET WATER MAIN PLAN
C-3	SE CORTEZ STREET WATER MAIN PLAN
C-4	SE MADRID STREET WATER MAIN PLAN
C-5	SE SEVILLE STREET WATER MAIN PLAN
D-1	DETAILS
D-2	DETAILS

JANUARY 2020

60% SUBMITTAL

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PH. (772) 919-4905
Cert. No. 26960

CHRISTINE J. MIRANDA, P.E.
License No: 60906

G-1

MONTEREY ROAD SUBDIVISION WATER MAIN IMPROVEMENTS

GENERAL ABBREVIATIONS

ABND	Abandon or Abandoned
ACP	Asbestos Cement Pipe
ADD'L	Additional
AL, Alum	Aluminum
APPROX	Approximate
ARV	Air Release Valve
ASP, Asph	Asphalt
BFP	Backflow Preventer
BFV	Butterfly Valve
B/L	Base Line
BLDG	Building
BM	Benchmark
BO	Blowoff
BOP	Bottom of Pipe
CATV	Cable Television
CB	Catch Basin
CO	Cleanout
CL	Center Line
CLF	Chain Link Fence
CIP	Cast Iron Pipe / Cast in Place
CMP	Corrugated Metal Pipe
CONC	Concrete
CONST	Construct/Construction
DE	Drainage Easement
DI	Ductile Iron
DIP	Ductile Iron Pipe
DIA	Diameter
DR	Dimensional Ratio/Drainage
DWY	Driveway
EL	Elevation
EP	Edge of Pavement
ESMT	Easement
EOW	Edge of Water
EX, EXIST	Existing
FDOT	Florida Department of Transportation
FH	Fire Hydrant
FL	Flanged
FM	Force Main
FND	Found
FNPT	Female Nominal Pipe Thread
FPL	Florida Power and Light
FW	Finished Water
GPS	Global Positioning System
GV	Gate Valve
HB	Hose Bibb
HDD	Horizontal Directional Drill
HDPE	High Density Polyethylene
HYD	Hydrant
ID	Identification/Inside Diameter
INV	Invert/Invert Elevation
IRC	Iron Rod & Cap
IRR	Irrigation
LAE	Limited Access Easement
LF	Linear Feet
LP	Light Pole
LS	Lift Station
LSA	Landscape Area
MAX	Maximum
MB	Mailbox
MECH	Mechanical
MH	Manhole
MIN	Minimum
MISC	Miscellaneous
MJ	Mechanical Joint
N/D	Nail and Disk
No	Number
NTS	Not to Scale
OC,O/C	On Center
OD	Outside Diameter
OHW	Overhead Wire
ORB	Official Records Book
PB	Plat Book
PE	Polyethylene Piping
PGL	Profile Grade Line
PVC	Polyvinyl Chloride/Polyvinyl Chloride Pipe
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
RCW	Reclaimed Water
RED	Reducer
REINF	Reinforce/Reinforced
RJ	Restrained Joint
RWM	Raw Water Main
R/W,ROW	Right of Way
S=	Slope (FT/FT)/(Rise/Run)
SAN	Sanitary
SCH/SCHED	Schedule
SEC	Section
SF	Silt Fence
SP	Sample Point
SS	Sanitary Sewer
STA	Station
TBM	Temporary Benchmark
TEMP	Temporary
TOB	Top of Bank
TON	Top of Nut
TOP	Top of Pipe
TOS	Toe of Slope
TYP	Typical
UE	Utility Easement
UEC	Underground Electric Conduit
UGE	Underground Electric
UGT	Underground Telephone
UNK	Unknown
W/	With (Combined Form)
WF	Wood Fence
WM	Water Main or Water Meter
WPB	Wire Pullbox
WTP	Water Treatment Plant
WV	Water Valve
WWTP	Waste Water Treatment Plant

PIPING SYMBOLOGY

- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- UNION
- BALL VALVE (BV)
- GATE VALVE (GV)
- BUTTERFLY VALVE (BFV)/ ODOR CONTROL DAMPENER
- PLUG VALVE (PV)
- CHECK VALVE (CV)
- PLUG/CAP
- CLEAN OUT (CO)
- TAPPING VALVE
- LINE STOP
- HOSE BIBB
- EXISTING PIPE
- EXISTING BURIED PIPE
- PROPOSED PIPE
- PROPOSED BURIED PIPE
- MECHANICAL JOINT
- FLANGE JOINT
- FLEXIBLE COUPLING
- FLEXIBLE COUPLING WITH THRUST TIES
- ELBOW UP
- ELBOW DOWN
- 90° ELBOW
- TEE UP
- TEE DOWN
- TEE
- CROSS

LINETYPES

	EXISTING*	PROPOSED*
CABLE TV	CATV	
CENTER LINE		
DRAIN	DR	DR
EASEMENT		
ELECTRIC	E	
FENCE (BARB/FIELD)	X	X
FENCE (CHAINLINK)	O	O
FENCE (WOOD)	WF	WF
FIBER OPTIC	FOC	FOC
FORCE MAIN	FM	FM
FORCE MAIN (LOW PRESSURE)	LPF	LPF
FUEL	FUEL	FUEL
GAS	GAS	
GUARDRAIL		
IRRIGATION	IRR	
OVERHEAD UTILITIES	OHU	
RAILROAD TRACK		
RAW WATER MAIN	RWM	RWM
RECLAIMED WATER MAIN	RCW	RCW
RIGHT-OF-WAY		
SANITARY SEWER	S	S
SANITARY SEWER SERVICE	SS	SS
SILT FENCE		SF
STORM DRAINAGE	ST	ST
TELEPHONE	T	
TOP OF BANK		
TOE OF SLOPE		
TRAFFIC SIGNAL	TS	TS
TURBIDITY BARRIER		TB
UNKNOWN	UNK	
VACUUM SEWER	VS	VS
WATER MAIN	WM	WM
WATER SERVICE	WS	WS

* DEPICTS ABOVE GRADE — TEXT — TEXT — TEXT —

* DEPICTS BELOW GRADE --- TEXT --- TEXT --- TEXT --- TEXT -

CIVIL SYMBOLOGY

- CONSTRUCTION BASE LINE — 0+00
- DIRECTION OF FLOW
- EXIST. SPOT ELEVATION — x 79.5
- REFERENCE ELEVATION — REF. EL. 20.90
- NEW CONTOUR ELEV. — 79.5
- EXIST. UTILITY POLES — UTILITY, POWER, TELEPHONE, LIGHT
- NEW UTILITY POLES — UTILITY, POWER, TELEPHONE, LIGHT
- PIPING CONFLICT LOCATION — C-1
- SAMPLE POINT — SP1
- WATER SURFACE — PLAN; SECTION — EL 48.00
- FIRE HYDRANT — NEW, EXIST.
- EXIST. MANHOLE, DRAINAGE STRUCTURE
- NEW MANHOLE, DRAINAGE STRUCTURE
- TO BE REMOVED/DEMOLISHED

SECTION/DETAIL SYMBOL

SECTION — 5 / 15 — SECTION LETTER/DETAIL NUMBER; SHEET/DRAWING NO. ON WHICH SECTION/DETAIL IS SHOWN

SCALE:

1 / 101 — SECTION LETTER/DETAIL NUMBER; SHEET/DRAWING NO. ON WHICH SECTION/DETAIL IS SHOWN

SECTION CUT

A — A

SECTION CUT ON DETAILS

PIPE DESIGNATION — 8" DIP FORCE MAIN

- NOMINAL PIPE DIA.(IN.)
- PIPE MATERIAL (IF SHOWN)
- FLOW STREAM IDENTIFICATION (IF SHOWN)

SURVEY LEGEND

- = DRAINAGE MANHOLE
- = CABLE TV
- = WOOD UTILITY POLE
- = CONCRETE UTILITY POLE
- = POLE ANCHOR
- = MAILBOX
- = SIGN
- = SATELLITE DISH
- = TELEPHONE BOX
- = WOOD UTILITY POLE
- = UTILITY POLE WITH LIGHT

NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR POTHOLING, TEST PITS, ETC. IN THE VICINITY OF THE PROJECT WORK AREA TO LOCATE AND VERIFY THE EXISTING UTILITY LOCATIONS PRIOR TO INITIATING WORK. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT THE EXISTING UTILITIES DURING CONSTRUCTION AT NO ADDITIONAL COST TO THE OWNER.
2. THE LOCATION OF EXISTING UTILITIES ARE APPROXIMATE AND ARE BASED UPON LIMITED RECORD DRAWING INFORMATION AND SURFACE SURVEY. CONTRACTOR SHALL VERIFY EXISTING HORIZONTAL AND VERTICAL LOCATION OF ALL UTILITY CROSSINGS AND FOR UTILITIES IN CLOSE PROXIMITY OF PROPOSED PIPING.
3. THE PROPOSED WATER MAIN IS TO HAVE A MINIMUM 36" COVER OR AS OTHERWISE NOTED.
4. CONTRACTOR SHALL REPLACE ALL DAMAGED DRIVEWAYS AND ROADWAYS AS A MINIMUM TO MATCH THE EXISTING THICKNESS, TYPE, REINFORCING, ETC. THE LIMIT OF RESTORATION IS FROM THE RIGHT-OF WAY TO THE EDGE OF PAVEMENT, UNLESS OTHERWISE NOTED OR REQUIRED BY THE AGENCY HAVING JURISDICTION OF THE ROADWAY.
5. CONTRACTOR SHALL MAINTAIN ACCESS FOR RESIDENTS AND BUSINESSES AT ALL TIMES. EXTREME CARE SHALL BE TAKEN TO PROTECT EXISTING LANDSCAPING, IRRIGATION, LIGHTING, AND OTHER SURFACE FEATURES. ALL DAMAGED LANDSCAPING, IRRIGATION, LIGHTING, AND SURFACE FEATURES SHALL BE REPAIRED TO EXISTING CONDITIONS OR BETTER AT NO ADDITIONAL COST TO THE OWNER. ALL DAMAGED IRRIGATION LINES AND SPRINKLER HEADS SHALL BE REPAIRED THE SAME DAY THEY ARE DAMAGED.
6. ELEVATIONS SHOWN HEREON ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
7. CONTRACTOR SHALL COORDINATE WITH CITY OF STUART A MINIMUM 48 HOURS PRIOR TO ANY TIE-INS OR INSPECTIONS.
8. THE CONTRACTOR SHALL BE RESPONSIBLE AT NO ADDITIONAL COST, FOR HOLDING ELECTRIC, TELEPHONE AND SIGNAL POLES AS NECESSARY DURING CONSTRUCTION, UNLESS NOTED ON PLANS. COORDINATE WITH UTILITY COMPANIES WHERE NECESSARY.
9. M.O.T. PLANS MUST BE APPROVED BY AGENCY HAVING JURISDICTION.
10. CITY OF STUART HOURS OF OPERATION ARE MONDAY THROUGH FRIDAY FROM 8:30 AM TO 5:00 PM. CONTRACTOR SHALL ADHERE TO THIS SCHEDULE. WHERE CITY OF STUART INVOLVEMENT IS REQUIRED OUTSIDE OF THESE TIMES, CONTRACTOR SHALL REIMBURSE CITY OF STUART AT PREVAILING RATES.

Symbols:

#	Pounds/Number
∢	Angle
Ø	Round/Diameter

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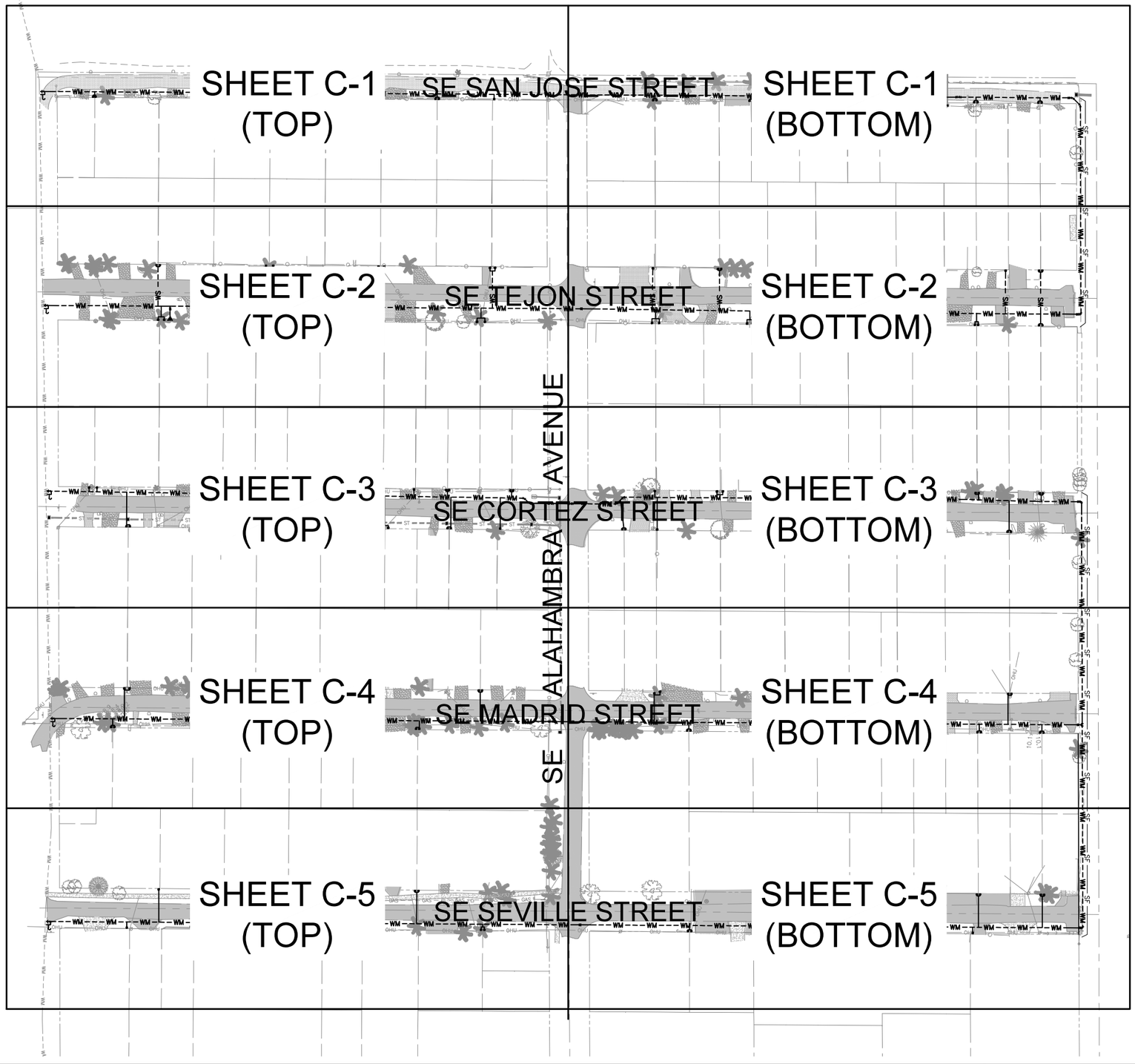
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MONTEREY ROAD SUBDIVISION
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G-2



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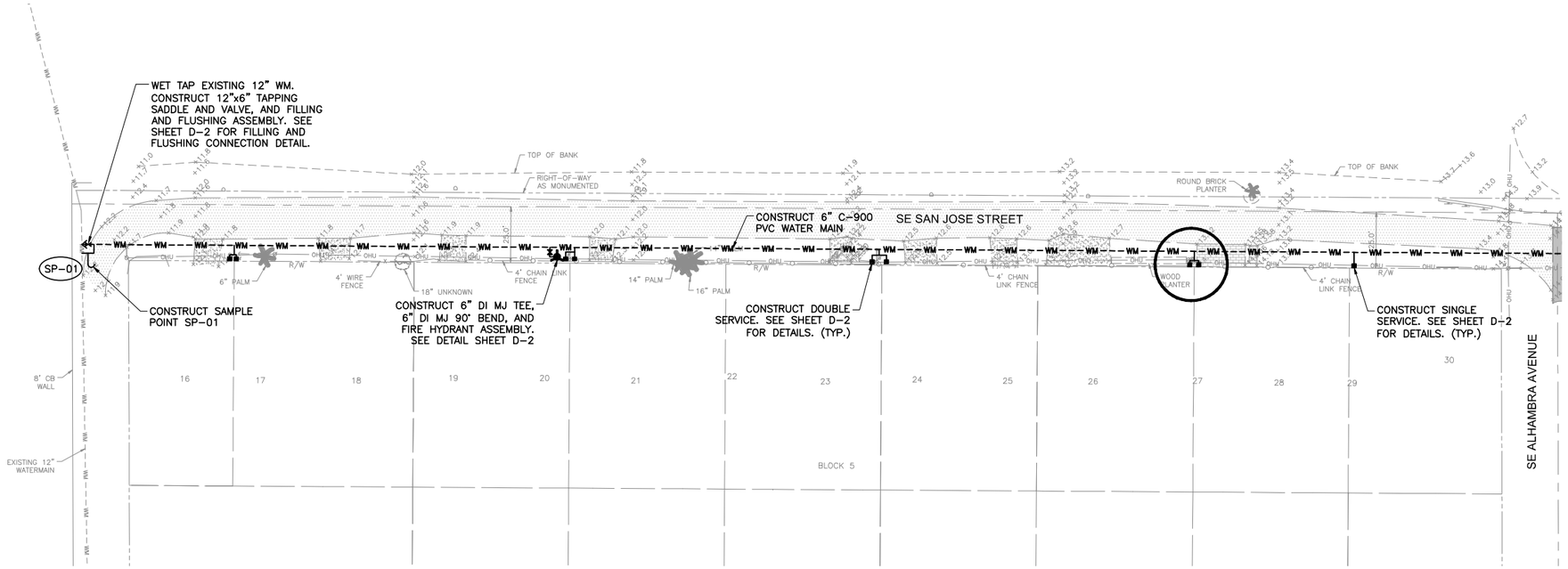
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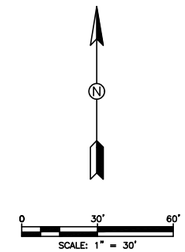
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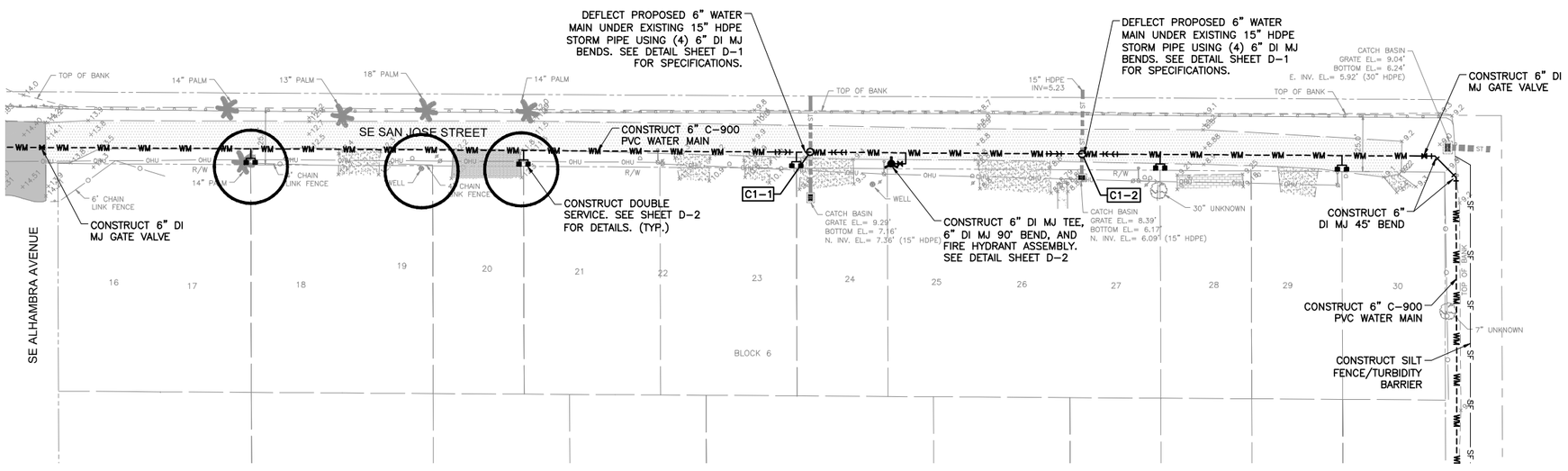
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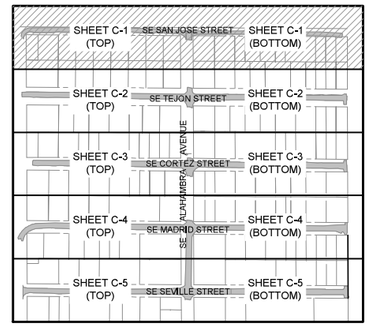


HATCH LEGEND

- ASPHALT
- ROCK
- CONCRETE
- BRICK PAVER
- DIRT
- SHELLROCK



C1-1	PROPOSED 6" C-900 PVC POTABLE WATER PIPE UNDER EXISTING 15" HDPE STORM SEWER PIPE. MAINTAIN MIN. 18" CLEARANCE.
C1-2	PROPOSED 6" C-900 PVC POTABLE WATER PIPE UNDER EXISTING 15" HDPE STORM SEWER PIPE. MAINTAIN MIN. 18" CLEARANCE.



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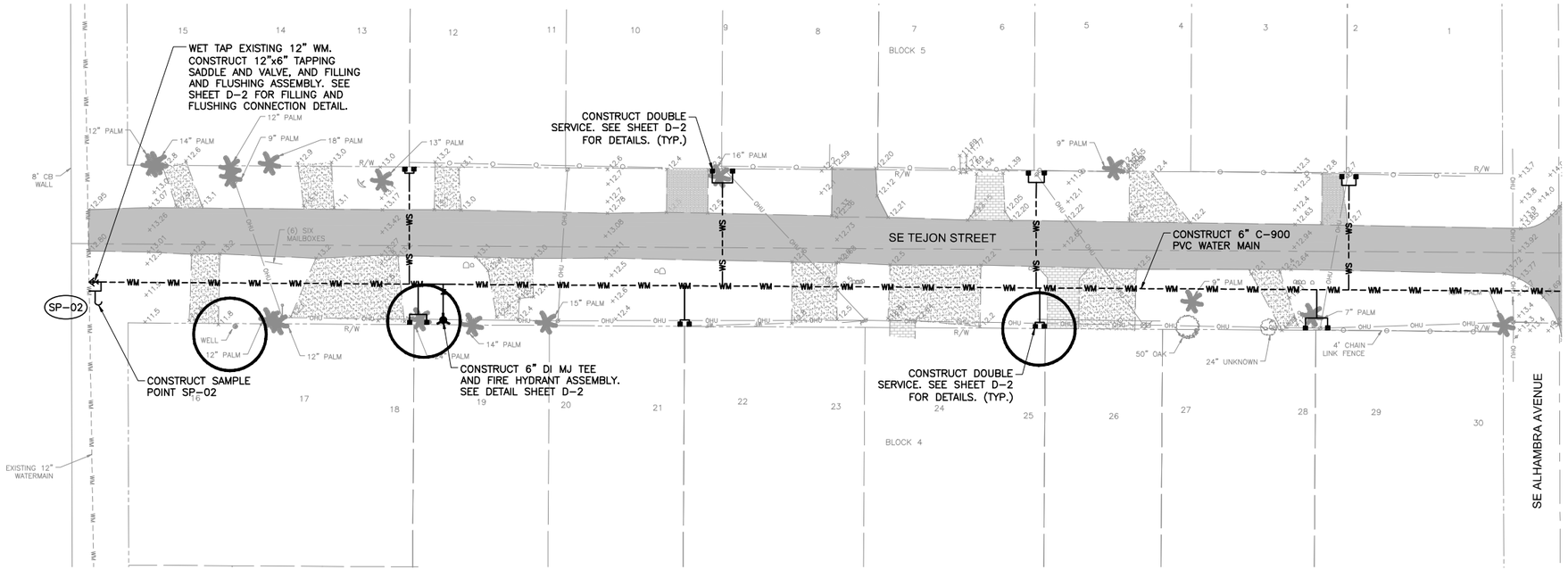
SE SAN JOSE STREET
WATER MAIN PLAN

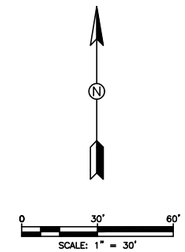
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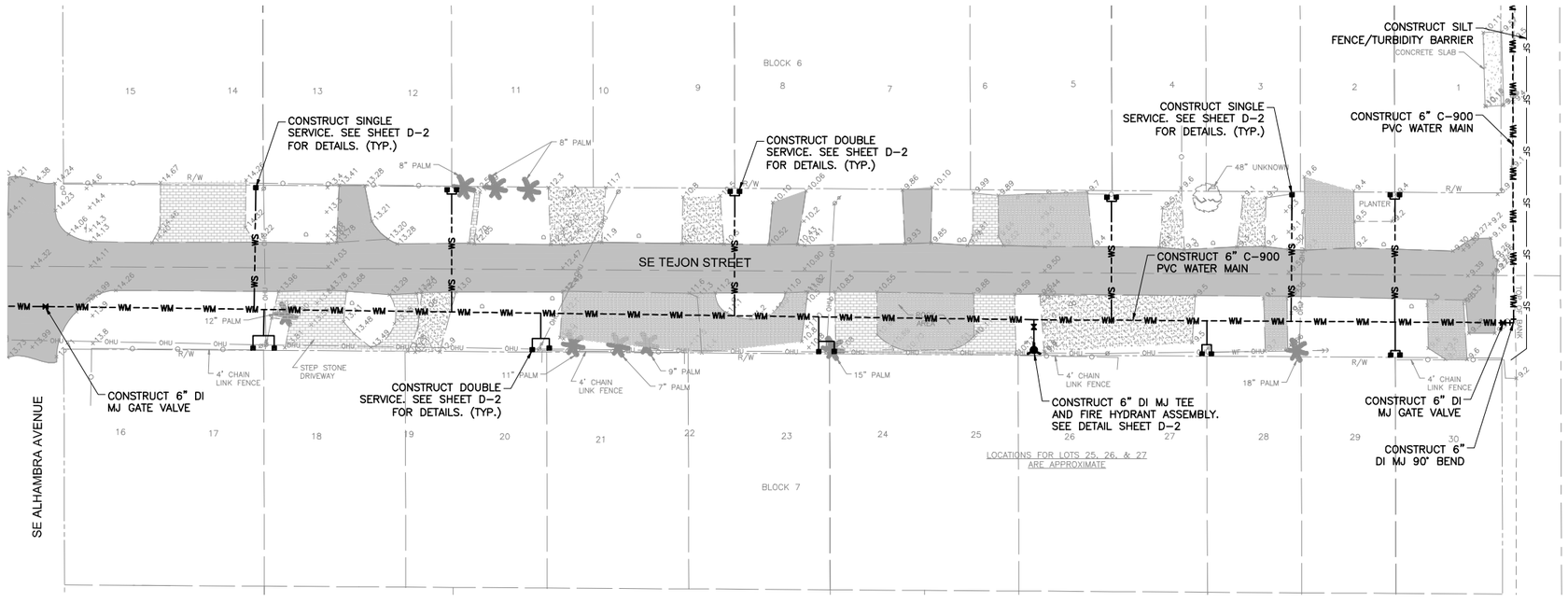
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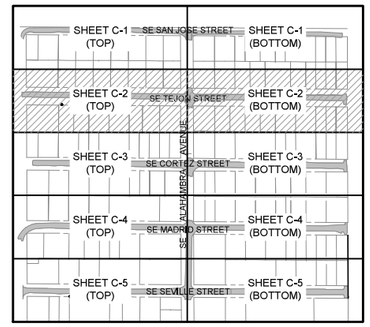




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- BRICK PAVER
- DIRT
- SHELLROCK





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MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

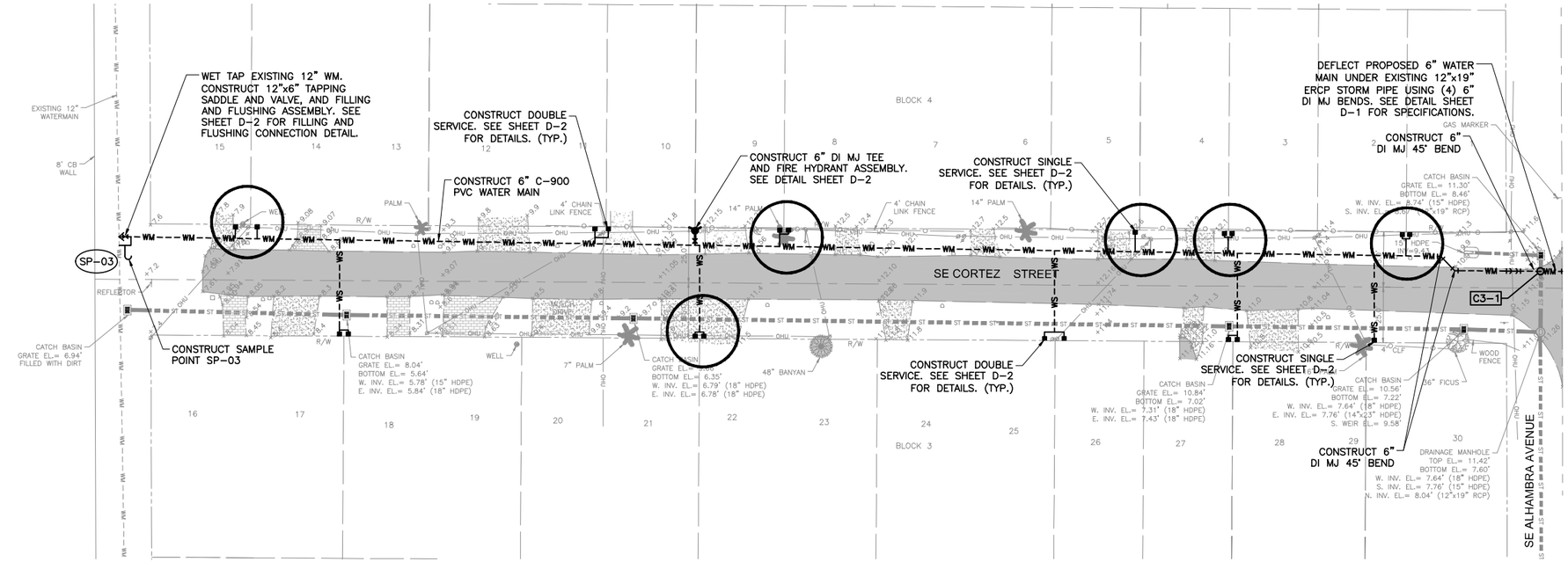
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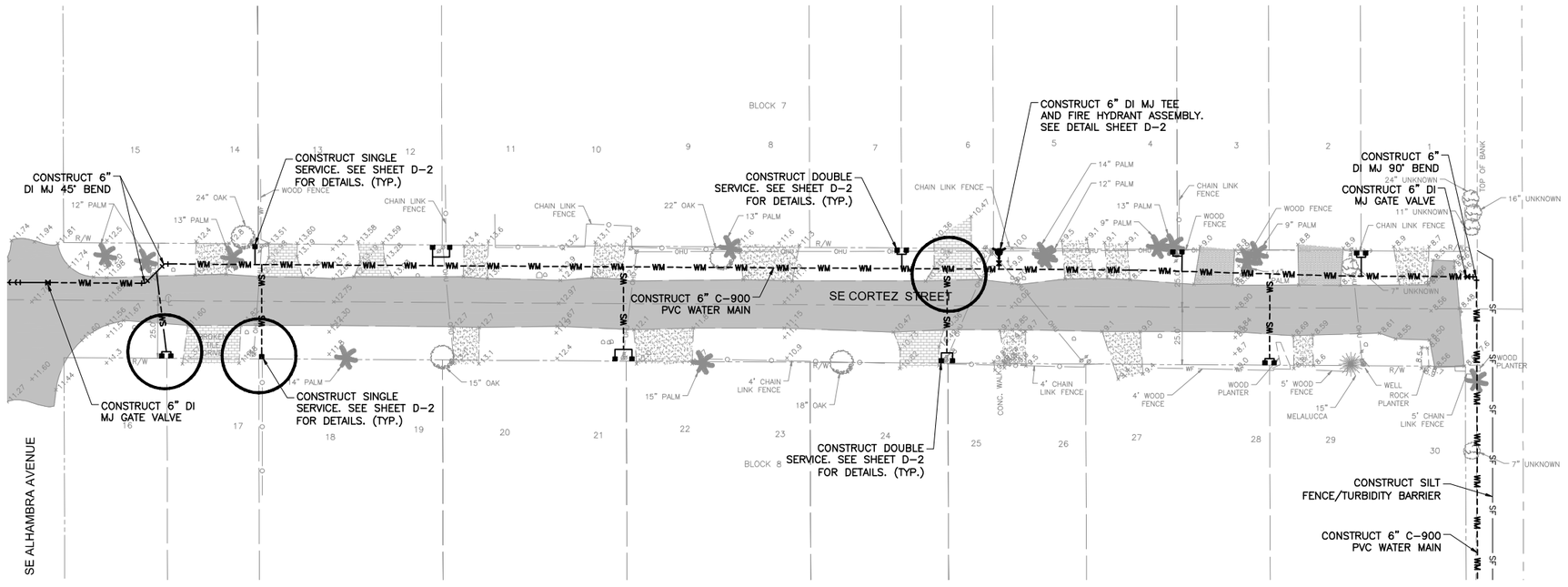
HOLTZ CONSULTING ENGINEERS, INC.
607 SW ST. LUCIE CRESCENT, SUITE 103
STUART, FLORIDA 34994
PH. (772) 919-4905
Cert. No. 26960

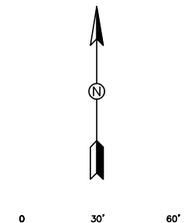
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C-2

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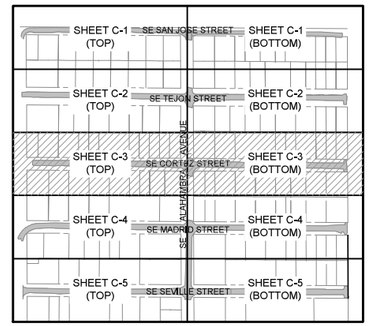




HATCH LEGEND

- ASPHALT
- ROCK
- CONCRETE
- BRICK PAVER
- DIRT
- SHELLROCK

C3-1	PROPOSED 6" C-900 PVC POTABLE WATER PIPE UNDER EXISTING 12"x19" ERCP STORM SEWER PIPE. MAINTAIN MIN. 18" CLEARANCE.



SHEET INDEX
(NOT TO SCALE)

DATE	BY	REVISIONS

Date: 12/20/19
Scale: AS NOTED
Design By: CM
Drawn By: RR
Check By: DH

CITY OF STUART
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

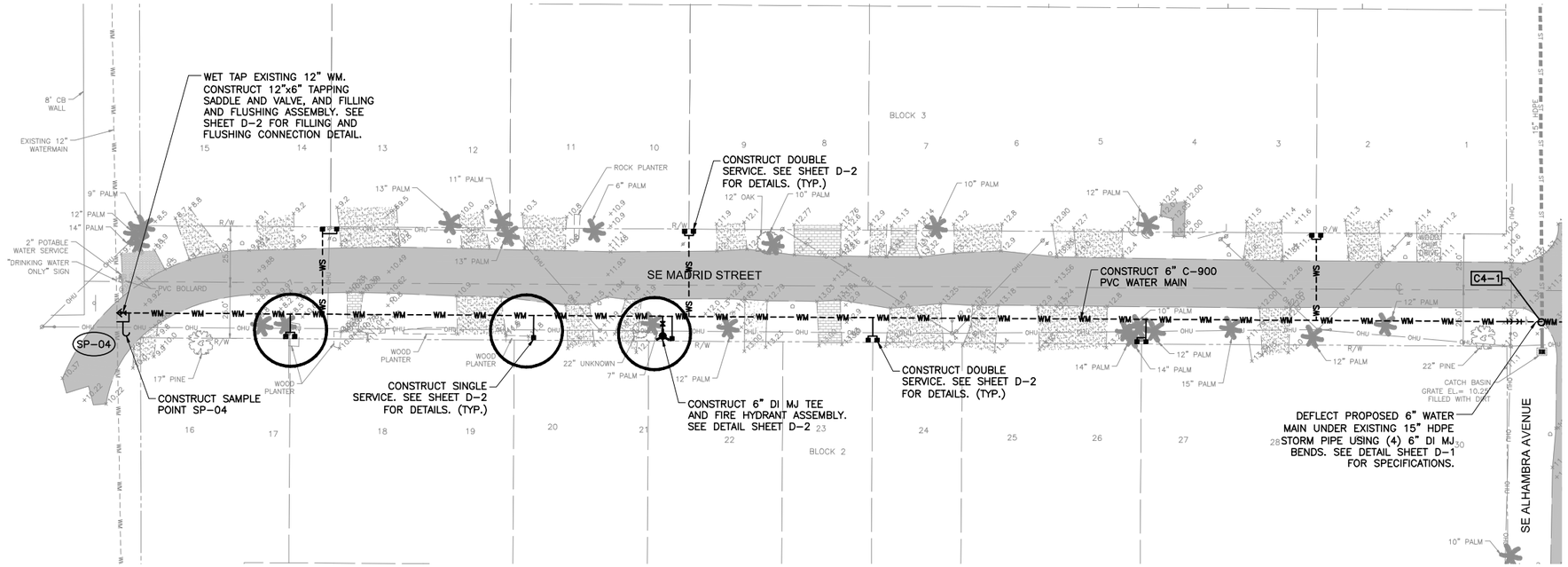
SE CORTEZ STREET
WATER MAIN PLAN

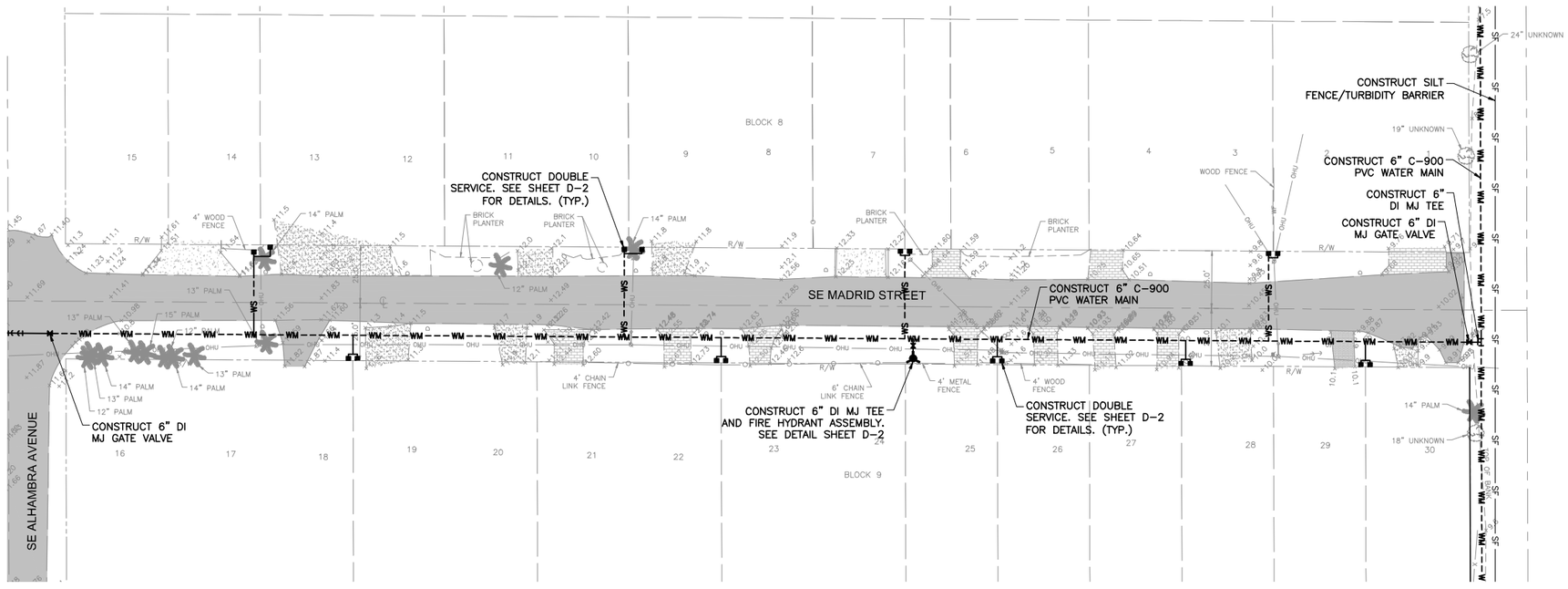
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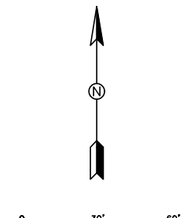
C-3

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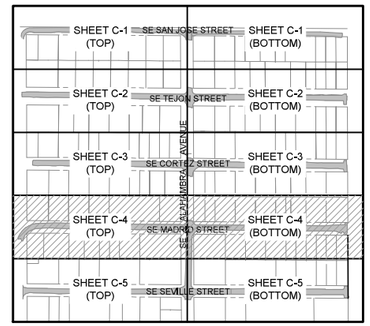


C4-1	PROPOSED 6" C-900 PVC POTABLE WATER PIPE UNDER EXISTING 15" HDPE STORM SEWER PIPE. MAINTAIN MIN. 18" CLEARANCE.



HATCH LEGEND

- ASPHALT
- ROCK
- CONCRETE
- BRICK PAVER
- DIRT
- SHELLROCK



SHEET INDEX
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Date: 12/20/19
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Design By: CM
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Check By: DH

CITY OF STUART
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

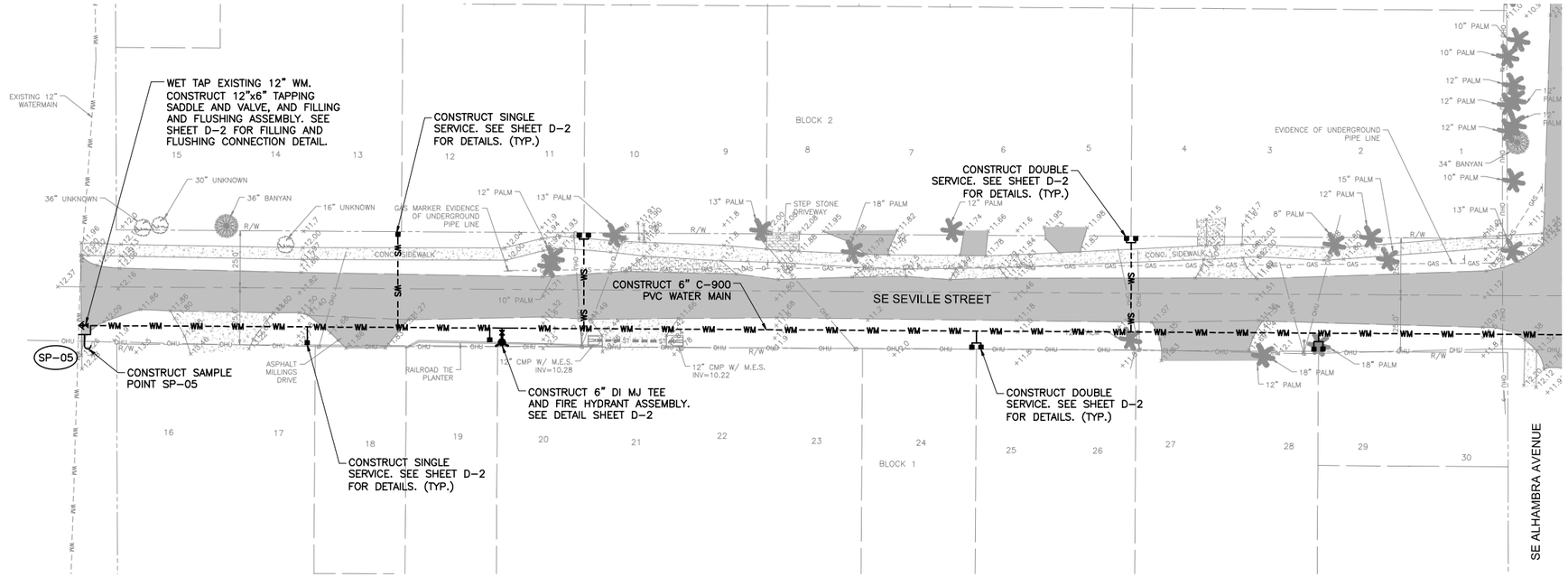
SE MADRID STREET
WATER MAIN PLAN

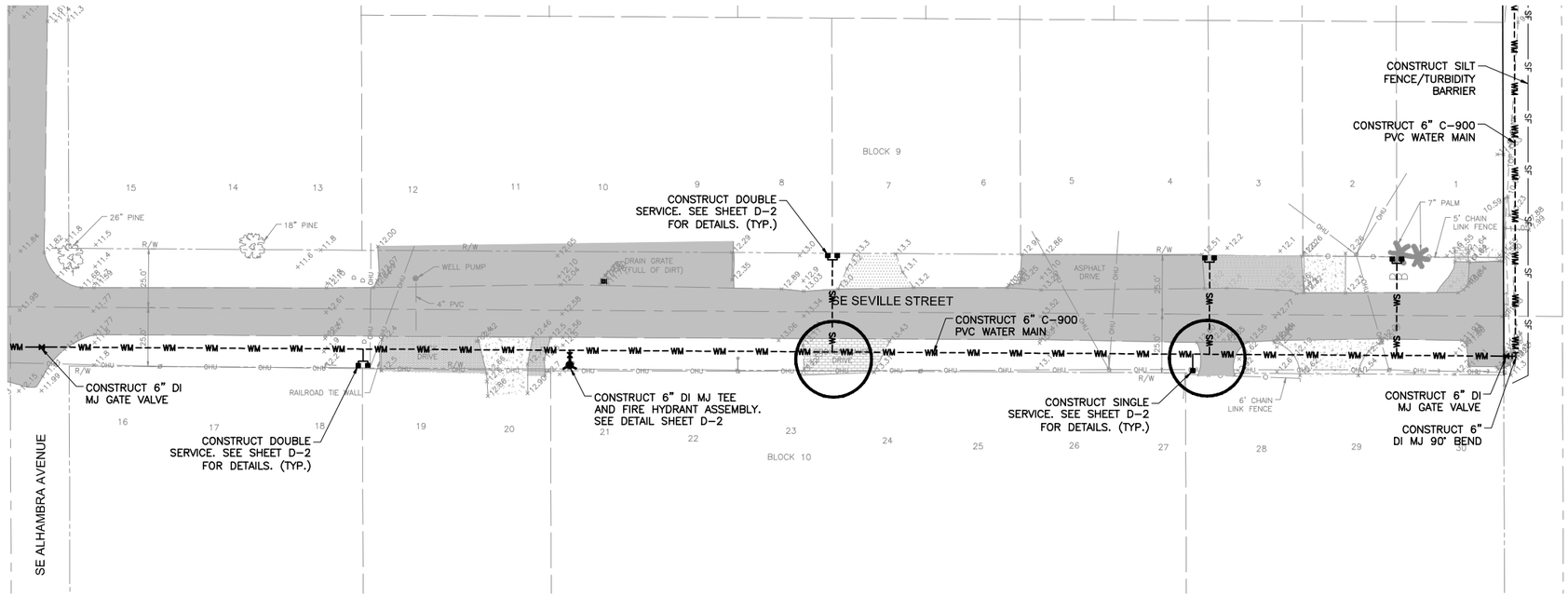
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607 SW ST. LUCIE CRESCENT, SUITE 103
STUART, FLORIDA 34994
PH. (772) 919-4905
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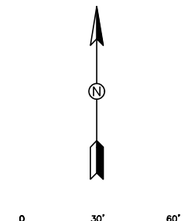
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C-4

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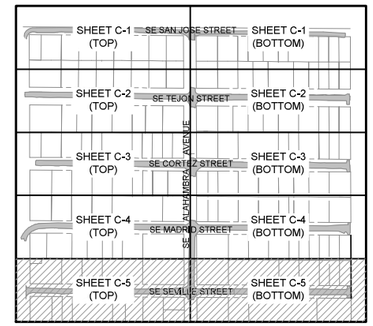






HATCH LEGEND

- ASPHALT
- ROCK
- CONCRETE
- BRICK PAVER
- DIRT
- SHELLROCK



SHEET INDEX
(NOT TO SCALE)

DATE	BY	REVISIONS

Date: 12/20/19
Scale: AS NOTED
Design By: CM
Drawn By: RR
Check By: DH

CITY OF STUART
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

SE SEVILLE STREET
WATER MAIN PLAN

HOLTZ CONSULTING ENGINEERS, INC.
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C-5

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CITY OF STUART
WATER DISTRIBUTION NOTES

1. ALL CONSTRUCTION MATERIAL, INSTALLATION AND TESTING SHALL CONFORM TO THE STANDARD SPECIFICATIONS OF THE CITY OF STUART.
2. WATER MAIN WHERE SPECIFIED AS POLYVINYL CHLORIDE (PVC) SHALL CONFORM TO AWWA C-900 OR C-905, PRESSURE CLASS 150 OR 235, DR (18).
3. MIN. CLASS 50 WATER MAIN, WHERE SPECIFIED AS DUCTILE IRON PIPE , SHALL CONFORM TO ANSI/AWWA C-150/A-21.50 OR ANSI/AWWA C-151/A-21.51 AND SHALL BE PRESSURE CLASS 350 (MINIMUM).
4. POLYVINYL CHLORIDE WATER MAIN SHALL BE BLUE IN COLOR. ALL PIPE REQUIRE THHN TRACER WIRE.
5. FITTINGS SHALL BE CAST OR DUCTILE IRON, CONFORMING TO AWWA C-110 AND ANSI A21.11, CLASS 250 MINIMUM, CEMENT LINED, AND SEAL COATED.
6. GATE VALVES SHALL BE RESILIENT WEDGE SEAT, VALVES SHALL CONFORM TO AWWA C-509 AS WELL AS THE CITY OF STUARTS PRODUCT LIST.
7. WATER LINES SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH THE CITY OF STUART'S DESIGN AND CONSTRUCTION STANDARDS. THE CONTRACTOR SHALL SUBMIT CERTIFIED DENSITY TESTS AS REQUIRED BY THE CITY AND THE COUNTY, FDOT. IN CASES WHERE AREAS FALL WITHIN THE JURISDICTION OF LOCAL OR STATE AGENCIES, THE COMPACTION REQUIREMENTS SHALL NOT BE LESS THAN THE MINIMUM REQUIRED BY THE APPROPRIATE RESPONSIBLE AGENCY.
8. NO FIELD CHANGES OR DEVIATIONS FROM THE DESIGN SHALL BE MADE WITHOUT PRIOR APPROVAL OF THE ENGINEER AND CITY/COUNTY/FDOT.
9. THE CONTRACTOR SHALL NOTIFY THE ENGINEER, CITY OF STUART AND COUNTY/FDOT 48 HOURS PRIOR TO COMMENCING CONSTRUCTION.
10. A PRE-CONSTRUCTION CONFERENCE BETWEEN THE ENGINEER, THE CONTRACTOR, THE CITY, COUNTY/FDOT AND ANY OTHER APPLICABLE AGENCIES SHALL BE MANDATORY PRIOR TO COMMENCEMENT OF CONSTRUCTION.
11. TRAFFIC CONTROL, BARRICADES, ETC., SHALL BE IN ACCORDANCE WITH THE FLORIDA DEPARTMENT OF OF TRANSPORTATION STANDARDS AND APPROVED BY THE CITY ENGINEER.
12. MINIMUM COVER SHALL BE 36 INCHES EXCEPT AS APPROVED BY THE ENGINEER AND CITY/COUNTY/FDOT.
13. DISTURBED AREAS SHALL BE RESTORED IN CONFORMANCE WITH THE APPLICABLE GOVERNING AGENCY REQUIREMENTS.
14. EXISTING UTILITIES AND DRAINAGE SHALL BE FIELD VERIFIED PRIOR TO CONSTRUCTION AND PROTECTED BY THE CONTRACTOR.
15. WATER MAINS SHALL BE TESTED AND DISINFECTED IN ACCORDANCE WITH THE APPLICABLE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION AND AWWA C-601 FOR DISINFECTION.

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

WATER DISTRIBUTION NOTES

DATE: OCTOBER 2016
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SHEET NUMBER 1

CITY OF STUART
WATER DISTRIBUTION NOTES
CONTINUED

16. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING EXISTING UTILITIES AND DRAINAGE.
17. THE CONTRACTOR SHALL FURNISH RECORD DRAWING INFORMATION TO THE ENGINEER INCLUDING LOCATIONS OF VALVES, FITTINGS, SERVICE CONNECTIONS, BLOWOFFS, AIR RELEASE VALVES, AND ANY OTHER PERTINENT INFORMATION NECESSARY TO LOCATE ITEMS CONSTRUCTED UNDER THIS PROJECT, AS REQUIRED BY THE UTILITIES ENGINEER.
18. THE CONTRACTOR SHALL TAP EXISTING LINES UNDER THE SUPERVISION OF THE CITY OF STUART ONLY AFTER TESTING AND DISINFECTION HAS BEEN COMPLETED AND APPROVED ON THE TAPPING SLEEVE AND VALVE.
19. SAMPLE POINT TAPS SHALL BE PLACED APPROXIMATELY THREE FEET AWAY FROM GATE VALVES, AS SHOWN, FOR TESTING. FOLLOWING TESTING AND STERILIZATION OF WATER LINES. CONTRACTOR SHALL PLACE A BRASS PLUG IN CORPORATION STOPS AND CURB STOPS SHALL BE REMOVED FROM TESTING LOCATIONS.
20. MECHANICAL RESTRAINTS TO BE USED ON ALL FITTINGS AND PLACED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND CITY OF STUART REQUIREMENTS, MORE STRINGENT SHALL APPLY.
21. ALL MAINS SHALL BE TESTED AT A MINIMUM OF 150 PSI. TESTING METHODS SHALL CONFORM TO AWWA C-600.

$$L = \frac{SD(P)\,1/2}{133,200}$$ OR CURRENT AWWA STANDARD

L= LEAKAGE IN GPH
S= LENGTH OF PIPE IN FEET
D= PIPE DIAMETER IN INCHES
P= TESTING PRESSURE IN PSI

22. PRIOR TO ANY TESTING, ALL MAINS 3" IN DIA. AND LARGER SHALL HAVE A LINE SIZE SWAB PASSED THRU THE ENTIRE LENGTH OF THE LINE. NOTE: SWAB SHOULD BE PLACED IN 1st. JOINT OF NEW LINE. END OF MAIN SHOULD BE "TURNED UP" AT 45% AND EXTENDED SO THAT SWABBING AND A FULL BORE FLUSH CAN BE ACCOMPLISHED. BLOW-OFF ASSY CAN THEN BE PLACED. WHERE LINES BRANCH, SWABS WILL BE PLACED IN BRANCH LINES AND SEQUENTIALLY SWABBED AND FLUSHED.
23. TEN FEET MINIMUM HORIZONTAL AND 12 INCHES MINIMUM VERTICAL SEPARATION SHALL BE MAINTAINED BETWEEN THE WATER MAIN AND ANY WASTWATER LINES. THE DISTANCE SHALL BE MEASURED FROM OUTSIDE OF PIPE TO OUTSIDE OF PIPE OR STRUCTURE. WHERE THIS MINIMUM SEPARATION CANNOT BE MAINTAINED, THE CROSSING SHALL BE ARRANGED SO THAT THE WASTEWATER PIPE JOINTS AND THE WATER MAIN PIPE JOINTS ARE EQUIDISTANT FROM THE POINT OF CROSSING, AND THE WATER MAIN SHALL BE CONSTRUCTED OF DUCTILE IRON PIPE (DIP) AT THE CROSSING. SUFFICIENT LENGTHS OF DIP MUST BE USED TO PROVIDE A MINIMUM SEPARATION OF 10 FEET BETWEEN ANY TWO JOINTS. ALL JOINTS ON THE WATER MAIN WITHIN 20 FEET OF THE CROSSING MUST BE MECHANICALLY RESTRAINED. A MINIMUM VERTICAL CLEARANCE OF 6 INCHES MUST BE MAINTAINED AT ALL CROSSINGS.
24. WHERE A WATER MAIN IS TO BE INSTALLED BELOW A STORM DRAIN PIPE, A MINIMUM OF 6 INCHES OF VERTICAL CLEARANCE BETWEEN PIPES SHALL BE CONSTRUCTED OF DIP AT THE CROSSING, AND SHALL BE MECHANICALLY RESTRAINED WITHIN 20 FEET OF THE CROSSING.
25. CONTRACTOR SHALL COMPLY WITH FLORIDA TRENCH SAFETY ACT REQUIREMENTS.

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

WATER DISTRIBUTION NOTES

DATE: OCTOBER 2016
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SHEET NUMBER 2

STANDARD SEPARATION STATEMENT FOR WATER / SEWER CONFLICTS

1. SANITARY SEWER FORCE MAINS, AND STORM SEWERS SHOULD CROSS UNDER WATER MAINS WHENEVER POSSIBLE. SANITARY SEWERS, FORCE MAINS AND STORM SEWERS CROSSING WATER MAINS SHALL BE LAID TO PROVIDE A MINIMUM VERTICAL DISTANCE OF 18 INCHES BETWEEN THE INVERT OF THE UPPER PIPE AND THE CROWN OF THE LOWER PIPE WHENEVER POSSIBLE.

   WHERE SANITARY SEWER, FORCE MAINS, STORM SEWERS MUST CROSS A WATER MAIN LESS THAN 18 INCHES VERTICAL DISTANCE, BOTH THE SEWER AND WATER MAIN SHALL BE CONSTRUCTED OF DUCTILE IRON PIPE (DIP) AT THE CROSSING. (DIP IS NOT REQUIRED FOR STORM SEWERS.) SUFFICIENT LENGTHS OF DIP MUST BE USED TO PROVIDE A MINIMUM SEPARATION OF 10 FEET BETWEEN TWO JOINTS. ALL JOINTS ON THE WATER MAIN WITHIN 20 FEET OF THE CROSSING MUST BE MECHANICALLY RESTRAINED. A MINIMUM VERTICAL CLEARENCE OF 6 INCHES MUST BE MAIN-AINED AT ALL CROSSINGS.

   ALL CROSSINGS SHALL BE ARRANGED SO THAT THE SEWER PIPE JOINTS AND WATER MAIN PIPE JOINTS ARE EQUIDISTANT FROM THE POINT OF CROSSING (PIPES CENTERED ON THE CROSSING)

   WHERE A NEW PIPE CONFLICTS WITH AN EXISTING PIPE WITH LESS THAN 18 INCHES VERTICAL CLEARANCE, THE NEW PIPE SHALL BE CONSTRUCTED OF DIP (EXCEPT STORM SEWERS) AND NEW PIPES SHALL BE ARRANGED TO MEET THE CROSSING REQUIREMENTS ABOVE.

2. A MINIMUM 10-FOOT HORIZONTAL SEPARATION SHALL BE MAINT-AINED BETWEEN ANY TYPE OF SEWER AND WATER MAIN IN PARALLEL INSTALLATIONS WHENEVER POSSIBLE.

   IN CASES WHERE IT IS NOT POSSIBLE TO MAINTAIN A 10-FOOT HORIZONTAL SEPARATION, THE WATER MAIN MUST BE LAID IN A SEPARATE TRENCH OR ON A UNDISTURBED EARTH SHELF LOCATED ON ONE SIDE OF THE SEWER OR FORCE MAIN AT SUCH AN ELEVATION THAT THE BOTTOM OF THE WATER MAIN IS AT LEAST 18 INCHES ABOVE THE TOP OF THE SEWER.

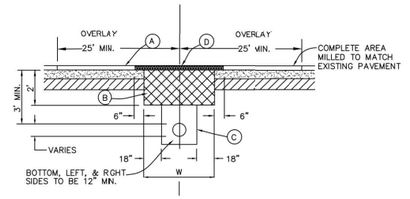
   WHERE IT IS NOT POSSIBLE TO MAINTAIN A VERTICAL DISTANCE OF 18 INCHES IN PARALLEL INSTALLATIONS, THE WATER MAIN SHALL BE CONSTRUCTED OF DIP AND THE SEWER OR THE FORCE MAIN SHALL BE CONSTRUCTED OF DIP (EXCEPT STORM SEWER) WITH A MINIMUM VERTICAL DISTANCE OF 6 INCHES. THE WATER MAIN SHOULD ALWAYS BE ABOVE THE SEWER. JOINTS ON THE WATER MAIN SHALL BE LOCATED AS FAR APART AS FOSSIBLE FROM JOINTS ON THE SEWER OR FORCE MAIN (STAGGERED JOINTS).

3. ALL DIP SHALL BE PRESSURE CLASS 350 MIN.. ADEQUATE PROTECTIVE MEASURES AGAINST CORROSION SHALL BE USED AS DETERMINED BY THE DESIGN ENGINEER.

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

WATER and SEWER CONFLICT NOTES

DATE: OCTOBER 2016
FILE NAME: 2016 COS Std Details.dwg
SHEET NUMBER 4



A. OVERLAY SHALL EXTEND BEYOND TRENCH WALL ON BOTH SIDES OF ROAD CUT. MINIMUM TYPE S-III ASPHALT OR MATCH EXISTING SURFACE MATERIAL WHEN POSSIBLE.

B. CONSTRUCT 2.0' DEEP X WIDTH AND LENGTH OF TRENCH WITH CEMENTED COQUINA OR LIMEROCK. SEE SPECIFICATIONS #2 BELOW FOR COMPACTION REQUIREMENTS.

C. PROVIDE CLEAN BACKFILL. BACKFILL SHALL BE REPLACED IN 6" LAYERS. EACH LAYER SHALL BE MECHANICALLY COMPACTED TO A MINIMUM 98% DENSITY AS DETERMINED BY AASHTO T-180.

D. DITCH WIDTH (W)+12", MATCH EXISTING TYPE AND THICKNESS OF ASPHALT OR TYPE S-III.

NOTES:

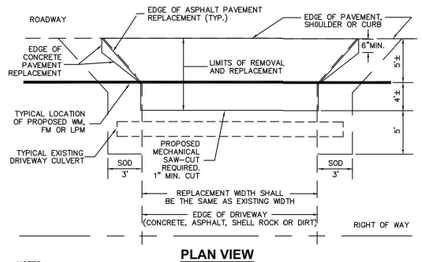
1. REPLACED BASE MATERIAL OVER DITCH SHALL BE AS SHOWN ABOVE.
2. BASE MATERIAL SHALL BE PLACED IN 6" LAYERS OR AS OTHERWISE APPROVED AND EACH LAYER THOROUGHLY MECHANICALLY COMPACTED TO (98%) DENSITY AS DETERMINED BY AASHTO T-180.
3. FINAL ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MILLED TO MATCH EXISTING ASPHALT.
4. ALL PAVEMENT JOIN'S SHALL BE MECHANICALLY SAWED 90 DEGREES.
5. SURFACE MATERIAL WILL BE CONSISTENT WITH EXISTING SURFACE OR AS OTHERWISE DIRECTED (TYPE S-III) AND PLACED IN ACCORDANCE WITH FDOT REQUIREMENTS.
6. A MINIMUM OF TWO DENSITY TESTS SHALL BE TAKEN FOR EACH SIX (6) INCH LIFT OF SUBGRADE AND EACH OPEN CUT CROSSING. WHEN THE SPECIFIED COMPACTED BASE IS GREATER THAN SIX AND ONE-HALF (6-1/2) INCHES THE BASE SHALL BE CONSTRUCTED IN TWO OR MORE COURSES. PROCTORS FOR MATERIALS USED IN BACK-FILLING SHALL BE OBTAINED BY A CERTIFIED LABORATORY. DENSITY TESTS SHALL BE CONDUCTED BY A CERTIFIED LABORATORY OR THE PERMITTEE'S CONSULTANTS. THE FERCENTAGE OF MAXIMUM DENSITY REQUIRED SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE FLORIDA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS. A COPY OF ALL COMPLETED AND ACCEPTED DENSITY TESTS SHALL BE FURNISHED TO THE PUBLIC WORKS DEPT. AND/OR THE ENGINEER OF RECORD.

CITY OF STUART PAVEMENT RESTORATION DETAIL (ASPHALT)

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

PAVEMENT RESTORATION DETAIL (ASPHALT)

DATE: OCTOBER 2016
FILE NAME: 2016 COS Std Details.dwg
SHEET NUMBER 7



PLAN VIEW

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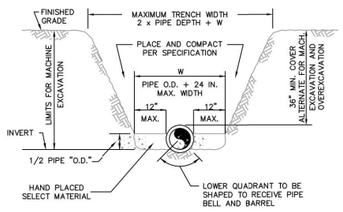
1. ALL DRIVEWAYS SHALL BE REPLACED WITH MATERIAL OF THE SAME TYPE AND COMPOSITION AS THE MATERIAL REMOVED, TO THE LIMITS OF THE EXISTING DRIVE.
2. ALL CONCRETE DRIVEWAYS WITHIN THE CITY OF STUART SHALL BE 6" THICK, 4000 PSI FIBER MESH CONCRETE. THE SUB-GRADE FOR THE CONCRETE SHALL BE 6" SAND OR OTHER APPROVED MATERIAL COMPACTED TO 98% MAXIMUM DENSITY PER ASSHTO T-180
3. ALL ASPHALT DRIVEWAYS SHALL BE 1" TYPE S-1 AND 6" COMPACTED LINEROCK BASE.
4. SAW-CUT AND REMOVE ALL EXISTING DRIVEWAYS TO LIMITS AND REPLACE TO SAME GRADE AND LINES AS ORIGINAL. CONCRETE DRIVEWAYS SHOULD BE REMOVED TO THE NEAREST EXISTING JOINT TO E.O.P.(EDGE OF PAVEMENT).
5. SOD 3' MINIMUM OUTSIDE OF EDGE OF REPLACED DRIVEWAY AND ALL DISTURBED AREAS.
6. ROCK/SHELL AND DIRT DRIVEWAYS SHALL BE COMPACTED TO 98% MAXIMIM DENSITY PER ASHTO T-180. ROCK/SHELL DEPTH SHALL BE SIX INCHES, COMPACTED DEPTH.
7. CONTRACTOR SHALL REPLACE ALL DRIVEWAYS IN KIND, IN ACCORDANCE WITH THIS DETAIL, THE SPECIFICATIONS OR THE CITY OF STUARTS STANDARDS, WHICHEVER IS THE MOST STRINGENT.
8. NEW DRIVEWAYS SHALL BE SLOPED IN A WAY THAT WILL NOT ALLOW PONDING OF STORM WATER.
9. CONTRACTOR SHALL DISPOSE OF ALL REMOVED MATERIAL IN A SUITABLE FASHION IN ACCORDANCE WITH ALL CITY, COUNTY AND STATE REGULATIONS.
10. FOR ASPHALT DRIVEWAYS, THE BASE SHALL EXTEND SIX INCHES BEYOND THE ASPHALT OVERLAY.
11. ALL ASPHALT DRIVEWAYS SHALL BE OVERLAYED WITHIN THE LIMITS OF THE RIGHT-OF-WAY.

TYPICAL DRIVEWAY RESTORATION

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
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TYPICAL DRIVEWAY RESTORATION

DATE: OCTOBER 2016
FILE NAME: 2016 COS Std Details.dwg
SHEET NUMBER 8



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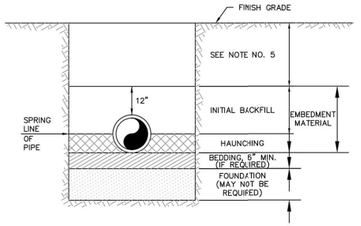
1. THE CONTRACTOR SHALL COMPLY WITH REQUIREMENTS OF THE FLORIDA TRENCH SAFETY ACT.
2. INITIAL BACKFILL SHALL BE HAND PLACED TO 12" ABOVE THE PIPE. BACKFILL SHALL BE MECHANICALLY TAMPED TO A MINIMUM OF 90% OF MAX. DENSITY AS DETERMINED BY AASHTO METHOD T-180.

TYPICAL TRENCH DETAIL

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

TYPICAL TRENCH DETAIL

DATE: OCTOBER 2016
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SHEET NUMBER 9



NOTES:

1. IN CERTAIN SOIL CONDITIONS A FOUNDATION MAY BE REQUIRED.
2. BEDDING IS REQUIRED PRIMARILY TO BRING THE TRENCH BOTTOM UP TO GRADE. BEDDING MATERIALS SHALL PROVIDE A UNIFORM AND ADEQUATE LONGITUDINAL SUPPORT UNDER THE PIPE.
3. HAUNCHING MATERIAL SHALL BE HAND PLACED TO THE SPRINGLINE OF THE PIPE. MATERIAL SHALL BE CONSOLIDATED UNDER THE PIPE AND HAND TAMPED TO PROVIDE ADEQUATE SIDE SUPPORT.
4. INITIAL BACKFILL MATERIAL SHALL BE HAND PLACED TO 12" ABOVE THE TOP OF PIPE AND BE COMPACTED USING A HAND OPERATING TAMPING DEVICE.
5. BACKFILL SHALL BE COMPACTED TO 98% OF MAX. DENSITY AS PER AASHTO T-180.
6. DENSITY TEST SHALL BE PREFORMED AT AREAS DETERMINED BY THE DESIGN ENGINEER OR PERMIT AGENCY HAVING JURISDICTION.

BACKFILLING REQUIREMENTS OVER CITY OF STUART UTILITIES

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

BACKFILLING REQUIREMENTS

DATE: OCTOBER 2016
FILE NAME: 2016 COS Std Details.dwg
SHEET NUMBER 10

MIN. LENGTH (IN FEET) OF PIPE TO BE RESTRAINED

(SOURCES: EBAA IRON RESTRAINT LENGTH CALCULATION PROGRAM FOR PVC PIPE, RELEASE 3.1, AND DIPRA THRUST RESTRAINT FOR DUCTILE IRON PIPE, RELEASE 3.2)

FITTING TYPE		PIPE SIZE 4"	6"	8"	10"	12"	16"	20"	24"
90° HORIZ. BEND		14	20	25	30	35	45	54	62
45° HORIZ. BEND		6	8	11	13	15	19	22	26
22.5° HORIZ. BEND		3	4	5	6	7	9	11	12
11.25° HORIZ. BEND		1	2	3	3	4	4	5	6
90° VERT. OFFSET	UPPER BEND	29	41	53	64	74	95	115	134
	LOWER BEND	7	10	13	16	19	25	30	35
45° VERT. OFFSET	UPPER BEND	12	19	24	29	34	39	48	56
	LOWER BEND	3	4	6	7	8	10	12	15
22.5° VERT. OFFSET	UPPER BEND	6	9	12	14	17	19	23	27
	LOWER BEND	1	2	4	4	4	5	6	7
11.25° VERT. OFFSET	UPPER BEND	3	4	6	7	8	9	11	13
	LOWER BEND	1	1	1	2	2	2	3	3
PLUG (DEAD END)		32	45	59	70	83	107	129	151
IN-LINE VALVE		32	45	45	45	45	55	65	80
TFF (BRANCH RESTRAINT)	4"X ø	23	–	–	–	–	–	–	–
	6"X ø	21	35	–	–	–	–	–	–
	8"X ø	18	34	47	–	–	–	–	–
	10"X ø	16	32	46	58	–	–	–	–
	12"X ø	13	30	44	57	69	–	–	–
	16"X ø	7	26	41	56	67	90	–	–
	20"X ø	1	21	38	52	65	88	109	–
	24"X ø	1	16	34	49	62	86	108	129
	30"X ø	1	8	28	44	58	83	106	127
	36"X ø	1	1	22	39	54	80	103	124
	42"X ø	1	1	15	33	49	77	100	122
	48"X ø	1	1	7	27	44	73	97	120
REDUCER (LARGER PIPE RESTRAINT)	6"X ø	23	–	–	–	–	–	–	–
	8"X ø	38	25	–	–	–	–	–	–
	10"X ø	57	43	24	–	–	–	–	–
	12"X ø	72	60	44	41	–	–	–	–
	16"X ø	99	90	78	75	45	–	–	–
	20"X ø	123	116	107	105	81	45	–	–
	24"X ø	146	140	132	131	111	82	45	–

NOTES:
1. THE DATA IN THE ABOVE TABLE ARE BASED UPON THE FOLLOWING INSTALLATION CONDITIONS:
   SOIL TYPE-SAND TEST PRESSURE-150 PSI DEPTH OF BURY-3'
   TRENCH TYPE-3 SAFETY FACTOR- 1.5 VERTICAL OFFSET-3'
   MINIMUM PIPE LENGTH ALONG TEE RUN-5'
2. THE RESTRAINED PIPE LENGTHS APPLY TO DUCTILE IRON AND PVC PIPE.
3. ALL JOINTS BETWEEN UPPER AND LOWER BENDS SHALL BE RESTRAINED.
4. RESTRAINED PIPE LENGTHS APPLY TO PIPE ON BOTH SIDES OF VALVES AND FITTINGS.

STANDARD UTILITY DETAILS
City of Stuart Public Works Department
121 S.W. Flagler Avenue, Stuart, Florida 34994
(772) 288-5300

MECHANICAL JOINT REQUIREMENTS NOTES

DATE: OCTOBER 2016
FILE NAME: 2016 COS Std Details.dwg
SHEET NUMBER 12

DATE	BY	REVISIONS

Date: 12/20/19
Scale: AS NOTED
Design By: CM
Drawn By: RR
Check By: DH

CITY OF STUART
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

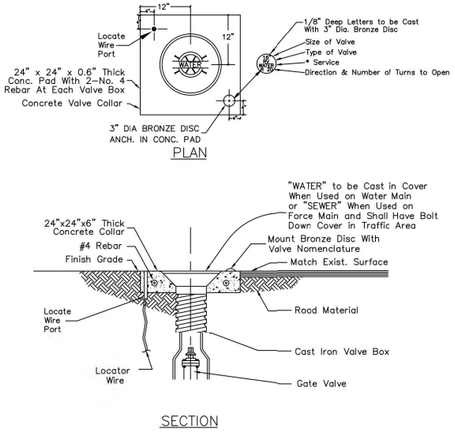
DETAILS

HOLTZ CONSULTING ENGINEERS, INC.
607 SW ST. LUCIE CRESCENT, SUITE 103
STUART, FLORIDA 34994
PH. (772) 919-4905
Cert. No. 26960

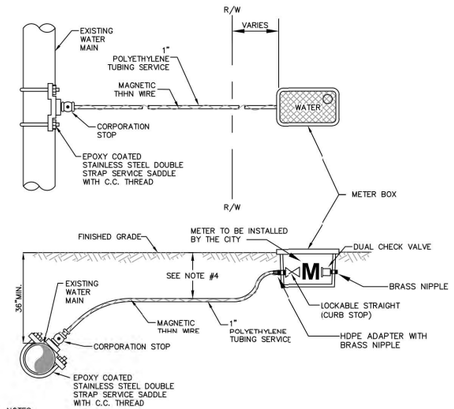
CHRISTINE J. MIRANDA, P.E.
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D-1

Drawing Name: P:\PROJECTS\City of Stuart\WA #6 - Monterey Rds. Subdivision\Design\Drawings\DETAILS.dwg - Layout Name: DET 01 - Plotted by: Russell Ryan - Date: 12/23/2019 - 11:13 AM - Holtz Consulting Engineers



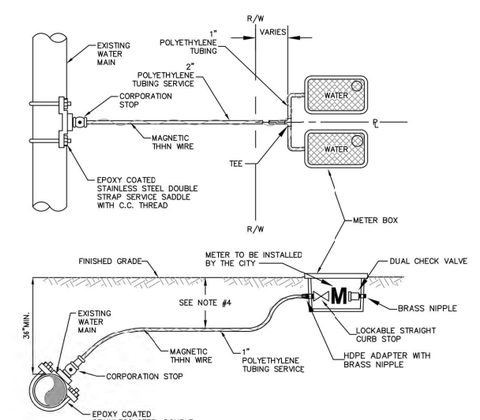
CONCRETE VALVE COLLAR



NOTES:

1. BLUE 10 GAUGE THHN WIRE SHALL BE ATTACHED TO THE SERVICE LINE.
2. WHERE SERVICES UNDER PAVEMENT ARE REQUIRED, THE POLYETHYLENE TUBING SHALL BE INSTALLED WITHIN SCHEDULE 40 PVC CASING PIPE.
3. 3/4"& 1" METER SIZES SHALL REQUIRE A LOCKABLE CURB STOP.
4. MINIMUM COVER IN UNPAVED AREAS IS 18", IN PAVED AREAS OR PLANNED ROADWAYS OR SWALES MIN. COVER SHALL BE 36".

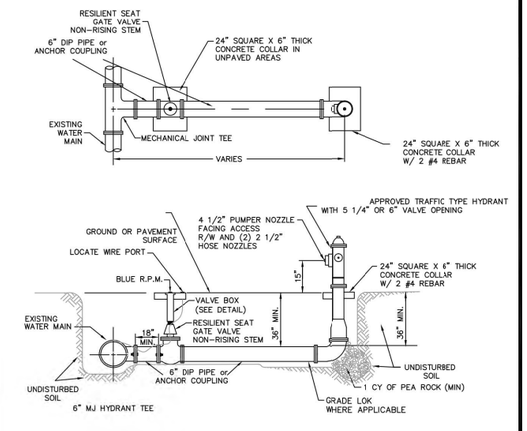
TYPICAL SINGLE WATER SERVICE CONNECTION



NOTES:

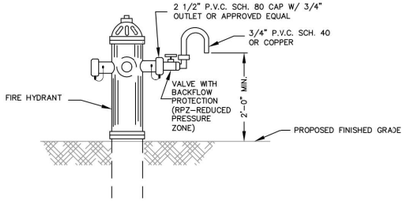
1. BLUE 10 GAUGE THHN WIRE SHALL BE ATTACHED TO THE SERVICE LINE.
2. WHERE SERVICES UNDER PAVEMENT ARE REQUIRED, THE POLYETHYLENE TUBING SHALL BE INSTALLED WITHIN SCHEDULE 40 PVC CASING PIPE.
3. 3/4" & 1" METER SIZES SHALL REQUIRE A LOCKABLE CURB STOP.
4. MINIMUM COVER IN UNPAVED AREAS IS 18", IN PAVED AREAS OR PLANNED ROADWAYS OR SWALES MIN. COVER SHALL BE 36".

TYPICAL DOUBLE WATER SERVICE CONNECTION



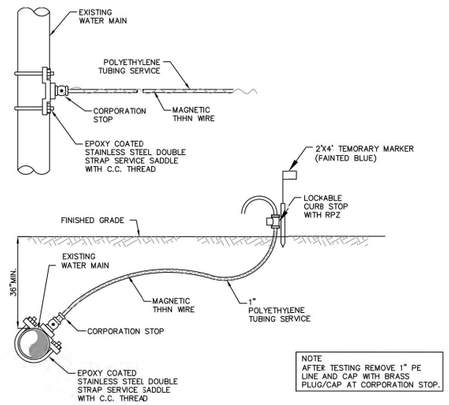
1. HYDRANT SHALL BE INSTALLED PLUMB & TRUE.
2. HYDRANT SHALL BE PAINTED FROM FACTORY.
3. HEEL TO REST IN UNDISTURBED SOIL.
4. HYDRANT ASSEMBLY MUST BE RESTRAINED TO TEE.
5. ALL FITTINGS TO BE MECHANICAL JOINT.
6. ENTIRE ASSEMBLY TO BE MECHANICALLY RESTRAINED.
7. ALL HYDRANTS ARE TO UTILIZE ANCHOR COUPLINGS, WHEN APPLICABLE.

TYPICAL FIRE HYDRANT ASSEMBLY



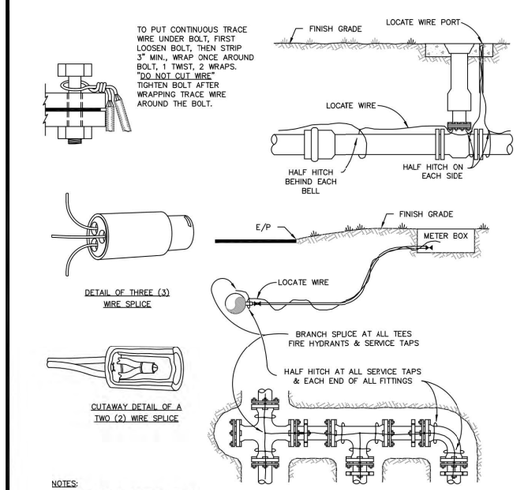
BACTERIOLOGICAL SAMPLING POINT @ FIRE HYDRANT

NOTE: ADD LAMINATED SIGN NOTING THAT "TESTING IS IN PROGRESS" WHILE SAMPLE POINT IS IN SERVICE.



BACTERIOLOGICAL SAMPLING POINT DETAIL

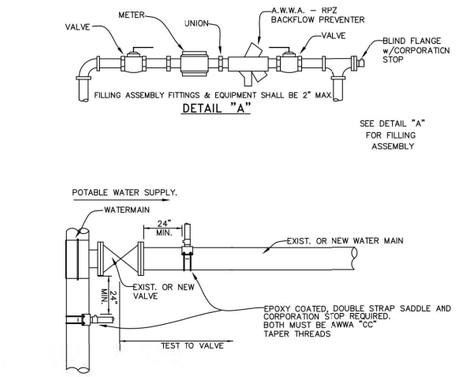
NOTE: ADD LAMINATED SIGN NOTING THAT "TESTING IS IN PROGRESS – DO NOT DISTURB" WHILE SAMPLE POINT IS IN SERVICE.



NOTES:

1. LOCATE WIRE IS REQUIRED ON ALL PIPE AS NOTED BY UTILITIES ENGINEER, AND SHOWN IN STANDARD DETAILS.
2. INCLUDE ALL COST OF MATERIAL & LABOR IN PRICE OF PIPE.
3. CONTRACTOR IS RESPONSIBLE FOR CONTINUITY OF ALL LOCATE WIRE.

LOCATE WIRE DETAIL



NOTES:

1. GATE VALVE SHALL BE KEPT CLOSED.
2. DEPARTMENT SHALL BE NOTIFIED BEFORE FILLING AND FLUSHING.
3. AFTER BACTERIOLOGICAL CLEARANCE, GATE VALVE IS TO BE OPEN WITH VALVE BOX.
4. PRESSURE TEST PUMP CONNECTS TO SERVICE LINE OR BLOWOFF. NO EXTRA TAPS ARE PERMITTED.
5. PRESSURE GAUGE TO BE LOCATED IN VICINITY OF TEST PUMP CONNECTION.
6. GAUGE AND RISER TO BE REMOVED AFTER PRESSURE TEST.
7. REMOVE TEMPORARY CONNECTION AT CORPORATION STOPS AFTER FILLING & FLUSHING HAS BEEN COMPLETED.
8. INJECT CHLORINE ON PROJECT SIDE OF BACKFLOW PREVENTER.
9. MUST OBTAIN METER AND BACKFLOW ASSEMBLY FROM CITY OF STUART. PRIOR TO INSTALLATION.

FILLING AND FLUSHING CONNECTION

DATE	BY	REVISIONS

Date: 12/20/19
Scale: AS NOTED
Design By: CM
Drawn By: RR
Check By: DH

CITY OF STUART
MONTEREY ROAD SUBDIVISION
WATER MAIN IMPROVEMENTS

DETAILS

HOLTZ CONSULTING ENGINEERS, INC.
607 SW ST. LUCIE CRESCENT, SUITE 103
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Cert. No. 26960

CHRISTINE J. MIRANDA, P.E.
License No: 60906

D-2

Drawing Name: F:\PROJECTS\City of Stuart\Wtr & Ff - Monterey Rd. Subdivision\Design\Drawings\DETAILS.dwg Layout Name: DET 02 – Plotted by: Russell Ryan – Date: 12/23/2019 – 11:13 AM – Holtz Consulting Engineers

Chapter 6.0 Implementation and Compliance

6.1 Public Hearing/Dedicated Revenue Hearing

The public hearing on the Facilities Plan for the City of Stuart Water Main Replacement Project was held on July 5, 2018. The meeting advertisement, proof of publication, minutes, sign-in sheet and other documentation is included in **Appendix C**. The public hearing for the amended Facilities Plan will be held in January 2020. The supporting information for the second public hearing will be provided upon completion of the meeting.

6.2 Regulatory Agency Review

To qualify for a loan from the Florida Department of Environmental Protection State Revolving Fund, various government agencies must be satisfied with the recommended alternative for the City of Stuart water system. Copies of the facilities plan adopted by the City Council will be sent to the following government agencies for review and comment.

1. Florida Department of Environmental Protection
2. Florida Department of Health
3. South Florida Water Management District
4. U.S. Environmental Protection Agency
5. Treasure Coast Regional Planning Council
6. State of Florida, State Clearinghouse

6.3 Financial Planning

The Department of Environmental Protection's State Revolving Fund is expected to be the financing source for the project. The Drinking Water State Revolving Fund Business Plan is provided in **Appendix D**.

6.4 Implementation

The City of Stuart has the sole responsibility and authority to implement the recommended facilities. The City of Stuart has an inter-local agreement with Martin County to provide drinking water services within the incorporated areas outside of the City's service area and within unincorporated areas of Martin County. However, the project area referenced within this plan are within the City of Stuart's service area.

6.5 Implementation Schedule

The implementation schedule for the project is as follows:

May 2018 – Submit Water Facilities Plan to Florida Department of Environmental Protection and other governmental agencies.

June 2018 - Hold public hearing on facilities plan and business plan.

June 2018 – Submit plans and specifications for pretreatment system (Phase 1) to FDEP for review.

August 2018 – Be on the agenda for approval at the SRF hearing for a construction loan for the Phase 1 pretreatment system and a design loan for Phase 2A and 2B of the alternative water supply project.

September 2018 – Sign State Revolving Fund loan agreements.

September 2018 – Start project construction of the Phase 1 pretreatment system.

May 2019 – Submit plans and specifications for Phase 2A and 2B of the alternative water supply project to FDEP for review.

June 2019 – Complete construction of the Phase 1 pretreatment system project.

July 2019 – Certify operational performance of the Phase 1 pretreatment system project and complete close-out project documentation.

August 2019 - Be on the agenda for approval at the SRF hearing for a construction loan of Phase 2A and Phase 2B of the alternative water supply project and a design loan for Phase 2C of the alternative water supply project.

September 2019 – Sign State Revolving Fund loan agreements.

September 2019 – Start project construction of Phase 2A and 2B of the alternative water supply project.

January 2020 – Submit Request for Inclusion, Amended Facilities Plan, and plans and specifications for the Monterey Subdivision water main improvements

February 2020 – Be on the agenda for approval at the SRF hearing for a construction loan for the Monterey Subdivision water main improvements

March 2020 – Sign State Revolving Fund loan agreements

March 2020 – Start project construction of the Monterey Subdivision water main improvements

July 2020 – Complete construction of the Monterey Subdivision water main improvements

August 2020 – Certify operational performance of the Monterey Subdivision water main improvements and complete project close out documentation

TBD – Submit plans and specifications of Phase 2C of the alternative water supply project to FDEP for review.

TBD - Complete construction of Phase 2A and 2B of the alternative water supply project.

TBD – Certify operational performance of Phase 2A and 2B of the alternative water supply project and complete close-out project documentation.

TBD – Start project construction of Phase 2C of the alternative water supply project.

TBD - Complete construction of Phase 2C of the alternative water supply project.

TBD - Certify operational performance of Phase 2C of the alternative water supply project and complete close-out project documentation.

2027 – Complete Phase 3 of the alternative water supply project.

2032 – Complete Phase 4 of the alternative water supply project.

6.6 Compliance

1. The treated drinking water delivered via the selected alternative will be in compliance with Florida Department of Environmental Protection drinking water standards.

2. The selected alternatives will meet the reliability requirements as per Chapter 62-555, F.A.C.

3. The environmental aspects of the proposed facilities are satisfactory.

4. The recommended facilities are consistent with the City's Comprehensive Plan.