Conceptual Design Report for the Sustainable Water Infrastructure Project

March 2018

Prepared for:
City of Santa Monica

Prepared by:
Stantec
300 N Lake Ave, Suite 400
Pasadena, CA 91101

Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board. California's Clean Water State Revolving Fund is capitalized through a variety of funding sources, including grants from the United States Environmental Protection Agency and state bond proceeds. The contents of this document do not necessarily reflect the views and policies of the foregoing, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Prepared by ______________________
(signature)

R. Tyler Hadacek

Reviewed by ______________________
(signature)

Areeba Syed

Approved by ______________________
(signature)

Jim Borchardt

REGISTERED PROFESSIONAL ENGINEER
JAMES H. BORCHARDT
No. 35819
Exp. 6/30/19
CIVIL
STATE OF CALIFORNIA

Stantec

City of Santa Monica

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

Note: The aerial images in the figures of this report are courtesy of Google and Google Earth software; Map data: Google, DigitalGlobe.

LIST OF APPENDICES

Abbreviations

ADA	American with Disabilities Act
ACH	Air Changes per Hour
AFY	Acre-feet per year
AOP	Advanced Oxidation Process
AWTF	Advanced Water Treatment Facility
BLS	Broadway Lift Station
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CBC	California Building Code
CBI	Clean Beaches Initiative
CCR	California Code of Regulations
CFS	Cubic feet per second
CIP	Clean-In-Place
COD	Chemical Oxygen Demand
CSB	City Services Building
CWSRF	Clean Water State Revolving Fund
DAF	Dissolved Air Flotation
DDW	State Water Resources Control Board Division of Drinking Water
DFA	Division of Financial Assistance
DO	Dissolved Oxygen
ECLS	Early Childhood Lab School
EED	Electrical Energy Dose
EV	Electric Vehicle
EWMP	Enhanced Watershed Management Plan
FCLS	First Court Lift Station
GAC	Granular Activated Carbon
GRRP	Groundwater Replenishment Reuse Project
HEM	Oil and Grease (n-Hexane Extractable Material)
HMI	Human Machine Interface
HRT	Hydraulic Retention Time
HVAC	Heating, Ventilation, and Air Conditioning
IPR	Indirect Potable Reuse
ISO	International Standards Organization
LARWQCB	Los Angeles Regional Water Quality Control Board
LCP	Local Control Panel
LS	Lift Station
MAPS	Moss Avenue Pump Station
MBR	Membrane Bioreactor
MCC	Motor Control Center
MCL	Maximum Contaminant Level

MGD	Million Gallons per Day
MH	Manhole
MLSS	Mixed Liquor Suspended Solids
MPDLS	Memorial Park Drain Lift Station
MPN	Most Probable Number
ND	Non-detect
NEC	National Electrical Code
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
NWRI	National Water Research Institute
OALS	Ocean Avenue Lift Station
ORP	Oxidation Reduction Potential
PBLS	Pico Boulevard Lift Station
PLC	Programmable Logic Controller
PV	Photovoltaic
PVC	Polyvinyl Chloride
RAS	Return Activated Sludge
RED	Reduction Equivalent Dose
RO	Reverse osmosis
RFP	Request for Proposals
RTU	Remote Terminal Unit
SMBLS	Santa Monica Boulevard Lift Station
SCADA	Supervisory Control and Data Acquisition
SCE	Southern California Edision
SMURRF	Santa Monica Urban Runoff Recycling Facility
SRT	Solids Retention Time
SWIP	Sustainable Water Infrastructure Project
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TMP	Transmembrane Pressure
UF	Ultrafiltration
UPS	Uninterruptible Power Supply
UV	Ultraviolet
UVT	UV Transmittance
VCP	Vendor Control Panel
VFD	Variable Frequency Drive
VPN	Virtual Private Network
WAS	Waste Activated Sludge
WDR/WRR	Waste Discharge/Water Recycling Requirements
WTP	Water Treatment Plant

1.0 INTRODUCTION

1.1 BACKGROUND

To achieve long term sustainability and drought resilience, the City of Santa Monica (the City) recognizes it must utilize all of its water resources including recycled municipal wastewater, stormwater runoff, and brackish/saline impaired groundwater. The City's Sustainable Water Infrastructure Project (SWIP) will harvest and integrate these three valuable resources to produce approximately 1,680 acre-feet per year (AFY) of advanced treated water. The SWIP takes a forward thinking approach to help secure the City's water future by extensive use of existing City infrastructure, and by linking together three distributed water reuse elements into a single cohesive new water supply. The SWIP will produce water of advanced treated quality that, when properly permitted, will be acceptable for indirect potable reuse via groundwater recharge. In the interim, the water will be used to reduce the use of potable water by meeting existing recycled water demands, such as irrigation, street cleaning, and toilet flushing.

1.2 PURPOSE OF REPORT

The purpose of this report is to describe the proposed facilities and conceptual design concepts for the SWIP facilities. It provides guidance for subsequent development of detailed design documents and construction planning. All information contained within this conceptual document will be verified and fully developed during project implementation. During implementation, the project will need to meet the State Revolving Fund Requirements, Envision Requirements and other design requirements as specified by the City.

1.3 SWIP CONCEPTUAL DESIGN REPORT ELEMENTS

The SWIP is organized into three Elements. An overview of the SWIP Element locations can be found in Figure 1-1. This shows the Element proximity in relation to the City as well as the location of the Pico-Kenter outfall.

Element 1 will consist of the installation of a modular containerized reverse osmosis (RO) treatment unit at the City's existing Santa Monica Urban Runoff Recycling Facility (SMURRF), enclosing the effluent clearwell, new solar panels and other facility improvements. The SMURRF currently reclaims and recycles urban runoff and low flow stormwater runoff for non-potable reuse. This water would otherwise reach the ocean and impact water quality. The SWIP helps improve beach water quality by treating some of this water for reuse. Part of Element 1 will also include solar panels to offset grid energy used at the SMURRF.

Figure 1-1 SWIP Element Locations

Element 1 leverages the separate, recently funded, and currently under construction Clean Beaches Initiative (CBI) stormwater tank project by treating stormwater harvested from the City's 106-acre Pier Drainage Area. The 1.6 MG CBI below grade tank project began construction in 2017 and will be commissioned in August 2018. A new substructure drain system in the CBI tank will collect brackish/saline groundwater as a secondary source of water for treatment and reuse when stormwater is scarce. In addition to servicing the City's current reclaimed water customer base, any surplus water from the upgraded SMURRF will be used for groundwater recharge when properly permitted. Advanced treated SMURRF water will be distributed via the City's existing recycled water (purple pipe) system.

Element 2 will consist of a new below grade advanced water treatment facility (AWTF) capable of harvesting and treating City municipal wastewater blended with stormwater to produce 1.0 MGD product water, when available. The proposed treatment represents approximately 10% of the City's total daily wastewater flow. The facility will be located beneath the City's Civic Center parking lot. Advanced treated water from the proposed recycled water treatment facility will be distributed via the City's existing recycled water system for immediate non-potable reuse, and when properly permitted, groundwater recharge.

Element 3 will consist of the installation of two below grade stormwater harvest tanks. One tank, sized at 1.5 MG, will be located adjacent to the AWTF beneath the Civic Center Parking Lot. The Civic Center Tank would harvest stormwater from the City's municipal separate storm sewer system (MS4) and surrounding drainage area. The Civic Center Tank would be plumbed to the proposed recycled water treatment facility, where it would convey stormwater for treatment.

The second tank will have a volume of 3.0 MG and will be located beneath the playing fields at the City's Memorial Park. After a storm event, the Memorial Park Tank will hold its captured water until there is capacity in the Civic Center Tank. Once monitoring devices signal there is capacity, the Memorial Park

Tank will divert is contents down the existing storm drains to the Civic Center Tank and conveyed to the new AWTF for treatment and distribution via the City's existing recycled water system. During times when stormwater is being treated, the automated treatment monitoring system will scale down the amount of municipal wastewater being treated for reuse. The goal is to capture and treat the maximum amount of wet-weather stormwater possible.

Due to their proximity within the same site area, the AWTF (Element 2) and Civic Center Tank (part of Element 3) are discussed within the same section of this report. It is anticipated that the Civic Center Tank and the AWTF will be constructed in coordination with one another.

The schematic in Figure 1-2 depicts an overview of the SWIP, including all three elements. Note that flows and as-built references for all SWIP components are not shown in Figure 1-2 on the following page, but are shown in the individual schematics in Section 3 and 4.

1.4 CONCEPTUAL DESIGN REPORT CONTENT

The conceptual design report contains the following content:

- Background information (Section 1)
- Conceptual design of the major project components, including conceptual level design criteria, layouts and schematic drawings, information for connection to source water and support utilities
    - SMURRF (Section 2)
    - Civic Center Tank & AWTF (Section 3)
    - Memorial Park tank (Section 4)
- Controls and operation strategy (Section 5)
- Proposed project implementation (Section 6)
- Concept Design Drawings (Appendix A, and Figures throughout Sections 2, 3, 4, and 5)
- Additional Water Quality Information (Appendix B)
- Outline of general requirements across design disciplines. (Appendix C)
    - City Standards
    - Civil
    - Process Mechanical
    - Structural
    - Electrical
    - Instrumentation and Controls
    - Architectural
- Conceptual pump station and conveyance calculations (Appendix D)
- Supplemental references, including as-built drawings, flow monitoring data, and select previous reports and studies (Appendix E)

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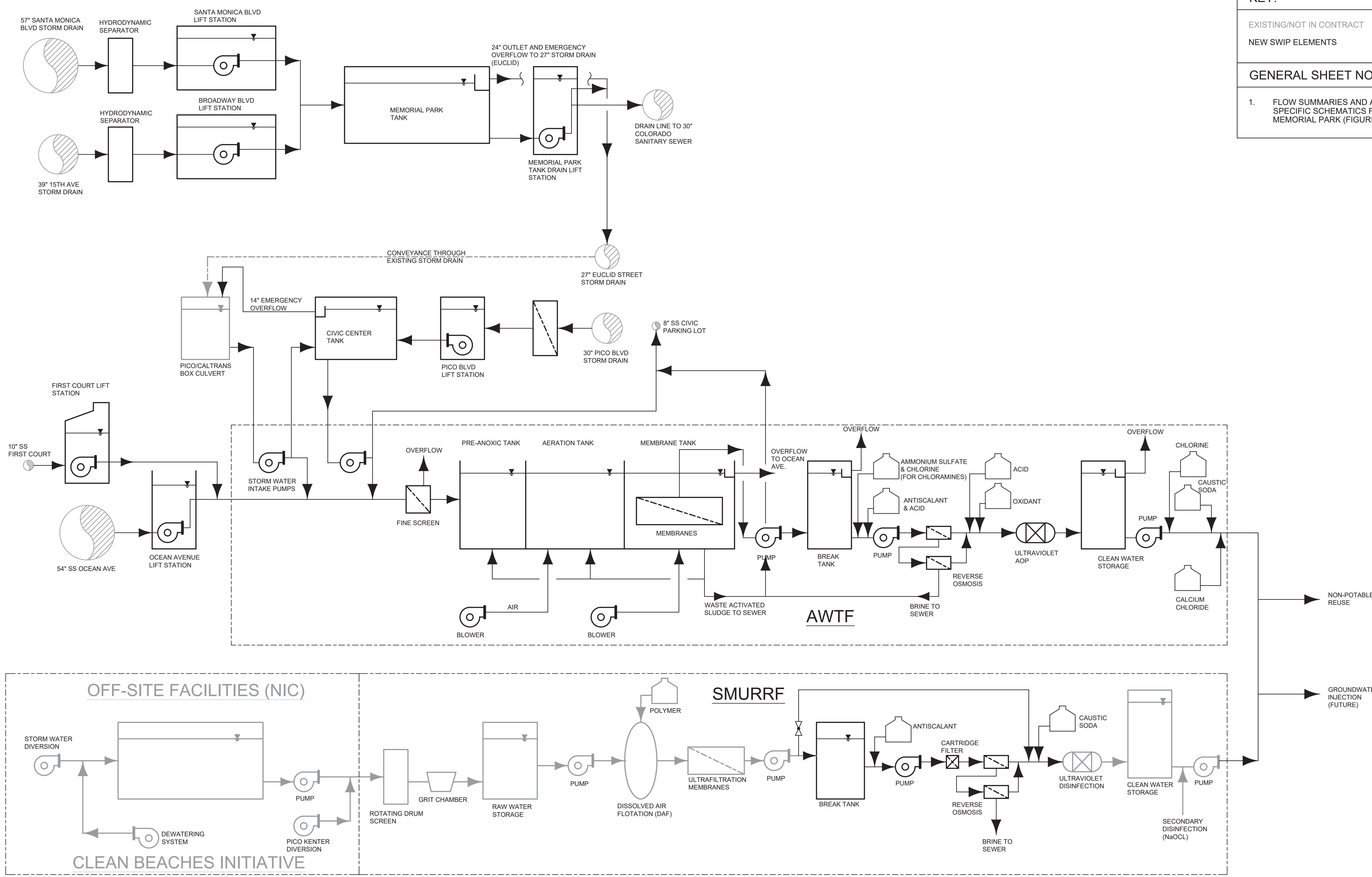
KEY:

EXISTING/NOT IN CONTRACT

NEW SWIP ELEMENTS

GENERAL SHEET NOTES

1. FLOW SUMMARIES AND AS-BUILT REFERENCES CAN BE FOUND IN SPECIFIC SCHEMATICS FOR CIVIC CENTER (FIGURE X-X AND MEMORIAL PARK (FIGURE X-X).



T-X

City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

Stantec

CONSULTANT

REVIEWED : DATE : ________ 20__
SELIM EREN, P.E. CIVIL ENGINEER
REVIEWED : DATE : ________ 20__
REVIEWED : DATE : ________ 20__

CITY CLIENTS

REFERENCE :
DATE : ________ 20__
SUBMITTED BY :
CURTIS CASTLE, P.E. PRINCIPAL CIVIL ENGINEER
APPROVED BY :
RICK VALTE, P.E., CIVIL ENGINEER
DATE : ________ 20__
COMPUTER FILE NAME:
SP-FILE NO.: SP 2456

CIVIL ENGINEERING SERVICES

SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 1-2
OVERALL SWIP SYSTEM SCHEMATIC

PROJECT AND SHEET TITLE

DESIGNED BY :
DRAWN BY :
CHECKED BY :
CONSULTANT JOB/SHEET NO.
DRAWING NO.
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2.0 SMURRF CONCEPTUAL DESIGN

Dry weather flows and runoff from some low intensity storm events at the Pier and Pico-Kenter outfalls are currently diverted to the SMURRF for treatment for non-potable reuse. SMURRF will also treat stormwater harvested by the CBI Project, which began construction in 2017. Funded by a grant through the State Water Resources Control Board, this 1.6 MG below grade tank will capture runoff generated by an 85th percentile storm from the City's 106-acre Pier Drainage Area and will help improve beach water quality by reducing discharges at the Pier outfall. Brackish groundwater from horizontal underdrains of the CBI tank will also be collected. The tank is equipped with a pump to deliver a design flow of 520 GPM additional flow to SMURRF. SMURRF will be upgraded with a modular brackish RO skid which will allow expanded reuse of SMURRF effluent to include indirect potable reuse via groundwater recharge.

2.1 EXISTING CONDITIONS

The City's existing SMURRF was constructed as a best management practice (BMP) for the treatment and reuse of dry-weather urban runoff. The facility is located adjacent to the Moss Avenue Pump Station (MAPS), near the Santa Monica Pier, and is shown in blue on Figure 2-1.

The SMURRF is capable of producing 0.5 MGD (560 AFY). However, due to the City's mandated conservation efforts, the SMURRF is currently only able to service its recycled (i.e. reclaimed) water customer base by producing between 80 AFY and 134 AFY. A portion of this volume is often comprised of supplemental potable water to meet contracted demand and when needed, reduce total dissolved solids (TDS) in the supplied water. Treated water is currently distributed to 20 customers. A majority of these customers are various City departments. Treated SMURRF effluent is distributed via the City's existing 4.5 mile recycled water distribution system. Uses of recycled water include irrigation, toilet flushing, and street sweeping.

Figure 2-1 SMURRF Location

SMURRF was originally designed with a multi-step treatment system including the following treatment processes:

- Drum Screen
- Grit Removal
- Dissolved Air Flotation (DAF)
- Ultrafiltration (UF)
- Ultraviolet (UV) Disinfection
- Sodium Hypochlorite Dosing (i.e. secondary disinfection)

2.2 WATER QUALITY

2.2.1 Influent Water Quality

SMURRF is currently listed as a structural regional BMP under the City's *Enhanced Watershed Management Plan for Santa Monica Bay Jurisdictional Groups 2 and 3* and was designed to produce an effluent water quality equivalent to Title 22 recycled water for non potable reuse. Final effluent from SMURRF is supplemented with potable water as needed to meet the current finished TDS water quality limit of 1,000 mg/L. A summary of raw influent water quality for SMURRF from 2010-2017 is presented in Table 2-1 and was used for the design basis of the SMURRF upgrades. A more comprehensive summary of available water quality parameters for SMURRF can be found in Appendix B. Additional water quality sampling may be required during final design for parameters such as temperature and Total Organic Carbon (TOC).

Table 2-1 SMURRF Raw Influent Water Quality 2010-2017

Parameter	Unit	Average	Median	95th %	Min	Max
Alkalinity as CaCO3	mg/l	159	155	205	120	217
Bicarbonate Alkalinity as HCO3	mg/l	184	180	219	120	220
Calcium, Total	mg/l	59.9	58.0	80.5	33.1	81.5
Chloride, Total	mg/l	225	150	334	83.3	1,900
Copper, Total	ug/l	69.8	44.0	196	ND	560
Fecal Coliform	MPN/100ml	82,995	3,400	155,500	ND	16,000,000
Fluoride, Total	mg/l	0.6	0.6	0.9	ND	0.9
Iron, Total	ug/l	710	320	3,280	ND	4,500
Lead, Total	ug/l	0.6	ND	3.8	ND	5.3
Manganese, Total	ug/l	27.8	21.0	84.4	ND	130
Nickel, Total	ug/l	1.6	ND	5.7	ND	12.5
Nitrate as N	mg/l	2.0	1.9	3.9	0.8	5.9
Oil & Grease (HEM)	mg/l	8.0	8.0	8.3	6.5	12.1
pH	--	14.3	8.4	34.0	3.1	140
Potassium, Total	mg/l	1,229	1,000	1,819	47	12,000
Specific Conductance (EC)	umhos/cm	122	117	166	39	350
Sulfate as SO4	mg/l	331,777	32,000	500,000	ND	16,000,000
Total Coliform	MPN/100ml	734	622	1,167	29	6,400
Total Dissolved Solids	mg/l	270	231	480	180	633
Total hardness as CaCO3	mg/l	11.9	6.0	53.0	ND	92.0
Total Suspended Solids	mg/l	9.5	4.7	32.3	ND	160
Turbidity	NTU	159	155	205	120	217

ND = non-detect

With the completion of the CBI Project, SMURRF will be fed with wet- and dry-weather runoff harvested from the City's 106- acre Pier Drainage Area and brackish groundwater from shallow horizontal underdrains of the CBI to supplement any runoff currently treated at the facility. In addition to servicing the City's current reclaimed water customer base, the upgraded SMURRF final effluent to be used for aquifer reinjection when properly permitted. Depending on the time of year and amount of either dry or wet weather runoff, the influent water quality into SMURRF is expected to vary and the design for new upgrades will accommodate this variance. Table 2-2 presents a summary of water quality from the newly constructed CBI Project, with further details in Appendix B. The table contains only water quality sampled since the release of this report. Additional sampling by the City will provide provide further definition to the brackish water quality.

Table 2-2 CBI Project Brackish Groundwater Quality

Parameter	Unit	Average	Median	95%	Min	Max
Alkalinity as CaCO3	mg/l	317.7	320.0	354.0	280.0	360.0
Bicarbonate Alkalinity as HCO3	mg/l	387.7	390.0	434.5	350.0	440.0
Calcium, Total	mg/l	78.3	81.0	86.8	57.0	88.0
Chloride, Total	mg/l	283.8	260.0	496.0	150.0	520.0
Copper, Total	ug/l	0.3	ND	1.6	ND	4.0
Fecal Coliform	MPN/100ml	0.9	ND	2.8	ND	4.0
Fluoride, Total	mg/l	0.3	0.3	0.4	0.3	0.5
Iron, Total	ug/l	824.5	200.0	3,600.0	98.0	5,400.0
Lead, Total	mg/l	ND	ND	ND	ND	ND
Magnesium, Total	mg/l	51.5	49.0	71.0	40.0	74.0
Nickel, Total	mg/l	0.0	0.0	0.0	ND	0.0
Nitrate as N	mg/l	0.0	ND	0.0	ND	0.1
Oil & Grease (HEM)	mg/l	0.1	ND	0.6	ND	1.3
pH	Units	7.9	7.9	7.9	7.8	8.0
Potassium, Total	mg/l	12.5	9.0	27.0	5.7	27.0
Sodium, Total	mg/l	221.5	180.0	368.0	120.0	380.0
Specific Conductance (EC)	umhos/cm	2,007.7	1,800.0	3,260.0	1,300.0	3,500.0
Sulfate as SO4	mg/l	197.7	200.0	222.0	160.0	240.0
Total Coliform	MPN/100ml	46.4	27.0	110.0	4.0	110.0
Total Dissolved Solids	mg/l	1,146.9	1,100.0	1,620.0	800.0	1,800.0
Total hardness as CaCO3	mg/l	408.5	400.0	452.0	360.0	470.0

ND = non-detect

2.2.2 Water Quality Goals

SMURRF water quality goals are summarized in Table 2-3 below. These are intended to be equivalent to California Code of Regulations (CCR) Title 22 standards for non-potable uses such as irrigation and flushing toilets and urinals, as is deemed applicable for urban and stormwater runoff and brackish groundwater source water, not wastewater. The final water quality requirements will be determined in coordination with the City and the California State Water Resources Control Board, Division of Drinking Water (DDW) for the ultimate permitting of the facility as part of SWIP.

Table 2-3 SMURRF Water Quality Goals

Parameter	Unit	Effluent Water Quality Goal		
		Median	95^{th} Percentile	Max
Total Coliform	MPN/100 mL	< 2.2	-	23
Turbidity	NTU	-	< 0.3	1
TDS	mg/L	500	-	1000

2.2.3 Proposed Pathogen Removal Goals

Table 2-4 shows the proposed pathogen removal goals for SMURRF as part of SWIP.

Table 2-4 SMURRF Pathogen Treatment Goals

Pathogen	Log Reduction Across Individual Processes			
	UF	UV	Total credit*	Minimum Required
Virus	-	≥5	≥5	4
Cryptosporidium	2-4	0-1	≥2	2
Giardia	2-4	0-1	≥3	3

**excludes the log reduction credits which could be achieved by RO and Cl2 at SMURRF, groundwater travel time, and the Arcadia WTP.*

The proposed pathogen removal requirements in Table 2-4 are equivalent to surface water treatment for potable use, which are anticipated to be appropriate for ultimate use as diluent water for groundwater replenishment under CCR Title 22 requirements. The pathogen removal achieved includes the existing UF system (GE's ZW500d membranes, credited as a technology for up to 4-log removal of Cryptosporidium and Giardia by DDW) and UV system (Trojan UV3000Plus, on the list of conditionally approved technologies by DDW for alternative disinfection). The RO process and chlorine disinfection will achieve additional disinfection but is not necessary for meeting the minimum pathogen removal requirements. Additionally, the future groundwater recharge and treatment at Arcadia WTP provide additional pathogen removal that is applicable for ultimate groundwater recharge and reuse.

The final pathogen removal requirements will be determined in coordination with the City and the DDW for the ultimate permitting of the facility as part of SWIP.

2.3 FACILITIES DESCRIPTION & DESIGN CRITERIA

Upgrades at SMURRF will consist of constructing a new RO system with associated improvements to the control system, installing solar panels, enclosing the UV system and final effluent basin, and upgrading the site security. A site plan of the major existing process components at SMURRF is provided in Figure 2-2.

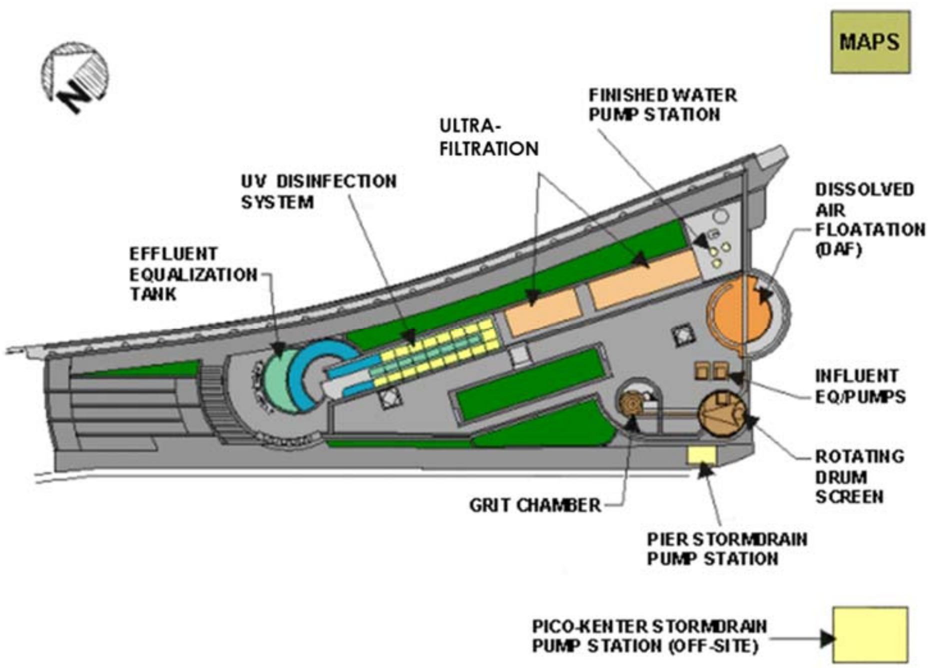

Figure 2-2 Existing SMURRF Overview

2.3.1 Materials Improvements for Corrosion resistance with New Water Quality

The introduction of the new brackish water source and therefore higher chloride concentrations may cause corrosion with existing materials. The presence of corrosion should be monitored during operations of the new upgrades and any further improvements or material replacements due to corrosion should be evaluated and coordinated with the City as needed.

2.3.2 UF Modifications

It is anticipated that the UF system will require integrity testing for approval of pathogen removal credit as part of the permitting with DDW. The existing packaged UF system will require modification in order to accommodate the integrity testing and controls and operation required for obtaining pathogen removal credit. This will need to be coordinated during final design with the required pathogen removal credit for the UF system.

2.3.3 RO Upgrades

Due to the new brackish source water from the CBI Project and continuing TDS limits, the proposed upgrades at SMURRF will add a containerized RO unit to its existing treatment process, as shown in Figure 2-3. The RO will be designed to treat a sufficient portion of the flow to lower the TDS to acceptable levels while allowing a bypass from the UF to the UV system without the need for additional potable water.

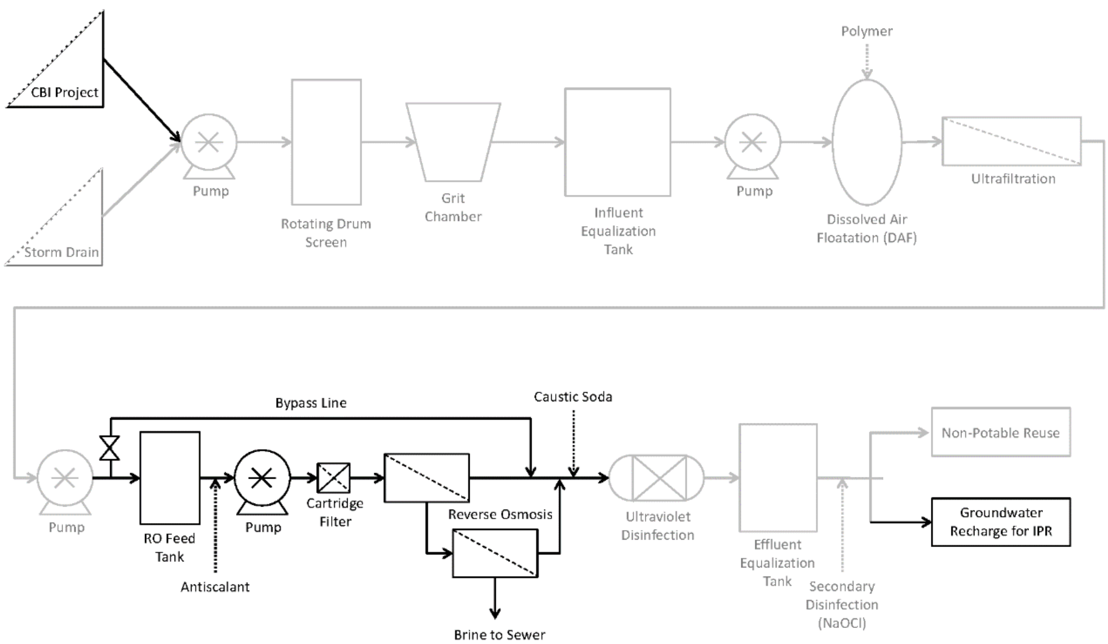

Figure 2-3 SMURRF Upgraded Process Flow Diagram

The new RO treatment is designed as a 2-stage process to treat approximately 60-80% of the SMURRF influent flow and achieve a 75% recovery. The 75% recovery was chosen to eliminate the need for system interstage boosters and decrease chemical addition requirements, such as elimination of acid as pre-treatment for RO, and reduction in post-RO stabilization chemicals needed. Higher recovery may be possible by utilizing a 3-stage process and/or high cross-flow technologies. These technologies may be explored in design development, but should take into consideration the added pumping and chemical requirements.

The conceptual RO design was based on treating an average 70% bypass flow of the UF effluent using an average TDS influent of 1,200 mg/L to produce a final effluent TDS between 300 and 450 mg/L, which is below the recommended secondary maximum contaminant level (MCL) of 500 mg/L. The percentage of bypass flow is based on average water quality characteristics but could be adjusted as needed for variable flows and variable influent TDS concentrations. Final design should account for future conditions while still producing effluent below the final TDS limit. With the addition of the RO system, the influent feed into SMURRF will increase to produce a consistent final effluent of 0.5 MGD, as shown in Table 2-5. The existing processes and associated equipment are expected to handle the increased flows but this will be confirmed during final design of the RO system to maintain a final effluent of 0.5 MGD.

Table 2-5 Updated SMURRF Flow Balance

Description	Units	Value
Design Capacity, Plant		
Influent	MGD	0.75
Product Water	MGD	0.50
Design Capacity, by Process		
DAF Influent	MGD	0.68
UF Influent	MGD	0.68
UF Effluent (based on 90% recovery)	MGD	0.61
RO Influent	MGD	0.43
RO Bypass	MGD	0.18
RO Permeate (based on 75% recovery)	MGD	0.32
RO Concentrate (based on 75% recovery)	MGD	0.11
UV Influent	MGD	0.50

Because the SMURRF feed water will be a mix of runoff and brackish groundwater from the CBI Project, flow is expected to be fairly constant but water quality will have seasonal and diurnal variability, which may affect the amount of flow bypassed. SMURRF will treat all runoff it receives and will supplement the additional flow with brackish groundwater to meet its’ nominal capacity. Since the majority of influent water will be supplied from the brackish groundwater well, the RO system is designed to handle influent up to 6,000 mg/L to account for any future increases in TDS levels from the brackish groundwater. At these higher levels of TDS, the bypass configuration as currently designed cannot treat these high levels of TDS below the 500 mg/L MCL, but the design will still meet the current finished TDS water quality goal of 1,000 mg/L.

The RO system consists of multiple components, including the following:

- Pre-treatment chemical feed systems - Pre-treatment will consist of dosing antiscalant for scaling prevention. With the limited recovery of 75%, additional strong acids should not be required.
- RO feed tank – provided to account for variation in flows from UF backpulse and cleaning upstream. This tank is primarily for the purpose of ensuring the RO system can operate as a constant flow without interruption.
- RO feed pumps – to pump from RO feed tank to RO skids.
- RO skid – one 295 GPM production RO skid, based on 70% treated flow through RO as discussed above. The RO skid will include the following items as a packaged system: cartridge filters, membrane vessels, and instrumentation and control. The final design should consider additional space on the RO skid to accommodate future membrane vessels for potential changes in water quality.
- Clean In Place (CIP) system – including tank and heater, CIP pump(s), and chemical feeds systems. CIP tank shall be provided with immersion heaters, as well as a dry chemical feed system for use with proprietary chemicals, if needed. The design shall include provision of cleaning each stage separately. CIP system will be supplied by the RO system supplier, with automated sequence for cleaning procedure and subsequent neutralization of cleaning solution. Cleaning will be initiated based on either a time interval, or control system alarm indication due to fouling. The neutralized solution after CIP will be drained to the sewer.
- Flush system – flush tank with RO permeate and flush pumps.
- Instrumentation – this shall be provided as per typical design practice for control and monitoring.

Post-stabilization is achieved by blending the RO permeate with the bypassed water which adds hardness and alkalinity back into the effluent, as shown in Table 2-6. For this reason, no additional chemicals are expected for post treatment. However, final pH adjustment with caustic soda (NaOH) may be needed and should be confirmed in the final design.

Table 2-6 Expected Blended Water Quality

Parameter	mg/L	as $CaCO_3$	mmol/L	meq/L
Cations				
Calcium	30.3	76	0.76	1.52
Magnesium	25.8	106	1.06	2.12
Sodium	76.6	166	3.33	3.33
Potassium	12.8	16.4	0.33	0.33
Total Cations				7.3
Anions				
Bicarbonate	94.2	77	1.54	1.54
Carbonate	0.3	0.5	0.00	0.01
Chloride	143.2	202	4.03	4.03
Sulfate	62.5	65	0.65	1.30
Nitrate	6.6	5	0.11	0.11
Total Anions				7.0
General				
TDS	452			
Alkalinity		78		1.6
M/D Ratio				1.0
pH	7.8			
Electroneutrality				4%
Total Carbonate			1.61	
	α_1 =	0.96	α_2 =	0.00

The RO system concept design has been developed using the 95th percentile SMURRF influent quality. However, final design shall consider varying influent TDS (600-6,000 mg/L) with RO system and scaling projection modeling using recent water quality data from SMURRF and the CBI Project. The concept design criteria are included in Table 2-7.

Table 2-7 RO Design Criteria

Description	Units	Value
RO Feed Tank		
Tank Volume	gallons	3,000
Number of Tanks	--	1
RO Feed Pumps		
Number of RO Feed Pumps[1]		2
Power	hp	25-75
Pump Pressure	psi	100-300
RO Skids		
Type	--	2-Stage
Feed Flow	MGD	0.43
Total Recovery	%	75
Design Flux[2]	gfd	11
Membrane Array		8:4
Elements per Vessel	--	6
Assumed Membrane Area per Vessel	ft^2	400
Number of Skids	--	1

1. Two RO feed pumps in series are recommended to account for large variations in feed flow, flux and osmotic pressure

2. Final design shall consider a flux ranging from approximately 9.5 gfd -15 gfd to account for variances in influent TDS. This may also vary the total system recovery.

Brine (25% of the RO influent flow), neutralized chemical cleaning solutions after membrane cleanings (intermittent flow) and flush flows from the RO system will be sent to the 12-inch existing drain in the drum screen structure. Sizing of the brine line will be completed during final design to account for the design range of flows treated. Final design will also confirm that the 12-inch drain can handle all waste flows at SMURRF and upsizing is not required.

2.3.4 Solar Panels

Energy savings for SMURRF can be realized via the installation of a solar photovoltaic (PV) system to help power the treatment equipment. A new PV system will be designed and erected at the facility on top of the new RO containers and UF containers so to not interfere with filter replacements, other maintenance operations or fire access. The solar panels are expected to generate approximately 15,000 kWh/year (nameplate size of 12kW) to help offset energy requirements. Other locations for solar installations should be investigated during design for the additional generation capacity. Final design shall provide provisions for interconnection, electrical protection, coordination and revenue metering in accordance with the National Electrical Code (NFPA 70), Southern California Edison (SCE) requirements, as well as state and local regulatory requirements governing photovoltaic systems.

2.3.5 UV Disinfection

The addition of RO into the main process train will result in an increased UV transmittance (UVT) of the feed water quality through the UV system. At average flow, the existing UV system operates with a UV dose of 140 mJ/cm^2. This could be decreased with the increased UVT, as outlined by National Water Research Institute (NWRI) guidelines for UV Disinfection to meet 5 log virus removal for water reuse which state much lower requirements for UV dose downstream of UF and/or RO. As such, the UV system will easily meet the requirements for 5-log virus removal. Additional pathogen removal credit for protozoa should be investigated for the UV system if helpful to meet the permitting requirements that are currently under review by DDW for this facility for SWIP. It is noted that NWRI guidelines and the 5-log virus removal credit is equivalent to Title 22 requirements, and greater than virus removal requirements per Surface Water Treatment Rule. UV dosing operations should be considered during final design to account for the new water quality.

Additional upgrades to the UV system, such as the inclusion of advanced oxidation, may be required. Permitting for the new uses of the SMURRF final effluent and possible oxidation requirements are under review by the DDW. At the time of this report, the City is pursuing these topics and the final determination will be incorporated into the final design.

2.3.6 Effluent Equalization Tank

The UV disinfected effluent is discharged into an effluent equalization tank underneath the process area. The discharge facility is currently open to the air as shown in Figure 2-4. Due to permitting changes of the SMURRF facility, the effluent equalization tank must be fully enclosed to prevent open water surfaces. Final design will include the effluent equalization tank enclosure in compliance with necessary fire codes and requirements. An overview of regulations and permitting requirements pertaining to SMURRF can be found in Section 6 .

Figure 2-4 SMURRF Effluent Equalization Tank

2.3.7 Site Security

Site security at SMURRF will also be improved as part of the upgrades to improve public interaction and the safety of the on-site equipment. Improvements to enhance site security include the replacement of site fencing, lighting improvements, and securing the DAF and pumping areas in addition to the chemical facilities area from public access. Final design of site security upgrades will be coordinated with the City.

While security is a primary concern for the facility, SMURRF should still be an open facility for public outreach that is conducive to a learning and public-facing environment.

2.4 FACILITES LAYOUT

Preliminary conceptual layouts of the SMURRF upgrades have been developed based on the design criteria described above and are shown in Appendix A. The overall intent for SMURRF is for public outreach and education and should be maintained during the design of the upgrade elements. Final renderings will be required for all upgrades to show the aesthetic compatibility with the existing SMURRF structures. A notification to the public regarding the project will be issued during final design of the project.

2.4.1 RO Upgrades

The new RO unit will be located at the designated site shown in Figure 2-5. The RO system is expected to fit into a 40 ft. International Standards Organization (ISO) shipping container, with CIP system and required chemicals in an adjacent 20 ft container. It is preferred that containers not be stacked on top of each other, and this should be coordinated with the City during design to ensure no public view corridors are obstructed and compliance with any height/footprint limitations at the site are met.

Dependent on the RO system selected, the RO feed tank may or may not fit within the designated site. However, the RO feed tank may also be located below the RO system within the equalization tank. This issue will be further evaluated and finalized during final design.

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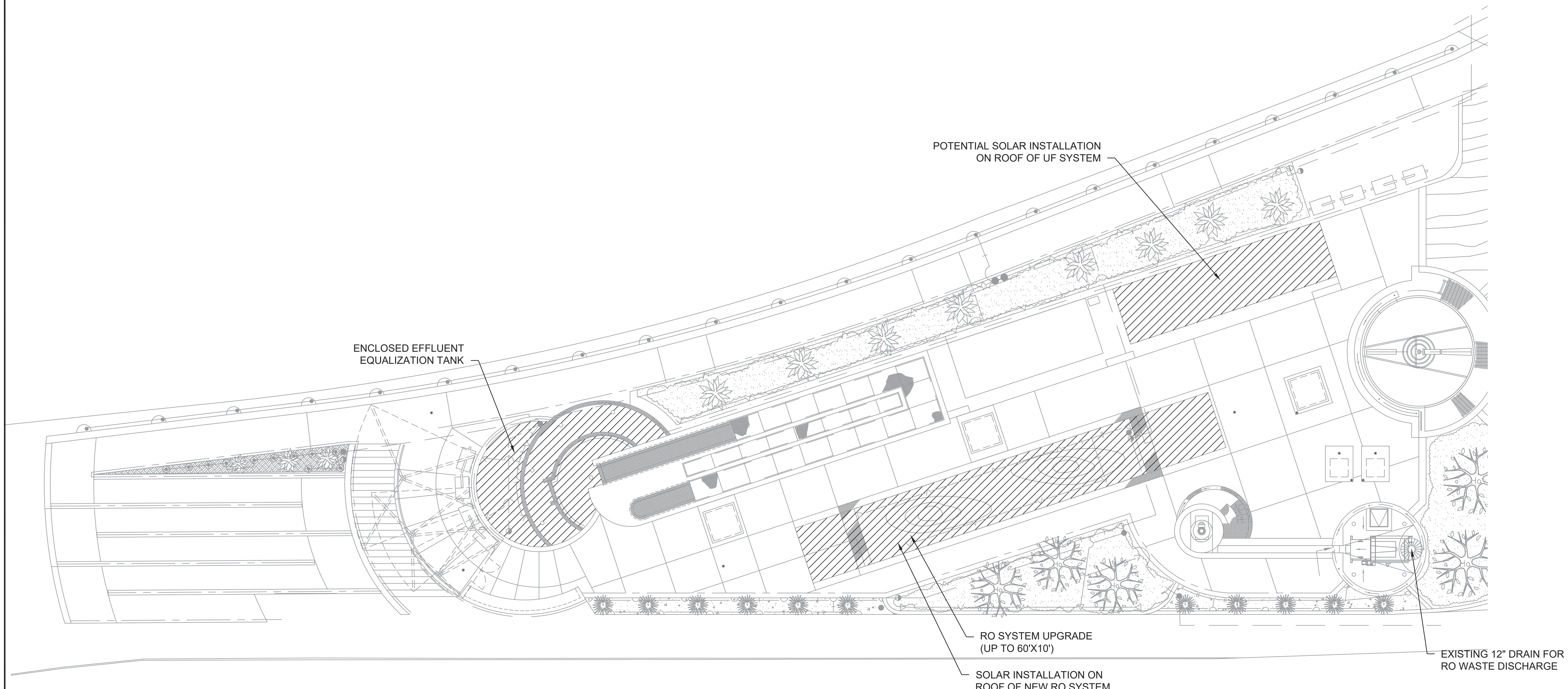
GENERAL SHEET NOTES

1. SITE SECURITY UPGRADE LOCATION TO BE DETERMINED UPON CONSULTATION WITH THE CITY.



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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

Stantec

CONSULTANT

REVIEWED : DATE : ________ 20__
SELIM EREN, P.E.
CIVIL ENGINEER
REVIEWED : DATE : ________ 20__
REVIEWED : DATE : ________ 20__

CITY CLIENTS

REFERENCE :
DATE : ________ 20__
SUBMITTED BY :
CURTIS CASTLE, P.E.
PRINCIPAL CIVIL ENGINEER
COMPUTER FILE NAME:
SP-FILE NO.: SP 2456
APPROVED BY :
DATE : ________ 20__
RICK VALTE, P.E., CIVIL ENGINEER

CIVIL ENGINEERING SERVICES

SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 2-5
UPGRADE SITE LOCATIONS AT SMURRF

PROJECT AND SHEET TITLE

DESIGNED BY :
DRAWN BY :
CHECKED BY :
CONSULTANT JOB/SHEET NO.
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2.4.2 Solar Panels

To help power the SMURRF, solar panels will be erected at the facility on the roof of the RO and UF systems. These solar panels will generate approximately 15,000 kWh/year. Other locations to increase solar production will be evaluated during final design, such as on top of other existing processes or at various off-site locations nearby.

2.4.3 Effluent Equalization Tank

The effluent equalization tank, shown in Figure 2-5, will be fully enclosed, in accordance with all permitting requirements for SMURRF.

2.4.4 Site Security

The location of specific security upgrades to SMURRF will be coordinated with the City.

2.5 CONSTRAINTS & LIMITATIONS

The main constraints and limitations of the upgrades to SMURRF include:

- The addition of the RO system must fit within the existing footprint (up to approximately 60ft x 10ft) at the site. Additional locations for equipment related to the RO system may be evaluated, such as within the equalization basins, but should not interfere with access around the site for maintenance and tours. The final dimensions of the container for the RO system must also be coordinated with the City so as to not be a visual obstruction.
- Height of any upgrade and new equipment to the SMURRF site must not obstruct existing public viewsheds.
- Some work may need to be performed at night due to limitations on daytime street closures.
- Any upgrades to SMURRF must be designed and implemented with the intent of the site being an open facility for public outreach, conducive to a learning and public-facing environment.
- Chemical area has limited space. Any additional chemicals must be added within the existing area, or within packaged RO containers. Chemical piping around the site must be minimized and adequate safety measures provided due to use of the facility for public outreach and learning.
- The RO system design flows and recovery shall be finalized with consideration of the CBI pump capacity and turn-down, and upstream process capacities at SMURRF.
- Utility tie-ins must be coordinated so as to not disrupt existing services.
- Construction schedule and operations will be coordinated with the City to maintain plant operations and minimize downtime, as needed.

- All upgrades and improvements must be designed and constructed to comply with fire protection codes and regulations.

2.6 UTILITIES & CONNECTIONS

The new upgrades to SMURRF will require new pipeline connections, along with new connections for electrical and control operations. The new groundwater collection subdrains and associated connections are part of the CBI Project and are outside the scope of SWIP.

2.6.1 Brine Line

Based on the design criteria in Section 2.3, the RO system will produce approximately 0.11 MGD of brine, which will be discharged into the existing 12-inch facility drain located in the drum screen structure. This drain line currently captures other waste flows at the facility site (i.e. UF waste and DAF waste) and discharges into the existing sewer system through which is pumped through MAPS for treatment at the Hyperion Water Reclamation Plant.

2.6.2 Potable Connection

As described previously, SMURRF recycled water is diluted with potable water during high-TDS events in order to be in compliance with regulations. The potable water connection is on the SMURRF site, and includes an air-break to the effluent equalization basin to protect the potable water supply. With the addition of the RO system, the potable connection should not be necessary but will remain in case of a disruption in RO treatment.

2.6.3 Electrical Power Supply

The MAPS is the source of power for SMURRF. The pump station is provided with a "normal source" service entrance from an SCE transformer located above ground. The "standby source" is a diesel engine generator located within the pump station that is connected to an automatic transfer switch. Loss of SCE power automatically starts the generator and restores power to the MAPS and only partial power to SMURRF. The partial power to the SMURRF is sufficient to operate the finished water pumps and the potable water control value.

Preliminary investigation of record drawings indicated there is sufficient power at MAPS for the RO upgrade but this should be confirmed during final design. Refer to Appendix A for the SMURRF RO Upgrades Single Line and Appendix C for further design guidelines.

Table 2-8 shows connected load in kVA and Amps for projects in SMURRF. Lighting, heating, ventilation, and air conditioning (HVAC), and ventilation loads were omitted from the calculation. These are preliminary loads to be confirmed during final design.

Table 2-8 SMURRF Upgrades Preliminary Electrical Load Summary

Projects	Connected Load, kVA	Connected Load, Amps @ 480V
SMURRF RO Upgrades	92.2	111

The solar installation could add approximately 15,000 kWh/yr to MAPS. This PV system should be designed and constructed in accordance with Article 690 of 2016 California Electrical Code [2014 National Electrical Code (NEC)] and should take into account any changes in 2017 NEC that may have an impact. Tie-in requirements such as protective relaying, battery storage for stabilization and required studies shall be in conformance with SCE requirements. All tie-ins will be coordinated with SCE to determine impact to bus and breaker sizes, available fault current, etc. Arc flash results will require updating if increased fault values are determined. Interconnections into the existing system will be in accordance with Article 705 of 2014 NEC and should take into account any change in 2017 NEC that may have an impact.

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3.0 AWTF & CIVIC CENTER TANK CONCEPTUAL DESIGN

3.1 EXISTING CONDITIONS

The location for these facilities is the far west portion of the Civic Center Parking Lot, closest to the Main Street entrance and directly adjacent to the Chain Reaction sculpture. This location and the immediately surrounding area and facilities are of historical and cultural significance to the City of Santa Monica. This includes but is not limited to the City Courthouse, the historic Civic Center Auditorium, historic trees adjacent to the Auditorium, and the historical/cultural landmark of the Chain Reaction sculpture. The significance of these components and the sensitivity of the site must be carefully considered throughout the design and construction of the facilities.

The facilities location is generally shown highlighted in yellow in Figure 3-1.

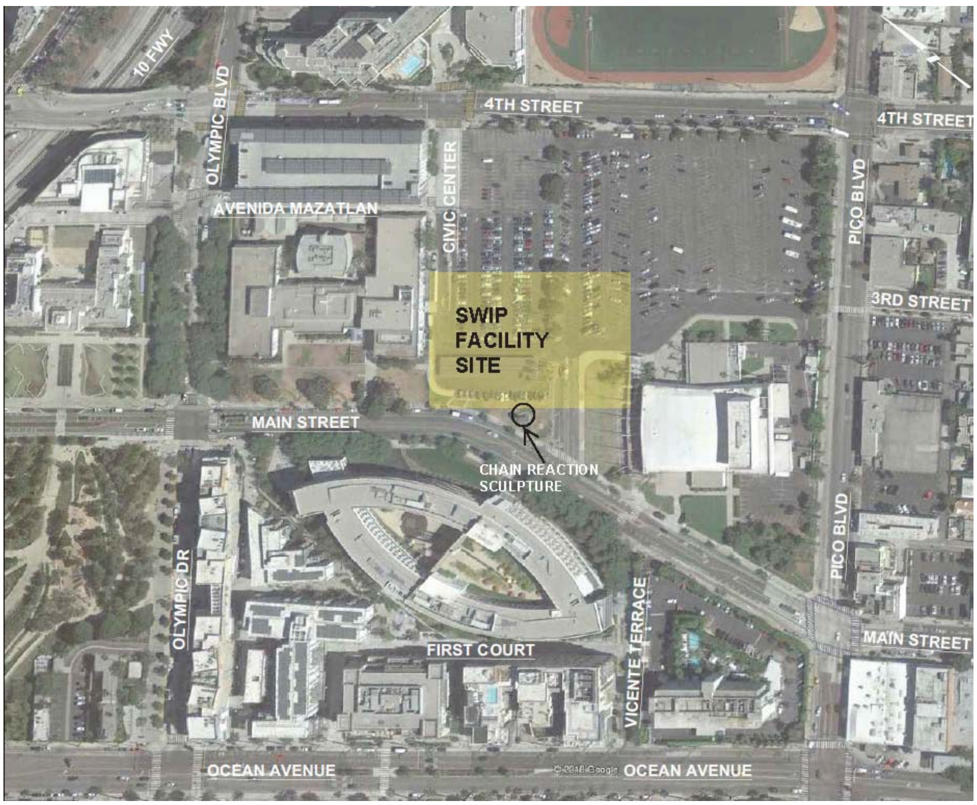


Figure 3-1 Civic Center SWIP Facility Site

3.2 WATER QUALITY

3.2.1 Influent Water Quality

The influent water quality to the AWTF will be a blend of wastewater and stormwater. Due to limited water quality data, the conceptual design is based on typical municipal wastewater quality and limited sampling results for nearby sanitary sewers that are included in Appendix B. Water quality sampling is required to be performed during final design to inform and confirm the final design of the AWTF.

3.2.2 Recycled Water Regulations

The AWTF is designed to consistently produce advanced treated effluent that meets all relevant federal, state, and local regulatory requirements applicable to a groundwater replenishment reuse project. These include Federal and State Maximum Contaminant Levels and Notification Levels set under the Safe Drinking Water Act, as well as requirements for recycled water set forth by the State of California.

California's requirements for the use of recycled water include:

- California Health and Safety Code, Chapter 5, Article 2, Sections 116800-116820 –Cross-Connection Control by Water Users (Health and Safety Code)
- California Water Code, Division 7 – Water Quality, Section 13050-13583, 13627, 14875-14877.3 (Water Code)
- California Code of Regulations, Title 17 – Public Health, Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies, Sections 7583 through 7605 (Title 17)
- California Code of Regulations, Title 22 – Social Security, Division 4 – Environmental Health, Chapter 3 – Water Recycling Criteria, Section 60301 through 60475 (Title 22)

These regulations are discussed in detail in the *SWIP Technical Report* and are incorporated here by reference.

3.2.3 Groundwater Basin Requirements

The AWTF must meet all requirements in the Los Angeles Basin Plan for the Coastal Plain of Los Angeles Groundwater Basin, Santa Monica Subbasin.

3.2.4 Pathogen Removal Credits

The pathogen reduction requirements per Title 22 groundwater replenishment of recycled water regulations form a major design criteria for the AWTF. Table 3-1 summarizes the pathogen treatment requirements and goals for the AWTF. It should be noted that the total pathogen reduction shown in Table 3-1 does not include the reductions that would normally be credited for the groundwater retention time between injection and extraction, and for the Arcadia WTP.

Table 3-1 AWTF Pathogen Treatment Goals

Pathogen	Log Reduction Across Individual Processes					
	MBR*	RO	UV/AOP	Pipeline Cl_2	Total**	Minimum Required
Virus	-	1.5-2	6	6	13.5-14	12
Cryptosporidium	2.5	1.5-2	6	-	10-10.5	10
Giardia	2.5	1.5-2	6	-	10-10.5	10

**Log credits for MBR depend on approval from the regulators*

***Excludes the log reduction credits which could be achieved by the Arcadia WTP*

For the purposes of this report, the minimum log reduction requirements of 12, 10, and 10 for virus, *Cryptosporidium*, and *Giardia* are intended to be met by the AWTF processes. Additional log reduction credit for virus may be achieved by groundwater retention time per Title 22 regulations. Further log reduction credits may also be given for the treatment processes at the Arcadia WTP, however groundwater replenishment water from the AWTF may not always be treated at the Arcadia WTP in the future. Therefore, SWIP will be designed to meet the minimum log reductions through the AWTF, distribution system piping, and the groundwater retention time credit as a minimum.

The City hopes to obtain regulatory approval for membrane bioreactor (MBR) for pathogen removal credit at AWTF. Efforts by others are underway to obtain this approval from DDW ahead of the AWTF based on current project schedules. This includes the Metropolitan Water District of Southern California who is planning to begin testing in early 2019 at an Advanced Water Treatment Demonstration Facility and produce operational data to demonstrate that MBR provides robust removal of pathogens. If additional removal credits are needed, an additional process such as ultraviolet disinfection or micro- or ultra-membrane filtration may be required to achieve these credits, and be added at the AWTF. A final removal profile will have to be approved by DDW.

3.3 FACILITIES DESCRIPTION & DESIGN CRITERIA

The AWTF and Civic Center Tank are co-located at the Civic Center site. These facilities have three lift stations located within the nearby vicinity, which are described in detail in Section 3.6 Utilities and Connections:

1) the Ocean Ave Lift Station (OALS) which pumps raw wastewater to the AWTF for treatment from the 54-inch trunk sewer in Ocean Avenue,

2) the First Court Lift Station (FCLS) that pumps wastewater from the future City Services Building (CSB), and

3) Pico Blvd Lift Station (PBLS) which conveys urban runoff/stormwater to the Civic Center Tank from 48-inch stormdrain on Pico Blvd and which is then blended into the AWTF influent for treatment. The PBLS is designed to capture flows during all times of the year, both dry weather and wet weather.

The AWTF will pump runoff water from either the Pico/Caltrans Box Culvert or from the Civic Center Tank into the AWTF. The AWTF influent pumps can also pump from the Pico/Caltrans Box Culvert into the Civic Center Tank for storage. Figure 3-2 shows a schematic of these facilities and their interconnections.

3.3.1 AWTF

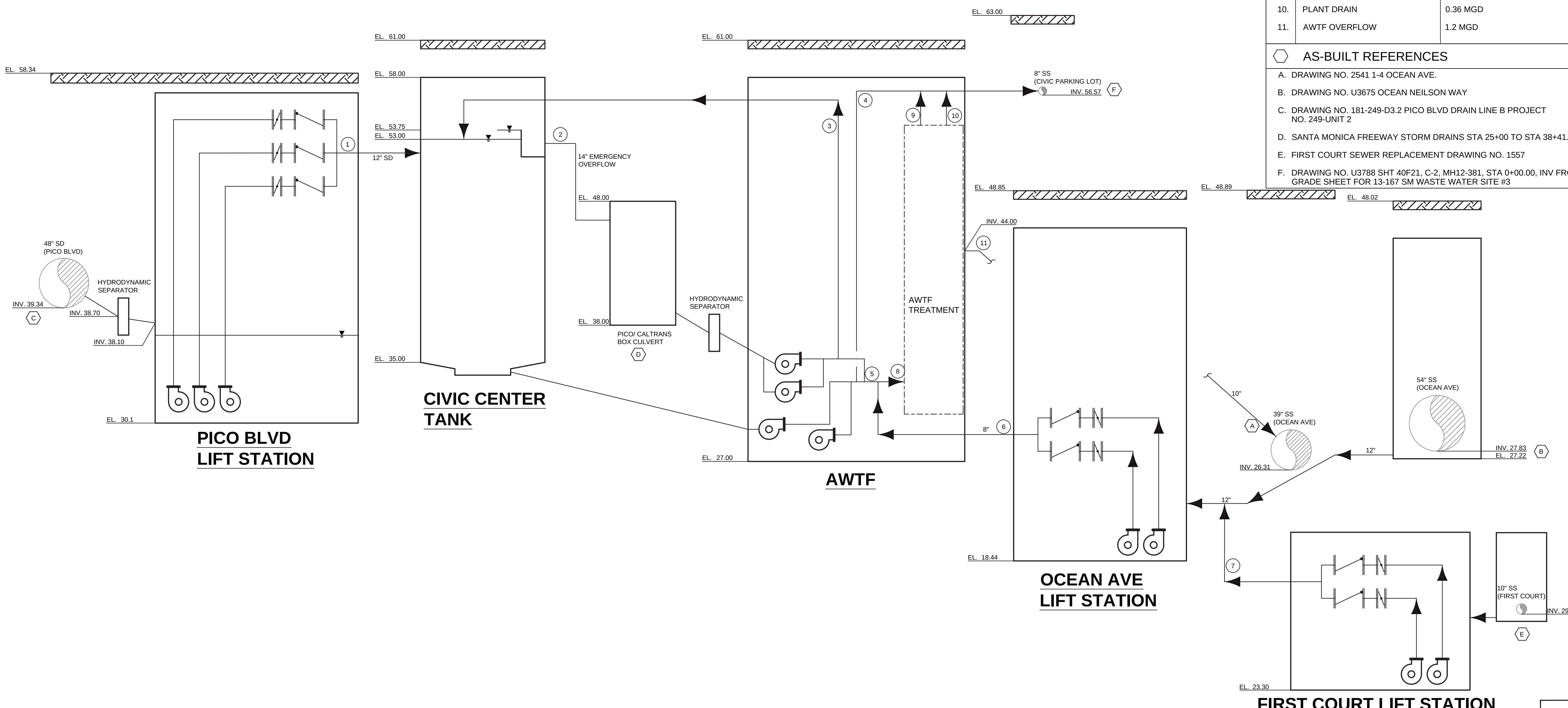
The AWTF is a completely underground treatment facility that will treat a blend of raw wastewater and urban runoff/stormwater to produce minimum of 1.0 MGD of advanced treated effluent. The treatment process train is MBR-RO-UV/Advanced Oxidation Process (AOP) (see Figure 3-3). For code requirements and applicable discipline design guidelines, see Appendix C.

FLOW RATE SUMMARY

#	DESCRIPTION	PEAK FLOW
1.	PBLS	3.6 MGD
2.	TANK EMERGENCY OVERFLOW	3.6 MGD
3.	SW CAPTURE	1.0 MGD
4.	TANK DRAIN	0.36 MGD
5.	AWTF SW FEED	0.36 MGD
6.	OALS/AWTF WW FEED	1.2 MGD
7.	FCLS	0.03 MGD
8.	AWTF COMBINED FEED	1.2 MGD
9.	BRINE WASTE	0.18 MGD
10.	PLANT DRAIN	0.36 MGD
11.	AWTF OVERFLOW	1.2 MGD

AS-BUILT REFERENCES

A. DRAWING NO. 2541 1-4 OCEAN AVE.
B. DRAWING NO. U3675 OCEAN NEILSON WAY
C. DRAWING NO. 181-249-D3.2 PICO BLVD DRAIN LINE B PROJECT NO. 249-UNIT 2
D. SANTA MONICA FREEWAY STORM DRAINS STA 25+00 TO STA 38+41.19
E. FIRST COURT SEWER REPLACEMENT DRAWING NO. 1557
F. DRAWING NO. U3788 SHT 40F21, C-2, MH12-381, STA 0+00.00, INV FROM GRADE SHEET FOR 13-167 SM WASTE WATER SITE #3



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City of Santa Monica
Department of Public Works

1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

Stantec

CONSULTANT

REVIEWED : DATE : ________ 20__
SELIM EREN, P.E. CIVIL ENGINEER
REVIEWED : DATE : ________ 20__
REVIEWED : DATE : ________ 20__

CITY CLIENTS

REFERENCE :
DATE : ________ 20__
SUBMITTED BY :
CURTIS CASTLE, P.E. PRINCIPAL CIVIL ENGINEER
APPROVED BY :
RICK VALTE, P.E., CIVIL ENGINEER
DATE : ________ 20__
COMPUTER FILE NAME:
SP-FILE NO.: SP 2456

CIVIL ENGINEERING SERVICES

SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 3-2
CIVIC CENTER FACILITIES SCHEMATIC

PROJECT AND SHEET TITLE

DESIGNED BY :
DRAWN BY :
CHECKED BY :
CONSULTANT JOB/SHEET NO.
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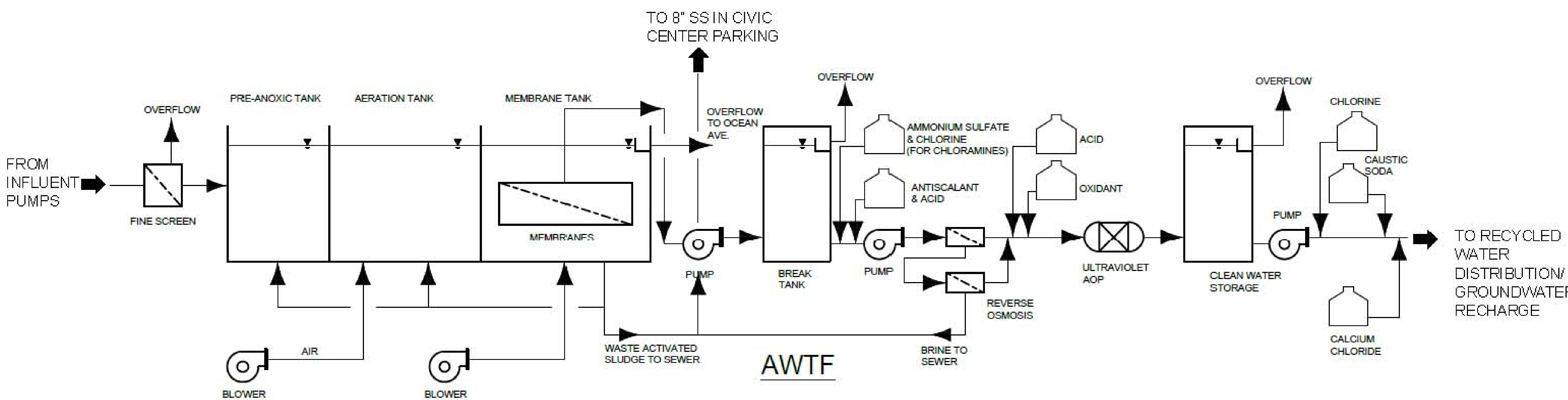

Figure 3-3 Process Flow Diagram for AWTF (1 MGD)

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3.3.1.1 Plant Flow Rates & Recoveries

Table 3-2 presents a summary of the plant flow balance and process minimum recoveries. The recoveries for each process are the basis for this conceptual design however, lower minimum recoveries could be considered during final design if they prove to be more optimal for overall cost and operation of the facility since the wastewater influent flow could be increased. Additionally, increasing process recoveries may be possible and should be evaluated during final design. The losses of water through the treatment process will include the following major streams:

- **MBR Waste Activated Sludge:** Solids will be wasted from the MBR process to maintain the desired solids residence time and mixed liquor suspended solids concentration in the biological reactor. This will likely lead to a net loss of 1% to 3% of the influent.
- **MBR Membrane Recovery:** The gross filtration rate of the MBR membranes is greater than the net filtrate production, due to the cleaning cycles of the membranes. Depending on the particular membrane system used, these losses will be attributable either to backpulse (which pushes filtrate across the membranes in the reverse direction), or relaxation (which stops flow through the membranes for a short period and therefore reverses net filtrate production). The net recovery of filtrate across the MBR membranes will likely range from 90% to 95%.
- **RO Permeate Recovery:** The recovery ratio of permeate flow to feed flow is a key operating parameter for the RO process. This will likely range from 75% to 85%. Selecting 75% RO recovery requires greater feed flow, but scaling propensity will be reduced, and it is typically possible to control scaling in the RO with antiscalant only and no strong acid at 75% recovery. Selecting 85% RO recovery reduces the flow through the upstream processes, but will likely require more chemical conditioning such as pH control upstream of the RO to avoid scaling.

Table 3-2 Plant Flow Rates & Recoveries

Description	Units	Range
Plant Flow Balance		
Design Capacity, Plant		
Influent	MGD	1.19 to 1.37
Product Water	MGD	1.00
Design Capacity, by Process		
MBR Influent (based on WAS)	MGD	1.19 to 1.37
MBR Filtrate (based on MBR Recovery)	MGD	1.24 to 1.48
RO Influent	MGD	1.18 to 1.33
AOP Influent	MGD	1.00
Losses/Recoveries for Unit Processes		
MBR Waste Activated Sludge Flow	% of Influent	1% to 3%
MBR Recovery	% of Influent	90% to 95%
RO Permeate Recovery	% of Influent	75% to 85%

3.3.1.2 Source Water Blending

The microbiology present in the MBR system will be dependent on the carbon and nutrient rich wastewater. The flow rate of stormwater to be blended will be dependent upon the requirements of the existing microbiology, and must take into account dynamic changes in microbiology due to changing water quality in order to continually produce the required treated effluent quality during changes in stormwater blending flows. The water quality blending must also take into account potential impacts to membrane fouling with stormwater-wastewater blends as discussed in the literature. The basis of the conceptual design is a maximum blend ratio of 70% wastewater to 30% stormwater (see Table 3-3 for summary of blend flow rates). The optimum blend ratio to maximum stormwater use is an important design criteria for the facility, stormwater diversions, pumping and tank management and must be refined further during design development, utilizing site specific water quality data and biological process modeling.

Table 3-3 Influent Blending Flow Ranges

Description	Units	Value
Influent Flow Blending		
Wastewater Influent Flow Range (70 - 100% of Total)	MGD	0.84 - 1.20
Stormwater Influent Flow Range (0 - 30% of Total)	MGD	0 - 0.36

3.3.1.3 Redundancy Requirements

The AWTF is a scalping facility and therefore major processes and some mechanical equipment do not have standby trains. The facility includes one inlet screen that receives the entire flow, and the rest of the major processes are designed with two trains that are sized to each receive half of the total plant flow; two MBR trains, two RO trains, and two UV-AOP trains. If one train of the major process equipment is out of service, the plant will run at a lower capacity until the equipment is brought back online.

Most mechanical equipment within the AWTF, especially that which is in continuous operation and/or is prone to maintenance issues, should have a standby unit equivalent to 50% redundancy to reduce downtime and reduced plant flows. This includes but is not limited to influent pumps, process aeration blowers, air compressors, and chemical feed pumps.

3.3.1.4 Influent Pumps

The AWTF will receive wastewater from the Ocean Ave Lift Station (see Section 3.6 Utilities & Connections for details) and stormwater from influent pumps located at the AWTF. The AWTF influent pumps include Stormwater Feed pumps that will pump from Civic Center Tank to the AWTF, and Stormwater Capture pumps that will pump from the Pico/Caltrans Box Culvert (which contains flows released from Memorial Park Tank) to the Civic Center Tank or AWTF as shown in the schematic in Figure 3-2.

The Stormwater Capture Pumps are responsible for pumping flow sent from Memorial Park Tank down through the Pico/Caltrans Box Culvert to either the AWTF or the Civic Center Tank. The pumps are sized equivalent to the pumps at the Memorial Park Tank Drain Lift Station that will send flows down the Pico/Caltrans Box Culvert. The two pumps are 0.5 MGD each, and equipped with variable frequency drive (VFDs). The design intent is for one pump to be able to operate at reduced speed to provide stormwater directly to the AWTF at 30% of total inflow (0.36 MGD). Both pumps in operation could convey up to 1.0 MGD from the Pico/Caltrans Box Culvert to the Civic Center Tank for storage and future treatment.

The Stormwater Feed Pumps are sized as 0.36 MGD each, equivalent to the stormwater influent design basis of 30% of the total plant influent. These pumps are also intended to drain the Civic Center Tank to the nearby 8-inch sanitary sewer when necessary for maintenance or to create available volume to capture a future storm. The design criteria for the influent pumps is included in Table 3-4.

Table 3-4 Stormwater Influent Pump Design Criteria

Description	Units	Value
Influent Pump Station		
Influent Pumps - Stormwater Capture Pumps		
Number Pumps	--	2
Pump Capacity, Each	MGD	0.50
Total Dynamic Head	ft	20.50
VFD (Y/N)		Y
Wire to water efficiency, assumed	%	70
Motor horsepower, each	hp	3
Influent Pumps - Stormwater Feed Pumps		
Number of Pumps	--	2
Stormwater Feed Pump Capacity, Each	MGD	0.36
Total Dynamic Head, Max	ft	23.50
VFD (Y/N)		Y
Wire to water efficiency, assumed	%	70
Motor horsepower, each	hp	3

3.3.1.5 Fine Screen

The blended effluent will pass through a rotary drum fine screen with 1-mm perforations before going to the biological treatment basins. This process is for pretreatment upstream of the membranes in the MBR and is a warranty requirement for MBR vendors. Design criteria for the screen is included in Table 3-5.

The concept design includes an enclosed screen with the headspace ventilated through the odor control system for the facility.

Table 3-5 Fine Screen Design Criteria

Description	Units	Value
Fine Screen		
Type of Screen		Internally-fed rotary drum screen
Number of Screens	--	1
Total Feed Flow, Peak	MGD	1.36
Total Feed Flow, Average	MGD	1.20
Size of Perforations	mm	1

3.3.1.6 Membrane Bioreactor and Biological Basins

The MBR process will utilize anoxic, aerobic, and membrane basins to achieve carbonaceous biochemical oxygen demand (BOD) removal, nitrification, partial denitrification, and solids separation. The biological basin design is 12 days solids retention time (SRT) and 7 hours total hydraulic retention time (HRT) for including all aerobic, anoxic, and membrane basin volumes. The biological basins have been sized based on preliminary biological process modeling to maintain membrane tank mixed liquor suspended solids (MLSS) below 10,000 mg/L MLSS, based on typical wastewater characterization fractions and limited water quality data, and a maximum of 670 mg/L Chemical Oxygen Demand (COD) and 70 mg/L TKN. This shall be confirmed during final design with biological process modeling with site-specific water quality and characterization data per a City-approved sampling and analysis protocol.

The process consists of anoxic basins, aerobic basins, and membrane separation, each discussed briefly below. The concept design includes covers over the basins with the headspace ventilated through the odor control system for the facility.

Provisions for oil and grease removal in the basins need to be provided in the final design.

Anoxic Basins

Anoxic basins are provided for denitrification of recycle flows from the aeration basins. The basins are unaerated, and each is equipped with two mechanical mixers to keep mixed liquor in suspension.

Aeration Basins

Aeration basins are provided for carbonaceous BOD removal and nitrification. Fine bubble diffusers will be used to provide aeration. Three blowers (2+1) are provided for aeration and sized based on BioWin process modeling of aeration demand. Noise attenuation should be provided, such as locating within an isolated room or using sound and equipment mounted enclosures. A submersible return activated sludge (RAS) pump is used to provide recycle flows back to the anoxic zone of up to 500% of influent flow.

Membrane Separation

The membrane design criteria is based on a maximum instantaneous flux of 17 gfd. A clean-in-place tank is not necessary for the MBR and is not provided since typical cleans only involve chemicals injected during reverse flow and the RO feed tank provides enough water for filling the basins for recovery cleans. The automated CIP system sequence will be provided with MBR system supplier controls, to be initiated based on elapsed time or loss of specific flux. Chemical will be injected into the reverse flow during cleaning for a set duration, with set duration of soaking of the membranes, with the details of the procedure per the MBR system supplier programming as is specific to their system.

The RO feed tank is also designed to reserve backwash water for MBR membranes with sufficient volume so as to not interupt or impact RO operation. A redundant RO feed fank and/or dedicated MBR backwash tank could be provided to further protect against interruption or impact to RO operation and this should be invesitigated during final design.

The MBR system includes membrane cassettes, filtrate/backpulse pumps, blowers for aeration and air scour, chemical feed systems for membrane cleaning chemicals, compressed air system for pneumatic valve actuators and pressure decay testing, and other appurtenances. Blowers are required to have noise attenuation.

MBR drain pumps are provided to drain the MBR basins, and also to drain the Aeration and Anoxic basins if required. The design criteria is included in Table 3-6.

Table 3-6 MBR and Biological Basin Design Criteria

Description	Units	Value
Membrane Bioreactor		
Bioreactor Basins		
Total Volume (Anoxic and Aerobic Zones, incl. Membrane Tanks)	gal	348,000
Total HRT (Anoxic and Aerobic Zones, incl. Membrane Tanks)	hrs	7.0
SRT	days	12.0
Anoxic Zone		
Anoxic Zone Volume, Total	gal	94,000
Number of Basins	--	2
Basin Volume, each	gal	47,000
HRT (excluding recycle flow)	hours	1.9
Number of Mixers, Each Basin	--	2
Mixer Power, Each	hp	5
Aerobic Zone		
Aerobic Zone Volume, Total	gal	232,000
Number of Basins	--	2
Basin Volume, each	gal	116,000
HRT (excluding recycle flow)	hours	4.6
RAS Flow (Entering Membrane Tanks), Typical	% of Q	300

Table 3-6 MBR and Biological Basin Design Criteria

Description	Units	Value
RAS Flow (Entering Membrane Tanks), Max Organic Loading	% of Q	500
Number of RAS Pumps, Each Tank	--	1
RAS Pump Capacity, Each	gpm	1816
RAS Pump Power, Each	hp	15
Number of Waste Activated Sludge (WAS) Pumps, Each Basin	--	1
WAS Pump Capacity, Each	gpm	50
WAS Pump Power, Each	hp	0.5
Number of Process Air Blowers, Total (Duty + Standby)	--	2+1
Process Air Blower Capacity, Each	cfm	886
Process Air Blower Power, Each	hp	50
Membrane System		
Type	--	Submerged Hollow Fiber
Tank Volume, Total	gallons	22,000
Number of Tanks	--	2
Maximum Instantaneous Flux	gfd	17
Minimum Recovery	%	90
Minimum Membrane Area Required	ft^2	76,894
Membrane Area per Cassette	ft^2	19,240
Number of Cassettes, Total	--	4.0
Number of Filtrate Pumps, Each Tank	--	1
Filtrate Pump Capacity, Each	gpm	454
Filtrate Pump Horsepower, Each	hp	7.5
Number of Membrane Air Blowers, Each Tank	--	1
Membrane Air Blower Horsepower, Each	hp	15

3.3.1.7 Reverse Osmosis

RO treatment is designed as a 2-stage process to achieve a maximum of 85% recovery. Higher recovery may be possible by utilizing a 3-stage process and/or high cross-flow technologies and should be evaluated during design development.

The RO system consists of multiple components, including the following:

- Pre-treatment chemical feed systems - Pre-treatment will consist of dosing antiscalant and sulfuric acid for scaling prevention, and dosing sodium hypochlorite and liquid ammonium sulfate for the formation of chloramines for biological fouling prevention.

- RO feed tank – provided to account for variation in flows from MBR upstream and RO downstream due to cleans and backwashes, primarily for the purpose of ensuring the RO system can operate as a constant flow without interruption.
- RO feed pumps – to pump from RO feed tank to RO skids.
- RO skid - two, 0.5 MGD production RO skids. The RO skids will include the following items as a packaged system: cartridge filters, first stage and second stage booster pumps, membrane vessels, and instrumentation and control.
- CIP system – including tank and heater, CIP pump(s), and chemical feeds systems. CIP tank shall be provided with immersion heaters, as well as a dry chemical feed system for use with proprietary chemicals, if needed. The design shall include provision of cleaning each stage separately. CIP system will be supplied by the RO system supplier, with automated sequence for cleaning procedure and subsequent neutralization of cleaning solution. Cleaning will be initiated based on either a time interval, or control system alarm indication due to fouling. The neutralized solution after CIP will be drained to the sewer.
- Flush system – flush tank with unchlorinated RO permeate and flush pumps.
- Instrumentation – this shall be provided as per typical design practice for control and monitoring. This includes monitoring with oxidation reduction potential (ORP) upstream of the membrane and in the RO flush tank for chlorine for protection against oxidizing the membranes. TOC analyzer shall be used for log removal credit as a minimum, and addition monitoring of surrogates for pathogen removal such as TRASAR and others shall be considered within design.

The RO system and pre-treatment concept design has been developed using typical wastewater quality and needs to be confirmed during final design with RO system and scaling projection modeling after site specific water quality is collected. The concept design criteria is included in Table 3-7.

Table 3-7 Reverse Osmosis Design Criteria

Description	Units	Value
Reverse Osmosis		
RO Feed Tank		
Tank Volume	gallons	29,000
Number of Tanks	--	1
RO Feed Pumps		
Number of RO Feed (Transfer) Pumps		2
Motor Power	hp	7.5
RO Skids		
Type	--	2-Stage
Feed Flow	MGD	1.18
Total Recovery	%	0.85

Table 3-7 Reverse Osmosis Design Criteria

Description	Units	Value
Cartridge Filter Rating	µm	5.00
Design Flux	gfd	11
Membrane Surface Area (per element)	ft2	400
First Stage Pump Pressure	psi	150
First Stage Motor Power	hp	60
Second Stage Pump Pressure	psi	40
Second Stage Motor Power	hp	7.5
Membrane Array		13:6
Elements per Vessel	--	6
Number of Skids	--	2
RO CIP System		
CIP Tank Volume	gallons	1600
Number of CIP Tanks	--	1
CIP Tank Diameter	ft	6
CIP Tank Water Depth	ft	7.6
Number of CIP Pumps	--	1
CIP Pump Flow Rate	gpm	550
CIP Pump Pressure	psi	60
CIP Pump Motor	hp	30
CIP Tank Heater Power	kW	18
RO Flush System		
Flush Tank Volume	gallons	6,700
Number of Tanks	--	1
Number of Flush Pumps	--	2
Flush Pump Flow Rate	gpm	400
Flush Pump Pressure	psi	60
Flush Pump Motor	hp	20

3.3.1.8 Ultraviolet-Advanced Oxidation Process

UV-AOP design is based on low-pressure high output reactors, utilizing chlorine as the oxidant. Chlorine was chosen to avoid the addition of another chemical onsite or the need for quenching the oxidant after UV-AOP, and due to RO permeate pH being low and suitable for UV-AOP with chlorine. Hydrogen peroxide and alternative oxidants may be considered in the final design. The design must achieve a minimum of 0.5 log reduction of 1,4 – dioxane per Title 22 recycled water oxidation requirements, and achieve a final effluent concentration below the notification limit of various nitrosamine compounds of 10 ng/L.

Bench or pilot testing during final design should be considered based on site-specific water quality testing to verify and fine-tune design criteria for UV/AOP system. UV/AOP design criteria can be found in Table 3-8.

Table 3-8 UV/AOP Design Criteria

Description	Units	Value
Ultraviolet /Advanced Oxidation Process		
Type	--	Low Pressure, High Intensity
Oxidant	--	Chlorine
Feed Flow, Total	MGD	1.0
Feed Design pH	--	5.5
Number of UV Reactors	--	2
Minimum Design UVT	%	96
Target Contaminant Reduction	-	0.5 log 1,4-dioxane
Target Nitrosamine Effluent Concentration	ng/L	<10 ng/L
Applied UV Dose, Minimum	mJ/cm^2	900
Electrical Energy Dose (EED), Minimum	kWh/kgal	0.2

3.3.1.9 Chemical Stabilization

After RO the water will require chemical stabilization to raise the pH and alkalinity of the water. The stabilization must condition the water such that it is not too aggressive for recycled water distribution in plastic and copper pipe and various plumbing fixtures (e.g. toilets when used for flushing water), and also such that it does not clog the future injection wells or release metal contaminants in the groundwater (such as arsenic). Sodium hydroxide and calcium chloride are used for stabilization instead of lime for operational simplicity and safety for this underground facility. Conceptual design criteria and water quality targets for post-RO stabilization are shown in Table 3-9. The design criteria and the deisgn of mixing systems shall be finalized during detailed design to ensure effective performance and appropriate final chemistry is achieved for this application for groundwater recharge.

Table 3-9 Chemical Stabilization Design Criteria

Description	Units	Value
Chemical Stabilization		
Target pH range	--	7.5 - 8.5
Target Alkalinity	mg/L as CaCO3	> 60

Table 3-9 Chemical Stabilization Design Criteria

Description	Units	Value
Sodium Hydroxide Design Dose	mg/L	50
Calcium Chloride Design Dose	mg/L	50

3.3.1.10 Clearwell and Final Effluent Pumps

The clearwell will received stabilized water, which will be pumped into the recycled water distribution system and eventually to the future groundwater injection wells by the final effluent pumps. Conceptual design criteria for clearwell and final effluent pumps is included in Table 3-10.

Table 3-10 Clearwell and Final Effluent Pumps Design Criteria

Description	Units	Value
Clearwell		
Clearwell Volume	gallons	85,000
Number of Tanks	--	1
Length	ft	24
Width	ft	32
Side Water Depth	ft	16
Retention Time	hours	2.0
Number of Final Effluent Pumps	--	2 (1+1)
Design Flow, per Pump	MGD	0.5

3.3.1.11 Odor Control System

An odor control system is required for the treatment plant ventilation flow. This is of particular importance due to the proximity of the treatment facility to popular and widely used public spaces at the Civic Center site, especially the Child Center and Courthouse. Odor cannot be detected from the AWTF at these nearby facilities.

The odor control system services both the upper and lower levels of the AWTF. It is designed to treat 40,000 cfm, which provides 12 Air Changes per Hour (ACH) for the Treatment Chemical Storage area, MBR area, and enclosed headspaces of the biological basins and fine screens, and 6 ACH for the maintenance facilities and other process control equipment. The final design shall consider methods of enclosure and ventilation in order to minimize areas that require explosion proofing, including maintaining a vacuum on fine screen and biological basin headspaces (see Appendix C for relevant design guidelines and code requirements, including NEC-NFPA 70 and NFPA 820). Ambient monitoring and interlocks for shutdown upon ventilation failure shall be provided where required (e.g. headspace of the fine screen)

The design criteria is included in Table 3-11. This is based on a carbon adsorption system, but other systems such as ionized air should be considered in final design.

Table 3-11 Odor Control System Design Criteria

Description	Units	Value
Odor Control System		
Air Flowrate	cfm	40,000
Odor Control Carbon Vessels		
Type	--	Dualbed
Number of Vessels	--	4 (3+1)
Vessel Diameter	ft	12
Odor Control Exhaust Fans		
Number of Fans	--	2 (1+1)
Fan Motor Power, Each	hp	100

3.3.1.12 Chemical Dosing Systems

Chemicals are stored in totes for ease of loading/unloading. There is one standby pump for each chemical metering pump size per chemical for redundancy. Additionally, there is a minimum of two storage totes (1+1) for all chemicals, in order to have redundancy so that operation is uninterrupted by the replacement of chemical storage. It should be considered during final design whether chemicals that are not continuously dosed should be reduced to one tote, assuming the chemical volumes required for a cleaning or neutralization activities are sufficiently provided with one tote. Static mixers or other methods of enhancing mixing of chemicals injected into process streams shall be provided where deemed necessary based on process water quality goals and equipment protection. The design criteria for chemical storage is provided in Table 3-12.

Table 3-12 Chemical Systems Design Criteria

Description	Units	Value
Chemical Dosing Systems		
Minimum Days of Storage	days	7
Total Number of 330-gal Chemical Totes	--	27
Sodium Hypochlorite		
Uses	--	MBR Effluent, UV/AOP Influent/Effluent, MBR/MF EFM/CIPs
Strength	%	12.5
Total Storage Volume Required	gallons	1676
Number of 330-gal Chemical Totes	gal	6
Number of Pumps (Duty + Standby)	--	4+1
Liquid Ammonium Sulfate		
Uses	--	MBR Effluent
Strength	%	40
Total Storage Volume Required	gallons	259
Number of 330-gal Chemical Totes	-	2
Number of Pumps (Duty + Standby)	--	1+1
Sulfuric Acid		
Uses	--	RO Influent, UV/AOP Influent,
Strength	%	93
Total Storage Volume Required	gallons	158
Number of 330-gal Chemical Totes	-	2
Number of Pumps (Duty + Standby)	--	5+2
Antiscalant		
Uses	--	RO Influent
Strength	%	100
Total Storage Volume Required	gallons	36
Number of 330-gal Chemical Totes	-	2
Number of Pumps (Duty + Standby)	--	2+1
Citric Acid		
Uses	--	MBR/RO CIP
Strength	%	50
Total Storage Volume Required	gallons	41
Number of 330-gal Chemical Totes	-	2
Number of Pumps (Duty + Standby)	--	1+1

Table 3-12 Chemical Systems Design Criteria

Description	Units	Value
Sodium Hydroxide		
Uses	--	RO CIP, CIP Neutralization, Post Stabilization
Strength	%	25
Total Storage Volume Required	gallons	1418
Number of 330-gal Chemical Totes	-	5
Number of Pumps (Duty + Standby)	--	2+1
Sodium Bisulfite		
Uses	--	CIP Neutralization
Strength	%	20
Total Storage Volume Required	gallons	12
Number of 330-gal Chemical Totes	-	2
Number of Pumps (Duty + Standby)	--	1
Calcium Chloride		
Uses	--	Post Stabilization
Strength	%	37
Total Storage Volume Required	-	2,285
Number of 330-gal Chemical Totes	-	7
Number of Pumps (Duty + Standby)	--	1+1

3.3.1.13 AWTF Waste Streams and Drain System

Waste streams and drain water from the AWTF will be sent to the 8-inch sanitary sewer line adjacent to the facility. Waste streams from the AWTF include the following:

- WAS (2% of influent), continuous flow
- Neutralized chemical cleaning solutions after membrane cleanings, intermittent flow
- RO brine, continuous flow
- Plant drains, intermittent flow

The biological basins and any tank within the AWTF will be provided with a means of draining to the sanitary sewer.

3.3.1.14 Emergency Overflows

Emergency overflows from the AWTF shall be mitigated by interlocks for pumps and tank water level float switches throughout the facility, hardwired wherever feasible. A means of emergency overflows shall be provided throughout the AWTF to protect the facility and equipment from damage and/or flooding. Emergency overflows shall be directed to the 39-inch sanitary sewer at Ocean Ave.

3.3.2 Civic Center Tank

The Civic Center stormwater tank will have a capacity of 1.5 MG. This volume is in accordance with the 85th percentile, 24-hour storm volume outlined in the approved *Enhanced Watershed Management Plan for Santa Monica Bay Jurisdictional Groups 2 and 3 (EWMP)*. Capture of the 85th percentile, 24-hour storm volume aids the City in both improving beach quality and compliance with non-point source control requirements as outlined in their MS4 permit. Figure 3-4 (sourced from Appendix A of the EWMP) shows the drainage area for the Civic Center in purple, which totals approximately 88 acres.

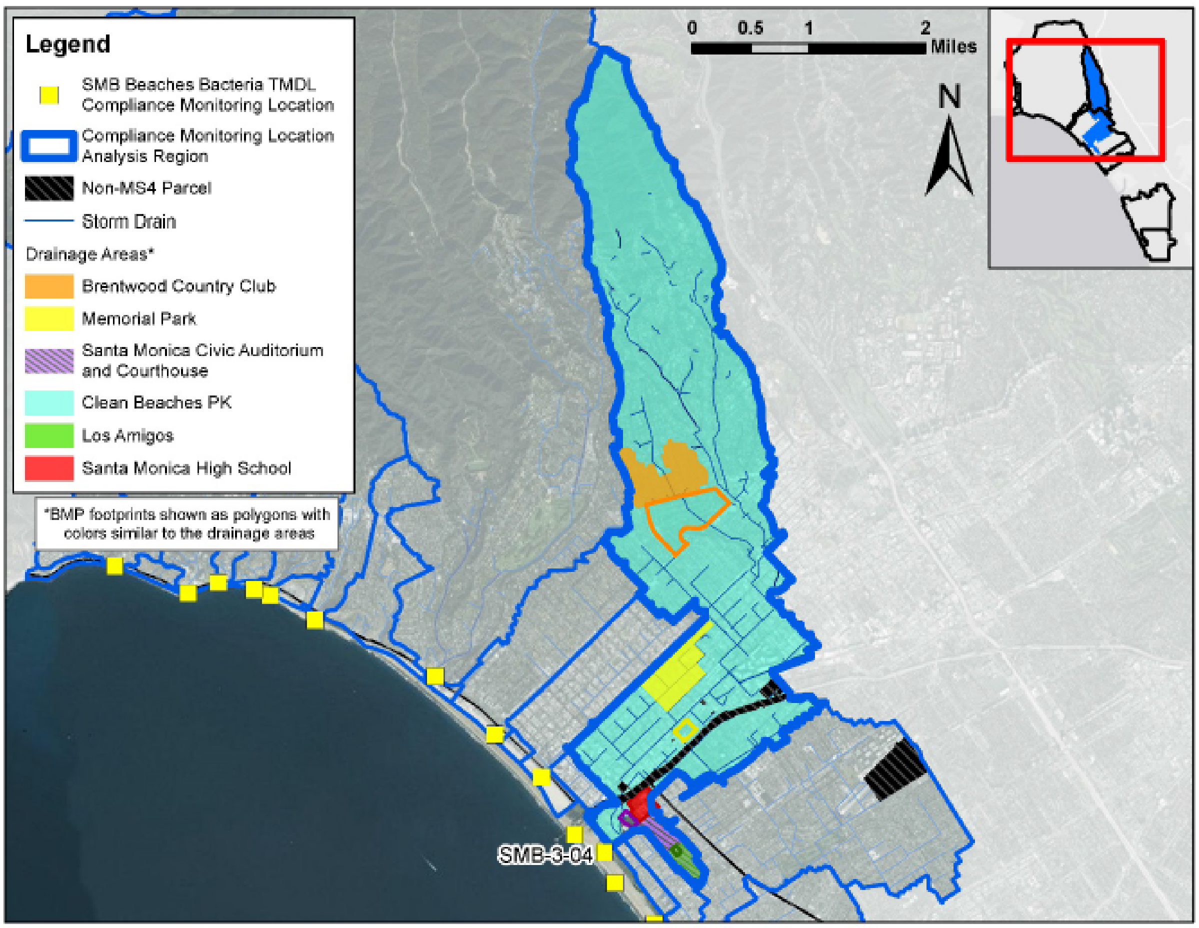

Figure 3-4 Civic Center Drainage Area

The stormwater harvest tank will be constructed entirely below grade adjacent to the AWTF. The source of the stormwater for the tank will be the tributary area of the Pico-Kenter watershed within the City and the associated Pico/Caltrans storm drain system. The tank will capture both wet- and dry weather flows.

The type of construction for the tank shall be determined during final design, and may be made of prefabricated modular units, a standard cast in place reinforced concrete tank, or pre-stressed concrete tank. The most cost effective configuration that fits the available space is desired.

The concept design and layout is based on a rectangular type tank, and the design criteria is summarized in Table 3-13.

Table 3-13 Civic Center Tank Design Criteria

Component	Value
Tank Volume	1.5 MG
Tank Type	TBD during final design
Minimum Tank Cover	4 ft
Freeboard	5 ft
Tank Length x Width (Rectangular Type)	110 ft x 110 ft
Water Depth	18 ft
Total Tank Depth	26 ft
Number of Hatches, Minimum	2
Hatch dimensions	4 ft x 6 ft
Overflow Flow Rate	5.5 cubic feet per second (CFS)
Overflow Weir Headloss	6 in
Overflow Weir Length	4.8 ft

While the final tank design parameters will be determined during final design, the tank must meet the following design criteria requirements, in addition to the constraints and limitations outlined in Section 3.5.Tank design must meet all applicable structural design code requirements, as outlined in Appendix C.

- **Underdrain –** A pipe underdrain system will be provided to allow detection of any leakage and to determine the approximate location of the leak. Underdrain piping may consist of perforated polyvinyl chloride (PVC) or similar materials. The structural underdrain may also assist in preventing groundwater intrusion. However, groundwater in the vicinity has reportedly been detected between approximately 42 feet and 58 feet below ground surface and is not anticipated to be an issue.

- **Standard columns and footings** – For structural integrity and to allow public use above the stormwater harvesting tank. Standard column and footing with additional loading factors will be constructed. Additionally, tank walls will have constant thickness, and with no tapered walls provided.

- **Tank Cover and Freeboard –** A minimum cover of 4 feet above the top of the stormwater harvesting tank will be provided to allow for traffic loading. Freeboard within the tank will be 5 feet to account for water sloshing and prevent damage to the tank roof in case of a seismic event.

- **Tank Inlet Pipe (Discharge into Tank)** – The tank inlet pipe shall be designed to discharge into the tank to minimize splashing. The conceptual design includes this inlet pipe entrance upward through the bottom of the tank assuming a pre-stressed tank to eliminate a wall penetration through the pre-stressed wrapping. Other options for discharge into the tank should be considered during final design, including a downward sloping discharge similar to the CBI Project.

- **Sump and Discharge Outlet –** A sump will be located near the center of the tank, with tank floors sloping downwards toward the sump. A high curb will be provided around all sides of the sump to help exclude sand and debris. The sump will contain a discharge outlet to drain the tank as well as convey stormwater from the harvesting tank to the outlet line.

- **Access Hatches –** For maintenance purposes, a 4 ft x 6ft Bilco-type Caltrans H-20 traffic rated spring loaded double leaf hatch type, or similar, will be included to allow for equipment access into the tank. At a minimum the tank shall include two additional entries to allow personnel access. Final size of entries should be determined with the City's operations staff. Fall protection within hatches should also be provided. The hatch must be able to handle traffic loading, such as a Bilco-type Loaded Hatch.

- **Emergency Overflow –** To prevent overflow within the tank, an overflow structure shall be constructed into the tank. This box type overflow weir structure can prevent tank overflow and requires less maintenance than a sole pipe overflow. Within the overflow structure would be a new pipeline connecting to the Pico/Caltrans Box Culvert as shown in Figure 3-2. To mitigate occurrences of overflows, float switches are interlocked to the pump station(s) to shut off pumps in the case of high-high tank level. The use of hardwire interlocks with fiber communication shall be evaluated during final design.

- **Vents -** Vents should be routed away from public use areas. Screened vents will be considered as a means for vector control. The vents must blend with existing surface structures and be located to avoid conflicts with existing surface level parking and, most importantly, away from the ECLS.

- **Odor and Vector Control –** To prevent foul odors within the public area, odor control provisions shall be implemented. Granular activated carbon (GAC), ionized air, or similar technologies will be considered for odor control in the detailed design, and may be shared with the AWTF. The tank will be supplied with exhaust fan(s) sized for six air changes per hour. Additionally, the tank will be drained as efficiently as possible and mechanisms will be installed to prevent vector control and stagnant waters.

- **Grit, debris, oil & grease handling** - Provisions for handling grit and debris as well as oil and grease that may accumulate within the tank must be accommodated in the final design, this may include access for manual cleaning, removal of oil and grease by skimming, or other methods. Automatic cleaning and flushing systems (including water flushing systems from center or edge of tank) should be considered.

3.4 FACILITES LAYOUT

3.4.1 Civic Center Site Overall Layout

The overall Civic Center Site Layout is included in the figures below and discussed in this section. The area above the AWTF and Civic Center Tank will be re-paved post-construction to restore previous parking spaces. In consultation with the City's urban forester, the City will provide means to re-establish landscaping, as needed. The carport with solar panels needs to be restored as well.

Wastewater in the 54-inch sanitary sewer on Ocean Ave will be pumped via the new OALS to the AWTF for treatment. Stormwater will be captured from both the existing 48-inch storm line along Pico Blvd. and the 10' x 10' Pico/Caltrans Box Culvert that runs underneath the Civic Center parking lot (the box culvert will also contain any flows transferred from Memorial Park Tank down to the Civic Center site). Harvested stormwater will be pumped from the Civic Center Tank or the box culvert into the AWTF to be blended with wastewater together for treatment. The tank may be circular or rectangular in shape and will be determined per discussions with the City during final design.

Treated water is pumped from the AWTF into the 8-inch recycled water line on Main St. An emergency overflow from the Civic Center Tank is diverted to the Pico/Caltrans 10' x 10' box culvert. Waste flows from the AWTF and Civic Center drain water is conveyed to the 8-inch sanitary sewer bisecting the Civic Center Parking Lot sloping toward Pico Blvd. Additional details regarding utility connections are provided in Section 3.6 for the Civic Center area and Section 4.5 for the Memorial Park area.

Figure 3-5 below shows the overall civic center site layout and all adjacent facilities and the utility connections between them. The pipeline alignments shown are preliminary, and improvements to these alignments shall be investigated during final design. Construction must be contained within the limits indicated in the figures. Stockpiling of soil will not be allowed at the Civic Center site.

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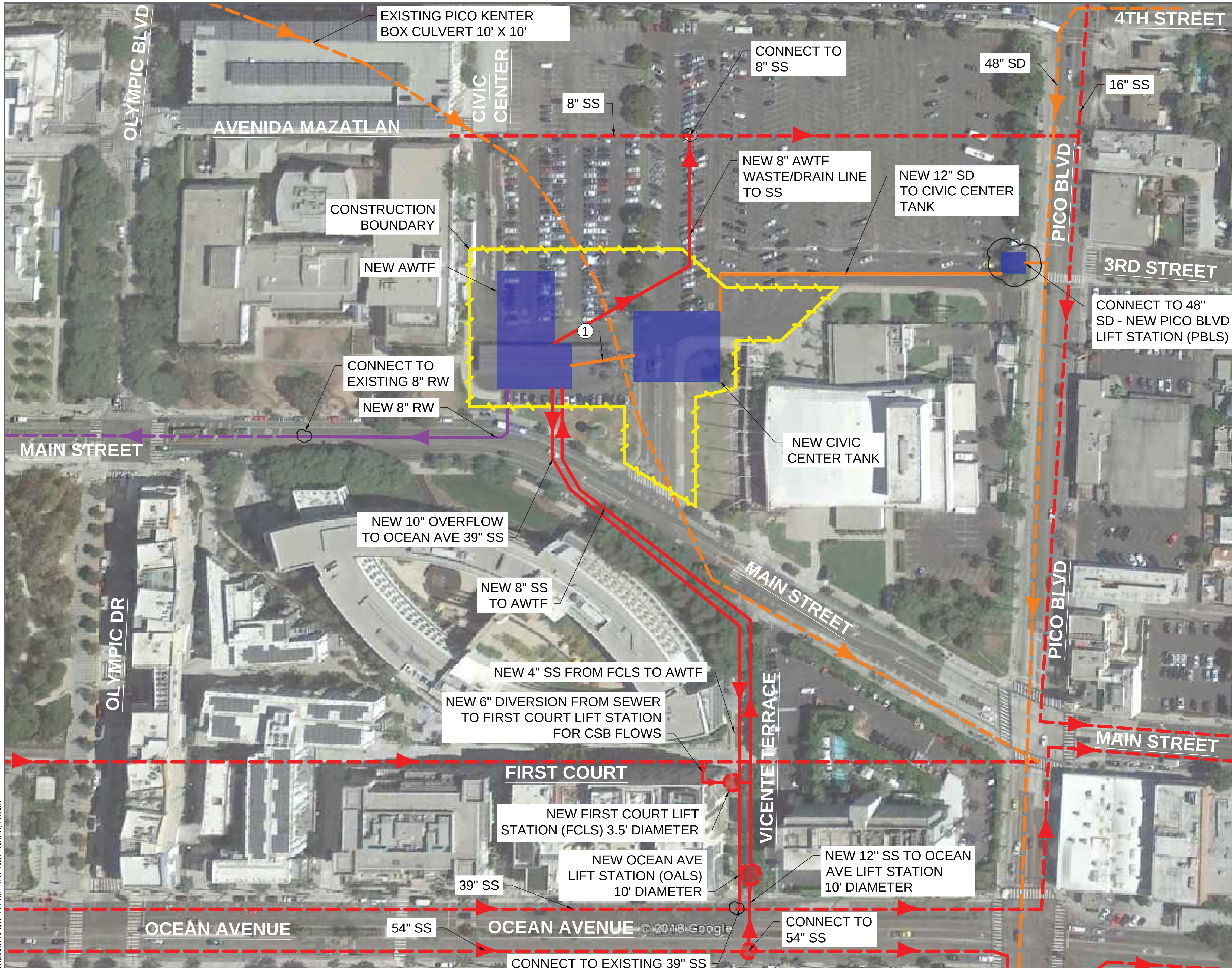

KEY:

EXISTING SANITARY SEWER	
NEW SANITARY SEWER	
EXISTING STORM DRAIN	
NEW STORM DRAIN	
EXISTING RECYCLED WATER	
NEW RECYCLED WATER	
CONSTRUCTION BOUNDARY	

GENERAL SHEET NOTES

1. MULTIPLE CONNECTIONS:
   1) FROM CULVERT TO AWTF
   2) FROM AWTF TO TANK
   3) FROM TANK TO AWTF
   4) FROM TANK TO CULVERT (OVERFLOW)

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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

Stantec

CONSULTANT

REVIEWED : DATE : ________ 20__
SELIM EREN, P.E.
CIVIL ENGINEER

REVIEWED : DATE : ________ 20__

REVIEWED : DATE : ________ 20__

CITY CLIENTS

REFERENCE :

DATE : ________ 20__
SUBMITTED BY :
CURTIS CASTLE, P.E.
PRINCIPAL CIVIL ENGINEER

COMPUTER FILE NAME:

SP-FILE NO.: SP 2456

APPROVED BY :
RICK VALTE, P.E., CIVIL ENGINEER
DATE : ________ 20__

CIVIL ENGINEERING SERVICES

SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 3-5
CIVIC CENTER FACILITIES SITE LAYOUT

PROJECT AND SHEET TITLE

DESIGNED BY :
DRAWN BY :
CHECKED BY :
CONSULTANT JOB/SHEET NO.
DRAWING NO. XXXX
SHT X OF X SHTS

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After construction of all facilities at the Civic Center Site, a final restored parking lot is required. The criteria for the Civic Center Site parking lot includes the following:

- The final layout shall be determined in consultation with the City, including the Planning Department, and must coordinate with surrounding projects.
- The layout must comply with City standards and applicable code requirements, including but not limited to: parking, loading, circulation, and electric vehicle spaces per Santa Monica Municipal Code (SMMC) Chapter 9.28; landscaping requirements per SMMC 9.26.110; lighting requirements per SMMC 9.28.120; accessibility requirements per 2016 California Building Code (CBC) and Americans with Disabilities Act (ADA) (see Appendix C for City Standards).
- The layout must maximize parking spot quantities, based on compact-sized stalls.
- The layout must include a minimum of 12 Electric Vehicle (EV) charging stations to match existing quantity.
- The layout must maximize the quantity of solar panels to the extent possible.
- The layout must be coordinated with the access locations to the AWTF, designed in such a way that prevents blockage of access points, hatches, sidewalk elevators, and stairs. Elevator and stairway access includes at-grade hatches that are lifted to allow access when authorized personnel enter or exit the facility.
- All at- and above-grade components of the AWTF shall be designed to prevent obstruction of public view corridors.
- The design shall be compatible with historic resources and maintain public circulation around the project site.

Two layouts for the final restored surface of Civic Center site and parking lot are conceptualized for this report; both using compact-sized stalls to maximize the number of parking spots. Option 1, shown in Figure 3-6, contains 65 compact parking spaces, while Option 2, shown in Figure 3-7, contains 66. Adhering to the 2016 CBC, each layout includes four compact handicap accessible parking spots and one van handicap accessible parking spot, with access aisles provided as needed. To match the existing infrastructure, 12 EV parking spaces are included in the layouts; nine of which are compact, three of which are van accessible. Both layouts reincorporate the existing solar canopy, maximizing the amount of solar panels.

Option 1 includes a dual use fire lane and bike path stretching from Civic Center Drive to Pico Boulevard. Fire trucks are permitted entrance and exit via Civic Center Drive and Pico Boulevard. Entrance and exit for through-traffic is permitted via Civic Center Drive and by driveway to Main Street. Option 2 integrates a fire lane into the parking lot. A bike lane stretches from Civic Center Drive to Pico Boulevard, with dual use occurring along the northeast side of the Civic Auditorium. As such, fire trucks may enter and exit via Civic Center Drive, Pico Boulevard, and Main Street.

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GENERAL SHEET NOTES

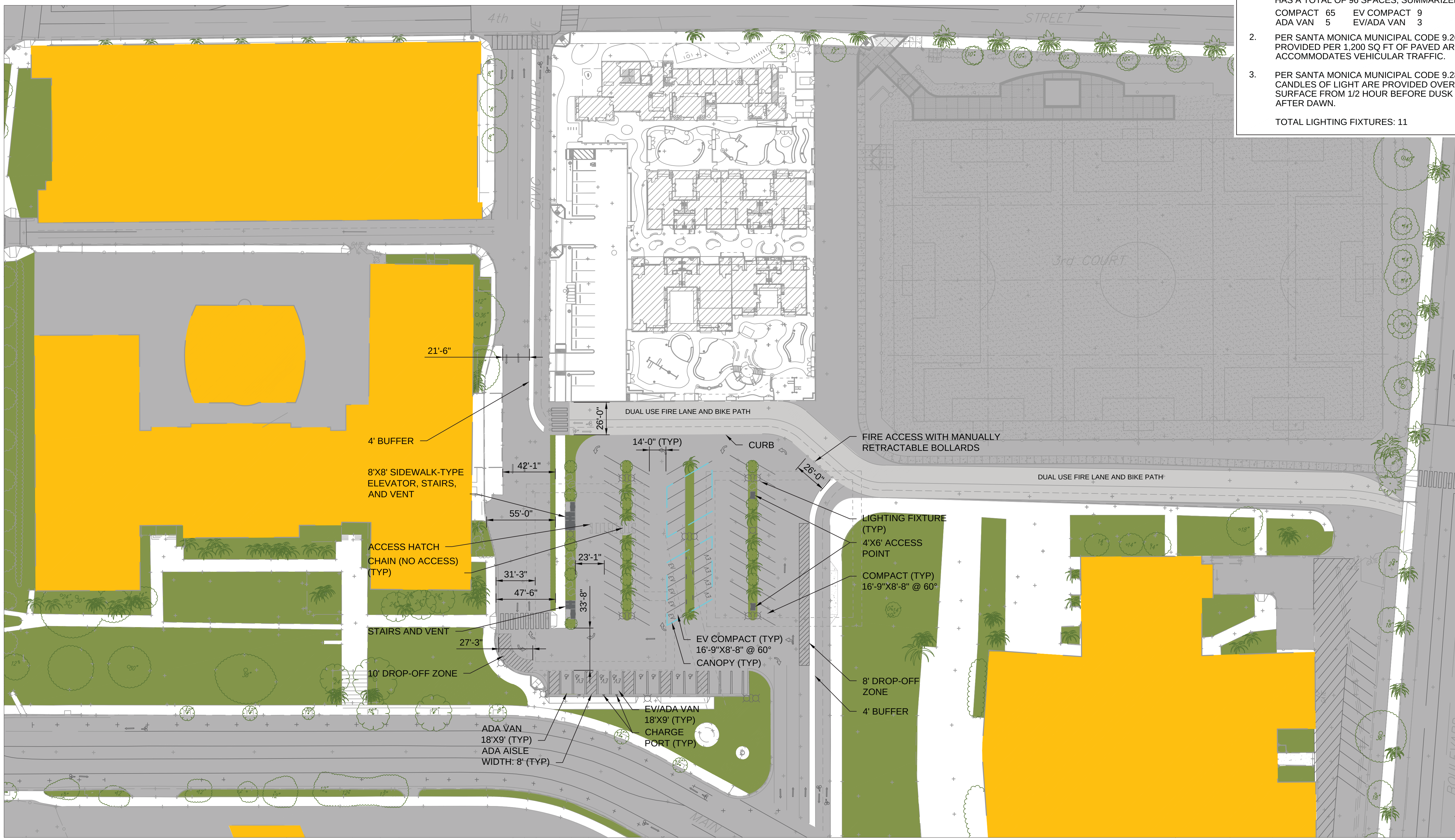
1. PER 2016 CALIFORNIA BUILDING CODE, A PARKING FACILITY PROVIDING 76 TO 100 SPACES SHALL HAVE A MINIMUM NUMBER OF 4 ACCESSIBLE PARKING SPACES. THIS PARKING FACILITY HAS A TOTAL OF 96 SPACES, SUMMARIZED BELOW:

COMPACT	65	EV COMPACT	9
ADA VAN	5	EV/ADA VAN	3

2. PER SANTA MONICA MUNICIPAL CODE 9.26.110, ONE TREE IS PROVIDED PER 1,200 SQ FT OF PAVED AREA THAT ACCOMMODATES VEHICULAR TRAFFIC.

3. PER SANTA MONICA MUNICIPAL CODE 9.28.120, 0.5 TO 3.0 FOOT CANDLES OF LIGHT ARE PROVIDED OVER THE PARKING SURFACE FROM 1/2 HOUR BEFORE DUSK UNTIL 1/2 HOUR AFTER DAWN.

TOTAL LIGHTING FIXTURES: 11



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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

Stantec

CONSULTANT

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SELIM EREN, P.E. CIVIL ENGINEER
REVIEWED : DATE : ________ 20__
REVIEWED : DATE : ________ 20__

CITY CLIENTS

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SUBMITTED BY :
SP-FILE NO.: SP 2456
CURTIS CASTLE, P.E. PRINCIPAL CIVIL ENGINEER
APPROVED BY :
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CIVIL ENGINEERING SERVICES

SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 3-6
RESTORED CIVIC CENTER SITE PLAN
(OPTION 1)

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GENERAL SHEET NOTES

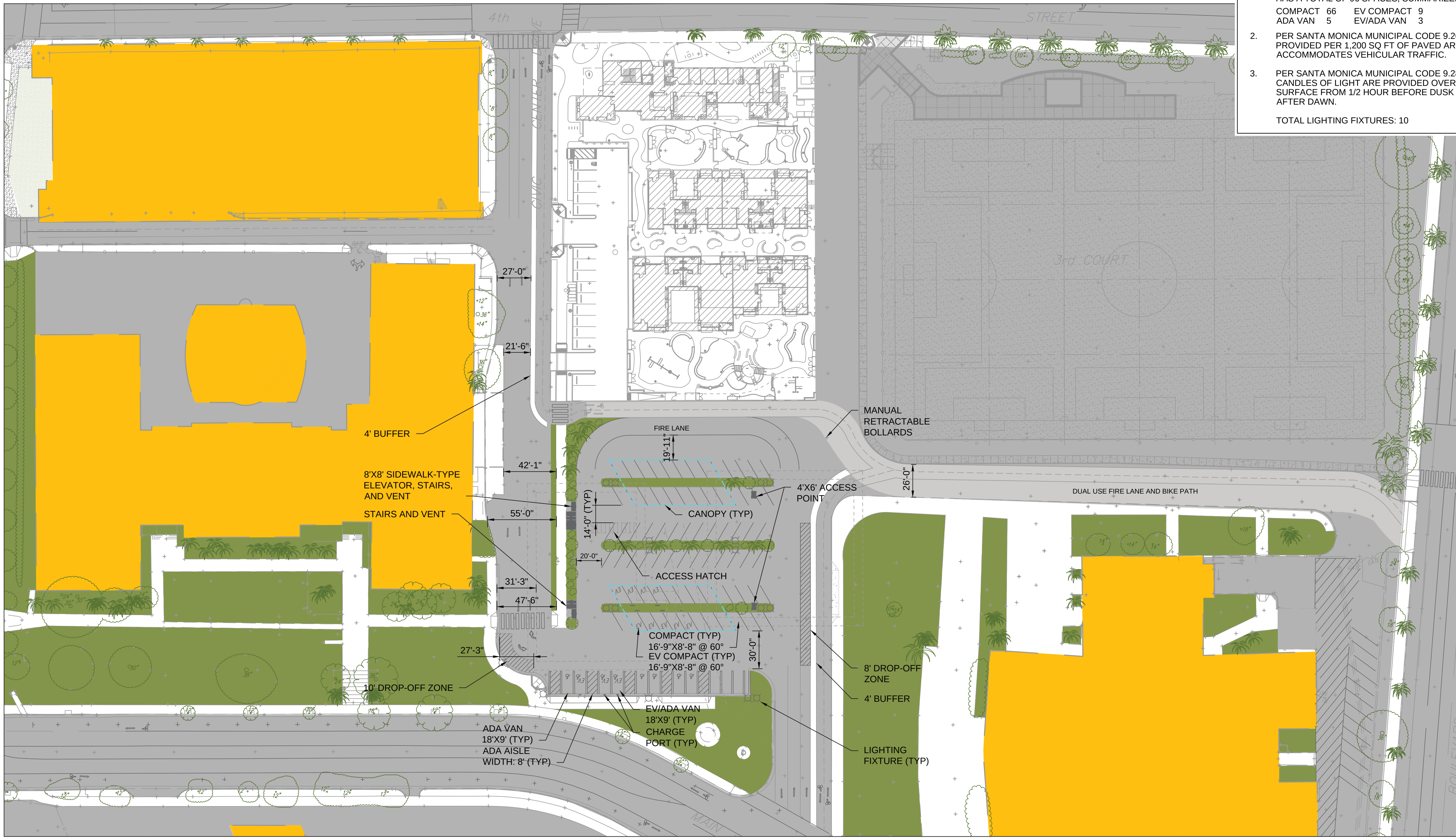
1. PER 2016 CALIFORNIA BUILDING CODE, A PARKING FACILITY PROVIDING 76 TO 100 SPACES SHALL HAVE A MINIMUM NUMBER OF 4 ACCESSIBLE PARKING SPACES. THIS PARKING FACILITY HAS A TOTAL OF 96 SPACES, SUMMARIZED BELOW:

   COMPACT 66 EV COMPACT 9
   ADA VAN 5 EV/ADA VAN 3

2. PER SANTA MONICA MUNICIPAL CODE 9.26.110, ONE TREE IS PROVIDED PER 1,200 SQ FT OF PAVED AREA THAT ACCOMMODATES VEHICULAR TRAFFIC.

3. PER SANTA MONICA MUNICIPAL CODE 9.28.120, 0.5 TO 3.0 FOOT CANDLES OF LIGHT ARE PROVIDED OVER THE PARKING SURFACE FROM 1/2 HOUR BEFORE DUSK UNTIL 1/2 HOUR AFTER DAWN.

   TOTAL LIGHTING FIXTURES: 10



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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

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SELIM EREN, P.E.
CIVIL ENGINEER
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SUBMITTED BY :
CURTIS CASTLE, P.E.
PRINCIPAL CIVIL ENGINEER
COMPUTER FILE NAME:
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SUSTAINABLE WATER INFRASTRUCTURE PROJECT
CONCEPTUAL DESIGN

FIGURE 3-7
RESTORED CIVIC CENTER SITE PLAN
(OPTION 2)

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3.4.2 AWTF

Preliminary conceptual layouts of the AWTF have been developed based on the design criteria. Figure 3-8 shows the plan view of the ground level. The facility has two grade level access points; a freight elevator and stairs located on one end of the facility, with another set of stairs located on the opposite end. The location of the access locations must be coordinated with the surface parking lot layout. All components of the AWTF, including at grade access and vents, are to be designed to not have any structures above grade that would obstruct public view corridors. Elevator and stairway access are designed with hatches that are at grade level, and are lifted to allow access when authorized personnel enter or exit the facility but otherwise are flush with grade level. There will also be a traffic-rated access hatch on the ground level to allow the MBR cassettes to be pulled up for maintenance. The typical replacement period for MBR cassettes is approximately five to seven years. When not in use, the area over the MBR access hatch can be used for ground level parking.

Figure 3-9 shows a plan view of the upper level of the AWTF, which contains the water treatment chemical storage area and maintenance facilities. The two areas will be divided by a separation wall. This allows the two areas to be classified independently and significantly reduces the number of required air changes needed from the facility's ventilation system. The chemical area includes chemical storage totes, pumping skids, clean in place tanks, clean in place pumps, and a treatment chemical loading zone. The chemical loading zone will be used to store empty totes between deliveries. In order to accommodate a forklift for delivery of chemical totes, aisles in front of the chemical totes are 12 feet wide. Maintenance facilities on the other side of the separation wall include the control room, electrical room, blower room, mechanical room, and staff locker room.

Figure 3-10 shows a plan view of the lower level of the facility, which is also divided by a separation wall. Similar to the chemical storage area above, the area with MBR equipment requires a higher number of air changes per hour. Keeping the MBR equipment contained on one side of the wall reduces the overall ventilation requirement for the facility. The side with the MBR equipment also contains the stormwater influent pumps, MBR equipment, RO Feed Tanks, and carbon filter Odor Control System. Figure 3-11 shows a section view of the AWTF.

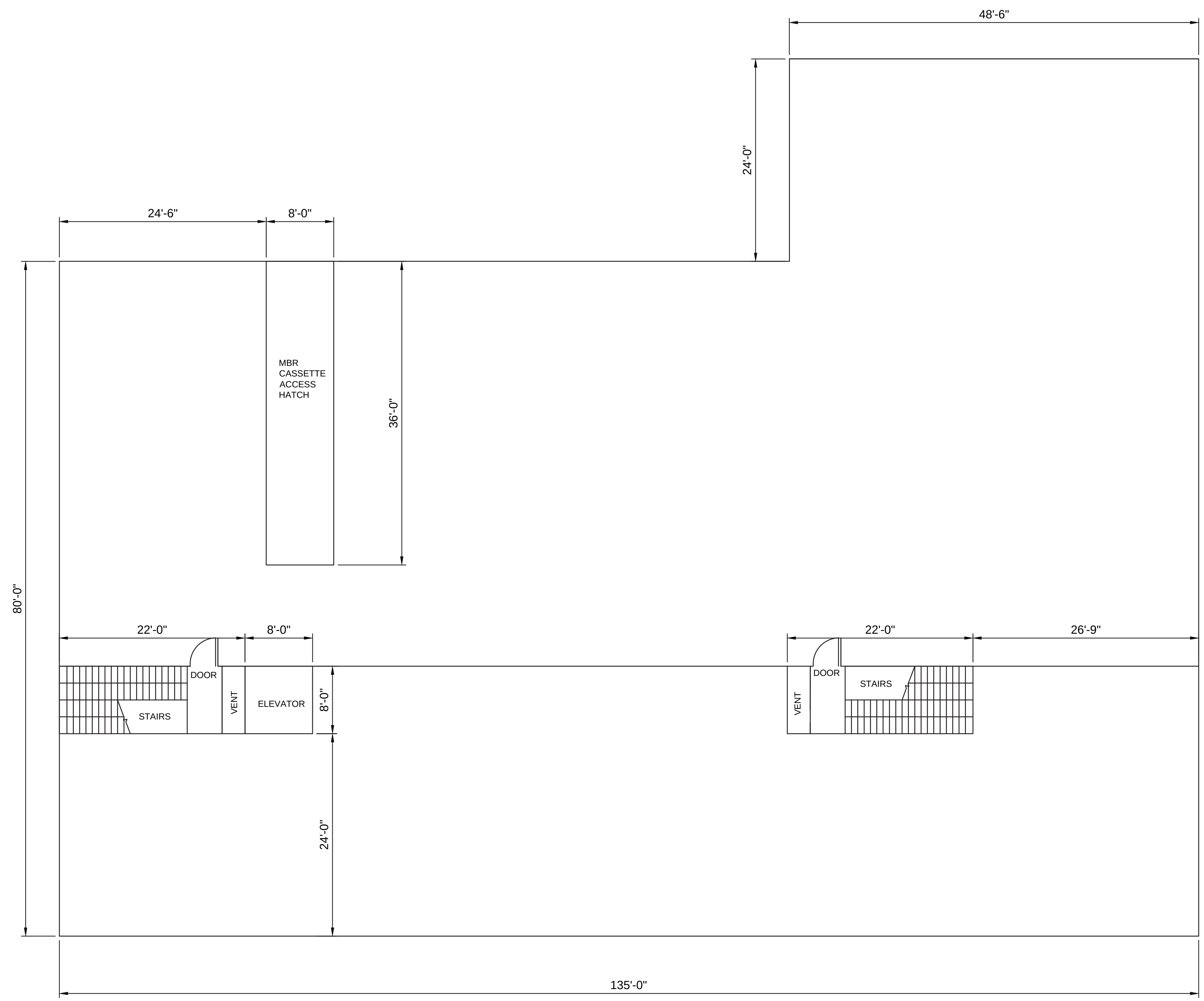
There are four stormwater pumps in total. Two are stormwater capture pumps that deliver water from the Pico/Caltrans box culvert into the Civic Center tank. The other two are stormwater feed pumps that convey water from the Civic Center tank back into the AWTF for treatment. The RO Feed Tank serves as a break tank between the MBR and RO systems.

The RO, UV systems and Product Water Clearwell are located on the other side of the separation wall. The MF/UF system is shown in a dotted line in Figure 3-10, as it will not be needed if DDW approves an MBR-RO-UV/AOP treatment train for groundwater recharge indirect potable reuse (IPR). The clearwell will hold post-conditioned water prior to distribution to the groundwater basin. The effluent pumps are located on the top of the clearwell on the upper level. Part of the clearwell is partitioned for RO Flush water. RO Flush water is unchlorinated effluent used to flush the RO membranes during maintenance and system startup/shutdowns.

Overall, this is a preliminary layout whose advantages and disadvantages should be considered during detailed design as the layout is finalized within the constraints present. A few noted items for consideration include the following:

- The elevator access location provides for truck access and delivery of chemicals at grade, though the pathway between the elevator and chemical areas could provide for easier operation of loading/unloading totes if it was shorter and/or wider.

- The inclusion of a separation wall to divide area classifications is considered an advantage and a critical component to the layout. The reduction of facility area that is classified (and therefore requires higher air changes and/or special electrical ratings) is of high importance in order to protect operator safety and also reduce costs.



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Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
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PRINCIPAL CIVIL ENGINEER
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CONCEPTUAL DESIGN

FIGURE 3-8
AWTF GROUND LEVEL LAYOUT

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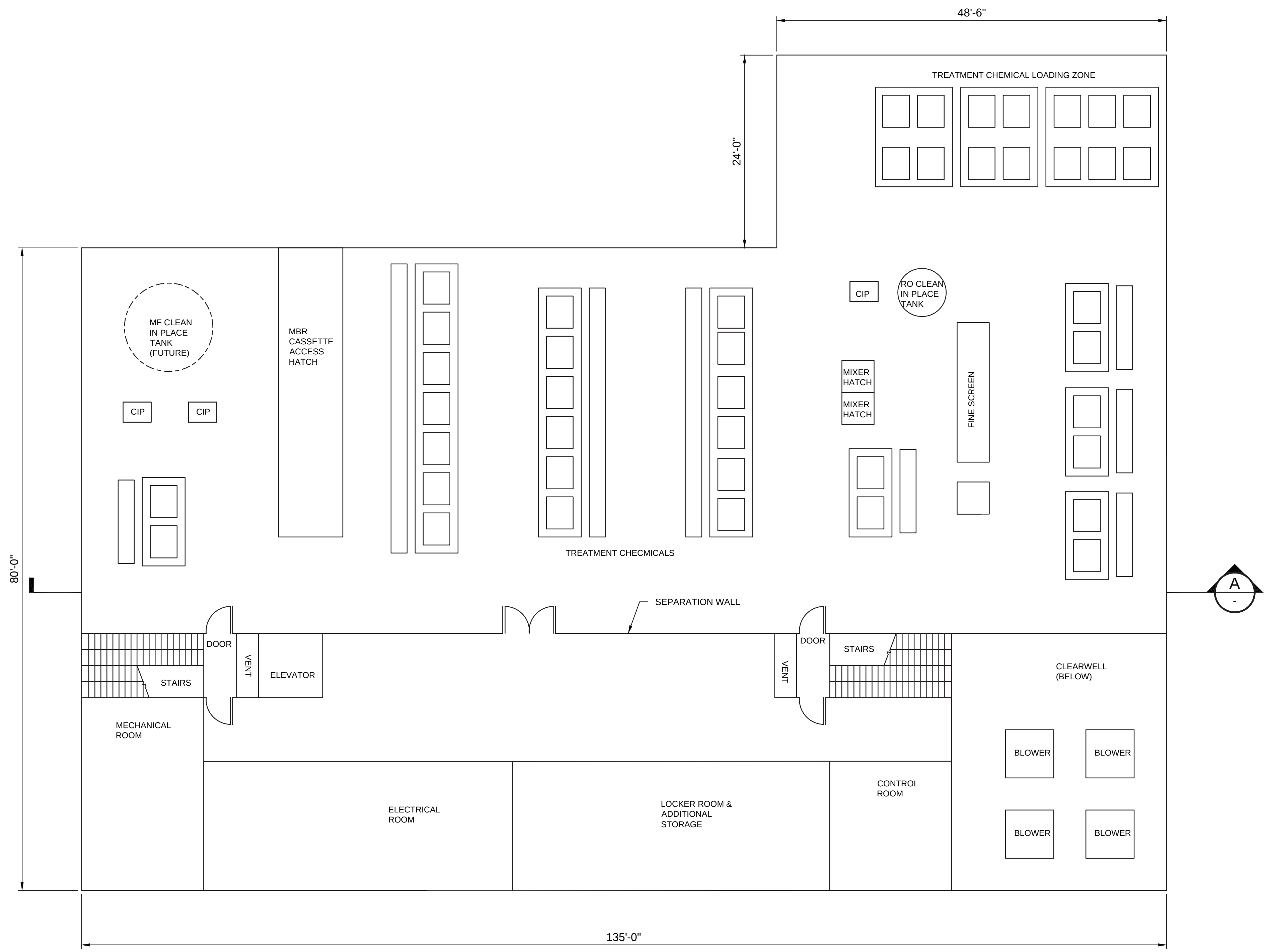

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Department of Public Works
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TEL. (310) 458-8721 FAX. (310) 393-4425
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SUSTAINABLE WATER INFRASTRUCTURE PROJECT
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FIGURE 3-9
AWTF UPPER LEVEL LAYOUT

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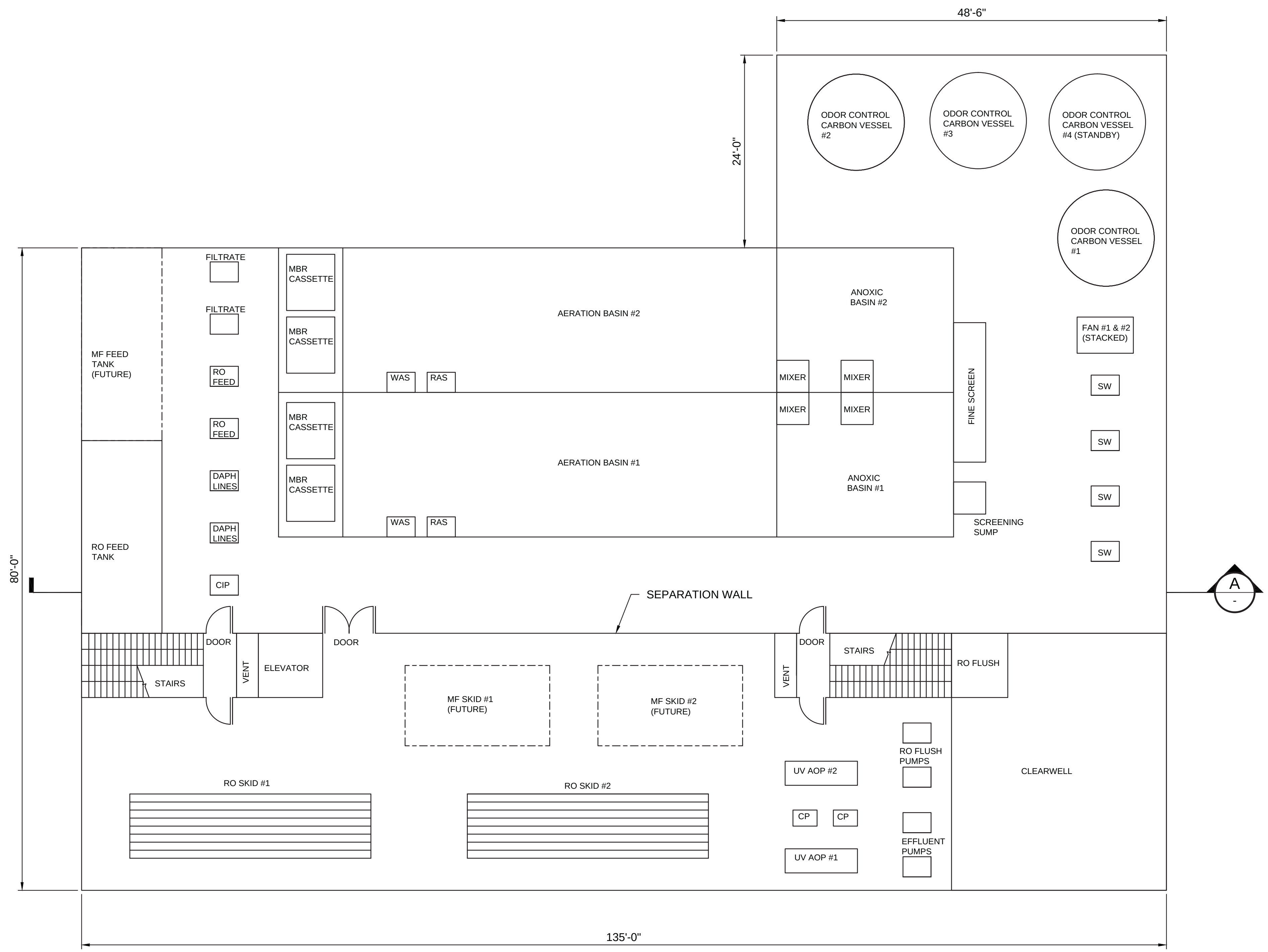

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TEL. (310) 458–8721 FAX. (310) 393–4425
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FIGURE 3-10
AWTF LOWER LEVEL LAYOUT

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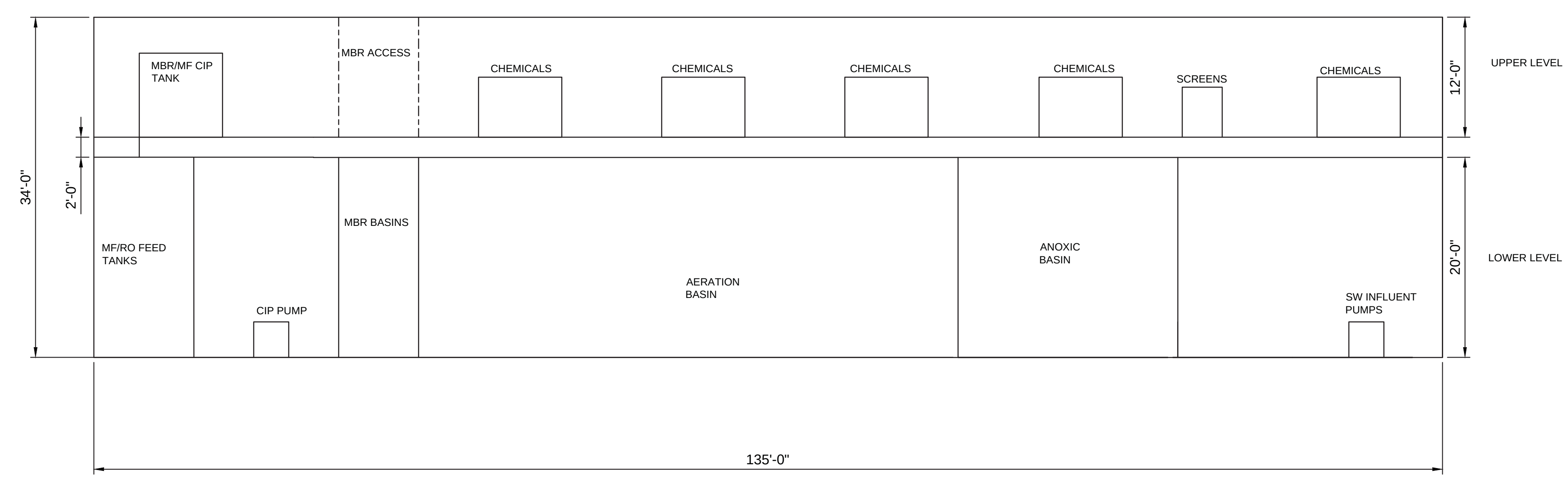
GENERAL SHEET NOTES

1. ACCESS STAIR AND ELEVATORS ARE DESIGNED WITH HATCHES THAT LIFT TO ALLOW ENTRANCE/EXIT BUT ARE FLUSH WITH GRADE LEVEL DURING ALL OTHER TIMES



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Department of Public Works
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SUSTAINABLE WATER INFRASTRUCTURE PROJECT
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FIGURE 3-11
AWTF SECTION VIEW LAYOUT

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3.5 CONSTRAINTS & LIMITATIONS

There are site constraints within the project location area as follows:

- The Pico/Caltrans storm drain is a 10 foot box culvert that bisects the parcel available for the AWTF and the stormwater tank. The siting and design of both the AWTF and the Civic Center stormwater tank needs to be coordinated with the presence of this storm drain.
- The City's Historical Landmarked Chain Reaction sculpture, located at the Main Street entrance of the Civic Center Parking Lot, is a copper chain link and stainless steel artwork that has been part of the City's cultural landscape since 1991. The siting and construction of the AWTF and associated stormwater harvest tank infrastructure is planned so that the sculpture will not be disturbed.
- The planned construction of the Early Childhood Lab School (ECLS), and Multipurpose Field on the Civic Center Parking Lot, adjacent to the parcel available for the SWIP Elements. This constraint requires consideration for construction traffic and staging areas based on other projects, and location and use of SWIP facilities due to increased use of the parking lot and presence of children during school time hours for the ECLS.
- Reduction in the number of parking spaces due to above ground structures for the facilities shall be minimized. This includes using access hatches rated for traffic loading to allow parking on top of facility access locations where possible.
- As Civic Center is a widely used public space, design and construction of the facilities should minimize disruption of the remaining public facilities to the extent possible.
- Stockpiling of excavated soils during construction is not allowed.
- Odor control should be provided and vents should be located as far away from the most densely used public areas to avoid any potential odor complaints.
- Above grade visual obstructions should be eliminated if possible, or minimized as much as possible if unavoidable.
- Ocean Ave, Pico Blvd, and other streets that will be affected during construction are heavily used by the public. Design and construction should minimize the impact to traffic and pedestrians to the greatest extent possible.
- Minimum distance of 40 feet from the Los Angeles County Courthouse shall be kept clear during construction.
- Minimum distance of 30 feet from the ECLS site extents (parking lot/landscaping) shall be kept clear during construction.
- Utility tie-ins must be coordinated so as to minimize disruption to existing services.

- Construction schedule and operations will be coordinated with the City with other project construction at the Civic Center Site.
- Restore carport with solar panels.
- Pre-fabricated materials are preferred to reduce the construction cost and durations.

3.6 UTILITIES & CONNECTIONS

Since the project will tie in to active sewers and storm drains, care must be taken to consider how best to keep the existing utilities in service during construction. In most cases when tieing into an existing gravity pipe, a new manhole will be constructed on top of the existing pipe and the new gravity pipe intercept connected to this new manhole. When ready, a portion of the existing pipe will be removed to allow flow to be diverted (in whole or in part) to the new intercept pipe.

In all cases, only a portion of the flow capacity in the existing pipe will be diverted to the new intercept pipe and thence to a lift station. Each lift station will be designed to allow surcharge of the intercept pipe when the flow diverted exceeds the lift station capacity or if the control system has removed the “run permissive” for that lift station.

The following subsections discusses the new connections and utilities needed at a conceptual level. All new connections should provide traffic control and outreach to minimize traffic impacts.

3.6.1 New Stormwater Connections

The proposed configuration of stormwater connections between the local storm drains, the AWTF, and the Civic Center Tank is shown in a schematic profile in Figure 3.2. A diversion manhole to be constructed on the existing 48-inch storm drain in Pico Boulevard at the intersection with 3rd Street will divert stormwater into a 16-inch diameter intercept pipe that will discharge to the proposed PBLS located about 10 to 20 feet inside the Civic Center Parking lot. Upstream of the PBLS will be placed a hydrodynamic separator, such as the CDS® unit by Contech, that will remove trash and debris. The discharge from the screening unit will enter the PBLS wet well. The screening device, the PBLS and its electrical infrastructure will be located entirely underground with traffic rated hatches for maintenance access. Pumps at the PBLS will pump at the peak design rate, based on the 85th percentile-rainfall storm at peak intensity.[1] Calculations in Appendix D show the hydrographs developed for all stormwater capture lift stations.

The diversion manhole on the existing 48-inch storm drain in Pico Boulevard will be designed to capture all low-flow urban runoff (dry weather flow) and design storm events (wet weather flow). This can be accomplished by setting an invert elevation for the intercept drain that is a few inches lower than the

[1] The HydroCalc model as provided by the Los Angeles County Department of Public Works was used with inputs from the report *Santa Monica Bay Jurisdictional Group 2 and 3 Enhanced Watershed Management Program*, page 59. The resulting hydrograph for 85%-ile storm was used to determine the maximum design flow for the pump station.

invert of the existing storm drain at the intercept point and building channels in the bottom of the diversion manhole to facilitate low-flow capture.

An air jumper will be provided between the PBLS wet well and the 48-inch Pico Blvd. storm drain to allow the wet well to remain at atmospheric pressure while also not discharging foul air to atmosphere.

Note that the PBLS wet well level can rise to the level of the stormwater flow in the 48-inch Pico Boulevard storm drain when the storm flow exceeds the pump station capacity or if the Civic Center Tank is full. During this high stormwater flow event, the 18-inch storm drain intercept will be surcharged until the storm flow abates and the Civic Center Tank can take stormwater flow again.

Note also that the existing 48-inch Pico Boulevard storm drain also serves the SMURRF. However, the SMURRF has sufficient water sources without the urban runoff that will be captured from the existing 48-inch Pico Boulevard storm drain.

The design criteria for the stormwater intercept and PBLS are shown in Table 3-14. The force main from the PBLS to the Civic Center Tank will be routed below grade across the Civic Center parking lot and into the tank. The Pico Blvd Lift Station Profile in Appendix A shows a profile of the intercept at the 48-inch Pico Boulevard storm drain and the PBLS. The Rectangular Lift Station Configuration Figure in Appendix A shows a plan and section of a typical stormwater lift station, such as the PBLS.

Table 3-14 Pico Boulevard Storm Drain Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Intercept			
Design Peak Flow	5.5 (2,468)	MGD (gpm)	Based on 85%-ile hydrograph
Size of Storm Drain Intercept	18	inch	
Invert Elevation of 48-inch Pico-Kenter Drain invert at 3rd St	39.34	ft	Interpolated from 48-inch profile
New manhole (MH) approximate rim elevation	58.34	ft	Interpolated from 48-inch profile
Invert Elev at new MH of 18-inch diameter Intercept	38.90	ft	Drop in new MH to maximize capture of low-flow storm events
d/D in Intercept	0.76	--	
Intercept Slope	1%	--	
Intercept Velocity	5.1	ft/sec	
Invert of Intercept at Screening Device	38.70	ft	
Screening Device			
Loss thru Screening Device	0.33	ft	
Invert of Intercept at PBLS	38.10	ft	
Pico Blvd Lift Station			
Type	Submersible	--	

Table 3-14 Pico Boulevard Storm Drain Intercept and Lift Station Design Criteria

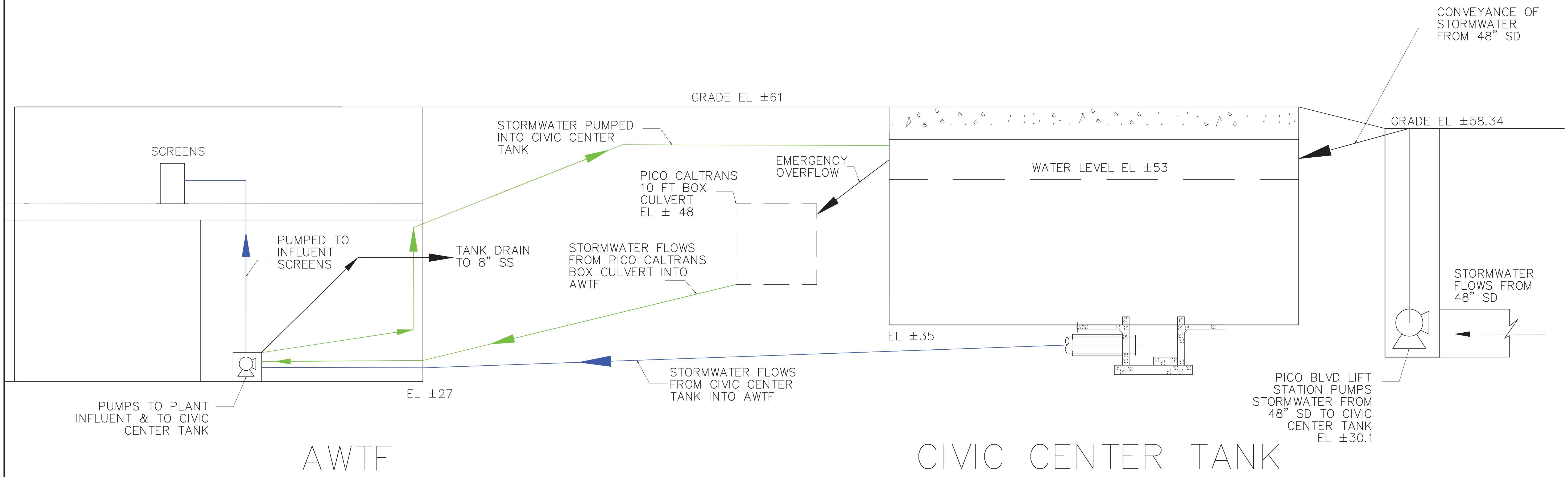
Parameter	Value	Units	Comment
Pump Drives	Constant speed		Fill & draw
No. of Pumps	3	--	2 Large, 1 Jockey pump
Largel Size Pump Capacity	1,300	gpm	
Jockey Pump Capacity	780	gpm	
Wet Well Working Volume	3,920	gal	V = Qt/4; t = 12 minutes
Wet Well Inside Dimensions	17 x 7.7	ft x ft	Length x Width
Elevation of Lift Station Bottom	30.10	ft	
Standby Pump Provided?	Partial		Two large pumps meet design flow
Force Main Size	12	inch	Design velocity under 8 ft/sec
Pump Total Dynamic Head	36	ft	
Full Size Pump Motor	25	hp	
Jockey Pump Motor	15	hp	

Stormwater collected in the Civic Center Tank will be pumped to the AWTF for blending with raw wastewater from the OALS and from the FCLS for treatment. Prevention of backflow into the Civic Center Tank will be achieved with the use of check valves on the AWTF stormwater feed pumps.

As noted earlier, stormwater from Memorial Park Tank will be conveyed through the existing storm drains to the Pico/Caltrans 10-foot x 10-foot box culvert. This contributor of stormwater to the AWTF is depicted in Figure 3-2 and Figure 3-12. A detail for modifications to the Pico/Caltrans box culvert to enable capture of low flows and transfer flows from the Memorial Park Tank is shown in the Pico/Caltrans Box Culvert to AWTF Section Detail (Appendix A).

An important part of the detailed design will be hydraulic modeling of the Pico/Caltrans box culvert's performance with the installation of a low flow, diagonal cross-culvert weir to divert water to the 12-inch intercept that takes flow to the pumps in the AWTF. Hydraulic modeling can help determine the maximum size of bump that will not reduce the capacity of the Pico/Caltrans box culvert below its design capacity.

Figure 3-12 shows a section view of the connection between the Pico Boulevard storm drain and the AWTF via the PBLS and the Civic Center Tank (this is a schematic and is not entirely shown to scale). Conveyance of stormwater from the Pico/Caltrans box culvert to the tank is shown conceptually in green, while conveyance of stormwater to the AWTF is shown in blue.



Note: this is a schematic and is not entirely shown to scale

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SUSTAINABLE WATER INFRASTRUCTURE PROJECT
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FIGURE 3-12
STORMWATER DIVERSION CONFIGURATION

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3.6.2 New Wastewater Connections

Connection to an existing sewer line is essential to supplying the AWTF with its main source of influent. Figure 3-5 shows an overview of existing sewer lines within the study area. The majority of these sewers are 8 and 10 inch in diameter, and as a result would only be able to reliably provide sufficient supplementary flow of 0.5 MGD, less than the design flow of 1.19 to 1.37 MGD required. However, immediately south of the proposed AWTF location is a 54-inch sanitary sewer in Ocean Avenue that collects flow from MAPS and continues southbound. This sewer line can provide sufficient consistent flow and is a feasible source of supply the AWTF in excess of 1.37 MGD.

In addition to tapping the existing sewer in Ocean Avenue, flows from the future CSB and nearby buildings will be diverted and treated at the AWTF.

3.6.2.1 Ocean Avenue Lift Station

The invert elevation of the 54-inch sewer line along Ocean Ave. is approximately El. 27.83 feet. The grade elevation at the plant is approximately El. 61 feet. Because the elevation of the 54-inch sewer line is well below the elevation of the influent screens at the AWTF, a lift station will be required. The OALS will serve this purpose, located below grade in Vicente Terrace approximately 20 feet from the north curb line of Ocean Avenue. Traffic-rated hatches will be provided for maintenance access to the OALS, its electrical infrastructure and carbon canister(s) for odor control.

The alignment of the 12-inch sanitary sewer intercept from the 54-inch sanitary sewer to the new OALS must cross under the existing 39-inch sanitary sewer aligned parallel to the 54-inch in Ocean Avenue. The intercept is provided with a slope change as it passes under the 39-inch sanitary sewer, without a manhole.

Note that when the flow in the 54-inch sanitary sewer in Ocean Avenue exceeds 1.37 MGD (and this will be by far the predominant condition) the level in the OALS will be nearly the same as the level in the 54-inch sanitary sewer, estimated to be 5 feet above the top of the intercept where it enters the OALS. Only in the rare (or scheduled) event when the rate of flow in the 54-inch sanitary sewer drops below 1.37 MGD will the level in the OALS drop below the top of the intercept where it enters the OALS wet well.

An air jumper will be provided between the OALS wet well and the 54-inch Ocean Ave. sewer to allow the wet well to remain at atmospheric pressure while also not discharging foul air to atmosphere.

The elevation for the 12-inch intercept at the proposed new manhole on the 54-inch sewer should be set based on flow monitoring results for the 54-inch so that the 12-inch can withdraw up to 1.37 MGD while not withdrawing a disproportionate amount of grit. If possible, it is desired to set the invert of the 12-inch three to six inches above the invert of the 54-inch sewer to allow grit to remain in the 54-inch line.

Figure 3-5 shows the proposed sewer connection alignment and necessary facilities. Table 3-15 shows design criteria for the new wastewater connection. The Circular Wet Well Configuration in Appendix A shows a typical plan and section of the OALS.

Table 3-15 Ocean Avenue Sanitary Sewer Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Intercept			
Design Peak Flow	1.2 (833)	MGD (gpm)	Design Influent to AWTF
Size of Sanitary Sewer Intercept	12	inch	
Invert Elevation of 54-inch Sewer in Ocean Ave. at Vicente Terrace.	27.83	ft	Interpolated from 54-inch profile
New MH approximate rim elevation at San Vicente Terrace intersection	48.02	ft	Interpolated from 54-inch profile
Invert Elev at new MH of 12-inch diameter Intercept	27.83[2]	ft	[Reset after flow monitoring]
d/D in 12-inch Intercept	0.61	--	Only when not surcharged
Intercept Slope	11% / 0.8%	--	Higher slope from 54-inch to point under the 39-inch sewer; lower slope from 39-inch sewer area to OALS
Intercept Velocity	varies	ft/sec	
Invert of Intercept at OALS wet well	23.85	ft	
Ocean Avenue Lift Station			
Type	Submersible	--	
Pump Drives	Variable speed		Match flow requirement of the AWTF
Wet Well Working Volume	833	gal	t = 1 minute for VFD pumps
Wet Well Inside Diameter	10	ft	
Elevation of Lift Station Bottom	18.44	ft	
Standby Pump Provided?	Yes		
No. of Pumps	2	--	
Pump Capacity	833	gpm	
Force Main Size	8	inch	Design velocity under 8 ft/sec
Pump Total Dynamic Head	53	ft	
Pump Motor	30	hp	

Conveyance for the new 8-inch wastewater force main would then continue up Vicente Terrace toward Main Street, turning northwest on Main Street continuing towards the AWTF. The alignment would continue north towards the AWTF, but remain on the west side of the street, as there are a number of existing utilities along the east side of Main Street. The sewer connection would cross beneath these utilities once the pipeline is directly opposite of the AWTF.

Trenchless techniques such as microtunnel or bore-and-jack would be used to cross the existing utilities without disturbance. The utilities that would be crossed when connecting the sewer line include two fiber

[2] Modify invert following receipt of flow monitoring results for the 54-inch sewer so as to capture at least 1.2 MGD at low flow while minimizing grit capture.

lines, one owned by the City and one owned by a commercial communications entity, as well as a City potable water line. The fiber lines are likely to be 3 to 4 feet below grade, while the potable water line is likely to be approximately 10 feet below grade. Thus, jack and boring underneath these existing utilities to connect the extended sewer line to the AWTF is feasible.

3.6.2.2 First Court Lift Station

As noted earlier, the wastewater flows from the future CSB and other buildings located on the same sanitary sewer will be captured for treatment. The flow in existing sewer that will serve the future CSB was monitored and found to convey an average of 2,068 gpd. The estimated peak flow could be four times as high or 0.03 MGD.

Unfortunately, the 10-inch sewer in First Court that will serve the future CSB is too low to gravity flow to the OALS when the existing 54-inch Ocean Avenue sanitary sewer flows at more than approximately 25% of its depth. A separate lift station for the First Court sewer be required, the FCLS.

Based on flow monitoring data provided by the City[3] a peak flow of 20 gpm was assumed during business hours to account for the peak flows generated by the future CSB and City Hall. However, the 10-inch sewer that conveys wastewater from the two City buildings is combined with other buildings on first court, resulting in the 10-inch First Court sewer carrying 63,000 gpd average flow [4]. FCLS is sized to capture 2,068 gpd (20 gpm peak flow) and route to the AWTF for treatment. In order for this to balance flows from the OALS, a flow meter must be installed at this LS.

Like the OALS, an air jumper will be provided between the FCLS wet well and the 10-inch First Court sewer to allow the wet well to remain at atmospheric pressure while also not discharging foul air to atmosphere.

The FCLS will discharge to the same 8-inch force main as the OALS as shown in Figure 3-5. The FCLS design criteria is given in Table 3-16 below.

[3] Average daily flow from City Hall was measured for 2017 to be 1,492 gpd. For the future City Services Building, the flow is estimated to be 576 gpd. Total average daily flow during business hours would be 2,068 gpd from these two buildings. A peaking factor and counting only 11 hours per day gives a design flow of 14 gpm, rounded up to 20 gpm for the pump design.

[4] Flow data from Pico and 3rd – Ocean and Pico sewer flow studies, ADS environmental site report.

Table 3-16 First Court Sanitary Sewer Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Intercept			
Design Peak Flow	0.03 (20)	MGD (gpm)	Capturing estimated future CSB peak flow from CSB First Court sewer
Size of Sanitary Sewer Intercept	6	inch	
Invert Elevation of existing 10-inch Sewer in First Court near Vicente Terrace.	29.44	ft	At existing Manhole 3
New Rim Elevation	47.5	ft	
First Court Lift Station			
Type	Submersible	--	Consider grinder pump
Pump Drives	Constant speed		Match flow requirement of the AWTF
Wet Well Working Volume	75	gal	Using 15 minutes between pump motor starts
Wet Well Inside Diameter	3.5	ft	
Elevation of Lift Station Bottom	24.3	ft	
Standby Pump Provided?	Yes		
No. of Pumps	2	--	1 + 1
Pump Capacity	20	gpm	
Force Main Size	1.5	inch	
Pump Total Dynamic Head	40	ft	
Pump Motor	1.0	hp	

3.6.2.3 Side Streams and Stormwater

The WAS, RO brine discharge, neutralized CIP solutions, and plant drains from the AWTF will be discharged into an existing sewer for treatment at the Hyperion Water Reclamation Plant. Thus, similar to the previously identified preferred location an additional connection to an existing sewer line is needed. This discharge line from the AWTF is currently aligned to connect to the existing 8-inch sewer line that runs through the Civic Center parking lot. Based on previous flow studies conducted for the SWIP Technical Report, the sewer collection system beneath Pico Boulevard has adequate capacity to carry this additional flow. This AWTF discharge sewer line would exit out of the northeast corner of the AWTF and run diagonally towards the existing 8-inch sewer line.

As mentioned in paragraph 3.3.2, the Civic Center stormwater tank will have a connection to the Pico/Caltrans box culvert for emergency overflow purposes. A separate connection will be made to the existing 8-inch sewer line within the Civic Center parking lot to convey surplus stormwater through controlled discharge back into the sewer system, if necessary. This new connection is also shown in Figure 3-5

3.6.3 New Treated Water Connection

Advanced treated water produced by the AWTF will be connected to the City's existing recycled water (purple pipe) distribution system. Figure 3-5 shows an overview of all the City's existing recycled water pipelines within the vicinity of study area. The existing 8-inch recycled water pipeline along Main St is in proximity and is feasible to connect to from the AWTF. A proposed new treated water connection is shown on Figure 3-5. This alignment will extend the existing 8-inch recycled water pipeline down Main St, before crossing over adjacent to the AWTF. This alignment will require the crossing of a City-owned fiber utility, a commercial fiber line, and a City pressurized water main. This alignment was chosen as it would require the least amount of construction outside of the limits of the Civic Center parking lot area.

3.6.4 Electrical Power Supply

The AWTF power source will be determined during detailed design. There is a potential power source for Ocean Avenue Lift Station at a power pole located on Ocean Avenue at Vicente Terrace lift station. There is a potential power source for Pico Blvd. Lift Station at a power pole located at Pico Blvd. at 3rd street (east of Civic Auditorium area).

If power is lost, a temporary portable generator can be brought to the AWTF for aeration of biological basins and flushing of RO membranes. Uninterruptible Power Supply (UPS) backup will power the Supervisory Control and Data Acquisition (SCADA) and essential safety lighting and ventilation. Refer to Appendix A for the Lift Station Single Line and the AWTF Single Line and Appendix C for further design guidelines.

The below table shows connected load in kVA and Amps for projects in the Civic Center Tank and AWTF per single line drawings in Appendix A. Lighting, HVAC, and ventilation loads were omitted from the calculation. These are preliminary loads to be confirmed and finalized during final design.

Table 3-17 Civic Center Facilities Preliminary Electrical Load Summary

Projects	Connected Load, kVA	Connected Load, Amp @ 480V
AWTF	899	1082.7
Ocean Avenue Lift Station	66.4	80
First Court Lift Station	2.5	3
Pico Blvd. Lift Station	73.9	89

3.6.1 Additional Connections

Additional connections shall be provided as required for operation of the facility, including new gas service and potable water connection.

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4.0 MEMORIAL PARK TANK CONCEPTUAL DESIGN

4.1 EXISTING CONDITIONS

Memorial Park is located between Colorado Ave and Olympic Blvd and bounded by 14th and 16th St. A City Landscape Maintenance Yard (also known as Colorado Yard) facility also runs along the entire northwest side of the park. The park contains multiple ball fields, tennis courts, a skate park, and other recreational areas and facilities available for public use. This site area will be the location for the 3.0 MG Memorial Park tank that will be used to harvest stormwater from the Memorial Park drainage area. 57-inch and 39-inch stormwater lines run along Santa Monica Blvd and Broadway, respectively. These stormwater lines will be tapped for the Memorial Park tank and are discussed in further detail in later sections. A site area overview including surrounding areas is shown in Figure 4-1 with a focus on Memorial Park in Figure 4-2.

Figure 4-1 Memorial Park Site Overview

Figure 4-2 Memorial Park

4.2 FACILITIES DESCRIPTION & DESIGN CRITERIA

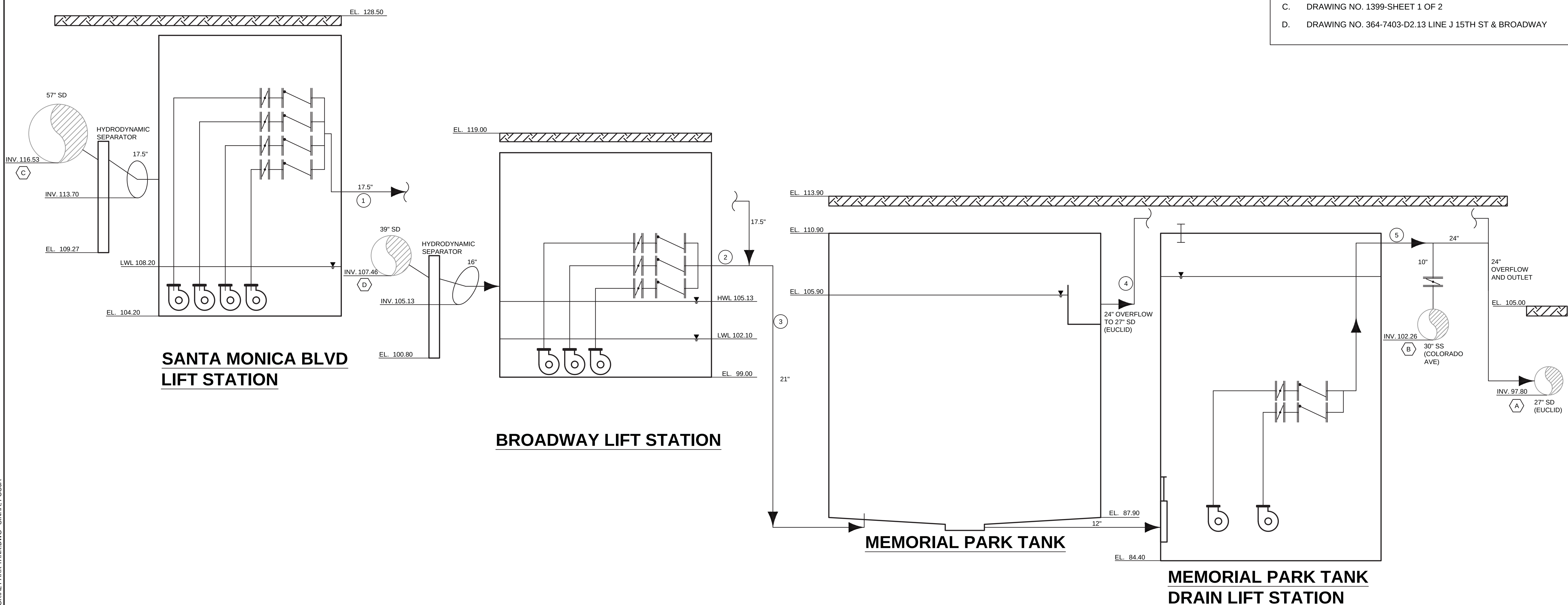
Memorial Park Tank will divert urban runoff/stormwater from both the existing 57-inch storm line along Santa Monica Blvd. and the 39-inch storm drain at the intersection of 15th St and Broadway. The two intercepts are designed to capture flows during all times of the year, both dry weather and wet weather.The new 24-inch stormwater diversion line will run along 15th St to Memorial Park tank. Harvested stormwater will be pumped from the Memorial Park tank through a new 24-inch stormwater outlet line and connect to an existing 33-inch storm drain on Olympic Blvd south of Euclid St. The stormwater will then utilize existing infrastructure for conveyance down to the Civic Center site area. A schematic of the Memorial Park Tank diversions and respective elevations is shown in Figure 4-3. Additional details regarding utility connections are provided in Section 4.5.

FLOW RATE SUMMARY

#	DESCRIPTION	PEAK FLOW
1.	SMBLS	5.97 MGD
2.	BLS	1.78 MGD
3.	SMBLS + BLS	7.8 MGD
4.	EMERGENCY OVERFLOW	7.8 MGD
5.	TANK DRAIN	1.0 MGD

AS-BUILT REFERENCES

A.	DRAWING NO. 0443-4
B.	DRAWING NO. US-3B-102 REV1
C.	DRAWING NO. 1399-SHEET 1 OF 2
D.	DRAWING NO. 364-7403-D2.13 LINE J 15TH ST & BROADWAY



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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

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REVIEWED : DATE : ________ 20__
REVIEWED : DATE : ________ 20__

CITY CLIENTS

REFERENCE :
DATE : ________ 20__
SUBMITTED BY :
CURTIS CASTLE, P.E. PRINCIPAL CIVIL ENGINEER
COMPUTER FILE NAME:
SP-FILE NO.: SP 2456
APPROVED BY :
RICK VALTE, P.E., CIVIL ENGINEER
DATE : ________ 20__

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FIGURE 4-3
MEMORIAL PARK TANK SCHEMATIC

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The Memorial Park tank is sized to capture the 85th percentile, 24-hour storm volume as outlined in the approved *Enhanced Watershed Management Plan for Santa Monica Bay Jurisdictional Groups 2 and 3*. Capture of the 85th percentile, 24-hour storm volume aids the City in both improving beach quality and compliance with non-point source control requirements as outlined in their MS4 permit. Figure 4-4 (from Appendix A of the EWMP) shows the drainage area for Memorial Park Tank which totals 135.9 acres. The tank will capture both wet- and dry weather flows.

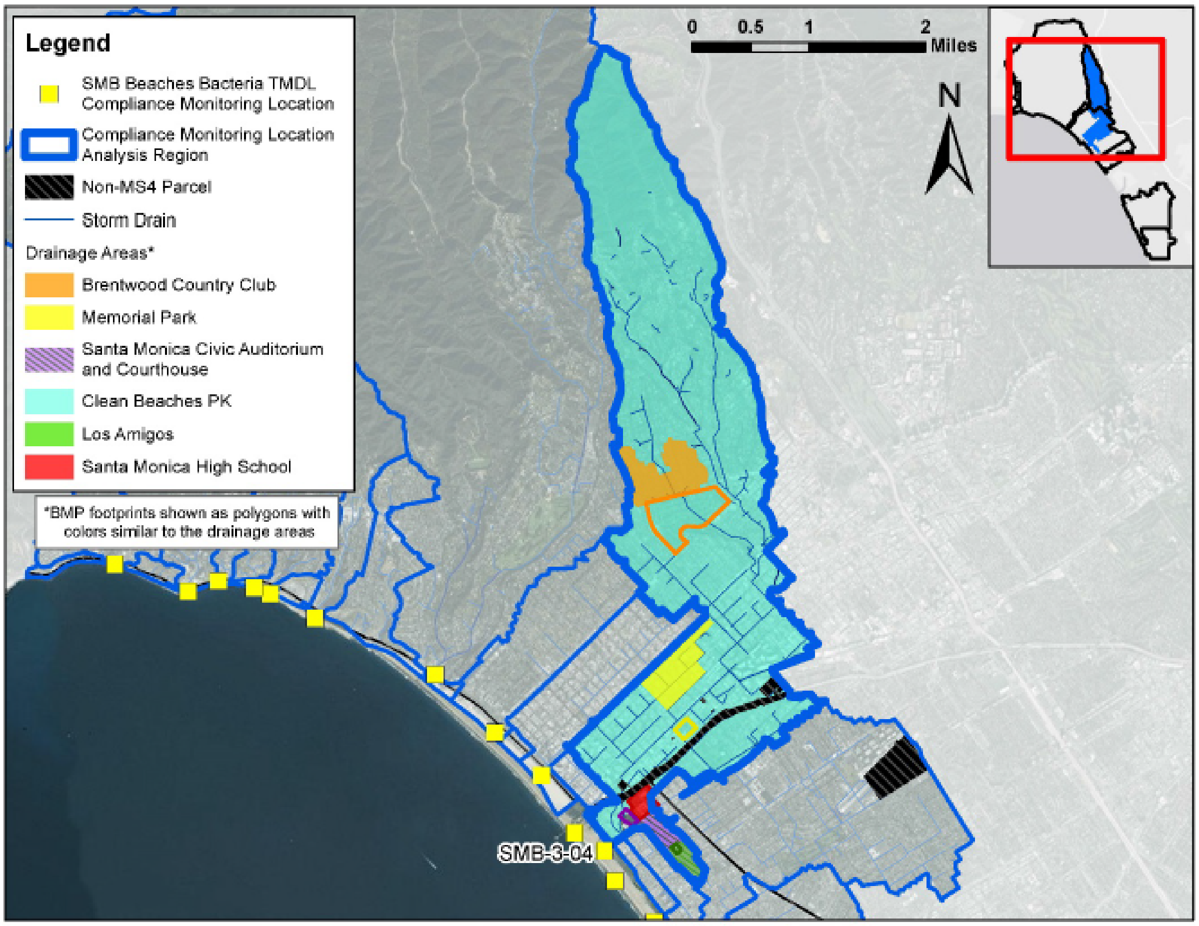

Figure 4-4 Memorial Park Tank Drainage Area

Final construction method and tank shape shall be determined during final design. The tank could be composed of prefabricated modular units, a standard cast in place reinforced concrete tank, or a pre-stressed concrete tank. The tank may also be circular or square. The most cost effective configuration and material is desired and will be determined during final design in accordance with City input.

Table 4-1 Memorial Park Tank Design Criteria

Component	Value
Tank Volume	3 MG
Tank Type & Shape	TBD during final design
Minimum Tank Cover	4 ft
Freeboard	5 ft
Water Depth	18 ft
Total Tank Depth	23 ft
Number of Hatches, Minimum	1
Hatch Dimensions	4 ft x 6 ft
Overflow Flow Rate	12.7 CFS
Overflow Weir Headloss	9 in
Overflow Weir Length	6 ft

While the final tank design parameters will be determined during final design, the tank must meet the following design criteria requirements, in addition to the constraints and limitations outlined in Section 4.4. Design criteria must be considered in conjunction with the City's planning department to accommodate any future plans for the area. Tank design must also meet all applicable structural design code requirements, as outlined in Appendix C.

- **Underdrain System –** A pipe underdrain system will be provided to detect leakage and to determine the approximate location of the leak. Underdrain piping may consist of perforated PVC or similar materials.

- **Standard columns and footings** – For structural integrity and to allow public use above the stormwater harvesting tank, standard column and footing with additional loading factors will be constructed. Additionally, tank walls will have constant thickness, with no tapered walls provided.

- **Tank Cover and Freeboard –** A cover of 4 feet above the top of the stormwater harvesting tank will be provided to allow for additional loading. Freeboard within the tank will be 5 feet to account for water sloshing and prevent damage to the tank roof in case of a seismic event.

- **Tank Inlet Pipe (Discharge into Tank)** – The tank inlet pipe shall be designed to discharge into the tank to minimize splashing. The conceptual design includes this inlet pipe entrance upward through the bottom of the tank assuming a pre-stressed tank to eliminate a wall penetration through the pre-stressed wrapping. Other options for discharge into the tank should be considered during final design, including a downward sloping discharge similar to the CBI Project.

- **Sump and Discharge Outlet –** A sump will be located near the center of the tank, with tank floors sloping downwards toward the sump. A high curb will be provided around all sides of the sump to help exclude sand and debris. The sump will contain a discharge outlet to drain the tank as well as convey stormwater from the harvesting tank to the outlet line.

- **Tank Access –** For maintenance purposes, a 4 ft x 6 ft Bilco-type Caltrans H-20 loading traffic rated spring loaded double leaf hatch type, or similar, will be included to allow for equipment access into the tank. At a minimum the tank shall also include two additional entries to allow personnel access. Final size of entries should be determined with the City's operations staff. If access points are located within the ball field, measures to prevent a trip hazard must be taken. Suggested measures include incorporation of imitation grass or similar material cover. Fall protection within hatches should also be provided.

- **Vents -** Screened vents will be considered as a means for vector control. In addition, vents should be routed away from public use areas. It is recommended to provide odor control sufficient to scrub 720 cfm, representing the rate at which air in the tank could be displaced by incoming (pumped) stormwater flow.

- **Emergency Overflow –** Under normal operations, the tank will discharge stormwater via the Memorial Park Drain Lift Station (MPDLS) into a 24-inch storm drain that will connect to an existing 33-inch storm drain in Olympic Blvd. From this point, the stormwater flow will be conveyed to the AWTF ultimately via the existing Pico/Caltrans 10 x 10 box culvert underneath the Civic Center site. In case of a power or instrumentation failure, this same outlet discharge line will be used as a passive emergency overflow using a sharp-crested weir with elevation a few inches above the high water level in the Memorial Park Tank. The receiving storm drain in Olympic Blvd may have capacity for the entire peak overflow of 12 CFS, even in a storm event.

- **Odor and Vector Control –** To prevent foul odors within the public area, a carbon canister or similar device shall be provided to treat displaced air when the tank is filled. The design fill rate is 12 CFS or 720 cubic feet per minute (CFM). Additionally, the tank will be drained as efficiently as possible and mechanisms will be installed to prevent vector control and stagnant waters.

- **Grit, debris, oil & grease handling** - Provisions for handling grit and debris as well as oil and grease that may accumulate within the tank must be accommodated in the final design, this may include access for manual cleaning, removal of oil and grease by skimming, or other methods. Automatic cleaning and flushing systems (including water flushing systems from center or edge of tank) should be considered.

4.3 FACILITIES LAYOUT

The Memorial Park tank shall be located within the larger ball field at the park. The tank may be circular or rectangular in shape and will be determined with the City during detailed design. A proposed circular layout along with newly proposed connections is shown in Figure 4-5 and a rectangular tank is shown in Figure 4-6.

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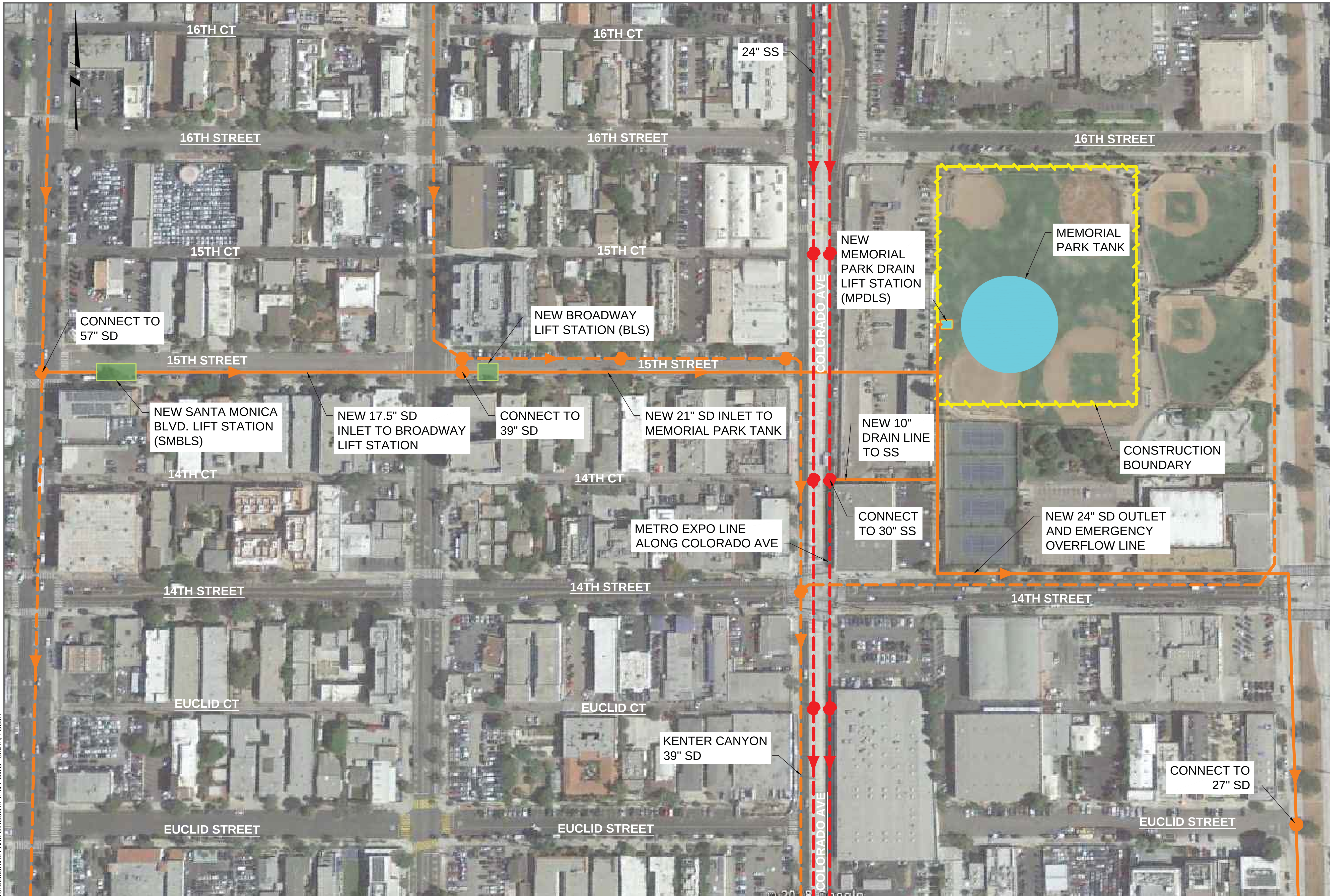

KEY:

EXISTING SANITARY SEWER	
EXISTING STORM DRAIN	
NEW STORM DRAIN	
CONSTRUCTION BOUNDARY	

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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

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CONSULTANT

REVIEWED : DATE : ______ 20__
SELIM EREN, P.E.
CIVIL ENGINEER
REVIEWED : DATE : ______ 20__
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CITY CLIENTS

REFERENCE :
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SUBMITTED BY :
CURTIS CASTLE, P.E.
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COMPUTER FILE NAME:
SP-FILE NO.: SP 2456
APPROVED BY :
DATE : ______ 20__
RICK VALTE, P.E., CIVIL ENGINEER

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FIGURE 4-5
MEMORIAL PARK CIRCULAR TANK
SITE LAYOUT

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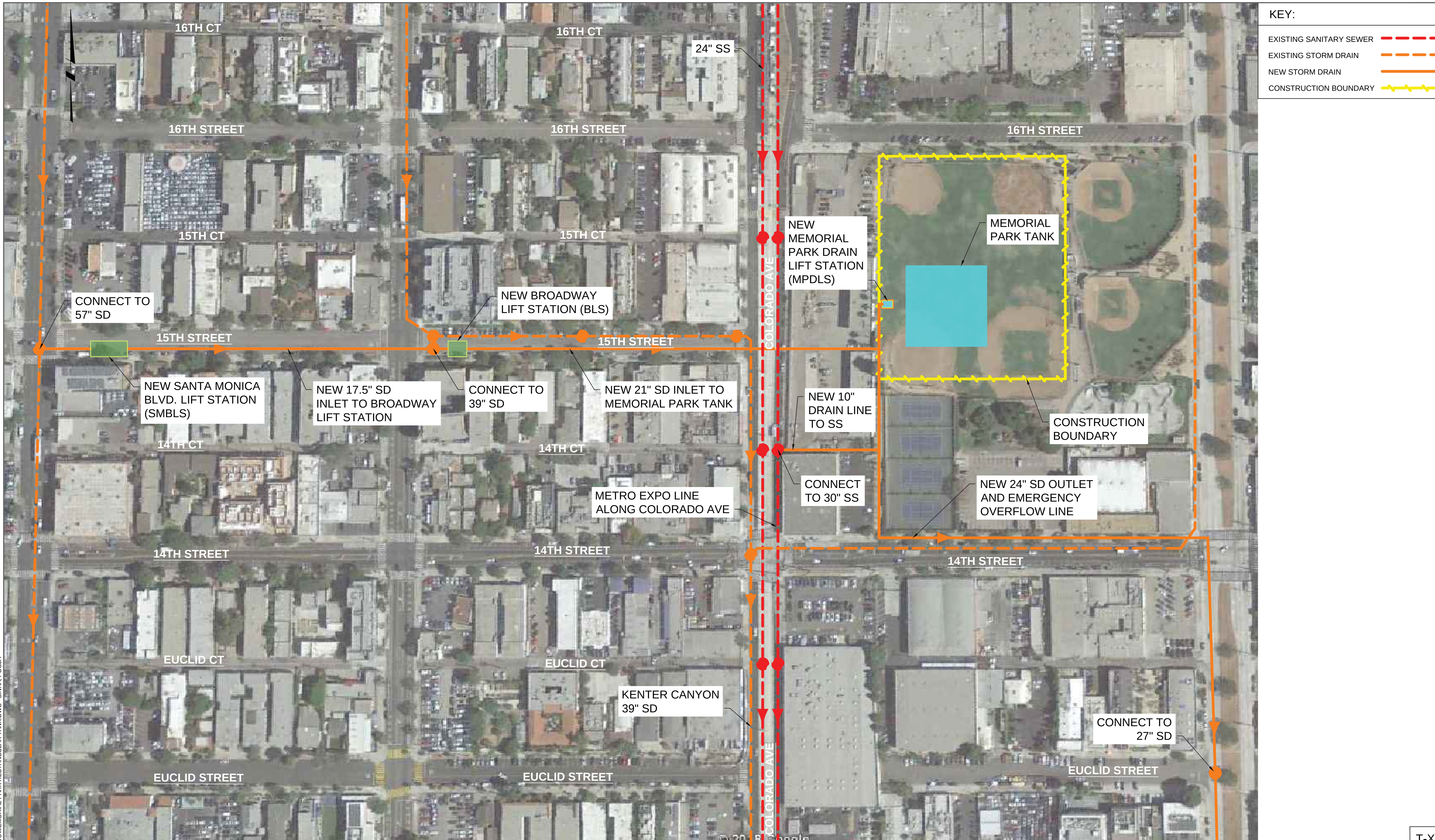

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City of Santa Monica
Department of Public Works
1437 Fourth Street Suite 300, Santa Monica, CA 90401
TEL. (310) 458-8721 FAX. (310) 393-4425
e-mail : sm.engineering@smgov.net

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DATE : ________ 20__
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CURTIS CASTLE, P.E. PRINCIPAL CIVIL ENGINEER
COMPUTER FILE NAME:
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SUSTAINABLE WATER INFRASTRUCTURE PROJECT
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FIGURE 4-6
MEMORIAL PARK RECTANGULAR TANK
SITE LAYOUT

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The overall construction boundary shall be maintained within the larger ball field. Site access is preferred to be near the staging area along the less congested 16th St. The stockpile area shall be located away from public use areas in service during construction activities as much as possible. A lift station (the Memorial Park Drain lift station), responsible for conveying water from the tank, will be located adjacent to the tank but away from the ball fields. The location of Memorial Park Tank and SWIP facilities must be coordinated with upcoming Memorial Park Master Plan efforts. Construction must maintain public circulation around the project site. Surface restoration of Memorial Park should restore preconstruction conditions, however the City must approve of materials used.

4.4 CONSTRAINTS & LIMITATIONS

Design and construction of Memorial Park tank must take into account several constraints and limitations listed below:

- The tank location should consider the most cost effective approach for construction and restoration of field activities.
- Final tank location must also be coordinated with ongoing City planning efforts.
- As Memorial Park is a widely used public space, design and construction of the Memorial tank should minimize disruption during construction of the remaining public facilities to the extent possible. The ball fields along Olympic Blvd. are intended to remain in use during construction of Memorial Park tank.
- Stockpile location during construction should be located away from public use areas.
- Diversion from the existing storm drains to Memorial Park tank will include an Expo Metrorail crossing on Colorado Avenue. This constraint will require a permit and a trenchless technology such as directional drilling or microtunnel underneath the Metro crossing to connect the new storm drain diversion to the tank.
- The stormwater pumped outlet line and passive overflow must be connected by a new 24-inch gravity storm drain to the existing 33-inch storm drain in Olympic Blvd and south of Euclid St. This existing Olympic Boulevard storm drain continues in the southwest direction and converges with storm drains to discharge to the Civic Center site Pico/Caltrans 10’ x 10’ box culvert. Hence, the outlet line utilizes the existing storm drain infrastructure to convey stormwater flows from Memorial Park tank down to the Civic Center site.
- To accommodate potential future site development, the tank must be located a minimum of 30 feet away from any existing facilities and streets along the park boundaries.
- Utility tie-ins must be coordinated so as to minimize disruption to existing services.

- Pipelines must pass below the Metro Train tracks and the large brick-arched kenter canyon stormdrain along Colorado Avenue. Microtunneling is expected to be the method of construction for this portion.

4.5 UTILITIES & CONNECTIONS

The following subsections discusses the new connections and utilities needed at a conceptual level. All new connections should provide traffic control and outreach to minimize traffic impacts during construction.

4.5.1 New Stormwater Diversion Connection and Lift Stations

Stormwater from the Memorial Park drainage area will be harvested from two existing storm drains and conveyed to the Memorial Park Tank. Similar to the strategy employed at the PBLS intercept manhole, the stormwater diversion connections for the Memorial Park drainage area will be designed to capture all low-flow urban runoff (dry weather flow) and flows up to the design storm (wet weather flow). Higher flows will be allowed to continue to flow in the existing storm drain.

Several means of conveying stormwater were considered:

- Install one stormwater lift station to serve both storm drains.
- Install two stormwater lift stations, one for Santa Monica & 15th Street and a second for harvesting stormwater from Broadway & 15th Street.

The first method has a fatal flaw in that it would allow flow from Santa Monica Blvd. to surcharge the Broadway & 15th storm drain and was eliminated. The selected collection method is to provide two independent lift stations. Because grades are favorable, each lift station will discharge to a proposed gravity line or force main in 15th Street that will extend from Santa Monica Blvd. to the Memorial Park Tank, collecting lift station discharges along its route.

The objective of stormwater collection is to maximize flow harvesting up to the 85th percentile storm, and allow larger storm flows to continue in their respective storm drains. To do this, gravity collection must be stopped when larger-than-design flows occur. The method adopted for this drainage area is to install a lift station at each harvesting point and control the rate of discharge from each lift station to a peak flow representing the flow expected from a design storm. The level in the lift stations will rise to the level in the respective storm drain when storm flows exceed the pumping rate.

The peak flow that the lift stations must accommodate was determined from the 85th percentile rainfall hydrograph at peak flow.[5] Table 4-2 presents parameters of the constituent parts of the stormwater harvesting system.

Table 4-2 Memorial Park Drainage Area – Key Elevations

Location	Storm Drain Size	Estimated 85th %-ile flow and Conveyance Capacity	Surface Grade	Invert Elev.
Santa Monica Blvd. & 15th Street (77%)	57-inch (Existing) 21-inch Intercept	5.97 MGD (9.24 CFS)	128.5	116.53
Broadway & 15th Street (23%)	39-inch (Existing) 16-inch Intercept	1.78 MGD (2.76 CFS)	119.0	107.46
Proposed Memorial Park Tank	21-inch Broadway to Memorial Park Tank	7.8 MGD (12 CFS)	113.9	87.4

The ratio of flows was estimated based on the relative capacities of the two storm drains (accounting for diameter and slope).

For both stormwater lift stations, air jumpers will be provided between the wet well and the corresponding storm drain to allow the wet well to remain at atmospheric pressure while also not discharging foul air to atmosphere.

A gravity storm sewer will be provided to convey stormwater from both the lift stations to Memorial Park Tank, although it is feasible to provide a forcemain with reduced pipe size and vacuum relief valves.

Finished grades along 15th Street starting at Santa Monica Blvd and progressing southeasterly allow for gravity drainage from the two harvesting locations once these are pumped. A profile of the existing storm drain points of connection, the proposed lift stations, and the proposed gravity storm drain connecting the lift stations to the Memorial Park Tank are shown in the Memorial Park Tank Stormwater Capture System Profile in Appendix A.

4.5.1.1 Santa Monica Boulevard Lift Station

The Santa Monica Boulevard Lift Station (SMBLS) will collect 77% of the total stormwater flow to be collected for the Memorial Park drainage area. Similar to the PBLS, a hydrodynamic separator will be installed upstream of the lift station. Table 4-3 below presents the design criteria for this stormwater lift station.

[5] Hydrologic model was used as noted in earlier footnote for Pico Boulevard Lift Station. Peak design stormwater flow is 12 CFS for 85th %-ile stormwater flows to be captured in the Memorial Park Tank.

Table 4-3 Santa Monica Boulevard Storm Drain Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Intercept			
Design Peak Flow	5.97 (4,147)	MGD (gpm)	Based on 85%-ile hydrograph
Size of Storm Drain Intercept	21	inch	
Invert Elevation of 57-inch Storm Drain invert at 15th St	116.53	ft	
New MH approximate rim elevation	128.50	ft	
Invert Elev at new MH of 21-inch diameter Intercept	114.53	ft	Drop in new MH to maximize capture of low-flow storm events
d/D in Intercept	0.65	--	
Intercept Slope	0.8%	--	
Intercept Velocity	5.4	ft/sec	
Invert of Intercept at Screening Device	115.17	ft	
Screening Device			
Loss thru Screening Device	0.33	ft	
Invert of Intercept at SMBLS	114.59	ft	
Santa Monica Blvd Lift Station			
Type	Submersible	--	
Pump Drives	Constant speed		Fill & draw
No. of Pumps	4	--	3 Large, 1 Jockey pump
Large Size Pump Capacity	1,390	gpm	
Jockey Pump Capacity	900	gpm	65% of large pump size
Wet Well Working Volume	4,170	gal	V = Qt/4; t = 12 minutes
Wet Well Inside Dimensions	18 x 6.2	ft x ft	Length x Width
Elevation of Lift Station Bottom	105.09	ft	
Standby Pump Provided?	Partial		Three large pumps meet design flow
Force Main Size	16	inch	Design velocity under 8 ft/sec
Pump Total Dynamic Head	17	ft	
Full Size Pump Motor	15	hp	
Jockey Pump Motor	7.5	hp	

4.5.1.2 Broadway Lift Station

The Broadway Lift Station (BLS) will collect 23% of the total stormwater flow to be collected for the Memorial Park drainage area. Similar to the PBLS and SMBLS, a hydrodynamic separator will be installed upstream of the lift station. Table 4-4 below presents the design criteria for this stormwater lift station.

As mentioned earlier gravity sewer or forcemain conveying stormwater from BLS to Memorial Park Tank will be provided. It is to be noted that this line will require an inverted siphon and tunnel to be built under the Metro Expo railroad crossing on Colorado Ave and 15th street. Horizontal drilling or Pipe Jacking/Tunneling may be used to reroute the gravity undern

eath existing utilities on Colorado Ave.[6] Borings pits are anticipated to be installed 50-100 feet on either side of the siphon, therefore, 15th street northwest of the Colorado Avenue intersection will be closed during a three to four week construction period. **Figure entitled Profile: Memorial Park Tank Stormwater Capture System** in Appendix A shows the pump stations and collection lines described above.

Table 4-4 Broadway Storm Drain Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Intercept			
Design Peak Flow	1.78 (1,236)	MGD (gpm)	Based on 85%-ile hydrograph
Size of Storm Drain Intercept	16	inch	
Invert Elevation of 39-inch Storm Drain invert at 15th St & Broadway	107.46	ft	
New MH approximate rim elevation	119.00	ft	
Invert Elev at new MH of 16-inch diameter Intercept	106.00	ft	Drop in new MH to maximize capture of low-flow storm events
d/D in Intercept	0.49	--	
Intercept Slope	0.8%	--	
Intercept Velocity	3.89	ft/sec	
Invert of Intercept at Screening Device	106.47	ft	
Screening Device			
Loss thru Screening Device	0.33	ft	
Invert of Intercept at SMBLS	105.89	ft	
Broadway Lift Station			
Type	Submersible	--	
Pump Drives	Constant speed		Fill & draw
No. of Pumps	3	--	2 Large, 1 Jockey pump
Large Size Pump Capacity	620	gpm	

[6] Vertical clearances between the underground utilities at this intersection have been assumed per drawing notes. Required clearances should be confirmed during detailed design.

Table 4-4 Broadway Storm Drain Intercept and Lift Station Design Criteria

Parameter	Value	Units	Comment
Jockey Pump Capacity	372	gpm	
Wet Well Working Volume	1,395	gal	V = Qt/4; t = 12 minutes
Wet Well Inside Dimensions	17 x 5	ft x ft	Length x Width
Elevation of Lift Station Bottom	99.39	ft	
Standby Pump Provided?	Partial		Two large pumps meet design flow
Force Main Size	10	inch	Design velocity under 8 ft/sec
Pump Total Dynamic Head	17	ft	
Full Size Pump Motor	7.5	hp	
Jockey Pump Motor	5.0	hp	

4.5.1.3 Memorial Park Tank Drain Lift Station

Conveyance of captured stormwater from the Memorial Park Tank to the AWTF will be achieved by controlled-rate pumping at the MPDLS. The maximum flow rate selected was 1.0 mg, to empty the Memorial Park Tank in three days. Stormwater for subsequent treatment at the AWTF will be discharged via the MPDLS to an existing 33-inch storm drain in Olympic Blvd that discharges ultimately to the Pico/Caltrans Box Culvert that passes very near to the AWTF and can be subsequently pumped to the Civic Center Tank. An emergency passive gravity overflow will be routed to the same discharge point.

The MPDLS discharge piping will be provided with a tee: one branch for the stormwater destined for the AWTF and the other branch destined for the 30-inch sanitary sewer in Colorado Avenue. Each discharge is described below.

4.5.1.4 New Stormwater Outlet line

A 24-inch line serves as both primary conveyance from the MPDLS ultimately to the AWTF and for emergency gravity overflow. The 24-inch will be routed through Memorial Park and lands to the northwest to an existing 33-inch storm drain south of the intersection of Euclid and Olympic Boulevard as described above. Sufficient grade change is available for gravity flow.

4.5.1.5 New Sewer Connection

A 10-inch force main / gravity line will be routed to the northwest to the existing 30-inch sewer in Colorado Avenue. This 10-inch line will be used when the Memorial Park Tank content is either not suitable for subsequent treatment at the AWTF or if for other reasons the tank must be emptied, as for example to capture an expected storm event. The existing destination sewer for the 10-inch line is located on the southeast side of the Metro Expo Line rail and will not require crossing of the rail line.

4.5.2 Electrical Power Supply

The Ocean Avenue Lift Station and Pico Blvd Lift Station will provide power for equipment serving the Civic Center 1.5MG Tank. The Santa Monica Blvd Lift Station, Broadway Lift Station, and Memorial Park Drain Lift Station will provide power for equipment serving the Memorial Park 3.0 MG Tank. No emergency power will be required for the above lift stations. There is a potential power source for the lift stations serving the Memorial Park tank at a power pole located at 15th Street about 500 feet to the northwest of Memorial Park. Refer to Appendix A for the Lift Station Single Line and Appendix C for further design guidelines.

The table below shows connected load in kVA and Amps for projects in the Memorial Park Tank. Lighting, HVAC, and ventilation loads were omitted from the calculation. These are preliminary loads to be confirmed and finalized during detailed design.

Table 4-5 Memorial Park Facilities Preliminary Electrical Load Summary

Projects	Connected Load, kVA	Connected Load, Amp @ 480V
Santa Monica Blvd Lift Station	84.7	102
Broadway Lift Station	29.9	36
Memorial Park Drain Lift Station	23.3	28

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5.0 SCADA CONTROLS & OPERATION STRATEGY

5.1 SYSTEM LEVEL CONTROLS & OPERATIONS STRATEGY

The overall strategy for the operation and controls for the SWIP will be to provide Programmable Logic Controllers (PLCs) and Human Machine Interfaces (HMIs) that match the requirements of the soon to be created City of Santa Monica SCADA standards for each of the new processes both within existing and new facilities. The new PLCs and HMIs will be mostly provided as part of vendor packages at the SMURRF and AWTF that will enable the operators at the facilities to manually and automatically control individual and the overall processes based on setpoints entered at the HMIs. The overall SWIP system will have workstations and historians located at a central location that will enable the whole system to be monitored and controlled. This will be accomplished through communication links between each of the existing and new facilities. The links will be through a fiber optic communication cable where new pipelines are installed and over telecommunication link where existing infrastructure connects the facilities. Additionally, remote control and monitoring capability will be provided for the SMURRF Facility through a secure VPN link. An independent operations group will temporarily operate the facility for the City on an initial temporary basis.

The control of the overall SWIP will include a weather prediction and active-controls software system to manage stormwater volumes. Weather forecasting data from the National Oceanic and Atmospheric Administration (NOAA) will be collected by the software system through an internet connection. SWIP will integrate this data and based on the predicted storms and on the size of the watersheds, the SWIP software system will calculate the potential precipitation amounts to control the stormwater storage. Based on the weather forecasting information, the pumps that capture and discharge stormwater from the Civic Center and Memorial Park Tank should be controlled in order to optimize capture and treatment of stormwater.

5.2 SMURRF CONTROL NARRATIVE

5.2.1 Existing SMURRF Controls

A Human Machine Interface (HMI) is provided at SMURRF for equipment and process monitoring and control. The HMI is located in the MAPS electrical room at local control panel (LCP)-100 and includes monitoring functions and limited control functions for the following:

Pico-Kenter Pump Station	Ultra Filtration System
Pier Pump Station	UV Disinfection System

Rotating Drum Screen	Finished Water System (pumps and motors, piping, flow meter, analyzer, and chlorinator)
Grit Chamber	Potable Water System
Dissolved Air Flotation System	

The Moss Avenue Pump Station houses a Remote Terminal Unit (RTU) for interface with Santa Monica's existing SCADA system. SMURRF facility control and alarm functions are wired directly to the RTU. SMURRF equipment operation may be inhibited (shut-down) from the SCADA terminal at Moss Avenue Pump Station.

The plant does not include automatic monitoring of water quality in the storm drain system. Instead, a manual system is implemented by the City to notify the treatment plant of any illegal discharges, chemical spills, or similar circumstances. City staff must then take appropriate action to dilute the plant effluent, send flow to the Moss Avenue Pump Station, or halt facility operations.

5.2.2 New RO Train Control

The SWIP will add a new RO system to the SMURRF along with chemical addition. The new RO system train will be initiated automatically by the SMURRF RO PLC. Train operation will be under the control of the SMURRF RO PLC which will be connected and synchronize with SMURRF Main PLC.

The RO System is primarily provided to remove total dissolved solids with a partial bypass and blend operation strategy to meet TDS water quality goals. The RO System will have a dedicated RO Feed Pump that will draw water from the RO Feed Tank and pump it through the cartridge filters and membranes. When the differential pressure across a given cartridge filter vessel reaches a pre-defined terminal value, a high-pressure alarm will notify the operator, and a high-high-pressure alarm will automatically take that vessel offline; the filter cartridges shall be replaced manually.

With the automatic initiation of an RO System, the associated VFD-equipped RO Feed Pumps will be called by the SMURRF RO PLC to operate and maintain a preset pressure on the RO feed header, automatically adjusting to meet the permeate setpoint. The RO System startup bypass valve shall open and remain in a fixed (backpressure inducing) startup position until the feed analyzers (pH, temperature, ORP and conductivity) confirm detection of acceptable feed water quality. The RO System will also be allowed to be bypassed if the TDS level prior to the RO system is acceptable.

The RO Feed Pumps will pump from the RO Feed Tank. If the level in the RO Feed Tank reaches a Low-Low Level set point, the RO system shall be shut down until the level in the RO Feed Tank reaches the High-level setpoint. If the RO system is shutdown for a certain set time duration, the RO flush system witll flush the elements to preserve them from fouling. The RO Feed Tank shall be equipped with redundant level sensors.

The RO System shall operate at constant feed and recovery set points based on the manufacturer provided minimum, maximum and optimum operating states. In order to achieve the constant feed flow and recovery set points, the feed pressure to the individual RO stage shall be altered to achieve the desired feed flow and the concentrate valve shall be modulated to achieve the desired recovery.

The RO System shall be flushed before a shutdown as well as before and after CIP. The RO Flush Pumps shall take water from the RO Flush Tank and pump it through the RO vessels. A single RO Flush Pump will be used to flush the membranes. The RO Flush Pump shall run for the length of time required to fill the designated skid with flush water, including membrane pressure vessels and piping. Only one RO System shall be allowed to flush at any time.

The RO train shall be provided with a skid mounted magnetic flowmeter. This will be monitored by the SMURRF RO PLC and used to determine instantaneous and total RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the RO feed water stream prior to introduction to the RO train.

- Antiscalant – to prevent membrane scaling. Dose will be flow controlled.

The following skid mounted instrumentation will be employed in the analysis of the First Pass RO feed water:

- Conductivity analyzer – to ensure feed water levels are within the membrane manufacture specified range prior to introduction to the membranes.
- ORP – elevated levels shall call for automatic shutdown of RO trains if ORP reaches a critical level.
- pH – elevated levels shall call for sulfuric acid, in order to control scaling in the RO membranes.
- Flow meters – for permeate and concentrate of each stage

All analyzers will be equipped with the means to detect sensor failure or transmitter malfunction with the alert routed to the SMURRF RO PLC via separate discrete outputs or by means of signal analysis logic.

5.2.3 Clean-in-Place and Neutralization System

The SMURRF Main PLC shall monitor the status of the cleaning system equipment and instrumentation via the SMURRF RO PLC. When an RO train is in a CIP, the Plant flow will decrease and/or stop accordingly. Membrane preservations and CIPs shall be automatically inititated by the SMURRF RO PLC.

CIP make-up water shall be RO permeate or potable water, supplied from the RO Flush Tank or RO Permeate Tank by CIP Transfer Pump to the RO CIP Tank or manually filled by the Operator respectively. The CIP Transfer Pump shall shut down on a CIP tank high level alarm. RO cleaning chemicals will be injected in the discharge piping loop of the RO CIP Pump so it is mixed well before being diverted back to the RO CIP Tank. The cleaning solution shall be heated using immersion heaters to achieve the target temperature and then a target pH will be achieved. . Following that, the heated cleaning solution shall be recirculated through the RO System using the RO CIP Pump for an operator-specified period. The cleaning solution inside the RO CIP Tank is neutralized by adding the neutralization chemical in the discharge piping loop of the RO CIP Pump while no cleaning solution is delivered to the RO Systems. The high pH cleaning solution is prepared using Sodium Hydroxide and neutralized using Sulfuric Acid. The low pH cleaning solution is prepared using Citric Acid and neutralized using Sodium Hydroxide. If a proprietary cleaning solution is used, it will be prepared using a mixer in the tank, and neutralized with the appropriate chemical, as required. The details of cleaning procedures, including chemical doses, will be provided by the RO system supplier.

5.2.4 Flush System

After the CIP is complete, the RO System is flushed using the RO Flush Pump. RO flushes shall occur automatically on shutdown at the SMURRF RO PLC.

5.3 AWTF CONTROL NARRATIVE

The control of the AWTF is based on operator input of the number of RO trains that shall be operated. The number of trains to operate will be automatically determined by the AWTF Main PLC based on the predicted demand of the groundwater recycled water users. Normal operation is anticipated to be a constant base production flow of 1.0 MGD, with all duty RO trains in operation.

The MBR filtrate pumps will operate to meet the production flow required based on the RO system feed flow. The MBR Filtrate Pumps shall come online (if not online already) or ramp up (if already online) on a based on a level control setpoint for the RO Feed Tank. Should a Low-Low Level alarm be reached in the RO Feed Tank, the RO system shall shutdown until the RO Feed Tank reaches the Level setpoint.

The RO high pressure pumps will be controlled by the number of RO trains that are operating. Flow and pressure will be adjusted to maintain a set permeate flow and recovery. The UV system will be online when RO permeate is being produced and offline when no RO permeate is produced. The UV dose or EED will be determined by the RO permeate flow and UV transmittance.

The Clearwell Pumps will operate to maintain a desired operational level range in the Clearwell.

5.3.1 AWTF Influent

The influent to the AWTF consists of wastewater collected from the OALS and the FCLS and stormwater collected from the Pico/Caltrans Storm Drain and the Civic Center Storage Tank as described previously. See Section 5.4 for the control strategy for the OALS and FCLS.

During normal operation of the AWTF, the two Civic Center Tank Stormwater Feed Pumps will draw water from the Civic Center Storage Tank as long as the level in the Civic Center Storage Tank is above a predetermined level. Two additional Pico/Caltrans Stormwater Capture pumps pump stormwater from the Pico/Caltrans Storm Drain into either the AWTF directly, or the Civic Center Storage Tank.

Each of the four feed pumps will be equipped with a VFD in an LCP. The feed pumps will operate in Local, Off and Remote Modes. In Remote Mode, the Operator will select Auto or Manual pump control from the AWTF Main PLC. In Remote Auto Mode, the feed pumps will operate to maintain a set pressure to feed the influent through the new Influent Screens. When the feed or capture pumps are used to pump to the Civic Center Tank or to drain, each pair of two pumps will operate as Lead/Lag as needed to maintain a set pressure to feed water to the Civic Center Tank.

5.3.2 MBR System

The AWTF MBR System will be comprised of a vendor provided equipment package PLC, Integrator supplied PLCs in addition to an interface with the AWTF Main PLC and HMI System. The AWTF Main PLC will provide start-up/shutdown interlocks, MBR Filtrate Pump flow setpoint and RO flow limit setpoints to the AWTF MBR Master PLC to control the MBR start-up/shutdown sequences. The operating parameters of the MBR system (i.e. flow rates, pressures, train modes, setpoints) shall be networked to the AWTF Main PLC. Control of the MBR process will mostly be provided locally at the MBR process area. A single internally fed perforated rotary drum fine screen (1 mm) will provide screening of primary effluent before it is fed to the Anoxic Tank of the MBR process.

The fine screen will operate continuously unless stopped by the Operator or a fault condition. The fine screen will be equipped with adjustable timers that control the washwater spray bar (frequency and duration and on differential pressure delay across the screen) on top of the screen drum. When active, the washwater spray bar will receive the Plant's utility water to clean the drum periodically. The screenings from the fine screen will drop by gravity into the Plant Sump, from which they will be pumped out to the sanitary sewer at the AWTF. The screen's internal mechanism eliminates the possibility of unscreened primary effluent to flow into bioreactor tanks. If clogged, the unscreened wastewater will flow through the screen overflow to the AWTF drain. The screened effluent flows by gravity to the bioreactor basins. Two MBR Trains will be used that include an MBR Scour Air Blower, MBR Filtrate Pump and RAS Pumps and WAS Pumps. While the level in the bioreactor tanks remains above a level setpoint and the receiving RO Feed Tank does not indicate an extended overflow period, the MBR System will remain in service once initiated until the Operator calls the System to stop or a fault condition is detected (requiring System reset and restart by the Operator).

The MBR System is designed such that it can be operated under a Partial Denitrification Mode. During this mode of operation Mixed liquor flows by gravity to the Aerobic Tank for nitrification. Nitrified-denitrified mixed liquor is then pumped from the Aerobic Tank to the Membrane Tank using RAS Pumps. The RAS Pumps will operate continuously at an operator-specified percentage of the MBR Filtrate flow ranging from 200 to 400%. The MBR Filtrate Pump shall not operate until the RAS Pump for the MBR System is confirmed operational by the RAS flow rate. The Membrane Tank overflows to the Aerobic Tank for solids recycle. The WAS Pumps will operate based on a timed volume of sludge that will be removed which equates to approximately 3% of the total flow through the MBR System.

The water level in the bioreactor basins will be maintained at a constant level while allowing it to fluctuate between a narrow bandwidth. If the water level in the bioreactor basins drop below a pre-defined level, then the RAS Pumps will be turned off; such condition will occur if the Feed Pumps fail. If the water level in the bioreactor basins reach a high-high level, then the Feed Pumps will be turned off.

The MBR Filtrate Pump draws water through the membranes and sends it to the RO Feed Tank. The flow setpoint for the MBR Filtrate Pumps will be calculated and provided by the AWTF Main PLC to the AWTF MBR Master PLC. The flow setpoint will be calculated based on the Plant Production Flow setpoint specified by the Operator.

The MBR Filtrate Pumps shall operate continuously during the filtration cycle specified by the Operator. The MBR Filtrate Pumps may also act as MBR Backwash Pumps and in such scenario, will draw MBR Filtrate from the RO Feed Tank for backwashing the membranes. The MBR System Supplier may choose to use relaxation instead of backwashing to mitigate membrane fouling. The Operator will be able to adjust the frequency and duration of membrane relaxation and/or backwash within a vendor-recommended range. The Operator will also be able to adjust the backwash flow within a vendor-recommended range.

The Aerobic Tank is aerated using fine bubble diffusers whereas the Anoxic Tank is mixed using Submersible Mixers which will operate continuously. The Process Aeration Blowers will also operate continuously to maintain the operator-specified dissolved oxygen (DO) setpoint in the Aerobic Tank. Alternatively, the Operator shall be able to select the frequency/speed of the Blowers and Blowers based on Contractor provided air to water ratio and shall operate at that speed irrespective of the DO concentration in the Aerobic Tank.

When brought online, the Membrane Scour Air Blowers shall operate either continuously or intermittently, according to the MBR vendor guidelines/requirements.The MBR Filtrate Pump shall not operate if a fault is detected on the Membrane Scour Air Blowers and/or based on the scour airflow measured by the flow meter.

The AWTF MBR Master PLC will monitor membrane system performance using temperature-corrected specific flux (calculated using membrane surface area, transmembrane pressure [TMP], temperature, and flow-rate) to determine conditions for initiation of maintenance clean or recovery clean. A Normalization Database program will be provided by the Contractor to gather the data to determine when a clean is needed. The program will send an alarm to the Operator indicating a need for chemical cleaning. The Operator will then initiate the chemical cleaning upon availability of the cleaning systems. Supporting CIP chemicals include Sodium Hypochlorite to remove organic fouling and Citric Acid to remove inorganic scaling.

The AWTF MBR Master PLC will monitor and control the following process equipment:

1. MBR Air Scour Blowers (via Blower package PLC)
2. MBR Influent Pumps
3. Utility Air System
4. MBR Bioreactors

   a. Pre Anoxic Zone Mixers
   b. Anoxic Recycle Pumps
5. Utility Water Pumps
6. WAS Pumps
7. RAS Pumps
8. MBR Membrane Basins
   a. MBR Pumps
   b. MBR Filtrate / Backwash Pumps
   c. MBR Drain Pumps
9. Hypochlorite System including Feed Pumps
10. Citric Acid System including Feed Pumps

The AWTF MBR Master PLC shall interface with monitor and control the following process equipment:

1. Rotary Drum Screens (via Drum Screen package PLC)
2. MBR Aeration Blowers (via Blower package PLC)
3. Motor Control Center (MCC), switchboard, and unit substation power and status monitoring

The AWTF Main PLC interface to the AWTF MBR Master PLC will provide the following signals to the MBR control system.

1. Feed Flow/Level (requirements to be determined during the detail design phase)
2. RO System permissive signal
3. RO flow limit setpoints

The membrane filter system consists of a series of membrane cells each with isolation valves and submerged membrane filtration cassettes, and is supplied as an equipment package, complete with its own PLC based control system.

5.3.3 RO System

The RO System is provided to remove total dissolved solids, chemicals of emerging concerns, pathogens and nitrogen species. The RO System will have a dedicated RO Feed Pump that will draw water from the RO Feed Tank and pump it through the cartridge filters to the RO Skids and RO First Stage Booster Pumps. When the differential pressure across a given cartridge filter vessel reaches a pre-defined terminal value, a high-pressure alarm will notify the operator, and a high-high-pressure alarm will automatically take that vessel offline; the filter cartridges shall be replaced manually.

With automatic initiation of an RO System, the associated VFD-equipped Feed Pumps will be called by the AWTF RO Master PLC to operate and maintain a preset pressure on the RO feed header, automatically adjusting to meet the permeate setpoint. The RO System startup bypass valve shall open and remain in a fixed (backpressure inducing) startup position until the feed analyzers (pH, temperature, ORP and conductivity) confirm detection of acceptable feed water quality.

The RO Feed Pumps will pump from the RO Feed Tank. If the level in the RO Feed Tank reach a Low-Low Level set point, the RO system shall be shut down until the level in the RO Feed Tank reaches the High-level setpoint. If the RO system is shutdown for a certain set time duration, the RO flush system witll flush the elements to preserve them from fouling. The RO Feed Tank shall be equipped with redundant level sensors.

The RO Systems shall operate at constant feed and recovery set points based on manufacturer provided minimum, maximum and optimum operating states . In order to achieve the constant feed flow and recovery set points, the feed pressure to the individual RO stage shall be altered to achieve the desired feed flow and the concentrate valve shall be modulated to achieve the desired recovery. The interstage booster pumps shall operate to achieve the operator-specified feed flow and will ramp up and down as needed based on membrane fouling conditions.

The RO Systems shall be flushed before a shutdown as well as before and after CIP. The RO Flush Pumps shall take water from the RO Flush Tank and pump it through the RO vessels. A single RO Flush Pump will be used to flush the membranes. The RO Flush Pump shall run for the length of time required to fill the designated skid with flush water, including membrane pressure vessels and piping. Only one RO System shall be allowed to flush at any time.

Each of the two RO trains shall be provided with a skid mounted magnetic flowmeter. This will be monitored by the AWTF RO Master PLC and used to determine instantaneous and total RO feed water flow as well as control pre-treatment chemical injection. The chemicals listed below will be injected into the RO feed water stream prior to introduction to the RO trains.

- Sodium Hypochlorite – to combine with ammonia to form chloramines for protection against biological fouling of the RO membranes. Dose will be controlled to meet the total chlorine concentration target in the RO feed water as measured by the Total Chlorine analyzer. Operator shall also monitor Total Chlorine after mixing.

- Liquid Ammonium Sulfate – to add ammonia to form chloramines for protection against biological fouling of the RO membranes. Dose will be controlled by Ion Selective in-line ammonia analyzer that has built in pH and temperature probes. Operator shall also monitor Chlorine Residual after mixing.

- Sulfuric Acid – to lower pH to prevent membrane scaling. Dose will be flow controlled with a pH trim.
- Antiscalant – to prevent membrane scaling. Dose will be flow controlled.

The following skid mounted instrumentation will be employed in the analysis of the RO feed and permeate water:

- Conductivity analyzer – to ensure feed water levels are within the membrane manufacture specified range prior to introduction to the membranes.
- ORP – elevated levels shall call for automatic shutdown of RO trains if ORP reaches a critical level.
- pH – elevated levels shall call for sulfuric acid, in order to control scaling in the RO membranes.
- TOC – for monitoring for effluent water quality and a surrogate for pathogen removal.
- Flow meters – for permeate and concentrate of each stage

All analyzers will be equipped with the means to detect sensor failure or transmitter malfunction with the alert routed to the AWTF RO Master PLC via separate discrete outputs or by means of signal analysis logic.

5.3.4 Clean-in-Place and Neutralization System

The AWTF Main PLC shall monitor the status of the cleaning system equipment and instrumentation via the AWTF RO Master PLC. No remote controls shall be provided. When an RO train is in a CIP, the AWTF Main PLC will decrease the flow accordingly. Membrane preservations and CIPs shall be operator initiated at the AWTF RO Master PLC.

CIP make-up water shall be RO permeate or potable water, supplied from the RO Flush tank by CIP Transfer Pump to the RO CIP Tank or filled manually by the Operator respectively. The CIP Transfer Pump shall shut down on a CIP tank high level alarm. RO cleaning chemicals will be injected in the discharge piping loop of the RO CIP Pump so it is mixed well before being diverted back to the RO CIP Tank. The cleaning solution shall be heated using immersion heaters to achieve the target temperature and then a target pH will be achieved. . Following that, the heated cleaning solution shall be recirculated through the RO System using the RO CIP Pump for an operator-specified period. The cleaning solution inside the RO CIP Tank is neutralized by adding the neutralization chemical in the discharge piping loop of the RO CIP Pump while no cleaning solution is delivered to the RO Systems. The high pH cleaning solution is prepared using Sodium Hydroxide and neutralized using Sulfuric Acid. The low pH cleaning solution is prepared using Citric Acid and neutralized using Sodium Hydroxide. If a proprietary cleaning solution is used, it will be prepared using a mixer in the tank, and neutralized with the appropriate chemical, as required. The details of cleaning procedures, including chemical doses, will be provided by the RO system supplier.

5.3.5 Flush System

After the CIP is complete, the RO System is flushed using the RO Flush Pump. RO flushes shall occur automatically on shutdown or can be operator initiated at the AWTF RO Master PLC.

5.3.6 UV-AOP

The AWTF Main PLC will Auto Start/Stop process equipment based on the condition of the RO trains (i.e. if one or more RO trains are in operation, the UV system will operate). Operational parameters of the UV-AOP will be managed by the UV Vendor Control Panel (VCP) as per operator preset control set points.

The UV/AOP System shall consist of closed vessel reactors capable of virus inactivation and removal of 1,4-dioxane and N-nitrosodimethylamine in RO permeate. Once initiated by the Operator, the UV/AOP Systems shall remain in operation unless a fault is detected or the System is shut down by the Operator. The Operator shall be able to select one of the two modes of operation for the UV/AOP Systems:

- Target Electrical Energy Dose (EED) – During this mode of operation, the UV/AOP vendor controller will determine the number of lamps required to be online and the ballast power level of the lamps to deliver the target electrical energy dose. The UV/AOP feed flow-rate shall be used to maintain the required UV Intensity level.

- Reduction Equivalent Dose (RED) – During this mode of operation, the UV/AOP vendor controller shall orchestrate control of the reactor and chemical dosing for the UV/AOP process to achieve the System RED at UV/AOP feed flow-rate measured by the UV/AOP feed flow meter.

Sodium Hypochlorite shall be injected upstream of the UV reactors to generate hydroxyl radicals for the advanced oxidation process. Dosing shall be flow-paced and controlled by the Vendor controller. An initial operator-adjustable set-point shall be used to start dosing and the dose shall be adjusted as needed to achieve desired effluent water quality. Sulfuric Acid shall be injected flow-paced with a trim from pH analyzer upstream of the UV reactor (after Sodium Hypochlorite dosing) to maintain the UV/AOP feed water pH at an operator-adjustable setpoint.

5.3.7 Post Treatment Stabilization

The Recycled Water Discharge Magmeter, monitored by the AWTF Main PLC, will be used to calculate and transmit instantaneous and total recycled water flow as well as control post treatment chemical injection. The chemicals listed below may be injected into the recycled water distribution stream to adjust the pH, alkalinity, and hardness of the water, and add chlorine for disinfection.

- Sodium Hydroxide
- Calcium Chloride

The following instrumentation will be employed in the analysis of the distribution recycled water for reporting purposes:

- pH analyzer
- Conductivity
- Turbidity
- Free chlorine analyzer

5.3.8 AWTF Clearwell

The AWTF Discharge Clearwell will consist of one large tank. The discharge from the UV units will flow by gravity to the Clearwell, which will be equipped with two vertical turbine pumps that pump to the City's purple pipe recycled water distribution system.

The Clearwell Pumps will be equipped with VFDs and will come online when flow starts in the RO system in order to maintain a level set point in the Clearwell. Pumps will be shut down when a Low-Low Level set point is reached in the Clearwell. The pumps will also shut down on a High-High discharge pressure. Shutdown of the Clearwell Pumps will initiate a shutdown of the RO system, MBR System and the AWTF Feed Pumps. The Clearwell Pumps will be designed to operate in and automatic lead/lag fashion with an automatic alternation of the pump after each pump operation to ensure as much as possible equal runtime hours.

The AWTF Main PLC control logic will run the lead and lag pumps. Low discharge flow detection will be provided and will shut down the pumps after a time delay. Auto shutdown and pump lockout will be initiated if any fault condition is detected for greater than a preset time delay.

A flow transmitter will also be provided on the discharge of the pumps to track the overall pressure and flow to the purple pipe distribution system.

5.3.9 Chemical Storage and Feed

Under Global Plant Control, the primary plant chemicals will be automatically called to run once the process flow is detected to be greater than a preset "start" minimum for longer than a preset time period. If the process flow is detected to be lower than a preset "stop" minimum for longer than a preset time period, the chemical system will be called to stop. A dedicated "start" and "stop" control threshold will be provided for each chemical system to account for the operational requirements of a given chemical system. As indicated above, the Global Plant Auto Control start permissive will require that all chemical systems be in auto with the minimum number of equipment ready for operation.

Under Operator Auto Control, the following chemical system control scenarios may be applied:

Sodium Hydroxide is added to the effluent for conditioning and stabilizing the product water to meet water quality goals for alkalinity and pH.

The Operator shall be able to select from one of the two following modes of Sodium Hydroxide dosing.

- Flow-paced – When the Operator selects this mode, Sodium Hydroxide dosing shall be flow-paced based on UV/AOP effluent flow-rate.
- Flow-paced with Trim from pH Analyzer - When the Operator selects this mode, the Sodium Hydroxide dosing shall be flow-paced based on UV/AOP effluent flow-rate with trim based on pH measured downstream.

Calcium Chloride is added to the effluent for conditioning and stabilizing the product water to meet water quality goals for TDS and hardness.

The Operator shall be able to select from one of the two following modes of Calcium Chloride dosing.

- Flow-paced – When the Operator selects this mode, Calcium Chloride dosing shall be flow-paced based on UV/AOP effluent flow-rate.

Chloramine is dosed upstream of the RO Systems to control bio fouling. Sodium Hypochlorite and Ammonium Sulfate are mixed to form chloramines.

- Sodium Hypochlorite shall be dosed flow-paced with a Total Chlorine trim to meet the total chlorine concentration target in the RO feed water as measured by the Total Chlorine analyzer. Such arrangement ensures that sufficient chloramine concentration is always maintained upstream of the RO Systems.
- Ammonium Sulfate shall be dosed flow-paced and stoichiometrically with a trim based on residual ammonia concentration measured in the RO feed water.
- Sodium Hypochlorite dosing shall be completely stopped under the following circumstances:
  1. If RO Feed free chlorine analyzer detects free chlorine and/or
  2. If the ORP on the RO System Feed ORP analyzers on either one of the RO Systems exceeds an operator-specified value.

Sulfuric Acid is added upstream of the RO Systems for pH control to minimize inorganic scaling.

- The Operator will be able to select from one of the two following modes of Sulfuric Acid dosing for RO Systems.
- Flow-paced – When the Operator selects this mode, Sulfuric Acid dosing shall be flow-paced based on RO feed flow-rate for corresponding RO System.
- Flow-paced with Trim from pH Analyzer - When the Operator selects this mode, the Sulfuric Acid dosing shall be flow-paced based on RO feed flow-rate for corresponding RO System with trim based on corresponding RO feed pH. This will be the default mode of operation.

Antiscalant is added upstream of the RO Systems to minimize inorganic scaling. Antiscalant dosing shall be flow-paced based on RO feed flow-rate for corresponding RO System.

Sodium Hypochlorite is added upstream of the UV/AOP Systems as an oxidant to generate hydroxyl radicals for the advanced oxidation process. Dosing shall be flow-paced based on the UV/AOP feed flow-rate with trim based on free chlorine concentration measured in the UV/AOP feed. Operator-adjustable set-points for minimum and maximum allowable free chlorine concentrations shall ensure sufficient treatment and protection of the reactors.

Sulfuric Acid is added upstream of the UV/AOP Systems for pH control when Sodium Hypochlorite is used as an oxidant. The Operator will be able to select from one of the two following modes of Sulfuric Acid dosing for UV/AOP Systems:

- Flow-paced – When the Operator selects this mode, Sulfuric Acid dosing shall be flow-paced based on UV/AOP feed flow-rate for corresponding UV/AOP System.
- Flow-paced with Trim from pH Analyzer - When the Operator selects this mode, the Sulfuric Acid dosing shall be flow-paced based on UV/AOP feed flow-rate for corresponding UV/AOP System with trim based on corresponding UV/AOP feed pH. This shall be the default mode of operation.

Chemicals for CIP include Citric Acid, Sodium Hydroxide, and Sodium Hypochlorite, and for neutralization include Sulfiric Acid, Sodium Hydroxide, and Sodium Bisulfite. Chemical dosing for CIP shall be according to vendor provided set points for chemical concentrations. Neutralization chemical additions shall be based on feedback control with pH and ORP.

The operator is responsible for either manual or automatic start of all chemical systems. Once initiated, sequencing/control of pumping and batching equipment will be managed by the AWTF Main PLC or specific equipment PLC as per operator preset control setpoints.

5.3.10 Critical Process Interlocks, Alarms and Setpoints

The Operator shall be able to adjust the low-low, low, high and high-high set points for the flows, pressures and water levels. For the sake of simplicity, the alarm list includes only low and high levels but similar alarms shall be provided for low-low and high-high levels as well. Also, similar alarms shall be applicable to both Systems for unit processes (MBR and RO) when individual analyzers/sensors are provided for each System and referred to as System 1 and 2 (e.g. MBR System 1 Filtrate Turbidity High). The PLC shall send an alarm at the low and high levels whereas the System shall send an alarm and shut down at the low-low and high-high set points.

5.3.11 Process Interlocks

The following process interlocks shall be in place when the Plant is in Auto mode. The Operator shall be able to override these interlocks if there is a need to test any specific unit process beyond its normal operating range. An example would be evaluating the MBR Systems at higher flux while not changing the flow to the RO System; such test would require continuous overflow of the RO Break Tank.

- High-high Water Level in the Aerobic or Anoxic Tanks shall shut off the flow to the fine screen depending on the mode of operation.
- High-high Water Level in the RO Feed Tanks shall shut off the MBR Filtrate Pumps.
- High-high Water Level in the RO Flush Tank shall shut off RO Feed Pumps.
- Chemical Injection Pumps shall shut off when corresponding unit process goes offline.
- High-high Combined MBR Filtrate pH shall shut off the Sodium Hydroxide Dosing Pumps for MBR.

5.3.12 Alarms

The following alarm conditions and corresponding action, as minimum, shall be programmed into the corresponding Vendor System PLCs.

1. MBR
   - High TMP
   - Low Aerobic Tank Water Level
   - Low Anoxic Tank Water Level
   - High Aerobic Tank Water Level
   - High Anoxic Tank Water Level
   - Low Aerobic Tank pH
   - High Aerobic Tank pH
   - Low Aerobic Tank DO
   - High Aerobic Tank DO
   - High MBR Filtrate Turbidity (System 1 and 2)
   - High Combined MBR Filtrate Ammonia
   - High Combined MBR Filtrate Nitrate

2. RO
   - Low Feed Water Pressure
   - High Feed Water Pressure
   - Low Booster Pump Suction Pressure
   - High Cartridge Filter Differential Pressure
   - High Stage 1 Differential Pressure
   - High Stage 2 Differential Pressure
   - Low RO Concentrate Flow
   - Low RO Antiscalant Flow
   - Low RO Feed Tank Water Level
   - High RO Feed Tank Water Level
   - High RO Feed Water TOC
   - Low RO Feed Water pH
   - High RO Feed Water pH
   - High RO Feed Water ORP
   - Low RO Feed Water ORP

- High RO Permeate TOC
- High RO Permeate Conductivity
- High RO Permeate Backpressure
- High RO Feed Water Temperature

3. UV/AOP
   - UV/AOP Feed Water Low UV Transmittance
   - UV/AOP Feed Water High pH
   - UV/AOP Feed Water Low pH
   - UV/AOP Feed Water High Total Chlorine
   - UV/AOP Feed Water Low Free Chlorine
   - UV/AOP Feed Water High Free Chlorine
   - UV/AOP Effluent High Total Chlorine
   - UV/AOP Effluent Low Total Chlorine

5.3.13 Set Points

The following set points shall be available to the Operator as a minimum:

1. MBR
   - Aerobic Tank Water Level
   - MBR Filtrate Flow
   - Aerobic Tank DO
   - Combined MBR Filtrate Nitrate (Nitrification-Denitrification Modes)
   - RAS Pump Flow
   - MBR Filtration Cycle Duration
   - MBR Relaxation/Backwash Duration
   - MBR Backwash Flow
   - MBR Scour Air Flow (Per MBR Vendor Recommendation)

2. RO
   - RO Feed Pressure
   - 1st Stage Booster Pump Flow
   - Total Permeate Flow
   - Stage 2 Permeate Flow
   - Recovery Rate
   - Concentrate Flow
   - RO Feed pH
   - RO Antiscalant Flow (A combination of antiscalant specific gravity, concentration of solution and RO flow setpoint)

3. UV/AOP
   - UV/AOP Flow
   - UV/AOP EED
   - UV/AOP RED
   - UV/AOP Feed pH
   - UV/AOP Oxidant Dose

5.4 CIVIC CENTER TANK & LIFT STATIONS CONTROL NARRATIVE

As mentioned in Section 5.1, the pumps that capture and discharge stormwater to/from the Civic Center Tank should be controlled in order to optimize capture and treatment of stormwater based on the weather forecasting information from NOAA.

A lift station at Pico Boulevard will operate in manual and automatic modes. In manual mode the lift station will operate using start/stop buttons at the lift station. In automatic mode the lift station will operate based on a permissive from the Civic Center Tank float level switches. The lift station will be inhibited from operating if a low level condition exists at the station. The Civic Center tank will be continuously monitored using redundant radar level sensors. There will also be two independent float switches that will be integrated with lift station controls; one for high and one for high-high level. (The use of hard wired connections for these signals to the lift stations using fiber cable should be considered during final design.) The high level switch shall be located 1ft below the high-high level switch and the high-high level switch shall be set 1ft below the tank maximum capacity level. If the tank level reaches the high level switch the lift stations will be commanded to shut down. If the high-level switch fails the high-high level switch will also shut down the lift stations.

The primary lift station feeding the AWTF is the Ocean Ave Lift Station. Supplementing the wastewater flow to the AWTF is the FCLS which captures wastewater from the future CSB and a portion of existing flows in the First Court 10-inch sewer. Both the FCLS and OALS discharge to a common forcemain which will send wastewater to the AWTF at all times during operation. Flow will be controlled by SCADA at the AWTF based on the total influent flow called for and the flow from AWTF stormwater influent pumps. However, the SCADA flow control must give first priority to the FCLS, then supplement with the OALS and/or stormwater influent pumps to achieve the desired flow setpoint for the AWTF.

5.4.1 Civic Center Tank Instrumentation

The Civic Center Tank PLC will monitor and control the following process equipment:

1. Pico Boulevard Lift Station Permissive to operate, Run and Fail indication and alarm (through fiber line connected between Lift Station and Civic Center Tank)

2. Ocean Avenue Lift Station Permissive to operate, Run and Fail indication and alarm (through fiber line connected between Lift Station and AWTF)

3. Civic Center Tank Level (Redundant)

4. Civic Center Tank Level High and High-High Level Switches.

5.5 MEMORIAL PARK TANK & LIFT STATIONS CONTROL NARRATIVE

As mentioned in Section 5.1, the pumps that capture and discharge stormwater to/from the Memorial Park Tank should be controlled in order to optimize capture and treatment of stormwater based on the weather forecasting information from NOAA.

Two lift stations, one at Santa Monica Blvd. & 15th Street (SMBLS) and the other at Broadway & 15th Street (Broadway Lift Station) will harvest stormwater from existing storm drains into the Memorial Park Tank via a gravity drain line on 15th street when the Memorial Park Tank water level is below a high level setpoint. The tank is sized for 3 million gallons.

Each lift station will operate in manual and automatic modes. in manual mode the lift station will operate using start/stop buttons at the lift station. in automatic mode the lift station will operate based on a permissive from the Memorial Park Tank float level switches. The lift station will be inhibited from operating if a low level condition exists at the station. There will be two independent float switches in the Memorial Park Tank that will be integrated with lift station controls; one for high and one for high-high level. (The use of hard wired connections for these signals to the lift stations using fiber cable should be considered during final design.) The high level switch shall be located 1ft below the high-high level switch and the high-high level switch shall be set 1ft below the tank maximum capacity level. If the tank level reaches the high level switch the lift stations will be commanded to shut down. If the high-level switch fails the high-high level switch will also shut down the lift stations.

A separate pump station called the Memorial Park Tank Drain Lift Station will pump stormwater from the Memorial Park Tank to the Pico/Caltrans Storm Drain which then the stormwater to the AWTF for storage at the 1.5 MG Civic Center Storage Tank. The pump station will be operated when a storm event is predicted to pump the stormwater from the Memorial Park Tank down through Pico/Caltrans drain. The pumps will operate to make capacity available for the predicted incoming storm volume .

5.5.1 Memorial Tank Instrumentation

The Memorial Tank PLC and main SWIP PLC will monitor and control the following process equipment:

1. SMBLS and BLS Permissive to operate, Run and Fail indication and alarm (through fiber line connected between Lift Station and Civic Center Tank).

2. Memorial Tank Drain Lift Station Start/Stop Commands, Run and Fail indication and alarm

3. Memorial Tank Analog Level Indication (Redundant)

4. Memorial Tank Level Low, High and High-High Level Switches.

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6.0 PROJECT IMPLEMENTATION

Specific requirements of project implementation are covered in SWIP's Request for Proposals (RFP).

6.1 PERMITTING

6.1.1 Waste Discharge/Water Recycling Requirements Permit

The schedule must account for Clean Water State Revolving Fund (CWSRF) requirements from the Division of Financial Assistance (DFA). Dispersal of construction funding from the DFA is contingent upon submission of a Title 22 Engineering Report prepared pursuant to California Code of Regulations, Title 22, Section 60323, to DDW and the Los Angeles Regional Water Quality Control Board (LARWQCB) to apply for a Waste Discharge/Water Recycling Requirements Permit (WDR/WRR). Upon further discussion with the LARWQCB and DDW, it was agreed that a phased application approach for the WDR/WRR permit would be preferred. The phasing plan with DDW and LARWQCB is as follows:

- **Phase 1**: Submit the SWIP Engineering Report prepared pursuant to California Code of Regulations for regulatory agency review and approval. The Phase 1 report will contain an overview of all three SWIP technical elements with specific focused design details for the SMURRF upgrades (Element 1) and the runoff harvesting tanks at both Civic Center and Memorial Park (Element 3). SMURRF is an existing facility and is currently owned and operated by the City as a BMP for stormwater treatment, covered under the Los Angeles County Municipal Storm Water National Pollutant Discharge Elimination System (NPDES) Permit. Conversion of this facility from a BMP to a permitted facility is a necessary step for the inclusion of SMURRF product water in the subsequent groundwater replenishment reuse project (GRRP). The permit will include a new brackish groundwater supply to SMURRF and upgrading the SMURRF treatment system by the addition of reverse osmosis and enclosing the effluent channel. The SMURRF upgrades and stormwater harvesting tanks will initially be permitted separate from the AWTF and will be issued WDRs appropriate for the treated water application(s) such as non-potable reuse and eventual groundwater recharge. Submittal of the Phase 1 Engineering Report will fulfill requirements for CWSRF funding of the SMURRF upgrades, Civic Center Tank, and the Memorial Park Tank.

- **Phase 2:** Submit an updated SWIP Engineering Report for regulatory review and approval that includes the previously approved Phase 1 SWIP Elements along with detailed design for the new AWTF (Element 2). The AWTF will provide advanced treatment of local wastewater as well as harvested stormwater from the Civic Center and Memorial Park Tanks for non-potable reuse within the City. Treated water from both the AWTF and the upgraded SMURRF will be combined in the City's existing purple pipe system for non-potable water distribution, pending subsequent approval of Phase 3 permits. These elements will be issued WDRs appropriate for the treated water application(s) such as non-potable reuse and eventual groundwater recharge.

- **Phase 3:** Post SWIP construction and water quality testing, construction of recharge well, obtain final regulatory approval for groundwater recharge. Amend Phase 1 and 2 WDRs as necessary to include new injection wells and extension of the purple pipe system for SWIP to operate as a GRRP. Supporting information for this last step in the permitting process will be provided by on-going groundwater flow modeling and actual data collected from the operating facilities. Both SMURRF effluent and potable water are available for use as diluent supplies. As SWIP effluent will be re-treated at the City's Arcadia WTP after extraction, it is anticipated that diluent water will not be required for recharge.

The Engineering Report for Phase 1 of permitting will be completed by the City and is current underway. Subsequent phases (Phase 2 and Phase 3) will be completed during detailed design and consist of amending the original Phase 1 report to include additional information. The objective of the phased permitting plan is to comply with the above noted requirements for dispersal of SRF construction funds and to expedite completion of the project.

6.1.2 Additional Permitting

In addition to the WDR/WRR permit, it is expected that supplemental permits will be required for the construction of SWIP. It is anticipated that the following permits and/or regulatory approvals will include, but are not limited to:

- State Water Resources Control Board
- Regional Water Quality Control Board
- City of Santa Monica
- California Environmental Quality Act
- Los Angeles County Department of Public Health
- City of Santa Monica Fire Department
- California Coastal Commission
- Los Angeles Sanitation
- South Coast Air Quality Management District
- Los Angeles County Department of Public Works, Flood Control District
- Los Angeles County Metropolitan Transportation Authority (Metro)

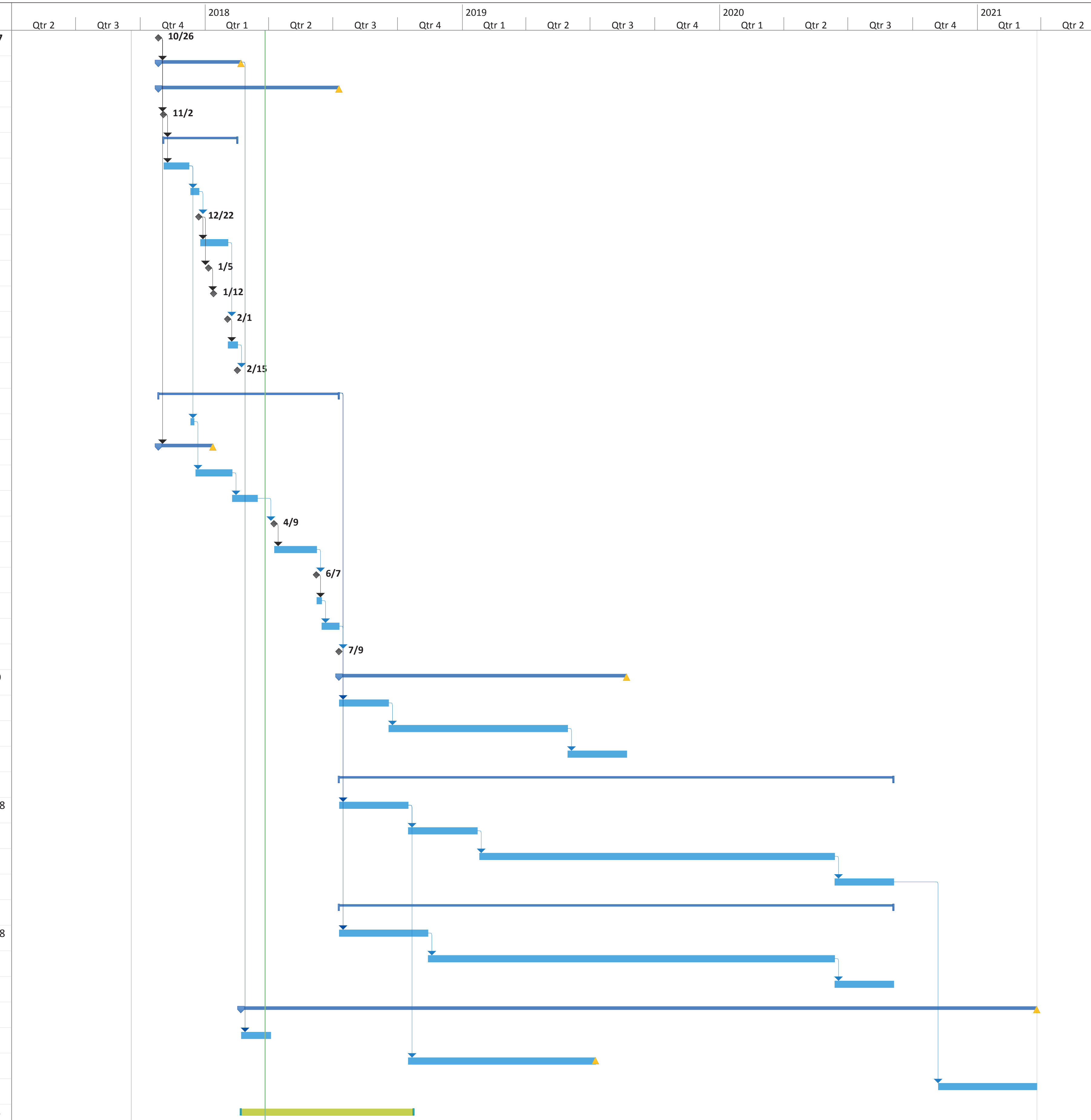
Such permits could include those related to construction, traffic, lane closure, encroachment, and grading, among others. Supplemental testing and monitoring to allow for aquifer reinjection may also be needed.

6.2 SCHEDULE

The following schedule includes a suggested approach to completing phases in a streamlined manner, however proposed schedules to increase efficiency are encouraged. The schedule in Figure 6-1 shows a preliminary schedule for development of the SWIP facilities. The SWIP project will be completed in the summer of 2020, with the final stages of permitting to be completed in 2021.

City of Santa Monica
Owner's Representative for SWIP

ID	Task Name	Duration	Start	Finish
1	**Notice to Proceed**	**1 day**	**Thu 10/26/17**	**Thu 10/26/17**
2	**Application and Title 22 Report (Phase 1)**	**83 days**	**Fri 10/27/17**	**Tue 2/20/18**
8	**Design Build Procurement**	**182 days**	**Fri 10/27/17**	**Mon 7/9/18**
9	RFQ/RFP Planning and Strategy Meeting	**1 day**	**Thu 11/2/17**	**Thu 11/2/17**
10	RFQ	**75 days**	**Fri 11/3/17**	**Thu 2/15/18**
11	Development of Draft RFQ	26 days	Fri 11/3/17	Fri 12/8/17
12	Draft RFQ Review	10 days	Mon 12/11/17	Fri 12/22/17
13	RFQ Release	0 days	Fri 12/22/17	Fri 12/22/17
14	Qualifications Preparation by Respondents	29 days	Mon 12/25/17	Thu 2/1/18
15	RFQ Pre-submittal meeting	0 days	Fri 1/5/18	Fri 1/5/18
16	Last Day for RFQ Questions	0 days	Fri 1/12/18	Fri 1/12/18
17	SOQs Received	0 days	Thu 2/1/18	Thu 2/1/18
18	SOQs Reviewed	10 days	Fri 2/2/18	Thu 2/15/18
19	DB Shortlist Announced	0 days	Thu 2/15/18	Thu 2/15/18
20	Procurement of DB	**182 days**	**Fri 10/27/17**	**Mon 7/9/18**
21	Draft RFP and Contract	5 days	Mon 12/11/17	Fri 12/15/17
22	Conceptual Design Report	**55 days**	**Fri 10/27/17**	**Thu 1/11/18**
26	Draft RFP and Contract Review	38 days	Mon 12/18/17	Wed 2/7/18
27	Final Draft RFP and Contract	26 days	Thu 2/8/18	Thu 3/15/18
28	Issue RFP	0 days	Mon 4/9/18	Mon 4/9/18
29	DB Proposal Prep Period	44 days	Mon 4/9/18	Thu 6/7/18
30	DB Proposals Received	0 days	Thu 6/7/18	Thu 6/7/18
31	DB Proposals Review and Ranking	5 days	Fri 6/8/18	Thu 6/14/18
32	DB Proposal Review, Processing and Award	17 days	Fri 6/15/18	Mon 7/9/18
33	Design Build Notice to Proceed	0 days	Mon 7/9/18	Mon 7/9/18
34	**SMURRF Construction**	**292 days**	**Tue 7/10/18**	**Wed 8/21/19**
35	GMP Development	50 days	Tue 7/10/18	Mon 9/17/18
36	Final Design and Construction	182 days	Tue 9/18/18	Wed 5/29/19
37	Startup, Testing and Operation	60 days	Thu 5/30/19	Wed 8/21/19
38	**Civic Center Tank and SRWTF**	**563 days**	**Tue 7/10/18**	**Thu 9/3/20**
39	Design Development	70 days	Tue 7/10/18	Mon 10/15/18
40	GMP Development	70 days	Tue 10/16/18	Mon 1/21/19
41	Final Design and Construction	360 days	Fri 1/25/19	Thu 6/11/20
42	Startup, Testing and Operation	60 days	Fri 6/12/20	Thu 9/3/20
43	**Memorial Park Tank**	**563 days**	**Tue 7/10/18**	**Thu 9/3/20**
44	GMP Development	90 days	Tue 7/10/18	Mon 11/12/18
45	Final Design and Construction	413 days	Tue 11/13/18	Thu 6/11/20
46	Startup, Testing and Operation	60 days	Fri 6/12/20	Thu 9/3/20
47	**Permit Submittal and Approval**	**807 days**	**Wed 2/21/18**	**Thu 3/25/21**
48	Phase 1 Permitting	30 days	Wed 2/21/18	Tue 4/3/18
49	Phase 2 Permitting	190 days	Tue 10/16/18	Mon 7/8/19
50	Post Construction (IPR/Phase 3) Permitting	100 days	Fri 11/6/20	Thu 3/25/21
51	Focused Salt Nutrient Management Plan	175 days	Wed 2/21/18	Tue 10/23/18



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