AGENDA REPORT
City Council

MEETING DATE:	May 17, 2023		
PREPARED BY:	Matt Widelski, P.E. Principal Engineer	**DEPARTMENT DIRECTOR:**	Jill Bankston, P.E
DEPARTMENT:	Engineering	**CITY MANAGER:**	Pamela Antil

SUBJECT:

City of Encinitas Sewer Master Plan Update

RECOMMENDED ACTION:

Receive the City's Sewer Master Plan Update (SMPU).

STRATEGIC PLAN:

This project aligns with the Environmental Health and Leadership Focus Area of the 2023-24 Strategic Plan by continuing our responsible solid waste disposal efforts.

ENVIRONMENTAL CONSIDERATIONS:

The action being considered by the City Council is not subject to the California Environmental Quality Act (CEQA) because it is not a "project" per Section 15060 (c) (3) and 15378 (b) (5) of the CEQA Guidelines. The action authorizes staff to implement an organizational or administrative activity of government that by itself will not result in a direct or indirect physical change in the environment.

This item is not related to the Climate Action Plan.

FISCAL CONSIDERATIONS:

There are no direct fiscal impacts associated with the recommended action to accept the SMPU. Future financial actions may be taken to fund projects recommended in the SMPU.

BACKGROUND:

On December 18, 2019, Council awarded a contract to NV5 to develop an update to the Citywide Sewer Master Plan for both the Encinitas Sanitary Division and Cardiff Sanitary Division, and to prepare a Sewer Rate Study for both divisions. The purpose of the updated Sewer Master Plan was to evaluate the City's existing and future sewer capacity and rehabilitation needs. It included an assessment of the existing system, future needs determined by demographic projections and a comprehensive review of maintenance procedures. The last update to the Citywide Sewer Master Plan was performed in 2011.

ANALYSIS:

The City of Encinitas wastewater collection system consists of two divisions: the Encinitas Sanitary Division (ESD), with nearly 40 miles of sewer pipeline in the central coastal portion of the City; and the Cardiff Sanitary Division (CSD), with approximately 82 miles of sewer pipeline in the Cardiff and Olivenhain areas. A separate legal entity, the Leucadia Wastewater District, provides sewer services to the remaining northern and central areas of the City, including a majority of Leucadia and New Encinitas, and is not included in this study.

Most flows generated within the ESD are collected in the Encinitas Trunk Sewer and flow to the Moonlight Beach Pump Station which sends flow north via the Batiquitios Pump Station to the Encina Water Pollution Control Facility. Flows generated within the CSD are collected by four major trunk sewers and then pumped or conveyed south via gravity to the San Elijio Water Reclamation Facility.

The ages of the sewer pipelines in ESD and CSD range from new to over 70 years old. Nearly 40 percent and 32 percent of sewer pipelines in ESD and CSD are over 60 years old respectively. In addition, there are three pump stations in the CSD and one pump station in the ESD, ranging from 49 to 64 years old. All four pump stations have been rehabilitated with the most recent taking place in 2016 for Coast Highway Pump Station, and oldest in 1991 for Cardiff Pump Station. A major rehabilitation of Moonlight Beach Pump Station is planned by the San Elijo Joint Power Authority (SEJPA) in the near future.

The City's Utilities Department is responsible for the inspection, operation, and maintenance of the City's wastewater collection system. SEJPA and Encina Wastewater Authority operate and maintain their respective sewer pump stations. To minimize and prevent system blockages that can lead to sewer system overflows, the City's Operation and Maintenance (O&M) Program performs regular citywide cleaning and inspection of the sewer collection system. Closed-Circuit Televising (CCTV) inspection and assessment includes periodic and systematic inspection of the sanitary sewer system pipelines and manholes. The City uses Cityworks as its Computer Maintenance Management System which allows City staff to document a variety of information including daily maintenance activities, repairs, service calls, and citizen complaints.

The design criteria used in this SMPU is based on existing City design standards. Like previous master plans, the peaking factor used in the hydraulic analysis are based on historical dry and wet weather peak flows observed from existing sewer pump stations' metering data. The capacity of each gravity sewer is based on the relative depth of flow within the respective pipeline reach. For sewer pump stations the system was modeled with a minimum of two pumps and a minimum capacity of handling ultimate peak wet weather flow, and 100% standby capacity with emergency power standby.

Capacity analysis of the existing collection system was performed under existing and forecasted dry and wet weather flow conditions for 2025, 2030 and 2035. The residential population data was based on the SANDAG Series 13:2050 Regional Growth Forecast. The City has continued to experience gradual increase in the number of wastewater customers due to population growth, however; wastewater flows have decreased due to ongoing region-wide water conservation efforts.

The main tool used in the capacity analysis was a dynamic hydraulic model simulating flow conditions, such as wastewater flow depth, flow rate, and velocity within pipes and manholes in the City's wastewater collection system.

Generally, the hydraulic analysis indicates the existing system has sufficient capacity to accommodate the projected dry weather conditions for each planning horizon. However, under projected peak wet weather conditions, replacement of several pipe sections with larger diameter pipes is recommended within the planning horizon.

Field inspection of pump stations was conducted, and several improvements were identified for the Cardiff, Coast Highway, Olivenhain and Moonlight Beach pump stations. Cost estimates for proposed improvements were developed in 2021. City staff will update the preliminary opinions of probable costs for proposed improvements to reflect the recent inflationary impacts. Once the new cost estimates are finalized, an updated Sewer Rate Study will be prepared and presented to the Council.

The SMPU identified areas where the City can improve its Asset Management System by better integration of its Geographic Information System (GIS) with its Cityworks database. The regular integration of the Cityworks data and review by the City's Utilities Department may facilitate an improved systematic approach to the management of the capital assets and infrastructure.

ATTACHMENTS:

1) Sewer Master Plan Update Report

CITYWIDE SEWER MASTER PLAN UPDATE

Prepared For:

CITY OF ENCINITAS
505 South Vulcan
Avenue Encinitas, CA
9202

15092 Avenue of Science, Suite 200
San Diego, CA 92128

PROJECT NUMBER 227519-0000687.00

ACKNOWLEDGMENTS

CITY OF ENCINITAS

NV5, Inc. would like to acknowledge the following staff of the City of Encinitas for their assistance and cooperation provided during the preparation of this Master Plan Update. The comprehensive plans included herein reflect the City's on-going commitment to the effective and efficient operation, maintenance, and management of its wastewater collection system and achieving the City's objectives.

CITY OF ENCINITAS TEAM MEMBERS

Isam Hireish, PE.. Assistant Director / Assistant General Manager

Bill Wilson.. Senior Management Analyst

Matt Widelski, PE... Senior Engineer

NV5 TEAM MEMBERS

Carmen Kasner, PE.. Principal-In-Charge

Cynthia Peraza, PE.. Project Manager

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ABBREVIATIONS AND ACRONYMS

ADWF	Average Dry Weather Flow
Caltrans	California Department of Transportation
CCTV	Closed Circuit Television
CGTS	Cardiff Gravity Trunk Sewer
CIP	Capital Improvement Program
CIWQS	California Integrated Water Quality System
CMMS	Computer Maintenance Management System
COF	Consequence of Failure
CRS	Cardiff Relief Sewer
CSD	Cardiff Sanitation Division
CTS	Cardiff Trunk Sewer
CWEA	California Water Environment Association
d/D	Depth of flow over pipe diameter
DIP	Ductile Iron Pipe
DU	Dwelling Units
EDM	Engineering Design Manual
EDU	Equivalent Dwelling Units
EPS	Extended Period Simulations
ESD	Encinitas Sanitary Division
ESVCP	Extra Strength VCP
ETS	Encinitas Trunk Sewer
EWA	Encina Wastewater Authority
EWPCF	Encina Water Pollution Control Facility
FPS	Feet Per Second
GIS	Geographical Information System
GPCD	Gallons Per Capita Per Day
GPD	Gallons Per Day
GPM	Gallons Per Minute

H_2S	Hydrogen Sulfide
HFML	High Frequency Maintenance Location
Hp	Horse Power
Hwy	Highway
I-5	Interstate 5
I&I	Inflow and Infiltration
JPA	Joint Powers Authority
LOF	Likelihood of Failure
LWD	Leucadia Wastewater District
MOU	Memorandum of Agreement
MRP	Monitoring and Reporting Program
MGD	Million Gallons per Day
NASSCO	National Association of Sewer Service Companies
NCTD	North County Transit District
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and Maintenance
OPS	Olivenhain Pump Station
OTS	Olivenhain Trunk Sewer
PDWF	Peak Dry Weather Flows
PVC	Polyvinyl Chloride
PWWF	Peak Wet Weather Flow
QA/QC	Quality Assurance and Quality Control
RDII	Rain Derived Infiltration and Inflow
RHNA	Regional Housing Needs Assessment
RSFCSD	Rancho Santa Fe Community Services Division
SANDAG	San Diego Association of Governments
SEJPA	San Elijo Joint Powers Authority
SEWRF	San Elijo Water Reclamation Plant
SSMP	Sanitary Sewer Management Plan
SSO	Sanitary Sewer Overflow

TAZ	Transportation Analysis Zone
VCP	Vitrified Clay Pipe
VFD	Variable Frequency Drive
WDRs	Waste Discharge Requirements
WPCF	Water Pollution Control Facility

EXECUTIVE SUMMARY

This Sewer Master Plan Update serves to summarize the comprehensive evaluation the City of Encinitas' (City) existing and projected sewer facility needs, development of recommendations, and the preliminary opinion of probable cost developed for the improvements identified.

The evaluation of the capacity of the City's collection included development of a hydraulic model that includes the collection system and major elements within both the Cardiff and Encinitas Sanitary Divisions. The primary components of the Master Plan update include the following Sections and evaluations:

- Summary of the City's existing facilities.
- Sewer flow generation analysis and evaluation of the existing system.
- Development and calibration of the City's collection system.
- Projection of ultimate sewer flows and evaluation of future infrastructure needs.
- Field review of existing sewer pump stations.
- Development of risk assessment methodology.
- Preparation of recommended Capital Improvement Program projects.

ES-2 CARDIFF SANITARY DIVISION

The Cardiff Sanitary Division (CSD) is owned by the City of Encinitas and operated by the City of Encinitas' Public Works Department and serves a population of approximately 20,000 residents in an 8.3 square-mile area in the southern and easterly portions of the City.

There are approximately 82 miles of sewer mains and over 1600 manholes in the collection system. CSD serves residential units, stores, restaurants, offices, and medical buildings, including a portion of Scripps Hospital. Flows generated within the CSD are collected in one of the following trunk sewer systems are then pumped or conveyed by gravity to the San Elijo Water Reclamation Facility:

- Cardiff Trunk Sewer
- Cardiff Relief Sewer
- Cardiff Gravity Trunk Sewer
- Olivenhain Trunk Sewer

ES-3 ENCINITAS SANITARY DIVISION

The Encinitas Sanitary Division (ESD) is owned by the City of Encinitas and operated by the City of Encinitas' Public Works Department and serves a population of approximately 17,000 residents in a three (3) square-mile area in the westerly and central portion of the City.

ESD serves primarily residential units with some commercial development in the downtown area. The majority of flows generated within the ESD are collected in the Encinitas Trunk Sewer and flow to the Moonlight Beach Pump Station. Flows from the Moonlight Beach Pump Station are pumped to the Batiquitos Pump Station which is ultimately pumped together with flow from the Leucadia Wastewater District to the Encina Water Pollution Control Facility.

ES-4 EXISTING FACILITIES

Information pertaining to the characteristics of the City's wastewater collection system and used to develop the hydraulic model to perform the capacity analysis, was collected and quantified from the City Geographic Information System (GIS), previously prepared reports and studies, and input from City staff. Information obtained from the GIS generally included:

- Facility ID
- Location
- Install Date
- Pipe Length
- Pipe Diameter
- Pipe Material
- Division

Further details of pump stations, treatment plants, flow metering and other information was collected from San Elijo Joint Powers Authority (SEJPA) staff and used to develop the comprehensive hydraulic model. The capacity of the collection system was evaluated based on existing meter data and projected wastewater flows.

Table ES-1 includes a summary of the collection system pipelines for CSD and ESD and Table ES-2 summarizes existing pump station facilities.

Table ES - 1 Existing Pipeline by Diameter

Pipe Diameter (Inches)	CSD		ESD		Total	
	Feet	Miles	Feet	Miles	Feet	Miles
6	15, 936	3.0	29,487	5.6	45,423	8.6
8	363,183	68.8	158,625	30.0	521,808	98.8
10	13,280	2.5	8,536	1.6	21,816	4.1
12	5,790	1.1	5,303	1.0	11,093	2.1
14	10,078	1.9	4,538	0.9	14,616	2.8
15	21,825	4.2	1,193	0.2	23,018	4.4
Unknown	313	0.1	1,083	0.2	1,396	0.3
TOTAL	**430,405**	**81.6**	**208,765**	**39.5**	**639,170**	**121.1**

Table ES - 2 Existing Pump Stations

Pump Station[3]	Construction/ Rehabilitation Date	Pump and Motor Information			Storage	Capacity[1]	Force Main
		Quantity	Motor Size	Design Point			
Cardiff Pump Station	1963/1991	2 1	40 HP 25 HP	1,000 gpm @ 45' 900 gpm @ 45'	210,000 gallon storage basin	2,000 gpm	10-inch Diameter (dual)[2]
Coast Highway 101 Pump Station	1959/2016	2	10 HP	125 gpm @ 70'	4,000 gallon wet well	125 gpm	4-inch Diameter (dual)
Moonlight Beach Pump Station	1974/2006	3	60 HP	1,000 gpm @ 107'	180,000 gallon storage basin	2,000 gpm	14-inch Diameter
Olivenhain Pump Station	1972/2011	3 1	43 HP 7.5 HP	900 gpm @ 69.5' 350 gpm @ 49.5'	216,000 gallon storage basin	2,700 gpm	14-inch Diameter (dual)

1. Capacity is based on one pump out of service.
2. The Cardiff Pump Station force main ties into the Olivenhain Pump Station Force Main.
3. ESD Included the Moonlight Beach Pump Station. CSD includes the Coast Highway 101 Pump Station and the Olivenhain Pump Station.
4. Gallons per minute (gpm)
5. Horsepower (HP)

ES-5 FLOW GENERATION AND HYDRAULIC MODEL DEVELOPMENT

Flow generation rates were determined based on flow meter data captured at various locations over the last several years and was provided by SEJPA staff. Using the City's InfoSWMM hydraulic model obtained from the City, the model was updated primarily with the City's GIS data. The GIS data was imported and an updated model was created and reviewed to verify the original model data was input correctly and the flow direction, size, and layout of the modeled pipelines were logical.

Wastewater flows at each of the major trunk sewers are measured and recorded and metered. The meter basins within CSD and ESD are delineated and wastewater flows generated within each metered basin were provided by the San Elijo JPA. The meters are located at the following four (4) locations:

- Moonlight Beach Pump Station
- Cardiff Gravity Trunk Sewer
- Cardiff Pump Station
- Olivenhain Pump Station

A summary of the average annual flows from 2017 to 2019 is presented in Table 4-B. The three most recent years of data should provide an accurate representation of the flows currently encountered. While there is an existing flow meter located at the Coast Boulevard Pump Station, the data available was not used as the flow measurements from 2017 to 2019 were inconsistent (several empty data values and did not follow a typical diurnal pattern) and therefore is not presented.

Generation Rates Using SANDAG Population Forecasts

Development of a population-based unit generation rate was determined to establish the estimated average wastewater flow generated by a resident over a given day. This rate was used to forecast the anticipated wastewater flows the City can expect to generate through a specific planning horizon based on the expected population growth. The initial per capita unit generation rate was determined through establishing the relationship between the existing SANDAG population data within each sanitary division and the average wastewater flows observed at the flow meters.

Residential population data was obtained from the SANDAG Series 13: 2050 Regional Growth Forecast. The forecast represents one possibility for future growth in the San Diego Region. The Series 13 Regional Growth Forecast represents a combination of economic and demographic projections, existing land use plans and policies, as well as potential land use plan changes that may occur in the region between 2030 and 2050. The following includes a summary of the population and unit generation rates for each sanitary division.

Table ES - 3 Population Forecasts and Generation Rates

Sanitary Division	2020 Residential Population	Unit Generation Rate (gpcd)	Estimated Wastewater Generation (MGD)
Cardiff Sanitary Division	19,625	65	1.276
		Metered 2017 Flow =	**1.275**
		Percent Error =	**0.07%**
Encinitas Sanitary Division	13,267	75	1.009
		Metered 2017 Flow =	**0.981**
		Percent Error =	**1.41%**

Notes:
1. gpcd = gallons per capita per day
2. MGD = million gallons per day

Generation Rates Using Encinitas Land Use Data

The generation rate is used to project the amount of wastewater flow the City can expect to be generated through a specific planning horizon. Land use categories were defined as Single-Family Residential, Multi-Family Residential, Mobile Home Parks, Commercial, and Industrial. Single-Family Residential, Multi-Family Residential and Mobile Home Parks are considered residential categories while Commercial and Industrial are considered non-residential.

For commercial and industrial land use categories, sewer billing data was superimposed onto the non-residential land use areas to identify the parcels not currently generating sewer flows. With the total area of non-residential land use types contributing flow determined, an average flow (gallons per acre) was approximated to obtain an estimated commercial and industrial land use wastewater generation rate for each sanitary division. The following includes a summary of the land use units and unit generation rates for each sanitary division.

Table ES - 4 Land Use Units and Generation Rates

Category	Units	Unit Generation Rate	Estimated Wastewater Generation (MGD)
Cardiff Sanitary Division			
Single-Family Residential	5,946 DUs	180 gpd / DU	1.070
Multi-Family Residential	1,785 DUs	110 gpd / DU	0.196
Mobile Home Park	239 DUs	80 gpd / DU	0.019
Commercial	57.6 acres	400 gpd / acre	0.023
Industrial	0.3 acres	400 gpd / acre	0.000
		Subtotal =	1.309
		Metered 2017 Flow =	1.275
		Percent Error =	2.68%
Encinitas Sanitary Division			
Single-Family Residential	4,169 DUs	180 gpd / DU	0.750
Multi-Family Residential	1,252 DUs	110 gpd / DU	0.138
Mobile Home Park	168 DUs	80 gpd / DU	0.013
Commercial	113.4 acres	400 gpd / acre	0.045
Industrial	24.7 acres	400 gpd / acre	0.010
		Subtotal =	0.957
		Metered 2017 Flow =	0.981
		Percent Error =	-2.48%

Notes:

1. DUs = dwelling units
2. gpd = gallons per day

Recommended Unit Generation Rates

Based on the analysis conducted, the City has relatively uniform wastewater generation rates for land use and population projections. To project flows based on projected future development, the following wastewater generation rates are recommended.

Table ES - 5 Wastewater Generation Rates

Category	Recommended Unit Generation Rate
Population	
Residential Population	70 gpcd
Land Use	
Single-Family	180 gpd / DU
Multi-Family Residential	110 gpd / DU
Mobile Home Park	80 gpd / DU
Commercial	400 gpd / acre
Industrial	400 gpd / acre

ES-6 CAPACITY ANALYSIS

A capacity analysis of the existing collection system was performed under existing and forecasted dry and wet weather flow conditions. Model simulations were performed for the 2025, 2030, and 2035 planning horizons to identify potential improvement projects. Projects were evaluated under the existing wastewater flows to identify project priority and phasing. For each of the sanitation divisions, a hydraulic analysis was performed for each of the following scenarios:

- 2020 Dry and Wet Weather Scenario (Existing)
- 2025 Dry and Wet Weather Scenario
- 2030 Dry and Wet Weather Scenario
- 2035 Dry and Wet Weather Scenario (Build Out)

Wastewater flow generation factors were applied to the developable parcels. To analyze the capacity of the existing system and determine if future capacity upgrades are needed, the projected Ultimate Peak Wet Weather Flows (PWWF) were evaluated.

Generally, the hydraulic analysis indicates the existing system has sufficient capacity to accommodate the projected dry weather scenarios for each planning horizon. However, for the wet weather scenarios, there are several pipe sections that exceed the d/D ratio of 0.90. While more detail is provided in Chapter 7, the following includes a summary of the pipelines in each sanitary division not meeting the evaluation criteria.

Table ES - 6 Length of Pipelines Exceeding Criteria (LF)

Sanitation Division	2020	2025	2030	2035
Cardiff	11,734	12,118	13,360	17,855
Encinitas	-	-	-	105
TOTAL	**11,734**	**12,118**	**13,360**	**16,442**

Pump Station Capacity

A capacity evaluation was performed for the four (4) pump stations. To determine station capacities, it was assumed one (1) pump was out of service. All pump stations have capacity to meet the build-out PWWF. The build-out PWWF for the Moonlight Beach Pump Station indicates it is at approximately 97% of the pump station capacity if operating with one pump out of service.

Table ES - 7 Pump Station Capacity

Pump Station	Capacity (MGD)	Build-Out PWWF (MGD)
Moonlight Beach	2.880	2.773
Coast Highway 101	0.180	0.086
Cardiff	2.880	2.343
Olivenhain	3.888	2.277

ES-7 CONDITION ASSESSMENT

Review and assessment of City inspection videos was not included as part of this Master Plan Update effort. However, the City's Sewer Asset Management Plan, prepared in January 2015, was reviewed and which included inspection and assessment of approximately 8 miles of the 37 miles that make up the ESD and approximately 15 miles of the 79 miles that make up CSD.

Since preparation of the Asset Management Plan, the City has issued two (2) projects to address the pipelines and manhole deficiencies identified and that were recommended for rehabilitation, repair, or replacement. Specifically, the City completed the following projects which capture a large majority of the projects:

- 2016-2017 Annual Citywide Sewer Rehabilitation Project, April 2017 and
- 2019-2020 Annual Citywide Sewer Rehabilitation Project, June 2020

At the time this Master Plan Updated was being prepared, the City did not have any specific condition related projects identified. While condition related projects were not specifically identified, it is recommended the City allocate up to $500,000 for potential improvements as they are identified through the ongoing inspection program.

Pump Stations

To document and confirm the necessary improvements for the City's pump stations, a review of the reports and design plans provided by the City was performed and is summarized in Chapter 10.0.

As part of the Master Plan Update, field inspections of the Cardiff, Coast, Olivenhain and Moonlight Beach Pump Stations were performed. Physical site inspections were conducted with SEJPA staff to document the existing physical condition of each pump station and identify necessary improvements. Improvements not yet completed since the previous assessments but still considered necessary were documented.

Several improvements were identified for the Cardiff Pump Station and are prioritized as Essential, Highly Recommended and Recommended. Essential and Highly Recommended improvements include replacement of the older breakers, addition of a new wet well level sensor and controls and alarms for drywell ventilation. The Coast Highway Pump Station underwent a major renovation in 2016 and does not currently require any major improvements. For the Moonlight Beach Pump Station, improvements to the existing pumps and pump arrangement, as well as piping and valve replacement were identified. At the Olivenhain Pump Station site, fence and pavement repairs, due to the Caltrans project were identified. Additionally, the City may need to consider replacement of the existing generator as due to the new permitting requirements the Air Pollution Control District of San Diego County may not allow its continued use.

ES-8 ASSET MANAGEMENT AND RISK ANALYSIS

A risk analysis is comprised of factors that include the likelihood of failure (LOF) and the consequences of failure (COF). Data for the LOF, which characterizes the sewer's physical condition, was obtained through the City's GIS and inspection and condition assessment program to determine the likelihood of failure for each pipe segment based on the assigned rating.

The COF ratings are intended to represent the degree of impact a pipe segment failure will have on the service area that is in close proximity. The factors include evaluating the receiving environment, City facilities critical to the operation of the City during emergencies, the circulation systems, and impacts to residential and commercial and/or industrial facilities.

Recognizing that each criterion is not of equal importance in determining the criticality, weighting factors are used to prioritize the degree of importance. The higher weighting factor indicates the criterion is of greater importance in the decision-making process. LOF and COF scores were weighted with factors ranging from 10% to 40%.

Information available to use to perform the risk analysis and assess the health of the system assets was based primarily on information obtained from the City's GIS and inspection and assessment program. The LOF and COF process was developed as a method to assist the City with prioritization of the improvements identified in this Master Plan Update.

The combination of the LOF and COF ratings (LOF x COF = Risk) were used to prioritize the repairs or replacement of system assets to mitigate risk. While data was not available to complete the risk assessment for every pipeline, the prioritization and methodology established will serve to provide the City with a plan for focusing the available resources and funding on the most immediate needs based on this analysis. This method may be updated by City staff as more information is obtained as additional condition assessment is performed.

ES-9 RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

This Master Plan Update includes the findings of the capacity evaluation and condition assessment of the pump stations for ESD and CSD. The information is summarized in a comprehensive list of recommended capital improvement projects. Projects are identified for existing condition and for 5-year, 10 year, and 15 year planning horizons. While the projects are identified for each sanitary division by planning horizon, the required improvements will be dependent on the timing of actual development within each sanitary division. The City will determine the actual needs and priority of its infrastructure improvements at that time and will phase the improvements accordingly. As such, the proposed projects are presented as potential phases versus planning horizons.

The summary of grouped recommended CIP projects by sanitary division and planning phase is provided in Table ES-8 below. Table ES-9 includes a summary of the estimated costs for each of the respective pump stations.

Table ES - 8 Pipeline Improvement Projects

No.	CIP Project ID	Location Description	Length (ft)	Estimated Diameter (inches)	Proposed Diameter (inches)	Sanitary Division	Estimated Total
Phase I							
1	A1	OTS Jackie Lane to Brookside Lane	1,106	8	10	CSD	$618,210
2	B1	OTS – Olivenhain Pump Station to Siphon	594	15	18	CSD	$484,754
7	D1	CTS Cardiff Pump Station to Manchester Avenue	158	15	18	CSD	$128,708
8	E1	Tributary to CTS – Cardiff Pump Station	53	8	10	CSD	$29,413
9	F1	CRTS – Chesterfield Drive to Liverpool Drive	849	12	15	CSD	$583,851
10	G1	CRTS – Burkshire Avenue to Sheffield Avenue	284	10	15	CSD	$195,010
11	H1	CRTS – Sheffield Avenue to Loch Lomond Drive	2,142	10	12	CSD	$1,381,174
12	I1	Tributary to CRTS – Cathy Lane and Oakley Lane	15	10	12	CSD	$9,585
13	J1	CTS – Liszt Avenue to Verdi Avenue	433	8	10	CSD	$242,053
		Phase I Total	**5,633**				**$3,672,758**
Phase II							
3	B2	OTS – Olivenhain Pump Station to Siphon	61	15	18	CSD	$49,856
14	J2	CTS – Liszt Avenue to Verdi Avenue	323	8	10	CSD	$180,239
		Phase II Total	**384**				**$230,096**
Phase III							
4	B3	OTS – Olivenhain Pump Station to Siphon	536	15	18	CSD	$437,423
6	C3	OTS – Liszt Avenue to Verdi Avenue	113	15	18	CSD	$91,921
		Phase III Total	**684**				**$529,344**
Phase IV							
5	B4	OTS – Olivenhain Pump Station to Siphon	3,722	15	18	CSD	$3,039,514
16	B5	OTS – El Camino Del Norte to Bella Collina	820	15	18	CSD	$669,648
17	B6	OTS – Mira Costa College Rd to S Rancho Santa Fe Rd	593	15	18	CSD	$484,270
15	K4	Tributary to ETS – Property of East Ocean Avenue	105	8	10	CSD	58,721
		Phase IV Total	**5,240**				**$4,252,152**
			TOTAL				**$8,684,349**

Table ES - 9 Estimated Costs of Pump Station Improvements

Category	Moonlight Beach[1]	Cardiff	Coast Highway 101[2]	Olivenhain
Recommended Improvements	Refer to Referenced Report	$300,200	NA	$75,000
General Requirements	Refer to Referenced Report	$56,000	NA	$8,000
Engineering (15%)	Refer to Referenced Report	$45,030	NA	$11,250
Overhead and Profit (15%)	Refer to Referenced Report	$45,030	NA	$11,250
Contingency (30%)	Refer to Referenced Report	$90,060	NA	$22,500
Totals	**$573,000**	**$536,320**	**NA**	**$128,000**

Notes

1. Estimated cost is based on the September 2019 Moonlight Beach Pump Station, Pump Replacement Evaluation Report (Appendix 9).
2. Based on the site visit conducted and discussion with SEJPA staff, no improvements are necessary or identified at this time.

Also, as previously noted, it is recommended the City allocate up to $500,000 for potential rehabilitation improvements as they are identified through the ongoing inspection program.

1.0 INTRODUCTION

In April 2011, the City of Encinitas (City) completed the Cardiff and Encinitas Sewer Master Plan Update. The 2011 master plan included an evaluation of the existing sanitary system, a capacity analysis, inspection, assessment, hydraulic modeling of several system trunk sewers, manhole inspections, pump station evaluations, and development of ultimate flow projections. The master plan also included recommendations for pipeline and pump station improvements and development of several sewer related programs. Additional information pertaining to major elements of the City's wastewater collection system and specific system improvements is available in this Sewer Master Plan Update.

The City is updating its 2011 Cardiff and Encinitas Sewer Master Plan Update for the existing wastewater collection system within both the Cardiff (CSD) and Encinitas Sanitary Divisions (ESD). The previous master plan included an evaluation of the condition and capacity of the larger components of the City's wastewater infrastructure within the CSD and ESD.

The capacity of the collection system was determined based on existing flow meter data and future wastewater flow projections. The anticipated flow was incorporated into a wastewater system model that included the major trunk sewers. To determine the rehabilitation improvement needs, video pipeline inspections were performed in the areas identified by the operations and maintenance staff, visual inspections of manholes were performed and visual inspections were performed of the pump stations.

Due to increased growth, system expansions, and aging infrastructure, the City is addressing its infrastructure needs and updating its 15-year Capital Improvement Program (CIP) with this master plan update.

This introductory chapter of the Master Plan provides a summary of the:

- Master Plan objective
- Contents and organization of this report
- Background information about the City's sanitary wastewater system
- Overview of Regulatory Requirements
- Asset Management

1.1 SEWER MASTER PLAN PURPOSE / OBJECTIVES

The purpose of this Sewer Master Plan Update (Master Plan) is to reevaluate the City's existing and future wastewater system infrastructure needs. The Master Plan includes a general assessment of the existing wastewater collection system, including its pump stations, to develop a recommended CIP for the City to implement over the next 15-years. The recommended CIP includes required pipeline and pump station condition and capacity related improvement projects to reflect growth in development, modifications to the wastewater system and ongoing water conservation efforts. Other key objectives with preparation of the master plan are to:

- Reflect land use and development patterns implemented consistent with the General Plan which was last modified in 2016

- Assess the current status and condition of the wastewater system, available capacity within the system, and identify specific improvements over the next 5, 10 and 15 years
- Review of the current Housing Element and updating population estimates and wastewater flow projections
- Review of wastewater system improvements since 2011
- Review of wastewater system operational data including the City's condition inspection and assessment program
- Review of wastewater flow data to determine existing unit wastewater generation flow rates
- Document infiltration issues and estimate of infiltration rates taking into account repairs and improvements made to the system since 2011
- Estimate future wastewater flow rates
- Hydraulic analysis of the wastewater system for current and ultimate conditions
- Develop a phased improvement plan
- Estimate wastewater system improvement costs

1.2 REPORT ORGANIZATION

This Master Plan provides a comprehensive review and evaluation of the City's wastewater collection, conveyance, and capacity requirements under existing and ultimate conditions. Based on findings of the evaluation, the Master Plan includes recommended facility improvements and estimated capital cost requirements to assure that aging infrastructure remains serviceable and allow for the continued growth within the City. The findings will be incorporated to the sewer rate study prepared in conjunction with this Master Plan Update to allow the City to maintain sufficient funding to efficiently and effectively maintain the wastewater collection system and implement capital improvements needs. The Master Plan Update is presented in the following ten (10) chapters;

- Chapter 1 provides an introduction and background to the project.
- Chapter 2 presents an overview of the study area and existing wastewater collection facilities.
- Chapter 3 presents an overview of the City's wastewater facilities within CSD and ESD.
- Chapter 4 presents a description of the methodology used for developing recommended unit generation rates.
- Chapter 5 presents a summary of the wastewater system design criteria used to determine capacity related improvements for wastewater mains, pump stations and major trunk sewers.
- Chapter 6 presents a description of the capacity analysis performed including, evaluation criteria, model selection, development and calibration, capacity analysis, and recommended phased improvements.
- Chapter 7 presents the hydraulic and capacity evaluation for the planning horizons.
- Chapter 8 presents an overview of the City's Operations and Maintenance Program.

- Chapter 9 presents a summary of the asset management and risk analysis.
- Chapter 10 presents a summary of the recommended Capital Improvement Program projects.

1.3 BACKGROUND

The City is located in north San Diego County along a six (6) mile stretch of Pacific coastline. It encompasses approximately twenty (20) square miles and serves a population of approximately 60,000 residents. The City was incorporated in 1986 and brought together the communities of Old Encinitas, New Encinitas, Leucadia, Cardiff-by-the-Sea, and Olivenhain. Within the City boundary, wastewater services are provided by either the Encinitas Sanitary Division (ESD), the Cardiff Sanitary Division (CSD), or Leucadia Wastewater District (LWWD). Generally, CSD provides service to the communities in Cardiff and Olivenhain and also collects flows from portions of the Rancho Santa Fe Community Services District (RSFCSD) and the City of Solana Beach. ESD serves the communities formally known as Old Encinitas and New Encinitas and parts of Leucadia. Figure 1-A illustrates the general location of the City of Encinitas and the boundary for each sanitation division.

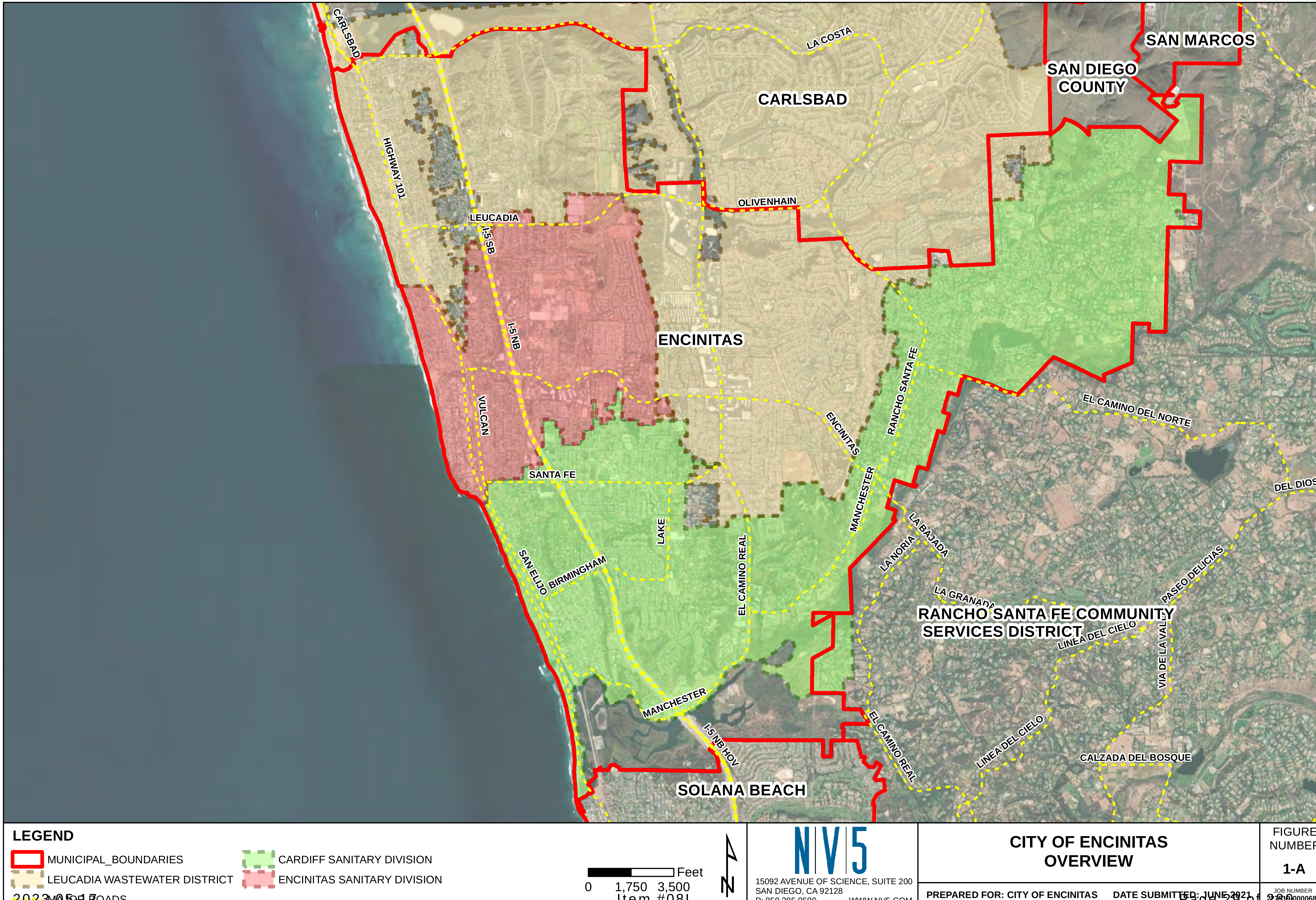
Following incorporation of the City, authority over the formerly owned and operated sanitation districts by the County of San Diego, was transferred to the City and the districts became the ESD and the CSD. The two divisions consist of a total of approximately 122 miles of wastewater mains. CSD includes approximately 82 miles of wastewater pipelines while ESD includes approximately 40 miles. The pipelines range from 6-inches to 15-inches in diameter and consist of vitrified clay pipe (VCP), asbestos cement (AC) pipe, ductile iron pipe (DIP), and polyvinylchloride (PVC) pipe.

Operation and maintenance of the City's four (4) pump stations is contracted to and provided by the San Elijo Joint Powers Authority (SEJPA). Additionally, five (5) trunk sewers serve to convey flows to the City lift stations and ultimately to either the Encina Water Pollution Control Facility (EWPCF) located in Carlsbad or the San Elijo Wastewater Reclamation Facility (SEWRF) located in Cardiff. The trunk sewers include the Encinitas Trunk Sewer, Cardiff Trunk Sewer, Cardiff Relief Trunk Sewer, Cardiff Gravity Trunk Sewer, and the Olivenhain Trunk Sewer. The system also includes four (4) pump stations; three pump stations are located in CSD and the fourth pump station is located in ESD.

The Encinitas City Council makes all decisions regarding the ESD and CSD and appoints elected officials as representatives to sit as voting members on the Encina Wastewater Authority (EWA) Board for treatment and ocean disposal of ESD flows and the SEJPA Board for treatment and ocean disposal of CSD flows.

1.3.1 Cardiff Sanitary Division

The CSD was originally formed to provide collection, transmission and treatment of wastewater for the community of Cardiff-by-the-Sea. CSD serves an 8.3-square mile area and a population of approximately 20,000 residents in the southern and eastern area of the City. Facilities included a small treatment plant near the San Elijo Lagoon, the Cardiff Trunk Sewer, and the associated gravity pipelines. The treatment plant was ultimately replaced with the SEWRF in the 1960s and an ocean outfall was jointly constructed by the CSD and the City of Solana Beach. The Cardiff Pump Station was constructed to pump flows from the Cardiff Trunk Sewer to the SEWRF and a separate gravity pipeline was constructed to convey a portion of Cardiff flows from the east. In 1972, the Olivenhain Pump Station (OPS) was constructed to serve areas further east that are tributary to the San Elijo Lagoon, which include areas of Olivenhain, the City of Solana Beach and RSFCSD.



NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

CITY OF ENCINITAS OVERVIEW

FIGURE NUMBER 1-A

PREPARED FOR: CITY OF ENCINITAS DATE SUBMITTED: JUNE 2021

JOB NUMBER 000000687

The initial reaches of the Olivenhain Trunk Sewer (OTS) were constructed in 1972 along the north side of the lagoon. CSD serves primarily residential units, stores, restaurants, offices, and medical buildings, including a portion of Scripps Hospital. Flows generated within the CSD are collected in one of the following trunk sewer systems:

- Cardiff Trunk Sewer
- Cardiff Relief Sewer
- Cardiff Gravity Trunk Sewer
- Olivenhain Trunk Sewer

The flows are then pumped from one of the three (3) pump stations within the sanitary division or conveyed by gravity to the SEWRF. The three (3) pump stations located within the CSD boundary are operated and maintained by SEJPA and include:

- Coast Boulevard Pump Station
- Cardiff Pump Station
- Olivenhain Pump Station

1.3.2 Encinitas Sanitary Division

The ESD serves a population of approximately 17,000 residents in a 3.0-square mile area in the westerly and central portion of the City. ESD serves primarily residential units with some commercial development in the downtown area. The service area is bounded on the north and east by the Leucadia Wastewater District and on the south and east by the northern boundary of the CSD service area. The ESD service area extends from the Pacific Ocean, approximately one mile inland, and represents approximately 10 percent of the total land area within the City.

The majority of flows generated within the ESD are collected in the Encinitas Boulevard Trunk Sewer and flow to the Moonlight Beach Pump Station. Flows from the Moonlight Beach Pump Station are pumped to the Batiquitos Pump Station which is ultimately pumped together with flow from the Leucadia Wastewater District to the Encina Water Pollution Control Facility (EWPCF). The pump station is operated and maintained by the SEJPA.

1.3.3 Encina Wastewater Authority

The Encina Wastewater Authority (EWA) is a public agency that provides wastewater treatment services to residents located in the north western San Diego County. EWA is a joint powers authority, which was created to serve as the Operator/Administrator of the Encina Joint System and is comprised of six (6) San Diego County wastewater member agencies including: the Buena Sanitation District, City of Carlsbad, City of Encinitas, Leucadia Water District, Vallecitos Water District, and the City of Vista. The agencies are governed by a Joint Powers Agreement in which the owners share the operation and management costs of EWA.

The EWA operates and maintains the EWPCF, Encina Ocean Outfall, a biosolids facility, and two lift stations jointly owned by the cities of Vista and Carlsbad. The EWPCF, which is located in Carlsbad, provides full secondary treatment, sludge handling, and disposal through a deep ocean outfall. Founded in 1961 EWA, currently operates and maintains the Encina Joint Sewerage system consisting of the EWPCF, the Encina Ocean Outfall and Agua Hedionda and Buena Vista Pump Stations.

Each EWA member agency has capacity rights to the EWPCF and Encina Ocean Outfall system. The capacity rights for the City, based on the 2014 Encina Joint Powers Authority Revised Basic Agreement, are 1.80 MGD average daily flow for treatment plant capacity (4.44% of total capacity) and capacity in the outfall (4.16% of total). Peak wet weather flows must remain below a 2.76 peaking factor, or 4.97 MGD. Flows from the City to the Encina WPCF are metered at the discharge of the Moonlight Beach Pump Station force main. Further discussion in provided in subsequent chapters.

1.3.4 San Elijo Joint Powers Authority

The San Elijo Joint Powers Authority's (SEJPA) member agencies include the cities of Encinitas and Solana Beach, and operates the SEWRF and nine (9) wastewater lift stations including the Moonlight Beach, Cardiff, Olivenhain and Coast Pump Stations. The SEWRF treats primarily domestic wastewater and is currently permitted to discharge up to 5.25 MGD of secondary treated water into the Pacific Ocean via the San Elijo Ocean Outfall, and up to 2.48 MGD of tertiary treated wastewater to recycled water users. Additionally, the SEJPA owns and maintains 20 miles of recycled water distribution pipelines and two recycled water reservoirs.

The cities of Encinitas and Solana Beach each have 50 percent interest in the SEWRF. RSFCSD leases 0.25 MGD of capacity, and the remainder is split equally between Encinitas and Solana Beach. The allocation of average daily wastewater flow (ADWF) for the City is therefore 2.5 MGD. Maintenance and operational costs for wastewater treatment and disposal are allocated between member agencies based on average daily flows for the calendar year.

The SEJPA shares ownership in the 30-inch and 48-inch diameter ocean outfall with the City of Escondido. The allocation of the outfall capacity to SEJPA is 21 percent, split 50-50 between Encinitas and Solana Beach, and 79 percent to Escondido. Based on the design outfall capacity of 25.5 MGD, the City of Encinitas is entitled to 2.7 MGD.

1.3.5 Rancho Santa Fe Community Services District

The RSFCSD encompasses the boundaries of the former Rancho Santa Fe Sanitation District and Rancho Santa Fe (Landscape) Maintenance District and provides wastewater collection and treatment services to approximately 2,600 customers. RSFCSD is responsible for the operations of the two dissolved districts and is regulated under the provisions of Section 61000 of the California Government Code (Community Services District Law). The RSFCSD is responsible for the operation of the Santa Fe Water Reclamation Facility and the Santa Fe Valley Water Reclamation Facility. The district's collection system includes the La Granada and Ranch Serena Pump Stations.

The Rancho Santa Fe WRF was originally constructed to serve the approximate 3000 acres of the Santa Fe Valley Specific Plan Area with a capacity of 0.485 MGD. The reclamation facility produces tertiary recycled water which is subsequently sold to the Olivenhain Municipal Water District for golf course irrigation. The south western portion of Rancho Santa Fe is served by San Elijo Water Reclamation Facility.

In 2012 the City of Encinitas and RSFCSD entered into a new agreement which supersedes the original agreement established in 1912 between the two agencies which permits RSFCSD to lease transmission capacity for the long-term conveyance of sewage through the OTS Pump Station and force main. The current agreement entitles RSFCSD to certain rights with regard to discharging wastewater to accommodate approximately 18-20% of the flows through the pump station which originate in the RSFCSD through April 2021. This portion of the wastewater flows generated within the RSFCSD service area are ultimately treated at the SEWRF. As the agreement has expired, the City must consider updating and extending the term of the agreement.

1.3.6 City of Solana Beach

Via the Solana Beach Pump Station located at the north-western most point in the City of Solana Beach, the majority of the wastewater flows generated in the City of Solana Beach are pumped directly to and treated at the San Elijo Water Reclamation Facility. Located in the northeastern portion of Solana Beach is the San Elijo drainage basin. Flows generated from this area within Solana Beach are conveyed to the Olivenhain Pump Station via the San Elijo Hills Pump Station and the siphon that also traverses the San Elijo Lagoon.

1.3.7 Leucadia Wastewater District

The Leucadia Wastewater District (LWD) was originally established in 1959 to provide wastewater collection and treatment services to its 2,700 residents. In 1962 the LWD constructed and began operating the 750,000 gallon per day Forest R. Gafner Water Reclamation Plant. Due to the eventual growth in the service area and population, the LWD joined the Encina Joint Powers Authority in 1971. Currently, the LWD owns approximately 20% of the treatment capacity at Encina's regional treatment plant and presently conveys an average of 4.5 MGD of wastewater flows to the Encina facility.

Since the upgrades to the Gafner Water Reclamation Facility in 1993 to meet regulatory standards for recycled water production, the LWD now pumps secondary treated effluent from the Encina plant to the Gafner facility where it produces up to 86 million gallons of recycled water per year which is used to irrigate the Omni La Cost Resort & Spa Golf Course.

LWD currently provides service to approximately 60,000 residents in a 16 square miles boundary that includes the original service area in Leucadia and portions of the cities of Carlsbad and northern Encinitas. According to a previous studies, the Batiquitos Pump Station conveys flows from both the LWD and the City of Encinitas where the LWD owns approximately 78% of the pump station and the City of Encinitas owns approximately 22%.

1.4 REGULATORY REQUIREMENTS

On May 2, 2006, the State Water Resources Control Board (SWRCB) adopted Order 2006-0003, the Statewide General Waste Discharge Requirements (WDRs) for Sanitary Sewer Systems, which requires all federal and state agencies, municipalities, counties, districts, and other public entities that own or operate a sanitary wastewater system greater than one (1) mile in length to comply with the elements of the WDRs. The WDRs serve to provide a unified statewide approach for reporting and tracking Sanitary Sewer Overflows (SSO), establishing consistent and uniform requirements for Sewer System Management Plan (SSMP) development and implementation, establishing consistency in reporting, and facilitating consistent enforcement for violations. Additionally, the WDRs require that the SSMP include directives for owners and operators of wastewater systems to demonstrate effective and efficient management, operation and maintenance of the sanitary sewer system.

In 2008, the SWRCB issued Order No. WQ 2008-0002-EXEC to address deficiencies in the notification procedures that were originally included in the General WDR Monitoring and Reporting Program (MRP). The 2008 Order included amending the MRP requirements of the WDRs to address timely notifications of SSOs discharged to waters of the State and ensure first responders are notified in a timely manner. Subsequently, Order No. WQ 2013-0058-EXEC was issued to address compliance and enforceability of the MRP and include a definition of a Category 3 SSO to the already defined Category 1 and Category 2.

Via a Memorandum of Agreement (MOU), the State Water Board collaborated with the California Water Environment Association (CWEA) to develop appropriate training courses for the Sanitary Sewer System WDR Program and to redesigning the CIWQS Online SSO Database to incorporate revisions associated with the additional executive orders.

The City recognizes the importance of preventing sewage spills for the mutual protection of it surface waters and the overall environment to safeguard public health and safety. In compliance with the State WDRs, the City prepared an SSMP that includes various plans and programs that are reflective of the City's existing processes and procedures pertaining to its wastewater collection system. In compliance with the WDR's, the City recently completed its internal audit of its SSMP in December 2019. The City's Public Works Department SSMP includes all of the eleven (11) WDR elements including a summary of the required changes and updates The SSMP is available on the City's website and includes detailed information demonstrating the City's efforts to comply with each of the mandatory and applicable elements required.

1.4.1 Impending Sewer Regulatory Issues

The SWRCB is currently considering implementing updates to the 2006 WDR Order. Organizations such as California Association of Sanitation Agencies continue to monitor the situation and address concerns with SWRCB in a direction that is aligned with the interests of wastewater agencies. Updates being considered include better alignment of the 2-Year Audit and the 5-Year SSMP Recertification Requirements, as well as efficiencies to maximize value for cost of compliance. The following new requirements are being considered:

- Monitoring and measuring the effectiveness of each SSMP element;
- Identifying and illustrating SSO trends. This should include SSO frequencies, locations, and volumes;

- Additional guidelines on the expected timing and content of the change log;
- Additional guidelines on frequency of review and definition of significant change for updating the SSMP;
- The addition of planning requirements for present and future climate change impacts on wastewater system operations such as water conservation, drought, high intensity rain events and sea level rise;
- Improved quality of data in California Integrated Water Quality System; and
- Regulations for larger private collection systems.

As the State continues to evaluate and determine the revisions to the WDRs, the City continues to monitor the status as the requirements may potentially affect several City programs and the data required to be documented and collected. As well, the City's SSMP will need to be updated to reflect the requirements.

1.5 ASSET MANAGEMENT

In 2015, the City prepared a comprehensive citywide wastewater asset management plan in its continued effort to systematically operate and maintain its wastewater collection infrastructure. The asset management plan served to identify and plan for future infrastructure needs. Estimated costs of the planned improvements supported development of wastewater rates to allow for recovery of capital, operations, and maintenance costs for providing the necessary services. The plan also served to assist the City in developing a long-range plan and financial framework for the City's operating and capital budgets and provide guidance for the efficient management of the City's wastewater system assets.

The City developed a wastewater asset management plan to proactively maintain an acceptable level of service at the lowest life-cycle costs for its wastewater collection system assets. The plan contains a summary of the City's wastewater system assets, identified recommended capital improvements, and the estimated associated costs. Development of the plan included an evaluation of the wastewater collection system in its existing condition, recommendations for repair, rehabilitation or replacements based on a projected useful life, and provided a plan for implementing the improvements.

Generally, to maintain long-term sustainability of the City's wastewater utilities, the asset management plan served to allow the City to:

- Plan and make informed investment decisions;
- Improve emergency response;
- Increase knowledge of asset criticality;
- Improve operational efficiency;
- Establish wastewater rates based on operational information;
- Identify capital improvement projects to meet the system needs;
- Demonstrate committed stewardship of City assets.

As the City implements its ongoing efforts to capture, document and update information pertaining to it wastewater assets, and with development of the risk assessment methodology presented in this Master Plan Update, the City can refine its approach to:

- Prioritize inspections, maintenance and repairs
- Reduce the occurrences of emergency repairs
- Extend asset service life
- Meet customer demands with system sustainability
- Minimize cost of operating, maintaining, and renewing assets
- Prioritize its resources toward sustaining the performance of assets
- Facilitate development of funding plans.

2.0 STUDY AREA

This chapter provides a description of the Master Plan study area including:

- Potential impacts to the existing wastewater system;
- Existing and planned land uses;
- Existing and projected populations;
- Physical attributes of the wastewater system; and
- Regional sewage facilities serving the City.

2.1 STUDY AREA OVERVIEW

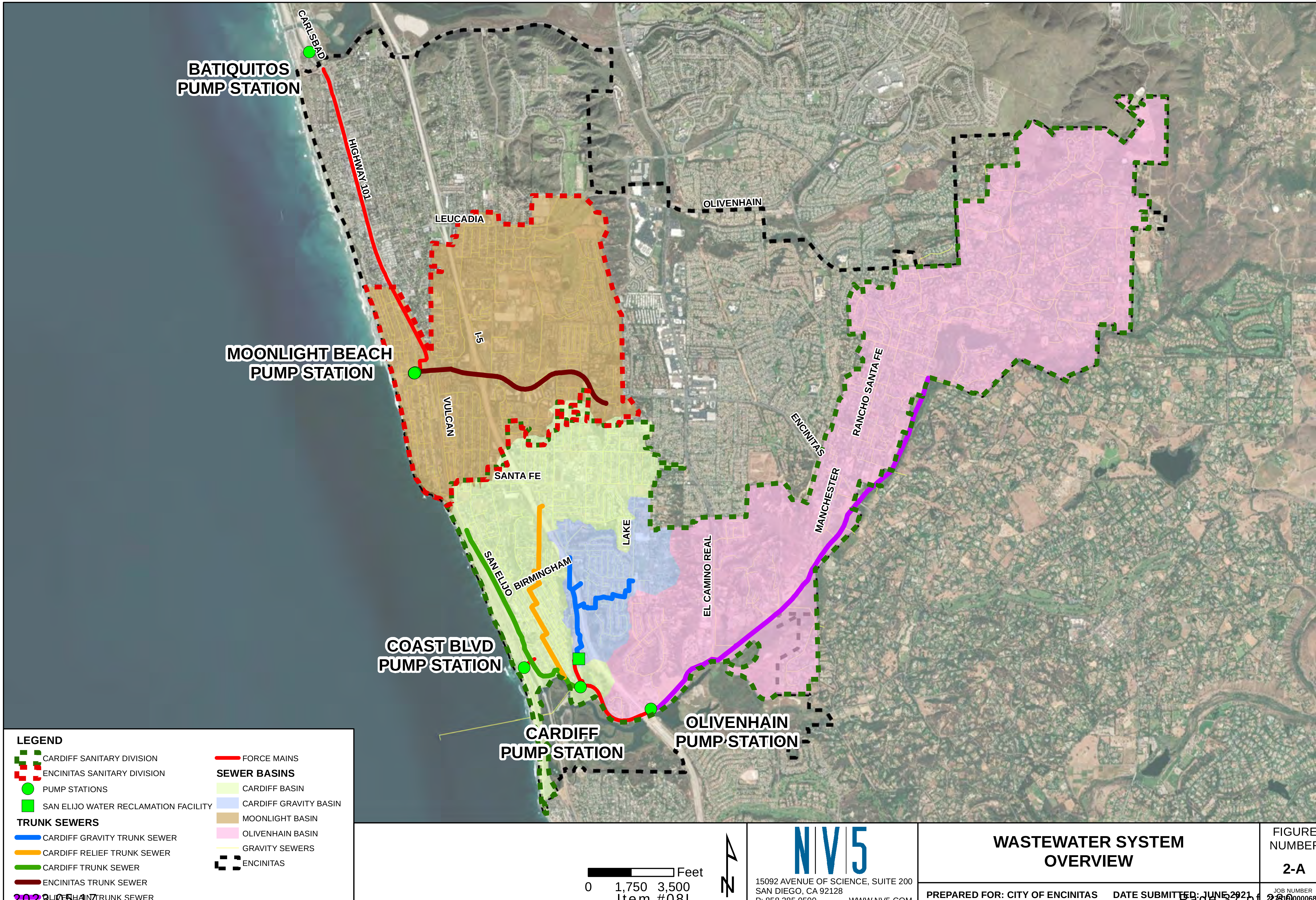
The (City) is a beach city located in the North County area of San Diego County, California. It is approximately 25 miles north of downtown San Diego with a population of approximately 60,000 residents. The City sits along Coast Highway 101 and is bordered by the Batiquitos Lagoon on the north and the San Elijo Lagoon on the south. The City has a total area of approximately 20.0 square miles with elevations ranging between sea level to over 500 feet above sea level and an average annual precipitation is 10 inches, with most of the rainfall occurring between the months of November and March.

The study area encompasses the ESD and CSD. The CSD service area within the City includes the southern and southeastern portions of the City. Elevations range from sea level along the coast to over 500 feet in the northeastern corner of the service area. The system drains towards the Escondido Creek and San Elijo Lagoon. Areas south of the City limits also drain to San Elijo Lagoon, and some of these areas discharge wastewater to portions of the CSD collection system. The boundaries of the CSD and its relationship to other wastewater service districts were illustrated on Figure 1-A.

The ESD service area lies entirely within the boundary of the City, primarily along the coast as shown previously in Figure 1-A. The service area covers approximately 2.9 square miles and is bounded on the north and east by the LWD and on the south and east by the CSD service area. The ESD service area extends from the Pacific Ocean approximately 1 mile inland and represents about 10 percent of the total land areas within the City. While the LWD does cover a large portion of the City, it is not included in this Master Plan Update as the City is not responsible for its planning or maintenance.

The CSD service area also lies entirely within the City boundary and is located along the southerly and easterly portion of the City. The service area includes approximately 12 square miles and is bounded on the north by the LWD and the City of Carlsbad and on the east by the County of San Diego and RSFCSD.

Both sanitary divisions collect and convey sewage to regional treatment facilities. CSD flows are treated at the SEWRF which is operated by the San Elijo Joint Powers Authority (SEJPA) with a capacity of 2.5 MGD owned by the City. ESD flows are treated at the Encina Water Pollution Control Facility (EWPCF) which is operated by the Encina Wastewater Authority (EWA). Figure 2-A illustrates the boundary of each sanitary division and several of the main trunk sewers that convey the flows for treatment.



NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

WASTEWATER SYSTEM OVERVIEW

FIGURE NUMBER 2-A

PREPARED FOR: CITY OF ENCINITAS DATE SUBMITTED: JUNE 2021

JOB NUMBER [illegible]-0000687

2.1.1 City of Encinitas Sewer Basins

The ESD and CSD service area is generally comprised of four (4) wastewater basins which drain from the north and north-eastern service area boundaries towards the west to the coast. General descriptions of the wastewater drainage basins, which align with the gravity trunk sewer alignments as illustrated in Figure 2-A, are provided below. The wastewater drainage basins were delineated with the development of the updated, more comprehensive, wastewater system model to include the City's entire wastewater collection system.

Encinitas Sewer Basin

Flows within the Encinitas Sewer Basin are conveyed to the Moonlight Pump Station via the Encinitas Trunk Sewer. The basin encompasses approximately 1,896 acres and includes a population of approximately 13,267 residents, which is equivalent to approximately 5,307 dwelling units. The length of wastewater mains within the basin is approximately 28,461 feet with diameters ranging from 6-inches to 15-inches and with installation dates as early as 1951.

Cardiff Gravity Sewer Basin

Wastewater flows in the Cardiff Gravity Sewer Basin are conveyed to the SEWRF via the Cardiff Gravity Trunk Sewer. This basin encompasses approximately 453 acres and serves an estimated population of 2,199 people, which is equivalent to approximately 880 dwelling units. The length of sewer mains within the basin is approximately 1,326 feet with diameters ranging from 4-inches to 10-inches, and with installation dates as early as 1957.

Cardiff Sewer Basin

Flows within the Cardiff Sewer Basin are conveyed via two (2) trunk sewers including the Cardiff Trunk Sewer and the Cardiff Relief Trunk Sewer. The sewer basin encompasses approximately 1,247 acres. The estimated population is 9,296 residents, which is equivalent to approximately 3,718 dwelling units. The length of sewer mains within the basin is approximately 46,536 feet with diameters ranging from 4-inches to 15-inches, and installation dates as early as 1959.

Cardiff Relief Trunk Sewer: The Cardiff Relief Trunk Sewer originates to the east of I-5, at the intersection of Loch Lomond Drive and Ocean Drive, ranges in diameter from 10-inches to 12-inches and is approximately 8,340 feet in length. The trunk sewer continues south until in converges with the Cardiff Trunk Sewer at the intersection of San Elijo Avenue and Manchester Avenue.

Cardiff Trunk Sewer: Flows from the Cardiff Trunk Sewer flows into the Cardiff Pump Station and flows are then pumped to the SEWRF.

Olivenhain Trunk Sewer Basin

Flows originating in the Olivenhain Sewer Basin are conveyed to the Olivenhain Pump Station via the Olivenhain Trunk Sewer. The sewer basin encompasses approximately 3,631 acres and conveys flows from the estimated population of 8,129 residents, which is the equivalent of approximately 3,252 dwelling units. The length of sewer pipelines within the basin is approximately 58,827 with diameters ranging between 4-inches to 15-inches and with installation dates as early as 1968. Flows from several unincorporated areas associated with the RSFCSD and LWD also discharge into the OTS. Additional information is included in Chapter 3.

The Olivenhain Trunk Sewer originates at the intersection of Wiegand Street and Lone Jack Road, ranges in diameter from 8-inches to 15-inches in diameter and is approximately 27,110 feet in length. The City has prepared plans for the Olivenhain Trunk Sewer Improvements Project, which includes the upsizing of approximately 2,670 feet of the Olivenhain Trunk Sewer from 8-inches to 15-inches in diameter from Lone Jack Road between El Camino Del Norte and Crystal Ridge Road. Additionally, the improvements include lining of several manholes and the removal of a siphon between manholes 1286 and 1287.

2.2 GENERAL LAND USE

The Encinitas General Plan (General Plan) was originally adopted in 1989, under Resolution No. 89-17. The General Plan was developed to guide the City with implementation of its long term growth and land development goals. The General Plan includes the City's policies necessary to accommodate the City's anticipated short and long term growth while protecting its environmental, social, cultural and economic resources. Based on available City information, a comprehensive update of the General Plan was last performed in 2013.

The Housing Plan Update was prepared in 2019 and includes the 2013-2021 Housing Element Update also includes plans to implement the Housing Plan Update

The General Plan has continuously been updated to include specific elements, including Land Use, Housing, Circulation, Public Safety, Resource Management (Open Space and Conservation, Recreation and Noise, all of which satisfy the content of State General Plan law. Also included are the goals, policies, provisions and standards to guide in meeting the requirements.

2.3 EXISTING LAND USE

Existing land uses within the City boundary are based on the City's Geographic Information System (GIS) general plan land use layer and primarily includes residential with open space, some agricultural, commercial and minimal industrial and mixed use. Table 2-A includes a summary of the existing land uses within the City boundary.

Table 2-A Encinitas Land Use Summary

Land Use	City Acres	% of Total Area
Single Family Residential	9,127	72.8%
Multi Family Residential	115	0.9%
Commercial	645	5.1%
Industrial	29	0.2%
Agricultural	110	0.9%
Mixed Use	62	0.5%
Community Use	669	5.3%
Open Space	1,342	10.7%
Transportation Corridor	437	3.5%
TOTAL	12,536	100.0%

The following sections include a summary of the land use types by sanitation division. The LWD makes up the balance of the City's land acreage.

2.3.1 CSD Land Use

Existing land uses within CSD are listed in Table 2-B. The service area includes predominantly residential area. Illustrated in Figure 2-B is the general land use for CSD.

Table 2-B CSD Land Use Summary

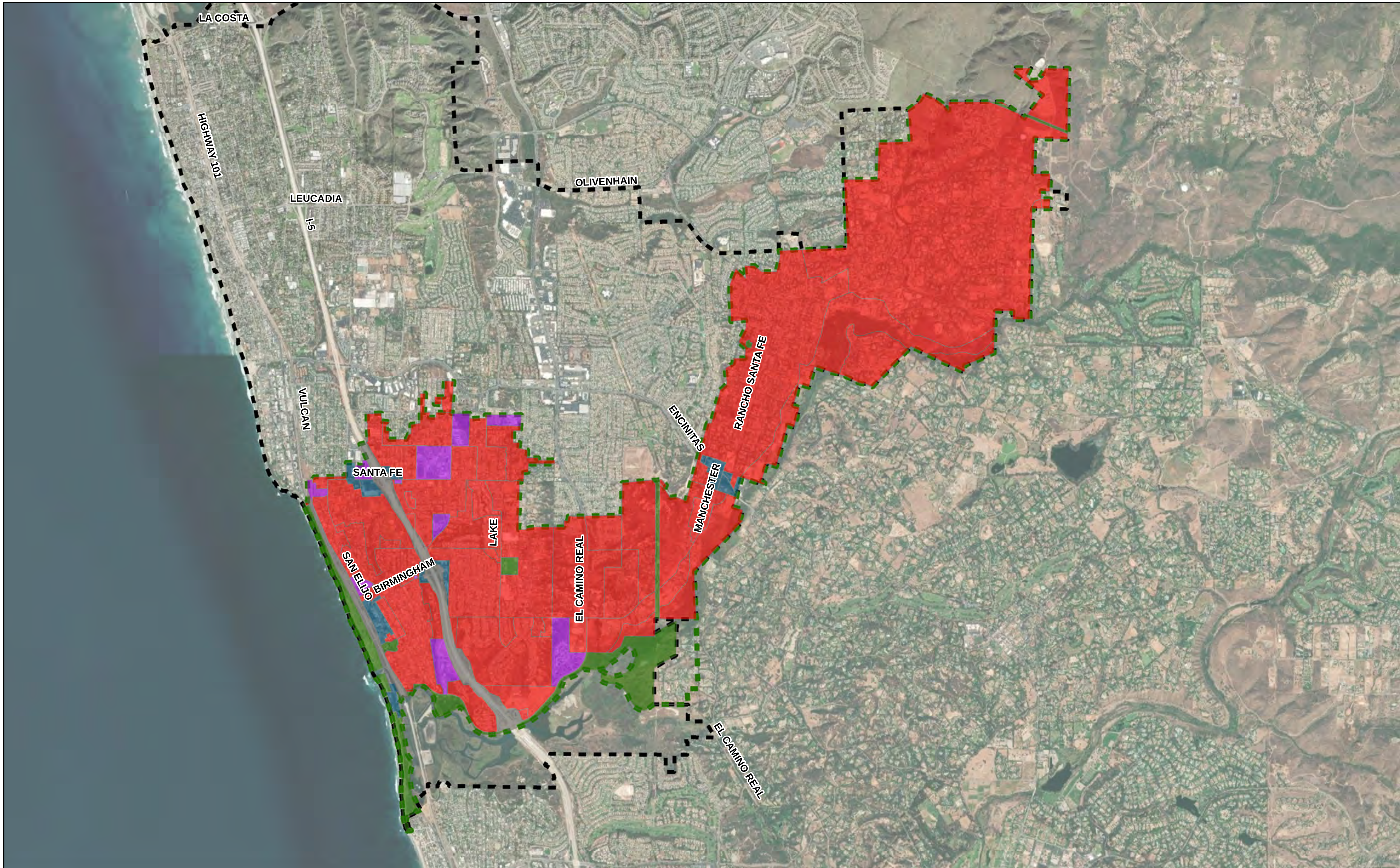
Land Use	City Acres	CSD Acres	% of Total City Acres	% of CSD Total Area
Single Family Residential	9,127	4,489	35.8%	85.8%
Multi Family Residential	115	-	0.0%	0.0%
Commercial	645	90	0.7%	1.7%
Industrial	29	-	0.0%	0.0%
Agricultural	110	-	0.0%	0.0%
Mixed Use	62	-	0.0%	0.0%
Community Use	669	185	1.5%	3.5%
Open Space	1,342	291	2.3%	5.6%
Transportation Corridor	437	175	1.4%	3.3%
TOTAL	12,536	5,230	41.7%	100.0%

2.3.2 ESD Land Use

Existing land uses within ESD are listed in Table 2-C. Similar to CSD, the service area includes predominantly residential area. Illustrated in Figure 2-C is the general land use for ESD.

Table 2-C ESD Land Use Summary

Land Use	City Acres	ESD Acres	% of Total City Acres	% of ESD Total Area
Single Family Residential	9,127	1,065	8.5%	55.8%
Multi Family Residential	115	65	0.5%	3.4%
Commercial	645	167	1.3%	8.8%
Industrial	29	29	0.2%	1.5%
Agricultural	110	102	0.8%	5.4%
Mixed Use	62	14	0.1%	0.7%
Community Use	669	266	2.1%	13.9%
Open Space	1,342	90	0.7%	4.7%
Transportation Corridor	437	109	0.9%	5.7%
TOTAL	12,536	1,906	15.2%	100.0%



LEGEND

LAND USE

- SINGLE FAMILY RESIDENTIAL
- MULTI FAMILY RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- AGRICULTURAL
- MIXED USE
- COMMUNITY USE
- OPEN SPACE
- TRANSPORTATION CORRIDOR
- CARDIFF SANITARY DIVISION
- ENCINITAS

NV5

15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

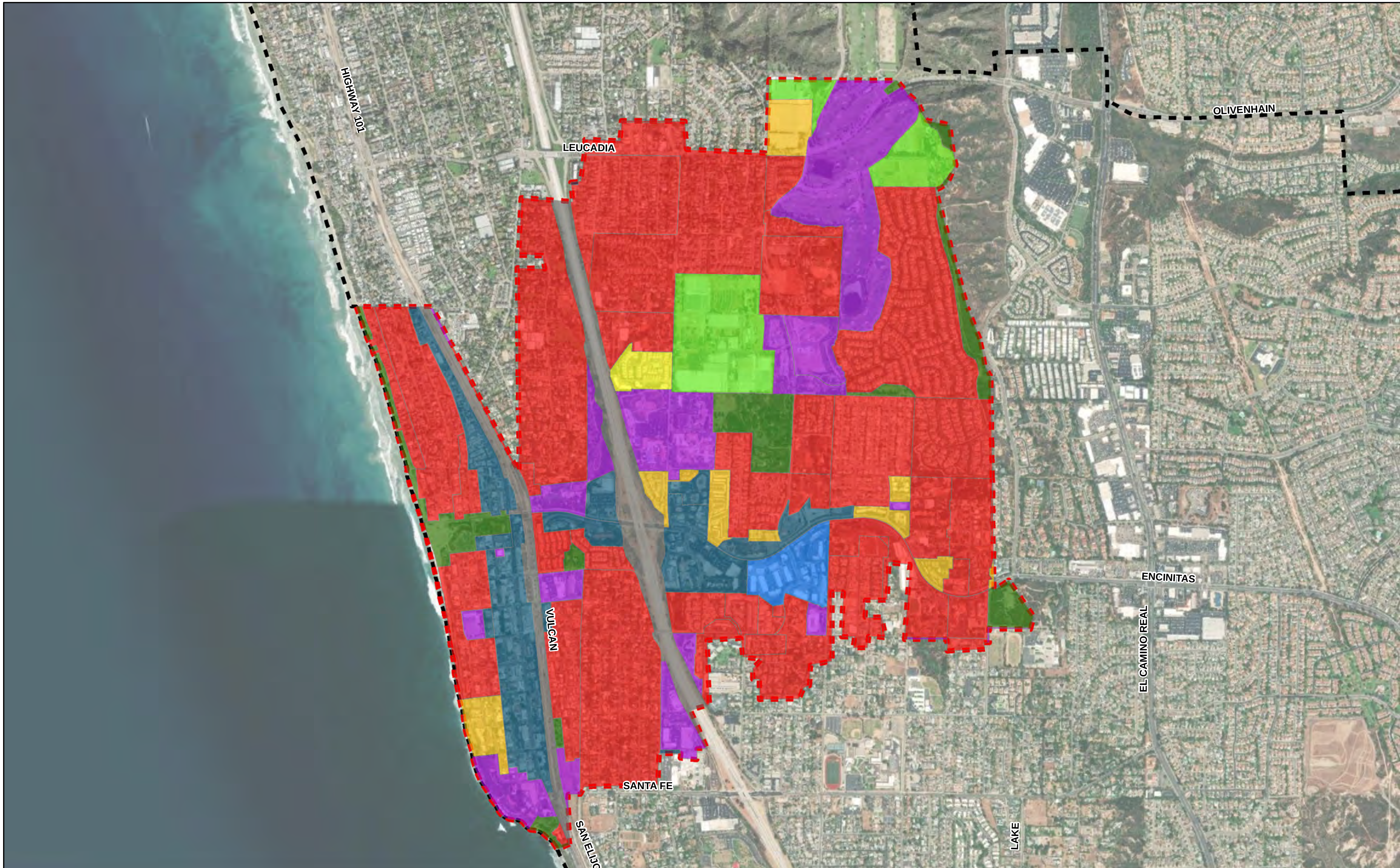
CSD LAND USE OVERVIEW

PREPARED FOR: CITY OF ENCINITAS

DATE SUBMITTED: JUNE 2021

FIGURE NUMBER 2-B

JOB NUMBER 226-0000687



LEGEND

LAND USE

- SINGLE FAMILY RESIDENTIAL
- MULTI FAMILY RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- AGRICULTURAL
- MIXED USE
- COMMUNITY USE
- OPEN SPACE
- TRANSPORTATION CORRIDOR
- ENCINITAS SANITARY DIVISION
- ENCINITAS

Feet: 0 750 1,500

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

ESD LAND USE OVERVIEW

FIGURE NUMBER **2-C**

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER 227819-0000687

2.4 EXISTING AND FORECASTED POPULATIONS

Residential population projections for the study area were obtained from the San Diego Association of Governments (SANDAG) for the years 2012, 2020, 2035, and 2050 based on the Series 13: 2050 Regional Growth Forecast. Using the SANDAG Series 13, projected growth rates based on future land use plans prepared by the various municipalities within San Diego County, population projections can be made.

The SANDAG Regional Growth Model develops their existing estimates from data provided by the United States Census Bureau, the San Diego County Assessor, local jurisdictions, and the California Department of Finance.

The series incorporates SANDAG defined population; housing and employment growth rates and applies them at a transportation analysis zone (TAZ) level to account for spatial variability. SANDAG maintains two sets of TAZ data for the Regional Transportation Plan (2012-2050) along with socioeconomic data for the region. Within each TAZ, SANDAG has derived spatial data relating to population, housing, and employment under current conditions, and developed projections for the years 2012, 2020 2035, and 2050. This detailed and comprehensive dataset was used for this Master Plan Update project. A summary of the SANDAG data for the CSD and ESD is provided in Appendix 1.

Since the population estimates are originally grouped by TAZ, and TAZ areas overlap into one or more sanitary divisions, a weighted average was used to calculate the population numbers for each sanitary division. Based on the forecasted populations according to SANDAG information, populations within CSD and ESD are expected to grow by approximately 10% and 9% respectively, between 2020 to 2050. Table 2-D includes a summary of the residential population projections through 2050.

Table 2-D Forecasted Residential Populations

Sanitary Division	2012 Residential Population	2020 Residential Population	2035 Residential Population	2050 Residential Population
Cardiff Sanitary Division	18,496	19,625	20,812	21,507
Encinitas Sanitary Division	12,393	13,267	14,407	14,421
TOTAL	**31,339**	**32,892**	**35,219**	**35,928**

2.4.1 Housing Plan Update 2019

The City prepared the 2019 Housing Plan Update in response to an order of the San Diego Superior Court issued in December 2018. The Housing Plan Update is intended to provide the City with a coordinated and comprehensive plan for promoting and developing safe and affordable housing for the Encinitas community.

As part of the 2019 Housing Plan Update analysis, the City evaluated the availability of infrastructure from a citywide and site-specific standpoint. Included in Appendix C of the Housing Plan Update, is a summary of the site inventory and analysis of sites proposed to meet the City Regional Housing Needs Assessment (RHNA) allocation for the planning period of 2013-2021.

To determine the feasibility of sites to accommodate the City's RHNA needs, availability of infrastructure provisions was a determining factor. The analysis served to verify the City has adequate water and sewer capacity to accommodate the planned increase in housing developments. The designated sites were evaluated to determine the designated income category was adjacent to a public street that contains appropriate distribution facilities for water, sewer, and dry utilities (including cable and telephone). It was determined that the availability and location of water, sewer and dry utilities and their distribution facilities do not pose a constraint to development.

2.4.2 Employment

The City's Fiscal Year 2019 Comprehensive Annual Finance Report estimates a total of 34,745 employees within the City with annual visitors averaging about 3 million. Described in further detail in Chapter 4.0 to determine projected growth rates, SANDAG Series 13:2050 Regional Growth Forecast takes into account the future land use plans developed by municipalities within San Diego County. The series incorporates SANDAG defined population, housing and employment growth rates and applies them at a transportation analysis zone (TAZ) level to account for the spatial variability. Within each TAZ, SANDAG derived spatial data to include for population, housing, and employment under existing conditions, and developed projections for the years 2020 and 2050.

The job forecasts for the City based on the Series 13: 2050 Regional Growth Forecast is summarized in Table 2-E. Flows are further analyzed in non-residential wastewater loads are discussed in more detail in Chapter 4.0.

Table 2-E City of Encinitas Employment Forecast

Sanitation Division	2020 Jobs	2035 Jobs	2050 Jobs
Cardiff Sanitary Division	5,924	6,203	6,469
Encinitas Sanitary Division	6,817	7,075	7,261
TOTAL	12,741	13,278	13,729

3.0 SUMMARY OF WASTEWATER ASSETS

The following section includes a description and summary of the City's wastewater facilities within CSD and ESD. The facilities include trunk sewers, manholes, pump stations and the wastewater treatment facilities that serve the sanitation divisions.

Information pertaining to the characteristics of the existing wastewater collection system was obtained primarily from the City's GIS, previously prepared reports and studies, and input from City staff. Information obtained from the GIS included, but was not limited to, characteristics pertaining to pipelines, cleanouts, and laterals. Generally, the records for the sewer pipelines included:

- Facility ID
- Location
- Install Date
- Pipe Length
- Pipe Diameter
- Pipe Material
- Division

The following includes a summary of the City's system assets and characteristics for each sanitation division based on the information obtained from the GIS and City staff.

3.1 CARDIFF SANITATION DIVISION

The wastewater collection system within the CSD was constructed during the 1960s and 1970s. The residential and commercial area located west of the Interstate 5 (I-5) interchange at Manchester Avenue, along Manchester Avenue to the eastern most boundary of the sanitation division to approximately El Camino Del Norte Avenue, consists primarily of Vitrified Clay Pipe (VCP) and was constructed in the 1970s. The collection system located east of Lake Drive consists primarily of PVC pipe and was constructed during the 1980s, 1990s, and 2000s. According to the database records, approximately 18,935 linear feet (3.6 miles) has been constructed since the last master plan was prepared in 2011. A general summary of the CSD wastewater collection system by the decade of installation, number of segments, and the approximate length of pipe is summarized in Table 3-A.

Table 3-A CSD Sewers by Installation Year

Installation Year	Number of Segments	Feet	Miles	% of Total CSD Footage
1950 to 1959	33	6,132	1.16	1.4%
1960 to 1969	564	133,404	25.26	30.8%
1970 to 1979	325	77,200	14.62	17.8%
1980 to 1989	341	74,699	14.15	17.2%
1990 to 1999	374	76,820	14.55	17.7%
2000 to 2009	191	32,857	6.22	7.6%
2010 to 2019	132	14,699	2.78	3.4%
Unknown	111	17,881	3.39	4.1%
TOTAL	2,071	433,692	82.13	100.0%

Included in Table 3-B is a summary of the CSD collection system by material, the number of pipe segments, and the approximate length of pipe associated with the material type. Information presented in Table 3-A and Table 3-B is illustrated graphically in and Figure 3-B, respectively.

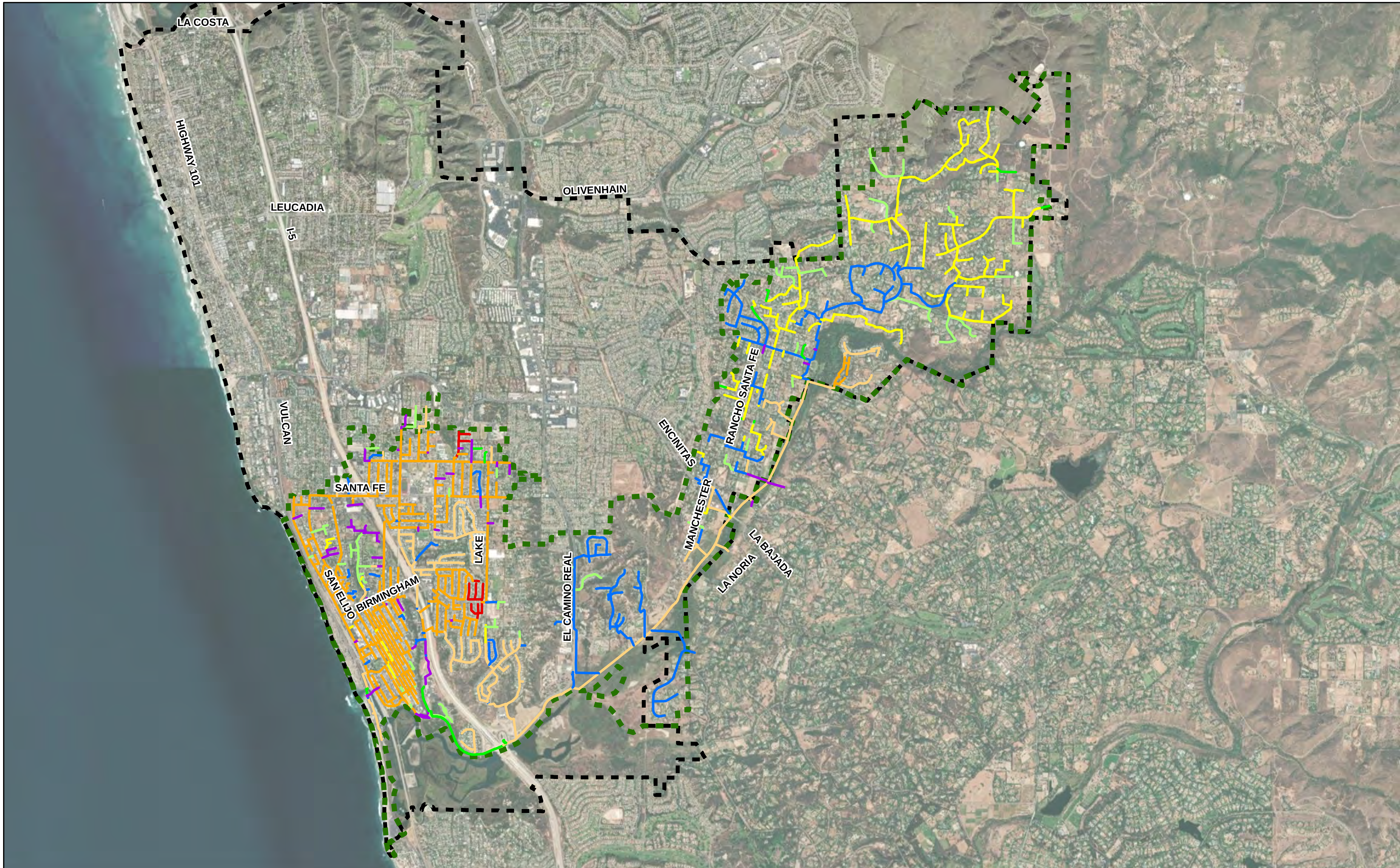
Table 3-B CSD Sewers by Material

Pipe Material	Number of Segments	Feet	Miles	% of Total CSD Footage
Asbestos Cements (AC)	2	129	0.02	0.0%
Concrete (CON)	1	426	0.08	0.1%
Ductile Iron (DI)	9	2,571	0.48	0.6%
Extra Strength Vitrified Clay (ESVC)	21	4,336	0.82	1.0%
Polyvinyl Chloride (PVC)	1,081	206,692	39.15	47.7%
Reinforced Concrete (RCON)	2	718	0.14	0.2%
Vitrified Clay (VC)	941	217,177	41.13	50.1%
Unknown	13	1,312	0.25	0.3%
Other	1	331	0.06	0.1%
TOTAL	2,071	433,692	82.13	100.0%

Generally, pipelines within the CSD system range from 4-inches to 15-inches in diameter with the majority of the pipelines being 8-inches. The CSD sewer pipelines categorized by pipe diameter are illustrated in Figure 3-C. The discrepancy in length appears to be due to some data not included in the GIS files.

Table 3-C CSD Sewers by Pipe Diameter

Pipe Diameter (inches)	Number of Segments	Feet	Miles	% of Total CSD Footage
6	92	15,936	3.02	3.7%
8	1,689	363,183	68.78	84.3%
10	64	13,280	2.52	3.1%
12	19	5,790	1.10	1.3%
14	97	10,078	1.91	2.3%
15	72	21,825	4.21	5.2%
Unknown	8	313	0.05	0.1%
TOTAL	2,041	430,405	81.51	100.0%



LEGEND

SEWER - INSTALLATION YEAR

UNKNOWN
1950s
1960s
1970s
1980s
1990s
2000s
2010s
CARDIFF SANITARY DIVISION
ENCINITAS

Feet
0 1,750 3,500

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

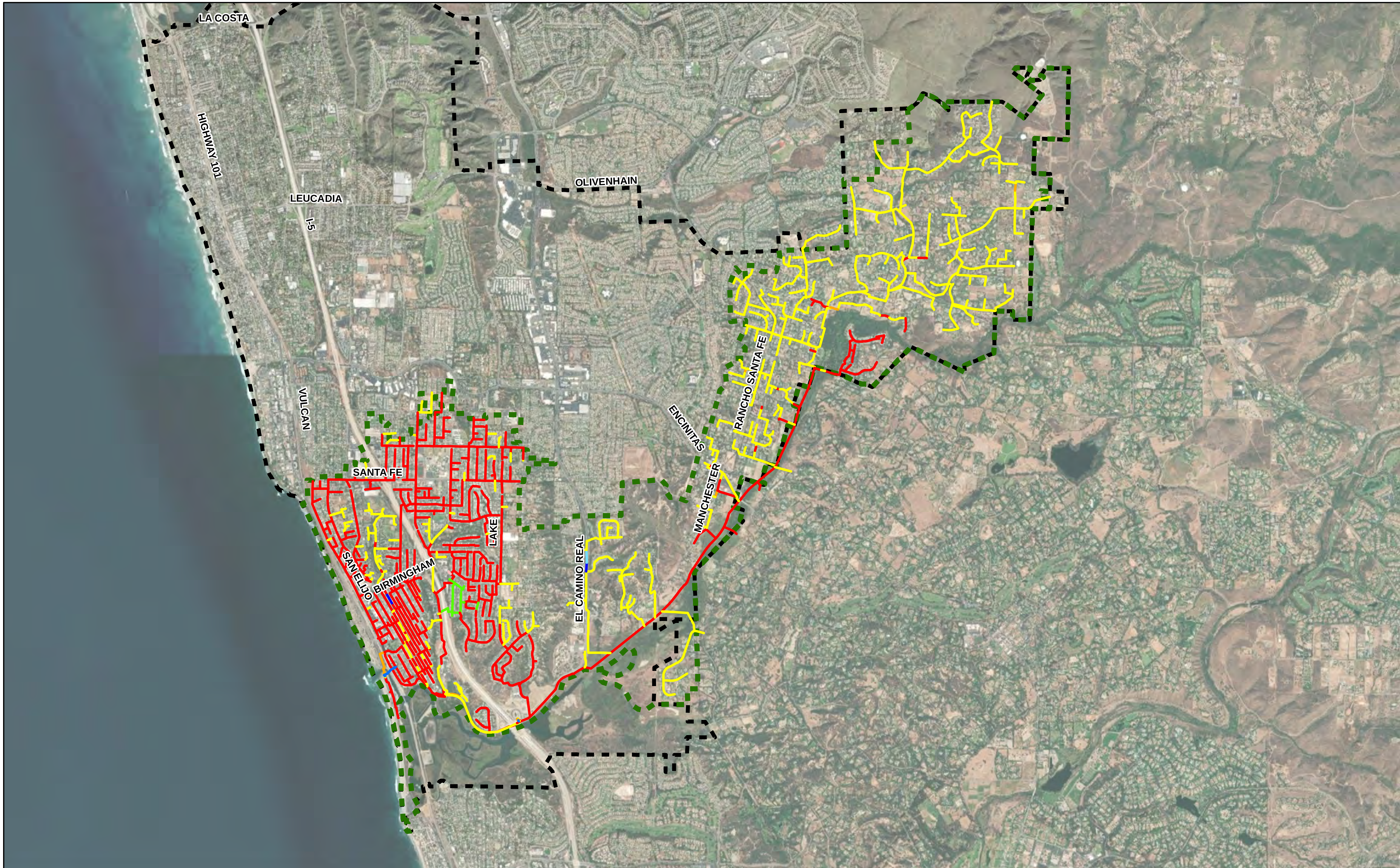
CSD SEWER
INSTALLATION YEAR

PREPARED FOR: CITY OF ENCINITAS

DATE SUBMITTED: JUNE 2021

FIGURE NUMBER
3-A

JOB NUMBER
226000000687



LEGEND

SEWER - PIPE MATERIAL

- OTHER
- ASBESTOS CEMENT
- CONCRETE
- DUCTILE IRON
- EXTRA STRENGTH VITRIFIED CLAY
- POLYVINYL CHLORIDE
- REINFORCED CONCRETE
- VITRIFIED CLAY
- UNKNOWN
- CARDIFF SANITARY DIVISION
- ENCINITAS

Feet
0 1,750 3,500

N

NV5

15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

CSD SEWER PIPE MATERIAL

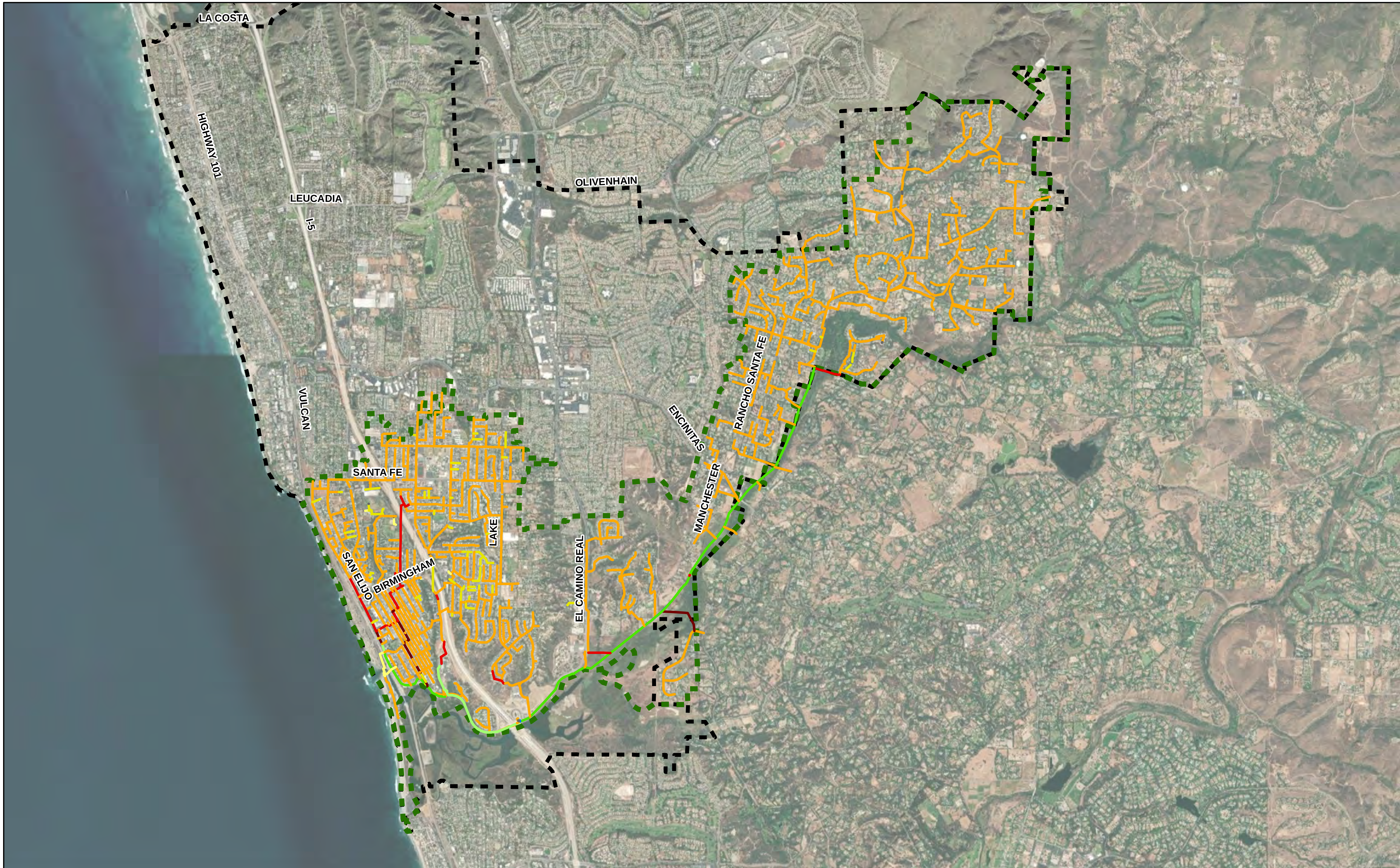
FIGURE NUMBER

3-B

PREPARED FOR: CITY OF ENCINITAS

DATE SUBMITTED: JUNE 2021

JOB NUMBER
[illegible]0000687



LEGEND

conduit_change pipe size

GRAVITY SEWER - PIPE DIAMETER

UNKNOWN DIAMETER
4-IN
6-IN
8-IN
10-IN
12-IN
14-IN
15-IN
18-IN
20-IN
30-IN

CARDIFF SANITARY DIVISION
ENCINITAS

Feet
0 1,750 3,500

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

CSD SEWER PIPE DIAMETER

FIGURE NUMBER
3-C

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER
227519-0000687

2023-05-17
Item #08I

3.2 ENCINITAS SANITATION DIVISION

The wastewater collection system within the ESD was initially constructed in the 1950s and consists primarily of Vitrified Clay Pipe (VCP), including extra strength VCP (ESVCP). Development continued eastward during the 1960s and 1970s, and also included use of VCP.

The pipelines constructed in the 1950s are concentrated in the residential and commercial areas located west of Coast Highway 101 (Hwy 101) and primarily consist of VCP. A small area east of Hwy 101, situated along the northern most edge of the ESD boundary and located north of Union Street, east of I-5, south of Leucadia Boulevard and west of Quail Gardens Drive was also constructed during the 1950s and consists of VCP. Generally, the pipelines located between Hwy 101 and I-5 were constructed of VCP in the 1960s and 1970s. Although there are some additional VCP pipelines in various areas of ESD, the remainder of the system consists primarily of PVC pipe and was constructed during the 1990s and 2000s.

A general summary of the ESD wastewater collection system by the decade of installation, number of segments, and the approximate length of pipe is included in Table 3-D.

Table 3-D ESD Sewers by Installation Year

Installation Year	Number of Segments	Feet	Miles	% of Total ESD Footage
1950 to 1959	237	57,804	10.95	27.7%
1960 to 1969	109	23,264	4.41	11.1%
1970 to 1979	177	39,980	7.57	19.1%
1980 to 1989	39	5,870	1.11	2.8%
1990 to 1999	81	16,056	3.04	7.7%
2000 to 2009	239	46,697	8.84	22.4%
2010 to 2019	73	11,154	2.11	5.3%
Unknown	53	8,036	1.52	3.8%
TOTAL	**1,008**	**208,861**	**39.55**	**100.0%**

Table 3-E includes a summary of the ESD collection system by material, the number of pipe segments, and the approximate length of pipe associated with the material type. Information presented in Table 3-D and Table 3-E is illustrated graphically in Figure 3-D and Figure 3-E, respectively.

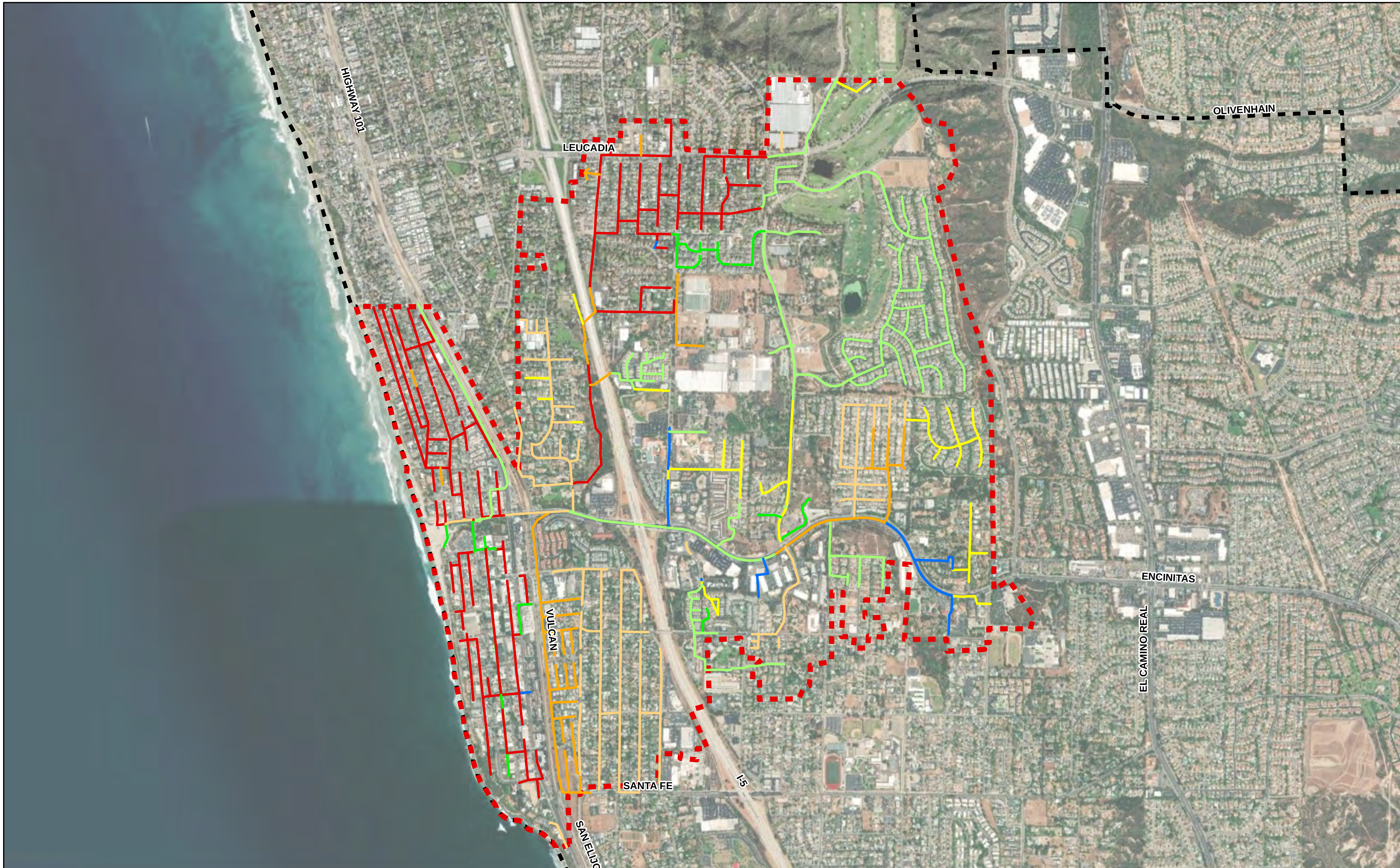
Table 3-E ESD Sewers by Material

Pipe Material	Number of Segments	Feet	Miles	% of Total ESD Footage
Asbestos Cements (AC)	0	-	0.00	0.0%
Concrete (CON)	0	-	0.00	0.0%
Ductile Iron (DI)	14	1,578	0.30	0.8%
Extra Strength Vitrified Clay (ESVC)	69	15,079	2.86	7.2%
Polyvinyl Chloride (PVC)	409	76,333	14.45	36.5%
Reinforced Concrete (RCON)	0	-	0.00	0.0%
Vitrified Clay (VC)	508	114,592	21.70	54.9%
Unknown	2	171	0.03	0.1%
Other	6	1,109	0.21	0.5%
TOTAL	1,008	208,861	39.55	100.0%

Pipelines within the ESD system range from 6-inches to 15-inches in diameter and similarly to CSD the majority of the pipelines are 8-inches in diameter. Table 3-F includes a summary of the wastewater collection system by pipe diameter. The ESD sewers categorized by pipe diameter is presented graphically in Figure 3-F.

Table 3-F ESD Sewers by Pipe Diameter

Pipe Diameter (inches)	Number of Segments	Feet	Miles	% of Total ESD Footage
6	138	29,487	5.57	14.1%
8	781	158,625	30.04	75.9%
10	36	8,536	1.62	4.1%
12	29	5,303	1.00	2.5%
14	9	4,538	0.86	2.2%
15	10	1,289	0.23	0.6%
Unknown	5	1,083	0.21	0.5%
TOTAL	1,008	208,861	39.55	100.0%



LEGEND

SEWER - INSTALLATION YEAR

- UNKNOWN
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s
- ENCINITAS SANITARY DIVISION
- ENCINITAS

Feet 0 750 1,500

N

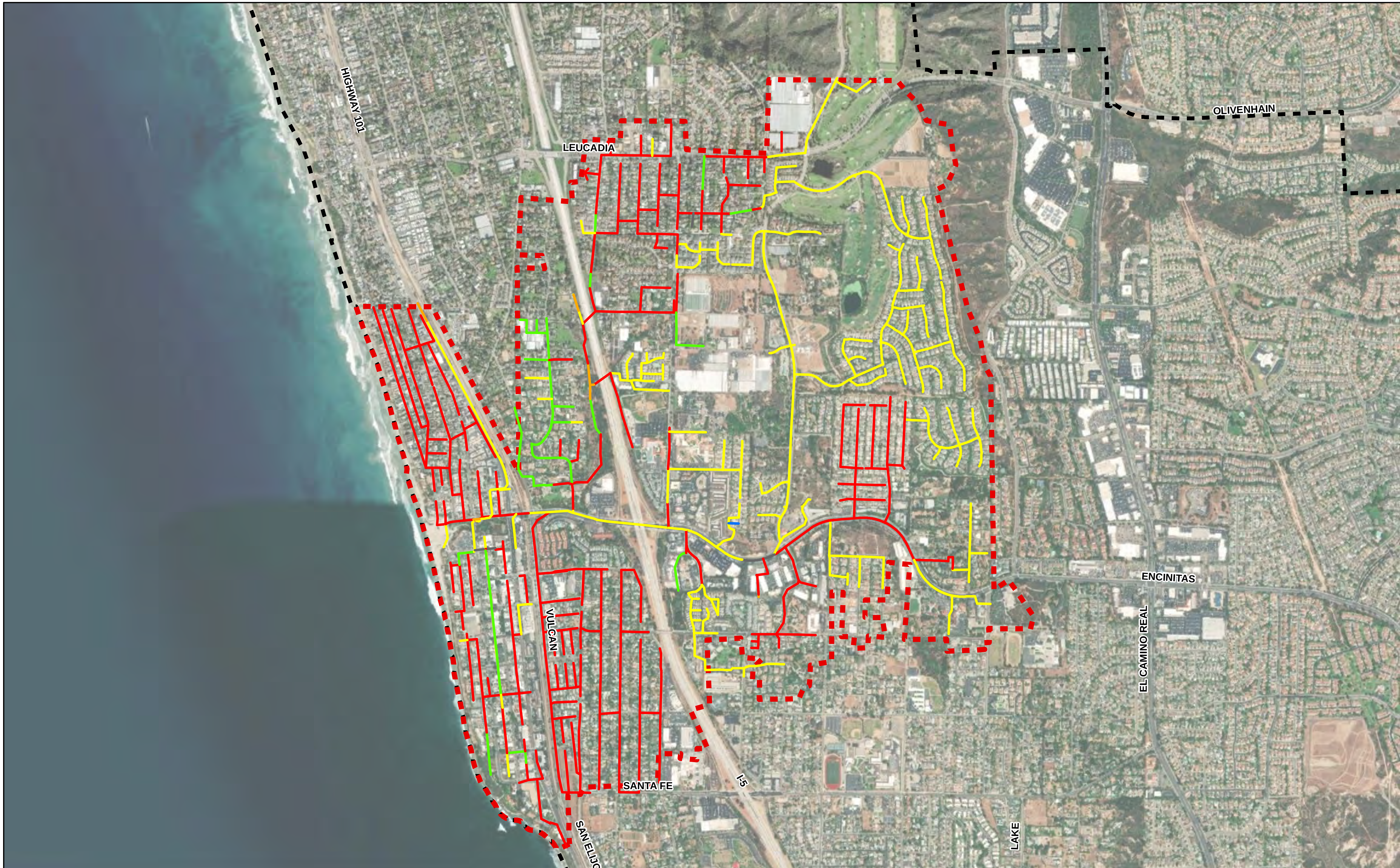
NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

ESD SEWER INSTALLATION YEAR

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

FIGURE NUMBER **3-D**

JOB NUMBER [illegible]-0000687



LEGEND

SEWER - PIPE MATERIAL

- OTHER
- ASBESTOS CEMENT
- CONCRETE
- DUCTILE IRON
- EXTRA STRENGTH VITRIFIED CLAY
- POLYVINYL CHLORIDE
- REINFORCED CONCRETE
- VITRIFIED CLAY
- UNKNOWN
- ENCINITAS SANITARY DIVISION
- ENCINITAS

Feet
0 750 1,500

N

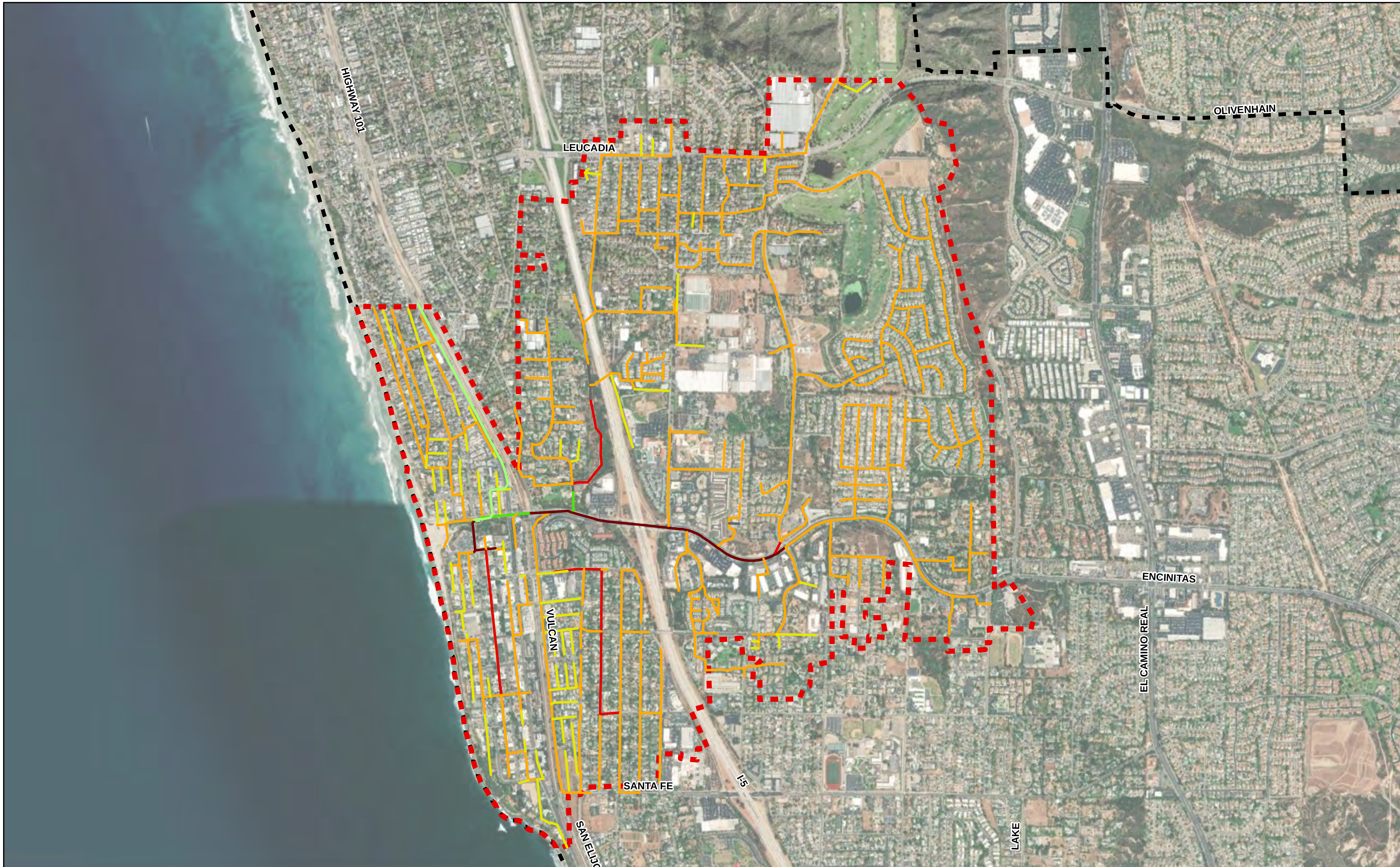
NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

ESD SEWER PIPE MATERIAL

FIGURE NUMBER
3-E

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER
22819-0000687



LEGEND

GRAVITY SEWER - PIPE DIAMETER

- UNKNOWN DIAMETER
- 4-IN
- 8-IN
- 10-IN
- 12-IN
- 14-IN
- 15-IN
- 18-IN
- 20-IN
- 30-IN
- ENCITAS SANITARY DIVISION
- ENCINITAS

Feet
0 750 1,500

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

ESD SEWER PIPE DIAMETER

FIGURE NUMBER
3-F

PREPARED FOR: CITY OF ENCINITAS DATE SUBMITTED: JUNE 2021

JOB NUMBER

3.3 TRUNK SEWERS

Flows generated within CSD are collected and conveyed in one of the four trunk sewers and then pumped or conveyed by gravity to the SEWRF while flows generated within the ESD are collected in a single trunk sewer and pumped to the Encina WPCF. Table 3-G includes a summary the characteristics of the trunk sewers in CSD and ESD.

Table 3-G Trunk Sewer Summary

Trunk Sewer	Diameter (inches)	Total Length (feet)	Material	Installation Year
Encinitas Trunk Sewers	8 to 15	8,799	PVC, VCP	1951 to 2004
Cardiff Trunk Sewer	8 to 15	8,751	VCP	1962 to 1963
Cardiff Relief Trunk Sewer	10 to 12	8,337	PVC, VCP	1963 to 2000
Cardiff Gravity Trunk Sewer	6 to 10	8,405	PVC, VCP	1957 to 1988
Olivenhain Trunk Sewer*	8 to 15	27,109	PVC, VCP	1973 to 1991

* Does not include information pertaining to the planned upsizing of the OTS

The following includes a summary and description of the five (5) trunk sewers serving the City in the sanitary divisions.

3.3.1 Encinitas Trunk Sewer

The Encinitas Trunk Sewer (ETS) begins at Sweet Alice Lane and flows west in Encinitas Boulevard. East of I-5 flows from the western portion of Encinitas Ranch. Miscellaneous commercial and residential areas along both sides of Encinitas Boulevard discharge into the trunk sewer. West of I-5 the ETS flows from the community of Leucadia and Old Encinitas, including the downtown commercial area, and discharges into the trunk sewer. The ETS terminates just west of Highway 101 at the Moonlight Beach Pump Station. Flows from areas west of Highway 101 enter the pump station directly from the west. Pipelines in the ETS range from 8 to 15-inches in diameter. Flows from the Moonlight Beach Pump Station are pumped to the Encina WPCF for treatment.

3.3.2 Cardiff Trunk Sewer

The original Cardiff Trunk Sewer (CTS) was constructed to serve the community of Cardiff-by-the-Sea in the early 1950's. The trunk sewer ranges from 8-inches to 15-inches in diameter, begins south of Santa Fe Drive, and flows in a southwardly direction. The pipeline is located in San Elijo Avenue and eventually veers eastward, aligning with Manchester Avenue along the northern shore of the San Elijo Lagoon and terminates at the Cardiff Pump Station.

Cardiff Relief Sewer

Due to increased development in the Cardiff service area, several of the flatter sections of the CTS reached maximum capacity. To provide relief to the CTS, the City constructed the Cardiff Relief Sewer (CRS) to intercept flows from a sizable area located east of the I-5, including the San Dieguito Academy and other commercial developments along Santa Fe Drive.

The CRS begins just north and east of I-5 and is located in Somerset Avenue. The trunk sewer conveys flows southwardly to Birmingham Drive where the trunk sewer flows west and then south in a succession of turns to ultimately connect to the CTS at Manchester and San Elijo Avenue.

Cardiff Gravity Trunk Sewer

The Cardiff Gravity Trunk Sewer (CGTS) collects flows from residential areas located east of I-5, and from apartment complexes along the west side of I-5. The pipelines are 8 and 10-inches in diameter. The CGTS begins at Lake Drive and Birmingham Drive, and flows south and west in several streets before crossing beneath I-5 near the south end of Playa Riviera Drive. Two separate upstream sections of the trunk sewer start just east of I-5 further north, and collect flows from areas north of Birmingham Drive, crossing under I-5 near Emma Drive and Nolbey Street. West of I-5 the CGTS flows south in Carol View Lane and then in an easement to the north end of the SEWRF.

3.3.3 Olivenhain Trunk Sewer

The original reaches of the Olivenhain Trunk Sewer (OTS) were constructed in 1972 to serve areas located in the east including the community of Olivenhain and portions of Cardiff and unincorporated San Diego County. The original 1972 OTS extended from the Olivenhain Pump Station upstream in three generally described reaches including:

OTS Reach 1: Alignment northeasterly along Manchester Ave – approximately 4,000 feet of 15-inch VCP sewer primarily along Manchester Avenue;

OTS Reach 2: Alignment from Manchester Ave and continuing northeasterly between Escondido Creek and Rancho Santa Fe Road, mostly as 15-inch VCP gravity sewer for approximately 16,000 feet. The OTS in this reach is located in cross-country easements within the 100-year frequency flood plain of San Elijo Lagoon and Escondido Creek and crosses sensitive and protected wetlands and wetland habitat. Within this reach, there is one short section of three parallel 10-inch diameter inverted siphon pipelines crossing under a now-abandoned irrigation pipeline. Along this reach there are also four incoming connections to OTS by formal agreement with the RSFCSD.

OTS Reach 3: The existing alignment includes approximately 8,000 feet long extension of the OTS that continues northerly from El Camino Del Norte as an 8-inch sewer parallel to Lone Jack Road and extending up into the Copper Creek rural residential area (2 to 4 acres per EDU). Based on recommendations included in previous master plans, the City is in the process of replacing the OTS with a 15-inch diameter pipeline.

In addition to City flows, the OTS conveys flows from several unincorporated areas south of the San Elijo Lagoon and 26 residential dwelling units in the Stonebridge development, which were detached from the RSFCSD district boundary as provided by an agreement. Flows from 18 residential units in the LWD service area within the City of Carlsbad (Rancho Verde Unit 4) also discharge to upstream collector pipelines within the OTS service area, as provided for through an interagency agreement with LWD.

For the 2011 Sewer Master Plan Update, topside inspection for 27 of the 54 manholes along the OTS alignment between El Camino Del Norte and Intestate 5 at Manchester Avenue were performed. At that time, the inspections revealed that manholes constructed in the 1970s are located within easements with limited access and the majority of manhole components were assessed as being heavily corroded due to long term exposure to H_2S gas, infiltration and age.

In December 2018, the City performed a flow analysis for the portion of the OTS extending from El Camino Del Norte to the intersection of Lone Jack Road and Santa Fe Vista Road. Based on the findings of the report, the City has proceeded with the design to upsize the trunk sewer from El Camino Del Norte to the bend in Lone Jack Road from 8-inches to 15-inches. The project includes rehabilitation of 15 manholes, removal of an existing siphon and associated manholes, realignment of approximately 2,800 linear feet of the OTS and upsizing of approximately 2,225 linear feet of the sewer main to 15-inches.

3.4 PUMP STATIONS AND FORCE MAINS

There are three pump stations in the CSD and one pump station in the ESD which are operated and maintained by the SEJPA under a contract with the City. Table 3-H includes a summary of the pump stations based on information included in as-built plans provided by the City and other reference documents.

Table 3-H Pump Station Summary

Pump Station[3]	Construction / Rehabilitation Date	Pump and Motor Information			Storage	Capacity[1]	Force Main
		Quantity	Motor Size	Design Point			
Cardiff Pump Station	1963/1991	2 1	40 Hp 25 Hp	1,000 gpm @ 45' 900 gpm @ 45'	210,000 gallon storage basin	2,000 gpm	10-inch Diameter (dual)[2]
Coast Highway 101 Pump Station	1959/2016	2	10 Hp	125 gpm @ 75'	4,000 gallon wet well	125 gpm	4-inch Diameter (dual)
Moonlight Beach Pump Station	1974/2006	3	60 Hp	1,000 gpm @ 107'	180,000 gallon storage basin	2,000 gpm	14-inch Diameter
Olivenhain Pump Station	1972/2011	3 1	43 Hp 7.5 Hp	900 gpm @ 69.5' 350 gpm @ 49.5'	216,000 gallon storage basin	2,700 gpm	14-inch Diameter (dual)

Notes:
1. Capacity is based on one pump out of service.
2. The Cardiff Pump Station force main ties into the Olivenhain Pump Station Force Main.
3. ESD includes the Moonlight Beach Pump Station. CSD includes the Coast Highway 101 Pump Station and the Olivenhain Pump Station.

3.4.1 Cardiff Pump Station

The Cardiff Pump Station is located on the south side of Manchester Avenue, directly across from the SEWRF. The pump station, which was originally constructed in 1963 with two (2) pumps had a third pump added in 1972. The third pump consisted of a 25 Hp grinder pump. In 1981 the City installed a motor control building over the drywell and the two original pumps were replaced with larger 40 Hp units equipped with variable frequency drives. The pump station wet well was relined in 1991.

Flows from the Cardiff Pump Station are pumped from the Cardiff Trunk Sewer and Cardiff Relief Sewer via a 10-inch diameter ACP forcemain that extends approximately 1,490 feet. Typically only one pump operates at a time, but a second pump can be activated in response to high wet well levels. An existing flow meter located at the SEWRF records flows from the discharge in the forcemain. The pump station is also equipped with an emergency storage tank with a capacity of approximately 210,000 gallons.

3.4.2 Coast Pump Station

The Coast Pump Station was originally constructed in 1977 to serve a small commercial area consisting primarily of restaurants located along Highway 101, just south of the San Elijo Lagoon outlet. This area is often referred to as the City's "restaurant row".

The Coast Pump station is located west of Highway 101 adjacent to an existing parking lot. The original pump station was a suction lift station with a wet well/drywell configuration. However, in 1982 pump station was redesigned to include submersible pumps. In 2016 the City performed major improvements to the pump station including the replacement of two (2) new 4-inch force mains approximately 600 feet long contained in one casing, replacement of the electrical panel, valve vault and access hatch, cover and access hatch over the existing wet well, and mechanical equipment including incorporating two new submersible pumps.

3.4.3 Olivenhain Pump Station

The OPS is an underground station that pumps flow from the Olivenhain Trunk Sewer to the SEWRF. The original OPS was constructed in 1972 on a right-of-way parcel owned by the California Department of Transportation (Caltrans), located adjacent to the I-5 northbound off-ramp at Manchester Avenue. Major renovations occurred in 1984, when two 75-Hp pumps were installed to replace the original 20 Hp units. Variable frequency drives and an upper floor motor control center were also added. In 1986, the original 10-inch diameter OPS force main in Manchester Avenue was replaced with a 5,100-foot long 14-inch diameter ductile iron pipe main aligned in Manchester Avenue. A flow meter at the SEWRF records flows from the discharge of the force main. Due to the age of the pump station, capacity limitations, maintenance problems, and susceptibility to inflow and infiltration (I&I), the pump station was replaced in 2014 at the same location.

The new Olivenhain Pump Station was constructed in an above grade building that is above the 100-year floodplain of the adjacent San Elijo Lagoon. The pump station design includes emergency overflow storage, a pressurized surge tank, and an upstream grinder. The pump station includes three (3) screw centrifugal submersible pumps equipped with variable frequency drives. Two (2) pumps operating together meet the pump station design flow capacity of 2.6 MGD (1,800 gpm). The 216,000 gallon emergency storage basin was been sized to store two (2) hours of the design flow capacity in the event of a pump station failure. In 2014, the forcemain between the OPS and SEWRF was replaced.

3.4.4 Moonlight Beach Pump Station

The Moonlight Beach Pump Station was originally constructed in 1974 at Third and "B" Streets to deliver effluent to the Encina WPCF through a force main and gravity pipelines. It is a multi-story underground structure with a dry pit/wet well configuration and conveys up to 1.1 MGD of sewage. The force main consists of approximately 13,780 feet of 14-inch diameter PVC pipe that follows the Old Highway 101 corridor and discharges into the Batiquitos Gravity Sewer at the intersection of Highway 101 and La Costa Avenue. A flow meter at the pump station measures flows discharging into the force main.

In the 1990's the City replaced the force main and made several pump station upgrades. As part of the Moonlight Beach Sewer Pump Station Renovation Project in 2006, significant upgrades to the pump station were performed, including construction of an emergency underground storage basin; relocation of all electrical equipment above ground in a new masonry building; installation of an activated carbon/biofilter odor control system; replacement/upgrade of pumps with three (3) 60 Hp vertical centrifugal pumps; installation of in-line grinders; replacement/upgrade of auxiliary generators; and modifications to the adjacent Moonlight Beach Urban Runoff Treatment Facility. The capacity of the emergency storage basin is 180,000 gallons and sized to provide storage for two hours based on peak ultimate flow conditions.

At the time this master plan update was being performed, the San Elijo Joint Powers Authority retained a consultant to evaluate the pump station for replacement with the initial goal of determining the preferred option between the following over a twenty-year period:

1. Continued use of the existing vertical extended shaft pumps and inline sewage grinder units on suction piping assembly (includes replacement of grinder units as they fail).
2. Removal of inline sewage grinders from suction piping assembly and replacing existing pumps with solids handling dry-pit submersible pumping units.

In addition to this analysis, the study included an evaluation of the necessary improvements and costs associated with the proposed pumping system renovations. As well, additional improvements were being evaluated including improvements to the mechanical equipment and piping, electrical equipment, heat rejection and ventilation systems. Based on the findings and recommendations, the City will determine the option to implement. For planning purposes, the costs associated with the recommended improvements noted in the report were included in this Master Plan Update and included in Appendix 10. The study is titled *Moonlight Beach Pump Station, Pump Replacement Evaluation*, September 2019, included in Appendix 9.

3.5 ESD JOINT TRANSMISSION FACILITIES

The City jointly owns assets and capacity in multiple facilities including interceptors and pump stations. Agencies with which the City is in agreements include the City of Carlsbad, Leucadia Wastewater District, and City of Vista. ESD Joint Transmission Facilities include:

- The Batiquitos Pump Station
- The Occidental Sewer (Ponto Sewer), and
- Segment VC16 of the Vista/Carlsbad Interceptor Sewer System.

Facilities jointly owned by ESD and LWD and which are generally located north of the City limits include:

- The Batiquitos Pump Station
- Dual 24-inch force mains (B2 and B3)
- Batiquitos Influent Sewer
- Lanakai Gravity Sewer

The ESD and LWD jointly owned facilities convey all wastewater flows from the two agencies to the Occidental Sewer (Ponto Sewer) which is mutually owned between ESD, LWD, and the City of Carlsbad.

The Occidental Sewer delivers the combined flow from the three (3) agencies to the 60-inch gravity sewer Segment VC16 of the Vista/Carlsbad Interceptor Sewer System. The 60-inch VC16 sewer conveys the combined wastewater flows from ESD, LWD, the City of Carlsbad, and the City of Vista to the headworks of the regional Encina Water Pollution Control Facility (EWPCF). The following includes a summary of the facilities jointly owned by EDS and LWD.

3.5.1 Batiquitos Pump Station

In 1994 an agreement between ESD and LWD was established regarding ownership, operation and maintenance of the Batiquitos Pump Station and related facilities, replacing the original 1972 agreement. Revisions to the 1994 agreement is currently being considered. Per the agreement, LWD operates the Batiquitos Pump Station and ownership of the system is split 77.86% for LWD and 22.14% for ESD. Flow capacity rights based on the average dry weather flow (ADWF) are 7.11 MGD for LWD and 1.80 MGD for ESD. Operation, maintenance and repair expenses are shared in proportion to each agency's respective flow through the station over the billing period covered, and not based on capacity rights. Flows are metered through the Encina Flow Metering Program.

The Batiquitos Pump Station is located along the east side of Highway 101 and is a conventional wet pit/dry pit station with a 190,000 gallon emergency overflow wet well. An additional 90,000 gallons of emergency storage is available in the wet well. The Batiquitos Pump Station was originally constructed in 1974 and equipped with three (3) pumps and a 10,240-foot 14-inch diameter force main (B1). A substantial electrical system upgrade was performed in 1998, and improvements made in 2006 included the addition of a fourth pump, valve replacements, and new odor control facilities.

3.5.2 Dual Force Mains (B2 and B3)

In 1980 the original force main was replaced with 10,263 feet of 24-inch diameter Ductile Iron Pipe (DIP) pipeline (B2), and a 10,167 feet long parallel 24-inch diameter DIP forcemain (B3) was added in 1988.

3.5.3 Batiquitos Influent Sewer

Flows from the Moonlight Beach Pump Station are pumped to the Batiquitos Gravity Sewer. The Batiquitos Gravity Sewer, which was replaced in 2009 with a 24-inch PVC to address capacity and hydraulic alignment challenges extends north up to 860 feet along Highway 101 from La Costa Avenue to the Batiquitos Pump Station.

This 860 foot section of pipeline, which conveys sewage flows from both ESD and LWD, is referred to as the Batiquitos Influent Sewer. The ESD Moonlight Beach force main and two Leucadia PS force mains (L1 and L2) all enter the Batiquitos Gravity Sewer at the intersection of Highway 101 and La Costa Avenue. Flows are subsequently conveyed to the Batiquitos Pump Station.

3.5.4 Lanakai Gravity Sewer

Ownership of the Lanakai Sewer (previously known as the La Costa Boulevard Sewer) is governed by a 1972 agreement between the ESD, LWD and the Encina JPA. In this agreement, the La Costa Boulevard Sewer is described as the "Railroad Crossing" and ownership is: 57% LWD and 43% ESD. At the time of this Master Plan Update, the City was working with LWD on potential updates / revisions to the existing agreement.

The Batiquitos force main system discharges to the Lanikai Gravity Sewer, which consists of approximately 380 feet of 18-inch and 320 feet of 21-inch gravity sewer along the old “La Costa Boulevard” alignment. The Lanakai Gravity Sewer crosses from the west to the east side of the AT&SF Railroad Tracks, which is operated by North County Transit District (NCTD) and joins with flow from a portion of the City of Carlsbad at the beginning of the Occidental Sewer.

3.6 INTERAGENCY AGREEMENTS

Wastewater collection systems operate primarily on a gravity flow basis. However, agency boundaries do not always align with the natural drainage contours. Consequently, some portions of a service area may drain in a direction, away from the gravity collection system which requires an inter-agency agreement. Interagency agreements are developed to allow wastewater flows to be conveyed into and/or through the collection system of an adjacent district or agency.

CSD and ESD discharge wastewater to treatment plants that are jointly owned with other agencies and have entered into joint powers agreements to establish capacity rights, control operations and administration, and allocate costs. ESD has additional agreements with LWD and the City of Carlsbad for offsite facilities required to convey flows to the Encina WPCF. CSD has several agreements with other agencies and property owners for conveyance of wastewater flows through its facilities. Table 3-I provides a list of interagency agreements for the CSD and ESD.

Table 3-I Interagency Agreements

Outside Agency / Owner	Agreement / Date
CSD Agreements	
City of Solana Beach	Agreement for the Lease of Transmission Capacity between the City of Encinitas, Cardiff Sanitary Division and the City of Solana Beach, September 23, 2015, effective for thirty (30) years.
City of Solana Beach	Restatement of the agreement establishing the San Elijo JPA for wastewater treatment and disposal, & for treatment, storage, transmission, sale & disposal of recycled water- 6/25/2008. In process of being updated.
Rancho Santa Fe Community Services District	Agreement for the lease of transmission capacity in the OTS, OPS and force main - 4/9/91; - Term extends to 4/9/2021.
Leucadia Wastewater District	Agreement to provide wastewater collection, treatment and disposal service for Rancho Verde Unit 4, 18 residential lots in the City of Carlsbad - 10/1998.
Stonebridge / El Mirlo Property Owners (29)	Individual agreements for sewer service to 26 residential properties outside of the City boundaries that discharge to the OTS-2000.
ESD Agreements	
City of Vista, City of Carlsbad, Buena Sanitation District, Vallecitos Water District, Leucadia Wastewater District	Revised Basic Agreement for the planning, design, acquisition, construction, ownership, operation maintenance and use of the Encina WPCF and the Encina Ocean Outfall – Revised / Updated in 2014.
Occidental, City of Carlsbad, Leucadia Wastewater District	Agreement in Regard to Construction (and maintenance) of Sewer Pipeline South from the Encina Water Pollution Control Facility – Revision / update currently under consideration.
Leucadia Wastewater District	Agreement regarding Ownership, Operation & Maintenance of the Batiquitos Pump Station and Related Facilities. Revision / update currently under consideration.
Lanakai Gravity Sewer	Currently being developed.

3.7 WASTEWATER TREATMENT AND DISPOSAL

Both sanitary divisions convey sewage to regional treatment facilities. The Cities of Encinitas and Solana beach each have 50 percent interest in the SEWRF. SEWRF is operated by the San Elijo Joint Powers Authority (SEJPA) and has a capacity of 5.25 MGD. The allocation of ADWF at SEWRF for the Cities of Encinitas and Solana Beach is 2.5 MGD for each with the remaining 0.25 MGD allocated to RSFCSD.

SEWRF is jointly owned by the Cities of Encinitas and Solana Beach. ESD sewage flows are treated at the Encina Water Pollution Control Facility (EWPCF) which is operated by the Encina Wastewater Authority (EWA).

3.7.1 San Elijo Water Reclamation Facility

The SEWRF is owned and operated by the SEJPA and includes the treatment facility, eight (8) lift stations and the San Elijo Ocean Outfall, which is co-owned with the City of Escondido. The water reclamation system consists of tertiary treatment facilities, 19 miles of recycled water distribution pipelines, and three recycled water reservoirs holding 750,000 to 1 million gallons.

Wastewater entering the plant is treated with bar screens and an aerated grit chamber before it flows to the primary sedimentation basins. From the primary sedimentation basins, flows are directed to equalization basins for attenuation of daily peak flows, then to conventional activated sludge basins equipped with anaerobic selectors and then to final clarification. Digested materials are dewatered and the biosolids are delivered to farms in Arizona for land application.

The SEJPA produces approximately 450 million gallons of recycled water per year. The water reclamation facility is permitted to discharge up to 3.02 MGD of tertiary-treated water to recycled water users, and up to 5.25 MGD of secondary effluent to the Pacific Ocean. The SEJPA wholesales recycled water to the San Dieguito Water District, Santa Fe Irrigation District, Olivenhain Municipal Water District and the City of Del Mar to irrigate fairgrounds, golf courses, parks, school properties and highway rights-of-way.

3.7.2 Encina Water Pollution Control Facility

The Encina Water Pollution Control Facility (EWPCF) was designed to treat wastewater to the secondary level and to discharge into the Encina Ocean Outfall. Up to 5 MGD of the treated wastewater is recycled for onsite use and the remaining 7 MGD of treated wastewater is conveyed to the Carlsbad Water Reclamation Facility for further treatment and reuse.

The treatment processes at the EWPCF include screening, grit removal, primary clarification, and treatment of activated sludge. The waste activated sludge is thickened and stabilized in anaerobic digesters. The biosolids withdrawn from the digesters are dewatered, dried and processed to produce biosolids pellets, which are sold for reuse as biofuel or fertilizer.

The master plan for the EWPCF, which was completed in 2014 indicates the facility will have sufficient liquid and solids treatment capacity beyond the planning horizon of 2040. The Encina Wastewater Authority will continue to monitor influent trends and capacities will be addressed accordingly.

3.8 HISTORICAL WASTEWATER FLOWS

Wastewater flows at each of the major trunk sewers are measured and recorded at meters located at the respective pump stations which are further described in subsequent chapters.

The meter for the Encinitas Trunk Sewer is located at Moonlight Beach Pump Station and measures flow at the forcemain. The data collected is transmitted to the Encina JPA. The three (3) flow meters located in CSD measure flows captured in the force mains that are ultimately conveyed to the SEWRF. The recorded average yearly flows over the past 10 years are summarized in Table 3-J.

Table 3-J Average Annual Historical Wastewater Flows

Year	Average Moonlight Pump Station Flows (MGD)	Average Cardiff Gravity Sewer Flows (MGD)	Average Cardiff Flows (MGD)	Average Olivenhain Flows (MGD)
2010	1.039	0.186	0.556	0.739
2011	1.055	0.186	0.536	0.700
2012	1.079	0.184	0.649	0.663
2013	1.048	0.178	0.690	0.655
2014	1.008	0.167	0.673	0.625
2015	0.957	0.148	0.637	0.594
2016	0.953	0.172	0.627	0.593
2017	0.981	0.212	0.654	0.619
2018	0.957	0.221	0.629	0.608
2019	0.981	0.174	0.648	0.650

As shown on Table 3-J, wastewater flows gradually decreased from 2010 through about 2015/2016 and started to rebound in 2016/2017. This was typical of various Southern California sewer agencies and can be attributed to the economic downturn which affected construction from 2009 through 2016. Additionally, drought related water conservation measures were implemented in 2009 and again in 2015 through 2016. Generally, the average yearly flows have been lower than the allocations noted in the existing agreement.

4.0 WASTEWATER GENERATION ANALYSIS

Population has continued to grow in coastal areas of San Diego County including the City of Encinitas. As the City has continued to experience gradual increases in the number of wastewater customers due to growth, wastewater flows have lessened due to ongoing region-wide water conservation efforts.

This chapter documents existing wastewater flows within the sewer service areas and how unit flows are developed for residential and commercial/industrial areas. Peaking curves for each interceptor system and contributing basins are developed for dry weather flows. Existing defect flows from rainfall-induced inflow and infiltration (RDII) are quantified based on historical events. This chapter provides description of the wastewater generation methodology including:

- Existing flow meter data summary
- Methodology for developing unit generation rates
- Recommended unit generation rates, and
- Regional capacity.

4.1 FLOW METERS

The meter basins within CSD and ESD are delineated based on the four (4) permanent flow meters. Wastewater flows generated within each meter basin are based on flows observed at each meter as provided by the San Elijo JPA with meters located at the following four (4) locations:

- Moonlight Beach Pump Station
- Cardiff Gravity Trunk Sewer
- Cardiff Pump Station
- Olivenhain Pump Station

Figure 4-A includes a flow schematic of the wastewater collection system. As illustrated, the Moonlight Beach Pump Station pumps flows captured by the Encinitas Trunk Sewer to the Batiquitos Pump Station which then pumps flows to the EWPCF. The Encinitas Trunk Sewer meter is located at the Moonlight Beach Pump Station and measures flows in the force main. The three (3) flow meters located in CSD measure flows captured in the force mains that are ultimately conveyed to the SEWRF.

Table 4-A includes a summary of the meter locations and the flows metered per location. Flows conveyed via the Cardiff Gravity Trunk Sewer are metered at the SEWRF. The flow meter at the Cardiff Pump Station measures the flows captured by the Cardiff Trunk Sewer and the Cardiff Relief Sewer that are pumped to the SEWRF. The Olivenhain Pump Station pumps all the flow captured by the Olivenhain Trunk Sewer to the San Elijo Water Reclamation Facility. The Olivenhain Pump Station flow meter measures all the flow leaving the pump station.

Figure 4-A Sewer System Flow Schematic

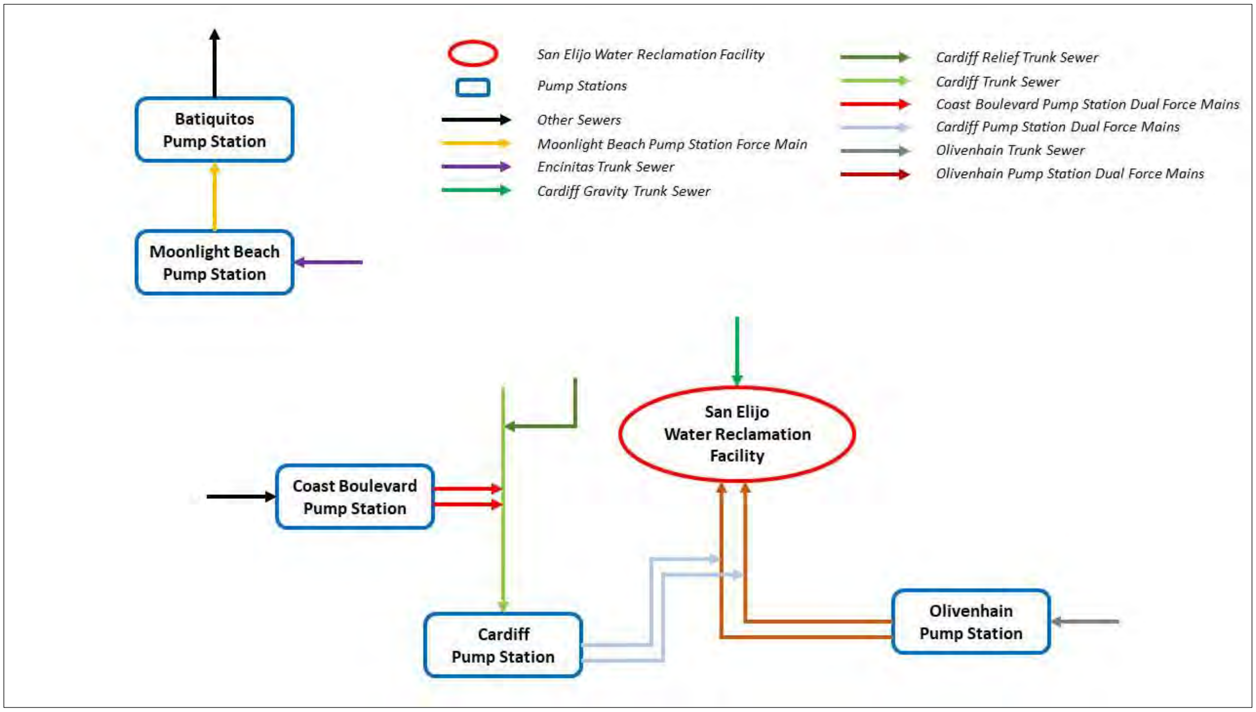


Table 4-A Flow Metering Summary

Meter Location	Metered Flow
Moonlight Beach Pump Station	Encinitas Trunk Sewer
Coast Boulevard Pump Station	Sewers Serving a Small Commercial Area to the West of Highway 101
Cardiff Pump Station	Cardiff Trunk Sewer, Cardiff Relief Trunk Sewer
Olivenhain Pump Station	Olivenhain Trunk Sewer
SEWRF	Cardiff Gravity Trunk Sewer

A summary of the average annual flows from 2017 to 2019 is presented in Table 4-B. The three (3) most recent years of data should provide an accurate representation of the flows currently encountered. While there is an existing flow meter located at the Coast Boulevard Pump Station, the data available was not used as the flow measurements from 2017 to 2019 were inconsistent (several empty data values and did not follow a typical diurnal pattern) and therefore is not presented.

Table 4-B 2017 to 2019 Flow Metering Data Summary

Meter	Average 2017 Flow (MGD)	Average 2018 Flow (MGD)	Average 2019 Flow (MGD)
Moonlight Beach Pump Station	0.981	0.957	0.981
Encinitas Sanitary Division Subtotal	*0.981*	*0.957*	*0.981*
Cardiff Gravity Trunk Sewer	0.212	0.221	0.174
Cardiff Pump Station	0.654	0.629	0.648
Olivenhain Pump Station	0.619	0.608	0.650
Cardiff Sanitary Division Subtotal	*1.485*	*1.458*	*1.472*

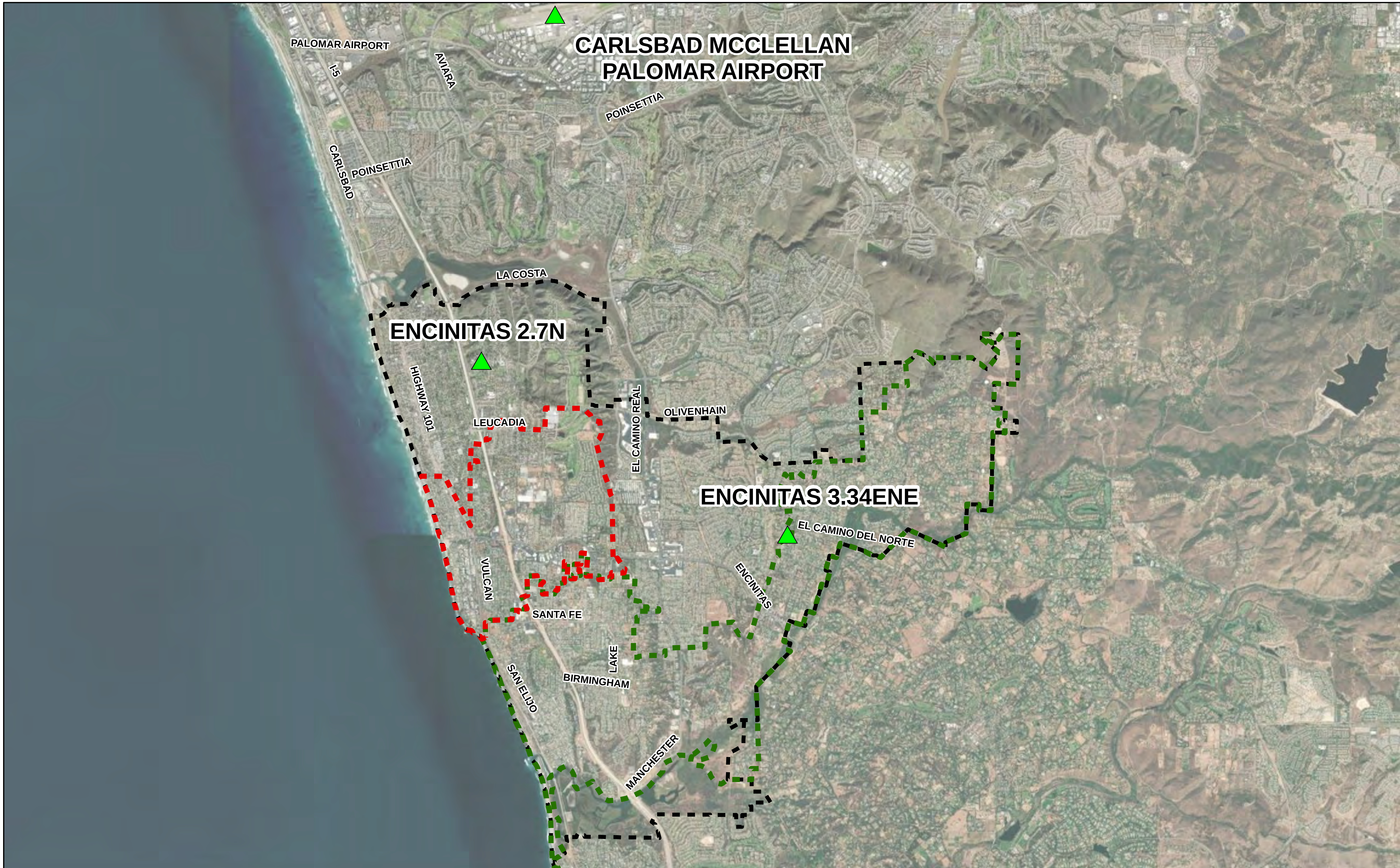
As previously noted, the flow data in the Olivenhain Pump Station Flow Meter includes flow from RSFCSD and the San Elijo Hills sewer basin from the City of Solana Beach. Based on 2014 to 2019 flow data, the average annual flow contribution by RSFCSD was approximately 0.128 MGD and the average annual flow contribution from San Elijo Hills was approximately 0.082 MGD. The total combined flow contribution from these two entities to the Olivenhain Pump Station is approximately 0.210 MGD.

4.2 PRECIPITATION DATA

Precipitation data obtained from three (3) weather stations indicates that 2017 rainfall data represents a typical/average rainfall amount. The location of the three (3) weather stations are shown in Figure 4-B and a summary of the precipitation data is presented in Table 4-C. Only the Carlsbad McClellan Palomar Airport Weather Station, which is located approximately four (4) miles to the north of the Encinitas Sanitary Division, provides precipitation data in hourly increments. The other two weather stations provide precipitation data as daily totals.

Table 4-C Precipitation Data Summary

Year	Precipitation at Encinitas 2.7N Weather Station (inches)	Precipitation at Encinitas 3.34ENE Weather Station (inches)	Precipitation at Carlsbad McClellan Palomar Airport Weather Station (inches)
2011	11.50	11.60	11.70
2012	5.24	8.14	8.07
2013	3.53	5.50	5.24
2014	8.09	7.88	7.61
2015	7.75	7.86	7.56
2016	10.67	14.97	11.69
2017	11.01	13.32	10.56
2018	8.25	9.00	9.42
2019	18.38	19.44	18.53



LEGEND

- WEATHER STATIONS
- ENCINITAS
- CARDIFF SANITARY DIVISION
- ENCINITAS SANITARY DIVISION

Feet
0 2,500 5,000

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

RAINFALL STATION LOCATIONS

FIGURE NUMBER
4-B

PREPARED FOR: CITY OF ENCINITAS DATE SUBMITTED: JUNE 2021

JOB NUMBER
[illegible]00000687

4.3 WASTEWATER GENERATION RATES

The purpose of establishing wastewater generation rates serves to characterize the existing unit rate by either population or land use, and for subsequent use in forecasting wastewater flows. A system-wide approach was used and based on data provided by San Elijo JPA from the system flow meters.

Flow meter data from 2017 was used as this year appeared to represent an average amount of rainfall. The 2017 metered flows were associated with land use data and population estimates to develop planning level unit wastewater generation rates for CSD and ESD. The wastewater generation rates presented in the following subsections do not include RSFCSD or San Elijo Hills flows as they are located outside the service boundaries of CSD and ESD.

4.3.1 Generation Rates Using SANDAG Population Forecasts

Development of a population based unit generation rate is to establish the estimated average amount of wastewater flow generated by a resident over a given day. This rate is ultimately used to forecast the anticipated volume of wastewater the City can expect to generate through a specific planning horizon based on the expected population growth. The initial per capita unit generation rate is determined through establishing the relationship between the existing SANDAG population data within a given sanitary division and the average wastewater flows observed at that flow meter.

Residential population data was obtained from the SANDAG Series 13: 2050 Regional Growth Forecast. The forecast represents one possibility for future growth in the San Diego Region. The Series 13 Regional Growth Forecast represents a combination of economic and demographic projections, existing land use plans and policies, as well as potential land use plan changes that may occur in the region between 2030 and 2050.

The first step in estimating population based unit generation rates was to define flow tributary areas. A tributary flow area was created for each sanitary division. To define the population within each sanitary division, the SANDAG population data, which was originally presented based on TAZ area, and as certain TAZ areas overlap into one or more tributary flow areas, a weighted average was used to calculate the projected population. It was assumed that the projected population was evenly distributed throughout the TAZ area. Once each sanitary division had a population number associated with the service area, a gallons per capita per day (gpcd) value was calculated and assigned to each flow area to obtain the estimated wastewater generated for each sanitary division.

Table 4-D includes a summary of the population and unit generation rates for each sanitary division. The estimated residential per capita unit generation rate ranges from 65 to 75 gpcd. The estimated flows are all within 1.5% of 2017 metered flows. The metered flow for the Cardiff Sanitary Division does not include 0.210 MGD of flow originating from RSFCSD and San Elijo Hills; the average flow from these two areas were subtracted from the total average flow of CSD as they are not within the CSD service area.

Table 4-D Wastewater Unit Generation Rate Based on 2020 SANDAG Population

Sanitary Division	2020 Residential Population	Unit Generation Rate (gpcd)	Estimated Wastewater Generation (MGD)
Cardiff Sanitary Division	19,625	65	1.276
		Metered 2017 Flow = Percent Error =	1.275 0.07%
Encinitas Sanitary Division	13,267	75	1.009
		Metered 2017 Flow = Percent Error =	0.981 1.41%

Notes:
gpcd = gallons per capita per day

4.3.2 Generation Rates Using Encinitas Land Use Data

The purpose of estimating land use based unit generation rates is to establish the amount of wastewater generated in a day over an acre of land based on designated land use types. This is used to estimate the amount of wastewater the City can expect to be generated through a specific planning horizon. Land use based unit generation rates are determined through a comparison of the existing area per land use type within a given sanitary division against the average wastewater flows observed at the affected flow meters.

Land use categories were defined as Single-Family Residential, Multi-Family Residential, Mobile Home Parks, Commercial, and Industrial. Single-Family Residential, Multi-Family Residential and Mobile Home Parks are considered residential categories while Commercial and Industrial are considered non-residential.

For the residential categories, 2010 Census data was used to calculate the total residential dwelling units. Since the dwelling unit counts were originally in a Census block area, and certain Census blocks intersect one or more tributary flow areas, a weighted average was applied to calculate the approximate number of dwelling units. It was assumed the dwelling units were evenly distributed throughout the Census block area. Since the 2010 Census data does not include information on housing type, information contained in Appendix B of the Encinitas 2013 – 2021 Housing Element was used to determine the dwelling unit counts for single-family, multi-family, and mobile homes. Appendix B of the Encinitas 2013 – 2021 Housing Element includes the percentage of the total dwelling units included in each of the three residential categories. With the total 2010 dwelling unit counts established for the three residential categories, a gallons per dwelling unit value was assigned to each flow area to obtain the estimated residential wastewater flows anticipated to be generated for each sanitary division.

For commercial and industrial land use categories, sewer billing data was superimposed onto the non-residential land use areas to identify the parcels not currently generating sewer flows. Once the total area of non-residential land use types currently contributing flow was determined, an average flow (gallons per acre) value was approximated to obtain an estimated commercial and industrial land use wastewater generation rate for each sanitary division.

Table 4-E summarizes the land use numbers and unit generation rates for each sanitary division. The estimated flows are all within 3% of 2017 metered flows. The metered flow for the Cardiff Sanitary

Division does not include 0.210 MGD of flow originating from RSFCSD and San Elijo Hills as they are not within the CSD boundary. Thus, the average flow from these two areas have been subtracted from the total average flow of CSD.

Table 4-E Wastewater Unit Generation Rate Based on Land Use

Category	Units	Unit Generation Rate	Estimated Wastewater Generation (MGD)
Cardiff Sanitary Division			
Single-Family Residential	5,946 DUs	180 gpd / DU	1.070
Multi-Family Residential	1,785 DUs	110 gpd / DU	0.196
Mobile Home Park	239 DUs	80 gpd / DU	0.019
Commercial	57.6 acres	400 gpd / acre	0.023
Industrial	0.3 acres	400 gpd / acre	0.000
		Subtotal =	1.309
		Metered 2017 Flow =	1.275
		Percent Error =	2.68%
Encinitas Sanitary Division			
Single-Family Residential	4,169 DUs	180 gpd / DU	0.750
Multi-Family Residential	1,252 DUs	110 gpd / DU	0.138
Mobile Home Park	168 DUs	80 gpd / DU	0.013
Commercial	113.4 acres	400 gpd / acre	0.045
Industrial	24.7 acres	400 gpd / acre	0.010
		Subtotal =	0.957
		Metered 2017 Flow =	0.981
		Percent Error =	-2.48%

Notes:
DUs = dwelling units
gpd = gallons per day

4.3.3 Recommended Unit Generation Rates

The City of Encinitas Engineering Design Manual (EDM) currently recommends a sewer flow contribution of 80 gpcd for projected residential flows. The EDM also uses the concept of Equivalent Dwelling Units (EDUs), which converts the sewer flows to an equivalent multiple of residential dwelling unit (DU) usage. The EDM guidelines are based on the assumption that one EDU is equivalent to 280 gpd/DU (280 gpd / 80 gpcd = 3.5 people per dwelling unit). For the City, the SANDAG Series 13 Regional Growth Forecast calculates a persons per household value of 2.51 in 2020 while the 2010 Census has a calculated 2.47 persons per household.

Based on the analysis conducted, the City has relatively uniform wastewater generation for land use and population projections. To project flows based on projected future development, it is recommended that wastewater generation rates included in Table 4-F be applied.

Table 4-F Recommended Wastewater Unit Generation Rates

Category	Recommended Unit Generation Rate
Population	
Residential Population	70 gpcd
Land Use	
Single-Family	180 gpd / DU
Multi-Family Residential	110 gpd / DU
Mobile Home Park	80 gpd / DU
Commercial	400 gpd / acre
Industrial	400 gpd / acre

The City may need to consider updating the EDM to reflect the lower 70 gpcd. It should be noted that the rate may continue to decrease due to continued conservation efforts and the incorporation of Green Building Codes. Additionally, as the State allows agencies to permit accessory dwelling units as a method to achieve housing goals, the impact to the City's system will need to be evaluated to account for such additional flows.

5.0 SEWER COLLECTION SYSTEM DESIGN CRITERIA

The level of service that is provided to a community is directly related to compliance with applicable regulations and implementation of improvements planned and designed in accordance with accepted criteria. The capacity of the collection system is analyzed with a hydraulic model and findings are evaluated against established and verified design criteria to identify capacity deficiencies.

Included in this chapter is a description of the design criteria and hydraulic modeling methodology used to evaluate the collection system based on current flow conditions. The evaluation method employs the use of the InfoSWMM hydraulic modeling software, which performs hydraulic calculations with extended period simulations (EPS) and fully dynamic flow routing to calculate water depth in open channels and pipelines, velocities and headloss in force mains.

Also included is a description of the City's criteria associated with designing and operating the City's sewer system, the design criteria used for planning and design of new sewer infrastructure, and "trigger" criteria for evaluating capacity of existing and future infrastructure.

5.1 DESIGN CRITERIA BACKGROUND

The CSD and ESD collection system is operated and maintained by City staff. The City provides a level of service that complies with state and federal sanitary sewer regulations to assure the collection system is efficiently and effectively managed to meet public health and safety standards. The City has developed and adheres to the criteria included in its 2009 Engineering Design Manual (EDM) which serves to assist the professional design community and the general public by consolidating information related to the City's engineering standards. Chapter 4.0 of the manual includes specific requirements related to the City's sewer system.

The design criteria used in this Master Plan Update is based on existing City design standards. Similar to previous master plans, the peaking factors used in the hydraulic analysis are based on historical dry and wet weather peak flows observed from metering data, as previously presented in Chapter 4.0 of this Master Plan Update and discussed in more detail at the end of this chapter.

5.2 GRAVITY MAIN DESIGN CRITERIA

The primary evaluation criteria for gravity sewers are the depth of flow and velocity, which are calculated in the hydraulic model based on Manning's Equation. The capacity of each gravity sewer is based on the relative depth of flow within the respective pipeline reach. Gravity sewers are not typically designed to flow full, as unoccupied space at the top of the pipe is required for conveyance of sewage gasses and to provide contingent capacity for wet weather inflow and infiltration. Pipeline sizing is typically based on the pipeline flowing 75 percent full at the PWWF if the pipe is larger than 16-inches in diameter (d/D = 0.75). For a pipeline with a diameter of 16-inches, or smaller, a d/D factor of 0.50 is generally used.

Friction (roughness) factors for pipelines are a required input to the model. The factors vary with the material and the age of the pipe. A roughness factor as indicated by a Manning's coefficient ("n") of 0.013 is typically used to evaluate existing gravity sewers and for projection of future sizing needs. Previous studies have shown that this value typically accounts for the roughness of most pipes, joints, and fouling that occurs after several years of operation. EDM design standards are summarized in Table 5-A.

Table 5-A Engineering Design Manual Criteria – Sewers

Category	Criteria
Minimum Pipeline Diameter	8-inches
Minimum Pipeline Slope	1.0%
Minimum Pipeline Velocity at Peak Design Flow	2 ft per sec
Pipeline Roughness Coefficient	n = 0.013
Maximum d/D Ratio, Diameter ≤ 16-inches	0.50
Maximum d/D Ratio, Diameter > 16-inches	0.75

5.3 PUMP STATION DESIGN CRITERIA

In the design of sewer lift stations, it is required that spare pumping units be included for mechanical reliability. The City requires that a wastewater facility be capable of conveying peak wet weather flows with the largest operating unit out of service. Lift stations are typically equipped with two or more pumps, including one pump of the largest size as a standby unit, and have a secondary or emergency power source consisting of either installed generators or a connection for a portable generator.

Force mains are evaluated based on maintenance of a minimum or maximum allowable flow velocity, varying between 2.5 and 8.0 fps. Velocities less than 2.5 fps can result in deposition of debris in the force main, while velocities greater than 8.0 fps can damage the pipeline through excessive abrasion. The relevant pump station design criteria used in the previous Master Plan, and which will apply to the Master Plan Update is summarized in Table 5-B.

Table 5-B Pump Station Design Criteria

Category	Criteria
Minimum Number of Pumps	Two
Minimum Pump Capacity	Duty Pumps Capable of Pumping Ultimate Peak Wet Weather Flow
Standby Capacity	100% of Largest Duty Pump Capacity
Emergency Power	Required
Emergency Storage Capacity	Six hours of Average Dry Weather Flow
Velocity for Force Mains	Minimum Allowable Velocity – 2.5 ft per sec Maximum Allowable Velocity – 8 ft per sec

6.0 HYDRAULIC MODEL DEVELOPMENT

This chapter provides a description of the capacity analysis performed as part of the Master Plan, and includes:

- Evaluation criteria
- Model selection, development, and calibration
- Capacity analysis
- Recommended phased improvements.

6.1 BACKGROUND

A capacity evaluation of the City wastewater collection system was completed to identify sewer reaches that may be deficient under recommended design criteria and to identify any upgrades needed to accommodate existing and projected dry and wet weather wastewater flows. Based on the capacity evaluation, phased facility improvements were identified to reduce the potential for sanitary sewer overflows as well as to allow for projected growth within the study area.

InfoSWMM allows for the evaluation of the diurnal nature of wastewater flows to reflect the peak flows that typically occur during specific time periods during the morning and evening hours in residential neighborhoods. As the model accounts for and attenuates the peak flows through the pipe network over time and throughout the 24 hour period, it serves to minimize the pipe diameter needed to accommodate the peak flows.

6.2 METHODOLOGY

The principal tool utilized in the capacity analysis was a dynamic hydraulic model. The hydraulic model simulates flow conditions, such as wastewater flow depth, flow rate, and velocity, within pipes and manholes in the City's wastewater collection system.

The City provided an initial model that was developed previously in InfoSWMM. The initial model only included the following five (5) trunk sewers:

- Encinitas Trunk Sewer
- Cardiff Trunk Sewer
- Cardiff Relief Trunk Sewer
- Cardiff Gravity Trunk Sewer
- Olivenhain Trunk Sewer

To perform the capacity analysis, the InfoSWMM model was updated to include the following:

- All system pipelines, manholes, and pump stations based on available and current GIS data
- Calibration of the model to measured flows,
- Identification of facilities required to serve projected growth within the service area.

6.3 LIMITATIONS OF HYDRAULIC MODELING

The hydraulic model was utilized as the primary planning tool for the sewer capacity analysis and provides a reasonable representation of actual flow conditions within a sanitary sewer system in response to existing and future sewage loading. The accuracy of the simulation however, is directly related to the accuracy of the model input data, including physical parameters and sewage loading projections. For example, in a case where roots had entered the sewer causing a blockage, the model would be unable to predict a resulting surcharge condition. Consequently, an understanding of the data sources is critical in interpreting the modeling results.

6.4 MODEL DEVELOPMENT / UPDATE

The City's hydraulic model combines information on the physical and operational characteristics of the wastewater collection system, and performs calculations to solve a series of mathematical equations to simulate the flows in pipes. The model update process consisted of the following steps, as described below:

- The InfoSWMM hydraulic model obtained from the City was updated primarily with the City's GIS data. The InfoSWMM software allowed for the importing of the GIS data into a format that would be useable in the program.
- Once the GIS data was imported into InfoSWMM, the updated hydraulic model was reviewed to verify the model data was input correctly and the flow direction, size, and layout of the modeled pipelines were logical. Quality assurance and quality control (QA/QC) involved comparing the updated hydraulic model with other limited data sources such as record drawings and discussion with City and SEJPA personnel.

6.4.1 Hydraulic Model Elements

An overview of the hydraulic model is presented in Figure 6-A. The major elements of the hydraulic model and the required input parameters are summarized below:

- Pipes: Sewer mains are represented as pipes in the hydraulic model. Input parameters for pipes include length, friction factor (Manning's n values), pipe diameter, pipe shape, upstream and downstream offset (if applicable), and force main status.
- Junctions: Sewer manholes, as well as other locations where sewer pipe sizes change, sewer pipes intersect or where sewer pipes start or end, are represented as junctions. Input parameters for junctions are invert elevation and maximum depth.
- Outfalls: Outfalls represent areas where flow leaves the system. For sewer system modeling, outfalls typically represent the connection to the inlet at a wastewater treatment plant and/or the boundary point for the sewer system. Input parameters for outfalls include outfall type and invert elevation.
- Pumps: Pumps in the hydraulic model were modeled as Ideal Pumps. Ideal pumps are used to pump at a rate equal to the inflow at the inlet node.

- Wet wells: Wet wells are typically required at pumping stations to store wastewater before it is pumped. Input parameters for wet wells include invert elevation, maximum depth, and shape type and curve.
- Load Allocation: The load represents the wastewater flows discharged into the wastewater collection system and used to either maintain or size the infrastructure for existing and future conditions.

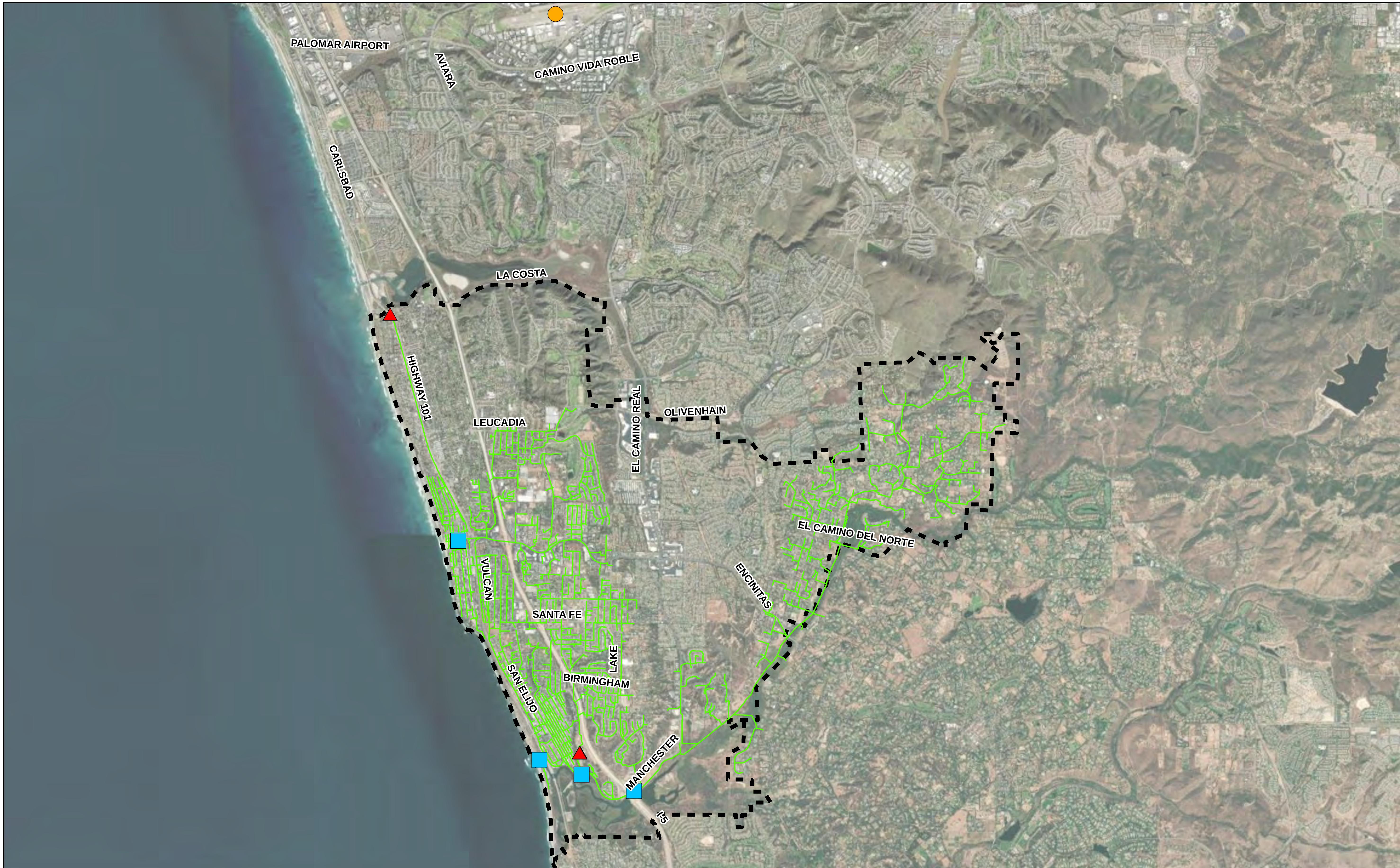
6.4.2 Wastewater Load Allocation

A significant component of the hydraulic model is the quantity of average dry weather wastewater flows generated and the method used to distribute the flows throughout the sewer system. While there are various methods to assign wastewater flows to hydraulic models, adequate estimates of the wastewater loads are an important part in maintaining and sizing sewer system infrastructure both for existing and future conditions.

For this update, wastewater loads were divided into residential and non-residential loads. Residential loads were allocated in the hydraulic model based on the 2020 population forecast obtained from the SANDAG Series 13: 2050 Regional Growth Forecast. Non-residential loads were allocated in the hydraulic model based on 2019 water billing data which was provided by Scott Associates obtained from the San Dieguito Water District and Olivenhain Water District. The 2019 water billing data provides the annual average water consumption based on a five (5) year rolling average. The water billing data also includes return to sewer factors which were applied to the model.

The general process for assigning wastewater loads was as follows:

- The City's service area was divided into loading polygons. The loading polygons were generated using InfoSWMM's Create Thiessen Polygon tool. Thiessen polygons provide a means to divide an area into polygons by creating regions that bisect known points (junctions). These polygons typically represent the bounded region closest to each of the junctions. Each loading polygon represented the geographic area that contributes flows to a specific manhole.
- For the residential loads, each loading polygon was assigned a population value. Since the SANDAG population data was originally in a TAZ area, and certain TAZ areas overlap one or more loading polygon areas, a weighted average was used to calculate the population numbers. It was assumed the population was evenly distributed throughout the TAZ area. Once the loading polygons were allocated a population number, a gallons per capita per day (gpcd) value was assigned to each polygon to obtain the average residential flow.
- For the non-residential (commercial and/or industrial) loads, non-residential flows were calculated using the 2019 water billing data with the majority of the return to sewer factors ranging between 0.85 and 0.95. Once the average non-residential flows were obtained, the values were mapped and digitally linked to the Assessor Parcel Numbers (APN). Flows from each parcel were joined digitally to the nearest collector sewer manhole and flows along the collector pipelines were added and input in to the model at the point of discharge to the trunk sewer.



LEGEND

- RAIN GAUGE
- CONDUITS
- ENCINITAS
- STORAGE
- OUTFALLS

Feet
0 2,500 5,000

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

HYDRAULIC MODEL OVERVIEW

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

FIGURE NUMBER
6-A

JOB NUMBER
...0000687

6.4.2.1 Outside Agencies – Load Allocation

In addition to the customers in Rancho Verde Unit 4 and the Stonebridge Development, wastewater service is also provided to RSFCSD and the San Elijo Hills area of the City of Solana Beach. Flow data provided by SEJPA staff was used to estimate the flow from these two areas. A summary of the flow data is presented in Table 6-A. The average flow of 0.128 MGD from RSFCSD and 0.082 MGD from San Elijo Hills was used for the hydraulic model. An overview of the RSFCSD and San Elijo parcels is presented in Figure 6-B.

Table 6-A Flow Summary for Outside Agencies

Year	RSFCSD Flow (MGD)	San Elijo Hills Flow (MGD)
2015	0.115	0.094
2016	0.115	0.045
2017	0.147	0.134
2018	0.122	0.070
2019	0.141	0.068
Average	0.128	0.082

It should be noted that during the metering period between January and May of 2017, the siphon meter failed which resulted in an elevated meter reading for San Elijo Hills.

6.4.2.2 Rancho Santa Fe Community Services District Flows

RSFCSD staff provided GIS mapping information that included the boundaries for areas tributary to each of the four (4) connections to the OTS. The connected parcels and manhole discharge locations to the OTS are illustrated in Figure 6-B. A summary of the flows and parcels is provided in Table 6-B. At build-out (2035), it is assumed all parcels within the respective boundaries will be connected. Based on the existing agreement, the maximum flow allocated to RSFCSD is 0.25 MGD. Thus, it is assumed the maximum flow of 0.25 MGD will be connected at build-out.

The flow at the four (4) connection locations to the OTS is composed of both metered and unmetered flows. RSFCSD Connection 1 currently has 103 connected parcels. Flow to this connection is unmetered. RSFCSD Connection 2 currently has seven (7) connected parcels. Flow to this connection is also unmetered. RSFCSD Connection 3 currently has a total of 309 connected parcels. The flow of 41 parcels is unmetered. The flow of 268 parcels is metered through the La Granada Pump Station. RSFCSD Connection 4 currently has a total of 127 connected parcels. The flow of 51 parcels is unmetered, while flow of 76 parcels is metered through the Rancho Serena Pump Station.

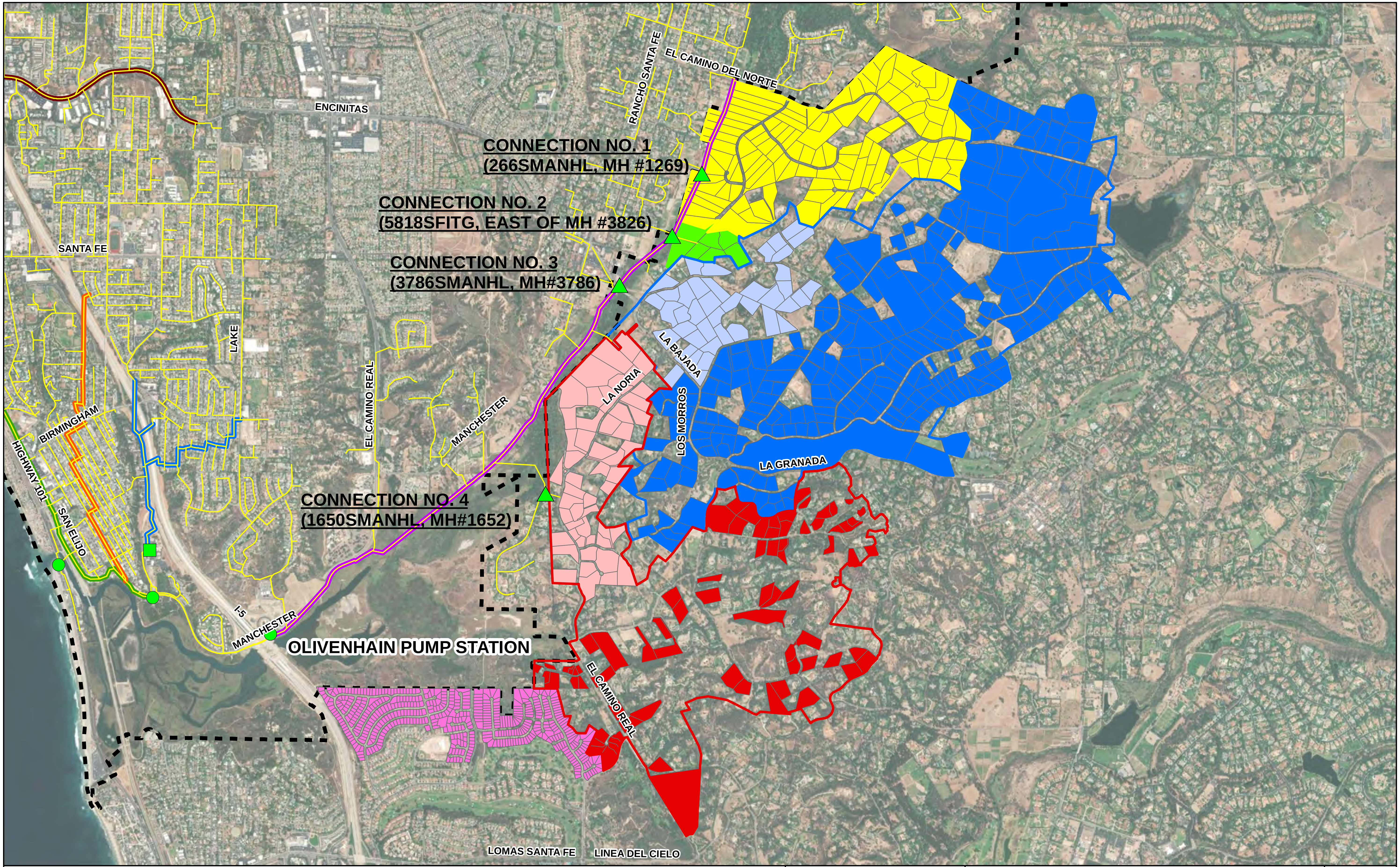
All unmetered flow is estimated by multiplying the number of connected parcels with the wastewater generation rate calculated at the RSFCSD operated Rancho Santa Fe Treatment Plant and an added flow multiplier of 1.1. Based on the 2020 estimated flows, the wastewater generate rate for the RSFCSD parcels flowing to the OTS is approximately 230 gallons per day per equivalent dwelling unit.

Table 6-B Flow Summary at RSFCSD Connection Locations

Connection No.	2020		2035	
	No. of Connected Parcels	Estimated Sewer Flow (MGD)	No. of Connected Parcels	Estimated Sewer Flow (MGD)
Connection 1 (Unmetered Flow)	103	0.018	115	0.023
Connection 2 (Unmetered Flow)	7	0.001	7	0.001
Connection 3 (Unmetered Flow)	41	0.007	71	0.018
Connection 3 (Metered Flow – La Granada Pump Station)	268	0.071	366	0.108
Connection 4 (Metered Flow – Rancho Serena Pump Station)	51	0.009	68	0.015
Connection 4 (Unmetered Flow)	76	0.019	254	0.084
TOTAL	**546**	**0.126**	**881**	**0.250**

6.4.2.3 San Elijo Hills – City of Solana Beach

The San Elijo Hills area of the City of Solana Beach is served by a gravity sewer connected directly to the OPS wet well influent. The flow is obtained from a flow meter that measures the flow generated by the San Elijo Hills area. There are approximately 486 single family homes in the OTS service area of San Elijo Hills, as shown previously on Figure 6-B. According to recent information provided by the City of Solana Beach, there has been no change in the ADWF for planning purposes and remains as 200 gpd/EDU. Using this planning value, the total flow for San Elijo Hills is calculated at 0.097 MGD. Based on an average flow of 0.082 MGD as noted in Table 6-A above, the estimated wastewater generation rate within the San Elijo Hills area served by the City is approximately 170 gpd / DU.



LEGEND

- SAN ELIJO WATER RECLAMATION FACILITY
- PUMP STATIONS
- CONNECTION POINTS
- SEWERS

TRUNK SEWERS

- CARDIFF GRAVITY TRUNK SEWER
- CARDIFF RELIEF TRUNK SEWER
- CARDIFF TRUNK SEWER
- ENCINITAS TRUNK SEWER
- OLIVENHAIN TRUNK SEWER

RSFCSD CONNECTED PARCELS

- CONNECTION 1 (UNMETERED)
- CONNECTION 2 (UNMETERED)
- CONNECTION 3 (UNMETERED)
- CONNECTION 3 (LA GRANADA PS)
- CONNECTION 4 (UNMETERED)
- CONNECTION 4 (RANCHO SERENA PS)

CONNECTION BOUNDARY

- CONNECTION 1
- CONNECTION 2
- CONNECTION 3
- CONNECTION 4

- SAN ELIJO HILLS PARCELS
- ENCINITAS

0 1,100 2,200 Feet

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

OUTSIDE AGENCY PARCELS

FIGURE NUMBER
6-B

PREPARED FOR: CITY OF ENCINITAS DATE SUBMITTED: JUNE 2021

JOB NUMBER [illegible]-0000687

6.5 MODEL CALIBRATION

Hydraulic model calibration is a critical step in the hydraulic modeling effort. Calibrating the model results to match measured values assures the most accurate results possible. The calibration process consists of calibrating to both dry and wet weather conditions.

As previously noted, flow monitoring data was obtained from each of the four flow meters located at each of the pump stations including the Moonlight Beach Pump Station, Cardiff Pump Station, Cardiff Gravity Trunk Sewer, and the Olivenhain Pump Station. The model was calibrated by refining estimated model parameters under dry and wet weather conditions so as to simulate model flow conditions that reasonably approximate the measured flow conditions. Diurnal curves were adjusted for the dry weather calibration such that simulated and recorded wastewater flow hydrographs matched within a reasonable calibration such that simulated and recorded wastewater peak flows matched to within a reasonable level of accuracy.

Hourly precipitation data was obtained from the Carlsbad McClellan Palomar Airport Weather Station, located approximately four miles to the north of the Encinitas Sanitary Division as this is the closest weather station that records precipitation data on an hourly basis.

6.5.1 Dry Weather Flow Calibration

Dry weather flow calibration serves to accurately model the base wastewater flows in the service area. For loading of the areas tributary to the flow meters, dry weather flows were calibrated to flow monitoring data captured between April 17, 2017 to April 23, 2017. For the loading of the areas tributary to the flow meter at the Olivenhain Pump Station, dry weather flows were calibrated to flow monitoring data between April 10, 2017 to April 23, 2017. Flow estimates for areas outside the CSD that discharge to the OTS and OPS, primarily in RSFCD and San Elijo Hills in Solana Beach, were verified and allocated as described in the section above.

The calibration process included verification that the calculated average flow from the areas tributary to the flow meters matched the measured average flows at each flow meter. The calculated average flow was subsequently adjusted by modifying the gallons per capita per day value assigned to the loading tributary area.

Once the calculated average flow matched the measured average flow, hourly diurnal patterns were created and adjusted to match the distribution of flow throughout the day. An hourly diurnal pattern is a pattern of hourly multipliers that are applied to the base average flow to simulate the flow variation that occurs throughout the day. For residential flows, a weekday and weekend diurnal pattern was developed for each tributary flow meter area. The residential diurnal patterns and detailed dry weather flow calibration summary for each of the four (4) flow meters is presented in Appendix 2. For non-residential flows, it was assumed that the weekday and weekend diurnal pattern were similar. The non-residential diurnal pattern is presented in Figure 6-C.

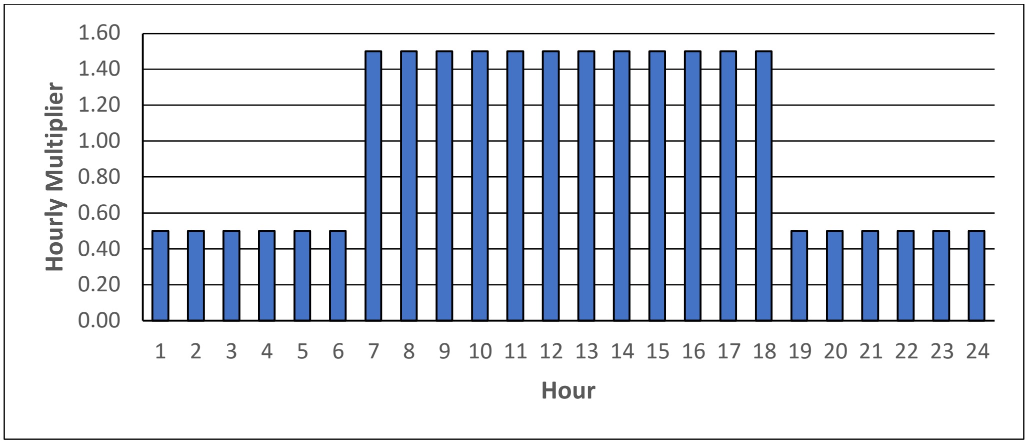


Figure 6-C Non-residential Diurnal Pattern

A summary of the weekday and weekend dry weather flow calibration is presented in Table 6-C and Table 6-D, respectively. Average and peak flows are all within +/- 5 percent.

Table 6-C Weekday Dry Weather Flow Calibration Summary

Meter Location	Measured Data		Modeled Data		Percent Error	
	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (%)	Peak Flow (%)
Moonlight Beach Pump Station	0.947	1.411	0.962	1.410	1.52%	-0.10%
Cardiff Gravity Trunk Sewer	0.198	0.310	0.199	0.307	0.86%	0.92%
Cardiff Pump Station	0.652	1.022	0.657	1.024	0.79%	0.14%
Olivenhain Pump Station	0.630	0.907	0.637	0.912	1.12%	0.52%

Table 6-D Weekend Dry Weather Flow Calibration Summary

Meter Location	Measured Data		Modeled Data		Percent Error	
	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (%)	Peak Flow (%)
Moonlight Beach Pump Station	0.963	1.498	0.972	1.498	0.93%	0.00%
Cardiff Gravity Trunk Sewer	0.207	0.353	0.207	0.356	-0.05%	0.92%
Cardiff Pump Station	0.662	1.058	0.661	1.053	-0.19%	-0.50%
Olivenhain Pump Station	0.621	0.936	0.626	0.927	0.81%	-0.95%

6.5.2 Wet Weather Flow Loading and Calibration

Collection systems may be compromised when they must transport higher flows than what they were designed to convey. Additionally, increased flows affect the cost associated for wastewater treatment and exceeding the capacity of a collection system can result in a discharge of untreated wastewater into the environment.

Wet Weather Flow Loading

Inflow and Infiltration (I&I) generally consists of wet weather infiltration and stormwater inflow that enters the wastewater collection system. Infiltration may enter the collection system through defects in the system pipelines which may include, cracks, broken pipe, offset joints, break-in connections, and manholes due to temporary high groundwater levels as a result of rainfall percolation or consistent high water levels. Inflow includes surface stormwater that rapidly enters the sewer system from above ground sources including faulty manhole covers, foundation drains, uncapped cleanouts, and storm drain cross-connections. Typically, infiltration from rainfall events can be estimated using flow metering technology and rainfall records. However, inflow and infiltration that occurs year-round is generally detected by performing inspections of the pipelines and manholes and occur in areas with high groundwater elevations.

Wet Weather Calibration

Wet weather flow calibration assures accurate modelling of anticipated I&I into the sewer system. I&I can be interpreted as the difference between dry weather flow and wet weather flow. Wet weather flows were calibrated to a rain event that occurred on February 27, 2017 from 1:00 AM to 11:00 PM. Rainfall data was obtained from the Carlsbad McClellan Palomar Airport Weather Station. The total amount of rainfall during the rain event was approximately 3.23 inches. Based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates, the rain event is between a 25-Year and 50-Year 24 Hour Storm. It should be noted that while the model was calibrated to the 25-year storm event, a 10-year event was used to determine appropriate capacity of the wastewater collection system.

For the wet weather flow calibration process, rain derived infiltration and inflow (RDII) areas tributary to each loading area was developed. The RDII tributary areas were calculated in ArcGIS using a Land Cover shapefile provided through the San Diego GIS Data Warehouse. Any Land Cover area classified as buildings, roads or other paved surfaces was assumed to contribute to RDII flow. The RDII tributary areas allow the transformation of the hourly rainfall depths into corresponding I&I flows.

The primary step in the wet weather flow calibration process involves using the RTK Method to generate RDII hydrographs based on precipitation data. The RDII hydrograph is the sum of three unit hydrographs, one for a short-term response, one for an intermediate-term response, and one for a long-term response. The unit hydrographs are defined by three parameters: R (the fraction of rainfall volume that enters the sewer system), T (the time from the onset of rainfall to the peak of the unit hydrograph in hours), and K (the ratio of time to recession of the unit hydrograph to the time of peak). An example RDII hydrograph in InfoSWMM is presented in Figure 6-D. The nine (9) separate variables for the RDII hydrographs were adjusted until the modeled flows matched with the measured flows.

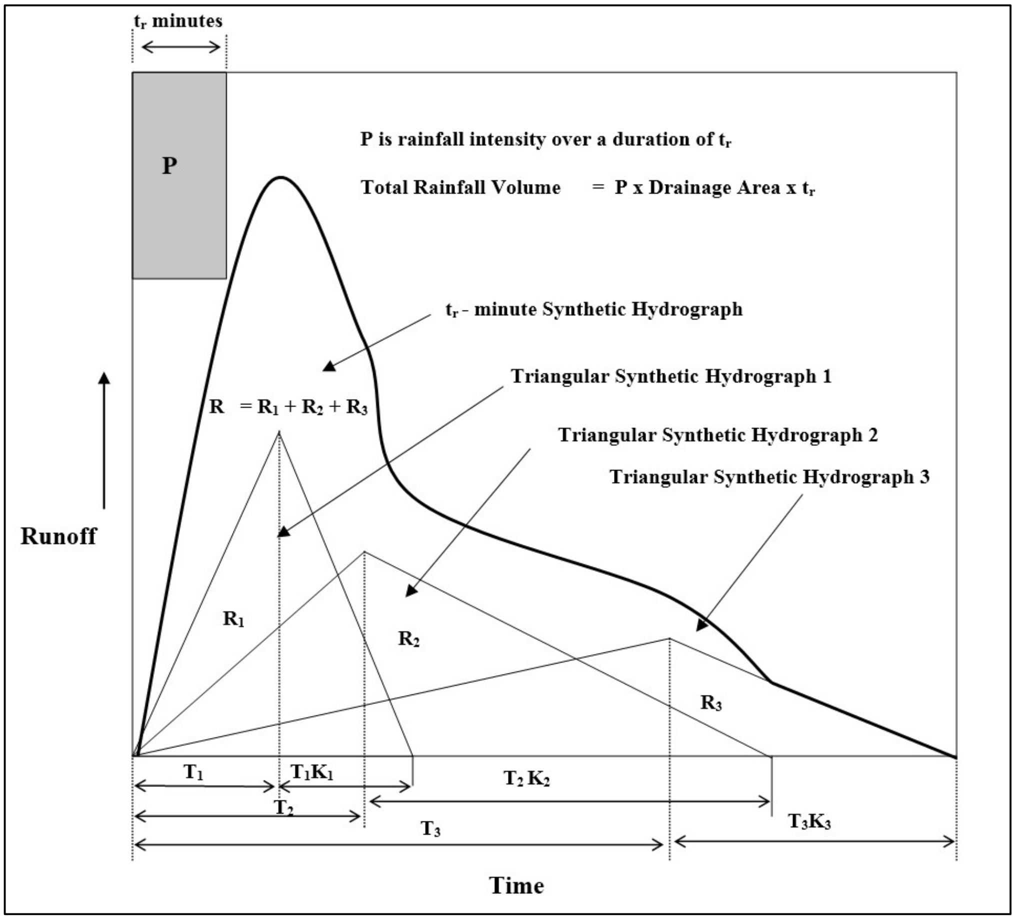


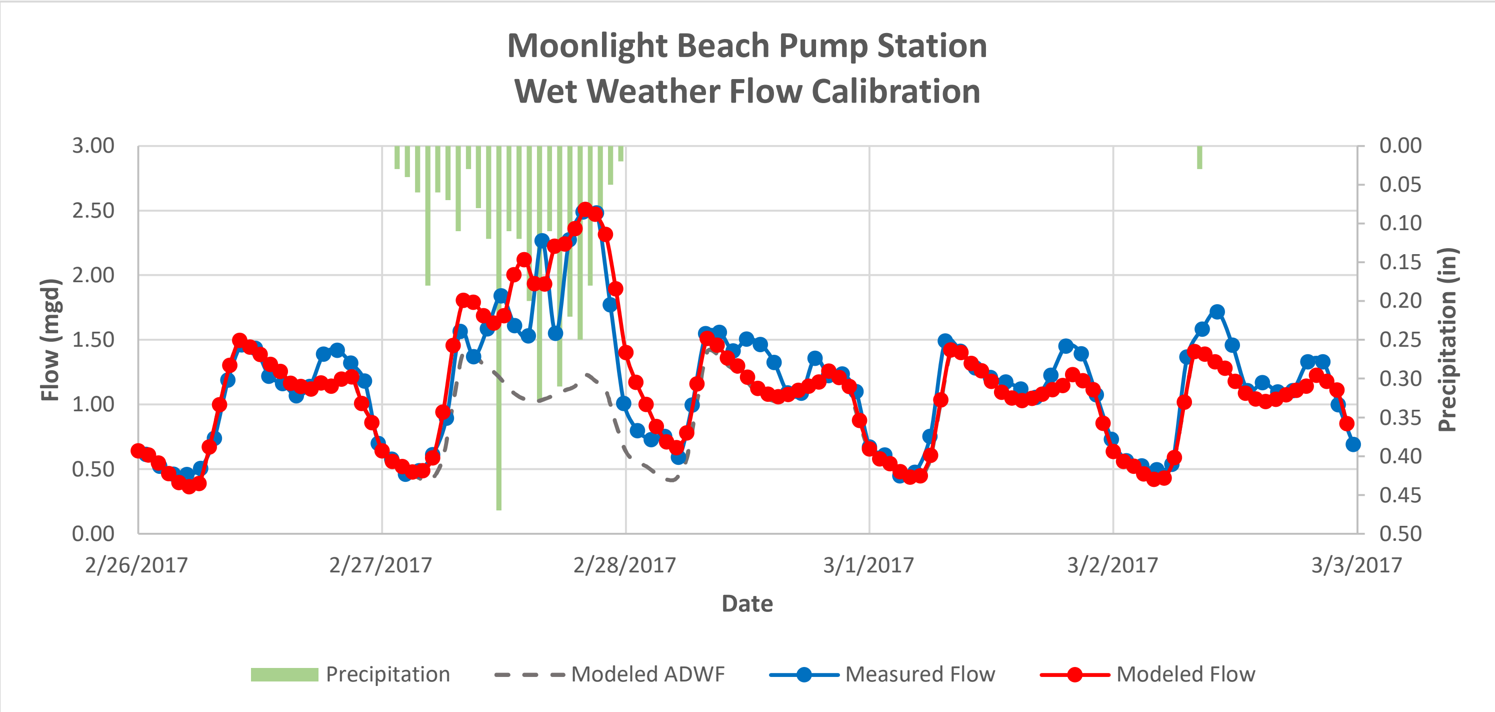
Figure 6-D Example InfoSWMM RDII Hydrograph

A summary of the wet weather flow calibration is presented in Table 6-E. Average flows are all within +/- 11 percent and peak flows are all within +/- 5 percent. Appendix 3 contains the detailed wet weather flow calibration summary for the four flow meters. It is important to note that there is a possibility that the hourly precipitation data obtained from the Carlsbad McClellan Palomar Airport Weather Station, which is several miles to the north of the City, may not be representative of the actual precipitation that the sewer system encountered during the rain event (i.e. the rainfall event that occurred at the Carlsbad McClellan Palomar Airport may not be the same rainfall event that occurred in Encinitas). While there are two closer weather stations (Encinitas 2.7N and Encinitas 3.34ENE), these only provide daily precipitation data.

Table 6-E Wet Weather Flow Calibration Summary

Meter Location	Measured Data		Modeled Data		Percent Error	
	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (MGD)	Peak Flow (MGD)	Avg. Flow (%)	Peak Flow (%)
Moonlight Beach Pump Station	1.321	2.491	1.358	2.512	2.84%	0.85%
Cardiff Gravity Trunk Sewer	0.377	0.822	0.395	0.829	4.75%	0.80%
Cardiff Pump Station	1.136	2.357	1.193	2.336	5.04%	-0.88%
Olivenhain Pump Station	1.613	2.346	1.437	2.374	-10.90%	1.16%

Below is an illustration of the wet weather flow calibration results for the Moonlight Beach Pump Station.



7.0 HYDRAULIC / CAPACITY EVALUATION

7.1 EVALUATION CRITERIA

The evaluation criteria for gravity sewers includes the depth of flow and velocity, which are calculated using the hydraulic model. The capacity of the gravity sewer pipeline are typically designed to accommodate and transport sewer gasses that may result in undesirable odors and provide for conveyance of wet weather inflow and infiltration. Based on City criteria, pipelines are sized based on the pipeline flowing up to 75% full (d/D=0.75) at PWWF if the pipe is larger than 16-inches in diameter. For pipelines with a diameter of 16-inches or smaller, a d/D factor of 0.50 is used.

The 2011 Master Plan, and similarly, in this Master Plan Update, the PWWF analysis assumes peak I&I rates coincide with the Peak Dry Weather Flow (PDWF) and the duration of the PWWF condition is brief. Thus, when gravity pipelines are evaluated to determine if there is adequate capacity under the PWWF condition, separate pipeline evaluation criteria is used to determine the allowable d/D ratio before a pipeline is recommended for upsizing. Based on discussions with City staff, the evaluation criteria, which has been widely established and accepted by other agencies, gravity sewers are permitted to flow up to 90 percent of the pipeline capacity (d/D=.90) at PWWF before triggering the need for upsizing.

The following data was used to evaluate the capacity of the gravity sewers under existing and build out conditions:

- 2020 population forecasts for residential flows (existing);
- Water billing data for non-residential flows (existing);
- A flow of 0.126 MGD (2020 Scenario) for RSFCSD, subdivided into four (4) connection locations;
- A flow of 0.082 MGD (2020 Scenario) for San Elijo Hills at one location;
- For all sewer main diameters, the maximum d/D Ratio is 0.90;
- A 10-year storm was used for existing and wet weather flows to determine appropriate capacity.

Sewer pipelines that exceed the d/D ratio of 0.90 were identified as capital improvement projects. Additionally, an analysis was performed to identify pipelines where the d/D ratio of 0.75 was exceeded under PWWF conditions. Pipelines which exceeded a d/D ratio of 0.75 under the conditions noted above were identified as potential improvement projects if either or both of the following situations exist:

- There are corresponding operations and maintenance issues associated with the pipeline;
- The pipeline is identified for replacement due to condition related deficiencies,

If either of these situations occur, the pipeline(s) is to be replaced and upsized per the City design criteria stated above. The replacement and upsized pipeline must also meet the minimum velocity requirements. Table 7-1 includes a summary of the pipelines identified as exceeding the d/D ratio of 0.75 under PWWF conditions and which could be considered potential projects should one or both of the conditions listed above occur.

Table 7-1 Potential Projects – d/D Exceeds 0.75 under PWWF Conditions

No.	CIP Project ID	Location Description	Length (ft)	Existing Diameter (inches)	Proposed Diameter (inches)	Sanitary Division
1	A1	OTS - Crystal Ridge Road to Wildflower Valley Drive	2,204	8	10	CSD
2	B1	Tributary to OTS - Crystal Ridge Road and Lone Jack Road	119	8	10	CSD
3	C1	OTS - Olivenhain Pump Station to Siphon	7,101	15	18	CSD
4	C2	OTS - Olivenhain Pump Station to Siphon	593	15	18	CSD
5	C4	OTS - Olivenhain Pump Station to Siphon	216	15	18	CSD
6	D1	OTS - Siphon to S Rancho Santa Fe Road	1,285	15	18	CSD
7	D2	OTS - Siphon to S Rancho Santa Fe Road	961	15	18	CSD
8	D3	OTS - Siphon to S Rancho Santa Fe Road	146	15	18	CSD
9	E1	CTS - Cardiff Pump Station to Manchester Avenue	448	15	18	CSD
10	F1	Tributary to CTS - Cardiff Pump Station	53	8	12	CSD
11	G1	CRTS - Manchester Avenue to Liverpool Drive	401	12	18	CSD
12	G1X	CRTS - Manchester Avenue to Liverpool Drive	361	12	15	CSD
13	G3	CRTS - Manchester Avenue to Liverpool Drive	463	12	15	CSD
14	G4	CRTS - Manchester Avenue to Liverpool Drive	448	12	15	CSD
15	H1	CRTS - Liverpool Drive to Sheffield Avenue	612	10	12	CSD
16	H2	CRTS - Liverpool Drive to Sheffield Avenue	324	10	15	CSD
17	I1	CRTS - Sheffield Avenue to Loch Lomond Drive	2,142	10	12	CSD
18	J1	Tributary to CRTS - Loch Lomond Drive to Orkney Lane	333	10	12	CSD
19	K1	Tributary to CRTS - Orkney Lane to Santa Fe Drive	562	8	10	CSD
20	K3	Tributary to CRTS - Orkney Lane to Santa Fe Drive	245	8	10	CSD
21	K4	Tributary to CRTS - Orkney Lane to Santa Fe Drive	37	8	10	CSD

No.	CIP Project ID	Location Description	Length (ft)	Existing Diameter (inches)	Proposed Diameter (inches)	Sanitary Division
22	L1	CTS - Montgomery Avenue to End of CTS	1,591	8	10	CSD
23	L2	CTS - Montgomery Avenue to End of CTS	23	8	10	CSD
24	M1	Tributary to CTS - End of CTS to Devonshire Drive	843	8	10	CSD
25	N1	Tributary to ETS - Moonlight Beach Pump Station	104	14	18	ESD
26	O2	Tributary to ETS - Property East of Ocean Avenue	105	8	10	ESD
27	O3	Tributary to ETS - Property East of Ocean Avenue	585	8	10	ESD
28	P4	Tributary to ETS - Alley (C Street and G Street, 2nd Street and 3rd Street)	1,241	8	10	ESD
Total			23,457			

7.1.1 Dry Weather Flows at Build Out

For the ultimate system analysis, future wastewater flows were added to existing flows. Future flows to the wastewater collection system include those generated from the development of vacant parcels or redevelopment of existing parcels. For the dry weather at build-out scenario, additional dry weather flows are based on the City's 2019 Housing Element which is a comprehensive document that outlines the City's housing needs and establishes the City's strategies to meet the established housing goals.

There are several planned development projects identified in the as part of the 2019 Housing Element and future wastewater flows for these projects are projected based on the number of housing units and the building area for non-residential development. While GIS layer of the planning housing developments was not available, the City Planning Department Staff provided a copy of the housing element containing information on the specific developments. An overview of the additional housing units based on information obtained from the 2019 Housing Element is illustrated in Table 7-A The planned developments are summarized in Appendix 4.

A summary of the additional anticipated housing units through 2035 is summarized in Table 7-A. A population density of 2.5 persons per dwelling unit and a flow rate of 70 gallons per capita per day were used to calculate the projected flows.

Table 7-A Housing Element Additional Flows

Housing Unit Type	Additional Units	Additional Flow (MGD)
Very Low Low Income	1,193	0.263
Recycled	60	0.011
Moderate Income Sites	410	0.123
Above Moderate Income Sites	86	0.031
Approved Units Without Permits	89	0.020
TOTAL	**1,838**	**0.448**

A linear growth of dry weather flow was assumed between 2020 (Existing Scenario) and 2035 (Build-Out Scenario). For the 2025 Scenario, 2035 dry weather flows were scaled back by approximately 33% for each planning horizon. Thus, for the 2030 Scenario, 2035 dry weather flows were scaled by approximately 66%.

Rancho Santa Fe Community Services District

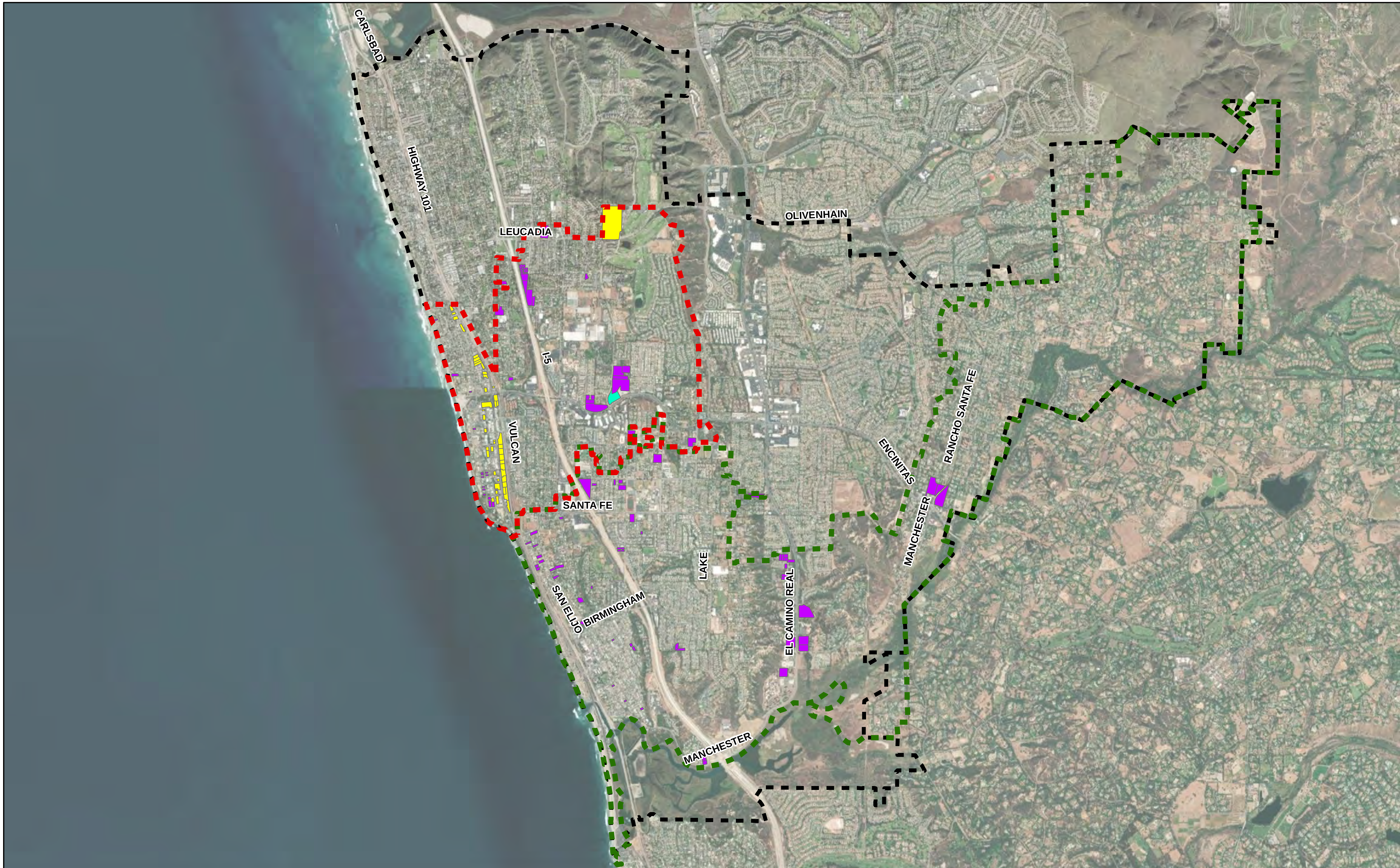
For RSFCSD, a flow of 0.25 MGD, which is based on the full capacity per the current agreement between RSFCSD and CSD, is used for the build-out scenario. The estimated flow at each connection is summarized in Table 7-B.

Table 7-B RSFCSD Connections Summary – Build-out Scenario

Connection No.	Estimated Flow (MGD)
1	0.023
2	0.001
3	0.126
4	0.100
TOTAL	**0.250**

San Elijo Hills

For the 2025 and 2035 Scenarios, a linear growth of dry weather flow was assumed between 2020 (Existing Scenario) and 2035 (Build-Out Scenario). For the 2025 Scenario, 2035 dry weather flows were scaled by approximately 33% for each planning horizon. Thus, for the 2030 Scenario, 2035 dry weather flows were scaled by approximately 66%



LEGEND

LandUse

- COMMERCIAL
- MIXED USE
- SINGLE-FAMILY RESIDENTIAL

SANITARY DIVISION BOUNDARY

- ENCINITAS
- CARDIFF SANITARY DIVISION
- ENCINITAS SANITARY DIVISION

0 1,750 3,500 Feet

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

HOUSING ELEMENT OVERVIEW

FIGURE NUMBER **7-A**

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER
...0000687

7.2 CAPACITY ANALYSIS

A capacity analysis of the existing collection system was performed under existing and forecasted dry and wet weather flow conditions. Model simulations were performed for the 2025, 2030, and 2035 planning horizons to identify potential improvement projects. Projects were evaluated under the existing wastewater flows to identify project priority and phasing. For each of the sanitation divisions, a hydraulic analysis was performed for each of the following scenarios:

- 2020 Dry and Wet Weather Scenario (Existing)
- 2025 Dry and Wet Weather Scenario
- 2030 Dry and Wet Weather Scenario
- 2035 Dry and Wet Weather Scenario (Build Out)

7.3 GRAVITY PIPELINES

The following includes a summary of findings of the capacity analysis performed for each scenario. Capacities in the CSD and ESD trunk sewers with projected ultimate flows were evaluated under dry and wet weather flow scenarios based on the d/D criteria. Findings of the hydraulic analysis for each trunk sewer are provided in Appendix 5 and further described in the following sections. Pipe reaches with a d/D ratio at greater than 0.90 at PWWF are identified as potential improvement reaches.

7.3.1 Existing (2020) Dry Weather Scenario

Table 7-C includes a summary of the flows under existing condition. Under the existing PDWF condition, model results indicate that no pipeline reach exceeds the d/D ratio of 0.90. The maximum d/D of any gravity sewer under this scenario is approximately 0.686 and located in the Cardiff Sanitation Division.

Table 7-C Existing Scenarios Flow Summary

Basin	Average Dry Weather Flow (MGD)	Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Moonlight Beach Pump Station	0.965	1.495	2.464
Cardiff Gravity Trunk Sewer	0.202	0.356	0.808
Cardiff Pump Station	0.659	1.051	2.311
Olivenhain Pump Station	0.634	0.924	2.086
ESD Total	**0.965**	**1.495**	**2.464**
CSD Total	**1.495**	**2.331[1]**	**5.205[1]**

Notes:
1. Assumes peak flows occur simultaneously.

7.3.2 Existing (2020) Wet Weather Scenario

Under existing wet weather conditions, approximately 11,734 feet of gravity sewers were identified as having a d/D ratio greater than 0.90. A summary of the pipelines is provided in Appendix 5 and the location of these sewers are illustrated on Figure 7-B.

7.3.2.1 CSD

Along the Olivenhain Trunk Sewer, the hydraulic analysis indicates that approximately 3,980 feet of pipe (8-inches, and 10-inches) exceeds the d/D of 0.90 with values ranging from 0.97 to 1.00. Additionally, surcharging is occurring at 15 manholes with the majority of these manholes located at the upstream portion of the Olivenhain Trunk Sewer or sewers tributary to the upstream portion of the Olivenhain Trunk Sewer. The surcharged manholes are summarized in Appendix 6. Several of these manholes have been included in the proposed OTS Improvement Plans along Lone Jack Road.

Along the Cardiff Trunk Sewer, approximately 591 feet of pipe (8-inches and 15-inches) exceeds a d/D of 0.90 with values ranging from 0.92 to 0.96 while along the Cardiff Relief Trunk Sewer: approximately 2,426 feet of pipe (10-inches) is over the 0.90 d/D with all values capped at 1.00.

Of the other CSD sewer mains, approximately 4,737 feet of pipe (8-inches and 10-inches) were identified as having d/D ratios greater than 0.90 and ranging from 0.92 to 1.00. The pipelines are summarized in Appendix 5.

7.3.2.2 ESD

The hydraulic analysis indicates the Encinitas Trunk Sewer can convey peak wet weather flows within the capacity of the pipeline. During peak wet weather flows, the highest d/D ratio is 0.62 in pipeline ID 14115SMAIN (15-inch). Thus, no capacity improvements are necessary along the Encinitas Trunk Sewer. All other sewers outside of the Encinitas Trunk Sewer have a d/D ratio less than 0.90.

7.3.3 2025 Dry Weather Scenario

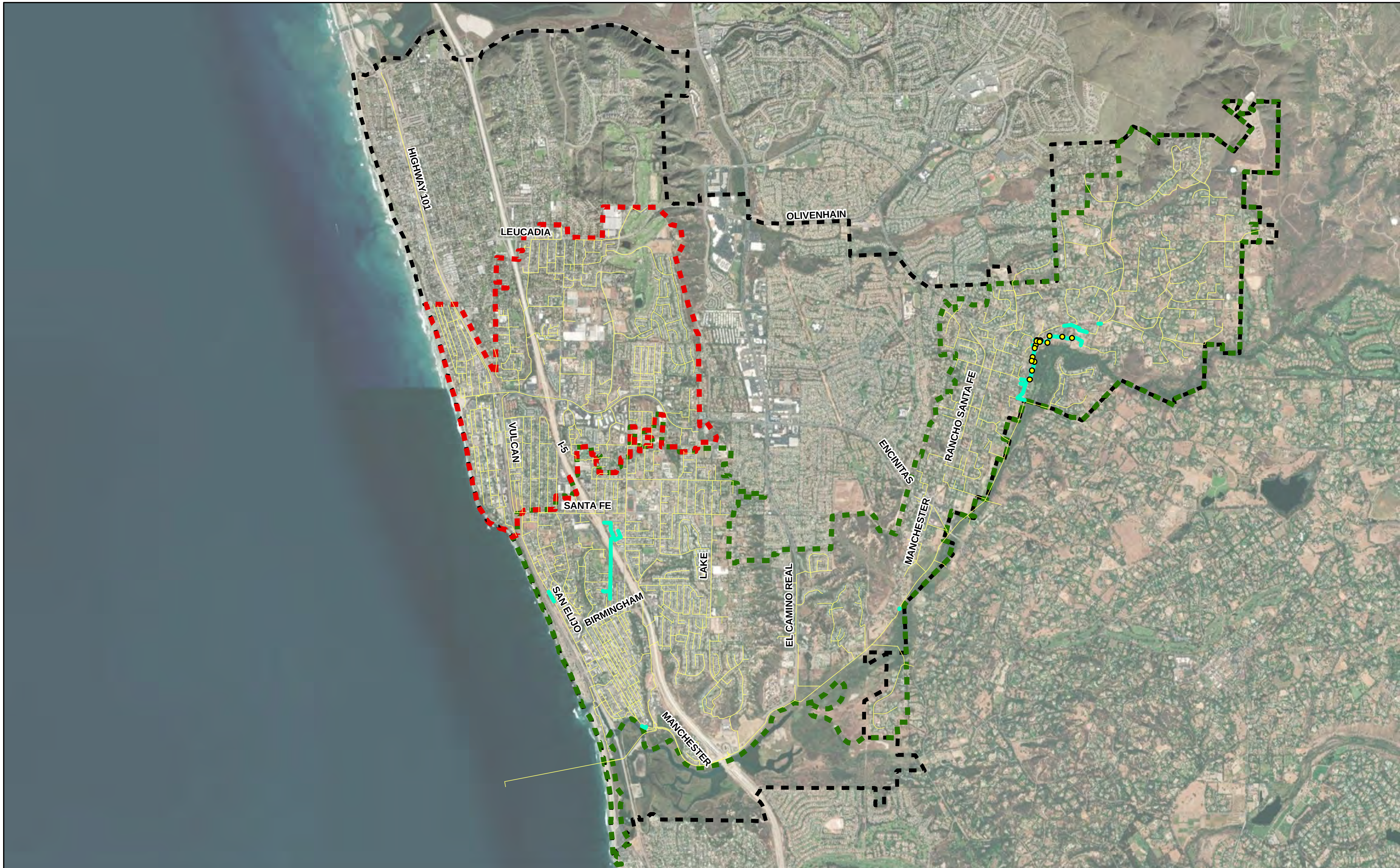
Table 7-E includes a summary of the projected flows at the affected pump stations under the 2025 scenario. Generally, under the existing PDWF condition, model results indicate that there are no pipelines that exceed the d/D ratio of 0.90.

Table 7-D 2025 Scenario Flow Summary

Basin	Average Dry Weather Flow (MGD)	Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Moonlight Beach	1.044	1.621	2.567
Cardiff Gravity	0.202	0.357	0.809
Cardiff	0.667	1.066	2.323
Olivenhain	0.700	1.019	2.168
ESD Total	**1.044**	**1.621**	**2.567**
CSD Total	**1.569**	**2.441**	**5.300**[1]

Notes:
1. Assumes peak flows occur simultaneously.

The maximum d/D of any gravity sewer under this scenario is approximately 0.686, which is located in the Cardiff Sanitation District. This Information is included in Appendix 5.



LEGEND

- SURCHARGED MANHOLES
- GRAVITY SEWERS OVER 0.90 d/D
- GRAVITY SEWERS

SANITARY DIVISION BOUNDARY

- ENCINITAS
- CARDIFF SANITARY DIVISION
- ENCINITAS SANITARY DIVISION

0 1,750 3,500 Feet

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

EXISTING WET WEATHER SCENARIO GRAVITY SEWERS OVER 0.90 d/D

FIGURE NUMBER **7-B**

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER **227819-0000687**

7.3.4 2025 Wet Weather Scenario

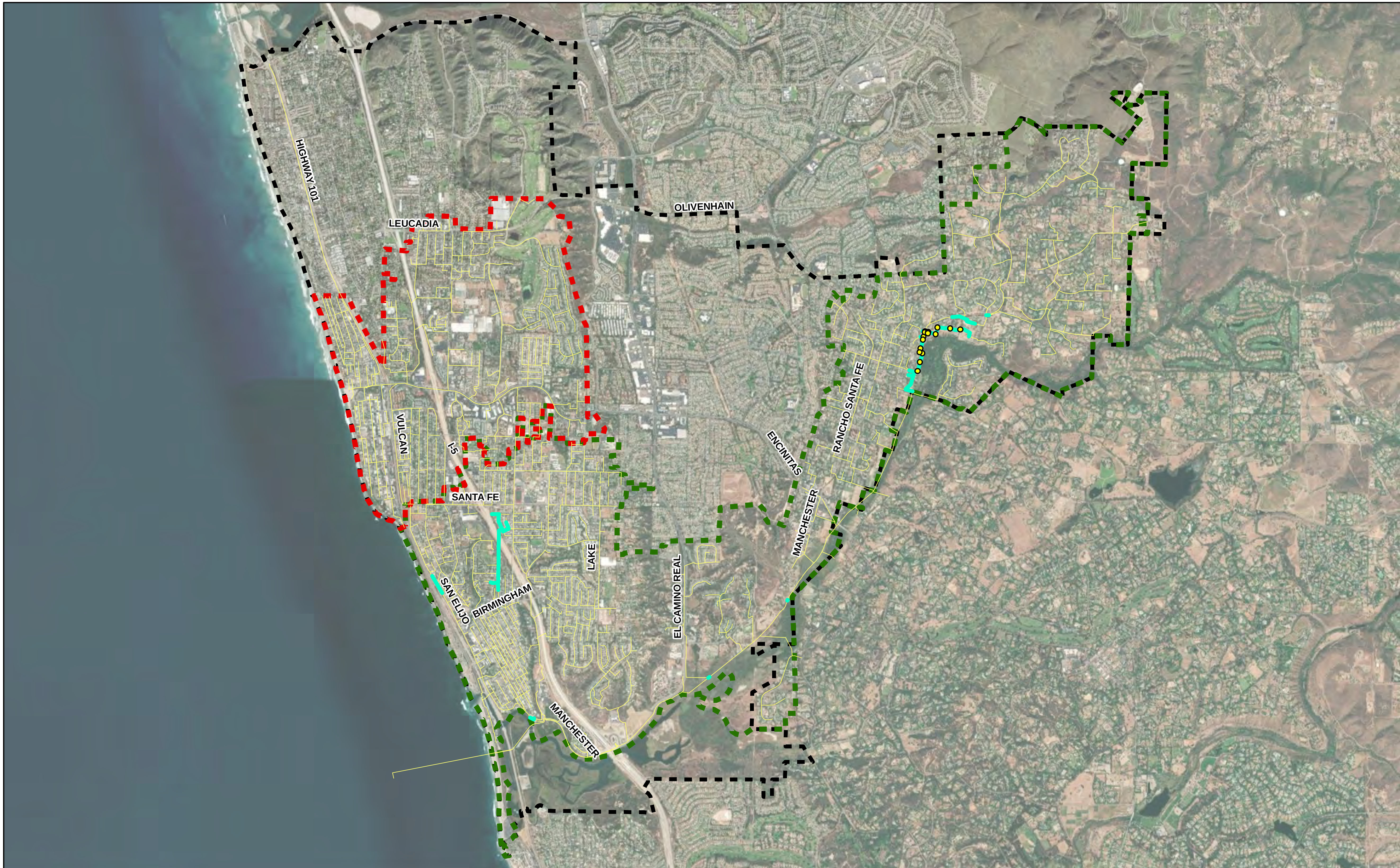
For the 2025 wet weather scenario, approximately 12,118 feet of gravity sewers were identified as having a d/D ratio greater than 0.90. A summary of the pipelines is provided in Appendix 5 and the location of these sewers are illustrated on Figure 7-C. The existing gravity sewer not meeting the evaluation criteria is summarized below.

7.3.4.1 CSD

Along the Olivenhain Trunk Sewer, the hydraulic analysis indicates that approximately 4,042 feet of pipe is over the 0.90 d/D with values ranging from 0.90 to 1.00. Additionally, the same manholes were identified as surcharging as were under the 2020 wet weather flow conditions. The 15 manholes are located at the upstream portion of the Olivenhain Trunk Sewer or sewers tributary to the upstream portion of the Olivenhain Trunk Sewer and are summarized in Appendix 5.

Along the Cardiff Trunk Sewer, approximately 913 feet of pipe (8-inches and 15-inches) is over the 0.90 d/D with values ranging from 0.90 to 0.96 while along the Cardiff Relief Trunk Sewer, approximately 2,426 feet of pipe (10-inches) exceeds 0.90 with all values capped at 1.00.

Of the other CSD sewer mains, approximately 4,737 feet of pipe (8-inches and 10-inches) were identified as having d/D ratios greater than 0.90 and ranging from 0.92 to 1.00. The pipelines are also summarized in Appendix 5.



LEGEND

SURCHARGED MANHOLES

GRAVITY SEWERS OVER 0.90 d/D

GRAVITY SEWERS

SANITARY DIVISION BOUNDARY

ENCINITAS

CARDIFF SANITARY DIVISION

ENCINITAS SANITARY DIVISION

Feet
0 1,750 3,500

N

NV5

15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

2025 WET WEATHER SCENARIO
GRAVITY SEWERS OVER 0.90 d/D

FIGURE NUMBER
7-C

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER
0000687

7.3.4.2 ESD

The hydraulic analysis indicates the Encinitas Trunk Sewer can convey peak wet weather flows within the capacity of the pipeline. During peak wet weather flows, the highest d/D ratio is 0.64 in pipeline ID 14115SMAIN (15-inch). Thus, no capacity improvement are necessary along the Encinitas Trunk Sewer. The analysis also indicates that all other sewer mains have a d/D ratio less than 0.90.

7.3.5 2030 Dry Weather Scenario

Table 7-F includes a summary of the flows for 2030 dry weather scenario. Under the existing PDWF condition, model results indicate that that there are no pipeline reaches that exceed the d/D ratio of 0.90. The maximum d/D of any gravity sewer under this scenario is approximately 0.701 and located in the Cardiff Sanitation District. This Information is included in Appendix 5.

Table 7-E 2030 Scenario Flow Summary

Basin	Average Dry Weather Flow (MGD)	Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Moonlight Beach	1.124	1.747	2.670
Cardiff Gravity	0.203	0.358	0.810
Cardiff	0.676	1.080	2.333
Olivenhain	0.764	1.108	2.243
ESD Total	**1.124**	**1.747**	**2.670**
CSD Total	**1.643**	**2.546**	**5.386**[1]

Notes:

1. Assumes peak flows occur simultaneously.

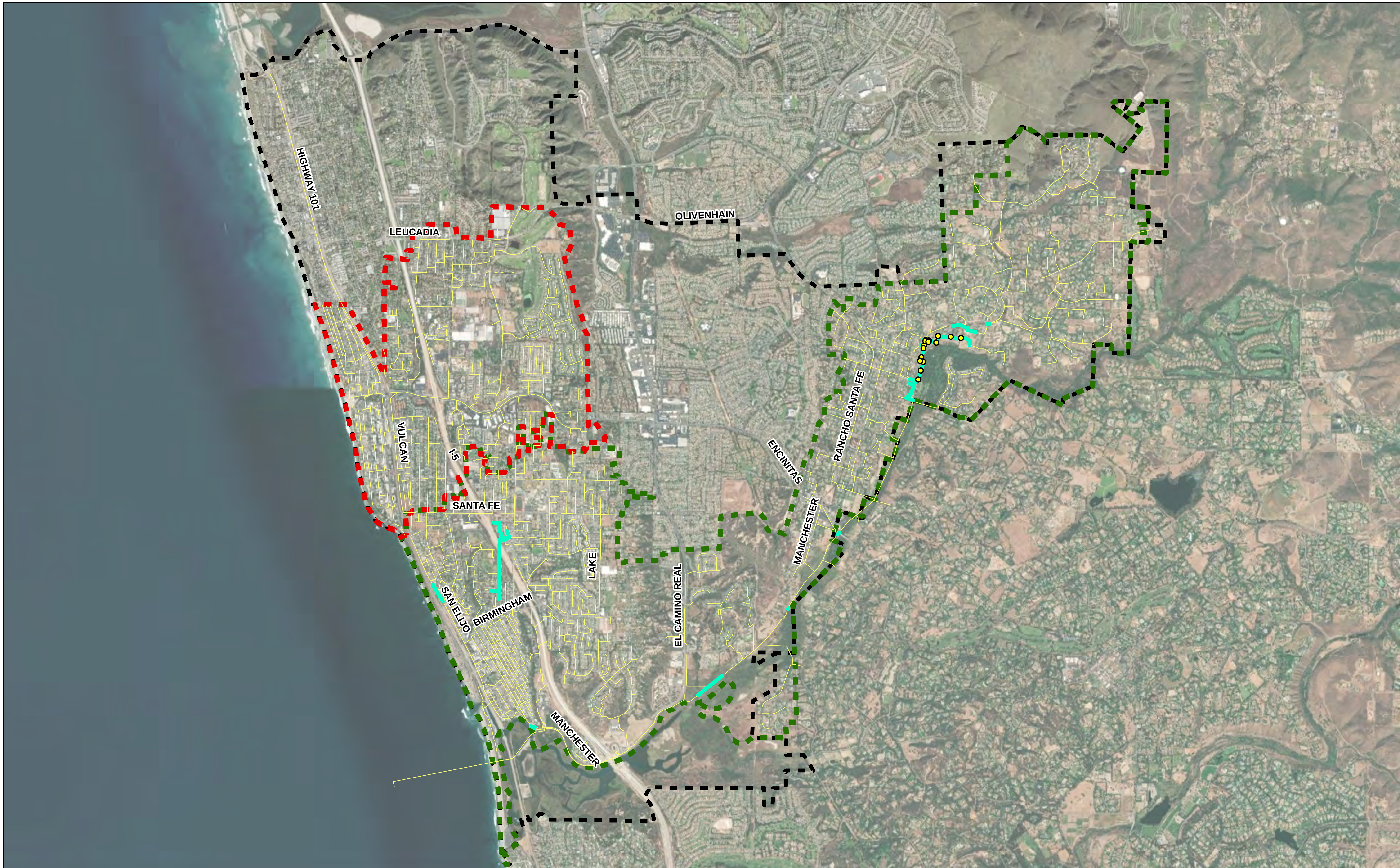
7.3.6 2030 Wet Weather Scenario

For the 2030 wet weather scenario, approximately 13,360 feet of gravity sewers were identified as having a d/D ratio greater than 0.90. A summary of the pipelines is provided in Appendix 5 and the location of these sewers are illustrated on Figure 7-D. The existing gravity sewer not meeting the evaluation criteria is summarized below.

7.3.6.1 CSD

Along the Olivenhain Trunk Sewer, the hydraulic analysis indicates that approximately 5,283 feet of pipe is over the 0.90 d/D with values ranging from 0.92 to 1.00. Additionally, the same manholes were identified as surcharging as were under the 2020 and 2025 wet weather flow conditions.

Along the Cardiff Trunk Sewer, approximately 913 feet of pipe (8-inches and 15-inches) is over the 0.90 d/D with values ranging from 0.92 to 0.97 while along the Cardiff Relief Trunk Sewer approximately 2,426 feet of pipe (10-inches) is over the 0.90 d/D with values at 1.00.



LEGEND

- SURCHARGED MANHOLES
- GRAVITY SEWERS OVER 0.90 d/D
- GRAVITY SEWERS

SANITARY DIVISION BOUNDARY

- ENCINITAS
- CARDIFF SANITARY DIVISION
- ENCINITAS SANITARY DIVISION

Feet
0 1,750 3,500

N

NV5
15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

2030 WET WEATHER SCENARIO GRAVITY SEWERS OVER 0.90 d/D

FIGURE NUMBER
7-D

PREPARED FOR: CITY OF ENCINITAS
DATE SUBMITTED: JUNE 2021
JOB NUMBER 0000687

Of the other CSD sewer mains, approximately 4,737 feet of pipe (8-inches and 10-inches) were identified as having d/D ratios greater than 0.90 and ranging from 0.93 to 1.00. The pipelines are summarized in Appendix 5.

7.3.6.2 ESD

The analysis indicates the Encinitas Trunk Sewer has the capacity to convey peak wet weather flows within the capacity of the pipeline. During peak wet weather flows, the highest d/D ratio is 0.68 in pipeline ID 14115SMAIN (15-inch). Thus, no capacity improvements are necessary along the Encinitas Trunk Sewer. All other sewers outside of the Encinitas Trunk Sewer have a d/D ratio less than 0.90.

7.3.7 Build-Out (2035) Dry Weather Scenario

Table 7-G includes a summary of the flows for 2035 dry weather scenario. Under the PDWF condition, model results indicate that no pipeline reaches exceed the d/D ratio of 0.90. The maximum d/D of any gravity sewer under this scenario is approximately 0.745 and is located in the Cardiff Sanitation District.

Table 7-F Build-Out Scenarios Flow Summary

Basin	Average Dry Weather Flow (MGD)	Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Moonlight Beach	1.213	1.877	2.773
Cardiff Gravity	0.203	0.359	0.810
Cardiff Pump	0.684	1.097	2.343
Olivenhain Pump	0.828	1.209	2.277
ESD Total	**1.203**	**1.877**	**2.773**
CSD Total	**1.716**	**2.665**[1]	**5.430**[1]

Notes:
1. Assumes peak flows occur simultaneously.

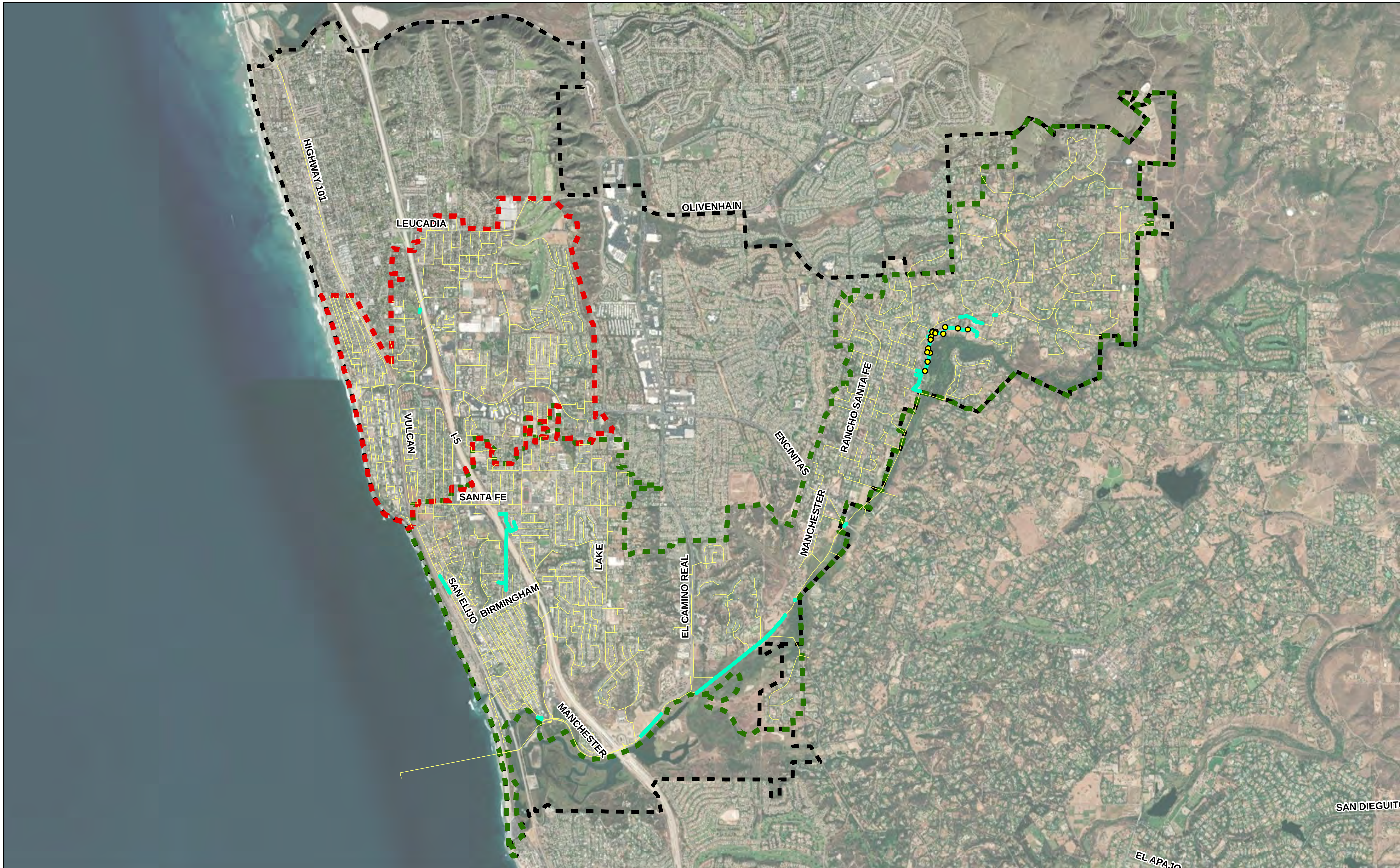
7.3.8 Build-Out (2035) Wet Weather Scenario

For the 2035 wet weather scenario, approximately 17,855 feet of gravity sewers were identified as having a d/D ratio greater than 0.90. A summary of the pipelines is provided in Appendix 5 and the location of these sewers are illustrated on Figure 7-E. The existing gravity sewer not meeting the evaluation criteria is summarized below.

7.3.8.1 CSD

The hydraulic analysis indicates that approximately 9,674 feet of the Olivenhain Trunk Sewer exceeds the 0.90 d/D ratio with values ranging from 0.90 to 1.00 and the same manholes were identified as surcharging as were under the 2020, 2025, and 2030 wet weather flow conditions.

Along the Cardiff Trunk Sewer, approximately 913 feet of pipe (8-inches and 15-inches) is over the 0.90 d/D with values ranging from 0.93 to 1.00 while along the Cardiff Relief Trunk Sewer: approximately 2,426 feet of pipe (10-inches) is over the 0.90 d/D with values capped at 1.00.



LEGEND

- SURCHARGED MANHOLES
- GRAVITY SEWERS OVER 0.90 d/D
- GRAVITY SEWERS

SANITARY DIVISION BOUNDARY

- ENCINITAS
- CARDIFF SANITARY DIVISION
- ENCINITAS SANITARY DIVISION

Feet
0 1,750 3,500

N

15092 AVENUE OF SCIENCE, SUITE 200
SAN DIEGO, CA 92128
P: 858.385.0500 WWW.NV5.COM

BUILD-OUT WET WEATHER SCENARIO GRAVITY SEWERS OVER 0.90 d/D

FIGURE NUMBER **7-E**

PREPARED FOR: CITY OF ENCINITAS **DATE SUBMITTED: JUNE 2021**

JOB NUMBER [illegible]0000687

Of the CSD sewer mains, approximately 4,737 feet of pipe (8-inches and 10-inches) were identified as having d/D ratios greater than 0.90 and ranging from 0.93 to 1.00. The pipelines are summarized in Appendix 5.

7.3.8.2 ESD

The analysis indicates the Encinitas Trunk Sewer has the capacity to convey wet weather flows within the capacity of the pipeline. During peak dry weather flow, the highest d/D ratio is 0.68 in pipe ID 14115SMAIN (15-inch). Thus, no capacity improvements are necessary along the Encinitas Trunk Sewer. However, outside of the Encinitas Trunk Sewer, approximately 105 feet of pipeline was identified as exceeding the d/D ratio of 0.90. The d/D for the single pipeline is 0.91.

7.3.9 Summary of Scenarios

A summary of the pipeline lengths (in feet) in each sanitary division not meeting the evaluation criteria is presented in Table 7-H.

Table 7-G Pipeline Lengths Not Meeting Evaluation Criteria for Peak Wet Weather Flows

Sanitation Division	2020	2025	2030	2035
Cardiff	11,734	12,118	13,360	17,855
Encinitas	-	-	-	105
TOTAL	**11,734**	**12,118**	**13,360**	**16,442**

7.4 PUMP STATIONS

A capacity evaluation was performed for the four (4) pump stations is summarized in Table 7-I. The station capacities listed assume one pump out of service. All pump stations have capacity to meet the build-out PWWF. It should be noted that the build-out PWWF for the Moonlight Beach Pump Station is approximately 97% of the pump station capacity if operating with one pump out of service.

Table 7-H Pump Stations Capacity Analysis Results

Pump Station	Capacity (MGD)	Build-Out PWWF (MGD)
Moonlight Beach	2.880	2.773
Coast Highway 101	0.180	0.086
Cardiff	2.880	2.343
Olivenhain	3.888	2.277

7.6 REGIONAL FACILITIES

The capacity evaluations for the following facilities are discussed in more detail in the following subsections:

- Batiquitos Pump Station
- Encina Water Pollution Control Facility
- San Elijo Water Reclamation Facility

7.6.1 Batiquitos Pump Station

The Batiquitos Pump Station was originally built in 1974 and is the largest pump station in the Leucadia Wastewater District. The station is jointly owned by ESD and the Leucadia Wastewater District and is located on the southwest side of the Batiquitos Lagoon adjacent to Coast Highway 101. The Leucadia Wastewater District owns approximately 78% of the pump station and is responsible for the operation and maintenance of the pump station. The City of Encinitas owns approximately 22 percent and is billed for its fair share of the operation and maintenance costs. The pump station is equipped with four pumps each of which can pump 8,440 gallons per minute (12.6 MGD). According to a 2018 Asset Management Plan, major upgrades were completed in 1988, 1998, 2005, and 2013.

ESD is allocated approximately 1.80 MGD of ADWF at the Batiquitos Pump Station. Flows from ESD at the pump station are summarized in Table 7-J. Based on the existing ADWF and build-out ADWF, ESD has surplus capacity at the pump station and there are currently no known contractual limitations associated with ESD's PWWF at the pump station.

Table 7-I ESD Flows at the Batiquitos Pump Station

Scenario	Flow (MGD)
Existing ADWF	0.965
Existing PWWF	2.464
Build-Out ADWF	1.213
Build-Out PWWF	2.773

7.6.2 Encina WPCF

As previously noted, flows generated within the ESD are treated at the Encina WPCF which is operated and administered by the EWA under joint powers agreement, and is owned by six members including the LWD, Cities Carlsbad and Vista, the Vallecitos Water District, the Buena Sanitation District and the City of Encinitas.

Based on the 2004 Encina Joint Powers Authority Revised Basic Agreement (Basic Agreement), ESD has capacity rights of 1.80 MGD based on the ADWF. The agreement also states that the wet weather peaking factors on the ADWF are to remain below 2.76, and that each member agency is to maintain a reserve capacity of up to 5 percent of their total capacity. For ESD the reserve capacity equates to 0.09 MGD. The projected ESD ultimate ADWF is 1.213 MGD, which results in a reserve capacity of 0.061 MGD. The projected ultimate PWWF is estimated to be 2.79 MGD, which equates to a peaking factor of approximately 2.30 based on the projected ADWF, and a 1.55 based on capacity rights. ESD flows at the Encina WPCF are summarized in Table 7-K. It is therefore projected that ESD will have surplus capacity at the Encina WPCF at build-out conditions. Based on the existing and build-out flows, ESD has surplus capacity for both ADWF and PWWF at the Encina WPCF.

Table 7-J ESD Flows at the Encina WPCF

Scenario	Flow (MGD)
Existing ADWF	0.965
Existing PWWF	2.464
Build-Out ADWF	1.213
Build-Out PWWF	2.773

7.6.3 SEWRF

Wastewater flows generated in CSD are treated at the SEWRF. Existing and projected flows are summarized in Table 7-L with 2.5 MGD of ADWF allocated to CSD. There are currently no known contractual limitations associated with CSD's PWWF at the SEWRF. Thus, based on the existing ADWF and projected ADWF at build-out, CSD has surplus capacity at the SEWRF.

Table 7-K CSD Flows at the SEWRF

Scenario	Flow (MGD)
Existing ADWF	1.494
Existing PWWF	5.205
Build-Out ADWF	1.716
Build-Out PWWF	5.430

8.0 OPERATION AND MAINTENANCE PROGRAM

The City's Operations and Maintenance program is performed by the City's Public Works Department and partners with the Development Services Department to deliver the services necessary to ensure a well-functioning wastewater system that meets the current and future needs of the community. System information collected during operations and maintenance activities is provided to the Development Services Department who prioritize and execute completion of the capital improvement projects.

8.1 BACKGROUND

The City's Public Works Department is responsible for the inspection, operation, and maintenance of the City's wastewater collection system including the access manholes and related appurtenances. Additionally, this department is responsible for ensuring the implementation of City and regulatory agency policies and procedures to ensure that wastewater operations are effective and economical. A well-maintained sanitary sewer system is critical to preventing community nuisances, preventing sewer spills for the mutual protection of surface waters and the environment, and to safeguard public health and safety that may potentially result in significant penalties.

8.2 SUMMARY OF OPERATION AND MAINTENANCE PROGRAM

Elements of the City's operation and maintenance program include proactive, preventive and corrective maintenance of gravity sewers. The City's primary goal is to clean the pipelines in each sanitation division on a 15-month basis.

8.2.1 Review of Cleaning/Preventive Maintenance Program

To minimize and prevent system blockages that can lead to sewer system overflows (SSOs) the City's Operations and Maintenance (O&M) Program primarily includes performing regular citywide cleaning and inspection of the collection system in each of the sanitation districts.

An effective O&M Program helps to identify and prevent blockages in gravity sewers caused by structural defects or by accumulation of debris in the pipeline. Debris that can accumulate in the pipelines include fats, oil, grease, sediment, or other materials. Certain structural defects, such as protruding lateral connections or cracked pipes, may trap debris and result in accumulated buildup of solids and ultimately potential blockages. Root intrusion through structural defects may result in blockages. Thus, repair or elimination of any defects that contribute to buildup of material is evaluated as part of the rehabilitation program as defects will create maintenance challenges.

8.2.1.1 Mechanical Cleaning Procedures

The City Public Work staff conducts routine mechanical cleaning of the City's wastewater collection pipelines using a combination jet rodder/vactor truck(s). As the citywide cleaning in conducted, the data is captured using handheld tools directly uploaded to Cityworks. Thus, the locations and maintenance history of the City's maintained wastewater system pipes and associated appurtenances are documented.

8.2.1.2 High Frequency Maintenance Locations

The City's preventative maintenance program includes having staff pay particular attention to locations that have been identified as High Frequency Maintenance Locations (HFMLs) in each sanitation division. Generally, the HFMLs include pipeline locations that rapidly accumulate excessive amounts of grease, sludge, root concentrations or have possible pipeline sags. The locations are included on a HFML list for cleaning on a more frequent schedule.

As City crews perform the regular maintenance activities and implement their Closed-Circuit Televising (CCTV) Inspection Program, locations identified as possibly requiring changes to the maintenance cycle are documented and evaluated for inclusion in the subsequent HFML site cleaning cycle and/or for inclusion on the subsequent root treatment schedule.

8.3 SUMMARY OF INSPECTION AND ASSESSMENT PROGRAM

Inspection, documentation, and assessment of the condition of the sanitary sewer pipelines and manholes are important components for properly maintaining and operating a sewer collection system. Collectively the components are used to evaluate and identify potential maintenance issues and structural defects which can contribute to potential sanitary overflows.

CCTV cameras offer valuable insight to the structural and maintenance condition of underground infrastructure. Video inspection of sewer pipelines is used to evaluate the existence and severity of cracks, misaligned joints, accumulation of roots or silt, and potential sources of infiltration. Information obtained from routine inspections serves to:

- Identify existing or potential problems;
- Provide accurate information regarding any existing or potential problems;
- Isolate the location of any existing or potential problems;
- Provide information regarding the criticality of any existing or potential problems;
- Facilitate identification of the optimal method to rectify existing or potential problems.

The City's goal is to inspect the condition of its gravity sewers on a regular basis and to use the information obtained during implementation of its operations and maintenance program for identifying and prioritizing projects for the necessary improvements on a yearly basis.

8.3.1 Pipeline Inspection Criteria and Documentation Procedures

The City's CCTV Inspection and Assessment Program includes City crews performing periodic and systematic inspection of the sanitary sewer system pipelines and manholes in each sanitation division. The City employs CCTV technology for the inspection of system pipelines. The City's CCTV trucks are equipped with Cues inspection equipment which allows formal and regular documentation of the existing condition of the City's wastewater collection system. The information is documented using National Association of Sewer Service Companies (NASSCO) codes and collected in digital format and integrated into Cityworks to facilitate record keeping, reporting, and retrieval of information in a timely manner.

Although the City does not currently have a formal manhole inspection and assessment program, City crews conduct visual inspections of the manholes. Manholes are visually inspected during maintenance and/or annual cleaning of the pipelines, information is documented and defects are noted for tracking and reporting purposes.

8.3.2 Documentation of Inspection Findings

The City applies the NASSCO inspection codes and ratings to document the observations noted during the inspection process as the NASSCO codes provide a consistent method in the manner in which the inspections are conducted and the observations and ratings noted. Structural type observations are distinguished from maintenance type observations with the use of an "S" to denote a structural observation while an "M" is used to denote maintenance related observations.

The numeric severity rating (1-5) assigned to the specific structural and/or maintenance observations are also defined. A NASSCO severity rating of one (1) is minor while a severity rating of five (5) is severe. The severity ratings, as noted, are automatically assigned based on the structural and/or maintenance observation noted by the CCTV operator.

8.4 REVIEW OF SEWER MAINTENANCE DATABASE (CITYWORKS)

Asset management is data intensive and management tools and processes often provide necessary support to collect, assemble, manage, analyze and utilize asset data. The development and use of management tools can improve organizational knowledge and decision making.

The City uses Cityworks as its Computer Maintenance Management System (CMMS). Cityworks is a robust asset management tool with a variety of modules to allow the City to engage in more active management of its assets such as measuring of asset performance, improving capital planning and measuring asset resilience. Using the web-based version of the Cityworks program as its CMMS and repository to catalog the wastewater system assets, City staff documents a variety of information including daily maintenance activities, service calls, citizen complaints and requests received. Maintenance and/or inspection activities as well as repairs and improvements needed by specific asset are also documented.

City staff continues to leverage the capability of GIS to interface with Cityworks which serves to facilitate the comprehensive documentation of system features. Cityworks is used for the scheduling and management of wastewater related operation and maintenance activities, including, but not limited to, routine cleaning, CCTV inspections, and any improvements made to the system assets. With the GIS interface. Cityworks could be used to perform a spatial analysis of work activities and field operations and gain additional operational insights to maintain an ongoing understanding of the general health of the infrastructure and measure asset performance, prioritize repair, rehabilitation and/or replacement activities, and allow City staff to strategically identify and plan for capital investments, implement process improvements, and enhance organizational efficiency.

The City has incorporated workflows within Cityworks to facilitate scheduling of regularly planned maintenance, generate work orders as needed for activities that are not performed on a regular basis, and allows staff to quickly and easily complete work orders. As well, the City has developed SQL reports for reporting and tracking purposes.

While the City continues to work to maintain its GIS to reflect the most current system conditions, based on the review of City provided GIS data it appears the location, type and extent of repairs implemented are not fully documented in the City's GIS and may reside only in the Cityworks data. The regular integration of the Cityworks data and review by the City's Engineering Department may facilitate improved planning. Additionally, continuing to expand the use of Cityworks and integrate more of its capabilities will allow for a more systematic approach to the management of the capital assets and infrastructure. Thus, maintaining this tool is imperative for the City's effective management of its wastewater collection system.

8.5 PIPELINE CONDITION

Review and assessment of City inspection videos was not included as part of the Master Plan Update effort. However, reviewed was the City's Sewer Asset Management Plan, prepared in January 2015, which included inspection and assessment of approximately 8 miles of the 37 miles that make up the ESD and approximately 15 miles of the 79 miles that make up CSD. The pipelines inspected and assessed equated to the physical inspection and condition assessment of approximately 20% of each sanitation division's wastewater collection system. Additionally, associated manholes were inspected and assessed in each sanitation division.

The pipelines inspected included a representative cross-section of the gravity pipelines within each sanitation division and were proportionate to each material / age category by length. The inspections were conducted using NASSCO inspection codes and severity ratings to consistently document the observations noted during the inspections.

The findings of the assessments for pipelines and manholes were used to identify the most effective method to restore the facility to its most efficient condition and extend its useful life. A summary of the findings and recommendations are included in appendices and illustrated in exhibits included in the document.

Since preparation of the Asset Management Plan, the City has issued two (2) construction projects to address the pipelines and manhole deficiencies identified and that were recommended for rehabilitation, repair, or replacement. Specifically, the City prepared the following projects which captures the large majority of the projects:

- 2016-2017 Annual Citywide Sewer Rehabilitation Project, April 2017 and
- 2019-2020 Annual Citywide Sewer Rehabilitation Project, June 2020

At the time this Master Plan Updated was being prepared, the City did not have any additional specific condition related projects identified.

8.6 PUMP STATION EVALUATIONS

Sewer pump station upgrades are well documented in several reports previously prepared. A detailed summary of these pump station inspections and recommended improvements are included in the following reports:

- Cardiff and Encinitas Sewer Master Plan Update, Dudek, April 2011.
- Cardiff Pump Station Evaluation Report, Dudek, April 2012.
- City of Encinitas Sewer Asset Management Plan, Atkins, January 2015.
- Coast Boulevard Pump Station, Final Evaluation Report, Dudek, April 2012.
- Moonlight Beach Pump Station, Pump Replacement Evaluation, Dudek, September 2019.

The following design plans provided by the City were also used as a reference:

- City of Encinitas, Coast Highway 101 Sewer / Pump Station Rehabilitation, Dudek, April 2016.
- City of Encinitas, Olivenhain Sewer Pump Station Improvement Project, Kennedy/Jenks Consultants, December 2010.

To document and confirm the necessary improvements for the City's pump stations, a review of the reports and design plans previously prepared and provided by the City was performed and are summarized in Chapter 10.0.

Additionally, as part of the Master Plan Update, field inspections of the Cardiff, Coast, Olivenhain and Moonlight Beach Pump Stations were performed on January 16, 2020. Physical site inspections were conducted with SEJPA staff to document the existing physical condition of each pump station and identify necessary improvements. The effort served to document improvements that were not yet completed since the completion of the previous assessments but still considered necessary.

9.0 ASSET MANAGEMENT AND RISK ANALYSIS

For wastewater agencies, asset management is generally defined as managing infrastructure capital assets to minimize the total cost of owning and operating them while delivering the minimum level of service. Generally, active asset management is intended to be a method of improving planning and efficiency, offering cost savings and to reduce risk.

In a proactive effort, the City prepared a citywide wastewater asset management plan in 2015. The goal of the asset management plan was to identify and plan for future infrastructure needs and to support the development of appropriate sewer rates to allow recovery of capital, operations, and maintenance costs for providing the necessary services.

To date, the City has been managing the condition of the collection system by performing rehabilitation improvements as they are identified through its inspection and assessment program and is aimed to reduce infrastructure failures that may contribute to sewer overflows.

As an ongoing effort to managing the wastewater collection system, the City performed a risk analysis of the capital improvements identified in this Master Plan Update. The process implemented is described below.

9.1 LIKELYHOOD OF FAILURE (LOF)

A risk analysis is comprised of factors that include the likelihood of failure (LOF) and the consequences of failure (COF). The LOF characterizes the sewer's physical condition. The data collected through the City's GIS and inspection and condition assessment program can be used to determine the likelihood of failure for each pipe segment based on the assigned rating.

LOF scores are intended to represent the probability that a pipe segment or facility will fail based on the conditions of the pipe segment and the physical characteristics. LOF criteria used may include age, material of construction, condition (as observed and recorded through field inspections), work history, and capacity. The following includes a brief description of the LOF criteria used for the criticality analysis of the improvements identified.

<u>Material Age:</u> Pipe materials age and deteriorate over time due to abrasive, structural and mechanical forces, and corrosive agents. All pipelines, therefore, have an anticipated useful service life, which is extremely difficult to predict because of the multitude of variables impacting it. Generally, industry standards indicate VCP has a life expectancy of approximately 60-70 years if property installed, not disturbed and roots are controlled. While there is documentation that PVC pipe can endure for up to 90 years or more, the expected lifespan of PVC can range from approximately 50-80 years with an average life of approximately 70 years.

<u>Pipe Material:</u> Pipe material is a critical factor in determining the most typical failure modes for a given pipe segment. Most ferrous and cement-based pipe failures are attributed to corrosion (internal or external), PVC and other plastic pipe failures can generally be attributed to improper installation.

<u>Pipe Condition:</u> Pipe condition is a critical factor in determining the asset's physical condition and is mostly based on that inspection data captured as the City implements its inspection program. Using the NASSCO PACP codes assigned, pipelines are assigned a condition rating.

Pipe Capacity: Exceeding pipe capacity may occur due to several conditions in the system including under sizing of a pipeline due to increased flows, inflow and infiltration, debris accumulation in the mains or insufficient slope. Exceeding capacity can result in structural failures, may create a pressurized system that can lead to failures at joints or lateral connections and result in sewer overflows.

9.2 CONSEQUENCE OF FAILURE

Consequence of failure (COF) ratings are intended to represent the degree of impact of a pipe segment or facility failure on the service area located in close proximity. The COF criteria typically considers direct impacts, such as loss of service, cost for repair and cleanup, health and environmental impacts such as public health risks, environmental resource impacts, and socioeconomic impacts such as transportation and business disruption. The following is a brief description of the COF criteria used for the criticality analysis.

Receiving Environment: The potential receiving environment, including surface waters as a result of a failure, pipelines located in closest proximity to surface waters are scored higher than pipelines located farther from surface waters. For purposes of this analysis, a proximity of 500 feet was used as the evaluation criteria.

Critical City Facilities: The potential impacts to critical City facilities, which may include hospitals and medical facilities, fire stations, police stations, and schools, pipelines located in the closest proximity (within 0.25 mile radius) to City facilities are scored higher than pipelines located farther from said facilities.

Circulation Systems: Due to the potential impact to transportation systems in the event of a failure, this criterion is scored based on the number and type of transportation systems traversed by the pipeline.

Residential Impacts: Due to the potential impacts to residents in the event of a failure, this criterion is scored based on whether residential parcels located are located within a potential construction repair corridor.

Commercial and/or Industrial Impacts: Due to the potential impacts to businesses in the event of a failure, this criterion is scored based on whether commercial and/or industrial parcels are located within a potential construction repair corridor.

9.3 WEIGHTING FACTORS - LOF

Recognizing that criterion is not of equal importance in determining the criticality, weighting factors are used to prioritize the degree of importance. The higher weighting factor indicates the criterion is of greater importance in the decision making process.

LOF scores were weighted with factors ranging from 10% to 40%. By applying greater weight to specific parameters, the prioritization places a greater emphasis on pipe segments with a higher likelihood or probability of failure, due to the age and condition of the pipe. Table 9-1 includes a summary of the evaluation parameters, categories, ratings and significance of each parameter. For each LOF parameter the following weighting factors are applied to the raw scores to arrive at the weighted score for each parameter.

Table 9-1 Parameters for Likelihood of Failure

Weight of Parameters	Evaluation Parameter	Categories	Rating
20%	Age (Install Decade)	Unknown	5
		1950	5
		1960	4
		1970	3
		1980	2
		1990	1
		2000	1
		2010	1
30%	Capacity (d/D)	0 - 0.5	1
		0.5 - 0.75	2
		0.75 - 0.85	3
		0.86 - 0.89	4
		= > 0.90	5
10%	Material	Asbestos	5
		Concrete	5
		Reinforced Concrete	5
		Ductile Iron	5
		VCP	3
		ESVCP	3
		Unknown	5
		PVC	1
40%	Condition[1] (Stuctural + O&M)	10-9	5
		7-8	4
		6-7	3
		4-5	2
		2-3	1
		1-2	0

[1] Value from CCTV Inspection Data, NASSCO PACP Codes

9.4 WEIGHTED FACTORS - COF

The objective to applying the COF is identify the pipe segments and facilities that represent the highest consequence of failure and assist in the planning and implementation of corrective actions prior to a failure event occurring. The multi-criteria decision making method includes the following:

City Facilities: City facilities located throughout the City serve to accommodate personnel and the services critical to maintaining the City in operation to achieve the required level of service and assure the public's health and safety. A pipeline failure could affect the emergency response to services required. Therefore, a higher rating was assigned if a failure were to occur in a pipeline that is no more than two (2) segments downstream from a City facility.

Receiving Environment: Any wastewater spill has a negative impact on the environment. It is expected that City crews would have a better chance of locating and containing a wastewater spill that occurs on land, as compared to a spill that occurs in the water or reaches surface water. Therefore, the environmental impact was estimated based on the distance of the pipe from a lagoon, the ocean or creek. In each case, the ratings assigned were at the highest levels. The location of the streams and wetlands was based on GIS and other City data.

Residents/Business: A failure of sewer pipes can adversely affect the community and have an economic consequence on businesses impacted. While there will be impacts to residents and businesses, it was assumed that if a pipe failed in a residential or business area, the impact would be less impactful than if a pipeline were to fail in an area within the vicinity of the identified City facilities or within 500 feet of the water bodies.

Circulation System: The impact to traffic flow, if a pipe were to fail, is based on the type of transportation that is in the near vicinity of the pipe. It is assumed that if a pipe fails under a highway or railroad, the impact to traffic flow would be greater than if the pipe failed in an easement or under a less-traveled local street. A failure under a railroad track would also have a large impact on railway transportation, assuming the railroad would have to be closed while repairs were being made.

Table 9-2 includes a summary of the evaluation parameters, categories, ratings and significance of each parameter. For each COF the following weighting factors are applied to the raw scores to arrive at the weighted score for each criterion.

Table 9-2 Parameters for Consequence of Failure

Weight of Parameters	Evaluation Parameter	Categories	Rating
40%	City Facilities (2 segments downstream)	Fire Station (2 segments downstream)	5
		Public Works / City Hall	5
		Secondary Emergency Operations Center	5
		Hospitals	5
		City Buildings	3
		School	3
40%	Receiving Environment (within 500 ft)	Lagoon (within 500ft)	5
		Ocean	5
		Creek	5
10%	Resident / Business	Residential	1
		Commercial	4
		Industrial	4
10%	Circulation System (Crossings)	Highway	5
		Railway	5
		Bus Routes	3
		Arterials	3
		Residential	0

9.5 RISK

Information available to use to perform the risk analysis and assess the health of the system assets was based primarily on information obtained from the City's GIS and inspection and assessment program. The LOF and COF process was developed as a method to assist the City with prioritization of the improvements identified in this Master Plan Update.

Areas selected for immediate consideration are those identified as having the highest probability of failure (suspected worst condition) and highest consequence of failure (most critical). The combination of the LOF and COF ratings (LOF x COF = Risk) were used to prioritize the repairs or replacement of system assets to mitigate risk. The prioritization will provide the City with a plan for focusing the available resources and funding on the most immediate needs based on this analysis.

9.6 SUMMARY OF FINDINGS

The methodology presented above serves to initiate the establishment of guidelines for prioritizing the City's wastewater collection system improvements. Risk assessment, as another proactive measure to prioritize capital expenditures and resources, requires understanding the causes and consequences of an event and thus requires the consistent collection and management of information pertaining to the system.

The risk analysis methodology was applied only to the capacity improvement projects identified through the hydraulic analysis. The list of projects was tabulated according to the evaluation parameters and categories listed in Table 9-1. With the ratings and weighted factors applied, the LOF rating was determined. This process was applied to list of projects identified as exceeding both the d/D factor of 0.75 and 0.90.

The age and material of pipe is based on information obtained from the City's GIS and the capacity ratings are based on the d/D factors determined through the hydraulic analysis for each planning horizon. However, at the time the master plan was completed, information pertaining to the condition of the system was not available and therefor is not reflected in the analysis. Thus, as the City continues to perform the inspection and assessment process, it is recommended the City include the condition related ratings and the risk assessment for the respective pipelines as they are documented.

Similarly, based on the evaluation parameters and corresponding categories included in Table 9-2, the ratings with the weighted factors were applied and the COF was determined. Using the LOF and the COF, the risk factor was calculated. This method should be applied to all future pipes as the condition of the pipes is determined.

Included with development of this Master Plan Update is a comprehensive list and summary of the initial risk analysis in excel format so as to allow the City to continue to expand on the criteria to apply and further populate as additional information is collected. As additional information pertinent to the pipelines identified for improvements is gathered, it will allow the City to further refine the risk analysis. Appendix 7 includes a sample of the initial analysis developed for pipeline projects exceeding a d/D ratio of 0.75 and 0.90 criteria.

9.7 SUMMARY OF RECOMMENDATIONS

Factors that influence the future requirements of the wastewater collection system include the City's projected growth, infiltration rates and continued water conservation efforts. Thus, these factors will continue to drive some of the changes in how the City manages the existing sanitary sewer assets and the process in which new assets and improvements are prioritized and incorporated into the system. However, there are practices the City currently implements that can be modified to effectively improve the collection, documentation, and reporting of asset data.

9.7.1 Asset Inventory

The City's wastewater system asset inventory is generally complete. During the preparation of the Master Plan Update, discrepancies were noted in asset features, primarily pipeline diameters and material. Additionally, improvements implemented in the last several years are not reflected in the GIS, including spot repairs and CIPP lining projects. Therefore, as was recommended in the City's 2015 Asset Management Plan, as the City performs system repairs, the City's GIS and Cityworks should be updated to incorporate the repair date and methods implemented to maintain a current inventory of the type and location of improvements performed. Maintaining an updated and accurate GIS will serve to assure a more refined and accurate risk analysis.

Additionally, the City should consider continuing to invest effort in utilizing its current CMMS system, CityWorks, and expand its use to include the City's Engineering Department as this will serve to increase coordination for planning, projecting, and eventual funding of the necessary system improvements.

Expanding the use of Cityworks to integrate more of its capabilities and document more system information will allow for a more systematic and comprehensive approach to the management of the capital assets. The added information can also later be used to expand the risk analysis as at time this Master Plan was prepared, there was insufficient information available to complete the analysis. Thus, maintaining this tool is imperative for the City's effective management of its wastewater collection system.

9.7.2 Condition Assessment

While the City applies NASSCO inspection codes and ratings to document the observations and defects noted during the inspection process, the information collected is not utilized for long-term planning purposes. The condition assessment of the sewer pipelines is performed in the field during the inspection process. Defects detected are recorded to document the type of defect and the potential need for a repair. Improvements are performed as they are detected.

While the City has been proactive in implementing improvements to the system as they are identified, it is recommended the City consider developing standardized assessment criteria and rankings to allow for a consistent evaluation of the condition of all pipelines inspected and prioritization of improvements. Formally documenting the existing condition and tracking the condition of the sewer pipelines over time will serve to develop a benchmark of the entire system, facilitate project identification, prioritize improvements and facilitate development of short range, mid-range and long-range planning for funding of the improvements.

As the City has identified the condition of the asset as a measure for evaluating the LOF, establishing a formal assessment procedure to document and track the condition of the assets is imperative for completing the risk analysis. During the Master Plan Update, the condition related information for the capacity projects was not available and therefore not included in the risk analysis. Thus, it is recommended that as the City continues to implement the Inspection and Assessment Program, the overall condition of the pipelines be documented in the risk assessment analysis to help plan and prioritize the improvements to be implemented.

The City does not yet have a formal manhole inspection and assessment program. Manholes are visually inspected during the maintenance and/or annual cleaning of the pipelines. As recommended for the City's pipelines, it is recommended the City develop and implement standardized assessment criteria and rankings to allow for a consistent evaluation of the condition of the manholes inspected to prioritization of improvements. Formally documenting the condition of the sewer manholes will serve to develop a benchmark of the entire system, facilitate project identification, prioritize improvements and facilitate incorporation of the improvements into the short range, mid-range and long-range planning for funding of the improvements.

9.7.3 Asset Management Program

Asset management is the practice of managing infrastructure with the intent of minimizing the overall total cost of owning and operating the assets as the City delivers the expected level of service to its customers.

To achieve the goal of ensuring the long-term sustainability of its wastewater infrastructure, it is recommended the City's managing team develop an asset management strategy and plan and the elements necessary to create and implement the program.

To develop an asset management strategy, the City should work to develop the elements necessary to create and implement and effective and sustainable program. Elements for developing a formal strategy may include establishing methods for assessing current asset management practices, maintaining a robust asset inventory, planning for system upgrades, internal/external communications, and developing an implementation plan for the elements.

Elements of an asset management plan may include implementing the methods and tools to improve or modify documentation and validation of the asset inventory, the understanding the state of the assets, data management measures, management of asset life cycles, and financial planning for improvements.

The program management team may be composed of either in-house staff, outside consultants, or a combination of the two; however, communications and regular coordination between team members is critical to the successful implementation of the program.

The City will receive a number of benefits from implementing and utilizing a formal program management approach including incorporation and coordination of the program with other City efforts, more efficient use of budgeted monies to achieve program objectives, improved documentation of program benefits and results, and enhanced understanding of infrastructure needs and key program objectives and benefits.

10.0 RECOMMENDED CAPITAL IMPROVEMENT PROJECTS (CIP)

This chapter presents the proposed Capital Improvement Program (CIP) projects based on the findings of the Master Plan and includes:

- Development of Unit Costs
- Identified sanitary sewer improvement projects
- Capital Improvement Project Summary of Cost and Timing

Detailed CIP projects developed for the City's sanitary sewer system are prioritized capacity or reliability improvements to the existing system. The CIP projects are organized by sanitation division.

10.1 DEVELOPMENT OF UNIT COSTS

The unit costs developed for this study are for general master planning purposes and for guidance in project evaluation and implementation. The final cost of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors that may include: investigation of alternatives and detailed utility and topography surveys. However, since costs of materials and labor fluctuate over time, new estimates should be obtained at or near the time of construction of proposed facilities.

The unit costs presented are based on representative and available data at the time of this report. Included are factors to account for the engineering design, construction management and administration, and project contingency are intended to provide "order of magnitude".

10.1.1 Sewer System Pipelines

Base unit costs for pipeline material and installation including system appurtenances that, collectively constitute elements of the wastewater collection system are presented in Table 10-A.

Table 10-A Pipeline Unit Costs

Diameter (in)	Unit Cost
10	$325
12	$375
15	$400
18	$475

10.1.2 Sewer System Pump Stations

Physical site inspections of the Cardiff, Coast, Olivenhain and Moonlight Beach Pump Stations with SEJPA staff served to document improvements not completed since previous assessments were performed and which are still deemed necessary. Based on the site visits and discussions with SEJPA personnel, neither the Coast Highway 101 Pump Station nor the Olivenhain Pump Station require improvements as major rehabilitation improvements were performed as recently as 2016 and 2013 respectively. For the Cardiff Pump Station and the Moonlight Beach Pump Station, the recommended improvements are further described in Section 10.2.3. As costs vary based on the improvements identified, the estimated costs are also included below.

10.2 RECOMMENDED SEWER COLLECTION SYSTEM IMPROVEMENTS

The proposed pipeline projects were identified as potential CIP projects based on the hydraulic capacity analysis and the evaluation criteria described in Section 7.1. The proposed diameters are based on the evaluation criteria for the d/D ratios at peak wet weather build-out flows to not exceed 0.90.

10.2.1 Recommended Capacity Improvements for Pipelines

The CIP projects identify facilities needed to meet existing system needs based on the City's evaluation criteria for its sanitary sewer system. A summary of the CIP projects for each sanitation division is presented in below.

10.2.1.1 CSD

There are 16 CIP projects identified in CSD that total approximately 10,990 feet. There are no CIP projects identified that are associated with the Cardiff Gravity Trunk Sewer.

- CIP Projects A1, B1, B2, B3, B4, B5, B6 and C3, which total approximately 7,545 feet, are all associated with the Olivenhain Trunk Sewer
  - CIP Project A1, which addresses capacity issues under existing conditions, is located upstream of the Olivenhain Trunk Sewer Improvement Project along Lone Jack Road. This project involves upsizing approximately 1,106 feet of pipe from an 8-inch diameter to a 10-inch diameter.
  - CIP Projects B1, B2, B3, B4, B5, and B6 include upsizing approximately 6,326 feet of pipe, located between the Olivenhain Pump Station and the existing Olivenhain Trunk Sewer, from a 15-inch diameter to an 18-inch diameter. B1 includes upsizing approximately 594 feet of pipe. B2 addresses approximately 61 feet of pipe due to 2025 capacity conditions. B3 addresses approximately 536 feet of pipe due to 2030 capacity conditions. B4, B5, and B6 address approximately 5,135 feet of pipe under 2035 capacity condtions.
  - CIP Project C3, which addresses 2030 conditions, involves upsizing approximately 113 feet of pipe, located along S Rancho Santa Fe Road, from a 15-inch diameter to an 18-inch diameter.
- CIP Projects D1, J1, and J2, which total approximately 913 feet, are all associated with the Cardiff Trunk Sewer.
  - CIP Project D1, which addresses 2020 conditions, is located at the most downstream portion of the Cardiff Trunk Sewer and requires upsizing approximately 158 feet of pipe from a 15-inch diameter to an 18-inch diameter.
  - CIP Projects J1, and J2 includes upsizing approximately 756 feet of pipe from an 8-inch diameter to a 10-inch diameter. J1 addresses approximately 433 feet of pipe under 2020 conditions. J2 addresses approximately 323 feet of pipe under 2025 conditions.
- CIP Project E1, which addresses 2020 conditions, requires upsizing approximately 53 feet of pipe from an 8-inch diameter to a 12-inch diameter. This sewer is tributary to the Cardiff Trunk Sewer.

- CIP Projects F1, G1, and H1, which total approximately 3,275 feet, all address 2020 conditions associated with the Cardiff Relief Trunk Sewer.
  - CIP Project F1 involves upsizing approximately 849 feet of pipe from a 12-inch to a 15-inch diameter.
  - CIP Project G1 involves upsizing approximately 284 feet of pipe from a 10-inch to a 15-inch diameter.
  - CIP Project H1 involves upsizing approximately 2,142 feet of pipe from a 10-inch to a 12-inch diameter.
- CIP Project I1, which addresses 2020 conditions, requires upsizing approximately 15 feet of pipe from a 10-inch diameter to a 12-inch diameter. This sewer is tributary to the Cardiff Relief Trunk Sewer.

10.2.1.2 ESD

There is one (1) CIP project identified in ESD that totals approximately 105 feet. There are no CIP projects identified that are associated with the Encinitas Trunk Sewer.

- CIP Project K4, which addresses 2035 conditions, requires upsizing approximately 105 feet of pipe from an 8-inch diameter to a 10-inch diameter.

The proposed CIP pipeline projects summarized above are tabulated in Table 10-B. A detailed description of the pipelines associated with the proposed CIP projects is provided in Appendix 8. Phase I though IV represent the planning horizons for which the hydraulic model was developed. However, ultimately, conditions will be dependent on actual development within CSD and ESD boundaries. Thus, the timing for implementation of the projects may ultimately be adjusted as actual development occurs. At that time, the City will evaluate and determine the actual needs and prioritize infrastructure improvements accordingly. As such, the proposed projects are presented as potential phases versus planning horizons.

It should be noted that the Olivenhain Trunk Sewer Improvement Project, which addresses several capacity issues identified at the northern end of the trunk sewer is nearing the start of construction and therefore is not included in the CIP project list. The planned improvement project, which is located in the vicinity of Lone Jack Road, includes the upsizing of approximately 2,900 feet of pipe from an 8-inch diameter to a 15-inch diameter pipeline. The improvement project also includes eliminating the surcharging that occurs at the 15 manholes as previously noted and removal of the existing siphon located in the vicinity of 4030 Manchester Avenue.

Table 10-B Pipeline CIP Summary

No.	CIP Project ID	Location Description	Length (ft)	Estimated Diameter (inches)	Proposed Diameter (inches)	Sanitary Division
Phase I						
1	A1	OTS Jackie Lane to Brookside Lane	1,106	8	10	CSD
2	B1	OTS – Olivenhain Pump Station to Siphon	594	15	18	CSD
7	D1	CTS Cardiff Pump Station to Manchester Avenue	158	15	18	CSD
8	E1	Tributary to CTS – Cardiff Pump Station	53	8	10	CSD
9	F1	CRTS – Chesterfield Drive to Liverpool Drive	849	12	15	CSD
10	G1	CRTS – Burkshire Avenue to Sheffield Avenue	284	10	15	CSD
11	H1	CRTS – Sheffield Avenue to Loch Lomond Drive	2,142	10	12	CSD
12	I1	Tributary to CRTS – Cathy Lane and Oakley Lane	15	10	12	CSD
13	J1	CTS – Liszt Avenue to Verdi Avenue	433	8	10	CSD
		Phase I Total	**5,633**			
Phase II						
3	B2	OTS – Olivenhain Pump Station to Siphon	61	15	18	CSD
14	J2	CTS – Liszt Avenue to Verdi Avenue	323	8	10	CSD
		Phase II Total	**384**			
Phase III						
4	B3	OTS – Olivenhain Pump Station to Siphon	536	15	18	CSD
6	C3	OTS – Liszt Avenue to Verdi Avenue	113	15	18	CSD
		Phase III Total	**684**			
Phase IV						
5	B4	OTS – Olivenhain Pump Station to Siphon	3,722	15	18	CSD
16	B5	OTS – El Camino Del Norte to Bella Collina	820	15	18	CSD
17	B6	OTS – Mira Costa College Rd to S Rancho Santa Fe Rd	593	15	18	CSD
15	K4	Tributary to ETS – Property of East Ocean Avenue	105	8	10	CSD
		Phase IV Total	**5,240**			

10.2.2 Recommended Condition Improvements for Pipelines

To address the City's wastewater collection system needs it is also essential to assure that appropriate budgetary estimates for pipeline rehabilitation and replacement improvements identified to mitigate potential system deficiencies.

A review of system specific CCTV inspection videos and data was not performed as part of this Master Plan Update therefore specific pipeline improvements are not included. For purposes of this update, information provided by the City was reviewed to determine the status of the City's rehabilitation program. Information reviewed included:

- City of Encinitas Sewer Asset Management Plan, January 2015
- 2016-2017 Annual Citywide Sewer Rehabilitation Project, April 2017 and
- 2019-2020 Annual Citywide Sewer Rehabilitation Project, June 2020

Based on review of the above information, it appears the City has been proactive in implementing necessary improvements to the system as they are identified by City maintenance crews. The projects completed with the two (2) Annual Citywide Sewer Rehabilitation Projects included the large majority of the condition related projects identified in the 2015 Sewer Asset Management Plan. The projects included primarily CIPP lining projects, several spot repairs, pipeline replacements, and rehabilitation of manholes.

The software used by City staff incorporates NASSCO inspection codes for documenting system defects. Associated with the various defect codes is a numeric severity rating system with values ranging from 1 to 5 with 5 being the most severe. The defect codes together with the severity rating serve to document the occurrence of structural and maintenance related deficiencies observed by the operator during field inspections. As the conditions encountered may include both or a combination of structural and maintenance related conditions, it is recommended that prior to performing work on the system pipelines, the City perform a more comprehensive review of the inspection data to identify and prioritize the necessary improvements based on the assessed risk of the defects and their location within the overall collection system.

Appendix 11 includes planning level estimates of probable project costs for the pipeline improvements based on the unit costs listed in Section 10.1.1.

10.2.3 Recommended Pump Station Improvements

The following includes a brief summary of the recommended improvements for each pump station based on recommendations identified in previously prepared reports, site inspections performed, and discussions with SEJPA staff.

10.2.3.1 Cardiff Pump Station

The City completed a thorough inspection and evaluation of the pump station and the findings are included in the City's Cardiff Pump Station Evaluation Report, dated April 2012. Also included in the report is a summary of the improvements performed since the original construction and a summary and prioritization of the recommended structural, mechanical, and HVAC improvements and upgrades.

Based on the most recent site visit with SEJPA personnel, the following improvements are recommended and included in as CIP projects. Improvements have been categorized as essential, highly recommended, or recommended.

- Essential
  - Replacement of the older 480-volt panel with a new panel.
  - Replacement of one VFD (40 hp pump) within the existing enclosure. The 480-volt breakers in the distribution panel that reportedly trip are associated with older VFDs. The breaker may be tripping due to the higher harmonics older drives generate.
- Highly Recommended
  - Addition of a submersible or ultrasonic wet well level sensor to the wet well for control.
  - Addition of NFPA 820 controls and alarm for drywell ventilation.
  - Replacement of the existing old air conditioner (one) on the VFD with a new air conditioner.
  - Replacement of the existing 40 hp pumps with recessed impeller or chopper type impeller style to mitigate problems with ragging. This will include modifying the existing piping and appurtenances to accommodate the new pumps.
- Recommended
  - Installation of a ventilation system to comply with NFPA 820 requirements.
  - Transfer of the minor pump control interface from the MCC section to the new enclosure.
  - Demolition of the existing MCC.
  - Replacement of the existing wet well with a newer wet well. The existing wet well appears to be in good condition. It is approximately 8-feet by 8-feet inside dimension in plan. SEJPA staff expressed interest in installing a much larger wet well, which would have a length of the entire pump station building. Similar improvements are being conducted at the Solana Beach Pump Station.
  - Installation of a fuel-tank level sensor for stand-by generator.
  - Replacement of the corroded louver door at the pump station and the stand-by generator building.
  - Replacement of the existing acoustic insulation in the stand-by generator building with aluminum enclosed acoustic panels to prevent vermin infestation.
  - Painting and recoating of building trim, interior steel.
  - Painting and recoating of pipes, valves and appurtenances inside the drywell.
  - Relocation of existing emergency bypass connection. The existing emergency bypass tank is currently buried under a County storage yard being used to store traffic signs and other miscellaneous items. The bypass connection not readily accessible within the storage yard. SEJPA staff currently brings a portable pump to the back of the generator building during bypass operations. A bypass suction pipe plumbed to a more convenient location would improve efficiency.

According to SEJPA staff, an Arc Flash Study is scheduled to be prepared in 2021. It is recommended the electrical related improvements associated with the Cardiff Pump Station be reevaluated once the study is completed.

10.2.3.2 Coast Highway 101 Pump Station

The Coast Highway 101 Pump Station was originally constructed in 1977 to serve a small commercial area consisting primarily of restaurants along Highway 101, south of the San Elijo lagoon outlet. The Coast Pump Station is located west of Highway 101 within a state beach parking lot.

Based on the most recent site visit and discussion with SEJPA staff, the Coast Highway 101 Pump Station does not currently require any major improvements since it was rehabilitated less than four (4) years ago.

10.2.3.3 Moonlight Beach Pump Station

The Moonlight Beach Pump Station was originally constructed in 1974 and underwent significant renovation in 2006. It is located on the southeast corner of the intersection of 3rd Street and B Street in the City of Encinitas. SEJPA authorized the preparation of a pump replacement evaluation for this pump station and the findings are detailed in the September 2019 Moonlight Beach Pump Station, Pump Replacement Evaluation. Based on the evaluation, the following improvements are recommended:

- Replacement of the existing pump arrangement to allow for a smaller capacity, solids-handling jockey pump to flow match the wet well's overnight low influent flows.
- Implementation of a daily high-flow flushing schedule to re-suspend settled solids that may have accumulated in the 14-inch force main following the overnight low flow period.
- Replacement of the existing extended shaft sewage pumps with solids handling, dry pit submersible style pumps capable of passing rags and solids. This would also involve removal of the existing inline sewage grinders from the pump suction assembly and replacement of the existing pump suction and pump discharge piping assembly (piping and valve replacement).
- Installation of a new portable gantry crane in the pump room, equipped with 1-ton mechanically operated hoist.
- Replacement of the existing non-functional 18-inch sluice gate located inside the wet well with a new 18-inch 316 stainless steel sluice gate.
- Replacement of the existing wet well ultrasonic level sensor and mount. Re-calibration of both wet well level sensors to ensure correct wet well level reading output from both elements.
- Replacement of the existing air supply fan assembly is not currently necessary. However, it is recommended that operations staff visually inspect the condition of the fan assembly's exterior corrosion on a monthly basis. If corrosion continues to worsen, the air supply fan assembly may have to be replaced in the near future.

10.2.3.4 Olivenhain Pump Station

The Olivenhain Pump Stations is located at the northeast corner of the Manchester Avenue and I-5 interchange. Caltrans is currently performing construction work in the area as part of the San Elijo Lagoon Highway Bridge Replacement project. The Caltrans project removed some of the pavement and fence wall located within the pump station.

Based on the most recent site visit and discussion with SEJPA staff, the following minimal improvements are suggested:

- Fence and pavement repair due to Caltrans project. It is anticipated that once the San Elijo Lagoon Highway Bridge Replacement project is completed, Caltrans will repair the fencing and the pavement impacted by their construction work.
- Pavement repair within the pump station property. SEJPA staff has indicated they may request Caltrans to do a complete overlay of the entire pavement area since it has visible sign of wear. SEJPA staff also mentioned the possibility of the City doing the complete overlay of the entire pavement area as part of the City street repairs.
- Replacement of the existing generator. The generator is from the old pump station. SEJPA staff indicated that the Air Pollution Control District of San Diego County may not allow its continued use.

10.3 SUMMARY OF RECOMMENDED PUMP STATION CAPITAL IMPROVEMENT PROJECTS

A detailed breakdown of the estimated pump station improvement costs for the respective pump station is included in Appendix 10. Table 10-C includes a summary of the estimated improvement cost for each pump station.

Table 10-C Estimated Costs for Pump Station Improvements

Category	Moonlight Beach[1]	Cardiff	Coast Highway 101[2]	Olivenhain
Recommended Improvements	Refer to Referenced Report	$300,200	NA	$75,000
General Requirements	Refer to Referenced Report	$56,000	NA	$8,000
Engineering (15%)	Refer to Referenced Report	$45,030	NA	$11,250
Overhead and Profit (15%)	Refer to Referenced Report	$45,030	NA	$11,250
Contingency (30%)	Refer to Referenced Report	$90,060	NA	$22,500
Totals	**$573,000**	**$536,320**	**NA**	**$128,000**

Notes

1. Estimated cost is based on the September 2019 Moonlight Beach Pump Station, Pump Replacement Evaluation Report (Appendix 9).
2. Based on the site visit conducted and discussion with SEJPA staff, no improvements are necessary or identified at this time.

Appendix 1

SANDAG Series 13 Data for ESD and CSD

Source:	Series13: SANDAG Regional Growth Forecast
Date:	June 2015
Geography:	TAZ (series 13)
	For a TAZ shapefile, please see:
	http://www.sandag.org/resources/maps_and_gis/gis_downloads/trans.asp

File format: 20YY worksheet tab, where 20YY = year of data

Variable description:

TAZ	series 13 traffic analysis zone
pop	population (total)
hhp	household population
gq_civ	group quarters - civilian
gq_mil	group quarters - military
hs	housing stock (total units)
hs_sf	single-family housing
hs_mf	multi-family housing
hs_mh	mobile homes
hh	occupied housing units (i.e. households)
hh_sf	occupied single-family
hh_mf	occupied multi-family
hh_mh	occupied mobile homes

taz	pop	hhp	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1287	436	436	0	0	0	171	0	171	0	160	0	160
1290	523	523	0	0	0	261	260	1	0	230	230	0
1308	175	175	0	0	0	101	101	0	0	66	66	0
1336	2147	2147	0	0	0	659	395	264	0	658	395	263
1340	120	120	0	0	0	48	29	0	19	48	29	0
1344	404	404	0	0	0	139	46	0	93	133	46	0
1358	315	315	0	0	0	94	94	0	0	94	94	0
1359	258	258	0	0	0	138	0	138	0	128	0	128
1366	8	0	8	8	0	0	0	0	0	0	0	0
1368	529	529	0	0	0	183	183	0	0	183	183	0
1373	340	340	0	0	0	114	114	0	0	110	110	0
1375	18	18	0	0	0	5	5	0	0	4	4	0
1377	901	901	0	0	0	322	223	0	99	322	223	0
1378	378	378	0	0	0	150	150	0	0	146	146	0
1379	826	819	7	7	0	311	311	0	0	311	311	0
1380	0	0	0	0	0	0	0	0	0	0	0	0
1381	26	26	0	0	0	14	14	0	0	14	14	0
1389	127	127	0	0	0	42	42	0	0	42	42	0
1393	557	557	0	0	0	210	210	0	0	210	210	0
1400	838	700	138	138	0	563	0	563	0	520	0	520
1401	0	0	0	0	0	0	0	0	0	0	0	0
1402	543	539	4	4	0	220	104	116	0	186	99	87
1403	120	120	0	0	0	48	48	0	0	48	48	0
1405	427	427	0	0	0	341	316	25	0	191	166	25
1412	175	175	0	0	0	55	55	0	0	55	55	0
1413	895	895	0	0	0	351	351	0	0	351	351	0
1414	202	202	0	0	0	73	73	0	0	73	73	0
1415	835	835	0	0	0	255	255	0	0	236	236	0
1417	226	226	0	0	0	83	83	0	0	83	83	0
1418	41	41	0	0	0	17	17	0	0	17	17	0
1419	0	0	0	0	0	1	1	0	0	0	0	0
1424	1579	1579	0	0	0	686	352	253	81	669	345	245
1427	34	34	0	0	0	9	9	0	0	9	9	0
1428	273	273	0	0	0	112	112	0	0	104	104	0
1429	1448	1448	0	0	0	468	468	0	0	466	466	0
1430	165	165	0	0	0	80	70	10	0	74	69	5
1431	2701	2701	0	0	0	914	914	0	0	879	879	0
1433	34	34	0	0	0	18	17	1	0	18	18	0
1436	916	908	8	8	0	359	359	0	0	355	355	0
1440	0	0	0	0	0	0	0	0	0	0	0	0
1441	0	0	0	0	0	0	0	0	0	0	0	0
1443	138	138	0	0	0	56	56	0	0	54	54	0
1446	0	0	0	0	0	0	0	0	0	0	0	0
1448	0	0	0	0	0	0	0	0	0	0	0	0
1449	634	634	0	0	0	279	172	107	0	279	172	107
1453	991	991	0	0	0	426	426	0	0	396	396	0
1454	0	0	0	0	0	0	0	0	0	0	0	0
1455	240	240	0	0	0	75	75	0	0	75	75	0
1457	1342	1342	0	0	0	449	449	0	0	447	447	0
1458	1483	1483	0	0	0	506	146	360	0	482	122	360
1464	863	863	0	0	0	299	299	0	0	299	299	0

taz	pop	hhp	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1465	619	619	0	0	0	229	229	0	0	220	220	0
1466	61	61	0	0	0	19	19	0	0	19	19	0
1469	643	643	0	0	0	296	279	17	0	286	271	15
1471	11	11	0	0	0	3	3	0	0	3	3	0
1472	430	430	0	0	0	137	137	0	0	137	137	0
1475	422	422	0	0	0	120	120	0	0	119	119	0
1476	555	555	0	0	0	173	173	0	0	173	173	0
1478	217	217	0	0	0	77	77	0	0	77	77	0
1481	408	408	0	0	0	255	254	1	0	179	179	0
1484	1578	1578	0	0	0	589	589	0	0	580	580	0
1491	435	432	3	3	0	191	191	0	0	191	191	0
1493	0	0	0	0	0	0	0	0	0	0	0	0
1496	977	977	0	0	0	348	348	0	0	348	348	0
1497	1574	1558	16	16	0	552	552	0	0	552	552	0
1498	91	91	0	0	0	57	52	5	0	53	48	5
1500	177	177	0	0	0	80	80	0	0	80	80	0
1507	283	283	0	0	0	93	93	0	0	93	93	0
1508	2	2	0	0	0	1	0	1	0	1	1	0
1517	278	273	5	5	0	112	112	0	0	104	104	0
1518	222	222	0	0	0	113	63	50	0	113	63	50
1519	438	438	0	0	0	238	87	151	0	190	38	152
1520	523	523	0	0	0	257	71	186	0	257	71	186
1521	628	628	0	0	0	401	61	340	0	345	60	285
1522	362	362	0	0	0	166	166	0	0	136	136	0
1523	36	36	0	0	0	14	14	0	0	14	14	0
1524	0	0	0	0	0	0	0	0	0	0	0	0
1540	194	194	0	0	0	53	53	0	0	53	53	0
1541	258	258	0	0	0	79	79	0	0	69	69	0
1550	0	0	0	0	0	0	0	0	0	0	0	0
1552	441	441	0	0	0	184	184	0	0	184	184	0
1555	301	282	19	19	0	82	81	1	0	82	82	0
1556	409	409	0	0	0	206	206	0	0	206	206	0
1557	630	630	0	0	0	247	145	102	0	247	145	102
1561	1201	1201	0	0	0	583	583	0	0	583	583	0
1563	162	162	0	0	0	59	59	0	0	56	56	0
1566	485	485	0	0	0	221	221	0	0	221	221	0
1569	27	27	0	0	0	15	12	3	0	15	12	3
1582	220	215	5	5	0	65	47	18	0	65	47	18
1583	894	894	0	0	0	348	348	0	0	348	348	0
1585	539	539	0	0	0	322	322	0	0	245	245	0
1598	66	66	0	0	0	46	46	0	0	46	46	0
1601	1222	1222	0	0	0	849	849	0	0	809	809	0
1613	27	27	0	0	0	14	13	1	0	12	12	0
1647	603	603	0	0	0	295	290	5	0	290	286	4

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1287	416	416	0	0	0	171	0	171	0	150	0	150	0
1290	531	531	0	0	0	261	260	1	0	229	228	1	0
1308	180	180	0	0	0	101	101	0	0	66	66	0	0
1336	2217	2217	0	0	0	671	395	276	0	665	394	271	0
1340	181	181	0	0	0	98	79	0	19	82	63	0	19
1344	415	415	0	0	0	139	46	0	93	134	46	0	88
1358	315	315	0	0	0	94	94	0	0	92	92	0	0
1359	262	262	0	0	0	138	0	138	0	127	0	127	0
1366	2	0	2	2	0	0	0	0	0	0	0	0	0
1368	543	543	0	0	0	183	183	0	0	183	183	0	0
1373	356	356	0	0	0	114	114	0	0	110	110	0	0
1375	12	12	0	0	0	5	5	0	0	4	4	0	0
1377	1005	1005	0	0	0	359	260	0	99	359	260	0	99
1378	364	364	0	0	0	150	150	0	0	145	145	0	0
1379	840	835	5	5	0	311	311	0	0	311	311	0	0
1380	0	0	0	0	0	0	0	0	0	0	0	0	0
1381	43	43	0	0	0	14	14	0	0	14	14	0	0
1389	177	177	0	0	0	61	61	0	0	60	60	0	0
1393	546	546	0	0	0	214	214	0	0	212	212	0	0
1400	850	716	134	134	0	563	0	563	0	520	0	520	0
1401	174	174	0	0	0	64	64	0	0	59	59	0	0
1402	557	557	0	0	0	220	104	116	0	185	99	86	0
1403	124	124	0	0	0	48	48	0	0	48	48	0	0
1405	432	432	0	0	0	341	316	25	0	190	165	25	0
1412	191	191	0	0	0	59	59	0	0	59	59	0	0
1413	924	924	0	0	0	352	352	0	0	352	352	0	0
1414	203	203	0	0	0	74	74	0	0	74	74	0	0
1415	924	924	0	0	0	289	289	0	0	265	265	0	0
1417	323	323	0	0	0	114	114	0	0	114	114	0	0
1418	43	43	0	0	0	17	17	0	0	17	17	0	0
1419	0	0	0	0	0	1	1	0	0	0	0	0	0
1424	1621	1621	0	0	0	686	352	253	81	669	345	245	79
1427	27	27	0	0	0	9	9	0	0	9	9	0	0
1428	280	280	0	0	0	112	112	0	0	104	104	0	0
1429	1474	1474	0	0	0	468	468	0	0	462	462	0	0
1430	165	165	0	0	0	87	77	10	0	73	65	8	0
1431	2733	2733	0	0	0	914	914	0	0	871	871	0	0
1433	34	34	0	0	0	16	15	1	0	15	14	1	0
1436	956	953	3	3	0	360	360	0	0	356	356	0	0
1440	0	0	0	0	0	0	0	0	0	0	0	0	0
1441	0	0	0	0	0	0	0	0	0	0	0	0	0
1443	150	150	0	0	0	56	56	0	0	54	54	0	0
1446	0	0	0	0	0	0	0	0	0	0	0	0	0
1448	0	0	0	0	0	0	0	0	0	0	0	0	0
1449	673	673	0	0	0	288	181	107	0	287	181	106	0
1453	1011	1011	0	0	0	426	426	0	0	395	395	0	0
1454	0	0	0	0	0	0	0	0	0	0	0	0	0
1455	244	244	0	0	0	75	75	0	0	75	75	0	0
1457	1383	1383	0	0	0	461	461	0	0	458	458	0	0
1458	1511	1511	0	0	0	508	148	360	0	483	123	360	0
1464	837	837	0	0	0	301	301	0	0	298	298	0	0

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1465	584	584	0	0	0	229	229	0	0	218	218	0	0
1466	297	297	0	0	0	130	130	0	0	104	104	0	0
1469	660	660	0	0	0	303	289	14	0	289	277	12	0
1471	262	262	0	0	0	93	93	0	0	93	93	0	0
1472	612	612	0	0	0	204	204	0	0	201	201	0	0
1475	420	420	0	0	0	120	120	0	0	119	119	0	0
1476	624	624	0	0	0	190	190	0	0	190	190	0	0
1478	222	222	0	0	0	77	77	0	0	77	77	0	0
1481	479	479	0	0	0	291	290	1	0	217	216	1	0
1484	1612	1612	0	0	0	589	589	0	0	580	580	0	0
1491	443	442	1	1	0	196	196	0	0	195	195	0	0
1493	0	0	0	0	0	0	0	0	0	0	0	0	0
1496	1000	1000	0	0	0	348	348	0	0	348	348	0	0
1497	1593	1578	15	15	0	552	552	0	0	549	549	0	0
1498	101	101	0	0	0	57	52	5	0	53	48	5	0
1500	223	223	0	0	0	95	95	0	0	95	95	0	0
1507	288	288	0	0	0	96	96	0	0	92	92	0	0
1508	3	3	0	0	0	1	0	1	0	1	0	1	0
1517	316	312	4	4	0	115	115	0	0	115	115	0	0
1518	220	220	0	0	0	113	63	50	0	112	62	50	0
1519	524	524	0	0	0	269	114	155	0	220	64	156	0
1520	539	539	0	0	0	259	73	186	0	258	72	186	0
1521	660	660	0	0	0	401	61	340	0	345	60	285	0
1522	371	371	0	0	0	166	166	0	0	136	136	0	0
1523	37	37	0	0	0	14	14	0	0	14	14	0	0
1524	0	0	0	0	0	0	0	0	0	0	0	0	0
1540	187	187	0	0	0	53	53	0	0	53	53	0	0
1541	242	242	0	0	0	79	79	0	0	69	69	0	0
1550	0	0	0	0	0	0	0	0	0	0	0	0	0
1552	451	451	0	0	0	184	184	0	0	183	183	0	0
1555	276	266	10	10	0	82	81	1	0	81	81	0	0
1556	419	419	0	0	0	206	206	0	0	206	206	0	0
1557	663	663	0	0	0	256	154	102	0	256	154	102	0
1561	1210	1210	0	0	0	583	583	0	0	577	577	0	0
1563	159	159	0	0	0	60	60	0	0	56	56	0	0
1566	496	496	0	0	0	221	221	0	0	221	221	0	0
1569	36	36	0	0	0	21	12	9	0	17	9	8	0
1582	16	16	0	0	0	4	4	0	0	4	4	0	0
1583	919	919	0	0	0	348	348	0	0	347	347	0	0
1585	554	554	0	0	0	322	322	0	0	245	245	0	0
1598	113	113	0	0	0	48	48	0	0	47	47	0	0
1601	1263	1263	0	0	0	849	849	0	0	807	807	0	0
1613	27	27	0	0	0	14	13	1	0	12	11	1	0
1647	626	626	0	0	0	297	292	5	0	279	274	5	0

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1287	422	422	0	0	0	171	0	171	0	155	0	155	0
1290	541	541	0	0	0	261	260	1	0	233	232	1	0
1308	186	186	0	0	0	101	101	0	0	68	68	0	0
1336	2220	2220	0	0	0	671	395	276	0	668	395	273	0
1340	287	287	0	0	0	133	114	0	19	128	109	0	19
1344	450	450	0	0	0	153	60	0	93	147	60	0	87
1358	321	321	0	0	0	94	94	0	0	94	94	0	0
1359	275	275	0	0	0	138	0	138	0	133	0	133	0
1366	11	0	11	11	0	0	0	0	0	0	0	0	0
1368	549	549	0	0	0	185	185	0	0	185	185	0	0
1373	362	362	0	0	0	114	114	0	0	111	111	0	0
1375	11	11	0	0	0	5	5	0	0	4	4	0	0
1377	1055	1055	0	0	0	382	283	0	99	382	283	0	99
1378	635	635	0	0	0	247	247	0	0	245	245	0	0
1379	848	839	9	9	0	311	311	0	0	311	311	0	0
1380	50	50	0	0	0	19	19	0	0	19	19	0	0
1381	43	43	0	0	0	14	14	0	0	14	14	0	0
1389	183	183	0	0	0	61	61	0	0	61	61	0	0
1393	636	636	0	0	0	253	253	0	0	248	248	0	0
1400	860	723	137	137	0	563	0	563	0	522	0	522	0
1401	182	182	0	0	0	64	64	0	0	62	62	0	0
1402	561	561	0	0	0	220	104	116	0	187	101	86	0
1403	124	124	0	0	0	48	48	0	0	48	48	0	0
1405	466	466	0	0	0	354	315	39	0	203	165	38	0
1412	193	193	0	0	0	62	62	0	0	62	62	0	0
1413	970	970	0	0	0	369	369	0	0	369	369	0	0
1414	203	203	0	0	0	74	74	0	0	74	74	0	0
1415	1015	1015	0	0	0	313	313	0	0	293	293	0	0
1417	325	325	0	0	0	114	114	0	0	114	114	0	0
1418	50	50	0	0	0	21	21	0	0	19	19	0	0
1419	3	3	0	0	0	1	1	0	0	1	1	0	0
1424	1748	1748	0	0	0	724	345	298	81	715	338	298	79
1427	25	25	0	0	0	9	9	0	0	9	9	0	0
1428	285	285	0	0	0	112	112	0	0	105	105	0	0
1429	1515	1515	0	0	0	468	468	0	0	467	467	0	0
1430	160	160	0	0	0	81	71	10	0	71	62	9	0
1431	2770	2770	0	0	0	914	914	0	0	881	881	0	0
1433	25	25	0	0	0	12	11	1	0	11	10	1	0
1436	1103	1097	6	6	0	412	412	0	0	408	408	0	0
1440	0	0	0	0	0	0	0	0	0	0	0	0	0
1441	0	0	0	0	0	0	0	0	0	0	0	0	0
1443	176	176	0	0	0	65	65	0	0	64	64	0	0
1446	0	0	0	0	0	0	0	0	0	0	0	0	0
1448	0	0	0	0	0	0	0	0	0	0	0	0	0
1449	690	690	0	0	0	295	177	118	0	293	177	116	0
1453	1028	1028	0	0	0	426	426	0	0	400	400	0	0
1454	0	0	0	0	0	0	0	0	0	0	0	0	0
1455	658	658	0	0	0	206	206	0	0	206	206	0	0
1457	1394	1394	0	0	0	461	461	0	0	461	461	0	0
1458	1517	1517	0	0	0	508	148	360	0	483	123	360	0
1464	863	863	0	0	0	307	307	0	0	307	307	0	0

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1465	603	603	0	0	0	229	229	0	0	221	221	0	0
1466	303	303	0	0	0	130	130	0	0	108	108	0	0
1469	711	711	0	0	0	324	289	35	0	310	280	30	0
1471	534	534	0	0	0	189	189	0	0	189	189	0	0
1472	670	670	0	0	0	220	220	0	0	220	220	0	0
1475	424	424	0	0	0	120	120	0	0	119	119	0	0
1476	635	635	0	0	0	193	193	0	0	193	193	0	0
1478	222	222	0	0	0	77	77	0	0	77	77	0	0
1481	522	522	0	0	0	296	295	1	0	233	232	1	0
1484	1623	1623	0	0	0	589	589	0	0	582	582	0	0
1491	460	452	8	8	0	196	196	0	0	196	196	0	0
1493	0	0	0	0	0	0	0	0	0	0	0	0	0
1496	1002	1002	0	0	0	348	348	0	0	348	348	0	0
1497	1606	1588	18	18	0	552	552	0	0	552	552	0	0
1498	106	106	0	0	0	57	52	5	0	55	50	5	0
1500	220	220	0	0	0	95	95	0	0	95	95	0	0
1507	304	304	0	0	0	97	97	0	0	97	97	0	0
1508	2	2	0	0	0	1	0	1	0	1	0	1	0
1517	326	315	11	11	0	116	116	0	0	116	116	0	0
1518	222	222	0	0	0	113	63	50	0	113	63	50	0
1519	535	535	0	0	0	269	114	155	0	223	67	156	0
1520	542	542	0	0	0	259	73	186	0	259	73	186	0
1521	672	672	0	0	0	401	61	340	0	350	61	289	0
1522	458	458	0	0	0	171	171	0	0	166	166	0	0
1523	38	38	0	0	0	14	14	0	0	14	14	0	0
1524	0	0	0	0	0	0	0	0	0	0	0	0	0
1540	188	188	0	0	0	53	53	0	0	53	53	0	0
1541	930	930	0	0	0	261	261	0	0	260	260	0	0
1550	0	0	0	0	0	0	0	0	0	0	0	0	0
1552	454	454	0	0	0	184	184	0	0	184	184	0	0
1555	258	223	35	35	0	70	69	1	0	70	69	1	0
1556	421	421	0	0	0	206	206	0	0	206	206	0	0
1557	663	663	0	0	0	256	154	102	0	256	154	102	0
1561	1230	1230	0	0	0	583	583	0	0	583	583	0	0
1563	162	162	0	0	0	61	61	0	0	58	58	0	0
1566	501	501	0	0	0	221	221	0	0	221	221	0	0
1569	38	38	0	0	0	21	12	9	0	18	12	6	0
1582	13	13	0	0	0	4	4	0	0	4	4	0	0
1583	923	923	0	0	0	348	348	0	0	348	348	0	0
1585	564	564	0	0	0	322	322	0	0	248	248	0	0
1598	117	117	0	0	0	48	48	0	0	48	48	0	0
1601	1279	1279	0	0	0	849	849	0	0	811	811	0	0
1613	34	34	0	0	0	14	13	1	0	14	13	1	0
1647	625	625	0	0	0	297	292	5	0	278	275	3	0

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1287	441	441	0	0	0	171	0	171	0	163	0	163	0
1290	533	533	0	0	0	261	260	1	0	231	231	0	0
1308	187	187	0	0	0	101	101	0	0	68	68	0	0
1336	2221	2221	0	0	0	671	395	276	0	671	395	276	0
1340	282	282	0	0	0	134	115	0	19	126	108	0	18
1344	434	434	0	0	0	153	60	0	93	145	60	0	85
1358	321	321	0	0	0	96	96	0	0	94	94	0	0
1359	271	271	0	0	0	138	0	138	0	132	0	132	0
1366	20	0	20	20	0	0	0	0	0	0	0	0	0
1368	551	551	0	0	0	186	186	0	0	186	186	0	0
1373	365	365	0	0	0	115	115	0	0	112	112	0	0
1375	12	12	0	0	0	5	5	0	0	4	4	0	0
1377	1040	1040	0	0	0	382	283	0	99	380	283	0	97
1378	631	631	0	0	0	247	247	0	0	244	244	0	0
1379	847	835	12	12	0	311	311	0	0	310	310	0	0
1380	47	47	0	0	0	19	19	0	0	18	18	0	0
1381	40	40	0	0	0	14	14	0	0	13	13	0	0
1389	181	181	0	0	0	61	61	0	0	60	60	0	0
1393	630	630	0	0	0	253	253	0	0	247	247	0	0
1400	861	721	140	140	0	563	0	563	0	522	0	522	0
1401	176	176	0	0	0	64	64	0	0	60	60	0	0
1402	572	572	0	0	0	222	106	116	0	191	105	86	0
1403	124	124	0	0	0	48	48	0	0	48	48	0	0
1405	464	464	0	0	0	354	315	39	0	203	165	38	0
1412	197	197	0	0	0	63	63	0	0	63	63	0	0
1413	971	971	0	0	0	369	369	0	0	369	369	0	0
1414	202	202	0	0	0	74	74	0	0	74	74	0	0
1415	995	995	0	0	0	313	313	0	0	287	287	0	0
1417	325	325	0	0	0	114	114	0	0	114	114	0	0
1418	40	40	0	0	0	21	21	0	0	15	15	0	0
1419	0	0	0	0	0	1	1	0	0	0	0	0	0
1424	1781	1781	0	0	0	741	345	315	81	731	338	315	78
1427	25	25	0	0	0	9	9	0	0	9	9	0	0
1428	283	283	0	0	0	112	112	0	0	105	105	0	0
1429	1516	1516	0	0	0	468	468	0	0	467	467	0	0
1430	160	160	0	0	0	81	71	10	0	71	62	9	0
1431	2750	2750	0	0	0	914	914	0	0	881	881	0	0
1433	25	25	0	0	0	12	11	1	0	11	10	1	0
1436	1119	1110	9	9	0	420	420	0	0	414	414	0	0
1440	0	0	0	0	0	0	0	0	0	0	0	0	0
1441	0	0	0	0	0	0	0	0	0	0	0	0	0
1443	176	176	0	0	0	65	65	0	0	64	64	0	0
1446	0	0	0	0	0	0	0	0	0	0	0	0	0
1448	0	0	0	0	0	0	0	0	0	0	0	0	0
1449	694	694	0	0	0	300	177	123	0	296	177	119	0
1453	1022	1022	0	0	0	427	427	0	0	399	399	0	0
1454	0	0	0	0	0	0	0	0	0	0	0	0	0
1455	945	945	0	0	0	311	311	0	0	311	311	0	0
1457	1385	1385	0	0	0	461	461	0	0	459	459	0	0
1458	1505	1505	0	0	0	508	148	360	0	482	122	360	0
1464	922	922	0	0	0	335	335	0	0	332	332	0	0

taz	pop	hhp	gq	gq_civ	gq_mil	hs	hs_sf	hs_mf	hs_mh	hh	hh_sf	hh_mf	hh_mh
1465	590	590	0	0	0	229	229	0	0	215	215	0	0
1466	295	295	0	0	0	130	130	0	0	106	106	0	0
1469	902	902	0	0	0	416	287	129	0	394	276	118	0
1471	531	531	0	0	0	189	189	0	0	189	189	0	0
1472	660	660	0	0	0	220	220	0	0	218	218	0	0
1475	419	419	0	0	0	120	120	0	0	119	119	0	0
1476	631	631	0	0	0	193	193	0	0	193	193	0	0
1478	221	221	0	0	0	77	77	0	0	77	77	0	0
1481	501	501	0	0	0	296	295	1	0	227	226	1	0
1484	1615	1615	0	0	0	589	589	0	0	581	581	0	0
1491	463	452	11	11	0	196	196	0	0	196	196	0	0
1493	0	0	0	0	0	0	0	0	0	0	0	0	0
1496	997	997	0	0	0	348	348	0	0	348	348	0	0
1497	1609	1588	21	21	0	552	552	0	0	551	551	0	0
1498	111	111	0	0	0	63	52	11	0	57	50	7	0
1500	219	219	0	0	0	95	95	0	0	95	95	0	0
1507	281	281	0	0	0	97	97	0	0	90	90	0	0
1508	0	0	0	0	0	1	0	1	0	0	0	0	0
1517	330	316	14	14	0	116	116	0	0	116	116	0	0
1518	220	220	0	0	0	113	63	50	0	112	62	50	0
1519	532	532	0	0	0	269	114	155	0	222	67	155	0
1520	541	541	0	0	0	261	75	186	0	259	73	186	0
1521	666	666	0	0	0	401	61	340	0	349	61	288	0
1522	465	465	0	0	0	177	177	0	0	170	170	0	0
1523	38	38	0	0	0	14	14	0	0	14	14	0	0
1524	0	0	0	0	0	0	0	0	0	0	0	0	0
1540	362	362	0	0	0	100	100	0	0	100	100	0	0
1541	1179	1179	0	0	0	342	342	0	0	340	340	0	0
1550	0	0	0	0	0	0	0	0	0	0	0	0	0
1552	454	454	0	0	0	184	184	0	0	184	184	0	0
1555	219	166	53	53	0	54	53	1	0	52	52	0	0
1556	421	421	0	0	0	206	206	0	0	206	206	0	0
1557	659	659	0	0	0	256	154	102	0	254	152	102	0
1561	1204	1204	0	0	0	585	585	0	0	573	573	0	0
1563	163	163	0	0	0	61	61	0	0	58	58	0	0
1566	501	501	0	0	0	221	221	0	0	221	221	0	0
1569	422	422	0	0	0	205	7	198	0	185	4	181	0
1582	13	13	0	0	0	4	4	0	0	4	4	0	0
1583	927	927	0	0	0	348	348	0	0	348	348	0	0
1585	563	563	0	0	0	322	322	0	0	248	248	0	0
1598	133	133	0	0	0	56	56	0	0	55	55	0	0
1601	1267	1267	0	0	0	849	849	0	0	808	808	0	0
1613	26	26	0	0	0	14	13	1	0	11	11	0	0
1647	649	649	0	0	0	309	304	5	0	288	285	3	0

Appendix 2

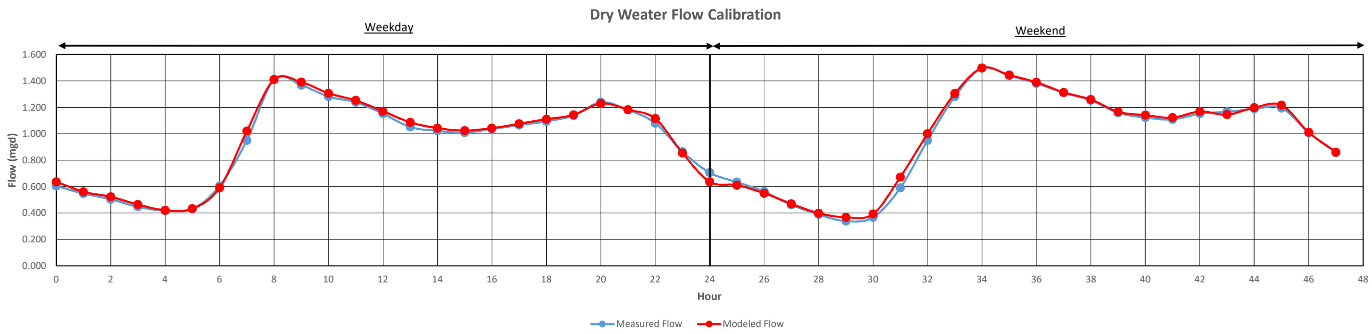
Dry Weather Flow Calibration

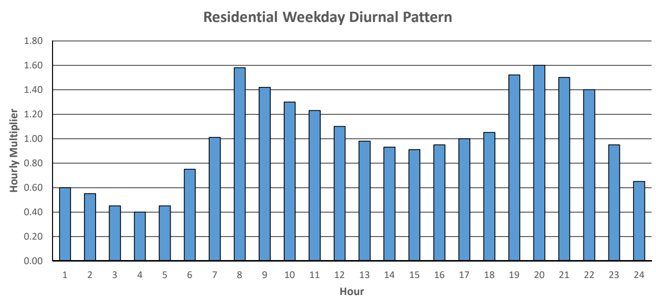
	Weekday Dry Weather Flow						Weekend Dry Weather Flow						Total Dry Weather Flow		
	Measured Data		Modeled Data		Percent Error %		Measured Data		Modeled Data		Percent Error %				
Meter Location	Average Flow (mgd)	Peak Flow (mgd)	Average Flow (mgd)	Peak Flow (mgd)	Average Flow	Peak Flow	Average Flow (mgd)	Peak Flow (mgd)	Average Flow (mgd)	Peak Flow (mgd)	Average Flow	Peak Flow	Measured ADWF (mgd)	Modeled ADWF (mgd)	Percent Error %
Moonlight Beach Pump Station	0.947	1.411	0.962	1.410	1.52%	-0.10%	0.963	1.498	0.972	1.498	0.93%	0.00%	0.952	0.965	1.33%
Cardiff Gravity Trunk Sewer	0.198	0.310	0.199	0.307	0.86%	0.92%	0.207	0.353	0.207	0.356	-0.05%	0.92%	0.200	0.202	0.59%
Cardiff Pump Station	0.652	1.022	0.657	1.024	0.79%	0.14%	0.662	1.058	0.661	1.053	-0.19%	-0.50%	0.655	0.658	0.51%
Olivenhain Pump Station	0.630	0.907	0.637	0.912	1.12%	0.52%	0.621	0.936	0.626	0.927	0.81%	-0.95%	0.628	0.634	1.02%

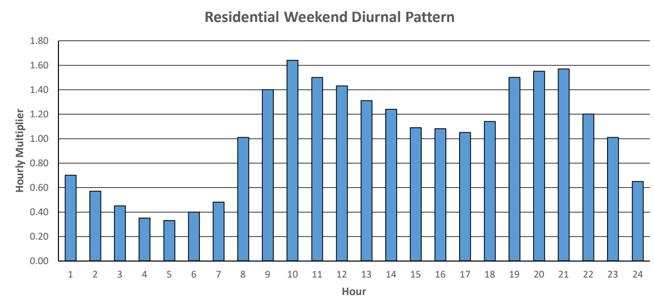
City of Encinitas
Citywide Sewer Master Plan Update
Moonlight Beach Pump Station Flow Monitoring Dry Weather Flow Calibration

	Hour	Time	Measured Flow (mgd)	Modeled Flow (mgd)	Calibrated Curve
Weekday	0	12:00 AM	0.605	0.636	0.60
	1	1:00 AM	0.547	0.560	0.55
	2	2:00 AM	0.504	0.522	0.45
	3	3:00 AM	0.446	0.464	0.40
	4	4:00 AM	0.418	0.421	0.45
	5	5:00 AM	0.432	0.433	0.75
	6	6:00 AM	0.605	0.591	1.01
	7	7:00 AM	0.950	1.020	1.58
	8	8:00 AM	1.411	1.410	1.42
	9	9:00 AM	1.368	1.391	1.30
	10	10:00 AM	1.282	1.307	1.23
	11	11:00 AM	1.238	1.252	1.10
	12	12:00 PM	1.152	1.170	0.98
	13	1:00 PM	1.051	1.087	0.93
	14	2:00 PM	1.022	1.043	0.91
	15	3:00 PM	1.008	1.024	0.95
	16	4:00 PM	1.037	1.043	1.00
	17	5:00 PM	1.066	1.076	1.05
	18	6:00 PM	1.094	1.110	1.52
	19	7:00 PM	1.138	1.144	1.60
	20	8:00 PM	1.238	1.229	1.50
	21	9:00 PM	1.181	1.182	1.40
	22	10:00 PM	1.080	1.114	0.95
	23	11:00 PM	0.864	0.854	0.65
Weekend	24	12:00 AM	0.706	0.636	0.70
	25	1:00 AM	0.634	0.611	0.57
	26	2:00 AM	0.562	0.549	0.45
	27	3:00 AM	0.461	0.469	0.35
	28	4:00 AM	0.389	0.398	0.33
	29	5:00 AM	0.338	0.368	0.40
	30	6:00 AM	0.367	0.392	0.48
	31	7:00 AM	0.590	0.672	1.01
	32	8:00 AM	0.950	1.000	1.40
	33	9:00 AM	1.282	1.305	1.64
	34	10:00 AM	1.498	1.498	1.50
	35	11:00 AM	1.440	1.445	1.43
	36	12:00 PM	1.382	1.390	1.31
	37	1:00 PM	1.310	1.313	1.24
	38	2:00 PM	1.253	1.259	1.09
	39	3:00 PM	1.159	1.166	1.08
	40	4:00 PM	1.123	1.141	1.05
	41	5:00 PM	1.109	1.122	1.14
	42	6:00 PM	1.152	1.168	1.50
	43	7:00 PM	1.166	1.145	1.55
	44	8:00 PM	1.188	1.198	1.57
	45	9:00 PM	1.195	1.217	1.20
	46	10:00 PM	1.008	1.011	1.01
	47	11:00 PM	0.857	0.861	0.65
Average					
	Weekday		0.947	0.962	1.01
	Weekend		0.963	0.972	1.03
	ADWF		0.952	0.965	1.02
Percent Error on Average					
	Weekday			1.52%	
	Weekend			0.93%	
Peak					
	Weekday		1.411	1.410	
	Weekend		1.498	1.498	
Percent Error on Peak					
	Weekday			-0.10%	
	Weekend			0.00%	

Notes:
1. ADWF = (5 x Weekday Average + 2 x Weekend Average) / 7



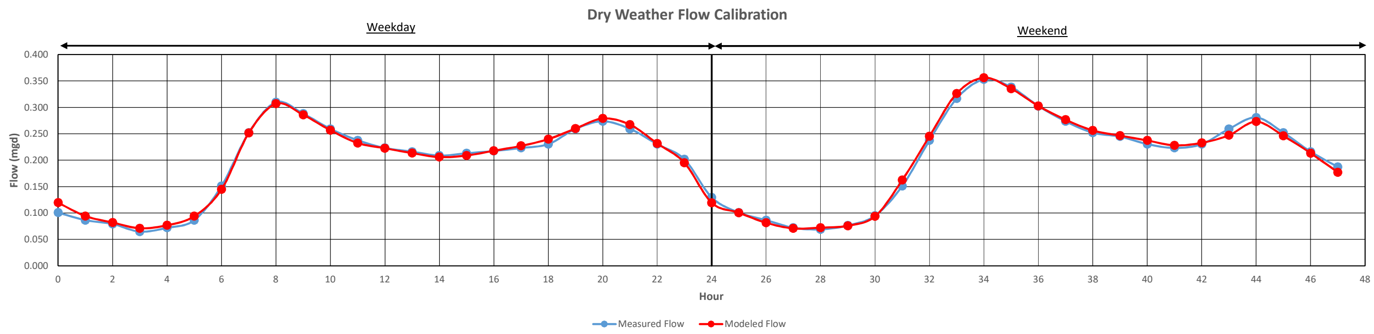


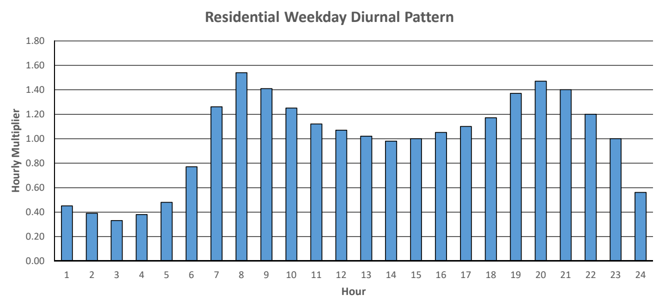


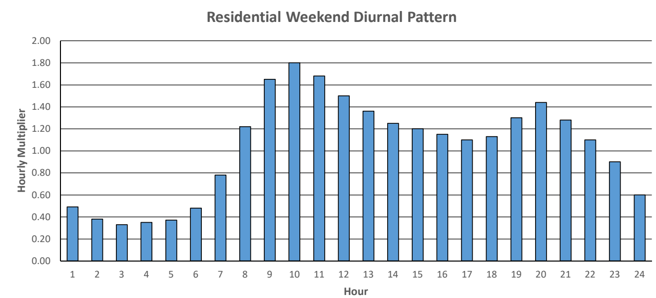
City of Encinitas
Citywide Sewer Master Plan Update
Cardiff Gravity Trunk Sewer Flow Monitoring Dry Weather Flow Calibration

	Hour	Time	Measured Flow (mgd)	Modeled Flow (mgd)	Calibrated Curve
Weekday	0	12:00 AM	0.101	0.119	0.45
	1	1:00 AM	0.086	0.094	0.39
	2	2:00 AM	0.079	0.082	0.33
	3	3:00 AM	0.065	0.071	0.38
	4	4:00 AM	0.072	0.077	0.48
	5	5:00 AM	0.086	0.094	0.77
	6	6:00 AM	0.151	0.145	1.26
	7	7:00 AM	0.252	0.252	1.54
	8	8:00 AM	0.310	0.307	1.41
	9	9:00 AM	0.288	0.286	1.25
	10	10:00 AM	0.259	0.257	1.12
	11	11:00 AM	0.238	0.233	1.07
	12	12:00 PM	0.223	0.223	1.02
	13	1:00 PM	0.216	0.213	0.98
	14	2:00 PM	0.209	0.206	1.00
	15	3:00 PM	0.213	0.209	1.05
	16	4:00 PM	0.217	0.218	1.10
	17	5:00 PM	0.223	0.227	1.17
	18	6:00 PM	0.230	0.240	1.37
	19	7:00 PM	0.259	0.260	1.47
	20	8:00 PM	0.274	0.279	1.40
	21	9:00 PM	0.259	0.267	1.20
	22	10:00 PM	0.230	0.232	1.00
	23	11:00 PM	0.202	0.195	0.56
Weekend	24	12:00 AM	0.130	0.119	0.49
	25	1:00 AM	0.101	0.100	0.38
	26	2:00 AM	0.086	0.081	0.33
	27	3:00 AM	0.072	0.071	0.35
	28	4:00 AM	0.069	0.072	0.37
	29	5:00 AM	0.076	0.076	0.48
	30	6:00 AM	0.095	0.094	0.78
	31	7:00 AM	0.151	0.162	1.22
	32	8:00 AM	0.238	0.245	1.65
	33	9:00 AM	0.317	0.326	1.80
	34	10:00 AM	0.353	0.356	1.68
	35	11:00 AM	0.338	0.335	1.50
	36	12:00 PM	0.302	0.303	1.36
	37	1:00 PM	0.274	0.277	1.25
	38	2:00 PM	0.252	0.256	1.20
	39	3:00 PM	0.245	0.247	1.15
	40	4:00 PM	0.230	0.237	1.10
	41	5:00 PM	0.223	0.228	1.13
	42	6:00 PM	0.230	0.233	1.30
	43	7:00 PM	0.259	0.247	1.44
	44	8:00 PM	0.281	0.273	1.28
	45	9:00 PM	0.252	0.246	1.10
	46	10:00 PM	0.216	0.213	0.90
	47	11:00 PM	0.187	0.177	0.60
Average					
Weekday			0.198	0.199	0.99
Weekend			0.207	0.207	1.04
ADWF			0.200	0.202	1.00
Percent Error on Average					
Weekday				0.86%	
Weekend				-0.05%	
Peak					
Weekday			0.310	0.307	
Weekend			0.353	0.356	
Percent Error on Peak					
Weekday				-0.89%	
Weekend				0.92%	

Notes:
1. ADWF = (5 x Weekday Average + 2 x Weekend Average) / 7



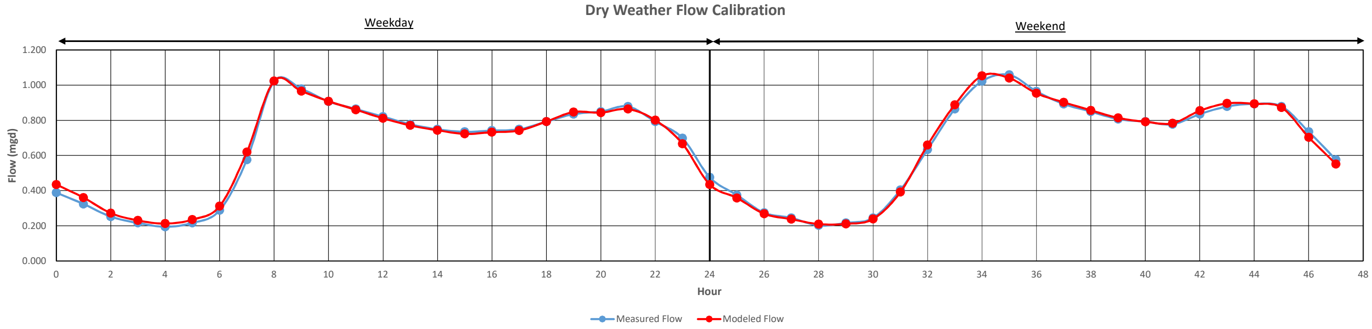


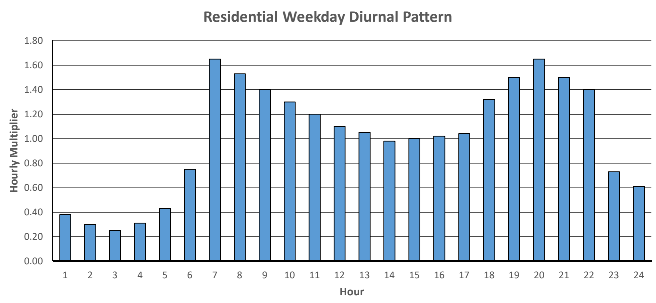


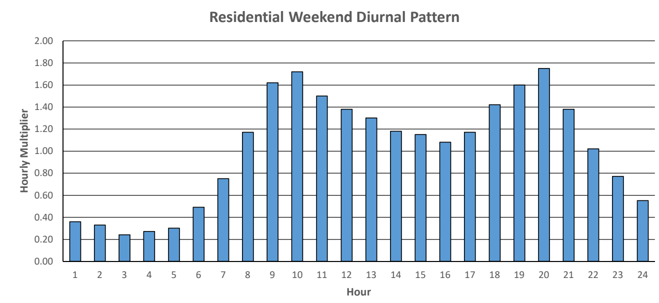
City of Encinitas
Citywide Sewer Master Plan Update
Cardiff Pump Station Flow Monitoring Dry Weather Flow Calibration

	Hour	Time	Measured Flow (mgd)	Modeled Flow (mgd)	Calibrated Curve
Weekday	0	12:00 AM	0.389	0.434	0.38
	1	1:00 AM	0.324	0.360	0.30
	2	2:00 AM	0.252	0.272	0.25
	3	3:00 AM	0.216	0.230	0.31
	4	4:00 AM	0.194	0.212	0.43
	5	5:00 AM	0.216	0.235	0.75
	6	6:00 AM	0.288	0.312	1.65
	7	7:00 AM	0.576	0.619	1.53
	8	8:00 AM	1.022	1.024	1.40
	9	9:00 AM	0.979	0.966	1.30
	10	10:00 AM	0.907	0.908	1.20
	11	11:00 AM	0.864	0.860	1.10
	12	12:00 PM	0.821	0.812	1.05
	13	1:00 PM	0.778	0.771	0.98
	14	2:00 PM	0.749	0.743	1.00
	15	3:00 PM	0.734	0.723	1.02
	16	4:00 PM	0.742	0.732	1.04
	17	5:00 PM	0.749	0.742	1.32
	18	6:00 PM	0.792	0.793	1.50
	19	7:00 PM	0.835	0.847	1.65
	20	8:00 PM	0.850	0.843	1.50
	21	9:00 PM	0.878	0.864	1.40
	22	10:00 PM	0.792	0.801	0.73
	23	11:00 PM	0.698	0.666	0.61
Weekend	24	12:00 AM	0.475	0.434	0.36
	25	1:00 AM	0.374	0.358	0.33
	26	2:00 AM	0.274	0.268	0.24
	27	3:00 AM	0.245	0.237	0.27
	28	4:00 AM	0.202	0.209	0.30
	29	5:00 AM	0.216	0.211	0.49
	30	6:00 AM	0.245	0.238	0.75
	31	7:00 AM	0.403	0.391	1.17
	32	8:00 AM	0.634	0.659	1.62
	33	9:00 AM	0.864	0.888	1.72
	34	10:00 AM	1.022	1.053	1.50
	35	11:00 AM	1.058	1.040	1.38
	36	12:00 PM	0.965	0.953	1.30
	37	1:00 PM	0.893	0.902	1.18
	38	2:00 PM	0.850	0.857	1.15
	39	3:00 PM	0.806	0.813	1.08
	40	4:00 PM	0.792	0.792	1.17
	41	5:00 PM	0.778	0.783	1.42
	42	6:00 PM	0.835	0.854	1.60
	43	7:00 PM	0.878	0.896	1.75
	44	8:00 PM	0.893	0.894	1.38
	45	9:00 PM	0.878	0.873	1.02
	46	10:00 PM	0.734	0.703	0.77
	47	11:00 PM	0.576	0.551	0.55
Average					
	Weekday		0.652	0.657	1.02
	Weekend		0.662	0.661	1.02
	ADWF		0.655	0.658	1.02
Percent Error on Average					
	Weekday			0.79%	
	Weekend			-0.19%	
Peak					
	Weekday		1.022	1.024	
	Weekend		1.058	1.053	
Percent Error on Peak					
	Weekday			0.14%	
	Weekend			-0.50%	

Notes:
1. ADWF = (5 x Weekday Average + 2 x Weekend Average) / 7





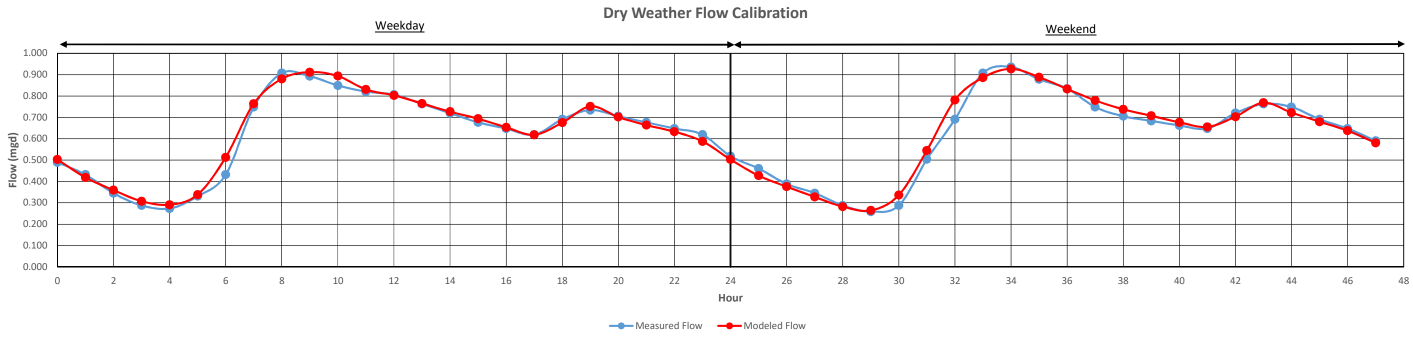


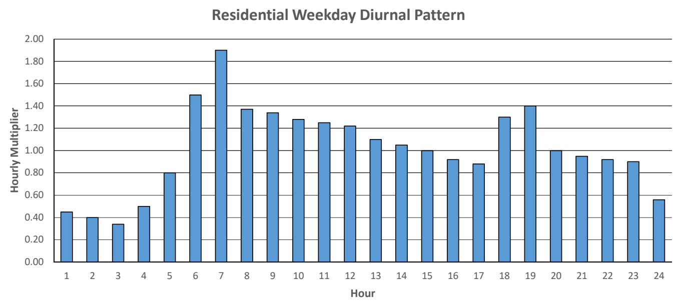
City of Encinitas
Citywide Sewer Master Plan Update
Olivenhain Pump Station Flow Monitoring Dry Weather Flow Calibration

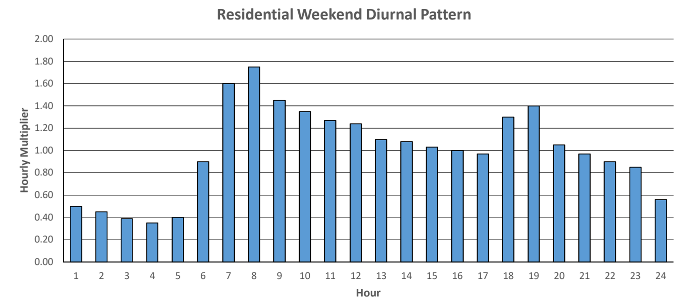
	Hour	Time	Measured Flow (mgd)	Modeled Flow (mgd)	Calibrated Curve
Weekday	0	12:00 AM	0.490	0.503	0.45
	1	1:00 AM	0.432	0.419	0.40
	2	2:00 AM	0.346	0.360	0.34
	3	3:00 AM	0.288	0.308	0.50
	4	4:00 AM	0.274	0.291	0.80
	5	5:00 AM	0.331	0.339	1.50
	6	6:00 AM	0.432	0.513	1.90
	7	7:00 AM	0.749	0.764	1.37
	8	8:00 AM	0.907	0.881	1.34
	9	9:00 AM	0.893	0.912	1.28
	10	10:00 AM	0.850	0.894	1.25
	11	11:00 AM	0.821	0.831	1.22
	12	12:00 PM	0.806	0.803	1.10
	13	1:00 PM	0.763	0.765	1.05
	14	2:00 PM	0.720	0.727	1.00
	15	3:00 PM	0.677	0.694	0.92
	16	4:00 PM	0.648	0.654	0.88
	17	5:00 PM	0.619	0.619	1.30
	18	6:00 PM	0.691	0.676	1.40
	19	7:00 PM	0.734	0.752	1.00
	20	8:00 PM	0.706	0.702	0.95
	21	9:00 PM	0.677	0.664	0.92
	22	10:00 PM	0.648	0.633	0.90
	23	11:00 PM	0.619	0.588	0.56
Weekend	24	12:00 AM	0.518	0.503	0.50
	25	1:00 AM	0.461	0.427	0.45
	26	2:00 AM	0.389	0.376	0.39
	27	3:00 AM	0.346	0.328	0.35
	28	4:00 AM	0.288	0.282	0.40
	29	5:00 AM	0.259	0.265	0.90
	30	6:00 AM	0.288	0.337	1.60
	31	7:00 AM	0.504	0.545	1.75
	32	8:00 AM	0.691	0.782	1.45
	33	9:00 AM	0.907	0.887	1.35
	34	10:00 AM	0.936	0.927	1.27
	35	11:00 AM	0.878	0.889	1.24
	36	12:00 PM	0.835	0.833	1.10
	37	1:00 PM	0.749	0.780	1.08
	38	2:00 PM	0.706	0.738	1.03
	39	3:00 PM	0.684	0.707	1.00
	40	4:00 PM	0.662	0.677	0.97
	41	5:00 PM	0.648	0.655	1.30
	42	6:00 PM	0.720	0.703	1.40
	43	7:00 PM	0.763	0.769	1.05
	44	8:00 PM	0.749	0.723	0.97
	45	9:00 PM	0.691	0.680	0.90
	46	10:00 PM	0.648	0.638	0.85
	47	11:00 PM	0.590	0.581	0.56

	Measured Flow (mgd)	Modeled Flow (mgd)	Calibrated Curve
Average			
Weekday	0.630	0.637	1.01
Weekend	0.621	0.626	0.99
ADWF	0.628	0.634	1.01
Percent Error on Average			
Weekday		1.12%	
Weekend		0.81%	
Peak			
Weekday	0.907	0.912	
Weekend	0.936	0.927	
Percent Error on Peak			
Weekday		0.52%	
Weekend		-0.95%	

Notes:
1. ADWF = (5 x Weekday Average + 2 x Weekend Average) / 7



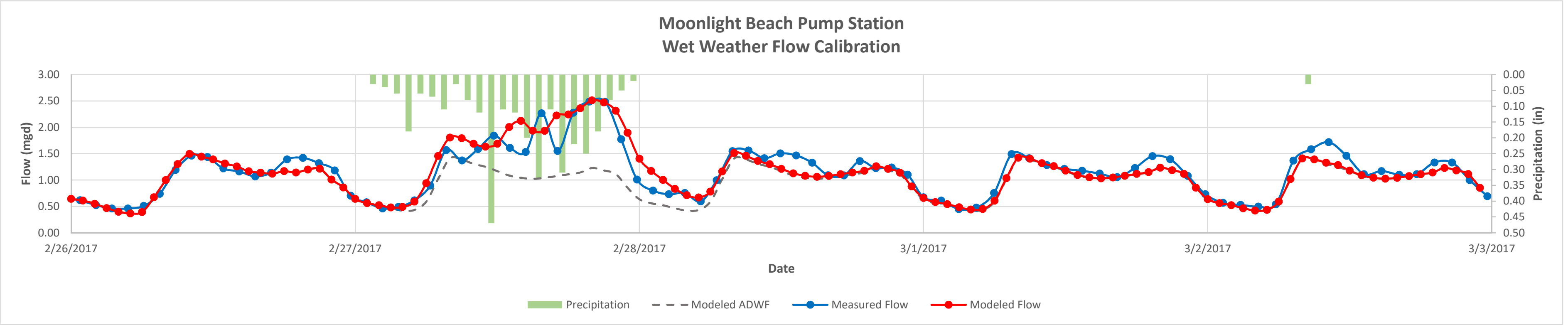




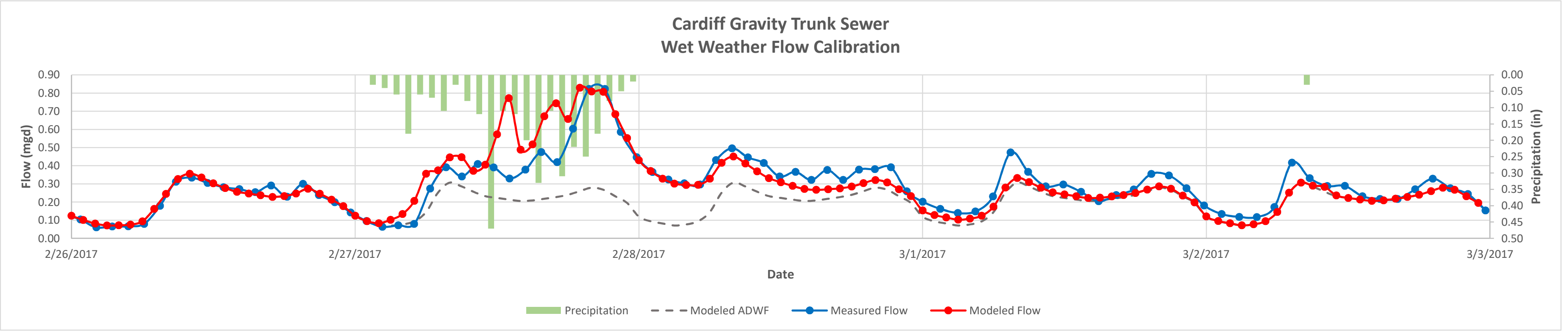
Appendix 3

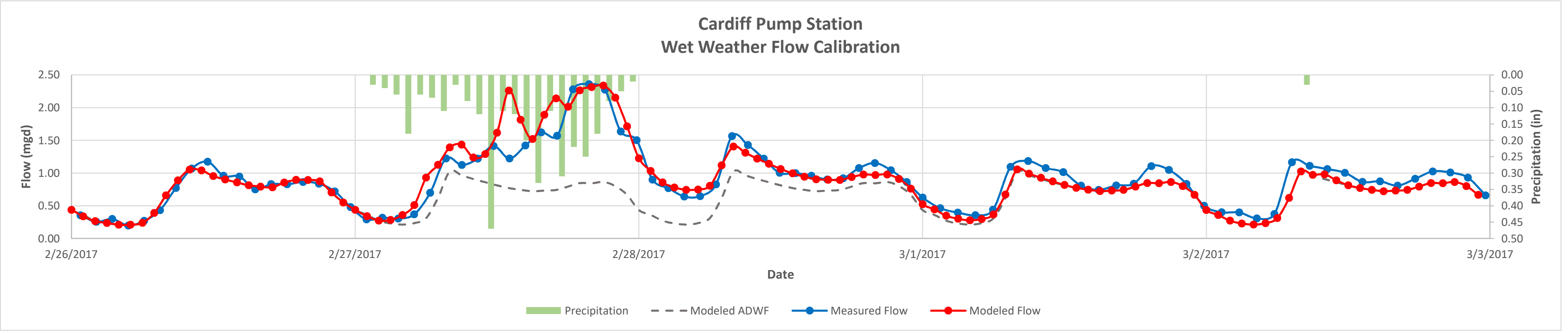
Wet Weather Flow Calibration

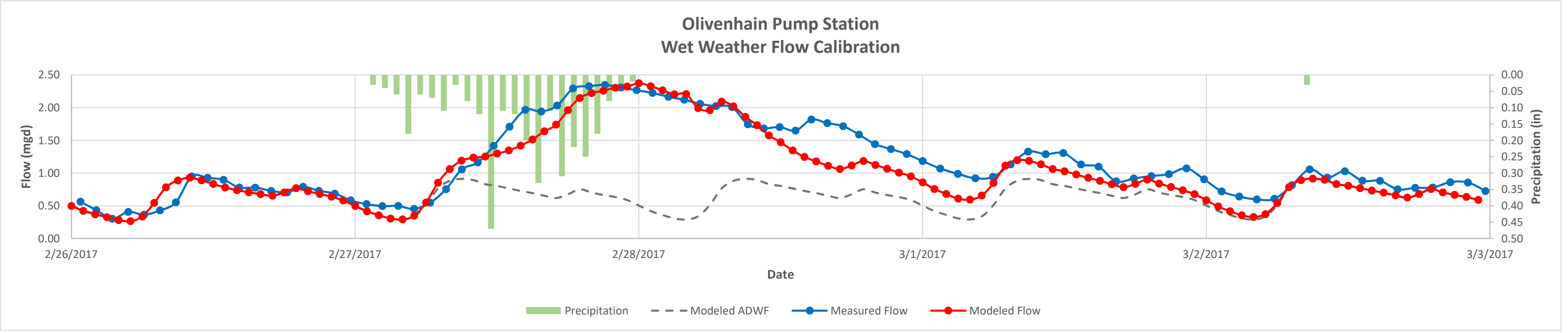
Wet Weather Calibration Summary						
	Measured Data		Modeled Data		Percent Error %	
Meter Location	Average Flow (mgd)	Peak Flow (mgd)	Average Flow (mgd)	Peak Flow (mgd)	Average Flow	Peak Flow
Moonlight Beach Pump Station	1.321	2.491	1.358	2.512	2.84%	0.85%
Cardiff Gravity Trunk Sewer	0.377	0.822	0.395	0.829	4.75%	0.80%
Cardiff Pump Station	1.136	2.357	1.193	2.336	5.04%	-0.88%
Olivenhain Pump Station	1.613	2.346	1.437	2.374	-10.90%	1.16%



Moonlight Beach Pump Station
Wet Weather Flow Calibration
Flow (mgd)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Precipitation (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
2/26/2017
2/27/2017
2/28/2017
3/1/2017
3/2/2017
3/3/2017
Date
Precipitation
Modeled ADWF
Measured Flow
Modeled Flow


Cardiff Gravity Trunk Sewer
Wet Weather Flow Calibration
Flow (mgd)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Precipitation (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
2/26/2017
2/27/2017
2/28/2017
3/1/2017
3/2/2017
3/3/2017
Date
Precipitation
Modeled ADWF
Measured Flow
Modeled Flow


Cardiff Pump Station
Wet Weather Flow Calibration
Flow (mgd)
2.50
2.00
1.50
1.00
0.50
0.00
Precipitation (in)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
2/26/2017
2/27/2017
2/28/2017
3/1/2017
3/2/2017
3/3/2017
Date
Precipitation
Modeled ADWF
Measured Flow
Modeled Flow


Olivenhain Pump Station
Wet Weather Flow Calibration
Flow (mgd)
Precipitation (in)
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
2/26/2017
2/27/2017
2/28/2017
3/1/2017
3/2/2017
3/3/2017
Date
Precipitation
Modeled ADWF
Measured Flow
Modeled Flow

Appendix 4

Housing Element Developments

Housing Element Developments

Project Reference	Housing Element Category	Land Use	Division
2583502800	Above Moderate Income	Single Family	CSD
2592215700	Above Moderate Income	Single Family	CSD
2595607400	Above Moderate Income	Single Family	CSD
2600835800	Above Moderate Income	Single Family	CSD
2601310200	Above Moderate Income	Single Family	CSD
2602730100	Above Moderate Income	Single Family	CSD
2605730700	Above Moderate Income	Single Family	CSD
2605731300	Above Moderate Income	Single Family	CSD
2620621300	Above Moderate Income	Single Family	CSD
2620621400	Above Moderate Income	Single Family	CSD
2621603100	Above Moderate Income	Single Family	CSD
13-096	Approved Units Without Permits	Single Family	CSD
14-007 TPM/CDP	Approved Units Without Permits	Single Family	CSD
14-111 TM/DR	Approved Units Without Permits	Single Family	CSD
14-168 DR/PMW	Approved Units Without Permits	Single Family	CSD
14-209 TPM/CDP	Approved Units Without Permits	Single Family	CSD
14-256 TPM/CDP	Approved Units Without Permits	Single Family	CSD
15-133 a	Approved Units Without Permits	Single Family	CSD
15-133 b	Approved Units Without Permits	Single Family	CSD
15-134	Approved Units Without Permits	Single Family	CSD
15-179 a	Approved Units Without Permits	Single Family	CSD
15-179 b	Approved Units Without Permits	Single Family	CSD
15-179 c	Approved Units Without Permits	Single Family	CSD
16-09	Approved Units Without Permits	Single Family	CSD
16-161	Approved Units Without Permits	Single Family	CSD
16-164	Approved Units Without Permits	Single Family	CSD
16-184	Approved Units Without Permits	Single Family	CSD
17-081	Approved Units Without Permits	Single Family	CSD
17-109	Approved Units Without Permits	Single Family	CSD
2582710400	Moderate Income - Residential Only	Single Family	CSD
2582735000	Moderate Income - Residential Only	Single Family	CSD
2582740100	Moderate Income - Residential Only	Single Family	CSD
2582742500	Moderate Income - Residential Only	Single Family	CSD
2600830600	Moderate Income - Residential Only	Single Family	CSD
2600831100	Moderate Income - Residential Only	Single Family	CSD
2603511300	Moderate Income - Residential Only	Single Family	CSD
2604141400	Moderate Income - Residential Only	Single Family	CSD
2606200700	Moderate Income - Residential Only	Single Family	CSD
2606201500	Moderate Income - Residential Only	Single Family	CSD
2606202700	Moderate Income - Residential Only	Single Family	CSD
2606203300	Moderate Income - Residential Only	Single Family	CSD
2606300300	Moderate Income - Residential Only	Single Family	CSD
2606300600	Moderate Income - Residential Only	Single Family	CSD
2606300700	Moderate Income - Residential Only	Single Family	CSD
2612003300	Moderate Income - Residential Only	Single Family	CSD
01	Very Low and Low Income	Single Family	CSD

Housing Element Developments

Project Reference	Housing Element Category	Land Use	Division
08a	Very Low and Low Income	Single Family	CSD
08b	Very Low and Low Income	Single Family	CSD
AD1	Very Low and Low Income	Single Family	CSD
AD11	Very Low and Low Income	Single Family	CSD
AD9	Very Low and Low Income	Single Family	CSD
2543624600	Above Moderate Income	Single Family	ESD
2561711500	Above Moderate Income	Single Family	ESD
2561712400	Above Moderate Income	Single Family	ESD
2563144800	Above Moderate Income	Single Family	ESD
2570203100	Above Moderate Income	Single Family	ESD
2581111700	Above Moderate Income	Single Family	ESD
2593111000	Above Moderate Income	Single Family	ESD
14-069 TPM	Approved Units Without Permits	Single Family	ESD
14-275 CDP/PMW	Approved Units Without Permits	Single Family	ESD
15-064 a	Approved Units Without Permits	Single Family	ESD
15-064 b	Approved Units Without Permits	Single Family	ESD
15-064 c	Approved Units Without Permits	Single Family	ESD
15-064 d	Approved Units Without Permits	Single Family	ESD
15-064 e	Approved Units Without Permits	Single Family	ESD
15-064 f	Approved Units Without Permits	Single Family	ESD
15-064 g	Approved Units Without Permits	Single Family	ESD
15-064 h	Approved Units Without Permits	Single Family	ESD
15-064 i	Approved Units Without Permits	Single Family	ESD
15-064 j	Approved Units Without Permits	Single Family	ESD
15-064 k	Approved Units Without Permits	Single Family	ESD
15-064 l	Approved Units Without Permits	Single Family	ESD
15-064 m	Approved Units Without Permits	Single Family	ESD
16-211	Approved Units Without Permits	Single Family	ESD
16-235	Approved Units Without Permits	Single Family	ESD
16-281	Approved Units Without Permits	Single Family	ESD
16-62	Approved Units Without Permits	Single Family	ESD
17-016	Approved Units Without Permits	Single Family	ESD
17-121	Approved Units Without Permits	Single Family	ESD
17-147	Approved Units Without Permits	Single Family	ESD
17-163	Approved Units Without Permits	Single Family	ESD
2562721100	Moderate Income - Mixed Use	Mixed Use	ESD
2562721400	Moderate Income - Mixed Use	Mixed Use	ESD
2562721500	Moderate Income - Mixed Use	Mixed Use	ESD
2562910300	Moderate Income - Mixed Use	Mixed Use	ESD
2563920300	Moderate Income - Mixed Use	Mixed Use	ESD
2563920400	Moderate Income - Mixed Use	Mixed Use	ESD
2563920600	Moderate Income - Mixed Use	Mixed Use	ESD
2563921000	Moderate Income - Mixed Use	Mixed Use	ESD
2563921100	Moderate Income - Mixed Use	Mixed Use	ESD
2563921200	Moderate Income - Mixed Use	Mixed Use	ESD
2580320800	Moderate Income - Mixed Use	Mixed Use	ESD

Housing Element Developments

Project Reference	Housing Element Category	Land Use	Division
2580341900	Moderate Income - Mixed Use	Mixed Use	ESD
2580360900	Moderate Income - Mixed Use	Mixed Use	ESD
2580361700	Moderate Income - Mixed Use	Mixed Use	ESD
2580361800	Moderate Income - Mixed Use	Mixed Use	ESD
2580521200	Moderate Income - Mixed Use	Mixed Use	ESD
2580850500	Moderate Income - Mixed Use	Mixed Use	ESD
2580862000	Moderate Income - Mixed Use	Mixed Use	ESD
2581631000	Moderate Income - Mixed Use	Mixed Use	ESD
2581641700	Moderate Income - Mixed Use	Mixed Use	ESD
2581641900	Moderate Income - Mixed Use	Mixed Use	ESD
2581821700	Moderate Income - Mixed Use	Mixed Use	ESD
2581901300	Moderate Income - Mixed Use	Mixed Use	ESD
2581901400	Moderate Income - Mixed Use	Mixed Use	ESD
2581901500	Moderate Income - Mixed Use	Mixed Use	ESD
2581901600	Moderate Income - Mixed Use	Mixed Use	ESD
2581901700	Moderate Income - Mixed Use	Mixed Use	ESD
2581901800	Moderate Income - Mixed Use	Mixed Use	ESD
2581901900	Moderate Income - Mixed Use	Mixed Use	ESD
2581902000	Moderate Income - Mixed Use	Mixed Use	ESD
2582941100	Moderate Income - Mixed Use	Mixed Use	ESD
2583120900	Moderate Income - Mixed Use	Mixed Use	ESD
2583121500	Moderate Income - Mixed Use	Mixed Use	ESD
2583121600	Moderate Income - Mixed Use	Mixed Use	ESD
2583161700	Moderate Income - Mixed Use	Mixed Use	ESD
2583170500	Moderate Income - Mixed Use	Mixed Use	ESD
2583170800	Moderate Income - Mixed Use	Mixed Use	ESD
2580232200	Moderate Income - Residential Only	Single Family	ESD
2581720100	Moderate Income - Residential Only	Single Family	ESD
2581720200	Moderate Income - Residential Only	Single Family	ESD
2581720500	Moderate Income - Residential Only	Single Family	ESD
2581831400	Moderate Income - Residential Only	Single Family	ESD
2581831600	Moderate Income - Residential Only	Single Family	ESD
2582920900	Moderate Income - Residential Only	Single Family	ESD
2582921300	Moderate Income - Residential Only	Single Family	ESD
2582921500	Moderate Income - Residential Only	Single Family	ESD
2582941300	Moderate Income - Residential Only	Single Family	ESD
2582941700	Moderate Income - Residential Only	Single Family	ESD
207 C STREET	Recycled	Mixed Use	ESD
674 COAST HIGHWAY 101	Recycled	Mixed Use	ESD
686 COAST HIGHWAY 101	Recycled	Mixed Use	ESD
687 COAST HIGHWAY 101	Recycled	Mixed Use	ESD
960 COAST HIGHWAY 101	Recycled	Mixed Use	ESD
97 COAST HIGHWAY 101	Recycled	Mixed Use	ESD
402 SECOND STREET	Recycled	Single Family	ESD
12	Very Low and Low Income	Commercial	ESD
09	Very Low and Low Income	Mixed Use	ESD

Housing Element Developments

Project Reference	Housing Element Category	Land Use	Division
AD14	Very Low and Low Income	Mixed Use	ESD
05	Very Low and Low Income	Single Family	ESD
AD2a	Very Low and Low Income	Single Family	ESD
AD2b	Very Low and Low Income	Single Family	ESD
AD2c	Very Low and Low Income	Single Family	ESD
AD31	Very Low and Low Income	Single Family	ESD

Appendix 5

Pipelines Not Meeting Evaluation Criteria

Pipelines Not Meeting Evaluation Criteria

No.	Sewer ID	Location Description	Upstream MH ID	Downstream MH ID	Upstream Invert (ft)	Downstream Invert (ft)	Pipe Diameter (in)	Pipe Length (ft)	Pipe Slope (%)	Existing (2020) Peak Wet Weather Flow (mgd)	2025 Peak Wet Weather Flow (mgd)	2030 Peak Wet Weather Flow (mgd)	Build-Out (2035) Peak Wet Weather Flow (mgd)	Existing (2020) Maximum Wet Weather d/D	2025 Maximum Wet Weather d/D	2030 Maximum Wet Weather d/D	Build-Out (2035) Maximum Wet Weather d/D	Sanitary Division	Pipe Category
4	12061SMAIN	East of I-5, private property	2428SMANHL	2435SMANHL	180.29	179.92	10	131	0.28%	0.954	0.960	0.965	0.970	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
5	12064SMAIN	I-5 Crossing	2435SMANHL	2003SMANHL	179.92	179.09	10	208	0.40%	0.955	0.961	0.966	0.971	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
8	12716SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	2449SMANHL	1999SMANHL	175.50	174.39	10	321	0.35%	0.962	0.968	0.973	0.978	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
9	12717SMAIN	West of I-5, private property	2000SMANHL	2449SMANHL	175.59	175.50	10	25	0.36%	0.959	0.965	0.970	0.975	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
44	9197SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	1998SMANHL	1997SMANHL	173.25	172.40	10	284	0.30%	0.972	0.978	0.983	0.988	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
45	9589SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	1999SMANHL	1998SMANHL	174.39	173.25	10	357	0.32%	0.968	0.974	0.979	0.983	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
46	9592SMAIN	West of I-5, private property	2001SMANHL	2000SMANHL	176.77	175.59	10	346	0.34%	0.958	0.964	0.969	0.974	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
47	9593SMAIN	West of I-5, private property	2002SMANHL	2001SMANHL	177.78	176.77	10	343	0.29%	0.956	0.962	0.967	0.972	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
48	9594SMAIN	I-5 Crossing	2003SMANHL	2002SMANHL	179.09	177.78	10	412	0.32%	0.955	0.961	0.966	0.971	1.000	1.000	1.000	1.000	CSD	Cardiff Relief Trunk Sewer
1	11125SMAIN	San Elijo Avenue between Cornish Drive and Montgomery Avenue	2288SMANHL	2286SMANHL	73.22	71.62	8	323	0.50%	0.512	0.516	0.520	0.528	0.882	0.902	0.948	1.000	CSD	Cardiff Trunk Sewer
59	11126SMAIN	San Elijo Avenue between Cornish Drive and Montgomery Avenue	2286SMANHL	2289SMANHL	71.62	70.00	8	433	0.37%	0.552	0.556	0.560	0.572	0.957	0.964	0.970	0.982	CSD	Cardiff Trunk Sewer
65	15391SMAIN	West of Cardiff Pump Station	2030SMANHL	3561SMANHL	16.12	15.82	15	158	0.19%	2.276	2.286	2.295	2.303	0.920	0.924	0.928	0.931	CSD	Cardiff Trunk Sewer
2	12014SMAIN	East of I-5, Loch Lomond Drive	2427SMANHL	2428SMANHL	181.11	180.29	10	101	0.81%	1.011	1.014	1.020	1.026	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
3	12039SMAIN	East of I-5, Loch Lomond Drive	2434SMANHL	2428SMANHL	181.30	180.29	10	319	0.32%	0.124	0.124	0.123	0.123	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
6	12080SMAIN	East of I-5, Orkney Lane	2436SMANHL	2430SMANHL	183.73	182.28	8	270	0.50%	0.099	0.100	0.101	0.102	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
7	12132SMAIN	East of I-5, Loch Lomond Drive	2432SMANHL	2434SMANHL	182.23	181.30	8	278	0.42%	0.096	0.096	0.101	0.105	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
10	15374SMAIN	East of I-5, private property	3553SMANHL	2427SMANHL	182.17	181.11	10	217	0.54%	1.008	1.010	1.016	1.022	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
11	15375SMAIN	East of I-5	2430SMANHL	3553SMANHL	182.28	182.17	10	15	0.74%	0.552	0.551	0.554	0.558	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
12	15494SMAIN	Sheffield Avenue, between Oxford Avenue and Somerset Avenue	1013SPLUG	1998SMANHL	173.87	173.25	8	156	0.40%	0.040	0.041	0.042	0.041	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
16	16645SMAIN	East of I-5, Faith Avenue	1066SPLUG	2432SMANHL	183.65	182.23	8	260	0.55%	0.053	0.056	0.059	0.061	1.000	1.000	1.000	1.000	CSD	Flows Into Cardiff Relief Trunk Sewer
57	15495SMAIN	Sheffield Avenue, between Oxford Avenue and Somerset Avenue	2292SMANHL	1013SPLUG	174.41	173.87	8	132	0.41%	0.020	0.020	0.020	0.019	0.921	0.949	0.973	0.996	CSD	Flows Into Cardiff Relief Trunk Sewer
64	15390SMAIN	West of Cardiff Pump Station	3557SMANHL	3561SMANHL	16.34	15.82	8	53	0.99%	0.007	0.007	0.007	0.007	0.926	0.928	0.931	0.933	CSD	Flows Into Cardiff Trunk Sewer
15	16608SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	3031SCOUT	1138SMANHL	44.78	42.83	6	195	1.00%	0.030	0.030	0.030	0.030	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
17	16822SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1077SPLUG	1135SMANHL	45.90	45.16	6	74	1.00%	0.024	0.023	0.024	0.024	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
18	3043SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1118SMANHL	1119SMANHL	60.51	59.69	8	153	0.53%	0.043	0.043	0.045	0.041	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
28	3304SMAIN	OTS, between El Camino Del Norte and Bella Collina	1130SMANHL	1129SMANHL	54.24	50.89	8	38	8.95%	0.599	0.599	0.599	0.599	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
29	3311SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1145SMANHL	1137SMANHL	51.12	43.30	8	216	3.63%	0.245	0.245	0.245	0.245	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
32	3482SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1124SMANHL	1125SMANHL	51.24	51.01	8	54	0.42%	0.076	0.076	0.077	0.079	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
33	3483SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1123SMANHL	1124SMANHL	52.51	51.24	8	301	0.42%	0.076	0.076	0.078	0.078	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
34	3484SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1122SMANHL	1123SMANHL	53.59	52.51	8	271	0.40%	0.076	0.075	0.077	0.077	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
35	3485SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1121SMANHL	1122SMANHL	55.42	53.59	8	493	0.37%	0.067	0.070	0.068	0.066	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
36	3486SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1120SMANHL	1121SMANHL	57.79	55.42	8	386	0.61%	0.065	0.068	0.066	0.061	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
37	3487SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1119SMANHL	1120SMANHL	59.69	57.79	8	404	0.47%	0.063	0.066	0.064	0.059	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
51	3303SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1125SMANHL	1129SMANHL	51.01	50.89	8	119	0.10%	0.076	0.077	0.076	0.078	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
52	4364SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	608SMANHL	612SMANHL	59.08	50.70	8	131	6.40%	0.048	0.045	0.046	0.046	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
53	4369SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1221SMANHL	1130SMANHL	62.83	54.24	8	103	8.37%	0.042	0.042	0.042	0.045	1.000	1.000	1.000	1.000	CSD	Flows Into Olivenhain Trunk Sewer
13	16598SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1286SMANHL	1287SMANHL	10.94	10.90	10	26	0.16%	0.464	0.476	0.488	0.501	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
14	16599SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1286SMANHL	1287SMANHL	10.94	10.90	10	25	0.16%	0.468	0.479	0.491	0.504	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
19	3279SMAIN	OTS, between El Camino Del Norte and Bella Collina	387SMANHL	1126SMANHL	95.00	93.58	8	285	0.50%	0.580	0.580	0.580	0.580	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
20	3289SMAIN	OTS, between El Camino Del Norte and Bella Collina	1133SMANHL	1134SMANHL	47.00	46.56	8	110	0.40%	0.640	0.639	0.640	0.641	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
21	3290SMAIN	OTS, between El Camino Del Norte and Bella Collina	1134SMANHL	1135SMANHL	46.56	45.16	8	350	0.40%	0.641	0.640	0.641	0.642	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
22	3291SMAIN	OTS, between El Camino Del Norte and Bella Collina	1135SMANHL	1136SMANHL	45.16	43.68	8	369	0.40%	0.645	0.644	0.645	0.646	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
23	3292SMAIN	OTS, between El Camino Del Norte and Bella Collina	1136SMANHL	1137SMANHL	43.68	43.30	8	132	0.29%	0.646	0.646	0.646	0.647	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
24	3293SMAIN	OTS, between El Camino Del Norte and Bella Collina	1137SMANHL	1138SMANHL	43.30	42.83	8	160	0.29%	0.881	0.881	0.885	0.883	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
25	3294SMAIN	OTS, between El Camino Del Norte and Bella Collina	1138SMANHL	1139SMANHL	42.83	41.86	8	328	0.30%	0.886	0.886	0.890	0.889	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
26	3300SMAIN	OTS, between El Camino Del Norte and Bella Collina	1139SMANHL	1140SMANHL	41.86	40.74	8	277	0.40%	0.889	0.889	0.893	0.892	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
27	3301SMAIN	OTS, between El Camino Del Norte and Bella Collina	1140SMANHL	1141SMANHL	40.74	39.25	8	284	0.52%	0.904	0.904	0.907	0.906	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
30	3437SMAIN	OTS, between El Camino Del Norte and Bella Collina	1129SMANHL	612SMANHL	50.89	50.70	8	177	0.11%	0.627	0.627	0.628	0.628	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
31	3438SMAIN	OTS, between El Camino Del Norte and Bella Collina	612SMANHL	1131SMANHL	50.70	49.00	8	108	1.57%	0.634	0.634	0.635	0.635	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
38	5204SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1295SMANHL	1345SMANHL	4.49	4.41	15	61	0.13%	1.569	1.636	1.705	1.740	0.844	0.899	0.989	1.000	CSD	Olivenhain Trunk Sewer
39	6651SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1299SMANHL	1500SMANHL	7.37	7.07	15	180	0.17%	1.514	1.581	1.652	1.691	0.760	0.792	0.833	1.000	CSD	Olivenhain Trunk Sewer
40	6652SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1500SMANHL	1298SMANHL	7.07	6.41	15	419	0.16%	1.561	1.628	1.698	1.732	0.771	0.802	0.847	1.000	CSD	Olivenhain Trunk Sewer
41	894SMAIN	OTS, between El Camino Del Norte and Bella Collina	389SMANHL	386SMANHL	96.97	98.58	8	320	0.50%	0.550	0.550	0.550	0.550	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
42	895SMAIN	OTS, between El Camino Del Norte and Bella Collina	389SMANHL	388SMANHL	96.97	96.65	8	66	0.49%	0.552	0.552	0.552	0.552	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
43	896SMAIN	OTS, between El Camino Del Norte and Bella Collina	388SMANHL	387SMANHL	96.65	95.00	8	330	0.50%	0.553	0.553	0.553	0.553	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
49	3287SMAIN	OTS, between El Camino Del Norte and Bella Collina	1131SMANHL	1132SMANHL	49.00	47.60	8	353	0.40%	0.636	0.635	0.636	0.637	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
50	3288SMAIN	OTS, between El Camino Del Norte and Bella Collina	1132SMANHL	1133SMANHL	47.60	47.00	8	151	0.40%	0.637	0.637	0.638	0.639	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
54	5053SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1286SMANHL	1287SMANHL	10.94	10.90	10	25	0.16%	0.474	0.486	0.498	0.511	1.000	1.000	1.000	1.000	CSD	Olivenhain Trunk Sewer
55	5065SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1298SMANHL	1294SMANHL	6.41	5.45	15	603	0.16%	1.563	1.630	1.698	1.734	0.768	0.802	0.877	1.000	CSD	Olivenhain Trunk Sewer
56	5066SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1294SMANHL	1295SMANHL	5.45	4.49	15	594	0.16%	1.567	1.635	1.702	1.738	0.805	0.852	0.949	1.000	CSD	Olivenhain Trunk Sewer
58	7885SMAIN	OTS, between El Camino Del Norte and Bella Collina	1291SMANHL	1652SMANHL	9.23	8.72	15	464	0.11%	1.412	1.446	1.484	1.519	0.830	0.859	0.895	0.983	CSD	Olivenhain Trunk Sewer
60	5205SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1345SMANHL	1296SMANHL	4.41	3.53	15	536	0.16%	1.731	1.809	1.880	1.929	0.845	0.892	0.955	0.981	CSD	Olivenhain Trunk Sewer
61	931SMAIN	OTS, between El Camino Del Norte and Bella Collina	413SMANHL	381SMANHL	118.32	117.79	8	106	0.50%	0.529	0.529	0.529	0.529	0.974	0.974	0.974	0.975	CSD	Olivenhain Trunk Sewer
62	5119SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1302SMANHL	1291SMANHL	10.00	9.23	15	593	0.13%	1.411	1.445	1.482	1.513	0.803	0.829	0.863	0.958	CSD	Olivenhain Trunk Sewer
63	7886SMAIN	OTS, between El Camino Del Norte and Bella Collina	1652SMANHL	1303SMANHL	8.72	8.59	15	114	0.11%	1.485	1.552	1.623	1.684	0.819	0.848	0.880	0.958	CSD	Olivenhain Trunk Sewer
66	16581SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1260SMANHL	3786SMANHL	19.10	18.87	15	113	0.20%	1.168	1.177	1.188	1.202	0.865	0.883	0.904	0.931	CSD	Olivenhain Trunk Sewer
67	5108SMAIN	OTS, between Olivenhain Pump Station and Mira Costa College Road	1309SMANHL	1318SMANHL	-1.88	-2.97	15	542	0.20%	1.792	1.867	1.936	1.978	0.812	0.846	0.887	0.920	CSD	Olivenhain Trunk Sewer
68	5083SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1304SMANHL	1299SMANHL	8.19	7.37	15	216	0.38%	1.513	1.581	1.651	1.709	0.650	0.673	0.702	0.919	CSD	Olivenhain Trunk Sewer
69	5874SMAIN	OTS, between El Camino Del Norte and Bella Collina	1303SMANHL	1425SMANHL	8.59	8.33	15	242	0.11%	1.485	1.553	1.624	1.683	0.771	0.795	0.820	0.915	CSD	Olivenhain Trunk Sewer
70	5068SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1296SMANHL	1297SMANHL	3.53	2.88	15	414	0.16%	1.732	1.810	1.881	1.929	0.806	0.840	0.876	0.904	CSD	Olivenhain Trunk Sewer
71	5091SMAIN	OTS, between Olivenhain Pump Station and Mira Costa College Road	1310SMANHL	1309SMANHL	-0.68	-1.88	15	603	0.20%	1.791	1.866	1.935	1.977	0.786	0.820	0.862	0.900	CSD	Olivenhain Trunk Sewer
72	13732SMAIN	Property east of Ocean View Avenue	3175SMANHL	3174SMANHL	108.29	107.74	8	105	0.52%	0.281	0.316	0.351	0.387	0.726	0.767	0.813	0.911	ESD	Flows Into Encinitas Trunk Sewer

Appendix 6

Surcharged Manholes

Surcharged Manholes								
No.	Manhole ID	Location Description	Invert (ft)	Depth (ft)	Existing (2020) Wet Weather Status	2025 Wet Weather Status	2030 Wet Weather Status	Build-Out (2035) Wet Weather Status
1	1122SMANHL	Lone Jack Road - Tributary to OTS	53.59	7.30	Surcharged	Surcharged	Surcharged	Surcharged
2	1130SMANHL	Lone Jack Road - OTS	54.24	9.43	Surcharged	Surcharged	Surcharged	Surcharged
3	1132SMANHL	Lone Jack Road - OTS	47.60	12.06	Surcharged	Surcharged	Surcharged	Surcharged
4	1134SMANHL	Lone Jack Road - OTS	46.56	8.34	Surcharged	Surcharged	Surcharged	Surcharged
5	1135SMANHL	Lone Jack Road - OTS	45.16	9.24	Surcharged	Surcharged	Surcharged	Surcharged
6	1136SMANHL	Lone Jack Road - OTS	43.68	9.82	Surcharged	Surcharged	Surcharged	Surcharged
7	612SMANHL	Lone Jack Road - OTS	50.70	10.35	Surcharged	Surcharged	Surcharged	Surcharged
8	1131SMANHL	Lone Jack Road - OTS	49.00	11.25	Surcharged	Surcharged	Surcharged	Surcharged
9	1129SMANHL	Lone Jack Road - OTS	50.89	12.59	Surcharged	Surcharged	Surcharged	Surcharged
10	1123SMANHL	Lone Jack Road - Tributary to OTS	52.51	10.00	Surcharged	Surcharged	Surcharged	Surcharged
11	1124SMANHL	Lone Jack Road - Tributary to OTS	51.24	9.59	Surcharged	Surcharged	Surcharged	Surcharged
12	1125SMANHL	Lone Jack Road - Tributary to OTS	51.01	6.99	Surcharged	Surcharged	Surcharged	Surcharged
13	1133SMANHL	Lone Jack Road - OTS	47.00	12.00	Surcharged	Surcharged	Surcharged	Surcharged
14	1120SMANHL	Lone Jack Road - OTS	57.79	4.65	Surcharged	Surcharged	Surcharged	Surcharged
15	1121SMANHL	Lone Jack Road - Tributary to OTS	55.42	7.89	Surcharged	Surcharged	Surcharged	Surcharged

Appendix 7

Risk Analysis

Sewer ID	Location Description	Year	Material	LOF (Existing)							LOF (2025)							LOF (2030)							LOF (2035)							COF				Sanitary Division	Pipe Category
				Age	Material	Capacity	Condition	LOF (Existing)	COF (Existing)	Risk (Existing)	Age	Material	Capacity	Condition	LOF (2025)	COF (2025)	Risk (2025)	Age	Material	Capacity	Condition	LOF (2030)	COF (2030)	Risk (2035)	Age	Material	Capacity	Condition	LOF (2030)	COF (2030)	Risk (2035)	City Facilities	Receiving Environment	Resident /Business	Circulation System		
12061SMAIN	East of I-5, private property	1961	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
12064SMAIN	I-5 Crossing	1963	VCP	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	0	0		5	CSD	Cardiff Relief Trunk Sewer
12716SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
12717SMAIN	West of I-5, private property	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
9197SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
9589SMAIN	Somerset Avenue, between Caretta Way and Brighton Avenue	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
9592SMAIN	West of I-5, private property	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
9593SMAIN	West of I-5, private property	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Cardiff Relief Trunk Sewer
9594SMAIN	I-5 Crossing	1963	VCP	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	0	0		5	CSD	Cardiff Relief Trunk Sewer
11125SMAIN	San Elijo Avenue between Cornish Drive and Montgomery Avenue	1963	VCP	4	3	4		2.3	2.3	5.3	4	3	5		2.6	2.3	6.0	4	3	5		2.6	2.3	6.0	4	3	5		2.6	2.3	6.0	0	5		3	CSD	Cardiff Trunk Sewer
11126SMAIN	San Elijo Avenue between Cornish Drive and Montgomery Avenue	1963	VCP	4	3	5		2.6	2.3	6.0	4	3	5		2.6	2.3	6.0	4	3	5		2.6	2.3	6.0	4	3	5		2.6	2.3	6.0	0	5		3	CSD	Cardiff Trunk Sewer
15391SMAIN	West of Cardiff Pump Station	0	VCP	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	0	5		0	CSD	Cardiff Trunk Sewer
12014SMAIN	East of I-5, Loch Lomond Drive	1961	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
12039SMAIN	East of I-5, Loch Lomond Drive	1961	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
12080SMAIN	East of I-5, Orkney Lane	1961	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
12132SMAIN	East of I-5, Loch Lomond Drive	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
15374SMAIN	East of I-5, private property	1961	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
15375SMAIN	East of I-5	1961	VCP	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	4	3	5		2.6	0.5	1.3	0	0		5	CSD	Flows Into Cardiff Relief Trunk Sewer
15494SMAIN	Sheffield Avenue, between Oxford Avenue and Somerset Avenue	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
16645SMAIN	East of I-5, Faith Avenue	1963	VCP	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
15495SMAIN	Sheffield Avenue, between Oxford Avenue and Somerset Avenue	1986	VCP	2	3	5		2.2	0.0	0.0	2	3	5		2.2	0.0	0.0	2	3	5		2.2	0.0	0.0	2	3	5		2.2	0.0	0.0	0	0		0	CSD	Flows Into Cardiff Relief Trunk Sewer
15390SMAIN	West of Cardiff Pump Station	0	VCP	5	3	5	5	4.8	2.3	11.0	5	3	5	5	4.8	2.3	11.0	5	3	5	5	4.8	2.3	11.0	5	3	5	5	4.8	2.3	11.0	0	5		3	CSD	Flows Into Cardiff Trunk Sewer
16608SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	0	VCP	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	5	3	5	5	4.8	2.0	9.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
16822SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	0	PVC	5	1	5	5	4.6	2.0	9.2	5	1	5	5	4.6	2.0	9.2	5	1	5	5	4.6	2.0	9.2	5	1	5	5	4.6	2.0	9.2	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3043SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3304SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3311SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1988	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3482SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3483SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	DIP	1	5	5		2.2	2.0	4.4	1	5	5		2.2	2.0	4.4	1	5	5		2.2	2.0	4.4	1	5	5		2.2	2.0	4.4	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3484SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3485SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3486SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3487SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
3303SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1991	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
4364SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1993	PVC	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	1	1	5		1.8	2.0	3.6	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
4369SMAIN	Tributary to OTS, between El Camino Del Norte and Crystal Ridge Road	1985	VCP	2	3	5		2.2	2.0	4.4	2	3	5		2.2	2.0	4.4	2	3	5		2.2	2.0	4.4	2	3	5		2.2	2.0	4.4	0	5		0	CSD	Flows Into Olivenhain Trunk Sewer
16598SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
16599SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
3279SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3289SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3290SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3291SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3292SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3293SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3294SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3300SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3301SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3437SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3438SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
5204SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
6651SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
6652SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
894SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
895SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
896SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3287SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
3288SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
5053SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5065SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5066SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
7885SMAIN	OTS, between El Camino Del Norte and Bella Collina	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5205SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
931SMAIN	OTS, between El Camino Del Norte and Bella Collina	1980	PVC	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	2	1	5		2.0	2.0	4.0	0	5		0	CSD	Olivenhain Trunk Sewer
5119SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
7886SMAIN	OTS, between El Camino Del Norte and Bella Collina	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
16581SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	4		2.1	2.0	4.2	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5108SMAIN	OTS, between Olivenhain Pump Station and Mira Costa College Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5083SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	2		1.5	2.0	3.0	3	3	2		1.5	2.0	3.0	3	3	2		1.5	2.0	3.0	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5874SMAIN	OTS, between El Camino Del Norte and Bella Collina	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5068SMAIN	OTS, between Mira Costa College Road and S Rancho Santa Fe Road	1975	VCP	3	3	3		1.8	2.0	3.6	3	3	3		1.8	2.0	3.6	3	3	4		2.1	2.0	4.2	3	3	5		2.4	2.0	4.8	0	5		0	CSD	Olivenhain Trunk Sewer
5091SMAIN	OTS, between Olivenhain Pump Station and Mira Costa College Road	1975	VCP	3	3	3		1.8	2.3	4.1	3	3	3		1.8	2.3	4.1	3	3	4		2.1	2.3	4.8	3	3	5		2.4	2.3	5.5	0	5		3	CSD	Olivenhain Trunk Sewer
13732SMAIN	Property east of Ocean View Avenue	1964	VCP	4	3	2		1.7	0.0	0.0	4	3	3		2.0	0.0	0.0	4	3	3		2.0	0.0	0.0	4	3	5		2.6	0.0	0.0	0	0		0	ESD	Flows Into Encinitas Trunk Sewer

Appendix 8

Pipeline CIP Projects

PROPOSED PIPELINE CIP PROJECTS									
No.	CIP Project ID	Pipeline	Location Description	Length (ft)	Existing Diameter (inches)	Proposed Diameter (inches)	Existing Diameter 2035 Peak Wet Weather d/D	Proposed Diameter 2035 Peak Wet Weather d/D	Sanitary Division
1	A1	3279SMAIN	OTS - Jackie Lane to Brookside Lane	285	8	10	1.000	0.774	CSD
2	A1	896SMAIN	OTS - Jackie Lane to Brookside Lane	330	8	10	1.000	0.539	CSD
3	A1	895SMAIN	OTS - Jackie Lane to Brookside Lane	66	8	10	1.000	0.533	CSD
4	A1	894SMAIN	OTS - Jackie Lane to Brookside Lane	320	8	10	1.000	0.532	CSD
5	A1	931SMAIN	OTS - Jackie Lane to Brookside Lane	106	8	10	0.975	0.700	CSD
6	B4	6686SMAIN	OTS - Olivenhain Pump Station to Siphon	92	15	18	0.882	0.717	CSD
7	B4	6685SMAIN	OTS - Olivenhain Pump Station to Siphon	297	15	18	0.889	0.642	CSD
8	B4	5108SMAIN	OTS - Olivenhain Pump Station to Siphon	542	15	18	0.925	0.618	CSD
9	B4	5091SMAIN	OTS - Olivenhain Pump Station to Siphon	603	15	18	0.908	0.598	CSD
10	B4	5115SMAIN	OTS - Olivenhain Pump Station to Siphon	324	15	18	0.884	0.683	CSD
11	B4	5087SMAIN	OTS - Olivenhain Pump Station to Siphon	31	15	18	0.878	0.593	CSD
12	B4	5068SMAIN	OTS - Olivenhain Pump Station to Siphon	414	15	18	0.908	0.684	CSD
13	B3	5205SMAIN	OTS - Olivenhain Pump Station to Siphon	536	15	18	0.983	0.631	CSD
14	B2	5204SMAIN	OTS - Olivenhain Pump Station to Siphon	61	15	18	1.000	0.627	CSD
15	B1	5066SMAIN	OTS - Olivenhain Pump Station to Siphon	594	15	18	1.000	0.607	CSD
16	B4	5065SMAIN	OTS - Olivenhain Pump Station to Siphon	603	15	18	1.000	0.589	CSD
17	B4	6652SMAIN	OTS - Olivenhain Pump Station to Siphon	419	15	18	1.000	0.590	CSD
18	B4	6651SMAIN	OTS - Olivenhain Pump Station to Siphon	180	15	18	1.000	0.582	CSD
19	B4	5083SMAIN	OTS - Olivenhain Pump Station to Siphon	216	15	18	0.946	0.510	CSD
20	B5	7885SMAIN	OTS - El Camino Del Norte to Bella Collina	464	15	18	0.830	0.983	CSD
21	B5	7886SMAIN	OTS - El Camino Del Norte to Bella Collina	114	15	18	0.819	0.958	CSD
22	B5	5874SMAIN	OTS - El Camino Del Norte to Bella Collina	242	15	18	0.771	0.915	CSD
23	B6	5119SMAIN	OTS-Mira Costa College to S Rancho Santa Fe Road	593	15	18	0.803	0.958	CSD
24	C3	16581SMAIN	OTS - S Rancho Santa Fe Road	113	15	18	0.931	0.764	CSD
25	D1	15391SMAIN	CTS - Cardiff Pump Station to Manchester Avenue	158	15	18	0.931	0.738	CSD
26	E1	15390SMAIN	Tributary to CTS - Cardiff Pump Station	53	8	10	0.933	0.871	CSD
27	F1	8426SMAIN	CRTS - Chesterfield Drive to Liverpool Drive	401	12	15	0.819	0.752	CSD
28	F1	8425SMAIN	CRTS - Chesterfield Drive to Liverpool Drive	448	12	15	0.751	0.531	CSD
29	G1	9197SMAIN	CRTS - Burkshire Avenue to Sheffield Avenue	284	10	15	1.000	0.871	CSD
30	H1	9589SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	357	10	12	1.000	0.811	CSD
31	H1	12716SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	321	10	12	1.000	0.693	CSD
32	H1	12717SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	25	10	12	1.000	0.677	CSD
33	H1	9592SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	346	10	12	1.000	0.680	CSD
34	H1	9593SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	343	10	12	1.000	0.710	CSD
35	H1	9594SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	412	10	12	1.000	0.717	CSD
36	H1	12064SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	208	10	12	1.000	0.672	CSD
37	H1	12061SMAIN	CRTS - Sheffield Avenue to Loch Lomond Drive	131	10	12	1.000	0.688	CSD
38	I1	15375SMAIN	Tributary to CRTS - Cathy Lane and Orkney Lane	15	10	12	1.000	0.800	CSD
39	J1	11126SMAIN	CTS - Liszt Avenue to Verdi Avenue	433	8	10	0.982	0.684	CSD
40	J2	11125SMAIN	CTS - Liszt Avenue to Verdi Avenue	323	8	10	1.000	0.555	CSD
41	K4	13732SMAIN	Tributary to ETS - Property East of Ocean Avenue	105	8	10	0.911	0.736	ESD

Appendix 9

Moonlight Beach Pump Station Pump Replacement Evaluation

DUDEK

Moonlight Beach Pump Station

Pump Replacement Evaluation

Prepared for:

San Elijo Joint Powers Authority
2695 Manchester Avenue
Cardiff by the Sea, CA 92007
Contact: Christopher Trees, PE

September 2019

Dudek
760.942.5147

605 Third Street
Encinitas, California 92024

INTENTIONALLY LEFT BLANK

DUDEK

Table of Contents

SECTIONS

TABLES

FIGURES

APPENDICES

INTENTIONALLY LEFT BLANK

1 Introduction

1.1 Background

The Moonlight Beach Pump Station (MBPS) is a sanitary sewer pump station in Encinitas, California that is owned by the City of Encinitas (City) and operated by the San Elijo Joint Powers Authority (SEJPA). Originally constructed in 1974, MBPS is a critical component of the City's infrastructure. Located at the southeast corner of 3rd Street and B Street, MBPS conveys an average daily flow of 1.1 million gallons per day (MGD) of raw sewage collected from the central area of Encinitas and pumps it to the Bataquitos Pump Station. This flow ultimately discharges to the Encina Water Pollution Control Facility in Carlsbad, California.

The current pump station configuration at MBPS consist of three stories:

- 3rd Floor: located at ground level, electrical and pump motor room
- 2nd Floor: below grade, intermediate floor that houses a surge tank and air compressor system
- 1st Floor: bottom floor, dry pit pump room, adjacent to existing wet well

This pump station layout is set up as a dry well/wet well, with three (3) existing vertical centrifugal pumps located on the 1st floor. The three (3) existing pumps are installed with extended drive shafts that run vertically through the 2nd floor and up to electrical motors located on the 3rd floor. This common configuration is used to safeguard the electrical motors from submergence if the wet well were to leak into the dry pit. The MBPS also includes electric motor powered inline sewage grinders originally installed on the suction piping of each pump to limit ragging.

Due to recent issues with MBPS's inline grinders, SEJPA has asked Dudek to investigate if the MBPS could be retrofitted with solids handling, dry pit submersible style pumps capable of passing rags and solids. These proposed pumps would eliminate the need to include grinders upstream of each pump. Another feature of dry pit submersible pumps is that they are manufactured with flood-proof motors and electrical components capable of operating in a dry or periodically submerged environment. Using this type of pumping unit at MBPS eliminates the need for at-grade motors and extended drive shafts, and repositions the pump motors down to the 1st floor (directly above the pumps). Ultimately, these pumping unit modifications have a direct impact on the existing ventilation design of the station when considering heat rejection of the equipment. Therefore, SEJPA has requested evaluation of the potential for upgrading the wastewater pumps at MBPS.

1.2 Authorization

In June of 2019, the SEJPA authorized preparation of this pump replacement evaluation for the Moonlight Beach Pump Station.

1.3 Project Goals

The primary goal of this analysis was to determine which of the following two operational setups at MBPS is more cost effective over the next 20 years:

1. Continued use of the existing vertical extended shaft pumps and inline sewage grinder units on suction piping assembly (includes replacement of grinder units as they fail).

2. Removal of inline sewage grinders from suction piping assembly and replacing existing pumps with solids-handling dry-pit submersible pumping units.

In addition to this analysis, this study evaluated the necessary improvements and costs associated with the proposed pumping system renovations.

To achieve the project goal, Dudek included evaluation of the mechanical, electrical, and operational requirements necessary to retrofit the existing MBPS with dry-pit submersible pumps. Through collection of MBPS SCADA data, review of as-built drawings, communication with MBPS operations staff, and visual observation conducted during a site visit at the pump station, Dudek performed an evaluation of the following:

- Hydraulic design of pumping system
- Pumping unit manufacturer alternatives
- Mechanical pump suction and discharge piping/valves/appurtenances
- Heat rejection comparison of existing versus new equipment
- Ventilation system design, capacity, and condition
- Associated construction costs of proposed improvements
- Life cycle cost of the existing and proposed equipment

2 Existing Conditions

The MBPS is a critical component of the City of Encinitas' infrastructure. This station receives an average daily flow of 1.1 MGD of raw sewage from the central area of the City and pumps it north to the Encina Water Pollution Control Facility in Carlsbad. Significant upgrades to the MBPS were constructed between the years 2005 and 2007 as a part of the Moonlight Beach Sewer Pump Station Renovation Project. This project included the following improvements:

- Construction of an emergency overflow basin
- Installation of new pumping units (3 total)
- Installation of in-line grinders on pump suction piping
- Installation of improved electrical system (relocated above-grade)
- Installation of improved SCADA alarm system
- Installation of an odor control system
- Installation of a new, upgraded auxiliary generator
- Construction of new above-grade masonry structure to house electrical panels and motors

Minor mechanical modifications to the pump station have occurred since these last major improvements to the MBPS took place. The following is a brief discussion of the existing layout and condition of mechanical and electrical equipment associated with the pumping system at MBPS.

2.1 Existing Pumping Units

MBPS houses three (3) vertical centrifugal pumping units, located on the 1st floor of the pump station. Each pump has a dedicated suction line that draws sewage from the adjacent pump station wet well. Discharge piping for each pump connects to a common 14" diameter manifold in the 1st floor, which is then routed outside of the pump station structure where it transitions into the MBPS force main.

Figure 2.1: 1st Floor Existing Pumps and Discharge Piping Manifold

The following Table 2.1 includes characteristics and information of the existing pumping units.

Table 2.1: Existing Pump Characteristics

Existing Pumping Unit Characteristics	
Manufacturer	Fairbanks Morse
Type	Vertical Centrifugal (extended shaft)
Pump Size and Model #	5" - B5414
Design Capacity	1000 gpm @ 107 ft TDH
Power	60 HP
Speed	1200 rpm @ 60 Hz (VFD control)
Phase/Hertz/Voltage	3/60/460
Suction	6" diameter
Discharge	5" diameter
Solids Passing	4" diameter

2.1.1 Existing Vertical Extended Shaft Pumps

Each of the existing pumps is constructed on a 12-inch tall concrete support pedestal, and spaced 9'-0" apart center to center. Each pump is equipped with an extended drive shaft that extends vertically from the 1st floor up to the 3rd floor where it connects to the corresponding pump motors. These extended shafts are housed inside of 18-inch diameter shaft guards and routed through penetrations in the 2nd floor and 3rd floor slabs. Figure 2.1 and 2.2 show existing shafts and floor penetrations. MBPS operations staff explained that preventative maintenance is performed every quarter on the shaft bearings for each pump. This maintenance requires two workers, includes lockout/tagout of the pump, and requires 10 grease points application. Furthermore, the shaft bearings and u-joints have to be replaced and the shafts need to be removed and profesionally balanced every three years (on average).

Figure 2.2: 1st Floor Existing Pumps & Extended Pump Shafts Penetrating into 2nd Floor

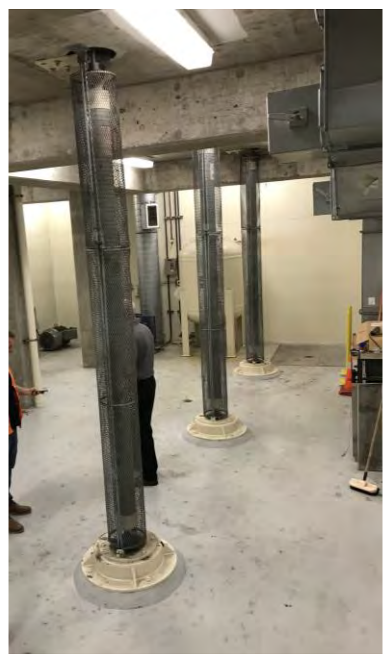


Figure 2.3: 2nd Floor Extended Pump Shaft Penetrations

2.1.2 Existing Pump Operation and Flow Analysis

Per the 2011 Cardiff and Encinitas Sewer Master Plan Update (2011 CESMPU), the MBPS design capacity is listed as 2,000 gpm (with one pump out of service), with an ultimate Peak Wet Weather Flow (PWWF) into the wet well of 1,850 gpm. In addition to pump station flow capacity, the existing on-site emergency storage basin has a capacity of 180,000 gallons and was sized to provide storage for two hours of peak ultimate flow. The following Table 2.2 is a summary of the MBPS ultimate flow projects as indicated in the 2011 CESMPU.

Table 2.2: MBPS Ultimate Flow Projections

MBPS Ultimate Flow Projections from 2011 CESMPU							
Pump Station Name	Trunk Sewer System	Station Capacity (1)		Ultimate PWWF at Wet Well (2)		Force Main	
		(MGD)	(gpm)	(MGD)	(gpm)	Dia.	Velocity
Moonlight Beach	ESD	2.9	2,000	2.7	1,850	14”	3.9 fps

(1) Station Capacity is the duty capacity with 1 pump out-of-service.

(2) Flow entering the wet well may be less than the total flow discharged to the trunk sewer due to surcharging/spillage.

Currently, the pumps at MBPS are equipped with variable frequency drive (VFD) motors to allow the pumped flowrate to match the sewer flowrate entering the wet well. Dudek collected recent SCADA flow data from MBPS operations staff to review the station’s diurnal pump flows and verify normal pump operating procedure. The following flow periods were observed:

- January 10, 2019 through January 14, 2019 (wet weather flow, rain event)
- May 25, 2019 through May 29, 2019 (dry weather flow, no rain)

The SCADA data included pump station discharge flowrate recorded every 15 minutes, plus corresponding motor operating frequency per pump. Analysis of this data indicated the following flow averages:

Table 2.3: SCADA Flow Data Summary

SCADA Flow Data Summary from January 2019 and May 2019 Observed Data		
	Wet Weather Period	Dry Weather Period
Description	01/10/19 through 01/14/19	05/25/19 through 05/29/19
Average Discharge Flowrate	706 gpm	696 gpm
Average Weekday Peak Flowrate (1)	943 gpm	954 gpm
Average Weekend Peak Flowrate (2)	1030 gpm	962 gpm
Overnight Low Flow Range (3)	450 gpm to 600 gpm	450 gpm to 700 gpm
Instantaneous Peak Flowrate (4)	1,340 gpm	1,250 gpm

(1) Average Weekday Peak Flowrate represents calculated flow average between the peak flow hours of 6:00pm and 9:00pm during weekdays.

(2) Average Weekend Peak Flowrate represents calculated flow average between the peak flow hours of 10:00am and 1:00pm during weekends.

(3) Overnight Low Flow Range represents daily flow period between 12:00am and 6:00am.

(4) Single pump operation.

Review of the SCADA data indicated that only single-pump operation was occurring during the observed flow periods. Each of the pumps operate on a lead-lag-lag cycle, with each pump alternating in operation for the same duration throughout each day.

During the overnight low flow period, SCADA data showed that the pump station normally runs intermittently, with one pump kicking on every 30 to 45 minutes. Due to the low influent flows, once the pump kicks on, the existing pumps cannot operate at a slow enough speed to maintain wet well level, and ultimately shut off once the wet well level is drawn down to low level. This results in extended periods of time between pump operation (30 minutes to 1 hour) where sewage sits stagnant in the wet well and force main throughout the night. These non-operating periods of the station may result in the stagnant sewage to become septic and develop odorous gases.

Daily peak flowrates were also observed. Review of the SCADA data showed that the MBPS occasionally experiences periodic peak flows of up to 1,340 gpm (single pump operation).

- During the period from 01/10/19 through 01/14/19, SCADA data showed instantaneous recorded flowrate above 1,100 gpm occurring 9 times.
- During the period from 05/25/19 through 05/29/19, SCADA data showed instantaneous recorded flowrate above 1,100 gpm occurring 7 times.

2.1.3 Existing Flow Velocity in MBPS 14-inch Force Main

Analysis of the MBPS SCADA data revealed that the pump station experiences a daily pumped flowrate range of approximately 450 gpm (low flow minimum operating limit) to 1,340 gpm (instantaneous peak daily flow) under single pump operation. The SCADA data indicates that the existing 1,000 gpm rated pumps struggle to flow match the minimal wet well influent flows. As a result, the duty pump ramps down to a flow rate between 450 gpm and 700 gpm, draw down the wet well to the pump-off level, shut off until the wet well slowly fills to the pump-on level (approximately 30 to 45 minutes), then the cycle continues until influent flows increase. Although this is an acceptable operating scenario considering the low number of starts per pump per hour, these low flows do not achieve the industry standard minimum cleansing velocity of 2.0 feet per second (fps). Per Garr Jones' *Pumping Station Design, 3rd edition,* best design practice for sanitary sewer force main low flow velocity is as follows:

- The lowest design velocity for raw wastewater is 2.0 fps to keep grit moving, and a peak daily velocity of 3.5 fps is desirable to re-suspend settled solids.
- If velocities are less than 2.0 fps, a daily flush at 4.0 fps is desirable.

The SCADA flow data indicates the following approximate daily flow velocity ranges in the 14-inch force main:

Table 2.4: Calculated Flow Velocities in MBPS 14-inch Force Main

Calculated Flow Velocities in MBPS 14-inch Force Main based on SCADA Data		
	Wet Weather Period	Dry Weather Period
Description	01/10/19 through 01/14/19	05/25/19 through 05/29/19
Average Discharge Flow Velocity	1.5 fps	2.0 fps
Average Weekday Peak Flow Velocity (1)	2.0 fps	2.0 fps
Average Weekend Peak Flow Velocity (2)	2.2 fps	2.0 fps
Overnight Low Flow Velocity Range (3)	0.94 fps to 1.25 fps	0.94 fps to 1.5 fps
Instantaneous Peak Flow Velocity (4)	2.8 fps	2.6 fps

(1) Average Weekday Peak Flow Velocity calculated from pumped flow average between the peak flow hours of 6:00pm and 9:00pm during weekdays.

(2) Average Weekend Peak Flow Velocity calculated from pumped flow average between the peak flow hours of 10:00am and 1:00pm during weekends.
(3) Overnight Low Flow Velocity Range calculated from daily pumped flow period between 12:00am and 6:00am.
(4) Calculated from peak pump station flowrate observed during study period. Does not occur daily.

SCADA data from the periods of study indicate that the pump station is not maintaining a daily minimum 2.0 fps cleansing velocity in the 14-inch force main and is not achieving the recommended 3.5 fps peak daily velocity to re-suspend settled solids.

2.2 Existing Mechanical Equipment and Piping

MBPS operations staff have made minor mechanical equipment and piping modifications to the station as a result of the issues experienced with the existing inline sewage grinders. The following subsection discusses the existing mechanical equipment and piping layout at MBPS.

2.2.1 Existing Pump Suction Assembly & Inline Sewage Grinders

Following the MBPS Renovation Project improvements that were completed in 2007, each pump train was equipped with a motorized inline sewage grinder installed on its suction piping assembly. As shown in Figures 2.4 and 2.5, the existing pump suction assembly for each pump train includes an 8-inch diameter ball-centric plug valve, 8-inch diameter pipe spool connection to the 12-inch inline sewage grinder (JWC Muffin Monster, model 40K w/ 10 HP motor), followed by a 12-inch diameter pipe spool and 12-inch by 6-inch reducer fitting that connects to the pump suction elbow. Each inline grinder unit includes a control panel located on the 3rd floor of the pump station.

Figure 2.4: Existing Pump Suction Piping and Inline Sewage Grinder View #1

Figure 2.5: Existing Pump Suction Piping and Inline Sewage Grinder View #2

MBPS operations staff explained that the cutter/macerator blades in the grinder units are inspected annually, and a preventative maintenance lubrication is performed on each unit quarterly. Initially, maintenance of the grinder units was cost effective since worn down cutters/macerators within the grinders could be replaced. In recent years, the manufacturer of the grinder units (JWC Environmental) has discontinued the option to replace worn parts, leaving full replacement of the grinder units as the only option if cutters are worn down.

In 2013, MBPS operations staff had to rebuild two of the grinder units. Then in 2016, two of the grinders were replaced under the manufacturer's exchange program. MBPS operations staff indicated that the grinders are normally effective, but experience severe wear and even immediate failure of the cutter/macerator blades if harder material/objects are sucked through the grinder. These issues with the inline grinders in combination with the periodic low flow pumping conditions led operations staff to completely remove the existing inline grinder from the pump #3 suction assembly. The inline grinder was replaced with an 8-inch diameter pipe spool and 8-inch by 6-inch reducer fitting to connect to the pump suction elbow. A picture of this modified suction piping assembly is included as Figure 2.6.

Figure 2.6: Existing Pump #3 Modified Suction Assembly

Figure 2.7: Existing Pump Discharge Piping Assembly

Also noticeable in Figure 2.6 is the recently replaced pump volute – in 2016, the Fairbanks-Morse pump volute and impeller were replaced with parts manufactured by ABBA, a similar, more budget-friendly pump manufacturer. MBPS operations staff explained that they have experienced an increase in ragging on pump #3 following the removal of the grinder unit from pump #3. Operations staff reported that they now need to de-rag pump #3 approximately one to two times a week, with the pump running 8 hours per day.

Regarding pump #1 and pump #2, operations staff believes that these two pumps are due for replacement soon as well.

2.2.2 Existing Pump Discharge Piping and Check Valves

The existing discharge piping assembly for each pump includes a combination of steel and ductile iron pipe of various sizes, which routes overhead to connect to the existing 14-inch diameter discharge manifold. Currently, the 5-inch pump discharge expands into an 8-inch diameter welded steel pipe that turns upward 90 degrees and connects to a vertically mounted 10-inch swing check valve (as seen in Figure 2.7).

The discharge piping then turns 90 degrees back to horizontal and is rotated at a 45 degree angle towards the discharge manifold. This overhead section includes a 12-inch isolation plug valve followed by a 14-inch diameter wye that connects to the discharge manifold. The overhead location of the plug valves is not ideal as they are inconvenient to access.

Operations staff have indicated that the raised location and vertical orientation of the existing 10-inch discharge check valves makes maintenance difficult as well. Operations staff also reported that they occasionally have to de-rag the check valves. The existing 10-inch check valve size in combination with low flow velocities and the valve's vertical orientation increases the potential for ragging.

2.2.3 Existing Pump and Grinder Access & Removal Capability

During Dudek's site visit of the pump station, operations staff explained that removal of the existing pumps and inline grinders requires the use of ceiling-mounted eyebolts and manual lifting chains to lift the equipment up and onto a utility cart positioned adjacent to the equipment. The cart is then manually wheeled over and positioned underneath the existing monorail crane, where the equipment can be picked up with the existing 3-ton monorail hoist and moved over to the existing hatch opening in the ceiling. Figure 2.8 shows the location of the existing overhead monorail beam and hatch opening in relation to the existing pumps. Operations staff did indicate that the existing monorail beam and hoist are in good working condition and are still currently utilized.

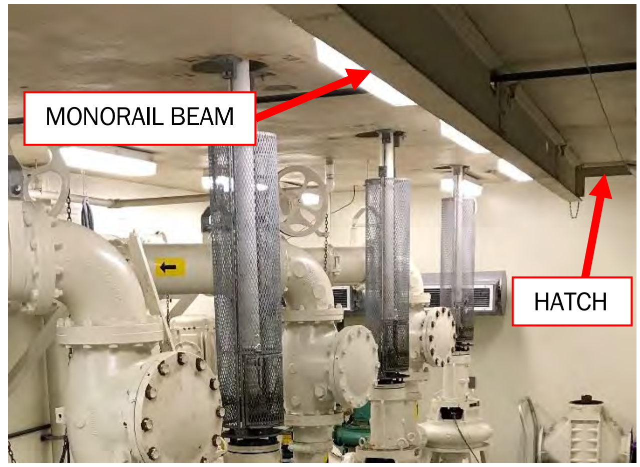


Figure 2.8: Existing Monorail Beam and Hatch

It was observed that access to the inline grinders requires clear space between the pump suction assemblies, which suggests why the existing individual pump discharge piping was routed overhead in the original mechanical piping design.

If pumps or grinder units need to be completely removed from the facility, a separate monorail crane system and extended 2-ton capacity hoist located on the 3rd floor of the building can be used to pick up equipment located on the 1st floor. This 3rd floor monorail crane system is designed to lift the equipment through the existing 1st and 2nd floor hatch openings, and into the 3rd floor. The 3rd floor monorail beam is aligned across the center of the 3rd floor ceiling allowing equipment to be moved out to the pump station driveway. Figure 2.9 shows the existing 3rd floor monorail beam routed across the 3rd floor ceiling, leading out of the pump station double door entry, and out to the driveway.


Figure 2.9: Existing 3rd Floor Monorail Beam Alignment

In addition, the 3rd floor monorail crane system can be used to remove the pump motors located on the 3rd floor. The existing pump motors are positioned directly below the existing monorail beam.

2.2.4 Miscellaneous Pump Station Equipment

Existing 18" Sluice Gate Valve: During the MBPS site visit, operations staff indicated that the existing 18" sluice gate located inside the wet well is in poor condition and may not be functional. This existing sluice gate serves to isolate the wet well from the 18" influent sanitary sewer line.

Existing Surge Tank: While on site, Dudek observed the existing sewage surge tank and associated air compressor system. This existing surge tank is ASME rated for 250psi and manufactured by Wessels Company. Per discussions with MBPS operations staff, there is no known issues with the existing surge tank and air compressor, and the surge protection system is in good working condition.

Existing Ultrasonic Level Sensor in Wet Well: Operations staff explained that there are currently two level elements that read and record level in the wet well. The existing ultrasonic level sensor is currently mounted on the wet well riser, and can be accessed through the existing wet well hatch. The existing ultrasonic level sensor mount appears to be moderately corroded and is in need of replacement. In addition, operations staff indicated that the output readings of the two level sensors are not in agreement. Dudek's review of the SCADA wet well level recordings for both level sensors concluded that the two level sensors have a variance of approximately 1.2 feet.

Figure 2.10: Moderate Corrosion on Existing Ultrasonic Level Sensor Mount

2.3 Existing Electrical Equipment

Per the previous MBPS Renovation Project improvements, all of the existing pumping system electrical motors and control panels are located on the 3rd floor of the building (above grade). During a site visit, Dudek documented motor, VFD, and panel nameplate information. The following subsection discusses the existing pumping unit electrical components and control panels.

2.3.1 Existing Pump Motors, VFDs, Grinder Motors, & Electrical Panels

Existing Pump Motors

Existing pump motors are mounted to the floor slab of the 3rd floor, with the extended pump shafts connecting through existing 3rd floor slab penetrations directly underneath each motor. Table 2.5 lists the existing motor characteristics for the pump motors.

Table 2.5: Existing Pump Motor Characteristics

Existing Pumping Unit Motor Characteristics	
Manufacturer	Emerson Motor Company
Type	RVI Inverter Duty Rated
Enclosure	WPI
Horsepower	60
Service Factor	1.15
Voltage/Hertz/Phase	460/60/3
Hertz Range	6 - 60
RPM Range	120 - 1200

Existing Pump Control Panels and VFD Panels

The MBPS motor control center (MCC) and pumping unit control/VFD panels are located on the 3rd floor, along the inside of the building's south wall. Each pumping unit has a dedicated control panel and VFD housed in a stand-alone NEMA 4X rated enclosure. In addition, each pump control panel enclosure has a dedicated air conditioner unit attached, manufactured by Mclean Thermal. The existing VFD has the following characteristics:

Table 2.6: Existing VFD Characteristics

Existing Pumping Unit Motor Characteristics	
Manufacturer	Allen-Bradley
Model	Powerflex 700
Enclosure Rating	NEMA 4X
Voltage/Hertz/Phase	460/60/3
Amps	96
HP	75
Frame	5

Existing Grinder Motors Control Panels

Each inline sewage grinder has a dedicated motor and control panel. The existing grinder motors are Class 2, Div. 1 rated and are attached to the grinder units on the first floor, while the grinder control panels are located on the 3rd floor. The existing grinder motors have the following characteristics:

Table 2.7: Existing Grinder Motor Characteristics

Existing Pumping Unit Motor Characteristics	
Manufacturer	JWC Environmental/Baldor
Enclosure Rating	NEMA 6P Immersible
Horsepower	10
Service Factor	1.15
Voltage/Hertz/Phase	460/60/3
RPM	1765
Class	F

The three grinder control panels are located along the inside of the pump station building's north wall. Each grinder control panel is wall mounted and housed in a NEMA 4X rated enclosure.

2.4 Heat Rejection of Existing Pumping Equipment

Heat rejection of existing equipment was calculated by analyzing equipment operating efficiencies. When equipment does not operate at 100% efficiency, a percentage of the energy lost is rejected as heat. The following assumptions were made:

- Horsepower and motor efficiency – Assumed 15% of the energy lost is rejected as heat to the surrounding area.
- Control panels – Control panels were rated with varying heat loss approximations in regards to their input amperage.
- Variable frequency drives (VFDs) – Assumed to be 95% efficient. The 5% energy loss translates to the heat rejected from the VFDs. The power input of the motors at the various flow conditions was used for the VFD load.
- Inline Sewage Grinders – Known to be 91.5% efficient. Since there is no mechanical way for the grinders to reject their heat to the sewage flow, all energy lost is assumed to be rejected to the surrounding air space.

Table 2.8 below summarizes the calculated heat rejection for the existing pump related equipment.

Table 2.8: Heat Rejection of Existing Equipment

Fairbanks Morse Pump and Emerson Motor Company Motors			
Flow (gpm)	Motor Efficiency (%)	BHP	Heat Rejection (Btu/hr)
500	94.5	20	415.5
600	94.5	34	716.7
1000	94.5	42	883.5
1750	94.5	49	1,022.5
Allen-Bradley Control Panels			
AC Input (amps)	AC Output (amps)	Heat Reject (watts)	Heat Rejection (Btu/hr)
97.4	96	200	683.0
VFDs			
Flow (gpm)	Hz	Watts	Heat Rejection (Btu/hr)
500	48	737.3	2,518
600	48	1,271.7	4,343
1000	55	1,567.8	5,354
1750	60	1,814.3	6,196
Inline Sewage Grinders			
Motors Running	Motor Efficiency (%)	BHP	Heat Rejection (Btu/hr)
1	91.5	10	2,165
2	**91.5**	**10**	**4,330**

2.5 Existing Ventilation System

The MBPS building is equipped with a forced air supply and forced air exhaust system to provide proper ventilation throughout each floor of the pump station. This subsection discusses the components and condition of the existing system.

2.5.1 Existing Air Supply System

Outside air is drawn into the pump station building by an inline centrifugal supply fan and ducting located on the north wall of the pump station building's 3rd floor. The existing supply fan draws in air through a 24"x36" louvre and 24"x30"x40"H plenum and filter box located overhead as seen in Figure 2.11. The MBPS's close proximity to the beach puts the pump station equipment at higher risk of corrosion due to the salt content in the surrounding ambient air (salt air).

Figure 2.11: Existing Inline Air Supply Fan, Filter Box, and Ducting on North Wall of 3rd Floor

The existing air supply ducting consists of a single transmission duct that's continuously routed through each floor of the pump station building. Aligned on the north wall of each floor, the main transmission duct includes overhead supply vents on each floor, sized to supply a specific capacity of air to each room. Table 2.9 below includes existing supply fan characteristics and a breakdown of air supply capacity distribution.

Table 2.9: Existing Air Supply System Details

Existing Air Supply Fan Characteristics	
Supply Fan Manufacturer	Greenheck
Fan Type	Inline Centrifugal
Capacity	3200 cfm
Speed	1488 rpm
ESP	1-1/4"
BHP	1.27
HP	1-1/2
Drive Type	Belt
Voltage/Hertz/Phase	230/60/3
Control	Continuous
Existing Air Supply Capacity Distribution	
Total Supply Capacity	3200 cfm
3rd Floor Supply	3 vents @ 400 cfm each
2nd Floor Supply	3 vents @ 350 cfm each
1st Floor Supply	3 vents @ 310 cfm each

During Dudek's site visit at MBPS, it was observed that the existing air supply fan unit has experienced significant exterior corrosion. Figure 2.11 shows clear deterioration of the existing supply fan enclosure. Although the existing supply fan displayed signs of corrosion, the outside salt air has not appeared to have significant impact on the rest of the equipment inside of the pump station. Also in Figure 2.11, it is observed that the existing air supply system ducting on the 3rd floor is wrapped in insulation material, preventing visual observation of the exterior condition of the ducting on that floor.

Figure 2.12: Existing Air Supply Ducting and Vents on 2nd Floor

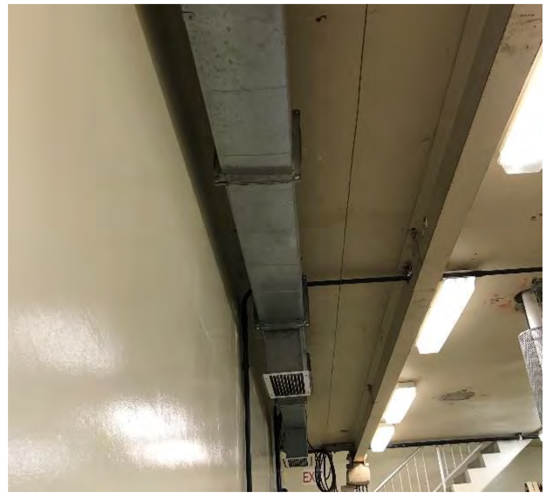


Figure 2.13: Existing Air Supply Ducting and Vents on 1st Floor

Conversely, the 2nd floor and 1st floor ducting was not wrapped in any insulation material and exterior condition was observed. As seen in Figures 2.12 and 2.13, no significant corrosion was noticeable on the exterior of the system and the condition of the air supply ducting on the 2nd and 1st floors of MBPS appear in good condition.

2.5.2 Existing Air Exhaust System

Air inside of the pump station building is exhausted to the outside of the building by an inline centrifugal supply fan and ducting located on the south wall of the pump station building's 3rd floor. The existing exhaust fan expels air through a 24"x36" louvre and 24"x30"x40"H plenum located overhead as seen in Figures 2.14 and 2.15.

The existing air exhaust ducting consists of a single transmission duct that is continuously routed through each floor of the pump station building. Located on both the south wall and west wall of the building, the main

Figure 2.14: Existing Air Exhaust Fan and Ducting on South Wall of 3rd Floor

Figure 2.15: Existing Inline Centrifugal Air Exhaust Fan South Wall of 3rd Floor

transmission duct includes exhaust vents on each floor, specifically sized to exhaust a specific capacity of air from each room. Table 2.10 below includes existing exhaust fan characteristics and a breakdown of air exhaust capacity distribution.

Table 2.10: Existing Air Exhaust System Details

Existing Air Exhaust Fan Characteristics	
Supply Fan Manufacturer	Greenheck
Fan Type	Inline Centrifugal
Capacity	3200 cfm
Speed	1956 rpm
ESP	1”
BHP	153
HP	1-1/2
Drive Type	Belt
Voltage/Hertz/Phase	230/60/3
Control	Continuous
Existing Air Exhaust Capacity Distribution	
Total Supply Capacity	3190 cfm
3rd Floor Supply	2 vents @ 615 cfm each
2nd Floor Supply	1 vent @ 400 cfm each
1st Floor Supply	2 vents @ 780 cfm each

During Dudek’s site visit at MBPS, it was observed that the existing air exhaust fan unit and associated exhaust ducting is in good condition. Figures 2.16 and 2.17 show the existing air exhaust ducting and vents in good condition.

Figure 2.16: Existing Air Exhaust Ducting and Vent on West Wall of 2nd Floor

Figure 2.17: Existing Air Exhaust Ducting and Vents on West Wall of 1st Floor

2.5.3 Existing Air Ventilation System Design

Dudek referenced existing room volume and ventilation system information in the MBPS as-built drawings to determine the existing air changes per hour for each floor of the pump station building. It should be noted that the existing single bathroom located on the 3rd floor of the pump station is a totally enclosed room with its own designated ceiling mounted exhaust fan/heater/light unit, which includes its own separate ventilation ducting. It should be noted that although the existing stair well is open to each floor, this was not taken into account when calculating the existing air changes per hour (ACPH) for each room. To calculate the existing ACPH for each room, the larger air flow capacity (supply or exhaust) was divided by the approximate room volume.

The follow table indicates the calculated approximate existing air changes per hour (ACPH) per floor of the MBPS building.

Table 2.11: Existing Ventilation System Summary

Approximate Existing Air Changes Per Hour Per Floor					
Floor	Room Description	Air Supply In (cfm)	Air Exhaust Out (cfm)	(1)Approximate Room Volume (ft^3)	Air Changes
3rd Floor	Motor/Electrical Room	1,200	**1,230**	7,580	9.7 ACPH
2nd Floor	Intermediate Room	**1,050**	400	11,800	5.3 ACPH
1st Floor	Dry Pit Pump Room	930	**1,560**	7,183	13 ACPH

(1) Approximate room volume assumes the following volume percentage of each room occupied by equipment:

a. 3rd Floor = 20%

b. 2nd Floor = 8%

c. 1st Floor = 15%

3 Upgrade Alternatives

Based on the evaluation of the existing pumping system equipment and conditions, Dudek has provided the following recommended upgrades, design considerations, and alternatives for the MBPS pumping system. The following section describes the pump station operating capacity considerations, evaluation of pump replacement alternatives, pump suction and discharge mechanical piping design considerations, heat rejection analysis of existing versus proposed equipment, and ventilation system recommendations.

3.1 Pump Station Operation Consideration

Complete removal of the existing inline sewage grinders requires that the existing MBPS pumping units be provided with new, solids-handling pumps. Dudek proposes a new pump arrangement at MBPS in addition to the proposed change in pump type. The new pump arrangement and capacity is summarized in Table 3.1.

Table 3.1: Proposed Pumping Units

Proposed Solids-Handling Pump Arrangements and Individual Pump Flow Capacity			
Pump # (Description)	Pump Type	Design Capacity	Capacity at Full Speed
Pump #1 (duty)	Submersible Dry-pit, Solids Handling	1200 gpm	1375 gpm
Pump #2 (stand-by)	Submersible Dry-pit, Solids Handling	1200 gpm	1375 gpm
Pump #3 (jockey)	Submersible Dry-pit, Solids Handling	650 gpm	800 gpm
MBPS Total Pump Capacity vs. Ultimate Peak WWF Comparison			
Description	Current MBPS Design Capacity	Proposed MBPS Design Capacity	
Total Firm Capacity (largest pump out of service)	2000 gpm	1850 gpm	
Ultimate Peak WWF into wet well (from 2011 CESMPU)	1850 gpm	1850 gpm	

This proposed pump arrangement has been selected to better flow match the daily overnight low flows into the wet well, as well as allow for operation of a daily high-flow flush cycle to prevent excess accumulation of settled solids in the MBPS 14-inch force main. Table 3.1 also indicates that the firm capacity of the new pump arrangement can still handle the anticipated ultimate peak WWF into the MBPS wet well.

3.1.1 Flow Matching During Low Flow Period

Currently, the MBPS is unable to flow match the low influent flows that occur during the overnight low flow period. As discussed in Section 2.1.3, the existing 1,000 gpm rated pumps intermittently operate throughout the night, leaving periods of time where stagnant sewage in the wet well and force main may become septic and develop odorous gases.

Recommendation: Dudek proposes a new pump arrangement to allow for a smaller capacity, solids-handling jockey pump to flow match the wet well's overnight low influent flows.

The jockey pump will perform more continuous low-flow operation during the overnight low flow period, thus reducing the intermittent, short pump operating cycles that are currently occurring.

3.1.2 Cleansing Flow Velocity in MBPS 14-inch Force Main

SCADA data from the flow periods of study indicate that the pump station is not maintaining a daily minimum 2.0 fps cleansing velocity in the 14-inch force main and is not achieving the recommended 3.5 fps peak daily velocity to re-suspend settled solids.

Recommendation: Dudek recommends implementation of a daily high-flow flushing schedule to re-suspend settled solids that may have accumulated in the 14-inch force main following the overnight low flow period.

An example flushing cycle is as follows: Pump #1 and Pump #2 each have a duty point of 1,375 gpm when ramped up to full speed (1765 rpm). Based on manufacturer's pump performance curves, the anticipated operating envelope of the MBPS system is approximately is 1,810 gpm to 2,010 gpm when both Pump #1 and Pump #2 are running in parallel at full speed. This operating flow range equates to a flow velocity range in the 14-inch force main of approximately 3.8 ft/sec to 4.2 ft/sec. A combined flow output of 1,920 gpm achieves 4.0 ft/sec. Anticipated flow velocities in the 14-inch force main are summarized in Table 3.2.

Table 3.2: Summary of Pipeline Flow Velocities

Summary of Flow Velocities for Proposed Pumps				
	Flowrate	(1) 6-inch Suction/ Discharge Velocity (ft/s)	(2) 8-inch Suction/ Discharge Velocity (ft/s)	14-inch FM Velocity (ft/s)
Design Pump Flow & Pipeline Velocities				
Pump #1	1200 gpm	-	7.7	2.5
Pump #2	1200 gpm	-	7.7	2.5
Jockey Pump	650 gpm	7.4	-	1.4 (3)
Minimum Pump Flow & Pipeline Velocities				
Pump #1	500 gpm	-	3.2	1.0
Pump #2	500 gpm	-	3.2	1.0
Jockey Pump	260 gpm	3.0	-	0.5 (3)
Proposed Daily Flush Cycle				
Pump #1 & Pump #2 (Running in parallel @ full speed)	1920 gpm	-	-	4.0

(1) 6-inch suction and discharge piping is proposed for the jockey pump train.

(2) 8-inch suction and discharge piping is proposed for the 1200 gpm pump trains.

(3) Low flow velocities (< 2.0 ft/s) are acceptable with proposed daily flushing cycle

Following the low flow period, we anticipate possible solids buildup in the existing 14-inch force main immediately downstream of the MBPS discharge flow meter due to the existing pipe alignment including approximately 12 feet of vertical 14-inch pipe. In addition, we also anticipate possible buildup of solids in the first 100 to 130 feet of 14-inch force main downstream of the pump station due to the steep section of force main on B Street and Second Street (approximately 270 feet of 10% to 18% slope). Per the force main as-built drawings, the steepest section of the force main (positive slope) occurs with the first 500 feet following the MBPS building. Although the force main continues on a positive slope following this section, the slope varies between 0.3% and 3.0% with one intermediate 60 foot long section of 4.7% slope prior to reaching the force main's high point.

For the purpose of the proposed daily high-flow flush, our goal would be to re-suspend and move any settled solids out of the vertical sections of the 14-inch force main just outside the pump station and help move them through the steepest-sloped portion of the force main that stretches the first roughly 500 linear feet after the pump station. A complete flush of the entire force main is limited by the available storage capacity in MBPS's existing wet well in combination with the existing 14-inch force main's extremely long alignment. As such, the proposed daily high flow flush provides a sufficient solution to re-suspend possible settled solids following the MBPS's daily overnight low flow period.

The proposed plan is to set up a daily high-flow flush of 1,920 gpm to achieve 4 ft/sec in the force main during the morning peak flow hours. During this morning peak time, the lowest recorded flow from the SCADA data was approximately 800 gpm. Conservatively, this means our net drawdown rate in the wet well would be: 1,920 gpm (Q_{out}) – 800 gpm (Q_{in}) = 1,120 gpm (Q_{netdd}). Usable volume in the wet well between max and min water level is approximately 4,900 gallons. Dividing 4,900 gallons by 1,120 (Q_{netdd}), the estimated duration of the flushing cycle during peak hours is approximately 4.4 minutes (264 seconds). Depending on the peak hour flow into the wet well (Q_{in}) during the flush, the duration of the flushing cycle may be slightly longer (4.8 to 5 minutes).

The daily high flow flush cycle would require the following steps:

1. Morning peak flow period into wet well begins
2. Wet well fills up to the max water level
3. The high-flow flush cycle is activated upon max water level and Pump #1 and Pump #2 kick on in parallel
4. Pump #1 and Pump #2 are immediately ramped up to full speed
5. The high flow flush cycle draws down the wet well to the minimum water level
6. Pump #1 and Pump #2 switch to normal duty + standby lead-lag operation

3.2 Pump Alternatives

An alternative to the current pumping system at MBPS is to replace the existing extended shaft sewage pumps with solids handling, dry pit submersible style pumps capable of passing rags and solids. These proposed pumps would eliminate the need to include grinders upstream of each pump. Another feature of dry pit submersible pumps is that they are manufactured with flood-proof motors and electrical components capable of operating in a dry or periodically submerged environment. Using this type of pumping unit at MBPS eliminates the need for at-grade motors and extended drive shafts, and repositions the pump motors down to the 1st floor (directly above the pumps).

Following discussions with SEJPA staff, two (2) solids-handling pump manufacturers were identified to be considered as alternatives for the pump replacements: Flygt and Hidrostal. In addition to these two pump manufacturers, Vaughan chopper-style pumps were also evaluated for consideration. The following summarizes the recommended pump type, model, and hydraulic compatibility of the recommended pumps from these three pump manufacturers.

3.2.1 Flygt

For this application, Flgyt recommends their N-series solids-handling pump. Details of this pump design are below:

Pump Type: The specific pump model, the NT, is vertically mounted for permanent dry well installation. Pump includes flanged connections for suction and discharge pipework.

Pump Impeller: The N-series solids handling pump utilizes a semi-open self-cleaning impeller to pass high solids and fibrous content sewage. Flygt's N-series impeller is an adaptive impeller that moves axially away from the insert ring when an extra heavy load of solids is encountered. Once the debris or material is cleared, the impeller automatically returns to its normal operating position.

Pump Motor: All pumping units (duty, standby, and jockey) will include a Class H squirrel-cage induction motor. The motor is manufactured by ITT Water &Wastewater, and is constructed for submersible use. The motor has a NEMA Class B maximum operating temperature rise of 176°F.

Pump Capacity: Table 3.3 summarizes characteristics of the proposed Flygt pumps.

Table 3.3: Summary of Proposed Flygt Pump Characteristics

Design Flow (gpm)	TDH (ft)	Speed (rpm)	Efficiency (%)	Rated HP
Pump #1 Duty				
1,200	101	1785	72	54
Pump #2 Stand-By				
1,200	101	1785	72	54
Pump #3 Jockey				
650	81	1755	72	25

3.2.2 Hidrostal

Hidrostal is recommending their K-line screw centrifugal immersible pumps. Details of these pumps can be found below:

Pump Type: The K-line of pumps is recommended for permanent dry well installation. Leakage of wastewater is avoided by tandem seals running in an oil bath. These pumps are capable of passing viscous liquids and small suspended solids.

Pump Impeller: The impeller on the K-line pumps is a screw impeller fixed with a shoulder shield on the screw tip to prevent the blade from hooking onto fibrous solids. The screw type impeller makes for an open channel design from suction to discharge which prevents ragging and clogging of solids.

Pump Motor: All pumping units (duty, standby, and jockey) will include immersible motors. The motor recommended for the jockey pumps has a NEMA Class K maximum operating temperature rise of 239°F. The motor recommended for the larger duty pumps has a NEMA Class H maximum operating temperature rise of 257°F.

Pump Capacity: Table 3.4 summarizes characteristics of the proposed Hidrostal pumps.

Table 3.4: Summary of Proposed Hidrostal Pump Characteristics

Design Flow (gpm)	TDH (ft)	Speed (rpm)	Efficiency (%)	Rated HP
Pump #1 Duty				
1,200	101	1765	75.6	55
Pump #2 Stand-By				
1,200	101	1765	75.6	55
Pump #3 Jockey				
650	81	2757	71.9	30

Both the proposed Flygt and proposed Hidrostal pumps provide similar operational characteristics, with the exception of the proposed jockey pumps. As indicated in Table 3.3 and 3.4, the Hidrostal jockey pump utilizes a 2-pole motor compared to the Flygt jockey pump's 4-pole motor, meaning the Hidrostal jockey pump operates at faster speed.

3.2.3 Vaughan

Vaughan is recommending their DP-Series dry pit submersible chopper pumps for this application. Details of these pumps can be found below:

Pump Type: The DP-series pumps are recommended for permanent dry well installation. These chopper-style pumps are designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials in the flow stream are chopped/macerated by the pump as an integral part of the pumping action.

Pump Impeller: The pump impeller is a semi-open type with pump out vanes that reduce seal area pressure. Chopping/maceration of materials is achieved by the action of cupped and sharpened leading edges of the impeller blades moving across a cutter bar at the intake openings. The cutter bar plate is recessed into the pump bowl and contains 2 shear bars extending diametrically across the intake opening of a rotating cutter nut tooth.

Pump Motor: All pumping units (duty, standby, and jockey) will include continuous-in-air submersible motors. The motor is manufactured by Reliance, and is CSA certified Class 1, Group D with a T3C temperature code (320°F maximum temperature) for the jockey pump, and a T2A temperature code (536°F maximum temperature) for the larger duty pumps.

Pump Capacity: Table 3.5 summarizes characteristics of the proposed Vaughan pumps.

Table 3.5: Summary of Proposed Vaughan Pump Characteristics

Design Flow (gpm)	TDH (ft)	Speed (rpm)	Efficiency (%)	Rated HP
Pump #1 Duty				
1,200	101	1770	70.0	50
Pump #2 Stand-By				
1,200	101	1770	70.0	50
Pump #3 Jockey				
650	81	1755	59.0	30

3.3 Mechanical Piping and Equipment Considerations

Several piping and mechanical equipment modifications at MBPS are proposed to improve O&M access, pumping system and force main operation, and pumping unit removal capability. The following paragraphs discuss piping, valve, and equipment accessibility considerations, as well as proposed improvements.

3.3.1 Pump Suction and Discharge Piping

Inline Sewage Grinder Removal: The proposed pumping units allow for the removal of the existing inline sewage grinders located on the pump suction assembly. As explained in Section 1.1, MBPS operations staff have experienced issues with the effectiveness of the existing inline grinders, and one of the grinder units has been completely removed from the Pump #3 train. Operations staff expects that the two remaining inline grinders are nearing the end of their useful life and may require replacement in the next 1 to 2 years.

Recommendation: Remove existing inline sewage grinders from pump suction assembly when providing new dry pit submersible solids handling pumping units.

Pump Suction/Discharge Riser Piping Diameter: Upgrade and/or modification of the existing pump suction and discharge riser piping must be considered to improve pumping system hydraulics. Per Hydraulic Institute design standards, the recommended flow velocity in the pump suction and discharge riser piping during normal pump operation is 3 ft/sec to keep solids in suspension. Per Section 1.1, the existing pump suction and discharge riser piping contains a mix of 8-inch, 10-inch, 12-inch and 14-inch diameter piping. Based on the reviewed SCADA flow data, the current lower operating flows at MBPS (450 gpm to 600 gpm) result in flow velocities that are less than 3 ft/sec in the existing pump suction and discharge riser piping. The recommended pump suction and discharge riser piping diameters correspond with the proposed new pump arrangement.

Recommendation: For pump suction piping assembly, provide new 8-inch diameter suction piping between the existing 8-inch isolation plug valve and the pump suction elbow for new solids handling Pump #1 and #2. Provide 6-inch diameter suction piping and 8-inch by 6-inch reducer from existing bypass tee fitting to pump suction elbow on new solids handling Pump #3. For pump discharge riser assembly, replace discharge piping assembly with 8-inch diameter piping and valves from pump discharge flange to 14-inch diameter discharge manifold.

As indicated in Table 3.2, the proposed suction and discharge piping diameters meet the recommended minimum flow velocity of 3 ft/sec in pump suction and discharge riser piping at the minimum pump flow operating capacity. Sizing down the check valve diameter will increase flow velocity through the valve, thus reducing the chance of ragging to occur in the check valves.

Discharge Riser Piping Assembly, Check Valve, and Isolation Valve: The current discharge piping assembly, in combination with the existing vertically oriented 10-inch diameter swing check valve and overhead 12-inch diameter isolation plug valve, makes maintenance on these existing valves inconvenient and difficult for MBPS operations staff.

Recommendation: Realign pump discharge piping to orient discharge check valve in the horizontal position. Install both check valve and isolation plug valve in the horizontal piping at the same elevation as the pump volute. Provide riser section of pump discharge piping downstream of plug valve to connect to discharge manifold.

With the existing inline grinders removed from the pump suction piping assemblies, the pump discharge piping, check valve, and isolation plug valve no longer need to be routed overhead. The discharge check valve and isolation plug valve would now be easier to access for maintenance. In addition, the smaller diameter valves will also be easier to handle and remove.

3.3.2 Discharge Check Valves

The existing traditional single disc swing style check valves at MBPS close through a long 70 to 90 degree arc, and include an outside lever and spring to assist in valve closure during reverse flow. The number of moving parts in the traditional swing check valve requires routine maintenance and replacement of parts. Although these traditional swing check valves are commonly used, Dudek recommends to replace the existing check valves with rubber flapper style swing check valves, which do not require regular maintenance and also have a reduced tendency to clog.

Recommendation: Replace existing traditional swing style check valves on pump discharge piping assembly with APCO rubber flapper style check valves or equivalent.

3.3.3 Pump Access & Removal Capability

Current removal of pumps at MBPS requires significant effort from MBPS operations staff and manual transport to move pumps from pump pedestal to the existing monorail crane. Removal of the proposed dry pit solids handling pumps with submersible motors can be simplified by providing mechanical equipment to lift and move the pumping units from the pedestal to the existing monorail crane.

Recommendation: Provide portable gantry crane in pump room, equipped with 1-ton mechanically operated electric hoist.

Provision of a portable gantry crane and electric hoist system will allow operations staff to lift the pumping units vertically in place above the pump pedestals and move them over to the existing monorail system. The proposed reconfigured discharge piping for each pump train should allow for more space to move and position the gantry crane. This upgrade requires less manual effort for MBPS operations staff and allows for faster removal of pumps.

3.3.4 Miscellaneous Pump Station Upgrades

Wet Well Influent 18” Sluice Gate Valve: The existing 18-inch sluice gate located inside the wet well is in poor condition and may not be functional. This existing sluice gate must be replaced to be able to isolate the wet well from the 18” influent sanitary sewer line.

Recommendation: Replace existing 18-inch sluice gate with new 18-inch 316 stainless steel sluice gate, Waterman or equivalent.

Wet Well Ultrasonic Level Sensor & Mount: The existing ultrasonic level sensor support in the wet well riser is moderately corroded and is in need of replacement. In addition, the existing ultrasonic level sensor may not be functioning accurately.

Recommendation: Replace existing wet well ultrasonic level sensor and mount. Re-calibrate both wet well level sensors to ensure correct wet well level reading output from both elements.

3.4 Heat Rejection of Alternative Equipment

Changes and upgrades to mechanical equipment such as motors and VFDs in enclosed rooms can modify the ambient room temperature, and ultimately impact proper air flow/ventilation around equipment. An evaluation of the heat rejection of existing mechanical equipment was investigated and compared to the resulting heat rejection of the new/proposed mechanical equipment to determine if any modifications to the existing ventilation system would be necessary at MBPS.

Three significant mechanical equipment arrangements would take place at MBPS if the existing extended shaft sewage pumps were replaced with dry pit submersible solids handling pumps:

i. Three (3) existing 10HP inline sewage grinder motors will be removed from the **1st floor.**

ii. Three (3) existing 60HP pump motors will be removed from the **3rd floor.**

iii. Two (2) new 55 to 60 HP motors and one (1) new 30HP motor will be installed on the **1st floor.**

These proposed modifications create the following ambient air impacts to the MBPS:

1. Total combined heat rejection from mechanical equipment on the **3rd floor** will be reduced due to removal of the 60HP pump motors.
2. Total combined heat rejection from mechanical equipment on the **1st floor** may increase or decrease depending on the anticipated heat rejection of the existing versus new equipment (inline grinder motors versus Flygt/Hidrostal/Vaughan pump motors)

Based on these two (2) impacts, further detailed evaluation of the 2nd floor and 3rd floor heat rejection is not necessary. During Dudek's site visit to MBPS, operations staff indicated that there have not been any issues regarding ambient air temperatures on any of the MBPS floors during daily pump station operation. This suggests that the existing forced air ventilation system at MBPS is currently working properly to ventilate any rejected heat from lost efficiency of equipment. Therefore, we can conclude that removal of the existing pump motors from the 3rd floor would actually benefit the 3rd floor ambient air condition since we are removing a heat source. The 2nd floor is not undergoing any modifications to heat producing equipment, and therefore not of any concern. The focus then would be to evaluate the 1st floor due to the addition of the dry pit submersible pump motors.

The following heat rejection evaluation between the existing inline grinders and the proposed Flygt/Hidrostal/Vaughan pump motors was conducted to determine if this 1st floor equipment upgrade will require modification to the existing forced air ventilation system.

Heat rejection of existing inline grinder motors was calculated and used as an acceptable "base condition" since no ambient air issues have been reported by operations staff on the 1st floor.

3.4.1 Flygt Pump Motor

The following table shows a breakdown of the added heat rejection to the first floor if Flgyt pumps and motors were installed. The most critical operating scenario in regard to heat rejection of equipment on the 1st floor is during the proposed daily force main flushing cycle (1,920 gpm pump station flow operation) that would occur every morning during the peak wet well influent flow period. At this time, both of the duty pumps would be running in parallel at maximum operating speed. This directly correlates to the maximum heat rejection condition for these pumps and motors.

Table 3.6: New Flygt Pumps Heat Loss

No. of Pumps	Flow (gpm)	Pump Efficiency (%)	Head (ft)	Total Motor Input (HP)	Motor Efficiency (%)	Heat Rejection (Btu/hr)
Flygt NT 3202 Pump and 3202.830 Motor						
1	720	63	122	37	95.3	663.4
1	960	68	112	41.9	95.3	752.3
1	1,200	72	102	45	95.3	808.9
2	**1,920**	**68**	**112**	**83.8**	**95.3**	**1,504.7**
Flygt NT 3171 Pump and 3171.095 Motor						
1	500	68	92	19.2	88.9	814.9
1	650	72	84	21.5	88.9	913.5
1	750	74	78.5	22.6	88.9	958.4

3.4.2 Hidrostal Pump Motor

Heat rejection information of the alternative Hidrostal pumping units option can be seen in Table 3.7. Comparing total heat rejection during the 1,920 gpm flushing cycle, the Hidrostal motors have a significant amount more heat rejection than the Flygt motors. This is expected due to the slight decrease in motor efficiencies compared to the Flygt equipment.

Table 3.7: New Hidrostal Pumps Heat Loss

No. of Pumps	Flow (gpm)	Pump Efficiency (%)	Head (ft)	Total Motor Input (HP)	Motor Efficiency (%)	Heat Rejection (Btu/hr)
Hidrostal F4K-S Pump and FE5B4-MYAK Motor						
1	720	66.7	157	46.8	91.5	1,518.9
1	960	73.3	141	51	91.5	1,655.0
1	1,200	76.2	124	53.9	91.5	1,750.1
2	**1,920**	**73.3**	**141**	**101.9**	**91.5**	**3,310.1**
Hidrostal D4K-LT Pump and DEXW2-MYAK Motor						
1	500	71	100	21.7	82	1,491.4
1	650	71.9	81	22.6	82	1,550.8
1	750	68.2	71	24.1	82	1,653.6

3.4.3 Vaughan Pump Motor

Heat rejection information of the alternative Vaughan pumping units option can be seen in Table 3.8. Comparing total heat rejection during the 1,920 gpm flushing cycle, the Vaughan motors have a slight increase in heat rejection when compared to the previous Hidrostal motors. This can be explained by observing that Vaughan's provided Baldor motors have the lowest motor efficiency of the three options.

Table 3.8: New Vaughan Pumps Heat Loss

No. of Pumps	Flow (gpm)	Pump Efficiency (%)	Head (ft)	Total Motor Input, HP	Motor Efficiency (%)	Heat Loss (Btu/hr)
Vaughan S4T 50 HP and W06466-A-A001 Motor						
1	720	60	112	38.4	88.5	1,684.9
1	960	68	112	45.1	88.5	1,982.3
1	1,200	70	103	50	88.5	2,213.6
2	**1,920**	**68**	**112**	**90.2**	**88.5**	**3,964.5**
Vaughan S4T 30 HP and W01773-A-A001 Motor						
1	500	57	87.5	21.4	90.4	786.4
1	650	59	81	24.9	90.4	914.3
1	750	63	76	25	90.4	927

3.4.4 Impact of Equipment Heat Rejection to Pump Station

Table 3.6, 3.7 and 3.8 show that each of Flygt's, Hidrostal's and Vaughan's proposed equipment have lower values for their maximum anticipated heat rejection when compared to the existing equipment (inline sewage grinders and motors) located in the first floor pump room. To create an equal comparison, it is expected that if SEJPA elects to maintain the existing equipment at MBPS, a similar daily morning flushing cycle would be implemented. This would create an operating scenario in which two of the existing pumping units and grinders would be operating in parallel, which is estimated to be the worst case heat-rejection operating scenario for the station.

As indicated in Table 2.8, when two inline sewage grinders are running, they are rejecting approximately **4,330 Btu/hr** into the surrounding air space of the pump room. At maximum operation, Flygt, Hidrostal, and Vaughan's equipment emit approximately **1,505 Btu/hr**, **3,310 Btu/hr, and 3,965 Btu/hr** respectively. Since the sewage grinders are proposed to be removed, the proposed pumping equipment modifications on the 1st floor results in a net heat rejection of equipment that would be lower than the current condition. Currently, MBPS is not experiencing any issues with their ventilation system, and therefore the proposed pumping system improvements will not require upgrades to the existing ventilation system.

3.5 Ventilation System Considerations

Per the proposed pump replacement design, pump motors will be added to the 1st floor pump room. Minimum ventilation rate for the pump room must comply with NFPA 820 Table 9.1.1.4 for unclassified space, which mandates at least 6 ACPH. NFPA 820 Chapter 9 Section 2.4 also requires that all mechanical ventilated spaces be served by both supply and exhaust fans.

3.5.1 Air Supply System

With the new dry pit submersible pump motors on the 1st floor predicted to produce less heat rejection than the existing inline grinder motors, air supply system capacity and intake distribution per floor does not require any modification. As indicated in Section 2.5.3, the current air ventilation ACPH is adequate and does not require modification if the grinder units are removed and the pumps are replaced with the proposed solids-handling dry-pit submersible pumps.

Although visual observation of the air supply fan and filter box on the 3rd floor indicated that the existing air supply fan assembly has experienced moderate corrosion, MBPS operations staff reported that the existing air supply fan has been working well.

Recommendation: Replacement of the existing air supply fan assembly is not necessary at the moment, but MBPS operations staff is recommended to visually inspect the condition of the fan assembly's exterior corrosion every month. If corrosion continues to worsen, the air supply fan assembly may have to be replaced in the near future.

3.5.2 Air Exhaust System

Similar to the air supply system, air exhaust system capacity and air exhaust distribution per floor does not require any modification. As indicated in Section 2.5.3, the current air ventilation ACPH is adequate and does not require modification if the grinder units are removed and the pumps are replaced with the proposed solids-handling dry-pit submersible pumps.

No recommendations are required at this time due to the good condition of the air exhaust system equipment and ducting.

4 Cost Analysis

This section summarizes Dudek's opinion of probable construction costs associated with the improvements recommended in this evaluation, as well as a life cycle cost analysis to assist SEJPA and the City in understanding the most cost effective, efficient, and beneficial approach to improving the pumping system at MBPS.

4.1 Opinion of Probable Costs for Construction of Recommended Improvements

The opinion of probable construction costs associated with the improvements/upgrades recommended in this evaluation are summarized in Table 4.1. Note that this cost summary is based on provision of Flygt pumps – the most cost effective pump upgrade alternative.

Table 4.1 MBPS Engineer's Opinion of Probable Construction Costs

Specification Division			Total
Division 1 - General Requirements		$	66,000
Division 2 - Sitework		$	50,000
Division 3 - Concrete		$	10,000
Division 4 - Masonry		$	-
Division 5 - Metals		$	-
Division 6 - Wood and Plastics		$	-
Division 7 - Thermal and Moisture Protection		$	-
Division 8 - Doors, Windows, and Hardware		$	-
Division 9 - Finishes		$	-
Division 10 - Specialties		$	-
Division 11 - Equipment		$	162,306
Division 12 - Furnishings		$	-
Division 13 - Special Construction		$	-
Division 14 - Conveying Systems		$	3,960
Division 15 - Mechanical		$	96,120
Division 16 - Electrical		$	7,000
Division 17 - Instrumentation		$	7,000
Totals		**$**	**403,000**
Project Level Allowance	25%	$	100,750
Insurance	1.50%	$	6,045
Profit	10%	$	40,300
Bond	1%	$	4,030
Escalation to Midpoint (3%/yr x 3 yrs)	9.0%	$	18,135
Total		$	170,000
Grand Total		**$**	**573,000**

4.2 Life Cycle Cost Analysis

A life cycle cost (LCC) analysis is a management tool that can help cities and municipalities minimize waste and maximize energy efficiency for many types of systems, such as pumping systems. The life cycle cost of a piece of equipment is the total lifetime cost to purchase, install, operate, maintain, and dispose of that equipment. The life cycle cost analysis in this section includes life cycle cost comparison between the following pump station scenarios. To allow for direct comparison between scenarios, only improvements directly related to the pumping unit upgrades were included in the LCC analysis.

- **LCC SCENARIO 1 (LCC1):** Keeping and maintaining the existing extended shaft sewage pumps, conventional motors, and inline sewage grinders
- **LCC SCENARIO 2 (LCC2):** Replacing existing pumping units with dry pit solids handling pumps and submersible motors (duty + standby + jockey pump), removing existing inline sewage grinders, and replacing/realigning pump suction and discharge piping with smaller diameter piping and valves. Note that this scenario includes three separate calculations, one for each pump manufacturer alternative.

4.2.1 Life Cycle Cost Equation

The LCC analysis used for this evaluation is based on the Pump Life Cycle Costs guide developed by Hydraulic Institute, Europump, and the US Department of Energy's Office of Industrial Technologies. Life cycle cost for each pump station was calculated based on the following equation:

$$LCC_x = C_{ic} + C_{in} + C_e + C_o + C_m + C_s + C_{env} + C_d$$

Elements of the life cycle cost equation are defined below:

LCC_x = life cycle cost

C_{ic} = initial costs, purchase price (pre-purchased equipment), engineering design costs,

bid costs, permitting costs

C_{in} = installation and commissioning cost (including training)

C_e = energy costs (predicted cost for system operation, including pump driver,

controls, and any auxiliary services)

C_o = operation costs (labor cost of normal system supervision)

C_m = maintenance and repair costs (routine and predicted repairs)

C_s = down time costs (loss of production)

C_{env} = environmental costs (contamination from pumped liquid and auxiliary equipment)

C_d = decommissioning/disposal costs

Note that annual inflation costs for individual elements are also incorporated into the ultimate calculated LCC Value for each scenario, and reflected in the LCC totals in Table 4.2.

4.2.2 Life Cycle Cost Elements: LCC1 vs. LCC2

A brief discussion for each LCC element is included below, highlighting any significant differences between the two life cycle cost scenarios.

C_{ic} – Initial Investment Costs

Initial investment costs include costs associated with items such as engineering design, regulatory permitting, bid process, purchase order admin, training, and purchased equipment.

LCC1: The existing pumping system currently only utilizes 2 out of the 3 inline sewage grinders. Recently, the inline sewage grinder dedicated to Pump #3 has become ineffective, and has been removed from the suction assembly. Assuming that the three existing grinders at MBPS were all installed at the same time, and have experienced equal operational run time during their installation, the grinders on the Pump #1 and Pump #2 suction assemblies are also expected to fail within the next year. Initial investment for LCC1 includes furnishing a new grinder for Pump #3 and replacement of the grinders on Pump #1 and Pump #2. It should be noted that the grinder manufacturer, JWC Environmental, no longer provides the cutter cartridge mechanism as a standalone spare part to be replaced within the grinder units. The entire grinder unit must be removed and replaced.

LCC2: Initial investment costs for the proposed pump upgrades is rather significant as it involves cost associated with engineering design, project bid process, purchase order administration, training, and pre-purchased equipment (pumps).

C_{in} – Installation and Commissioning (Start-up) Costs

Installation and Commissioning costs include costs associated with installation of equipment, construction, start-up and testing/inspection, project level allowance, insurance, profit, and bond.

LCC1: Installation/construction and start-up costs associated with LCC1 would only include installation of the new/replacement grinders on the three existing pump assemblies. All other equipment is existing.

LCC2: Installation/construction and start-up costs are also a significant element to LCC2. Costs associated with procurement of materials, construction, start-up and testing/inspection, and site supervision for the pumping system improvements provides a major impact on the LCC2 total. Note that costs associated with reprogramming of pump controls to administer a flushing cycle is not included in the LCC2 cost since the proposed flushing cycle is merely a recommendation and not a requirement if the proposed solids handling dry-pit submersible pumps are installed.

C_e – Energy Costs

LCC1: A major factor in LCC1 is the added energy consumption costs associated with operating the grinder units. Inline sewer grinders are known to be very inefficient and can result in increased energy costs. Energy costs associated with pump operation is evenly split between all three existing pumps because they each alternate at the same amount of run-time.

LCC2: A factor that differentiates pump operating costs under LCC2 is the constant use of the proposed jockey pump during the daily low flow period (overnight). The jockey pump's dedicated use for overnight flows results in a smaller horsepower pumping unit operating exclusively during the daily off-peak, lower energy cost period.

C_o – Operation Costs

LCC1/LCC2: Operation costs are labor costs related to the operation of a pumping system. The slight increase in labor cost to operate the grinders is negligible since the grinders are automated to operate with the existing pumping units. Operation costs regarding the pumping units is expected to be similar between both scenarios.

C_m – Maintenance and Repair Costs (routine and predicted repairs)

LCC1: Maintenance and repair costs associated with the grinder units significantly increases once the grinder unit cutter cartridge begins to wear down. MBPS operators must increase frequency of maintenance due to debris in the fluid stream making its way past the grinders and ragging up the pump impellers and discharge check valve. Maintenance costs in terms of labor hours can become costly when operations staff have to constantly come out to MBPS to de-rag or unclog the pumps and/or check valves. In addition, as previously mentioned, the inline sewage grinders cannot be serviced in-house with spare parts to replace the cutter cartridge. The entire grinder unit must be replaced which is very costly. In addition to the grinders, the existing extended shafts for the pumps requires additional costs. The extended shafts and bearing seals between floors are additional items that must be maintained and can be subject to additional labor hours for repairs due to accessibility.
LCC2: The new pumping units and motors allow for easier maintenance access resulting in less labor hours during repairs. In addition, new pump motors are less likely to fail in the short term compared to the older pump motors in LCC1 that would be continuing use. It should also be noted that the Vaughan chopper pumps are estimated to require replacement of the impeller and cutter nut every 8 to 12 years (per manufacturer's recommendation). This replacement time frame falls in line with the required screw-type impeller replacement of the Flygt and Hidrostal pumps.

C_s – Downtime and Loss of Production Costs

LCC1/LCC2: Since both LCC1 and LCC2 utilize standby pumps, downtime is not expected and loss of production costs is assumed to be negligible.

C_{env} – Environmental Costs

LCC1/LCC2: As a part of the MBPS Renovation Project completed in 2007, the station was equipped with an emergency storage overflow basin. For the purposes of this analysis, it is assumed that any pump failures are mitigated through pump redundancy and the available pump station emergency storage. Therefore, environmental costs associated with sewer spill contamination, cleanup, and fines is negated from this analysis.

C_d – Decommissioning/Disposal Costs, Including Restoration of the Local Environment

LCC1: The only disposal costs associated with LCC1 include disposal of the previous grinder units. This is minimal compared to the disposal costs associated with LCC2
LCC2: Disposal costs associated with LCC2 are more significant than LCC1 considering the demolition of existing equipment/piping/appurtenances necessary to provide the new pumps and new suction and discharge piping.

4.2.3 Life Cycle Cost Analysis Summary

Table 4.2 summarizes the LCC Analysis between LCC1 and LCC2. Note that inflation costs are factored into LCC elements and accounted for in the calculated bottom-line LCC Value Total.

Table 4.2 Life Cycle Cost Comparison Summary (20 year period)

LCC Element	Input Description	LCC1 (existing)	LCC2 (proposed w/ Flygt)	LCC2 (proposed w/ Hidrostal)	LCC2 (proposed w/ Vaughan)
C_{ic}	Initial investment cost:	$ 90,600	$ 204,210	$ 308,890	$ 399,330
C_{in}	Installation, construction, and commissioning cost:	$ 36,240	$ 305,500	$ 409,300	$ 499,000
C_e	Energy costs/year (calculated)	$ 43,800	$ 32,150	$ 38,590	$ 36,600
C_o	Operation costs/year (labor cost of normal system supervision)	$ 8,000	$ 5,000	$ 5,000	$ 5,000
C_m	Maintenance costs of pumping system equipment (routine maintenance/year)	$ 8,000	$ 5,000	$ 5,000	$ 5,000
	<u>One-time</u> replacement cost of all 3 grinder units (ocurring every 6 years, sans inflation)	$ 100,000	$ -	$ -	$ -
	<u>One-time</u> replacement cost for 3 existing pumps and 3 motors (ocurring in year 2027, end of useful 20 yr life, sans inflation)	$ 216,000	$ -	$ -	$ -
C_s	Down time costs/year (loss of production)	$ -	$ -	$ -	$ -
C_{env}	Environmental cost/year:	$ -	$ -	$ -	$ -
C_d	Disposal/Demo cost:	$ 1,500	$ 20,000	$ 20,000	$ 20,000
	Lifetime in years:	20	20	20	20
	Inflation rate (%):	3.0%	3.0%	3.0%	3.0%
	Output				
	LCC Value (20-yr total)	**$2,078,400**	**$1,406,700**	**$1,749,200**	**$1,865,100**

The following assumptions were made during preparation of the LCC analysis calculation:

- The initial investment costs include the costs of purchased mechanical equipment (pumping units/grinders), assuming these materials are pre-purchased by the Owner. All other equipment is assumed to be included in associated construction costs (C_{in}).
- The installation, construction, and commissioning costs include only material and labor costs associated with the pumping units and pump suction/discharge piping upgrades. Other miscellaneous recommended upgrades to the MBPS as recommended in this report were excluded from this LCC analysis.
- The current rate/kWh used to calculate C_e is $0.16/kWh based on the August 2019 SDG&E electric bill for MBPS provided by SEJPA.
- The useful life of the existing MBPS pumping units is assumed to be 20 years, therefore requiring full pumping unit replacement in the year 2027.
- Daily pump operation hours were based on the reviewed MBPS SCADA flow and recorded motor frequency data.
- There are no down time costs per year or environmental costs per year associated with this project for the purposes of this analysis.
- The two remaining grinder units currently installed at MBPS are nearing the end of their useful life and will need to be replaced in the next year.
- Inflation rate of 3% per year is assumed and applied/compounded annual for yearly expensed costs, as well as mechanical replacement costs taking place in future years.

Per the LCC analysis, maintaining and ultimately replacing the existing pumping equipment and inline sewer grinders in-kind over the next 20 years is anticipated to require increased LCC compared to upgrading of the pumping system:

- 48% increased LCC compared to upgrading the pumping system under LCC2 with Flygt pumps
- 19% increased LCC compared to upgrading of the pumping system under LCC2 with Hidrostal pumps
- 11% increased LCC compared to upgrading the pumping system under LCC2 with Vaughan pumps.

The procurement costs for the Vaughan pumping units was found to be significantly more expensive than the costs for the Flygt pumps (nearly double), with the procurement costs for the Hidrostal pumps falling right in between the two.

Regarding energy costs, Table 4.2 indicates that the annual cost to operate the existing pumps and grinder units (LCC1) is more expensive than each of proposed pump alternatives in LCC2. Based on the current average dollar-rate/kWh at MBPS, continuing use of inline sewage grinders for all 3 pump trains with the existing extended drive shaft pumps results in an approximate 36% greater energy cost per year (when compared to removal of the grinders and upgrading to Flygt pumping units).

Comparing energy costs between the Flygt, Hidrostal, and Vaughan pumps, the lower operating efficiencies of the Hidrostal and Vaughan equipment is anticipated to result in greater annual energy costs compared to the Flygt equipment over the next 20 years:

- Hidrostal – approximately 11% greater annual energy costs compared to the Flygt equipment

- Vaughan – approximately 14% greater annual energy costs compared to the Flygt equipment

Another significant impact to the overall LCC of the four scenarios is the continued maintenance and replacement costs associated with use of the inline sewage grinders. Not only do the inline grinders result in greater annual energy costs to operate the pump station, but the cost of replacement for each of the grinder units every six years results in significant equipment costs over the next 20 years (estimated over $430,000 after inflation).

Recommendation: Dudek recommends replacement of the existing extended shaft pumping units, conventional motors, and inline sewage grinders, with dry-pit submersible, solids handling pumping units. Although upgrading the pumping system with any of the proposed Flygt, Hidrostal, or Vaughan equipment is anticipated to result in lower life cycle costs over the next 20 years, the LCC analysis suggests that Flygt would be the most cost-effective alternative.

DUDEK

Appendix A

Proposed Mechanical Equipment Data Sheets

APCO CRF 100, 100SA & 100SR RUBBER FLAPPER SWING CHECK VALVES

Design & Construction

APCO CRF 100, 100SA and 100SR Rubber Flapper Swing Check Valves are uniquely simple in design but durable for use on a variety of applications. Available in sizes 2-48" (50-1200mm), they are available in Ductile Iron, Cast Iron or Bronze bodies with ASME 125/150 flanges and maximum pressure ratings up to 175 psi (1210 kPa). For additional abrasion resistance, full-flow area bodies can be lined with elastomers.

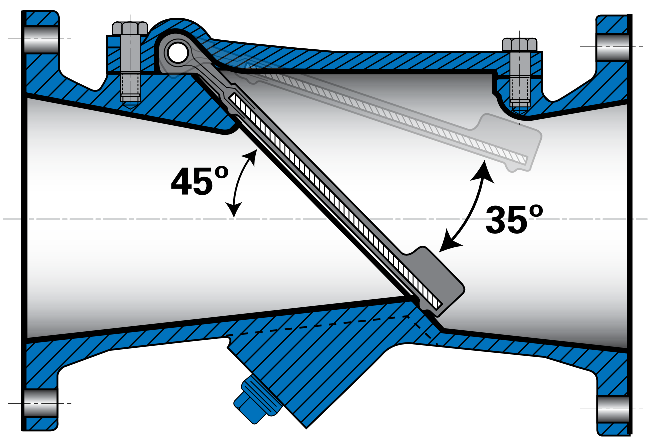
Since the APCO CRF Rubber Flapper Check Valve was introduced in 1965, it has been operating successfully in thousands of installations. The unique features of the Rubber Flapper Check Valve makes it ideally suited for applications such as raw sewage, water systems, industrial wastes, chemical lines, erosive services, ash service, acid lines, tailings systems, light slurries, corrosive services, leaching lines, scrubbers, and brine & salt water systems.

Unique 45° Angle Provides Non-Slam Properties

APCO CRF Rubber Flapper Swing Check Valves feature a unique, simple design with one moving part. The flapper does not swing from a hinge pin; it simply flexes open. The valve body seat is on an angle of 45° to the centerline of the pipe, permitting horizontal or vertical flow up installation. The unique 45° angle on the body seat gives the valve non-slamming properties. The flapper travels 35° from open to close, usually before column reversal can occur.

Full Flow Area

With the flapper fully open, there is a straight unobstructed flow passage, so all foreign matter is flushed away by the flowing medium. This eliminates clogging associated with other valve styles. Due to this unobstructed flow passage, the pressure drop is considerably lower through the APCO Rubber Flapper Check than through conventional swing check valves.



Precision Molded, Steel Reinforced Rubber Flapper Provides Bubble Tight Seating

The Acrylonitrile-Butadiene (NBR) flapper provides excellent abrasion-resistant qualities. The flapper can also be compression molded with Chloroprene (CR), Terpolymer of Ethylene Propylene & A Diene (EPDM), Fluoro Rubber (FKM) or other synthetic rubbers on application. A steel disc for strength and a steel bar are molded inside the flapper.

Cycle Tested Flapper Prevents Jamming or Sticking

A high strength fabric is integrally molded over the disc and bar to form a flexible joint. When the valve is assembled, the flapper is firmly clamped between body and cover. This feature eliminates problems of moving parts, shafts, pins, bearings, bushings or packing (as required in conventional check valves). The flapper design prevents jamming or sticking in the open position.

Rubber Flapper Provides Bubble-Tight Sealing

The o-ring seal molded into the disc face assures positive sealing, even at lower pressures.

No Regular Maintenance Required

With only three major parts: Body, Flapper and Cover, the CRF Rubber Flapper Check Valve requires relatively no maintenance. If maintenance should be required, the flapper can be replaced in a matter of minutes.

4.3" Size Designed Specifically for Raw Sewage

The 4.3" size Rubber Flapper Swing Check Valve is specifically designed for raw sewage with a flow area through the seat almost twice (23.76", 604mm) that of standard pipe (12.73", 323mm) permitting the valve to pass a 3" (76mm) diameter solid as required by many states and municipalities for 4" (100mm) check valves used on sewage lift stations.

Choice of Body Materials

Unlined bodies are normally made of Ductile Iron for 2-24" (50-600mm) sizes and Cast Iron for 30-48" (750-1200) sizes. Bronze body valves are available in sizes 2-10" (50-250mm) and Navy Bronze are available in 2-4.3" (50-100mm) sizes. Ductile Iron and Cast Iron valves can be lined with elastomers for additional abrasion resistance.

Buried Service Valves

When used in buried service applications, the CFR Rubber Flapper Swing Check Valve can be ordered with 316 stainless steel cover bolts for corrosion resistance.

Rubber Lined Bodies For Extra Abrasion Resistance

The CRF Rubber Flapper Swing Check Valve is specially designed for rubber lining. The valve contains no sharp corners or crevices, and the smooth body and cover contours readily accept the 1/8" rubber lining or coating. The result after lining is a totally encapsulated valve without any exposed metal surfaces. Bodies can be lined with Chloroprene (CR), Natural Rubber (NR), Terpolymer of Ethylene Propylene & A Diene (EPDM) or Acrylonitrile-Butadiene (NBR).

Spring Return Rubber Flapper Swing Check Valve (100SR)

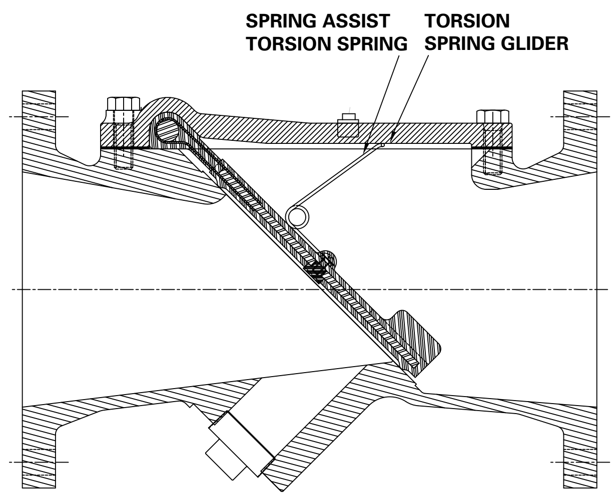
In difficult high head applications where rapid flow reversal can occur, standard swing check valves will often slam. The CRF-100SR Spring Return model was designed to eliminate or minimize slam in these applications, even in tough vertical flow-up installations.

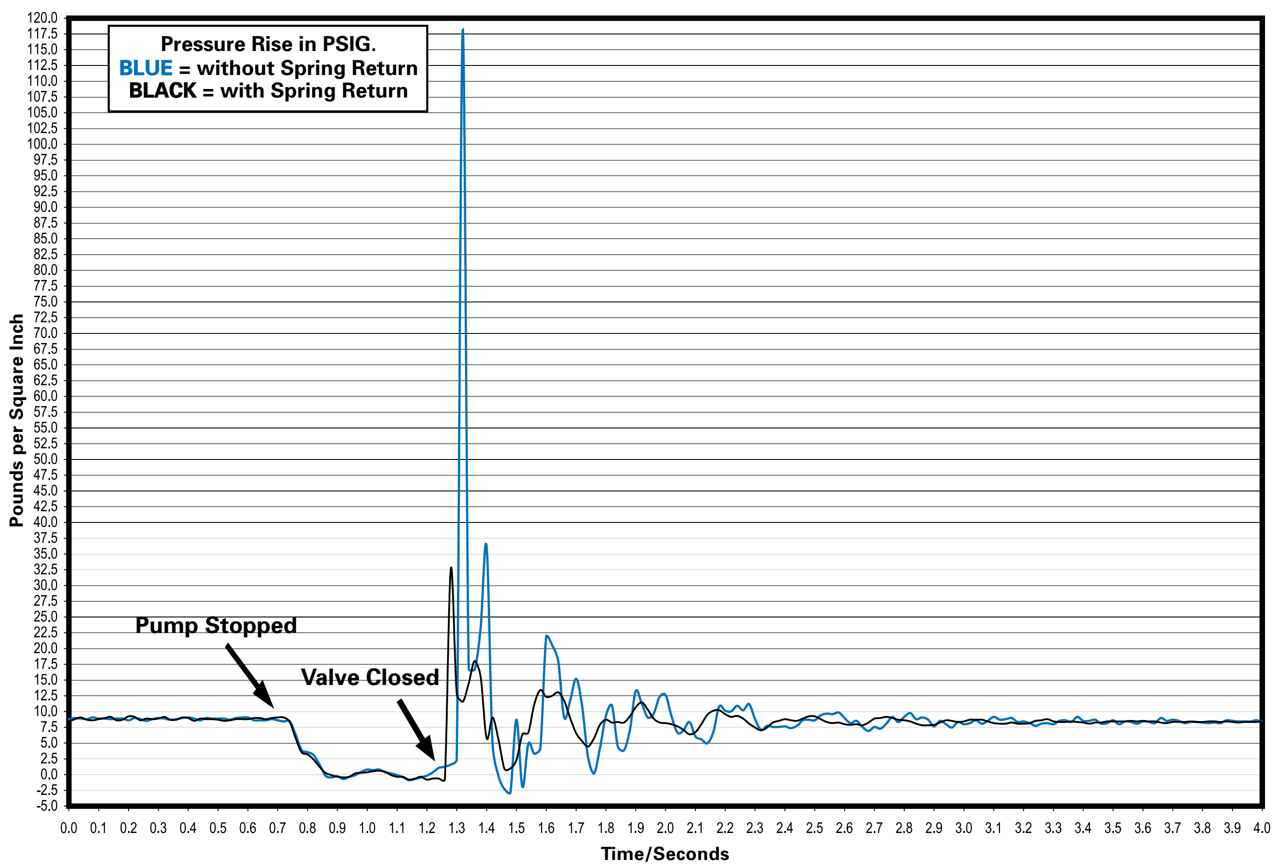
The externally adjustable spring return accelerates flapper closure before flow reversal can occur. The stainless steel helical compression spring can be externally adjusted without removing the cover from the valve or removing the valve from service. Adjustments are made by an external sealed screw which provides infinite adjustment to the internal spring compression.

The graph below compares closing characteristics of the rubber flapper swing check valve with and without the spring return closure. The installation is "flow up" and the power failure simulation for the tests was identical. The pressure rise (black line) with the spring return closure was only 33 psi (228 kPa). This represents a 85 psi (586 kPa) reduction in the pressure surge. Also, subsequent wave patterns were more subdued and rounded. On-site closure noise (valve slam) and pipe displacement disappeared with the 100SR Spring Return.

Spring Assist Rubber Flapper Swing Check Valve (100SA)

The CRF Rubber Flapper Check Valve with Spring Assist Closure includes a Stainless Steel double torsion spring mounted to the flapper that accelerates valve closure before reverse flow can occur, minimizing potential valve slam. The double torsion spring is rigidly secured to the flapper.

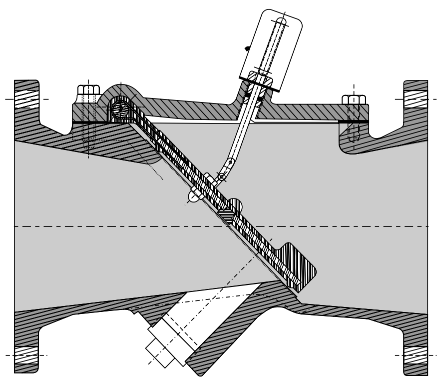




Options & Accessories

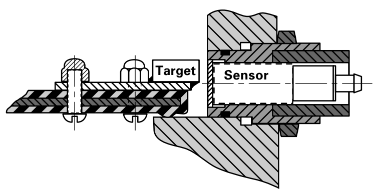
Disc Position Indicator (PI)

The Disc Position Indicator is mounted to the cover and clearly identifies the position of the flapper upon visual inspection. The Disc Position Indicator is available on body styles 100 and 100SA.



Proximity Switches & Limit Switches Available

An inductive type proximity switch can be mounted on the valve body with its target mounted internally on the flapper. The switch transmits an electrical signal indicating when the flapper is fully closed. Mechanical Limit switches are also available.

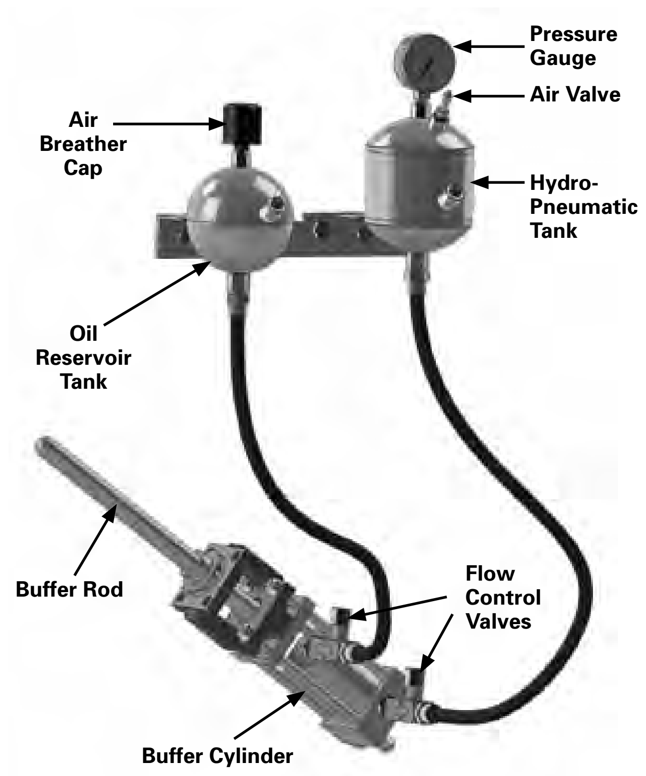


Hold Open Device For Backflushing

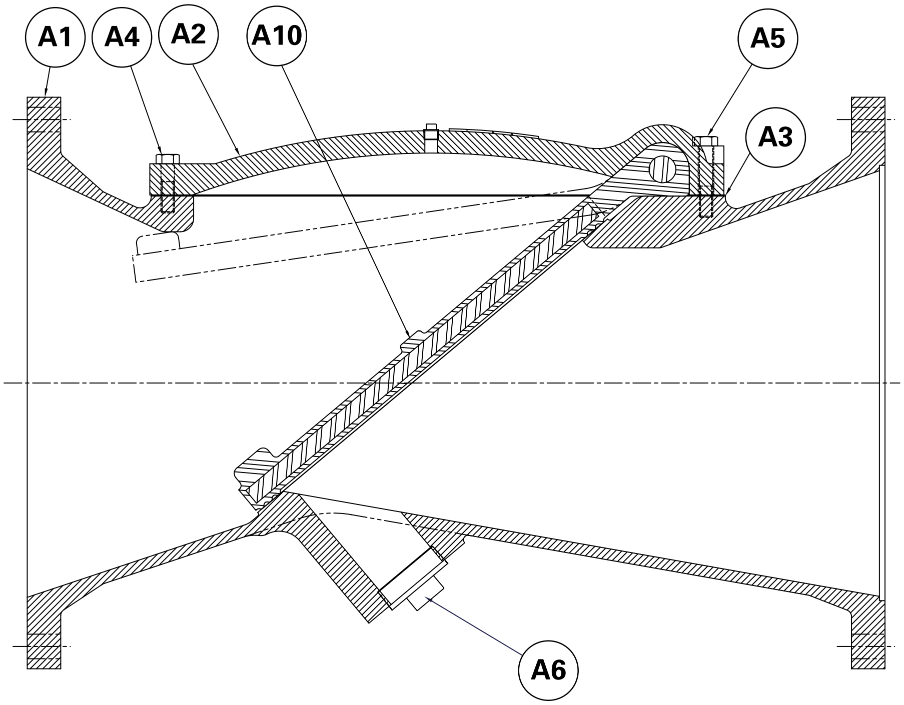
The Hold Open Device, available on 3-30" (80-750mm) valve sizes, can be ordered on the valve to make back-flushing the system, priming pumps or draining the system safe and convenient. The APCO Backflow Device meets OSHA's easily activated requirements without risk of injury to operating personnel during a backflow procedure. This Hold Open Device is positive and will not slip during full backflow. The Backflow Device can be operated without removing the check valve or taking the pump out of service. Hold Open Devices on size 3" and 4" (80 and 100mm) are constructed of Bronze ASTM B-584 as approved by U.S. Navy for fleet service.

Bottom Mounted Buffer

Bottom Mounted Buffers have been used successfully for decades to reduce slamming of the valve disc and resultant water hammer. The bottom hydraulic buffer permits free opening, but positive non-slam closure of the rubber flapper. The hydraulic buffer rod contacts the rubber flapper during the final 10% of closure to control closing speed until shut-off. The final closure can be adjusted with the two color-coded flow control valves which have locking set screws to secure the final setting. The oil hydraulic buffer controls disc closure speed to suit flow conditions and reduces slam, water hammer and pressure surges.



Materials of Construction



Item	Description	Material
A1	Body	Cast Iron, ASTM A126, Grade B
		Bronze, ASTM 584
		Ductile Iron, ASTM A536, Grade 65-45-12
		Bronze Navy "M" ASTM B584 C92200
A2	Cover	Same as body material
A3	Gasket*	Non-asbestos with butadiene rubber binder
A4	Cover Bolt	316 Stainless Steel, or Steel A449, Grade 5
		Brass ASTM B16 C36000 (On Bronze Body)
A5	Cover Bolt	316 Stainless Steel, or Steel A449, Grade 5
		Brass ASTM B16 C36000 (On Bronze Body)
A6	Body Pipe Plug	Iron, Malleable, ASTM A48, Class 40
A10	Rubber Flapper	Reinforced NBR, Acrylonitrile-Butadiene, Carbon Steel ASTM A36
		Reinforced CR, Chloroprene, Carbon Steel ASTM A36
		Reinforced EPDM, Terpolymer of Ethylene Propylene & A Diene, Carbon Steel ASTM A36
		Reinforced FKM, Fluoro Rubber, Carbon Steel ASTM A36

*Cover gasket is not used on lined valves

Valve Selection

Pressure Ratings

Body Style	Maximum Differential Cold Working Pressure
100, 100SA & 100SR	175 psi (1210 kPa)

Note: Specify operating pressure when ordering

Temperature Ratings

Material	Temperature Range*
NBR, Acrylonitrile-Butadiene	-70 to 250° F (-57 to 121° C)
CR, Chloroprene	-40 to 250° F (-40 to 121° C)
EPDM, Terpolymer of Ethylene Propylene & A Diene	-20 to 300° F (-29 to 150° C)
FKM, Fluoro Rubber	-40 to 425° F (-40 to 218° C)
NR, Natural Rubber	-40 to 180° F (-40 to 82° C)

*Maximum operating temperature is a function of the materials used in the valve.

All valves are rated to a maximum temperature of at least 180° F (82° C).

Contact application engineering if the valve is required to operate above 180° F (82° C).

Applicable Standards

APCO CRF Rubber Flapper Swing Check Valves are designed and/or tested to meet the following standards:	
MIL V 18436 F	Conforms to material requirements of Group A, Type III, Trim 1, Bronze Swing Check Valves
ASME B16.1	Cast iron pipe flanges and flanged fittings. Conforms to related flange drilling dimensions.
AWWA C508	Valves tested as a complete assembly per AWWA C508

Valve Weights

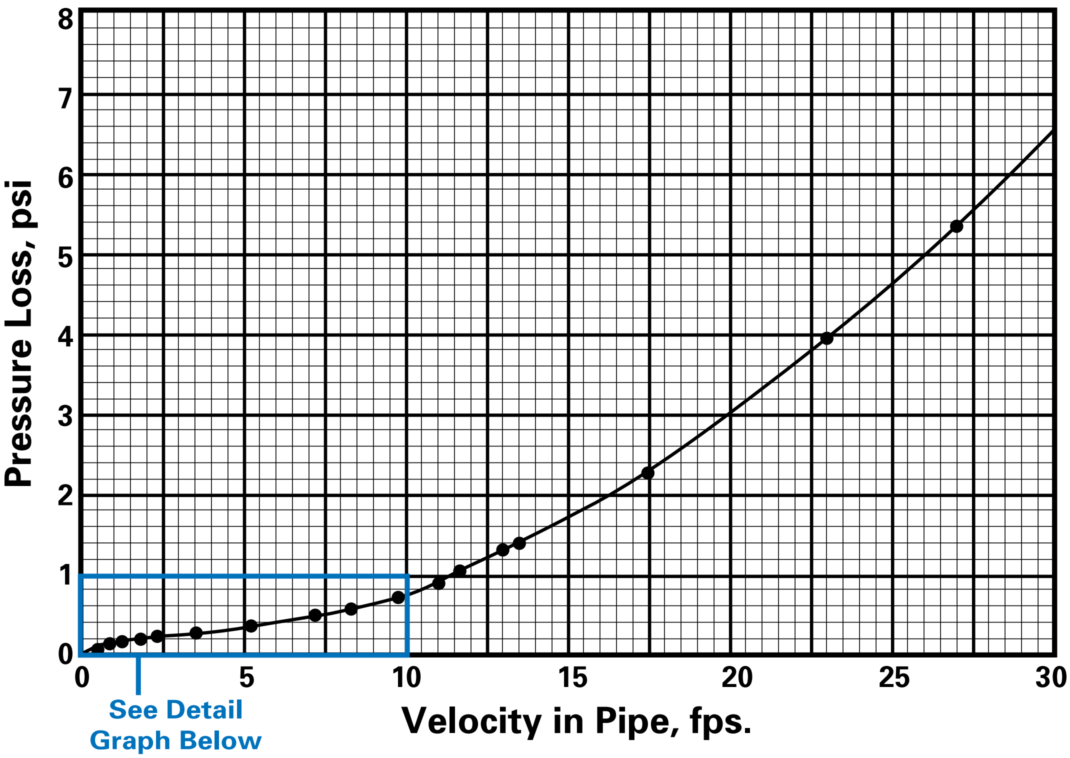
Valve Size	Ductile Iron Body
2" 50mm	19 8
2.5" 65mm	20 9
3" 80mm	21 10
4" 100mm	38 17
4.3" 110mm	70 32
5" 125mm	74 34
6" 150mm	100 45
8" 200mm	185 84
10" 250mm	335 152
12" 300mm	475 215
14" 350mm	640 290
16" 400mm	950 431
18" 450mm	1250 567
20" 500mm	1550 703
24" 600mm	2000 907
30-48" 750-1200mm	Contact DeZURIK

Pounds
Kilograms

Valve Selection

12" Rubber Flapper Swing Check Valve

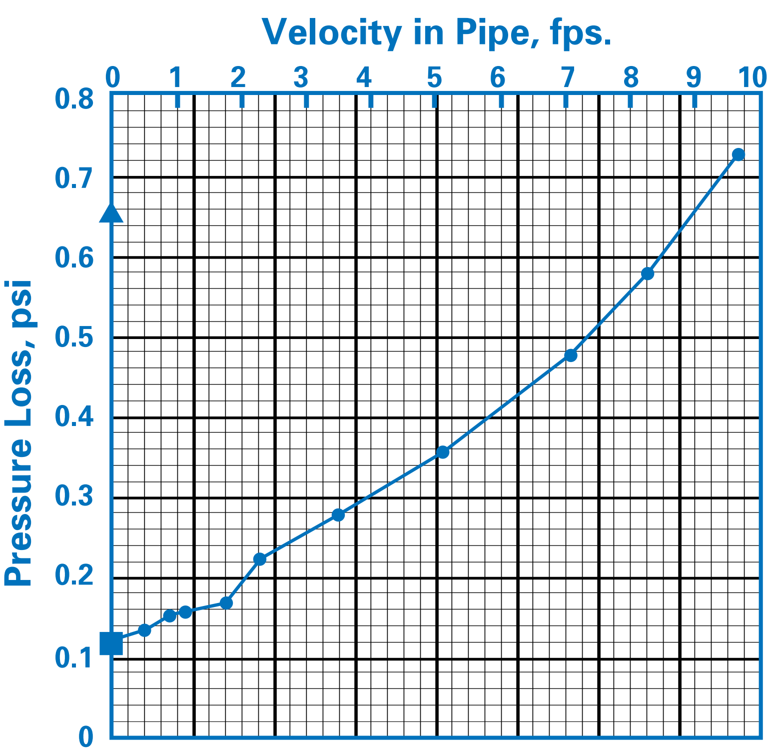
Tests indicate losses are slightly higher for smaller sizes and lower for larger sizes than shown here



Actual Test Points

Pressure head to unseat flapper with downstream pipe full (discharge side). Flapper submerged and bouyant

Pressure head to unseat flapper, downstream pipe empty



Ordering

To order, simply complete the valve order code from information shown.
An ordering example is shown for your reference.

Valve Style
Give valve style code as follows:

CRF	=	Rubber Flapper Swing Check Valves

Valve Size
Give valve size code as follows:

2	=	2"	(50mm)	14	=	14"	(350mm)
2.5	=	2.5"	(65mm)	16	=	16"	(400mm)
3	=	3"	(80mm)	18	=	18"	(450mm)
4	=	4"	(100mm)	20	=	20"	(500mm)
4.3	=	4"	(100mm)	24	=	24"	(600mm)
5	=	5"	(125mm)	30	=	30"	(750mm)
6	=	6"	(150mm)	36	=	36"	(900mm)
8	=	8"	(200mm)	42	=	42"	(1100mm)
10	=	10"	(250mm)	48	=	48"	(1200mm)
12	=	12"	(300mm)				

Body Style
Give body style code as follows:

100	=	Rubber Flapper (2-48")
100SA	=	Rubber Flapper with Spring Assist (4.3-30")
100SR	=	Rubber Flapper with Spring Return (3-30")

End Connection
Give end connection code as follows:

F1	=	Flanged ASME 125/150

Body Material
Give body material code as follows:

Unlined - Body 100, 100SA or 100SR

BRZ	=	Bronze (2-10")
CI	=	Cast Iron (standard for 30-48")
DI	=	Ductile Iron (standard for 2-24")
NBRZ	=	Navy Bronze (2-4.3"). For Navy Valve requirements, contact the factory (Body style 100)

Lined - Body Styles 100, 100SA & 100SR (2-24")

DICR	=	Ductile Iron, Chloroprene (CR) Lined
DINR	=	Ductile Iron, Natural Rubber (NR) Lined
DIEP	=	Ductile Iron, Terpolymer of Ethylene Propylene & A Diene (EPDM) Lined
DINB	=	Ductile Iron, Acrylonitrile Butadiene (NBR) Lined

Lined - Body Styles 100, 100SA & 100SR (30-48")

CICR	=	Cast Iron, Chloroprene (CR) Lined
CINR	=	Cast Iron, Natural Rubber (NR) Lined
CIEP	=	Cast Iron, Terpolymer of Ethylene Propylene & A Diene (EPDM) Lined
CINB	=	Cast Iron, Acrylonitrile Butadiene (NBR) Lined

Flapper Material
Give flapper material code as follows:

NBR	=	Acrylonitrile-Butadiene, -70 to 250° F (-57 to 121° C)
CR	=	Chloroprene, -40 to 250° F (-40 to 121° C)
EPDM	=	Terpolymer of Ethylene Propylene & A Diene -20 to 300° F (-29 to 150° C)
FKM	=	Fluoro Rubber, -40 to 425° F (-40 to 218° C) Body Styles 100, 100SA or 100SR, Unlined bodies only

Options
Give options code as follows:

DTR	=	DeZURIK Standard Certified Production Hydrostatic Shell & Seat Test Report
PI	=	Disc Position Indicator (4.3-30")
SB16	=	316 Stainless Steel Bolting

Accessories
Give accessory code as follows:

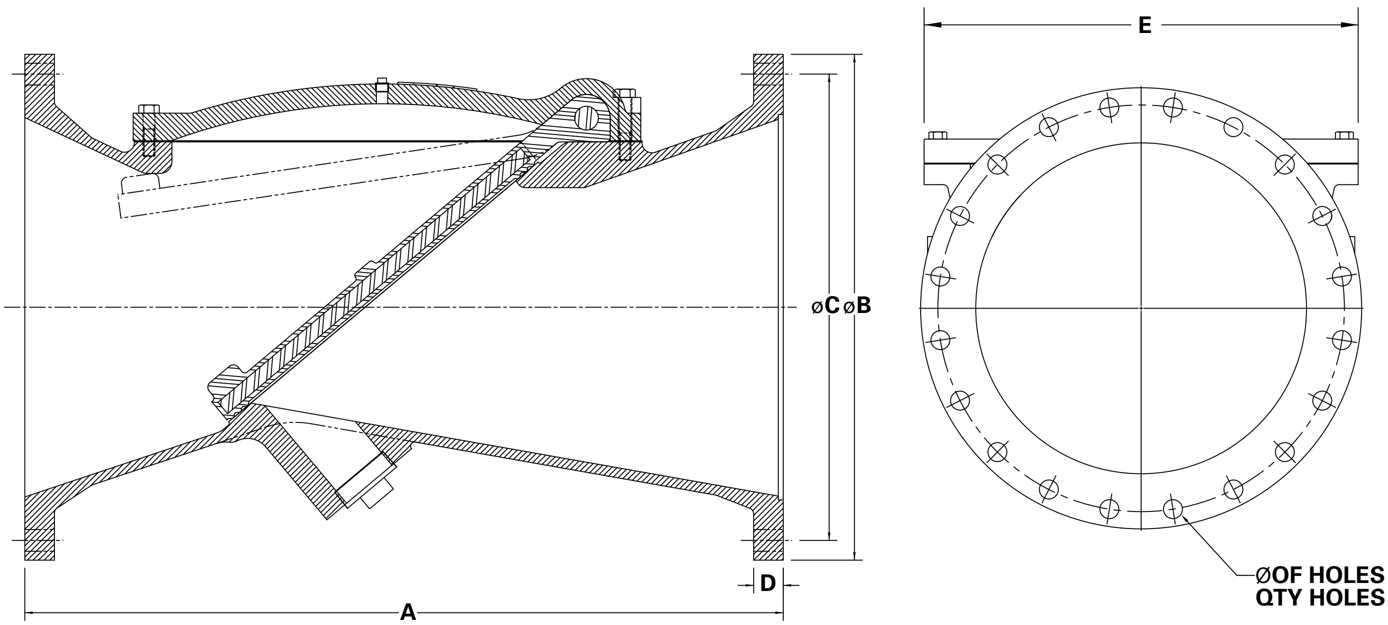
BMB	=	Bottom Mounted Buffer (4.3-48")
HOD	=	Hold Open Device (Back flush) (3-30")
SEL20	=	Limit Switch with Disc Position Indicator AB 802T-ATP (4.3-30") Body styles 100 or 100SA
SEL30	=	(1) Proximity Switch - SPDT GO 73-13526-B2. Body Styles 100 (2-12"), 100SA (10-12"), 100SR (8-12")
SEL31	=	(1) Proximity Switch - SPST - Balluff BES 516-432-E4-L-02. Body styles 100 (14-48"), 100SA or 100SR (14-30")

Ordering Example

CRF,10,100SA,F1,DICR,CR,SB16*BMB

Dimensions

Body Style 100

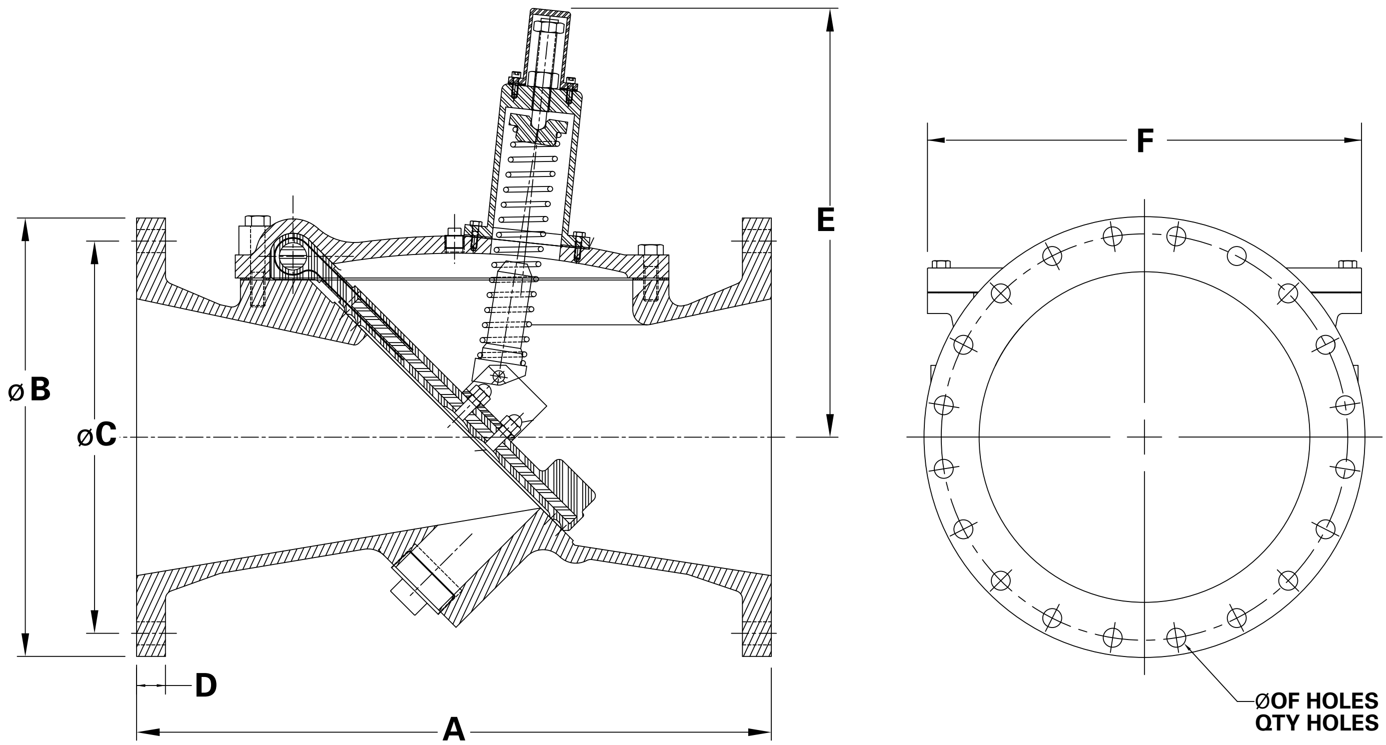


Valve Size	A	B	C	D	No. of Flange Bolts	Bolt Hole Size	E
2" 50mm	8.00 203	6.00 152	4.75 121	0.63 16	4	0.75 19	5.26 134
2.5" 65mm	8.50 216	7.00 178	5.50 140	0.69 18	4	0.75 19	4.88 124
3" 80mm	9.50 241	7.50 191	6.00 152	0.75 19	4	0.75 19	7.00 178
4" 100mm	11.50 292	9.00 229	7.50 191	0.94 24	8	0.75 19	7.38 187
4.3" 100mm	13.75 349	9.00 229	7.50 191	0.94 24	8	0.75 19	10.25 260
5" 125mm	13.75 349	10.00 254	8.50 216	0.94 24	8	0.88 22	10.25 260
6" 150mm	15.00 381	11.00 279	9.50 241	1.00 25	8	0.88 22	10.25 260
8" 200mm	19.50 495	13.50 343	11.75 298	1.13 29	8	0.88 22	15.25 387
10" 250mm	24.50 622	16.00 406	14.25 362	1.19 30	12	1.00 25	19.26 489
12" 300mm	27.50 699	19.00 483	17.00 432	1.25 32	12	1.00 25	19.26 489
14" 350mm	31.00 787	21.00 533	18.75 476	1.38 35	12	1.13 29	23.63 600
16" 400mm	32.00 813	23.50 597	21.25 540	1.44 37	16	1.13 29	24.00 610
18" 450mm	36.00 914	25.00 635	22.75 578	1.56 40	16	1.25 32	27.75 705
20" 500mm	40.00 1016	27.50 699	25.00 635	1.69 43	20	1.25 32	27.75 705
24" 600mm	48.00 1219	32.00 813	29.50 749	1.88 48	20	1.38 35	31.50 800
30" 750mm	70.50 1791	38.75 984	36.00 914	2.13 54	28	1.38 35	49.00 1245
36" 900mm	75.00 1905	46.00 1168	42.75 1086	2.38 60	32	1.63 41	55.00 1397
42-48" 1100-1200mm	Contact Factory						

Inches
Millimeters

Dimensions

Body Style 100SR, Spring Return

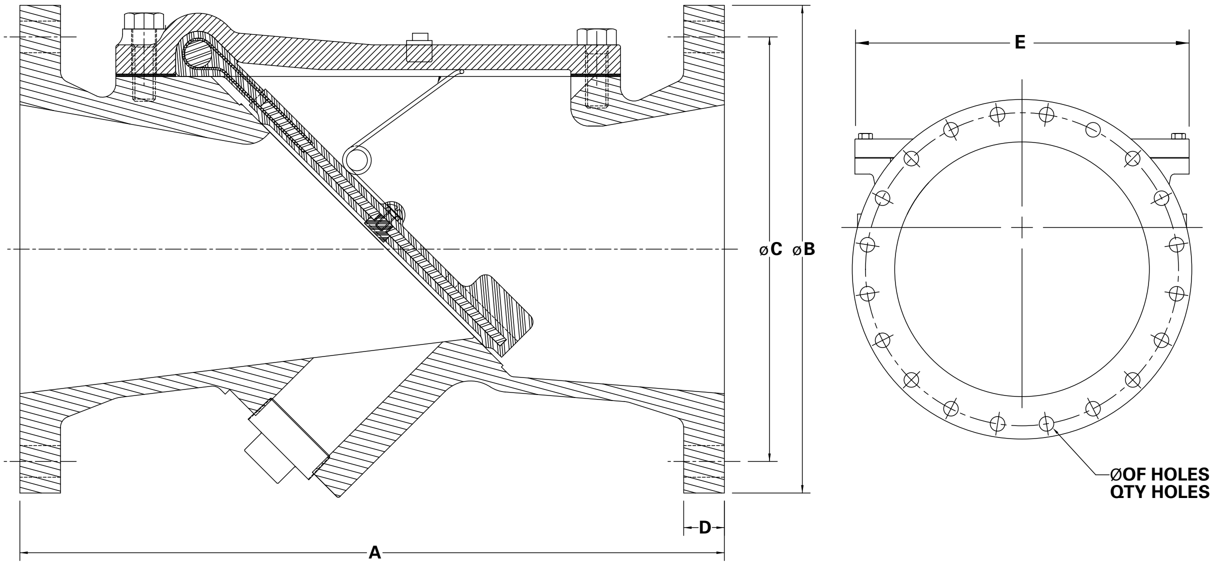


Valve Size	A	B	C	D	E	No. of Flange Bolts	Bolt Hole Size	F
3" 80mm	9.50 241	7.50 191	6.00 152	0.75 19	8.50 216	4	0.75 19	7.00 178
4" 100mm	11.50 292	9.00 229	7.50 191	0.94 24	8.50 216	8	0.75 16	7.38 187
4.3" 100mm	13.75 349	9.00 229	7.50 191	0.94 24	16.00 406	8	0.75 19	10.25 260
5" 125mm	13.75 349	10.00 254	8.50 216	0.94 24	16.00 406	8	0.88 22	10.25 260
6" 150mm	15.00 381	11.00 279	9.50 241	1.00 25	16.00 406	8	0.88 22	10.25 260
8" 200mm	19.50 495	13.50 343	11.75 298	1.13 29	17.00 432	8	0.88 22	15.25 387
10" 250mm	24.50 622	16.00 406	14.25 362	1.19 30	20.75 527	12	1 25	19.26 489
12" 300mm	27.50 699	19.00 483	17.00 432	1.25 32	20.75 527	12	1 25	19.26 489
14" 350mm	31.00 787	21.00 533	18.75 476	1.38 35	24.75 629	12	1.13 29	23.63 600
16" 400mm	32.00 813	23.50 597	21.25 540	1.44 37	24.75 629	16	1.13 29	24.00 610
18" 450mm	36.00 914	25.00 635	22.75 578	1.56 40	26.25 667	16	1.13 29	27.75 705
20" 500mm	40.00 1016	27.50 699	25.00 635	1.69 43	26.25 667	20	1.13 29	27.75 705
24" 600mm	48.00 1219	32.00 813	29.50 749	1.88 48	25.75 654	20	1.38 35	31.50 800

Inches
Millimeters

Dimensions

Body Style 100SA, Spring Assist

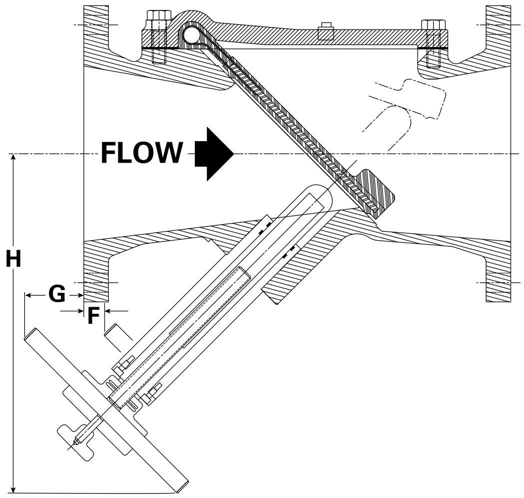


Inches
Millimeters

Valve Size	A	B	C	D	No. of Flange Bolts	Bolt Hole Size	E
4.3" 100mm	13.75 349	9.00 229	7.50 191	0.94 24	8	0.75 19	10.25 260
5" 125mm	13.75 349	10.00 254	8.50 216	0.94 24	8	0.88 22	10.25 260
6" 150mm	15.00 381	11.00 279	9.50 241	1.00 25	8	0.88 22	10.25 260
8" 200mm	19.50 495	13.50 343	11.75 298	1.13 29	8	0.88 22	15.25 387
10" 250mm	24.50 622	16.00 406	14.25 362	1.19 30	12	1.00 25	19.25 489
12" 300mm	27.50 699	19.00 483	17.00 432	1.25 32	12	1.00 25	19.25 489
14" 350mm	31.00 787	21.00 533	18.75 476	1.38 35	12	1.13 29	23.63 600
16" 400mm	32.00 813	23.50 597	21.25 540	1.44 37	16	1.13 29	24.00 610
18" 450mm	36.00 914	25.00 635	22.75 578	1.56 40	16	1.25 32	27.75 705
20" 500mm	40.00 1016	27.50 699	25.00 635	1.69 43	20	1.25 32	27.75 705
24" 600mm	48.00 1219	32.00 813	29.50 749	1.88 48	20	1.38 35	31.50 800

Dimensions

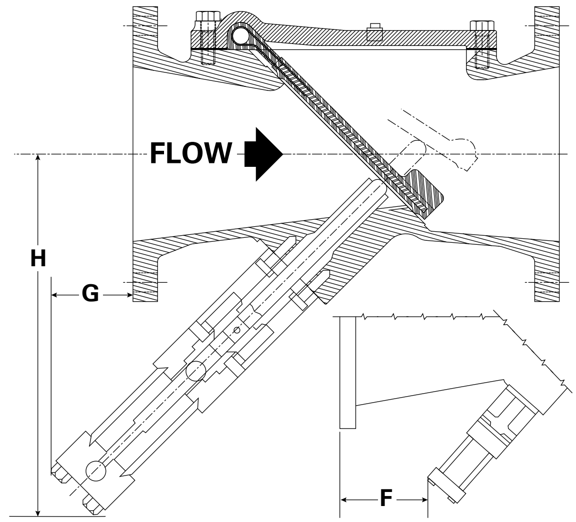
Hold Open Device



Valve Size	F	G	H
3" 80mm	1.00 25	—	8.00 203
4" 100mm	2.75 70	—	8.50 216
4.3" 100mm	—	2.25 57	12.25 311
5" 125mm	—	2.50 64	12.00 305
6" 150mm	—	1.63 41	12.50 318
8" 200mm	—	1.75 44	15.50 394
10" 250mm	—	1.75 44	22.00 559
12" 300mm	—	2.00 51	20.50 521
14" 350mm	0.75 19	—	22.00 559
16" 400mm	1.25 32	—	22.00 559
18" 450mm	—	2.00 51	28.00 711
20" 500mm	—	1.75 44	28.00 711
24" 600mm		1.75 44	30.00 762
30" 750mm	Contact DeZURIK		

Inches
Millimeters

Bottom Mounted Buffer



Valve Size	F	G	H
4.3" 100mm	—	3.25 83	13.25 337
5" 125mm	—	3.00 76	13.25 337
6" 150mm	—	2.75 70	13.25 337
8" 200mm	—	1.25 32	14.00 356
10" 250mm	—	1.25 32	18.00 457
12" 300mm	0.75 19	—	18.00 457
14" 350mm	4.00 102	—	18.00 457
16" 400mm	4.25 108	—	18.00 457
18" 450mm	3.00 76	—	22.50 572
20" 500mm	5.00 127	—	22.50 572
24" 600mm	6.00 152	—	26.00 660

Inches
Millimeters

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:
Web Site: www.dezurik.com E-Mail: info@dezurik.com

DeZURIK
APCO | HILTON

250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

Printed in the U.S.A.

BULLETIN 12.00-1D
FEBRUARY 2015

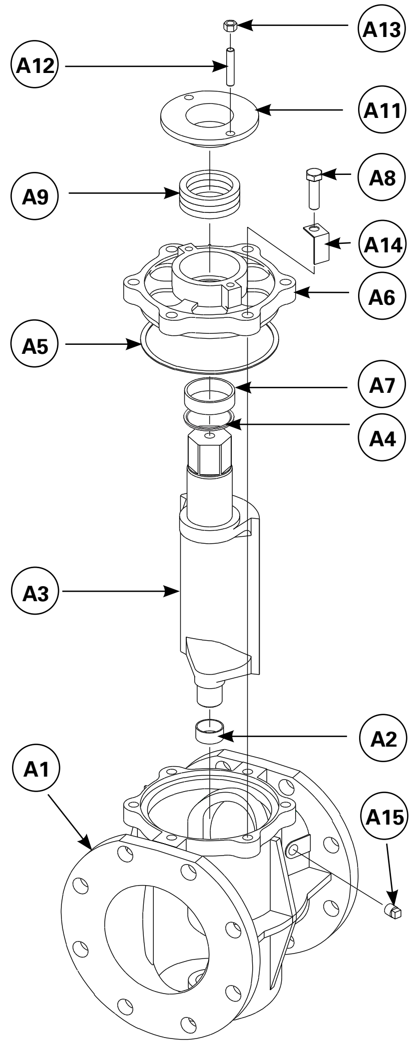
DeZURIK
APCO | HILTON

DeZURIK 4" (100mm) & LARGER PEC ECCENTRIC PLUG VALVES TECHNICAL SPECIFICATIONS

Materials of Construction

Item	Description	Material
A1	Body	Cast Iron, ASTM A126, Class B
		Ductile Iron, ASTM A536, Grade 65-45-12
		Acid Resistant Bronze, ASTM B427 Alloy C90700
		Carbon Steel, ASTM A216, Grade WCB
		316 Stainless Steel, ASTM A743, Grade CF-8M
		Alloy 20
		Hastelloy C
		Monel
		Aluminum, ASTM B26, Alloy 7130, Temper T5
		Cast Iron Hard Rubber Lined (flanged with NRH or NRCR plug facing only)
		Cast Iron Soft Rubber Lined (flanged with CR plug facing only)
A2	Body Bearing	316L Stainless Steel. Sintered Stainless Steel 4"-18" (100-450mm) only
		316 Stainless Steel, ASTM A743, Grade CF-8M 20"-36" (500-900mm) only
		Aluminum Bronze, ASTM B30, Alloy C95400 with 316 Stainless Steel, ASTM A240 Sleeve Bearings press-fit on each plug journal 42" (1100mm) & larger
A3	Plug * Indicates transfer molded process	Metal (same metal as valve body except cast iron which has 316 stainless steel plug)
		CR Chloroprene (RS16* and RS17)
		NBR Acrylonitrile-Butadiene (RS24* and RS25)
		NRH Hard Natural Rubber (RS53) (CIH Body Material only)
		CIIR Chloro-Isobutene Isoprene (RS55* and RS56)
		NRCR Hard Rubber with Chloroprene Overlay (CIH Body Material only)
		CSM Chloro-Sulfonyl Polyethylene (RS46 and RS47*)
		FKM Fluoro Rubber (RS48* and RS58)
		NBRD Acrylonitrile-Butadiene (RS26)
		EPDM Ethylene Propylene Diene Terpolymer
A4	Thrust Bearing	PTFE
A5	Gasket	Non-asbestos filler in Styrene-Butadiene Rubber binder
A6	Bonnet	Same material as body
A7	Bonnet Bearing	316L Stainless Steel, Sintered Stainless Steel 4–18" (100–450mm) only
		316 Stainless Steel, ASTM A743, Grade CF-8M 20–36" (500–900mm) only
		Aluminum Bronze, ASTM B30, Alloy C95400 with 316 Stainless Steel, ASTM A240 Sleeve Bearings press-fit on each plug journal 42" (1100mm) & larger
A8	Bonnet Screws	Carbon Steel, Grade 2, Zinc Plated (CI, ABZ, NR Body Materials)
		Carbon Steel, Grade 5, Zinc Plated (CS Body Material)
		18-8 Stainless Steel (S2, AA, HC, ML Body Materials)
A9	Packing	NBR Acrylonitrile-Butadiene, V-Type
		PTFE
A11	Gland	Cast Iron on all except Stainless Steel
A12	Gland Stud	Zinc Plated on all except Stainless Steel
A13	Nut	Stainless Steel
		Carbon Steel, Zinc Plated
A14	Caution Tag	Stainless Steel
A15	Pipe Plug (optional)	Galvanized Carbon Steel

Flanged Construction
4" (100mm) and Larger



Applicable Standards

DeZURIK PEC Eccentric Plug Valves are designed and/or tested to meet the following standards:

ANSI flange drilling conforms to ANSI B16.1, Class 125 and ANSI B16.5, Class 150.
ANSI/AWWA C517 Eccentric Plug Valves
Mechanical-joint end connections conform to ANSI/AWWA C111/A21.11.
Grooved joint end connections conform to ANSI/AWWA C606.
MSS-SP91 guidelines for manual operation of valves.
Metric 10 bar flange drilling conforms to the NP 10 requirements of International Standard ISO 2084, to the 10 bar requirements of British Standard 4504, and to the NP 10 requirements of German Standard DIN 2532.
Metric 16 bar flange drilling conforms to the NP 16 reguirements of International Standard ISO 2084, to the 16 bar requirements of British Standard 4504, and to the NP 16 requirements of German Standard DIN 2533.
British Table D flange drilling and Table E flange drilling conform to British Standard BS 10.
Japanese 10 bar flange drilling conforms to Japanese Industrial Standard JIS B 0203.

Valve Selection

Cv/Kv Values[1]

Valve Size	Cv* / Kv*
4" 100mm	560 484
5 & 6" 125 & 150mm	1180 1020
8" 200mm	2030 1760
10" 250mm	3130 2710
12" 300mm	4140 3580
14" 350mm	5500 4760
16" 400mm	7300 6320
18" 450mm	9600 8300
20" 500mm	13000 11200
24" 600mm	17500 15100
30" 750mm	28000 24200
36" 900mm	40000 34600
42" 1100mm	58000 50200
48" 1200mm	100000 86500
54" 1400mm	100000 86500
66" 1700mm	150000 130000
72" 1800mm	150000 130000

*Cv = Flow in GPM of water at 1 psi pressure drop.
*Kv = Flow in m³/hr. of water at 100 kPa pressure drop.

Valve Weights

Valve Size	Body Materials lb/kg				
	Cast Iron, Ductile Iron Flanged	Bronze, Acid Bronze Flanged	Aluminum Flanged	Carbon Steel Flanged	Stainless Steel Flanged
4" 100mm	65 30	69 31	24 11	87 39	78 35
5 & 6" 125 & 150mm	110 50	120 54	38 17	141 64	133 60
8" 200mm	171 78	190 86	61 28	225 102	205 93
10" 250mm	250 113	265 120	95 43	350 159	270 122
12" 300mm	390 177	420 191	142 64	505 229	410 186
14" 350mm	555 252	580 263	197 89	720 327	625 284
16" 400mm	720 327	755 342	255 116	890 404	795 361
18" 450mm	1000 454	1025 465	315 143	1255 569	995 451
20" 500mm	1300 590	1360 617	470 213	1690 767	1565 710
24" 600mm	2790 1266	–	–	3015 1368	–
30" 750mm	5250 2381	–	–	–	–
36" 900mm	6550 2971	–	–	–	–
42" 1100mm	11500 5216	–	–	–	–
48" 1200mm	23000 10433	–	–	–	–
54" 1400mm	24000 10886	–	–	–	–
66" 1700mm	39000 17690	–	–	–	–
72" 1800mm	44000 19958	–	–	–	–

Note: Weights for 4-8" (100-200mm) include NT nut.

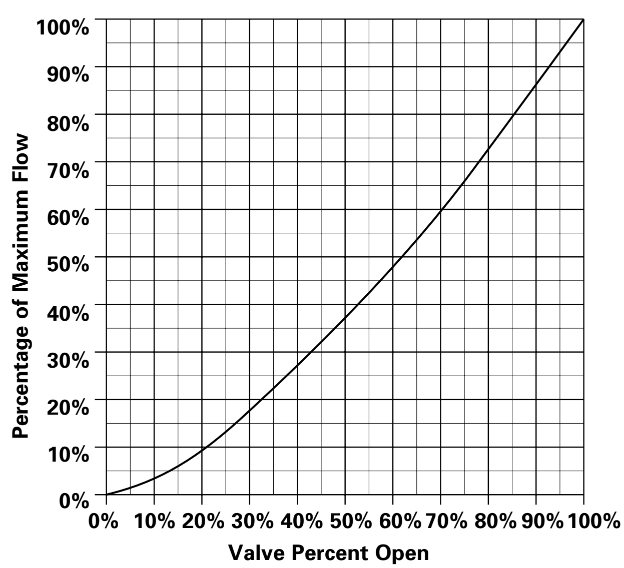
Pressure Ratings

C.W.P. Non-Shock Working Pressure Ratings

Material	Valve Size		
	4–12" (100–300mm)	14–36" (350–900mm)	42–72" (1100–1800mm)
Cast Iron (ASTM A126-Grade B)	175 psi 1210 kPa	150 psi 1035 kPa	150 psi 1035 kPa
Ductile Iron (ASTM A536, Grade 65-45-12)	285 psi 1965 kPa	250 psi 1724 kPa	250 psi 1724 kPa
Acid Resisting Bronze	200 psi 1380 kPa	150 psi 1035 kPa	–
Aluminum	150 psi 1035 kPa	125 psi 860 kPa	–
Carbon Steel**	285 Psi 1965 kPa	285 psi 1965 kPa	–
Stainless Steel** and other Alloys	275 psi 1896 kPa	275 psi 1896 kPa	–
Hard and Soft Rubber Lined Cast Iron* Body	175 psi 1210 kPa	150 psi 1035 kPa	–

* Cast Iron conforms to ANSI B16.1 Class 125 Hydrostatic Test.
** Carbon Steel and 316 Stainless Steel conforms to ANSI B16.5 Class 150.

Flow Characteristic



[1] **NOTE:** Cv/Kv values will be slightly higher for valves with threaded ends and for metal-to-metal seated valves. Sizing data is based on discharge into conduit rather than atmosphere.

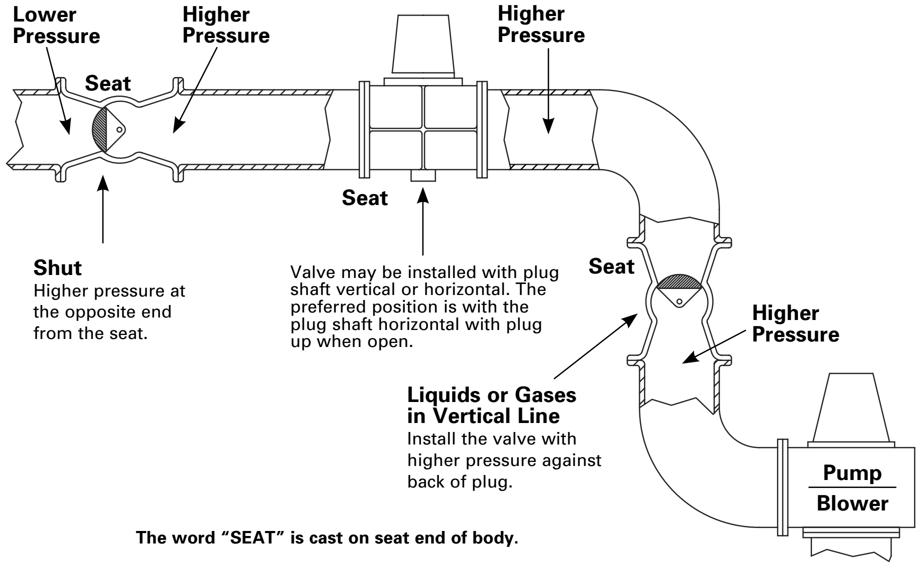
Installation Instructions

The type of materials carried in the pipeline and the location of the valve determine the correct installation procedure:

Liquids without Suspended Solids and Clean Gases

1. Before installation, remove foreign material such as weld spatter, oil, grease, and dirt from the valve and pipeline.
2. Install the valve as shown in Figure 1.
3. Ensure the valve and flanges are concentric to ensure proper flange sealing.
4. Tighten the flange bolts or studs in a criss-cross pattern.

Figure 1



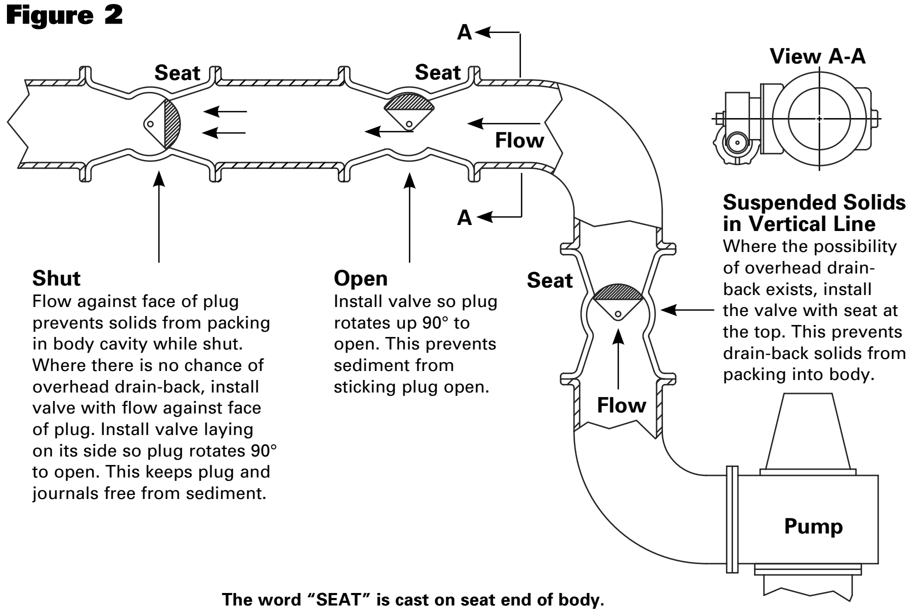
The word "SEAT" is cast on seat end of body.

Suspended Solids and Dirty Gases

If the pipeline carries suspended solids such as paper stock of 2% or higher consistency, mining slurry, or raw sewage:

1. Before installation, remove foreign material such as weld spatter, oil, grease, and dirt from the valve and pipeline.
2. Install the valve as shown in Figure 2.
   A. In horizontal pipelines install valve so plug is horizontal and rotates upward as valve opens.
   B. For vertical pipelines, install valve with the end marked "Seat" at top of valve.
3. Tighten the flange bolts or studs in a criss-cross pattern.
4. Ensure the valve and flanges are concentric to ensure proper flange sealing.

Figure 2

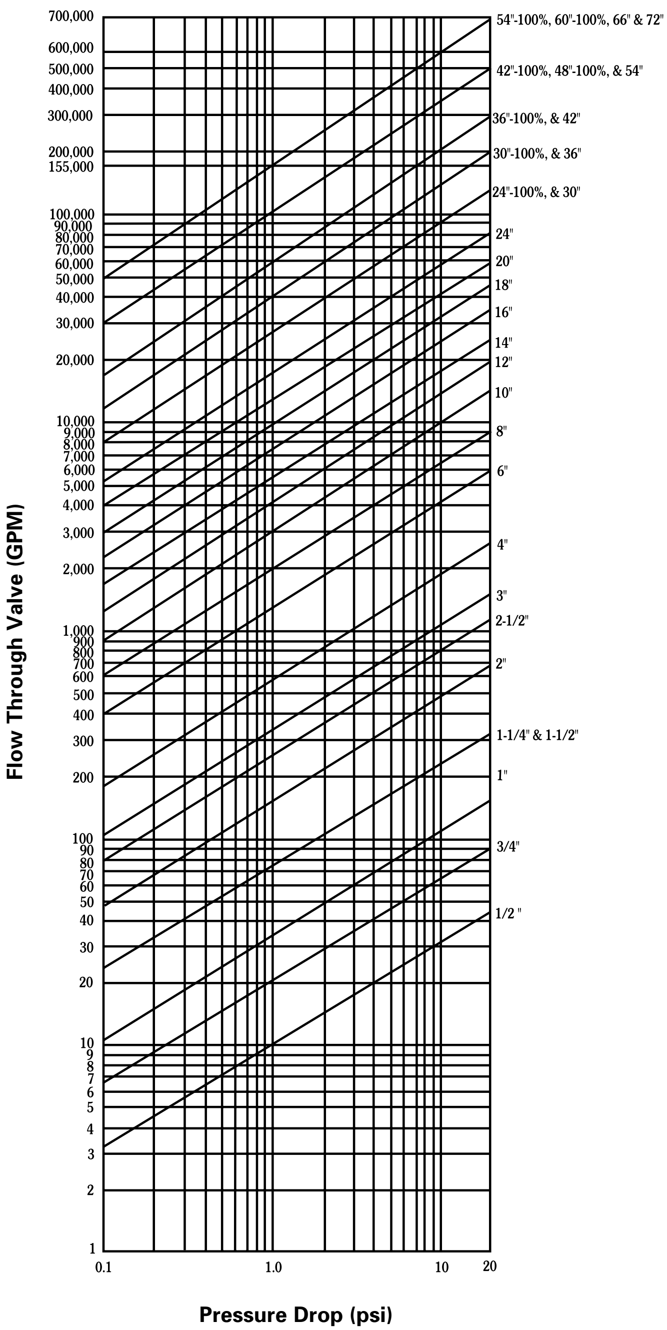


The word "SEAT" is cast on seat end of body.

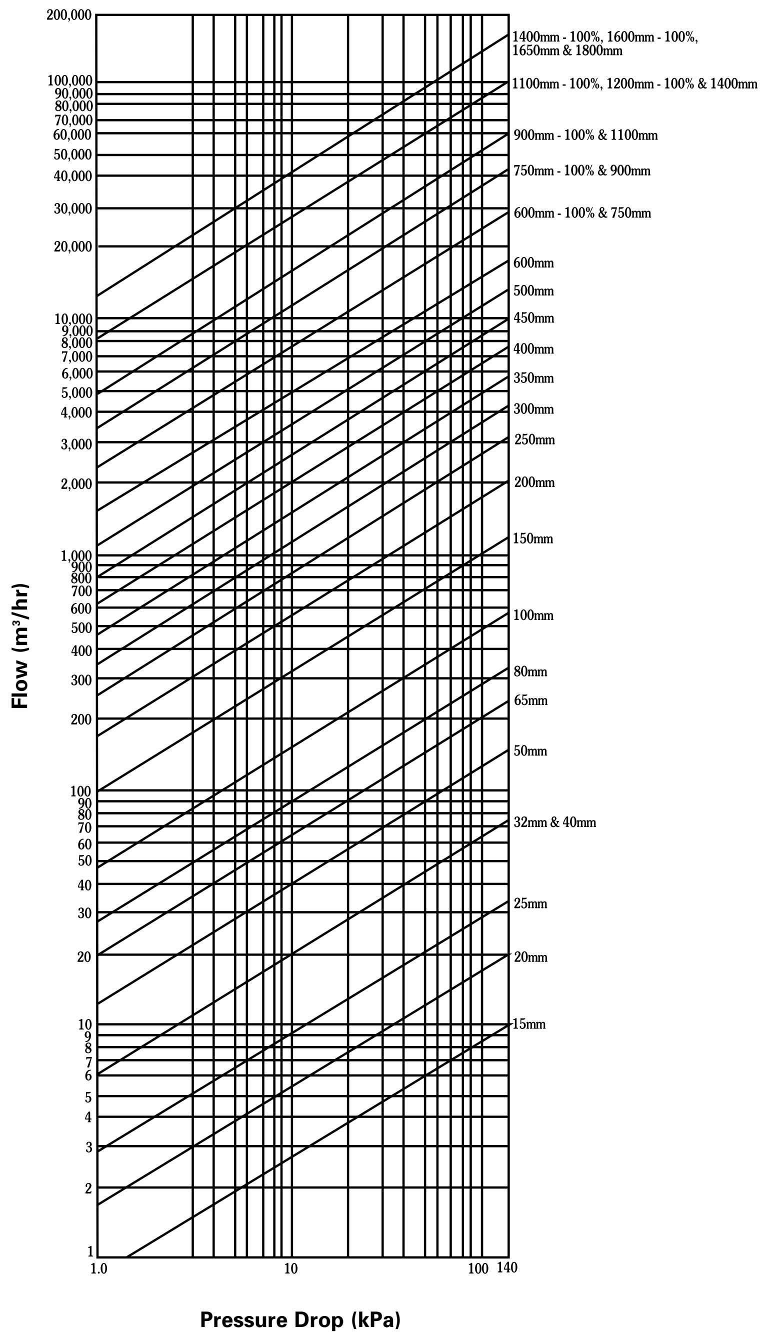
FOR PUMP ISOLATION SERVICE INSTALL THE DISCHARGE VALVE WITH THE SEAT DOWNSTREAM FROM THE PUMP AND WITH THE PLUG ROTATING TO THE TOP OF THE PIPELINE IN THE OPEN POSITION.

Valve Sizing
Flow Charts

Valve Fully Open



Valve Fully Open - Metric



Ordering

To order, simply complete the valve order code from information shown. An ordering example is shown for your reference.

Valve Style
Give valve style code as follows:

PEC = Eccentric Plug

Valve Size
Give valve size code as follows:

4	=	4"	(100mm)	24	=	24"	(600mm)
5	=	5"	(125mm)	30	=	30"	(750mm)
6	=	6"	(150mm)	36	=	36"	(900mm)
8	=	8"	(200mm)	42	=	42"	(1100mm)
10	=	10"	(250mm)	48.5	=	48.5"	(1250mm)
12	=	12"	(300mm)	54	=	54"	(1400mm)
14	=	14"	(350mm)	60.5	=	60.5"	(1550mm)
16	=	16"	(400mm)	66	=	66"	(1675mm)
18	=	18"	(450mm)	72	=	72"	(1800mm)
20	=	20"	(500mm)				

End Connection
Give end connection code as follows:

- T1 = Threaded 4" CI Valves Only
- F1 = Flanged, ANSI Class 125/150
- F110 = Flanged, Class 150 DIN 10 or BS4504/10
- F116 = Flanged, Class 150 DIN 16 or BS4504/16
- F1D = Flanged, Class 150 BS Table D Drilling
- F1E = Flanged, Class 150 BS Table E Drilling
- F1J1 = Flanged, Class 150 JIS 10 Drilling
- MJ = Mechanical Joint
- V7 = Grooved Ends Style 77 4–20" (100–500mm) per AWWA C606, Table 4
- VF = Flexible Grooved Ends Style 31 4" & 6–20" (100mm & 150–500mm) per AWWA C606, Table 2
- VR = Rigid Grooved Ends Style 31 4" & 6–20" (100mm & 150–500mm) per AWWA C606, Table 3

Body Material
Give body material code as follows:

- CI = Cast Iron (Nickel Seat, 4–72" [100–1800mm])
- DI = Ductile Iron (Nickel Seat, 4–72" [100–1800mm])
- CIS = Cast Iron, Soft Rubber Lined (Flanged Only with CR plug facing)
- DIS = Ductile Iron, Soft Rubber Lined (Flanged Only with CR plug facing)
- ABZ = Acid Bronze
- AL = Aluminum
- CS = Carbon Steel (Nickel Seat, 4–36" [100–900mm])
- S2 = 316 Stainless Steel
- AA = Alloy 20
- HC = Hastelloy C
- ML = Monel
- CIH = Cast Iron, Hard Rubber Lined (Flanged Only with NRH or NRCR plug facing)

Packing
Give packing code as follows:

- NBR = Acrylonitrile-Butadiene V-Type -20–250°F (-29–121°C)
- NBRL = Acrylonitrile-Butadiene V-Type low friction 4–8" (100–200mm) NT actuators only -20–250°F (-29–121°C)
- T = Solid PTFE to -20–450°F (-29–232°C)

Plug Facing
Give plug facing code as follows:

- M = Metal (same metal as valve body except cast iron which has a stainless steel plug)
- CR = Chloroprene (RS 16/17) -20 to 180°F (-29 to 83°C)
- NBR = Acrylonitrile-Butadiene (RS24/25) -20 to 180°F (-29 to 83°C)
- NBRD = Acrylonitrile-Butadiene (RS26), 4-6" (100-150mm) only -20 to 180°F (-29 to 83°C)
- NRH = Hard Natural Rubber (RS53) CIH Bodies only -20 to 180°F (-29 to 83°C)
- CIIR = Chloro-Isobutene Isoprene (RS55/56) -20 to 250°F (-29° to 121°C)
- NRCR = Hard Rubber with Chloroprene Overlay, use on CIH Body only -20 to 180°F (-29 to 83°C)
- CSM = Chloro-Sulfonyl Polyethylene (RS46/47) -20 to 200°F (-29 to 94°C)
- FKM = Fluoro Rubber (RS48/58) -20 to 450°F (-29 to 232°C)
- EPDM = Terpolymer of Ethylene Propylene & A Diene (R113) -20 to 250°F (-29 to 121°C)

Options
Give options codes as follows:

- ARRA = Conforms to: American Recovery and Reinvestment Act of 2009, Buy American, Section 1605, Use of American Iron, Steel and Manufactured Goods.
- BV1 = Upstream and downstream 1/8" NPT taps with air valve fittings and sealing caps.
- BV2 = Upstream and downstream 1/8" NPT taps with petcocks and quick disconnect couplings.
- DST = Dry seat test
- PD = 1/4" Pipe tap downstream
- PU = 1/4" Pipe tap upstream
- PDU = 1/4" Pipe tap upstream and downstream
- GE = Grit excluders
- GR = Grease fittings in body and bonnet.
- DI = Ductile Iron Plug (Resilient plugs only)
- S2 = Stainless Steel Plug (Resilient Plugs Only)

Ordering Example:

PEC,4,F1,CI,NBR,CR,PD*GS-6-PC4

Note:

The limiting factor in valve selection is the lowest temperature limit of the packing or seat.

Manual Actuators

Pressure Ratings

Direct shutoff pressure differentials for nut or lever actuated valves must not exceed the limits shown below. Reverse shutoff differentials must not exceed 25 psi (170 kPa). If valves must seal higher reverse pressure, use handwheel actuators. Handwheel or powered actuators are recommended on 6" (150mm) and larger valves as well as on applications where pipeline velocities are high and where sudden valve closure may cause water hammer.

Maximum Shutoff Pressure Differentials

Valve Size	Nitrile-Butadiene (Buna V) NBR Packing	Low Friction Nitrile-Butadiene (Buna V) NBRL Packing
4" 100mm	125 psi 860 kPa	40 psi 275 kPa
6–8" 150–200mm	100 psi 690 kPa	25 psi 170 kPa

Nut (NT)

Furnished as standard on 4-8" (100-200mm) valves. Must be ordered to use VB, ENLV, EF, LV, CH, LVF, and WRT. To order, add code NT to basic valve code.

Ordering Example:
PEC,4,F1,CI,NBR,CR*NT

Adjustable Memory Stop

All 4–8" (100-200mm) lever actuated valves are furnished with an adjustable, open position memory stop as standard. Adjustment of the stop to the desired open position allows the valve to be closed and reopened to the same throttling position.

Lever (LV)

For use with NT actuators on 4-8" (100-200mm) valves. Lever must be ordered separately.

Order Code	Size
ACC*LV-4	4" (100mm)
ACC*LV-6	6" (150mm)
ACC*LV-8	8" (200mm)

Ordering Example:
ACC*LV-4

Folding Lever (LVF)

For use with NT nut. Folding levers must be ordered separately.

Order Code	Size
ACC*LVF-4	4" (100mm)
ACC*LVF-6	6" (150mm)
ACC*LVF-8	8" (200mm)

Ordering Example:
ACC*LVF-6

Chain Handle (CH)

For use on 4-8" (100-200mm) valves with NT Nut. Chain Handle must be ordered separately by giving code ACC*CH followed by a dash and valve size.

Order Code	Size
ACC*CH-4	4" (100mm)
ACC*CH-6	6" (150mm)
ACC*CH-8	8" (200mm)

Ordering Example:
ACC*CH-4

Chain for Chain Handle (CN)

Order as a separate item by giving code per chart. Specify number of feet required and number of pieces.

Order Code	Description	Size
ACC*CN102	Standard 3/16	4" (100mm)
ACC*CN103	Galvanized 3/16	6" (150mm)
ACC*CN104	304 Stainless Steel	8" (200mm)

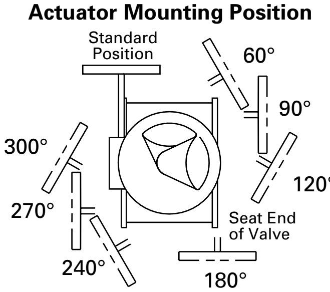
Ordering Example:
ACC*CN102
Chain 1 piece 10 feet long.

Manual Actuators

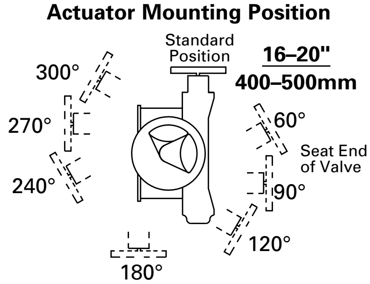
The G-Series manual actuator construction is totally enclosed and sealed, protecting moving parts from damage or corrosion. Continual lubrication is not required for operational ease. Heavy duty, corrosion-resistant actuator bearings provide lasting, easy valve operation and overall reliability. Rugged actuator castings, gears and shafts also add to reliability by assuring permanent alignment of moving parts for smooth operation.

Actuators for 4" - 20" (100 - 500mm) valves can be mounted at 30º increments clockwise from standard.

4" - 20" HD or CW or N Actuator Mounting Position

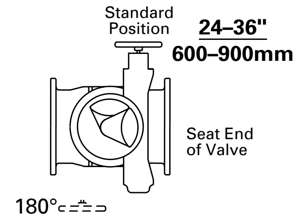


GS-16 HD or CW or N Actuator Mounting Position



Actuators for 24" - 36" (600 - 900mm) valves can be mounted 180º clockwise from standard. Specify mounting position other than standard after the actuator.

24" - 36" GS-16 HD or CW Actuator Mounting Position

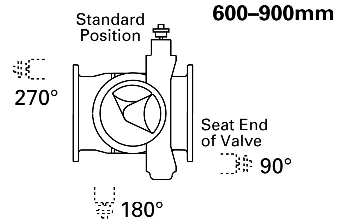


Ordering Example:
GS-12-HD12-180

To order, add the appropriate actuator code from the sizing tables to the valve order code. For buried service valves, substitute "GS" with "GB".

2" (50mm) Nut on GB & GS Actuators

The nut replaces the handwheel normaly supplied on GB & GS actuators. A 2" (50mm) nut is required for use with valve box (VB) or floor box (FB). To order replace the handwheel code with "N."



Ordering Example:
PEC,6,F1, CI,NBR,CR*GB-6-N-180

Direct Pressure, Resilient Plug, Metal Seat

Valve Size	Handwheel Order Code	Chainwheel Order Code	Max. Shutoff Pressure Differential psi/kPa
4" 100mm	GS-6-HD8	GS-6-CW8	285 / 1960
5 & 6" 125 & 150mm	GS-6-HD8	GS-6-CW8	175 / 1210
	GS-6-HD12	GS-6-CW12	285 / 1960
8" 200mm	GS-6-HD8	GS-6-CW8	100 / 690
	GS-6-HD12	GS-6-CW12	285 / 1960
10" 250mm	GS-6-HD8	GS-6-CW8	50 / 340
	GS-6-HD12	GS-6-CW12	125 / 860
	GS-12-HD12	GS-12-CW12	175 / 1210
	GS-12-HD16	GS-12-CW20	285 / 1960
12" 300mm	GS-6-HD8	GS-6-CW8	25 / 170
	GS-6-HD12	GS-6-CW12	75 / 520
	GS-12-HD12	GS-12-CW12	100 / 690
	GS-12-HD16	GS-12-CW20	150 / 1035
	GS-12-HD20*	GS-12-CW20*	200 / 1380
14" 350mm	GS-12-HD12	GS-12-CW12	50 / 340
	GS-12-HD16	GS-12-CW20	75 / 515
	GS-12-HD20**	GS-12-CW20**	125 / 860
	GS-12-HD24*	GS-12-CW30*	150 / 1035
16" 400mm	GS-12-HD12	GS-12-CW12	50 / 340
	GS-12-HD16	GS-12-CW20	100 / 690
	GS-12-HD20	GS-12-CW20	150 / 1030
	GS-12-HD24*	GS-12-CW30*	175 / 1210
	GS-16-HD16	GS-16-CW20	285 / 1960
18" 450mm	GS-12-HD12	GS-12-CW12	50 / 340
	GS-12-HD16	GS-12-CW16	75 / 520

Valve Size	Handwheel Order Code	Chainwheel Order Code	Max. Shutoff Pressure Differential psi/kPa
18" 450mm	GS-12-HD20	GS-12-CW20	100 / 690
	GS-12-HD24*	GS-12-CW30*	125 / 860
	GS-16-HD16	GS-16-CW20	200 / 1380
	GS-16-HD20	GS-16-CW20	225 / 1550
	GS-16-HD24	GS-16-CW30*	285 / 1960
20" 500mm	GS-12-HD12	GS-12-CW12	25 / 170
	GS-12-HD16	GS-12-CW20	50 / 340
	GS-12-HD20	GS-12-CW20	75 / 520
	GS-12-HD24*	GS-12-CW30*	100 / 690
	GS-16-HD16	GS-16-CW20	150 / 1030
	GS-16-HD20	GS-16-CW20	200 / 1380
	GS-16-HD24	GS-16-CW30*	225 / 1550
	GS-16-HD30*	GS-16-CW30*	250 / 1720
24" 600mm	GS-16-HD12	GS-16-CW12	75 / 520
	GS-16-HD16	GS-16-CW20*	100 / 690
	GS-16-HD20*	GS-16-CW20*	150 / 1030
	GS-16-HD24*	GS-16-CW30*	175 / 1210
	GS-16-HD30*	GS-16-CW30*	200 / 380
30" 750mm	GS-16-HD12	GS-16-CW12	50 / 340
	GS-16-HD16	GS-16-CW20*	75 / 520
	GS-16-HD20*	GS-16-CW20*	125 / 860
36" 900mm	GS-16-HD24*	GS-16-CW30*	25 / 170
	GS-16-HD30*	GS-16-CW30*	50 / 340

* Mounting positions 90, 120, 270 and 300° not available.
** Mounting positions 120 and 300° not available.

Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-HD8

Reverse Pressure, All Plugs, Metal Seat

Valve Size	Handwheel Order Code	Chainwheel Order Code	Max. Shutoff Pressure Differential psi/kPa
4" / 100mm	GS-6-HD8	GS-6-CW8	285 / 1960
5 & 6" / 125 & 150mm	GS-6-HD8	GS-6-CW8	150 / 1035
	GS-6-HD12	GS-6-CW12	285 / 1960
8" / 200mm	GS-6-HD8	GS-6-CW8	50 / 340
	GS-6-HD12	GS-6-CW12	150 / 1035
	GS-12-HD12	GS-12-CW12	285 / 1960
10" / 250mm	GS-6-HD12	GS-6-CW12	50 / 340
	GS-12-HD12	GS-12-CW12	125 / 860
	GS-12-HD16	GS-12-CW20	175 / 1210
	GS-12-HD20	GS-12-CW20	225 / 1550
	GS-12-HD24*	GS-12-CW30*	285 / 1960
12" / 300mm	GS-12-HD12	GS-12-CW12	50 / 340
	GS-12-HD16	GS-12-CW20	100 / 690
	GS-12-HD20*	GS-12-CW20*	150 / 1035
	GS-12-HD24*	GS-12-CW30*	175 / 1210
	GS-16-HD16	GS-16-CW20	285 / 1960
14" / 350mm	GS-12-HD12	GS-12-CW12	25 / 170
	GS-12-HD16	GS-12-CW20	50 / 340
	GS-12-HD20**	GS-12-CW20**	75 / 520
	GS-12-HD24*	GS-12-CW30*	100 / 690
	GS-16-HD16	GS-16-CW20	200 / 1380
	GS-16-HD20	GS-16-CW20	285 / 1960
16" / 400mm	GS-12-HD16	GS-12-CW20	25 / 170
	GS-12-HD24*	GS-12-CW30*	50 / 340
	GS-16-HD16	GS-16-CW20	150 / 1035
	GS-16-HD20	GS-16-CW20	200 / 1380
	GS-16-HD24	GS-16-CW30*	225 / 1550
	GS-16-HD30*	GS-16-CW30*	285 / 1960
18" / 450mm	GS-12-HD24*	GS-12-CW30*	25 / 170
	GS-16-HD16	GS-16-CW20	75 / 515
	GS-16-HD20	GS-16-CW20	100 / 690
	GS-16-HD24	GS-16-CW30*	150 / 1035
	GS-16-HD30*	GS-16-CW30*	200 / 1380
20" / 500mm	GS-16-HD16	GS-16-CW20	50 / 340
	GS-16-HD20	GS-16-CW20	75 / 515
20" / 500mm	GS-16-HD24	GS-16-CW30*	100 / 690
	GS-16-HD30*	GS-16-CW30*	125 / 860
24" / 600mm	GS-16-HD16	GS-16-CW20*	25 / 170
	GS-16-HD20*	GS-16-CW20*	50 / 340
	GS-16-HD30*	GS-16-CW30*	100 / 690
30" / 750mm	GS-16-HD24*	GS-16-CW30*	25 / 170

* Mounting positions 90, 120, 270 and 300° not available.
** Mounting positions 120 and 300° not available.

Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-CW12

Reverse Pressure, Resilient Plug and Resilient Seal

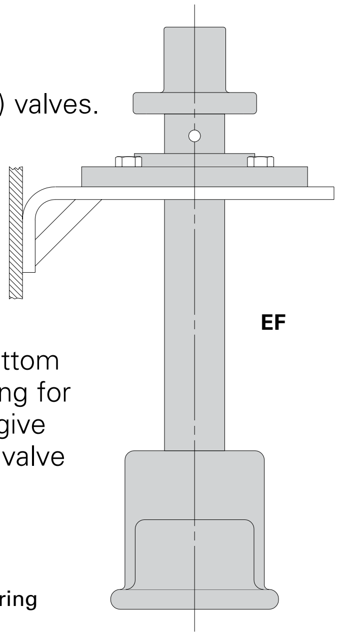
Valve Size	Handwheel Order Code	Chainwheel Order Code	Max. Shutoff Pressure Differential psi/kPa
4" / 100mm	GS-6-HD8	GS-6-CW8	285 / 1960
5 & 6" / 125 & 150mm	GS-6-HD8	GS-6-CW8	150 / 1035
	GS-6-HD12	GS-6-CW12	285 / 1720
	GS-12-HD12	GS-12-CW12	285 / 1960
8" / 200mm	GS-6-HD12	GS-6-CW12	125 / 860
	GS-12-HD12	GS-12-CW12	225 / 1550
	GS-12-HD20*	GS-12-CW20*	285 / 1960
10" / 250mm	GS-12-HD12	GS-12-CW12	100 / 690
	GS-16-HD12	GS-16-CW12	285 / 1960
12" / 300mm	GS-12-HD12	GS-12-CW12	75 / 520
	GS-16-HD12	GS-16-CW12	200 / 1380
14" / 350mm	GS-16-HD12	GS-16-CW12	100 / 690

Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-HD8

Accessories-Manual Actuators

EF Extension for Nut Actuated Valves

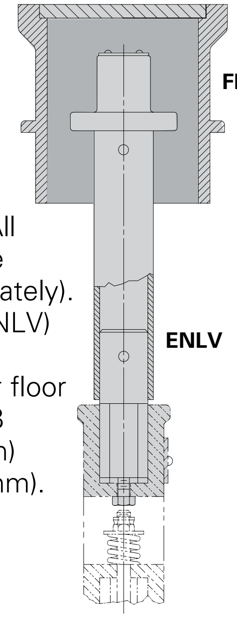
For use on 4–8" (100–200mm) valves. Includes extension pipe, bearing plate and couplings. Valves for use with EF extensions must be ordered with NT actuators. Order Extension Assembly as a separate item. Specify length from centerline of valve to bottom of bearing plate. When ordering for use with FS101 Floor Stand, give dimension from centerline of valve to base of floor stand.



Ordering Example:
ACC*EF-4
Centerline of valve to bottom of bearing plate 110" (2795mm).

FB Floor Box for Nut Actuated Valves

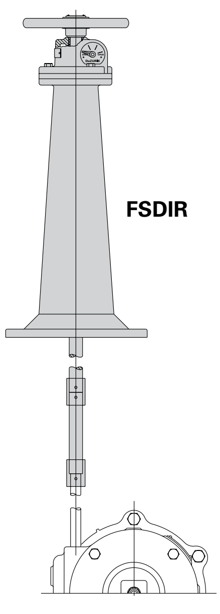
Includes floor box and cover only. Can be used with valves having operating nut mounted on the valve or extended with top of nut 2" (50mm) from top of floor box. All valves for use with floor boxes are Tee Wrench actuated (order separately). Order extended operating nuts (ENLV) separately. Floor box requires NT actuators (order seperately). Order floor boxes separately. Specify ACC*FB and depth of floor box in 1" (25mm) increments from 6–18" (150–455mm). Standard depth is 6" (150mm).

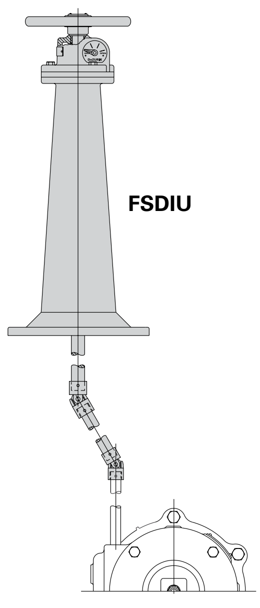


Ordering Example:
ACC*FB6

FSDIR or FSDIU Floor Stand for Gear Actuated Valves

For use on 4–36" (100–900mm) handwheel actuated valves. Includes floor stand, couplings, extension rod, and handwheel mounted on floor stand, with dial position indicator. Order floor stand by adding FSDIR or FSDIU to the valve actuator code.





Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-HD12,FSDIR
Centerline of valve to base of floor stand 96" (2400mm).

ENLV Extended Nut for Nut Actuated Valves

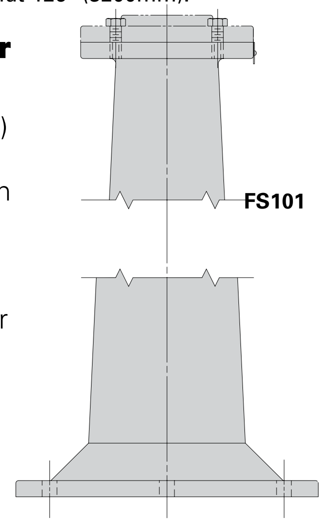
For use on 4–8" (100–200mm) nut actuated valves. Includes operating nut, couplings and pipe. Valves for use with ENLV Extended Nut must be ordered with NT actuators. All valves for use with ENLV are Tee Wrench activated (order seperately). Order as a separate item by giving ACC*ENLV followed by a dash and valve size. Give required length from centerline of valve to top of nut. Note dimensions in table.

Valve Size	Minimum Dimension C/L of Valve to Top of Nut
4" 100mm	16.50" 420mm
5–6" 125–150mm	20.75" 525mm
8" 2000mm	22.38" 570mm

Ordering Example:
ACC*ENLV-8
Centerline of valve to top of valve nut 126" (3200mm).

FS101 Floor Stand for Nut Actuated Valves

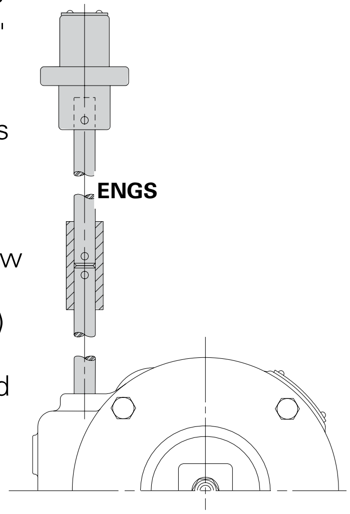
For use on 4–8" (100–200mm) nut actuated valves. Includes floor stand only. For extension pipe and fittings, order EF Extension Assembly. Lever actuated valves for use with EF Extension and FS101 Floor Stand must be ordered NT actuators. Order floor stands as a separate item.



Ordering Example:
ACC*FS101

ENGS Extended 2" (50mm) Nut for Gear Actuated Valves

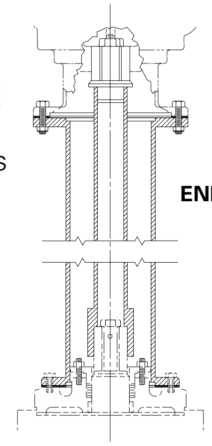
The ENGS is for use on 4–36" (200–900mm) Eccentric Plug Valves with G-Series Handwheel Actuator. Includes couplings, extension rod and 2" (50mm) square nut. If used with valve box, top of nut must be 6" (150mm) below grade. If used with floor box, top of nut must be 2" (50mm) below floor surface. Handwheels are not furnished on actuators ordered with ENGS. Order by adding ENGS to the valve actuator code. Specify required length from centerline of valve to top of nut as second line information.



Ordering Example:
PEC,6,F1,CI,NBR,CR*GB-6-N,ENGS
Centerline of valve to top of nut 72" (1830mm).

ENK Neck Extension for G-Series Actuators

Valves for buried or submerged service can be furnished with handwheel or cylinder actuators extended above the ground. Furnish service information for recommendations.



2" (50mm) Nut on GB & GS Actuators

The nut replaces the handwheel normally supplied on GB & GS actuators. A 2" (50mm) nut is required for use with valve box (VB) or floor box (FB). To order replace the handwheel code with "N".

Ordering Example:
PEC,6,F1,CI,NBR,CR*GB-6-N

WRT Tee Wrench

For use on 4–8" (100–200mm) nut or gear actuated valves with 2" (50mm) nut. Valves for Tee Wrench operation must be ordered with NT actuator. To order Tee Wrenches, list order code per table below.

Wrench Length	Valve Size		
	10–36" 250–900mm	4–8"* 100–200mm	4–8"** 100–200mm
4′ 120cm	ACC*WRT530	ACC*WRT540	ACC*WRT545
5′ 150cm	ACC*WRT531	ACC*WRT541	ACC*WRT546
6′ 185cm	ACC*WRT532	ACC*WRT542	ACC*WRT547
7′ 215cm	ACC*WRT533	ACC*WRT543	ACC*WRT548
8′ 245cm	ACC*WRT534	ACC*WRT544	ACC*WRT549

Note: 4" (100mm) is standard.

* For G-Series actuators, order with 2" (50mm) Square Nut or Extended Nut (ENGS).
** For lever actuators, order standard with 2" (50mm) Square Nut (NT) or Extended Nut (ENLV).

Stainless Steel Bolting

Specify bolting requirement by giving code SB18 for 18-8 Stainless Steel or SB16 for 316 Stainless Steel after the actuator code.

Ordering Example:
PEC,6,F1,CI,NBR,CR*GB-6-N,SB16

Accessories – Manual Actuators

VB Valve Box for Nut Actuated Valves

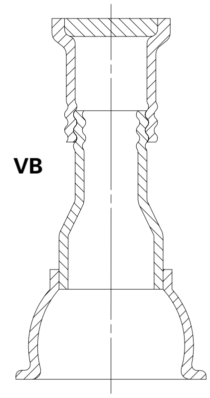
Valve boxes for use on 4–8" (100–200mm) valves require a nut (NT) or extended nut (ENLV) type actuator. Valve boxes for use on 4–36" (100–900mm) valves with a gear actuator (GB) require a 2" (50mm) Nut (N) or extended 2" (50mm) Nut (ENGS) actuator. Extended nut must be 6" (150mm) from the top of the valve box. Order nut actuator and Tee Wrenches separately. Horizontal plug valve installations require the plug to rotate to the top as the valve opens. Specify standard actuator mounting. Valve boxes must be ordered separately. To order valve boxes, list order code and specify valve centerline to top of valve box (grade). If an extension is required, add a dash and extension order code. Contact Application Engineering for 36-54" (750-1400mm) valves when valve boxes are required.

4-8" (100-200mm) Valve Boxes with NT

Valve Sizes			
4" 100mm	5 & 6" 125 & 150mm	8" 200mm	Valve Box Order Code
Valve Center Line To Top of Box (Grade)			
31–35" 785–890mm	32–36" 815–915mm	34–38" 865–965mm	ACC*VB635
38–47" 965–1195mm	39–48" 990–1220mm	41–50" 1040–1270mm	ACC*VB636
41–53" 1040–1345mm	42–54" 1065–1370mm	44–56" 1120–1420mm	ACC*VB637
50–59" 1270–1500mm	51–60" 1295–1525mm	53–62" 1345–1575mm	ACC*VB638
56–65" 1420–1650mm	57–66" 1450–1675mm	59–68" 1500–1725mm	ACC*VB639
50–71" 1270–1805mm	51–72" 1295–1830mm	53–74" 1345–1880mm	ACC*VB640
68–77" 1725–1955mm	69–78" 1750–1980mm	71–80" 1805–2032mm	ACC*VB641
68–89" 1725–2260mm	69–90" 1750–2285mm	71–92" 1805–2335mm	ACC*VB642
80–101" 2030–2565mm	81–102" 2055–2590mm	83–104" 2110–2640mm	ACC*VB643

4–36" (100–900mm) Valve Box Extensions

Extension Length (Grade)	Quantity	Extension Order Code
14" (350mm)	1	14A
	2	14B
	3	14C
	4	14D
	5	14E
18" (450mm)	1	18A
	2	18B
	3	18C
	4	18D
	5	18E



VB

4–36" (100–900mm) Valve Boxes - GB Actuator

Valve and Actuator Size					
4–8" (100–200mm) G6	10 & 12" (250 & 300mm) G12	14 & 20" (350 & 500mm) G12	24 & 36" (600 & 900mm) G12	12 & 36" (300 & 900mm) G16	Valve Box Order Code
Valve Center Line To Top of Box (Grade)					
35–39" 890–990mm	35–39" 890–990mm	38.5-42.5" 980–1080mm	34.5-38.5" 875–980mm	49.63–53.63" 1260–1360mm	ACC*VB635
42–51" 1065–1295mm	42–51" 1065–1295mm	45.5–54.5" 1155–1385mm	41.5–50.5" 1055–1280mm	56.63–65.63" 1440–1665mm	ACC*VB636
45–57" 1145–1450mm	45–57" 1145–1450mm	48.5–60.5" 1230–1535mm	44.5–56.5" 1130–1435mm	59.63–71.63" 1515–1820mm	ACC*VB637
54–63" 1370–1600mm	54–63" 1370–1600mm	57.5–66.5" 1460–1690mm	53.5–62.5" 1360–1590mm	68.63–77.63" 1745–1970mm	ACC*VB638
60–69" 1525–1750mm	60–69" 1525–1750mm	63.5–72.5" 1615–1840mm	59.5–68.5" 1510–1740mm	74.63–83.63" 1895–2125mm	ACC*VB639
54–75" 1370–1905mm	54–75" 1370–1905mm	57.5–78.5" 1460–1995mm	53.5–74.5" 1360–1890mm	68.63–89.63" 1745–2275mm	ACC*VB640
60–81" 1525–2055mm	60–81" 1525–2055mm	63.5–84.5" 1615–2145mm	59.5–80.5" 1510–2045mm	74.63–95.63" 1895–2430mm	ACC*VB644
72–81" 1830–2055mm	72–81" 1830–2055mm	75.5–84.5" 1915–2145mm	71.5–80.5" 1815–2045mm	86.63–95.63" 2200–2430mm	ACC*VB641
72–93" 1893–2360mm	72–93" 1893–2360mm	75.5–96.5" 1915–2450mm	71.5–92.5" 1815–2350mm	86.63–107.63" 2200–2735mm	ACC*VB642
84–105" 2135–2665mm	84–105" 2135–2665mm	87.5–108.5" 2220–2755mm	83.5–104.5" 2120–2655mm	98.63–119.63" 2505–3040mm	ACC*VB643

Ordering Example (without extension):
ACC*VB637
Valve centerline to top of box - 66" (1675mm).
Ordering Example (with extension):
ACC*VB637-14A
Valve centerline to top of box - 80" (2030mm).

Cylinder Actuators

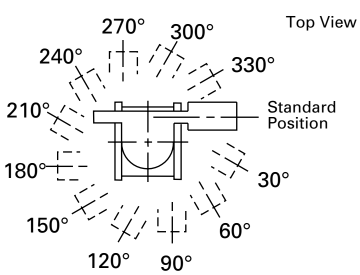
G-Series cylinder actuators feature a rack and pinion design for larger size rotary valves where constant torque capability throughout the stroke is required. It is engineered for high flow, high cycle applications. The G-Series line of actuators provides long service life and features a rugged, heavy cast gear sector. The cast iron actuator housing is sealed to prevent the entry of dirt, moisture and corrosive contaminants.
The G-Series actuator also features adjustable position stops, rugged cylinder construction and corrosion-resistant bearings.

Double-Acting

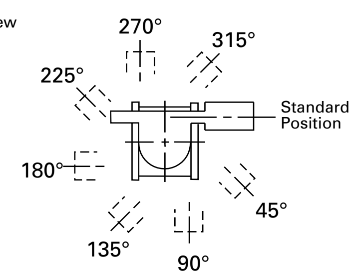
To order double-acting cylinder actuators for PEC Eccentric Plug Valves, add the order code from the proper table to the valve order code. Actuators for 4–20" (100–500mm) valves can be mounted at 30 degree increments clockwise from standard; actuators for 24–36" (600–900mm) valves can be mounted at 45 degree increments clockwise from standard. Specify mounting positions other than standard by adding the order code after the actuator. When using hydraulic supply media, specify type. Please note, valves for gas service must be furnished with gear or cylinder actuator.

Ordering Example:
GS-12-PC10-90
GS-16-PC12-225

4" - 20" (100 - 500mm) Actuator Mounting Position



24" - 36" (600 - 900mm) Actuator Mounting Position



Direct Pressure, Resilient Plug, Metal Seat 50 psi (340 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 50 psi 340 kPa
4" 100mm	GS-6-PC4	285 1960
5 & 6" 125 & 150mm	GS-6-PC4	25 170
	GS-6-PC6	175 1210
	GS-6-PC8	285 1960
8" 200mm	GS-6-PC6	75 520
	GS-6-PC8	100 690
	GS-12-PC6	200 1380
	GS-12-PC8	285 1960
10" 250mm	GS-6-PC6	25 170
	GS-6-PC8	50 340
	GS-12-PC6	75 520
	GS-12-PC8	200 1380
	GS-12-PC10	285 1960
12" 300mm	GS-6-PC8	25 170
	GS-12-PC8	100 690
	GS-12-PC10	225 1550
	GS-16-PC10	285 1960
14" 350mm	GS-12-PC6	25 170
	GS-12-PC8	50 340
	GS-12-PC10	125 860
	GS-16-PC10	150 1035
	GS-16-PC12	285 1960
16" 400mm	GS-12-PC8	50 340
	GS-12-PC10	75 520
	GS-16-PC10	100 690
	GS-16-PC12	175 1210
18" 450mm	GS-12-PC8	25 170
	GS-12-PC10	50 340
	GS-16-PC10	50 520
	GS-16-PC12	125 860
20" 500mm	GS-12-PC8	25 170
	GS-12-PC10	50 340
	GS-16-PC12	100 690
24" 600mm	GS-16-PC10	50 340
	GS-16-PC12	75 520
30" 750mm	GS-16-PC10	25 170
	GS-16-PC12	50 340

Cylinder Actuators
Double-Acting

Direct Pressure, Resilient Plug, Metal Seat 80 psi (550 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 80 psi / 550 kPa
4" / 100mm	GS-6-PC4	285 / 1960
5 & 6" / 125 & 150mm	GS-6-PC4	125 / 860
	GS-6-PC6	285 / 1960
8" / 200mm	GS-6-PC4	25 / 170
	GS-6-PC6	100 / 690
	GS-12-PC6	285 / 1960
10" / 250mm	GS-6-PC6	50 / 340
	GS-12-PC6	175 / 1210
	GS-12-PC8	285 / 1960
12" / 300mm	GS-6-PC6	25 / 170
	GS-12-PC6	100 / 690
	GS-12-PC8	285 / 1960
14" / 350mm	GS-12-PC6	50 / 340
	GS-12-PC8	125 / 860
	GS-16-PC8	175 / 1210
	GS-16-PC10	285 / 1960
16" / 400mm	GS-12-PC6	25 / 170
	GS-12-PC8	75 / 520
	GS-16-PC8	125 / 860
	GS-16-PC10	175 / 1210
	GS-16-PC12	285 / 1960
18" / 450mm	GS-12-PC6	25 / 170
	GS-12-PC8	50 / 340
	GS-16-PC8	75 / 520
	GS-16-PC10	125 / 860
	GS-16-PC12	200 / 1380
20" / 500mm	GS-12-PC8	50 / 340
	GS-16-PC8	75 / 520
	GS-16-PC10	100 / 690
	GS-16-PC12	150 / 1030
24" / 600mm	GS-16-PC8	50 / 340
	GS-16-PC10	75 / 520
	GS-16-PC12	100 / 690
30" / 750mm	GS-16-PC8	25 / 170
	GS-16-PC10	50 / 340
	GS-16-PC12	75 / 520

Direct Pressure, Metal Plug, Metal Seat or Soft Rubber Lined Valves Reverse Pressure, Resilient Plug, Metal Seat or Metal Plug, Metal Seat 50 psi (340 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 50 psi / 340 kPa
4" / 100mm	GS-6-PC4	150 / 1035
	GS-6-PC6	285 / 1960
5 & 6" / 125 & 150mm	GS-6-PC4	25 / 170
	GS-6-PC6	125 / 860
	GS-6-PC8	285 / 1960
8" / 200mm	GS-6-PC6	50 / 340
	GS-6-PC8	125 / 860
	GS-12-PC6	175 / 1210
	GS-12-PC8	285 / 1960
10" / 250mm	GS-6-PC8	50 / 340
	GS-12-PC6	75 / 520
	GS-12-PC8	150 / 1030
	GS-12-PC10	285 / 1960
12" / 300mm	GS-12-PC6	25 / 170
	GS-12-PC8	75 / 520
	GS-12-PC10	175 / 1210
	GS-16-PC10	250 / 1720
	GS-16-PC12	285 / 1960
14" / 350mm	GS-12-PC8	25 / 170
	GS-12-PC10	100 / 690
	GS-16-PC10	150 / 1035
	GS-16-PC12	225 / 1550
16" / 400mm	GS-12-PC10	50 / 340
	GS-16-PC10	100 / 690
	GS-16-PC12	150 / 1035
18" / 450mm	GS-12-PC10	25 / 170
	GS-16-PC10	50 / 340
	GS-16-PC12	100 / 690
20" / 500mm	GS-16-PC10	25 / 170
	GS-16-PC12	50 / 340
24" / 600mm	GS-16-PC12	25 / 170

Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-PC6

Double-Acting

Direct Pressure, Metal Plug, Metal Seat or Soft Rubber Lined Valves
Reverse Pressure, Resilient Plug, Metal Seat or Metal Plug, Metal Seat
80 psi (550 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 80 psi / 550 kPa
4" / 100mm	GS-6-PC4	285 / 1960
	GS-6-PC6	285 / 1960
5 & 6" / 125 & 150mm	GS-6-PC4	50 / 340
	GS-6-PC6	250 / 1720
8" / 200mm	GS-6-PC6	125 / 860
	GS-12-PC6	285 / 1960
10" / 250mm	GS-6-PC6	25 / 170
	GS-12-PC6	125 / 860
	GS-12-PC8	275 / 1890
	GS-16-PC8	285 / 1960
12" / 300mm	GS-12-PC6	75 / 520
	GS-12-PC8	175 / 1210
	GS-16-PC8	285 / 1960
14" / 350mm	GS-12-PC6	25 / 170
	GS-12-PC8	100 / 690
	GS-16-PC8	150 / 1030
	GS-16-PC10	275 / 1890
	GS-16-PC12	285 / 1960
16" / 400mm	GS-12-PC8	50 / 340
	GS-16-PC8	100 / 690
	GS-16-PC10	175 / 1210
	GS-16-PC12	275 / 1890
18" / 450mm	GS-12-PC8	25 / 170
	GS-16-PC8	50 / 340
	GS-16-PC10	100 / 690
	GS-12-PC12	175 / 1210
20" / 500mm	GS-16-PC8	25 / 170
	GS-16-PC10	75 / 520
	GS-16-PC12	125 / 860
24" / 600mm	GS-16-PC10	25 / 170
	GS-16-PC12	75 / 520
30" / 750mm	GS-16-PC12	25 / 170

Cylinder Actuators

Double-Acting

Reverse Pressure, Soft Rubber Lined Valves 50 psi (340 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 50 psi 340 kPa
4" 100mm	GS-6-PC4	50 340
	GS-6-PC6	285 1960
5 & 6" 125 & 150mm	GS-6-PC6	75 520
	GS-6-PC8	175 1210
8" 200mm	GS-6-PC8	75 520
	GS-12-PC6	100 690
	GS-12-PC8	250 1720
10" 250mm	GS-12-PC6	25 170
	GS-12-PC8	100 690
	GS-12-PC10	175 1210
12" 300mm	GS-12-PC8	50 340
	GS-12-PC10	100 690
	GS-16-PC10	175 1210
	GS-16-PC12	275 1890
14" 350mm	GS-12-PC10	50 340
	GS-16-PC10	100 690
	GS-16-PC12	150 1035
16" 400mm	GS-12-PC10	25 170
	GS-16-PC10	50 340
	GS-16-PC12	100 690
18" 450mm	GS-16-PC10	25 170
	GS-16-PC12	50 340
20" 500mm	GS-16-PC12	25 170

Double-Acting

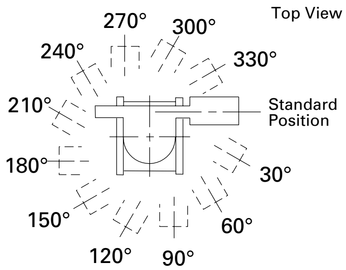
Reverse Pressure, Soft Rubber Lined Valves 80 psi (550 kPa) Air Supply

Valve Size	Actuator Code	Maximum Shutoff 80 psi 550 kPa
4" 100mm	GS-6-PC4	175 1210
	GS-6-PC6	285 1960
5 & 6" 125 & 150mm	GS-6-PC4	25 170
	GS-6-PC6	150 1035
	GS-6-PC8	285 1960
8" 200mm	GS-6-PC6	50 340
	GS-6-PC8	150 1035
	GS-12-PC6	200 1380
	GS-12-PC8	285 1960
10" 250mm	GS-6-PC8	50 340
	GS-12-PC6	75 520
	GS-12-PC8	175 1210
12" 300mm	GS-6-PC8	25 170
	GS-12-PC6	50 340
	GS-12-PC8	100 690
	GS-16-PC8	175 1210
	GS-16-PC10	285 1960
14" 350mm	GS-12-PC8	50 340
	GS-16-PC8	100 690
	GS-16-PC10	175 1210
	GS-16-PC12	285 1960
16" 400mm	GS-12-PC8	25 170
	GS-16-PC8	50 340
	GS-16-PC10	125 860
	GS-16-PC12	200 1380
18" 450mm	GS-16-PC8	25 170
	GS-16-PC10	50 340
	GS-16-PC12	125 860
20" 500mm	GS-16-PC10	25 170
	GS-16-PC12	75 520

Spring-Return

To order spring-return cylinder actuators, add the order code from the proper chart to the basic valve order code. Actuators can be mounted at 30° increments clockwise from standard. Specify mounting positions other than standard by adding the order code after the actuator.

Actuator Mounting Position



Resilient Plug, Metal Seat, Direct Pressure or Reverse Pressure Less Than 25 psi (170 kPa)

Spring-To-Close (Air-To-Open)

Valve Size	Order Code	Maximum Shutoff Pressure Differential Air Supply 50 psi 340 kPa
4" 100mm	GS-6-SC6	50 340
	GS-6-SC8	200 1380
5 & 6" 125 & 150mm	GS-6-SC8	25 170
8" 200mm	GS-12-SC10	125 860

Spring-To-Open (Air-To-Close)

Valve Size	Order Code	Maximum Shutoff Pressure Differential Air Supply 50 psi 340 kPa
4" 100mm	GS-6-SC6-A	120 860
5 & 6" 125 & 150mm	GS-6-SC6-A	50 340
	GS-6-SC8-A	125 860
8" 200mm	GS-12-SC10-A	125 860
10" 250mm	GS-12-SC10-A	125 860
12" 300mm	GS-12-SC10-A	50 340

Note: Contact Application Engineering for actuator sizing for metal seated valves, hard or soft rubber lined valves, or when reverse pressures are greater than 25 psi (170 kPa). Furnish service conditions.

Ordering Example:

PEC,6,F1,CI,NBR,CR*GS-6-SC8-A

GS-6-SC8-A-90

Accessories – Cylinder Actuators

Positioners

For use on all cylinder actuators. To order positioners, refer to bulletin 80.01-4.

3- & 4-Way Solenoid Valve (3V & 4V)

For use on cylinder actuators. To order solenoids, refer to bulletin 84.00-1.

4-Way Control Valve (CV)

For use on double-acting cylinder actuators. Order as a separate item by giving ACC* followed by appropriate 3-digit code from the table below. To order as part of a complete valve/actuator assembly, enter code from table below to the valve/actuator order code.

Pneumatic Actuators

Valve Size	NPT Size	Order Code
All Sizes	.25" 6.4mm	CV201

Hydraulic Actuators

Valve Size	NPT Size	Order Code
4-8" 100-200mm	.375" 9.5mm	CV202
10-36" 250-900mm	.5" 13mm	CV203

Ordering Example:
ACC*CV201 (separate item)
Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-PC6,CV201

4-Way Diaphragm Pilot Valve (4VD)

For use with double-acting pneumatic cylinders only. Order as separate item by giving ACC*4VD025. To order as part of a complete valve/actuator assembly, enter 4VD025 after valve/actuator code.

Ordering Example:
PEC,6,F1,CI,NBR,CR*GS-6-PC6,4VD025

On/Off Air Switch (SA)

Normally used with 4VD 4-Way Diaphragm Pilot Valve. Must be ordered as a separate item.

Ordering Example:
ACC*SA025

Position Indicating Switches (SEH)

For use on GS actuators. To order switches, refer to bulletin 83.00-1.

Manual Loading Station (CNP)

For use on all positioning actuators. Panel mounted, 3–15 psi (21–103 kPa) output. Includes signal output gauge and pressure reducing valve. Order as a separate item by entering ACC*CNP025.

Air Filter Regulator (AFR2)

For use on all pneumatic actuators. To order, refer to bulletin 83.00-2.

Filter/Strainer (FH/FP)

Filter for pneumatic actuators, strainer for hydraulic actuators. Order as a separate item per table below (not mounted).

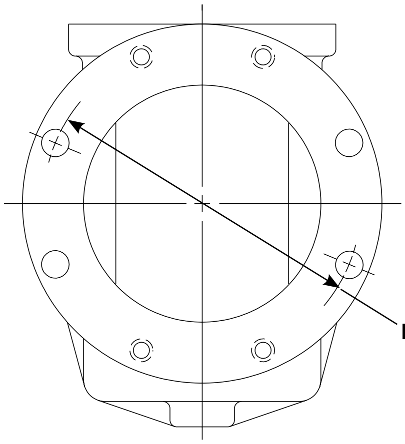
Description	Order Code
Pneumatic Filter	ACC*PCFP
Hydraulic Strainer	ACC*PCFH

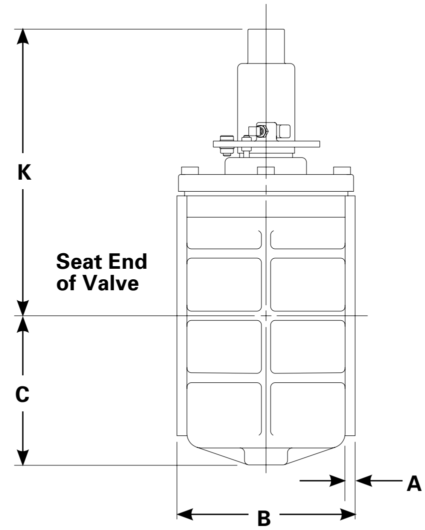
Ordering Example:
ACC*PCFP

Electric Motors

Dezurik offers a variety of electric motor actuators on Eccentric Plug valves. When ordering, please specify valve function, installation location, line fluid, maximum fluid temperature, pipe connection, line size, normal and maximum working pressure, normal and maximum wide open valve flow, and flow range desired if throttling or modulating control.

Dimensions





Basic Valve

CS=Carbon Steel, CI=Cast Iron, Ductile Iron, Bronze, Aluminum SST=Stainless Steel Alloys

<table>
<tr><th rowspan="3">Valve Size</th><th colspan="4">A</th><th colspan="4">B</th><th rowspan="3">C</th><th rowspan="3" colspan="2">D</th></tr>
<tr><th colspan="3">Flanged</th><th rowspan="2">Mechanical Joint</th><th rowspan="2">Flanged</th><th rowspan="2">Mechanical Joint</th><th rowspan="2" colspan="2">Grooved</th></tr>
<tr><th>CS</th><th>CI*</th><th>SST</th></tr>
<tr><td>4"
100mm</td><td>1.00
25</td><td>0.69
17</td><td>0.75
19</td><td>2.50
63</td><td>9.00
228</td><td>14.75
362</td><td colspan="2">10.40
264</td><td>5.38
36</td><td colspan="2">7.50
190</td></tr>
<tr><td rowspan="2">5 & 6"
125 & 150mm</td><td rowspan="2">1.06
26</td><td rowspan="2">0.75
19</td><td rowspan="2">0.88
22</td><td rowspan="2">2.50
63</td><td rowspan="2">10.50
266</td><td rowspan="2">15.75
400</td><td>5" (125mm)</td><td>6" (150mm)</td><td rowspan="2">6.50
165</td><td>5" (125mm)</td><td>6" (150mm)</td></tr>
<tr><td>12.50
318</td><td>12.88
327</td><td>8.50
215</td><td>9.50
241</td></tr>
<tr><td>8"
200mm</td><td>1.19
30</td><td>0.81
20</td><td>1.00
25</td><td>2.50
63</td><td>11.50
292</td><td>17.38
441</td><td colspan="2">14.00
356</td><td>8.25
209</td><td colspan="2">11.75
98</td></tr>
<tr><td>10"
250mm</td><td>1.25
31</td><td>0.88
22</td><td>1.06
27</td><td>2.50
63</td><td>13.00
330</td><td>19.38
492</td><td colspan="2">16.50
419</td><td>10.28
261</td><td colspan="2">14.25
362</td></tr>
<tr><td>12"
300mm</td><td>1.31
33</td><td>0.94
23</td><td>1.12
28</td><td>2.50
63</td><td>14.00
355</td><td>20.75
527</td><td colspan="2">17.50
445</td><td>11.69
296</td><td colspan="2">17.00
432</td></tr>
<tr><td>14"
350mm</td><td>1.44
36</td><td>1.00
25</td><td>1.25
31</td><td>3.50
89</td><td>17.00
431</td><td>24.50
622</td><td colspan="2">22.06
560</td><td>12.94
329</td><td colspan="2">18.75
476</td></tr>
<tr><td>16"
400mm</td><td>1.50
38</td><td>1.06
27</td><td>1.31
33</td><td>3.50
89</td><td>17.75
450</td><td>27.25
692</td><td colspan="2">23.56
598</td><td>14.31
363</td><td colspan="2">21.25
540</td></tr>
<tr><td>18"
450mm</td><td>1.62
41</td><td>1.12
28</td><td>1.44
36</td><td>3.50
89</td><td>21.50
546</td><td>29.25
743</td><td colspan="2">27.50
699</td><td>15.69
399</td><td colspan="2">22.75
578</td></tr>
<tr><td>20"
500mm</td><td>1.75
44</td><td>1.19
30</td><td>1.75
44</td><td>3.50
89</td><td>23.50
596</td><td>31.00
787</td><td colspan="2">31.00
787</td><td>17.19
437</td><td colspan="2">25.00
635</td></tr>
<tr><td>24"
600mm</td><td>1.88
47</td><td>1.88
47</td><td>–</td><td>3.50
89</td><td>42.00
1067</td><td>42.00
1067</td><td colspan="2">–</td><td>18.31
465</td><td colspan="2">29.50
749</td></tr>
<tr><td>30"
750mm</td><td>–</td><td>2.12
54</td><td>–</td><td>4.00
101</td><td>51.00
1295</td><td>51.00
1524</td><td colspan="2">–</td><td>21.88
556</td><td colspan="2">36.00
914</td></tr>
<tr><td>36"
900mm</td><td>–</td><td>2.38
60</td><td>–</td><td>4.00
101</td><td>60.00
1524</td><td>60.00
1524</td><td colspan="2">–</td><td>24.81
630</td><td colspan="2">42.75
1086</td></tr>
<tr><td rowspan="2">42"
1065mm</td><td rowspan="2">–</td><td rowspan="2">2.62
67</td><td rowspan="2">–</td><td rowspan="2">4.00
101</td><td rowspan="2">72.00
1829</td><td rowspan="2">74.00
1879</td><td rowspan="2" colspan="2">–</td><td rowspan="2">31.25
794</td><th>Flanged</th><th>Mechanical Joint</th></tr>
<tr><td>49.50
1257</td><td>50.62
1286</td></tr>
<tr><td>48"
1200mm</td><td>–</td><td>2.81
71</td><td>–</td><td>4.00
101</td><td>84.00
2134</td><td>84.00
2134</td><td colspan="2">–</td><td>40.00
1016</td><td>56.00
1422</td><td>57.50
1461</td></tr>
<tr><td>54"
1370mm</td><td>–</td><td>3.06
78</td><td>–</td><td>–</td><td>96.00
2438</td><td>–</td><td colspan="2">–</td><td>40.00
1016</td><td>62.75
1594</td><td>–</td></tr>
<tr><td>66"
1675mm</td><td>–</td><td>3.43
87</td><td>–</td><td>–</td><td>115.00
2921</td><td>–</td><td colspan="2">–</td><td>49.50
1257</td><td>76.00
1930</td><td>–</td></tr>
<tr><td>72"
1830mm</td><td>–</td><td>3.56
90</td><td>–</td><td>–</td><td>125.00
3175</td><td>–</td><td colspan="2">–</td><td>49.50
1257</td><td>82.50
2096</td><td>–</td></tr>
</table>

Inch
Millimeter

* Add .25/6.3 to A dimension for cast iron/rubber lined valves.

Nut Actuated Valves 4-8" (100-200mm)

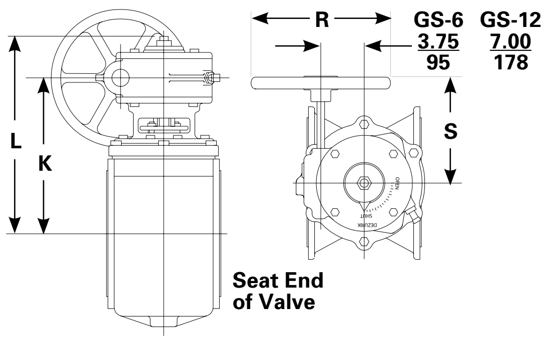
Valve Size	K
4" 100mm	10.19 258
5" 125mm	13.81 350
6" 150mm	13.81 350
8" 200mm	15.38 390

Inch
Millimeter

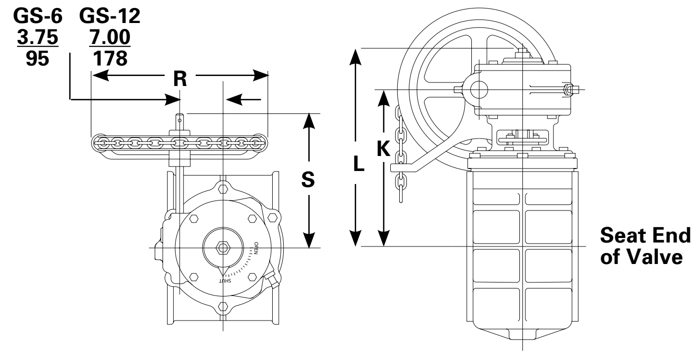
Dimensions

Handwheel/Chainwheel Actuated Valves

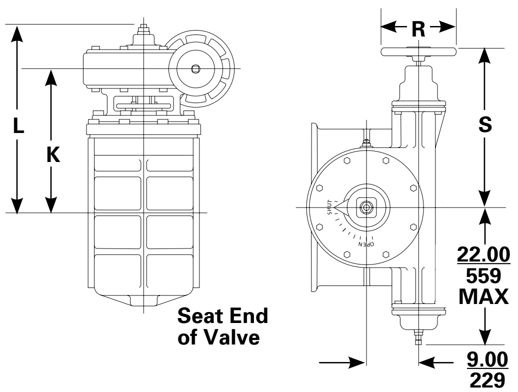
Handwheel 4–20" (100–500mm) GS-6-HD_ & GS-12-HD_



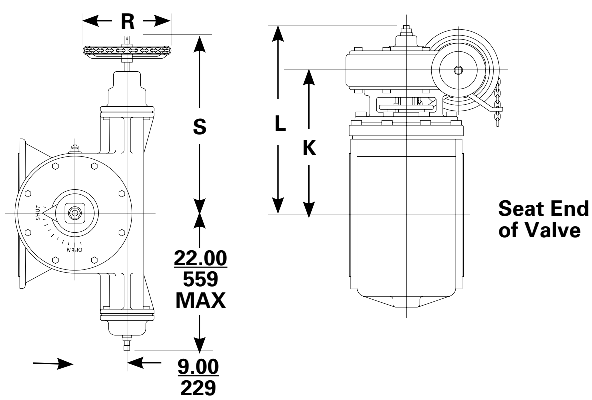
Chainwheel 4–20" (100–500mm) GS-6-CW_ & GS-12-CW_



Handwheel 16–36" (400–900mm) GS-16-HD_



Chainwheel 16–36" (400–900mm) GS-16-CW_



Handwheel/Chainwheel Actuated Valves

Valve Size	Actuator Code	K HD	K CW	L HD	L CW	R HD	R CW	S HD	S CW
4" 100mm	GS-6-HD-8 GS-6-CW_	9.62 245		13.27 338		8.00 203	10.06 256	6.88 174	8.81 224
5 & 6" 125 & 150mm	GS-6-HD_ GS-6-CW_	11.81 300		15.46 393		_8: 8.00 203	_12: 12.00 304	8.75 222	9.62 244
8" 200mm	GS-6-HD8 GS-6-CW8	13.63 347		17.28 340		8.00 203	10.06 256	8.75 222	9.62 244
	GS-6-HD12 GS-6-CW12	13.63 347		17.28 340		12.00 304	13.94 354	9.38 238	9.62 244
10" 250mm	GS-6-HD8 GS-6-CW8	15.12 384		18.77 477		8.00 203	10.06 256	11.12 282	11.88 302
	GS-6-HD12 GS-6-CW12	15.12 384		18.77 477		12.00 304	13.94 354	11.62 295	11.88 302
	GS-12-HD12 GS-12-CW12	15.74 400		19.39 493		12.00 304	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	15.74 400		19.39 493		16.00 406	21.62 549	17.88 454	17.38 441
12" 300mm	GS-6-HD8 GS-6-CW8	16.75 426		20.40 519		8.00 203	10.06 256	11.88 301	
	GS-6-HD12 GS-6-CW12	16.75 426		20.40 519		12.00 304	13.94 354	12.88 314	11.88 302
	GS-12-HD12 GS-12-CW12	16.75 426		23.13 588		12.00 304	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	16.75 426		23.13 588		16.00 406	21.62 549	18.25 464	17.38 441
	GS-12-HD20 GS-12-CW20	16.75 426		23.13 588		20.00 508	21.62 549	18.25 464	17.38 441
	GS-16-HD12	18.19 462	–	25.13 638	–	12.00 305	–	25.00 635	–
	GS-16-HD16 GS-16-CW20	18.19 462		23.13 588		16.00 406	21.62 549	25.00 635	24.93 633

Handwheel/Chainwheel Actuated Valves (continued)

Valve Size	Actuator Code	K		L		R		S	
		HD	CW	HD	CW	HD	CW	HD	CW
14" 350mm	GS-12-HD12 GS-12-CW12	18.74 476		25.12 638		12.00 305	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	18.74 476		25.12 638		16.00 406	21.62 549	18.25 464	17.38 441
	GS-12-HD20 GS-12-CW20	18.74 476		25.12 638		20.00 508	21.62 549	18.25 464	17.38 441
	GS-12-HD24 GS-12-CW30	18.74 476		25.12 638		24.00 610	31.46 799	22.25 565	17.38 441
	GS-16-HD12 GS-16-CW12	19.06 484		26.00 660		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	19.06 484	–	26.00 660	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	19.06 484		26.00 660		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24 GS-16-CW30	19.06 484		26.00 660		24.00 610	31.46 799	29.38 746	24.93 633
16" 400mm	GS-12-HD12 GS-12-CW12	20.24 514		26.62 676		12.00 305	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	20.24 514		26.62 676		16.00 406	21.62 549	18.25 464	17.38 441
	GS-12-HD20 GS-12-CW20	20.24 514		26.62 676		20.00 508	21.62 549	18.25 464	17.38 441
	GS-12-HD24 GS-12-CW30	20.24 514		26.62 676		24.00 610	31.46 790	22.25 565	17.38 441
	GS-16-HD12 GS-16-CW12	20.56 522		27.50 699		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	20.56 522	–	27.50 699	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	20.56 522		27.50 699		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24	20.56 522	–	27.50 699	–	24.00 610	–	29.38 746	–
	GS-16-HD30 GS-16-CW30	20.56 522		27.50 699		30.00 762	31.46 790	30.88 784	24.93 633
18" 450mm	GS-12-HD12 GS-12-CW12	21.12 536		27.50 699		12.00 305	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	21.12 536		27.50 699		16.00 406	21.62 549	18.25 464	17.38 441
	GS-12-HD20 GS-12-CW20	21.12 536		27.50 699		20.00 508	21.62 549	18.25 464	17.38 441
	GS-12-HD24 GS-12-CW30	21.12 536		27.50 699		24.00 610	31.46 799	22.25 565	17.38 441
	GS-16-HD12 GS-16-CW12	21.44 544		28.38 720		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	21.44 544	–	28.38 720	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	21.44 544		28.38 720		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24	21.44 544	–	28.38 720	–	24.00 610	–	29.38 746	–
	GS-16-HD30 GS-16-CW30	21.44 544		28.38 720		30.00 762	31.46 799	30.88 784	24.93 633
20" 500mm	GS-12-HD12 GS-12-CW12	23.12 587		29.50 749		12.00 305	13.94 354	17.88 454	17.38 441
	GS-12-HD16 GS-12-CW20	23.12 587		29.50 749		16.00 406	21.62 549	18.25 464	17.38 441
	GS-12-HD20 GS-12-CW20	23.12 587		29.50 749		20.00 508	21.62 549	18.25 464	17.38 441
	GS-12-HD24 GS-12-CW30	23.12 587		29.50 749		24.00 610	31.46 799	22.25 565	17.38 441
	GS-16-HD12 GS-16-CW12	23.32 592	23.44 595	30.26 754	29.82 757	12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	23.32 592	–	30.26 754	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	23.32 592	23.44 595	30.26 754	29.82 757	20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24	23.32 592	–	30.26 754	–	24.00 610	–	29.38 746	–
	GS-16-HD30 GS-16-CW30	23.32 592	23.44 595	30.26 754	29.82 757	30.00 762	31.46 799	30.88 784	24.93 633

Inch
Millimeter

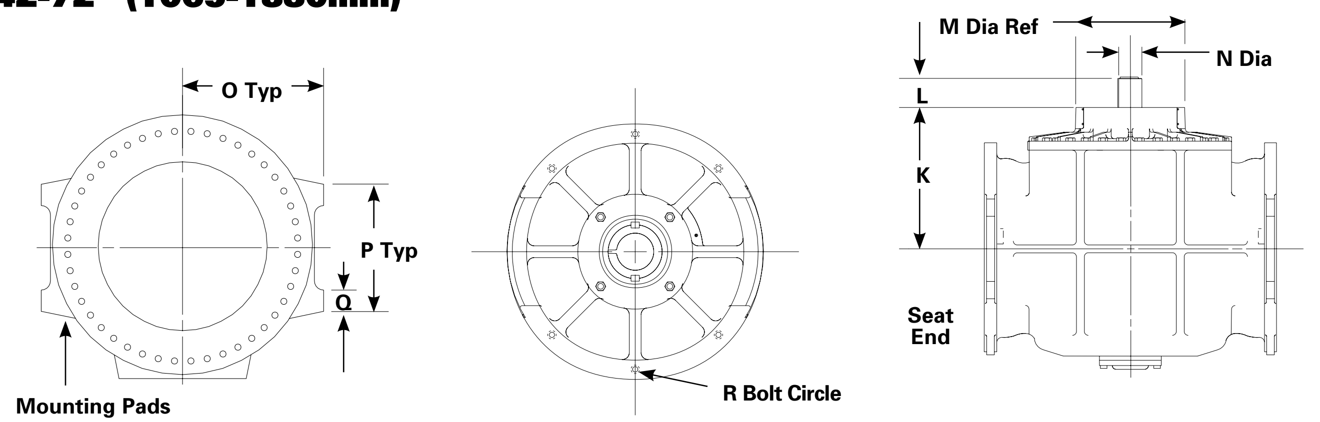
Dimensions

Handwheel/Chainwheel Actuated Valves (continued)

Valve Size	Actuator Code	K		L		R		S	
		HD	CW	HD	CW	HD	CW	HD	CW
24" 600mm	GS-16-HD12 GS-16-CW12	24.12 612		31.50 799		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	24.12 612	–	31.50 799	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	24.12 612		31.50 799		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24	24.12 612	–	31.50 799	–	24.00 610	–	29.38 746	–
	GS-16-HD30 GS-16-CW30	24.12 612		31.50 799		30.00 762	31.46 799	30.88 784	24.93 633
30" 750mm	GS-16-HD12 GS-16-CW12	28.19 716		35.57 903		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	28.19 716	–	35.57 903	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	28.19 716		35.57 903		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24 GS-16-CW30	28.19 716		35.57 903		24.00 610	31.46 799	29.38 746	24.93 633
36" 900mm	GS-16-HD12 GS-16-HD12	31.22 793		38.60 980		12.00 305	13.94 354	25.00 635	24.93 633
	GS-16-HD16	31.22 793	–	38.60 980	–	16.00 406	–	25.00 635	–
	GS-16-HD20 GS-16-CW20	31.22 793		38.60 980		20.00 508	21.62 549	25.00 635	24.93 633
	GS-16-HD24 GS-16-CW30	31.22 793	31.10 791	38.60 980	38.48 978	24.00 610	31.46 799	29.38 746	24.93 633
	GS-16-HD30 GS-16-CW30	31.22 793	31.10 791	38.60 980	38.48 978	30.00 762	31.46 799	30.88 784	24.93 633

Inch
Millimeter

Handwheel Actuated Valves 42-72" (1065-1830mm)



Handwheel 42-72" (1065-1830mm)

Valve Size	K	L	M	N	O	P	Q	R
42" 1065mm	34.81 884	10.50 267	34.50 876	6.50 165	27.25 692	28.00 711	4.00 102	32.00 813
48" 1200mm	44.94 1141	9.50 241	37.88 962	8.00 203	31.00 787	30.00 762	4.00 102	34.88 886
54" 1370mm	44.94 1141	9.50 241	37.88 962	8.00 203	34.37 873	32.00 813	4.00 102	34.88 886
66" 1675mm	52.81 1341	11.75 298	37.88 962	8.00 203	40.75 1035	36.00 914	6.00 152	34.88 886
72" 1830mm	52.81 1341	11.75 298	37.88 962	8.00 203	44.00 1118	38.00 965	6.00 152	34.88 886

Inch
Millimeter

For 4" (100mm) & larger 100% area valve information and 42" (1065mm) and larger chainwheel actuated valves, contact DeZURIK, Inc.

Cylinder Actuated Valves (see diagram on next page)

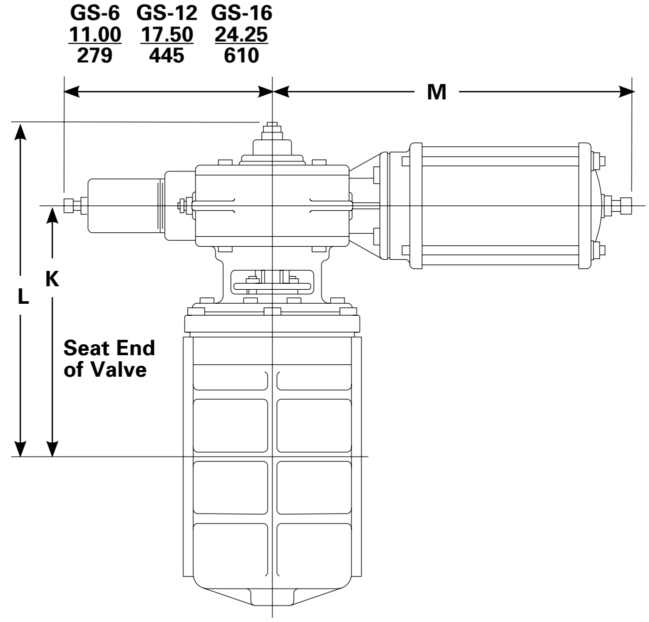
Valve Size	Actuator Code	K	L	M SC	M PC			N SC	N PC		
4" 100mm	GS-6-PC4	9.44 240	14.32 364	–	18.88 480			–	2.19 56		
	GS-6-SC6 GS-6-PC6	9.62 245	14.50 369	30.00 762	19.12 485			5.12 130	3.19 81		
	GS-6-SC8	9.62 245	14.50 369	32.19 818	–			6.12 155	–		
5 & 6" 125 & 150mm	GS-6-SC6 GS-6-PC6	11.81 300	16.69 424	30.00 762	19.12 485			5.12 130	3.19 81		
	GS-6-SC8 GS-6-PC8	11.81 300	16.69 424	32.19 818	19.38 482			6.12 155	4.56 115		
8" 200mm	GS-6-SC6 GS-6-PC6	13.63 347	18.51 471	30.00 762	19.12 485			5.12 130	3.19 81		
	GS-6-SC8 GS-6-PC8	13.63 347	18.51 471	32.19 818	19.38 482			6.12 155	4.56 115		
	GS-12-SC10 GS-12-PC_	14.25 362	20.63 524	46.00 1168	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	7.43 188	**PC6** 3.26 82	**PC8** 4.25 108	**PC10** 5.25 133
10" 250mm	GS-6-SC6 GS-6-PC6	15.12 384	20.00 508	30.00 762	19.12 485			5.12 130	3.19 81		
	GS-6-SC8 GS-6-PC8	15.12 384	20.00 508	32.19 818	19.38 482			6.12 155	4.56 115		
	GS-12-SC10 GS-12-PC_	15.74 400	22.12 562	46.00 1168	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	7.43 188	**PC6** 3.26 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	Contact DeZURIK									
12" 300mm	GS-6-SC8 GS-6-PC8	16.75 426	21.63 550	32.19 818	19.38 482	6.12 155	4.56 115	–	4.56 115		
	GS-12-SC10 GS-12-PC10	17.75 451	24.13 613	46.00 1168	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	7.43 188	**PC6** 3.26 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	Contact DeZURIK									
14" 350mm	GS-12-PC_	18.74 476	25.12 638	–	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	–	**PC6** 3.25 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	19.06 484	26.06 662	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 4.56 115	**PC10** 5.88 149	**PC12** 7.00 177
16" 400mm	GS-12-PC_	20.24 514	26.62 676	–	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	–	**PC6** 3.25 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	20.56 524	27.56 702	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 4.58 115	**PC10** 5.36 148	**PC12** 7.00 177
18" 450mm	GS-12-PC_	21.12 536	27.5 698	–	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	–	**PC6** 3.25 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	21.44 544	28.44 722	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 4.56 115	**PC10** 5.88 148	**PC12** 7.00 177
20" 500mm	GS-12-PC_	23.00 584	29.38 746	–	**PC6** 30.56 776	**PC8** 30.88 784	**PC10** 31.00 787	–	**PC6** 3.25 82	**PC8** 4.25 108	**PC10** 5.25 133
	GS-16-PC_	23.32 592	30.32 770	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 8.00 203	**PC10** 10.00 254	**PC12** 12.00 304
24" 600mm	GS-16-PC_	24.12 612	31.5 800	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 8.00 203	**PC10** 10.00 254	**PC12** 12.00 304
30" 750mm	GS-16-PC_	28.19 716	35.57 904	–	**PC8** 42.62 1082	**PC10** 43.25 1098	**PC12** 44.62 1133	–	**PC8** 8.00 203	**PC10** 10.00 254	**PC12** 12.00 304

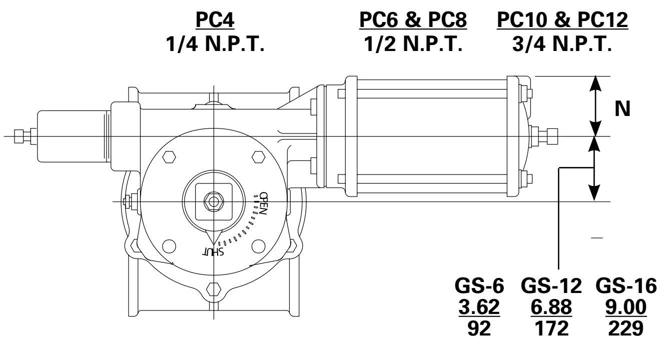
Inch
Millimeter

For 36" (900mm) and larger, 100% area valves, and booster cylinder actuated valves, contact factory.

Dimensions

Cylinder Actuated Valves





Sales and Service

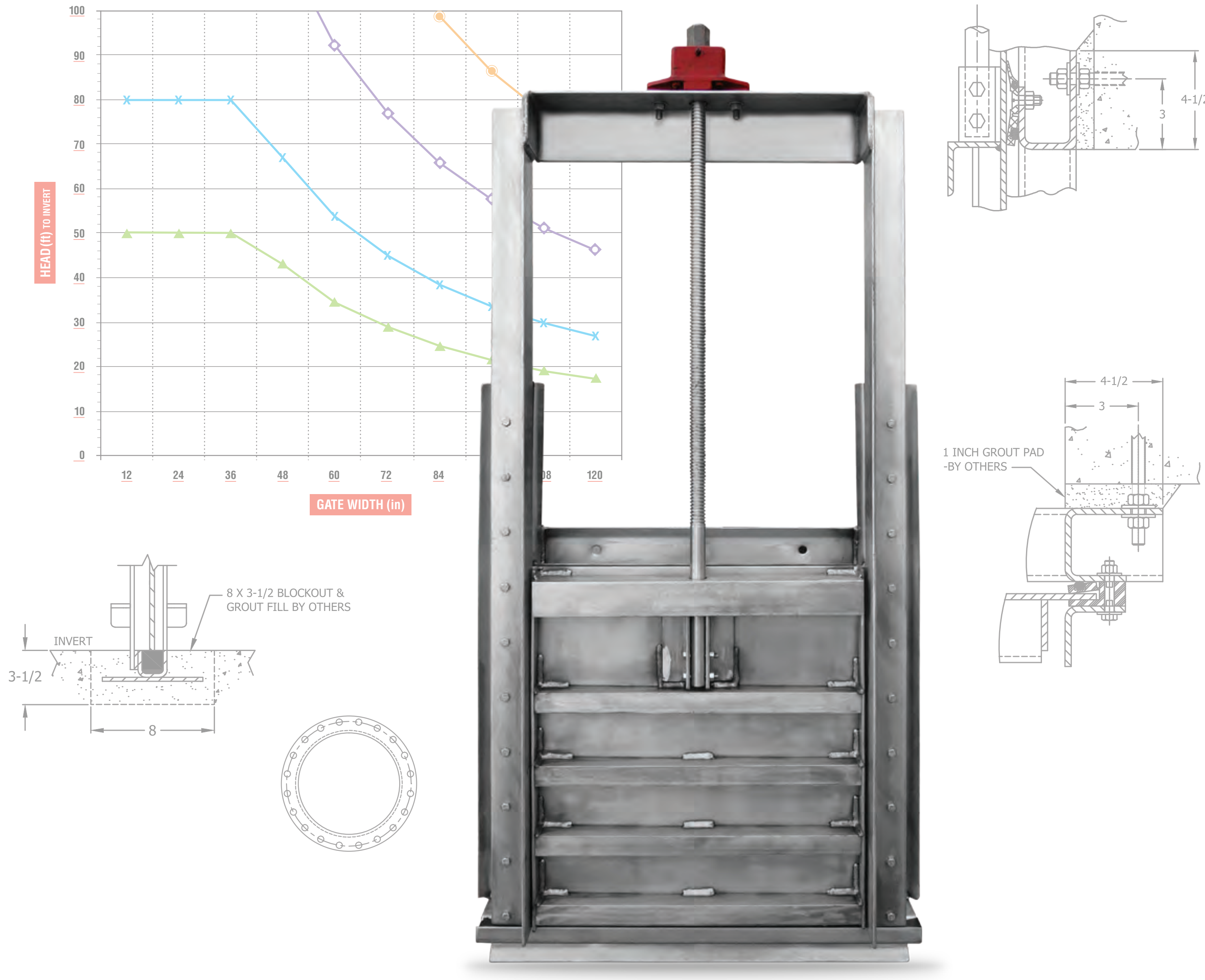
For information about our worldwide locations, approvals, certifications and local representative:
Web Site: www.dezurik.com E-Mail: info@dezurik.com

DeZURIK
APCO | HILTON
250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

Printed in the U.S.A.

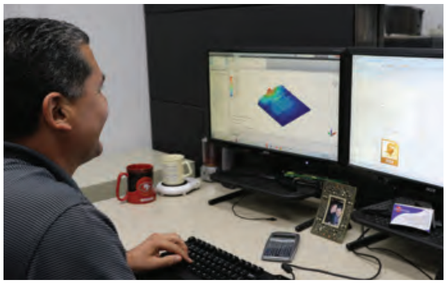
Waterman

STAINLESS STEEL SLIDE GATES SS-250 SERIES



For Generations

SS-250 SERIES STAINLESS STEEL FABRICATED SLIDE GATES



Company Overview:

The experts at Waterman have custom-engineered thousands of flow control gates for projects worldwide. Waterman's team excels at developing innovative custom solutions to project needs. Our commitment to a highly-trained, customer-focused engineering department is unmatched by our competitors. Using computer modeling technology and finite element analysis, Waterman has systematically improved the design and construction of fabricated gates.

Product Overview:

Best-in-class fabricated water control gates provide reliable performance for water, wastewater and hydropower applications. They are noted for their excellent sealing / leak resistance and for their long service life. Each gate is custom-designed to your project's requirements including seating and unseating heads incorporating safety factors per AWWA standards. SS-250 series gates conform to NSF 61/NSF 372.

Key Advantages and Performance:

- **Built for longevity and corrosion resistance** high strength 304L stainless steel and low-friction UHMW PE sliding and sealing surfaces lengthen the life of the gate. Optional 316L or 2205 stainless steel for use in unusually corrosive environments.
- **Guardian® seal system** (US Patent #8,820,711 awarded August 2015) dramatically increases seal life in both top and flush-bottom seals. Reduces leakage at critical corner joints. Offers superior performance to competitors' UHMW J-seal designs. No metal-to-metal contact prevents gate "sticking" and allows reliable operation even after years of no operation.
- **Best in class leakage performance Guardian®** UHMW PE continually self-adjusting seal system offers leakage rates up to 5 times better than the AWWA C561/C562 specification. The sealing system has been tested for 100,000 cycles (4x leading competitor) and continued to outperform the AWWA leakage specification.

Options:

- Models for normal aperture configuration, channel (embedded or surface mounted) as well as weirs (downward opening, often applied for decant and level control)
- SS-250 can be ordered as self-contained gates or with extension stems and separate operators.
- Gate frames can be embedded in channel walls, mounted to a wall with anchor bolts, mounted to a pipe flange or wall thimble. (Waterman offers a complete line of wall thimbles including “F”, “E”, “spigot style” as well as custom configurations.)
- “Q” seal bottom seal for high debris environments.
- Manual, electric or hydraulic actuation.
- Also available: A-250 Series Aluminum Slide Gates

SS-250 STAINLESS STEEL SLIDE GATE CONFIGURATIONS

TYPE OF GATE	APERTURE		END OF CHANNEL			IN CHANNEL	
(OPENING)	STANDARD	DOWNWARD OPENING	UPWARD OPENING	DOWNWARD OPENING (WEIR)	NON RESTRICTED FLOW	EMBEDDED GUIDE	WALL MTD. GUIDE
RISING STEM	251	252	253	254	255	256	257
MACHINED FLANGE	251-F	252-F					
CIRCULAR FLANGE	251-CF	252-CF					
FULLY CONTAINED SLIDE IN GUIDE RAIL	251-L	252-L	253-L	254-L	255-L	256-L	257-L
SELF-CONTAINED GATE	251-Y	252-Y	253-Y	254-Y	255-Y	256-Y	257-Y
NRS COVER	251-N	252-N	253-N	254-N	255-N	256-N	257-N
SPECIAL OR MODIFIED APPLICATION	251-X	252-X	253-X	254-X	255-X	256-X	257-X



FABRICATED STAINLESS STEEL GATES ADDITIONAL INFORMATION

NSF 61 / NSF 372:

The SS-250 series water control gates (6" – 120") conform to the requirements of NSF/ANSI 61 Drinking Water System Components – Health Effects and NSF/ANSI 372. They conform with the lead content requirements for "lead free" plumbing as defined by California, Vermont, Maryland, and Louisiana state laws and the U.S. Safe Drinking Water Act.

Range of Sizes:

Waterman offers in-stock gates in standard dimensions for quick delivery and lowest total cost. In addition, we can custom design and manufacture gates in a nearly unlimited range of sizes and configurations.

Non-Rising Stem:

Fabricated gates can be ordered with a non-rising stem for areas with restricted space above the gate operator. The disadvantage of a non-rising stem is the threaded operating nut and stem are always exposed in the gate well. Lubrication of the threads becomes difficult to maintain and can lead to premature wear.

Optional Wall Thimbles:

Waterman can supply wall thimbles for mounting of fabricated gates. A thimble can be requested to ship prior to the gate so that it can be included in concrete forms before the structure is poured. Use of a thimble dramatically reduces the time for installation by eliminating labor of placing and aligning anchor bolts and the potential for misplaced or misaligned anchors. With a properly-installed thimble, the gate can be installed quickly when it arrives on site. See page 19 for a complete range of configurations.

Tandem Lifts / Interconnected Actuators:

For large gates, tandem actuators can be specified. This configuration is often used for gates over 72" width.

Actuator Loads for Structures:

For standard gates that are not self-contained, opening and closing thrusts from the actuator are resisted by the structure. Consult with Waterman's engineering department for appropriate design parameters.

Actuators:

Waterman gates can be supplied with manual, electric or hydraulic actuators.

Manual actuators are typically geared "crank type" lifts, although handwheel-type actuators can be applied on small-sized gates with low operating loads. In situations where it will take substantial manual effort / time to open a gate, Waterman can supply electric or gasoline-powered portable operators. Consult with Waterman's engineering department for specifications.

Electric actuators provide convenience for frequent opening, faster opening speeds and readily lend themselves to automation.

Hydraulic cylinders are frequently used in repetitive cycling applications and where automatic gate opening / closing in the event of a power failure is desired.

AWWA Fabricated Slide Gate Part Numbering Guide

PART NUMBER BUILDER

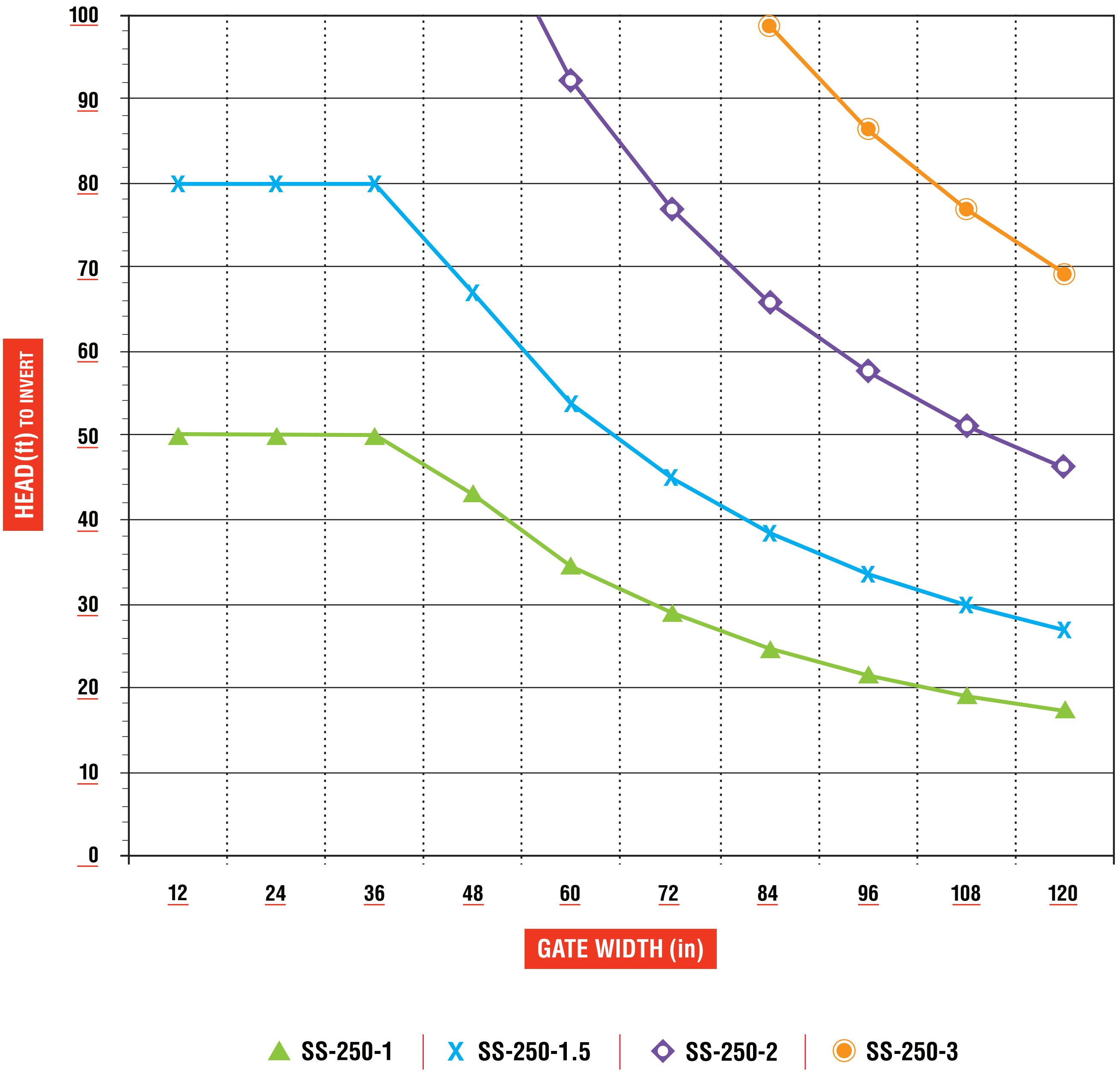
SS – 25 1 – 1 – Y – 36 x 42 10

Material	Opening Configuration Type	Series	Options	Dimensions W x H	Head Rating
A-25 = Aluminum **SS-25** = Stainless Steel	**1** = Standard **2** = Downward Opening **3** = Upward Opening **4** = Weir **5** = End of Channel Non Restricted Flow **6** = Embedded Guide **7** = Wall Mount	Indicate 1, 1.5, 2, or 3	Indicate **F** = Flanged **CF** = Circular Flange Modified ANSI 125# drilling **LF** = Fully Contained Slide **Y** = Self Contained Gate **N** = Non-Rising Stem Cover **X** = Special or Modified Option **Q** = Flush Bottom Seal **T** = Mounted to Wall Thimble	(separate with X), if metric, indicate MM after each number for millimeters	indicate head rating in 5' increment

SS-251-1-Y-36 x 42-10

Indicates a stainless slide gate, standard series, self-contained, with 36" W x 42" H, rated for 10 feet of head.

STAINLESS STEEL GATE SERIES
HEAD RATINGS FOR CUSTOM SIZES



Drawings shown in this booklet are for 250-1 models only. Request drawings and specs for other models.

NOTES:

1) Formula to determine seat pressure:
Gate width (in)* Head (ft)*.2166


MODEL JLC
Electric Chain Hoists
1 TON
COFFING
MODEL JLC
COFFING®
HOISTS

The New Coffing JLC
Leader Of The Pack

Coffing's JLC line of electric chain hoists combine new design features with standard features that put the JLC at the head of the class.

OUTSTANDING FEATURES

- **Capacities & Lifts –** Rated loads from 1/8 to 2 Ton Metric Rated. Standard lifts of 10, 15, and 20 feet. Other lifts available. CSA approved.
- **Voltages –** 115/230 – single phase; 230/460, 208, 380, 415, 575 – three phase 60 Hertz standard, 50 Hertz available.
- **Electrical Controls –** IEC style controls meet or exceed electrical codes.
- **Chain Container Standard –** Molded quick connect chain container prevents slack chain from interfering with operator. 20 ft. lift single reeved, 10 ft. lift double reeved.
- **Improved Hoist Motor –** Finned aluminum housing and Class F Insulation for longer life. 2-speed with 3 to 1 speed ratio available.

JLC Top Hook Suspension
Made in USA

Specifications

Hook and Lug

Capacity (Lb.)	Capacity (Ton)	Model Number	No. of Chains	Motor HP	Lift Speed (FPM) Single	Lift Speed (FPM) Two	Headroom* (In.)	Housing Dimensions (In.) H	Housing Dimensions (In.) W	Housing Dimensions (In.) L	Net Wt.** (Lb.)
250	1/8	**JLC-0232**	1	1/4	32	10.7	18 1/8	8 11/16	8 11/16	24 1/8	63
500	1/4	**JLC-0516**	1	1/2	16	5.3	18 1/8	8 11/16	8 11/16	24 1/8	63
500	1/4	**JLC-0532**	1	1/2	32	10.7	18 1/8	8 11/16	8 11/16	24 1/8	75
1000	1/2	**JLC-1016**	1	1/2	16	5.3	18 1/8	8 11/16	8 11/16	24 1/8	75
1000	1/2	**JLC-1032**	1	1	32	10.7	18 1/8	8 11/16	8 11/16	24 1/8	88
2000	1	**JLC-2016**	1	1	16	5.3	18 1/8	8 11/16	8 11/16	24 1/8	90
4000	2	**JLC-4008**	2	1	8	2.7	20 13/16	8 11/16	8 11/16	24 1/8	100

* For hook and lug mounted models only. ** Weight and dimensions for 10 ft. lift, single phase, top hook and lug suspension units.
Note: For complete dimensions, refer to dimensional data sheets.

The Leader Just Got Better

Coffing JLC Models – **Designed for industrial duty performance. Compact in size, the JLC has standard features such as a multiple disc motor brake, overload clutch, and adjustable limit switches.**

JLC Manual & Motorized Trolley Suspensions
Made in USA

OUTSTANDING FEATURES

- **H4 Duty Rating –** Handles heavy duty work environments.
- **Upper Composite Chain Guide –** Improves chain life.
- **Lower Chain Guide –** features easy capacity conversion.
- **Top Suspension –** Quick-change from hook mount to lug mount.
- **One Chain Size –** All models reduce inventory.
- **Manual & Motorized Trolleys –** Cross-mounted to improve end approach.
- **Increased Flange Range -** Up to 7 inches on motorized trolleys.
- **Improved Headroom -** For plain and motorized trolleys and 2 Ton models.
- **Weather Resistant -** Hoist is NEMA 3R enclosure.
- **Lifetime Warranty -** The Industry's Best.

Specifications

Trolley Mount

Capacity (Lb.)	Capacity (Ton)	Model Number	Trolley ‡ Mount	JLCET Hdrm (In.)	JLCMT Hdrm (In.)	JLCET Flange* Width (In.)	Beam Ht. (In.)	Min. Rad. Curve (In.)	JLCET Net Wt. (Lb.)	JLCMT Net Wt. (Lb.)
250	1/8	**JLC(†)-0232**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	87	173
500	1/4	**JLC(†)-0516**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	87	173
500	1/4	**JLC(†)-0532**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	99	185
1000	1/2	**JLC(†)-1016**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	91	185
1000	1/2	**JLC(†)-1032**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	112	198
2000	1	**JLC(†)-2016**	C	17 15/16	17 15/16	3 - 8	5 - 12	48	114	200
4000	2	**JLC(†)-4008**	C	20 5/8	20 5/8	3.33 - 8	6 - 18	60	156	210

† Specify JLCET for plain trolley and JLCMT for motorized trolley models. ‡ C = Cross mount, standard on all JLC trolley models.
* For JLCMT models, standard flange adjustment is 3.33 - 7". Consult factory for special beam size options.

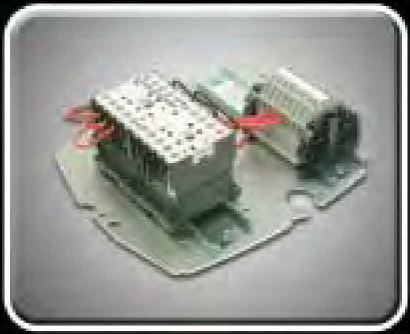
MODEL JLC

STANDARD FEATURES

- **Five-Pocket Load Sheave –** Increased chain and sheave engagement 25% over hoists with conventional four-pocket sheaves. Provides smoother lifting and reduces chain wear.
- **Mechanical Overload Protection Device –** Helps protect hoist, operator, and supporting structures from damaging overloads, chain jamming and reverse phasing.
- **Limit Switches –** Adjustable to regulate upper and lower load travel. Brass nuts standard for improved repeatability and chain positioning.
- **Multiple Disc Motor Brake –** Heavy duty design for reliable operation. Direct acting for positive load holding and spotting.
- **Chain End Stop Assembly –** Fits below dead end link on lifting chain for added measure of protection.
- **Oil Bath Transmission –** Precision machined alloy steel gears run in oil bath for longer, quieter operation.
- **Manual and Motorized trolleys –** Single and Dual Speed Models.
- **Wrap-Around Side Plates –** Act as safety lugs and as bumpers to protect wheels. Available to fit American Standard I-Beams, wide-flange, and patented track beams.
- **Precision Trolley Wheels –** Dual tread trolley wheels fit either flat or tapered I-Beams. Also available in bronze or stainless steel.

Easy Change Top Suspension

Quick Connect Chain Container



IEC Controls

⚠WARNING

Overloading and Improper Use Can Result In Injury

To Avoid Injury:
- Do not exceed working load limit, load rating, or capacity.
- Do not use to lift people or loads over people.
- Use only alloy chain and attachments for overhead lifting.
- Read and follow all instructions.

COFFING® HOISTS

Country Club Road • P.O. Box 779 • Wadesboro, NC 28170 USA

Phone: **(800) 477-5003 • (704) 694-2156** • Fax: **(800) 374-6853 • (704) 694-6829**

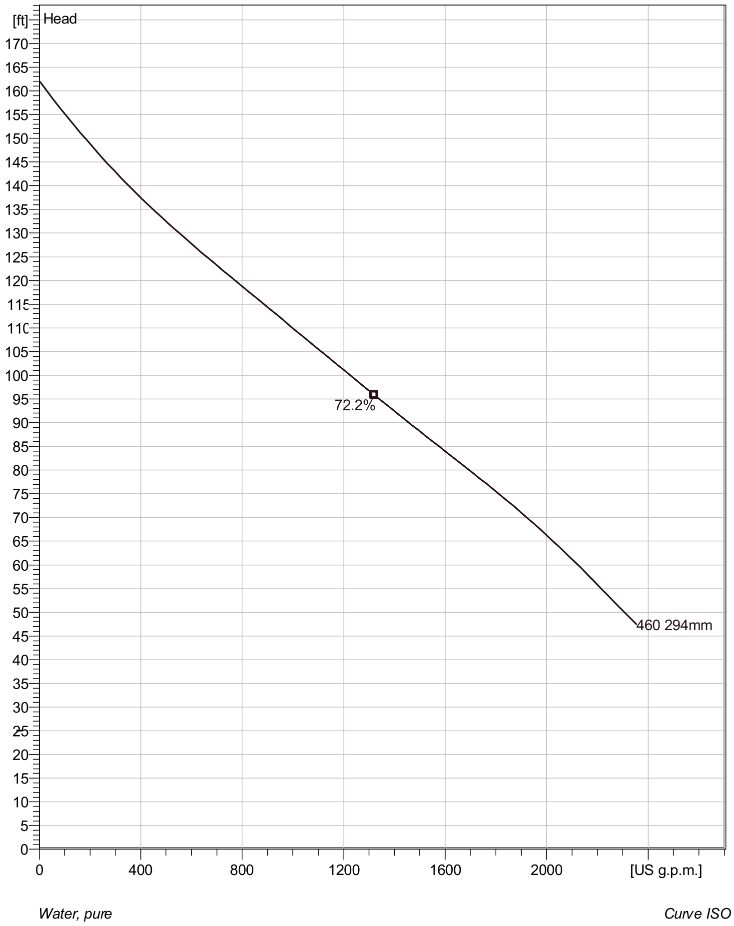
www.coffinghoists.com • Email: **coffing@cmworks.com**

xylem

NT 3202 HT 3~ 460

Technical specification

FLYGT



Note: Picture might not correspond to the current configuration.

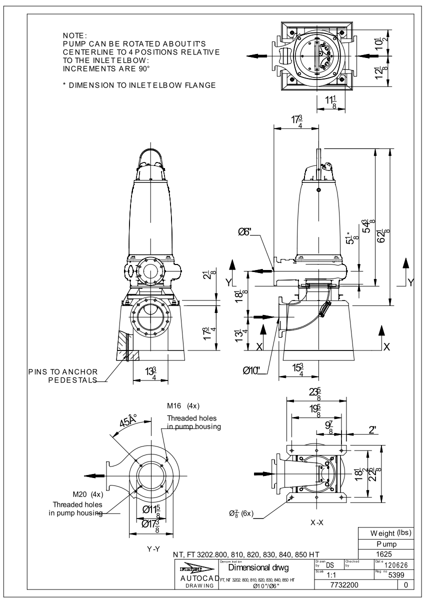
General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Hard-Iron ™
Discharge Flange Diameter	5 7/8 inch
Suction Flange Diameter	7 7/8 inch
Impeller diameter	294 mm
Number of blades	2

Installation: T - Vertical Permanent, Dry



Motor

Motor #	N3202.830 30-37-4IE-D IE3 54hp FM
Stator variant	4
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	54 hp
Rated current	61 A
Starting current	565 A
Rated speed	1785 rpm
Power factor	
1/1 Load	0.86
3/4 Load	0.81
1/2 Load	0.71
Motor efficiency	
1/1 Load	95.2 %
3/4 Load	95.5 %
1/2 Load	95.1 %

Configuration

Project	Project ID	Created by	Created on	Last update
			10/12/2018	

NT 3202 HT 3~ 460

Performance curve

Pump

Discharge Flange Diameter	5 7/8 inch
Suction Flange Diameter	200 mm
Impeller diameter	11 9/16"
Number of blades	2

Motor

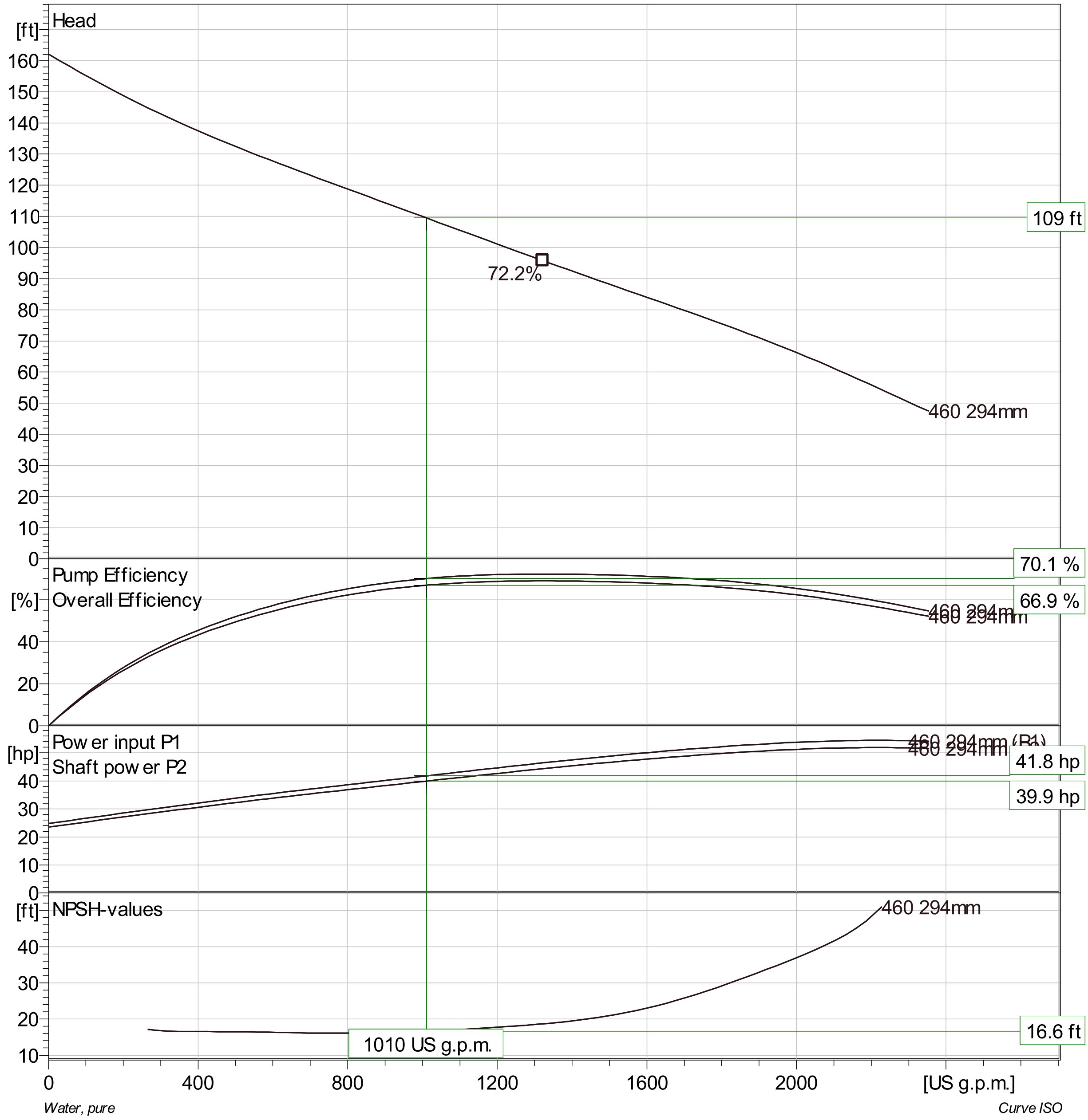
Motor #	N3202.830 30-37-4IE-D IE3 54hp
Stator variant	4
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	54 hp
Rated current	61 A
Starting current	565 A
Rated speed	1785 rpm

Power factor

1/1 Load	0.86
3/4 Load	0.81
1/2 Load	0.71

Motor efficiency

1/1 Load	95.2 %
3/4 Load	95.5 %
1/2 Load	95.1 %



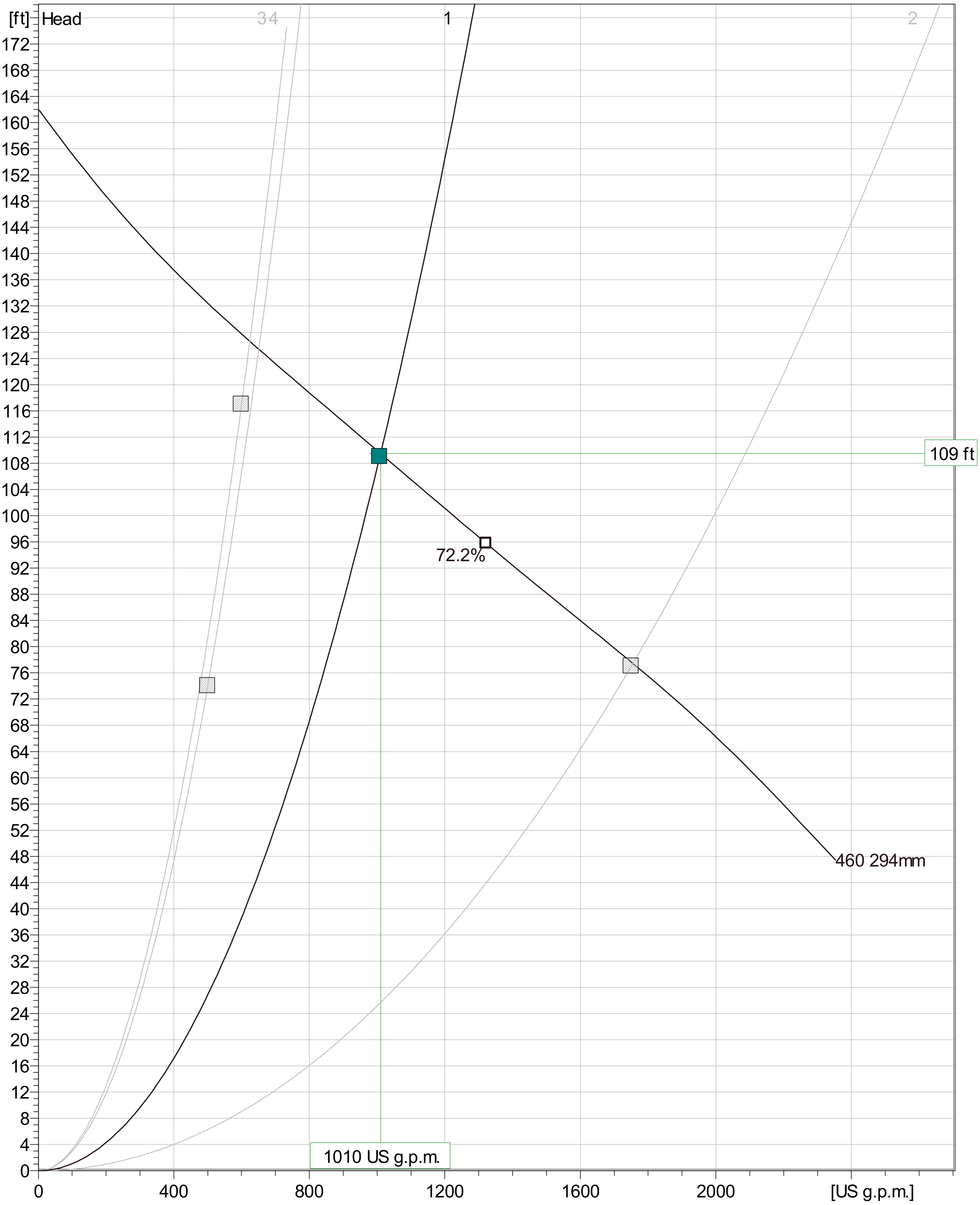
Duty point | **Guarantee**

Flow	**Head**	**Guarantee**
1010 US g.p.m.	109 ft	No
1750 US g.p.m.	77 ft	No
600 US g.p.m.	117 ft	No

Project	Project ID	Created by	Created on	Last update
			10/12/2018	

NT 3202 HT 3~ 460

Duty Analysis



Water, pure *Curve ISO*

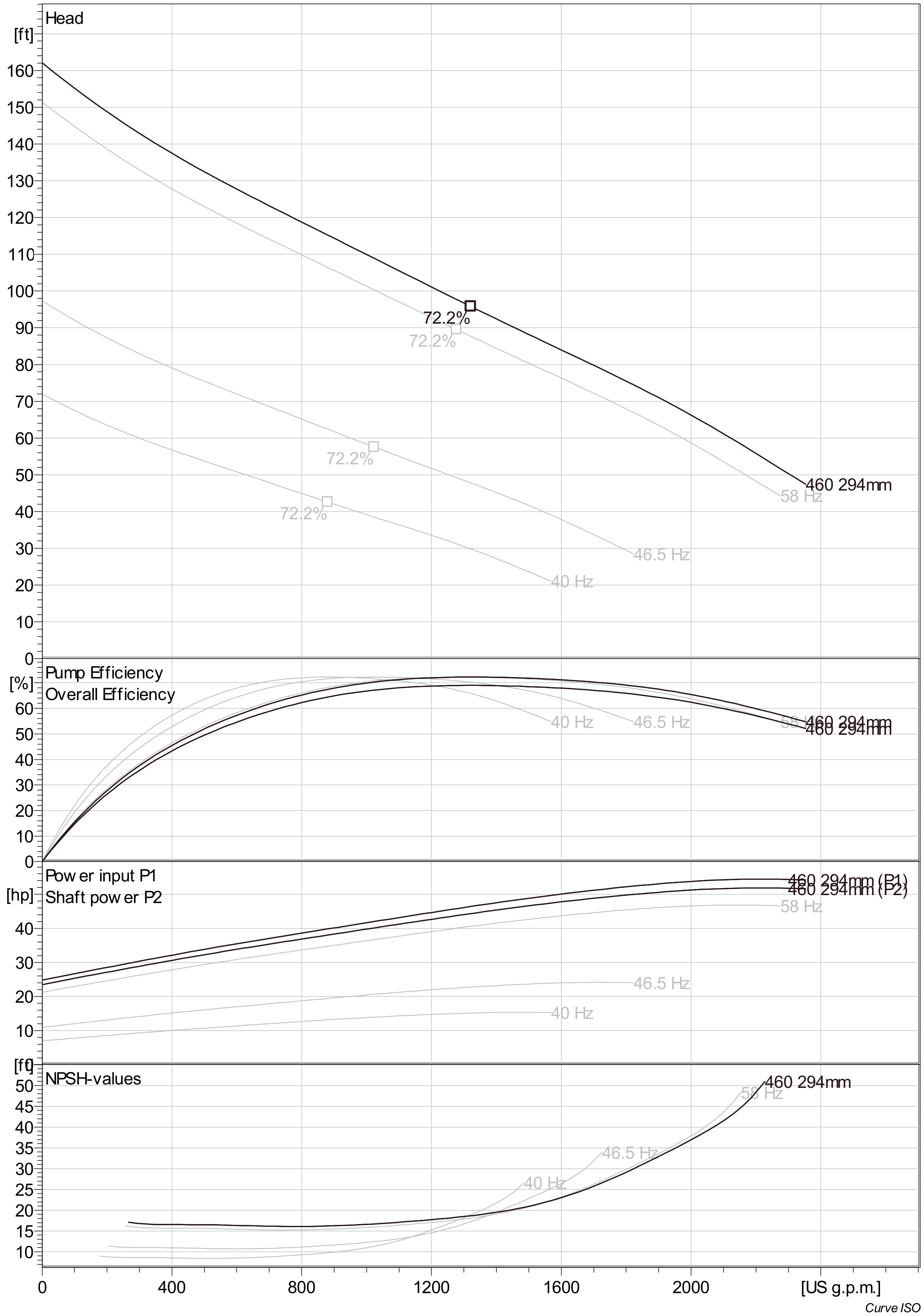
Curve issue 6

Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
4	651 US g.p.m.	125 ft	34.6 hp	651 US g.p.m.	125 ft	34.6 hp	59.6 %	693 kWh/US MG	16.2 ft
3	624 US g.p.m.	127 ft	34.2 hp	624 US g.p.m.	127 ft	34.2 hp	58.4 %	714 kWh/US MG	16.3 ft
2	1750 US g.p.m.	77.4 ft	49.4 hp	1750 US g.p.m.	77.4 ft	49.4 hp	69.7 %	366 kWh/US MG	27.6 ft
1	1010 US g.p.m.	109 ft	39.9 hp	1010 US g.p.m.	109 ft	39.9 hp	70.1 %	514 kWh/US MG	16.6 ft

Project	Project ID	Created by	Created on	Last update
			10/12/2018	

NT 3202 HT 3~ 460

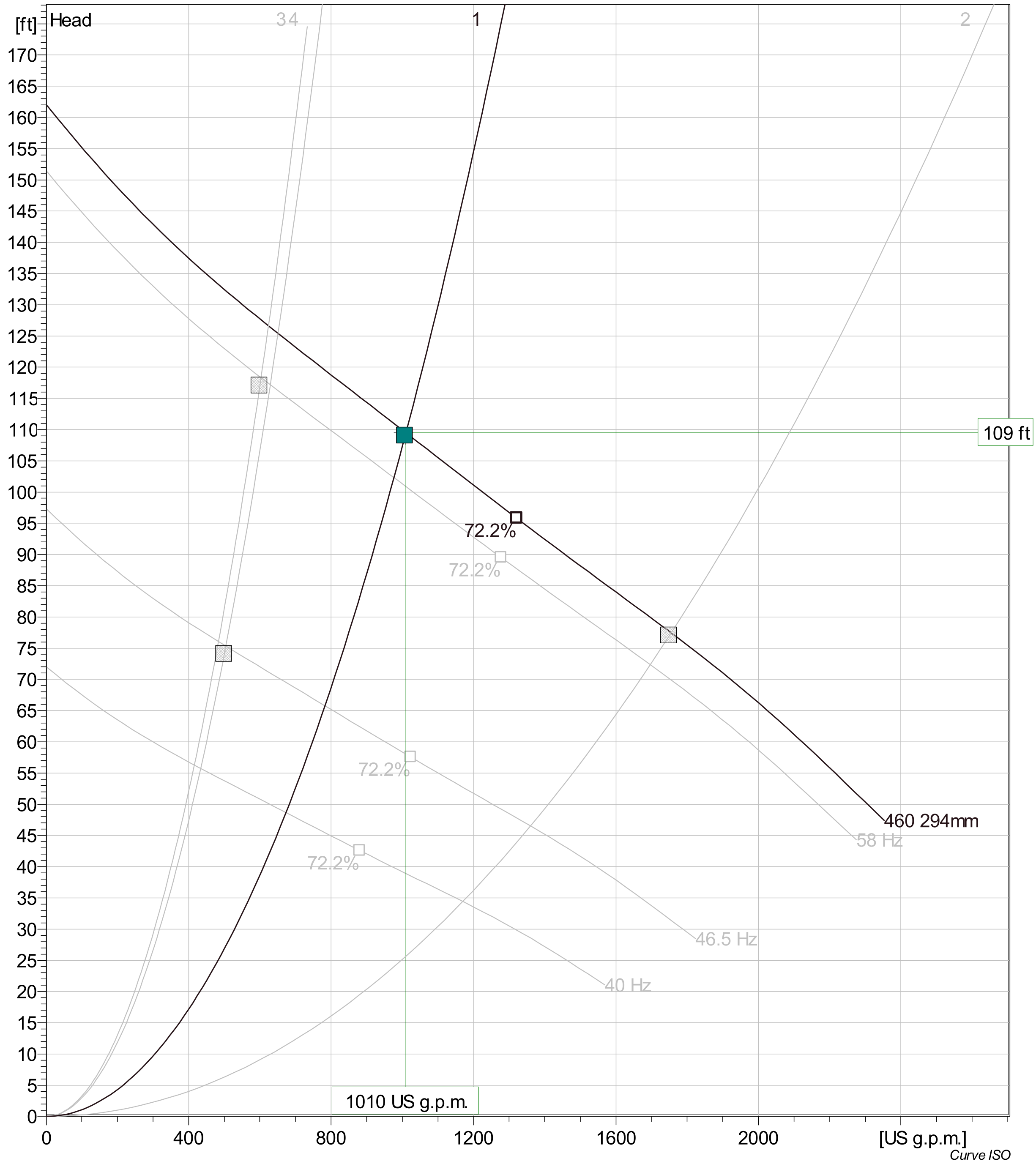
VFD Curve



Project	Project ID	Created by	Created on	Last update
			10/12/2018	

NT 3202 HT 3~ 460

VFD Analysis

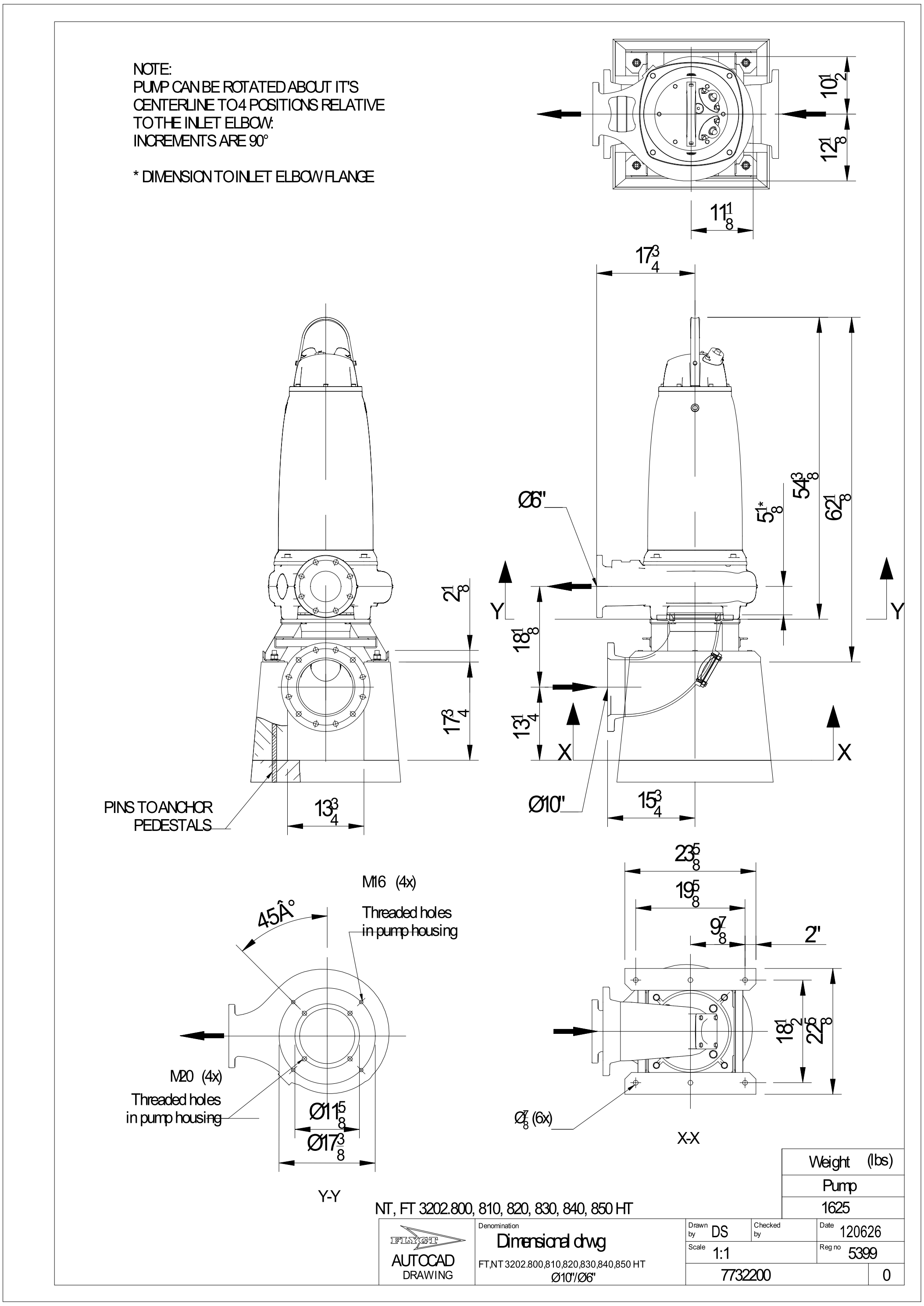


Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
4	60 Hz	651 US g.p.m.	125 ft	34.6 hp	651 US g.p.m.	125 ft	34.6 hp	59.6 %	693 kWh/US MG	16.2 ft
4	58 Hz	629 US g.p.m.	117 ft	31.3 hp	629 US g.p.m.	117 ft	31.3 hp	59.6 %	649 kWh/US MG	15.4 ft
4	46.5 Hz	504 US g.p.m.	75.3 ft	16.1 hp	504 US g.p.m.	75.3 ft	16.1 hp	59.6 %	424 kWh/US MG	10.8 ft
4	40 Hz	434 US g.p.m.	55.7 ft	10.3 hp	434 US g.p.m.	55.7 ft	10.3 hp	59.6 %	323 kWh/US MG	8.49 ft
3	60 Hz	624 US g.p.m.	127 ft	34.2 hp	624 US g.p.m.	127 ft	34.2 hp	58.4 %	714 kWh/US MG	16.3 ft
3	58 Hz	603 US g.p.m.	118 ft	30.9 hp	603 US g.p.m.	118 ft	30.9 hp	58.4 %	668 kWh/US MG	15.4 ft
3	46.5 Hz	484 US g.p.m.	76.1 ft	15.9 hp	484 US g.p.m.	76.1 ft	15.9 hp	58.4 %	437 kWh/US MG	10.8 ft
3	40 Hz	416 US g.p.m.	56.3 ft	10.1 hp	416 US g.p.m.	56.3 ft	10.1 hp	58.4 %	333 kWh/US MG	8.52 ft
2	60 Hz	1750 US g.p.m.	77.4 ft	49.4 hp	1750 US g.p.m.	77.4 ft	49.4 hp	69.7 %	366 kWh/US MG	27.6 ft
2	58 Hz	1700 US g.p.m.	72.4 ft	44.6 hp	1700 US g.p.m.	72.4 ft	44.6 hp	69.7 %	342 kWh/US MG	26.1 ft
2	46.5 Hz	1360 US g.p.m.	46.5 ft	23 hp	1360 US g.p.m.	46.5 ft	23 hp	69.7 %	222 kWh/US MG	18.3 ft
2	40 Hz	1170 US g.p.m.	34.4 ft	14.6 hp	1170 US g.p.m.	34.4 ft	14.6 hp	69.7 %	167 kWh/US MG	14.4 ft
1	60 Hz	1010 US g.p.m.	109 ft	39.9 hp	1010 US g.p.m.	109 ft	39.9 hp	70.1 %	514 kWh/US MG	16.6 ft
1	58 Hz	977 US g.p.m.	102 ft	36.1 hp	977 US g.p.m.	102 ft	36.1 hp	70.1 %	481 kWh/US MG	15.8 ft
1	46.5 Hz	783 US g.p.m.	65.8 ft	18.6 hp	783 US g.p.m.	65.8 ft	18.6 hp	70.1 %	313 kWh/US MG	11.1 ft

Project	Project ID	Created by	Created on	Last update
			10/12/2018	

NT 3202 HT 3~ 460

Dimensional drawing



Project	Project ID	Created by	Created on	Last update
			10/12/2018	

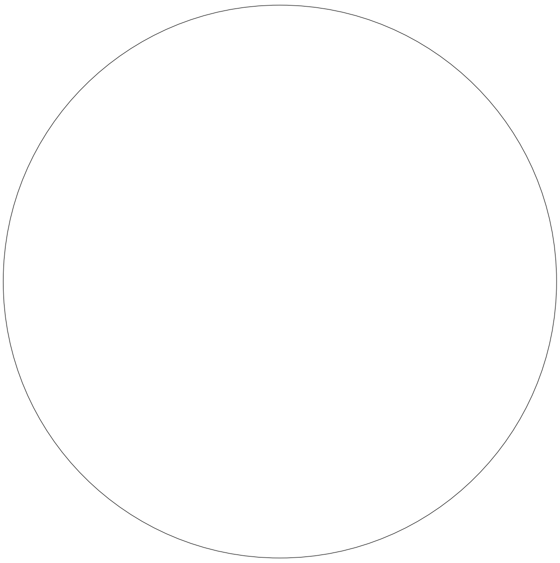
xylem

NT 3202 HT 3~ 460

Life cycle costs (LCC)

Total lifetime	15	Inflation rate (rate of price increases)	2 %
Annual operating time	5600	Interest rate (for investment)	3 %
Energy cost per kWh	0.00 USD		
Power input P1			

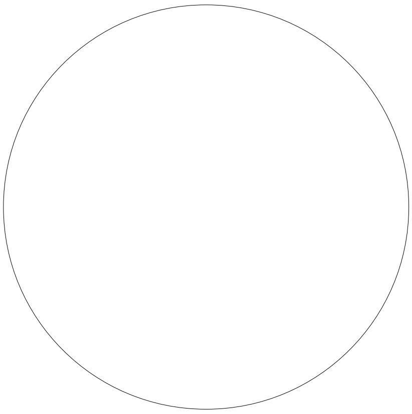
Total costs



0%	**0.00 USD**	Energy
0%	**0.00 USD**	Investment costs
0%	**0.00 USD**	Installation & commissioning
0%	**0.00 USD**	Operating cost
0%	**0.00 USD**	Maintenance & repair
0%	**0.00 USD**	Downtime
0%	**0.00 USD**	Environmental
0%	**0.00 USD**	Decommissioning

0.00 USD

First year costs



0%	**0.00 USD**	Energy (1st year)
0%	**0.00 USD**	Investment costs (1st year)
0%	**0.00 USD**	Installation & commissioning (1st year)
0%	**0.00 USD**	Operating cost (1st year)
0%	**0.00 USD**	Maintenance & repair (1st year)
0%	**0.00 USD**	Downtime (1st year)
0%	**0.00 USD**	Environmental (1st year)
0%	**0.00 USD**	Decommissioning (1st year)

0.00 USD

Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xylem inc can therefore not guarantee that the estimated savings will actually occur.

Project	Project ID	Created by	Created on	Last update
			10/12/2018	

FLYGT	Motor Chart	Motor Nr 30-37-4IE	Issue 10 / Date 2011-11-25

3202.830

Nominal Values

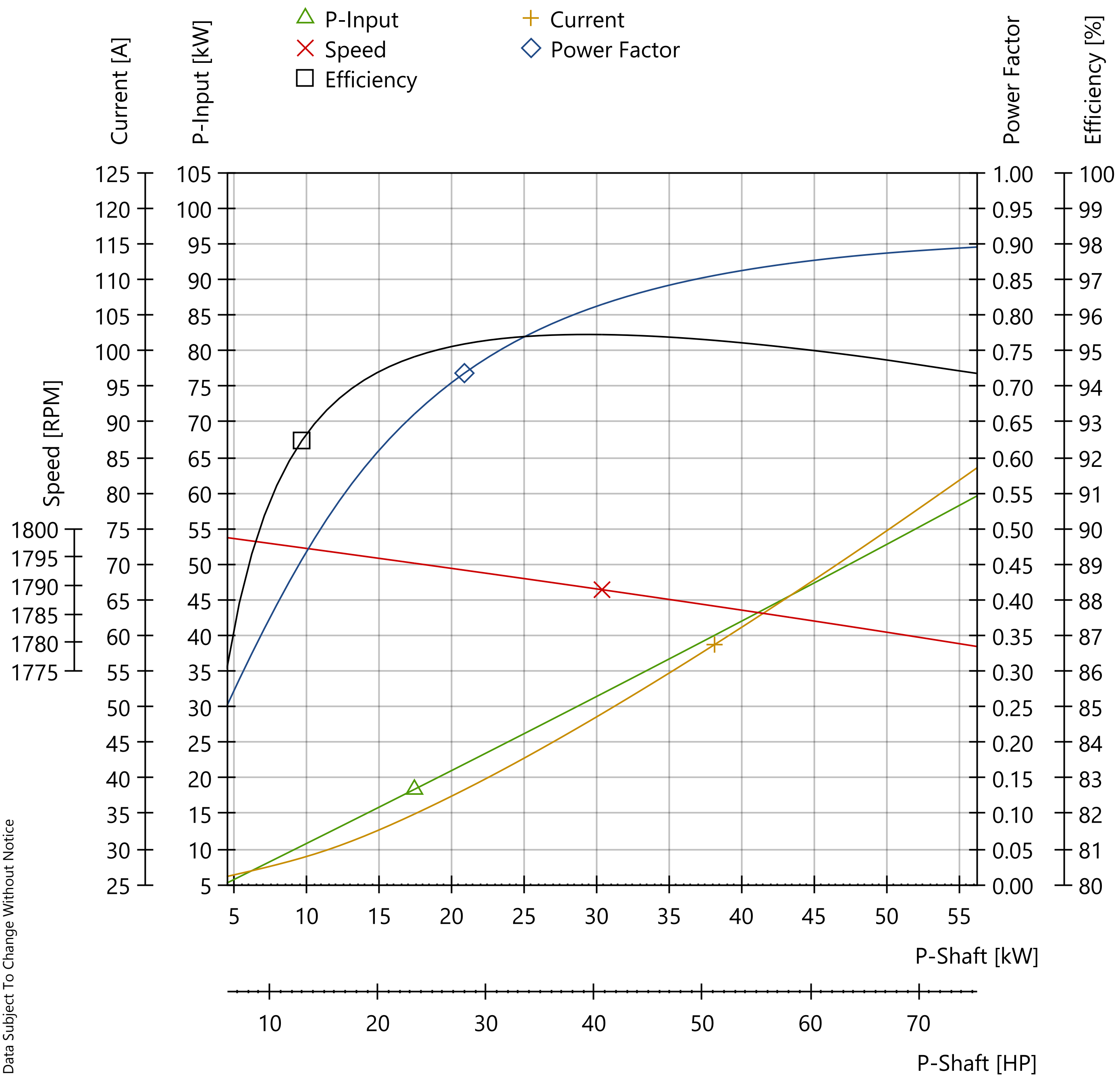
Voltage	3 * 460 V	Frequency	60 Hz	Poles	4	Stator	04 YSER
P-Input	42 kW	P-Shaft	40 kW / 54 HP	Current	61 A	Speed	1785 RPM

Torque (Nm / Quotient Compared To Torque At Nominal Speed)

			Moment Of Inertia
Start 415 / 1.9	Pull-Up 310 / 1.4	Break-Down 880 / 4.1	0.43 kgm²

Load	1/1	3/4	1/2
Power Factor	0.86	0.81	0.71
Efficiency %	95.2	95.5	95.1
Current A	61	49	37

Breakaway Starting Current (Locked Rotor Current Acc. To NEMA)	565 A
Breakaway Starting Power Factor	0.35
No Load Current	25 A
No Load Power Factor	0.035
Insulation	Class H



The values are stated with tolerances according to IEC 60034-1
at 75° C average winding temperature and 94 W friction losses

PP05 2.1.3

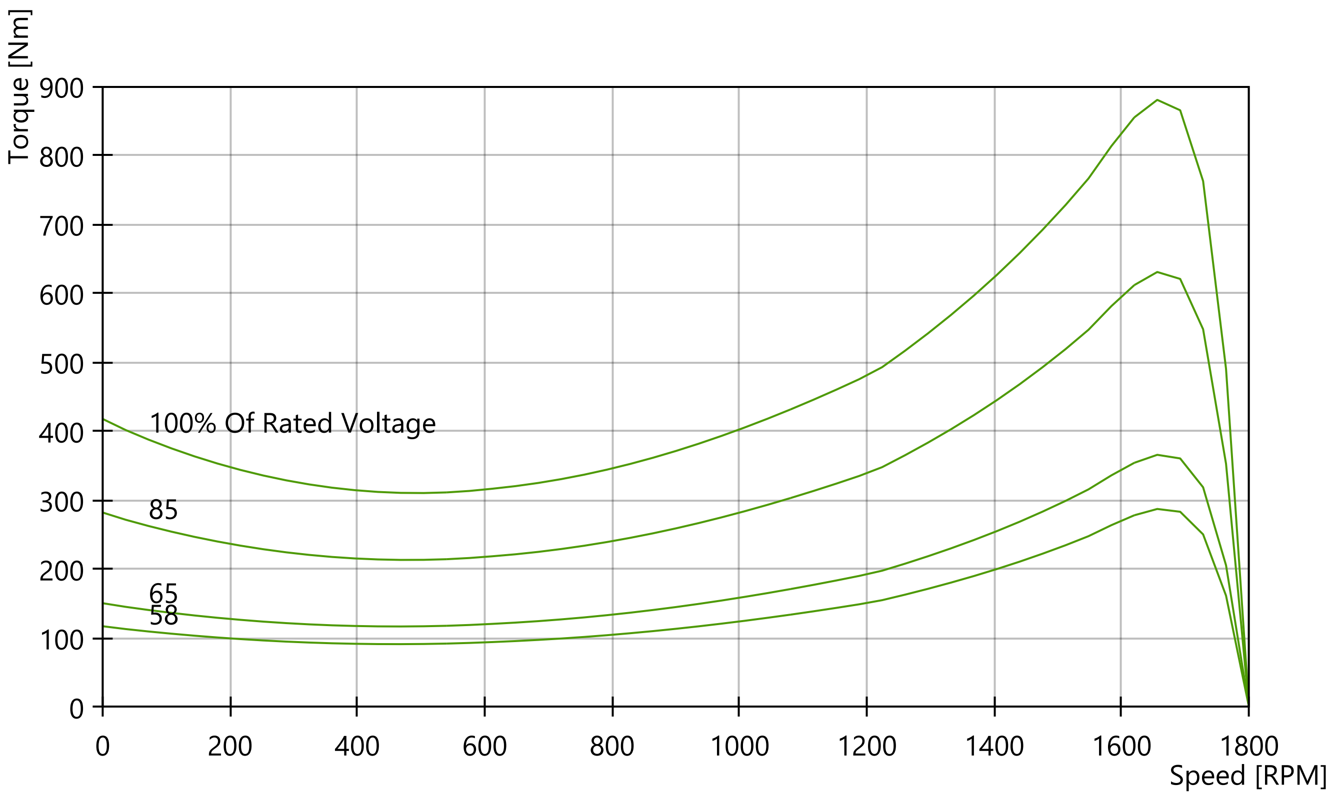
FLYGT

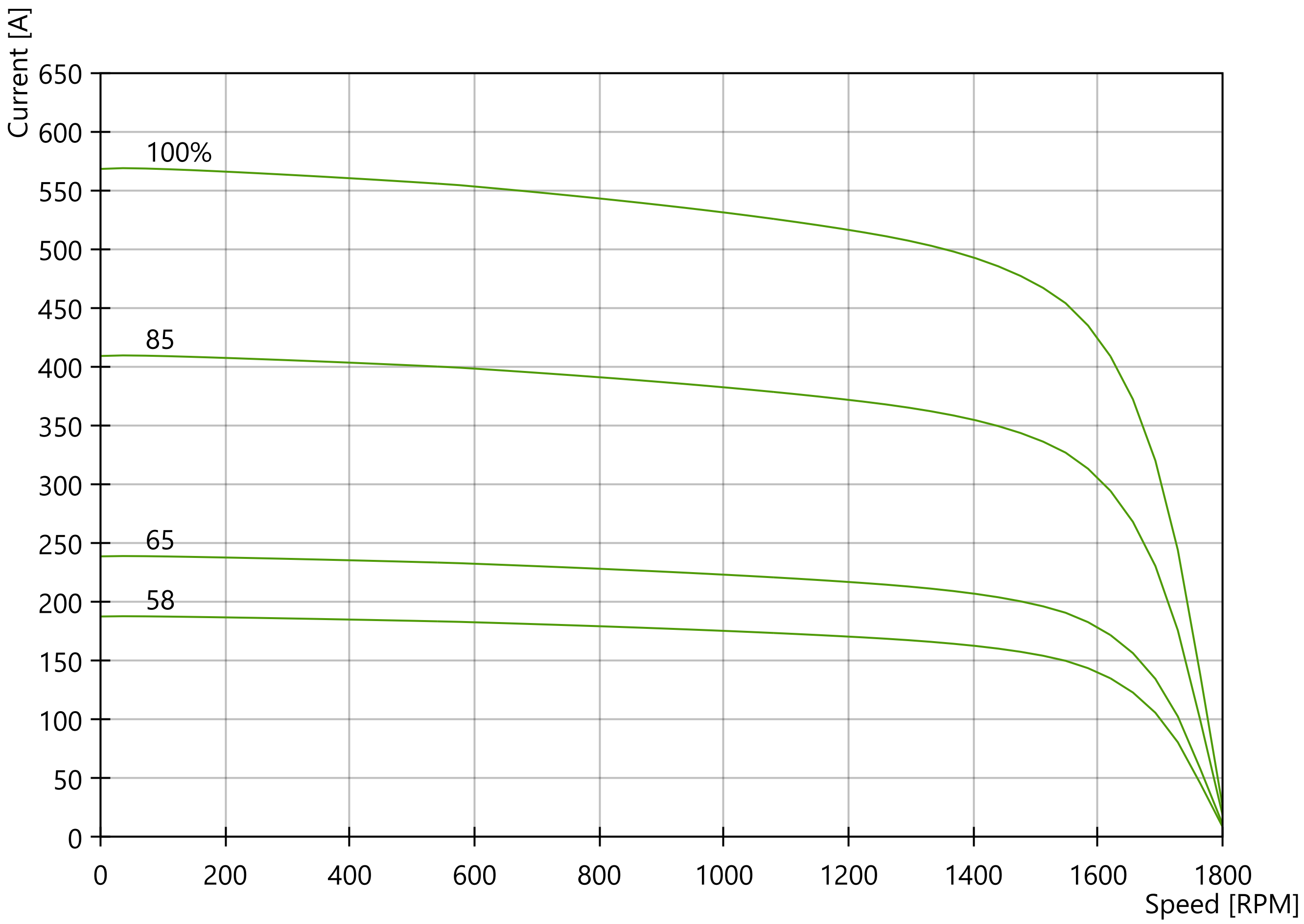
Torque-Current-Speed Chart

Motor Nr
30-37-4IE

Rated Values Voltage 3 * 460 V Frequency 60 Hz Stator 04 YSER

Issue 10
Date 2011-11-25





Run By: XY86272 Date: 2019-08-19 / MgData.Net (Version: 1.1.6)
Data Subject To Change Without Notice

PP05 2.1.3

Various Load Table

Motor Nr

30-37-4IE

Issue	10
Date	2011-11-25

Frequency:	60 Hz	
Number of Poles:	4	
Number of Phases:	3	
Rated Speed:	1785 RPM	
Rated Voltage:	460 V	
Rated Current:	61 A	
Rated OutPower:	40 kW	54 HP
Rated InPower:	42 kW	
Stator Variant:	04 YSER	

The values are valid at 75° C average winding temperature

		125%	110%	100%	90%	75%	50%	25%	10%
Output Power	kW	50	44	40	36	30	20	10	4
Output Power	HP	68	59	54	49	41	27	13.5	5.4
Input Power	kW	53	46	42	38	31	21	10.8	4.7
Efficiency	%	94.7	95.0	95.2	95.4	95.5	95.1	92.7	84.7
Current	A	75	66	61	56	49	37	29	26
Power Factor	-	0.89	0.87	0.86	0.85	0.81	0.71	0.47	0.23
Torque	Nm	265	235	215	190	160	105	53	21
Speed	RPM	1780	1785	1785	1785	1790	1795	1795	1800

No Load Current:	25 A		
Power factor at no load:	0.035		
Breakaway Starting Current:	565 A	Break. starting current/Rated current:	9.2
Breakaway Starting Power Factor:	0.35		
Starting torque:	415 Nm	Starting torque/Rated torque:	1.9
Max torque:	880 Nm	Max torque/Rated torque:	4.1
Speed at max. torque:	1660 RPM		
Rotor inertia:	0.43 kgm²		
Iron losses:	354 W		
Friction losses:	94 W	(at synchronous speed):	
Pull up torque:	310 Nm		

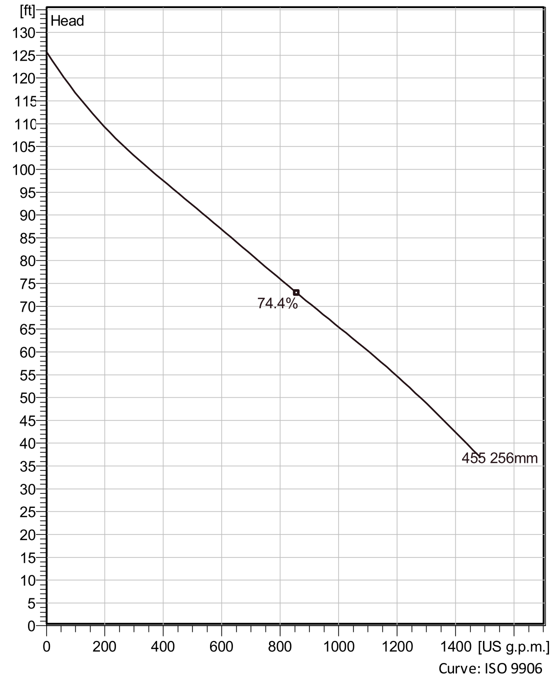
PP05 2.1.3

NT 3171 HT 3~ 455

Patented self cleaning semi-open channel impeller, ideal for pumping in most waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Technical specification

Curves according to: Water, pure [100%],39.2 °F,62.42 lb/ft³,1.69E-5 ft²/s



Configuration

Motor number
N3171.185 25-14-4AA-D 25hp

Installation type
T - Vertical Permanent, Dry

Impeller diameter
256 mm

Discharge diameter
3 15/16 inch

Pump information

Impeller diameter
256 mm

Discharge diameter
3 15/16 inch

Inlet diameter
100 mm

Maximum operating speed
1755 rpm

Number of blades
2

Materials

Impeller
Hard-Iron

Project	**Created by**		**Last update**	
Block	**Created on**	8/14/2019		

NT 3171 HT 3~ 455

Technical specification

Motor - General

Motor number N3171.185 25-14-4AA-D 25hp	**Phases** 3~	**Rated speed** 1755 rpm	**Rated power** 25 hp
Approval No	**Number of poles** 4	**Rated current** 31 A	**Stator variant** 7
Frequency 60 Hz	**Rated voltage** 460 V	**Insulation class** H	**Type of Duty** S1

Motor - Technical

Power factor - 1/1 Load 0.87	**Motor efficiency - 1/1 Load** 88.0 %	**Total moment of inertia** 3.28 lb ft²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.82	**Motor efficiency - 3/4 Load** 89.0 %	**Starting current, direct starting** 187 A	
Power factor - 1/2 Load 0.73	**Motor efficiency - 1/2 Load** 89.0 %	**Starting current, star-delta** 62.3 A	

Project	**Created by**		**Last update**	
Block	**Created on**	8/14/2019		

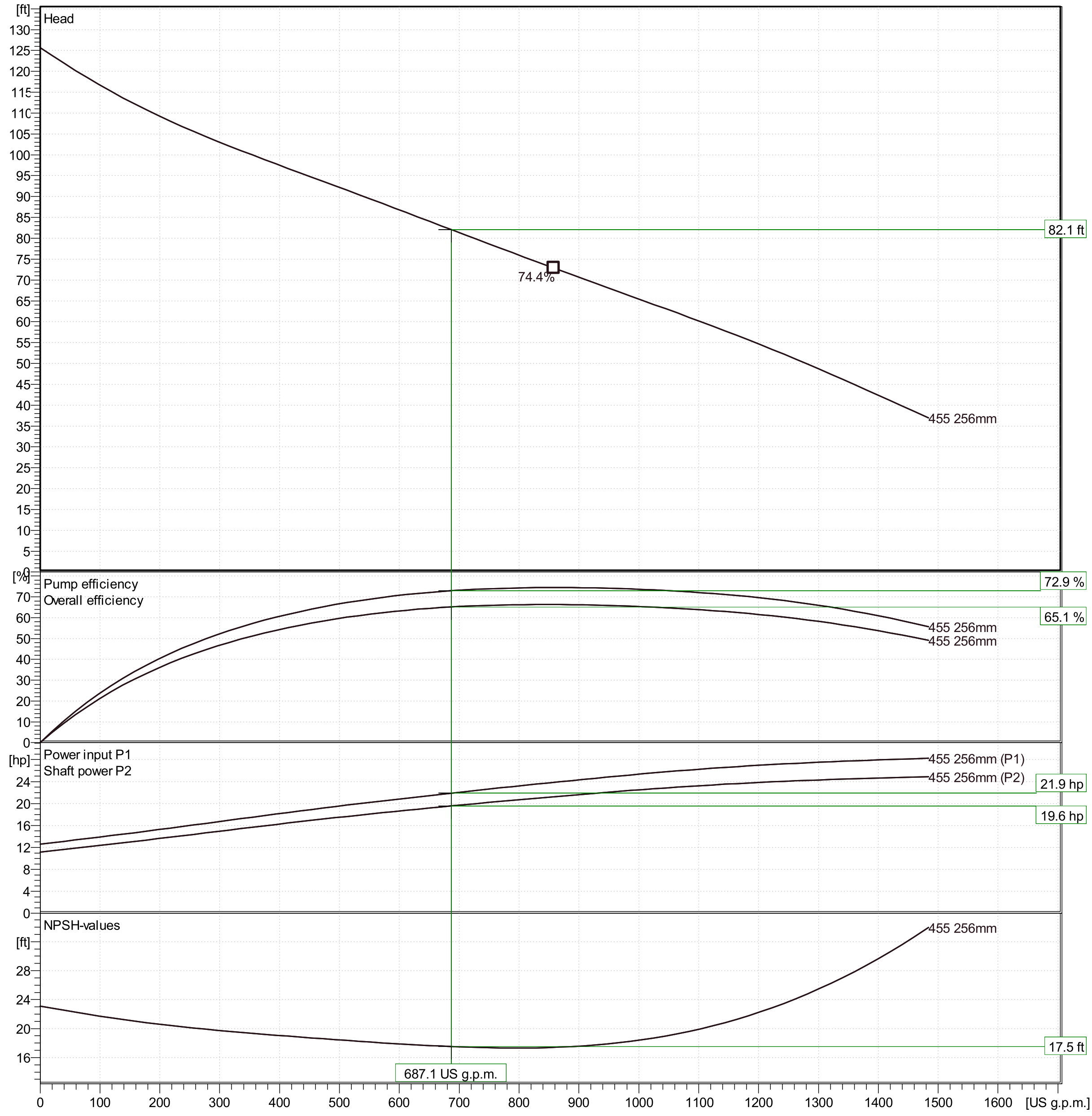
NT 3171 HT 3~ 455

Performance curve

Duty point

Flow	Head
687 US g.p.m.	82.1 ft

Curves according to: Water, pure [100%],39.2 °F,62.42 lb/ft³,1.69E-5 ft²/s



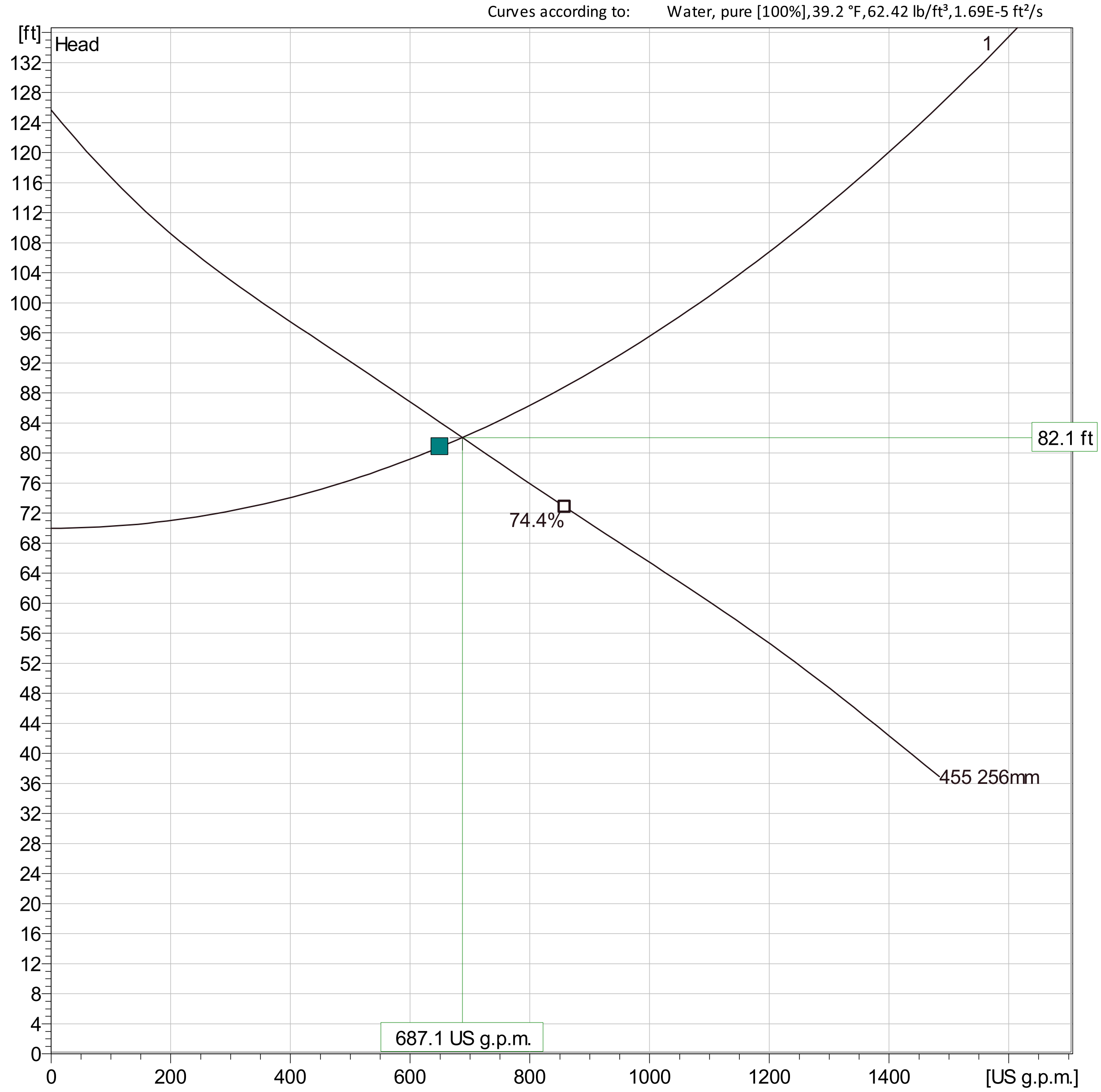
Curve: ISO 9906

Project	Created by	Last update
Block	Created on 8/14/2019	

NT 3171 HT 3~ 455

Duty Analysis

Curves according to: Water, pure [100%],39.2 °F,62.42 lb/ft³,1.69E-5 ft²/s



Curve: ISO 9906

Operating characteristics

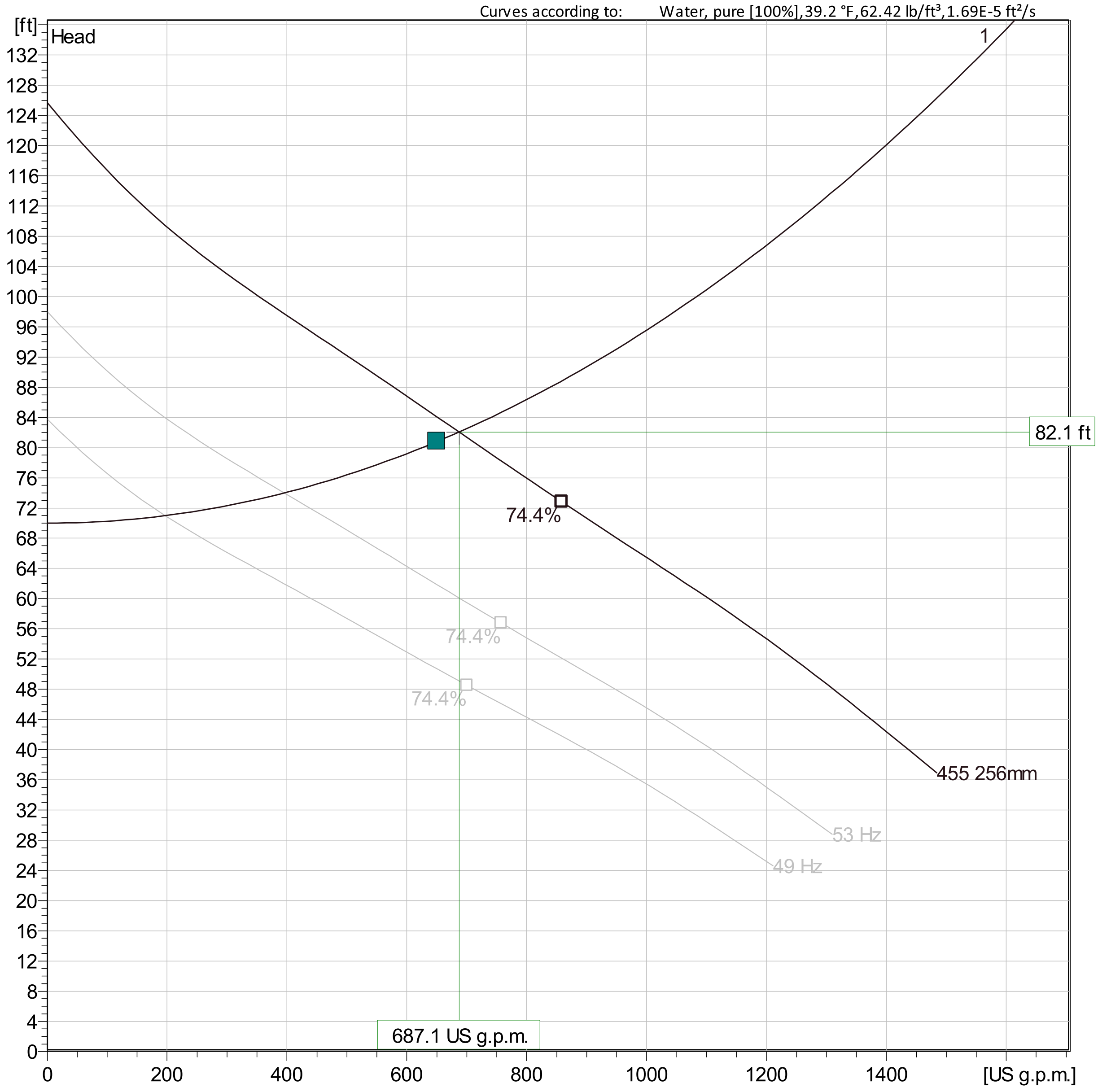
Pumps/Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
1	687 US g.p.m.	82.1 ft	19.6 hp	687 US g.p.m.	82.1 ft	19.6 hp	72.9 %	396 kWh/US M(	17.5 ft

Project	Created by		Last update	
Block	Created on	8/14/2019		

NT 3171 HT 3~ 455

VFD Analysis

Curves according to: Water, pure [100%],39.2 °F,62.42 lb/ft³,1.69E-5 ft²/s



Curve: ISO 9906

Operating Characteristics

Pumps/Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
1	60 Hz	687 US g.p.m.	82.1 ft	19.6 hp	687 US g.p.m.	82.1 ft	19.6 hp	72.9 %	396 kWh/US M	17.5 ft
1	53 Hz	396 US g.p.m.	74 ft	11.6 hp	396 US g.p.m.	74 ft	11.6 hp	63.8 %	411 kWh/US M	15.4 ft
1	49 Hz	197 US g.p.m.	71 ft	7.72 hp	197 US g.p.m.	71 ft	7.72 hp	45.9 %	560 kWh/US M	14.6 ft

Project	Created by		Last update	
Block	Created on	8/14/2019		

FLYGT

Motor Chart

Motor Nr

25-14-4AA

Issue	12
Date	2012-01-24

3171.095

Nominal Values

Voltage	3 * 460 V	Frequency	60 Hz	Poles	4	Stator	07 YSER
P-Input	21 kW	P-Shaft	18.6 kW / 25 HP	Current	31 A	Speed	1755 RPM

Torque (Nm / Quotient Compared To Torque At Nominal Speed)

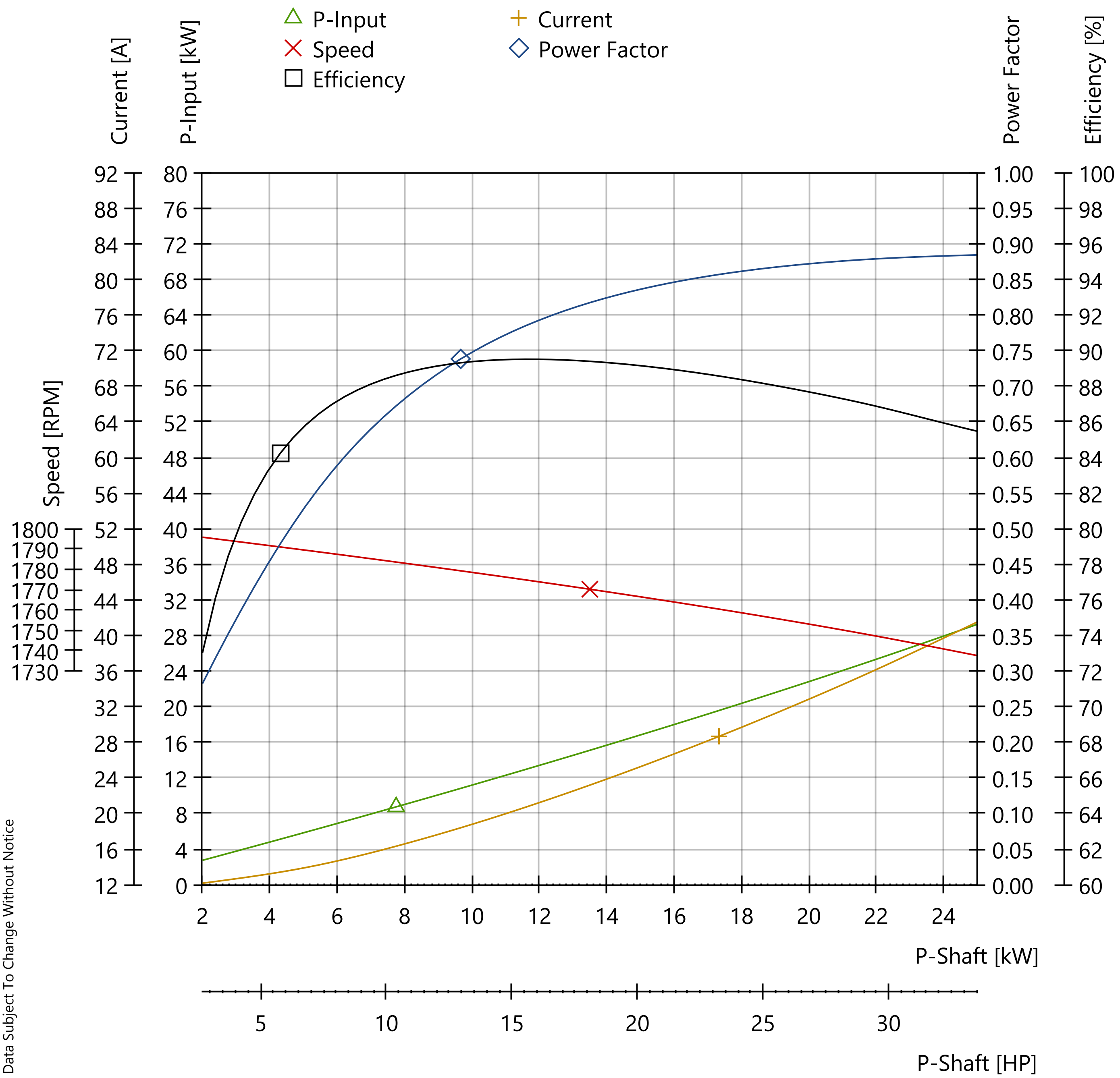
Start 135 / 1.3 Pull-Up 100 / 1.0 Break-Down 260 / 2.6

Moment Of Inertia

0.083 kgm²

Load	1/1	3/4	1/2
Power Factor	0.86	0.82	0.73
Efficiency %	88.2	89.3	89.2
Current A	31	24	18

Breakaway Starting Current (Locked Rotor Current Acc. To NEMA)	187 A
Breakaway Starting Power Factor	0.55
No Load Current	12 A
No Load Power Factor	0.077
Insulation	Class H



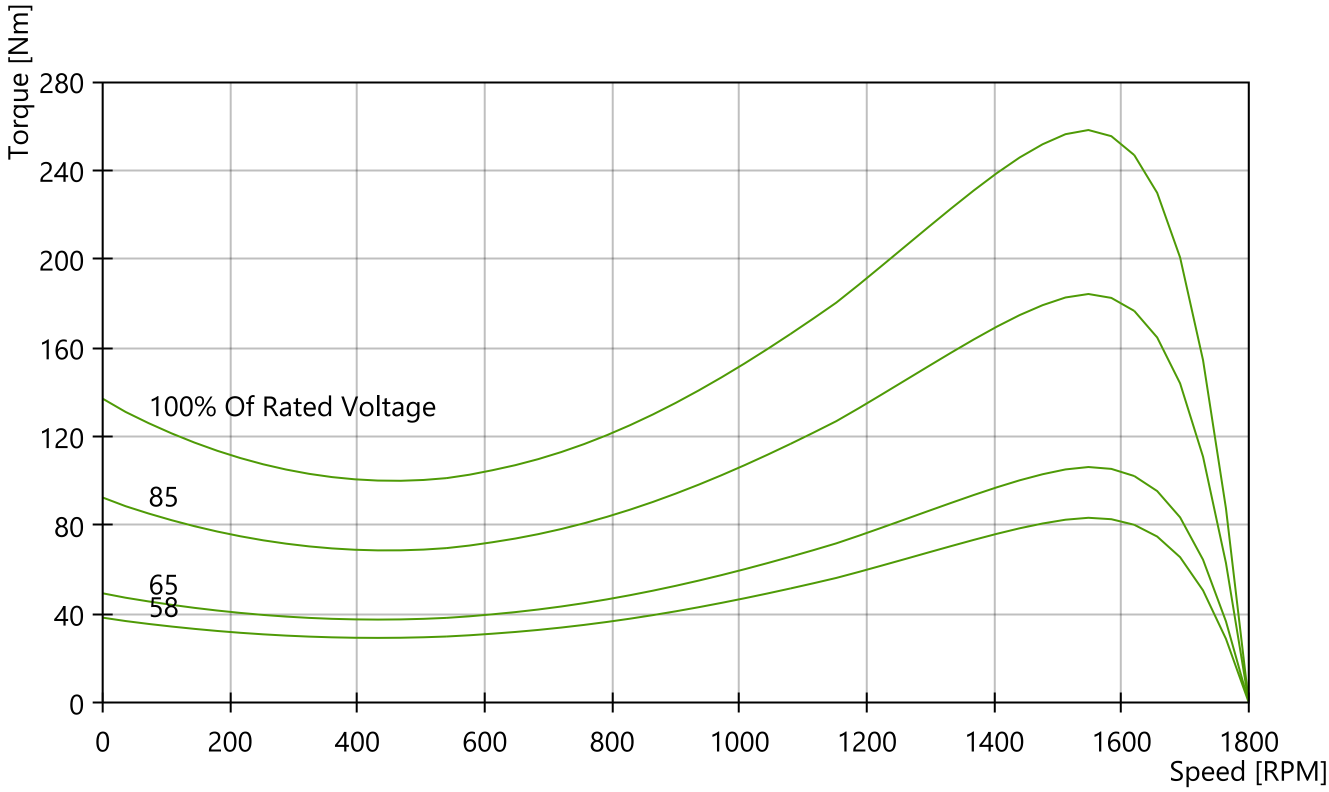
The values are stated with tolerances according to IEC 60034-1
at 75° C average winding temperature and 75 W friction losses

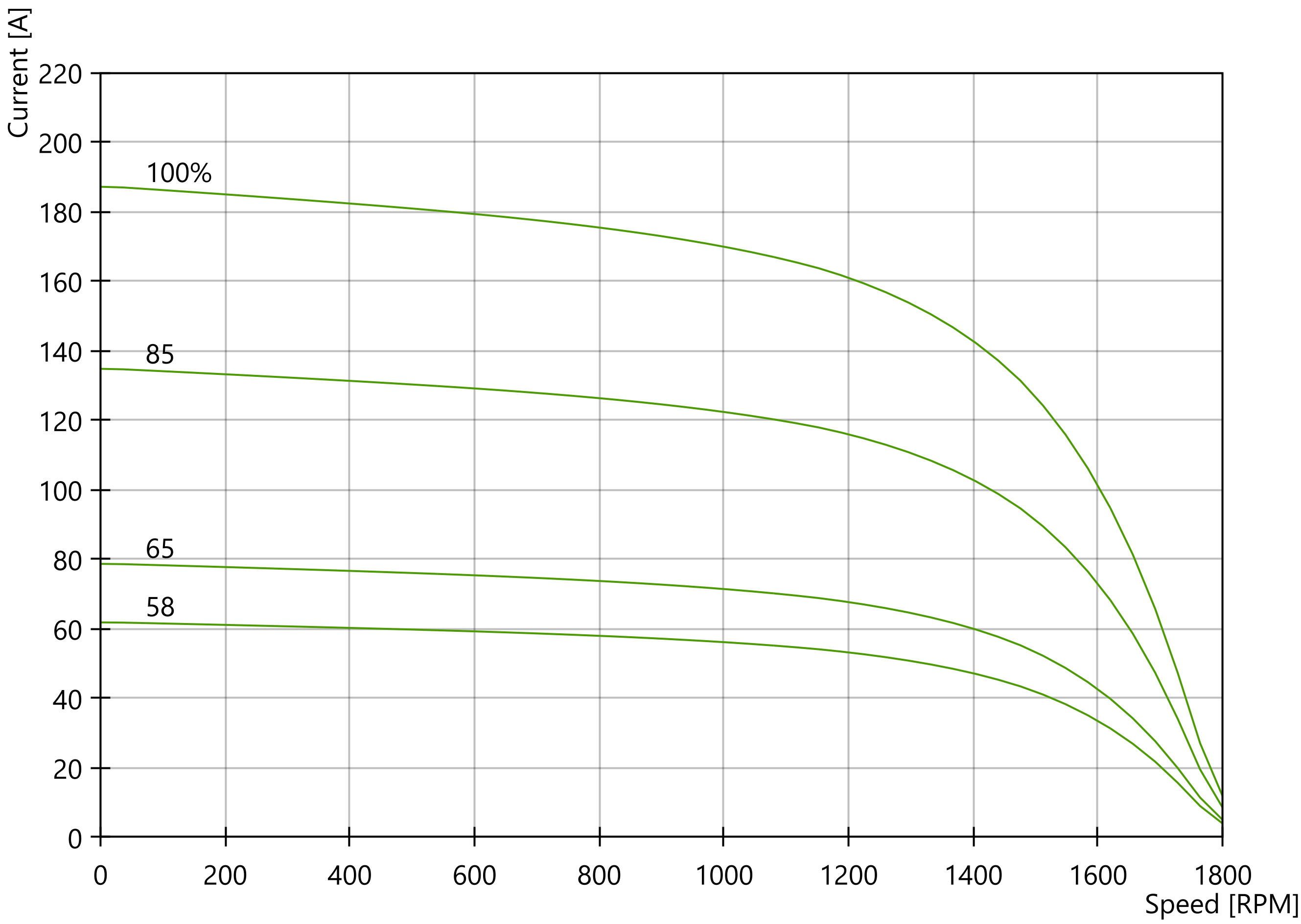
PP05 2.1.3

Torque-Current-Speed Chart

FLYGT	Torque-Current-Speed Chart	Motor Nr 25-14-4AA

Rated Values	Voltage	3 * 460	V	Frequency	60	Hz	Stator	07 YSER	Issue	12
									Date	2012-01-24





PP05 2.1.3

Various Load Table

Motor Nr

25-14-4AA

Issue 12

Date 2012-01-24

Frequency:	60 Hz
Number of Poles:	4
Number of Phases:	3
Rated Speed:	1755 RPM
Rated Voltage:	460 V
Rated Current:	31 A
Rated OutPower:	18.6 kW 25 HP
Rated InPower:	21 kW
Stator Variant:	07 YSER

The values are valid at 75° C average winding temperature

		125%	110%	100%	90%	75%	50%	25%	10%
Output Power	kW	23	20	18.6	16.7	14	9.3	4.7	1.9
Output Power	HP	31	28	25	23	18.8	12.5	6.3	2.5
Input Power	kW	27	23	21	18.9	15.6	10.4	5.5	2.6
Efficiency	%	86.3	87.5	88.2	88.7	89.3	89.2	85.0	71.7
Current	A	38	34	31	28	24	18	14	12
Power Factor	-	0.88	0.87	0.86	0.85	0.82	0.73	0.50	0.27
Torque	Nm	125	110	100	91	75	50	25	9.9
Speed	RPM	1745	1750	1755	1760	1770	1780	1790	1795

No Load Current:	12 A		
Power factor at no load:	0.077		
Breakaway Starting Current:	187 A	Break. starting current/Rated current:	6.1
Breakaway Starting Power Factor:	0.55		
Starting torque:	135 Nm	Starting torque/Rated torque:	1.3
Max torque:	260 Nm	Max torque/Rated torque:	2.6
Speed at max. torque:	1535 RPM		
Rotor inertia:	0.083 kgm^2		
Iron losses:	323 W		
Friction losses:	75 W	(at synchronous speed):	
Pull up torque:	100 Nm		

PP05 2.1.3

Pump Data Sheet - Hidrostal

Company:
Name:
Date: 08/12/2019

Pump:

Size:	F4K-S	Dimensions:	Suction:	8 in
Type:	K-Line		Discharge:	4 in
Synch Speed:	Adjustable			
Dia:	13.875 in			
Curve:	C-1413-1800			

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F		

Pump Limits:

Temperature:	---	Sphere Size:	2.95 in
Wkg Pressure:	---		

Search Criteria:

Flow:	1200 US gpm	Near Miss:	---
Head:	101 ft	Static Head:	71 ft

Motor:

Consult Hidrostal to select a motor for this pump.

Pump Selection Warnings:

None

--- Duty Point ---

Flow:	1375 US gpm
Head:	110 ft
Eff:	75.6%
Power:	50.7 hp
NPSHr:	8.99 ft
Speed:	1765 rpm

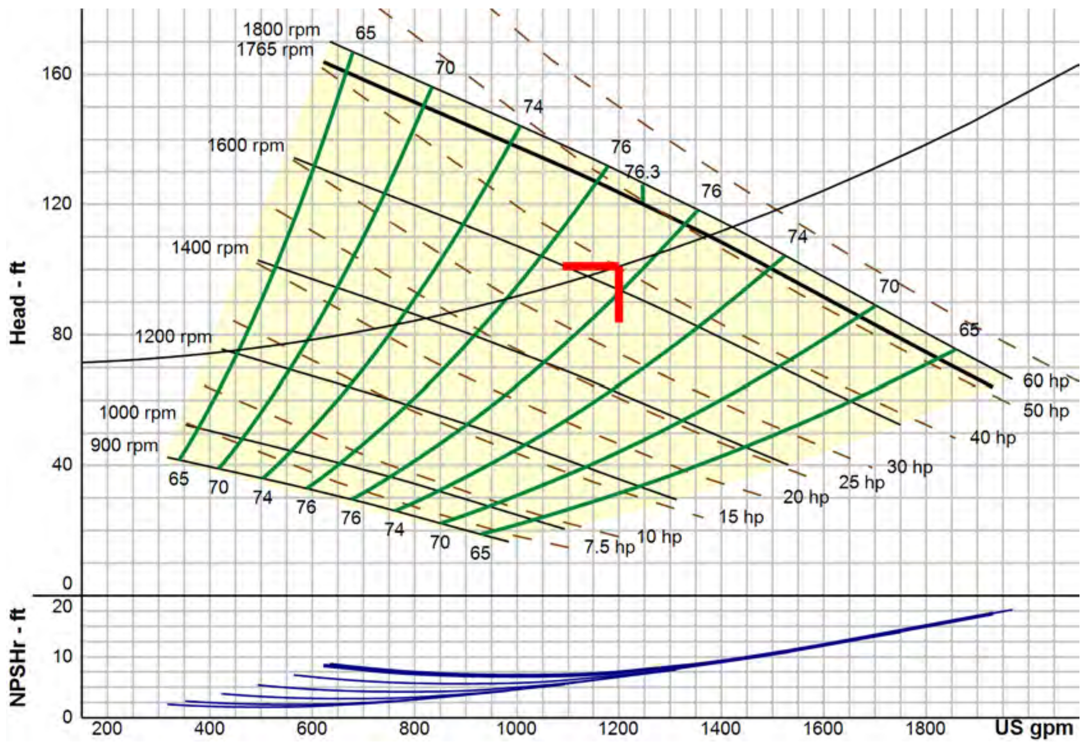
--- Design Curve ---

Shutoff Head:	164 ft
Shutoff dP:	71 psi
Min Flow:	--- US gpm

BEP: 76.3% @ 1246 US gpm
NOL Power:
51.6 hp @ 1669 US gpm

--- Max Curve ---

Max Power:
54.6 hp @ 1801 US gpm



Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
1440	1765	105	74.7	51	9.79
1200	1765	124	76.2	49.2	7.48
960	1765	141	73.3	46.5	6.88
720	1765	157	66.7	42.7	7.79
480	1765	---	---	---	---

FE5B4-MYAK Motor Data

Service Factor	1.02	MAX VFD POWER
Type	IMMERSIBLE	IMMERSIBLE
Speed	1 SPEED	1 SPEED
Size	TYPE F	TYPE F
Synchronous Speed	1800	1800
Motor Model	FE5B4-MYAK	FE5B4-MYAK
Voltage & Connected	460V	460V
HP @100%	74	65.3
RPM @100%	1772	1775
Efficiency @100%	91.5	91.6
Power Factor @100%	87	85
Input KW @100%	60.3	53.2
Amps (460V) @100%	87.1	78.6
HP @75%	55.5	49.0
RPM @75%	1779	1781
Efficiency @75%	91.7	91.4
Power Factor @75%	83	81
Input KW @75%	45.2	40.0
Amps (460V) @75%	68.4	62.0
HP @50%	37.0	N/A
RPM @50%	1786	N/A
Efficiency @50%	91	N/A
Power Factor @50%	78	N/A
Input KW @50%	30.3	N/A
Amps (460V) @50%	48.9	N/A
Start Amps (460V)	670	670
NEMA/NEC Code Letter	H	H
Cable Type	PURWIL EMC	PURWIL EMC
Power Cable OD	1 3/16"	1 3/16"
Power Cable Leads (# X mm)	4X25	4X25
Control Cable OD	7/16"	7/16"
Control Cable Leads (# X mm)	4X1.5	4X1.5
Control Cable OD	7/16"	7/16"
Control Cable Leads (# X mm)	5X1.5	5X1.5
Locked rotor/ run torque	3.7	3.7
Weight (lbs.)	1197	1197
Specific Wire Diagram	EL-2023-1000en	EL-2023-1000en
Relay Wire Diagram	WIR-1SPEED1POWER	WIR-1SPEED1POWER

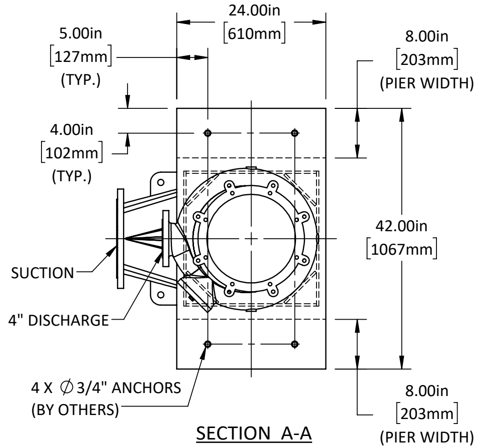
Maximum Temperature Rise (of windings): 115C
Maximum Ambient Temperature: 40C
Explosion Proof, Class 1, Division 1, Group C & D, Class F Insulation
Motor Data is Typical. Subject to Change.

 May 2018

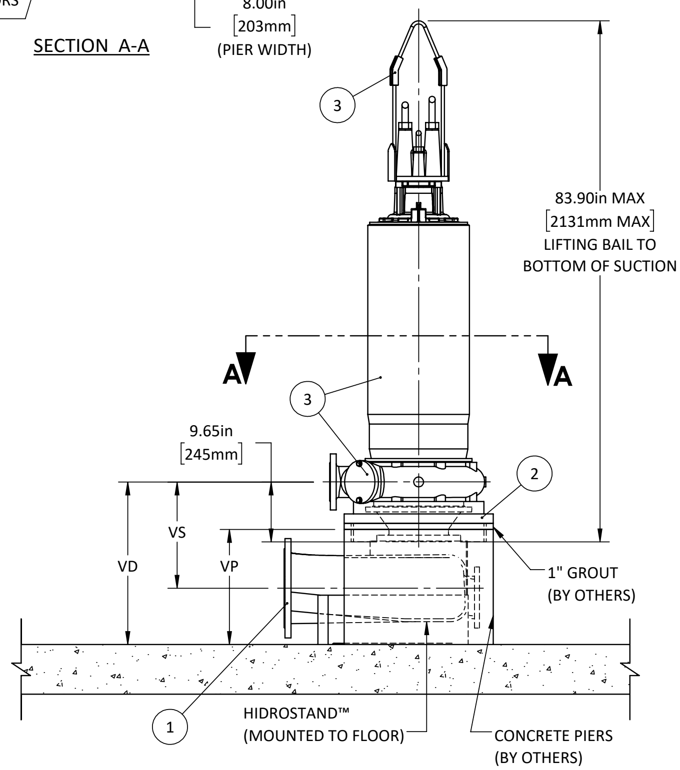
PUMP	HIDROSTAND™	SUCTION	VD	VS	VP	HA	HC	HD	HF
F4K-MH/-S	200 X 200	8"	23.82in [605mm]	16.34in [415mm]	16.53in [420mm]	18.11in [460mm]	7.28in [185mm]	14.57in [370mm]	12.60in [320mm]
	200 X 250	10"	26.18in [665mm]	17.13in [435mm]	18.54in [471mm]	21.65in [550mm]	9.06in [230mm]	18.11in [460mm]	14.57in [370mm]

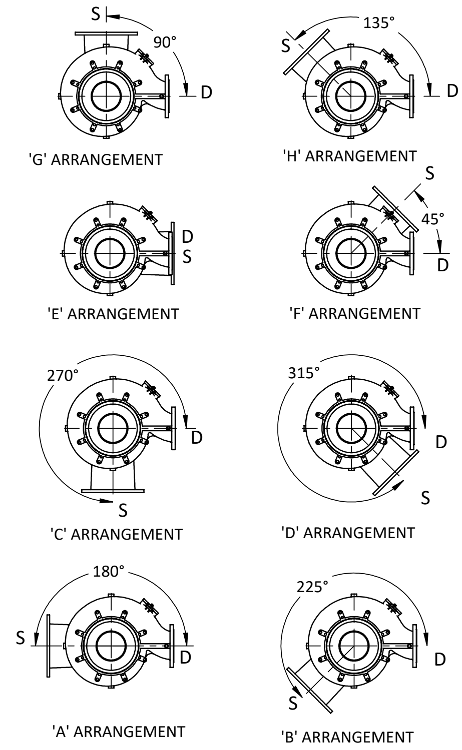
BILL OF MATERIALS

ITEM	QTY.	DESCRIPTION	APPROX. WEIGHT
1	1	HIDROSTAND™	180 LBS.
2	1	1 1/2" PUMP PIER PLATE W/SPACER	450 LBS.
3	1	PUMP	SEE TABLE



SECTION A-A





SUCTION AND DISCHARGE ARRANGEMENTS

MOTOR SIZE	APPROX. LIFTING WEIGHT (LBS.)
FE4A6	950 LBS.
FE4C4	1,000 LBS.
FE4S6	1,300 LBS.
FE4T4	1,200 LBS.
FE5B4	1,450 LBS.
FE5V4	1, 700 LBS.
FEXQ8	700 LBS.
FEXW6	800 LBS.
FEXW8	750 LBS.

*INCLUDES 82' OF CABLES & LIFTING BAIL

NOTES:

1. PUMP AND ACCESSORIES ARE DESIGNED FOR CONTINUOUS SERVICE.
2. PUMP SIZE, MODEL AND SERIAL NUMBER MUST BE SPECIFIED WHEN ORDERING SPARE PARTS.
3. CLOCKWISE ROTATION VIEWED FROM SHAFT END; CCW IS NOT AVAILABLE.
4. SUCTION AND DISCHARGE FLANGE MATE WITH CLASS 125 FLANGES.

F4K ™
F4K-MH ™
F4K-S ™

Hidrostal

HIDROSTAL PUMPS
North America

DESCRIPTION:
INSTALLATION
F4K-MH/-S
IMMERSIBLE/SUBMERSIBLE
VERTICAL PIER MOUNT & HIDROSTAND™

REV	DATE	ZONE	DESCRIPTION	APPROVED
A	09/26/18		UPDATED DRAWING WITH B.O.M & APPROX. WEIGHT.	

STANDARD MACHINE TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS IN INCHES

// .005 TIR   ↗ .005 TIR   .XX ±0.02   BREAK OUTSIDE EDGES .005-.035
⊥ .005 TIR   ∠ ± .5°   .XXX ±0.005   INSIDE CORNER R .035 MAX
◎ .005 TIR   √ 125 RMS   X/X ±1/32   ALL DRILL & TAP DEPTHS ±0.06

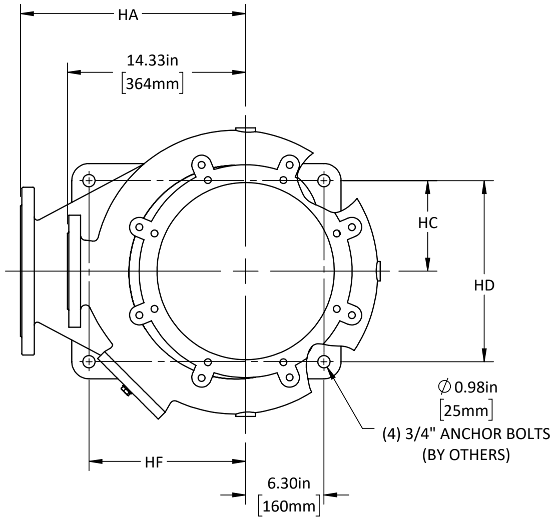
DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

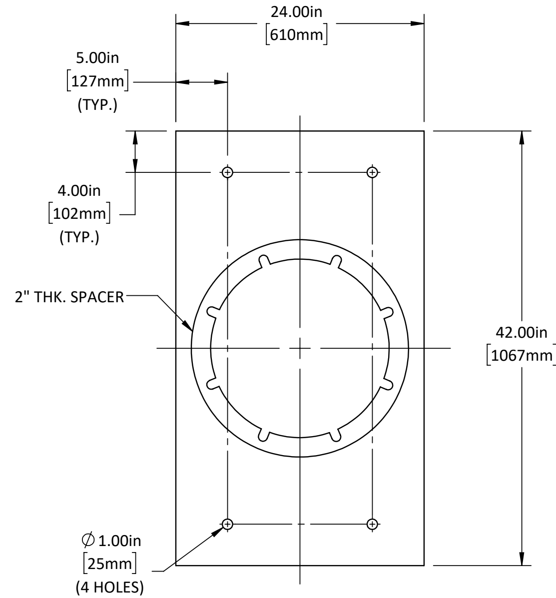
PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF HIDROSTAL LLC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF HIDROSTAL LLC IS PROHIBITED.

MODEL:	SALES ORDER:	DRAWING NUMBER: INS-IS-F4K-VPMHS	
DRAWN BY: TES	DATE: 01/04/16	WEIGHT:	SCALE: 1:20
CHECKED BY:	DWG. SIZE: B	SHEET 1 OF 2	REV. A

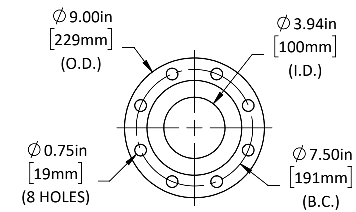


HIDROSTAND™ ANCHOR BOLT PLAN



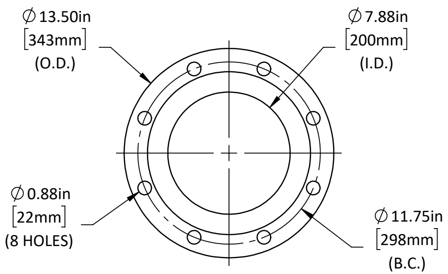
PUMP PIER PLATE

(SCALE: 1:12)



4" DISCHARGE FLANGE

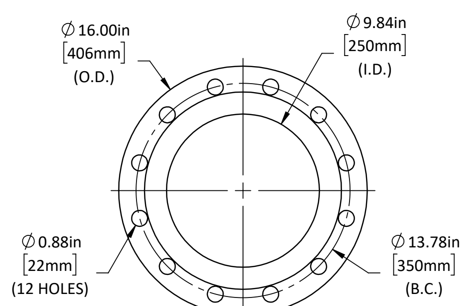
(SCALE: 1:8)



8" SUCTION FLANGE

(200X200 HIDROSTAND™)

(SCALE: 1:8)



10" SUCTION FLANGE

(200X250 HIDROSTAND™)

(SCALE: 1:8)

F4K ™
F4K-MH ™
F4K-S ™

HIDROSTAL PUMPS
North America

DESCRIPTION:
INSTALLATION
F4K-MH/-S
IMMERSIBLE/SUBMERSIBLE
VERTICAL PIER MOUNT & HIDROSTAND™

REV	DATE	ZONE	DESCRIPTION	APPROVED
A	09/26/18		UPDATED DRAWING WITH B.O.M & APPROX. WEIGHT.	

STANDARD MACHINE TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS IN INCHES

// .005 TIR ⟂ .005 TIR ◎ .005 TIR
↗ .005 TIR ∠ ± .5° √ 125 RMS
.XX ±0.02 .XXX ±0.005 X/X ±1/32
BREAK OUTSIDE EDGES .005-.035
INSIDE CORNER R .035 MAX
ALL DRILL & TAP DEPTHS ±0.06

DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF HIDROSTAL LLC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF HIDROSTAL LLC IS PROHIBITED.

MODEL:	SALES ORDER:	DRAWING NUMBER: INS-IS-F4K-VPMHS	
DRAWN BY: TES	DATE: 01/04/16	WEIGHT:	SCALE: 1:10
CHECKED BY:	DWG. SIZE: B	SHEET 1 OF 2	REV. A

DEXW2-MYAK Motor Data

Service Factor	1.04	MAX VFD POWER
Type	IMMERSIBLE	IMMERSIBLE
Speed	1 SPEED	1 SPEED
Size	TYPE D	TYPE D
Synchronous Speed	3600	3600
Motor Model	DEXW2-MYAK	DEXW2-MYAK
Voltage & Connected	230/460V CONNECTED 460V	230/460V CONNECTED 460V
HP @100%	30	26.6
RPM @100%	3520	3529
Efficiency @100%	84	83
Power Factor @100%	82	80
Input KW @100%	26.6	23.9
Amps (460V) @100%	40.8	37.6
HP @75%	22.5	20.0
RPM @75%	3540	3547
Efficiency @75%	82	80
Power Factor @75%	77	75
Input KW @75%	20.5	18.6
Amps (460V) @75%	33.4	31.2
HP @50%	15.0	N/A
RPM @50%	3560	N/A
Efficiency @50%	76	N/A
Power Factor @50%	71	N/A
Input KW @50%	14.7	N/A
Amps (460V) @50%	26.1	N/A
Start Amps (460V)	408	408
NEMA/NEC Code Letter	K	K
Cable Type	PURWIL EMC	PURWIL EMC
Power Cable OD	1 3/16"	1 3/16"
Power Cable Leads (# X mm)	4X25	4X25
Control Cable OD	7/16"	7/16"
Control Cable Leads (# X mm)	4X1.5	4X1.5
Control Cable OD	7/16"	7/16"
Control Cable Leads (# X mm)	5X1.5	5X1.5
Locked rotor/ run torque	4.9	4.9
Weight (lbs.)	389	389
Specific Wire Diagram	EL-2023-1000en	EL-2023-1000en
Relay Wire Diagram	WIR-1SPEED1POWER	WIR-1SPEED1POWER

Maximum Temperature Rise (of windings): 115C
Maximum Ambient Temperature: 40C
Explosion Proof, Class 1, Division 1, Group C & D, Class F Insulation
Motor Data is Typical. Subject to Change.

 April 2016

Pump Data Sheet - Hidrostal

Company:
Name:
Date: 08/15/2019

Pump:

Size:	D4K-LT	Dimensions:	Suction:	4 in
Type:	K-Line		Discharge:	4 in
Synch Speed:	Adjustable			
Dia:	8.75 in			
Curve:	C-1389-2900			

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F		

Pump Limits:

Temperature:	---	Sphere Size:	2.76 in
Wkg Pressure:	---		

Search Criteria:

Flow:	650 US gpm	Near Miss:	---
Head:	81 ft	Static Head:	71 ft

Motor:

Consult Hidrostal to select a motor for this pump.

Pump Selection Warnings:

None

--- Duty Point ---

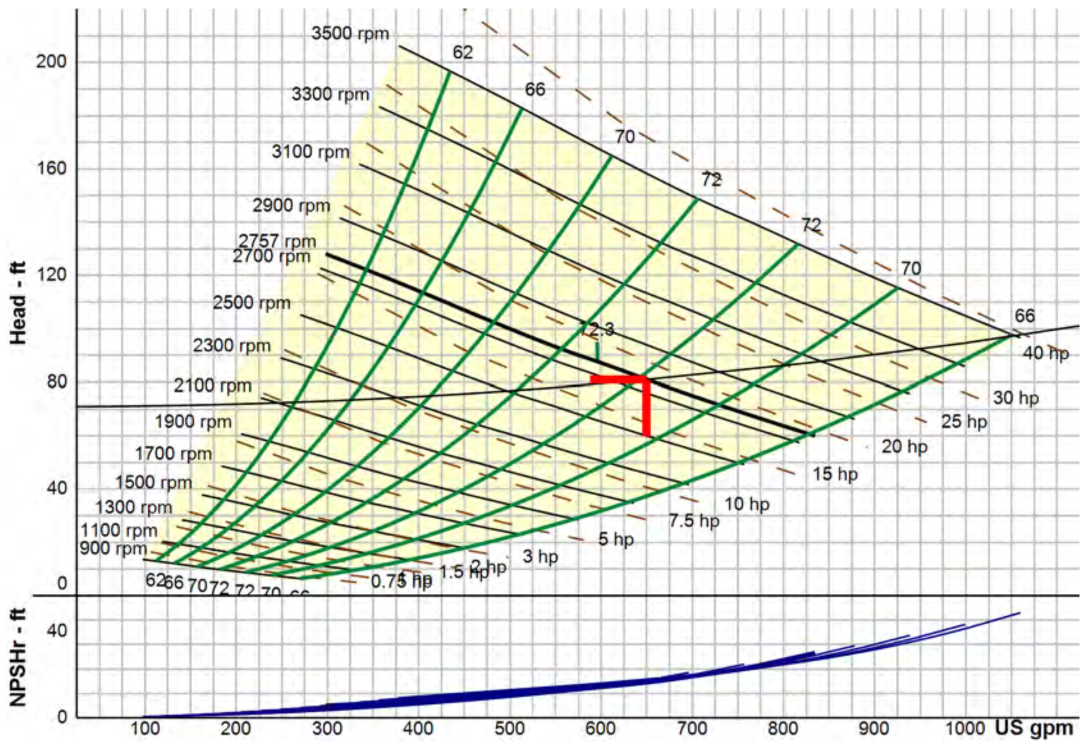
Flow:	650 US gpm
Head:	81 ft
Eff:	71.9%
Power:	18.5 hp
NPSHr:	14.4 ft
Speed:	2757 rpm

--- Design Curve ---

Shutoff Head: 128 ft
Shutoff dP: 55.5 psi
Min Flow: --- US gpm
BEP: 72.3% @ 596 US gpm
NOL Power:
19.3 hp @ 835 US gpm

--- Max Curve ---

Max Power:
39.4 hp @ 1060 US gpm



Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
780	2757	66	68.1	19.1	22.3
650	2757	81	71.9	18.5	14.4
520	2757	97.4	71	17.9	10.1
390	2757	116	65.1	17.5	7.05
260	2757	---	---	---	---

Selected from catalog: Hidrostal.update 1.60, Vers 0.0.5

Unmatched Reliability

Vaughan® Chopper

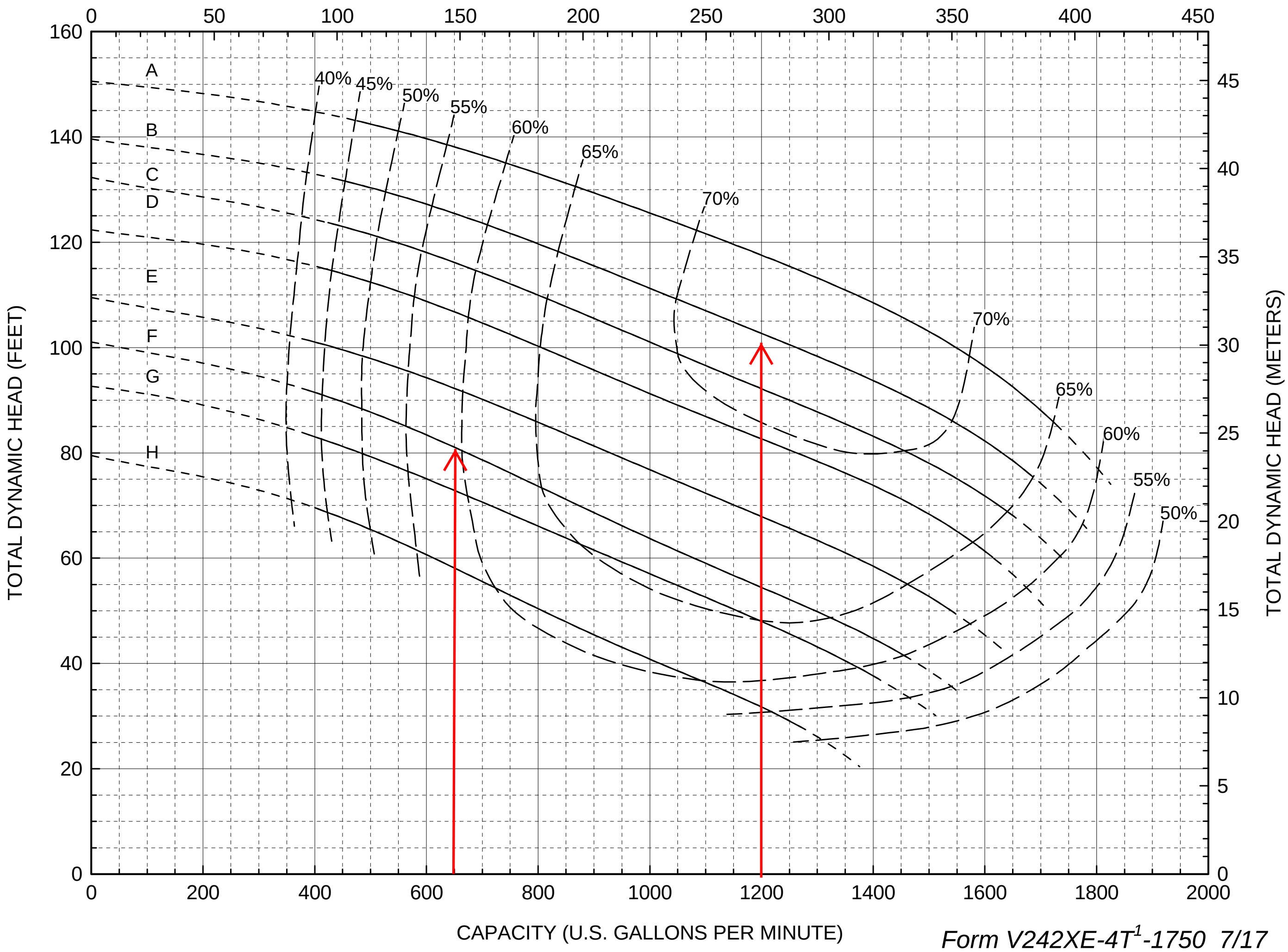
PERFORMANCE CURVE

Models:
S4T

6-Blade Impeller
4" Discharge

CURVE	POWER (HP/KW)	SPEED (RPM)	IMPELLER DIAMETER
A	60 / 45	1770	11.80" (300mm)
B	50 / 37	1770	11.30" (287mm)
C	50 / 37	1770	11.00" (279mm)
D	40 / 30	1740	10.80" (274mm)
E	40 / 30	1740	10.30" (262mm)
F	30 / 22	1755	9.90" (251mm)
G	25 / 19	1755	9.50" (241mm)
H	20 / 15	1750	8.90" (226mm)

DO NOT OPERATE PUMP IN DOTTED PORTION OF CURVES. PUMPS MAY EXCEED HP SHOWN IF OPERATED IN DOTTED PORTION OF CURVE. CURVES ARE SUBJECT TO CHANGE WITHOUT NOTICE. EFFICIENCIES SHOWN ARE NOMINAL BOWL. GUARANTEED MINIMUM EFFICIENCIES PER H.I. LEVEL A.



Form V242XE-4T[1]-1750 7/17

Appendix 10

Pump Station Cost Estimates

CARDIFF PUMP STATION IMPROVEMENT PROJECT COST ESTIMATE		
No.	**Recommended Improvement**	**Cost**
1	Replacement of the older 480-volt panel with a new panel	$15,000.00
2	Replacement of one VFD (40 hp pump) within the existing enclosure.	$15,000.00
3	Addition of a submersible or ultrasonic wet well level sensor to the wet well	$3,000.00
4	Addition of NFPA 820 controls and alarm for drywell ventilation	$5,000.00
5	Replacement of the existing old air conditioner (one) on the VFD with a new air conditioner	$7,500.00
6	Replacement of the existing 40 hp pumps with recessed impeller or chopper type impeller style	$49,000.00
7	Installation of a ventilation system to comply with NFPA 820 requirements	$25,000.00
8	Transfer of the minor pump control interface from the MCC section to the new enclosure	$37,000.00
9	Demolition of the existing MCC	$18,500.00
10	Replacement of the existing wet well with a newer wet well	$50,000.00
11	Installation of a fuel-tank level sensor for stand-by generator	$6,500.00
12	Replacement of the corroded louver door the pump station and the stand-by generator building.	$4,000.00
13	Replacement of the existing acoustic insulation in the stand-by generator building with aluminum enclosed acoustic panels	$35,000.00
14	Painting and recoating of building trim, interior steel.	$1,200.00
15	Painting and recoating of pipes, valves and appurtenances inside the drywell	$5,000.00
16	Relocation of existing emergency bypass connection	$23,500.00
	Subtotal	**$300,200.00**
	General Requirements	$56,000.00
	Engineering (15%)	$45,030.00
	Overhead and Profit (15%)	$45,030.00
	Contingency (30%)	$90,060.00
	Total	**$536,320.00**

OLIVENHAIN PUMP STATION IMPROVEMENT PROJECT COST ESTIMATE		
No.	**Recommended Improvement**	**Cost**
1	Pavement Overlay	$10,000.00
2	Replacement of Existing 200 KW Generator	$65,000.00
	Subtotal	**$75,000.00**
	General Requirements	$8,000.00
	Engineering (15%)	$11,250.00
	Overhead and Profit (15%)	$11,250.00
	Contingency (30%)	$22,500.00
	Total	**$128,000.00**

4 Cost Analysis

This section summarizes Dudek's opinion of probable construction costs associated with the improvements recommended in this evaluation, as well as a life cycle cost analysis to assist SEJPA and the City in understanding the most cost effective, efficient, and beneficial approach to improving the pumping system at MBPS.

4.1 Opinion of Probable Costs for Construction of Recommended Improvements

The opinion of probable construction costs associated with the improvements/upgrades recommended in this evaluation are summarized in Table 4.1. Note that this cost summary is based on provision of Flygt pumps – the most cost effective pump upgrade alternative.

Table 4.1 MBPS Engineer's Opinion of Probable Construction Costs

Specification Division			Total
Division 1 - General Requirements		$	66,000
Division 2 - Sitework		$	50,000
Division 3 - Concrete		$	10,000
Division 4 - Masonry		$	-
Division 5 - Metals		$	-
Division 6 - Wood and Plastics		$	-
Division 7 - Thermal and Moisture Protection		$	-
Division 8 - Doors, Windows, and Hardware		$	-
Division 9 - Finishes		$	-
Division 10 - Specialties		$	-
Division 11 - Equipment		$	162,306
Division 12 - Furnishings		$	-
Division 13 - Special Construction		$	-
Division 14 - Conveying Systems		$	3,960
Division 15 - Mechanical		$	96,120
Division 16 - Electrical		$	7,000
Division 17 - Instrumentation		$	7,000
Totals		**$**	**403,000**
Project Level Allowance	25%	$	100,750
Insurance	1.50%	$	6,045
Profit	10%	$	40,300
Bond	1%	$	4,030
Escalation to Midpoint (3%/yr x 3 yrs)	9.0%	$	18,135
Total		$	170,000
Grand Total		**$**	**573,000**

Appendix 11

CIP Pipeline Project Cost Estimates

City of Encinitas
CIP Capacity Improvement Projects

No.	CIP Project ID	Location Description	Length (ft)	Existing Diameter (inches)	Proposed Diameter (inches)	Sanitary Division	Unit Cost	Subtotal	Design (15%)	Construction Management (15%)	Contingency (30%)	Estimated Total
Phase 1												
1	A1	OTS - Jackie Lane to Brookside Lane	1,106	8	10	CSD	$325	$ 359,581	$ 53,937	$ 62,028	$ 142,664	$ 618,210
2	B1	OTS - Olivenhain Pump Station to Siphon	594	15	18	CSD	$475	$ 281,957	$ 42,293	$ 48,638	$ 111,866	$ 484,754
7	D1	CTS - Cardiff Pump Station to Manchester Avenue	158	15	18	CSD	$475	$ 74,863	$ 11,229	$ 12,914	$ 29,702	$ 128,708
8	E1	Tributary to CTS - Cardiff Pump Station	53	8	10	CSD	$325	$ 17,108	$ 2,566	$ 2,951	$ 6,788	$ 29,413
9	F1	CRTS - Chesterfield Drive to Liverpool Drive	849	12	15	CSD	$400	$ 339,596	$ 50,939	$ 58,580	$ 134,735	$ 583,851
10	G1	CRTS - Burkshire Avenue to Sheffield Avenue	284	10	15	CSD	$400	$ 113,428	$ 17,014	$ 19,566	$ 45,002	$ 195,010
11	H1	CRTS - Sheffield Avenue to Loch Lomond Drive	2,142	10	12	CSD	$375	$ 803,359	$ 120,504	$ 138,579	$ 318,733	$ 1,381,174
12	I1	Tributary to CRTS - Cathy Lane and Orkney Lane	15	10	12	CSD	$375	$ 5,575	$ 836	$ 962	$ 2,212	$ 9,585
13	J1	CTS - Liszt Avenue to Verdi Avenue	433	8	10	CSD	$325	$ 140,790	$ 21,118	$ 24,286	$ 55,858	$ 242,053
											Phase I Total	**$ 3,672,758**
Phase II												
3	B2	OTS - Olivenhain Pump Station to Siphon	61	15	18	CSD	$475	$ 28,999	$ 4,350	$ 5,002	$ 11,505	$ 49,856
14	J2	CTS - Liszt Avenue to Verdi Avenue	323	8	10	CSD	$325	$ 104,836	$ 15,725	$ 18,084	$ 41,594	$ 180,239
											Phase II Total	**$ 230,096**
Phase III												
4	B3	OTS - Olivenhain Pump Station to Siphon	536	15	18	CSD	$475	$ 254,426	$ 38,163.96	$ 43,889	$ 100,944	$ 437,423
6	C3	OTS - S Rancho Santa Fe Road	113	15	18	CSD	$475	$ 53,466	$ 8,019.88	$ 9,223	$ 21,213	$ 91,921
											Phase III Total	**$ 529,344**
Phase IV												
5	B4	OTS - Olivenhain Pump Station to Siphon	3,722	15	18	CSD	$475	$ 1,767,930	$ 265,189	$ 304,968	$ 701,426	$ 3,039,514
16	B5	OTS - El Camino Del Norte to Bella Collina	820	15	18	CSD	$475	$ 389,500	$ 58,425	$ 67,189	$ 154,534	$ 669,648
17	B6	OTS - Mira Costa College Road to S Rancho Santa Fe Road	593	15	18	CSD	$475	$ 281,675	$ 42,251	$ 48,589	$ 111,755	$ 484,270
15	K4	Tributary to ETS - Property East of Ocean Avenue	105	8	10	ESD	$325	$ 34,155	$ 5,123	$ 5,892	$ 13,551	$ 58,721
											Phase IV Total	**$ 4,252,152**
											TOTAL	**$ 8,684,349**

NV5 Delivering Solutions Improving Lives