

# Appendix K

## **Sewer Flow Study and Memo**





**Design with Purpose**

771 E Daily Drive, Suite 120  
Camarillo, CA 93010  
805.738.5434  
[www.ccedesignassociates.com](http://www.ccedesignassociates.com)

January 9, 2024

Mark Ross  
c/o Vintage Housing  
369 San Miguel Drive, Suite 135  
Newport Beach, CA 92660

Re: Lockwood 3  
CCE Project No. C20.0275D

Dear Mark Ross:

We have reviewed the preliminary flow data provided by ADS in real time during the sewer flow testing which was performed between December 13, 2023 and January 3, 2024. The sewer line that was tested exists between Manhole R-21-102 and Manhole R21-122, within the Rice Road Drain right-of-way owned by the Ventura County Watershed Protection District.

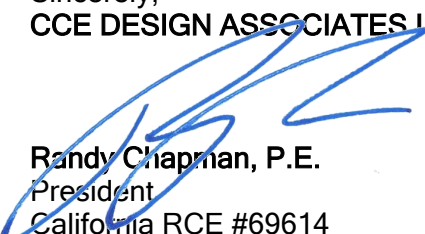
The total monitored section contains 5 manholes (3 of which had monitoring devices installed) and encompasses approximately 578 linear feet of 18" VCP sewer at a slope of 0.18%.

During the flow monitoring period, flow monitoring data showed several consistent intervals where flow peaked at a depth of over 14 inches. This represents approximately 78% full which exceeds the 75% allowable for pipe sizes of this diameter. Also noted is that these flows do not represent peak flows, and with peaking factors applied we anticipate these numbers to be higher.

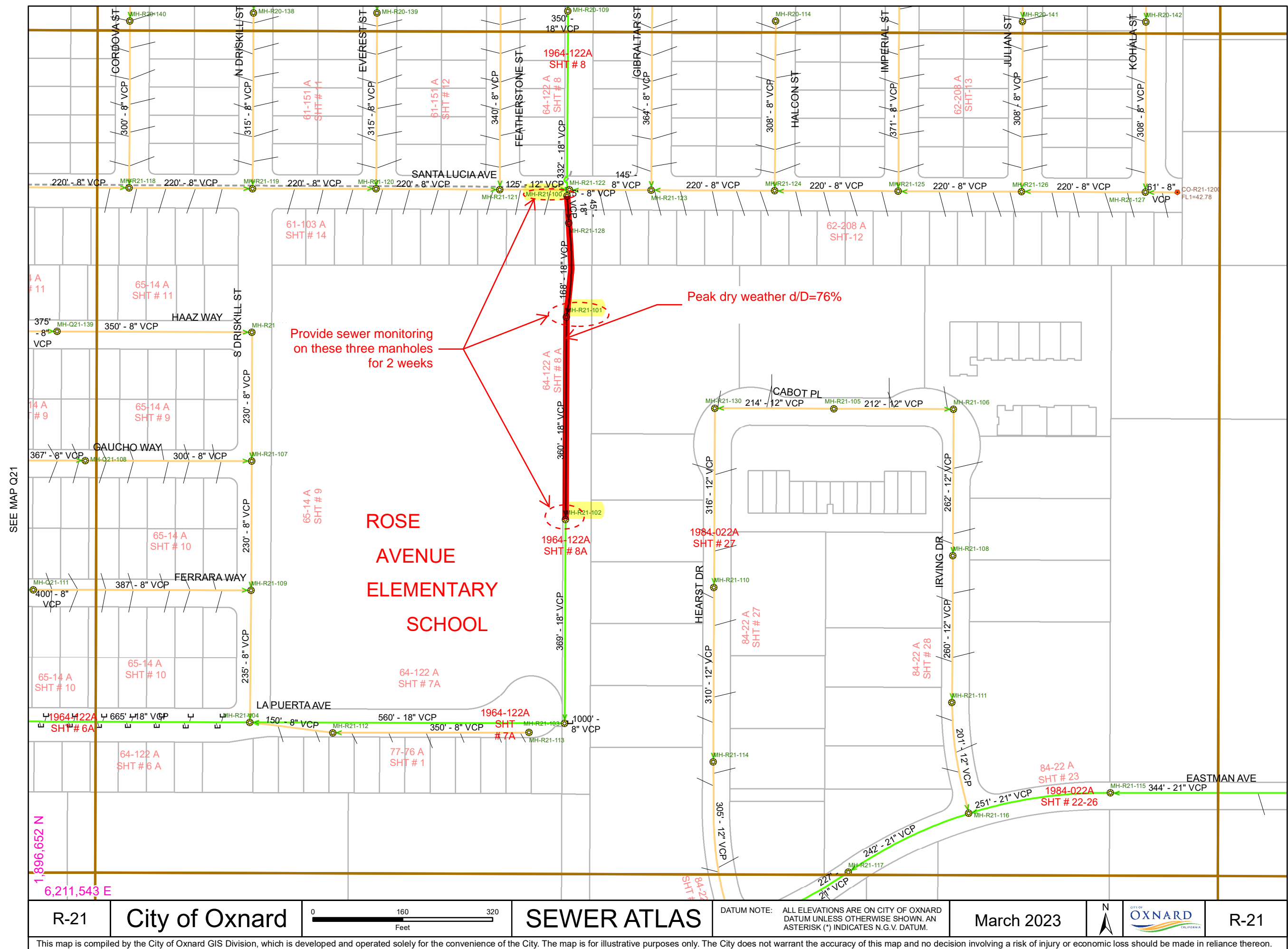
With this in mind, we are anticipating the upsizing of the lines in question from an 18" VCP sewer to a 24" PVC sewer. This will facilitate the existing surcharged flows, as well as the development of the Lockwood 1 and 2 projects currently under construction. This will also provide adequate capacity for the Lockwood 3 project and will provide additional capacity for future development that may be anticipated in this area.

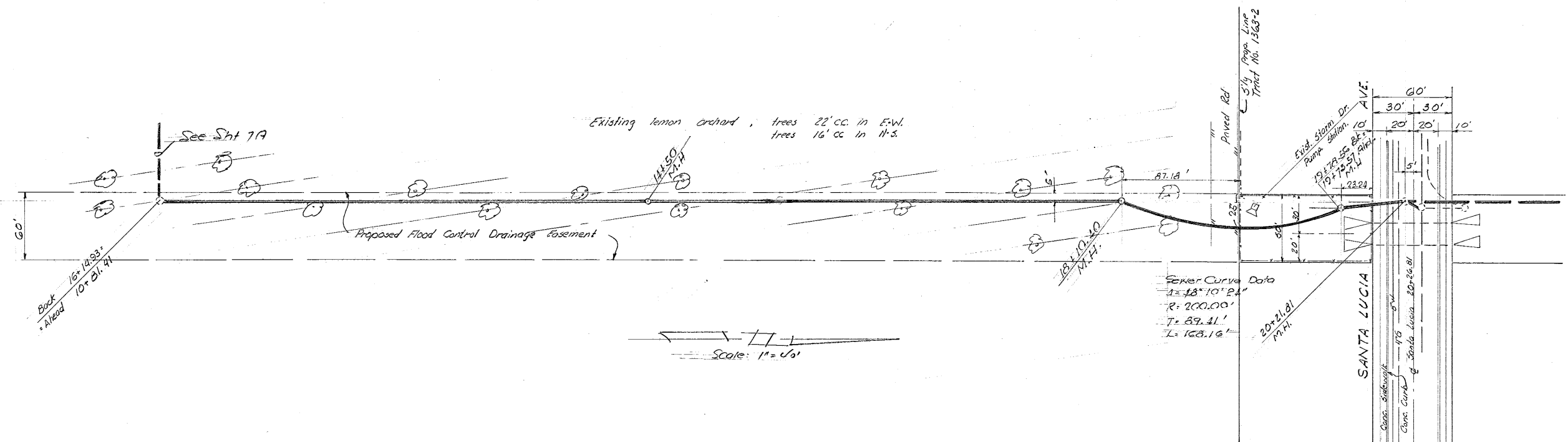
We have begun design of this sewer line and anticipate submitting these plans to the City of Oxnard by February 2, 2024. Attached to this email are as-built drawings of the existing 18" sewer line as well as the request provided by the city for monitoring of these lines. Final data will be provided once available.

Sincerely,  
CCE DESIGN ASSOCIATES INC.



Randy Chapman, P.E.  
President  
California RCE #69614





<b>Leonard Melberg</b> DATE 11/10/64 DRAWN <i>[Signature]</i> CE 9396		JOB 457 C DATE Mar 1964 DRAWN CAM CHKD CAM	REVISIONS Rose Rd. Realignment
--	--	---	-----------------------------------

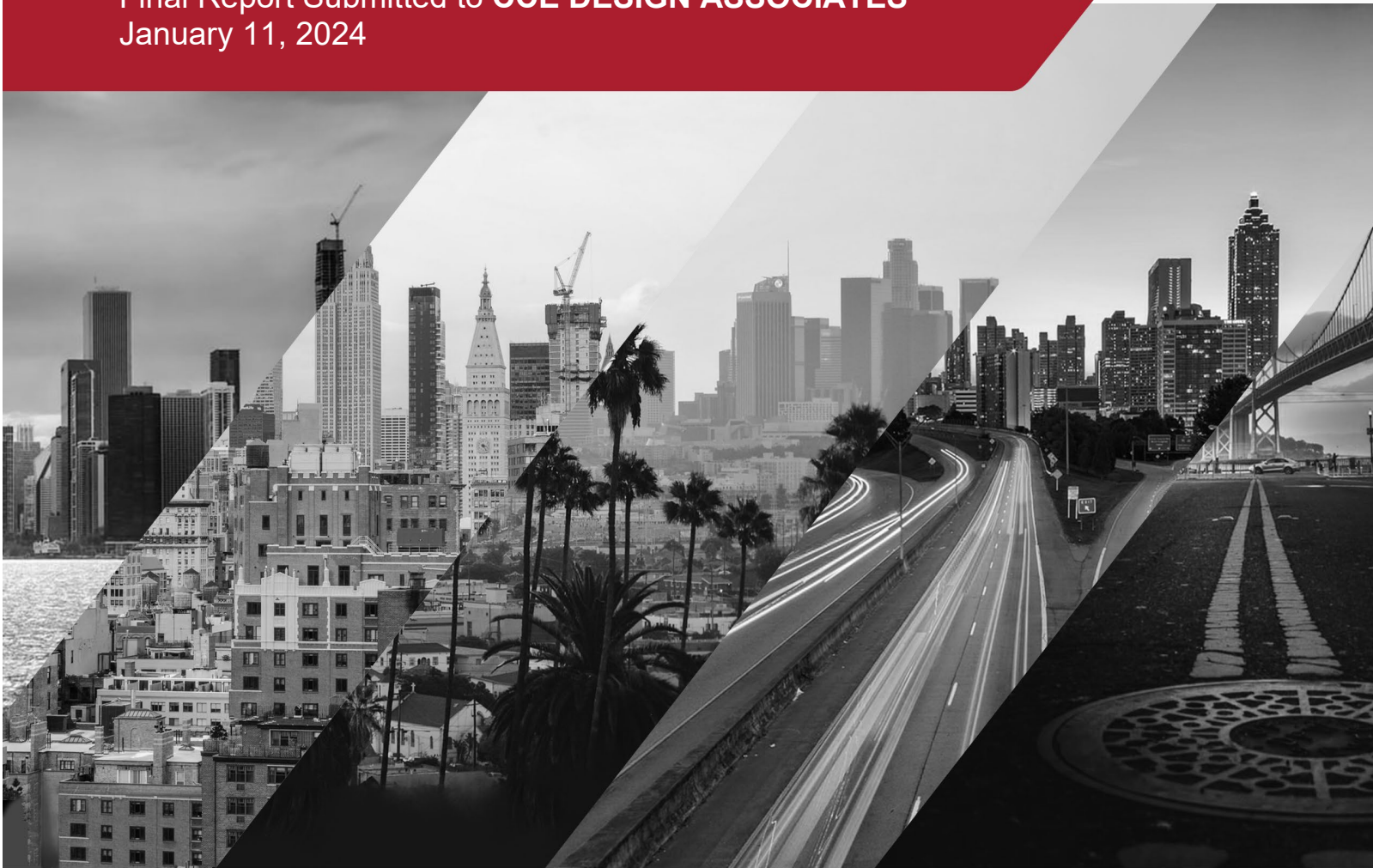
**AS BUILT**  
**ENGINEERING - SCIENCE, INC.**  
 ENGINEERS AND CONSULTANTS  
 150 EAST FOOTHILL BOULEVARD  
 ARCADIA, CALIFORNIA  
 ELIOTT 9-9381

SHEET  
**8A**  
 OF 49

64-122A

# Sewer Flow Study 2023

Final Report Submitted to **CCE DESIGN ASSOCIATES**  
January 11, 2024



**ADS** ENVIRONMENTAL  
SERVICES

# Sewer Flow Study 2023

## Prepared For:

Randy Chapman, P.E  
CCE Design Associates  
771 E. Daily Drive, Suite 120  
Camarillo, CA, 93010

## Prepared By:



ADS, LLC  
15201 Springdale St  
Huntington Beach, CA, 92648



January 11, 2024

Randy Chapman, P.E  
CCE Design Associates  
771 E. Daily Drive, Suite 120  
Camarillo, CA, 93010

**SUBJECT: Sewer Flow Study 2023**

Dear Randy Chapman,

ADS is pleased to submit the report for the **Sewer Flow Study 2023** completed on behalf of CCE Design Associates. The metering was conducted at three (3) locations. The study was conducted during the period of Thursday, 14 December 2023 to Tuesday, 02 January 2024.

The report contains depth, velocity, and quantity hydrographs as well as daily long tables for the metering period. An Excel file containing depth, quantity, and velocity entities for the monitoring location in 5-minute format is also provided.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, you may contact the Project Manager, Shay Koerber at 619.520.9168.

It has been our pleasure to be of service to you in the performance of this project. Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,

**ADS ENVIRONMENTAL SERVICES**

Tyler Bui  
Hydraulic Data Analyst



## Scope and Methodology

### Introduction

CCE Design Associates. entered into an agreement with ADS Environmental Services to conduct flow monitoring at (3) three locations in the Oxnard Sanitary Collection System. The study was scheduled for a period of (14) fourteen days. Once in place, the flow monitoring equipment was to be used to measure depth, velocity, and to quantify flows. The objective of this study was capacity study- flow vrs office vrs retail.

### Project Scope

The scope of this study involved using a flow monitor to quantify wastewater flow at the designated locations for the study period. Specifically, the study included the following key components.

- Investigate the proposed flow-monitoring site for adequate hydraulic conditions
- Flow monitor installation
- Flow monitor confirmations and data collections
- Flow data analysis

Equipment installation was completed on December 13, 2023. The monitoring period began on December 14, 2023, and was completed on January 2, 2024. Upon completion of the study, equipment was removed from the system.

### Flow Monitoring Equipment



The **ADS FlowShark Triton** monitor was selected for this project. This flow monitor is an area velocity flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS FlowShark Triton monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

The FS Triton monitor features cross-checking using multiple technologies in each sensor for continuous running of comparisons and tolerances. The FS Triton monitor can support two (2) sets of sensors. The sensor option used for this project was:

**The Peak Combo Sensor** installed at the bottom of the pipe includes three types of data acquisition technologies.

The ***up looking ultrasonic depth*** uses sound waves from two independent transceivers to measure the distance from the sensor upward toward the flow surface; applying the speed of sound in the water and the temperature measured by sensor to calculate depth.

The ***pressure depth*** is calculated by using a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube.

To obtain ***peak velocity***, the sensor sends an ultrasonic signal at an angle upward through the widest cross-section of the oncoming flow. The signal is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity.

## Installation

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed.

In pipes up to 42 inches in diameter, the sensors were mounted on expandable stainless-steel rings, inserted at least a foot upstream into influent pipes and tightened against the inside walls of the pipes. Influent pipe installations reduce the influences of turbulence and backwater often caused by changes in channel geometry in manholes.





### Data Collection, Confirmation, and Quality Assurance

Data collects were done remotely via wireless connect on a weekly basis. As needed, during the monitoring period, field crews visit each monitoring location to verify proper monitor operation and document field conditions. The following quality assurance steps are taken to assure the integrity of the collected data:

**Measure power supplies:** monitors were powered by dry cell battery packs. Voltages were recorded and battery packs replaced, as necessary. Separate batteries provided back-up power to memory allowing primary batteries to be replaced without loss of data.

**Clock synchronization:** Field crews synchronized monitor clocks to master clocks.

**Confirm depth and velocity readings:** Field crews descended into meter manholes to manually measure depths and velocities and compare the meter readings to confirm that they agreed. The site met the criteria for confirmation for depth and velocity unless noted otherwise in the site commentary section. They also measured silt levels, if any, in the inverts of the pipes. Silt areas were subtracted from flow areas to compute true areas of flow.

**Confirm average velocities through cross-sectional velocity profiles:** Since ADS velocity sensors measure peak velocity, field crews collected cross-sectional velocity profiles in order to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

**Upload and Review Data:** Data collected from the monitors were uploaded and reviewed by a Data Analyst for completeness, outliers and deviations in the flow patterns, which indicate system anomalies or equipment failure.

### Flow Quantification Methods

There are two main equations used to measure open channel flow: the **Continuity Equation** and the **Manning Equation**. The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

#### Continuity Equation

The Continuity Equation states that the flow quantity ( $Q$ ) is equal to the wetted area ( $A$ ) multiplied by the average velocity ( $V$ ) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow.

## Data Analysis and Presentation

### Data Analysis

A flow monitor is typically programmed to collect data at 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the ultrasonic depth, (2) the peak velocity and (3) the pressure depth. The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Occasionally the velocity sensor's performance may be compromised resulting in invalid readings sporadically during the monitoring period. This is generally caused by excessive debris (silt) blocking the sensor's crystals, shallow flows (~< 1") that may drop below the top of the sensor or very clear flows lacking the particles needed to measure rate. In order to use the Continuity equation to quantify the flow during these periods, a Data Analyst and/or Engineer will use the site's historical pipe curve (depth vs. velocity) data along with valid field confirmations to reconstitute and replace the false velocity recordings with expected velocity readings for a given historical depth along the curve.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

### Data Presentation

This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. Hydrographs are based on 15-minute averaging. Tables are provided in 5-minute format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the flow data table and hydrograph.

**DEPTH** - Final calculated depth measurement (in inches)

**QUANTITY** - Final calculated flow rate (in MGD)

**VELOCITY** - Final calculated flow velocity (in feet per second)

**REPORT TOTAL** - Total volume of flow recorded for the indicated time period (in MG)

## Lockwood01

### Site Commentary

#### SITE INFORMATION

Pipe	Round (18 in H)
Silt	3.50 (in)

#### OBSERVATIONS

This site functioned under normal conditions during the study period. No surcharge conditions were experienced at this location.

Field observation noted the presence of a 3.5 inches sediment in the pipe. Therefore, 3.5 inches was removed from the wetted cross section for flow calculations. Due to the presence of sediment, data confidence is lower than typical at this location.

This site was positioned upstream of site Lockwood02. A review of balancing indicates a minor imbalance due to the presence of sediment.

5-min flow depth, velocity, and quantity data observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	12.37	0.85	0.594
Minimum	10.02	0.41	0.206
Maximum	15.00	1.18	0.984
Min Time	12/14/2023 4:20:00 AM	12/14/2023 4:15:00 AM	12/14/2023 4:15:00 AM
Max Time	12/21/2023 1:55:00 AM	12/28/2023 1:30:00 PM	12/26/2023 12:45:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

## DATA UPTIME

Data uptime observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024** is provided in the following table:

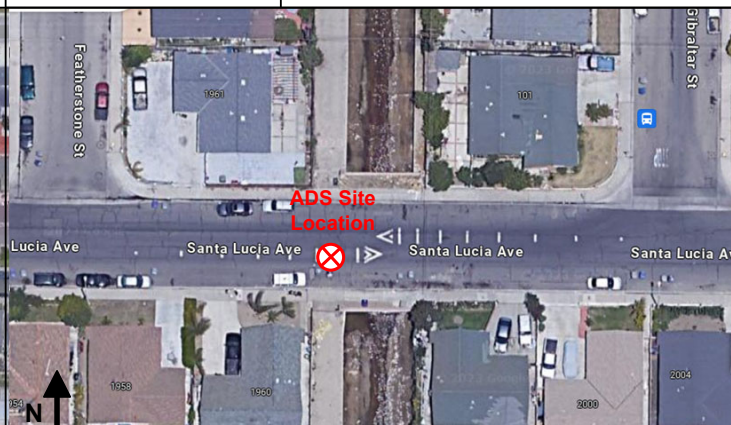
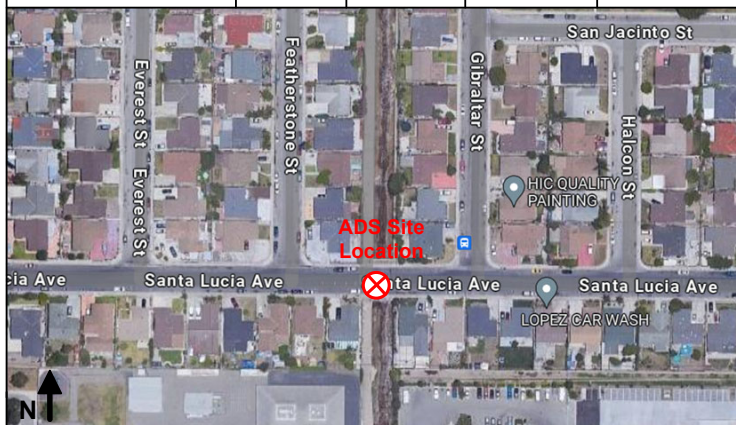
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100



# ADS Site Report

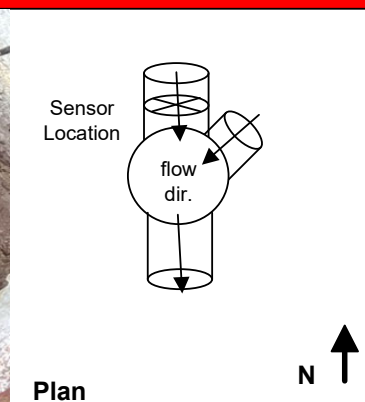
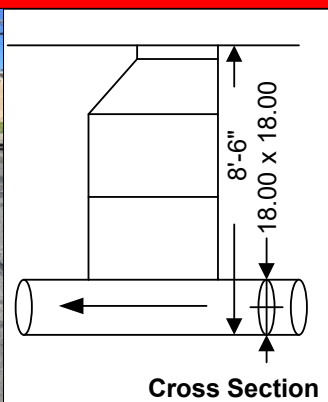
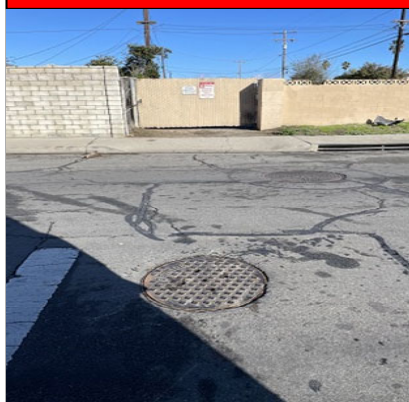
## Quality Form

<b>Project Name:</b> Oxnard.Vintage.TFM.CA23		<b>City:</b> Oxnard		<b>Agency:</b> Oxnard		<b>FM Initials:</b> VM	
<b>Site Name:</b> Lockwood01		<b>Install Date:</b> 12/13/23		<b>Monitor Type:</b> Peak Doppler			
<b>Address/Location:</b> 1960 Santa Lucia Ave, Oxnard, CA 93030				<b>Monitor Model:</b> Triton +			
				<b>Data Acquisition:</b> Manual/Wireless Collect			
				<b>Manhole ID:</b> MH-R21-100			
<b>Access:</b> Drive	<b>Type of System:</b>	<b>Sanitary</b> <input checked="" type="checkbox"/>	<b>Storm</b> <input type="checkbox"/>	<b>Combined</b> <input type="checkbox"/>	<b>Pipe Height:</b> 18.00 "		
					<b>Pipe Width:</b> 18.00 "		



Investigation Information:		Manhole Information:			
<b>Date/Time of Investigation:</b>	12/13/23 @ 11:23 AM	<b>Manhole Depth:</b> 8'-6"			
<b>Site Hydraulics:</b>	Good Straight Through Flow	<b>Manhole Material / Condition:</b> Precast/Good			
<b>Upstream Input: (L/S, P/S)</b>	--	<b>Pipe Material / Condition:</b> VCP/Good			
<b>Upstream Manhole:</b>	Not Investigated	<b>Land Use:</b>	Residential <input checked="" type="checkbox"/>	Commercial <input type="checkbox"/>	Industrial <input type="checkbox"/> Other <input type="checkbox"/>
<b>Downstream Manhole:</b>	Not investigated	<b>Oxygen:</b> 20.9	<b>H2S:</b> 0	<b>LEL:</b> 0	<b>CO:</b> 0
<b>Depth of Flow:</b>	13.00" +/- 0.25"	<b>Safety Notes:</b> 2 man crew required and one blower is to be operated at all times.			
<b>Range (Air DOF):</b>	+/-				
<b>Peak Velocity:</b>	1.13 fps				
<b>Silt:</b>	3.50 Inches				

### Other Information:



Installation Information		Backup		Yes	No	?	Distance
<b>Installation Type:</b> Standard		Trunk	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<b>Sensors Devices:</b> Ultrasonic/Velocity/Pressure		Lift / Pump Station	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<b>Surcharge Height:</b> 0		WWTP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<b>Rain Gauge Zone:</b>		Other	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		

### Additional Site Information / Comments:

Standard Traffic Control with No Safety Concerns

# Hydrograph Report

Lockwood01

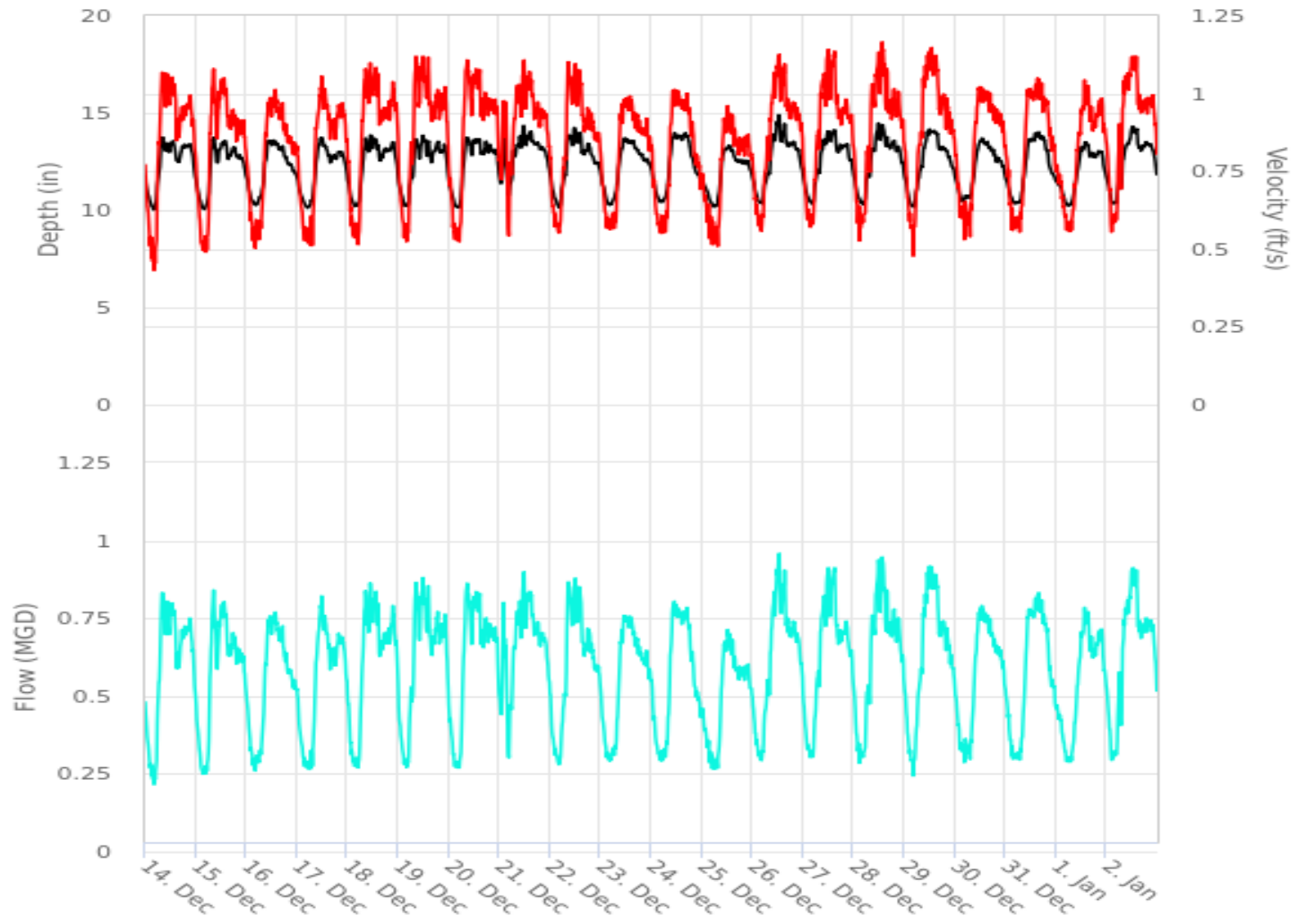
Flow Monitor  
**Lockwood01**

Pipe Height  
18.00  
in

Report Period  
12/14/2023  
To  
01/02/2024

Legend  
— DFINAL  
— Rain  
— VFINAL  
— QFINAL

**ADS** ENVIRONMENTAL  
SERVICES®

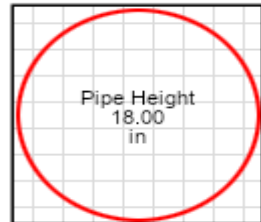




## Scattergraph Report

Lockwood01

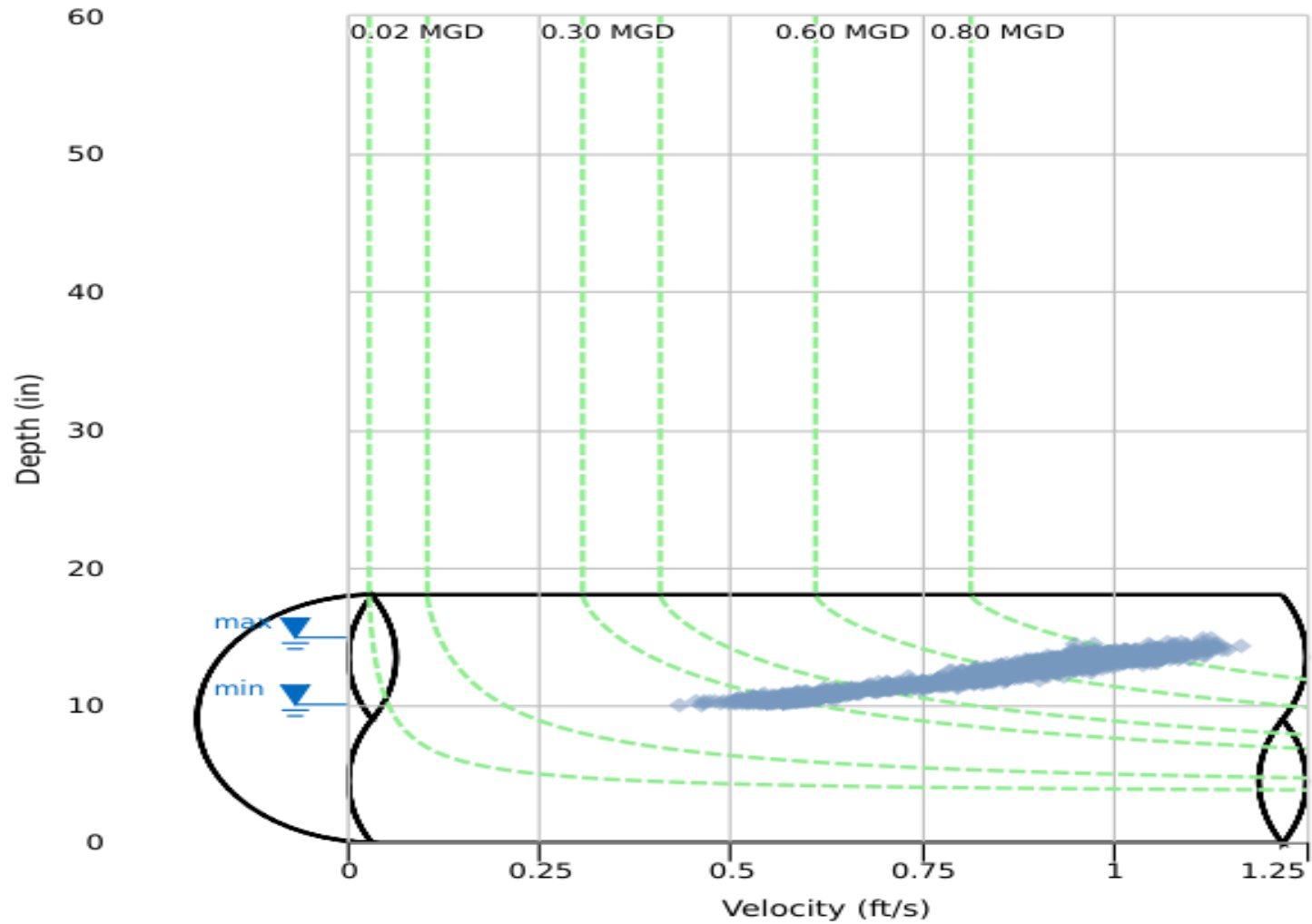
Flow Monitor  
**Lockwood01**



Report Period  
12/14/2023  
To  
01/02/2024

Legend  
○ DFINAL - VFINAL  
--- Iso-Q<sup>TM</sup>  
▼ Min-Max Depth

**ADS** ENVIRONMENTAL  
SERVICES®



## Daily Tabular Report

12/14/2023 00:00 - 01/02/2024 23:59

Lockwood01Pipe: Round (18 in H), Silt3.50 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total
12/14/2023	03:55	10.02	08:25	13.76	12.41	03:50	0.41	08:45	1.09	0.86	04:15	0.206	08:00	0.839	0.599	0.599
12/15/2023	04:10	10.04	08:35	13.73	12.27	04:05	0.45	08:30	1.09	0.84	04:05	0.225	08:30	0.851	0.579	0.579
12/16/2023	04:40	10.24	13:15	13.62	12.12	04:30	0.48	13:50	1.02	0.80	04:30	0.247	13:55	0.777	0.542	0.542
12/17/2023	05:05	10.11	11:50	13.75	12.09	05:45	0.44	11:55	1.08	0.82	05:45	0.225	11:55	0.837	0.551	0.551
12/18/2023	03:30	10.19	10:55	13.94	12.41	03:30	0.50	08:45	1.11	0.88	03:30	0.254	11:00	0.875	0.616	0.616
12/19/2023	03:25	10.20	11:45	13.85	12.43	02:55	0.50	11:50	1.14	0.89	02:55	0.260	11:50	0.898	0.623	0.623
12/20/2023	04:40	10.12	08:45	13.75	12.46	03:25	0.50	08:45	1.13	0.88	03:25	0.254	08:45	0.883	0.619	0.619
12/21/2023	04:35	10.74	01:55	15.00	12.95	04:30	0.52	11:50	1.12	0.92	04:30	0.291	01:50	0.935	0.668	0.668
12/22/2023	04:35	10.12	11:35	14.24	12.48	04:15	0.52	08:50	1.12	0.86	04:15	0.267	12:00	0.888	0.603	0.603
12/23/2023	04:20	10.26	11:40	13.74	12.26	06:05	0.51	11:15	1.01	0.81	06:05	0.273	11:15	0.782	0.557	0.557
12/24/2023	04:25	10.41	16:15	14.00	12.34	06:50	0.52	10:15	1.05	0.81	04:15	0.278	10:15	0.816	0.561	0.561
12/25/2023	05:40	10.17	13:20	13.31	11.95	05:10	0.47	12:15	0.97	0.76	05:10	0.243	12:40	0.722	0.502	0.502
12/26/2023	04:25	10.33	12:40	14.95	12.64	04:30	0.52	12:45	1.15	0.88	04:30	0.274	12:45	0.984	0.627	0.627
12/27/2023	04:15	10.32	14:50	14.13	12.56	03:30	0.52	15:00	1.17	0.89	03:30	0.278	15:00	0.940	0.633	0.633
12/28/2023	04:25	10.29	11:55	14.54	12.58	03:15	0.48	13:30	1.18	0.89	03:15	0.255	12:00	0.958	0.634	0.634
12/29/2023	04:45	10.15	12:00	14.19	12.49	04:25	0.44	13:05	1.16	0.90	04:25	0.225	12:05	0.928	0.632	0.632
12/30/2023	03:45	10.45	13:00	13.73	12.17	04:35	0.49	12:00	1.06	0.84	04:35	0.263	12:00	0.805	0.568	0.568
12/31/2023	04:45	10.33	15:45	14.08	12.23	06:55	0.52	15:20	1.07	0.84	06:55	0.274	15:45	0.841	0.573	0.573
01/01/2024	05:15	10.25	14:00	13.50	12.01	05:05	0.52	13:40	1.06	0.82	05:05	0.271	13:40	0.798	0.543	0.543
01/02/2024	03:20	10.33	12:25	14.31	12.59	02:25	0.52	12:45	1.14	0.90	02:25	0.272	12:45	0.924	0.642	0.641

12/14/2023 00:00 - 01/02/2024 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Total			11.875
Average	12.37	0.85	0.594

## Lockwood02

### Site Commentary

#### SITE INFORMATION

Pipe	Elliptical (17.5 in H x 18 in W)
Silt	0.00 (in)

#### OBSERVATIONS

This site functioned under normal conditions during the study period. No surcharge conditions were experienced at this location.

This site was positioned downstream of site Lockwood01 and upstream of site Lockwood03. See sites Lockwood01 and Lockwood03 for balancing details.

5-min flow depth, velocity, and quantity data observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	10.38	0.81	0.571
Minimum	6.94	0.32	0.131
Maximum	13.25	1.13	1.013
Min Time	12/29/2023 4:50:00 AM	12/29/2023 4:50:00 AM	12/29/2023 4:50:00 AM
Max Time	12/21/2023 2:00:00 AM	12/21/2023 2:05:00 AM	12/21/2023 2:00:00 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

#### DATA UPTIME

Data uptime observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024** is provided in the following table:

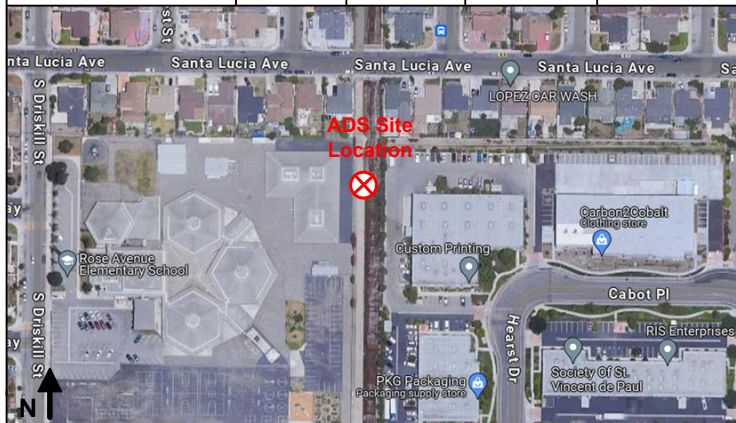
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100



# ADS Site Report

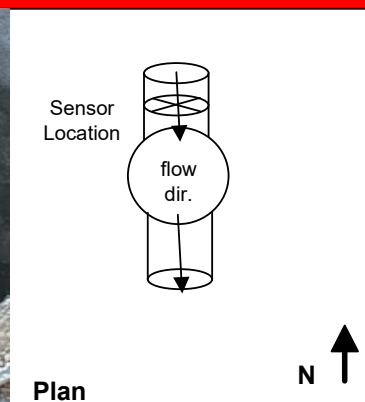
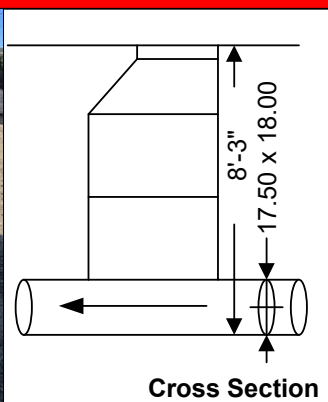
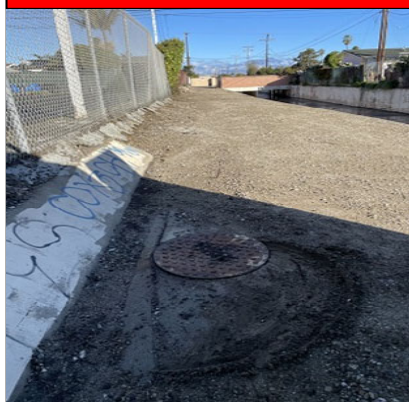
## Quality Form

<b>Project Name:</b> Oxnard.Vintage.TFM.CA23		<b>City:</b> Oxnard		<b>Agency:</b> Oxnard		<b>FM Initials:</b> VM	
<b>Site Name:</b> Lockwood02		<b>Install Date:</b> 12/13/23		<b>Monitor Type:</b> Peak Doppler			
<b>Address/Location:</b> 1960 Santa Lucia Ave, Oxnard, CA 93030 In the storm channel				<b>Monitor Model:</b> Triton +			
				<b>Data Acquisition:</b> Manual/Wireless Collect			
				<b>Manhole ID:</b> MH-R21-101			
<b>Access:</b> Drive	<b>Type of System:</b>	<b>Sanitary</b> <input checked="" type="checkbox"/>	<b>Storm</b> <input type="checkbox"/>	<b>Combined</b> <input type="checkbox"/>	<b>Pipe Height:</b> 17.50 "		
					<b>Pipe Width:</b> 18.00 "		



Investigation Information:				Manhole Information:			
<b>Date/Time of Investigation:</b>		12/13/23 @ 10:30 AM		<b>Manhole Depth:</b>		8'-3"	
<b>Site Hydraulics:</b>		Good Straight Through Flow		<b>Manhole Material / Condition:</b>		Precast/Good	
<b>Upstream Input: (L/S, P/S)</b>		--		<b>Pipe Material / Condition:</b>		VCP/Good	
<b>Upstream Manhole:</b>		Not Investigated		<b>Land Use:</b>	Residential <input type="checkbox"/>	Commercial <input type="checkbox"/>	Industrial <input type="checkbox"/>
<b>Downstream Manhole:</b>		Not investigated		<b>Oxygen:</b> 20.9	<b>H2S:</b> 0	<b>LEL:</b> 0	<b>CO:</b> 0
<b>Depth of Flow:</b>	11.88" +/- 0.25"			<b>Safety Notes:</b> 2 man crew required and one blower is to be operated at all times.			
<b>Range (Air DOF):</b>	+/-						
<b>Peak Velocity:</b>	1.08 fps						
<b>Silt:</b>	0.00 Inches						

### Other Information:



Installation Information		Backup		Yes	No	?	Distance
<b>Installation Type:</b> Standard		Trunk		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>Sensors Devices:</b> Ultrasonic/Velocity/Pressure		Lift / Pump Station		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>Surcharge Height:</b> 0		WWTP		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<b>Rain Gauge Zone:</b>		Other		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

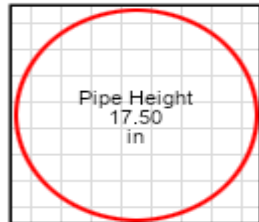
### Additional Site Information / Comments:

Standard Traffic Control with No Safety Concerns

# Hydrograph Report

Lockwood02

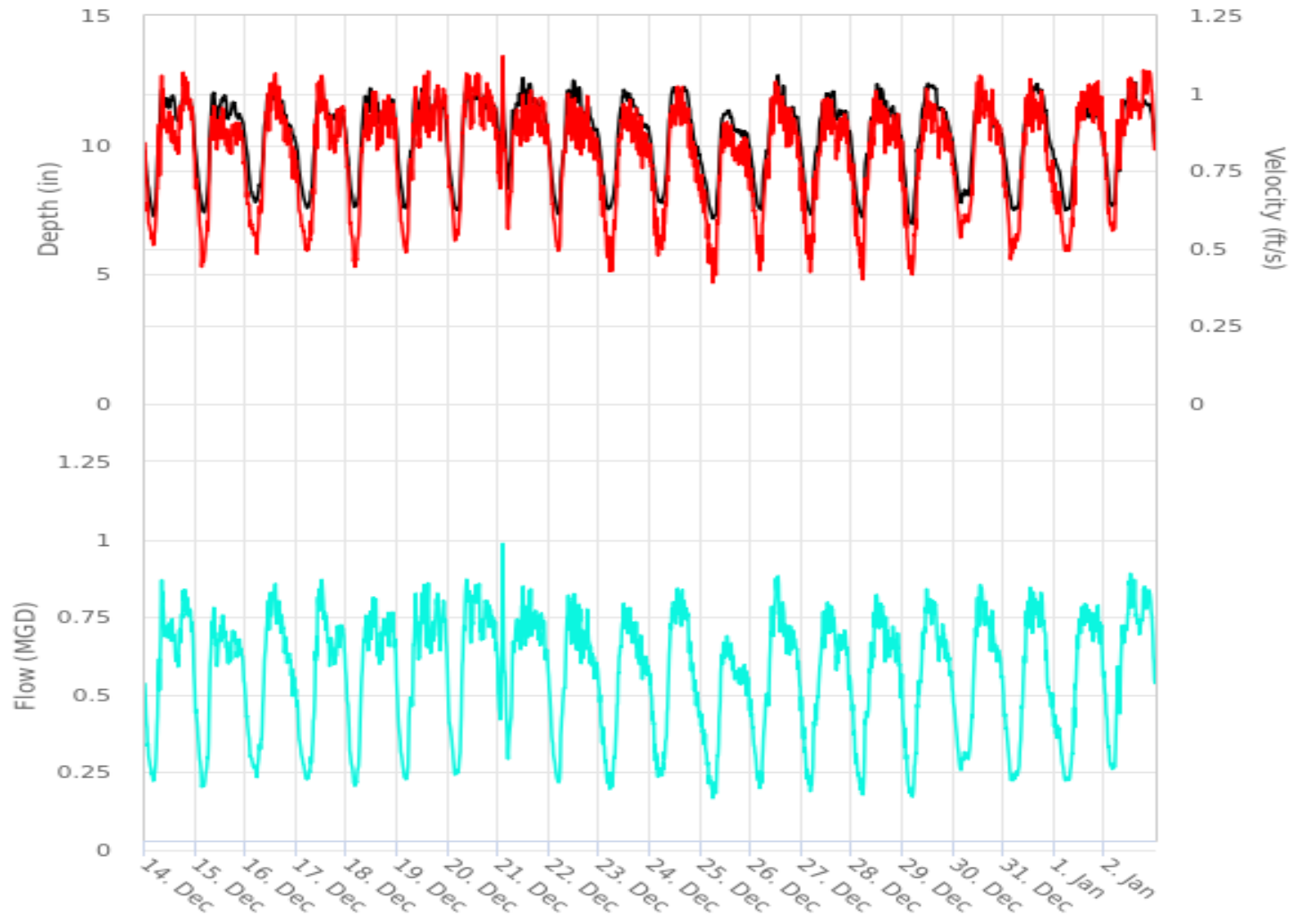
Flow Monitor  
**Lockwood02**



Report Period  
12/14/2023  
To  
01/02/2024

Legend  
— DFINAL  
— Rain  
— VFINAL  
— QFINAL

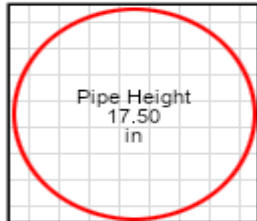
**ADS** ENVIRONMENTAL  
SERVICES®



## Scattergraph Report

Lockwood02

Flow Monitor  
**Lockwood02**



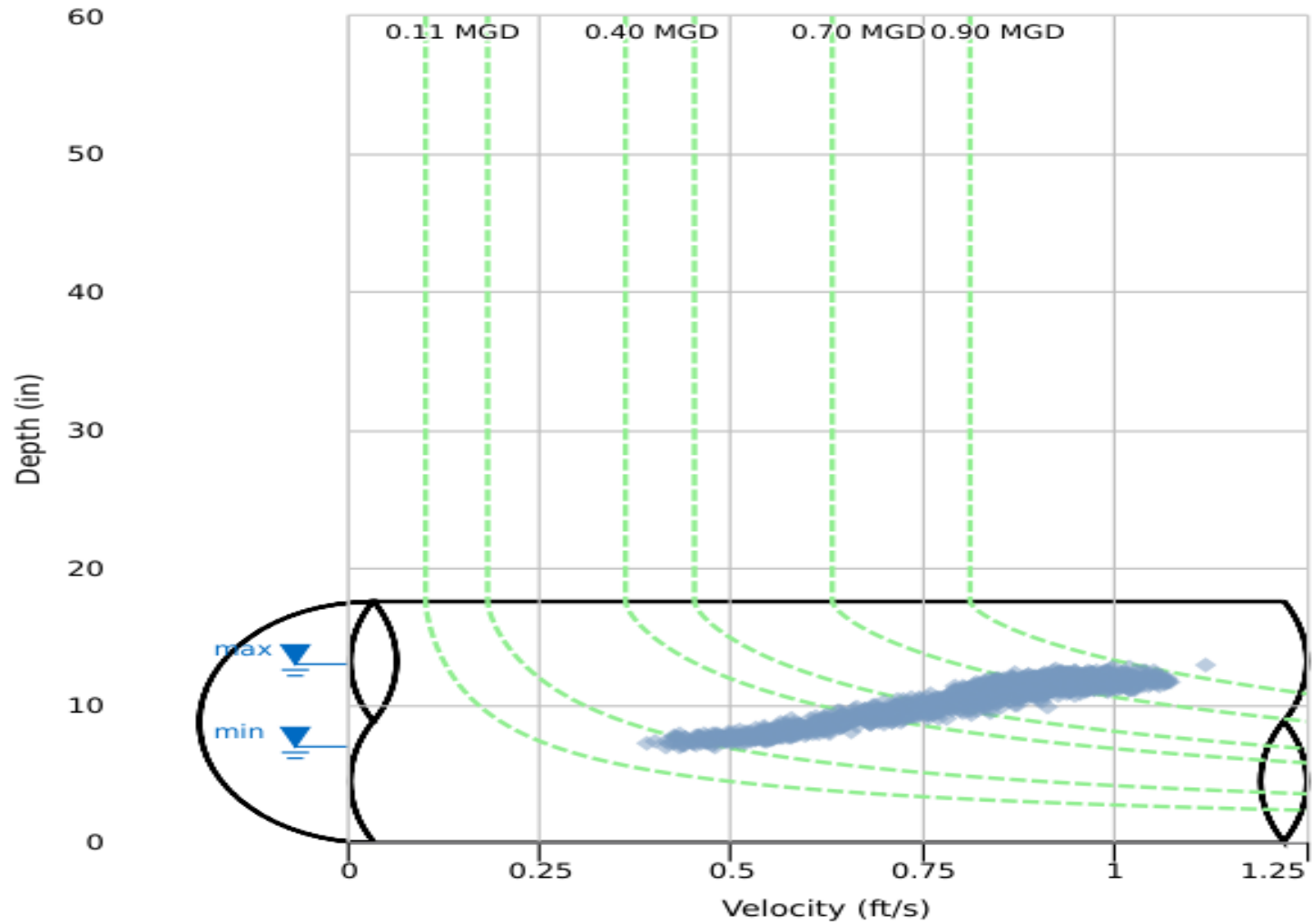
### Report Period

12/14/2023  
To  
01/02/2024

### Legend

- DFINAL - VFINAL
- Iso-Q<sup>TM</sup>
- Min-Max Depth

**ABS ENVIRONMENTAL SERVICES**



## Daily Tabular Report

12/14/2023 00:00 - 01/02/2024 23:59

Lockwood02Pipe: Elliptical (17.5 in H x 18 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total
12/14/2023	04:05	7.25	08:25	12.19	10.58	03:55	0.50	08:05	1.08	0.84	04:00	0.219	08:05	0.890	0.605	0.605
12/15/2023	04:10	7.38	08:40	12.05	10.43	03:00	0.43	12:05	0.99	0.79	03:00	0.200	08:45	0.805	0.558	0.558
12/16/2023	04:40	7.77	13:05	12.03	10.30	05:15	0.44	14:05	1.07	0.81	05:15	0.213	14:05	0.864	0.564	0.564
12/17/2023	05:10	7.55	11:20	12.17	10.23	04:35	0.49	11:10	1.09	0.80	05:10	0.226	11:10	0.885	0.557	0.557
12/18/2023	03:35	7.59	11:00	12.22	10.54	03:25	0.40	11:20	1.03	0.81	03:25	0.186	12:40	0.828	0.585	0.585
12/19/2023	03:25	7.55	11:50	12.19	10.58	03:55	0.48	14:30	1.08	0.84	03:55	0.226	14:30	0.869	0.608	0.608
12/20/2023	04:45	7.47	08:50	12.10	10.61	03:10	0.50	08:55	1.08	0.87	03:10	0.234	08:55	0.884	0.633	0.633
12/21/2023	04:35	8.29	02:00	13.25	11.14	04:30	0.56	02:05	1.13	0.87	04:35	0.288	02:00	1.013	0.655	0.655
12/22/2023	04:40	7.31	11:35	12.51	10.49	05:10	0.47	12:25	1.06	0.81	05:10	0.216	12:25	0.889	0.577	0.577
12/23/2023	03:55	7.49	11:40	12.22	10.26	04:45	0.39	11:35	1.06	0.77	04:45	0.178	11:35	0.875	0.536	0.536
12/24/2023	05:30	7.74	11:05	12.26	10.35	05:50	0.43	13:05	1.06	0.78	05:50	0.206	13:05	0.870	0.553	0.553
12/25/2023	05:45	7.15	13:20	11.36	9.69	06:05	0.34	13:35	0.97	0.72	06:05	0.147	13:35	0.733	0.469	0.469
12/26/2023	04:35	7.49	12:40	12.75	10.43	04:10	0.40	12:35	1.08	0.80	04:25	0.182	12:35	0.933	0.571	0.571
12/27/2023	04:15	7.31	15:00	12.09	10.34	04:25	0.37	13:45	1.03	0.79	04:25	0.165	14:40	0.841	0.553	0.553
12/28/2023	04:45	7.20	11:55	12.42	10.31	04:55	0.35	11:35	1.05	0.79	04:55	0.151	11:35	0.860	0.554	0.554
12/29/2023	04:45	6.94	12:00	12.38	10.38	04:50	0.32	15:15	1.06	0.78	04:50	0.131	15:15	0.871	0.556	0.556
12/30/2023	03:50	7.76	13:00	12.08	10.15	03:15	0.54	12:35	1.07	0.81	03:45	0.255	12:55	0.861	0.556	0.556
12/31/2023	04:55	7.47	15:45	12.41	10.18	03:10	0.45	15:30	1.06	0.78	03:20	0.219	15:30	0.879	0.541	0.541
01/01/2024	05:25	7.46	14:25	11.78	10.00	04:55	0.48	19:10	1.06	0.80	06:55	0.221	14:40	0.809	0.547	0.547
01/02/2024	03:20	7.64	12:20	12.53	10.64	01:35	0.55	11:35	1.13	0.88	03:40	0.256	11:35	0.939	0.637	0.637

12/14/2023 00:00 - 01/02/2024 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Total			11.414
Average	10.38	0.81	0.571

## Lockwood03

### Site Commentary

#### SITE INFORMATION

Pipe	Elliptical (17.75 in H x 18 in W)
Silt	0.00 (in)

#### OBSERVATIONS

This site functioned under poor hydraulic condition during the study period. Data analysis concluded the presence of a hydraulic jump/wave, causing lower data confidence than typical at this location.

This site was positioned downstream of site Lockwood02. A review of balancing indicates no problem.

5-min flow depth, velocity, and quantity data observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	3.93	3.68	0.698
Minimum	3.03	1.59	0.208
Maximum	4.63	4.91	1.116
Min Time	12/15/2023 4:15:00 AM	12/14/2023 4:00:00 AM	12/14/2023 4:00:00 AM
Max Time	12/24/2023 6:40:00 PM	12/26/2023 12:35:00 PM	12/26/2023 12:35:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

#### DATA UPTIME

Data uptime observed during **Thursday, 14 December 2023 to Tuesday, 02 January 2024** is provided in the following table:

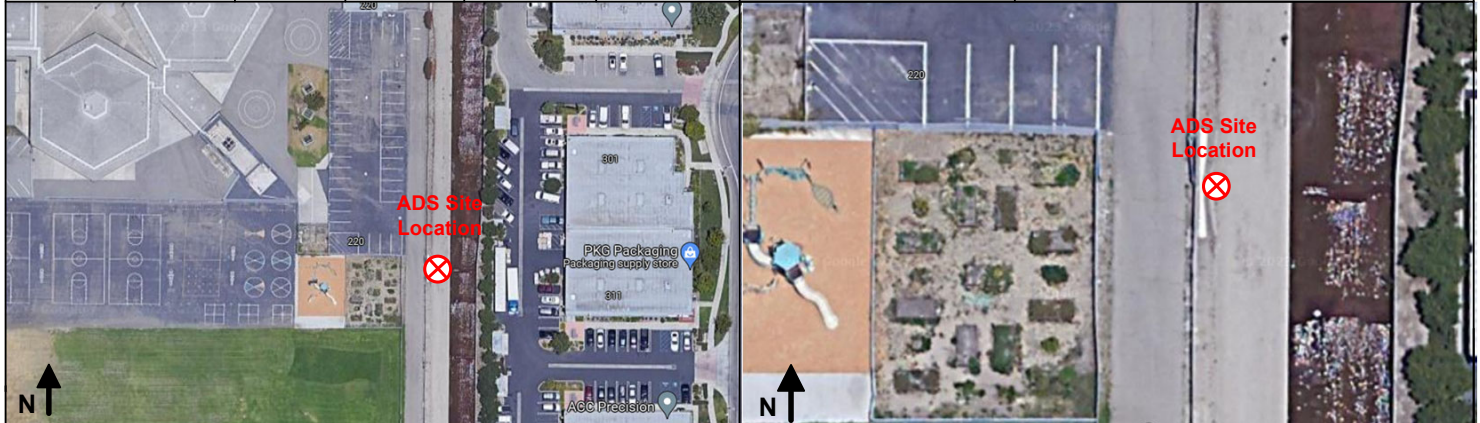
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100



# ADS Site Report

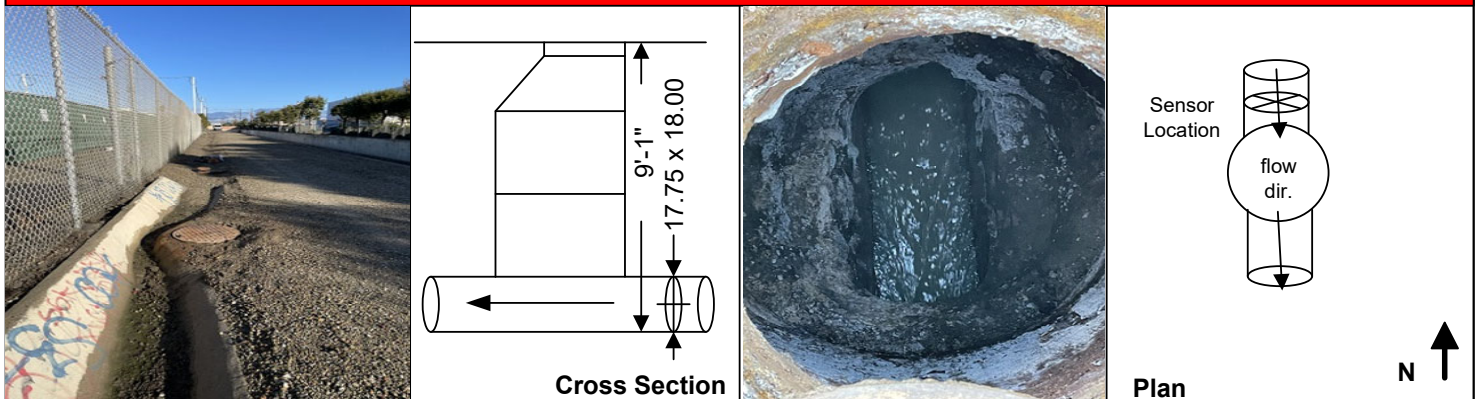
## Quality Form

<b>Project Name:</b> Oxnard.Vintage.TFM.CA23		<b>City:</b> Oxnard		<b>Agency:</b> Oxnard		<b>FM Initials:</b> VM	
<b>Site Name:</b> Lockwood03		<b>Install Date:</b> 12/13/23		<b>Monitor Type:</b> Peak Doppler			
<b>Address/Location:</b> 1960 Santa Lucia Ave, Oxnard, CA 93030 In storm channel				<b>Monitor Model:</b> Triton +			
				<b>Data Acquisition:</b> Manual/Wireless Collect			
				<b>Manhole ID:</b> MH-R21-102			
<b>Access:</b> Drive	<b>Type of System:</b>	Sanitary <input checked="" type="checkbox"/>	Storm <input type="checkbox"/>	Combined <input type="checkbox"/>	<b>Pipe Height:</b> 17.75 "		
					<b>Pipe Width:</b> 18.00 "		



Investigation Information:				Manhole Information:			
<b>Date/Time of Investigation:</b>		12/13/23 @ 9:48 AM		<b>Manhole Depth:</b>		9'-1"	
<b>Site Hydraulics:</b>		Good Straight Through Flow		<b>Manhole Material / Condition:</b>		Precast/Good	
<b>Upstream Input: (L/S, P/S)</b>		--		<b>Pipe Material / Condition:</b>		VCP/Good	
<b>Upstream Manhole:</b>		Not Investigated		<b>Land Use:</b>	Residential <input type="checkbox"/>	Commercial <input type="checkbox"/>	Industrial <input type="checkbox"/>
<b>Downstream Manhole:</b>		Not investigated			Other <input checked="" type="checkbox"/>		
<b>Depth of Flow:</b>		6.13 " +/- 0.25"		<b>Oxygen:</b> 20.9	<b>H2S:</b> 0	<b>LEL:</b> 0	<b>CO:</b> 0
<b>Range (Air DOF):</b>		+/-		<b>Safety Notes:</b> 2 man crew required and one blower is to be operated at all times.			
<b>Peak Velocity:</b>		3.50 fps					
<b>Silt:</b>		0.00 Inches					

### Other Information:



Installation Information		Backup	Yes	No	?	Distance
Installation Type: Standard		Trunk	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Sensors Devices: Ultrasonic/Velocity/Pressure		Lift / Pump Station	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Surcharge Height: 0		WWTP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Rain Gauge Zone:		Other	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

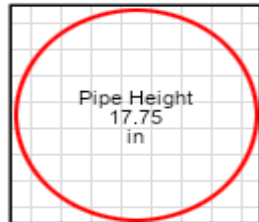
### Additional Site Information / Comments:

Standard Traffic Control with No Safety Concerns

# Hydrograph Report

Lockwood03

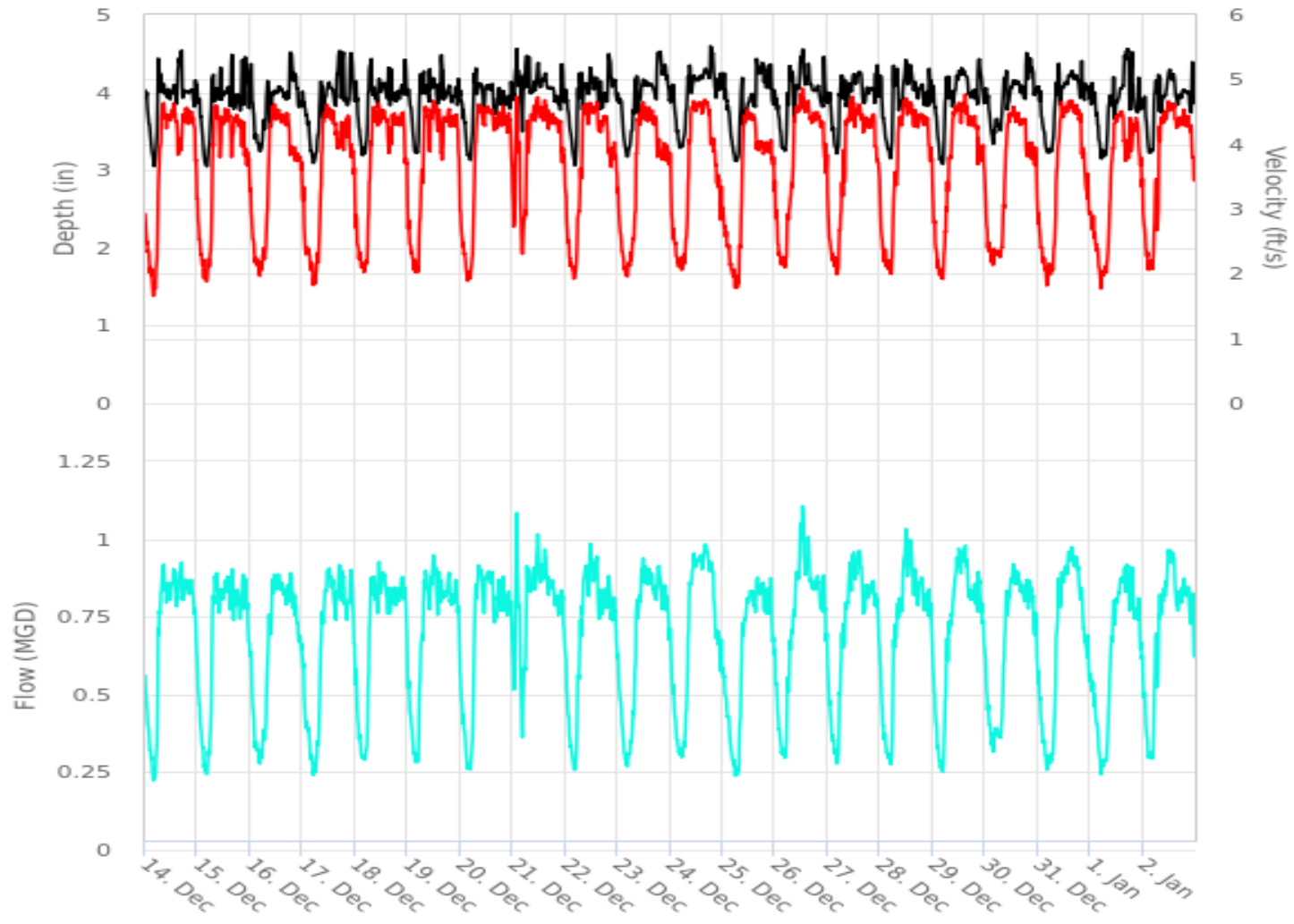
Flow Monitor  
**Lockwood03**



Report Period  
12/14/2023  
To  
01/02/2024

Legend  
— DFINAL  
— Rain  
— VFINAL  
— QFINAL

**ADS** ENVIRONMENTAL  
SERVICES®



# Scattergraph Report

Lockwood03

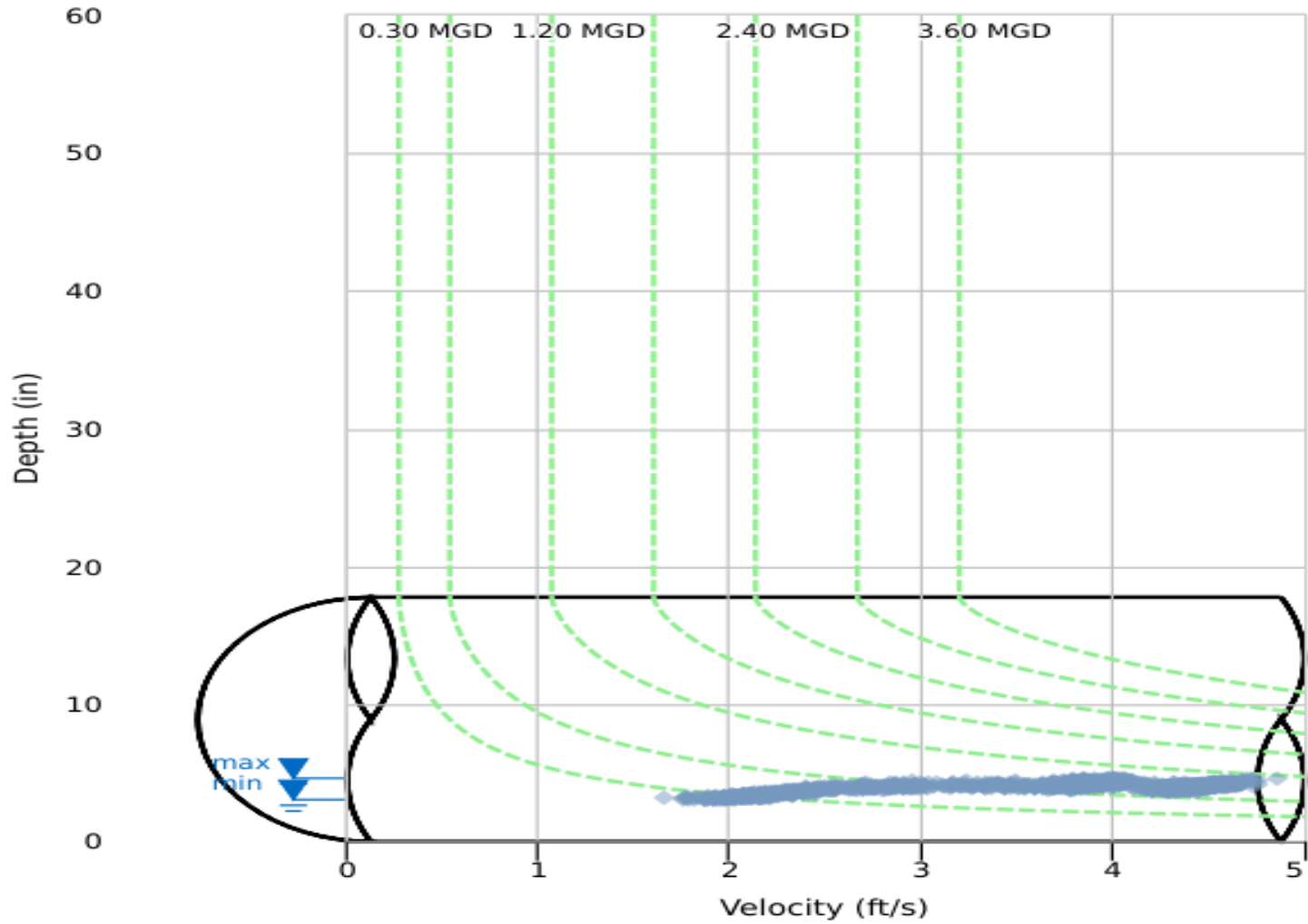
Flow Monitor  
**Lockwood03**

Pipe Height  
17.75  
in

Report Period  
12/14/2023  
To  
01/02/2024

Legend  
 ○ DFINAL - VFINAL  
 --- Iso-Q<sup>th</sup>  
 ▽ Min-Max Depth

**ABS ENVIRONMENTAL SERVICES**



## Daily Tabular Report

12/14/2023 00:00 - 01/02/2024 23:59

Lockwood03Pipe: Elliptical (17.75 in H x 18 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total
12/14/2023	04:10	3.05	16:55	4.55	3.93	04:00	1.59	13:05	4.69	3.75	04:00	0.208	16:45	0.941	0.710	0.710
12/15/2023	04:15	3.03	15:55	4.51	3.88	03:05	1.78	09:00	4.71	3.68	04:05	0.238	15:50	0.934	0.686	0.686
12/16/2023	04:40	3.23	18:25	4.56	3.88	05:25	1.82	11:10	4.72	3.56	05:25	0.264	19:00	0.935	0.661	0.661
12/17/2023	05:10	3.08	17:15	4.60	3.88	05:00	1.70	11:25	4.68	3.55	05:00	0.224	22:20	0.936	0.666	0.666
12/18/2023	03:40	3.17	07:00	4.54	3.92	04:05	1.99	10:45	4.68	3.76	04:15	0.284	11:05	0.936	0.709	0.709
12/19/2023	03:30	3.22	15:30	4.54	3.94	03:35	1.96	11:45	4.74	3.79	03:35	0.273	11:45	0.959	0.716	0.716
12/20/2023	04:55	3.12	07:25	4.36	3.86	03:25	1.80	12:50	4.66	3.80	03:25	0.250	08:35	0.921	0.701	0.701
12/21/2023	04:35	3.47	02:00	4.62	4.09	04:30	2.23	02:00	4.79	4.07	04:30	0.350	02:00	1.116	0.802	0.802
12/22/2023	04:40	3.04	20:00	4.50	3.94	04:30	1.79	14:40	4.78	3.72	04:30	0.234	11:30	0.993	0.708	0.708
12/23/2023	04:35	3.16	19:40	4.55	3.95	03:45	1.90	11:55	4.72	3.58	04:35	0.261	18:55	0.967	0.686	0.686
12/24/2023	04:40	3.28	18:40	4.63	4.01	05:25	1.94	10:50	4.76	3.60	05:25	0.280	16:15	1.001	0.705	0.705
12/25/2023	06:40	3.10	15:35	4.44	3.88	06:45	1.73	11:40	4.62	3.43	06:45	0.230	16:10	0.896	0.640	0.640
12/26/2023	04:30	3.24	12:40	4.57	3.97	03:05	2.07	12:35	4.91	3.79	04:30	0.293	12:35	1.116	0.730	0.730
12/27/2023	04:15	3.21	06:25	4.38	3.97	04:30	1.88	11:20	4.82	3.75	04:30	0.262	14:30	0.979	0.718	0.718
12/28/2023	04:50	3.14	11:55	4.46	3.94	05:15	1.92	12:05	4.82	3.76	05:00	0.267	11:55	1.062	0.715	0.715
12/29/2023	04:40	3.07	07:25	4.49	3.94	04:25	1.87	15:10	4.80	3.72	04:50	0.245	15:10	0.988	0.711	0.711
12/30/2023	03:55	3.32	19:05	4.53	3.96	03:35	2.09	12:55	4.61	3.53	03:35	0.308	13:00	0.927	0.673	0.673
12/31/2023	04:55	3.21	10:00	4.44	3.91	04:25	1.66	11:05	4.73	3.52	04:25	0.234	15:40	0.982	0.668	0.668
01/01/2024	05:15	3.14	17:10	4.58	3.86	05:00	1.77	14:45	4.55	3.44	05:10	0.240	15:55	0.944	0.638	0.638
01/02/2024	03:00	3.22	22:45	4.42	3.91	04:25	1.99	12:05	4.71	3.78	04:25	0.281	12:05	0.979	0.708	0.708

12/14/2023 00:00 - 01/02/2024 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Total			13.952
Average	3.93	3.68	0.698



# MEMO



February 27, 2024

TO: Developer

FROM: Tai P. Chau, PE, Supervising Civil Engineer

**SUBJECT: City of Oxnard Sewer Recommendations  
Lockwood 1, 2, and 3**

Dear Developer,

According to the Conditions of Approval 226 for Lockwood 1 and 230 and 231 for Lockwood 2, as well as the proposed Lockwood 3 project, the sewer calculations provided by your professional engineer have been reviewed by the engineering team members from the Community Development and Public Works Departments. The data from the sewer calculations was used to run the sewer modeling. The necessary improvements have been identified. They are listed below and are required to be constructed to accommodate the following Lockwood projects:

- 1) Lockwood 1 & 2 only (without the development of Lockwood 3).
  - Upgrade the existing 18-inch VCP sewer main to 21-in PVC from MH-R21-100 to MH-R21-103 with a minimum slope of 0.2%.
- 2) Lockwood 1, 2, & 3 combined:
  - Upgrade the existing 18-inch VCP sewer main to 21-in PVC from MH-R21-100 to MH-R21-103 with a minimum slope of 0.2%.
  - Upgrade the overcapacity pipes (d/D ratio above 60%) from MH-1 to MH-118 identified in Appendix 1.

If you have any questions or concerns, please contact me at (805) 385-7894 or [tai.chau@oxnard.org](mailto:tai.chau@oxnard.org).

Appendices:

1. Sewer calculations for Lockwood 1, 2, and 3
2. Sewer Survey Topographic Plans
3. Email from Public Works

# Appendix 1





Lockwood Senior Apartments  
Proposed Condition

Lockwood 1 and 2 only

	Street Name	Segment		Existing Pipe		*Design Capacity (cfs)		Area Contribution (ac)	Area Zoning Coefficient (cfs/ac)	Proposed Flow (cfs)	Calculated Flow (cfs)	**Cumulative Calculated Flow (cfs)	% Full Cumulative Flow/Capacity	PC Const. Plan #	Comments
		MH #	MH #	Size (in)	Slope (%)	1/2 Full(≤10")	60%								
City of Oxnard	Outlet Center Drive	4	3	10	0.28	0.587	0.7788	13.91	0.007		0.097	0.097	16.59%	1993-049a	Under Capacity
	Outlet Center Drive (LW-3)	4	3	10	0.28	0.587		5.17	0.007		0.036	0.134	22.75%	1993-049a	Under Capacity
	Outlet Center Drive (LW-2)	3	2	10	0.28	0.587				0.189	0.189	0.323	54.98%	1993-049a	Under Capacity
	Outlet Center Drive (LW-1)	3	2	10	0.28	0.587				0.198	0.198	0.520	88.65%	1993-049a	Under Capacity
	Outlet Center Drive	2	1	10	0.28	0.587		4.35	0.007		0.030	0.551	93.84%	1993-049a	Under Capacity
	Outlet Center Drive	1	109	10	0.28	0.587		8.91	0.007		0.062	0.613	104.46%	1993-049a	Over Capcity
	Lombard Street	109	108	10	0.28	0.587		1.46	0.007		0.010	0.623	106.20%		Over Capacity
	Lombard Street	108	106	10	0.28	0.587		4.16	0.007		0.029	0.653	111.17%		Over Capacity
	Lombard Street	106	107	10	0.28	0.587		1.66	0.007		0.012	0.664	113.14%		Over Capacity
	Wankel Way	107	105	10	0.28	0.587		1.58	0.007		0.011	0.675	115.03%		Over Capacity
	Wankel Way	105	104	10	0.28	0.587		1.50	0.007		0.011	0.686	116.82%		Over Capacity
	Wankel Way	104	118	10	0.28	0.587		0.69	0.007		0.005	0.691	117.64%		Over Capacity
	Wankel Way	104	118	10	0.28	0.587	0.7788	2.09	0.013		0.027	0.718	122.27%		Over Capacity

\*Calculated using Manning's Formula with n=0.013

\*\*Based on current land use and coefficients per City of Oxnard

\*\*\*For pipes ≤ 10", design capacity is defined as 1/2 full at peak flow

\*\*\*\*For pipes ≥ 12", design capacity is defined as 3/4 full at peak flow

Project Site Average Daily Flow = 200 gal/person/day/unit

Proposed Units Lockwood 1 = 193

Proposed Units Lockwood 2 = 183

Average Daily Flow Lockwood 1 = 38600 gpd = 0.06 cfs

Average Daily Flow Lockwood 2 = 36600 gpd = 0.06 cfs

Lockwood 1 Peak Flow = (Average Daily Flow)^0.822 x 2 = 0.198 cfs

Lockwood 2 Peak Flow = (Average Daily Flow)^0.822 x 2 = 0.189 cfs

For an existing sewer main d/D can be up to 0.60. Looks acceptable.

Lockwood Senior Apartments  
Proposed Condition

Lockwo0d 1, 2, and 3 combined

	Street Name	Segment		Existing Pipe		*Design Capacity (cfs)		Area Contribution (ac)	Area Zoning Coefficient (cfs/ac)	Proposed Flow (cfs)	Calculated Flow (cfs)	**Cumulative Calculated Flow (cfs)	% Full Cumulative Flow/Capacity	PC Const. Plan #	Comments
		MH #	MH #	Size (in)	Slope (%)	1/2 Full(≤10")	60%								
<div>→</div>	Outlet Center Drive	4	3	10	0.28	0.587	0.7788	13.91	0.007		0.097	0.097	16.59%	1993-049a	Under Capacity
	Outlet Center Drive (LW-3)	4	3	10	0.28	0.587				0.241	0.241	0.339	57.69%	1993-049a	Under Capacity
	Outlet Center Drive (LW-2)	3	2	10	0.28	0.587				0.189	0.189	0.528	89.92%	1993-049a	Under Capacity
	Outlet Center Drive (LW-1)	3	2	10	0.28	0.587				0.198	0.198	0.725	123.59%	1993-049a	Over Capacity
<div>City of Oxnard</div>	Outlet Center Drive	2	1	10	0.28	0.587		4.35	0.007		0.030	0.756	128.77%	1993-049a	Over Capcity
	Outlet Center Drive	1	109	10	0.28	0.587		8.91	0.007		0.062	0.818	139.40%	1993-049a	Over Capacity
	Lombard Street	109	108	10	0.28	0.587		1.46	0.007		0.010	0.828	141.14%		Over Capacity
	Lombard Street	108	106	10	0.28	0.587		4.16	0.007		0.029	0.858	146.10%		Over Capacity
	Lombard Street	106	107	10	0.28	0.587		1.66	0.007		0.012	0.869	148.08%		Over Capacity
	Wankel Way	107	105	10	0.28	0.587		1.58	0.007		0.011	0.880	149.96%		Over Capacity
	Wankel Way	105	104	10	0.28	0.587		1.50	0.007		0.011	0.891	151.75%		Over Capcity
	Wankel Way	104	118	10	0.28	0.587		0.69	0.007		0.005	0.896	152.58%		Over Capacity
	Wankel Way	104	118	10	0.28	0.587	0.7788	2.09	0.013		0.027	0.923	157.20%		Over Capacity

\*Calculated using Manning's Formula with n=0.013

\*\*Based on current land use and coefficients per City of Oxnard

\*\*\*For pipes ≤ 10", design capacity is defined as 1/2 full at peak flow

\*\*\*\*For pipes ≥ 12", design capacity is defined as 3/4 full at peak flow

Project Site Average Daily Flow = 200 gal/person/day/unit

Proposed Units Lockwood 1 =	193
Proposed Units Lockwood 2 =	183
Proposed Units Lockwood 3 =	246

Average Daily Flow Lockwood 1 =	38600	gpd	=	0.06	cfs
Average Daily Flow Lockwood 2 =	36600	gpd	=	0.06	cfs
Average Daily Flow Lockwood 3 =	49200	gpd	=	0.08	cfs

Lockwood 1 Peak Flow = (Average Daily Flow)^0.822 x 2 =	0.198	cfs
Lockwood 2 Peak Flow = (Average Daily Flow)^0.822 x 2 =	0.189	cfs
Lockwood 3 Peak Flow = (Average Daily Flow)^0.822 x 2 =	0.241	cfs

More than 60%,  
improvements start at  
this point.

# Appendix 2



# Appendix 3



Chau, Tai <tai.chau@oxnard.org>

---

## Lockwood development sewer analysis.

---

Withanage, Asitha <asitha.withanage@oxnard.org>

Mon, Feb 26, 2024 at  
5:28 PM

To: "Chau, Tai" <tai.chau@oxnard.org>

Cc: Morgan Kessler <morgan.kessler@oxnard.org>

Hello Tai,

I included the Lockwood phase 3, see comments below.

I have analyzed the existing sewer model to evaluate the potential impact of the proposed Lockwood development on the City's wastewater system as requested by you. This study aimed to assess the feasibility of incorporating the proposed development into the current wastewater system and to identify any potential issues that could arise as a result.

The proposed peak wastewater discharge is 0.198 cfs for Lockwood Phase 1, 0.189 cfs for Lockwood Phase 2, and 0.241 cfs for Phase 3 as shown in attached Appendix#1.

Due to additional wastewater discharge from the proposed development, downstream 18-inch sewer pipe sections between La Puerta Ave and Santa Lucia Ave (along the storm drain channel) exceed the maximum d/D ratio allowed.

### Recommendation:

1. Upgrade the existing 18-inch VCP sewer to 21-inch PVC from MH-R21-100 to MH-R21-103 with a minimum 0.002 slope. See Appendix #2
2. Upgrade the overcapacity pipes (d/D ratio above 60%) identified by the developer in Appendix#1.

Thanks

---

**Asitha Withanage, P.E. - Senior Civil Engineer**  
**Public Works Department, Engineering**