



Anza Drive and Arguello Boulevard Storm Drainage System Improvements



Alternatives Evaluation

FINAL / July 2023





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SECTION 1 INTRODUCTION

The City of Pacifica (City) collects and disposes of storm water runoff generated within the City service area. The storm drainage collection system consists of roughly 56 miles of drainage pipelines ranging from 4 to 120 inches in diameter and two pump stations. Stormwater collected in the City's drainage system outfalls to numerous streams and the Pacific Ocean.

The purpose of this *Alternatives Evaluation* is to summarize the evaluation of alternative strategies to address flooding in the Anza Drive and Arguello Boulevard (Anza-Arguello) area, which is located upstream of the Linda Mar lift station (LS) in the southern portion of the City's stormwater drainage system.

Figure 1 shows an overview of the study area. City staff have noted a history of observed flooding in this area; additionally, the City's 2022 *Storm Drainage System Master Plan (2022 Master Plan)*, done by Carollo Engineers (Carollo), identified capacity deficiencies in the storm drainage infrastructure at this location under modeled design storm conditions.

The 2022 *Master Plan* recommended the City address flooding in the Anza-Arguello area by installing new 30-inch and 36-inch diameter pipelines to increase system capacity and convey flows past the area that experiences flooding. It is expected that it will take the City several years to fully implement these recommended improvements. In the meantime, the City requested that Carollo investigate potential intermediate solutions to help mitigate near-term flooding.

This *Alternatives Evaluation* consists of the following sections:

- **Introduction:** This section presents an overview of the City's storm drainage system facilities in the study area and describes the purpose of the evaluation.
- **Background:** This section summarizes the findings from the 2022 *Master Plan* as well as other efforts focused on mitigating flooding in the Anza-Arguello area.
- **Survey Results and Model Updates:** This section describes the results from a survey conducted in the Anza-Arguello area and corresponding updates made to the City's storm drainage system hydraulic/hydrologic model.
- **Intermediate Storm Drainage Improvement Alternatives:** This section describes the intermediate strategies that were considered to improve flooding in the Anza-Arguello area.
- **Alternatives Analysis:** This section describes the alternatives analysis that was conducted to evaluate the benefits and costs of implementing the proposed intermediate strategies.
- **Recommendations:** This section presents the recommended strategy and proposed next steps.



Figure 1 Overview of Study Area

SECTION 2 BACKGROUND

The 2022 *Master Plan* recommended the following improvements to mitigate flooding in the Anza-Arguello area under 10- and 50-year design storm conditions:

- **WLM-1:** This project includes the installation of a new 36-inch pipeline from 711 Linda Mar Boulevard to the corner of Linda Mar Boulevard and Highway 1. The 36-inch pipeline would continue along Highway 1 to the existing manhole at the northern corner of the Chevron gas station.
- **WLM-2:** This project includes the installation of a new 30-inch pipeline from the corner of Peralta Road and Linda Mar Boulevard to 711 Linda Mar Boulevard.

Figure 2 shows an overview of the improvements recommended in the 2022 *Master Plan*. Following the 2022 *Master Plan*, the City contracted with Carollo to further investigate intermediate solutions to mitigate flooding in the Anza-Arguello area. The goal of this effort is to reduce near-term flooding until the recommended 2022 *Master Plan* improvements can be fully completed.

SECTION 3 SURVEY RESULTS AND MODEL UPDATES

Carollo subcontracted with CSG Consultants, Inc. (CSG) to conduct a field survey of the storm drainage infrastructure on Anza Drive near Arguello Boulevard, as well as the existing 36-inch diameter storm drain on the bike path adjacent to Highway 1. Appendix A provides the results from the survey, and the following summarizes main findings from the survey:

- The survey results revealed that the storm drain along Highway 1 north of Anza Drive is crowned and drains to both the Anza LS and the Linda Mar LS. Previously, it was thought that this storm drain sloped continuously southwest from the storm drain upstream of the Anza LS towards Linda Mar Boulevard.
- According to the survey, several storm drains in the Anza-Arguello area have either negative slopes (i.e., the upstream invert is below the downstream invert) or slopes less than 0.001 feet per foot. Figure 3 shows the storm drains in the Anza-Arguello area by slope.

The following updates were made to incorporate the survey results into the hydraulic/hydrologic model:

- All model invert and rim elevations within the survey extents were updated to be consistent with the measured survey elevations.
- Model pipe diameters were updated to be consistent with the survey results.
- Model subcatchments were modified to reflect topography shown on the survey results.

After incorporating the above changes, the model was run under existing 10-year and 50-year, 24-hour design storm conditions to determine whether the updates resulted in substantially different findings from the 2022 *Master Plan*. The modeled flooding results after completing the updates were similar to the results in the 2022 *Master Plan*. The results reinforce City staff observations of flooding in the Anza-Arguello area as well as capacity deficiencies previously identified in the storm drains upstream of the Linda Mar LS.



Figure 2 Recommendations for Anza-Arguello Area from 2022 Master Plan



Figure 3 Storm Drain Slopes in Anza-Arguello Area

SECTION 4 INTERMEDIATE STORM DRAINAGE IMPROVEMENT ALTERNATIVES

Four potential intermediate storm drainage improvements were identified to help mitigate near-term flooding in the Anza-Arguello area. Table 1 describes the four alternatives, and Figure 4 through Figure 7 show overviews of each alternative.

Table 1 Overview of Alternatives

Alternative	Description
Baseline	In this alternative, the City would not implement any intermediate solutions to mitigate flooding and only implement the long-term solution recommended in the <i>2022 Master Plan</i> .
Alternative 1	Increase inlet size at west end of Anza-Arguello.
Alternative 2	Increase inlet size at west end of Anza-Arguello and connect 36-inch and 48-inch diameter pipes upstream of Linda Mar LS.
Alternative 3	Install new pipelines to convey flows from Anza-Arguello to the 21-inch diameter pipe on the northeast corner of Anza Drive. This alternative would also involve installing new inlets on the east and west sides of Anza Drive adjacent to 951 Anza Drive.
Alternative 4	Install new pipelines to convey flows from Anza-Arguello to Highway 1 through a new backyard easement at 951 Anza Drive. This alternative would also involve installing new inlets on the east and west sides of Anza Drive adjacent to 951 Anza Drive.



Figure 4 Alternative 1 Overview



Figure 5 Alternative 2 Overview



Figure 6 Alternative 3 Overview

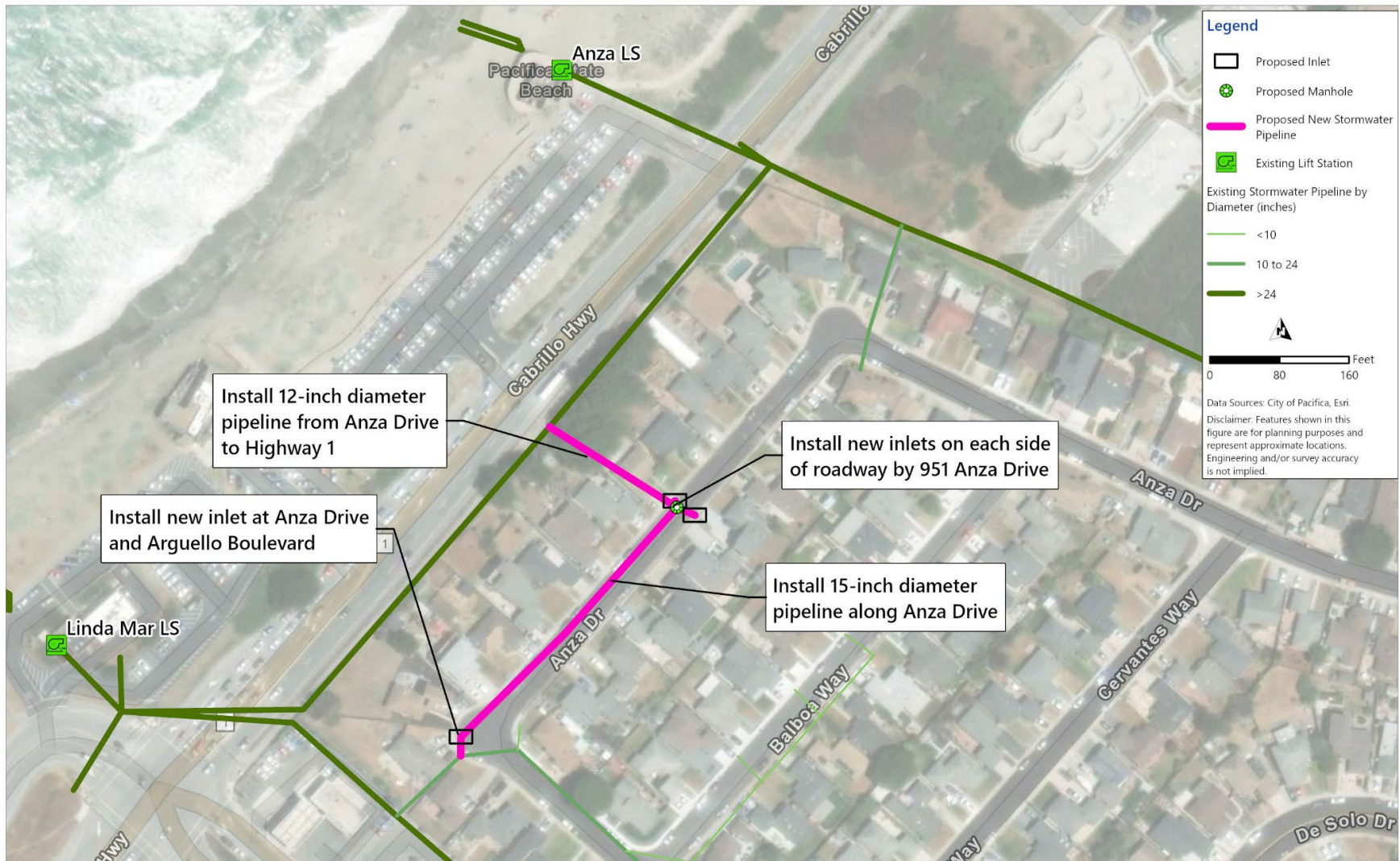


Figure 7 Alternative 4 Overview

SECTION 5 ALTERNATIVES ANALYSIS

The alternative flood mitigation alternatives were evaluated to understand potential flood mitigation benefits and economic costs. The following sections describe the hydraulic/hydrologic and economic analyses conducted as part of the evaluation.

5.1 Hydraulic/Hydrologic Analysis

The hydraulic/hydrologic model of the City’s stormwater drainage system that was updated as part of the 2022 *Master Plan* was used along with historical observations to estimate potential flood mitigation benefits from each alternative. Table 2 summarizes the findings from the hydraulic/hydrologic analysis.

Table 2 Summary of Hydraulic/Hydrologic Analysis Findings

Alternative	Hydraulic/Hydrologic Analysis Findings
Baseline	In the baseline alternative, flooding occurs in the Anza-Arguello area under 50-year, 24-hour design storm conditions. The area of greatest concern is at the intersection of Anza-Arguello.
Alternative 1	Model results and observed flooding indicate that the inlet located at the western side of the Anza-Arguello intersection is undersized. Upsizing the inlet to accommodate modeled runoff under 50-year, 24-hour design storm conditions would likely help mitigate flooding at this location.
Alternative 2	Model results suggest that connecting the 36-inch and 48-inch diameter stormwater pipelines upstream of the Linda Mar LS would provide minimal flood risk reduction benefits, assuming all existing infrastructure remains in service. However, connecting these pipes could improve redundancy by providing alternative conveyance if one of the pipelines crossing Highway 1 towards the Linda Mar LS were to fail during a storm event.
Alternative 3	Model results suggest that conveying flows from the Anza-Arguello intersection towards the existing 21-inch diameter stormwater pipeline at the northeast corner of Anza Drive via a new 21-inch diameter pipeline along Anza Drive could help mitigate flooding at this location. However, due to topography constraints, the new pipeline would have minimal cover, likely less than 1 foot. Therefore, this alternative is not considered constructable.
Alternative 4	Model results suggest that conveying flows from the Anza-Arguello intersection towards the Anza LS via the alignment proposed for Alternative 4 would help mitigate flooding at this location and would be topographically feasible. According to model results, the new pipeline would need to be 12 inches in diameter to fully mitigate flooding under 50-year, 24-hour design storm conditions. However, there may not be sufficient space to install a 12-inch diameter pipeline along the potential new easement through 951 Anza Drive. Model results suggest that reducing the diameter of this section to 10 inches would lead to minor flooding under the 50-year design storm condition, assuming the section along Anza Drive remains 12 inches in diameter or larger.

5.2 Economic Analysis

An economic analysis was performed to estimate the capital costs for the potential strategies. The cost estimates for this analysis were developed using methodologies consistent with those used in the 2022 *Master Plan* and are considered Class 5 estimates as defined by the American Association of Cost Estimating (AACE); Class 5 estimates have a range of accuracy of -50 percent to +100 percent and are typically used for cost screening and analysis related to project feasibility. Costs for selected alternatives should be refined during preliminary design.

Table 3 shows the total estimated capital costs for each alternative, and Appendix B provides detailed cost breakdowns. The estimated costs range from approximately \$37,000 for Alternative 1 to approximately \$787,000 for Alternative 3.

Table 3 Estimated Capital Costs for Intermediate Flood Mitigation Alternatives

Alternative	Capital Cost ⁽¹⁾⁽²⁾⁽³⁾
Baseline – No intermediate improvements.	\$0
Alternative 1 – Increase Anza and Arguello inlet size.	\$37,000
Alternative 2 – Increase Anza and Arguello inlet size and connect 36-inch and 48-inch diameter pipes upstream of Linda Mar LS.	\$59,000
Alternative 3 – Increase Anza and Arguello inlet size and install new pipe to convey flows from Anza-Arguello to the 21-inch diameter pipe on the northeast corner of Anza Drive.	\$787,000
Alternative 4 – Increase Anza and Arguello inlet size and install new pipe to convey flows from Anza-Arguello to Highway 1 through backyard easement.	\$684,000

Notes:

(1) Costs are in May 2023 dollars using the Engineering News Record 20-City Construction Cost Index of 13,288.

(2) All costs are rounded to the nearest \$1,000.

(3) Detailed cost breakdowns are provided in Appendix B.

5.3 Alternatives Analysis Summary

The hydraulic/hydrologic and economic analyses conducted for this evaluation indicate potential monetary and nonmonetary costs and benefits to the Anza-Arguello alternatives. Table 4 summarizes the main flood mitigation and economic advantages and disadvantages of each alternative.

In addition to the disadvantages listed in Table 4, none of the alternatives identified in this evaluation provide holistic flood mitigation in the area tributary to the Linda Mar LS. The improvements identified in the 2022 *Master Plan* must be implemented along with the selected alternatives to mitigate modeled flooding.

Table 4 Summary of Advantages and Disadvantages

Alternative	Advantages	Disadvantages
Baseline – No intermediate improvements.	<ul style="list-style-type: none"> Does not require any improvements beyond those already proposed in the 2022 <i>Master Plan</i>. Lowest capital cost. 	<ul style="list-style-type: none"> Does not help mitigate near-term flooding in Anza-Arguello area.
Alternative 1 – Increase Anza and Arguello inlet size.	<ul style="list-style-type: none"> Relatively low capital cost. Will likely help mitigate localized flooding at Anza and Arguello intersection. 	<ul style="list-style-type: none"> Does not mitigate localized flooding at the roadway dip by 951 Anza Drive.
Alternative 2 – Increase Anza and Arguello inlet size and connect 36-inch and 48-inch diameter pipes upstream of Linda Mar LS.	<ul style="list-style-type: none"> Relatively low capital cost. Provides additional redundancy if one of the existing Highway 1 storm drain crossings upstream of the Linda Mar LS goes out of service during a storm event. 	<ul style="list-style-type: none"> Does not mitigate localized flooding at the roadway dip by 951 Anza Drive. Does not provide meaningful additional flood mitigation benefit beyond Alternative 1 when all existing infrastructure is in service.
Alternative 3 – Increase Anza and Arguello inlet size and install new pipe to convey flows from Anza-Arguello to the 21-inch diameter pipe on the northeast corner of Anza Drive.	<ul style="list-style-type: none"> Relatively high capital cost. Helps mitigate localized flooding at the roadway dip by 951 Anza Drive. 	<ul style="list-style-type: none"> Topography poses major constructability challenges; construction may not be feasible with maintaining minimum cover and slope.
Alternative 4 – Increase Anza and Arguello inlet size and install new pipe to convey flows from Anza-Arguello to Highway 1 through backyard easement.	<ul style="list-style-type: none"> Relatively high capital cost. Helps mitigate localized flooding at the roadway dip by 951 Anza Drive. 	<ul style="list-style-type: none"> Requires construction through new, narrow backyard easement; construction through easement may not be feasible. Connection from new storm drain to existing storm drain adjacent to Highway 1 may pose additional constructability challenges.

SECTION 6 CONCLUSIONS AND RECOMMENDATIONS

The findings from this evaluation suggest potential flood mitigation benefits from the strategies identified. It is recommended that the City pursue the following actions to help mitigate near-term flooding in the Anza/Arguello area until the recommended 2022 *Master Plan* improvements are implemented:

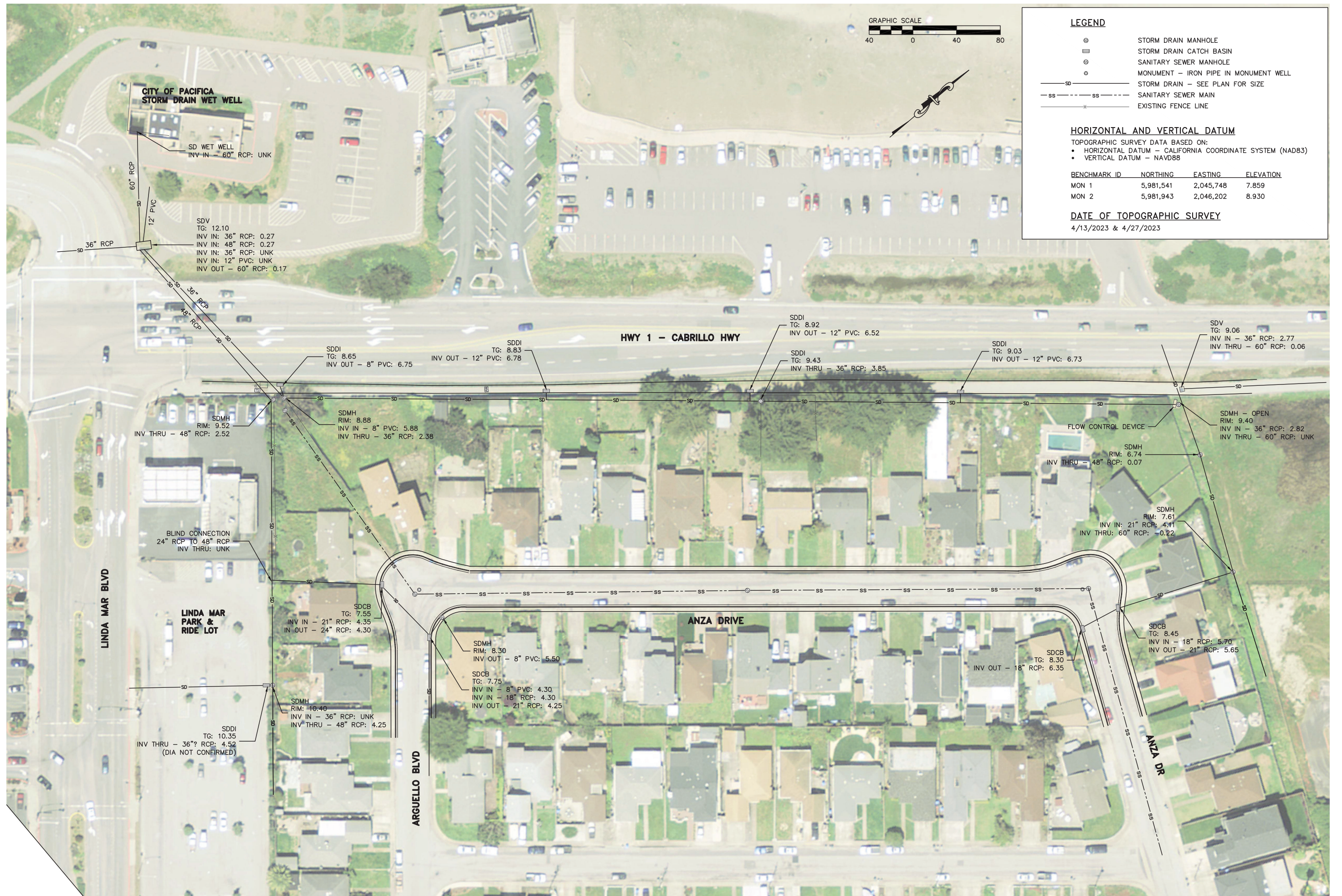
- The evaluation results indicate that installing new inlets and pipelines along the north section of Anza Drive would help mitigate flooding at Anza-Arguello as well as at the dip in the road by 951 Anza Drive. Due to topography constraints, it does not appear feasible to convey flows to the existing 21-inch diameter pipeline at the northeast corner of Anza Drive (i.e., Alternative 3). Therefore, it is

recommended that the City further investigate conveying flows to Highway 1 through a new easement along 951 Anza Drive (i.e., Alternative 4).

- The existing inlet at the west end of Anza-Arguello appears to be undersized to accommodate runoff at this location under design storm conditions. Further investigation of this inlet will help determine whether the inlet should be upsized to help mitigate localized flooding. Installing a new inlet at this location to convey flows to the east may eliminate the need to upsize the existing inlet.

APPENDIX A

SURVEY RESULTS



LEGEND

- ⊙ STORM DRAIN MANHOLE
- ⊞ STORM DRAIN CATCH BASIN
- ⊙ SANITARY SEWER MANHOLE
- ⊙ MONUMENT - IRON PIPE IN MONUMENT WELL
- SD— STORM DRAIN - SEE PLAN FOR SIZE
- SS- SS- SANITARY SEWER MAIN
- x- EXISTING FENCE LINE

HORIZONTAL AND VERTICAL DATUM

- TOPOGRAPHIC SURVEY DATA BASED ON:
- HORIZONTAL DATUM - CALIFORNIA COORDINATE SYSTEM (NAD83)
 - VERTICAL DATUM - NAVD88

BENCHMARK ID	NORTHING	EASTING	ELEVATION
MON 1	5,981,541	2,045,748	7.859
MON 2	5,981,943	2,046,202	8.930

DATE OF TOPOGRAPHIC SURVEY

4/13/2023 & 4/27/2023

SCALE: AS SHOWN	NO.	REVISIONS	DATE
DRAWN: -			
DESIGNED: -			
APPROVED: -			

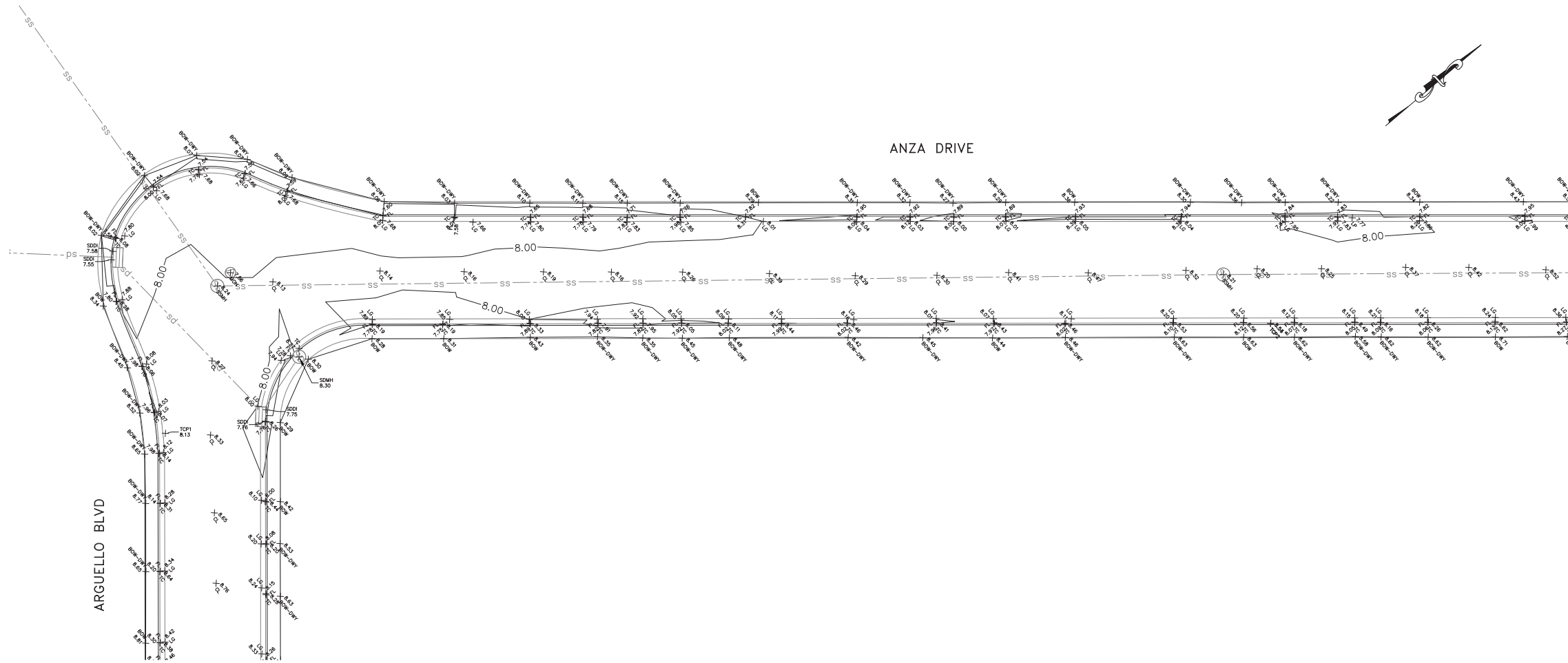
PREPARED BY:
CSG CONSULTANTS, INC.
 550 PILGRIM DRIVE
 FOSTER CITY, CA 94404
 PHONE: (650) 522-2500
 FAX: (650) 522-2599
 EMPLOYEE-OWNED

PREPARED FOR:
CAROLLO ENGINEERS
 50 WEST LIBERTY STREET
 SUITE 300
 RENO, NV 89501

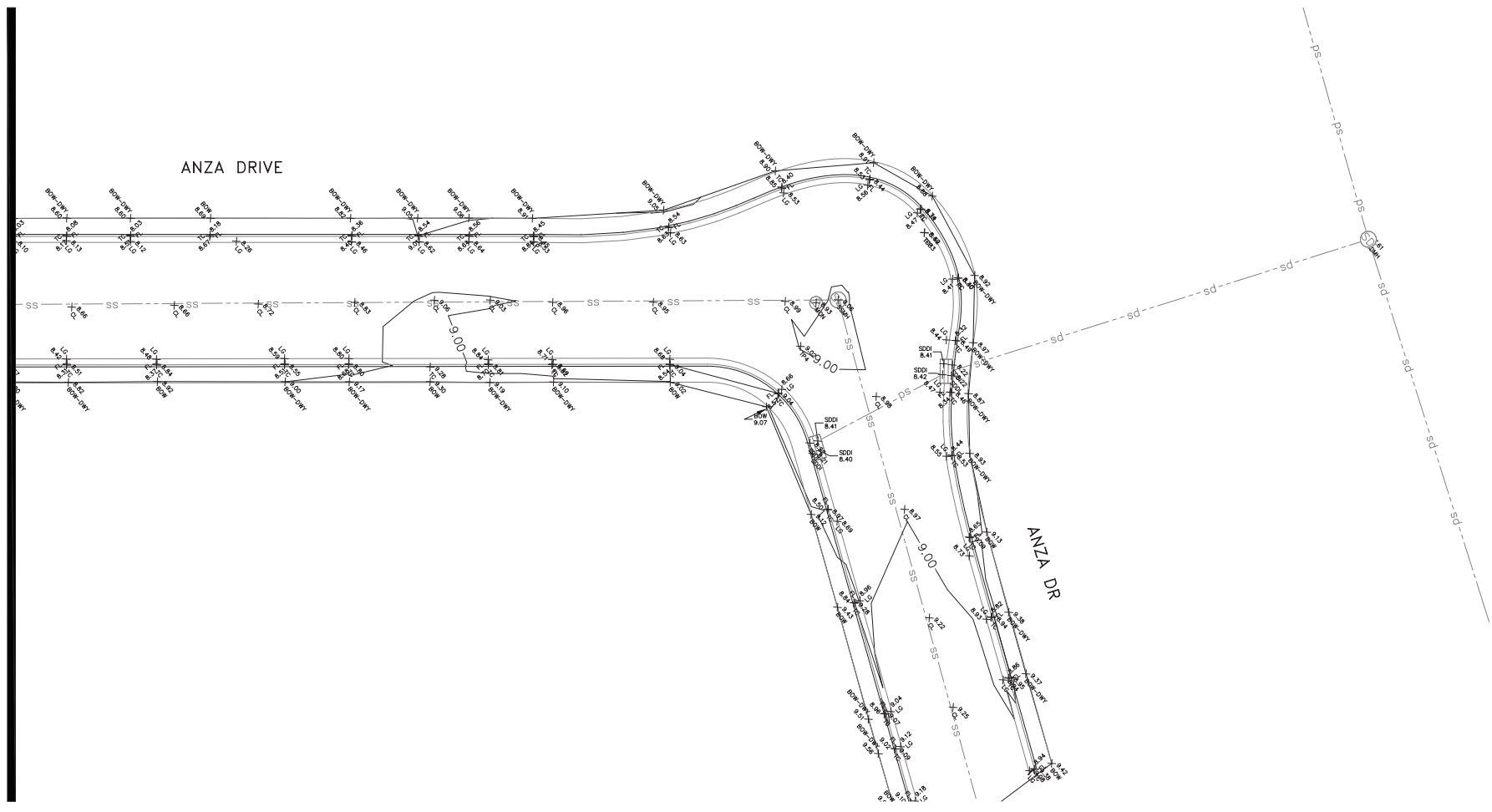
TITLE:
**LOWER LINDA MAR
 TOPO SURVEY & SD INVESTIGATION**

SHEET:
1 OF 1

DATE: 5/3/2023
 JOB#: 23.334



MATCH LINE - SEE BELOW



MATCH LINE - SEE ABOVE

TITLE:	LOWER LINDA MAR TOPO SURVEY & SD INVESTIGATION
SHEET:	OF ##
DATE:	5/3/2023
JOB#:	23.###
PREPARED FOR:	
PREPARED BY:	CSG CONSULTANTS, INC. 550 PILGRIM DRIVE FOSTER CITY, CA 94404 PHONE: (650) 522-2500 FAX: (650) 522-2599 EMPLOYEE-OWNED
SCALE:	AS SHOWN
DRAWN:	-
DESIGNED:	-
APPROVED:	-
NO.	
REVISIONS	
DATE	

APPENDIX B

COST ESTIMATING DETAILS

Table B.1 through Table B.4 show the planning level cost estimates for Alternatives 1 through 4, respectively.

Table B.1 Alternative 1 Capital Cost Estimate

Item No.	Description	Units	Quantity	Unit Price ⁽¹⁾	Budget ⁽²⁾
1	Mobilization	%	5%	\$19,000	\$1,000
2	Traffic Control	LS	1	\$1,000	\$1,000
3	Sheeting, Shoring, and Bracing	LS	1	\$1,000	\$1,000
4	Stormwater Pollution Prevention & Control	LS	1	\$1,000	\$1,000
5	Dewatering Operations	LS	1	\$1,000	\$1,000
6	Manholes	EA	1	\$15,000	\$15,000
7	30% Contingency	%	30%	\$20,000	\$6,000
Subtotal - Conceptual Opinion of Probable Construction Cost					\$26,000
8	Design	%	10%	\$26,000	\$3,000
9	Environmental/Permitting	%	10%	\$26,000	\$3,000
10	Construction Management/Inspection/Testing	%	15%	\$26,000	\$4,000
11	City Administration	%	5%	\$26,000	\$1,000
Subtotal - Engineering and Administration Cost					\$11,000
Total Project Cost					\$37,000

Notes:

(1) Unit costs are in May 2023 dollars.

(2) Costs are rounded to the nearest \$1,000 unless otherwise noted.

Table B.2 Alternative 2 Capital Cost Estimate

Item No.	Description	Units	Quantity	Unit Price ⁽¹⁾	Budget ⁽²⁾
1	Mobilization	%	5%	\$31,000	\$2,000
2	Traffic Control	LS	1	\$1,000	\$1,000
3	Sheeting, Shoring, and Bracing	LS	1	\$1,000	\$1,000
4	Stormwater Pollution Prevention & Control	LS	1	\$1,000	\$1,000
5	Dewatering Operations	LS	1	\$2,000	\$2,000
6	36-inch HDPE Pipe Replacement: Open Trench	LF	20	\$570	\$11,000
7	Manholes	EA	1	\$15,000	\$15,000
8	30% Contingency	%	30%	\$33,000	\$10,000
Subtotal - Conceptual Opinion of Probable Construction Cost					\$43,000
9	Design	%	10%	\$43,000	\$4,000
10	Environmental/Permitting	%	10%	\$43,000	\$4,000
11	Construction Management/Inspection/Testing	%	15%	\$43,000	\$6,000
12	City Administration	%	5%	\$43,000	\$2,000
Subtotal - Engineering and Administration Cost					\$16,000
Total Project Cost					\$59,000

Notes:

(1) Unit costs are in May 2023 dollars.

(2) Costs are rounded to the nearest \$1,000 unless otherwise noted.

Table B.3 Alternative 3 Capital Cost Estimate

Item No.	Description	Units	Quantity	Unit Price ⁽¹⁾	Budget ⁽²⁾
1	Mobilization	%	5%	\$412,000	\$21,000
2	Traffic Control	LS	1	\$10,000	\$10,000
3	Sheeting, Shoring, and Bracing	LS	1	\$5,000	\$5,000
4	Stormwater Pollution Prevention & Control	LS	1	\$2,000	\$2,000
5	Dewatering Operations	LS	1	\$2,000	\$2,000
6	18-inch HDPE Pipe Replacement: Open Trench	LF	660	\$505	\$333,000
7	Manholes	EA	4	\$15,000	\$60,000
8	30% Contingency	%	30%	\$433,000	\$130,000
Subtotal - Conceptual Opinion of Probable Construction Cost					\$563,000
9	Design	%	10%	\$563,000	\$56,000
10	Environmental/Permitting	%	10%	\$563,000	\$56,000
11	Construction Management/Inspection/Testing	%	15%	\$563,000	\$84,000
12	City Administration	%	5%	\$563,000	\$28,000
Subtotal - Engineering and Administration Cost					\$224,000
Total Project Cost					\$787,000

Notes:

- (1) Unit costs are in May 2023 dollars.
- (2) Costs are rounded to the nearest \$1,000 unless otherwise noted.

Table B.4 Alternative 4 Capital Cost Estimate

Item No.	Description	Units	Quantity	Unit Price ⁽¹⁾	Budget ⁽²⁾
1	Mobilization	%	5%	\$358,000	\$18,000
2	Traffic Control	LS	1	\$10,000	\$10,000
3	Sheeting, Shoring, and Bracing	LS	1	\$5,000	\$5,000
4	Stormwater Pollution Prevention & Control	LS	1	\$2,000	\$2,000
5	Dewatering Operations	LS	1	\$2,000	\$2,000
6	12-inch HDPE Pipe Replacement: Open Trench	LF	200	\$495	\$99,000
7	15-inch HDPE Pipe Replacement: Open Trench	LF	360	\$500	\$180,000
8	Manholes	EA	4	\$15,000	\$60,000
9	30% Contingency	%	30%	\$376,000	\$113,000
Subtotal - Conceptual Opinion of Probable Construction Cost					\$489,000
10	Design	%	10%	\$489,000	\$49,000
11	Environmental/Permitting	%	10%	\$489,000	\$49,000
12	Construction Management/Inspection/Testing	%	15%	\$489,000	\$73,000
13	City Administration	%	5%	\$489,000	\$24,000
Subtotal - Engineering and Administration Cost					\$195,000
Total Project Cost					\$684,000

Notes:

- (1) Unit costs are in May 2023 dollars.
- (2) Costs are rounded to the nearest \$1,000 unless otherwise noted.