

**SUMMARY OF FINDINGS FOR THE
ANNUAL DRAINAGE CHANNEL FIELD
ASSESSMENT AND MAINTENANCE PRIORITIZATION
PROJECT (PHASE 1)
FOR
THE CITY OF SAN DIEGO – MASTER STORM WATER
SYSTEM MAINTENANCE PROGRAM (MMP) MAP 51:
RED RIVER DR & CONESTOGA DR**


Job Number 17204-D

August 4, 2015

RICK
RICK ENGINEERING COMPANY
ENGINEERING COMPANY
RICK ENGINEERING CO

**SUMMARY OF FINDINGS FOR THE
ANNUAL DRAINAGE CHANNEL FIELD
ASSESSMENT AND MAINTENANCE PRIORITIZATION PROJECT (PHASE 1)
FOR
THE CITY OF SAN DIEGO – MASTER STORM WATER SYSTEM MAINTENANCE
PROGRAM (MMP) MAP 51: RED RIVER DR & CONESTOGA DR**

Job Number 17204-D


Jayne Janda-Timba
RCE #70649, Exp. 06/17
Associate



Prepared For:
City of San Diego
2781 Caminito Chollas
San Diego, California 92105

Prepared By:
Rick Engineering Company
Water Resources Division
5620 Friars Road
San Diego, California 92110-2596
(619) 291-0707

August 4, 2015

TABLE OF CONTENTS

1.0 Executive Summary	1
2.0 Introduction.....	1
3.0 Desktop Channel Maintenance Prioritization Analysis	1
4.0 Hydrologic Summary.....	2
5.0 Hydraulic Analysis.....	3
6.0 Other Channel Prioritization Factors	4
7.0 Summary of Findings and Recommendations	4

Tables

Table 1: Channel Prioritization Assessment Factors and Weighting	2
Table 2: 100-year Peak Discharge (Q100) Estimation Based on Watershed Size	2
Table 3: Summary of Approximate Hydrologic Data	3
Table 4: Summary of Hydraulic Analysis Results	4
Table 5: Channel Prioritization Assessment Scoring Summary.....	4

Appendices

Appendix A: Master Storm Water System Maintenance Program (MMP), dated October 2011, Storm Water Facilities Key Map and Map 51: Red River Dr & Conestoga Dr	
Appendix B: City of San Diego Operations and Maintenance (O&M) Channel Maintenance Inspection Forms completed for the channel and Site photos taken by the City of San Diego	
Appendix C: Hydrologic Support Material	
Appendix D: Hydraulic Analysis Output	
Appendix E: Channel Prioritization Assessment Sheet	
Appendix F: Channel Maintenance Prioritization Summary Sheet	
Appendix G: Available As-built plans	
Appendix H: Compact Disc: PDF Version of Full Report	

1.0 Executive Summary

This report and preliminary analyses concludes that the Channel Prioritization Score for the Red River Dr & Conestoga Dr (MMP Map 51) is **63.9 out of 100**. This score is average and indicates that the channel is recommended for maintenance. If the channel is maintained to reflect the as-built condition, the hydraulic capacity of the channel will increase from the current less than 2- to 2-year storm event capacity to a 100-year storm event capacity. Other factors considered in the analysis include water quality, community needs, and aesthetics related to the channel.

2.0 Introduction

This report summarizes the findings for the Annual Drainage Channel Field Assessment and Maintenance Prioritization Project (Phase 1) for the City of San Diego for Master Storm Water System Maintenance Program (MMP), dated October 2011, Map 51: Red River Dr & Conestoga Dr. Refer to Appendix A for the MMP Storm Water Facilities Key Map and Map 51.

Purpose

As part of the Master Storm Water System Maintenance Program (MMP), the City of San Diego performed site visits to drainage channels within the MMP and designated several drainage channels as maintenance priorities. The purpose of Phase 1 of this project is to perform a desktop analysis to evaluate the drainage channels identified by the City of San Diego and rank them in order of significance for the purposes of City of San Diego maintenance activities.

3.0 Desktop Channel Maintenance Prioritization Analysis

The desktop channel maintenance prioritization analysis is based on the following items which were reviewed and evaluated to determine the maintenance priority:

- City of San Diego Operations and Maintenance (O&M) Channel Maintenance Inspection Forms completed for the channel by the City of San Diego (Refer to Appendix B)
- Site photos taken by the City of San Diego (Refer to Appendix B)
- Available as-built plans (Refer to Appendix G)
- Hydraulic Analysis (Refer to Section 5.0 and Appendix D for detailed output)

Section 5.1 of the MMP discusses the Annual Maintenance Needs Determination Process. As part of the determination process, the MMP recommends that certain factors be evaluated including flood risk to life and property, water quality, community needs and aesthetics. These four factors were utilized for this channel maintenance prioritization analysis. For the purposes of prioritizing the channel for maintenance activities, each main factor is weighted as shown in the table below:

Table 1

Channel Prioritization Assessment Factors and Weighting	
Factor	Percent Weighted (%)
Flood Risk	75
Water Quality	10
Community Needs	10
Aesthetics	5

As part of the channel prioritization analysis, each of the main factors has been divided into subfactors. To determine the Flood Risk factor, a basic hydraulic analysis was performed for the channel. The hydraulic analysis is described in more detail in the Hydraulic Analysis section (Section 5.0) of this report. The remaining factors, Water Quality, Community Needs and Aesthetics were assessed based on the site photos and the information provided on the (O&M) Channel Maintenance Inspection Form completed for the channel provided by the City of San Diego. These factors and subfactors and how they relate to the Channel Prioritization Score are shown in more detail on the Channel Prioritization Assessment Sheet located in Appendix E.

4.0 Hydrologic Summary

Estimated Peak Discharges

A drainage study for the channel was not available at the authorship of this report. The drainage channel is not a Federal Emergency Management Agency (FEMA) defined channel and no detailed hydrologic analysis was available. Therefore, the 100-year storm event peak discharge (Q100) for the channel was estimated based on the size of the watershed tributary to the channel as shown in the table below:

Table 2

100-year Peak Discharge (Q100) Estimation Based on Watershed Size				
Watershed Area (square miles)	<1	1	2	>4
cfs¹ per acre	4	2	1.5	1

1. cfs = cubic feet per second

The 2-, 5-, 10-, 25-, and 50-year storm event flow rates were then approximated by taking the ratio of the unknown storm event 6-hour precipitation and the 100-year storm event 6-hour precipitation, and then multiplying Q100 by the ratio to estimate the flow rate for the unknown storm event. Hydrologic support material is located in Appendix C. A summary of the estimated peak discharges are provided in the table below:

Table 3

Summary of Approximate Hydrologic Data						
Drainage Area: 832 acres						
6-hour Precipitation (in)	1.2	1.6	1.7	2.0	2.2	2.5
Frequency	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Discharge (cfs)¹	799	1,065	1,132	1,331	1,464	1,664

1. cfs = cubic feet per second

5.0 Hydraulic Analysis

A basic hydraulic analysis of the channel was performed to assess the Flood Risk factor. The channel assessment limits are shown on Map 51 located in Appendix A. Manning’s equation was utilized to calculate the capacity of the channel under two conditions:

1. As-built Conditions: based on the material and geometry as shown on the available as-built plans. (Refer to Appendix G)
2. Current Conditions: based on the vegetation and sediment levels estimated from the site photos taken by the City of San Diego and information provided on the (O&M) Channel Maintenance Inspection Form prepared by the City of San Diego.

Culvert crossings that may exist within the channel reach were not analyzed as part of this hydraulic analysis. Existing culverts may be inefficient or undersized, however the culvert hydraulics were not considered as part of this analysis.

Based on the approximate vegetation information provided on the O&M Channel Maintenance Inspection form and the site photos taken by the City of San Diego there is heavy vegetation in portions of the channel and very light vegetation in other portions of the channel. This hydraulic analysis was done for both heavy and light vegetation resulting in a range of flows for the current capacity. The O&M Channel Maintenance Inspection form did not indicate an approximate sediment depth. Therefore, based on the site photos taken by the City of San Diego and the existence of vegetation, the sediment level was approximated to be 0.2 feet.

The multiple storm event peak discharges previously calculated in Section 4.0 were evaluated under each condition to assess the capacity of the channel and evaluate the benefit of performing maintenance activities on the channel. See the table below for a summary of the hydraulic results and Appendix D for detailed hydraulic output.

Table 4

Summary of Hydraulic Analysis Results			
CURRENT CHANNEL CAPACITY		AS-BUILT CHANNEL CAPACITY	
Current Condition (cfs)	Equivalent Storm Event (year)	As-built Condition (cfs)	Equivalent Storm Event (year)
431 – 799	Less than 2 to 2	1,664	100

cfs = cubic feet per second

6.0 Other Channel Prioritization Factors

Sections 4.0 and 5.0 above discuss the determination process for the Flood Risk factor. For more information on the assessment of the Water Quality, Community Needs, and Aesthetics factors please refer to the Channel Prioritization Assessment Sheet in Attachment E. The Channel Prioritization Assessment Sheet lists and describes the sub-factors that are considered in the determination of the four main channel assessment factors.

7.0 Summary of Findings and Recommendations

A summary of the Channel Assessment is shown in the table below.

Table 5

Channel Prioritization Assessment Scoring Summary		
Factor	Percent Weighted (%)	Weighted Factor Score/Maximum Possible Score
Flood Risk	75	61.9/75
Water Quality	10	2/10
Community Needs	10	0/10
Aesthetics	5	0/5
Overall Channel Score:		63.9/100

Additionally, the following items should be noted:

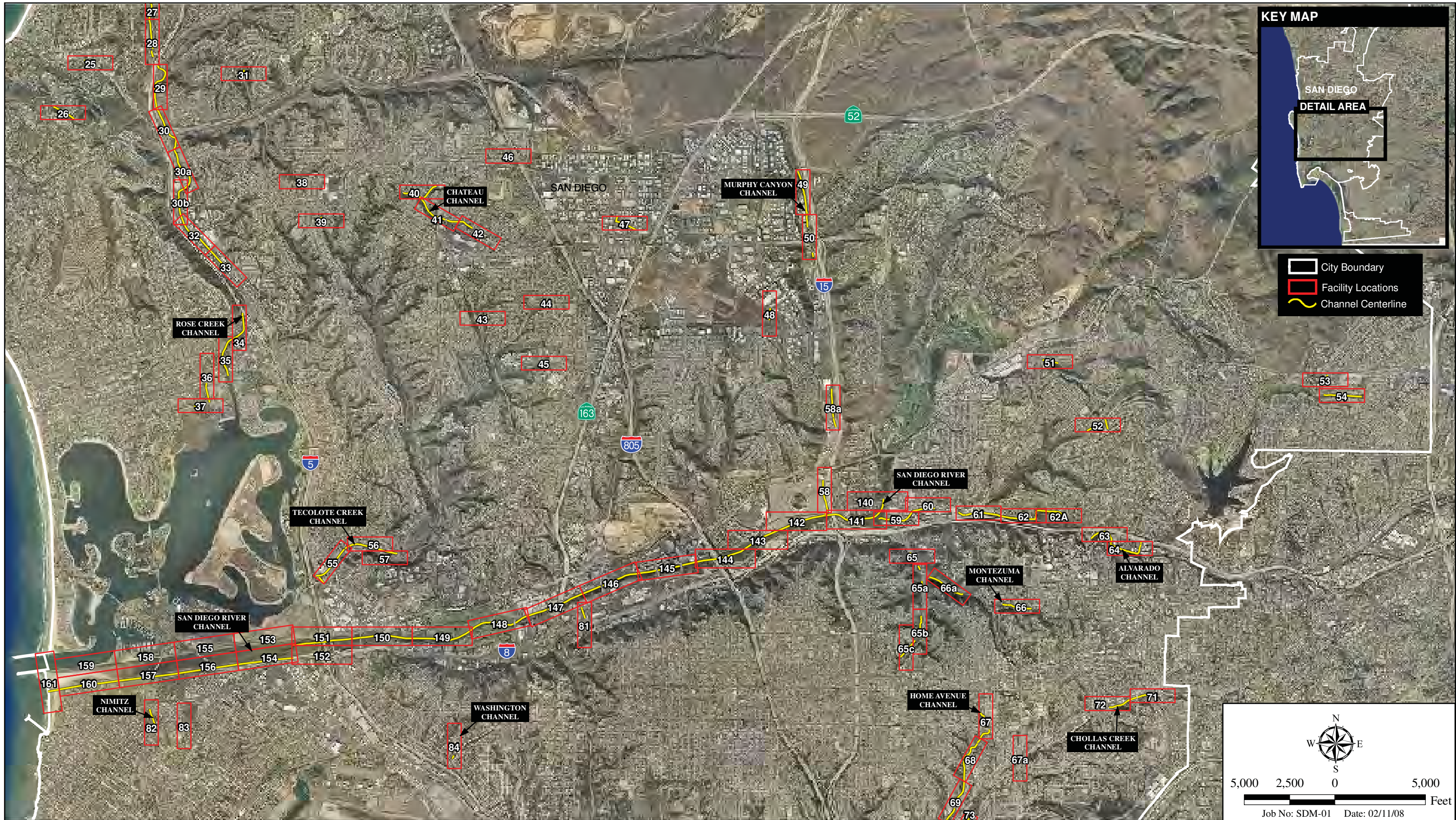
- It was noted on the O&M Channel Maintenance Inspection Form completed for the channel by the City of San Diego that there is heavy vegetation within portions of the channel. It appears from the site photos taken by the City of San Diego that the heavy vegetation exists at the upstream end. A high risk of vegetation flowing downstream and clogging the culvert exists.
- It was noted on the O&M Channel Maintenance Inspection Form completed for the channel by the City of San Diego that there is a small hole and broken concrete at the downstream end of the channel. Additionally, it appears from the site photos taken by the City of San Diego that there are cracks in the side slopes along the channel.

Based on the evaluation of the four weighted channel prioritization factors described in Section 3.0 of this report, the Channel Prioritization Score for MMP Map 51: Red River Dr & Conestoga Dr is **63.9**. Refer to the Channel Prioritization Assessment Sheet located in Appendix E for details on the evaluation of the weighted factors and resulting score for this channel.

It is recommended that this drainage channel be maintained to increase the current capacity of the channel from less than a 2- to 2-year storm event back to a 100-year storm event capacity.

A summary of the channel including an aerial map, channel prioritization score, and other pertinent information is shown on the exhibit titled “Channel Maintenance Prioritization Summary Sheet” located in Appendix F.

Appendix A
Master Storm Water System Maintenance Program (MMP),
dated October 2011, Storm Water Facilities
Key Map and Map 51: Red River Dr & Conestoga Dr

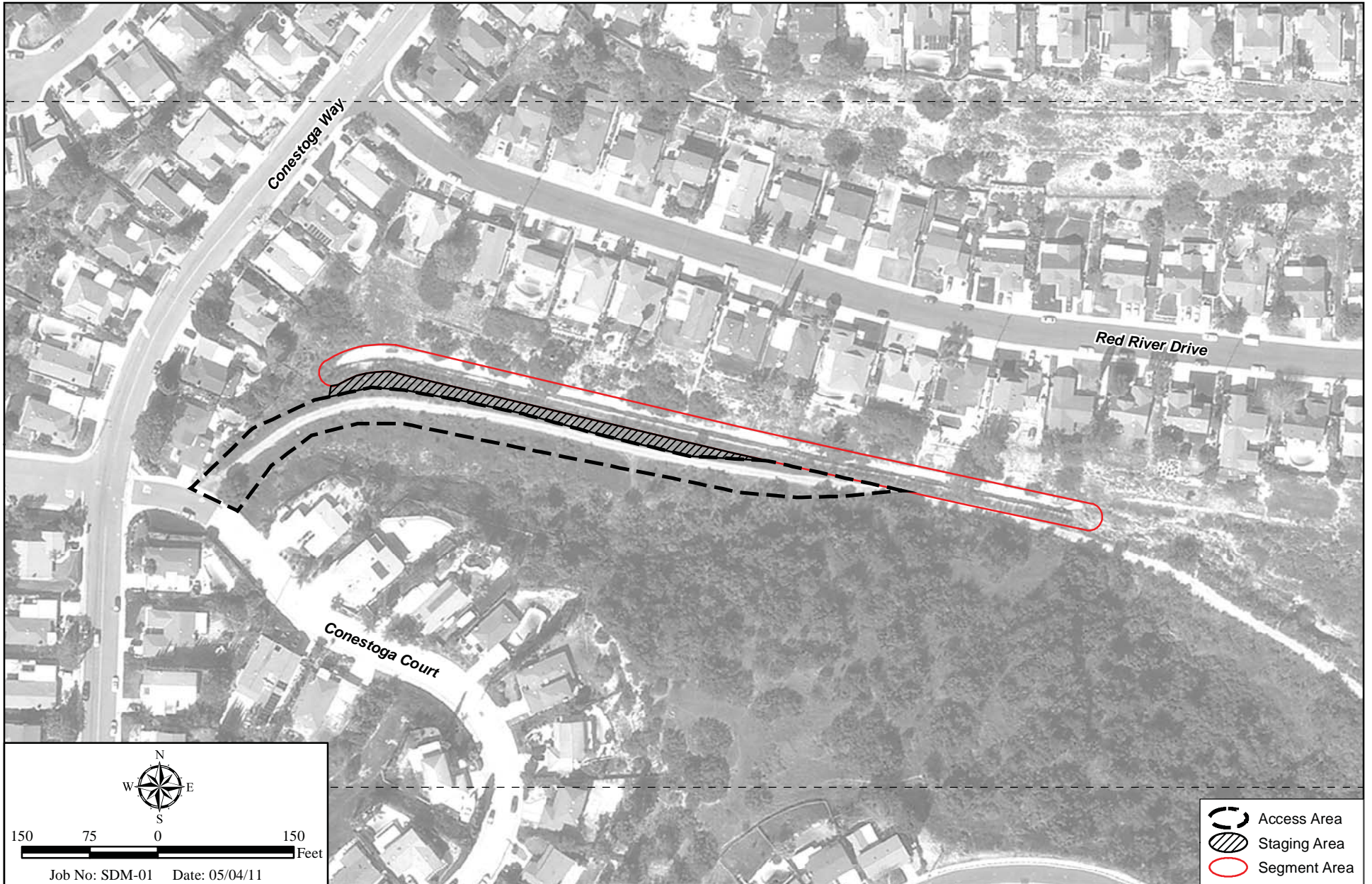


I:\ArcGIS\SDM-01\Map\ENV\MSMP\Fig2c_18_Corridor.mxd -NM

Stormwater Facilities - I-8 Corridor

CITY OF SAN DIEGO MASTER STORMWATER SYSTEM MAINTENANCE PROGRAM

Figure 2c



E:\ArcGIS\SDM-01 StormDrainMaintenance\Map\ENV\MasterPlan\Map51.mxd -RK

Access and Staging Areas

CITY OF SAN DIEGO MASTER STORMWATER SYSTEM MAINTENANCE PROGRAM

Appendix B
City of San Diego Operations and Maintenance (O&M)
Channel Maintenance Inspection Forms completed
for the channel and Site photos taken by the City of San Diego

Operations and Maintenance

Channel Maintenance Inspection Form

Date: **5-16-15** Time: **8:00**

Channel Map No.: **51**

Watershed: **SAN DIEGO**

Inspector: **MIKE/AUTHOR**

Weather: **CLOUDY**

Initial Inspection

Follow Up Inspection

Item	Condition	Comments
A. Channel Condition 1= Poor Condition/Needs Immediate Attention 2= Moderate Condition 3= Good Condition		
1. Structure Condition	1 <input checked="" type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> N/A	Small hole & broken concrete at the end of the channel
2. Erosion	1 <input type="radio"/> 2 <input checked="" type="radio"/> 3 <input type="radio"/> N/A	
3. Trash/Debris	1 <input type="radio"/> 2 <input checked="" type="radio"/> 3 <input type="radio"/> N/A	Type of trash and source: HEAVY VEG. IN THE SOIL PORTION
4. Water Conveyance/ Volume	1 <input checked="" type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> N/A	
5. Standing Water	Y <input checked="" type="radio"/> N <input type="radio"/>	
A. Ponding	Y <input checked="" type="radio"/> N <input type="radio"/>	
B. Noticeable odors	Y <input checked="" type="radio"/> N <input type="radio"/>	
C. Algae	Y <input checked="" type="radio"/> N <input type="radio"/>	
6. Vegetation	1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> N/A	Approx. Coverage/Density of Vegetation:
A. Invasive (Arundo)	1 <input type="radio"/> 2 <input type="radio"/> 3 <input checked="" type="radio"/> N/A	in the soil portion 100%
B. Native	1 <input checked="" type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> N/A	
7. Sediment	1 <input type="radio"/> 2 <input type="radio"/> 3 <input checked="" type="radio"/> N/A	Approx. Depth/Coverage of Sediment:
8. Transients/ encampments	Y <input checked="" type="radio"/> N <input type="radio"/>	

B. Culverts and Outfalls

1= Poor Condition/Needs Immediate Attention

2= Moderate Condition

3= Good Condition

Item	Condition	Comments
1. Structure Condition	1 2 3 N/A	clogging in the soil portion
2. Trash/Debris/Sediment	1 2 3 N/A	
3. Clogging	1 2 3 N/A	

C. See Map Attached

-Identify Key Issues on Map

-Inspect and take photographs from vantage points identified on Map

Other Comments:

D. To Be Completed by Management

Follow Up Actions

- 1.
- 2.
- 3.

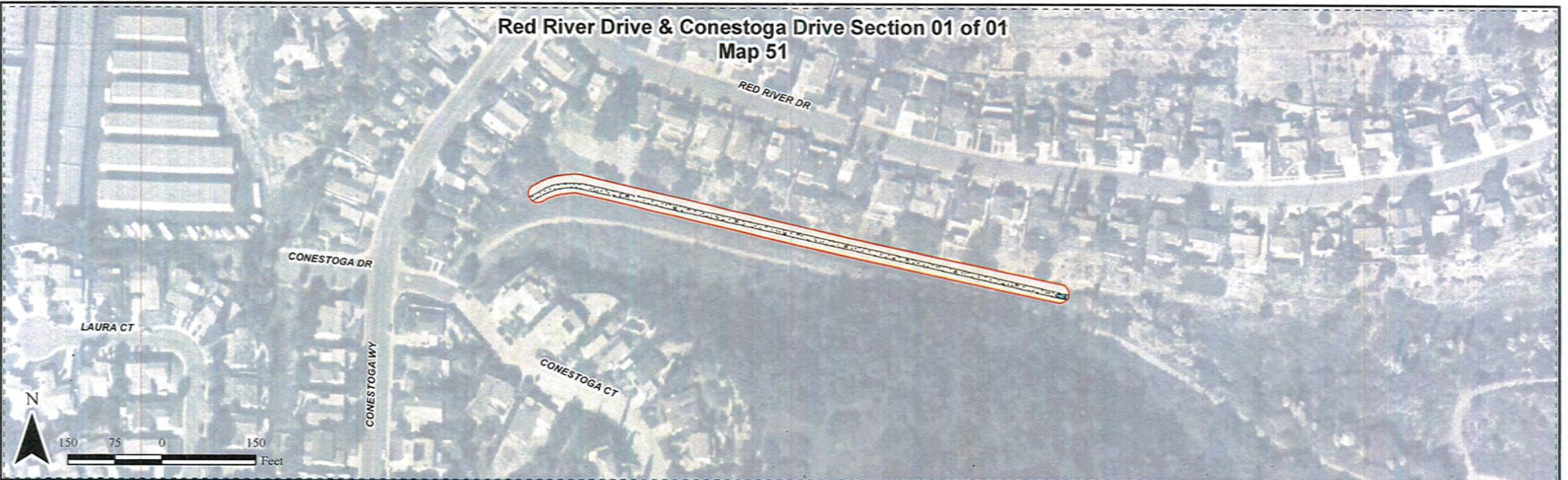
E. Infrastructure Failure Issues

Item	Condition	Comments
1. Broken Concrete/Gunite?	Y N N/A	
2. Broken/Missing Trash Fence?	Y N N/A	
3. Broken/Missing Poles/Supports?	Y N N/A	
4. Exposed Rebar?	Y N N/A	
5. Rock/Debris Accumulation?	Y N N/A	
6. Potential Flooding/Litigation?	Y N N/A	
7. Slope Failure?	Y N N/A	

Other Comments/Observations:

Empty rectangular box for providing additional comments or observations.

Red River Drive & Conestoga Drive Section 01 of 01
Map 51

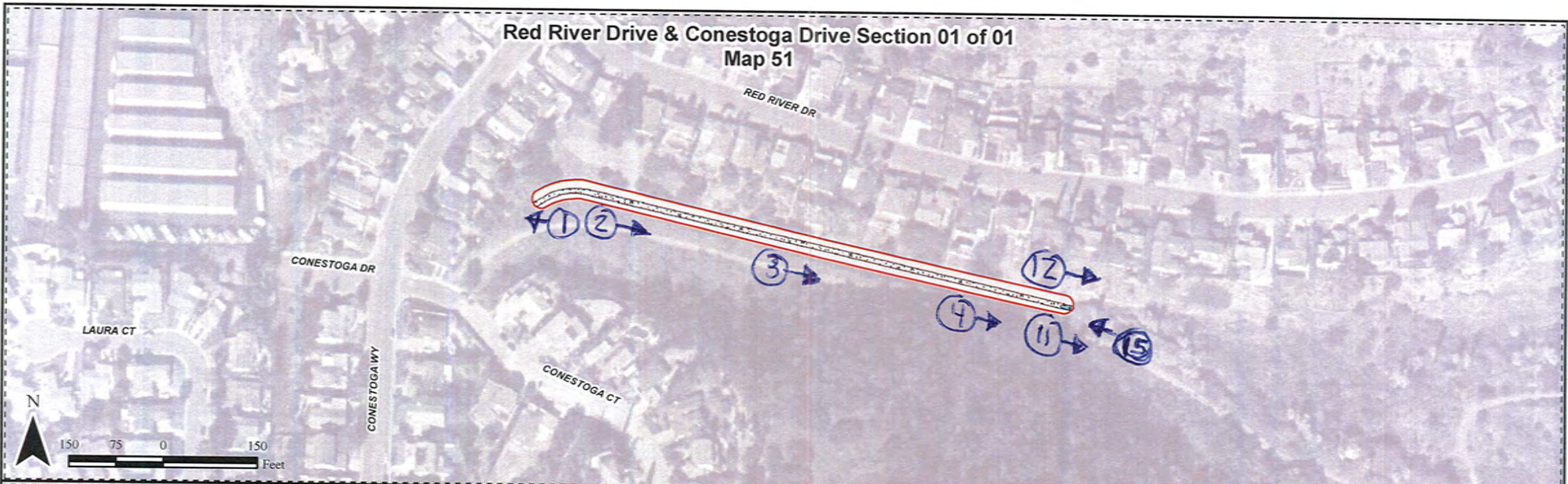


Camino Del Arroyo Section 01 of 01
Map 52



HELIX

Red River Drive & Conestoga Drive Section 01 of 01
Map 51



Camino Del Arroyo Section 01 of 01
Map 52



HELIX



Red River Drive & Conestoga Drive.1 (5-16-2015)



Red River Drive & Conestoga Drive.2 (5-16-2015)



Red River Drive & Conestoga Drive.3 (5-16-2015)



Red River Drive & Conestoga Drive.4 (5-16-2015)



Red River Drive & Conestoga Drive.11 (5-27-2015)



Red River Drive & Conestoga Drive.12 (5-27-2015)

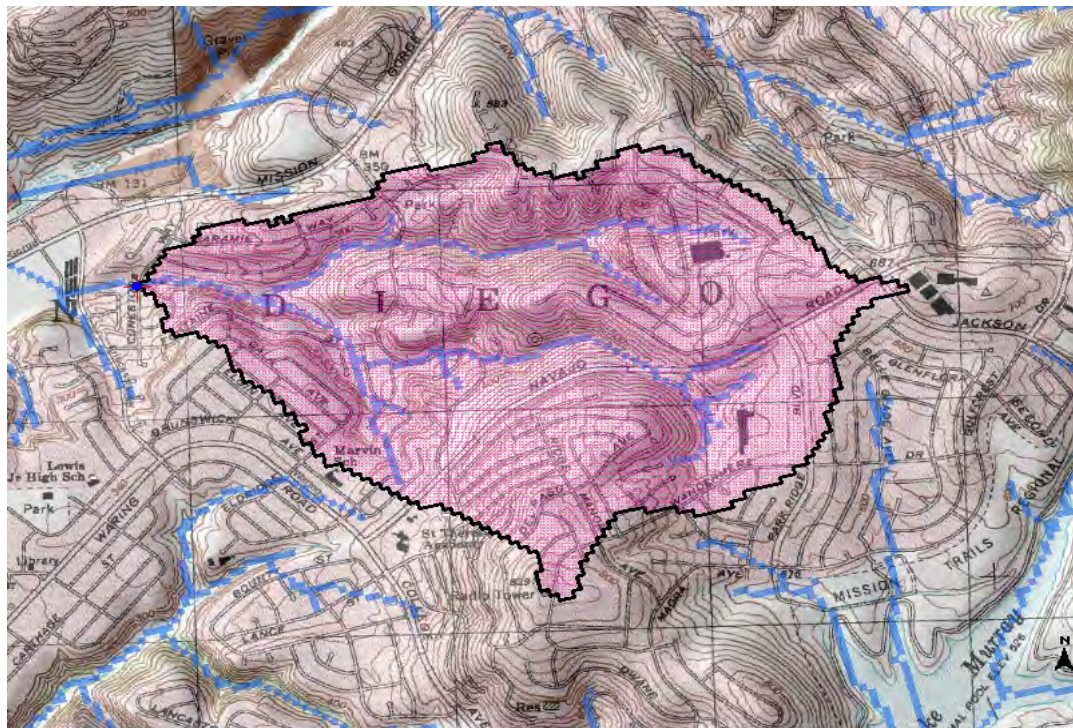


Red River Drive & Conestoga Drive.15 (5-27-2015)

Appendix C
Hydrologic Support Material



Red River and Conestoga Way MMP Map 51 Watershed



Explanation

- | | | |
|------------------------------|-------------------------------------|---------------|
| ★ GlobalWatershedPoint | ▲ Gaging Station, Continuous Record | □ hucpoly |
| ⊙ Centroid | ▲ Low Flow, Partial Record | — streams |
| ◆ huc_net_Junctions | ▲ Peak Flow, Partial Record | ⊗ ExcludePoly |
| ■ GlobalWatershed | ▲ Peak and Low Flow, Partial Record | |
| Synthetic Stream Grid | ▲ Stage Only | |
| ■ | ▲ Low Flow, Partial Record, Stage | |
| | ▲ Miscellaneous Record | |
| | ▲ Unknown | |



San Diego County Hydrology Manual



Prepared by the County of San Diego
Department of Public Works
Flood Control Section
June 2003

LIST OF APPENDICES

<u>LETTER</u>	<u>TITLE</u>	
A	Hydrologic Soil Groups Map	A-1
B	Isopluvial Maps	B-1
C	Precipitation Zone Number (PZN) Map	C-1
D	Worksheets for NRCS Hydrologic Method Calculations	D-1
E	85 th Percentile Precipitation Isopluvial Map	E-1

County of San Diego Hydrology Manual



Rainfall Isopleths

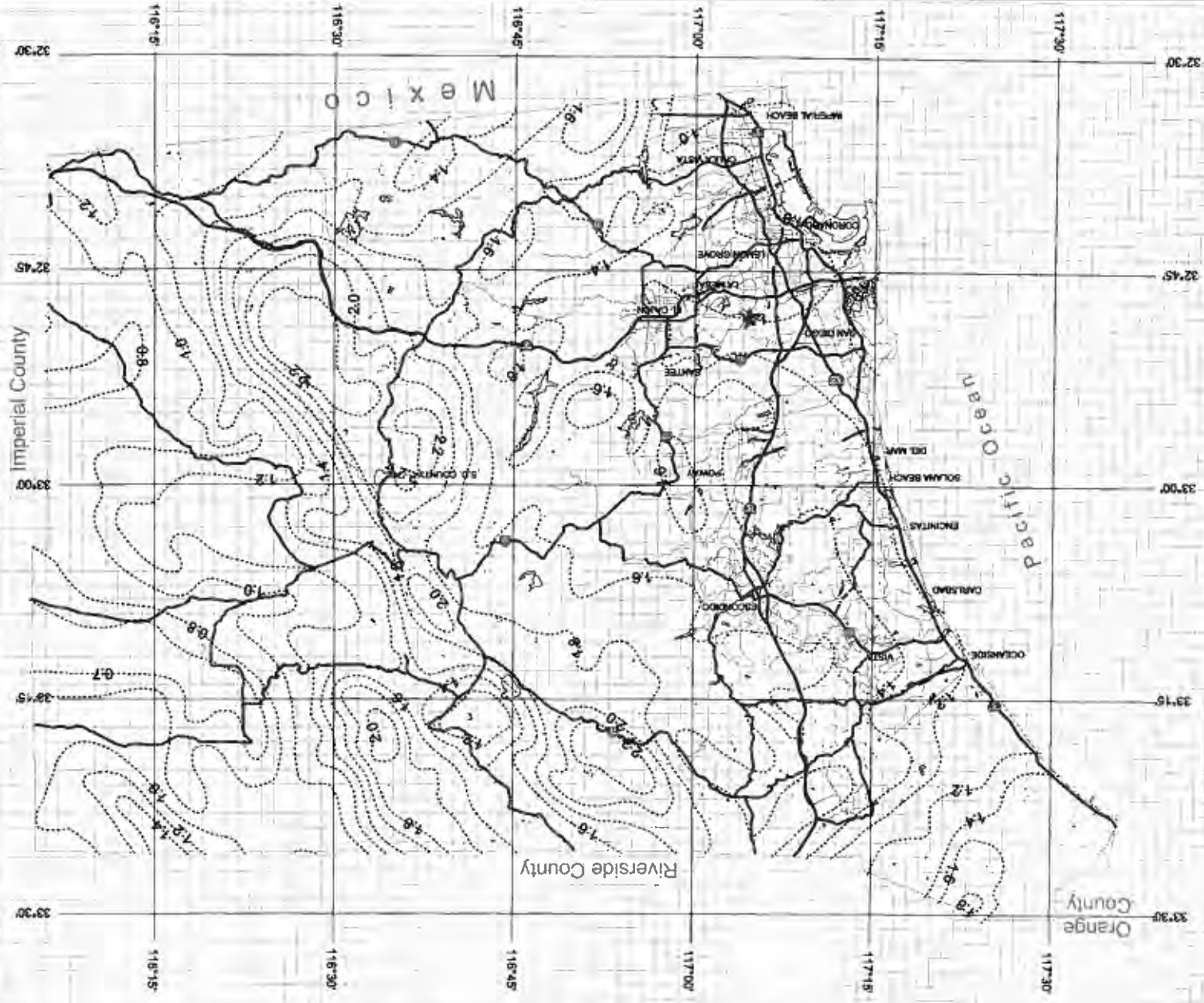
2 Year Rainfall Event - 6 Hours

----- (isopleth (inches))

* $P_0 = 1.2$ in



This map is provided without warranty or any kind of representation or assurance of accuracy and shall not be used for purposes other than those intended. The user assumes all liability for any use of this map. The publisher and author disclaim any liability for errors or omissions. Copyright © 2000 by Sangis.



County of San Diego Hydrology Manual

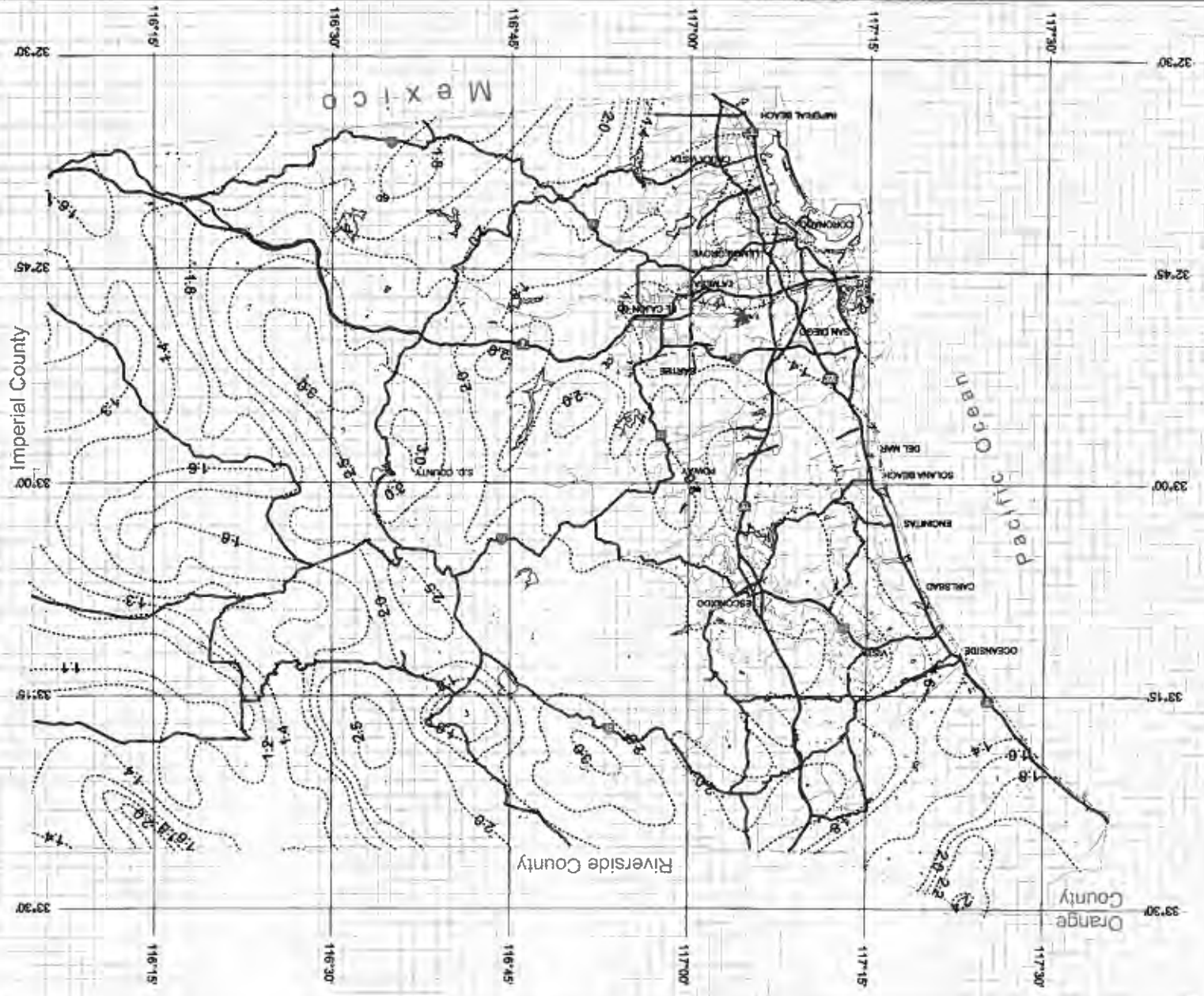


Kanfall Isoplethals

5 Year Rainfall Event - 6 Hours

..... Isoplethal (Inches)

#P₆ = 1.6 in



County of San Diego Hydrology Manual



Rainfall Isopleths

10 Year Rainfall Event - 6 Hours

..... Isohyetal (inches)

* $R_6 = 1.7$ in

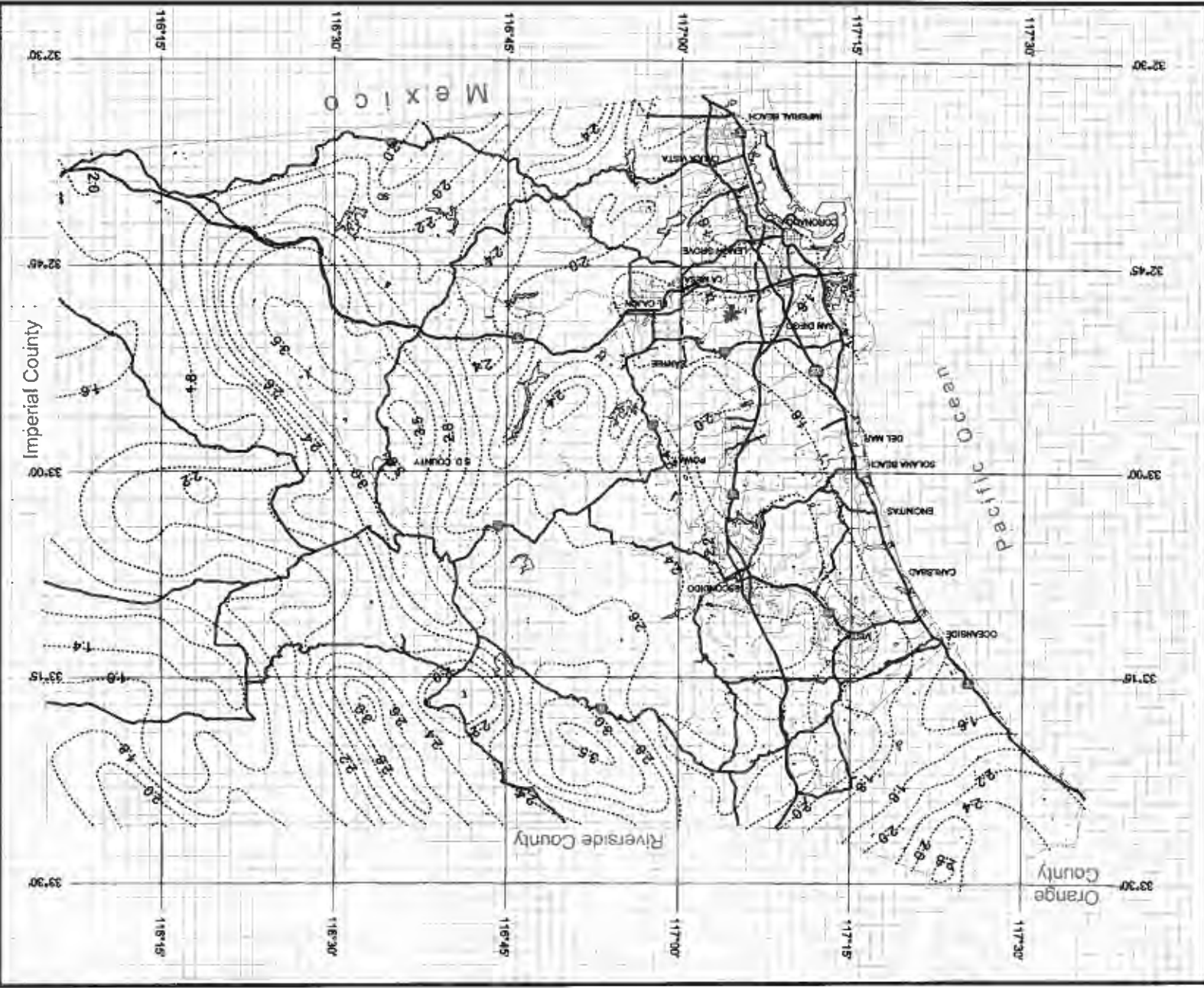



This map is provided without warranty of any kind. THE COUNTY OF SAN DIEGO, AND ITS AGENTS, MAKE NO WARRANTY, REPRESENTATION OR ASSURANCE FOR A PARTICULAR PURPOSE. Changes occur, as they should.

The authors are indebted to the SanGIS Department for providing the data used in this map. The authors are also indebted to the SanGIS Department for providing the data used in this map.

The authors are also indebted to the SanGIS Department for providing the data used in this map.

0 3 Miles





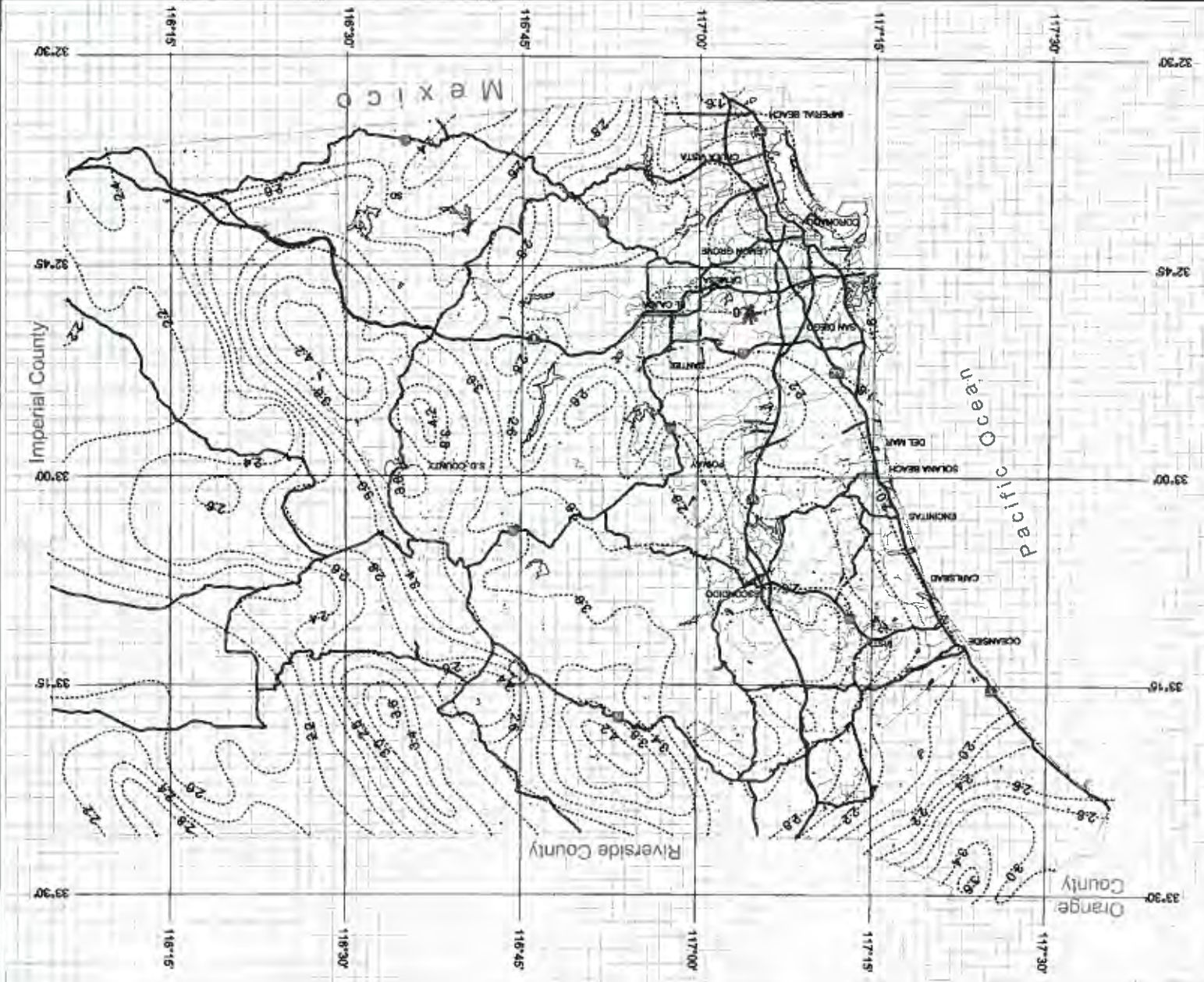
Scale: 0 3 Miles

North arrow pointing N, S, E, W.

SanGIS
We Have San Diego Covered

DPW GIS
Department of Public Works
Imperial Irrigation District

The data is provided without warranty of any kind, either express or implied. The user assumes all responsibility for any use of the data. The Imperial Irrigation District is not responsible for the accuracy of the data. The Imperial Irrigation District is not responsible for the accuracy of the data. The Imperial Irrigation District is not responsible for the accuracy of the data.



* $P_6 = 2.0$ in

25 Year Rainfall Event - 6 Hours
Isopleth (inches)

County of San Diego Hydrology Manual



Rainfall Isoplethals

County of San Diego Hydrology Manual



Rainfall Isopleths

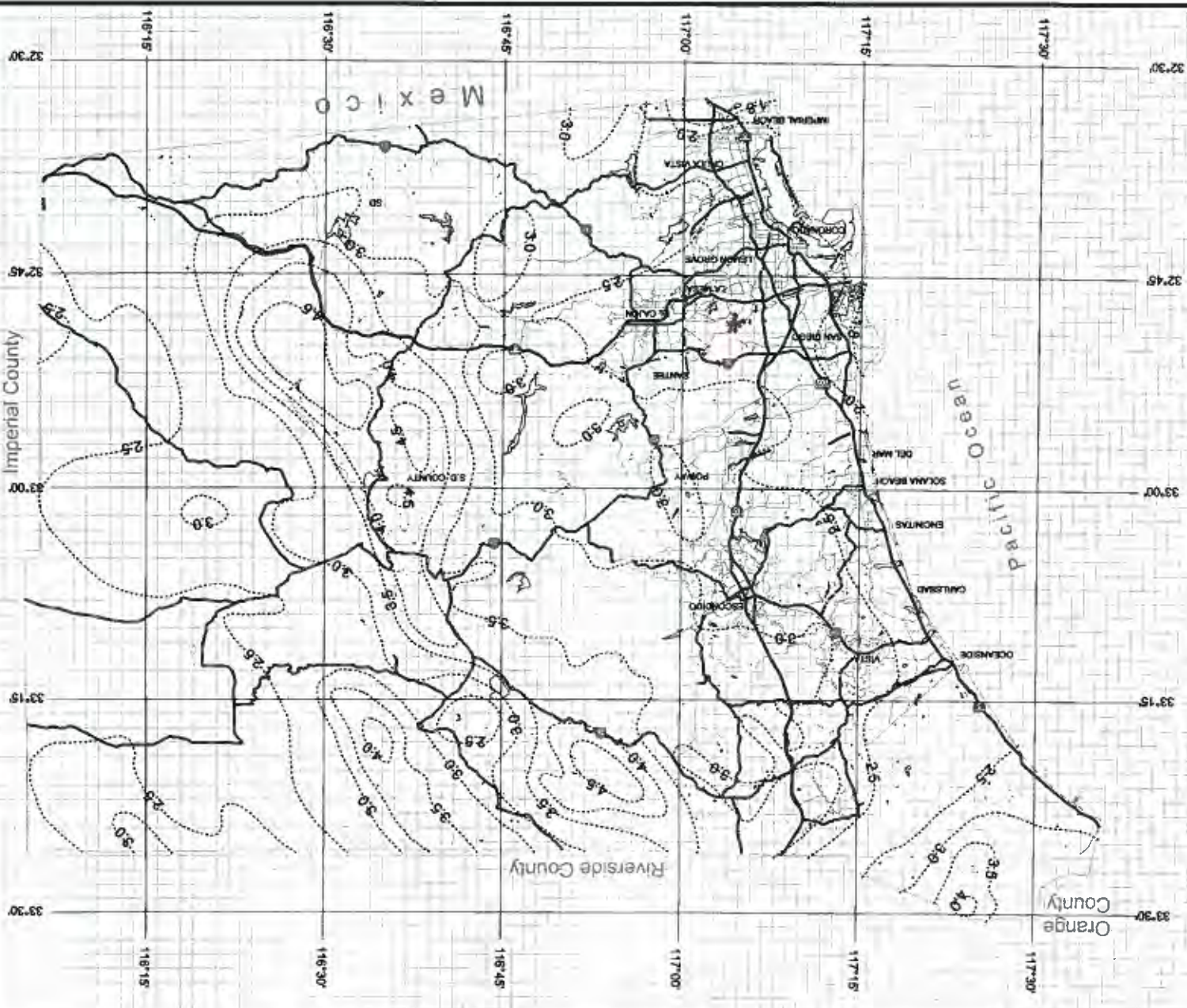
50 Year Rainfall Event - 6 Hours

Isopleth (inches)

* $R_e = 2.2$ in



THIS MAP IS PROVIDED WITHOUT WARRANTY OF ANY KIND, OTHER THAN THE WARRANTY OF MERCHANTABILITY AND FITNESS FOR THE LIMITED PURPOSES OF WHICH IT IS INTENDED. THE USER ASSUMES ALL LIABILITY FOR ANY DAMAGE, INCLUDING REASONABLE ATTORNEY'S FEES, ARISING FROM THE USE OF THIS MAP. THE USER ASSUMES ALL LIABILITY FOR ANY DAMAGE, INCLUDING REASONABLE ATTORNEY'S FEES, ARISING FROM THE USE OF THIS MAP.



County of San Diego Hydrology Manual



Rainfall Isopleths

100 Year Rainfall Event - 6 Hours

(isopleth (inches))

* $R_L = 2.5$ in

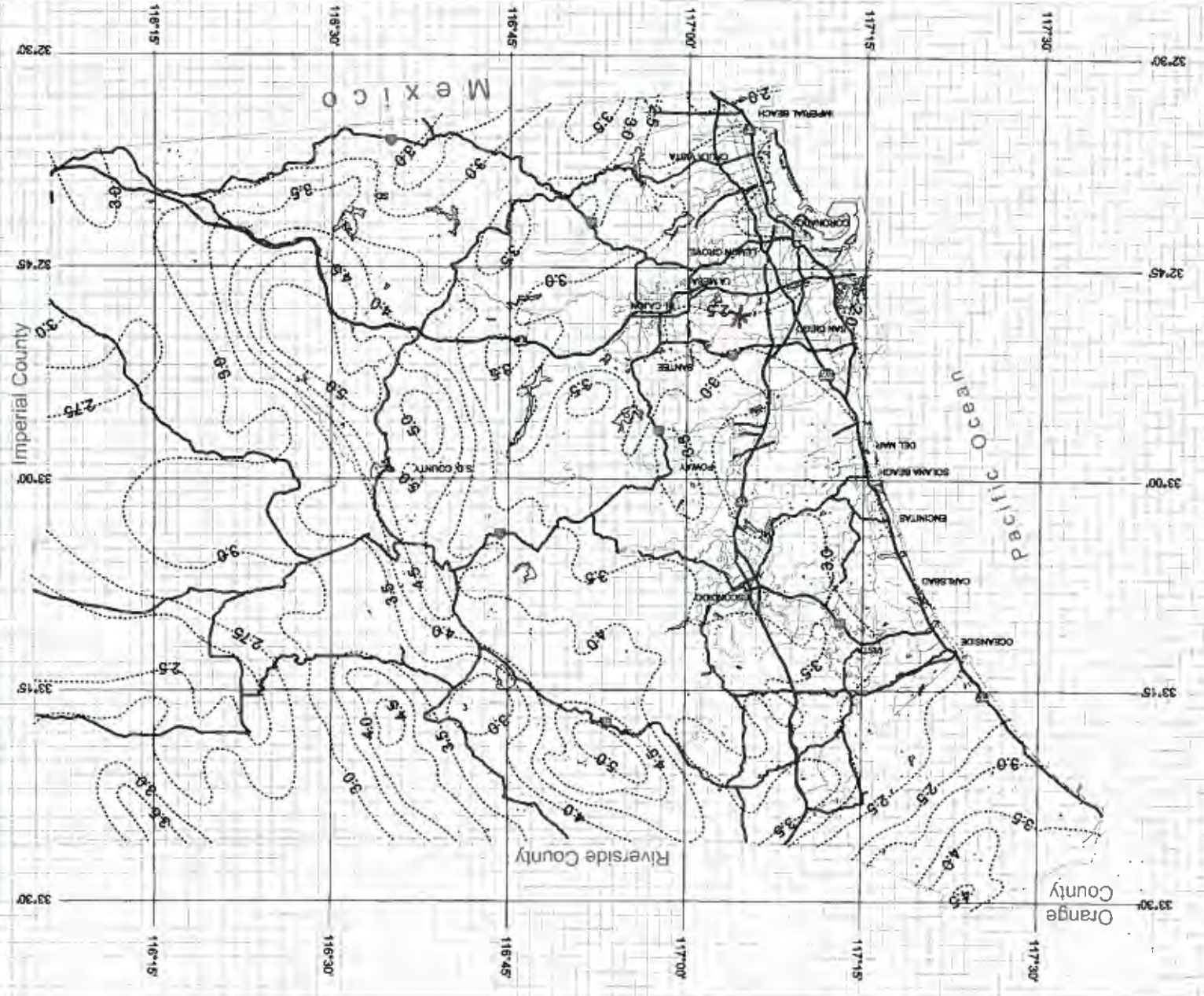


Scale: 0 to 3 Miles

DPW GIS (Department of Public Works, County of San Diego)

SanGIS (We Have You! Through GIS)

The public web-based editions from the SDGWID Regional Information System (RIS) are available on the Internet. The public web-based editions from the SDGWID Regional Information System (RIS) are available on the Internet. The public web-based editions from the SDGWID Regional Information System (RIS) are available on the Internet.



Appendix D
Hydraulic Analysis Output

Hydraulic Analysis Report

Project Data

Project Title: RedRiverandConestoga_Map51
Designer: Rick Engineering Company J-17204-D
Project Date: Friday, July 10, 2015
Project Units: U.S. Customary Units

Channel Analysis: asbuilt_100

Notes: The cross-section of the channel on the as-built plans show a gunite lined 8-foot wide channel bottom, 5 feet deep with 1.5:1 gunite lined side slopes. Pursuant to Table 1-104.14A of the City of San Diego Drainage Design Manual, dated April 1984, the roughness coefficients used for the channel side slopes and channel bottom are 0.016.

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5.00	0.0160
7.50	0.00	0.0160
15.50	0.00	0.0160
23.00	5.00	-----

Longitudinal Slope: 0.0180 (ft/ft)

Flow: 1664.0000 (cfs)

Result Parameters

Depth: 4.5620 (ft)
Area of Flow: 67.7128 (ft²)
Wetted Perimeter: 24.4484 (ft)
Hydraulic Radius: 2.7696 (ft)
Average Velocity: 24.5744 (ft/s)
Top Width: 21.6859 (ft)
Froude Number: 2.4508
Critical Depth: 7.0872 (ft)
Critical Velocity: 13.2583 (ft/s)
Critical Slope: 0.0025 (ft/ft)
Critical Top Width: 23.0000 (ft)
Calculated Max Shear Stress: 5.1240 (lb/ft²)
Calculated Avg Shear Stress: 3.1108 (lb/ft²)
Composite Manning's n Equation: Lotter method
Manning's n: 0.0160

Channel Analysis: current_2_upstream_reach_Q

Notes: The cross-section of the channel on the as-built plans show a gunite lined 8-foot wide channel bottom, 5 feet deep with 1.5:1 gunite lined side slopes. Based on the information provided on the O&M form and the site photos provided by the City of San Diego, there is heavy vegetation in portions of the channel and light vegetation in other portions of the channel. Additionally, there are areas where vegetation that has grown down over the side slopes from the top of the channel banks. **This channel analysis is for the reach of heavy vegetation.** The O&M form did not indicate an approximate sediment depth. Therefore, the sediment depth was estimated based on the site photos and the existence of vegetation to be approximately 0.2 feet. Pursuant to Table 1-104.14A of the City of San Diego Drainage Design Manual, dated April 1984, the roughness coefficients used for each of the channel side slopes and channel bottom are $n = 0.05$ and 0.11 , respectively. The roughness coefficient used for the side slopes is based on some weeds, light to heavy brush on banks. The roughness coefficient used for the channel bottom is based on medium to dense brush with trees in the channel with branches submerged at flood stage.

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5.00	0.0500
7.20	0.20	0.1100
15.80	0.20	0.0500
23.00	5.00	-----

Longitudinal Slope: 0.0180 (ft/ft)

Depth: 4.8000 (ft)

Result Parameters

Flow: 431.4178 (cfs)

Area of Flow: 75.8400 (ft²)

Wetted Perimeter: 25.9066 (ft)

Hydraulic Radius: 2.9274 (ft)

Average Velocity: 5.6885 (ft/s)

Top Width: 23.0000 (ft)

Froude Number: 0.5521

Critical Depth: 3.4696 (ft)

Critical Velocity: 9.0074 (ft/s)

Critical Slope: 0.0719 (ft/ft)

Critical Top Width: 19.0088 (ft)

Calculated Max Shear Stress: 6.9746 (lb/ft²)

Calculated Avg Shear Stress: 4.2331 (lb/ft²)

Composite Manning's n Equation: Lotter method

Manning's n: 0.0717

Channel Analysis: current_2_downstream_reach

Notes: The cross-section of the channel on the as-built plans show a gunite lined 8-foot wide channel bottom, 5 feet deep with 1.5:1 gunite lined side slopes. Based on the information provided on the O&M form and the site photos provided by the City of San Diego, there is heavy vegetation in portions of the channel and light vegetation in other portions of the channel. Additionally, there are areas where vegetation that has grown down over the side slopes from the top of the channel banks. **This channel analysis is for the reach of light vegetation.** The O&M form did not indicate an approximate sediment depth. Therefore, the sediment depth was estimated based on the site photos and the existence of vegetation to be approximately 0.2 feet. Pursuant to Table 1-104.14A of the City of San Diego Drainage Design Manual, dated April 1984, the roughness coefficients used for each of the channel side slopes and channel bottom are $n = 0.05$ and 0.03 , respectively. The roughness coefficient used for the side slopes is based on some weeds, light to heavy brush on banks. The roughness coefficient used for the channel bottom is based on some grass and weeds, little or no brush.

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5.00	0.0500
7.20	0.20	0.0300
15.80	0.20	0.0500
23.00	5.00	-----

Longitudinal Slope: 0.0180 (ft/ft)

Flow: 799.0000 (cfs)

Result Parameters

Depth: 4.2607 (ft)

Area of Flow: 63.8718 (ft²)

Wetted Perimeter: 23.9621 (ft)

Hydraulic Radius: 2.6655 (ft)

Average Velocity: 12.5094 (ft/s)

Top Width: 21.3820 (ft)

Froude Number: 1.2755

Critical Depth: 4.8476 (ft)

Critical Velocity: 10.3853 (ft/s)

Critical Slope: 0.0111 (ft/ft)

Critical Top Width: 23.0000 (ft)

Calculated Max Shear Stress: 4.7856 (lb/ft²)

Calculated Avg Shear Stress: 2.9939 (lb/ft²)

Composite Manning's n Equation: Lotter method

Manning's n: 0.0306

CITY OF SAN DIEGO



**DRAINAGE DESIGN
MANUAL**

APRIL • 1984

TABLE OF CONTENTS (Continued)

1-104.12	Chart/Gutter and Roadway Discharge - Velocity Chart . .	70A
1-104.13	Channel Easements	71
1-104.14	Mannings Roughness coefficient	73
1-104.14A	Table/Design Values for Mannings Roughness	
	Coefficient (n)	74
1-104.14B	Chart/Nomograph for Solution of Manning Equation . . .	76
1-104.15	Design Guides	77
1-104-15A	Figure/Typical Channel Plan	78
1-104.15B	Figure/Typical Channel Profile	79
APPENDIX I		
	Rational Method	80 thru 87
APPENDIX II		
	Modified Rational Method	88 thru 92
APPENDIX III		
	SCS Method	93 thru 119
SEDIMENT DETENTION		
	Basin Desilting	120 thru 126
APPENDIX IV		
	What pH Values Mean	131
	Definitions (CALTRANS-Highway Design Manual).	132 thru 138
	Department Instructionf for C.I.P.C.P.	139 thru 142
INDEX		
	Index	143 thru 146

TABLE 1-104.14A

DESIGN VALUES FOR MANNINGS ROUGHNESS COEFFICIENT (n)

<u>TYPE OF CHANNEL</u>	<u>N VALUE</u>
Unlined Channels:	
Clay Loam;	0.023
Sand	0.020
Gravel	0.030
Rock	0.040
Lined Channels:	
Portland Cement Concrete	0.015
Air Blown Mortar	0.018
Asphalt Concrete	0.018
Grass Lined Channels: (Shallow depths)	
2 inch length	0.050
4 - 6 inch length	0.060
6 - 12 inch length	0.120
12 - 24 inch + length	0.200
Pavement and Gutters:	
Concrete	0.015
Asphalt Concrete	0.018
Natural Streams: (Less than 100 feet wide at flood stage)	
1. Regular section	
a. Some grass and weeds, little or no brush	0.030
b. Dense growth of weeds, depth of flow substantially greater than weed height	0.040
c. Some weeds, light brush on bank	0.040
d. Some weeds, heavy brush on banks	0.060
e. With trees in channel, branches submerged at flood stage, increase above values by	0.015

TABLE 1-104.14A (Continued)

2.	Irregular section, with pools, slight channel meander increase all values listed in 1. Regular Section, by	0.015
----	--	-------

Flood Plains: (adjacent to natural streams)

1.	Pasture, no brush	
	a. Short grass	0.030
	b. High grass	0.040
2.	Cultivated areas	
	a. No crop	0.040
	b. Mature row crops	0.040
	c. Mature field crops	0.050
3.	Heavy weeds, scattered brush	0.050
4.	Light brush and trees	0.060
5.	Medium to dense brush	0.090
6.	Dense willows	0.170
7.	Cleared land with tree stumps, 100-150 per acre	0.060
8.	Heavy stand of timer, little undergrowth	
	a. Flood depth below branches	0.110
	b. Flood depth reaches branches	0.140

Appendix E
Channel Prioritization Assessment Sheet

Channel Prioritization Assessment Sheet for <u>Red River Drive and Conestoga Drive Channel MMP Map 51</u>							Total Channel Score:		63.9 /100			
Flood Hazard (75% of total weight)							Score	factor weight	Weighted Points			
Δ capacity							Sum of sub-factor a-c scores:		12	25%		15
							(out of 15)					
a. Risk of flooding		Current Channel Normal depth capacity ¹ :		431 - 799 cfs	<2- to 2 -yr. storm event	2-yr.=score of 5; 5-yr.=score of 4; 10-yr.=score of 3; 25-yr.=score of 2; 50-yr.=score of 1; 100-yr.=score of 0						
b. Increase in storm event capacity		Channel As-Built normal depth capacity ¹ :		1664 cfs	100 -yr. storm event	1 point given for every level increase in -year storm event capacity, post-maintenance						
c. Net percent increase in channel capacity post-maintenance				286%		Less than 100% = score of 0; 100%-199% = score of 1; 200%-299% = score of 2; 300%-399% = score of 3; 400%-500%= score of 4; Over 500% = score of 5						
Consequence of flooding adjacent areas							0 1 2 3 4		50%		28.125	
Surrounding area land use: (area within 100 feet of the channel or area in which more than 10,000 ft ² is impacted from flooding.)				Residential		Residential = score of 4; Commercial = score of 4; Roads = score of 2; Agriculture = score of 1; Other = score of 1						
Is there open space surrounding the channel?				Yes		If yes, subtract land use score by 1						
Clogging Potential							0 1 2 3 4		25%		18.75	
Are there trees/large debris that have potential to flow D/S and clog culverts/the channel?				Yes								
							Total Weighted Flood Hazard Points		61.9			
Water Quality/Channel Condition (10% of total weight)												
Trash/Debris							0 1 2 3 4		20%		0	
Type of trash and Source:		No information provided on O&M inspection form										
Standing water							0 1 2 3 4		15%		0	
Ponding?				No								
Noticeable odors?				No								
Algae?				No								
Sediment							0 1 2 3 4		35%		1	
Approx. sediment coverage: (Based on information provided on City of San Diego O&M Channel Maintenance Inspection Form)				Not Provided								
Rock/debris Accumulation?				No								
Transients/encampments							0 1 2 3 4		10%		0	
Culverts and Outfalls							0 1 2 3 4		10%		0	
Infrastructure Issues							0 1 2 3 4		10%		1	
Culvert structure condition				Good								
Broken concrete/gunite?				Yes								
Broken or missing trash fence/fence poles/supports?				Not Provided								
Slope failure?				Not Provided								
							Total Weighted Water Quality Points		2.0			
Community Input (10% of total weight)												
Community Complaints Received							YES NO		50%		0	
Community Outreach Input							0 1 2 3 4		50%		0	
							Total Weighted Community Input Points		0.0			
Aesthetics (5% of total weight)												
Aesthetics							0 1 2 3 4		100%		0	
Are the aesthetics of the channel compromised?				No								
							Total Weighted Aesthetics Points		0.0			

1. See appendix D for geometry parameters

Scoring Legend	
0	Factor is in good condition and does not need attention
1	Factor is in good condition, but will eventually need attention
2	Factor needs attention
3	Factor is in bad condition and needs attention
4	Factor is in severe condition and needs immediate attention

Appendix F
Channel Maintenance Prioritization Summary Sheet



Legend

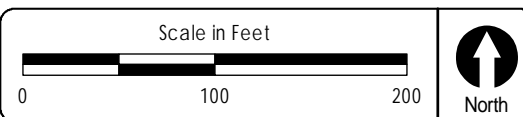
- Photo Location
- Channel Survey
- City Storm Drain Structure
- City Storm Drain

Photos:



Assessment Results

- **Channel Prioritization Score:**
63.9 out of 100
 - **Flood Hazard Score:**
61.9 out of 75
 - **Water Quality Score:**
2 out of 10
 - **Community Input Score:**
0 out of 10
 - **Aesthetics Score:**
0 out of 5
- **Capacity Prior to Maintenance:**
Less than 2 to 2-year storm event
- **Capacity After Maintenance (As-built Capacity):**
100-year storm event
- **Clogging Potential:** *HIGH*
- **Approximate Vegetation Coverage:** *MEDIUM*
- **Surrounding Area:** *Residential*
- **Infrastructure Failures:**
Holes and cracks in gunite channel
- **Site Evaluation Date:**
May 16, 2015
- **Notes/Comments:**
It was noted on the O&M Channel Maintenance Inspection Form that there is a small hole and broken concrete at the downstream end of the channel and cracks in the side slopes along the channel. A high risk of vegetation clogging the culvert exists.

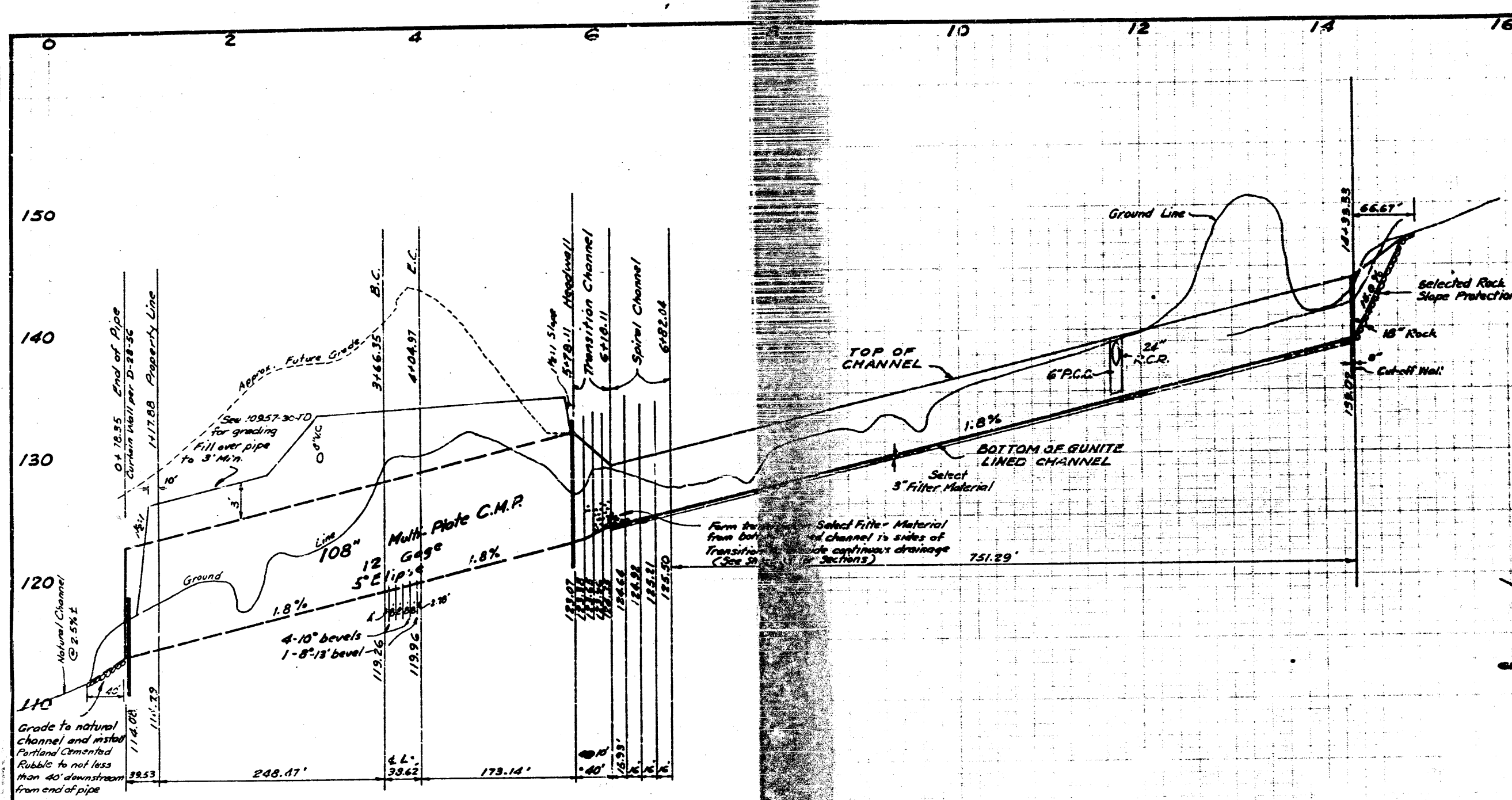


Channel: Red River Drive and Conestoga Drive

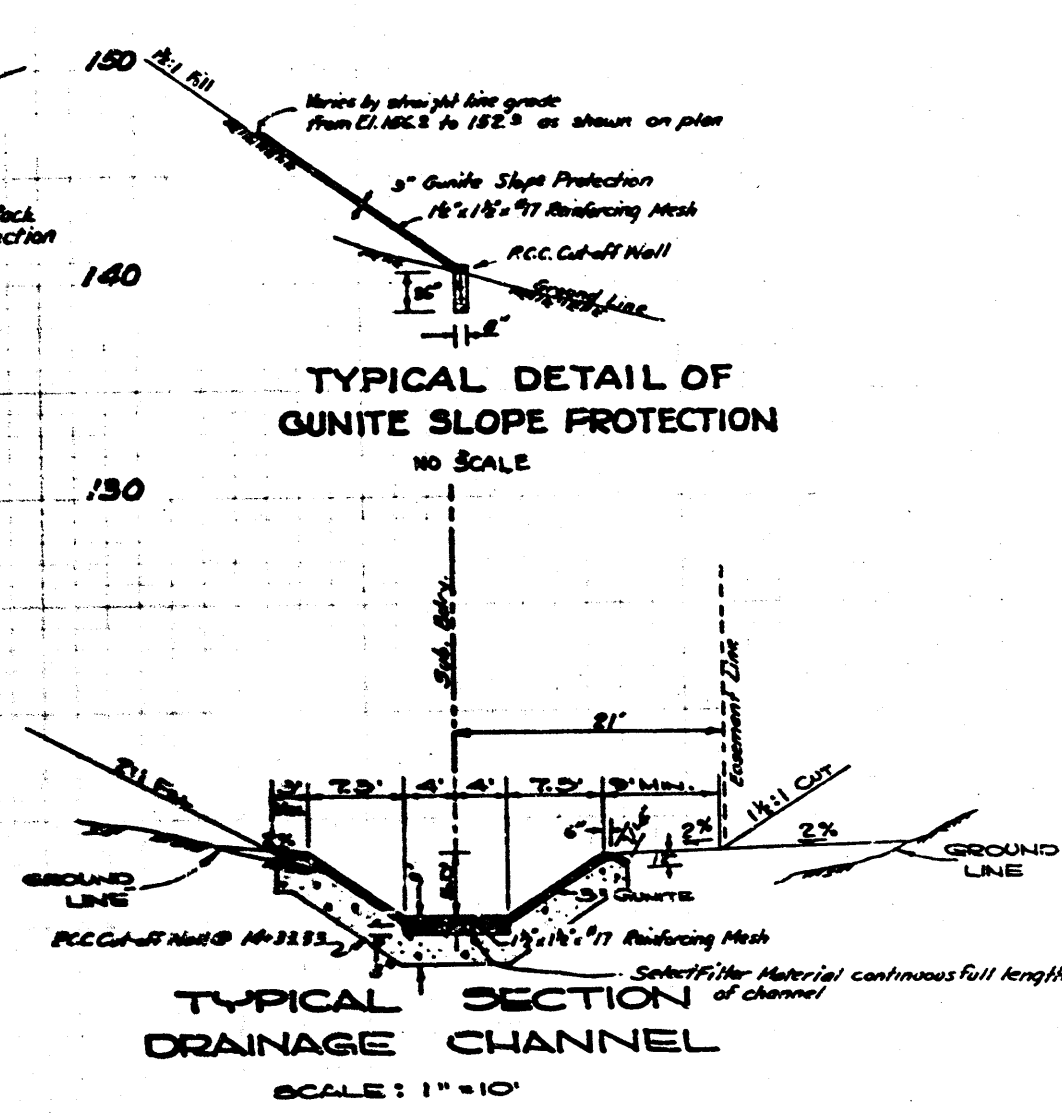
MMP Map # 51

Channel Maintenance Prioritization Summary Sheet

Appendix G
Available As-built plans



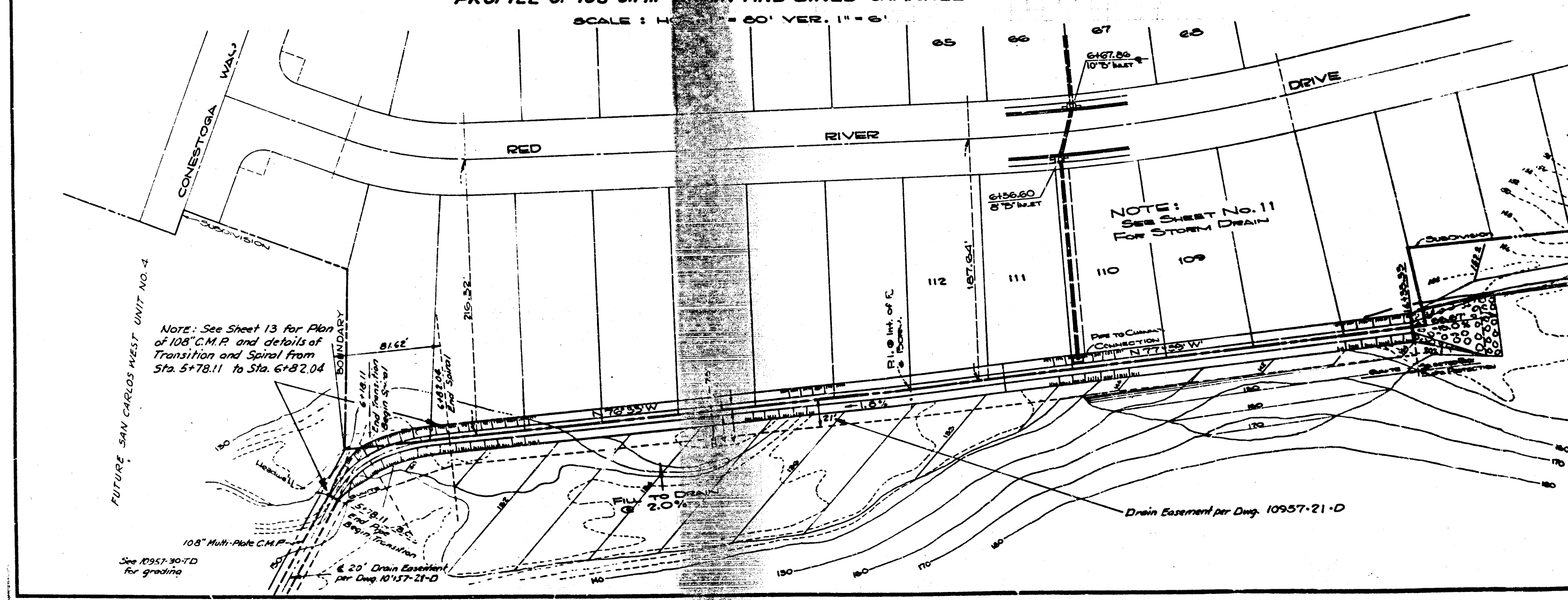
PROFILE OF 108" C.M.P. IN AND LINED CHANNEL
SCALE: HORIZ. = 60' VER. = 6'



TYPICAL DETAIL OF GUNITE SLOPE PROTECTION
NO SCALE

TYPICAL SECTION DRAINAGE CHANNEL
SCALE: 1" = 10'

B.M.
BRASS PLUG: SW CORNER
MOUND AVE. AND WASHINGTON ST.
ELEV. 532.72 (CITY DATUM)



5" Gunite Slope Protection (See detail)

SCALE: 1" = 50'

TOE OF 1 1/2:1 FILL

R.C.C. CUT-OFF WALL (See detail)

PRIVATE CONTRACT ENGINEER OF WORK
GUY W. WINTON JR.
R.C.E. 9490

MICROFILMED
JUL 16 1955

CITY OF SAN DIEGO ENGINEERING DEPARTMENT				SHEET 12 OF 18 SHEETS		W.D. 76752
PLAN REVISION				APPROVAL		CITY ENGINEER
As Built	NH 7-8-65					
DATE	6-19-63	BY	B-RT-65	DATE	May 16 1964	
DESIGNED		CHECKED		APPROVAL FOR		
DRAWN		APPROVED		DEPARTMENT		
INSTRUMENTED		REVISION		PLANNING		
CONTRACT		REVISION		DESIGN		
NO. 10957-21-D		REVISION		ELECTRICAL		
		REVISION		STRUCTURAL		
		REVISION		TRAFFIC		
		REVISION		CONTROL		

MICROFILMED
A-93

Appendix H
Compact Disc
PDF Version of Full Report