HYDROLOGY STUDY

FOR

SAN DIEGO RIVER TRAIL
CARLTON OAKS GOLF COURSE SEGMENT
CITIES OF SAN DIEGO AND SANTEE, CA

Prepared for

San Diego Association of Governments (SANDAG)

401 B Street #800
San Diego, CA 92101

Prepared by

Nasland Engineering

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San Diego, CA 92111
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N.E. Job No. 115-189.1

January 31, 2017
Updated 5/10/17

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PURPOSE:

The purpose of this hydrology study is to examine the existing drainage conditions and evaluate the impact of the San Diego River Trail Project along the southern property line of Carlton Oaks Country Club between West Hills Parkway and Carlton Hills Boulevard. This report will calculate the existing and proposed flow rates associated with the drainage areas that are affected by the proposed improvements and provide an assessment of the projects impact to the existing drainage patterns and facilities.

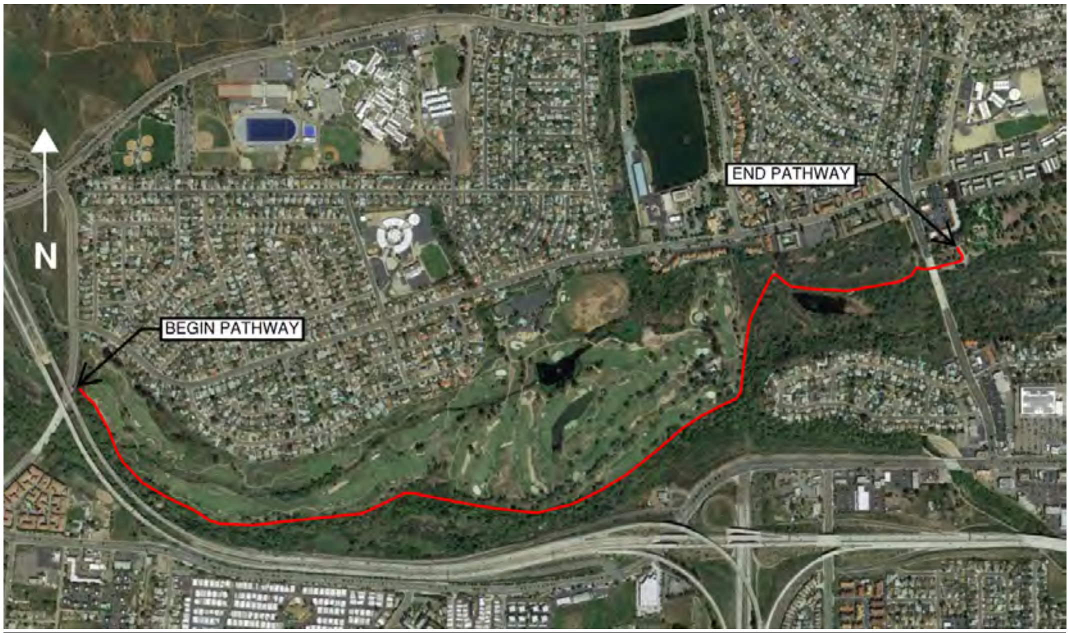
PROJECT DESCRIPTION:

The San Diego Association of Governments (SANDAG) proposes to construct the Carlton Oaks Golf Course Segment of the San Diego River Trail (SDRT) within the cities of San Diego and Santee (the proposed project). The proposed project would consist of a Class I bikeway for the exclusive use of people walking and riding bikes and related physical improvements. It would extend a distance of approximately two miles between Carlton Hills Boulevard and West Hills Parkway through Mast Park, Mast Park West, and the Carlton Oaks Golf Course.

Specifically, the proposed project would extend westward from the Mast Park parking lot, under the Carlton Hills Boulevard bridge, and along the existing dirt trail that continues westward for approximately 0.5 mile through Mast Park West and terminates at the Carlton Oaks Golf Course. West of the terminus of the existing dirt trail, the proposed project would generally be constructed on or adjacent to the existing berm along the southern edge of the golf course for a distance of approximately 1.5 miles before its terminus at the existing sidewalk along West Hills Parkway. In general, the proposed project would include a 10-foot-wide paved bike path with 2-foot-wide pervious shoulders. Near the west end, the proposed project would install a bridge or similar structure to cross Sycamore Creek. Additional physical improvements could include installation of fencing, pedestrian-scaled lighting for safety, slope protection in slope areas south of the existing berm in which erosion is evident, removal and replacement of low flow drainage crossings along Mast Park West, revegetation of slopes, restoration of disturbed areas within the golf course, retaining walls, and other minor improvements.

Construction of the project is estimated to begin in late 2018 and take approximately 12 months to complete. Construction staging is anticipated to occur within the golf course and will avoid sensitive biological resources. Access during construction could be provided from West Hills Parkway; an existing dirt road within a utility easement along the eastern boundary of the golf course accessible from Carlton Oaks Drive; and/or from the parking lot at Mast Park, which could require excavation under the Carlton Hills Boulevard bridge to provide adequate vertical clearance for construction equipment, and along the existing dirt trail in Mast Park West. Some construction access points would require a temporary construction easement or other permission/agreement from property owners before use for construction access.

PROPOSED PROJECT ALIGNMENT



Source: Google Earth

EXISTING DRAINAGE:

The existing drainage courses of the project area include the San Diego River that runs through the golf course and project area (nominal flows run south of the existing berm area), Forester Creek which converges with the San Diego River south of the existing berm, Sycamore Creek that runs through the Golf Course converging with the San Diego River and various locations of pipe outlets that collect runoff from nearby residential and commercial developments. Flow rates associated with the pipe outlets are provided by "City of Santee Citywide Drainage Study" prepared by BSI Consultants Inc., dated February 1990. See **Appendix C –** related excerpts from **the "City of Santee Citywide Drainage Study"** prepared by BSI Consultants Inc., for additional information.

Existing runoff from the berm and golf course is collected in various localized low points along the golf course, adjacent to the north side of the berm, and also is collected in reservoirs/water features within the golf course property. These areas allow for runoff to infiltrate into the existing landscaping or drain directly to the San Diego River, which combines with Sycamore Creek and continues to flow west underneath West Hills Parkway and Interstate 52

Near the eastern limits of the project, by Carlton Hills Boulevard and Mast Park, urban runoff from the north is collected by an existing curb inlet along the west side of Carlton Hills Boulevard and discharged into an existing earthen drainage channel via an existing 48" reinforced concrete pipe. Discharge travels south along said channel and joins the San Diego River. Continuing west along Mast Park West and prior to the golf course property, the existing trail has two low flow gravel drainage crossings at localized low points that allows for water to surface drain across the path and continue into the San Diego River.

The project site is within the FEMA AE Zone of the 100 year floodway of the San Diego River. The AE Zone is subject to inundation by the 1% annual chance flood and has base flood elevations determined. A copy of the FEMA map is included in **Appendix B.**

PROPOSED DRAINAGE:

Existing drainage patterns of the project site will not be altered during construction or as a result of the construction of the proposed Class I bikeway. The proposed Class I bikeway is designed with the cross slopes directed towards the golf course property which allows for runoff to be collected within existing localized collection areas that infiltrate into landscaped areas or continue to drain into the San Diego River. Directing runoff in this direction also prevents further erosion of the existing berm along the south side of the proposed bikeway. Localized drainage basins have been defined along the golf course as depicted in **Appendix A – Hydrologic Conditions Exhibit**. These basins drain to natural low points along the golf course which infiltrate low flows and do not have a direct connection to the adjacent San Diego River nominal flow area. A summary of the existing flows to these basins and increase in flows based on the addition of an impervious 10' wide all weather surface of the Class I bikeway are as follows:

Basin	Basin Area (acres)	Existing Runoff Coefficient	Proposed Runoff Coefficient	Existing Q100 (cfs)	Proposed Q100 (cfs)	Flow Increase (cfs)
1	1.97	0.20	0.20	1.59	1.59	0.00
2	3.22	0.20	0.24	2.61	3.13	0.52
3	0.93	0.20	0.26	0.75	0.98	0.23
4	0.89	0.20	0.28	0.72	1.01	0.29
5	1.53	0.20	0.27	1.24	1.67	0.43
6	1.52	0.20	0.25	1.23	1.53	0.31
7	1.50	0.20	0.26	1.22	1.58	0.36
8	2.76	0.20	0.25	2.23	2.79	0.56
9	1.87	0.20	0.23	1.51	1.74	0.23
10	3.52	0.20	0.21	2.85	2.99	0.14
11	1.70	0.20	0.24	1.38	1.65	0.28
12	2.44	0.20	0.23	1.97	2.27	0.30
13	2.51	0.20	0.23	2.03	2.34	0.30
14	0.62	0.20	0.23	0.50	0.58	0.08
15	4.27	0.20	0.22	3.45	3.80	0.35
16	0.95	0.20	0.24	0.77	0.92	0.15
17	2.76	0.20	0.22	2.23	2.46	0.22

The total flow increase from the project totals 4.74 cfs. This is a negligible increase compared to the 100 year flow rate of 38,000 cfs for the San Diego River. The negligible increase in flow does not have any impacts in the project area or downstream as runoff from smaller storms would infiltrate into landscape areas and does not have a direct connection to the adjacent San Diego River nominal flow area. As these localized basins are within the San Diego River Flood Plain fringe, in a significant flow, which would be higher than the berm, these localized basins would become a part of the San Diego River Flow, and as the project would be in an inundated area, there would be no peak flow increase .

For the portion of the project east of the golf course (Basin 16 and 17), the project proposes to replace 10' of DG pathway with 10' of impervious material. This increase in flow would be directed northerly of the path to the existing vegetated area. This increase in flow of 0.38 cfs is again considered negligible to the existing 38,000 cfs (FEMA flowrate) of the San Diego River.

See **Appendix A – Hydrologic Conditions Exhibit,** for further information.

HYDRAULICS:

This project proposes to improve three low flow drainage crossings as show in Appendix A in Basins A, B, and C.

Basin	Basin Area (acres)	Runoff Coefficient	Q50 (cfs)	Pipe Inflow (cfs)	Total Flow (cfs)
A	11.26	0.20	8.72	35	43.72
B	1.69	0.20	1.31	0	1.31
C	0.59	0.20	0.46	0	0.46
D	0.82	0.20	0.63	49	49.63

Proposed hydraulic improvements will include reconstruction of the low flow drainage crossings at localized low points to a concrete surface with rip-rap surrounding the locations to avoid undermining of the path and for erosion prevention. These locations are shown in Appendix A and are within Basins A, B, and C.

Flow within the earthen channel along Carlton Hills Boulevard (Basin D) will be conveyed underneath the proposed pathway by ~~a combination of small pipes~~ an open bottom culvert structure that ~~are~~ is designed to handle small storm events and still allow for larger storm events to surface flow across the path.

Additionally, a 14 foot wide crossing with a span of approximately 75 feet will be constructed across the Sycamore Creek. The span is still within the San Diego River Floodway and proposed to convey low flows only

A hydraulic analysis using the US Army Corps of Engineers' HEC-RAS model of the proposed project was performed and included in **Appendix D**. This analysis is performed to evaluate the base 100 year flood and the proposed project's impact on the base floodplain. The existing and proposed condition results of the 100 year flood analysis are included in the Appendix. The revised flood analysis is based on updated 100 year flow rates ranging from 48,000 cfs to 49,000 cfs as recommended in the City of Santee's Municipal Code (Chapter 15.52). The existing conditions includes the existing berm/levee on which the trail is placed that was constructed per City of Santee permit plans as-built June 25, 1997. The proposed conditions include the proposed trail improvements including all grading (10,000 cubic yards of net fill), berm/levee improvements, and consideration of proposed retaining walls. A comparison of the results reveals that the proposed project will result in an increase in flood elevations varying from +0.01' to +0.05' in elevation within the project site. Based on this analysis the berm/levee is overtopped by peak flows in both the existing and proposed conditions at the same location at that portion of the berm/levee on the east end of the golf course. As the project is proposing to raise flood elevations, the project will need to comply with section 65.12 of the Code of Federal Regulations (CFR) for the National Flood Insurance Program which requires the jurisdiction (City of San Diego and City of Santee) to apply for a conditional approval of this action to FEMA for a Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR).

HYDROLOGY METHODOLOGY/DESIGN CRITERIA:

Storm water runoff for both the existing and proposed site conditions is calculated, analyzed and compared in order to ensure that the proposed conditions do not negatively affect the existing hydrologic regime. Runoff is calculated by utilizing methods outlined in the San Diego County Hydrology Manual.

Existing drainage conditions from the surrounding residential areas which flow southerly onto the golf course were determined by referencing the "City of Santee Citywide Drainage Study" prepared by BSI Consultants Inc., dated February 1990.

CALCULATIONS:

Calculations have been performed per Rational Method guidelines set forth in Section 3 of the San Diego County Hydrology Manual.

- Runoff Coefficients were determined by using Table 3-1 of San Diego County Hydrology Manual.
- Times of Concentration values were determined by using Figure 3-4 of San Diego Hydrology Manual.
- Rainfall Intensity values were determined from Figure 3-1 of San Diego Hydrology Manual, "Intensity-Duration Design Chart".
- For hydrology calculations refer to the following page. For attachments and references to the calculations see **Appendix C – Hydrology References**

CONCLUSION:

The existing drainage patterns of the project site will not be altered as a result of the Class I bikeway construction. The Class I bikeway will direct the discharge to the adjacent golf course and low flow discharge will infiltrate within the golf course vegetation. No significant increase in runoff is expected during peak storms as the project area will be inundated as it is with the San Diego River Floodway with a 100-year flowrate of 38,000 cfs (FEMA flowrate). The project will require an application to FEMA with a Conditional Letter of Map Revision (CLOMR) for approval of the small increase to flood elevations.

ENGINEER OF WORK:

This report was prepared under the supervision of Samuel Waisbord, PE, Project Manager for Nasland Engineering.

DATE: 06-05-2017

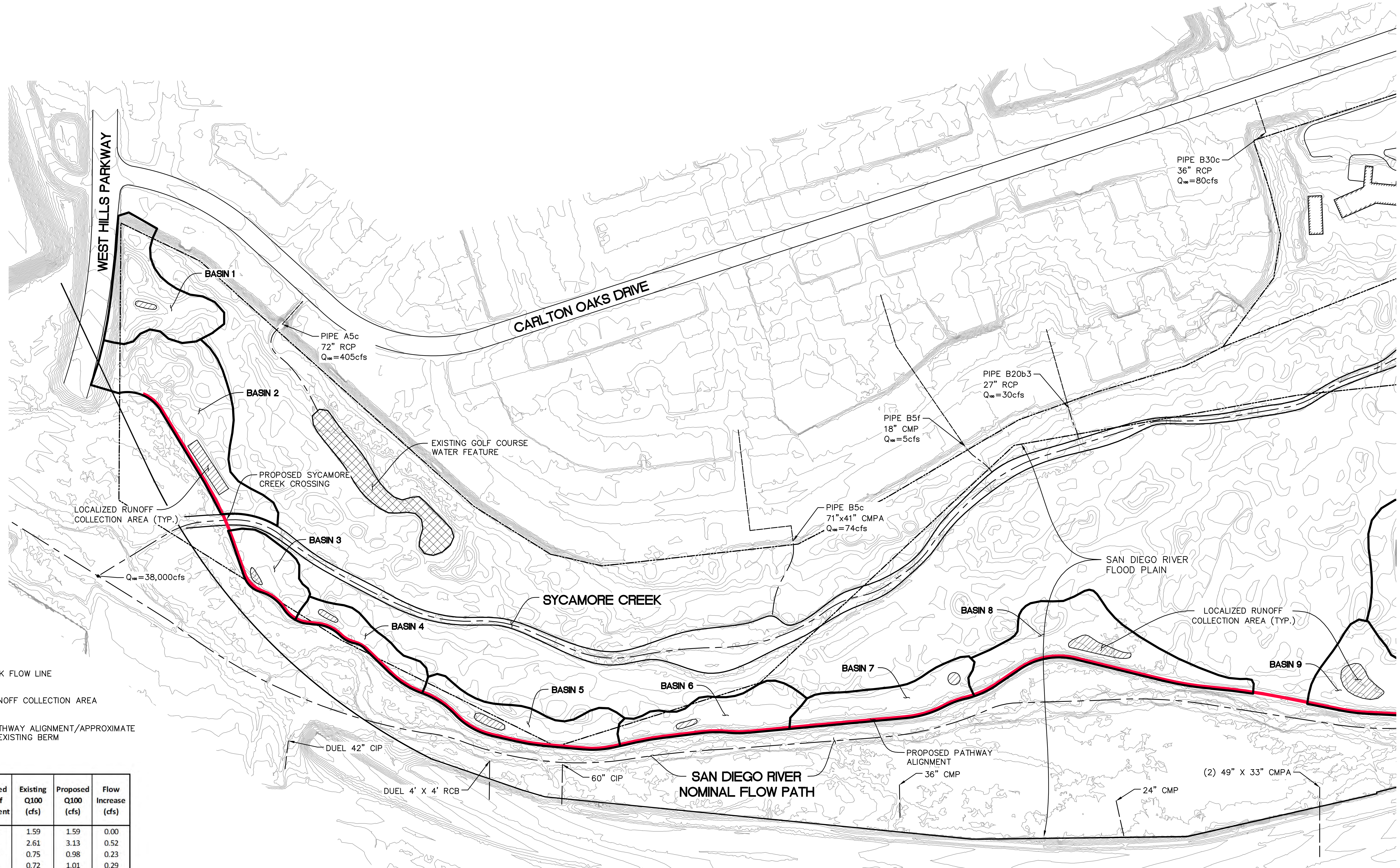
Samuel Waisbord • RCE 78071 • Expires 09-30-17

REGISTERED PROFESSIONAL ENGINEER
SAMUEL WAISBORD
No. 78071
CIVIL
STATE OF CALIFORNIA

APPENDICES

APPENDIX A

HYDROLOGIC CONDITIONS MAP



FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3

LEGEND:

- EXISTING CREEK FLOW LINE
- LOCALIZED RUNOFF COLLECTION AREA
- PROPOSED PATHWAY ALIGNMENT/APPROXIMATE LOCATION OF EXISTING BERM

Basin	Basin Area (acres)	Existing Runoff Coefficient	Proposed Runoff Coefficient	Existing Q100 (cfs)	Proposed Q100 (cfs)	Flow Increase (cfs)
1	1.97	0.20	0.20	1.59	1.59	0.00
2	3.22	0.20	0.24	2.61	3.13	0.52
3	0.93	0.20	0.26	0.75	0.98	0.23
4	0.89	0.20	0.28	0.72	1.01	0.29
5	1.53	0.20	0.27	1.24	1.67	0.43
6	1.52	0.20	0.25	1.23	1.53	0.31
7	1.50	0.20	0.26	1.22	1.58	0.36
8	2.76	0.20	0.25	2.23	2.79	0.56
9	1.87	0.20	0.23	1.51	1.74	0.23

175 0 175 350 525
SCALE 1" = 175'

N

SANDAG
San Diego's Regional Planning Agency

HYDROLOGIC CONDITIONS EXHIBIT

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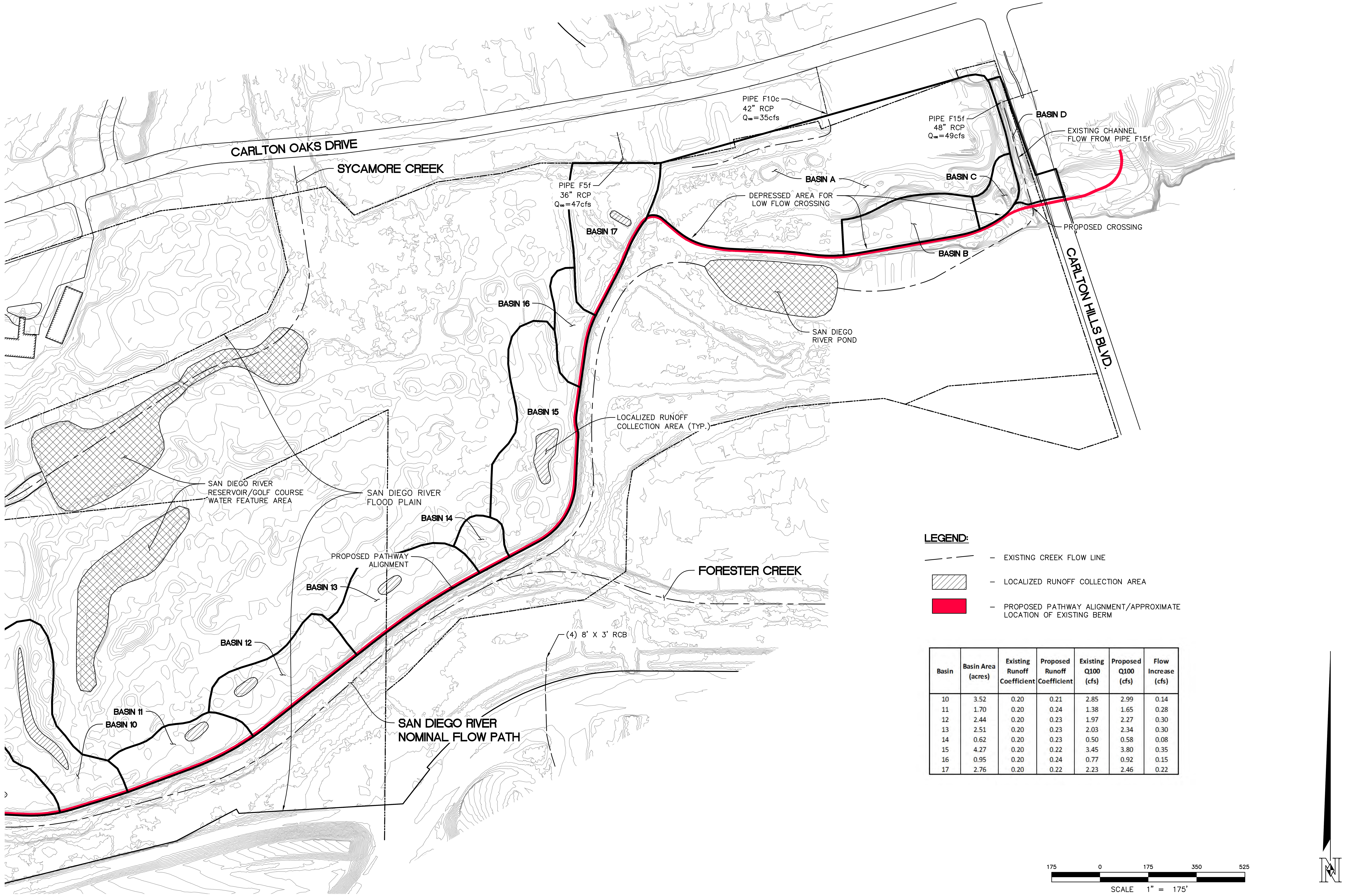
DESIGNED BY	DATE
SCOTT HEBERER	12/06/2016
DRAWN BY	
SCOTT HEBERER	12/06/2016
CHECKED BY	
SAMUEL WAISBORD	12/06/2016

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3



Basin	Basin Area (acres)	Existing Runoff Coefficient	Proposed Runoff Coefficient	Existing Q100 (cfs)	Proposed Q100 (cfs)	Flow Increase (cfs)
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15	4.27	0.20	0.22	3.45	3.80	0.35
16	0.95	0.20	0.24	0.77	0.92	0.15
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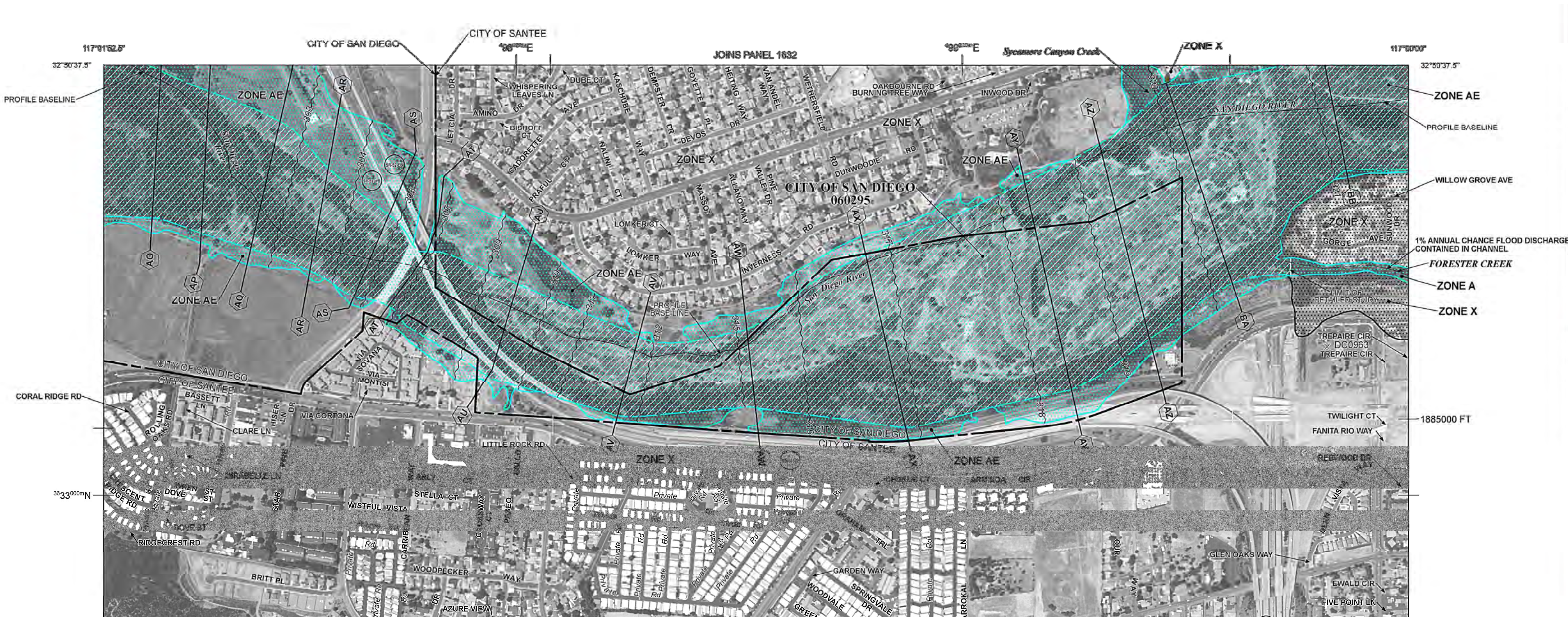
	DATE
DESIGNED BY SCOTT HEBERER	12/06/2016
DRAWN BY SCOTT HEBERER	12/06/2016
CHECKED BY SAMUEL WAISBORD	12/06/2016

APPENDIX B

FEMA FLOODWAY MAP



JOINS PANEL 1632
CITY OF SAN DIEGO
CITY OF SANTEE
117°01'52.5"
32°50'37.5"
117°00'00"
32°50'37.5"
Sycamore Canyon Creek
ZONE X
ZONE AE
PROFILE BASELINE
SAN DIEGO RIVER
San Diego River
CITY OF SAN DIEGO
060295
WILLOW GROVE AVE
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CHANNEL
FORESTER CREEK
ZONE A
TREPAIRE CIR
DC0963
TWILIGHT CT
FANITA RIO WAY
1885000 FT
CORAL RIDGE RD
ROLLING OAKS RD
BASSETT LN
HISER LN
CLARE LN
VIA CORTONA
VIA SOVANA
VIA MONTISI
LITTLE ROCK RD
WHISPERING LEAVES LN
DUBE CT
AMINO DR
CADORETTE
PRAFUL CT
KASCHUBE WAY
DEMPSTER DR
GOYETTE PL
HEIING WAY
VAN ANDEL WAY
WETHERSFIELD RD
OAKBOURNE RD
BURNING TREE WAY
INWOOD DR
DEVOS DR
DUNWOODIE RD
NALINI CT
LOMKER CT
LOMKER WAY
MASSOT AVE
ALLANO WAY
PINE VALLEY DR
INVERNESS RD
PROFILE BASE LINE
LET CIA DR
REDWOOD DR
WISTFUL VISTA
STELLA CT
DOVE ST
CRESCENT RIDGE RD
RIDGECREST RD
BRITT PL
WOODPECKER WAY
AZURE VIEW
GARDEN WAY
WOODVALE
SPRINGVALE DR
GLEN OAKS WAY
EWALD CIR
FIVE POINT LN
ARMINDA CIR
AO
AP
AQ
AR
AS
AT
AU
AV
AW
AX
AY
AZ
BA
BB

APPENDIX C

CITY OF SANTEE MASTER HYDROLOGY PLAN

PROJECT REPORT

City of Santee
Citywide Drainage Study

Presented to:

City of Santee

February 1990

BSI CONSULTANTS, INC.

BSI CONSULTANTS, INC.

February 2, 1990

Mr. Al H. Krier, P.E.
Director of Public Works
10765 Woodside Avenue
Santee, CA 92071-3198

Subject: **City-Wide Drainage Study - Project Report**

Dear Mr. Krier:

The attached project report for the City-Wide Drainage Study is final and includes all appropriate revisions suggested by the City staff.

We appreciate being of assistance to the City on this important project. If you have further questions, please let us know.

Sincerely,

BSI CONSULTANTS, INC.

Neal D. Brown
Project Engineer/Manager

Gary J. Hobson, P.E.
Principal-in-Charge

REGISTERED PROFESSIONAL ENGINEER
GARY J. HOBSON
No. 40779
Exp. 3/31/91
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STATE OF CALIFORNIA

NDB/lew
reports/santee/santedr.ndb

cc: Jeff Cooper

Copy No. 11

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APPENDIX II

SUMMARY OF EXISTING
CONDITONS AND
RECOMMENDED IMPROVEMENT

CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST (/LF)	COST ($)
* A5a	56 " CIP	0.0375	747	0.013	650	343					
* A5b	66 " CIP	0.02	931	0.013	475	371					
* A5c	72 " RCP	0.014	488	0.013	501	405	M				
A5d	24 " RCP	0.02	153	0.013	32	35	C				
A5e	24 " CMP	0.0844	108	0.024	36	35	S				
A5f	18 " CMP	0.0497	155	0.024	13	18	C,S				
A20a	24 " CMP	0.11	78	0.024	41	17	S				
A20b	24 " RCP	0.02	82	0.013	32	17					
* B5a	30 " CMP	0.0356	30	0.024	42	42	S				
* B5b	36 " CMP	0.0188	595	0.024	50	47	S				
* B5c	71 " x 47 " CMPA	0.005	457	0.024	81	74	S				
B5d1	18 " CMP	0.0456	174	0.024	12	5	S				
B5d2	18 " CMP	0.0483	132	0.024	13	5	S				
B5e	18 " CMP	0.0065	126	0.024	5	5	S				
B5f	18 " CMP	0.0232	301	0.024	9	5	S				
* B20a1	18 " RCP	0.0652	200	0.013	27	15					
* B20a2	18 " RCP	0.0556	236	0.013	25	20					
* B20b1	27 " RCP	0.0589	48	0.013	75	22					
* B20b2	27 " RCP	0.0312	136	0.013	55	25					
* B20b3	27 " RCP	0.01	28	0.013	31	30					
B30a	42 " CMP	0.03	284	0.024	94	57	S				
* B30b	36 " RCP	0.02	180	0.013	94	80					
* B30c	36 " RCP	0.05	120	0.013	149	80					
* C5a	27 " RCP	0.1079		0.013	102	62					
C5b	18 " RCP	0.018		0.013	14	5					
* +C5c	18 " CMP	0.025	[100]	0.024	9	24	C,S	24		130	13000
* C5d	18 " RCP	0.0638		0.013	27	24					
C10a	21 " x 13 " CMPA	0.01		0.024	5	15	C,S				
C15a1	27 " ACP	0.02	102	0.013	44	40					
C15a2	27 " CMP	0.062	37	0.024	42	55	C,S				
C15a3	27 " RCP	0.0672	201	0.013	80	55					
C15b	30 " RCP	0.062	37	0.013	102	70					
C15c	33 " RCP	0.032	470	0.013	95	70					
* C15d1	36 " RCP	0.032	44	0.013	119	85					
* C15d2	36 " RCP	0.0188	128	0.013	91	85					
C20a1	27 " ACP	0.031	103	0.013	55	44					
C20a2	27 " ACP	0.03	166	0.013	54	54					
C20a3	27 " ACP	0.056	210	0.013	73	65					
C20a4	27 " ACP	0.05	180	0.013	69	84	C				
C20b	30 " ACP	0.031	175	0.013	72	84	C				
C20c	18 " ACP	0.03	130	0.013	18	10					
C25a1	21 " ACP	0.025	123	0.013	25	36	C				
C25a2	21 " ACP	0.03	35	0.013	27	43	C				
C25a3	21 " ACP	0.04	106	0.013	32	43	C				
C25a4	21 " ACP	0.25	57	0.013	79	43					
C25b	24 " ACP	0.03	108	0.013	39	43	C				
C25c	27 " ACP	0.02	262	0.013	44	50	C				
C30a1	33 " RCP	0.07	93	0.013	140	68					
C30a2	33 " RCP	0.035	285	0.013	99	74					

* = MASTER DRAINAGE FACILITY + = DEFICIENT MASTER DRAINAGE FACILITY [ ] = ESTIMATED VALUE
DEFICIENCIES: C = CAPACITY E = EROSION M = MAINTENANCE S = SERVICE LIFE V = VELOCITY ? = NOT ENOUGH DATA

CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
C30a3	33 " RCP	0.03	167	0.013	92	79					
C35a1	43 " x 27 " CMPA	0.26	6	0.024	155	37	S				
C35a2	21 " RCP	0.0263	39	0.013	26	44	C				
C35a3	21 " ACP	0.0322	343	0.013	28	44	C				
C35b1	36 " ACP	0.0116	48	0.013	72	56					
C35b2	36 " RCP	0.0053	144	0.013	49	56	C				
C35c	(2) 81" x 59" CMPA	0.0558	269	0.024	1150	539	S				
C35d	18 " RCP	0.1436	30	0.013	40	10					
* +D5a	18 " RCP	0.04	[450]	0.013	21	96	C	36		175	78750
* D5b	36 " RCP	0.05		0.013	149	104					
* D5c	[b=4' h=3' s=2:1]	[0.05]	950	0.03	477	104	M,E,?				
* D5d	42 " CMP	0.046	236	0.024	117	114	S				
* D5e	(2) 4' x 2' RCB	0.03		0.013	242	135					
D5f	18 " CMP	0.01	48	0.024	6	10	C,S				
D5g	24 " CMP	0.01	94	0.024	12	10	S				
D20a	18 " CMP	0.024	41	0.024	9	30	C,S				
D20b	24 " RCP	0.065	97	0.013	58	30					
* D20c	(2) 29" X 18" CMPA	0.03		0.024	36	30	S				
D24a	18 " CMP	0.4		0.024	36	11	S				
D24b	22 " x 13 " CMPA	0.01		0.024	5	11	C,S				
D25a	21 " RCP	0.072		0.013	43	28					
D25b	30 " RCP	0.028		0.013	69	28					
D25c	30 " RCP	0.0232		0.013	62	38					
D25d	30 " RCP	0.064	340	0.013	104	38					
* D25e	42 " RCP	0.041	176	0.013	204	43					
* D25f	36 " CMP	0.042		0.024	74	43	S				
* D25g	[b=20' h=10' s=2:1]	0.12	420	0.03	23115	49	E,V,?				
* D25h	36 " RCP	0.24	64	0.013	327	56	?				
D25i	21 " RCP	0.02	104	0.013	22	5					
D25j	18 " CMP	0.08	89	0.024	16	7	S				
D35a	24 " RCP	0.05	100	0.013	51	53	C				
D35b	30 " CMP	0.036	42	0.024	42	53	C,S				
D35c	36 " RCP	0.016		0.013	84	62					
D40a	b=4' h=2.5' s=1.5:1	0.03		0.015	433	140					
D40b1	42 " CMP	0.032	136	0.024	97	146	C,S				
D40b2	42 " RCP	0.042	126	0.013	206	146					
D40c1	42 " CMP	0.036	94	0.024	103	146	C,S				
D40c2	42 " RCP	0.016	142	0.013	127	146	C				
D40c3	42 " CMP	0.036	94	0.024	103	154	C,S				
D40d	42 " RCP	0.031	112	0.013	177	164					
D45a1	18 " RCP	0.01	42	0.013	11	10					
D45a2	18 " RCP	0.018	115	0.013	14	10					
D45a3	18 " RCP	0.032	44	0.013	19	10					
D45a4	18 " RCP	0.036	106	0.013	20	10					
D50a1	18 " CMP	0.438	93	0.024	38	21	S				
D50a2	18 " CMP	0.0833	693	0.024	16	21	C,S				
D50b	30 " RCP	0.023	210	0.013	62	42					
D55a	24 " ACP	0.0456		0.013	48	41					
D55b	27 " ACP	0.015		0.013	38	41	C				

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
D55c	30 " RCP	0.015		0.013	50	45					
* D55d	36 " RCP	0.015		0.013	82	65					
D60a	42 " RCP	0.0262		0.013	163	177	C,M				
D60b	18 " RCP	0.0267		0.013	17	10					
D60c	42 " RCP	0.075		0.013	275	187					
D60d	18 " CMP	0.035		0.024	11	10	S				
* D60e	48 " RCP	0.051		0.013	324	214					
D65a	(5) 42" X 54" CMPA	N/A		0.024			S,?				
D65b	OPEN	N/A		0.03			?				
* D65c	[b=10 h=3 s=1.5:1]	[0.0096]	[550]	0.015	690	279	?				
* D65d1	(2) 36 " CMP	[0.02]	94	0.024	102	100	S,?				
* D65d2	(3) 30 " CMP	[0.02]	94	0.024	94	90	S,?				
* D65e	36 " X 48 " CMPA	[0.02]	94	0.024	93	90	S,?				
* D65f	[b=10' h=3' s=2:1]	[0.02]	[500]	0.03	542	300	?				
* +D65g	[b=5' h=3' s=3:1]	[0.0096]	[6000]	0.03	296	610	C,?	b=10' h=5' s=1.5:1		150	900000
* +D65h	(3) 58" X 36" CMPA	[0.0096]	[50]	0.024	194	297	C,S,?	MINOR			
* +E5a1	24 " RCP	0.016	42	0.013	29	30	C	MINOR			
* E5a2	30 " ACP	0.022	185	0.013	61	30					
* E5b	30 " RCP	0.026	575	0.013	66	40					
E5c	18 " RCP	0.0154	51	0.013	13	16	C				
* +E5d	30 " RCP	0.02	569	0.013	58	60	C	MINOR			
* E5e	30 " RCP	0.03	504	0.013	71	67					
E5f	18 " RCP	N/A		0.013		7	?				
* +E5g	(2) 72 " CMP	0.002	[730]	0.024	205	610	C,S	12X6 RCB		1085	792050
E20a	21 " ACP	0.0222	319	0.013	24	15					
E20b	24 " RCP	0.05		0.013	51	42					
E20c	18 " ACP	0.02	43	0.013	15	12					
E30a1	18 " CMP	0.01	50	0.024	6	7	C,S				
E30a2	b=1' h=1' s=1.5:1	0.1076	206	0.015	54	7					
E30b	18 " CMP	0.04	252	0.024	11	7	S				
* +E30c1	36 " CMP	0.02	86	0.024	51	77	C,S	36		175	15050
* +E30c2	36 " CMP	0.016	18	0.024	46	84	C,S	36		175	3150
* E30d	42 " RCP	0.02		0.013	142	118					
* +E30e	48 " RCP	0.0055	[600]	0.013	106	124	C	MINOR			
E30f	18 " RCP	0.05		0.013	23	22					
E30g	18 " CMP	0.048	37	0.024	12	12	S				
E30h	24 " CMP	0.1	95	0.024	39	12	S				
E30i	18 " CMP	0.08	100	0.024	16	6	S				
F5a	18 " RCP	0.0054		0.013	8	5					
F5b	18 " RCP	0.0064	135	0.013	8	5					
* F5c	18 " RCP	0.01	41	0.013	11	21					
* F5d	42 " CMP	0.01		0.024	54	37	S				
* F5e	36 " RCP	0.0322	99	0.013	120	47					
* F5f	36 " RCP	0.005	84	0.013	47	47					
F10a	18 " RCP	0.03		0.013	18	15					
F10b	24 " RCP	0.04		0.013	45	24					
* F10c	42 " RCP	0.015		0.013	123	35					
F15a	24 " CMP	0.02	38	0.024	17	19	C,S				
F15b	24 " CMP	0.062	100	0.024	31	19	S				

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	RECOMMENDATIONS PARALLEL PIPE	UNIT COST	COST
F15c	24 " CMP	0.004	90	0.024	8	33	C,S				
F15d	OPEN	[0.024]	1050	0.03		49	?				
* +F15e	36 " CMP	0.015	102	0.024	44	49	C,S	MINOR			
* F15f	48 " CMP	0.04	123	0.024	156	49	S				
* F15g	48 " CMP	0.01	303	0.024	78	49	S				
* F15h	48 " RCP	[0.01]		0.013	144	49	?				
F15i	48 " CMP	0.008	186	0.024	70	12	S				
F25a	18 " CMP	0.0104	150	0.024	6	12	C,S				
F25b	30 " CMP	0.007	316	0.024	19	18	S				
G10a1	60 " CIP	0.0236	199	0.013	400	359	M				
G10a2	60 " CIP	0.03	853	0.013	451	379					
G10a3	60 " RCP	0.025		0.013	412	379					
G10b	21 " ACP	0.108	180	0.013	52	10					
G10c	18 " ACP	0.047	102	0.013	23	10					
G10d	30 " RCP	0.014	55	0.013	49	10					
G10e1	18 " ACP	0.5	58	0.013	74	9					
G10e2	18 " ACP	0.0398	95	0.013	21	9					
G10e3	18 " ACP	0.013	41	0.013	12	9					
G10e4	21 " ACP	0.014	130	0.013	19	9					
G10f1	18 " RCP	0.36	32	0.013	63	12					
G10f2	18 " RCP	0.32	80	0.013	59	12					
G10f3	21 " RCP	0.03	96	0.013	27	12					
G10f4	24 " RCP	0.054		0.013	53	12					
G10f5	24 " RCP	0.0292		0.013	39	12					
* G10g1	b=3' h=3.5' s=1.5:1	0.0348	854	0.015	804	426					
* G10g2	66 " RCP	0.02	77	0.013	475	426					
G10h1	21 " ACP	0.01	40	0.013	16	12					
G10h2	21 " ACP	0.034	140	0.013	29	26					
G11a1	18 " CMP	0.02	116	0.024	8	23	C,S				
G11a2	18 " CMP	0.666	22	0.024	46	23	S				
* G15a	b=8' h=3' s=1.5:1	0.034	1280	0.015	1085	561	M				
G20a	18 " RCP	0.008		0.013	9	60	C				
* G20b	36 " RCP	0.0384	388	0.013	131	90					
* +G20c1	42 " CMP	0.014	116	0.024	64	90	C,S	MINOR			
* G20c2	42 " CMP	0.04	337	0.024	109	100	S				
* G20d1	36 " RCP	0.04	340	0.013	133	90					
* G20d2	36 " RCP	0.0184	66	0.013	90	90					
* G20e	60 " RCP	0.005	145	0.013	184	110					
G21a	18 " CMP	0.667	3	0.024	46	10	S				
G21b	18 " RCP	0.04	262	0.013	21	10					
G21c	18 " RCP	0.01	8	0.013	11	10					
G21d	18 " RCP	0.02	20	0.013	15	10					
* +G25a	(3) 48 " CMP	0.017	132	0.024	304	561	C,M,S	8X4 RCB		435	57420
G25b	18 " RCP	0.028	294	0.013	18	15					
G25c	24 " RCP	0.072	162	0.013	61	20					
G25d	18 " CMP	0.08	122	0.024	16	6	S				
* G25e	[b=20'h=3's=1:1]	0.017		0.03	803	625	E,M,V				
* G30a	(2) 60 " RCP	0.04	94	0.013	1041	625					
* G30b	(2) 60 " RCP	0.05	194	0.013	1164	635					

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* G30c	(2) 8'X 6' RCB	0.006	1136	0.013	1218	711					
G30d	18 " ACP	0.005	171	0.013	7						
G30e	10 " ACP	0.0733	15	0.013	6						
G30f	10 " ACP	0.0465	20	0.013	5						
G30g	12 " ACP	0.03	20	0.013	6						
G31a	18 " ACP	0.005	304	0.013	7						
G31b	24 " ACP	0.01	60	0.013	23						
G31c	30 " ACP	0.005	801	0.013	29						
G31d	36 " ACP	0.005	339	0.013	47						
G31e	18 " ACP	0.01	29	0.013	11						
G31f	18 " ACP	0.005	30	0.013	7						
G31g	18 " ACP	0.005	220	0.013	7						
G31h	12 " ACP	0.01	30	0.013	4						
G31i	12 " ACP	0.015	95	0.013	4						
G31j	12 " ACP	0.0148	170	0.013	4						
G31k	12 " ACP	0.0202	110	0.013	5						
G31l	12 " ACP	0.0623	60	0.013	9						
G31m	12 " ACP	0.146	15	0.013	14						
G32a	18 " ACP	0.005	99	0.013	7						
G32b	18 " ACP	0.006	189	0.013	8						
G33a	12 " ACP	0.01	29	0.013	4						
G33b	18 " ACP	0.0094	105	0.013	10						
G33c	18 " ACP	0.005	332	0.013	7						
G34a	12 " ACP	0.0145	154	0.013	4						
G34b	24 " ACP	0.005	385	0.013	16						
G34c	42 " ACP	0.0062	122	0.013	79						
G34d	12 " ACP	0.229	22	0.013	17						
H5a1	18 " RCP	0.078	176	0.013	29	50	C				
H5a2	18 " RCP	0.012	116	0.013	12	50	C				
* +H5a3	30 " CMP	0.02	37	0.024	31	67	C,S	36		175	6451
* +H5a4	30 " CMP	0.04	44	0.024	44	67	C,S	36		175	7700
* +H5a5	30 " CMP	0.06	26	0.024	54	67	C,S	36		175	4550
* H5a6	[b=32' h=5' s=2:1]	[0.09]	620	0.03	7683	115	E,M,?				
H5b1	18 " CMP	0.1184	98	0.024	20	10	S				
H5b2	18 " CMP	0.125	144	0.024	20	10	S				
H5b3	18 " CMP	0.13	116	0.024	21	10	S				
* H5c1	36 " RCP	0.06	154	0.013	163	135					
* +H5c2	42 " RCP	0.018	160	0.013	135	155	C	MINOR			
* +H5d1	42 " RCP	0.005	110	0.013	71	155	C	5X4 RCB		315	34650
* +H5d2	58 " X 36 " CMPA	0.005	[50]	0.024	47	173	C,S	5X4 RCB		315	15750
* +H5d3	65 " X 40 " CMPA	0.006	85	0.024	68	173	C,S	5X4 RCB		315	26744
* H5e	6'X 5' RCB	0.003	150	0.013	231	218					
H5f	12 " ACP	0.01	122	0.013	4						
H5g	12 " ACP	0.01	73	0.013	4						
H5h	18 " ACP	0.005	403	0.013	7						
H5i	12 " ACP	0.01	29	0.013	4						
H5j	18 " ACP	0.0055	104	0.013	8						
H5k	12 " ACP	0.005	23	0.013	3						
H5l	12 " ACP	0.01	20	0.013	4						

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

	LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
	H5m	18 " ACP	0.005	163	0.013	7						
	H5n	18 " ACP	0.005	214	0.013	7						
	H5o	12 " ACP	0.0179	136	0.013	5						
	H5p	18 " ACP	0.01	46	0.013	11						
	H5q	18 " ACP	0.01	67	0.013	11						
	H6a	18 " ACP	0.005	419	0.013	7						
	H6b	24 " ACP	0.005	431	0.013	16						
	H6c	12 " ACP	0.01	108	0.013	4						
	H6d	12 " ACP	0.01	92	0.013	4						
	H6e	12 " ACP	0.2141	27	0.013	16						
	I10a	24 " CMP	0.01		0.024	12		S				
*	I10b	36 " RCP	0.004	765	0.013	42	40					
*	I10c	42 " RCP	0.004	385	0.013	64	59					
*	I10d	48 " RCP	0.004	371	0.013	91	64					
	I10e	18 " ACP	0.0084	115	0.013	10						
	I10f	18 " ACP	0.01	35	0.013	11						
	I10g	18 " RCP	0.01	33	0.013	11						
	I10h	24 " ACP	0.1416	62	0.013	85						
	I10j	12 " ACP	0.0107	30	0.013	4						
	I10k	12 " ACP	0.014	42	0.013	4						
	I10l	18 " ACP	0.1514	20	0.013	41						
	I11a	18 " ACP	0.005	313	0.013	7						
	I11b	24 " ACP	0.011	30	0.013	24						
	I11c	18 " ACP	0.005	104	0.013	7						
	I11d	12 " ACP	0.0069	29	0.013	3						
	I11e	12 " ACP	0.005	139	0.013	3						
	I15a1	18 " RCP	0.0329	104	0.013	19	21	C				
	I15a2	18 " RCP	0.326	39	0.013	60	21					
	I15a3	18 " RCP	0.03	302	0.013	18	21	C				
	I20a	24 " RCP	0.02	147	0.013	32	30					
	I20b	24 " RCP	0.419	23	0.013	146	30	V				
	I20c1	24 " RCP	0.03	87	0.013	39	45	C				
	I20c2	24 " RCP	0.34	30	0.013	132	45					
	I20d	24 " RCP	0.03	323	0.013	39	50	C				
	I20e	24 " RCP	0.035	152	0.013	42	58	C				
	I25a	36 " RCP	0.025		0.013	105	65					
	I25b	36 " RCP	0.02		0.013	94	71					
*	I25c1	36 " RCP	0.0166		0.013	86	77					
	I25c2	36 " RCP	0.014		0.013	79	77					
*	I25d	48 " RCP	0.0285		0.013	242	83					
	I25e	21 " RCP	0.025		0.013	25	8					
*	I30a	54 " CMP	0.0197		0.024	149	91	S				
*	I30b	[b=2' h=2.7' s=1:1]	[0.013]	1500	0.15	170	100	E,?				
	J5a	36 " RCP	0.044	896	0.013	140	119					
	J5b	b=1' h=2.5' s=1.5:1	0.04	160	0.015	264	36					
	J10a1	18 " ACP	0.07	348	0.013	28	9					
	J10a2	18 " ACP	0.055	210	0.013	25	9					
	J10a3	18 " ACP	0.036	101	0.013	20	9					
*	J15a	42 " RCP	0.034	1220	0.013	185	184					

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* +J20a	54 " RCP	0.0071	345	0.013	166	235	C		42	200	69030
J25a	18 " RCP	0.045	327	0.013	22	30	C				
J25b1	18 " RCP	0.07	271	0.013	28	45	C				
J25b2	18 " RCP	0.035	279	0.013	20	40	C				
J25c1	OPEN					90					
J25c2	OPEN					111					
* +J25d	54 " RCP	0.0092	117	0.013	189	312	C	MINOR			
* +J25e	54 " RCP	0.0161	[900]	0.013	249	312	C		36	175	157500
* J25f	24 " RCP	0.02		0.013	32	30					
* J25g	b=14' h=6' s=1.5:1	0.0147		0.015	4093	1720					
J25h	(2) 50" x 31" CMPA	0.0063	95	0.024	70	90	C,S				
* +J30a	(2) 12.5' x 4.5' RCB	0.001	76	0.013	569	1720	C	MINOR			
* J30b	36 " RCP	0.005	246	0.013	47	15					
J30c	(2) 36" X 22" CMPA	0.0056	90	0.024	28	10	S				
* +J30d	[b=20' h=2.5' s=5:1]	0.007	[2000]	0.03	496	1800	C,E,M	b=20 h=6 s=1.5 n=.03		220	440000
K5a	18 " ACP	0.01		0.013	11	10					
K5b	54 " CIPP	0.0637		0.013	496	208					
K5c	54 " RCP	0.01		0.013	197	208	C				
K5d	54 " RCP	0.01		0.013	197	208	C				
K5e	42 " RCP	0.09		0.013	302	75					
K5f	83" X 57" CMPA	0.0265		0.024	319	440	C,S				
K5g	83" X 57" CMPA	0.007		0.024	163	515	C,S				
* K5h	[b=4 h=4.5 s=1.5:1]	0.0254		0.015	1059	750	M,?				
* +K5i	84 " CMP	0.015	67	0.024	424	780	C,S	84		390	26130
K10a	27 " RCP	0.0313	250	0.013	55	55					
K10b	27 " RCP	0.06		0.013	76	60					
K10c	27 " RCP	0.06		0.013	76	65					
K10d1	30 " CMP	0.02	282	0.024	31	70	C,S				
K10d2	30 " CMP	0.05	149	0.024	50	70	C,S				
* K10e1	b=4' h=6' s=1.5:1	0.005	60	0.015	1147	780					
* K10e2	b=4' h=4.5' s=1.5:1	0.018	480	0.015	1150	780					
* K10f1	28" x 20" CMPA	0.045	40	0.024	17	15	S				
* +K10f2	28" x 20" CMPA	0.008	138	0.024	9	15	C,S	MINOR			
* K10g1	b=4' h=4.5' s=1.5:1	0.025	620	0.015	1355	800					
* K10g2	b=4' h=4.5' s=1.5:1	0.0464	126	0.015	1846	800					
K10h1	18 " CMP	0.01	91	0.024	6	5	S				
K10h2	18 " CMP	0.48	49	0.024	39	5	S				
K10h3	18 " CMP	0.02	44	0.024	8	5	S				
K10h4	18 " CMP	0.48	22	0.024	39	5	S				
K15a	18 " ACP	0.018	155	0.013	14	15	C				
K15b1	30 " RCP	0.4	28	0.013	259	62	V				
K15b2	30 " RCP	0.04	261	0.013	82	62					
K15b3	33 " RCP	0.046	740	0.013	113	77					
* K15c	39 " RCP	0.019	332	0.013	114	77					
K15d1	18 " RCP	0.04		0.013	21	40	C				
K15d2	24 " RCP	0.004		0.013	14	40	C				
K15e1	24 " RCP	0.06	395	0.013	55	20					
* K15e2	30 " RCP	0.019	390	0.013	57	20					
K15f	18 " RCP	0.066	512	0.013	27	20					

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	RECOMMENDATIONS PARALLEL PIPE	UNIT COST	COST
K15g	24 " RCP	N/A	395	0.013		20	?				
* +K15h	36 " RCP	0.005	[1100]	0.013	47	60	C		24	130	143000
* K15i	[b=15' h=5' s=2:1]	0.02	1000	0.03	1959	1047	M,?				
* K15j1	b=8' h=6' s=1.5:1	0.0322		0.015	4143	1047	M				
* K15j2	[b=8 h=4.5 s=1.5:1]	0.0322		0.015	2310	1047	?				
K20a	PCC DITCH	N/A				30	?				
K20b	18 " ACP	0.2057	55	0.013	48	30					
K20c	21 " ACP	0.033	140	0.013	29	40	C				
K20d	24 " ACP	0.0286	289	0.013	38	40	C				
K20e	24 " ACP	0.0286	359	0.013	38	40	C				
* +K20f	24 " ACP	0.0343	327	0.013	42	45	C	MINOR			
* K20g	36 " RCP	0.023	486	0.013	101	45					
* K20h	b=8' h=6' s=1.5:1	0.02	1145	0.015	3258	1185	M				
K21a	18 " ACP	0.0349	166	0.013	20	10					
K21b	b=1' h=1.5' s=1.5:1	0.02		0.015	57	10					
K21c	18 " ACP	0.025	61	0.013	17	10					
K22a	b=2' h=3' s=1:1	0.06	715	0.015	462	80					
K22b	30 " RCP	0.015	500	0.013	50	90	C				
K22c	36 " RCP	0.01	158	0.013	67	100	C				
K25a	24 " RCP	0.016		0.013	29	35	C				
K25b	30 " RCP	0.016	138	0.013	52	35					
* K25c1	b=8' h=6' s=1.5:1	0.02		0.015	3258	1250	M				
* K25c2	20 ' X 6 ' RCB	0.02	54	0.013	3388	1263					
K30a	24 " RCP	0.008	269	0.013	20	30	C				
* K30b	b=8' h=6' s=1.5:1	0.01	1160	0.015	2304	1263	M				
K35a	21 " ACP	0.017	163	0.013	21	19					
K35b1	27 " ACP	0.014	48	0.013	37	36					
K35b2	33 " ACP	0.008	128	0.013	47	36					
* K35c	b=8' h=6' s=1.5:1	0.02		0.015	3258	1318	M				
L5a	18 " RCP	0.026	57	0.013	17	50	C				
L5b	21 " CMP	0.024	300	0.024	13	50	C,S				
* +L5c	27 " RCP	0.014	60	0.013	37	92	C	42		200	12000
L10a	18 " RCP	0.01		0.013	11	10					
L10b	3' PCC DITCH	0.01		0.015	17	10	M				
L10c	24 " ACP	0.0126		0.013	25	28	C				
* +L10d	30 " ACP	0.012	200	0.013	45	47	C	MINOR			
L10e	5' PCC V-DITCH	0.02	339	0.015	81	5					
* L10f1	30 " RCP	0.22	16	0.013	192	47	V				
* L10f2	30 " RCP	0.015		0.013	50	47					
* +L10f3	30 " RCP	0.01	16	0.013	41	47	C	MINOR			
* L10g	30 " ACP	0.014		0.013	49	47					
* +L10h	36 " RCP	0.024	800	0.013	103	137	C	42		200	160000
L10i	18 " ACP	0.02	161	0.013	15	40	C				
* +L10j	42 " RCP	0.01	500	0.013	101	228	C		48	230	115000
* +L15a1	(2) 36" X 22" CMPA	0.01	50	0.024	36	168	C,S	6X3 RCB		335	16750
* +L15a2	18 " CMP	0.01	50	0.024	6	28	C,S	SEE L15a1			
L15b	24 " ACP	0.005	215	0.013	16	6					
* +L15c	42 " RCP	0.0142	502	0.013	120	215	C		42	200	100470
L15d	30 " RCP	0.005		0.013	29	20					

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LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* +L15e	48 " RCP	0.0118	350	0.013	156	241	C		42	200	70000
* +L15f	64 " X 53 " CMPA	0.0163	131	0.024	146	247	C,S	54		260	33972
* +L15g	(2) 49" X 33" CMPA	0.009	121	0.024	84	247	C,S	60		285	34388
* L20a	36 " RCP	0.0104		0.013	68	32					
* +L20b1	54 " CIP	0.007	300	0.013	164	265	C		48	230	69000
* +L20b2	54 " RCP	0.003	350	0.013	108	265	C		48	230	80500
* +L20b3	54 " CIP	0.007	243	0.013	164	265	C		48	230	55805
L20c	30 " RCP	0.003	118	0.013	22	10					
L30a1	18 " RCP	0.0252	175	0.013	17	22	C				
L30a2	18 " RCP	0.05	360	0.013	23	22					
* L30b	30 " RCP	0.04	278	0.013	82	30					
L30c1	18 " RCP	0.628	36	0.013	83	12					
L30c2	18 " RCP	0.01	88	0.013	11	12	C				
L30c3	30 " RCP	0.0549	37	0.013	96	12					
L30c4	30 " RCP	0.055	251	0.013	96	22					
L30c5	18 " RCP	0.01	30	0.013	11	10					
* L30d	36 " CMP	0.18		0.024	153	76	S				
* +L30f	42 " RCP	0.004	989	0.013	64	76	C	MINOR			
L30g	18 " RCP	0.004		0.013	7	10	C				
* +L30h	42 " CIP	0.004	1005	0.013	64	102	C		36	175	175875
L35a1	24 " X 38 " RCPA	0.0026	189	0.013	21	10					
L35a2	29 " x 45 " RCPA	0.0026	327	0.013	32	10					
L35b	18 " RCP	0.005	205	0.013	7	7					
L35c	18 " RCP	0.003	166	0.013	6	6					
L35d	14 " X 23 " RCPA	0.005	203	0.013	6	10	C				
L35e1	30 " RCP	0.0026	555	0.013	21	20					
* L35e2	36 " RCP	0.0026	110	0.013	34	25					
* L35f	(2) 66 " CIP	0.0035	823	0.013	397	322					
L35g	18 " RCP	0.01	105	0.013	11	7					
L35h	18 " RCP	0.01	165	0.013	11	7					
* L35i	4.5 ' x 7 ' RCB	0.0025	86	0.013	222	30					
L35j1	18 " RCP	0.016	110	0.013	13	7					
L35j2	18 " RCP	0.0125	86	0.013	12	7					
L35k	18 " RCP	0.0131	228	0.013	12	7					
* L35l	(2) 5' X 6' RCB	0.005	48	0.013	596	322					
* L35m	[b=125' h=6' s=2:1]	0.0053		0.03	9139	322	?				
M10a	18 " RCP	0.0377		0.013	20	26	C				
* +M10b	24 " RCP	0.0188	[150]	0.013	31	33	C	MINOR			
M11a	24 " CMP	0.0254	106	0.024	20	10	S				
M11b	18 " CMP	0.163	12	0.024	23	5	S				
M11c	18 " CMP	0.02	36	0.024	8	5	S				
M11d	24 " CMP	0.044	112	0.024	26	5	S				
M15a	18 " RCP	0.0695	630	0.013	28	30	C				
M15b	18 " RCP	0.01	60	0.013	11	5					
* +M15c	24 " RCP	0.005	254	0.013	16	21	C	MINOR			
* +M15d	b=0 h=1.4 s=1:1	0.005	[550]	0.015	9	51	C	36		175	96250
* M15e	30 " RCP	0.037	281	0.013	79	55					
* +M15f	30 " RCP	0.0158	198	0.013	52	59	C	MINOR			
M15g	18 " RCP	0.184	136	0.013	45	10					

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LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
M15h	18 " RCP	0.148	128	0.013	40	7					
* +M20a1	24 " RCP	0.0343	344	0.013	42	85	C	33		160	55040
* +M20a2	24 " RCP	0.0414	271	0.013	46	99	C	33		160	43360
M20a3	18 " RCP	N/A	50	0.013		7	?				
* M20b	33 " RCP	0.065	185	0.013	135	113					
M25a	18 " ACP	0.005	106	0.013	7	7					
* +M25b	30 " RCP	0.006	[750]	0.013	32	42	C		24	130	97500
* +M25c1	30 " RCP	0.0057	175	0.013	31	58	C		30	150	26250
* M25c2	30 " RCP	0.0235	432	0.013	63	58					
* +M25d	30 " RCP	0.005	486	0.013	29	58	C		42	200	97266
* +M25e	36 " RCP	0.005	300	0.013	47	58	C	MINOR			
M30a1	18 " RCP	0.088	115	0.013	31	23					
M30a2	18 " RCP	0.063	137	0.013	26	23					
M30b	PIPE	N/A				52	?				
* +M30c	60 " RCP	0.003	[2000]	0.013	143	250	C		54	260	520000
M30d1	18 " ACP	0.012	101	0.013	12	12					
M30d2	24 " ACP	0.025	36	0.013	36	32					
M30d3	30 " RCP	0.028	260	0.013	69	32					
N5a	18 " CMP	0.1	156	0.024	18	25	C,S				
N5b	18 " RCP	0.05	212	0.013	23	15					
N5c	b=0 h=1 s=1:1	0.15		0.015	19	10					
O5a	18 " ACP	0.0612	179	0.013	26	14					
O5b1	30 " RCP	0.0035	446	0.013	24	20					
O5b2	30 " RCP	0.0042	66	0.013	27	20					
* O6a	(2) 5' X 3' RCB	0.006		0.013	254	192					
O10a	18 " CMP	0.01	186	0.024	6	10	C,S				
* +O10b1	24 " CMP	0.025	313	0.024	19	163	C,S	42		200	62600
* +O10b2	24 " CMP	0.03	400	0.024	21	163	C,S	42		200	80000
* +O10b3	24 " CMP	0.04	268	0.024	24	163	C,S	42		200	53600
O10c1	18 " CMP	0.01	114	0.024	6	10	C,S				
O10c2	18 " RCP	0.1498	135	0.013	41	30					
* +O10d	27 " RCP	0.0804	709	0.013	88	190	C	42		200	141720
* +O10e	36 " RCP	0.008	218	0.013	60	210	C		48	230	50172
* +O10f	54 " RCP	0.002	160	0.013	89	230	C	MINOR			
* +O10g	65 " X 40 " CMPA	0.002	362	0.024	39	230	C,S	(2)7X4 RCB		975	352950
* +O10h	72 " X 44 " CMPA	0.002	322	0.024	51	260	C,S	(2)7X4 RCB		975	313950
O15a1	24 " CMP	0.025	225	0.024	19	117	C,S				
O15a2	b=2' h=2' s=1.5:1	0.025	511	0.015	165	185	C				
O15a3	24 " CMP	0.22	114	0.024	57	185	C,S				
O15a4	18 " RCP	0.096	92	0.013	33	30					
O15a5	27 " RCP	0.028	229	0.013	52	215	C				
O15b	30 " CMP	0.031	449	0.024	39	215	C,S				
O15c	30 " CMP	0.062	457	0.024	55	215	C,S				
* +O15d	30 " RCP	0.009	168	0.013	39	114	C		33	160	26904
* +O15e	33 " RCP	0.009	420	0.013	50	137	C	6X3 RCB		335	140630
* +O15f	(2) 27 " RCP	0.008	154	0.013	55	166	C	6X3 RCB		335	51590
* +O15g	6' X 1.5' RCB	0.007	143	0.013	61	166	C	MINOR			
* +O15h	42 " RCP	0.004	160	0.013	64	166	C	SEE O10g			
* +O15i	72 " X 44 " CMPA	0.0020	594	0.024	52	166	C,S	SEE O10h			

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* 020a	(3) 4' X 6' RCB	0.005		0.013	657	475					
* 020b	[b=8' h=4' s=2:1]	[0.013]	600	0.03	661	475	E,M,?				
025a	18 " RCP	0.1158	149	0.013	36	34					
025b	18 " RCP	0.0964	166	0.013	33	40	C				
025c	21 " RCP	0.0145	243	0.013	19	45	C				
025d	21 " RCP	0.062	269	0.013	39	50	C				
025e	21 " RCP	0.0686	296	0.013	41	55	C				
025f	24 " RCP	0.0678	212	0.013	59	60	C				
* +025k	24 " RCP	0.005	212	0.013	16	64	C	42		200	42410
* +025l	30 " RCP	0.005	47	0.013	29	81	C		36	175	8225
026a	[b=2'h=1.5's=1.5:1]	0.043		0.03	59	193	C,E,V				
026b	18 " RCP	0.04	20	0.013	21	193	C				
026c	18 " RCP	0.01	78	0.013	11	193	C				
* +030a	30 " RCP	0.031	202	0.013	72	81	C	MINOR			
* 030b	48 " RCP	0.035		0.013	269	81					
* 030c	48 " RCP	0.0156		0.013	179	81					
* 030d	69 " RCP	0.0078		0.013	334	331					
* 030e	(2) 5' x 3' RCB	0.0092		0.013	315	252					
035a	33 " RCP	0.0042	773	0.013	34	25					
* 035b	(2) 60 " RCP	0.0055	1539	0.013	386	331					
035c	18 " RCP	0.005	63	0.013	7	7					
035d	18 " RCP	0.013	238	0.013	12	10					
035e	18 " RCP	0.01	52	0.013	11	5					
035f	24 " RCP	0.024	179	0.013	35	8					
* +040a	33 " RCP	0.0042	710	0.013	34	35	C	MINOR			
* +040b	(2) 54 " RCP	0.0095	635	0.013	383	430	C	MINOR			
P5a1	24 " RCP	0.009		0.013	21	7					
P5a2	(2) 22" X 13" CMPA	N/A		0.024		10	S,?				
P10a	30 " CMP	0.01		0.024	22	60	C,S				
P10b	36 " CMP	0.0108		0.024	38	55	C,S				
P10c	5 ' X 4 ' RCB	N/A		0.013		118	?				
P10d	b=3' h=2' s=2:1	0.025		0.015	244	130	M				
* +P10e1	42 " RCP	0.0113	281	0.013	107	135	C	MINOR			
* +P10e2	42 " RCP	0.0127	281	0.013	113	137	C	MINOR			
* +P10e3	42 " RCP	0.0261	308	0.013	162	187	C		24	130	39975
* +P10e4	42 " RCP	0.0182	301	0.013	136	187	C		30	150	45075
* +P10e5	42 " RCP	0.0145	189	0.013	121	187	C		36	175	33075
P10e7	24 " RCP	0.0712		0.013	60	50					
P15a1	24 " RCP	0.1415	154	0.013	85	50					
P15a2	24 " RCP	0.0177	191	0.013	30	50	C				
P15a3	24 " RCP	0.036	478	0.013	43	55	C				
P15a4	24 " RCP	0.0528	397	0.013	52	60	C				
P15b	30 " RCP	0.01	368	0.013	41	70	C				
* +P15c	48 " RCP	0.0135	212	0.013	167	282	C		42	200	42400
P15d	18 " RCP	0.007		0.013	9	30	C				
* +P15e	24 " RCP	0.0076	[1100]	0.013	20	118	C	48		230	253000
* +P15f	54 " RCP	0.0132	606	0.013	226	420	C		54	260	157560
* +P15g	(2) 57" X 38" CMPA	0.01	[610]	0.024	132	476	C,S	(2) 60		515	314150
P15h	OPEN	N/A				56	?				

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P15i	(2) 42 " RCP	N/A		0.013		56	?				
* +P20a	4 ' X 8 ' RCB	0.0031	456	0.013	247	476	C		72	315	143640
* +P20b	84 " CSP	0.001	562	0.013	202	507	C,S		72	315	177030
* +P20c	78 " CIP	0.001	66	0.013	166	515	C		72	315	20866
* +P20d	(2) 4'X 5 ' RCB	0.001	145	0.013	210	520	C		72	315	45675
* P20e	b=10' h=5' s=2:1	0.001	722	0.015	665	524					
* +P20f	(2) 5'X 5 ' RCB	0.001	65	0.013	155	524	C	MINOR			
* +Q5b	33 " RCP	0.008	362	0.013	47	176	C		42	200	72400
* +Q5c	33 " RCP	0.01	380	0.013	53	230	C	8X4 RCB		435	165680
* +Q5d	36 " ACP	0.008	347	0.013	60	300	C	8X4 RCB		435	151074
Q5e	OPEN	0.0384		0.015		45	?				
Q5f	18 " ACP	0.045		0.013	22	45	C				
Q5g	30 " RCP	0.0384		0.013	80	55					
Q5h	30 " RCP	0.02		0.013	58	55					
Q5i	30 " RCP	0.01		0.013	41	55	C				
Q5j	24 " RCP	0.012	52	0.013	25						
Q5k	24 " RCP	0.005	56	0.013	16						
Q5l	21 " RCP	0.01	56	0.013	16						
Q5m	48 " RCP	0.037		0.013	276						
Q5n	24 " RCP	0.032		0.013	40						
* +Q10a	42 " RCP	0.0039	329	0.013	63	325	C	10X4 RCB		585	192512
* +Q10b	48 " RCP	0.004	375	0.013	91	340	C	10X4 RCB		585	219246
* +Q10c	48 " RCP	0.0060	649	0.013	111	365	C	10X4 RCB		585	379782
* +Q15a	48 " RCP	0.0075	302	0.013	124	425	C	10X4 RCB		585	176933
* +Q15b	(2) 39 " RCP	0.0046	842	0.013	113	475	C	10X4 RCB		585	492278
* +Q20a	(2) 42 " RCP	0.002	383	0.013	90	502	C	10X4 RCB		585	223997
* +Q25a	18 " RCP	0.0055	416	0.013	8	20	C	MINOR			
* +Q25b	18 " RCP	0.0023	267	0.013	5	36	C	36		175	46811
* +Q25c	21 " ACP	0.005	825	0.013	11	40	C	36		175	144445
* +Q25d	21 " ACP	0.0066	69	0.013	13	45	C	36		175	12024
* +Q25e	33 " RCP	0.004	674	0.013	33	65	C	42		200	134800
* +Q25f	33 " RCP	0.005	20	0.013	37	75	C	42		200	4000
* +Q25g	[b=3.5' h=2.5' s=1:1]	[0.003]	[650]	0.03	51	581	C,?	b=10 h=5 s=1.5:1 n=.03		150	97500
* +Q25h	b=6' h=4.5' RECT	0.003	620	0.015	322	600	C	OK			
* +Q25i	42 " RCP	0.003	180	0.013	55		C,?	8X5 RCB		470	84146
* +Q25j	49" x 33" CMPA	0.003	86	0.024	24		C,S,?	10X5 RCB		640	55040
* +Q25k	42 " RCP	0.003	325	0.013	55		C,?	10X5 RCB		640	208000
* +Q25l	[b=3' h=7 s=1.5:1]	[0.003]	1570	0.03	573		C,?	b=10 h=6 s=1.5 n=.03		165	259050
Q25n	18 " RCP	0.0025	103	0.013	5	5					
Q25o	24 " RCP	0.01	47	0.013	23	5					
* +Q25p	18 " CMP	0.0256	116	0.024	9		S	8X5 RCB		470	54288
* +Q26a	18 " RCP	0.001	208	0.013	3	20	C	36		175	36400
Q26b	18 " RCP	0.0118	202	0.013	11	15	C				
Q26c	18 " RCP	0.002	322	0.013	5	10	C				
* Q26d	48 " RCP	0.0025	42	0.013	72	30					
Q26e	18 " CMP	0.05		0.024	13	5	S				
Q26f	24 " RCP	N/A		0.013		10	?				
* +Q30a	18 " RCP	0.0014	[300]	0.013	4	70	C	(2) 54 EXTEND TO		490	147000
* +Q30b1	28 " x 20 " CMPA	0.007	48	0.024	9	131	C,S	(2) 54 BUENA VISTA		490	23520

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* +Q30b2	28 " x 20 " CMPA	0.006	42	0.024	8	51	C,S	36		175	7350
* +Q30c	24 " CMP	0.006	462	0.024	9	131	C,S	8X5 RCB		470	217140
* +Q30d	24 " CMP	0.006	98	0.024	9		C,S,?	OK			
* +Q30e	24 " CMP	0.0058	208	0.024	9		C,S,?	OK			
* +Q30f	36 " CMP	0.0045	448	0.024	24		C,S,?	OK			
* +Q30g	64 " x 43 " CMPA	0.0025	1232	0.024	44		C,S,?	OK			
* +Q30h	71 " x 47 " CMPA	0.0025	664	0.024	57		C,S,?	OK			
* +Q30i	(2) 54 " RCP	0.003	2500	0.013	215		C,S,?	OK			
* +Q31a	64 " x 43 " CMPA	0.008	12	0.024	79	628	C,S	OK			
Q31b1	18 " CMP	0.004		0.024	4		S				
Q31b2	18 " RCP	0.0014		0.013	4						
Q31b3	18 " RCP	0.0029	510	0.013	6						
* +Q31c1	30 " CMP	0.0024	448	0.024	11		C,S,?	OK			
* +Q31c2	24 " CMP	0.004	540	0.024	8		C,S,?	OK			
* +Q31c3	30 " CMP	0.0025	276	0.024	11		C,S,?	OK			
* +Q31d	50 " x 31 " CMPA	0.0025	751	0.024	22		C,S,?	OK			
* +Q31e	49 " x 33 " CMPA	0.0025	282	0.024	22		C,S,?	OK			
* +Q31f	64 " x 43 " CMPA	0.0062	130	0.024	69		C,S,?	OK			
Q35a	18 " RCP	0.001	364	0.013	3						
* +R5a	27 " RCP	0.003	307	0.013	17	24	C	MINOR			
* +R5b	33 " RCP	0.0048	333	0.013	37	27		MINOR			
* +R5c	33 " RCP	0.003	296	0.013	29	47	C	MINOR			
* +R10a	36 " RCP	0.002	315	0.013	30	54	C	MINOR			
* +R10b	24 " RCP	0.0017	253	0.013	9	61	C	36		175	44275
R15b	42 " RCP	0.0024		0.013	49	49					
R15c	36 " RCP	0.0032		0.013	38	35					
R15d	36 " CIP	0.0179		0.013	89	25					
R15e	36 " CIP	0.0024		0.013	33	14					
R15h	b=3' h=4" RECT.	0.005	120	0.015	89	14					
R15i	18 " RCP	0.005		0.013	7	10	C				
* +R20a	54 " RCP	0.0023	[500]	0.013	94	100	C	MINOR			
S5a	18 " RCP	0.006		0.013	8	45	C				
S5b	42 " RCP	0.002	291	0.013	45	50	C				
* S5c	48 " RCP	0.0129	473	0.013	163	65					
S15a	15 " RCP	0.004		0.013	4	20	C				
* +S15b	35 " x 24 " CMPA	0.0036	178	0.024	11	28	C,S	(2) 24		220	39160
* +S15c	30 " RCP	0.005	277	0.013	29	70	C		36	175	48416
* +S15d	36 " RCP	0.005	159	0.013	47	95	C		36	175	27790
* +S15e	48 " RCP	0.0026	847	0.013	73	110	C		42	200	169428
* +S15f	48 " RCP	0.0049	280	0.013	101	120	C	MINOR			
* S15g	54 " RCP	0.0052	244	0.013	142	130					
* S15h	54 " RCP	0.0064	435	0.013	158	148					
S15i	24 " RCP	0.014		0.013	27	27					
S15j	24 " RCP	0.0036		0.013	14	14					
S15k	18 " RCP	0.005		0.013	7	7					
S15l	36 " RCP	0.0076	150	0.013	58	148	C				
T5a	18 " RCP	0.0193		0.013	15	10					
T5b	30 " RCP	0.0178	61	0.013	55	62	C				
* +T5c	30 " RCP	0.01	253	0.013	41	62	C		24	130	32937

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CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* +T5d	(2) 24 " RCP	0.01	88	0.013	45	62	C	MINOR			
T5e	18 " RCP	0.0232		0.013	16	10					
T5f	18 " RCP	0.015		0.013	13	12					
T25a	30 " CMP	N/A		0.024		99	S,?				
T25b	OPEN	N/A		0.03		115	?				
T25c	18 " CMP	N/A		0.024		15	S,?				
T25d	OPEN	N/A		0.03		25	E,?				
T25e	(2) 36 " CMP	N/A		0.024		140	M,S				
T30a1	N/A						?				
T30a2	OPEN	N/A		0.03		200	?				
T30b	6' x 3 ' RCB	N/A		0.013		211	M,?				
T30c	OPEN	N/A		0.015		211	M,?				
* +U5a1	43 " x 27 " CMPA	0.013	72	0.024	35	64	C,S	36		175	12535
* +U5a2	43 " x 27 " CMPA	0.016	49	0.024	38	64	C,S	36		175	8510
* U5b	36 " RCP	0.028	217	0.013	112	75					
* U5c	42 " RCP	0.0071	296	0.013	85	75					
* U5d	48 " RCP	0.0073	267	0.013	123	110					
U5e	30 " RCP	0.135	210	0.013	151	40					
U5f	30 " ACP	0.0135		0.013	48	20					
U5g	24 " ACP	0.0247	150	0.013	36	20					
U5h	29 " x 18 " CMPA	0.006	46	0.024	8	10	C,S				
U5i	18 " ACP	0.0143	201	0.013	13	20	C				
U6a	24 " CMP	[0.01]	60	0.024	12	10					
U6b	21 " RCP	0.01	920	0.013	16	10					
U6c	[b=5 h=3 s=2:1]	0.006	280	0.013		12	?				
U6d	30 " CMP	0.022	54	0.024	33	10	S				
* U10a	54 " RCP	0.0052	690	0.013	142	110					
* +U20a	28 " X 20 " CMPA	0.0051	1166	0.024	7	58	C,S	42		200	233200
* +U20b	30 " CMP	0.0037	394	0.024	14	68	C,S	42		200	78800
* +U20c	28 " X 20 " CMPA	0.0018	108	0.024	4	15	C,S	MINOR			
* +U20d	43 " X 27 " CMPA	0.0018	450	0.024	13	15	C,S	MINOR			
U20e	(2) 36 " RCP	0.0035		0.013	79	25					
U20f	OPEN	N/A				30	?				
* U20g	(2) 58" x 36" CMPA	0.005		0.024	93	50	S				
* U20h	72 " x 44 " CMPA	0.0065	240	0.024	92	50	S				
U20i	OPEN	N/A				5	?				
U20j	28 " x 20 " CMPA	0.0039	76	0.024	6	25	C,S				
* V25a	[b=10 h=8 s=1.5:1]	[0.02]	2300	0.015	6752	1000	?				
* V25b	(2) 8' x 5' RCB	0.0322		0.013	2794	1111					
* +V30a1	b=10 h=4.5 s=1.5:1	0.005	[100]	0.015	1067	1175	C,E,M	MINOR			
* +V30a2	[b=16' h=3' s=1:1]	[0.019]	[200]	0.03	684	1175	C,?	b=12 h=5.5 s=1.5 n=.03		155	31000
* V30b	(2) 8' x 5' RCB	[0.019]		0.013	1680	1290	?				
* V35a	[b=12 h=6 s=1.5:1]	[0.019]		0.015	4150	1300	M,?				
* V40a	(2) 9' x 4' RCB	0.012		0.013	1487	1312					
* V40b	(2)8'x4.75' RCB	0.012	602	0.013	1596	1350					
* V40c	b=10' h=5' s=1.5:1	0.0148	1155	0.015	2253	1381					
* +V40d	(2) 10' x 4' RCB	0.0062	74	0.013	913	1381	C,M	MINOR			
V45a	18 " RCP	0.005		0.013	7	5					
V45b	18 " RCP	0.0111		0.013	11	10					

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LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	RECOMMENDATIONS PARALLEL PIPE	UNIT COST	COST
* V45c	27 " RCP	0.009		0.013	29	25					
* +V45d	b=5' h=5' s=1.5:1	0.0181	[800]	0.03	810	1387	C,E,M	b=8 h=5 s=1.5 n=.015		230	184000
* +V45e1	(2) 6' X 5' RCB	0.0089	150	0.013	796	1387	C	MINOR			
* +V45e2	(2) 6' X 5' RCB	0.0192	96	0.013	1169	1387	C	MINOR			
* V45f	b=12' h=6' s=1.5:1	0.0192	278	0.015	4172	1400					
V45g	24 " RCP	0.005	105	0.013	16	15					
V45h	21 " RCP	0.005	300	0.013	11	10					
V45i	24 " RCP	0.005	300	0.013	16	15					
* V45j	b=12 h=6 s=1.5:1	0.006	462	0.015	2332	1455					
* +V45k	[b=7 h=5 s=1.5:1]	0.006	400	0.03	565	1472	C,?	b=12 h=6 s=1.5 n=.015		380	152000
* +V50a	(4) 8' X 3' RCB	0.0135	99	0.013	1351	1472	C,M	MINOR			
* V50b	[b=20'h=10s=1.5:1]	0.006		0.03	4553	1472	E,M,V				
V50c1	(2) 22" x 13" CMPA	0.005	100	0.024	7	15	C,S				
V50c2	24 " RCP	0.016	304	0.013	29	15					
V50d	24 " CMP	0.01	104	0.024	12	15	C,S				
V50e1	20 " X 28 " CMPA	0.0042	36	0.024	7	15	C,S				
V50e2	24 " CMP	0.004	340	0.024	8	15	C,S				
V50f	b=0' h=1' s=1.5:1	0.01	100	0.015	8	30	C				
W15a	36 " RCP	0.03	289	0.013	115	120	C				
W15b	36 " RCP	0.0381	253	0.013	130	120					
W15c	36 " RCP	0.03	375	0.013	115	130	C				
W15d	42 " RCP	0.0197	270	0.013	141	130					
W15e	42 " RCP	0.0162	247	0.013	128	130	C				
W15f	49 " x 33 " CMPA	0.012	36	0.024	48	130	C,S				
W15g	(2) 49" x 33" CMPA	0.0106	89	0.024	91	136	C,S				
W15h	18 " RCP	0.01	111	0.013	11	10					
W20a	30 " RCP	0.032	125	0.013	73	90	C				
W20b	30 " RCP	0.051	295	0.013	93	100	C				
W20c	30 " RCP	0.03	141	0.013	71	105	C				
W20d	36 " RCP	0.022	76	0.013	99	110	C				
W25a	43 " X 27 " CMPA	0.025		0.024	48	30	S				
W25b	36 " CIPP	0.023		0.013	101	42					
W25c	36 " CIPP	0.01		0.013	67	58					
W30a	22 " X 13 " CMPA	0.003		0.024	3	8	C,S				
W30b	16 " RCP	0.006		0.013	6	10	C				
W30c	22 " X 13 " CMPA	0.014		0.024	5	5	S				
W30d	20 " RCP	0.0178		0.013	19	12					
W30e	36 " CMP	0.01		0.024	36	70	C,S				
W35a	24 " CMP	0.011	280	0.024	13	51	C,S				
W35b	(2) 71" x 47" CMPA	0.01	100	0.024	229	51	S				
W35c	18 " CMP	0.0139	114	0.024	7	10	C,S				
W35d	24 " CMP	-0.0377		0.024	24	15	S				
W35e	24 " CMP	0.0173		0.024	16	25	C,S				
W35f	24 " CMP	0.0175		0.024	16	15	S				
W35g	18 " CMP	0.0065		0.024	5	5	S				
W35h	12 " RCP	N/A		0.013		5	?				
W35i	24 " CMP	0.0075		0.024	11	10	S				
W35j	24 " CMP	0.0244	94	0.024	19	15	S				
* X10a	[b=6' h=4' s=1:1]	0.05		0.03	774	350	E,M,?				

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LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* X10b	[b=20" h=3' s=2:1]	[0.025]		0.03	1520	960	E,M,?				
X10c	24 " RCP	N/A		0.013		20	?				
X10d	24 " RCP	N/A		0.013		20	?				
* +X15a	(2) 3.5' X 6' RCB	0.01	[50]	0.013	513	995	C,M		MINOR		
X15b	18 " RCP	0.014	36	0.013	12	20	C				
X15c	18 " RCP	0.039	111	0.013	21	25	C				
X15d	18 " RCP	0.047	60	0.013	23	25	C				
X15e	18 " RCP	0.006	97	0.013	8	25	C				
X15f	18 " RCP	0.014	36	0.013	12	30	C				
X15g	24 " RCP	0.47	48	0.013	155	30	V				
X15h	24 " RCP	0.0165	130	0.013	29	30	C				
X15i	24 " RCP	0.012	190	0.013	25	35	C				
X15j	[b=1.5'h=1.5's=1:1]	0.0047	200	0.03	13	35	C				
X15k	[b=1.5'h=1.5's=1:1]	0.02	100	0.03	27	35	C,E,V				
X15l	[b=1.5'h=1.5's=1:1]	0.15	80	0.03	73	35	E,V				
X15n	24 " RCP	N/A	67	0.013		40	?				
X15o	18 " RCP	0.0161	421	0.013	13	40	C				
X15p	18 " RCP	0.04	169	0.013	21	40	C				
X15q	18 " RCP	0.0518	112	0.013	24	45	C				
X15r	18 " RCP	0.0867	40	0.013	31	45	C				
X15s	18 " RCP	0.051	151	0.013	24	45	C				
X15t	18 " RCP	0.01	204	0.013	11	45	C				
X15u	18 " CMP	0.0417	137	0.024	12	45	C,S				
* X15v	[b=20' h=3' s=1:1]	[0.025]		0.03	1520	1021	E,M,?				
X20a	18 " RCP	0.1438	122	0.013	40	12					
* X20b	72 " RCP	0.014		0.013	501	1032	C,M				
X20c	(2) 4' X 4' RCB	0.06		0.013	896	50	M				
X30a	18 " RCP	0.015		0.013	13	10					
X30b	18 " RCP	0.01		0.013	11	10					
X30c	30 " CIP	0.0292		0.013	70	50					
X30d	42 " CIP	0.005		0.013	71	70					
X30e	60 " CIP	0.01		0.013	260	85					
Y10a	36 " RCP	0.06	236	0.013	163	259	C				
Y10b	36 " RCP	0.066	480	0.013	171	262	C				
Y10c	36 " RCP	0.033	83	0.013	121	265	C				
Y10d	OPEN	N/A	200			265	E,M,?				
Y10e	36 " RCP	0.0185	85	0.013	91	265	C				
Y10f	36 " RCP	0.1	140	0.013	211	270	C				
Y10g	36 " RCP	0.038	160	0.013	130	270	C				
Y10h	36 " RCP	0.062	163	0.013	166	289	C				
* +Y15a	36 " RCP	0.0138	232	0.013	78	289	C		48	230	53360
* +Y15b	48 " CIP	0.0395	563	0.013	285	289	C		MINOR		
Y15c1	18 " RCP	0.028	1645	0.013	18	10					
Y15c2	18 " RCP	0.02	178	0.013	15	15					
Y15c3	24 " RCP	0.02	94	0.013	32	28					
* Y15d	54 " CIP	0.026	475	0.013	317	316					
* Y15e	(2) 42 " CIP	0.0301	110	0.013	349	342	M				
Y15f	30 " RCP	0.012		0.013	45	26					
* +Y15g1	28 " x 20 " CMPA	0.0245	72	0.024	16	27	C,S	24		130	9360

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LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
* +Y15g2	24 " CMP	0.035	100	0.024	23	27	C,S	MINOR			
* +Y15h	18 " RCP	0.005	58	0.013	7	13	C	MINOR			
* Y15i	24 " CMP	0.0159	22	0.024	15	14	S				
Y20a	24 " CIP	0.0263	152	0.013	37	37					
Y20b	24 " CIP	0.0713	163	0.013	60	37					
Y20c	24 " CIP	0.0676	236	0.013	59	37					
Y20d	24 " CIP	0.0211	294	0.013	33	37	C				
Y20e	24 " CIP	0.0853	219	0.013	66	37					
Y20f	30 " CIP	0.0221	241	0.013	61	37					
Y20g	42 " x 29 " CMPA	0.0253	79	0.024	48	37	S				
Z10a	24 " CMP	0.1283	366	0.024	44	45	C,S				
Z10b	24 " CMP	0.069	210	0.024	32	55	C,S				
Z10c	30 " CMP	0.0297	54	0.024	38	66	C,S				
Z10d	30 " CMP	0.4726	61	0.024	153	70	S				
Z10e	27 " CMP	0.0441	103	0.024	35	75	C,S				
Z10f	27 " CMP	0.1017	167	0.024	53	80	C,S				
Z10g	30 " CMP	0.0098	131	0.024	22	82	C,S				
Z10h	30 " CMP	0.6462	29	0.024	179	84	S,V				
Z10i	30 " CMP	0.0116	88	0.024	24	93	C,S				
Z10j	30 " CMP	0.011	44	0.024	23	100	C,S				
Z10k	30 " CMP	0.0102	123	0.024	22	108	C,S				
Z10l	30 " CMP	0.4208	53	0.024	144	118	S				
Z10m	30 " CMP	0.0251	177	0.024	35	125	C,S				
Z10n	30 " CMP	0.018	68	0.024	30	135	C,S				
Z10o	30 " CMP	0.4639	33	0.024	151	145	S				
Z10p	30 " CMP	0.001	212	0.024	7	152	C,S				
Z10q	30 " CMP	0.379	16	0.024	137	159	C,S				
Z10r	30 " CMP	0.011	110	0.024	23	165	C,S				
Z10s1	36 " CMP	0.0086	208	0.024	33	150	C,S				
Z10s2	18 " CMP	0.0086	187	0.024	5	20	C,S				
Z10t1	36 " CMP	0.2311	37	0.024	174	155	S				
Z10t2	18 " CMP	0.2311	37	0.024	27	25	S				
Z10u	18 " RCP	0.01	1814	0.013	11	10					
Z15a1	36 " RCP	0.0326		0.013	120	40					
Z15a2	24 " RCP	0.0326		0.013	41	30					
Z15b1	36 " RCP	0.0326	115	0.013	120	186	C				
Z15b2	24 " RCP	0.0326	115	0.013	41	186	C				
Z15b3	[b=10'h=varies s=1:1]	0.005	170	0.03		186	?				
Z20a	24 " CMP	0.0051		0.024	9	45	C,S				
Z25a	54 " RCP	0.032		0.013	352	140					
Z25b	30 " RCP	0.0279		0.013	68	45					
Z25c	54 " RCP	0.032		0.013	352	266					
Z25d	24 " RCP	0.008		0.013	20	115	C				
Z25e	21 " RCP	0.017	204	0.013	21	10					
* Z25f	54 " RCP	0.0324	1032	0.013	354	286					
* Z25g	[b=14' h=2.5' s=1:1]	[0.039]		0.03	631	359	?				
* +Z25h	18 " CMP	[0.039]	[40]	0.024	11	359	C,S,?	6X3 RCB		335	13400
* +Z25i	[b=6' h=2.5' s=1:1]	[0.039]	[400]	0.03	264	359	C,?	b=6 h=4 s=1.5 n=.03		85	34000
* +Z25j	48 " RCP	0.0178	[50]	0.013	192	359	C		48	230	11500

* = MASTER DRAINAGE FACILITY + = DEFICIENT MASTER DRAINAGE FACILITY [ ] = ESTIMATED VALUE

DEFICIENCIES: C = CAPACITY E = EROSION M = MAINTENANCE S = SERVICE LIFE V = VELOCITY ? = NOT ENOUGH DATA

CITY OF SANTEE --- SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

LINE	SIZE	SLOPE	LENGTH (FT)	N VALUE	CAPACITY (CFS)	100-YEAR FLOW (CFS)	DEFICIENCY RATING	RECOMMENDATIONS REPLACEMENT PIPE	PARALLEL PIPE	UNIT COST	COST
Z26a	30 " CMP	0.046		0.024	48	30	S				
* +Z26b	36 " CMP	0.0678	[500]	0.024	94	170	C,S	36		175	87500
* Z26c	42 " RCP	0.12		0.013	348	200	V				
* +Z26d	24 " CMP	0.03	[700]	0.024	21	140	C,S	42		200	140000
Z35a	24 " CMP	0.01		0.024	12	8	S				
Z35b	24 " RCP	0.079		0.013	64	5					
Z35c	24 " RCP	0.01		0.013	23	23					
Z35d	b=2' h=2' RECT.	0.01		0.015	30	38	C,M				
Z35e	(2) 25" X 16" CMPA	0.041		0.024	29	38	C,S				
Z35f	25 " X 16 " CMPA	0.012		0.024	8	5	S				
Z35g	30 " CMP	0.01		0.024	22	42	C,M,S				
Z35h	OPEN	N/A				42	?				
Z35i	30 " RCP	N/A		0.013		42	?				

* = MASTER DRAINAGE FACILITY + = DEFICIENT MASTER DRAINAGE FACILITY [ ] = ESTIMATED VALUE
DEFICIENCIES: C = CAPACITY E = EROSION M = MAINTENANCE S = SERVICE LIFE V = VELOCITY ? = NOT ENOUGH DATA

CITY OF SANTEE
HYDROLOGY MASTER PLAN
EXISTING DRAINAGE FACILITIES

BSI CONSULTANTS, INC.
Consultants to Governmental Agencies
16880 West Bernardo Drive San Diego, CA 92127
(619) 451-6100

90-098

JANUARY 1990

PLATE 1

APPENDIX D

HYDRAULIC ANALYSES

HYDRAULIC ANALYSES

FOR

SAN DIEGO RIVER TRAIL

CARLTON OAKS GOLF COURSE SEGMENT

May 10, 2017

Wayne W. Chang, MS, PE 46548

Chang Consultants

Civil Engineering ◦ Hydrology ◦ Hydraulics ◦ Sedimentation

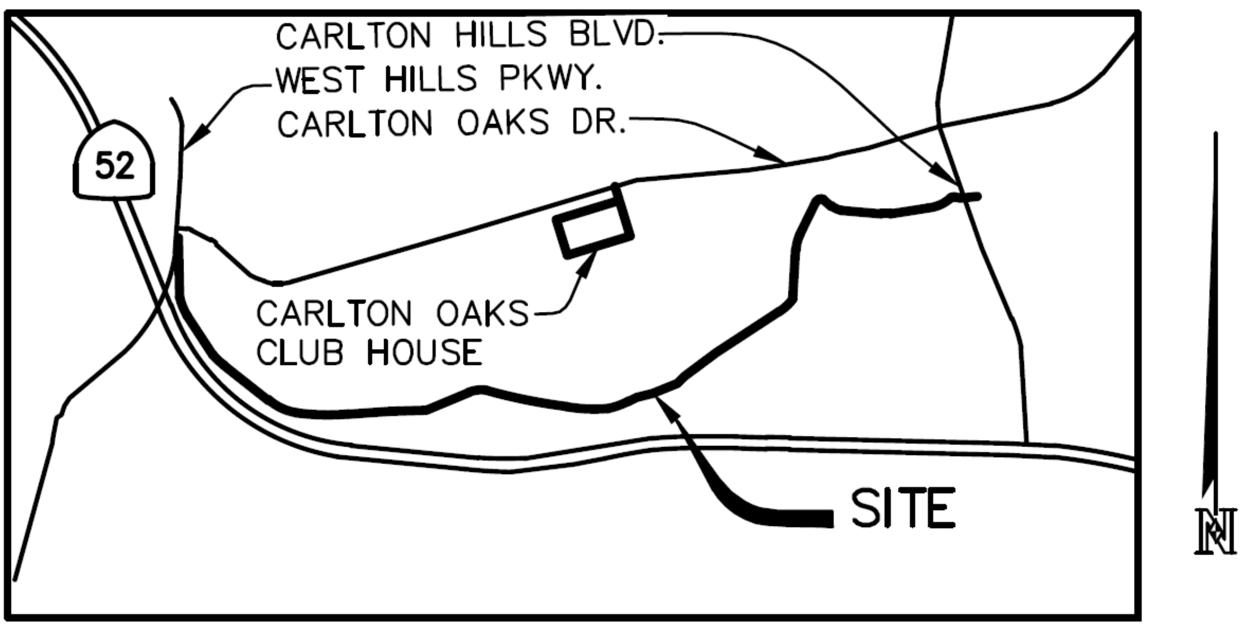
P.O. Box 9496
Rancho Santa Fe, CA 92067
(858) 692-0760

TABLE OF CONTENTS

INTRODUCTION

Updates in this May 10, 2017 report revision are as follows. All text modifications are underlined. Table 1 and Appendix A are completely revised based on the addition of cross-sections 318 and 325, and the utilization of amended 100-year peak discharge flow rates in accordance with Chapter 15.52 (Flood Damage Prevention) of the city of Santee's *Municipal Code*.

The San Diego Association of Governments (SANDAG) proposes to construct the Carlton Oaks Golf Course Segment of the San Diego River Trail (SDRT) within the cities of San Diego and Santee (the proposed project). The proposed project would consist of a Class I bikeway for the exclusive use of people walking and riding bikes and related physical improvements. It would extend a distance of approximately two miles between Carlton Hills Boulevard and West Hills Parkway through Mast Park, Mast Park West, and the Carlton Oaks Golf Course (see the Vicinity Map).



Vicinity Map

Specifically, the proposed project would extend westward from the Mast Park parking lot, under the Carlton Hills Boulevard bridge, and along the existing dirt trail that continues westward for approximately 0.5 mile through Mast Park West and terminates at the Carlton Oaks Golf Course. West of the terminus of the existing dirt trail, the proposed project would generally be constructed on or adjacent to the existing berm along the southern edge of the golf course for a distance of approximately 1.5 miles before its terminus at the existing sidewalk along West Hills Parkway. In general, the proposed project would include a 10-foot-wide paved bike path with 2-foot-wide decomposed granite shoulders. Near the west end, the proposed project would install a bridge or similar structure to cross Sycamore Creek. Additional physical improvements could include installation of fencing, pedestrian-scaled lighting for safety, ~~rock~~ slope protection in slope areas south of the existing berm in which erosion is evident, removal and replacement of low flow drainage crossings along Mast Park West, revegetation of slopes, restoration of disturbed areas within the golf course, and other minor improvements.

Construction of the project is estimated to begin in late 2018 and take approximately 12 months to complete. Construction staging is anticipated to occur within the golf course and will avoid sensitive biological resources. Access during construction could be provided from West Hills Parkway; an existing dirt road within a utility easement along the eastern boundary of the golf course accessible from Carlton Oaks Drive; and/or from the parking lot at Mast Park, which could require excavation under the Carlton Hills Boulevard bridge to provide adequate vertical clearance for construction equipment, and along the existing dirt trail in Mast Park West. Some construction access points would require a temporary construction easement or other permission/agreement from property owners before use for construction access.

The San Diego River floodplain and floodway are located within much of the site (see the HEC-RAS Work Map). The Flood Insurance Rate Maps (FIRM) encompassing the project site are Map No.'s 06073C01634G, 06073C01651G, and 06073C1653G dated May 16, 2012. The FIRMs delineate the 100-year floodplain as a Zone AE floodplain, which indicates that it is based on a detailed engineering analysis. Since a portion of the project will encroach and fill into the FEMA floodway, the project is required to avoid increasing the 100-year water surface elevations or a set of conditions must be met. This report contains the pre- (existing condition) and post-project (proposed condition) hydraulic analyses based on the 30 percent improvement plans prepared by Nasland Engineering including the existing berm and proposed berm widening. Low flow drainage improvements will be inundated in a 100-year event and, therefore, are not included in this analysis.

HYDRAULIC ANALYSES

The existing and proposed condition HEC-RAS analyses extend from FEMA effective cross-section 230 (just downstream of State Route 52) at the downstream end to FEMA effective cross-section 360 (just upstream of Carlton Hills Boulevard) at the upstream end. Both HEC-RAS analyses tie into the 100-year water surface elevation (307.25 ~~301.52~~ feet NGVD 29) at station 230 from BSI Consultants, Inc.'s July 1992, *San Diego River Flood Study*, which is based on the city of Santee's *Municipal Code* (Chapter 15.52) flow rates ~~the effective HEC-2~~. The 100-year flow rates of 36,000 to 38,000 cubic feet per second (cfs) from the effective results ~~was used~~ were not used. ~~The flow rate is 38,000 cfs from cross-section 230 to 260, 37,000 cfs from cross-section 270 to 320, and 36,000 cfs from cross-section 330 to 360.~~ The 100-year *Municipal Code* flow rates are 50,000 cfs from cross-section 230 to 260, 49,000 cfs from cross-section 270 to 310, and 48,000 cfs from cross-section 318 to 360.

The existing condition cross-sections were primarily created from the 1-foot contour interval topographic mapping (NGVD 29 vertical datum) flown for the project on May 10, 2016 (see the HEC-RAS Work Map in the map pocket). The topographic mapping was supplemented with 2014 2-foot contour interval mapping from SANDAG, where needed. The SANDAG mapping is on NAVD 88 datum, so the elevations were reduced by 2.04 feet to convert to NGVD 29 (the analyses were performed on NGVD 29). The cross-section locations are identical to the effective cross-section locations. The proposed condition cross-sections were based on the existing condition cross-sections, but modified to reflect the bike trail grading from Nasland Engineering's CAD files.

The existing and proposed condition roughness coefficients were assigned based on a review of aerial photographs. The golf course area was assigned a roughness value of n=0.040. The densely-vegetated river channel was assigned a roughness of n=0.10. The remaining areas with moderate vegetation were assigned a roughness of n=0.050.

The existing and proposed condition 100-year HEC-RAS results are included in Appendix A and summarized in Table 1. The table shows that the project will cause a slight increase in the 100-year water surface elevations.

Cross-Section	100-Year Water Surface Elevations, feet		
	Existing Conditions	Proposed Conditions	Difference (Prop. – Exist.)
360	328.97	328.99	0.02
359	328.08	328.11	0.03
357	327.79	327.82	0.03
355	327.51	327.54	0.03
345	327.13	327.17	0.04
340	326.64	326.68	0.04
330	324.95	324.98	0.03
325	321.6	321.62	0.02
320	320.16	320.18	0.02
318	320.01	320.03	0.02
310	319.36	319.37	0.01
300	318.06	318.08	0.02
290	316.85	316.89	0.04
285	316.22	316.26	0.04
280	315.84	315.89	0.05
270	314.40	314.44	0.04
260	311.06	311.09	0.03
250	310.24	310.26	0.02
245	309.56	309.56	0.00
244	308.77	308.77	0.00
239	307.93	307.93	0.00
230	307.25	307.25	0.00

Table 1. Summary of 100-Year HEC-RAS Results

CONCLUSION

Existing and proposed condition 100-year hydraulic analyses have been performed for the San Diego River Trail, Carlton Oaks Golf Course Segment project along the San Diego River in the city of Santee, California. A floodplain and floodway have been delineated along the river by FEMA. Since the project will encroach within the floodway, the regulations require that with a rise in the 100-year water surface elevations the conditions in the attached Section 65.12 from the *Code of Federal Regulations* must be met including a remapping of the FEMA floodway. The analyses show a maximum rise of 0.05 feet, so the existing and proposed floodplains will not have significant differences. In addition, the floodway delineations between existing and proposed conditions will also be similar.

(b)(1) through (7) of this section must be certified by a registered professional engineer. Also, certified as-built plans of the levee must be submitted. Certifications are subject to the definition given at § 65.2 of this subchapter. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

[51 FR 30316, Aug. 25, 1986]

§ 65.11 Evaluation of sand dunes in mapping coastal flood hazard areas.

(a) *General conditions.* For purposes of the NFIP, FEMA will consider storm-induced dune erosion potential in its determination of coastal flood hazards and risk mapping efforts. The criterion to be used in the evaluation of dune erosion will apply to primary frontal dunes as defined in § 59.1, but does not apply to artificially designed and constructed dunes that are not well-established with long-standing vegetative cover, such as the placement of sand materials in a dune-like formation.

(b) *Evaluation criterion.* Primary frontal dunes will not be considered as effective barriers to base flood storm surges and associated wave action where the cross-sectional area of the primary frontal dune, as measured perpendicular to the shoreline and above the 100-year stillwater flood elevation and seaward of the dune crest, is equal to, or less than, 540 square feet.

(c) *Exceptions.* Exceptions to the evaluation criterion may be granted where it can be demonstrated through authoritative historical documentation that the primary frontal dunes at a specific site withstood previous base flood storm surges and associated wave action.

[53 FR 16279, May 6, 1988]

§ 65.12 Revision of flood insurance rate maps to reflect base flood elevations caused by proposed encroachments.

(a) When a community proposes to permit encroachments upon the flood plain when a regulatory floodway has not been adopted or to permit encroachments upon an adopted regulatory floodway which will cause base flood elevation increases in excess of those permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter, the community shall apply to the Administrator for conditional approval of such action prior to permitting the encroachments to occur and shall submit the following as part of its application:

(1) A request for conditional approval of map change and the appropriate initial fee as specified by § 72.3 of this subchapter or a request for exemption from fees as specified by § 72.5 of this subchapter, whichever is appropriate;

(2) An evaluation of alternatives which would not result in a base flood elevation increase above that permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter demonstrating why these alternatives are not feasible;

(3) Documentation of individual legal notice to all impacted property owners within and outside of the community, explaining the impact of the proposed action on their property.

(4) Concurrence of the Chief Executive Officer of any other communities impacted by the proposed actions;

(5) Certification that no structures are located in areas which would be impacted by the increased base flood elevation;

(6) A request for revision of base flood elevation determination according to the provisions of § 65.6 of this part;

(7) A request for floodway revision in accordance with the provisions of § 65.7 of this part;

(b) Upon receipt of the Administrator's conditional approval of map change and prior to approving the proposed encroachments, a community shall provide evidence to the Administrator of the adoption of flood plain management ordinances incorporating the increased base flood elevations and/or revised floodway reflecting the post-project condition.

(c) Upon completion of the proposed encroachments, a community shall provide as-built certifications in accordance with the provisions of § 65.3 of this part. The Administrator will initiate a final map revision upon receipt of such certifications in accordance with part 67 of this subchapter.

[53 FR 16279, May 6, 1988]

§ 65.13 Mapping and map revisions for areas subject to alluvial fan flooding.

This section describes the procedures to be followed and the types of information FEMA needs to recognize on a NFIP map that a structural flood control measure provides protection from the base flood in an area subject to alluvial fan flooding. This information must be supplied to FEMA by the community or other party seeking recognition of such a flood control measure at the time a flood risk study or restudy is conducted, when a map revision under the provisions of part 65 of this subchapter is sought, and upon request by the Administrator during the review of previously recognized flood control measures. The FEMA review will be for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and shall not constitute a determination by FEMA as to how the flood control measure will perform in a flood event.

(a) The applicable provisions of §§ 65.2, 65.3, 65.4, 65.6, 65.8 and 65.10 shall also apply to FIRM revisions involving alluvial fan flooding.

(b) The provisions of § 65.5 regarding map revisions based on fill and the provisions of part 70 of this chapter shall not apply to FIRM revisions involving alluvial fan flooding. In general, elevations of a parcel of land or a structure by fill or other means, will not serve as a basis for removing areas subject to alluvial fan flooding from an area of special food hazards.

(c) FEMA will credit on NFIP maps only major structural flood control measures whose design and construction are supported by sound engineering analyses which demonstrate that the measures will effectively eliminate alluvial fan flood hazards from the area protected by such measures. The provided analyses must include, but are not necessarily limited to, the following:

(1) Engineering analyses that quantify the discharges and volumes of water, debris, and sediment movement associated with the flood that has a one-percent probability of being exceeded in any year at the apex under current watershed conditions and under potential adverse conditions (e.g., deforestation of the watershed by fire). The potential for debris flow and sediment movement must be assessed using an engineering method acceptable to FEMA. The assessment should consider the characteristics and availability of sediment in the drainage basin above the apex and on the alluvial fan.

(2) Engineering analyses showing that the measures will accommodate the estimated peak discharges and volumes of water, debris, and sediment, as determined in accordance with paragraph (c)(1) of this section, and will withstand the associated hydrodynamic and hydrostatic forces.

(3) Engineering analyses showing that the measures have been designed to withstand the potential erosion and scour associated with estimated discharges.

(4) Engineering analyses or evidence showing that the measures will provide protection from hazards associated with the possible relocation of flow paths from other parts of the fan.

(5) Engineering analyses that assess the effect of the project on flood hazards, including depth and velocity of floodwaters and scour and sediment deposition, on other areas of the fan.

(6) Engineering analyses demonstrating that flooding from scources other than the fan apex, including local runoff, is either insignificant or has been accounted for in the design.

(d) *Coordination*. FEMA will recognize measures that are adequately designed and constructed, provided that: evidence is submitted to show that the impact of the measures on flood hazards in all areas of the fan (including those not protected by the flood control measures), and the design and maintenance requirements of the measures, were reviewed and approved by the impacted communities, and also by State and local agencies that have jurisdiction over flood control activities.

(e) *Operation and maintenance plans and criteria*. The requirements for operation and maintenance of flood control measures on areas subject to alluvial

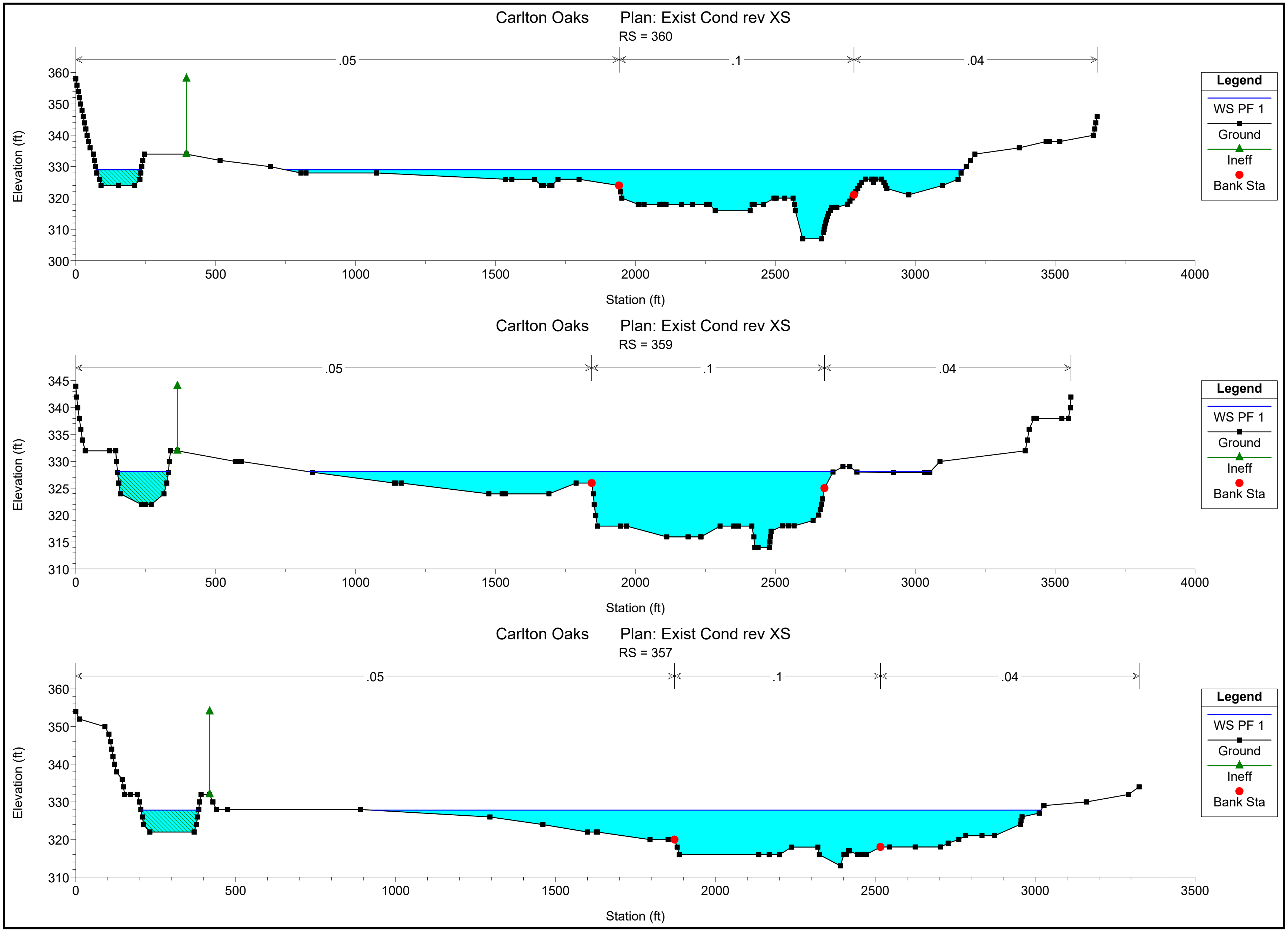
APPENDIX A

EXISTING CONDITION AND PROPOSED CONDITION HEC-RAS ANALYSES

Existing Condition Analysis

HEC-RAS Plan: EC Rev XS River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	360	PF 1	48000.00	307.00	328.97		329.15	0.001639	3.20	15114.62	2585.32	0.16
Reach-1	359	PF 1	48000.00	313.96	328.08		328.35	0.003662	4.35	11636.70	2323.46	0.23
Reach-1	357	PF 1	48000.00	313.00	327.79		328.02	0.001364	2.80	14438.37	2274.75	0.15
Reach-1	355	PF 1	48000.00	313.00	327.51		327.74	0.000921	2.34	14642.12	2055.22	0.12
Reach-1	345	PF 1	48000.00	312.00	327.13		327.42	0.000938	2.42	13760.89	1747.82	0.12
Reach-1	340	PF 1	48000.00	311.96	326.64		326.88	0.002727	3.99	12077.74	2125.01	0.21
Reach-1	330	PF 1	48000.00	311.96	324.95		325.30	0.004537	4.77	10073.85	1513.62	0.26
Reach-1	325	PF 1	48000.00	311.00	321.60		322.39	0.007493	5.14	7435.02	1176.27	0.32
Reach-1	320	PF 1	48000.00	308.00	320.16		321.02	0.005447	4.17	7126.58	1244.50	0.27
Reach-1	318	PF 1	48000.00	308.00	320.01		320.44	0.001719	2.50	9555.97	1485.04	0.15
Reach-1	310	PF 1	49000.00	307.00	319.36		319.67	0.001346	2.07	12133.97	1913.70	0.13
Reach-1	300	PF 1	49000.00	305.00	318.06		318.56	0.002458	2.92	9189.34	1614.98	0.18
Reach-1	290	PF 1	49000.00	300.00	316.85		317.16	0.001292	2.75	11532.06	1551.04	0.14
Reach-1	285	PF 1	49000.00	300.00	316.22		316.47	0.000774	1.79	13229.41	1598.92	0.10
Reach-1	280	PF 1	49000.00	299.00	315.84		316.06	0.000496	1.50	15447.25	1481.64	0.08
Reach-1	270	PF 1	49000.00	299.00	314.40		315.07	0.001729	3.08	8471.84	1002.53	0.16
Reach-1	260	PF 1	50000.00	295.00	311.06		312.42	0.004363	4.54	5997.23	680.05	0.25
Reach-1	250	PF 1	50000.00	295.96	310.24		310.57	0.000730	2.14	12595.96	1244.04	0.11
Reach-1	245	PF 1	50000.00	291.96	309.56		309.82	0.001617	3.42	13029.04	1168.98	0.16
Reach-1	244	PF 1	50000.00	291.96	308.77		309.32	0.004699	5.71	8556.31	1197.06	0.28
Reach-1	239	PF 1	50000.00	289.96	307.93		308.38	0.002121	3.84	10184.87	1038.49	0.19
Reach-1	230	PF 1	50000.00	289.96	307.25	299.46	307.51	0.001902	3.68	12699.05	1231.28	0.18



Carlton Oaks Plan: Exist Cond rev XS
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.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 359
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
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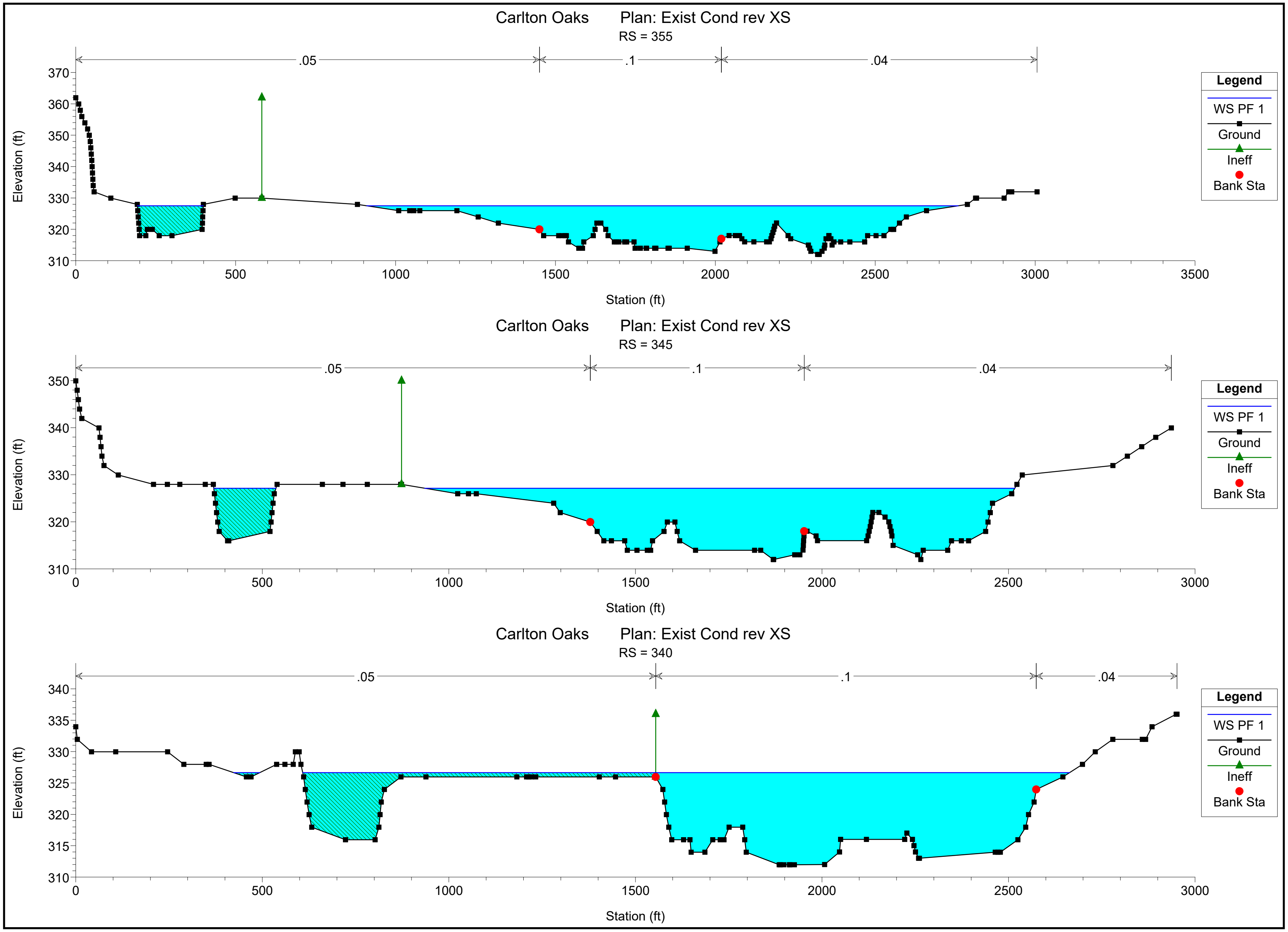
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta



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Station (ft)
Legend
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Ground
Ineff
Bank Sta
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.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
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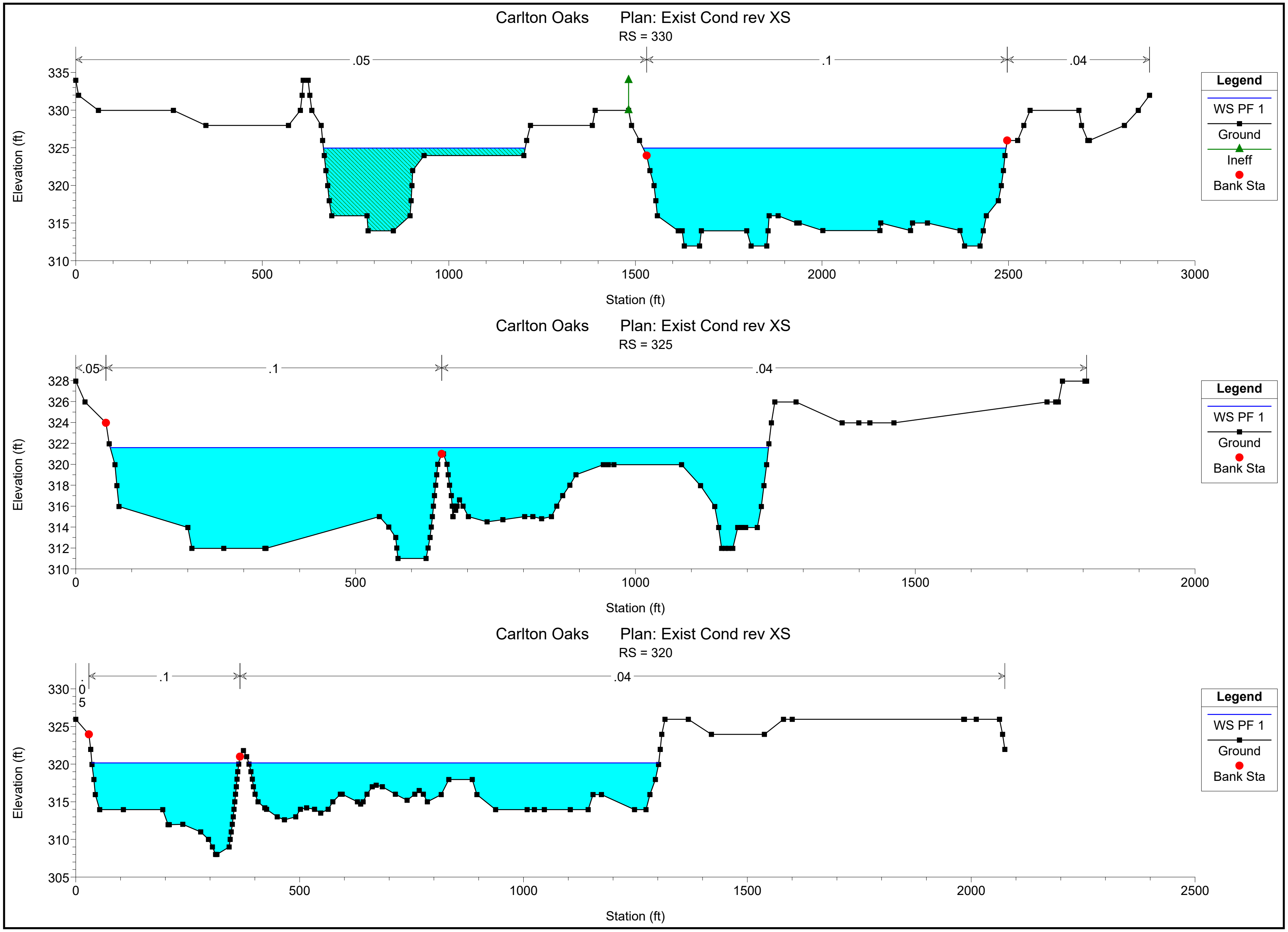
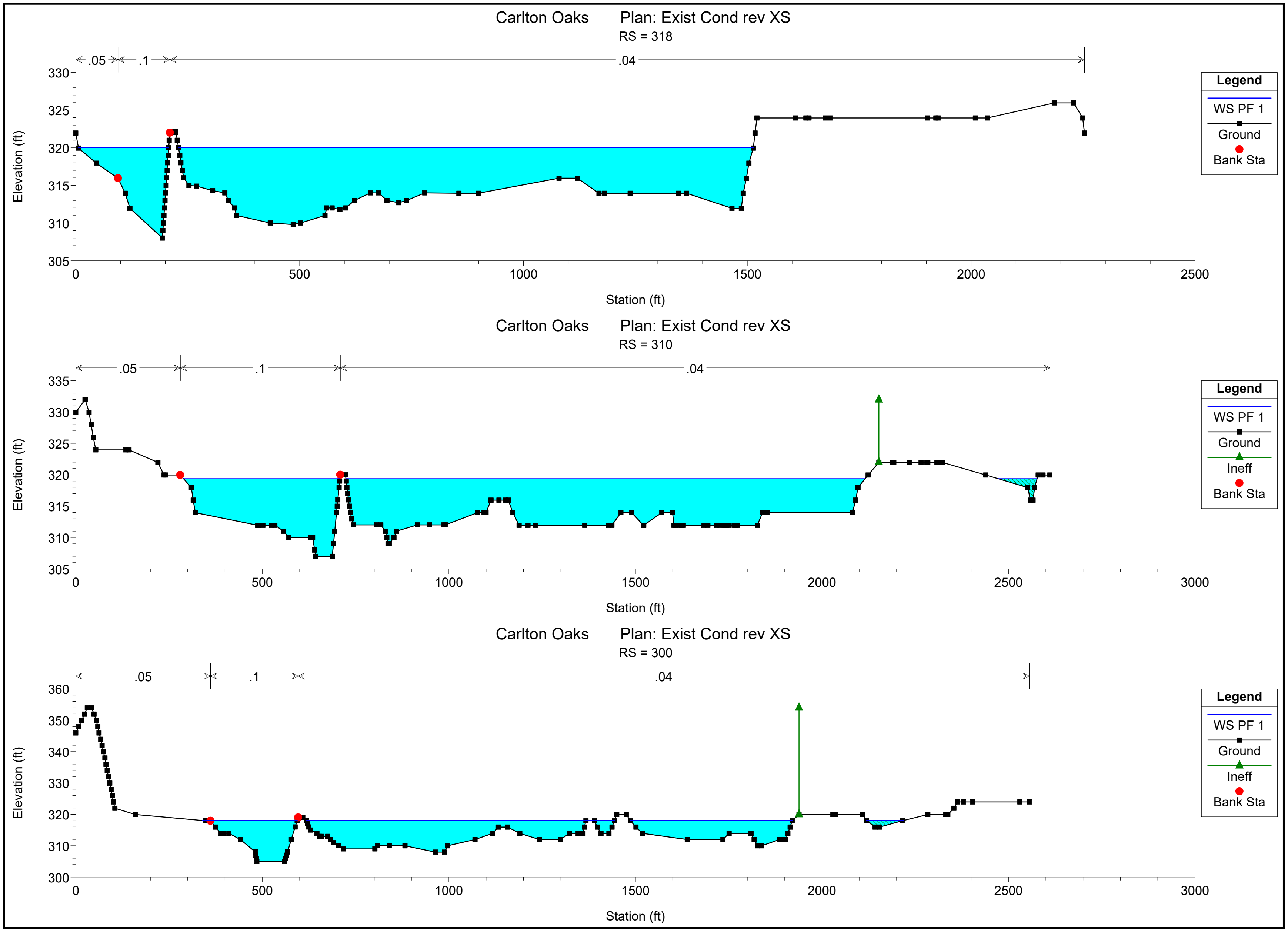
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta


Carlton Oaks Plan: Exist Cond rev XS
RS = 330
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 325
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 320
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta



Carlton Oaks Plan: Exist Cond rev XS
RS = 318
.05
.1
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Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 310
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
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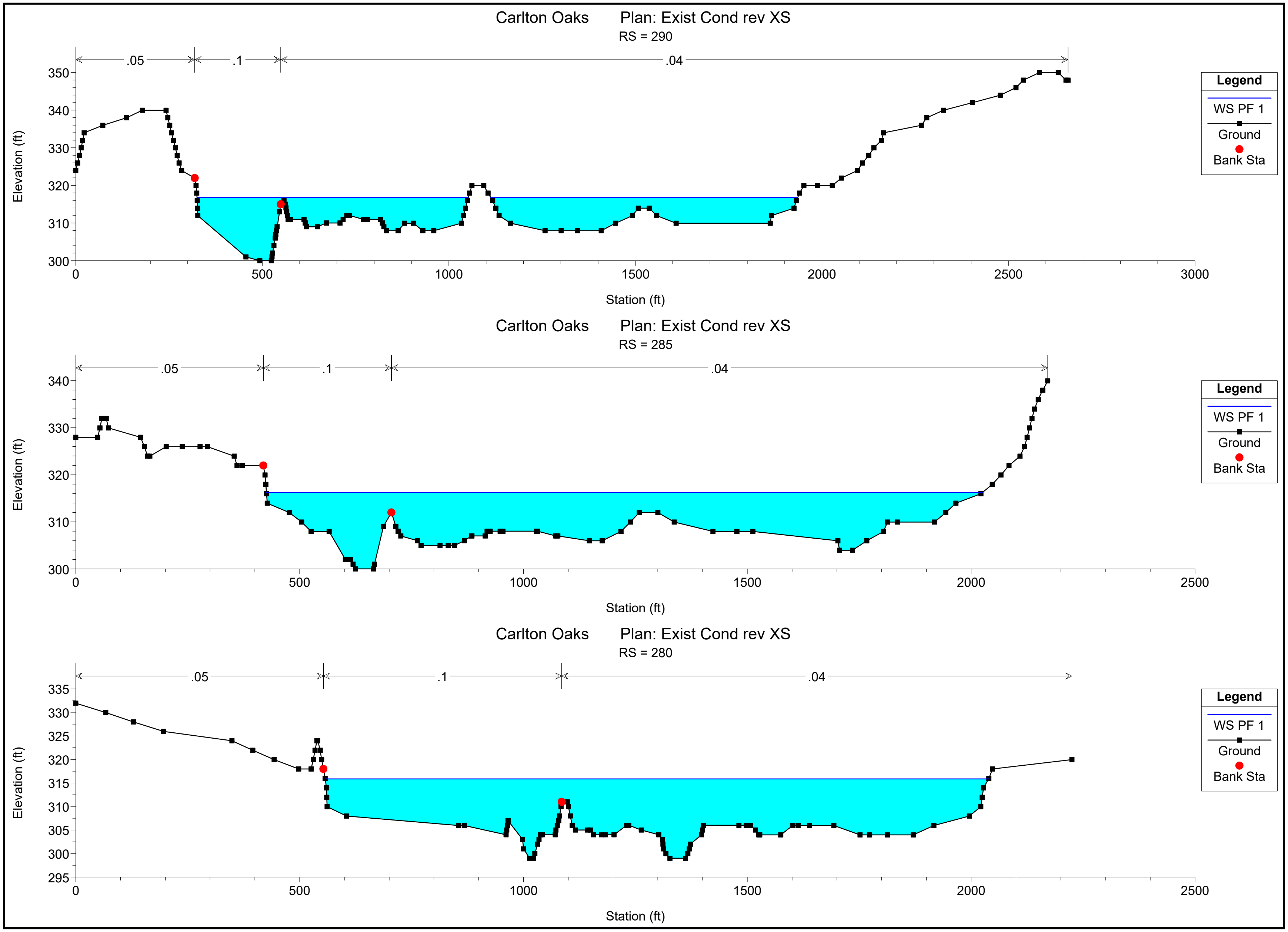
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta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.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 285
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 280
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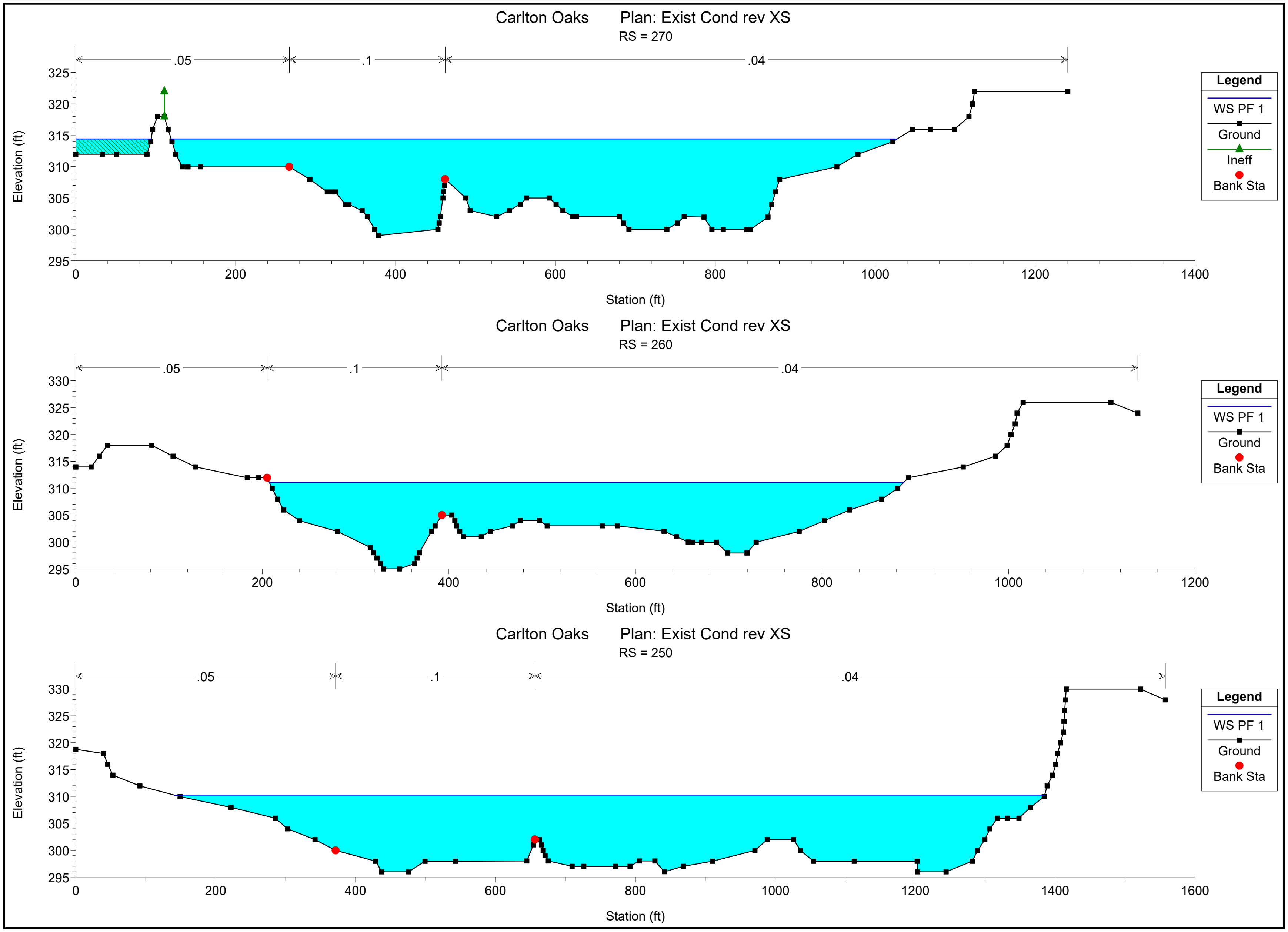
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta



Carlton Oaks Plan: Exist Cond rev XS
RS = 270
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
RS = 260
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Exist Cond rev XS
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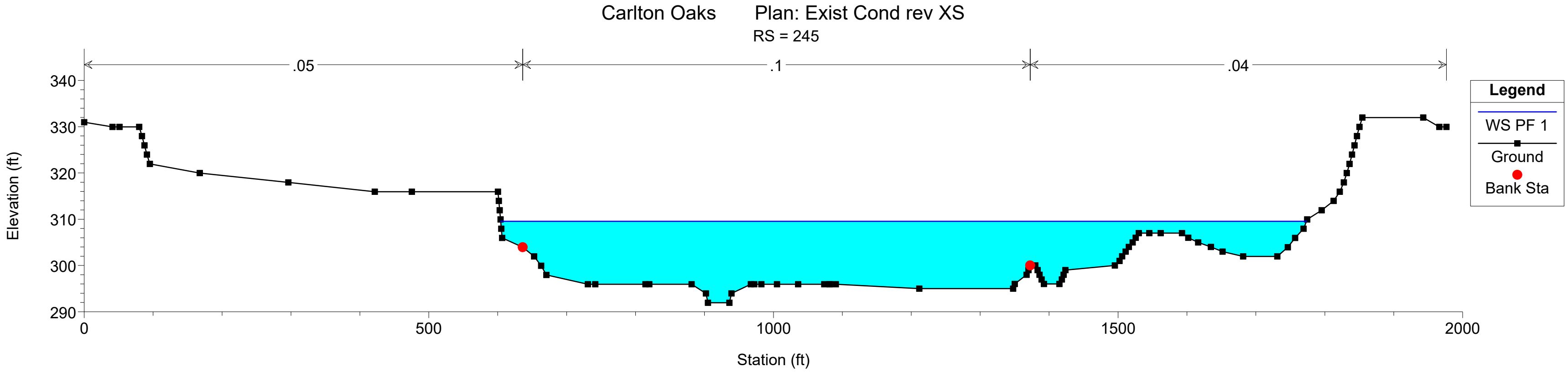
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta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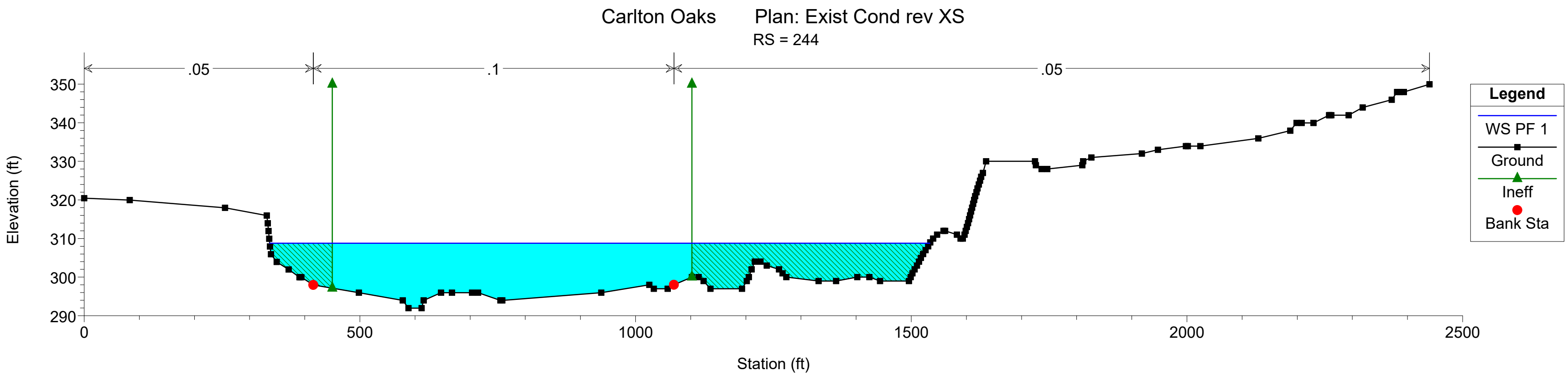
1000
1500
2000
Station (ft)
Legend
WS PF 1
Ground
Bank Sta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Elevation (ft)
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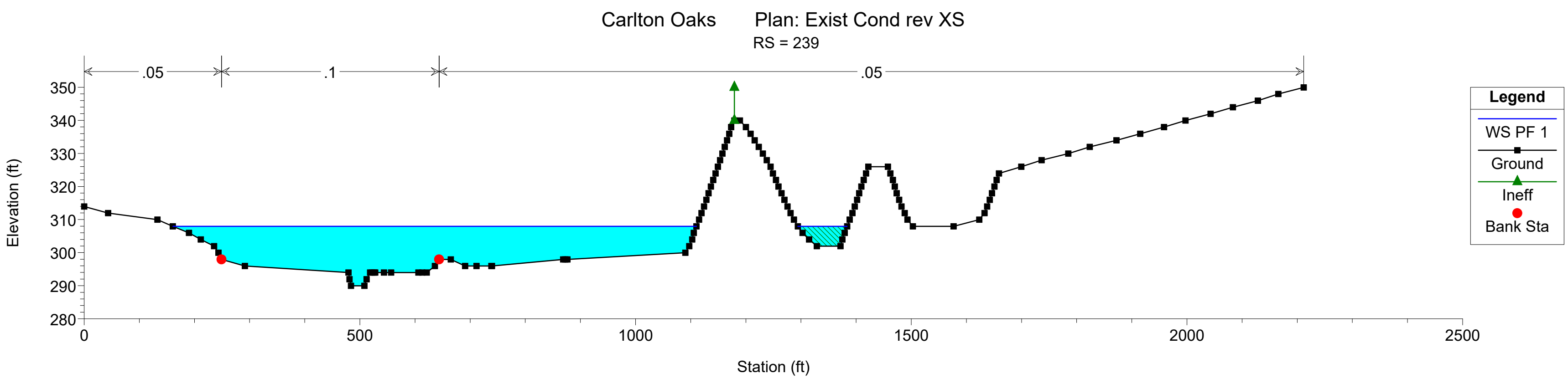
2000
2500
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta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Elevation (ft)
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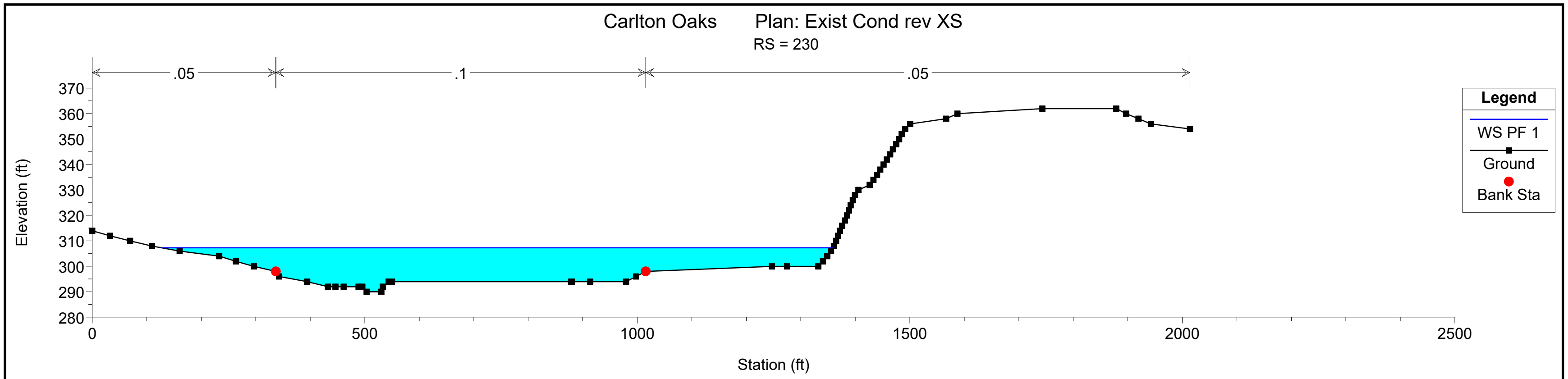
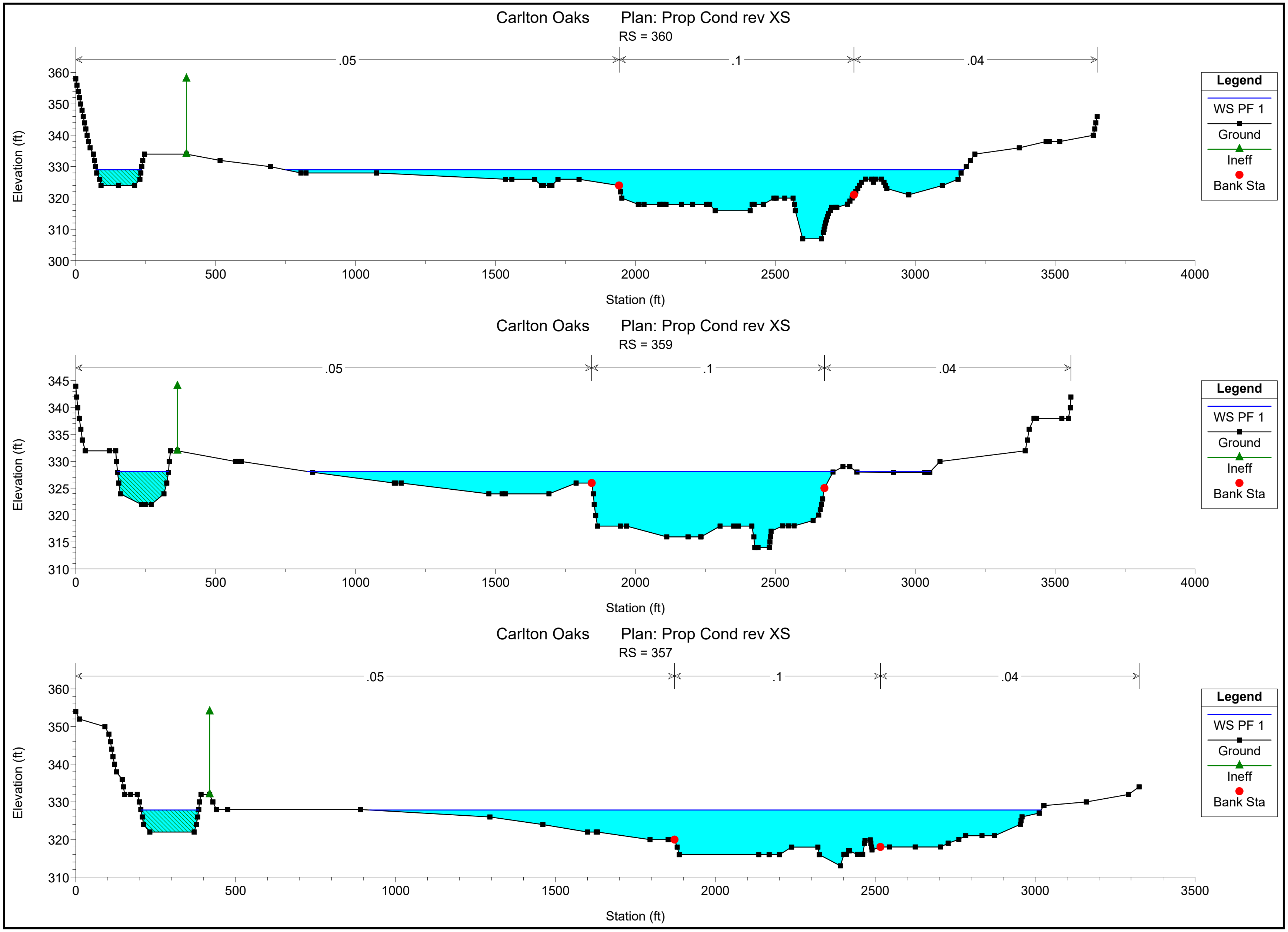
1500
2000
2500
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta


Carlton Oaks Plan: Exist Cond rev XS
RS = 230
.05
.1
.05
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
370
360
350
340
330
320
310
300
290
280
0
500
1000
1500
2000
2500

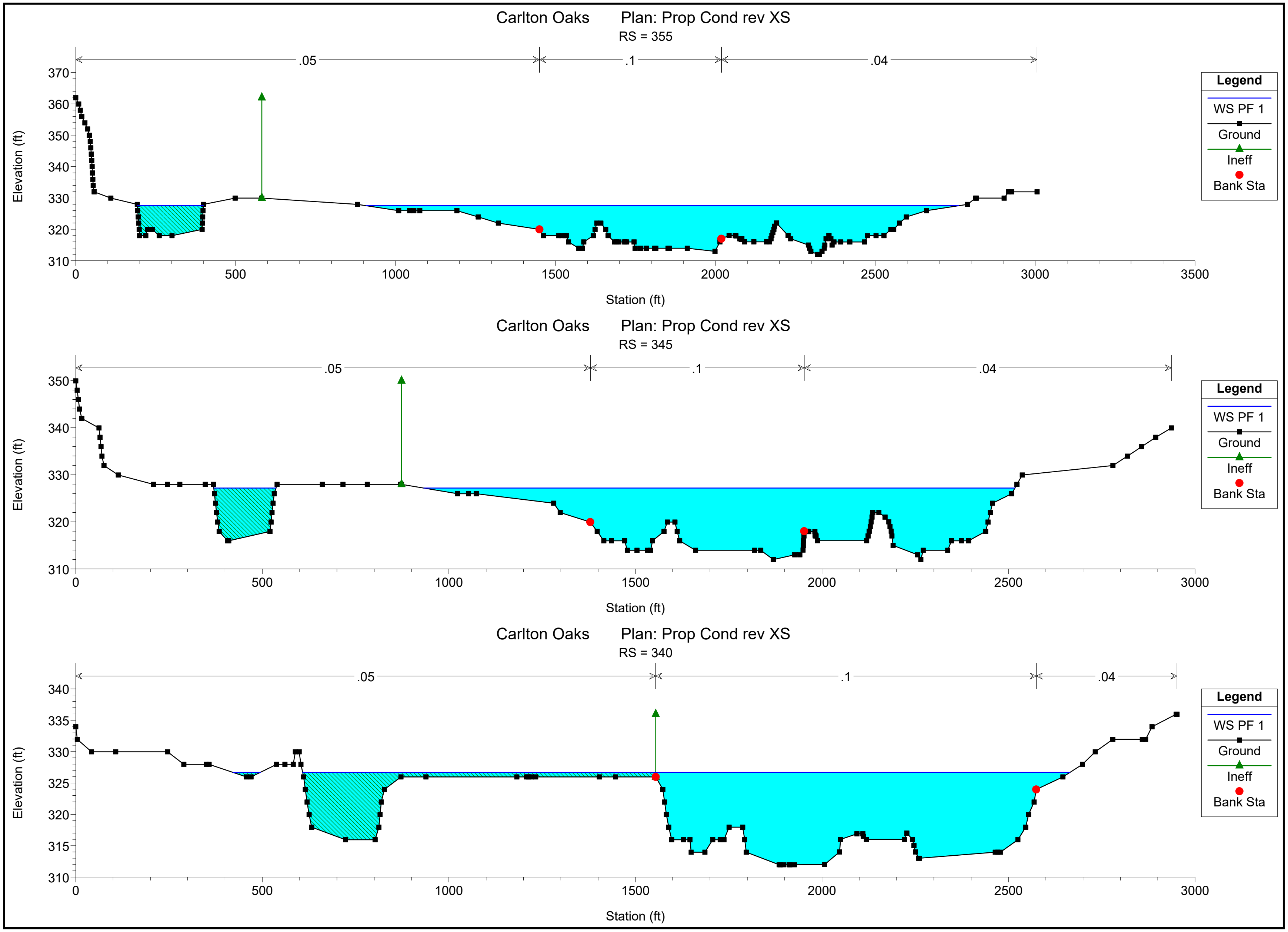
Proposed Condition Analysis

HEC-RAS Plan: PC Rev XS River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	360	PF 1	48000.00	307.00	328.99		329.17	0.001624	3.19	15161.24	2586.62	0.16
Reach-1	359	PF 1	48000.00	313.96	328.11		328.38	0.003611	4.33	11699.86	2329.66	0.23
Reach-1	357	PF 1	48000.00	313.00	327.82		328.05	0.001374	2.79	14405.45	2280.26	0.15
Reach-1	355	PF 1	48000.00	313.00	327.54		327.77	0.000909	2.32	14712.74	2059.46	0.12
Reach-1	345	PF 1	48000.00	312.00	327.17		327.45	0.000930	2.41	13810.93	1750.99	0.12
Reach-1	340	PF 1	48000.00	311.96	326.68		326.92	0.002725	3.99	12082.83	2129.34	0.21
Reach-1	330	PF 1	48000.00	311.96	324.98		325.34	0.004554	4.77	10064.24	1514.27	0.26
Reach-1	325	PF 1	48000.00	311.00	321.62		322.41	0.007567	5.19	7421.86	1176.43	0.32
Reach-1	320	PF 1	48000.00	308.00	320.18		321.03	0.005403	4.16	7137.76	1241.46	0.27
Reach-1	318	PF 1	48000.00	308.00	320.03		320.46	0.001715	2.50	9544.74	1477.84	0.15
Reach-1	310	PF 1	49000.00	307.00	319.37		319.68	0.001347	2.07	12127.20	1912.00	0.13
Reach-1	300	PF 1	49000.00	305.00	318.08		318.58	0.002428	2.91	9221.44	1617.61	0.18
Reach-1	290	PF 1	49000.00	300.00	316.89		317.20	0.001286	2.75	11549.92	1551.52	0.14
Reach-1	285	PF 1	49000.00	300.00	316.26		316.51	0.000762	1.80	13272.77	1599.51	0.10
Reach-1	280	PF 1	49000.00	299.00	315.89		316.10	0.000496	1.51	15464.18	1481.96	0.08
Reach-1	270	PF 1	49000.00	299.00	314.44		315.11	0.001752	3.10	8455.96	1003.15	0.16
Reach-1	260	PF 1	50000.00	295.00	311.09		312.44	0.004344	4.54	6006.31	680.30	0.25
Reach-1	250	PF 1	50000.00	295.96	310.26		310.58	0.000741	2.16	12555.23	1244.37	0.11
Reach-1	245	PF 1	50000.00	291.96	309.56		309.82	0.001632	3.43	13029.93	1168.99	0.16
Reach-1	244	PF 1	50000.00	291.96	308.77		309.32	0.004699	5.71	8556.31	1197.06	0.28
Reach-1	239	PF 1	50000.00	289.96	307.93		308.38	0.002121	3.84	10184.87	1038.49	0.19
Reach-1	230	PF 1	50000.00	289.96	307.25	299.46	307.51	0.001902	3.68	12699.05	1231.28	0.18



Carlton Oaks Plan: Prop Cond rev XS
RS = 360
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 359
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 357
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta



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RS = 355
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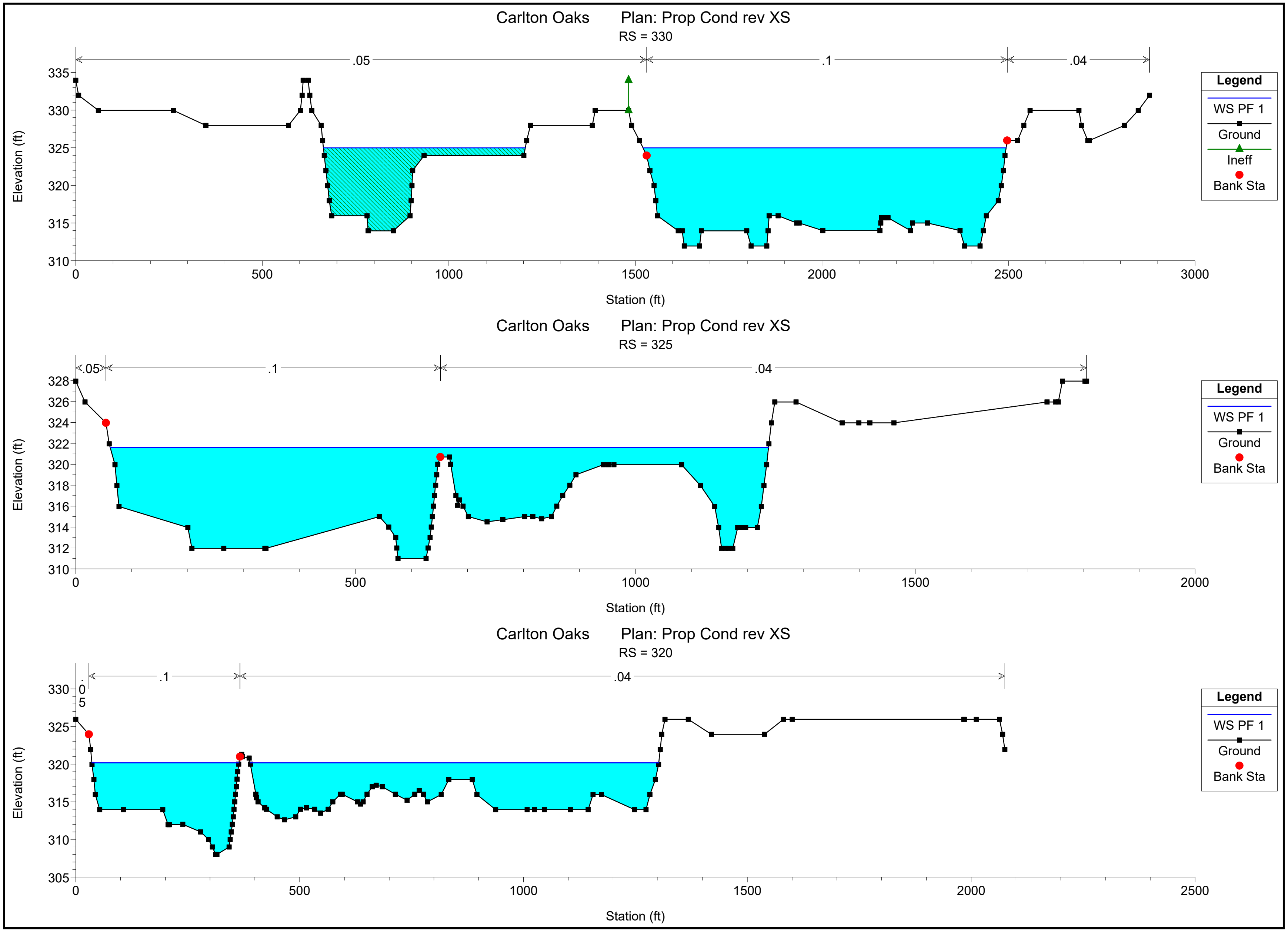
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 345
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 340
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta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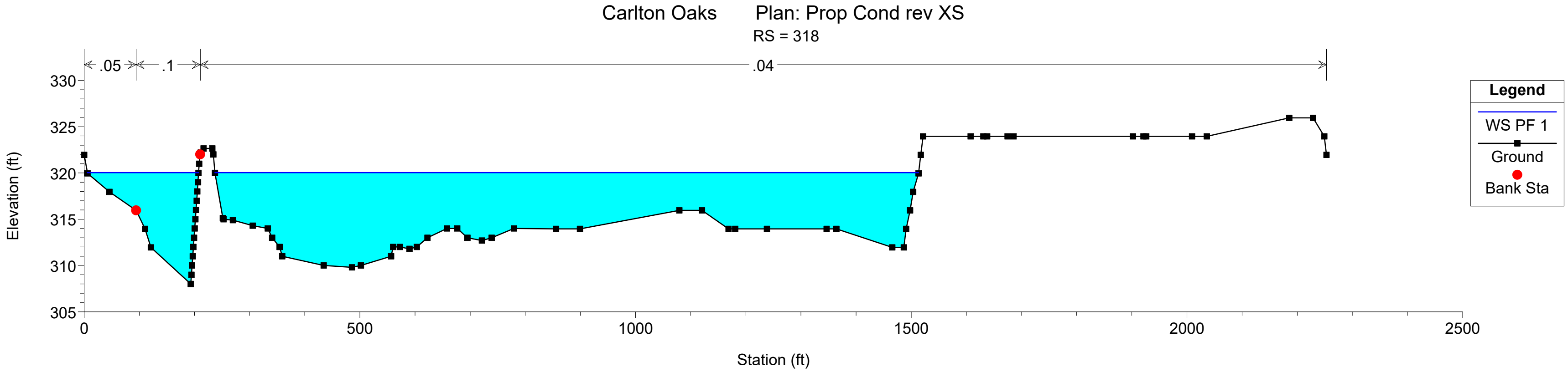
RS = 330
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 325
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 320
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta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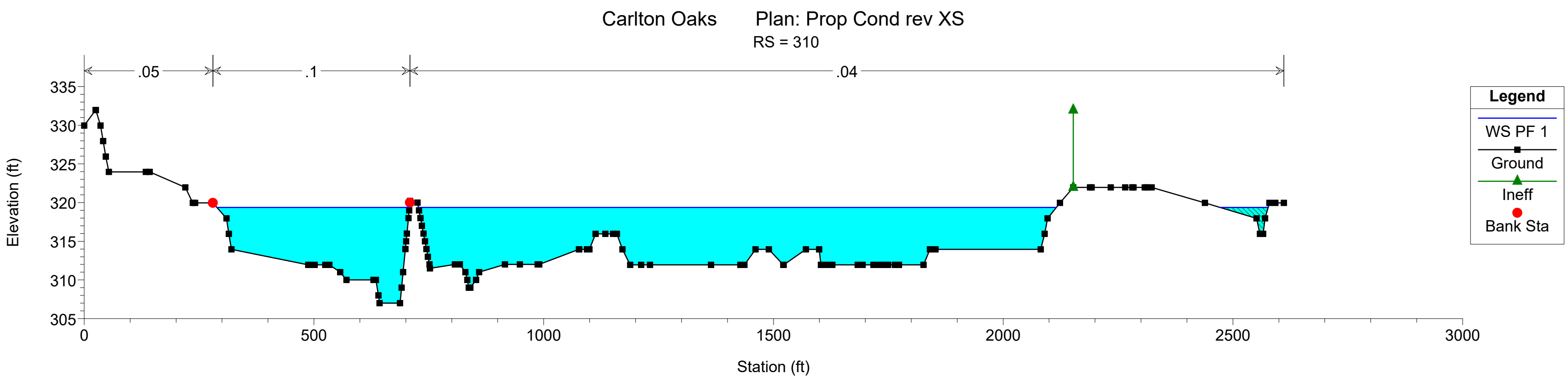
RS = 318
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta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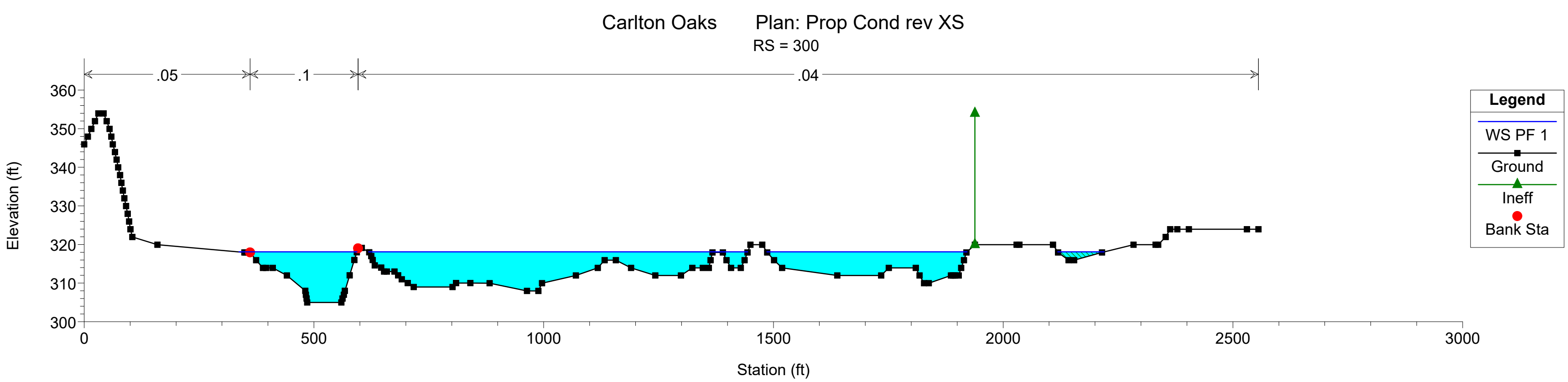
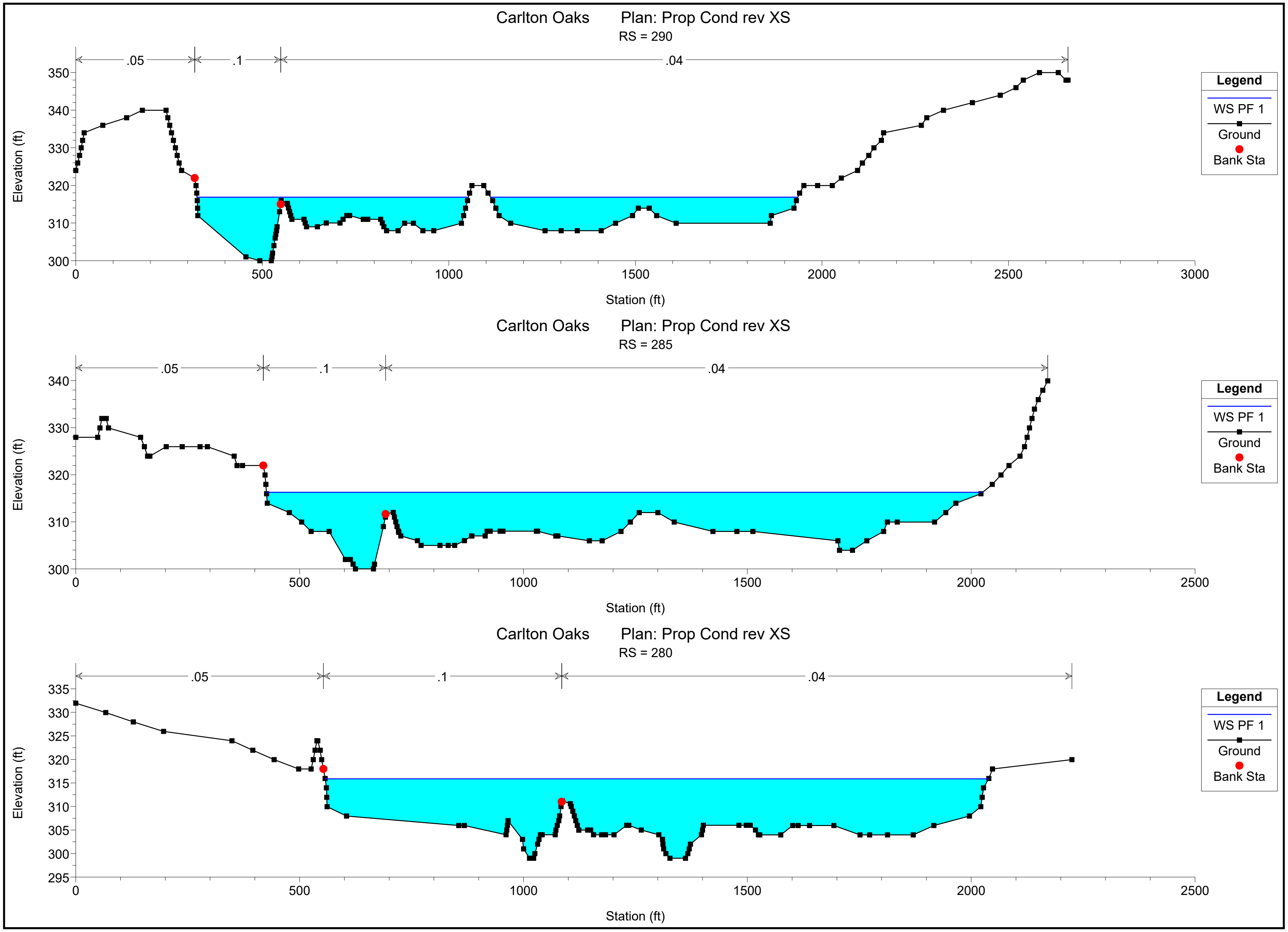
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta


Carlton Oaks Plan: Prop Cond rev XS
RS = 300
.05
.1
.04
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta



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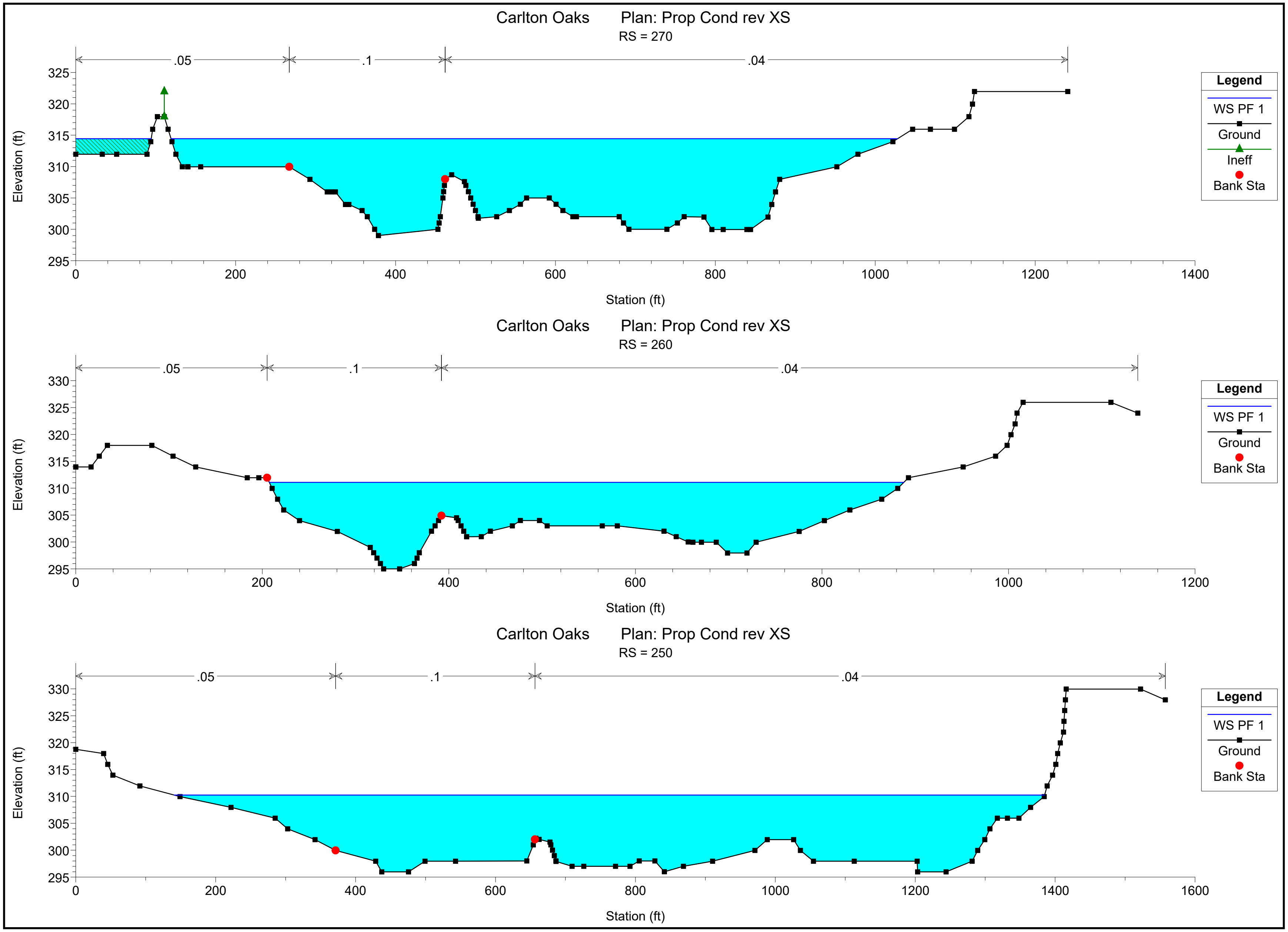
RS = 290
.05
.1
.04
Elevation (ft)
350
340
330
320
310
300
0
500
1000
1500
2000
2500
3000
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 285
.05
.1
.04
Elevation (ft)
340
330
320
310
300
0
500
1000
1500
2000
2500
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 280
.05
.1
.04
Elevation (ft)
335
330
325
320
315
310
305
300
295
0
500
1000
1500
2000
2500
Station (ft)
Legend
WS PF 1
Ground
Bank Sta


Carlton Oaks Plan: Prop Cond rev XS
RS = 270
.05
.1
.04
Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Carlton Oaks Plan: Prop Cond rev XS
RS = 260
.05
.1
.04
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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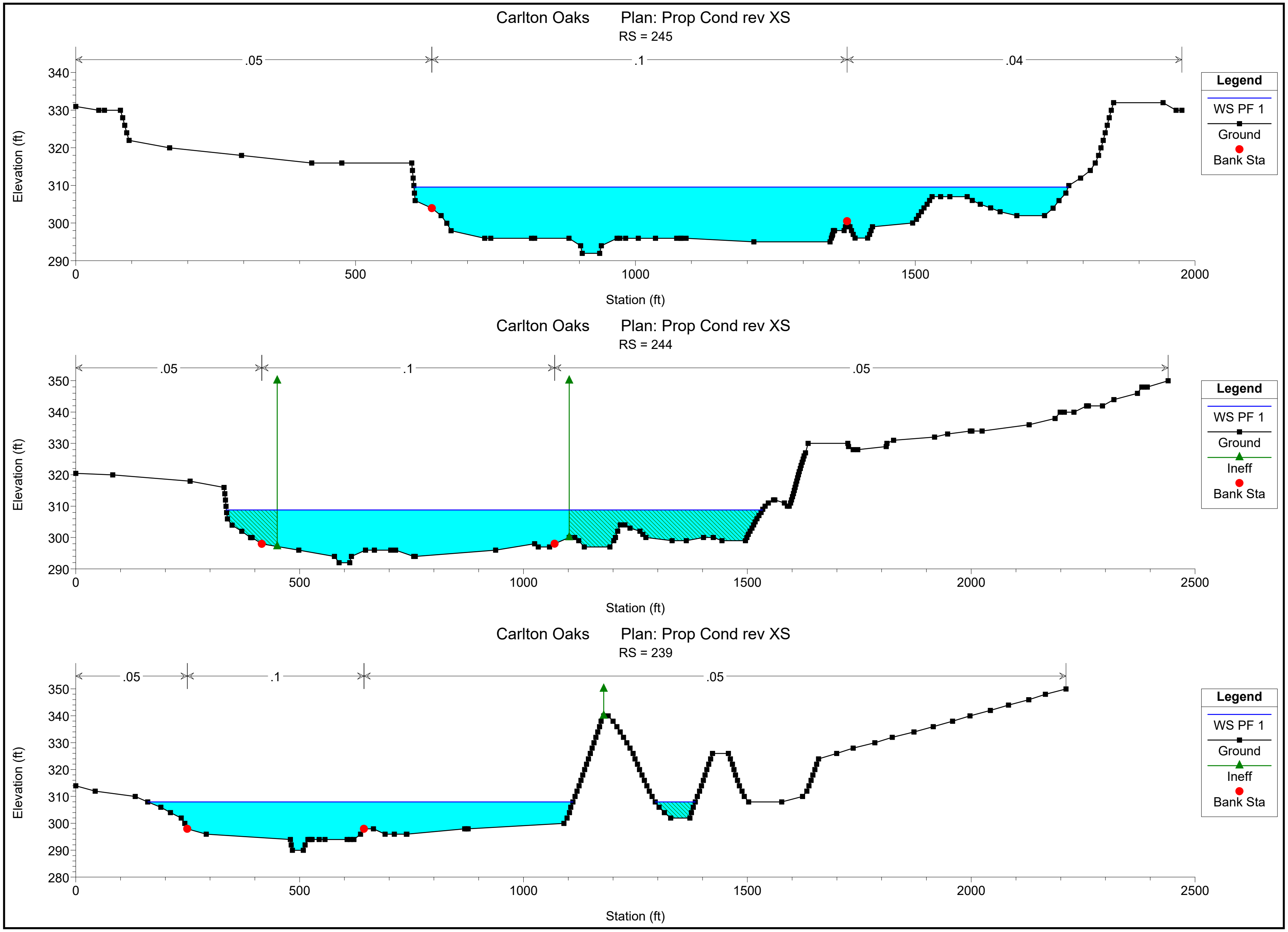
.04
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Carlton Oaks Plan: Prop Cond rev XS
RS = 245
.05
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Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
RS = 244
.05
.1
.05
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta
Carlton Oaks Plan: Prop Cond rev XS
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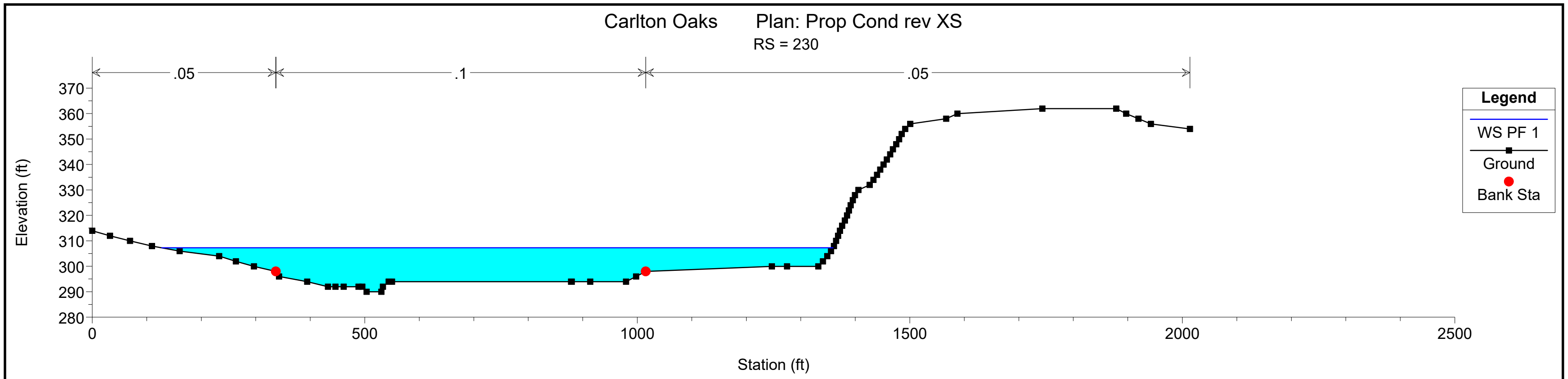
Elevation (ft)
Station (ft)
Legend
WS PF 1
Ground
Ineff
Bank Sta



Carlton Oaks Plan: Prop Cond rev XS
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.1
.05
Elevation (ft)
370
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330
320
310
300
290
280
0
500
1000
1500
2000
2500
Station (ft)
Legend
WS PF 1
Ground
Bank Sta

LEGEND:

HEC–RAS CROSS–SECTION

PROPOSED TRAIL GRADING

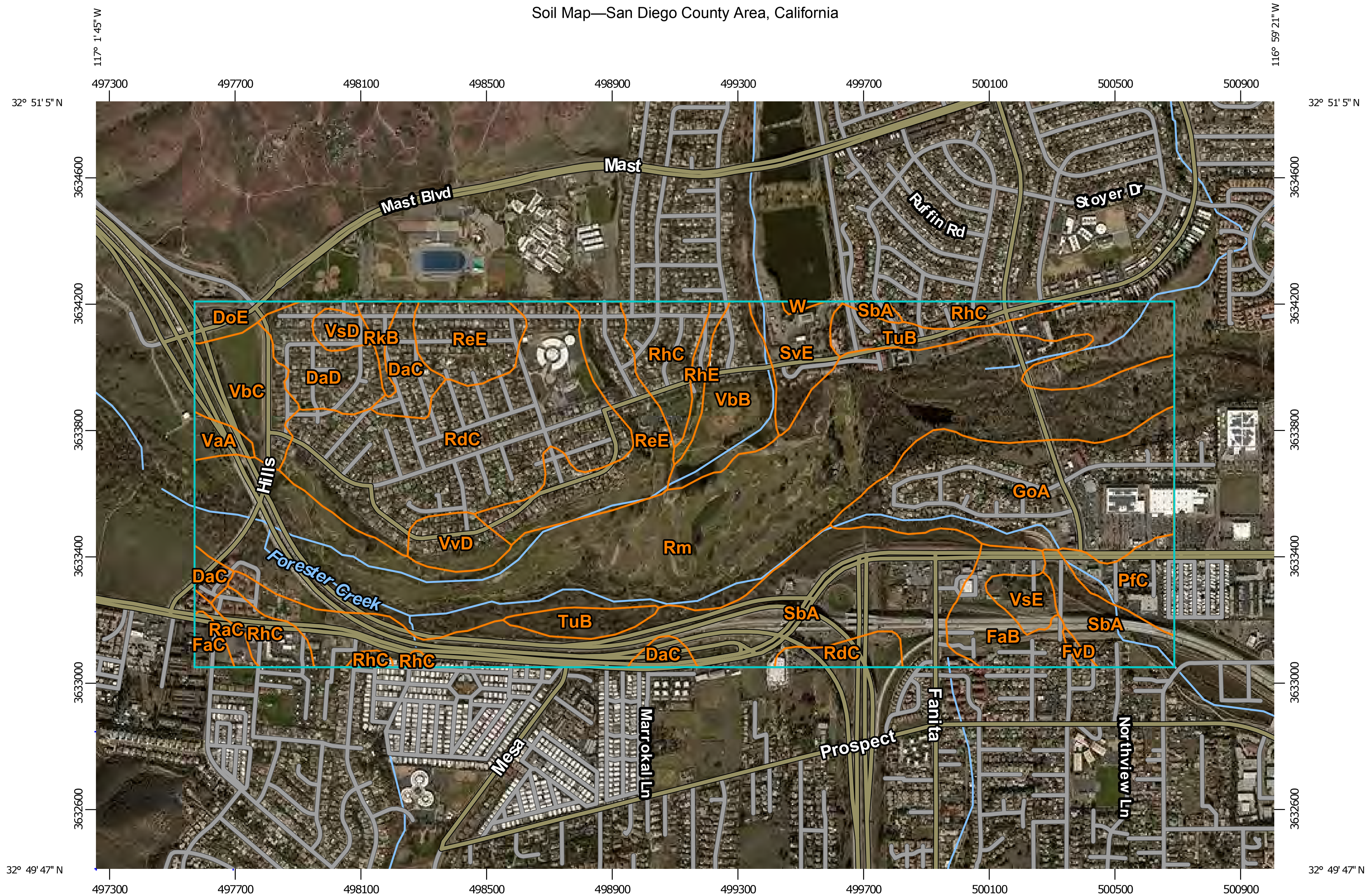
FEMA 100–YEAR FLOODPLAIN

FEMA FLOODPWAY

HEC–RAS WORK MAP

APPENDIX E

HYDROLOGY REFERENCES



Map Scale: 1:17,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 9, Sep 17, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 7, 2014—Jan 4, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

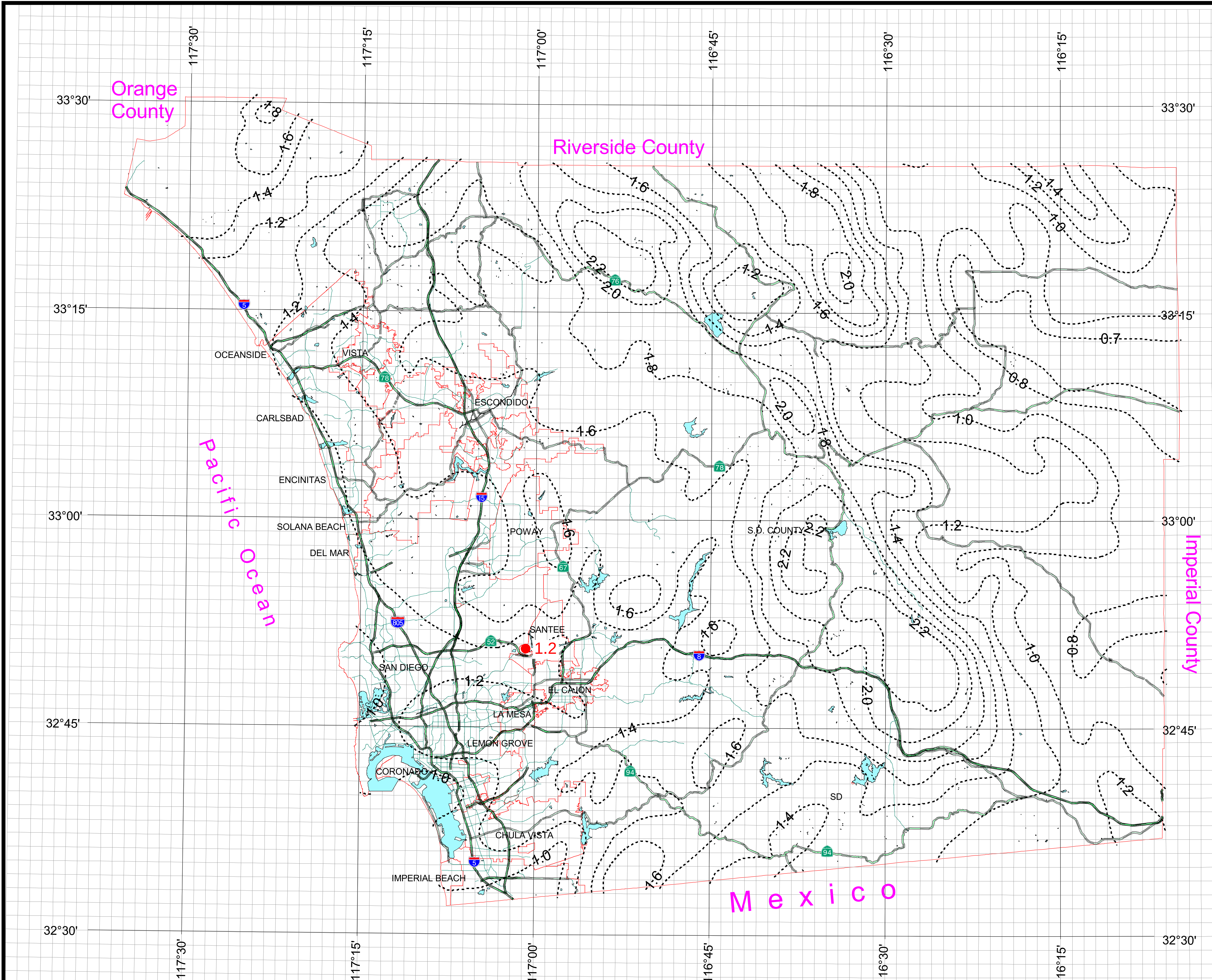
San Diego County Area, California (CA638)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
DaC	Diablo clay, 2 to 9 percent slopes	17.5	2.0%
DaD	Diablo clay, 9 to 15 percent slopes	21.0	2.3%
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes	6.4	0.7%
FaB	Fallbrook sandy loam, 2 to 5 percent slopes	21.6	2.4%
FaC	Fallbrook sandy loam, 5 to 9 percent slopes	3.8	0.4%
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes	1.2	0.1%
GoA	Grangeville fine sandy loam, 0 to 2 percent slopes	80.6	9.0%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	15.3	1.7%
RaC	Ramona sandy loam, 5 to 9 percent slopes	3.6	0.4%
RdC	Redding gravelly loam, 2 to 9 percent slopes	110.2	12.3%
ReE	Redding cobbly loam, 9 to 30 percent slopes	58.2	6.5%
RhC	Redding-Urban land complex, 2 to 9 percent slopes	39.1	4.4%
RhE	Redding-Urban land complex, 9 to 30 percent slopes	5.2	0.6%
RkB	Reiff fine sandy loam, 2 to 5 percent slopes	4.0	0.4%
Rm	Riverwash	241.2	26.9%
SbA	Salinas clay loam, 0 to 2 percent slopes, warm MAAT, MLRA 19	127.5	14.2%
SvE	Stony land	16.6	1.9%
TuB	Tujunga sand, 0 to 5 percent slopes	43.6	4.9%
VaA	Visalia sandy loam, 0 to 2 percent slopes	4.6	0.5%
VbB	Visalia gravelly sandy loam, 2 to 5 percent slopes	26.9	3.0%
VbC	Visalia gravelly sandy loam, 5 to 9 percent slopes	23.7	2.6%
VsD	Vista coarse sandy loam, 9 to 15 percent slopes	4.7	0.5%

San Diego County Area, California (CA638)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
VsE	Vista coarse sandy loam, 15 to 30 percent slopes	7.3	0.8%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	11.5	1.3%
W	Water	0.7	0.1%
Totals for Area of Interest		**896.0**	**100.0%**

County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours



Isopluvial (inches)

N
W E
S

3 0 3 Miles

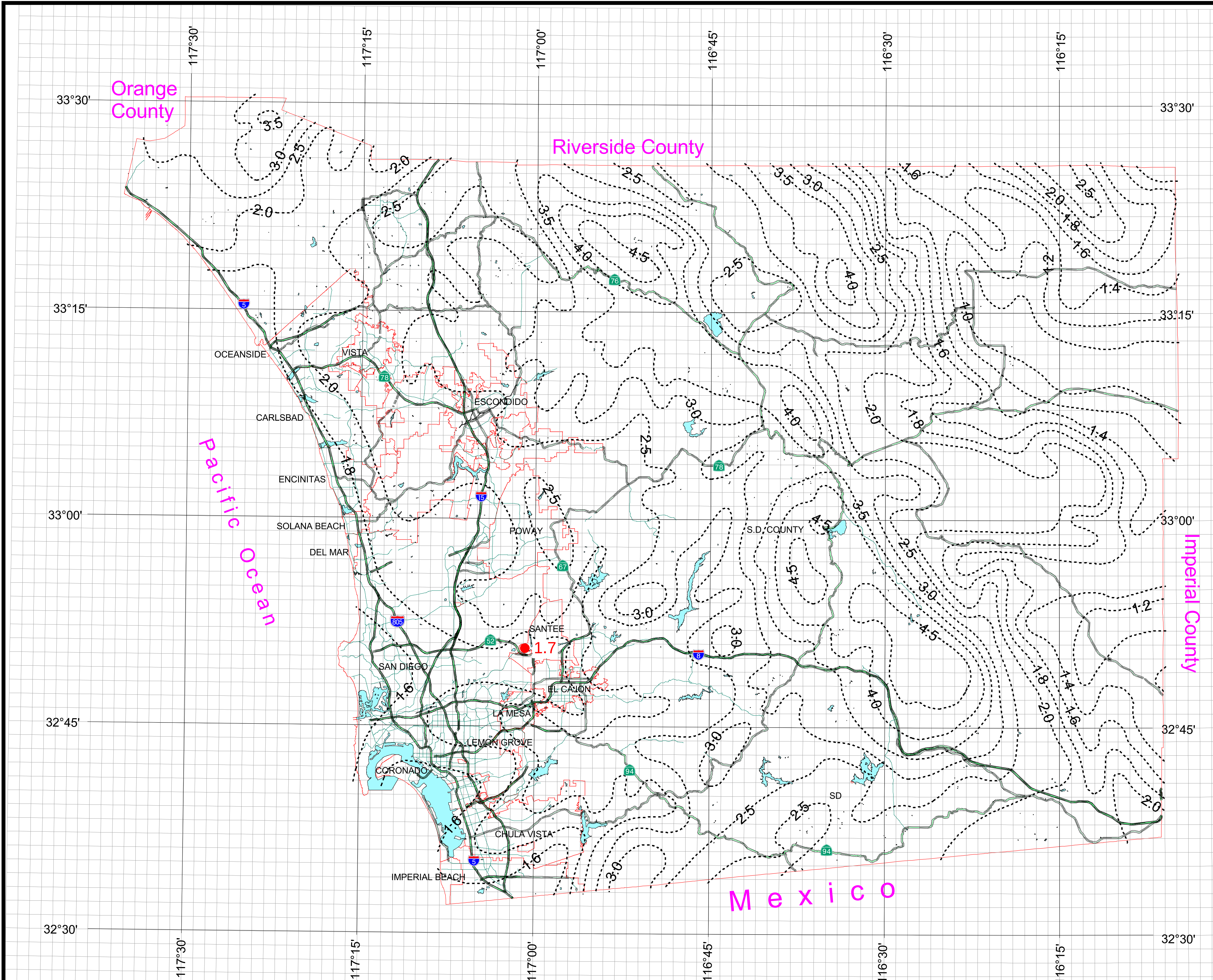
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 24 Hours

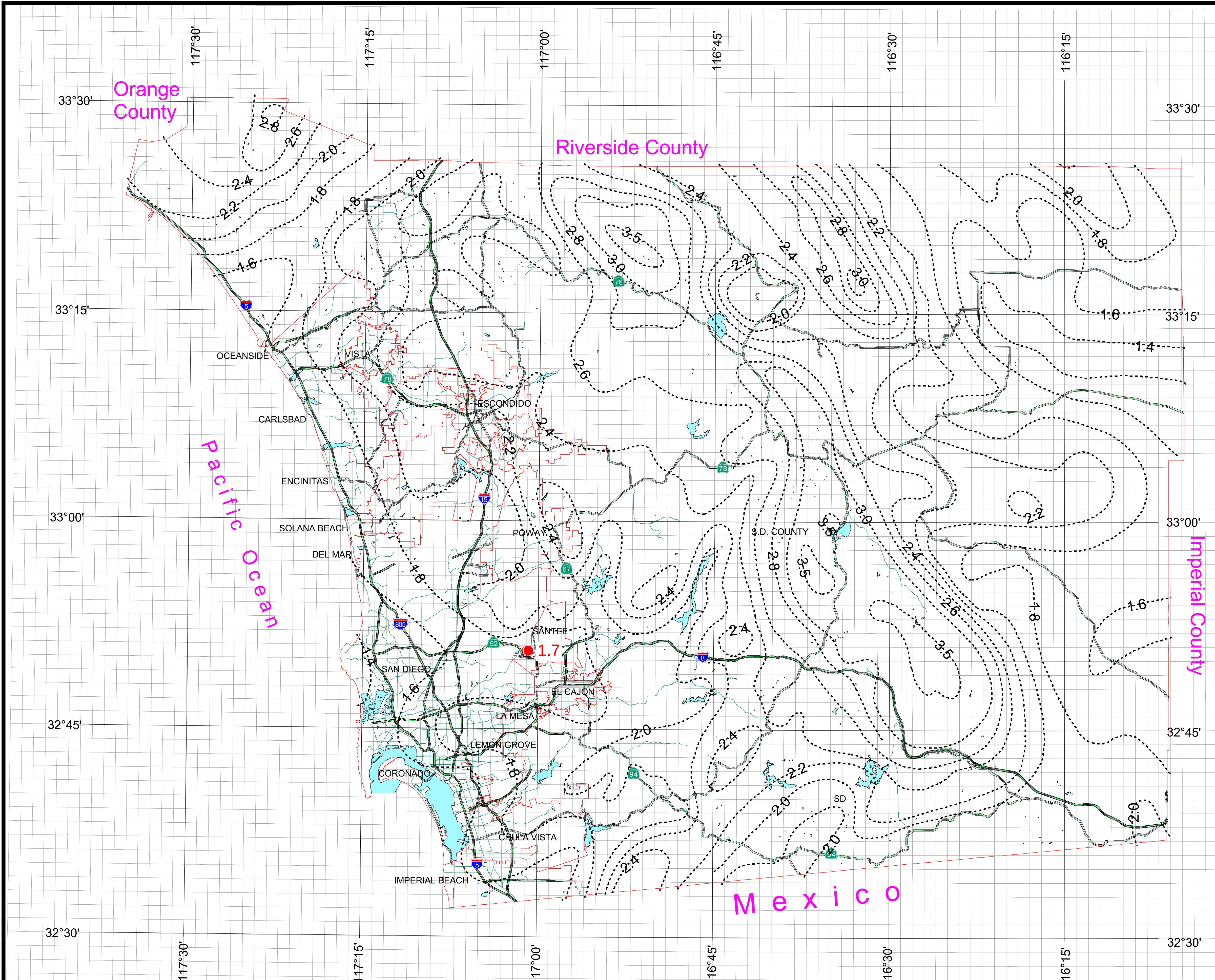


DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

County of San Diego Hydrology Manual

Rainfall Isopluvials



10 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

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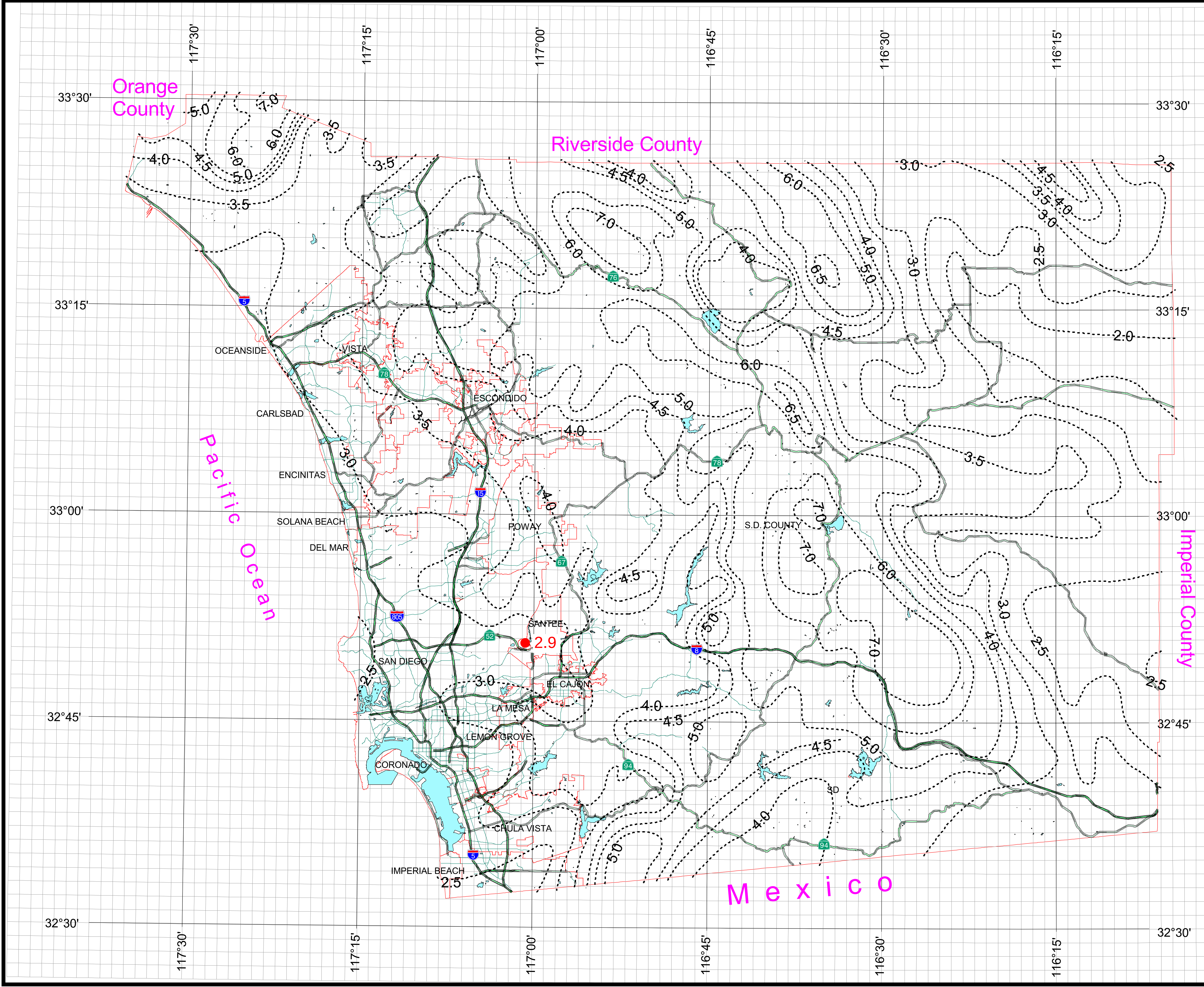
N S E W

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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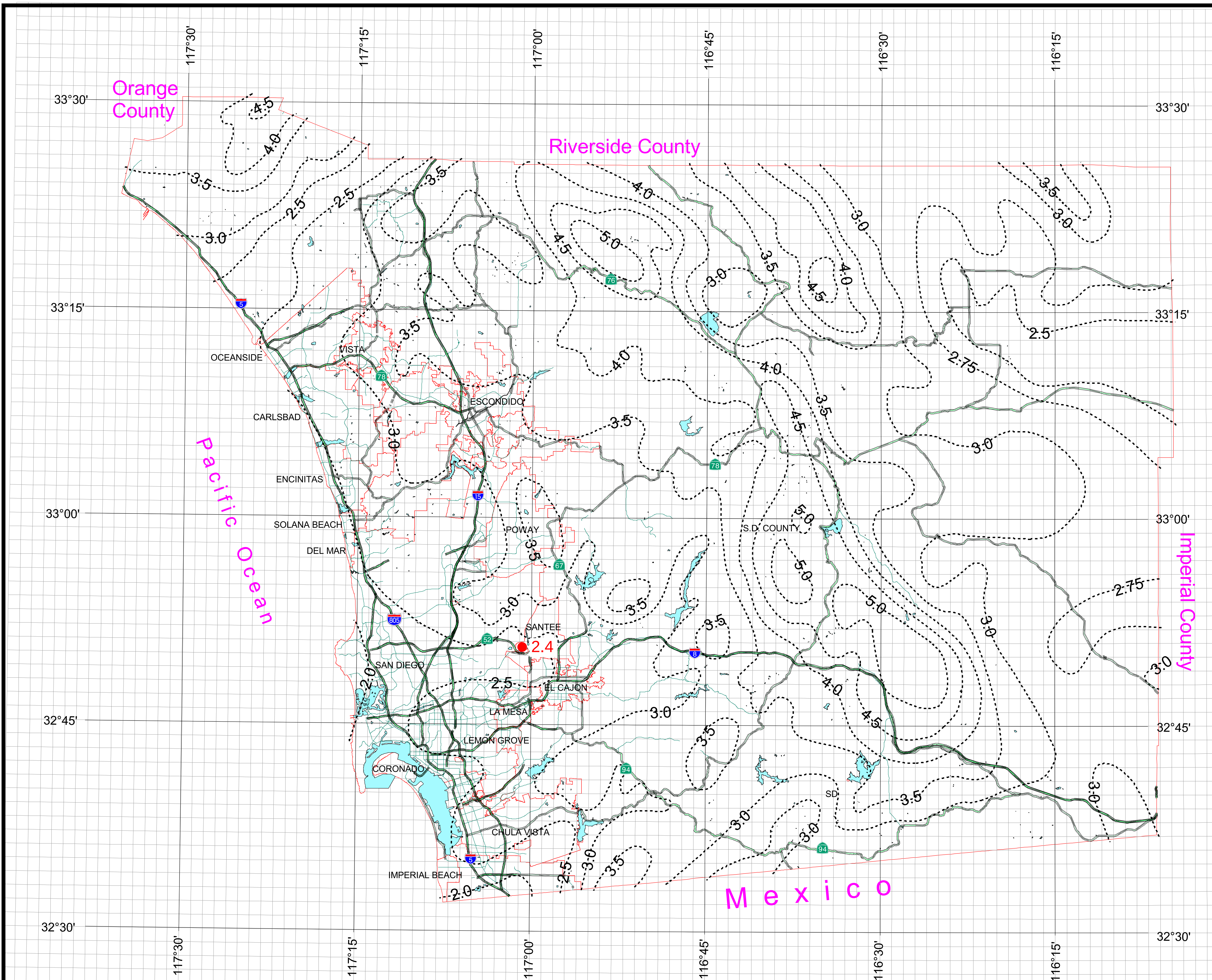
N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Department of Public Works Geographic Information Services

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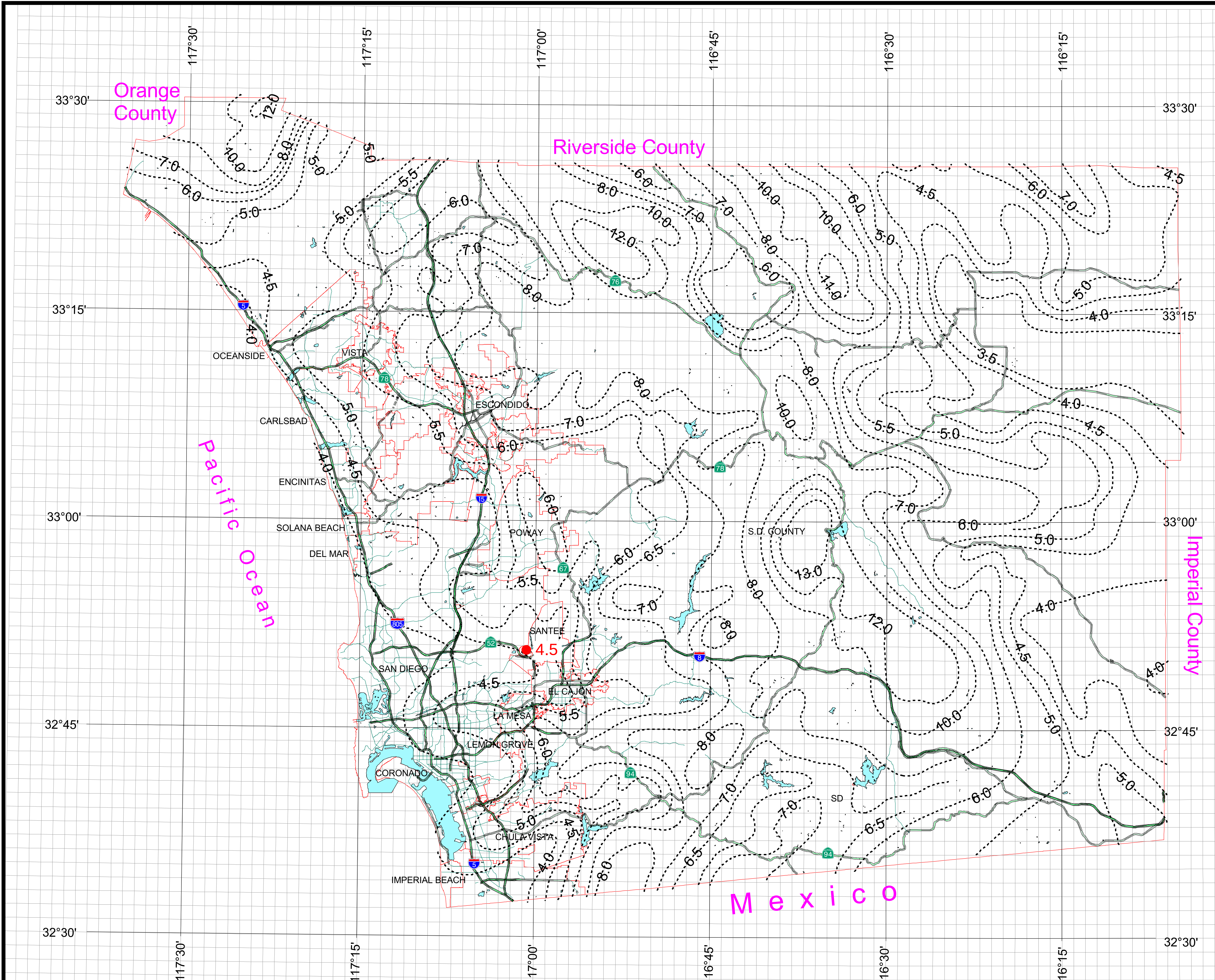
N
W E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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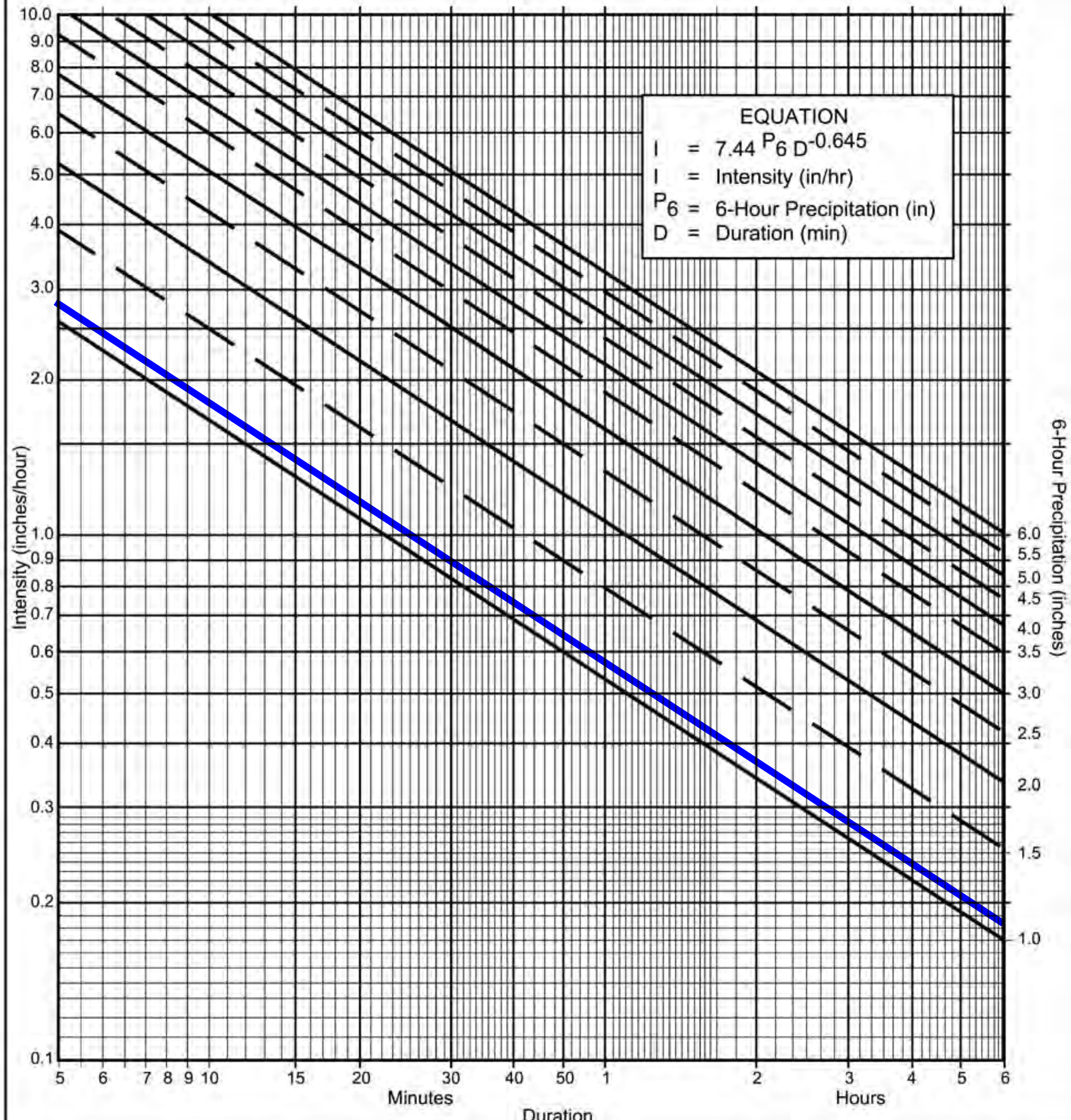
N
W E
S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency __2__ year

(b) P_6 = __1.2__ in., P_{24} = __1.7__ , $\frac{P_6}{P_{24}}$ = __0.70__ %(2)

(c) Adjusted $P_6^{(2)}$ = __1.1__ in.

(d) t_x = ______ min.

(e) I = __2.9__ in./hr.

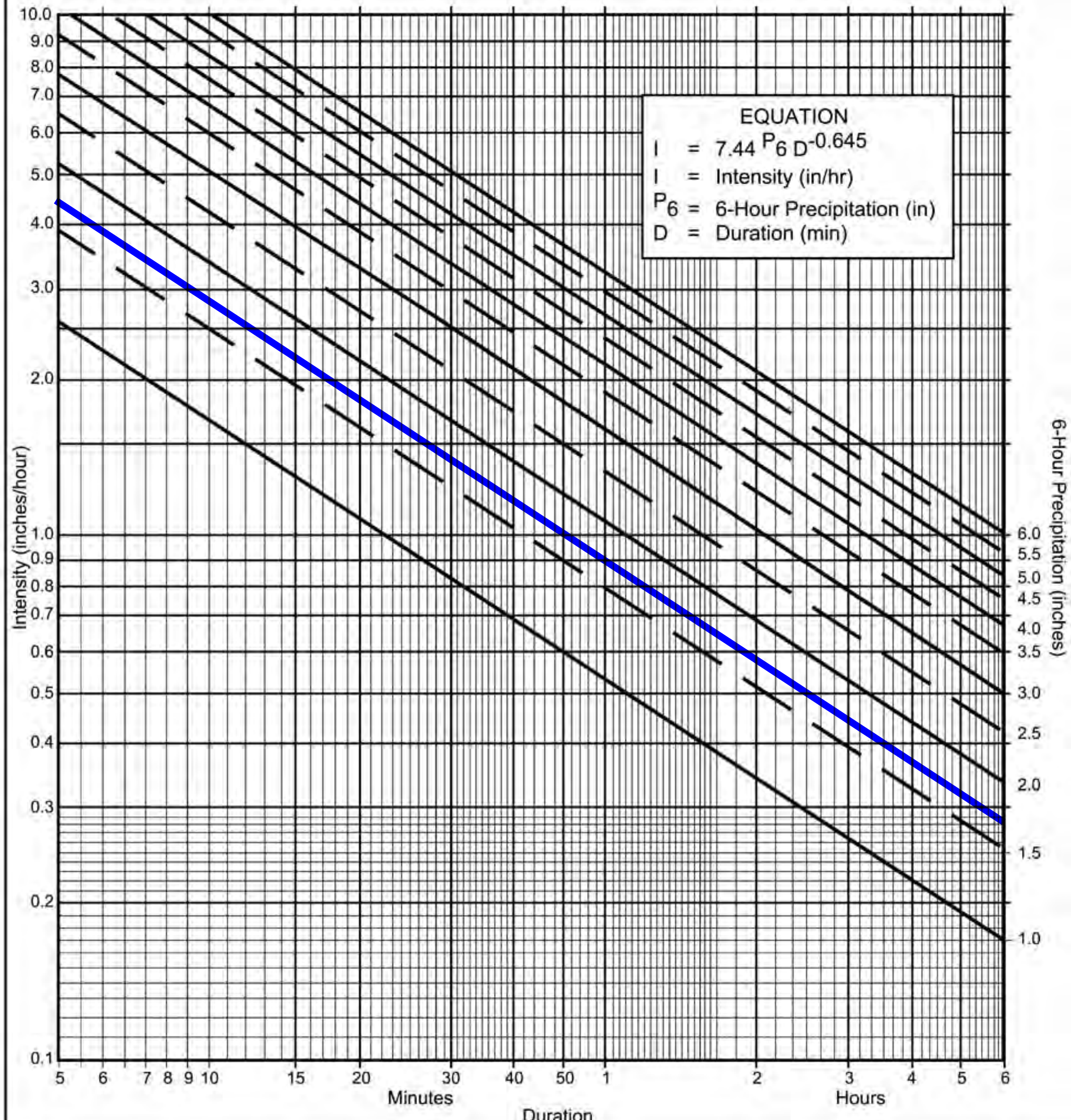
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



EQUATION

$I = 7.44\ P_6\ D^{-0.645}$

I = Intensity (in/hr)

P_6 = 6-Hour Precipitation (in)

D = Duration (min)

Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency __10__ year

(b) P_6 = __1.7__ in., P_{24} = __2.9__, $\frac{P_6}{P_{24}}$ = __0.59__ %(2)

(c) Adjusted P_6(2) = ______ in.

(d) t_x = ______ min.

(e) I = __4.5__ in./hr.

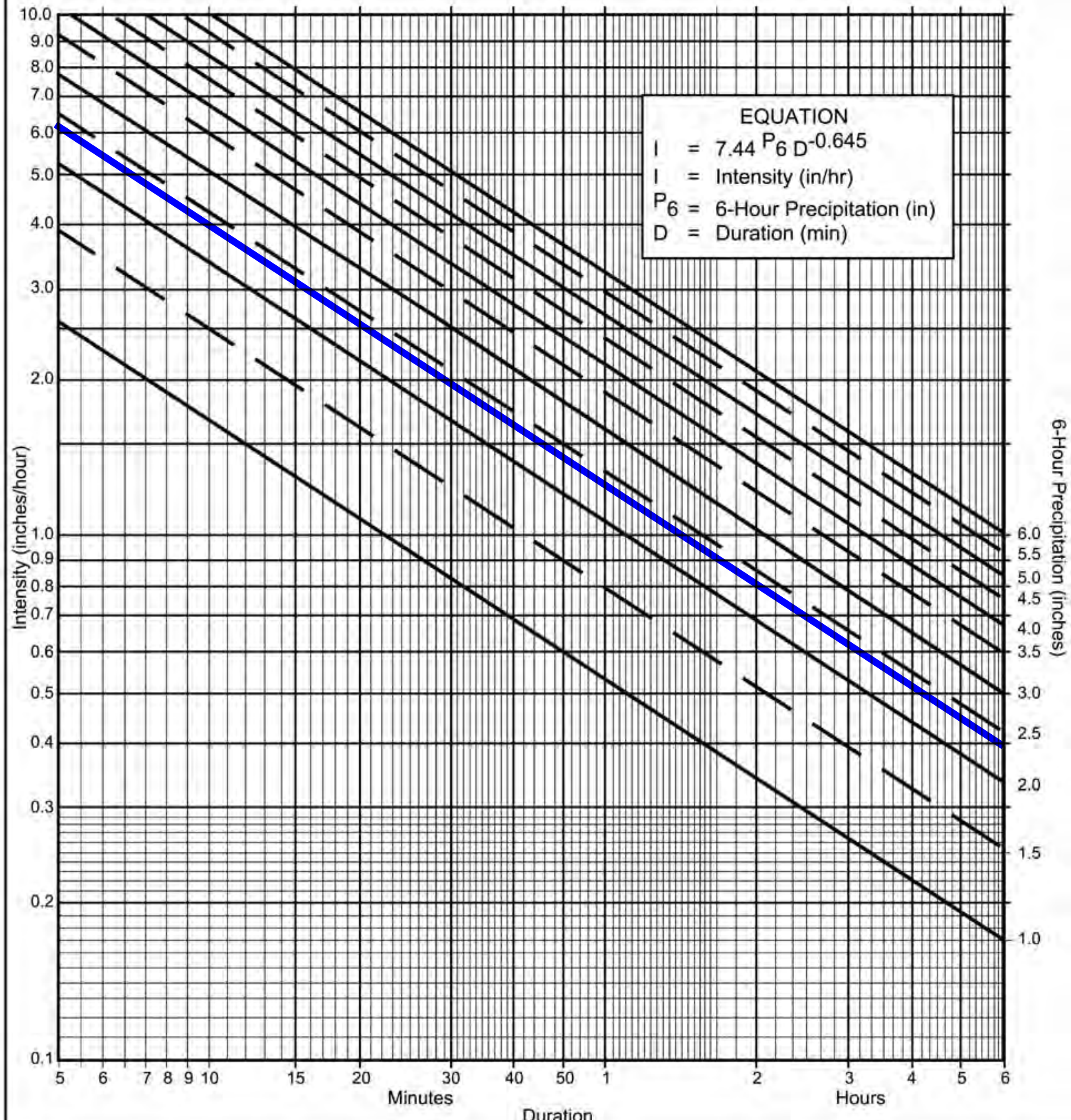
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



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(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.4 in., P_{24} = 4.5 , $\frac{P_6}{P_{24}}$ = 0.53 %$^{(2)}$

(c) Adjusted $P_6^{(2)}$ = ______ in.

(d) t_x = ______ min.

(e) I = 6.1 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1

NOAA Atlas 14, Volume 6, Version 2
Location name: Shaver Lake, California, USA*
Latitude: 37.4°, Longitude: -119.2°
Elevation: 7158.39 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.165 (0.142-0.193)	0.213 (0.184-0.250)	0.280 (0.240-0.329)	0.337 (0.287-0.401)	0.420 (0.342-0.520)	0.488 (0.387-0.620)	0.560 (0.432-0.735)	0.640 (0.476-0.868)	0.755 (0.534-1.08)	0.851 (0.577-1.27)
10-min	0.237 (0.204-0.277)	0.306 (0.263-0.358)	0.401 (0.344-0.472)	0.483 (0.411-0.574)	0.602 (0.491-0.746)	0.699 (0.555-0.889)	0.803 (0.619-1.05)	0.917 (0.682-1.24)	1.08 (0.765-1.54)	1.22 (0.827-1.82)
15-min	0.286 (0.247-0.335)	0.370 (0.318-0.433)	0.485 (0.417-0.571)	0.584 (0.497-0.695)	0.728 (0.593-0.902)	0.845 (0.671-1.07)	0.971 (0.748-1.27)	1.11 (0.825-1.50)	1.31 (0.926-1.87)	1.48 (1.00-2.20)
30-min	0.391 (0.337-0.457)	0.505 (0.435-0.592)	0.663 (0.569-0.780)	0.799 (0.679-0.949)	0.995 (0.811-1.23)	1.16 (0.917-1.47)	1.33 (1.02-1.74)	1.51 (1.13-2.06)	1.79 (1.26-2.55)	2.02 (1.37-3.00)
60-min	0.509 (0.439-0.596)	0.658 (0.567-0.771)	0.863 (0.741-1.01)	1.04 (0.884-1.24)	1.29 (1.06-1.60)	1.50 (1.19-1.91)	1.73 (1.33-2.27)	1.97 (1.47-2.68)	2.33 (1.65-3.33)	2.63 (1.78-3.91)
2-hr	0.757 (0.653-0.886)	0.960 (0.827-1.13)	1.24 (1.07-1.46)	1.49 (1.26-1.77)	1.84 (1.50-2.28)	2.13 (1.69-2.71)	2.45 (1.89-3.21)	2.79 (2.08-3.79)	3.29 (2.33-4.70)	3.71 (2.52-5.53)
3-hr	0.948 (0.818-1.11)	1.19 (1.03-1.40)	1.53 (1.31-1.80)	1.82 (1.55-2.17)	2.25 (1.83-2.79)	2.60 (2.07-3.31)	2.98 (2.29-3.91)	3.39 (2.52-4.60)	3.99 (2.82-5.70)	4.49 (3.05-6.69)
6-hr	1.41 (1.22-1.65)	1.76 (1.52-2.06)	2.24 (1.93-2.64)	2.66 (2.26-3.16)	3.26 (2.66-4.04)	3.76 (2.98-4.78)	4.29 (3.30-5.62)	4.87 (3.62-6.60)	5.70 (4.03-8.14)	6.39 (4.34-9.52)
12-hr	2.09 (1.80-2.44)	2.65 (2.29-3.11)	3.42 (2.94-4.03)	4.08 (3.47-4.85)	5.02 (4.09-6.22)	5.78 (4.59-7.35)	6.58 (5.07-8.63)	7.44 (5.54-10.1)	8.68 (6.14-12.4)	9.69 (6.57-14.4)
24-hr	2.89 (2.57-3.33)	3.79 (3.35-4.36)	4.99 (4.42-5.76)	6.01 (5.28-6.98)	7.44 (6.36-8.87)	8.58 (7.21-10.4)	9.78 (8.06-12.1)	11.1 (8.91-14.0)	12.9 (10.0-16.9)	14.4 (10.9-19.4)
2-day	3.85 (3.41-4.42)	5.13 (4.55-5.91)	6.87 (6.07-7.92)	8.32 (7.31-9.66)	10.4 (8.87-12.4)	12.0 (10.1-14.6)	13.7 (11.3-17.0)	15.5 (12.5-19.7)	18.1 (14.1-23.8)	20.2 (15.3-27.3)

3-day	4.42 (3.93-5.09)	5.97 (5.29-6.87)	8.04 (7.11-9.27)	9.78 (8.59-11.4)	12.2 (10.5-14.6)	14.2 (11.9-17.2)	16.2 (13.4-20.1)	18.4 (14.8-23.3)	21.5 (16.7-28.1)	23.9 (18.1-32.3)
4-day	4.87 (4.32-5.60)	6.58 (5.83-7.57)	8.87 (7.85-10.2)	10.8 (9.49-12.5)	13.5 (11.5-16.1)	15.6 (13.1-19.0)	17.9 (14.7-22.1)	20.2 (16.3-25.6)	23.6 (18.4-30.9)	26.3 (19.9-35.5)
7-day	5.89 (5.23-6.78)	7.89 (6.99-9.08)	10.6 (9.34-12.2)	12.8 (11.2-14.8)	15.9 (13.6-19.0)	18.4 (15.4-22.3)	20.9 (17.2-25.9)	23.6 (19.0-29.9)	27.4 (21.3-35.9)	30.5 (23.0-41.1)
10-day	6.67 (5.92-7.67)	8.88 (7.88-10.2)	11.8 (10.5-13.6)	14.3 (12.5-16.6)	17.7 (15.1-21.1)	20.3 (17.1-24.7)	23.1 (19.0-28.6)	26.0 (20.9-32.9)	30.1 (23.4-39.4)	33.3 (25.2-44.9)
20-day	8.72 (7.74-10.0)	11.6 (10.3-13.4)	15.3 (13.6-17.7)	18.4 (16.2-21.4)	22.5 (19.3-26.9)	25.7 (21.6-31.2)	28.9 (23.9-35.8)	32.3 (26.0-40.9)	36.9 (28.7-48.3)	40.4 (30.6-54.5)
30-day	10.7 (9.51-12.3)	14.2 (12.6-16.4)	18.7 (16.6-21.6)	22.3 (19.6-25.9)	27.1 (23.2-32.4)	30.7 (25.9-37.3)	34.4 (28.3-42.6)	38.1 (30.7-48.2)	43.1 (33.5-56.4)	46.9 (35.5-63.3)
45-day	13.4 (11.9-15.4)	17.7 (15.7-20.3)	23.0 (20.4-26.6)	27.3 (24.0-31.7)	32.8 (28.0-39.1)	36.8 (31.0-44.7)	40.9 (33.7-50.6)	44.9 (36.2-56.9)	50.2 (39.1-65.8)	54.2 (41.0-73.1)
60-day	15.9 (14.1-18.3)	20.9 (18.5-24.0)	27.0 (23.9-31.1)	31.7 (27.9-36.8)	37.8 (32.3-45.1)	42.2 (35.5-51.2)	46.5 (38.3-57.6)	50.8 (40.9-64.3)	56.3 (43.8-73.8)	60.4 (45.7-81.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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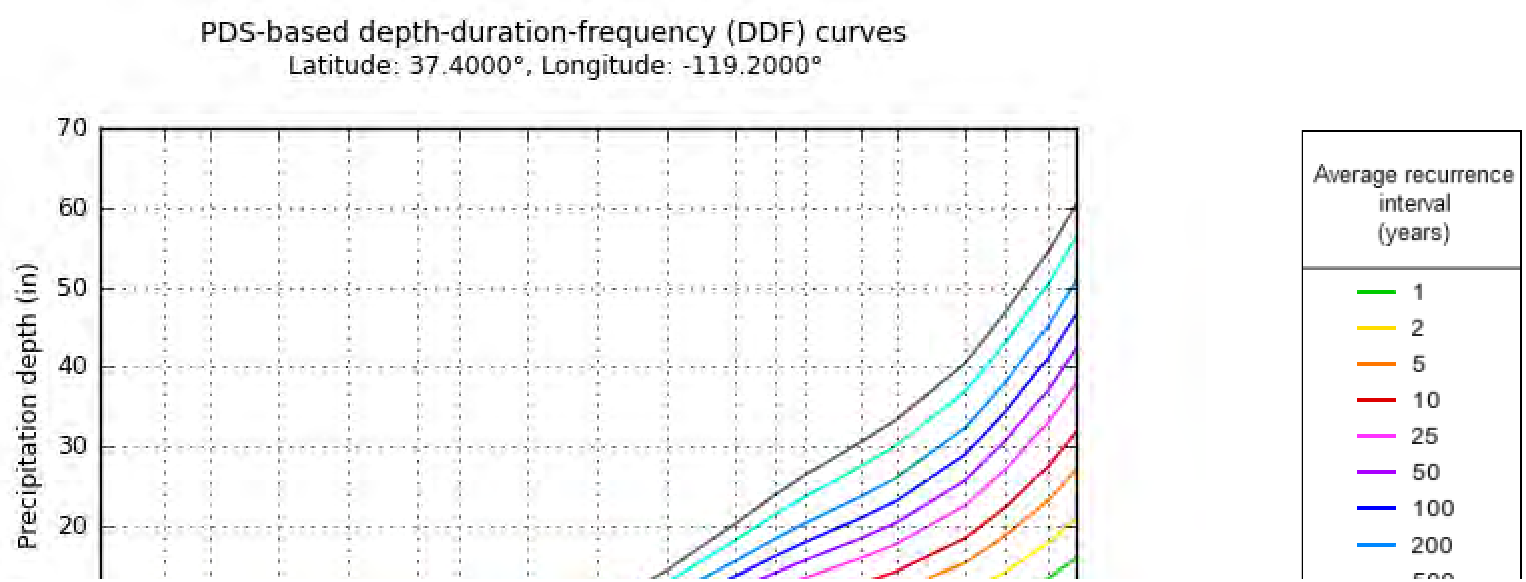
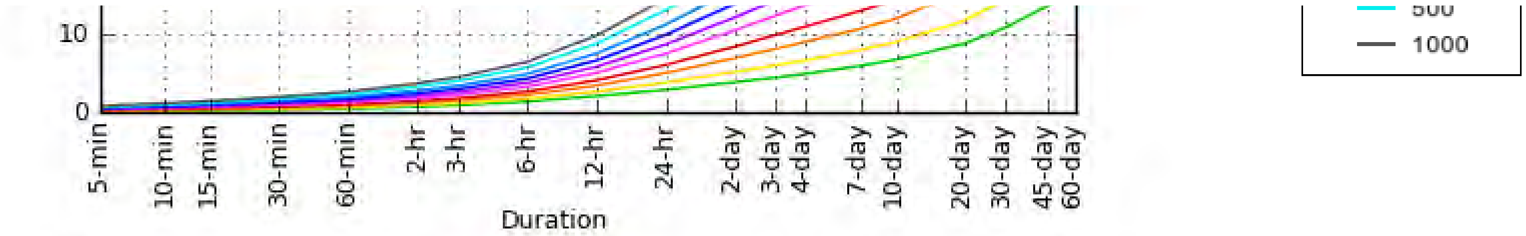
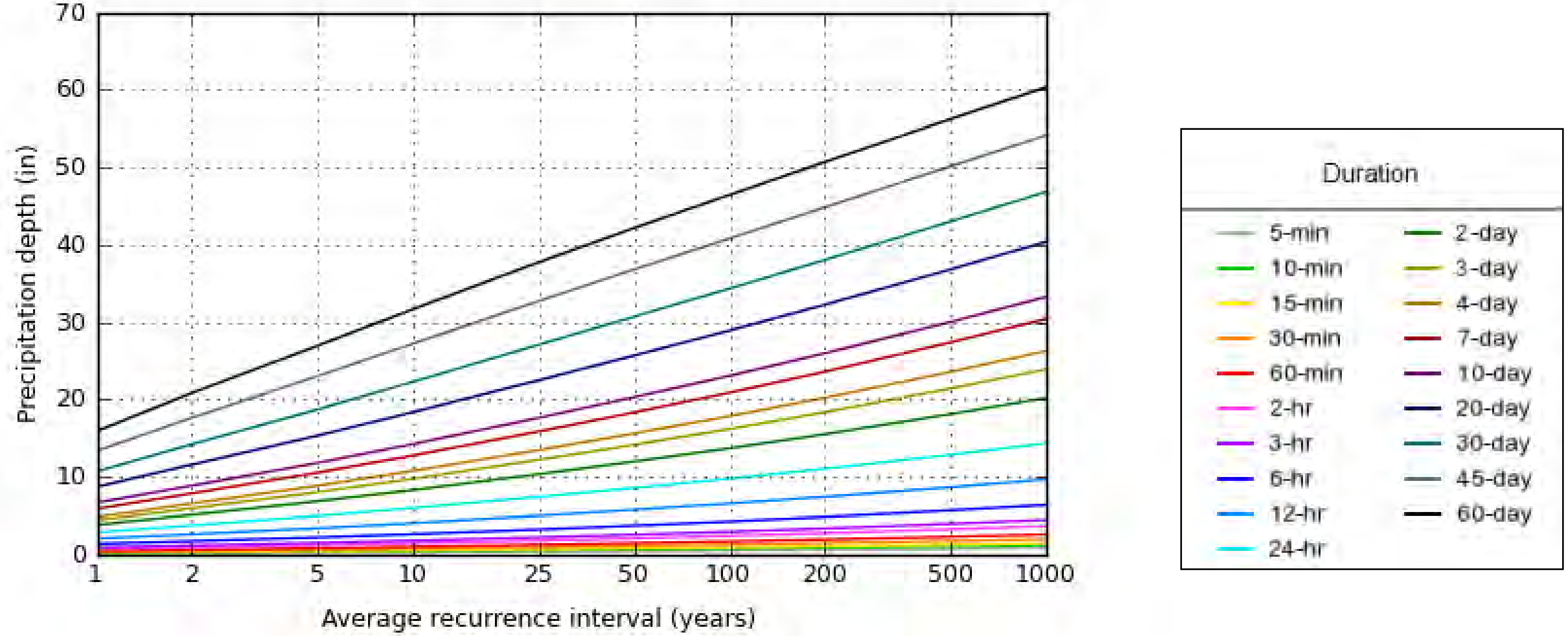
PF graphical







NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Mon Oct 3 16:26:34 2016

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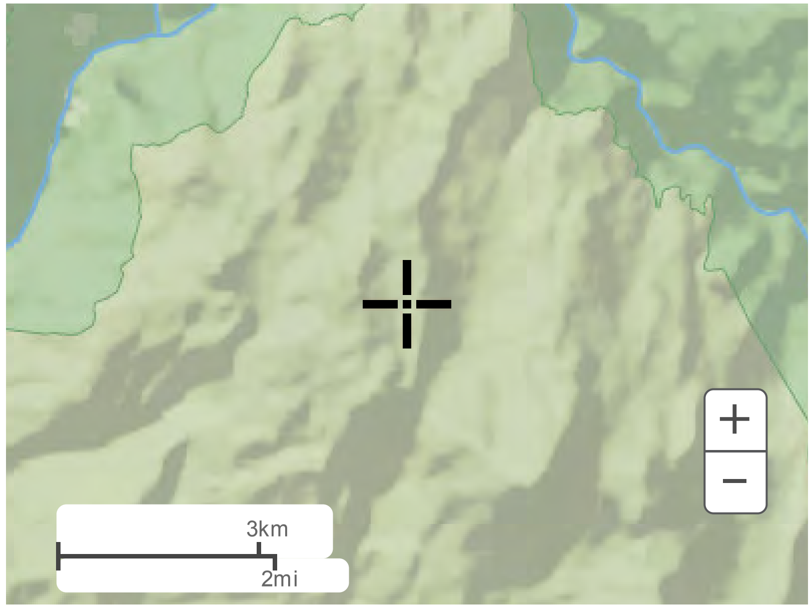
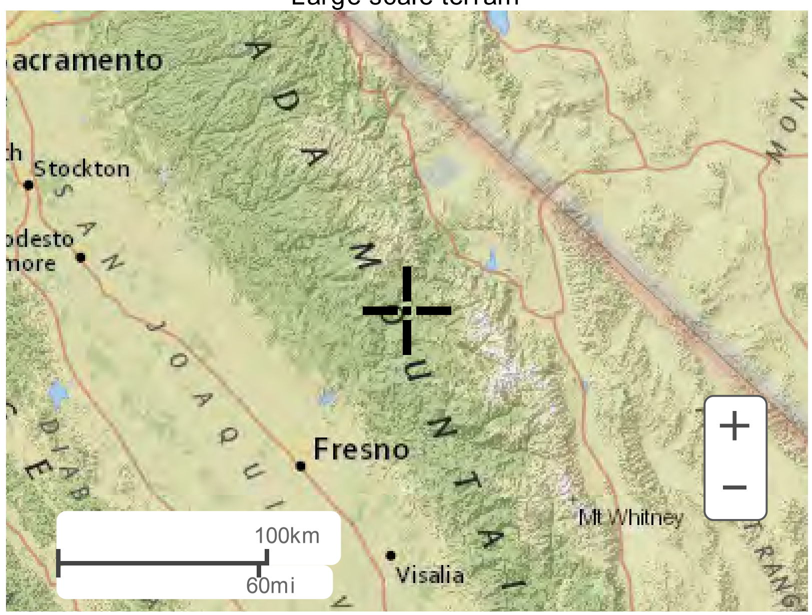
Maps & aerials

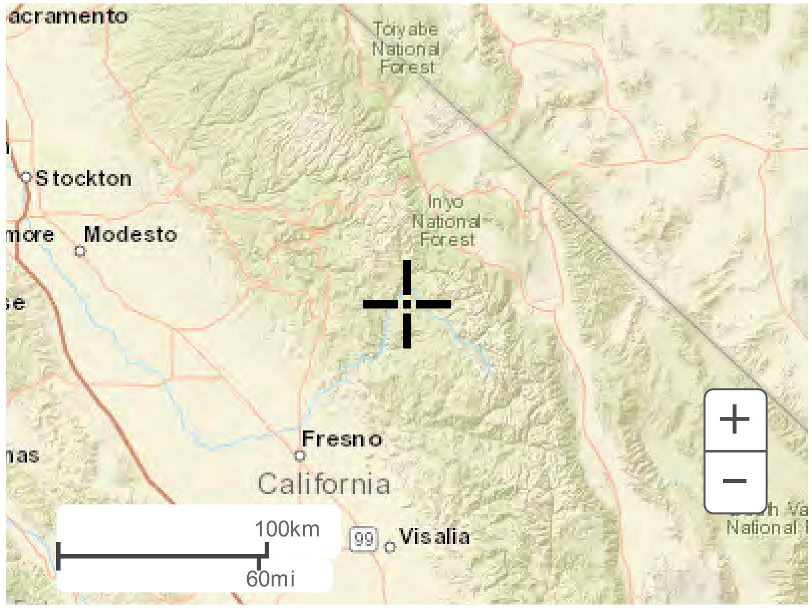
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

NOAA Atlas 14, Volume 6, Version 2
Location name: Santee, California, USA*
Latitude: 32.8393°, Longitude: -117.0079°
Elevation: 310.45 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.40 (1.18-1.68)	1.78 (1.49-2.14)	2.27 (1.90-2.74)	2.66 (2.22-3.25)	3.22 (2.58-4.06)	3.64 (2.86-4.69)	4.07 (3.11-5.39)	4.51 (3.35-6.16)	5.12 (3.64-7.30)	5.59 (3.83-8.26)
10-min	1.00 (0.846-1.21)	1.27 (1.07-1.53)	1.63 (1.36-1.96)	1.91 (1.58-2.33)	2.30 (1.85-2.91)	2.61 (2.05-3.37)	2.92 (2.23-3.86)	3.24 (2.40-4.42)	3.67 (2.60-5.23)	4.01 (2.74-5.92)
15-min	0.808 (0.680-0.972)	1.02 (0.860-1.24)	1.31 (1.10-1.58)	1.54 (1.28-1.88)	1.86 (1.49-2.34)	2.10 (1.65-2.71)	2.35 (1.80-3.12)	2.61 (1.93-3.56)	2.96 (2.10-4.22)	3.23 (2.21-4.77)
30-min	0.562 (0.472-0.676)	0.712 (0.598-0.856)	0.908 (0.760-1.10)	1.07 (0.888-1.30)	1.29 (1.03-1.63)	1.46 (1.14-1.88)	1.63 (1.25-2.16)	1.81 (1.34-2.47)	2.05 (1.46-2.92)	2.24 (1.53-3.31)
60-min	0.398 (0.334-0.478)	0.504 (0.423-0.607)	0.644 (0.539-0.777)	0.758 (0.629-0.923)	0.914 (0.731-1.15)	1.03 (0.809-1.33)	1.16 (0.882-1.53)	1.28 (0.950-1.75)	1.45 (1.03-2.07)	1.59 (1.08-2.34)
2-hr	0.274 (0.230-0.330)	0.346 (0.291-0.417)	0.441 (0.369-0.532)	0.518 (0.430-0.631)	0.622 (0.498-0.785)	0.702 (0.550-0.906)	0.784 (0.598-1.04)	0.867 (0.642-1.18)	0.980 (0.694-1.40)	1.07 (0.730-1.58)
3-hr	0.219 (0.184-0.264)	0.277 (0.233-0.334)	0.353 (0.295-0.426)	0.415 (0.344-0.505)	0.498 (0.399-0.628)	0.562 (0.440-0.724)	0.626 (0.478-0.829)	0.692 (0.513-0.944)	0.782 (0.554-1.11)	0.850 (0.581-1.26)
6-hr	0.147 (0.124-0.177)	0.187 (0.157-0.225)	0.239 (0.200-0.288)	0.281 (0.233-0.342)	0.337 (0.270-0.425)	0.380 (0.298-0.490)	0.424 (0.323-0.561)	0.469 (0.347-0.639)	0.529 (0.375-0.753)	0.575 (0.393-0.849)
12-hr	0.097 (0.081-0.116)	0.124 (0.104-0.150)	0.160 (0.134-0.193)	0.189 (0.157-0.230)	0.228 (0.183-0.288)	0.258 (0.202-0.333)	0.288 (0.220-0.382)	0.319 (0.236-0.435)	0.361 (0.256-0.514)	0.393 (0.269-0.580)
24-hr	0.061 (0.053-0.070)	0.079 (0.069-0.092)	0.103 (0.090-0.119)	0.122 (0.106-0.143)	0.148 (0.124-0.178)	0.167 (0.138-0.206)	0.187 (0.151-0.236)	0.207 (0.164-0.268)	0.235 (0.178-0.316)	0.256 (0.188-0.355)
2-day	0.038 (0.033-0.044)	0.049 (0.043-0.057)	0.065 (0.057-0.075)	0.077 (0.067-0.090)	0.093 (0.079-0.113)	0.106 (0.087-0.130)	0.118 (0.096-0.149)	0.131 (0.103-0.169)	0.148 (0.112-0.199)	0.161 (0.118-0.223)

3-day	0.028 (0.024-0.032)	0.037 (0.032-0.043)	0.049 (0.043-0.057)	0.058 (0.050-0.068)	0.070 (0.059-0.085)	0.080 (0.066-0.098)	0.089 (0.072-0.113)	0.099 (0.078-0.128)	0.112 (0.085-0.150)	0.122 (0.089-0.169)
4-day	0.023 (0.020-0.026)	0.030 (0.027-0.035)	0.040 (0.035-0.047)	0.048 (0.042-0.056)	0.058 (0.049-0.070)	0.066 (0.055-0.081)	0.074 (0.060-0.093)	0.082 (0.064-0.106)	0.092 (0.070-0.124)	0.101 (0.074-0.140)
7-day	0.016 (0.014-0.018)	0.021 (0.018-0.024)	0.027 (0.024-0.032)	0.033 (0.028-0.038)	0.040 (0.034-0.048)	0.045 (0.037-0.056)	0.051 (0.041-0.064)	0.056 (0.044-0.073)	0.064 (0.048-0.086)	0.069 (0.051-0.096)
10-day	0.012 (0.011-0.014)	0.016 (0.014-0.019)	0.021 (0.019-0.025)	0.025 (0.022-0.030)	0.031 (0.026-0.038)	0.035 (0.029-0.044)	0.040 (0.032-0.050)	0.044 (0.035-0.057)	0.050 (0.038-0.067)	0.055 (0.040-0.076)
20-day	0.007 (0.006-0.008)	0.010 (0.009-0.011)	0.013 (0.011-0.015)	0.016 (0.014-0.018)	0.019 (0.016-0.023)	0.022 (0.018-0.027)	0.024 (0.020-0.031)	0.027 (0.021-0.035)	0.031 (0.024-0.042)	0.034 (0.025-0.047)
30-day	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.010 (0.009-0.012)	0.012 (0.011-0.015)	0.015 (0.013-0.019)	0.018 (0.014-0.022)	0.020 (0.016-0.025)	0.022 (0.017-0.028)	0.025 (0.019-0.034)	0.027 (0.020-0.038)
45-day	0.005 (0.004-0.005)	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.010 (0.008-0.011)	0.012 (0.010-0.014)	0.014 (0.011-0.017)	0.015 (0.012-0.019)	0.017 (0.014-0.022)	0.020 (0.015-0.026)	0.022 (0.016-0.030)
60-day	0.004 (0.003-0.005)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.015)	0.013 (0.011-0.017)	0.015 (0.012-0.019)	0.017 (0.013-0.023)	0.019 (0.014-0.026)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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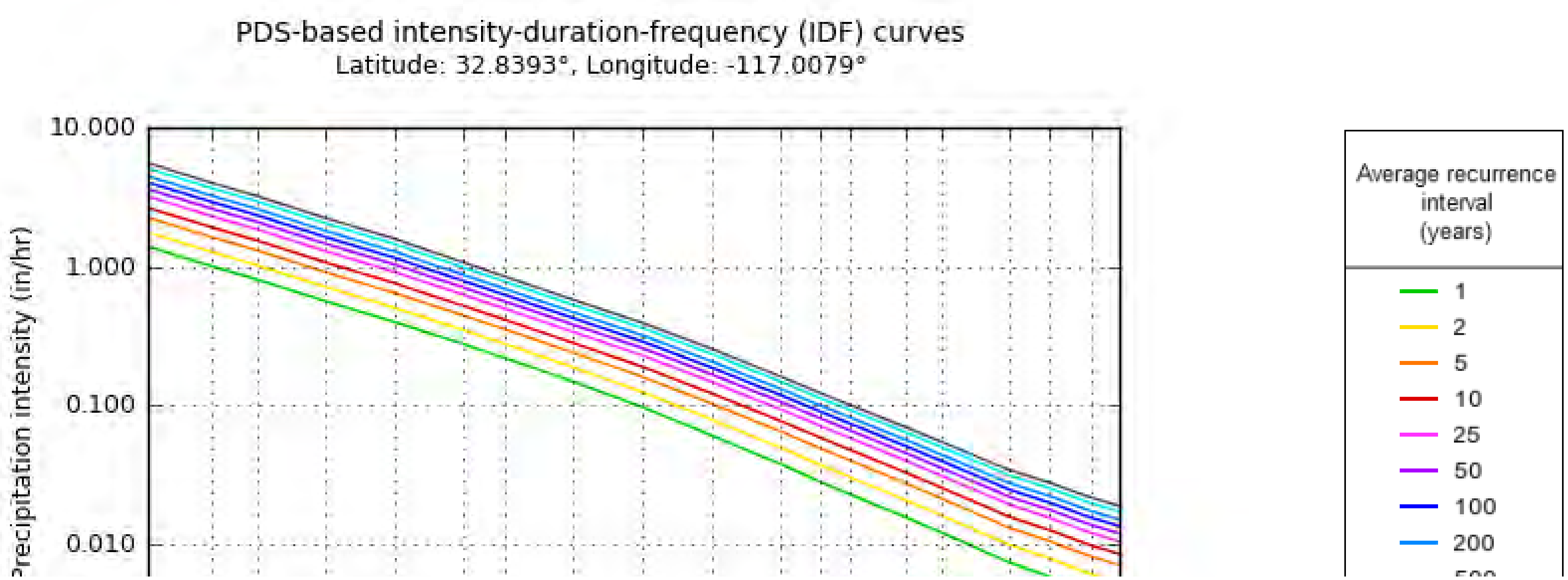
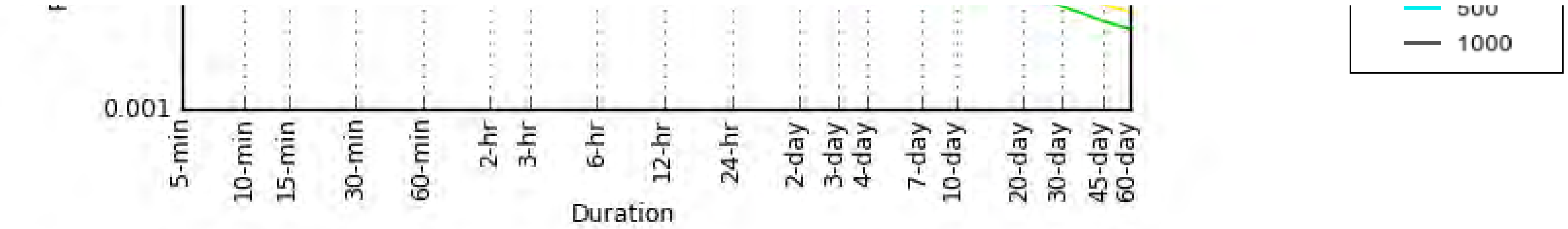
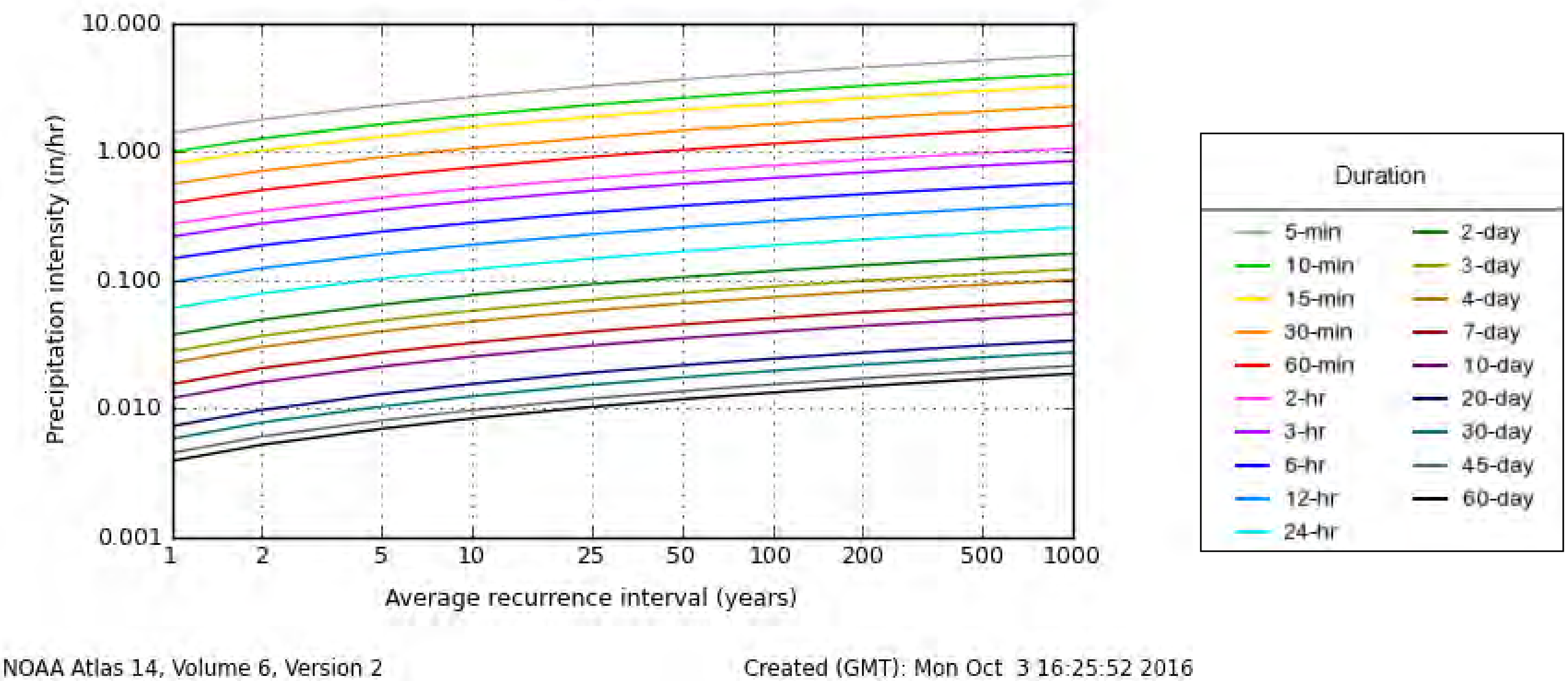
PF graphical







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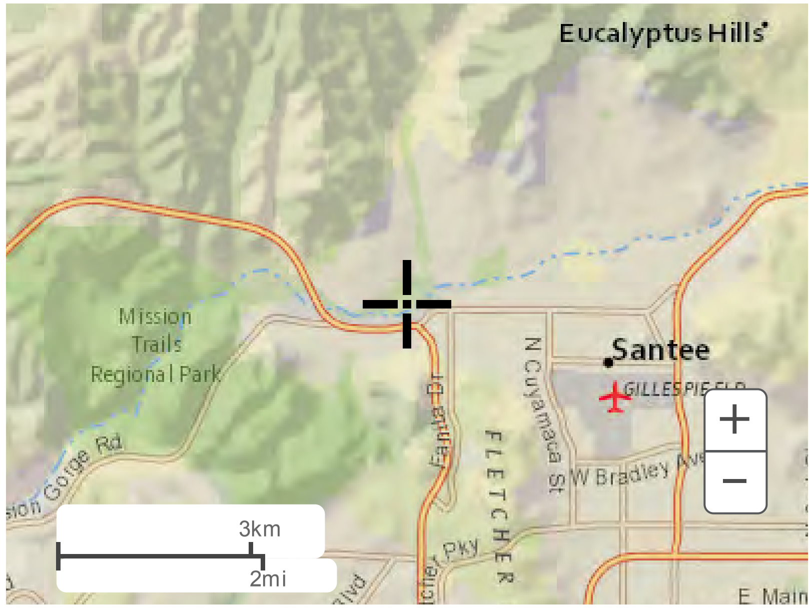
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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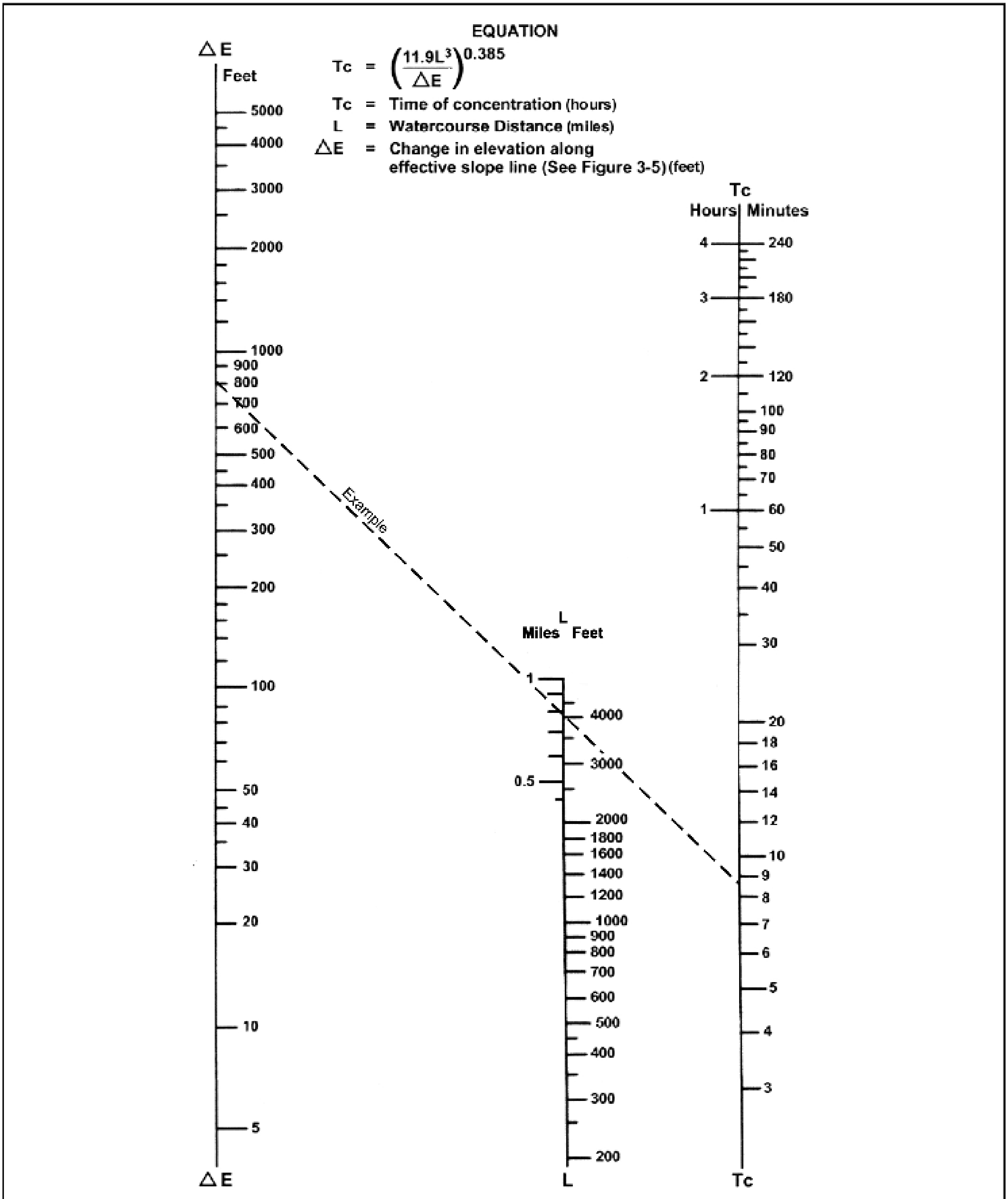

SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

FIGURE

3-4