LOCATION HYDRAULIC STUDY FORM *

Dist. 12 Co. Ora Rte. Golden Ave P.M. N/A

EA FPN: BRLS-5269(025) Bridge No. 55C0192

Floodplain Description:

Golden Ave. crossing Carbon Canyon Channel, as shown on Firm Panel 0063J. The project crosses Zone A (no BFE); however the entire zone is contained within the existing channel.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

The proposed project improvements include construction of catch basins along Golden Avenue and convey flows to Carbon Canyon Channel.

2. ADT: Current 5,000 Projected 10,512 (Year 2035)

3. Hydraulic Data: Base Flood Q_{100}= 1250 CFS

WSE_{100}= d = 6' ± The flood of record, if greater than Q_{100}:

Q= 1250 CFS WSE= d = 6' ±

Overtopping flood Q=_____CFS WSE=_____

Are NFIP maps and studies available? YES ✓ NO_____

4. Is the highway location alternative within a regulatory floodway ?

YES_____ NO ✓

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.

Potential Q_{100} backwater damages:

A. Residences? NO ✓ YES_____

B. Other Bldgs? NO ✓ YES_____

C. Crops? NO ✓ YES_____

D. Natural and beneficial

FLOODPLAIN VALUES? NO ✓ YES_____

6. Type of Traffic:

A. Emergency supply or evacuation route? NO ✓ YES_____

B. Emergency vehicle access? NO ✓ YES_____

C. Practicable detour available? NO ✓ YES_____

D. School bus or mail route? NO ✓ YES_____

7. Estimated duration of traffic interruption for 100-year event hours: 0

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level. N/A

A. Roadway $ N/A

B Property $ N/A

Total $ N/A

9. Assessment of Level of Risk Low ✓

Moderate ____

High ____

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

Signature – Dist. Hydraulic Engineer _____ Date _____
(Item numbers 3,4,5,7,9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible
Floodplain development? NO ✓ YES _____

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

Signature – Dist. Project Engineer _____ Date _____
(Item numbers 1,2,6,8)

* Same as Figure 804.7A Technical Information for Location Hydraulic Study located in Chapter 804 of the Highway Design Manual

SUMMARY FLOODPLAIN ENCROACHMENT REPORT*

Dist. 12 Co. Ora Rte. Golden Ave P.M. N/A

Project No.: FPN: BRLS-5269(025) Bridge No. 55C0192

Limits: Golden Avenue at Carbon Canyon Channel crossing. Approximate geographic coordinates are: 33°54'14.06"N, 117°50'45.53"W

Floodplain Description: Golden Ave. crossing Carbon Canyon Channel, as shown on Firm Panel 0063J. The project crosses Zone A (no BFE); however the entire zone is contained within the existing channel.

		No	Yes
1.	Is the proposed action a longitudinal encroachment of the base floodplain?	✓	
2.	Are the risks associated with the implementation of the proposed action significant?	✓	
3.	Will the proposed action support probable incompatible floodplain development?	✓	
4.	Are there any significant impacts on natural and beneficial floodplain values?	✓	
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain.	✓	
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q).	✓	
7.	Are Location Hydraulic Studies that document the above answers on file? If not explain.		✓

PREPARED BY:

_____ _____

Signature - Dist. Hydraulic Engineer Date

_____ _____

Signature - Dist. Environmental Branch Chief Date

_____ _____

Signature - Dist. Project Engineer Date

* Same as Figure 804.7B Floodplain Evaluation Report Summary located in Chapter 804 of the Highway Design Manual

HYDROLOGY/HYDRAULICS REPORT

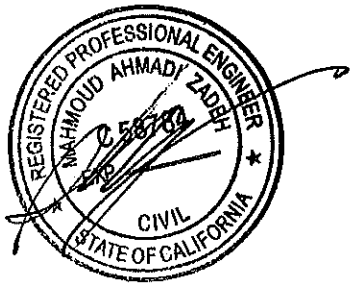
Golden Avenue Bridge Replacement Project

Prepared For:
Biggs Cardosa Associates

Prepared By:

ERSC
Public Works | Municipal Services | Water Resources

Engineering Resources of Southern California, Inc.
3550 East Florida Avenue, Suite B.
Hemet, CA 92544
(951) 765-6622



May 23, 2017

Job No. 16012001

INTRODUCTION

The City of Placentia has commissioned Biggs Cardosa Associates and their design team including ***Engineering Resources of Southern California, Inc.,*** to provide design and construction plans for Golden Avenue Bridge Replacement at Carbon Canyon Channel. This report was prepared to perform the hydrology and hydraulic analysis of the existing drainage facilities and determine the impact due to the proposed project improvements.

EXISTING CONDITION

Currently, the surface runoff along Golden Avenue is conveyed by the street gutter and then captured by a Corrugated Metal Pipe (CMP) into the Carbon Canyon Channel. The existing CMP drainage pipeline is not directly connected into the channel. The pipe is elevated with a pipe support above the top of the channel and has cause for potential erosion.

PROPOSED CONDITION

The proposed project improvements will include construction of two catch basins in Golden Avenue near the east end of the bridge to intercept the surface runoff. The flows will be conveyed via a Reinforced Concrete Pipe (RCP) to be connected and discharge into Carbon Canyon Channel with a concrete junction structure to make a connection between the storm drain pipeline and the existing concrete channel wall.

HYDROLOGY / HYDRAULIC ANALYSIS

The Hydrology Report for the Carbon Canyon Channel, Orange County Flood Control District (OCFCD) Facility No. E03, was provided by the OCFCD. The Channel is a major drainage facility that serves multiple cities within its watershed area. The total tributary watershed area to Carbon Canyon Channel is approximately 14,732 acres. As indicated in Table 4, Page 6 of the report, the 100-year peak discharge flow is approximately 1,250 cubic feet per second (cfs). Based on the as-built drawings, the existing concrete lined rectangular channel is 14 feet wide and 9 feet deep with a longitudinal slope of approximately 2.9 percent at the bridge.

A preliminary hydraulic analysis was performed utilizing Water Surface Pressure Gradient (WSPG) program, Civil Design, Version 14.03. Considering the above 100-year peak discharge flow, the calculated depth of the flow will be approximately 4.1 feet. Therefore, the flow is fully contained within the concrete lined channel with a minimum of 2 feet freeboard as required by OCFCD and the scouring will not be a factor into the design of the bridge foundation.

The impact of the street runoff discharge on the existing concrete channel is insignificant due to their peak time of concentration.

A copy of the hydrology report for Carbon Canyon Channel Facility No. E03 and the hydraulic analysis of the existing channel are included in the Appendix of this report.

APPENDIX

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

Program License Serial Number 6158

*** Improved Channel Analysis ***

Upstream (headworks) Elevation = 100.000(Ft.)
Downstream (outlet) Elevation = 98.800(Ft.)
Runoff/Flow Distance = 100.000(Ft.)
Maximum flow rate in channel(s) = 1250.000(CFS)

NORMAL DEPTH CALCULATIONS FOR CARBON CANYON CHANNEL
GOLDEN AVENUE BRIDGE WIDENING PROJECT
MAY 2017

++

*** CALCULATED DEPTH DATA AT FLOW = 1250.00(CFS) ***
Channel base width = 14.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.014
Maximum depth of channel = 9.000(Ft.)
Flow(q) thru channel = 1250.000(CFS)
Depth of flow = 4.083(Ft.)
Average velocity = 21.866(Ft/s)
Total flow rate in 1/2 street = 1250.000(CFS)
Channel flow top width = 14.000(Ft.)
Depth of flow in channel = 4.08(Ft.)

Total number of channels (same dimensions) = 1
Flow Velocity = 21.87(Ft/s)
Individual channel flow = 1250.000(CFS)
Total capacity of channel(s) = 1250.000(CFS)

Sub-Channel No. 1 Critical depth = 6.250(Ft.)
' ' ' Critical flow top width = 14.000(Ft.)
' ' ' Critical flow velocity= 14.286(Ft/s)
' ' ' Critical flow area = 87.500(Sq.Ft)

GOLDEN.WSW

```
T1  Hydraulic Analysis for Carbon Canyon Channel                                0
T2  Golden Avenue Bridge Widening Project
T3  May 2017
SO    1000.000 329.980  1      .014                  334.06
R     1071.710 330.880  1      .014
WX                      2
R     1088.330 331.080  2      .014                              00.000    .000 0
WE                      1
R     1500.000 336.02   1      .014
R     1998.860 350.390  1      .014
SH    1998.860 350.390  1      .014
CD    1  2   0   0.000   9.000   14.000  .000  .000   .00
CD    2  3   0    .000   9.000   14.000  .000  .000   .00
Q           1250.000   .0
```

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1000.000	329.980	3.821	333.801	1250.00	23.36	8.48	342.28	.00	6.28	14.00	9.000	14.000	.00	0 .0
71.710	.0126					.0147	1.06	3.82	2.11	4.02	.014	.00	.00	RECTANG
1071.710	330.880	3.776	334.656	1250.00	23.64	8.68	343.34	.00	6.28	14.00	9.000	14.000	.00	0 .0
WALL EXIT														
1071.710	330.880	3.775	334.655	1250.00	23.65	8.69	343.34	.00	6.28	14.00	9.000	14.000	.00	0 .0
16.620	.0120					.0151	.25	3.77	2.15	4.08	.014	.00	.00	BOX
1088.330	331.080	3.761	334.841	1250.00	23.74	8.75	343.59	.00	6.28	14.00	9.000	14.000	.00	0 .0
72.624	.0120					.0156	1.13	3.76	2.16	4.08	.014	.00	.00	RECTANG
1160.954	331.951	3.692	335.644	1250.00	24.18	9.08	344.72	.00	6.28	14.00	9.000	14.000	.00	0 .0
142.165	.0120					.0172	2.44	3.69	2.22	4.08	.014	.00	.00	RECTANG
1303.118	333.657	3.520	337.178	1250.00	25.36	9.99	347.17	.00	6.28	14.00	9.000	14.000	.00	0 .0
108.265	.0120					.0197	2.13	3.52	2.38	4.08	.014	.00	.00	RECTANG
1411.383	334.957	3.356	338.313	1250.00	26.60	10.99	349.30	.00	6.28	14.00	9.000	14.000	.00	0 .0
88.617	.0120					.0226	2.01	3.36	2.56	4.08	.014	.00	.00	RECTANG
1500.000	336.020	3.200	339.220	1250.00	27.90	12.09	351.31	.00	6.28	14.00	9.000	14.000	.00	0 .0
29.845	.0288					.0240	.72	3.20	2.75	3.02	.014	.00	.00	RECTANG
1529.845	336.880	3.222	340.102	1250.00	27.71	11.92	352.02	.00	6.28	14.00	9.000	14.000	.00	0 .0
139.978	.0288					.0222	3.11	3.22	2.72	3.02	.014	.00	.00	RECTANG

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip

L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1669.822	340.912	3.380	344.292	1250.00	26.42	10.84	355.13	.00	6.28	14.00	9.000	14.000	.00	0 .0
86.507	.0288					.0193	1.67	3.38	2.53	3.02	.014	.00	.00	RECTANG
1756.329	343.404	3.545	346.948	1250.00	25.19	9.85	356.80	.00	6.28	14.00	9.000	14.000	.00	0 .0
60.398	.0288					.0168	1.02	3.54	2.36	3.02	.014	.00	.00	RECTANG
1816.728	345.144	3.718	348.861	1250.00	24.02	8.96	357.82	.00	6.28	14.00	9.000	14.000	.00	0 .0
44.820	.0288					.0147	.66	3.72	2.20	3.02	.014	.00	.00	RECTANG
1861.547	346.435	3.899	350.334	1250.00	22.90	8.14	358.48	.00	6.28	14.00	9.000	14.000	.00	0 .0
34.395	.0288					.0128	.44	3.90	2.04	3.02	.014	.00	.00	RECTANG
1895.943	347.425	4.089	351.515	1250.00	21.83	7.40	358.92	.00	6.28	14.00	9.000	14.000	.00	0 .0
26.876	.0288					.0112	.30	4.09	1.90	3.02	.014	.00	.00	RECTANG
1922.819	348.200	4.289	352.489	1250.00	20.82	6.73	359.22	.00	6.28	14.00	9.000	14.000	.00	0 .0
21.154	.0288					.0098	.21	4.29	1.77	3.02	.014	.00	.00	RECTANG
1943.973	348.809	4.498	353.307	1250.00	19.85	6.12	359.42	.00	6.28	14.00	9.000	14.000	.00	0 .0
16.622	.0288					.0086	.14	4.50	1.65	3.02	.014	.00	.00	RECTANG
1960.595	349.288	4.718	354.006	1250.00	18.92	5.56	359.57	.00	6.28	14.00	9.000	14.000	.00	0 .0
12.915	.0288					.0075	.10	4.72	1.54	3.02	.014	.00	.00	RECTANG
1973.509	349.660	4.948	354.608	1250.00	18.04	5.06	359.66	.00	6.28	14.00	9.000	14.000	.00	0 .0
9.804	.0288					.0066	.06	4.95	1.43	3.02	.014	.00	.00	RECTANG

WATER SURFACE PROFILE LISTING

Date: 5-16-2017 Time: 5:29: 2

Hydraulic Analysis for Carbon Canyon Channel
Golden Avenue Bridge Widening Project
May 2017

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1983.313	349.942	5.190	355.132	1250.00	17.20	4.60	359.73	.00	6.28	14.00	9.000	14.000	.00	0 .0
7.136	.0288					.0057	.04	5.19	1.33	3.02	.014	.00	.00	RECTANG
1990.449	350.148	5.443	355.591	1250.00	16.40	4.18	359.77	.00	6.28	14.00	9.000	14.000	.00	0 .0

4.805	.0288					.0050	.02	5.44	1.24	3.02	.014	.00	.00	RECTANG	
1995.254	350.286	5.709	355.995	1250.00	15.64	3.80	359.79	.00	6.28	14.00	9.000	14.000	.00	0	.0
2.735	.0288					.0044	.01	5.71	1.15	3.02	.014	.00	.00	RECTANG	
1997.989	350.365	5.987	356.352	1250.00	14.91	3.45	359.81	.00	6.28	14.00	9.000	14.000	.00	0	.0
.871	.0288					.0039	.00	5.99	1.07	3.02	.014	.00	.00	RECTANG	
1998.860	350.390	6.281	356.671	1250.00	14.22	3.14	359.81	.00	6.28	14.00	9.000	14.000	.00	0	.0

HYDROLOGY REPORT BY ORANGE COUNTY FLOOD CONTROL DISTRICT

CARBON CANYON CHANNEL
FACILITY NO. E03
ENTIRE DRAINAGE SYSTEM

PURPOSE

This report provides 100-year expected value ultimate condition peak discharges for Carbon Canyon Channel, OCFCD Facility No. E03. The discharges are intended to serve as the basis for design of channel improvements.

GENERAL DESCRIPTION OF DRAINAGE AREA

The Carbon Canyon Channel watershed totals 14,732 acres and is separated into two main drainage areas by Carbon Canyon Dam, Facility No. E03D01, that is owned and operated by the US Army Corps of Engineers. Above the dam (upper watershed) there are 12,471 acres in Orange, Los Angeles, and San Bernardino Counties. The area downstream of the dam (lower watershed) consists of 2,261 acres that are within the Orange County cities of Brea, Placentia, and Yorba Linda. The headwaters of the upper watershed are located in the City of Chino Hills at an elevation of about 1,500 feet. From there, the topography slopes in a southwesterly direction for roughly 7 miles to an elevation of about 400 feet at the base of Carbon Canyon Dam. Outflow from the dam travels in a southerly direction via Carbon Canyon Channel for about 3½ miles and then joins Atwood Channel (E04). The combined flows immediately enter Miller Retarding Basin (E02B01), a flow-by facility. Outflow from the basin is conveyed to the Santa Ana River in Carbon Canyon Diversion Channel (E02).

The upper Carbon Canyon watershed is primarily natural hills and includes a portion of Chino Hills State Park. There are some residential and commercial developments in the Cities of Brea and Chino Hills. The lower watershed is nearly in its final development state consisting of residential and commercial areas, schools, and parks. Ultimate condition land uses were taken from the General Plan maps of the Cities and Counties. The upper watershed in Orange and San Bernardino Counties has predominately C and D soil groups and there are also small amounts of A and B soils. For the area in Los Angeles County the U.S. Natural Resources Conservation Service has not published soil surveys and no soil information is available. These soils were assumed to be half each of C and D to be consistent with comparable surrounding areas. In the lower watershed soil group D is the most prevalent followed by soil group B. There are also some areas of A and C soils.

In the upper watershed the flowpaths are natural streams for their entire length from the headwaters to the dam. None of these streams are owned by OCFCD/Orange County and this report does not provide any discharges for them. In the lower watershed, Carbon Canyon Channel is primarily a vertical-wall concrete open channel or reinforced concrete box. The most downstream reach from Chapman Avenue to the Atwood Channel confluence is a trapezoidal concrete or engineered earth channel with some rock slope protection. The OCFCD/Orange County-owned portion of Carbon Canyon Channel extends from Golden Avenue to Atwood Channel, a distance of about 14,700 feet.

BASIS FOR DETERMINATION OF DISCHARGES

The procedures of the 1986 Orange County Hydrology Manual and its 1996 Addendum No. 1 were applied to derive the peak discharges. Mapping resources within OC/Infrastructure Programs were used to determine drainage area boundaries, land use, soil groups, node elevations, flow path lengths and conveyance types. Hydrologic modeling of the watershed assumed that all of the 100-year stormwater runoff freely enters the County's regional flood control facilities even though existing inlets may be designed for lower flow rates.

Use of 100-year expected value discharges instead of high confidence values for the Atwood Channel watershed was approved previously (see Exhibit 10). Hydrology analyses for the inter-connected watersheds of Atwood, Carbon Canyon, and Carbon Canyon Diversion Channels are based on the same confidence level.

The OCHM's 25-year high confidence rainfall was input to generate the 100-year expected value discharges. Loss rates were established with a Microsoft EXCEL program which duplicates the procedures in Section C-Losses of the Hydrology Manual. Calculation of maximum loss rates, Fm, used pervious area loss rate, Fp, of 0.3 inches/hour for all soil types. Low loss fractions, Y-bars, were derived using 24-hour precipitation of 4.49 inches and curve numbers based on the actual soil groups with AMC II conditions.

The Advanced Engineering Software (AES) 2013 RATSCx computer program was used to perform the rational method analyses. Initial area lengths were limited to 330 feet. The streams above Carbon Canyon Dam were modeled to simulate natural conditions with a height/basewidth ratio of 0.5, side slope of 3:1, and Manning's "n" factor of 0.045. In the lower watershed, pipeflow routing was modeled with computer-estimated pipe sizes to prevent flow restrictions. Routing in improved channels was based on existing parameters but depth was increased slightly when necessary to accommodate all flows. The resulting times of

concentration, Tc, produced by the rational method were converted to lag times for input to the unit hydrograph analyses.

The AES 2013 FLOODSCx program was used to perform the flood routing/unit hydrograph analyses. Lag times were derived by multiplying 0.8 with the Tc from the rational method. This Tc was taken from the stream that produced the highest discharge to account for effective area influences created by the channelization effects of rapidly flowing storm drain systems. The Valley-Developed S-graph was used for relatively flat areas and anywhere that development exists. Hilly areas upstream of Carbon Canyon Dam that are to remain in their natural condition have been modeled with the Foothill S-graph. Hydrographs were developed with 5-minute time intervals to conform to the OCHM recommendation that they be about 20% of lag times and to correspond with the time interval of the synthetic critical storm pattern. Depth, outflow, and storage information needed to route hydrographs through the dam is shown in Table 1 below. This data was extracted from the Corps' 1990 Water Control Manual for Carbon Canyon Dam, excerpts of which are included in Exhibit 9.

TABLE 1: CARBON CANYON DAM FLOW-THROUGH BASIN ROUTING

Depth (ft)	Outflow (cfs)	Storage (ac-ft)
00.00	0.00	0.000
16.00	50.00	228.000
16.01	70.00	228.011
17.00	75.00	260.000
17.01	140.00	260.011
18.00	145.00	300.000
18.01	230.00	300.011
22.00	250.00	480.000
22.01	375.00	480.011
23.00	380.00	540.000
23.01	500.00	540.011
28.00	570.00	840.000
28.01	719.00	840.011
52.00	1000.00	3200.000
62.00	1000.01	4700.000
72.00	1000.02	6650.000

Effective volume filled above outlet = 228.00 ac-ft

Two types of flood routing/unit hydrograph model were developed. One of the models is a complex entire area analysis that begins with a hydrograph for the area tributary to Carbon Canyon Dam. This hydrograph is routed through the dam using the Modified Pul's flow-through basin process. The dam outflow is moved downstream via convex channel routing to each node on the Carbon Canyon Channel. Then a hydrograph is developed for the lower watershed below the dam for each node. This hydrograph is combined with the routed dam outflow to produce the final peak discharge. For the upstream reaches of Carbon Canyon Channel, this model produced the highest discharges.

The other flood routing/unit hydrograph model is based on the downstream area only as described in Addendum No. 2, Section V, of the 2000 OC Flood Control District Design Manual. This model omits the upper watershed above Carbon Canyon Dam and develops a single area hydrograph for just the area below the dam. Depth-area reduction factors are based on the downstream area only. No outflow from the dam is included. For the lower reaches of the Carbon Canyon Channel this model produced the highest discharges.

In addition to the above two analyses, a flood routing/unit hydrograph model with numerous hydrographs and channel routings, also known as a link-node model, was considered. In this scenario, a hydrograph is developed for a subarea and it is routed through a channel to a downstream node. Then another hydrograph is developed for the next subarea and combined with the routed flow. This process of routing and combining continues along the entire length of the channel. Breaking up the model into numerous hydrographs linked by channel routing deviates from the single area approach that was used in calibration of the OCHM. It introduces significant uncertainty and creates less reliable "accuracy" of the results. For this reason it was not used.

To ensure that the flood routing/unit hydrograph models with retarding basin (Carbon Canyon Dam) are not underestimating peak discharges, Section K.5 of the OCHM recommends that complex free-draining models (without the basin) be compared with single area models. This evaluation was made at each node on Carbon Canyon Channel. All free-draining discharges exceed the corresponding single area discharges. It was concluded that no calibration of the free-draining models by increasing rainfall is needed. See Table 2 below.

TABLE 2: FREE-DRAINING vs. SINGLE AREA COMPARISON

Node	Location	100-Year Expected Value Peak Discharge Free Draining (cfs)	Single Area (cfs)
3.06	Imperial Hwy	8,985	8,684
3.07	Golden Ave	8,991	8,684
3.08	Bastanchury Rd	9,005	8,664
3.09	Appling Ave	9,029	8,707
3.10	Yorba Linda Blvd	9,033	8,703
3.11	Palm Dr	9,106	8,889
3.12	Alta Vista St	9,133	8,909
3.13	Chapman Ave	9,107	8,878
3.14	Crowther Ave	9,175	8,981
3.15	Orangethorpe Ave/Atwood Chnl	9,175	8,918

A multi-day analysis was performed at each node downstream of Carbon Canyon Dam to determine the critical duration that would produce the highest discharge. The results of the entire area complex analyses indicate that the 2-day storm is the critical duration because these discharges are slightly more than the 1-day at each node. See Table 3 below.

TABLE 3: MULTI-DAY STORM COMPARISON

		Total Drainage Area (ac)	100-Year Expected Value Peak Discharge 1-Day (cfs)	2-Day (cfs)
3.90	Carbon Canyon Dam inflow	12,471	8,669	8,669
3.90	Carbon Canyon Dam outflow	12,471	839	847
3.06	Imperial Hwy	12,860	1,220	1,228
3.07	Golden Ave	12,888	1,250	1,258
3.08	Bastanchury Rd	12,990	1,349	1,357
3.09	Appling Ave	13,151	1,492	1,500
3.10	Yorba Linda Ave	13,312	1,612	1,620
3.11	Palm Ave	13,854	2,141	2,148
3.12	Alta Vista St	14,104	2,308	2,315
3.13	Chapman Ave	14,237	2,342	2,349
3.14	Crowther Ave	14,690	2,677	2,684
3.15	Orangethorpe Ave/Atwood Chnl	14,732	2,691	2,699

The Carbon Canyon Channel recommended 100-year expected value peak discharges are shown below in Table 4. When these discharges are compared with existing channel capacities, only a small portion of Carbon Canyon appears to be deficient.

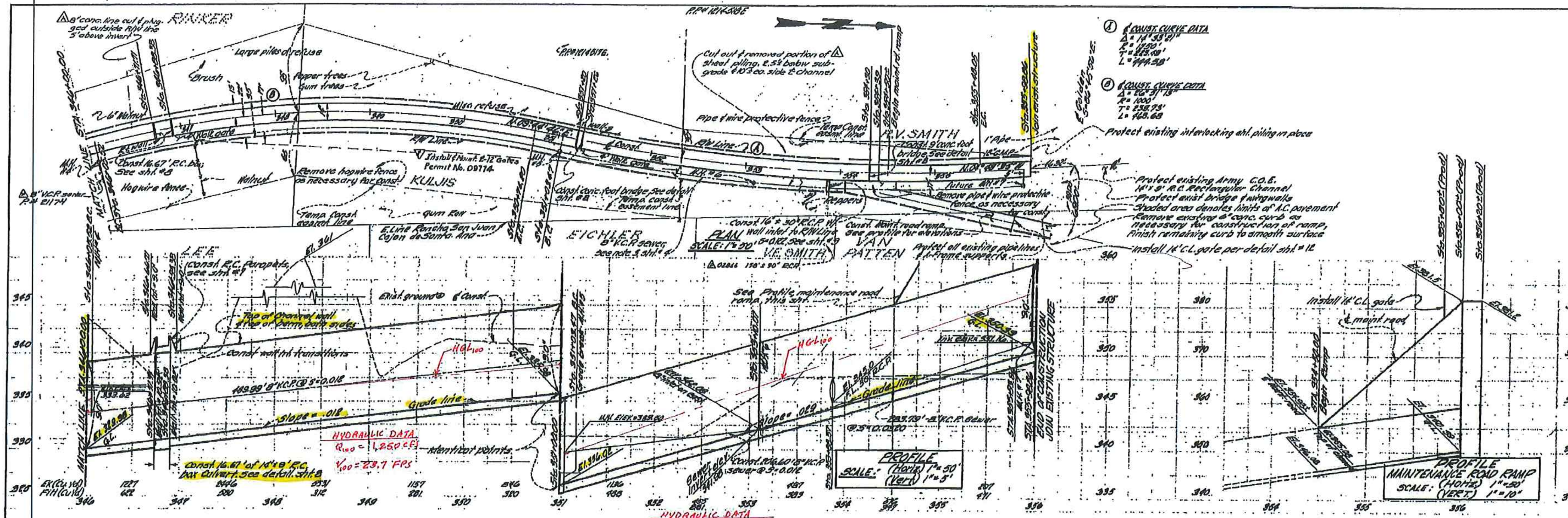
TABLE 4: RECOMMENDED DESIGN DISCHARGES

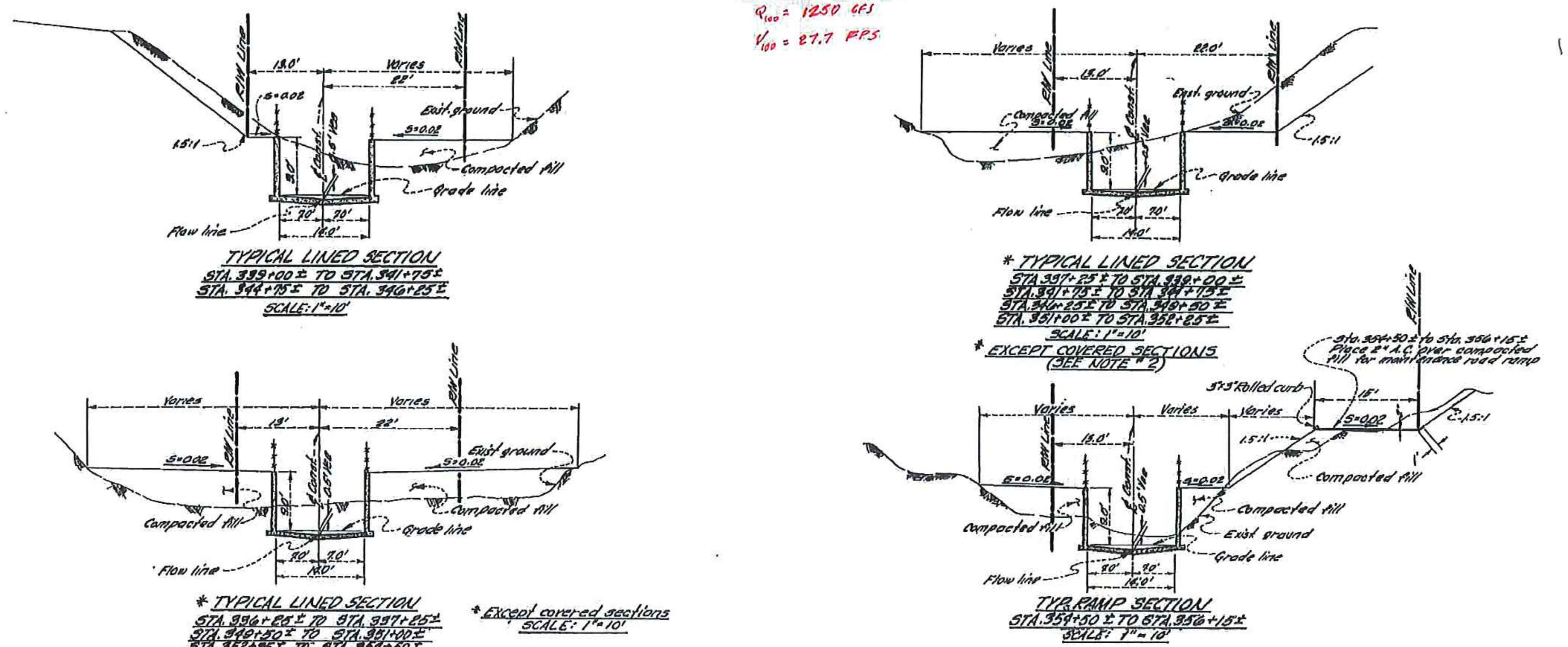
CARBON CANYON CHANNEL
FACILITY NO. E03

Node	Description	Drainage Area Total (ac)	Drainage Area D/S Dam only (ac)	100-Year Expected Value Peak Discharge Total Area (cfs)	100-Year Expected Value Peak Discharge D/S Dam only (cfs)
3.90	Carbon Cyn Dam inflow	12,471		8,700	
3.90	Carbon Cyn Dam outflow	12,471		840	
3.06	Imperial Hwy	12,860	389	1,250^{Q}	740^{RM}
3.07	Golden Ave	12,888	417	1,250^{Q}	780^{RM}
3.08	Bastanchury Rd	12,990	519	1,350^{Q}	920^{RM}
3.09	Appling Ave	13,151	680	1,500^{Q}	1,200
3.10	Yorba Linda Blvd	13,312	841	1,600^{Q}	1,350
3.11	Palm Dr	13,854	1,383	2,150	2,150^{Q}
3.12	Alta Vista St	14,104	1,633	2,300	2,400^{Q}
3.13	Chapman Ave	14,237	1,766	2,350	2,450^{Q}
3.14	Crowther Ave	14,690	2,219	2,700	2,900^{Q}
3.15	Orangethorpe Ave/Atwood Chnl	14,732	2,261	2,700	2,900^{Q}

^{Q} = Recommended Design Discharge
^{RM} = Discharge from rational method

EXHIBITS





HYDRAULIC DATA										
STA. TO STA.	Qn	b	z	s	n=0.013 dn	n=0.013 Vn	n=0.015 dn	n=0.015 Vn	do	Vc
346+00.00 to 351+03.47	1670	14.0	Vert.	.018	4.8	24.9	5.3	22.5	7.6	15.7
351+03.47 to 355+98.86	1670	14.0	Vert.	.029	3.5	34.1	3.9	30.6	7.6	15.7

CONST. NOTES:

① Remove portions of exist side slope fill material from Sta. 352+00± to end construction which is declared unstable by Engineer in field, before placing new fill material.

② Construct Citrus Ave. R.C. Box: Sta. 338+10.07 to Sta. 339+30.07. Construct typical R.C. Box Sta. 314+41.71 to Sta. 314+58.38, Sta. 341+83.21 to Sta. 341+99.88 & Sta. 346+71.71 to Sta. 346+88.38, Construct pedestrian footbridges: Sta. 283+04.00 to Sta. 283+10.00, Sta. 287+56.24 to Sta. 287+62.24, Sta. 311+34.00 to Sta. 311+40.00, Sta. 318+57.00 to Sta. 318+63.00, Sta. 335+50.00 to Sta. 335+56.00, Sta. 351+20.00 to Sta. 351+26.00, Sta. 354+30.00 to Sta. 354+39.00. See sht. #8

FENCING NOTES:
1. Join exist. fence at Sta. 355+98.86
2. Const. 14' chain link gate at ramp.

BENCH MARK: EL. 306.99
U.S.G.S. Brass cap in top of concrete handrail @ S.E. corner of bridge @ Yorba Linda Blvd.
DATUM: O.C.S. 1959 Adj. = O.C.F.C.D.

PRELIMINARY REVISION CODE
Disregard Prints Bearing Earlier Codes

REVISIONS		
MARK	DATE	DESCRIPTION
A	7/67	Permit 02866
B	12/67 7-74 7-75	" 09774

ORANGE COUNTY FLOOD CONTROL DISTRICT
CARBON CANYON CHANNEL
PLAN & PROFILE
STA. 346+00.00 TO STA. 356+15.00.

DESIGNED E.J.M.
DRAWN D.A.P. CHECKED R.K.W.
SUBMITTED [signature] DESIGN ENGINEER
RECOMMENDED [signature] DESIGN DIVISION ENGINEER
SCALE AS SHOWN | DATE MAR. 66 | DWG. NO. E03-101-2-A

consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program, dated 2005.

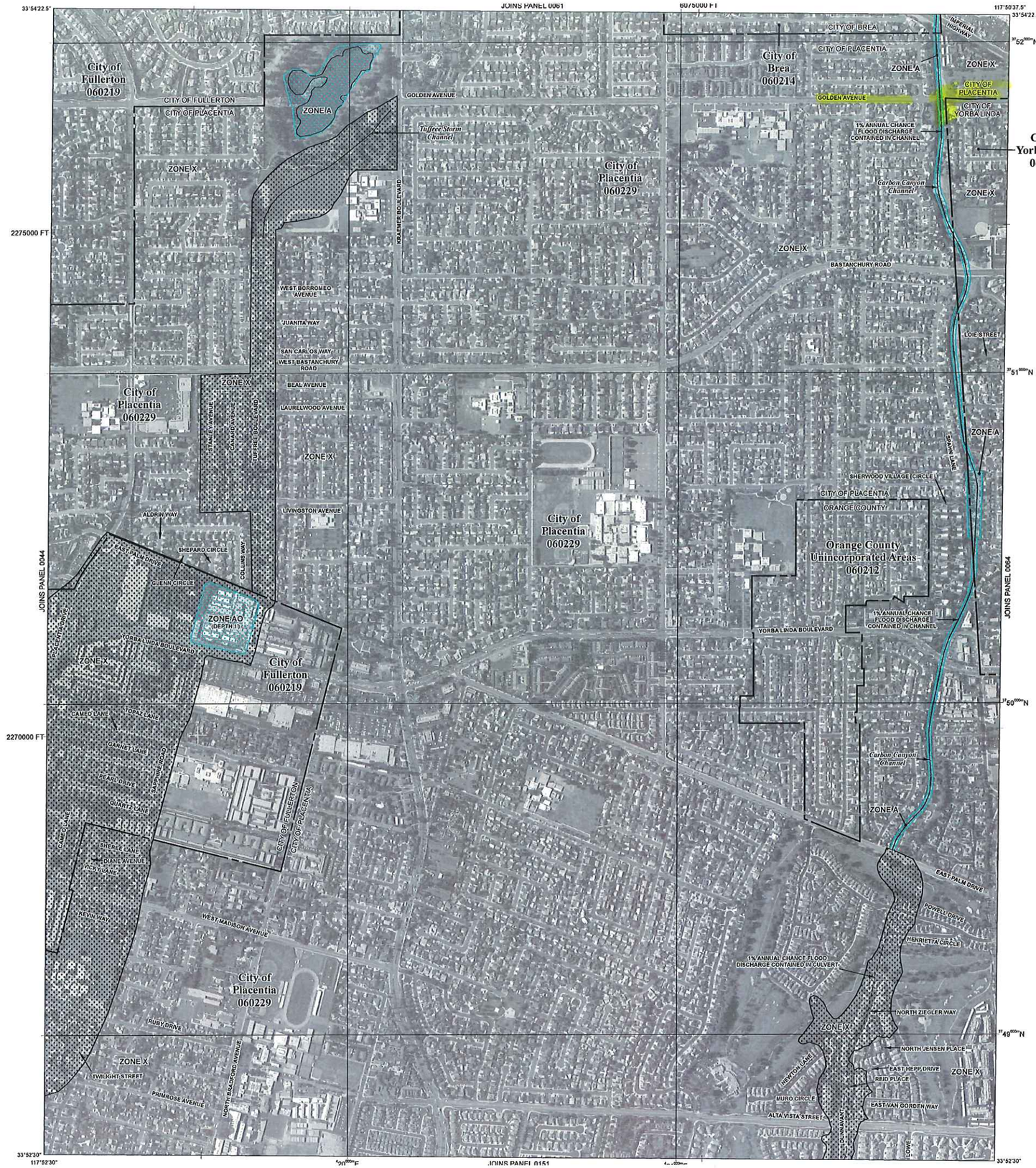
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 2476000mN — 1000-meter Universal Transverse Mercator grid values, zone NAD 1983 UTM Zone 11N
- 600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 15, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
February 5, 1992 - November 3, 1993 - January 3, 1997 - February 18, 2004 - December 3, 2009 : for description of revisions, see Notice to Users page in the Flood Insurance Study report.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0063J

FIRM

FLOOD INSURANCE RATE MAP

ORANGE COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 63 OF 539

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BREA, CITY OF	060214	0063	J
FULLERTON, CITY OF	060219	0063	J
ORANGE COUNTY	060212	0063	J
PLACENTIA, CITY OF	060229	0063	J
YORBA LINDA, CITY OF	060238	0063	J

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
06059C0063J

MAP REVISED