

3 Hydraulics

This section describes hydraulic analysis for the local storm drain facilities and the regional channel systems. The descriptions of the local water quality features are included in Section 5.

3.1 Local Facilities

3.1.1 Storm Drain Preliminary Design

The major backbone storm drain system for PA-3 is shown on Exhibit 10. The backbone storm drains were modeled using Water Surface Pressure Gradient (WSPGW) for the storm drains shown on Exhibit 10. The main lines included in the PA-3 storm drain master plan are the following:

1. Line A – from outlet 9 to Line A (Sta 91+94 Line A) with total length of 8194 ft.
2. Line A1 – from D/S side of Junction for Line A (Sta 51+91 Line A) to Line A1 (Sta 38+29 Line A1) with total length of 2829 ft
3. Line A2 – from D/S side of Junction for Line A (Sta 42+92 Line A) to Line A2 (Sta 58+46 Line A2) with total length of 4846 ft
4. Line B – from hydrology node 222 to Line B (Sta 61+10 Line B) with total length of 5110 ft
5. Line B1 – from D/S side of Junction for Line B (Sta 12+74 Line B) to Line B1 (Sta 49+78 Line B1) with total length of 3978 ft
6. Line C – from hydrology node 339 to Line C (Sta 97+40 Line C) with total length of 8740 ft.
7. Line C1 – from D/S side of Junction for Line C (Sta 64+60 Line C) to Line C1 (Sta 31+19 Line C1) with total length of 2119 ft
8. Line C2 – from D/S side of Junction for Line C (Sta 72+79 Line C) to Line C2 (Sta 38+99 Line C2) with total length of 2899 ft
9. Line C3 – from hydrology node 339 to Line C3 (Sta 94+01 Line C3) with total length of 8401 ft
10. Line C4 – from D/S side of Junction for Line C3 (Sta 77+18 Line C3) to Line C4 (Sta 25+16 Line C4) with total length of 1516 ft
11. Line C6 – from Hydrology node 371 to node 372 with total length of 488 ft
12. Line C7 – from outlet 13 to Line C7 (Sta 39+74 Line C7) with total length of 2974 ft
13. Line C8 – from D/S side of Junction for Line C7 (Sta 29+98 Line C7) to Line C8 (Sta 11+52 Line C8) with total length of 152 ft
14. Line C9 – from D/S side of Junction for Line C7 (Sta 23+98 Line C7) to line C9 (Sta 21+21 Line C9) with total length of 1121 ft
15. Line D – from hydrology node 420 to Line D (Sta 77+00 Line D) with total length of 6700 ft
16. Line D1 – from hydrology node 425 to Line D1 (Sta 41+22 Line D1) with total length of 3122 ft
17. Line D2 – from outlet 14 to Hydrology node 421 with total Length of 2382 ft

The major backbone storm drain system for PA-4 is shown on Exhibit 11. The main lines included in the PA-4 storm drain master plan are the following:

1. Line E1 – from hydrology node 813 to hydrology node 809 with total length of 1802 ft
2. Line E2 – from hydrology node 802 to Line E1 (Sta 17+62 Line E1) with total length of 843 ft
3. Line E3 – from hydrology node 820 to hydrology node 817 with total length of 1339 ft

4. Line E4 – lateral pipe collecting offsite flow from OE-6 to Line E3 (Sta 17+61) with total length of 330 ft
5. Line F1 – from hydrology node 901 to hydrology node 905 with total length of 3501 ft
6. Line F2 – from hydrology node 913 to Line F1 (Sta 34+27 Line F1) with total length of 890 ft
7. Line F3 – from hydrology node 926 to Line F1 (Sta 27+68 Line F1) with total length of 1336 ft
8. Line F4 – from hydrology node 932 to line F1 (Sta 27+68 Line F1) with total length of 331 ft
9. Line F5 – from hydrology node 942 to hydrology node 905 with total length of 1041 ft
10. Line F6 – from hydrology node 956 to hydrology node 905 with total length of 1304 ft
11. Line F7 – from Basin 4F-1 to Outlet 21 with total length of 1196 ft

The calculations are for preliminary planning only as the storm drain design will change during refined local PA-3&4 design improvement plans.

The backbone storm drain was designed for a 100-year high confidence storm using the hydrology from Section 2.2, Local Planning Area Analysis. The backbone storm drain ranges in size from 18 inches to 102 inches. There are natural areas tributary to storm drains in Subwatershed C, D, E and F (approximately 85.1 acres, 7.9 acres, 72.7 acres and 438.0 acres, respectively). Subwatershed A has a separate storm drain pipe for conveying the natural areas (approximately 62.2 acres). The hydraulic runs are included in Appendices I.1 and I.2

3.1.2 Outlet Preliminary Design

There are four outlets from the PA-3 developed area: outlet 9, outlet 11, outlet 13, and outlet 14. There is also one discharge point from the natural area O at outlet 17. Two outlets are planned from PA-4 developed area: outlet 20 and outlet 22. This section discusses the current and future outlet design for all points.

Outlet 11 is included in the ongoing design plan drainage sheets for Phase 2B of Cow Camp Road (Plans for Construction of Cow Camp Road Phase 2B). The proposed outlet extends to the San Juan Creek 100-year floodplain, with rock riprap protection extending to the 10-year floodplain. The outlet is a 48-inch reinforced concrete pipe and includes an energy dissipater, which is shown on sheet 60 of 105 (SD-013) of the Cow Camp Phase 2B storm drain plans. The pipe flow outlet velocity for outlet 11 is greater than 20ft/s. Therefore, an energy dissipater was included in the design to reduce the flow to non-erosive velocities (below 5 ft/s) at the discharge point. The Orange County Local Design Manual was used to design the structures. Backup calculations are included in Appendices E-G of the “Hydrology and Hydraulics in support of Cow Camp Road Improvements, Phase 2B, Station 101+05.00 to 149+00.00” prepared by Michael Baker International and dated April 2019.

Due to the preliminary nature of the site planning for the areas tributary to outlets 9, 13, 14, 17, 20, and 22 there is no preliminary outlet design included in this document. Any future outlet at these discharge points will be designed to minimize impacts to floodplains and erosion potential as required in the Approved Ranch Plan ROMP and the Orange County Local Drainage Manual Chapter 5, Section VIII Designs.

3.2 Channel Hydraulics

The hydraulic models for the analysis of San Juan Creek and Gobernadora Canyon were developed using the Hydraulic Engineering Center – River Analysis System (HEC-RAS, Version 5.0.6) from the USACE. HEC-RAS is a rigid boundary hydraulic model, which assumes the channel bed does not fluctuate. HEC-RAS

executes a one-dimensional solution of the energy equation, where energy losses are evaluated by friction through Manning's equation and contraction/expansion based on change in velocity head. When bridges and confluences are present, the momentum equation is used to manage these situations of rapidly varying water surface profile. The "mixed flow" option is available to accommodate the potential for subcritical and supercritical flow regimes within the model.

The 2013 Ranch Plan ROMP San Juan Creek model was updated for the flows influenced by the PA-3&4 development. The Gobernadora Scour Model was updated to reflect the updated hydrology from the PA-3 development. Figure 3-1 shows the Hydraulic Model Limits which extend from La Novia Bridge to regional node 119 in San Juan Creek, and from San Juan Creek to just upstream of PA-3 for Gobernadora. Figure 3-2a through Figure 3-2b and Figure 3-3a through Figure 3-3c show the cross-section locations for Gobernadora and San Juan Creek, respectively.

3.2.1 Floodplain Modeling and Mapping

Structures within the floodplains are being designed and constructed separate of the PA-3&4 ROMP and appropriate design hydraulic analysis will be provided in a separate document with design plans. The structures have been included in the hydraulic models for floodplain mapping purposes.

3.2.1.1 Gobernadora Canyon Creek

The following guidelines and assumptions were used to develop both the existing and proposed conditions for the floodplain modeling and mapping and for the stream stability models:

- Geometry: The existing and proposed condition geometry files were obtained from the Gobernadora Scour Report (September 2017) hydraulic analysis.
- Flow rates: Updated discharges for the 100-year expected value existing and ultimate proposed conditions were used for the floodplain analysis. The flowrates for the 2- through 100-year events were used in the stream stability modeling. The flowrates used in the HEC-RAS Models for Gobernadora are shown in Table 3-1.

3.2.1.2 San Juan Creek

The following guidelines and assumptions were used to develop both the existing and proposed conditions for the floodplain modeling and mapping and for the stream stability models:

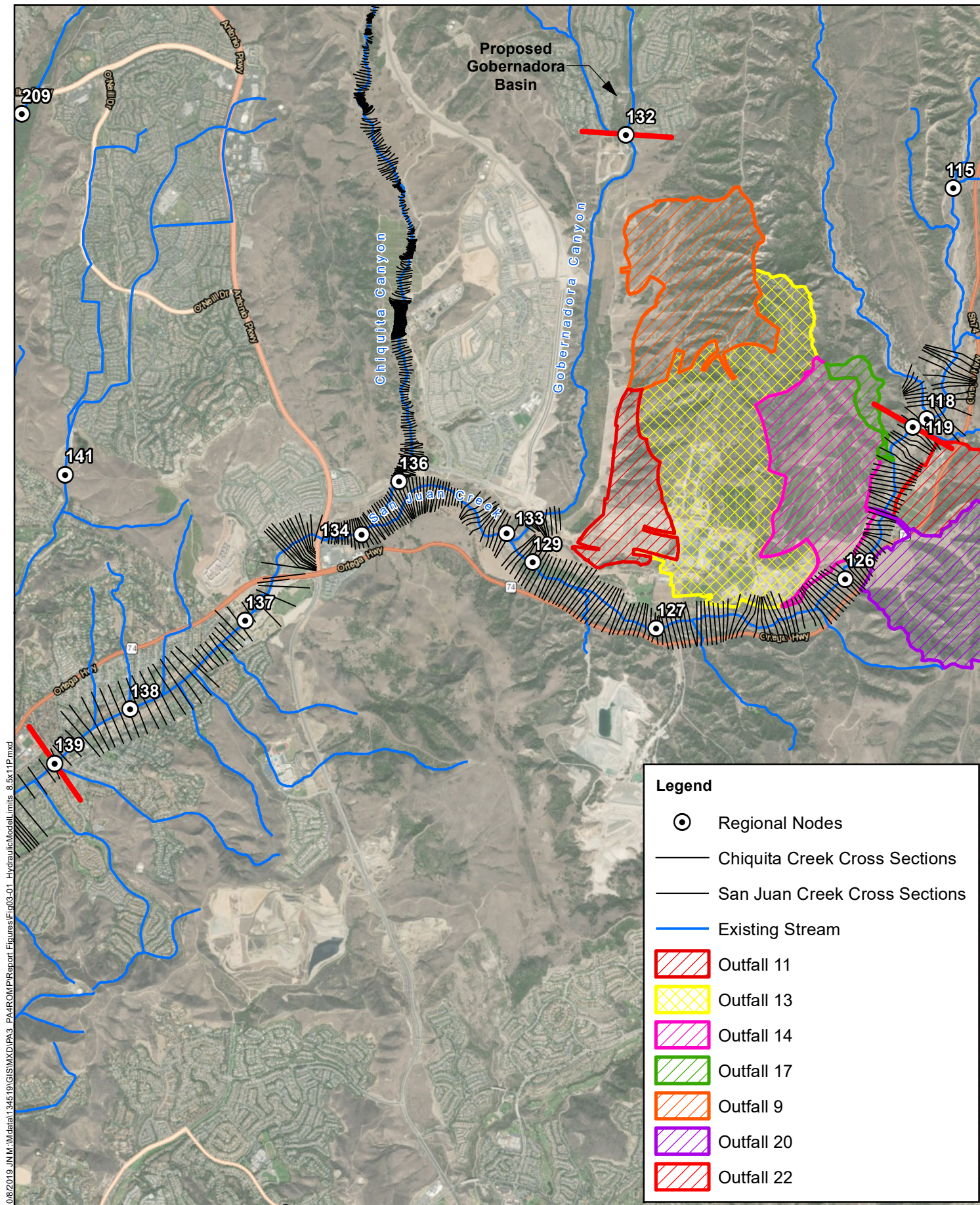
- Geometry: The existing and proposed condition geometry files were obtained from the Ranch Plan ROMP (April 2013) hydraulic analysis. A portion of the geometry was updated to match the Gibby Road Bridge Hydraulics and Scour Analysis (August 2017).
- Flow rates: Updated discharges for the 100-year expected value existing and ultimate proposed conditions were used for the floodplain analysis. The flowrates for the 2- through 100-year events were used in the stream stability modeling. The flowrates used in the HEC-RAS Models for San Juan Creek are shown in Table 3-2.

Subcritical Regime: This regime was used to determine the maximum depth and top width along the study reaches. The proposed floodplain was delineated using the subcritical regime results. The proposed floodplain is shown on Figure 3-4 and Figure 3-5 for Gobernadora and San Juan Creek.

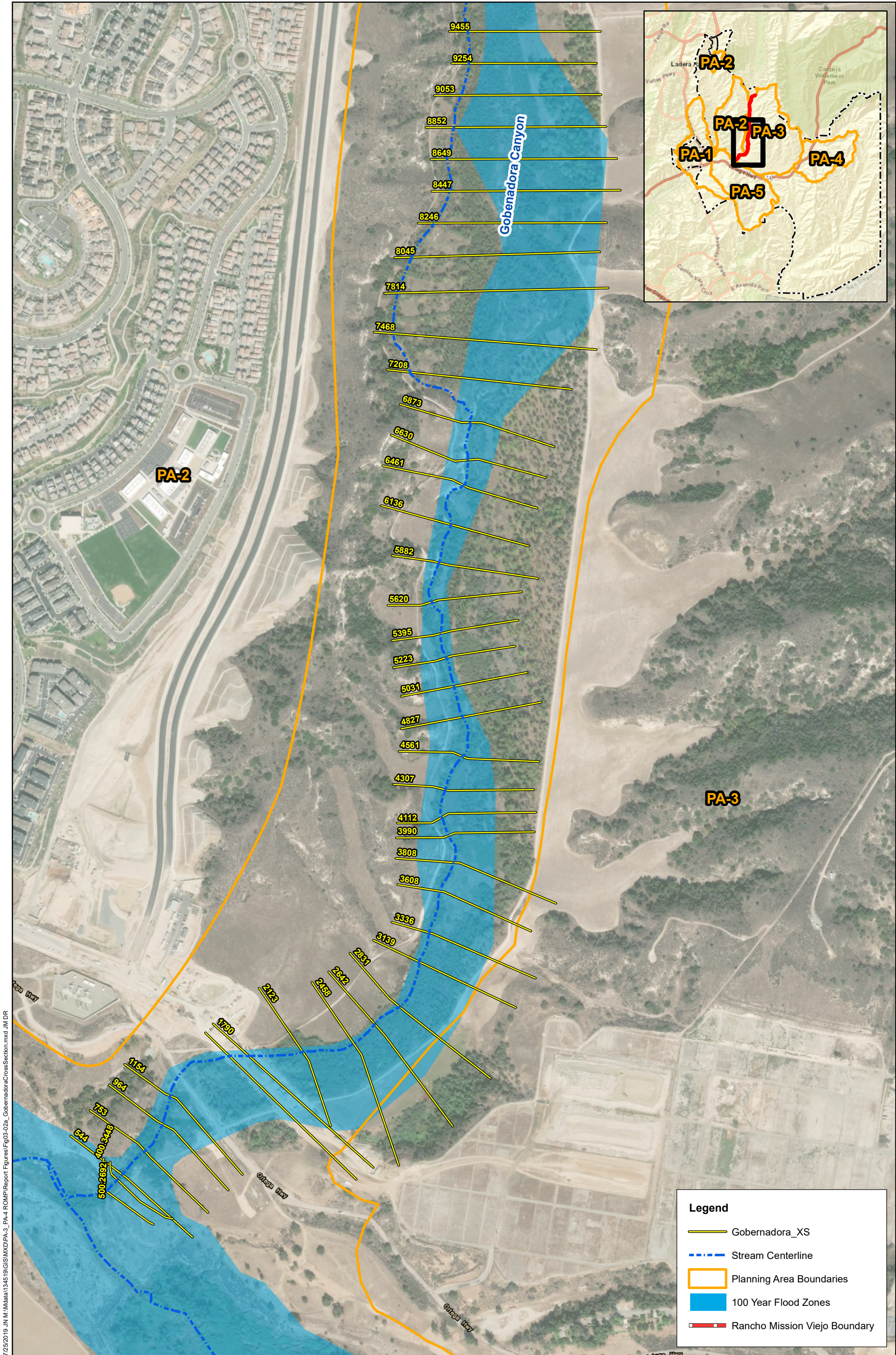
Mixed Flow Regime: Maximum velocity and scour was obtained with this model. This model was also used for the stream stability analysis for the 2- through 100-year events.

Table 3-1: Gobernadora Hydraulic Model Flowrates

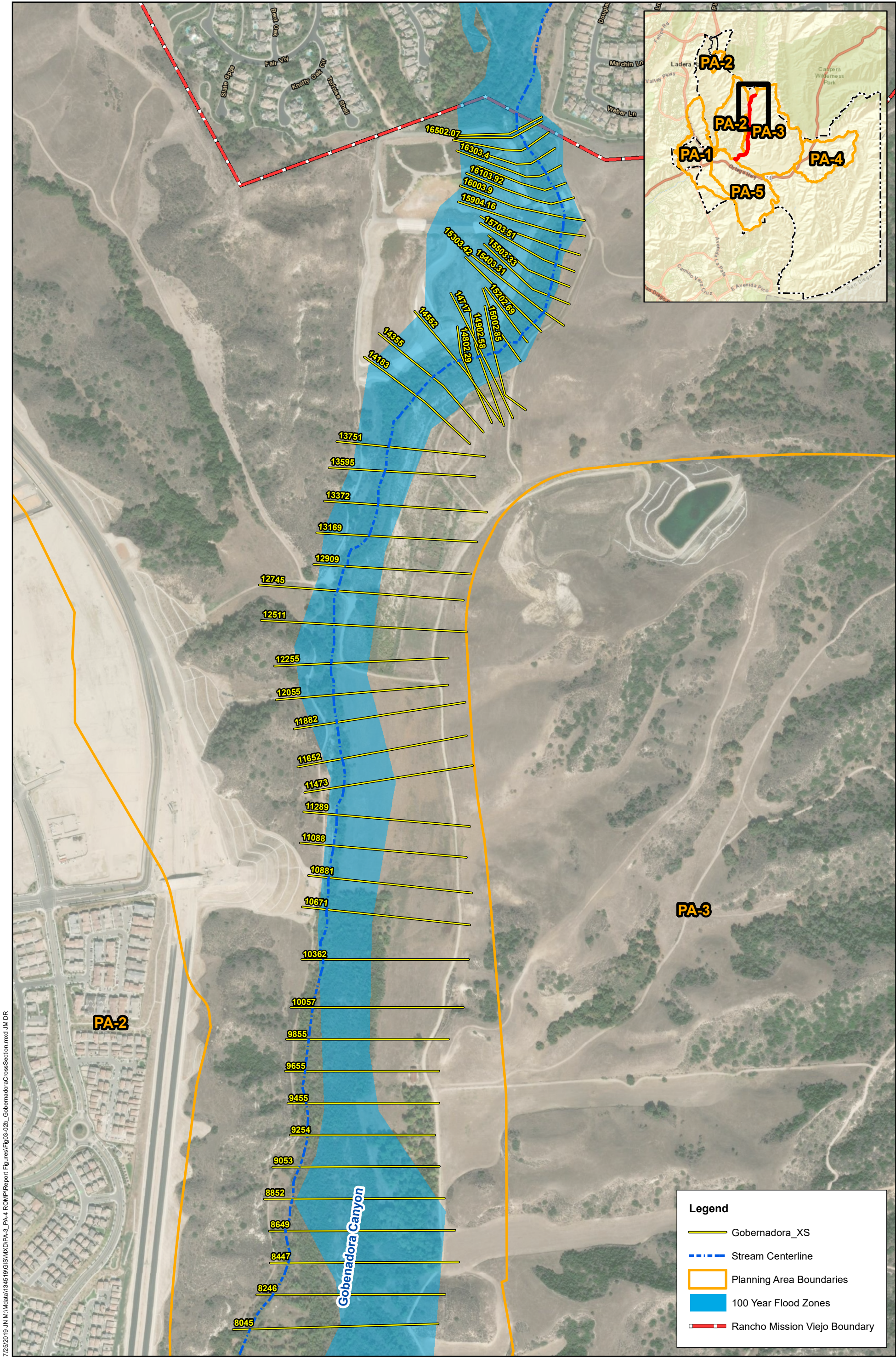
Condition	Node	Cross-Section	Storm Event Flowrate (cfs)					
			2-year EV	5-year EV	10-year EV	25-year EV	50-year EV	100-year EV
Existing	13222	14717	386	839	1847	2693	3155	3627
	13308	6873	368	813	1868	2845	3399	3826
Ultimate w/Basins	13222	14717	377	754	1573	2037	2282	2530
	13308	6873	404	805	1695	2289	2611	2849



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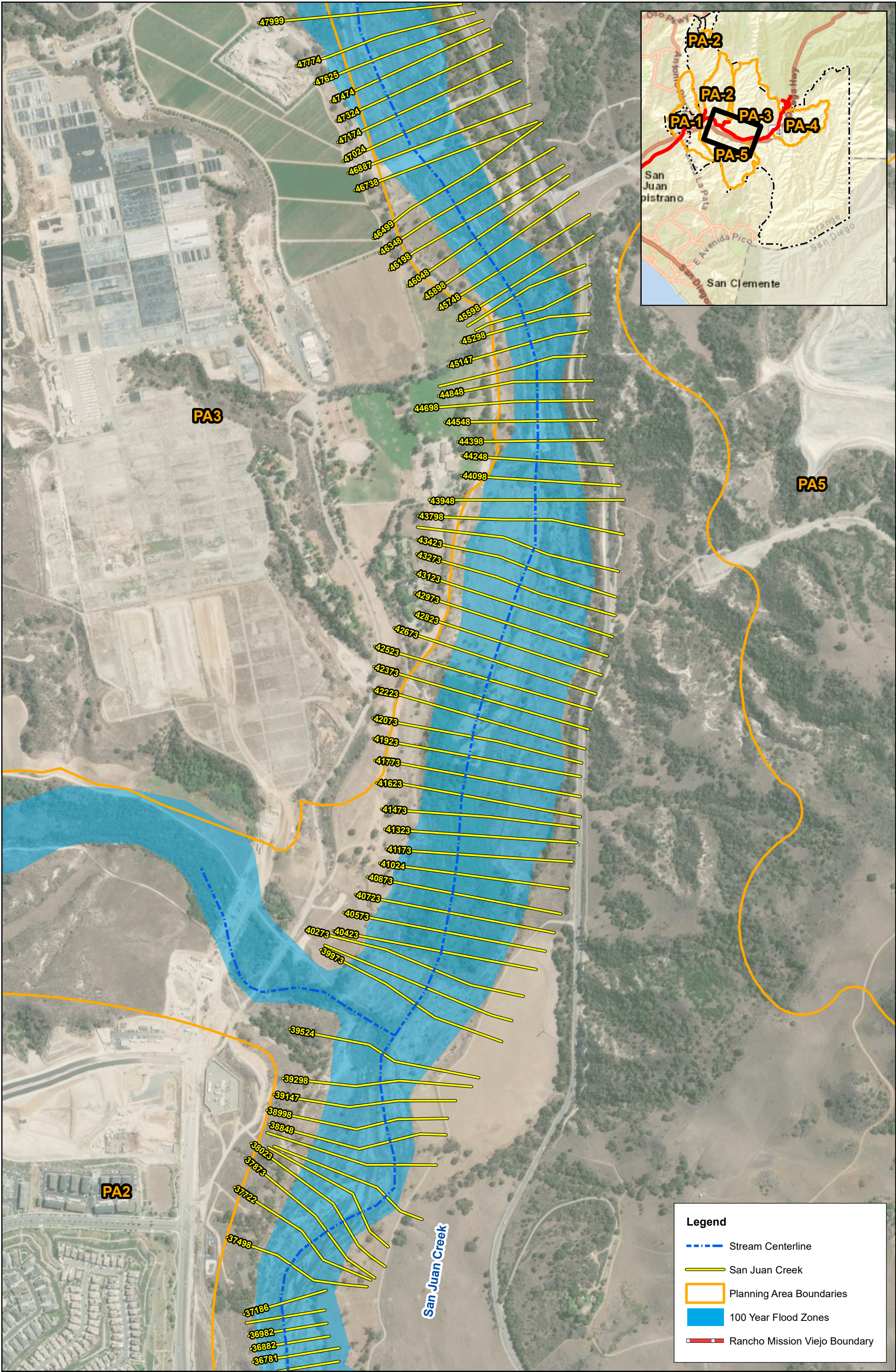


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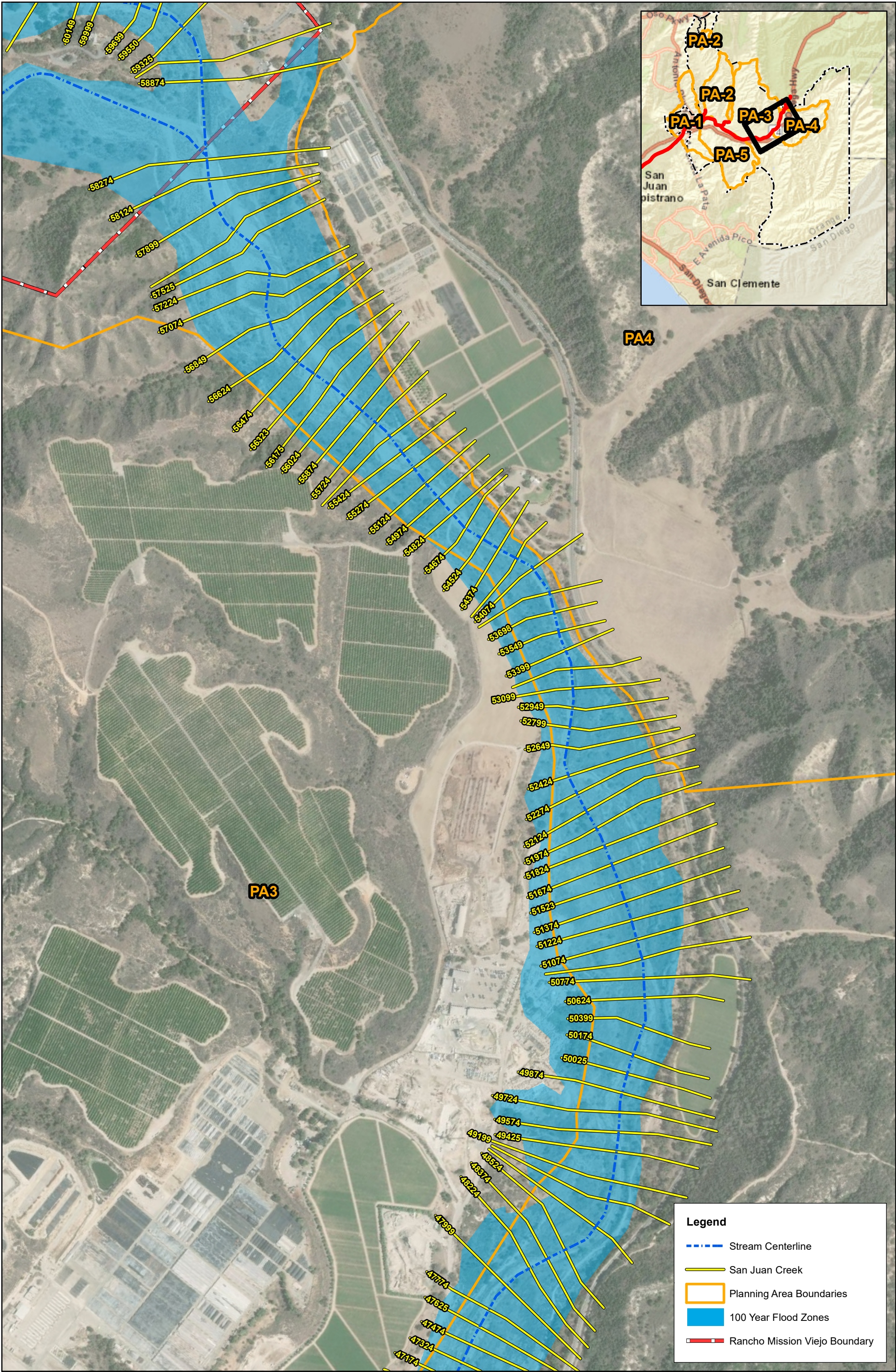
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